FPL

JUL 0 2 2004

L-2004-125

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
Request for Additional Information -
Triennial Fire Protection Inspection

By letter dated March 26, 2004, NRC issued the Triennial Fire Protection Inspection Report for Turkey Point Units 3 and 4. Eight Unresolved Items (URIs) were identified as a result of the inspection. The NRC determined that additional information was required to complete the evaluation of certain URIs.

Based on conversations between the NRC Staff and Florida Power & Light (FPL) held on May 12, 2004, the NRC Staff identified additional information needed related to the URIs. The response to the request for additional information is provided in the attachments to this letter. Attachment 1 provides the response to the NRC question regarding the effects of a postulated fire in the 4B Switchgear Room (Fire Zone 67) on the electrical power system. Attachment 2 provides the results of FPL's analysis of the Significance Determination Process related to findings for Fire Zones 63 and 67. Attachment 3 provides the final Condition Report (CR 04-0477) related to URI 05000251/2004007-004. Attachment 4 provides the final Condition Report (CR 04-0686) related to URI 05000250,251/2004007-009.

Please contact Walter Parker at (305) 246-6632 if there are any questions.

Very truly yours,

Terry Jones

Terry O. Jones
Vice President
Turkey Point Nuclear Plant

OIH

Attachments

cc: Regional Administrator, Region II, USNRC
Charles R. Ogle, Chief, Engineering Branch 1, DRS, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant

A006

NRC Request:
The NRC requested the following additional information regarding the effects of a postulated fire in the 4B Switchgear Room (Fire Zone (FZ) 67) on the electrical power system:

Could a fire in the 4B Switchgear Room (FZ 67) lead to a Loss of Offsite Power?

Could a fire in the 4B Switchgear Room (FZ 67) lead to a 4A bus lockout?

Could a fire in the 4B Switchgear Room (FZ 67) lead to a 4A EDG lockout?

Turkey Point Response:

The following discussion is provided in response to NRC questions regarding the effects of a postulated fire in the 4B Switchgear Room (FZ 67) on electrical power:

Could a fire in the 4B Switchgear Room (FZ 67) lead to a Loss of Offsite Power?
A fire in the 4B Switchgear Room could result in a plant trip and lockout/unavailability of the 4B Switchgear. The plant trip would initiate a fast bus transfer of the 4A and 4B Switchgear to the Unit 4 Startup Transformer. The startup transformer is a dual secondary winding transformer supplying the 4A and 4B Switchgear. The 4B Startup Transformer breaker is located at the west end of the room and the feeder cable is routed in a tray a short distance as it exits through the west wall of the room. As such, it is possible for a fire in the 4B Switchgear Room to damage the Unit 4 Startup Transformer breaker and / or the feeder cable. Such damage could result in a fault and subsequent lockout of the Unit 4 Startup Transformer. Therefore, it is possible for a fire in the 4B Switchgear Room to lead to a Unit 4 Loss of Offsite Power (LOOP). Note: A LOOP is assumed and analyzed for all fire zones at Turkey Point (PTN) regardless of whether or not the postulated fire can initiate the LOOP event.

Could a fire in the 4B Switchgear Room (FZ 67) lead to a 4A bus lockout?
Review of the PTN Safe Shutdown Analysis (SSA) for the 4B Switchgear Room (FZ 67) shows that a 4A Switchgear / bus lockout will not occur due to a postulated fire in the 4B Switchgear Room.

Could a fire in the 4B Switchgear Room (FZ 67) lead to a 4A Emergency Diesel Generator (EDG) lockout?
As previously discussed, it is possible for a fire in the 4B Switchgear Room to lead to a LOOP. This would create a loss of power to the 4A Switchgear. The loss of power to the 4A Switchgear would result in starting and loading of the 4A EDG. Review of the PTN SSA for the 4B Switchgear Room (FZ 67) shows that the 4A EDG lockout circuit will not be affected due to a postulated fire in the 4B Switchgear Room. However, there are four motors powered by the 4A Switchgear identified in the SSA that could start due to a fire induced spurious signal from a fire in FZ 67 and load onto the EDG. These motors are the Condensate Pump (CP) 4A, Reactor Coolant Pump (RCP) 4A, Heater Drain Pump (HDP) 4A and Turbine Plant Cooling Water Pump (TPCW) 4A. The potential cause of the spurious

start of each of these motors is a cable that runs between the 4A and 4B Switchgear breaker to provide an interlock in the close circuit of the breakers. A fire induced spurious actuation of this circuit can not be avoided as the 4B Switchgear breaker cubicles of each of these motors can not be protected from a fire in the 4B Switchgear Room. However, for a LOOP condition, the breakers for each of these motors receives a trip signal by the sequencer. The sequencer trip signal (i.e., 127/X2) for the CP 4A, HDP 4A and RCP 4A are maintained until the startup transformer breaker is closed and as such, these motors cannot spuriously load onto the EDG. The TPCW 4A motor receives a sequencer trip signal (127/X1) that is maintained until the EDG energizes the 4A bus. The additional load of the 400HP TPCW 4A motor (approximately 330 kW) to the EDG loads for safe shutdown is not expected to overload the EDG. Therefore, a 4A Switchgear / bus lockout is not expected to occur due to a postulated fire in the 4B Switchgear Room (FZ 67).

Manual Actions are provided in Procedure 0-ONOP-016.10, Fire Zone 67, to secure the breakers in the open position for TPCW 4A, CP 4A, HDP 4A and RCP 4A motors. This action for the CP 4A, HDP 4A and RCP 4A motors is considered conservative and not necessary. The action to secure the breaker in the open position for the TPCW 4A motor is considered conservative, but prudent. PTN is currently planning a project to review the effectiveness / appropriateness of various fire zone manual actions.

Summary

As discussed above, the following summarizes the response to the NRC questions:

It is possible for a fire in the 4B Switchgear Room (FZ 67) to lead to a Loss of Offsite Power. A Loss of Offsite Power is assumed and analyzed for all fire zones at PTN regardless of whether or not a fire can cause the event.

A 4A Switchgear / bus lockout will not occur due to a postulated fire in the 4B Switchgear Room (FZ 67).

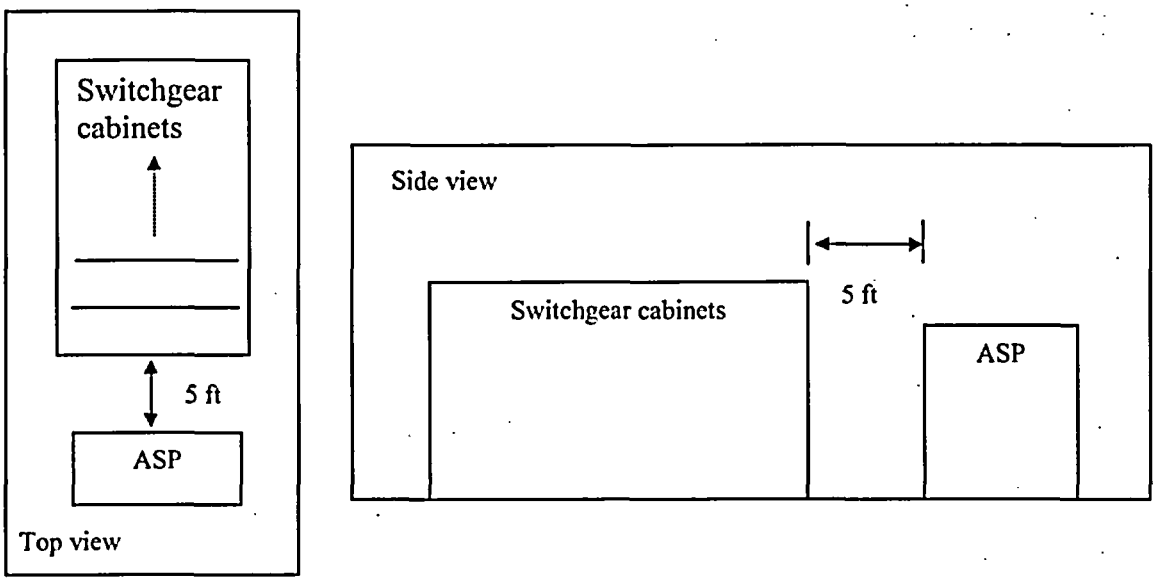
A 4A EDG lockout is not expected to occur due to a postulated fire in the 4B Switchgear Room (FZ 67).

Scoping Fire Risk Analysis for Fire Zones 67 and 63

Fire Zone 67

This section describes the thermal insult from a 4160 V switchgear fire to the auxiliary shutdown panel (ASP) located in the same switchgear room. The ASP faces the side-wall of the switchgear cabinet. Figure 1 illustrates the relative location of the ASP to the switchgear cabinet. The switchgear room is 73 ft x 18 ft x 23 ft high.

Figure 1: Relative location of the emergency switchgear room to auxiliary shutdown panel in the switchgear room.



Fires in Switchgear Cabinets

Fire events in switchgear cabinets can be classified as: 1) high energy arcing faults with or without ensuing fires after the initial blast, and 2) fires not resulting from high energy arcing faults.

A review of high-energy arcing fault events in the nuclear industry suggests that equipment or cables trays located within 5 ft above the cabinet, and 3 ft horizontally may experience mechanical damage from the initial blast. Combustible material within these distances may also ignite. The ensuing cabinet fire after the blast can be treated as a regular switchgear cabinet fire considering any combustible equipment ignited.

Switchgear cabinets in general do not contain a large combustible load. Most of the combustible loading is in the top cubicle where all the indication wiring is located. As a result, switchgear cabinet fires are sustained in the top section of the cabinet. The bottom section of the cabinet, where the breaker is located, usually has a limited amount of combustible.

Fire-generated Conditions in the Switchgear Room (FZ 67)

There are only two cable trays above the switchgear cabinet. Therefore, the assumed fire considers the contribution from the cabinet fire and two cable trays.

Cabinet fire intensity: Fire intensities have been assigned to switchgear cabinets in on-going fire risk re-quantification studies conducted jointly by EPRI/NRC-RES in the form of probability distributions. The 98th percentile of the distribution is 200 kW.

Cable tray heat release rate: The heat release rate from cable tray fires is estimated following the method described on NUREG 1805, which suggest the following equation: $\dot{Q}_{ct} = 0.45 \cdot \dot{q}''_{bs} \cdot A$; where Q_{ct} is the tray heat release rate, A is the burning area of the tray, and q_{bs} is the bench scale heat release rate approximated as 400 kW/m^2. The burning area is calculated assuming a 2 ft wide tray and a length of also 2ft. In this case, 2 ft represents the length of the switchgear cubicle. The estimated heat release rate is 67 kW per tray.

Total heat release rate: The total heat release rate is 334 kW, 200 kW from the switchgear fire and 134 kW from the cable tray fires.

Typical fire generated conditions in a room that would affect the ASP include flame radiation and smoke layer temperatures given the relative location of the cabinets.

The flame radiation 5 ft away from a fire in the closest switchgear cubicle to the ASP is 3.8 kW/m^2. This value is lower than the critical heat flux for unqualified cable considered in the EPRI-NRC/RES fire risk re-quantification project (5 kW/m^2). Notice that a 267 kW fire was considered for the analysis since there is only on tray above the closest switchgear cubicle to the ASP. Furthermore, given the location of the fire will likely be in the top section of the cabinet, the ASP may not receive direct radiation from the flames.

Table 1: Point source radiation analysis

EPRI's Five-Rev1 Analysis
Point Source Flame Radiation Model

Date	3/25/2004
Analyst:	Francisco Joglar

Inputs

Fire heat release rate [kW]	267
Radiation fraction	0.40
Distance from flames [m]	1.5

Results

Heat flux [kW/m^2]	**3.8**

The smoke layer temperature from the postulated fire is calculated using the MQH correlation for room temperature described in NUREG 1805. Assuming a fire duration of 30 min, the resulting temperature is 195 °F. This temperature is considerably lower than the one required for room flashover (around 932 °F), and the damage temperature of unqualified cable (424 °F)

Table 2: MQH room temperature analysis

EPRI's Five-Rev1
Analysis
MQH Temperature
Correlation

Date: 3/25/2004
Analyst: Francisco Joglar

Inputs

Ambient temperature [C]	20
Duration [sec]	1800
Opening area [m^2]	2
Height of opening [m]	2
Room length [m]	22
Room width [m]	5.5
Room height [m]	7
Thermal conductivity [kW/mK]	0.0014
Density [kg/m3]	2000
Specific heat [kJ/kg]	0.88
Wall thickness [m]	0.3
HRR [kW]	334

Results

Room Temp [C]	**100**	212 (°F)

Conclusions
A switchgear cabinet fire in the 4B switchgear room will not generate damaging conditions to the ASP. Specifically, two fire generated conditions could potentially damage the ASP. Those conditions are flame radiation, and smoke layer temperature. The fire modeling analysis described in this letter report indicates that no damage is expected.

Fire Zone 63
This section describes the fire-generated conditions in FZ 63 given a fire in the MCC cabinet. Fire zone 63 is a 41' x 13' x 11' room with two normally closed doors. There are two electrical cabinets in the room, one of them being the MCC.

Fires in MCC Cabinets
MCC cabinets usually consist of a number of stacked metal cubicles both vertically and horizontally. A fire is expected to start in one of the cubicles, and depending on the location of the cubicle, it may spread to other intervening combustibles. Fire events in MCC cabinets are in general not classified as energetic faults.

Fire Generated Conditions in the MCC Room (FZ 63)
There are three cable trays above the switchgear cabinet. Therefore, the assumed fire considers the intensities contribution from the cabinet fire and three cable trays.

Cabinet fire intensity: Fire intensities have been assigned to switchgear cabinets in on-going fire risk re-quantification studies conducted jointly by EPRI/NRC-RES in the form of probability distributions. The 98th percentile of the distribution is 200 kW.

Cable tray heat release rate: The heat release rate from cable tray fires is estimated following the method described on NUREG 1805, which suggest the following equation: $\dot{Q}_{ct} = 0.45 \cdot \dot{q}''_{bs} \cdot A$; where Q_{ct} is the tray heat release rate, A is the burning area of the tray, and q_{bs} is the bench scale heat release rate approximated as 400 kW/m^2. The burning area is calculated assuming a 2 ft wide tray and a length of also 2ft. In this case, 2 ft represents the length of the switchgear cubicle. The estimated heat release rate is 67 kW. A three tray fire is assumed to have an intensity of three times the value of a single tray or 201 kW.

Total heat release rate: The total heat release rate is 401 kW, 200 kW fires from the switchgear fire and 201 kW from the cable tray fire.

The smoke layer temperature from the postulated fire is calculated using the MQH correlation for room temperature described in NUREG 1805. Assuming a fire duration of 30 min, the resulting temperature is 300 °F. This temperature is considerably lower than the one required for room flashover (around 932 °F), and the damage temperature of unqualified cable (424 °F)

Table 3: MQH room temperature analysis

EPRI's Five-Rev1 Analysis
MQH Temperature
Correlation

Date: 3/25/2004
Analyst: Francisco Joglar

Inputs

Ambient temperature [C]	20
Duration [sec]	1800
Opening area [m^2]	2
Height of opening [m]	2
Room length [m]	12.58
Room width [m]	4
Room height [m]	3.4
Thermal conductivity [kW/mK]	0.0014
Density [kg/m3]	2000
Specific heat [kJ/kg]	0.88
Wall thickness [m]	0.3
HRR [kW]	401

Results

Room Temp [C]	**149**	300(°F)

Conclusions
No flashover, or room wide target damage is expected in FZ 63.

RISK ANALYSIS RESULTS

Number of switchgear rooms in the site	15
Number of control rooms in the site	1
Number of cable spreading rooms in the site	1
Number of units in the site	2

Location	Scenario	λ_{gen}	W_L	W_{IS} OR W_g	λ_{IS}	SF	λ_{severe}	P_{ns}	λ_{scen}	CCDP	Seal LOCA	CDF	ROOM CDF
FZ 67													
	Electrical cabinets	1.5E-02	0.13	5.0E-01	1.0E-03	2.0E-02	2.0E-05	6E-01	1.2E-05	1.00E-02	0.2	2.4E-08	
	Transients	1.3E-03	0.13	5.0E-01	8.7E-05	2.0E-02	1.7E-06	1E-01	1.7E-07	1.00E-02	0.2	3.5E-10	
	Transients caused by hotwork	3.1E-02	0.13	5.0E-01	2.1E-03	2.0E-01	4.1E-04	1E-01	4.1E-05	1.00E-02	0.2	8.3E-08	
	Cable fires caused by hotwork	5.1E-03	0.13	5.0E-01	3.4E-04	2.0E-01	6.8E-05	1E-01	6.8E-06	1.00E-02	0.2	1.4E-08	1.2E-07
FZ 63													
	Electrical cabinets	1.5E-02	0.13	5.0E-01	1.0E-03	9.5E-01	9.5E-04	6E-01	5.7E-04	3.00E-03	0.2	3.4E-07	
	Transients	1.3E-03	0.13	5.0E-01	8.7E-05	2.0E-02	1.7E-06	1E-01	1.7E-07	3.00E-03	0.2	1.0E-10	
	Transients caused by hotwork	3.1E-02	0.13	5.0E-01	2.1E-03	2.0E-01	4.1E-04	1E-01	4.1E-05	3.00E-03	0.2	2.5E-08	
	Cable fires caused by hotwork	5.1E-03	0.13	5.0E-01	3.4E-04	2.0E-01	6.8E-05	1E-01	6.8E-06	3.00E-03	0.2	4.1E-09	3.7E-07

Attachment 3 to L-2004-125
Condition Report 04-0477

CAPCO's 3/3/04

CONDITION REPORT

DUE: 3-4-04 (Date)

CR NO. 04-0477

PTN ☒ PSL ☐ JB ☐

PAGE 1 OF 19

CR Administrator

ORIGINATOR

SYSTEM #/NAME 016/Fire Protection UNIT 00

COMPONENT ID Various

COMPONENT NAME Combustible Liquid Containment

LOCATION (BLDG/ELEV) Turbine Building

DISCOVERY DATE/TIME 01/28/04 / 0900

EVENT DATE/TIME 7/19/72 / 0000

CR ORIGINATOR A. S. Dunstan

DEPT/PHONE Engineering / 6004

(ATTACH ADDITIONAL PAGES AS NECESSARY)

PROBLEM (WHAT HAPPENED, HOW WAS THE ISSUE DISCOVERED, WHAT ACTIVITIES, PROCESSES AND PROCEDURES WERE INVOLVED, PHYSICAL CONDITION EXISTING AT THE ISSUE LOCATION, WHY IS THIS ISSUE OR EVENT A CONCERN, HAVE YOU SEEN THIS ISSUE OCCUR BEFORE)

Containment facilities were reviewed during the NRC 2004 Fire Protection Triennial Inspection and appeared wanting with respect to NFPA 30, which requires that facilities be installed to contain 100% of the largest bulk inventory of combustible liquids. Of the station transformers, turbine lube oil storage tanks, hydrogen seal oil units and Unit 3 diesel fuel oil tank, curbing for hydrogen seal oil units (Fire Zones 082 & 087) appears insufficient to contain the full 846 gallon inventory described in the original Fire Hazards Analysis (L-77-57 dated February 25, 1977) and reflected in Sections 4.OD.17 and 4.OD.27 of UFSAR Appendix 9.6A. This CR is initiated to address the fire risk significance of this condition.

ORIGINATOR

REGULATION OR REQUIREMENT IMPACTED NFPA 30

IMMEDIATE CORRECTIVE ACTION TAKEN, ADDITIONAL CORRECTIVE ACTIONS COMPLETED Initiated CR for resolution of the issue.

NOTIFICATIONS None

NPS REVIEWS

OPERABILITY/REPORTABILITY DETERMINATION:

☐ A OPERABILITY ASSESSMENT REQUIRED (3 WORK DAYS) _____ DUE DATE

☐ B POTENTIALLY REPORTABLE (ATTACH ENS WORKSHEET, IF USED) _____ DUE DATE

☑ C NO OPERABILITY CONCERN/NOT REPORTABLE (EXPLAIN)

☐ D OTHER _____

OUTAGE RELATED? ☐ YES ☑ NO

MODE HOLD? ☐ YES ☑ NO

FOR ENTRY INTO MODE _____

☐ OWA

BASIS / COMMENTS: CR to document regd Evol. Any Reportable from evol will be addressed in answer to NRC Findings if any are identified

NPS/VPNE D. Hoffman (PRINT) / (SIGNATURE) DATE/TIME 2/3/04 / 0100

PGM APPROVAL

CONDITION REPORT ASSIGNED TO: Engr DUE DATE 3/4/04

COMMENTS: _____

INVESTIGATION TYPE

☐ Significance Level 1 ☐ Root Cause Analysis - A

☒ Significance Level 2 ☒ Apparent Cause - B

☐ Significance Level 3 ☐ Correction Only - C

☐ Nuclear Network Entry Required

☐ PGM Closeout

☐ Trend Only

☐ Potential Human Performance Issue

Affected Dept. _____

PGM/VPNE MO Rivera DATE 2-4-04

VICE PRES., NUCLEAR OPERATIONS SUPPORT

CRs ARE QA RECORDS WHEN CLOSED PLEASE ENSURE ALL RESPONSES AND ATTACHMENTS ARE LEGIBLE

ENG

FUNCTIONAL FAILURE: ☐ YES ☐ NO ☒ N/A BY: A. S. Dunstan / [signature] (PRINT / SIGNATURE)

N/A

ASSIGNEE

INVESTIGATION: ANALYSIS, CORRECTIVE ACTIONS. GENERIC IMPLICATIONS. DISPOSITION DETAILS, WORK INSTRUCTIONS (ATTACH ADDITIONAL PAGES AS NECESSARY)

Disposition pages 17-18

CAUSE CODES: 1) S1 2) _____ 3) _____

IF ACE OR RCE: THIS IS A REPEAT EVENT/ CONDITION ☐ YES ☒ NO

HU ERROR AFFECTS OTHER DEPT ☐ YES ☒ NO

AFFECTED DEPARTMENT _____

DOCUMENTATION INITIATED: (N/A if not applicable)

PWO N/A

PMAI Noted

RTS/PCR N/A

EVALUATION REQUIRED FOR:

EQ	☐ YES	☑ NO
10CFR50.59	☐ YES	☑ NO
10CFR21	☐ YES	☑ NO
ASME SECTION XI	☐ YES	☑ NO

NONCONFORMING/DEGRADED PLANT CONDITION DISPOSITION: ☑ N/A ☐ REWORK ☐ REPAIR ☐ USE-AS-IS ☐ GL 91-18

REVIEW / APPROVAL

DISPOSITION SIGNATURES: (N/A if not applicable)

PREPARER A S Dunstan / [signature] / 6004 (PRINT / SIGNATURE / DEPT. PHONE) DATE 2/23/04

OTHER DEPT. HEAD CONCUR See Page 19 (PRINT) _____ (SIGNATURE) DATE _____

ANII/SEC XI REVIEWER N/A (PRINT) _____ (SIGNATURE) DATE —

PNSC/FRG REVIEW ☐ YES ☒ NO

NUCLEAR NETWORK ☐ YES ☒ NO

DEPARTMENT MGR APPROVAL S P Chavigno / [signature] (PRINT / SIGNATURE) DATE 3/4/04

FRG/PNSC REVIEW (if required) MTG# _____ CHAIRMAN _____ DATE _____

APPROVAL FOR SL-1 CR OR IF REQUESTED IN PGM APPROVAL SECTION, OTHERWISE N/A

PGM _____ DATE _____

ADMIN

EVENT CODES: 1) R1 2) 01 3) 03 EXPLAIN OTHER: _____

CRs ARE QA RECORDS WHEN CLOSED. PLEASE ENSURE ALL RESPONSES AND ATTACHMENTS ARE LEGIBLE

Augmented Response to Question #76

The curb for the Unit 3 Turbine LO Storage Tank is nominal 7". There is no drain but there is a nominal 3.5" weir along the west side which directs overflow into the Unit 4 Startup Transformer pit. The transformer contains 9909 gal. The tank contains 13,875 gal. The transformer pit alone can accommodate 14,313 gal. Therefore, the combined available volume in the pit and curbed area should accommodate a lube oil spill without overflow to other areas. The containment wall encompassing the Unit 4 Turbine LO Storage Tank appears sufficient to contain the 13,875 gal. inventory.

Curbing and equipment pad for each Hydrogen Seal Oil Unit is nominal 6". The FHA reflects an oil inventory volume of 846 gallons. The net containment volume (curbed volume less equipment pad and pipe support volumes) is less than this inventory. There is a drain in the contained area to support containment that drains to the oil/separator at the fossil plant discharge (Drawings 5610-M-75 and 5610-C-13). Also, any overflow would spread on the turbine building floor to nearby area drains to the east and west of the curbed area. Spreading eastward would be limited by the "speed bump". The east drain was recently installed in conjunction with Thermo-Lag upgrades via PCM 97-024. Likewise, the speed bump was installed and ramps 2' on either side of the peak approximately 2.5" above nominal floor level (layout drawings attached). Therefore, most of the spillage beyond the curb would be removed by area drains such that oil spread and depth beyond the curb area would be minimal.

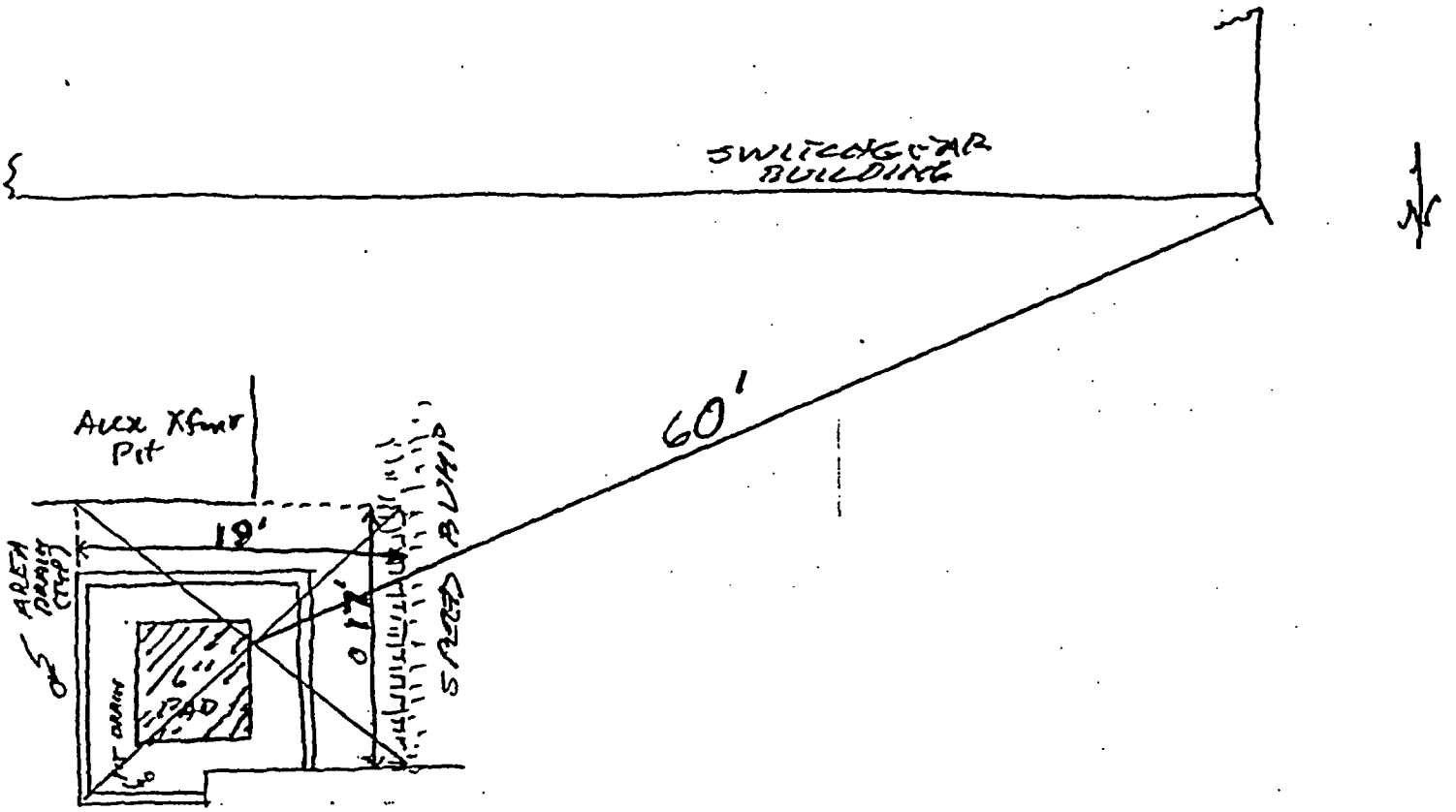
In addition, compliance with NFPA 30 is "in General" (Page 9.6A-32), meaning that PTN mostly complies with the guidance but not absolutely. Appendix 9.6A, page 9.6A-14, references Table 9.6A-12 for a listing of the NFPA codes used at Turkey Point for applicable guidance and NFPA 30 is not on that list. The current Technical Specifications, those in effect prior to converting the Technical Specifications into the UFSAR, and the SER for the License Amendment that authorized that shift made no specific mention of compliance with NFPA 30. No specific commitment to NFPA 30 was found than on page 9.6A-32. Note that CR 04-0369 was initiated to address PTN compliance requirements to NFPA.

The NRC noted that conformance to NFPA 30 was indicated in their SER dated 8/12/87 granting exemption for suppression and detection in outdoor areas. [Note that this exemption has been superseded by exemptions associated with recent Thermo-Lag upgrades and is not part of the present license basis] The conformance was regarding combustible liquid in containers, defined in NFPA 30 as any vessel of 60 gallons capacity or less used for transporting or storing liquids, and local protection including automatic fire suppression systems. The FPL submittal dated 4/25/86 cited the lube oil storage tank and station transformers as containers.

A Night Order was issued for increased awareness, by Operators, of unusual heat sources in the areas of the hydrogen seal oil units. Also, a preliminary risk-significance assessment was performed assuming spillage from the hydrogen seal oil units is not contained by the curbs but overflows to the turbine building floor. An illustration of assumed oil pool spreading limits and relative distance to a vulnerable target (Train A cable) are illustrated. The NUREG-1805 spreadsheet for this condition is also provided and indicates screens below cable qualification limits prior to reaching the vulnerable cable. This assessment will be finalized via CR 04-0477.

H_2 Seal Oil Units

Trench & Cable



Spread limits to Aux Xfmr Pit and speed bump peak.

$17' \times 19' = 323\ ft \Rightarrow \sim 20'$ effective diameter pool

$846\ gal \rightarrow 113.1\ ft^3$

$$\text{Pool depth} = \frac{113.1\ ft^3}{323\ ft^2} = 0.35' \approx 4.2''$$

CHAPTER 5. ESTIMATING RADIANT HEAT FLUX FROM FIRE TO A TARGET FUEL AT GROUND LEVEL UNDER WIND-FREE CONDITION POINT SOURCE RADIATION MODEL

The following calculations estimate the radiative heat flux from a fire to a target fuel.
The purpose of this calculation is to estimate the radiation transmitted from a burning fuel array to a target fuel positioned some distance from the fire at ground level to determine if secondary ignitions are likely with no wind.
Parameters should be specified ONLY IN THE YELLOW INPUT PARAMETER BOXES.
All subsequent output values are calculated by the spreadsheet and based on values specified in the input parameters. This spreadsheet is protected and secure to avoid errors due to a wrong entry in a cell(s).
The chapter in the NUREG should be read before an analysis is made.

INPUT PARAMETERS

Mass Burning Rate of Fuel (m")	0.039	kg/m^2-sec	
Effective Heat of Combustion of Fuel ($\Delta H_{c,eff}$)	46000	kJ/kg	
Fuel Area or Dike Area (A_{dike})	323.00	ft^2	30.01 m^2
Distance between Fire and Target (L)	60.00	ft	18.288 m
Radiative Fraction (χ_r)	0.35		

THERMAL PROPERTIES DATA

BURNING RATE DATA FOR FUELS

Fuel	Mass Burning Rate m" (kg/m^2-sec)	Heat of Combustion $\Delta H_{c,eff}$ (kJ/kg)	Density ρ (kg/m^3)
Methanol	0.017	20,000	796
Ethanol	0.015	26,800	794
Butane	0.078	45,700	573
Benzene	0.085	40,100	874
Hexane	0.074	44,700	650
Heptane	0.101	44,600	675
Xylene	0.09	40,800	870
Acetone	0.041	25,800	791
Dioxane	0.018	26,200	1035
Diethy Ether	0.085	34,200	714
Benzine	0.048	44,700	740
Gasoline	0.055	43,700	740
Kerosine	0.039	43,200	820
Diesel	0.045	44,400	918
JP-4	0.051	43,500	760
JP-5	0.054	43,000	810
Transformer Oil, Hydro	0.039	46,000	760
Fuel Oil, Heavy	0.035	39,700	970
Crude Oil	0.0335	42,600	855
Lube Oil	0.039	46,000	760
Douglas Fir Plywood	0.01082	10,900	500

Reference: *SFPE Handbook of Fire Protection Engineering*, 2nd Edition, 1995, Page 3-2

Select Fuel Type: Lube Oil
Scroll to desired fuel type
Click on selection

ESTIMATING RADIATIVE HEAT FLUX TO A TARGET FUEL

Reference: *SFPE Handbook of Fire Protection Engineering*, 3rd Edition, 2002, Page 3-272

POINT SOURCE RADIATION MODEL

$q'' = Q \chi_r / 4 \pi R^2$

Where
- q" = incident radiative heat flux on the target (kW/m^2)
- Q = pool fire heat release rate (kW)
- χ_r = radiative fraction
- R = distance from center of the pool fire to edge of the target (m)

Pool Fire Diameter Calculation

$A_{dike} = \pi D^2/4$

$D = \sqrt{(4 A_{dike}/\pi)}$

D = 6.18 m

Heat Release Rate Calculation

$Q = m''\Delta H_c A_{fire}$

Where
- Q = pool fire heat release rate (kW)
- m" = mass burning rate of fuel per unit surface area (kg/m^2-sec)
- ΔH_c = effective heat of combustion of fuel (kJ/kg)
- A = surface area of pool fire (area involved in vaporization) (m^2)

Q = 53833.78 kW

Distance from Center of the Fire to Edge of the Target Calculation

$R = L+D/2$

Where
- R = distance from center of the pool fire to edge of the target (m)
- L = distance between pool fire and target (m)
- D = pool fire diameter (m)

R = 21.38 m

Radiative Heat Flux Calculation

$q'' = Q \chi_r / 4 \pi R^2$

q" =	3.28 kW/m²	0.29 BTU/ft²-sec	ANSWER

CRITICAL HEAT FLUX FOR CABLES FAILURE

Cable Type	*Damage Threshold (kW/m^2)*	*Heat Flux*
IEEE-383 qualified	10	
IEEE-383 unqualified	5	

Reference EPRI 100370 Fire-Induced Vulnerability Evaluation (FIVE), April 1992, page 10 4-7

NOTE

The above calculations are based on principles developed in the SFPE Handbook of Fire Protection Engineering, 3rd Edition, 2002.
Calculations are based on certain assumptions and have inherent limitations. The results of such calculations may or may not have reasonable predictive capabilities for a given situation, and should only be interpreted by an informed user.
Although each calculation in the spreadsheet has been verified with the results of hand calculation, there is no absolute guarantee of the accuracy of these calculations.
Any questions, comments, concerns, and suggestions, or to report an error(s) in the spreadsheet, please send an email to nxi@nrc.gov.

NRR
Office of Nuclear Reactor Regulation

Appendix A Guidelines	Plant Conformance	Alternatives	Remarks
D.2 (d) Storage of flammable liquids should as a minimum, comply with the requirements of NFPA 30, "Flammable and Combustible Liquids Code."	Flammable liquid storage generally conforms to the guidance provided in NFPA 30.		
D.3 Electric Cable Construction, Cable Trays and Cable Penetrations			
D.3 (a) Only non-combustible materials should be used for cable tray construction.	Non-combustible material is used for cable tray construction.		
D.3 (b) See Section F3 for fire protection guidelines for Cable Spreading Rooms.	See F.3 of this Section.		
D.3 (c) Automatic water sprinkler systems should be provided for cable trays outside the Cable Spreading Room. Cables should be designed to allow wetting down with deluge water without electrical faulting. Manual hose stations and portable hand extinguishers should be provided as backup.		Cables in certain areas are generally Covered with an approved fire retardant coating or are qualified to the requirements of IEEE 383-1974. Hose stations and extinguishers are generally available for manual fire fighting.	Automatic suppression systems are provided in some areas to protect redundant safety related cables.
Safety related equipment in the vicinity of such cable trays, that does not require water fire protection, but is subject to unacceptable damage from sprinkler water discharge, should be protected from sprinkler system operation or malfunction. When safety related cables do not satisfy the provisions of Regulatory Guide 1.75, all exposed cables should be covered with an approved fire retardant coating and a fixed automatic water fire suppression system should be provided.	Open-ended electrical conduit is sealed if its physical configuration and location is such that automatic suppression water can be conducted into electrical equipment. New installation of equipment is required to be weatherproof or enclosed if located in areas susceptible to damage from automatic suppression systems.		Turkey Point is not required to conform to Regulatory Guide 1.75.

CR # 94-0477 PG 7 OF 19

Appendix A Guidelines	Plant Conformance	Alternatives	Remarks
F.10 Diesel Fuel Oil Storage Areas Diesel fuel oil tanks with a capacity greater than 1100 gallons should not be located inside the buildings containing safety related equipment. They should be located at least 50 feet from any building containing safety related equipment, or if located within 50 feet, they should be housed in a separate building with construction having a minimum fire resistance rating of three hours. Buried tanks are considered as meeting the three hour fire resistance requirements. See NFPA 30, "Flammable and Combustible Liquids Code," for additional guidance.		The Unit 3 diesel storage tank is located 30 feet east of the Unit 3 Diesel Generator Building. The area where the Unit 3 Diesel Oil Storage Tank is installed is provided with a dike to contain oil spillage. A manually operated open head fixed water spray system is located above the louvered air intakes located on the North, South and East sides of the Unit 3 Diesel Generator Building. The 4A & 4B Diesel Fuel Oil Tanks are integral to the Unit 4 diesel generator structure, but are totally enclosed by three hour rated fire barriers and are accessible only through removable concrete hatches located on the roof.	
When located in a separate building, the tank should be protected by an automatic fire suppression system such as AFFF or sprinklers.	Not applicable.		The Unit 3 diesel oil storage tank is not located in a separate building. Unit 4 diesel oil storage tanks are not located in separate buildings. The tank and oil transfer pump rooms are designated as one fire area. The transfer pump room contains a wet pipe sprinkler system.
Tanks, unless buried, should not be located directly above or below safety related systems or equipment regardless of the fire rating of separating floors or ceilings.	The fuel storage tank is not located above or below equipment.		
In operating plants where tanks are located directly above or below the diesel generators and cannot reasonably be moved, separating floors and main structural members should, as a minimum, have a fire resistance rating of three hours. Floors should be liquid tight to prevent leaking of possible oil spills from one level to another. Drains should be provided to remove possible oil spills and fire fighting water to a safe location.	See response to F.9 of this section.		
One of the following acceptable methods of fire protection should also be provided: (a) Automatic open head deluge or open head spray nozzle system(s); (b) Automatic closed head sprinklers; or (c) Automatic AFFF that is delivered by a sprinkler system or spray system.	Pre-action automatic sprinkler systems are provided for the day tanks.		

Appendix A Guidelines	Plant Conformance	Alternatives	Remarks
G. Special Protection Guidelines			
G.1 Welding and Cutting, Acetylene-Oxygen Fuel Gas Systems			
This equipment is used in various areas throughout the plant. Storage locations should be chosen to permit fire protection by automatic sprinkler systems. Local hose stations and portable equipment should be provided as backup. The requirements of NFPA 51 and 51B are applicable to these hazards. A permit system should be required to utilize this equipment. (Also refer to 2f herein.)	Welding and cutting operations follow the guidelines of NFPA 51B and are controlled by operational procedures. See B.3(a) of this Appendix. Portable extinguishers, yard hydrants and hose houses are strategically located for use.		
G.2 Storage Areas for Dry Ion Exchange Resins			
Dry ion exchange resins should not be stored near essential safety related systems. Dry unused resins should be protected by automatic wet pipe sprinkler installations. Detection by smoke and heat detectors should alarm and annunciate in the Control Room and alarm locally.	Dry ion exchange resins are normally stored in locations remote to safety related systems.		The warehouse is located outside the power block. Therefore a fire in this area will not damage equipment necessary for for safe plant shutdown.
Local hose stations and portable extinguishers should provide backup for these areas. Storage areas of dry resin should have curbs and drains. (Refer to NFPA 92M, "Waterproofing and Draining of Floors.")	Extinguishers and hose stations are available.		
G.3 Hazardous Chemicals			
Hazardous chemicals should be stored and protected in accordance with the recommendations of NFPA 49, "Hazardous Chemicals Data." Chemical storage areas should be well ventilated and protected against flooding conditions since some chemicals may react with water to produce ignition.	The guidelines in NFPA 30 are utilized for flammable liquid storage. Storage, protection, ventilation and flooding of hazardous chemicals were considered for chemical storage areas.		Chemicals maybe stored east of Units 1 and 2, next to the chemical addition building. Design of the storage area did not include NFPA 49 in its design bases. A fire in this area would not jeopardize safe plant shutdown.

CR # 94-0477 FG 2 OF 19

All of the fire zones and the Fire Areas to which they correspond are identified on Table 9.6A-1a. Figures 9.6A-8 through 9.6A-11 show the locations of fire walls, doors, dampers and fireproofing. Figures 9.6A-12 through 9.6A-15 show the locations of fire detection, suppression and emergency lighting.

The following is a demonstration of the format for each Fire Hazard Analysis:

FIRE HAZARD ANALYSIS FOR FIRE AREA "XX"

4.XX DESCRIPTION OF FIRE AREA

A description of the location and component fire zones of each Fire Area is provided.

4.XX.1 FIRE ZONE "0" - DESCRIPTION

Each of the fire zone descriptions provides the rating of the barriers enclosing the zone and lists the major equipment within the zone.

4.XX.1.1 Essential Equipment Within Fire Zone "0"

This section refers to Reference 15, which is the Appendix R Essential Equipment List.

4.XX.1.2 Fire Zone "0" Combustible Loadings

Combustible loadings have been calculated for each of the indoor and selected outdoor zones. This section provides the combustible inventory found in each zone during a walkdown circa 1985 and affirmed in 1999. These loadings are not meant to be an upper allowable limit but only an as-found condition determined by the walkdown inspection. These loadings are not used in the design basis for fire protection. In some cases, this inventory considers combustibles normally found in certain zones in place at the time of the walkdown. The combustibles have been classified as "cable insulation," "oil" and "other". Materials contained in storage cabinets qualified to NFPA 30 are considered an insignificant contribution to the combustible loadings and are not included in the inventory. For conservatism, cable trays were considered to be 40% full or actual fill if more than 40%. The combustible loadings, in BTUs, have been calculated using the conservative calorific values listed in Table 9.6A-13. An average combustible loading for each zone in BTU/ft2 has also been calculated.

For outdoor zones, only significant combustibles were taken into account. Approximately 200 gallons of concentrated combustible liquid (up to 68 million BTUs) was considered a significant combustible inventory when located outside. Other factors such as area size, proximity of the combustible source to equipment, type of fire detection and mitigation features available, and engineering judgement were used to determine if an item constituted a significant combustible inventory in an outdoor zone. Cable loadings and raceway fire wrap are not considered significant combustible loads in outdoor zones due to high ignition temperature of the cables and the nature of outdoor zones, which precludes the stratification of hot gases. Materials and equipment used for staging and routine maintenance activities, such as fork lifts, scaffolding, storage sheds and material trailers, are not considered significant combustible loads in outdoor zones and do not require transient combustible permits. Also, redistribution of combustible inventory within a fire zone, such as use of a temporary turbine lube oil conditioning skid, is not considered a change in inventory. In general, if in situ commodities are not itemized, the inventory is not considered significant.

4.XX.1.3 Fire Control

Effective fire control in plant operational areas is achieved through:

- Provision of fire containment structural features, fire detection and suppression systems, hazard and damage reduction facilities (e.g., smoke venting and drainage); and

The following outdoor fire zones are affected:

Fire Zone	Elevation	Fire Suppression	Description
76	18.00'	Fixed Water Spray	Unit 4 Lube Oil Reservoir
77	18.00'	N/A	Unit 4 Laydown Area & Condensate Storage Area
78	18.00'	Fixed Water Spray Part. Wet Pipe AS	Unit 4 Turbine Lube Oil Unit 4 Air Compressor Area
83	18.00'	Fixed Water Spray Part. Wet Pipe AS	Unit 3 Turb. Lube Oil Unit 3 Air Compressor Area
87	18.00'	Fixed Water Spray Part. Wet Pipe AS	Unit 3 Aux. Transformer & Hydrogen Seal Oil Unit Unit 3 Aux. Transformer Area
90	18.00'	N/A	Unit 3&4 DG Oil Storage Tank

Justification for Exemption

The fire zones listed above are located in outside areas or within the perimeter of the open structure Turbine Building. Essential redundant safe shutdown cables routed through these zones are separated horizontally by a minimum distance of 20 feet or are provided with one-hour rated protection where 20 feet separation cannot be maintained.

The in situ combustible inventory consists of cables routed in cable trays or combustible liquids enclosed in stationary containers (i.e., Lube Oil Storage Tanks or Main and Auxiliary Transformers). The other combustible loads in these zones are attributed to the combustible liquids and were evaluated under Appendix A to BTP 9-5.1 resulting in the addition of fixed fire suppression systems.

The in situ combustible loading contributed by the cable is considered insignificant due to the outdoor nature of these zones. Similarly, in situ combustible liquids are high flash point liquids, they are contained in containers equivalent to NFPA 30 containers and automatic fire suppression systems have been provided.

TABLE 9.6A-12

NATIONAL FIRE PROTECTION ASSOCIATION CODES

Code Number	Title
NFPA 10	Portable Fire Extinguishers
NFPA 12A	Halon 1301 Fire Extinguishing Systems
NFPA 13	Installation of Sprinkler System
NFPA 14	Standpipe and Hose Systems
NFPA 15	Water Spray Fixed Systems
NFPA 20	Centrifugal Fire Pumps
NFPA 24	Outside Protection
NFPA 50A	Gaseous Hydrogen Systems
NFPA 72A	Local Protective Signaling Systems
NFPA 72D	Proprietary Protective Signaling Systems
NFPA 72E	Automatic Fire Detectors
NFPA 80	Fire Doors and Windows
NFPA 90A	Air Conditioning and Ventilation Systems
NFPA 196	Fire Hose

Applicable design guidance provided by NFPA codes was generally taken from the revisions current at the time of installation of components.

For procurement of new equipment, the code in effect at the time of the purchase order is used.

Scope and compliance issues being addressed per CR 04-0369

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

March 21, 1979

Docket Nos. 50-250
and 50-251

Dr. Robert E. Uhrig, Vice President
Advanced Systems and Technology
Florida Power and Light Company
P. O. Box 529100
Miami, Florida 33152

Dear Dr. Uhrig:

In response to our request you have submitted a report reevaluating the Turkey Point Plant fire protection and have proposed a number of improvements to reduce the potential for exposure fires. As a result of your reevaluation, supplemented by later submittals and discussions with the staff, the Commission has issued the enclosed Amendment No. 45 to Facility Operating License No. DPR-31 and Amendment No. 37 to Facility Operating License No. DPR-41 for the Turkey Point Nuclear Generating Station, Unit Nos. 3 and 4. The amendments add license conditions relating to the completion of facility modifications and implementation of administrative controls to which your staff has agreed. The enclosed Safety Evaluation addresses your submittal dated February 25, 1977, your request for amendment dated December 22, 1977, supplemental submittals dated June 5 and 23, July 14, August 28 and November 7, 1978, and our observations at the Turkey Point site during the week of March 27-31, 1978.

Section 3.1 of the enclosed Safety Evaluation contains a summary of plant modifications which you have proposed in order to improve the fire protection program. You are requested to provide a schedule for the completion of these modifications within sixty days of the issuance date of these amendments. These modifications must be completed by December 1980. Certain items listed in Section 3.1 of the enclosed Safety Evaluation are marked with an asterisk to indicate that the NRC staff will require additional information in the form of design parameters, test results, or acceptance criteria to assure that the design is acceptable prior to actual implementation of these modifications. We request that you submit this information within six months of the issuance date of these amendments.

4.4.2 Breathing Equipment

Existing air breathing equipment will be supplemented to provide a total of 15 self-contained air breathing apparatus and 30 spare air cylinders. Six air cylinders will be stored at a readily accessible location near the control room as replacement for the three apparatus located therein. A six-bottle cascade system capable of refilling 23 air bottles will be provided. Additional backup capability for air breathing requirements can be provided by responding offsite fire assistance groups.

We find that, subject to implementation of the above described modifications, the air breathing equipment capability is adequate to insure that fire fighting access can be provided in a hostile environment. This satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

4.5 Floor Drains

Floor drains from the various areas of the plant are routed according to their content. The licensee analyzed the capacity of the drains in each area of the plant to assure that they were adequate. Curbs will be provided for several areas to limit the spread of oil spill fires as noted in Section 5.0 of this report.

We find that, subject to the modifications noted herein, the floor drain system is adequate to remove fire suppression water and combustible liquid spills to prevent damage to safety-related equipment. This satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

4.6 Lighting Systems

The normal lighting system receives its power from the station auxiliary transformers. Upon the loss of these sources, standby sources are made available from the station batteries and the diesel generators to provide an uninterrupted supply of power. The licensee has proposed to provide fixed seal beam self-contained battery-operated lighting units in the control room, auxiliary building corridor, cable spreading room, and switchgear rooms. In addition, portable seal beam battery-operated lights will be provided for fire brigade and emergency operations personnel use.

We find that, subject to implementation of the above described modifications, the emergency lighting provided for both operating personnel and the fire brigade is adequate to deal with emergency conditions. This satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

2-5.3 Ventilation.

2-5.3.1 Storage tank buildings storing Class I liquids or Class II or Class IIIA liquids at temperatures above their flash points shall be ventilated at a rate sufficient to maintain the concentration of vapors within the building at or below 25 percent of the lower flammable limit. Compliance with sections 2-5.3.2 through 2-5.3.5 shall be deemed as meeting the requirements of 2-5.3.1.

2-5.3.2* Ventilation requirements shall be confirmed by one of the following:

(a) Calculations based on the anticipated fugitive emissions. (*See Appendix F for calculation methods.*)

(b) Sampling of the actual vapor concentration under normal operating conditions. The sampling shall be conducted at a distance of 5 ft (1.5 m) radius from each potential vapor source extending to or toward the bottom and the top of the enclosed storage area. The vapor concentration used to determine the required ventilation rate shall be the highest measured concentration during the sampling procedure.

(c) Ventilation at a rate of not less than 1 ft^3 per min per ft^2 of solid floor area (0.3 m^3 per min per m^2).

2-5.3.3 Ventilation shall be accomplished by natural or mechanical ventilation, with discharge or exhaust to a safe location outside the building, without recirculation of the exhaust air.

Exception: Recirculation is permitted where it is monitored continuously using a fail-safe system that is designed to automatically sound an alarm, stop recirculation, and provide full exhaust to the outside in the event that vapor-air mixtures having concentrations over 25 percent of the lower flammable limit are detected.

2-5.3.4* Provision shall be made for introduction of make-up air in such a manner as to avoid short-circuiting the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors can collect. Where natural ventilation is inadequate, mechanical ventilation shall be provided and shall be kept in operation while flammable liquids are being handled. Local or spot ventilation might be needed for the control of special fire or health hazards. Such ventilation, if provided, shall be permitted to be used for up to 75 percent of the required ventilation.

2-5.3.5 For storage tank buildings with the interior grade more than 1 ft (30 cm) below the average exterior grade, continuous mechanical ventilation in accordance with 2-5.3.2(c) shall be provided or a vapor detection system shall be provided and set to give a warning alarm at 25 percent of the lower flammable limit and to start the mechanical ventilation system. The alarm shall sound at a constantly attended location.

2-5.4 Drainage.

2-5.4.1 Drainage systems shall be designed to minimize fire exposure to other tanks and adjacent properties or waterways. Compliance with 2-5.4.2 through 2-5.4.6 shall be deemed as meeting the requirements of 2-5.4.1.

2-5.4.2 A facility shall be designed and operated to prevent the normal discharge of flammable or combustible liquids to public waterways, public sewers, or adjoining property.

2-5.4.3 Except for drains, solid floors shall be liquidtight and the room shall be liquidtight where the walls join the floor and for at least 4 in. (10 cm) above the floor.

2-5.4.4 Openings in interior walls to adjacent rooms or buildings shall be provided with noncombustible, liquidtight raised sills or ramps at least 4 in. (10 cm) in height or shall be otherwise designed to prevent the flow of liquids to the adjoining areas. A permissible alternative to the sill or ramp is an open-grated trench (across the width of the opening inside of the room) that drains to a safe location.

2-5.4.5* The containment area shall have a capacity not less than that of the largest tank that can drain into it. Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. This might require curbs, scuppers, or special drainage systems to control the spread of fire (*see 2-3.4*).

2-5.4.6 Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators.

2-5.5 Vents.

2-5.5.1 Vents from tanks inside buildings shall be designed to ensure that flammable vapors are not released inside the building. Compliance with 2-5.5.2 and 2-5.5.3 shall be deemed as meeting the requirements of 2-5.5.1.

2-5.5.2 Vents for tanks inside buildings shall be as required in 2-3.5 and 2-3.6, except that emergency venting by the use of weak roof-to-shell seam shall not be permitted. Automatic sprinkler systems designed in accordance with the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, shall be accepted by the authority having jurisdiction as equivalent to water spray systems for purposes of calculating the required airflow rates for emergency vents in 2-3.6.7, provided the density and coverage requirements of NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 4-4.4.2 are met. Vents shall terminate outside the building.

2-5.5.3 Vent piping shall be in accordance with 2-3.7.

2-5.6 Tank Openings Other than Vents.

2-5.6.1 Tank openings other than vents from tanks inside buildings shall be designed to ensure that flammable liquids or vapors are not released inside the building. Compliance with 2-5.6.2 through 2-5.6.9 shall be deemed as meeting the requirements of 2-5.6.1.

2-5.6.2 All tank openings:

(a) Located at or below the maximum liquid level shall be liquid tight; and

(b) Located above the maximum liquid level shall be normally closed and shall be mechanically secured to prevent release of vapors.

2-5.6.3 Each connection through which liquid can gravity flow from a tank inside a building shall be provided with an internal or an external valve located as close as practical to the shell of the tank.

2-5.6.4 Each liquid transfer connection on any tank storing Class I or Class II liquids inside buildings shall be provided with:

(a) A normally closed remotely activated valve; or

(b) An automatic-closing, heat-activated valve; or

(c) Another approved device.

Exception: Connections used for emergency disposal or to provide for quick cutoff of flow in the event of fire in the vicinity of the tank need not meet this requirement.

Appendix A Guidelines	Plant Conformance	Alternatives	Remarks
D.1 (i) Floor drains, sized to remove expected fire fighting water flow should be provided in those areas where fixed water fire suppression systems are installed. Drains should also be provided in other areas where hand hose lines may be used if such fire fighting water could cause unacceptable damage to equipment in the area.	Means of drainage is provided in the main buildings. In areas containing fire suppression systems or hose stations, drainage provided removes expected fire water flows or controls accumulations, or such water does not cause unacceptable damage to equipment in the area.		
Equipment should be installed on pedestals, or curbs should be provided as required to contain water and direct it to floor drains. (See NFPA 92M, "Waterproofing and Draining of Floors.")	Equipment is generally on pads, and curbs are provided where required.		
Drains in areas containing combustible liquids should have provisions for preventing the spread of the fire throughout the drain system.	Areas with equipment containing significant amounts of combustible liquids have containment curbing to prevent inadvertent oil flows to surrounding areas and the drainage system.		Provisions are made for separation of oil drainage for the Emergency Diesel Generator 3A and 3B Rooms. Drainage from Emergency Diesel Generator 4A and 4B Rooms is routed through separate drain lines to an external holding sump.
Water drainage from areas which may contain radioactivity should be sampled and analyzed before discharge to the environment.	Water drainage from areas which may contain radioactivity are sampled and analyzed before discharge to the environment.		
In operating plants or plants under construction, if accumulation of water from the operation of new fire suppression systems does not create unacceptable consequences, drains need not be installed.	See above.		
D.1 (j) Floors, walls and ceilings enclosing separate fire areas should have minimum fire rating of three hours.		Rated fire barriers (floors, walls and ceilings) are provided to separate fire areas.	Refer to Section 4.0 of this Appendix, Fire Analyses for details.
Penetrations in these fire barriers, including conduits and piping, should be sealed or closed to provide a fire resistance rating at least equal to that of the fire barrier itself.	Penetrations in these barriers, including conduit and piping, are generally sealed to provide a fire resistance rating equivalent to the rating of the barrier.		In some cases, written calculations approved by a Fire Protection Engineer may be kept file to demonstrate acceptability of a fire rated barrier in accordance with Paragraph C of Reference 18.

CR # 04-0477 Pg 16 of 19

Problem Statement:

The CR was initiated to address the risk significance if curbing is insufficient to contain oil leakage from Hydrogen Seal Oil Units. In addition, the license basis for containment facilities for large inventories of combustible liquids may not be readily apparent. Facilities for transformers and lube oil storage were addressed during the inspection with no issues. Therefore, the purpose is to assess facilities containing significant concentrated inventories of combustible liquids for ability to contain or limit spreading of liquid spills.

Analysis:

The condition is associated with control of combustible liquids. This is associated with fire protection, which is classified as quality-related. ***Therefore, this CR is classified as QR.***

The issue of combustible liquid containment and NFPA 30 compliance was raised during the NRC 2004 Fire Protection Triennial Inspection. A copy of the response (Question #76) is included herein as Pages 3 through 12, indicating that the PTN facilities do not necessarily comply with all aspects of NFPA 30. As a precaution, a Night Order was issued for increased awareness, by Operators, of unusual heat sources in the hydrogen seal oil unit areas.

Initial review concluded that containment facilities for main, startup and auxiliary transformers and lube oil storage tanks are sufficient to either contain the largest combustible liquid inventory within their respective bounds or limit liquid spreading beyond containment bounds. It was also concluded that the hydrogen seal oil unit curbing would limit spreading because drains inside the curbed areas would remove spillage from the area. This conclusion was confirmed via additional review and research, described in the Nonconformance Evaluation section below.

For assessment purposes, however, it was assumed that lube oil would spill over the curbs to the turbine building floor (that is, no credit for the pit drain). Pooling would tend around area drains and liquid spreading would be limited by nearby structural barriers. An equivalent diameter for the pool was estimated and the center-of-circle established with respect to a selected target (cable from Train A entering the A Switchgear Room from the east). The heat flux from a hydrocarbon pool fire was estimated using NUREG-1805 and using the southeast corner of the switchgear building as a target point. No credit was taken for intervening structures or components. Since the heat flux at the corner is less than the critical heat flux required for cable failure (Page 6 herein), there is no need to extend the distance to the Train A cable. Therefore, it was concluded that oil overflow of the hydrogen seal oil unit curbing would be of low risk significance.

Apparent Cause:

As indicated elsewhere herein, there is no nonconformance or non-compliance issue and, therefore, no apparent cause evaluation is required. Even so, the reason for investigating risk-significance of pooling due to spillage from the hydrogen seal oil units is an NRC question raised during the inspection regarding apparent inability of curbing to contain the full volume of oil inventory pursuant to NFPA 30. The concern relates to fire size and intensity, which provide inputs to the significance determination process. NFPA 30 compliance determines how facilities are considered (normal or degraded) in a risk-informed/performance-based review per NRC Instruction MC609 Appendix F.

Nonconformance Evaluation:

A subsequent extended review noted that the NRC SER (excerpt Pages 13 and 14) for the FPL fire protection evaluation (L-77-57 dated February 25, 1977) concluded the floor drain system is adequate to prevent damage to safety-related equipment. In addition, NFPA 30 (excerpt Page 15) indicates that containment area drainage systems shall direct combustible liquid leakage to a safe location. These references are consistent with Appendix A guidelines and commitments described in Section 2.4.D.1(l) of UFSAR, Appendix 9.6A (Page 16). So is the hydrogen seal oil facility, which, having curbs and its own pit drain to remove oily spillage to a safe area, prevents inadvertent oil flows to surrounding areas and the drainage system. The "drainage system" referred to is the area drainage system at large and excludes the pit drain, which does not share flow paths with area drains. Therefore, there is ***no operability or nonconformance concern.*** In addition, the Night Order imposed by Operations to increase awareness of unusual heat sources from the hydrogen seal oil units may be cancelled.

Extent of Condition:

The capability to contain and control spillage from combustible liquid inventories is a general requirement of NFPA 30. For PTN, consideration applies to significant (>200 gallons) in situ inventories of combustible liquids. These inventories include station transformers, lube oil storage tanks and diesel fuel oil storage tanks as well as hydrogen seal oil units (RCP motor oil inventory spillage control is governed by 10 CFR 50, Appendix R, Section III.O licensing commitments). For documentation purposes, a corrective action is prescribed to address containment and control capability for significant combustible liquid inventories at PTN.

The population of items with similar conditions is limited to those where NFPA standards are set as the base standard by which compliance or guidance fidelity is assessed. As indicated in the response to NRC Question #76 (Page 3), CR 04-0369 was initiated to address PTN compliance requirements to NFPA. This bounds the extent of condition for NFPA 30.

Potential Repeat Occurrence/Event Review:

Review of PTN operating experience indicated Tenera performed a compliance review in the early 1980s but the report has not been updated. Review of recent PSL and Surry inspection reports noted no specific issues where compliance with NFPA 30 was called into issue. Also, no related experience was found in the PTN or PSL CR databases or recent OE issues, except for discovery of transformer oil as an unaccounted combustible liquid inventory during the PSL 2003 triennial inspection.

Review of the electronic CR databases for PTN and PSL did not identify previous occurrences regarding noncompliance with NFPA 30. Also, no such discrepancies had been identified during recent NEIL inspections or QA audits. Addressing the condition via CR serves to prevent repeat occurrences of the question; however, a repeat occurrence is possible in similar situations where a risk-informed/performance-based focus abides.

Corrective Action(s): PM04-03-148

1. Design Mechanical Engineering to document in situ significant combustible liquid inventories (>200 gallons) in Calculation PTN-BFSM-04-001. **PMAI due 8/20/04**
2. Operations to rescind the Night Order imposed to increase awareness of unusual heat sources from the hydrogen seal oil units. **Completed**

Preparer: A S Duncan / [signature] Date: 2/23/04
Print Signature

Verifier: A PINEDA / [signature] Date: 2/25/04
Print Signature

Concurrence: J. ANTIGNANO / [signature] Date: 2/25/04
(Fire Protection) Print Signature

Concurrence: V BAILEY / [signature] Date: 2/26/04
(Operations) Print Signature

Approver: J LaDue / [signature] Date: 3/4/04
Print Signature

Attachment 4 to L-2004-125
Condition Report 04-0686

CONDITION REPORT

DUE: 3-15-04 (Date)

CR NO. 04-0686

PTN ☒ PSL ☐ JB ☐

PAGE 1 OF _____

CR Administrator

ORIGINATOR

SYSTEM #/NAME 091/Fire Detection UNIT 09

COMPONENT NAME Smoke Detectors

DISCOVERY DATE/TIME 02/12/04 / 1400

CR ORIGINATOR A. S. Dunstan

COMPONENT ID Various

LOCATION (BLDG/ELEV) 4B Switchgear Rm

EVENT DATE/TIME 3/5/85 / 1200

DEPT/PHONE Engineering / 6004

(ATTACH ADDITIONAL PAGES AS NECESSARY)

PROBLEM (WHAT HAPPENED, HOW WAS THE ISSUE DISCOVERED, WHAT ACTIVITIES, PROCESSES AND PROCEDURES WERE INVOLVED, PHYSICAL CONDITION EXISTING AT THE ISSUE LOCATION, WHY IS THIS ISSUE OR EVENT A CONCERN, HAVE YOU SEEN THIS ISSUE OCCUR BEFORE)

Ceiling level fire detectors in the 4B Switchgear Room (Fire Zone 67) do not meet the spacing guidelines per NRC MC609F, Attachment 2. This is not consistent with UFSAR Section 3.5.1, which indicates that fire detection instrumentation ensures adequate warning capability for prompt detection of fire in their inscipient stage. Delay in detection, particularly to small, high heat-release (HHR) fires, could result in delays in annunciation response and allow fire growth to more severe levels. Assess the significance of the degraded detection capability. This issue was identified during the NRC 2004 Fire Protection Triennial Inspection.

ORIGINATOR

REGULATION OR REQUIREMENT IMPACTED: NFPA 72E. No operability concern per CR 01-0320.

IMMEDIATE CORRECTIVE ACTION TAKEN, ADDITIONAL CORRECTIVE ACTIONS COMPLETED: Initiated CR to address the issue.

NOTIFICATIONS: None

NPS REVIEWS

OPERABILITY/REPORTABILITY DETERMINATION:

☐ A. OPERABILITY ASSESSMENT REQUIRED (3 WORK DAYS) _____ DUE DATE

☐ B. POTENTIALLY REPORTABLE (ATTACH ENS WORKSHEET, IF USED) _____ DUE DATE

☒ C. NO OPERABILITY CONCERN/NOT REPORTABLE (EXPLAIN)

☐ D. OTHER

OUTAGE RELATED? ☐ YES ☐ NO

MODE HOLD? ☐ YES ☐ NO

FOR ENTRY INTO MODE _____

☐ OWA

BASIS / COMMENTS: evaluated per CR-01-0320

NPS/VPNE Wogan (PRINT) / Jim Wogan (SIGNATURE) DATE/TIME 3/13/04 2400

PGM APPROVAL

CONDITION REPORT ASSIGNED TO: Eng DUE DATE 3-15-04

COMMENTS: Address why deficiency not addressed in previous CR 01-320

INVESTIGATION TYPE

☐ Significance Level 1

☒ Significance Level 2

☒ Significance Level 3

☐ Root Cause Analysis - A

☒ Apparent Cause - B

☐ Correction Only - C

☐ Nuclear Network Entry Required

☐ PGM Closeout

☐ Trend Only

☒ Potential Human Performance Issue

Affected Dept. Eng

PGM/VPNE M Lacal DATE 3/13/04

VICE PRES., NUCLEAR OPERATIONS SUPPORT

CRs ARE QA RECORDS WHEN CLOSED. PLEASE ENSURE ALL RESPONSES AND ATTACHMENTS ARE LEGIBLE

ENG

FUNCTIONAL FAILURE: ☐ YES ☐ NO ☒ N/A BY: A. S. Dunstan / [signature] (PRINT / SIGNATURE)

N/A

ASSIGNEE

INVESTIGATION: ANALYSIS, CORRECTIVE ACTIONS. GENERIC IMPLICATIONS. DISPOSITION DETAILS, WORK INSTRUCTIONS (ATTACH ADDITIONAL PAGES AS NECESSARY)

See page 13

ASSIGNEE

CAUSE CODES: 1) S1 2) S2 3) _____

IF ACE OR RCE: THIS IS A REPEAT EVENT/ CONDITION ☐ YES ☐ NO

HU ERROR AFFECTS OTHER DEPT ☐ YES ☒ NO

AFFECTED DEPARTMENT _____

DOCUMENTATION INITIATED: (N/A if not applicable)

PWO N/A

PMAI Voided

RTS/PCR N/A

EVALUATION REQUIRED FOR:

EQ ☐ YES ☒ NO

10CFR50.59 ☐ YES ☒ NO

10CFR21 ☐ YES ☒ NO

ASME SECTION XI ☐ YES ☒ NO

NONCONFORMING/DEGRADED PLANT CONDITION DISPOSITION: N/A ☑ REWORK ☐ REPAIR ☐ USE-AS-IS ☐ GL 91-18 ☐

REVIEW / APPROVAL

DISPOSITION SIGNATURES: (N/A if not applicable)

PREPARER A S Dunstan / [signature] 6004 (PRINT / SIGNATURE / DEPT. PHONE) DATE 3/4/04

OTHER DEPT. HEAD CONCUR N/A / — (PRINT / SIGNATURE) DATE —

ANII/SEC XI REVIEWER N/A / — (PRINT / SIGNATURE) DATE —

PNSC/FRG REVIEW ☐ YES ☒ NO

NUCLEAR NETWORK ☐ YES ☒ NO

DEPARTMENT MGR APPROVAL S P CHAVIANO / [signature] (PRINT / SIGNATURE) DATE 3/13/04

FRG/PNSC REVIEW (if required) MTG# _____ CHAIRMAN _____ DATE _____

APPROVAL FOR SL-1 CR OR IF REQUESTED IN PGM APPROVAL SECTION, OTHERWISE N/A

PGM N/A DATE _____

REVIEW / APPROVAL

ADMIN

EVENT CODES: 1) R1 2) O1 3) D8 EXPLAIN OTHER: _____

ADMIN

CRs ARE QA RECORDS WHEN CLOSED. PLEASE ENSURE ALL RESPONSES AND ATTACHMENTS ARE LEGIBLE

Supplemental Response to #88

Fire Zone 67 is approximately 22' x 75' and has a ceiling height of approximately 22'. This detection system was installed during original plant construction. A review of NFPA 72E, 1982 edition, was reviewed for guidance pertaining to the conformance to the applicable code of record.

A measurement of the detector spacing was performed during a walk down of the fire zone. The following detector spacing was measured from the west wall, starting at detector 2-16. Detector 2-16 is approximately 9'-6" from the west wall. Detector 2-17 is approximately 11'-6" from detector 2-16, which is approximately 21' from the west wall. Detector 2-18 is approximately 20' from detector 2-17 (approximately 41' from the west wall). Detector 2-19 is approximately 27'-6" from Detector 2-18 (approximately 68'-5" from the west wall and approximately 7' from the east wall).

1. Code Requirements: Section 4-3.1 states: "The location and spacing of smoke detectors shall result from an evaluation based on engineering judgement supplemented by the guidelines detailed in this standard."

   Code Evaluation: Detectors in Fire Zone 67 meet this requirement.

2. Code Requirements: Section 4-3.1.1 states: " Where the intent is to protect from a specific hazard, the detector(s) may be installed closer to the hazard in a position where the detector will readily intercept the smoke."

   Code Evaluation: Detectors in Fire Zone 67 meet this requirement, since six (6) smoke detectors are placed over cable trays.

3. Code Requirements: Section 4-3.1.2 of NFPA 72E states "Stratification. The possible effect of smoke stratification at levels below the ceiling shall also be considered." Appendix B-1.2 states: "Generally, height is the most important single dimension where ceiling heights exceed 16 ft"

   Appendix A-4-3.1.2 provides design considerations to be considered in the selection of smoke detector types, installation location, and spacing of smoke detectors installed in high ceiling areas.

   Code Evaluation: The ceiling height of Fire Zone 67 is approximately 22 feet. One mitigating strategy in A-4-3.1.2 is to drop detectors below the ceiling so that some detectors are closer to the hazard. There are six (6) detectors strategically placed approximately 1'-6" above cable trays that protect safety-related cables. These spot detectors are not intended to mitigate the high ceiling configuration for fire zone 67 and provide an additional margin of fire safety in that a quicker response time could be achieved for overheating or smoldering cables.

4. Code Requirements: Section 4–3.2 of NFPA 72E states "Spot-type smoke detectors shall be located on the ceiling not less than 4 inches from a sidewall to the near edge, or if on the sidewall, between 4 in. and 12 in. down from the ceiling to the top of the detector."

   Code Evaluation: Detectors in Fire Zone 67 meet this requirement.

5. Code Requirements: Section 4-3.5.1 states: "On smooth ceilings, spacing of the 30 ft may be used as a guide. In all cases, the manufacturer's recommendations shall be followed. Other spacing may be used depending on ceiling height, different conditions or response requirements."

   Code Evaluation: Detectors in Fire Zone 67 meet the 30-ft spacing guide.

6. Code Requirement: Section 4–3.7.3 of NFPA 72E states " If beams exceed 18 in. in depth and are more than 8 ft. on centers, each bay shall be treated as a separate area requiring at least one spot-type or line-type detector."

   Code Evaluation: Detectors in Fire Zone 67 meet this requirement.

Although the fire detection system is compliant with NFPA 72E, the spacing of the detectors does not satisfy the recommendations contained in the Attachment 2 of the Fire Protection Significance Determination Process. Based upon the recommendations of the table in Attachment 2 of Appendix F, the recommended spacing for a smoke detector exposed to a medium rate fire and a 25' ceiling height is 18' between detectors. By extrapolation for a 22' ceiling height, the recommended spacing would be approximately 21'. There is one detector, Detector 2-18 that does not meet the recommended spacing of Attachment 2 to the Fire Protection Significance Determination Process, Appendix F. All other detectors are within the recommended detector spacing. Additionally, the 6 spot detectors placed over the cable trays are determined in compliance in order to mitigate the stratification concerns identified in NFPA 72E. Therefore, 1 out of 10 detectors is considered to be outside the spacing guidance of Attachment 2.

Additional guidance provided in Attachment 2 suggests that the condition has a moderate impact (degradation) on the fire detection system if: "The placement and spacing of 10 percent of the detectors within the fire area, zone, or room under consideration do not meet the spacing/placement conditions specified by the code-of-record or by their UL listing.

The purpose is to estimate the risk significance of degraded (moderate) detection features in Fire Zone 67. Defense-in-depth characteristics are collectively assessed with ignition frequency as the Fire Mitigation Frequency (FMF).

FMF = IF + FB + MS + AS + CC

Where:
IF = fire ignition frequency (log)
FB = fire barrier
MS = manual suppression/detection
AS = automatic suppression/detection
CC = dependencies/common cause contribution

From Table 5.1 of Appendix F,

AS = 0	(no automatic suppression)
MS = -0.5	(moderately degraded due to the potential for delayed response time)
FB = 0	(fire barrier not used in the FMF since we are applying the Single Room Term (SRT))
CC = 0	(no dependencies or common cause contribution)

IF = -2.725 (log 1.88-03- fire frequency from IPEEE)

FMF= IF + MS+ AS + CC

IF= FIRE IGNITION FREQUENCY (LOG)	log	0.00188	= -2.72584
FB= FIRE BARRIER = N/A (SRT)			= 0
MS = MANUAL SUPPRESSION/ DETECTION =			= -.5
AS = AUTOMATIC SUPPRESSION/DETECTION			= 0
CC = DEPENDENCIES/ COMMON CAUSE CONTRIBUTION			= 0
		FMF=	-3.22584

* Manual Suppression is shown as moderate degradation due to the low potential for delayed response time.

From Table 5.4, a FMF value of –3.22 equates to approximate frequency (1 per year) of 10^3 to 10^4. From Table 5.5, this frequency range corresponds to an estimated Likelihood Rating of D for > 30 days exposure to the degraded condition. From Table 5.6, the Risk Significance Rating is "Green", or not risk significant based on the loss of a single train plus recovery of a failed train for the 4B 4KV Switchgear Room.

Detector response time is based on many variables (ventilation, ceiling height, fire size and type, etc.). Arguably, the dominant factor for detector response time is the fire size and type/fuel. A small smoldering fire in Fire Zone 67 would not likely be detected rapidly (unless the source is below one of the spot detectors located above cable tray); however, a small smoldering fire would have no adverse effect on safe shutdown since this type of fire will not affect redundant safe shutdown functions. A large fire event that has the potential to cause damage to safe shutdown cables would be detected rapidly by the existing smoke detectors so that an effective and prompt fire brigade response can be credited with mitigating the effects of a worst case fire event in Fire Zone 67. Therefore, the spacing and location of the detectors in Fire Zone 67 are considered adequate for the hazards and will ensure prompt detection of a fire that has the potential to affect safety-related or safe shutdown circuits and components.

The purpose is evaluation is to estimate the Fire Mitigation frequency (FMF) associated with the fire protection features provided in Fire Zone 63.

FMF = IF + FB + MS + AS + CC

Where:
IF = fire ignition frequency (log)
FB = fire barrier
MS = manual suppression/detection
AS = automatic suppression/detection
CC = dependencies/common cause contribution

From Table 5.1 of Appendix F,

AS = 0 (no automatic suppression)

MS = -0.25 (highly degraded due to the potential for delayed response since no fire detection provided)

FB = 0 (fire barrier not used in the FMF since we are applying the Single Room Term (SRT))

CC = 0 (no dependencies or common cause contribution)

IF = -3.64 (log 2.31-04- fire frequency from IPEEE)

FMF= IF + MS+ AS + CC

IF= FIRE IGNITION FREQUENCY (LOG) =	log	0.000231	-3.63639
FB= FIRE BARRIER = N/A (SRT)			0
MS = MANUAL SUPPRESSION/ DETECTION =			-0.25
AS = AUTOMATIC SUPPRESSION/DETECTION=			0
CC = DEPENDENCIES/ COMMON CAUSE CONTRIBUTION =			0
			-3.88639

* Manual Suppression is shown as highly degraded due to lack of automatic detection.

From Table 5.4, a FMF value of –3.88 equates to approximate frequency (1 per year) of 10^3 to 10^4. From Table 5.5, this frequency range corresponds to an estimated Likelihood Rating of D for > 30 days exposure to the degraded condition. From Table 5.6, the Risk Significance Rating is "Green", or not risk significant based on the loss of a single train plus recovery of a failed train for the U3 Reactor Control Rod Equipment Room.

Fire Size (Btus/second) and Growth Rate	Maximum Ceiling height (feet)	Maximum Spacing (ft)
100 btus/sec - fire growing at a slow rate	10	22
	15	15
	18	12
250 btus/sec - fire growing at a slow rate	10	40
	15	35
	18	30
MEDIUM RATE		
100 btus/sec - fire growing at a medium rate	10	18
	15	12
	18	N/A
MEDIUM RATE		
250 btus/sec - fire growing at a medium rate	10	35
	15	28
250 btus/sec - fire growing at a medium rate	20	24
	25	18
	28	12
FAST RATE		
100 btus/sec - fire growing at a fast rate	10	12
	15	N/A
FAST RATE		
250 btus/sec - fire growing at a fast rate	10	28
	15	20
	20	14

Ceiling construction where beams are 8 inches or less in depth shall be considered equivalent to a smooth ceiling. If the beams are more than 8 inches in depth the spacing of spot type detectors in the direction perpendicular to the beams shall be reduced. If the beams are less than 12 inches in depth and less than 8 feet on center spot type detectors shall be permitted to be installed on the bottom of beams.

If the beams project more than 18 inches below the ceiling and are more than 8 feet on center each bay formed by the beams shall be treated as a separate area and have at least one detector installed within the bay.

Location and spacing of heat detectors should consider beam depth, ceiling height, beam spacing, and fire size. To

b) Portable fire extinguishers shall be selected for the specific class or classes of hazards to be protected and installed with due consideration given to possible adverse effects on safety-related equipment installed in the area. Further guidance on fire extinguisher selection shall be taken from NFPA 10.

c) Fire extinguishers shall be inspected and maintained via plant procedures in accordance with NFPA 10.

d) Fire extinguishers shall be periodically tested via plant procedures to ensure proper operation.

3.4.3 DESCRIPTION

Portable fire extinguishers are installed in strategic locations throughout the plant to ensure availability for use as a first line of defense against small fires. Refer to Table 9.6A-4 and Figures 9.6A-12 through 9.6A-15 for the locations and types of portable fire extinguishers.

Portable fire extinguishers are permanently installed in containment to provide manual firefighting capability.

Two pressurized water type fire extinguishers are maintained in the Control Room for fires involving Class A combustibles.

3.5 FIRE DETECTION SYSTEMS

3.5.1 INTRODUCTION

Fire detection instrumentation ensures that adequate warning capability is available for the prompt detection of fire. This capability is necessary in order to detect and locate fire in its incipient stage. Prompt detection of fire will reduce the potential for damage to safety-related equipment and is an integral element in the overall facility fire protection program. The fire detection system is installed in the areas of the plant that contain or present a possible fire hazard to safe shutdown equipment or safety related components, and is designed to be operable with or without offsite power. Details of the system are provide below.

3.5.2 DESIGN BASES

The design of the Fire Detection System is based on the guidance set forth in Appendix A to BTP 9.5-1 and 10 CFR 50 Appendix R, Section III.G. The following are specific design guidelines.

a) Fire detection systems should comply with NFPA 72D and 72E, as appropriate.

b) Fire detection instrumentation shall be operable with or without offsite power.

c) Fire detection systems shall give audible and visual alarms and annunciation in the Control Room. Visual indication should be provided at local graphics panels.

d) Fire alarms should be distinctive and unique.

Step 3: Qualitative Evaluation of Findings

Once the various inspection DID findings and a meaningful fire scenario have been established for the fire area, zone or room of concern, the individual findings must be evaluated with respect to their ability to satisfy the performance objective established by the applicable DID element. Upon determining which DID elements have been affected by the specific fire protection finding, a qualitative evaluation of each finding and its effects on accomplishing the DID objective is performed. It should be noted that many inspection findings can contribute to a degradation in a DID element. For example, poor training, poor fire brigade/operational drill performance, improperly installed detection, and inadequate hose coverage of a fire area can all contribute to the degradation rating assigned to manual suppression. Therefore, in order to perform this step, the existing plant conditions as noted by the inspection finding are evaluated against the deterministic/qualitative evaluation guidance and degradations categorization criteria established in Attachment 2 of Inspection Manual Chapter 0609, Appendix F.

The output from this deterministic/qualitative evaluation, results in a degradation rating (DR) being assigned to each DID element.

Step 4: Integrated Assessment of DID Findings (Excluding SSD) and Fire Ignition Frequency

Once Step 3 has been completed, the respective DID findings for a given fire area, zone, or room of concern are assessed collectively by summing, using the following formula, the fire Ignition Frequency (IF) and the DR for each of the fire protection DID elements. This value is called the Fire Mitigation Frequency (FMF) and inputs into the Significance Determination Process (SDP) to determine the change in risk. (Therefore, this formula should be used to evaluate the FMF for each scenario. As a result, the steps in this methodology describe how to calculate the risk for a single scenario. For multiple scenarios, the steps must be applied multiple times, even though many values of the FMF will remain unchanged since those scenarios will occur in the same zone, room, or fire area where the same degradations of automatic and manual suppression will exist.)

$$FMF = \log_{10}(IF) + FB + MS + AS + CC \text{ (when appropriate)}$$

where IF = Fire Ignition Frequency
FB = Fire Barrier (used for DRT only; see Step 9)
MS = Manual Suppression/Detection
AS = Automatic Suppression/Detection
CC = Dependencies/Common Cause Contribution

Table 5.4 below shows the association between the FMF and the approximate frequency in Table 5.5 (same as SDP Table 1, "Estimated Likelihood Rating for Initiating Event Occurrence During Degraded Period").

Step 5: Assignment of Quantitative Values

From Step 3, "Qualitative Evaluation of the Findings," a DR is assigned to each DID element. Once the DRs for a DID element have been determined, they are quantified by assigning a value from **Table 5.1.**

Table 5-1 Quantification of Degradation Ratings (DR) of the Individual DID Elements

Level of Degradation	3-Hour Fire Barrier	1-Hour Fire Barrier	20-feet Separation	Automatic Fire Suppression Effectiveness	Manual Fire Fighting Effectiveness (Fire Brigade)	
					Outside Control Room	Inside Control Room
High	0	0	0	0	-0.25	-0.75
Moderate	-1.25	-0.5	N/A	-0.75	-0.5	-1
Normal Operating State	-2 (door(s), or multiple dampers, or damper & door)) -2.5 (damper or multiple penseals or both) -3	-1	-2	-1.25	-1	-1.5

The normal operating state category reflects full compliance with existing regulations and regulatory guidance. Specified by the existing regulations and regulatory guidance is the need for fire protection systems and features to meet fire protection industry codes and standards. A fire protection system or feature is considered to be in a normal operating state when its design conform with the minimum design, installation, and performance criteria specified by the code-of-record.

Rigorous[4] compensatory measures for the DID elements are credited. The credit given for an rigorous compensatory measure to a DID element is the credit provided for a moderate degradation of the DID element.

The bases for the failure probabilities in Table 5.1 follow. The normal operating state probability for the 3 hour barrier is found in several NRC and industry documents (e.g. EPRI Fire PRA Implementation Guide p.4-43, NUREG/CR-4832 p.3-84, and other documents e.g. NUREG/CR-4550). The normal operating state probability for automatic suppression is found in EPRI FIVE methodology p.10.3-7 and in EPRI Fire PRA Implantation Guide p.4-38 and is used in many IPEEEs. The 1 hour barrier provides less protection than the 3 hour barrier, and the credit is assigned

[6] Each of these values in Tables 5.1, 5.2, and 5.3 is approximately an exponent of 10.

appropriately. Credit given for the normal operating state 20-foot separation relies on NUREG/CR-3192, and is substantial. The normal operating state probability for non-control room manual suppression is from FIVE p.6-30, and is used approximately in IPEEEs to characterize manual suppression reliability for fire areas. One basis for control room manual suppression unreliability is the estimate of suppression failure prior to forced evacuation due to smoke impaired visibility.[7] Also credit for manual suppression, in general, is limited since it is not viewed as reliable as an uncomplicated operator action.

Manual suppression capability is credited even when it is highly degraded, unlike other DID elements. This credit is based upon the potential for early detection and suppression of fires by personnel using hand-held fire extinguishers. Quantitatively, the credit provided for the control room comes from the control room severity factor (found in EPRI Fire PRA Implementation Guide p.D-14 and IPEEEs) which is partially based on detection and suppression by personnel inhabiting the control room. Less credit is given for a high degradation of non-control room areas since those are not normally manned continuously.

Dependencies exist between certain DID elements. Those dependencies and their values are expressed in Table 5.2 below.

Table 5.2 Quantification of Dependencies Between DID Elements

Automatic Fire Suppression Effectiveness Degradation	Manual Fire Fighting Effectiveness Degradation	Adjustment Due to Dependency
Medium	High	+0.75
Low	High	+0.5

These dependencies are based on the fact that automatic suppression merely controls the fire, and the fire brigade is needed to completely extinguish the fire. The resulting adjustment has the effect of providing partial credit for automatic suppression when it has a low degradation and is paired with a high degradation of manual fire fighting capability. No credit is provided for automatic suppression when it has a medium degradation and is paired with a high degradation of manual fire fighting capability.

[7] J.C. Chavez and S.P. Nowlen, "An Experimental Investigation of Internally Ignited Fires in Nuclear Power Plant Cabinets, Part II - Room Effects Tests," NUREG/CR-4527 Vol. 2, Sandia National Laboratories, Albuquerque, NM, October 1988. J.C. Chavez, "An Experimental Investigation of Internally Ignited Fires in Nuclear Power Plant Cabinets, Part I - Cabinet Effects Tests," NUREG/CR-4527 Vol. 1, Sandia National Laboratories, Albuquerque, NM, April 1987. These references indicate that approximately 10 minutes are available before control room evacuation is necessary due to smoke obscuration. J. Lambright et al., "Analysis of the LaSalle Unit 2 Nuclear Power Plant: Risk Methods Integration and Evaluation Program," NUREG/CR-4832, Vol. 9, Sandia National Laboratories, Albuquerque, NM, March 1993. J. Lambright et al., "A Review of Fire PRA Requantification Studies Reported in NSAC/181," Sandia National Laboratories, April 1994, NUDOCS accession number 9409220104. This reference produces a probability of failure to suppress a control room fire prior to a given time.

Table 5.3 Quantification of Common Cause Contribution Between Sprinkler Systems and Manual Fire Fighting Hose Stations		
Automatic Fire Suppression Effectiveness Degradation	*Manual Fire Fighting Effectiveness Degradation*	*Adjustment Due to Common Cause*
Low	Low	+0.25

The **Table 5.3** adjustment is made since a common water delivery and supply system exists for both automatic and manual water-based systems.

Step 6: Determination of Fire Ignition frequency

The next step is to determine the fire ignition frequency for the scenario. This fire ignition frequency for the scenario will be the ignition frequency of the component(s) which ignite the fire and damage a set of equipment. If the fire ignition frequency for the appropriate component(s) is contained in the plant-specific IPEEE, it should be used. However, if the IPEEE does not provide the ignition frequency of the appropriate component(s), then the analyst may contact NRR/SPSB to confirm a licensee-supplied frequency, or to provide a frequency.

To develop the ignition frequency for a scenario, the ignition frequency of all components initiating the scenario are added. For example, suppose two electrical cabinets are adjacent, and each can propagate the fire to each other. Suppose a target of interest is only susceptible to damage from one electrical cabinet. Then the frequencies from both cabinets would be added to determine the scenario frequency since a fire in either cabinet would damage the other cabinet, and as a result cause damage to the target. If the electrical cabinets would not damage each other, then distinct scenarios would be developed for each cabinet, and the frequency of the appropriate cabinet used for each distinct scenario. A new scenario must be developed each time different damage is postulated by the fire.

The next step is to convert the FMF which has been developed to an approximate frequency. Table 5.4 performs this conversion.

Problem Statement:

During the NRC 2004 Fire Protection Triennial Inspection, the suitability of the area detection configuration in Fire Zone 67 (4B Switchgear Room) was questioned. The issue is similar to that raised in 2001 regarding compliance with NFPA 72E for the 3B Switchgear Room. The issue was addressed via CR 01-0320 with no nonconformance or operability concerns. In addition, the configuration was evaluated (PTN-FPER-01-008) and determined to be of low risk significance. It should be noted that PTN-ENG-SEMS-01-0043 was also developed, based on NRC Instruction Manual MC0609 Appendix F, to provide guidance for performing risk significance estimates of fire protection features.

Since then, the evaluation criteria have expanded whereby the NRC noted that detector spacing does not meet the guidelines per MC609F, Attachment 2 (Page 7). The initial response to Question #88 (Pages 3 through 6) indicated there was no non-compliance with NFPA 72E but noted that Detector 2-18 does not meet spacing guidance and proceeded to assess the risk-significance of the condition. The detection configuration was assessed to be "Green", of low risk significance.

However, Section 3.5.1 of UFSAR Appendix 9.6A (Page 8) indicates the intent of having fire detection instrumentation is for providing adequate warning capability to promptly detect and locate a fire in its insipient stage. This capability directly relates to fire brigade response time. Accordingly, this CR was initiated to address how this capability is satisfied for Fire Zone 67.

Analysis:

The condition is associated with fire protection features, which are classified as quality-related. ***Therefore, this CR is classified as QR.***

Risk-significant issues are regarded in terms of degree, not necessarily pass-fail. As noted, there is no nonconformance or non-compliance concern with the issue. Rather, it is to assess whether there are conditions that could degrade the overall responsiveness of the fire brigade to a fire in the 4B Switchgear Room.

The sooner a fire is detected, the sooner the fire brigade will respond. The degree to which this capability exists is quantified as an input to the fire mitigation frequency (FMF) based on defense-in-depth (DID) features. Inputs to the FMF include ignition frequency, fire barrier, manual suppression/detection, automatic suppression/detection and dependencies/common cause contributions. These quantitative values, at various levels of degradation, are used in the significance determination process (SDP) to determine change in risk. An excerpt from MC609 Appendix F is provided as Pages 9 through 12 herein.

In the response to Question #88, the manual suppression/detection (MS) component was regarded as "moderately degraded" for potential delay in response time due to detector spacing. For the values shown in Table 5.1 (Page 10), the normal operating state is based on full compliance with regulations and regulatory guidance. The MS value is reviewed for Fire Zone 67 as follows, each item individually rated as normal or highly degraded per Table 5.1:

-1 The 4 ceiling detectors comply with NFPA 72E standard requirements.

-0.25 Detector 2-18 does not meet spacing guidance per MC609F.

-1 There are 6 spot detectors over cable trays at elevation near top of switchgear.

-1 All detectors in the area are periodically tested.

-0.25 Air handler discharge tends to delay smoke or hot gases from reaching ceiling detectors.

-1 Air mixing tends to disperse smoke or hot gases toward the cable tray spot detectors.

-1 Detector actuation signals in the Control Room, which mobilized fire brigade.

-0.25 Detector signal does not indicate which room in the Switchgear Building, must be determined at a local panel.

-1 The 4B Switchgear Room is in close proximity to the Control Room with clear access such that fire brigade early and full-complement arrivals are timely.

-1 Extinguishers and hose stations are located near 4B Switchgear Room doors.

The average of these values is -0.78, between normal and moderately degraded. Although somewhat simplistic, this assessment supports that the "moderately degraded" classification in the Question #88 response is reasonable and the detector configuration is of low risk significance.

Apparent Cause:

Detector 2-18 is part of the original plant area detection system and complies with NFPA 72E and the design bases presented in the UFSAR. Since then, the development of MC609 Appendix F with expanded inspection criteria added a risk-informed/performance-based perspective for regarding detection facilities. The NRC used these criteria during this triennial inspection and is expected to continue applying these criteria in future inspections. Therefore, the apparent cause of this condition is NRC regard for MC609 Appendix F criteria during inspections and evaluations of PTN fire protection features, where these criteria are beyond PTN design bases.

Nonconformance Evaluation:

The area detection in Fire Zone 67 complies with NFPA 72E, which satisfies design bases presented in UFSAR Appendix 9.6A Section 3.5.2. Therefore, there is ***no nonconformance.*** Also, analysis of composite design features indicates that the condition of Detector 2-18 spacing being inconsistent with MC609 Appendix F criteria is of low-risk significance. Therefore, there is ***no operability concern.***

Extent of Condition:

Based on the Tenera review for NFPA compliance (circa 1981) as well as the scope and results of numerous NRC inspections and QA audits since, it is reasonable to assume that all fire detection facilities conform to the design bases presented in Section 3.5 of UFSAR Appendix 9.6A. However, except for Fire Zones 63, 67 and 106 reviewed during this triennial inspection, it is considered likely that detection facilities in other areas are not consistent with the guidelines presented in MC609F, Attachment 2.

Potential Repeat Occurrence/Event Review:

The electronic CR databases for PTN and PSL were reviewed. This is a repeat condition to that addressed via PTN CR 01-0320 for area detection in the 3B Switchgear Room. No nonconformance was noted and corrective actions appeared to have quelled compliance concerns in the 4B Switchgear Room, partly because NRC guidance data had not then been well developed. Conformance to NFPA 72E was also addressed via CR 04-0476 for detection in Fire Zone 97. However, there is a potential for repeat occurrence in future inspections with regard to NRC use of MC609F Attachment 2 guidelines as part of the risk-significance determination process. Therefore, it is recommended that area detection facilities in all power block indoor fire areas (excluding containments and access restricted areas due to high radiation) be reviewed with respect to MC609F Attachment 2 guidelines.

Human Performance Review:

Review based on PGM 02-004, using Attachment 1 thereto for guidance, indicates no human performance concerns. Based on awareness of apparent regulatory trends and the potential to adopt a more risk-informed/performance-based perspective in fire protection, the proposed corrective action is considered reasonable and appropriate. No human performance issues were identified with respect to the present configuration.

Corrective Action(s):

1. Replace PM04-03-122 with a new action for Design Mechanical Engineering to review area detection in indoor power block areas (except containments or areas with radiological restrictions) with respect to guidelines contained in NRC Instruction MC609, Appendix F, Attachment 2, the review to be documented in the UFSAR or other referenceable source. **PMAI due 01/28/05** (See SITRIS CR 2004-190)

2. Licensing to evaluate revisiting NRC's position regarding FPL - PTN compliance to MC 609 Appendix F, Attachment 2 compliance.

   MC 609 is not PTN's licensing or design basis

   PMAI due 9/15/04 (See SITRIS CR 2004-190)

Preparer: _____ / _____ Date: 3/4/04 3/24/04
Print Signature

Verifier: A PINEDA / _____ Date: 3/9/04 AAP 3/12/04
Print Signature

Approver: J LoDuca / _____ Date: 3/12/04
Print Signature