

# Fire Detection and Protection Instructor Notes

## ACADs (08-006) Covered

1.3.4.3 5.1.1.2.1.7 5.1.1.2.12c4 5.1.2.18 5.2.2.8 5.4.3.3

## Keywords

Batteries, passive fire barrier, active fire barrier, diagram, drawing, Brown's Ferry.

## Description

This document provides instructor notes and references to other materials which may be used to develop a lesson on fire detection and protection systems.

## Supporting Material

"Fire Detection and Alarm System", System Training Manual, Article AS-20A

"Fire at Browns Ferry Nuclear Plant", TVA, 3-22-75

SPEER 88-01-012 "CO2 Isolation To Both ESF Switchgear Rooms"

SOER 82-10, "Fire Barrier Degradation"

38FT-9QK07 Fire Detection/Protection System Functional Test - MSSS Bldg

38FT-9QK08 Fire Detection/Protection System Supervised Test - MSSS Bldg

38FT-9QK14 Fire Detection/Protection System Supervised and Functional Test - Carbon Dioxide Panels

38FT-9FP01 Fire Detection/Protection System Backup Battery Test

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# PALO VERDE NUCLEAR GENERATING STATION

## Instrumentation & Controls Training

### Classroom Lesson



<b>I&amp;C Program</b>	<b>Date:</b>
<b>LP Number: NID08C000101</b>	<b>Rev Author: Thomas E. Blank</b>
<b>Title: Fire Detection/Protection Overview</b>	<b>Technical Review:</b>
<b>Duration : 6 Hours</b>	
	<b>Teaching Approval:</b>

**INITIATING DOCUMENTS:**

Site Maintenance Training Program Description

**REQUIRED TOPICS**

NONE

**CONTENT REFERENCES**

"Fire Detection and Alarm System", System Training Manual, Article AS-20A

"Fire at Browns Ferry Nuclear Plant", TVA, 3-22-75

SPEER 88-01-012 "CO2 Isolation To Both ESF Switchgear Rooms"

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**Lesson Plan Revision Data**

Feb 13, 2004 Ed Blank Record created

Tasks and Topics Covered

The following tasks are covered in Fire Detection/Protection Overview:

Task or Topic Number*	Task Statement
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Lesson: [Fire Detection/Protection Overview](#)

FP01	<a href="#">Troubleshoot and rework the Fire Protection Detection System</a>
FP03	<a href="#">Perform Fire Protection/Detection Supervisory Test</a>
FP02	<a href="#">Perform Fire Protection/Detection Functional Test</a>

Total tasks or topics: 3

**TERMINAL OBJECTIVE:**

- 1.1 Given the necessary resource and reference materials, describe the operation and system interfaces of the Fire Detection and Protection Systems. Mastery will be demonstrated by obtaining an overall average of 80% on a multiple choice exam.
  - 1.1.1 State the purpose of the Fire Detection & Protection Systems
  - 1.1.2 Describe the Fire Detection System including its subsystems and the systems with which it interfaces
  - 1.1.3 Describe the Fire Protection System including its subsystems and the systems with which it interfaces
  - 1.1.4 Determine the field device condition by evaluating the control room fire terminal indication.
  - 1.1.5 Determine the source of operating power for any control equipment in the Fire Protection and Detection Systems
  - 1.1.6 Discuss maintenance on Fire Detection/Protection Panel Back-up Batteries.

## Lesson Introduction: Fire Detection/Protection Overview

The following items are things to consider in your Lesson Introduction. They are not mandatory. You should develop your own introduction and place that material in the Program Hierarchy in the Lesson Introduction Tab or appropriate Training Unit.

### CLASSROOM GUIDELINES

- If applicable, remind students of class guidelines as posted in the classroom.
- Pass the attendance sheet around and have it signed in Dark ink.
- Ensure that student materials needed for the class are available for each student.
- Emphasize student participation and remind them of your philosophy on asking and answering questions, if applicable.

### ATTENTION STEP

- Give a brief statement or story to get student concentration focused on the lesson subject matter.

### LESSON INTRODUCTION

- Give a brief statement that introduces the specific lesson topic. Should be limited to a single statement.

### MOTIVATION

- Focus student's attention on the benefits they derive from the training. At Instructor's discretion. The need for motivation in each succeeding lesson must be analyzed by the Instructor and presented as necessary.
- Instructor should include how the STAR process can be used to improve or enhance Operator Performance, if applicable.
- Read and discuss lesson terminal objective and review lesson enabling objectives, if desired.
- If applicable, briefly preview the lesson topic outline and introduce the major points to be covered. The objective review may have been sufficient.
- REINFORCE the following PVNGS management expectations as opportunities become available:

- Nuclear Safety
- Industrial Safety Practices
- STAR and Self-Checking
- Procedure Compliance
- Communication Standards
- ALARA
- Prevent Events

<b>T.Obj 1.1</b>	<b>Given the necessary resource and reference materials, describe the operation and system interfaces of the Fire Detection and Protection Systems. Mastery will be demonstrated by obtaining an overall average of 80% on a multiple choice exam.</b>
<b>EO 1.1.1</b>	<b>State the purpose of the Fire Detection &amp; Protection Systems</b>

**1.1.1.1 Introduction**

Discuss the importance of the Fire Detection/Protection system. Cover OE:259-750322-1 "Fire at Browns Ferry Nuclear Plant", TVA, 3-22-75.

**1.1.1.2 Main Idea**

**CONTENT**

**METHODS AND ACTIVITIES**

System definition

- a) Discussion limited to power block equipment
- b) Two systems
  - i) Fire detection (QK)
  - ii) Fire protection (FP)
- c) Physically separate
- d) Functionally separate
  - (1) Exception
    - (a) Detection system outputs to preaction panel
- e) Both systems report through the security computer

- a) FPMT maintains ancillary building fire systems; but course does not cover fire pumps or switchyard (though Unit 1 responsibility)
- b) Display T004 (QK/FP overview diagram) and refer students to HO Fig 1-1.
- (1) In MSSS QK panel E15D outputs a signal to the E78 FP panel to initiate a preaction valve opening.

**Prevent Events: Use Procedures-**See 38FT-9QK07. Critical section 7.4  
**Prevent Events: Self Check/Peer Check.-** Second Party Validation step 7.4.1

**Purpose of the Fire Detection and Protection systems**

- a) Both systems provide alarms at
  - i) Each unit control room
  - ii) Locally
- a).Display T005 (Purpose; FP/QK)

iii)

1. The purpose of the Fire Detection system.

b) Fire Detection only alarms when fire condition exists.

i) Smoke

ii) Heat

iii) Light

2. The purpose of the Fire Protection System.  
Fire Protection system alarms and actuates local suppression devices

a) Fire protection alarms occur for:

i) Fire conditions or,

ii) Protection device actuation.

<b>EO 1.1.2</b>	<b>Describe the Fire Detection System including its subsystems and the systems with which it interfaces</b>
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### 1.1.2.1 Main Idea

#### CONTENT

#### METHODS AND ACTIVITIES

**Describe the Fire Detection system to include the major components and the systems with which it interfaces.**

Fire detection system description

c) Made up of eighteen panels containing;

- i) .A control cabinet
- ii) Multiple protection zones
- iii) Detectors
- iv) Indicators

d) Supervised circuits monitor

- i) Initiating devices
- ii) Indicating devices

e) Interfaces

- i) PSS Computer

a).Display T006 (QK block diagram) and refer student to HO Fig 1-2.

Describe each QK panel as a "stand-alone" subsystem - 17 installations.

b). Define "supervision" as constantly sending current through a loop to ensure its integrity.

- i). Define "initiating" devices as detectors monitored by the control panel, i.e. input devices
- ii). Define "indicating" devices as alarm bells, etc. driven by the panel, i.e. output devices

i). More detail on this later.



<b>EO 1.1.3</b>	<b>Describe the Fire Protection System including its subsystems and the systems with which it interfaces</b>
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### 1.1.3.1 Main Idea

#### CONTENT

**Describe the Fire Protection system to include the subsystems and the systems with which it interfaces.**

Fire protection description

- f) Water systems, delivered by:
  - i) Wet pipe
  - ii) Deluge
  - iii) Preaction
- g) Carbon Dioxide
- h) Halon
- i) Each of these delivery systems requires:
  - i) Control cabinet
  - ii) Distribution piping and valves
  - iii) Initiating devices
  - iv) Indicating devices
- j) Supervised circuits monitor;
  - i) Initiating devices
  - ii) Indicating devices
- k) Interfaces to:
  - i) HVAC
    - (1) Supply damper closers
    - (2) Return damper closers

#### METHODS AND ACTIVITIES

Display T007 (FP block diagram) and refer students to HO Fig 1-3.

e) Define "supervision" as constantly sending current through a loop to ensure its integrity.

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>(3) HVAC fan power</li> </ul>  | <ul style="list-style-type: none"> <li>1,2,3, - Isolate airflow in/out of room</li> </ul>   |
| <ul style="list-style-type: none"> <li>ii) Service Air</li> </ul>   | <ul style="list-style-type: none"> <li>ii). Supervisory air pressure to ensure header integrity</li> </ul>  |
| <ul style="list-style-type: none"> <li>iii) PSS computer</li> </ul>   | <ul style="list-style-type: none"> <li>iii). Display T008 (Security Computer System) and refer students to HO Fig 1-4.</li> </ul>   |
| <ul style="list-style-type: none"> <li>a) Concentrator cabinet</li> </ul>   | <ul style="list-style-type: none"> <li>a). Define responsibility boundaries for I&amp;C versus OCS; discuss work control philosophy of processing WO through OCS first for evaluation before routing to I&amp;C. Display T009 (Concentrator locations) and refer students to HO for similar information.</li> </ul> |
| <ul style="list-style-type: none"> <li>i) Receives bistable input from:           <ul style="list-style-type: none"> <li>(1) QK panels</li> <li>(2) FP panels</li> <li>(3) QK/FP field devices</li> <li>(4) Security equipment</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>3). Including various field located switches, e.g. valve position switches. NOTE: all tamperswitches inside the protected area have been removed. Only ones left are in the pump house.</li> </ul>   |
| <ul style="list-style-type: none"> <li>b) PSS Computer</li> </ul>   |   |
| <ul style="list-style-type: none"> <li>i) Twin Honeywell Level 6 Computers</li> </ul>   |   |
| <ul style="list-style-type: none"> <li>ii) Failover capability</li> </ul>   |   |
| <ul style="list-style-type: none"> <li>iii) Interface to Computrol concentrators</li> </ul>   | <ul style="list-style-type: none"> <li>iii) Discuss the "reconfiguration" capability of the concentrators</li> </ul>  |
| <ul style="list-style-type: none"> <li>iv) Sends/receives data from/to:           <ul style="list-style-type: none"> <li>(1) Security CAS</li> <li>(2) Security SAS</li> </ul> </li> </ul>  | <ul style="list-style-type: none"> <li>(1),(2)CAS and SAS no longer fire terminal location, but point activation performed here by security personnel</li> </ul>  |
| <ul style="list-style-type: none"> <li>v) Fire terminal in each control room</li> </ul>   |   |

<b>EO 1.1.4</b>	<b>Determine the field device condition by evaluating the control room fire terminal indication.</b>
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**1.1.4.1 Main Idea**

**CONTENT**

**METHODS AND ACTIVITIES**

**Determine the field device condition by evaluating the control room fire terminal indication as well as any applicable industry events.**

- |  |   |
|--|---|
| <p>a) Fields provide info in column format</p>   | <p>(a)Display (Fire Terminal/Keyboard; Sample Display)</p>  |
| <p>b) <u>IDENTITY</u>- field gives computer generated alarm ID number; flashes as long as alarm condition is present; used in alarm clearing procedure</p> | <p>Consider Fire Terminal "unreliable/anomalies" from SPEER 88-01-012.</p> <p>Mention that the data base is Safeguards due to its interface with the Security system.</p>   |
| <p>c) <u>REASON</u>- field describes kind of alarm received:</p>   | <p>(c)Discuss one method of processing resistance change in field, i.e. current source develops normal voltage across normal resistor, but develops two alarms from abnormal resistances.</p>   |
| <p>i) <u>ALARM</u>- noun indicates a fire condition detected; or fire suppression equipment activated</p>  | <p>Illustrate current loop of 1 vdc to 1 kilohm resistor causes 1 ma to flow, developing a NORMAL condition; 1 vdc to 2 kilohm resistor causes 0.5 ma to flow, developing an ALARM condition.</p> <p>Depending on database assignment, alarms can be annunciated as any noun.</p>   |
| <p>ii) <u>TROUBLE</u>- noun indicates problem detected, causes are unique to panel</p>   | <p>ii)For instance, (1) an open circuit in the detector monitoring from a fire panel, or (2) a loss of battery backup during AC operations, loss of AC with battery backup or (3) a loss of supervisory pressure on a preaction pipe header, or (4) grounds on fire panels, or (5) an open two wire loop from the concentrator to the fire panel.</p> |
| <p>iii) <u>LOP</u>- noun indicates loss of power, causes are unique to panel</p>   | <p>iii)LOP may be from loss of 110 VAC line or loss of DC after rectification. Check prints for each application.</p>   |
| <p>d) <u>IDENTITY</u>- field displays ID number assigned to equipment alarm</p>  | <p>d)Used in data base; should be referred to in work control or procedure</p>  |
| <p>e) <u>DESCRIPTION</u>- field assigned to equipment number and/or plant location</p>   | <p>e)Valuable information providing alarming panel ID and the zone in question. Use with appropriate print to determine problem.</p>  |

Title: Fire Detection/Protection Overview

Lesson Plan #: NID08C000101

- f) DATE-field used to record date/time alarm was initiated
- g) *'red' or 'white'*- field used to indicate status of condition. 'Red' indicates field condition exists. 'White' indicates field condition no longer exists.

If field condition no longer exists alarm 'REASON' field will go white.

When field condition no longer exists, Alarm is manually removed from screen

Note: *all tamperswitches inside the protected area have been removed. Only ones left are in the pump house.*

- 1) Communication Console: Removing clear conditions from screen.

Alarm received - Alarm received red  
 Silence Alarm - Push + key on numeric pad of keyboard  
 Condition in field clears - Alarm displays go white  
 To clear alarm:

Use mouse pointer and click middle button on Alarm description

- 1) Description will highlight, FTST 'button' will appear, FPOR 'button' will appear, Alarm Ack 'button' will appear
- 2) Use mouse pointer to click on 'Alarm Ack'
- 3) Use mouse pointer to click on 'FTST'
- 4) Use mouse pointer to click on 'FOPR'
- 5) Clear' button will appear
- 6) Use mouse pointer to click on 'Clear'
- 7) Alarm Description and Alarm clear and
- 8) Communication Console goes back to default display.

## 2) Location numbering systems

- a) Equipment Location coding can be used to determine general area
- b) Describe equipment locator system used at PVNGS
  - i) Explain that 00WJE08NJ02125 equals:
    - (1) 0' west of column line JE
    - (2) 8' north of column line J02
    - (3) Elevation 125'
- c) Describe equipment locator system used at PVNGS
  - i) Explain that 00WJE08NJ02125 equals:

i)Use EDOC to call up 13PZJL-303 (%CONTROL%EQUIPMENT%LOCATION%) and direct students to Control Building ("J") and 120' elevation (125) to find the panel J-QKN-E03D

- (1) 0' west of column line JE
- (2) 8' north of column line J02
- (3) Elevation 125'

- ii) This system used by work control/eq locator
- iii) Refer to 13-C-00A-008 for plant layout and column lines

*Optional Exercise if needed:*  
 Refer to 13-P-ZJL-302, research 01EJD02NJ04105 location.  
 Have students find JFPNE06C

**3) Maintenance requirements**

- a) Surveillance no longer required due to Fire Protection and Fire Detection equipment's deletion from Technical Specification testing
- b) Maintenance Testing procedures cover testing in two specific areas:
  - i) Function testing the alarm and suppression equipment
  - ii) Testing the supervisory circuitry associated with the fire protection cabinets
- c) FT/MT Procedure identification

**Prevent Events: Use Procedures** – Procedures have Critical steps in instructions, (especially for FP panels) to establish proper testing conditions, i.e., establish fire watches, isolate actuation valves & dampers, mechanical and electrical.

**Prevent Events: Self Check/Peer Check** – Second Party Verification in Procedures that proper testing conditions are established prior to beginning testing.

- i) 38FT-1QK32 thru 38MT-9QK26
- ii) Even procedure numbers are supervisory circuit tests; odd procedure numbers are functional tests (general rule of thumb)
- iii) Information contained in procedures
  - (1) Contain Fire Detector ID Verification sign off sheets as a result of past problems identified by QIR

i)critical MT's were changed to FT's so they could not be waived

ii)Review and discuss procedures and refer class to handout outlining the locations in the unit covered by the different procedures  
**Use EPROC**

iii) Review and discuss a Functional test and a Supervisory test procedure. (38FT-9QK14)

- b) Contains most of the information necessary to locate the equipment to be tested
- i) Core information is available on the

Talk about ' **See Ref Docs**' in most Procedures and

- Equipment Location drawing to identify the specific location. show how to find in SWMS – Use **CMPINFO**
- c) Detector location Use EPROC
  - i) Description of the detector location area
  - ii) Detector location drawing number
- d) P&ID drawing numbers
- e) Vendor drawing numbers Find Info for 1JQKNE13D. Use SWMS, Eproc, and Edoc. Find detector location print M651-47. View print for detector locations.
- f) Tech Manual numbers

**EO 1.1.5 Determine the source of operating power for any control equipment in the Fire Protection and Detection Systems**

**1.1.5.1 Main Idea**

**CONTENT**

**METHODS AND ACTIVITIES**

**Determine the source of operating power for any control equipment in the Fire Protection and Detection Systems.**

- g) Elementary diagram numbers
- h) Single Line diagram numbers
- i) Operating power source
  - (1) Often necessary for trouble shooting
  - (2) Not contained directly in the procedures

Procedures have most information

- (3) Can be obtained by use of
  - (a) Elementary Diagrams
  - (b) Single line diagrams

(3) Use example of procedures: 38FT-9QK05/06 to ID required print; J-QKN-E12D ID'ed on 01-E-QKB-001 as (52-01, D81C) go to 01-E-FPA-001

J-FPN-E11C ID'ed on 01-E-FPB-004 as (52-03), D84C) go to 01-E-FPA-001

J-FPN-E49 ID'ed on 01-E-FPB-001 as (52-01, D84E) go to 01-E-FPA-001.

If the procedure is not available, but the panel location is known, i.e. "Deluge System for the Lube Oil Room", the FP (FPB-001 through FPB-005) or QK (QKB-001) print can be scanned for the area desired, i.e. see 01-E-FPB-002 for J-FPN-E28 with power from E-QBN-D81D. Then verify this info on Singleline diagram FPA-001 and ID the breaker.

Some panels "daisy-chained" power, so follow chain to breaker. EX. On FPB-002, J-FPN-E23 indicates power from J-FPN-E16. On FPB-001, J-FPN-E16 indicates power from J-FPN-E15. On FPB-001, J-FPN-E15 indicates power from J-FPN-E14. On FPB-001, J-FPN-E14 indicates power from EQBND84D. On FPA-001, Single Line Diagram, Breaker IDed as 52-03.

If power is daisy chained to the panel as well as battery charger units, the battery charger unit will be a "F" sequence. EX. On FPB-002, J-FPN-E65 indicates power to E-FPN-F65, also (lower on print)

from J-FPN-E68, fed from EQBND81B. FPA-001 indicates Breaker 52-04.

FINAL EXERCISE: Given a panel location code, determine the power feeder cable number.

12EJA07SJ04105

Answer: 1st, determine the panel ID from 13-P-ZJL-302 (JFPNE09C).

2nd, determine what breaker feeds the panel from 01EFPA001 (D84C, 52-05).

*USE THIS SECOND EXERCISE ONLY IF NEEDED:*

01WJE07SJ02078

ANSWER: 1st, determine the panel ID from 13-P-ZJL-301 (JQKNE01D).

2nd, determine what breaker feeds the panel from 01EFPA001 (D84C, 52-01).

- i) Cabinets and associated drawings shown on drawings

Explain that a concentrator can be identified on an elementary drawing by (a) looking for a numbering sequence ending with F01(X) with the (X) being an alphabetic character unique to the specific concentrator, or (2) by looking for a multi-conductor cable from the fire panel, since a concentrator "concentrates" information into packages of data for transmission to the computer. Beware of the interposing "S" panels which house the diode matrix and resistor networks.

Passive and Active fire barriers

B.Cover material from SOER 82-10, Fire Barrier Degradation



<b>EO 1.1.6</b>	<b>Discuss maintenance on Fire Detection/Protection Panel Back-up Batteries.</b>
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**1.1.6.1 Main Idea**

**CONTENT**

**I&C is responsible for maintaining the Fire Detection/Protection Panel Batteries**

- 1) Batteries are now sealed units
- 2) Maintenance performed under procedure 36FT-9FP01 is primarily:
  - a) Voltage checks: Voltage specifications in procedure
  - i) AC supply removed and Voltage Readings taken at 2 & 4 hour interval

***Prevent Events: Two Minute Drill***

***Hazard assessment: Chemical Exposure; Eye/Skin Contact***

- 3) Visual inspections: Battery general condition, evidence of leaks etc
- 4) Problems found are corrected by issuing a CMWO.
  
- 5) Cover battery acid concerns
  
- 6) Review special P&ID symbols and have students fill in the missing information in their HO Fig 1-6.

**METHODS AND ACTIVITIES**

38FT-9FP01: Fire Detection/Protection Backup Battery Test

***Prevent Events: Use Procedures - Per 38FT-9FP01:***

**CONTINGENCIES**

10.1 If any battery/batteries failed to meet Target Values, initiate a WR, or CRDR, whichever is appropriate. If any Yuasa or Globe battery fail it is necessary to also replace the other series connected battery, due to overstressing. **(Reference CRDR #310136)**

10.1.1 If batteries fail during testing, system solenoids may require determ/reterm to prevent system actuation. If required, determ/reterm to prior to AC power restoration, reterm solenoids after power is restored, document per determ/reterm.

***PVNGS Safety Manual Relevant Chemical Sections***

## **SUMMARY OF MAIN PRINCIPLES**

The following items are things to consider in your lesson summary. They are not mandatory. You should develop your own summary.,

### **Objectives Review**

Review the Lesson Objectives

Topic Review

Restate the main principles or ideas covered in the lesson. Relate key points to the objectives. Use a question and answer session with the objectives.

### **Questions and Answers**

Oral questioning

Ask questions that implement the objectives. Discuss students answers as needed to ensure the objectives are being met.

### **Problem Areas**

Review any problem areas discovered during the oral questioning, quiz, or previous tests, if applicable. Use this opportunity to solicit final questions from the students (last chance).

### **Concluding Statement**

If not done in the previous step, review the motivational points that apply this lesson to students' needs. If applicable, end with a statement leading to the next lesson.

You may also use this opportunity to address an impending exam or practical exercise.

Should be used as a transitional function to tie the relationship of this lesson to the next lesson. Should provide a note of finality.