

Zion Generating Station
Mobile Fire Detection System
NFPA Code Evaluation

Prepared for:

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1. Introduction

Commonwealth Edison (CECO) has proposed creating a Mobile Fire Detection system to replace fire watches at the Zion Generating Station. The Mobile Fire Detection (MFD) system is intended to be an automatic fire detection system which can be quickly installed where ever fire surveillance patrols are needed to comply with the plant Fire Protection Program Requirements. The MFD system, however, is only intended to supplement the existing Plant Proprietary Alarm Signaling system and to provide a means of continuously monitoring areas for fire where a degraded fire protection system has been identified.

Fire surveillance patrols, or fire watches, are required under the following circumstances and frequencies:

- 1) If the number of operable fire detectors for a given zone is less than that required by Fire Protection Program, an hourly fire watch shall be performed in that zone until the detectors are restored to operable status.
- 2) If the sprinkler systems in the zones containing the diesel generator fuel oil are inoperable, a continuous fire watch shall be established in the inoperable zones until the sprinklers are restored to operable status.
- 3) If the carbon dioxide fire extinguishing systems in the diesel generator room zones are inoperable, a continuous fire watch shall be established in the inoperable zones until the carbon dioxide systems are restored to operable status.
- 4) If one or more of required penetration fire barriers are not intact, a continuous fire watch shall be established on at least one side of the affected penetration. If an operable fire detector is located in the area, an hourly inspection of the penetration fire barrier may be established rather than a continuous watch.

A Mobile Fire Detection system which is continuously monitored from the plant control room could be more reliable than traditional fire watches.

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Commonwealth Edison contracted Poem Lighting Company for the construction of a prototype Mobile Fire Detection system to test the viability of this concept. ABB Impell was requested to perform a code analysis of the prototype. This report contains the result of the code evaluation.

2. System Description

The prototype Mobile Fire Detection system is planned to consist of mobile units equipped with smoke and flame detectors which will alarm to a Central Receiving Station (CRS) located in the main control room. Alarm and trouble signals from each mobile unit will be transmitted to the control room via an approved digital communicator and the plant telephone system. The mobile units will be connected into phone jacks which will be installed on all of the telephones located in the areas of the plant which are affected by the fire protection Technical Specifications. The mobile unit control equipment will be capable of seizing the phone line to the Central Receiving Station located in the control room.

The information contained in this analysis was obtained through a walkdown of the fire watch routes on July 7, 1993, the observation of the installation of the CRS in the control room on July 8, and technical data obtained from the contractor constructing the system (Poem Lighting Company). A subsequent on-site walkdown was also conducted on August 31st through September 13, 1993 to review potential MFD locations.

Each mobile unit will consist of a hand cart, on which a telescoping pole with the smoke and flame fire detectors on top of the pole shall be mounted. The pole will be capable of being extended to four different elevations with the tallest being approximately 20 feet. A standby battery will be installed on the hand cart fork, with the control panel installed on a bracket above the battery. Multiple conductor cables on self-retracting reels will be provided for the initiating circuits between the control panel and the detectors. Brackets will be provided for coiling an AC power extension cord and telephone cable, each which will be uncoiled and connected to the appropriate outlets when the units are positioned in the plant. The control panel, standby battery, self-retracting reels, AC power and telephone cables shall all be contained within a NEMA 12 enclosure behind a locked door to prevent tampering or accidental damage.

The major components of the mobile units will be as follows:

- 1) Hand Cart - 43-inches tall with a 7 inch deep fork and 6-3/4 inch diameter wheels. The wheels will not touch the floor when the truck is in the upright position.
- 2) Pole - Four concentric, aluminum pipes. Ball locks/holes will be located at the end of each pipe to position the pole in one of four possible positions.
- 3) Detector Cable - Three conductor cable marked as follows: 18 AWG 3 COND E24642 LL44387 CSA 5VT 10500. Two cables, one for each detector, will be installed on self-retracting reels to allow positioning the detector height.
- 4) Fire Detectors - One flame detector and one smoke detector will be installed on a common junction box on top of the pole of each MFD unit. The detectors currently being considered for installation operate on 12 VDC. power and include: Pyrotector Model 30-2021 Ultraviolet Flame Detector (4-wire, FM approved) and System Sensor Model No. 2412 Photoelectric Detector (4-wire, UL listed/FM approved).
- 5) MFD Control Panel - The MFD control unit will be an Ademco model 5140XM fire alarm system. The 5140XM unit is U.L. listed for remote station and central station fire alarm service. The Ademco "Touch Tone" reporting format has also been tested for compatibility with the CRS (Silent Knight 9000) digital alarm receiver. Features of the 5140XM will include:
 - Microprocessor based programmable panel with memory (power loss does not result in loss of panel programming).
 - Supervised dialer output for transmitting alarm and system status to the CRS.
 - Supervised detection circuit (open and short conditions).
 - Supervised AC power loss and low battery alarm.
 - Built in battery charger and 24 hr. battery back-up.
 - Dialer test automatically transmits a test signal to the CRS once per hour.
 - Continuous call back to the CRS until the digital alarm receiver acknowledges the alarm signal.
 - Compatible with 4-wire detectors.

A NEMA 12 metal enclosure with continuous hinged cover, (40"x15"x9") will house the control equipment. The Ademco panel will monitor the fire detectors and transmit alarm and trouble signals via a digital communicator to the control room CRS over the existing in-plant phone lines. The MFD unit operates on a primary operating power source of 120 VAC. A supplementary fire alarm horn sounder and strobe light will be mounted on the top of the control panel enclosure. The combination fire horn strobe will be System Sensor Model SS-12. A back-up power supply consisting of two-7 amp hour batteries with a continuous floating charge circuit will also be provided.

- 6) AC Extension Cord - A three pronged extension cord will be used for providing AC power to the control unit and battery charger. The cord will connect to a standard 110V electrical outlet box. The marking on the cord is as follows:
POLAR/SOLAR 16-3 SJ150 WSA 90CA-4001 WATER RESISTANT.
- 7) Telephone Cord - A standard telephone cord with a modular phone jack will be installed.
- 8) Back-Up Power Supply - The standby battery back-up for the Ademco Fire Alarm system will consist of two-7 amp hour batteries which are connected in parallel along with a continuous 13.7 VDC floating charger.

A two pole double throw switch will be set to engage the standby batteries when 120 VAC is being utilized as the primary power supply.

When 120 VAC power is not available in the area for operating the MFD, an auxiliary 12 VDC battery rated at 675 ampere will be utilized as the primary power supply. The normal standby 7 amp batteries would be isolated from the control panel by the two pole double throw switch in order to align the 675 ampere auxiliary battery as the sole power supply to the panel.

The auxiliary battery has an operating time of approximately 4 weeks.

- 9) Central Receiving Station - The CRS will be a Silent Knight model 9000 digital alarm receiver which is U.L. listed and FM approved for central station service. Features of the model 9000 include:
- LCD status display for fire and supervisory alarms.
 - Built-in printer.
 - PROM memory which prevents loss of information if power is lost.
 - Back-up battery and charger.
 - Supervised AC power loss and low battery voltage.
 - Line fault for telephone line malfunction.
 - Compatible with Ademco "Touch Tone" reporting format.
 - Line card trouble alarm.
 - RS-232 port monitors computer communication link and provides constant trouble/supervisory alarms which must be acknowledged by operators.

The Silent Knight panel will be located in the control room. The CRS unit has both visual indicating devices for annunciating the receipt of fire detection and abnormal conditions and a printer for automatic logging of these conditions. The unit's primary power source is 120 VAC along with a 24 hour 12 volt battery back-up system.

3. Methodology

The following current editions of the National Fire Protection Association (NFPA) standards were used in the performance of this evaluation:

- 1) NFPA 72, *Standard for the Installation, Maintenance, and Use of Protective Signaling Systems*, 1990 edition.
- 2) NFPA 72E, *Standard on Automatic Fire Detectors*, 1990 edition.

The existing plant alarm signaling system at Zion Station would generally follow the system fundamentals of a proprietary protective signaling system since the central receiving station is located at the protected premises, and the system serves, operates and is maintained under one ownership.

Mobile Fire Detection systems are an innovative idea, not currently covered by existing NFPA standards. Fire protection engineering

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judgement was used to evaluate nonstandard features in comparison to NFPA guidelines. This is acceptable based on the following code statement [NFPA 72, Sec. 1-3.2]:

"A device or system having materials or forms different from those detailed in this standard may be examined and tested according to the intent of the standard and, if found equivalent, may be approved."

The intent of the MFD is to provide a compensatory measure in lieu of fire watches rather than making the MFD a permanent addition to the proprietary fire alarm system. In order to evaluate the use of the MFD for this purpose, the NFPA guidelines were reviewed for applicability to fire detection and signaling performance criteria.

For example, in a proprietary signaling system, NFPA 72 does not contemplate the use of a digital communicator to transmit signals over phone lines. However, digital alarm communication is a standard feature for remote station protective signaling systems. Therefore, the digital communication requirements for remote stations were considered in lieu of the signaling line circuit requirements for proprietary signaling systems.

The detailed code evaluation was prepared as a line-by-line analysis of the applicable sections of NFPA 72 and NFPA 72E. The results of this detailed analysis are included in the report as Appendix A.

4. Assumptions

The following assumptions were made in the course of this evaluation:

- 1) The Mobile Fire Detection system was completed using the materials and methods observed during our visits to the plant and Poem Lighting Company's office July 7 through August 3, 1993.
- 2) The system installation will follow the manufacture's detail instructions as contained in each vendor's installation manual.
- 3) An acceptance test will be prepared to test the successful performance of all the required operating features specified by NFPA and as indicated by the manufacturers. The method of verifying these features are indicated in the table contained in

Appendix A by the words "Acceptance Test" in the verification column.

- 4) Plant operation and maintenance procedures will be revised as needed, to satisfy code requirements and manufacturer recommendations. The method of verifying these items are indicated in the table contained in Appendix A by the words "Operation Test" or "Maintenance Tests" in the verification column.

5. Summary of Deviations

We found that the proposed Mobile Fire Detection system is a viable means for providing automatic fire detection. There are however, specific code deviations with respect to the proposed system configuration. The deviations have been identified along with the proposed justifications which consist of equivalent design features or compensatory measures.

In review of NFPA 72E, Automatic Fire Detectors, it was identified that the photoelectric smoke detectors would be limited to specific hazard spot protection [NFPA 72E, Section 4-4-1]. This protection method is utilized due to most areas of the plant having ceiling construction and equipment obstruction, air currents, and limited device quantities thus preventing the detectors from meeting their spacing and location requirements for complete area detection. In order to effectively locate the MFD units, walkdowns were performed to analyze these limiting factors noted above.

Secondly, NFPA 72E specifies that flame sensing detectors are suitable provided that the detector type, i.e. ultraviolet (UV), infrared, spark, etc. is matched to the characteristics of the fire, [NFPA 72E, Section 5-3.1]. The UV detector was selected due to its fast detection capability even though flame detectors are generally used in high hazard areas where rapid fires may occur. Typically, most areas of the plant are not considered high hazard, however, transient combustibles such as cleaning solvents or lube oil may be present on occasion. In these instances, the UV detector would provide an early warning method should a flaming fire occur. It should also be noted that the MFD unit also contains a photoelectric detector which is specifically designed to detect a slow to develop smoldering fire. Therefore, the combined detection principle which utilizes smoke and flame detectors is considered adequate for the MFD system application.

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The results of the NFPA 72 signaling system evaluation are shown on the table contained in Appendix A. A summary of the deviations follows with the applicable NFPA 72 sections shown in brackets:

- 1) All equipment shall be listed for the intended signaling purpose. The Ademco system is U.L. listed for Remote Station and Central Station applications, however, a switch has been added to transfer the power supply between the normal standby batteries and the auxiliary battery [2-1.2].
- 2) The multiconductor cable intended for the fire detectors is not labeled for fire protection signaling service [2-1.4].
- 3) A portion of the telephone lines to be used as signaling line circuits will be supervised in lieu of the circuit configurations specified in Table 2-7.1 [2-7.1 and 8-7.3.3.2].
- 4) Power supplies shall be installed in conformity with NFPA 70. The mobile fire detection panel auxiliary battery size of 675 amps exceeds the maximum rating of 105 amps marked on the battery enclosure [5-2].
- 5) In some areas of the plant, an AC outlet may not be available for the MFD unit. In these instances, the MFD panel will be powered from an auxiliary 675 amp battery as the primary and secondary supply.[5-3.1, 5-3.2 and 5-3.3].
- 6) A dedicated AC branch circuit will not be used to power the MFD panel [5-3.2 & 5-4.2].
- 7) The charger in the MFD panel is not capable of recharging the 675 amp battery. However, the normal standby 7 amp batteries will be on the Ademco panel charger when the unit is powered by AC [5-5.1].
- 8) The MFD digital alarm transmitter is connected to the in-plant private telephone system rather than a public switched telephone network [8-7.2.1].
- 9) The transmitter will be connected to only one phone line rather than two separate lines (numbers) [8-7.2.6 through 8-7.2.8].

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- 10) A spare CRS is not provided in the Control Room [8-7.3.1.1].
- 11) Only one incoming phone line will be used by the CRS [8-7.3.3.1 & 8-7.3.3.3].
- 12) Alarm signals transmitting simultaneously from multiple MFD units may not all be received within 90 seconds for 10% of the total number of initiating device circuits [9-8.3.2].
- 13) Telephone line integrity will be monitored as intended for the trunk line [9-8.2]. Automatic logging of an MFD not reporting to the system test signal is not performed by the CRS. However, a personal computer (PC) will monitor the MFD incoming system test signals and will automatically log any MFD which has not responded to the hourly test signal. The CRS operator would then initiate compensatory actions until a system check (MFD and telephone lines) is performed and the equipment is restored to service.

6. Conclusions

Our conclusions from this analysis are as follows:

- 1) The acceptance tests should be performed and the results considered along with this analysis to determine if any modifications should be made to the MFD system.
- 2) If conditions or hazards significantly change in the future, other fire detectors, such as projected beam smoke detectors, infrared, or smoke sampling should be considered for applications where flame detectors or spot smoke detectors may not be suitable.
- 3) The Mobile Fire Detection system is considered an acceptable compensatory method in lieu of fire watches, provided that the system is maintained and monitored as necessary.

7. References

- 1) Silent Knight Installation and Operating Instructions, Digital Receiver Model 9000.
- 2) Ademco 5140XM Installation Instructions.
- 3) Pyrotector Ultraviolet Flame Detector Model 30-2021, Model 30-2021E Instructions.
- 4) Pittway System Sensor, Installation and Maintenance Instructions for Model 2412 photoelectric smoke detector.
- 5) Underwriters Laboratories Fire Protection Equipment Directory 1993.

JUSTIFICATIONS

1. The two pole double throw switch has been added to alternate between the normal standby back-up batteries and the auxiliary battery. While this switch would modify the U.L. listed configuration of the Ademco system, the purpose of the switch is to allow the use of the standby batteries when the MFD is normally powered by AC or to transfer the primary power supply to the auxiliary battery if AC power is not available. Inspection, maintenance and testing will be performed to verify that the DC power supplies are ready for continuous service.
2. The fire detectors and their associated cabling will be periodically tested to ensure that the detector signaling circuit is operable.
3. The telephone line will be supervised from the CRS to the PABX center. The telephone lines to the MFD units are not supervised, however, the Ademco system will be programmed to perform an hourly test signal to the CRS. In the event the hourly test signal is not received from any one of the MFD units, a system check will be performed to determine the status of the non-responding unit. This will include a check of the non-supervised portion of the telephone line.
4. The battery enclosure for the 675 amp auxiliary battery should be replaced with a suitable rated enclosure.
5. In certain areas, AC power may not be available to power the MFD unit. The 675 amp battery will be the only power supply and is adequately sized up to a 4 week duration. An hourly signal test will be performed to verify that the aux. battery is sufficiently powering the MFD unit. In addition, periodic maintenance will be performed to ensure the battery is adequately charged.
6. Although the MFD unit will be powered from a common AC circuit with the plant as opposed to a separate dedicated circuit, power will be constantly monitored at the CRS in the event AC power is lost.

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7. The charger equipped with the Ademco system is not intended to maintain the 675 amp auxiliary battery. This battery has a 4 week reserve capacity and will be periodically tested and maintained to ensure it is adequately charged and capable of powering the MFD unit.
8. The MFD unit signaling line will be connected upstream of all other devices on the in-plant telephone lines. In the event that the MFD goes into alarm, the Ademco panel will seize the telephone line for transmitting the signal back to the CRS.
9. In the event that the initial MFD signal cannot be transmitted over the single telephone line due to simultaneous alarms from other MFD units or telephone line noise, the Ademco panel can be programmed to call back the CRS approximately eight times. The call-back would occur every 30 seconds until the CRS receives the signal. In the event the phone line is inoperable, an hourly signal test will be performed from the Control Room to identify that a MFD unit is not responding. The personal computer monitoring the CRS will automatically log the test signals received from each MFD unit and will alert the operators to initiate a system check if a MFD does not respond.
10. In the event of an inoperable CRS, compensatory measures will be taken until the CRS is returned to service.
11. To ensure the single phone line is available for signal transmission to the CRS, an hourly signal test will be performed. In the event of simultaneous alarms from multiple MFD units or telephone line interference, the Ademco panel will be programmed to call back the CRS on an indefinite basis.
12. In the event multiple simultaneous signals are not received at the CRS within 90 seconds, (due to the single phone line transmission and a MFD seizing the line), the Ademco system on each MFD unit can be programmed to call back the CRS on 30 second intervals for approximately eight times until the CRS receives the alarm signal from each MFD.
13. Hourly signal tests and the CRS personal computer automatic logging of reported test signals from each MFD unit will be performed.

APPENDIX A

MFD Evaluation

NFPA 72 Code Analysis

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NFPA 72-1990 Section	Compliance	Comments	Verification
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Chapter 1: Introduction		Heading	
1-1 Scope Modified to include NFPA 72A, B, C, D, and F series codes in the same standard.	Generic Issue.	Information only.	
1-2 Purpose	Generic Issue.	Information only.	
1-3 General		Heading	
1-3.1 Classification of protective signaling systems.	Generic Issue.	Information only.	
1-3.2 Device or system may be examined and tested according to intent of NFPA code, and if found equivalent, may be approved.	Complies.	The purpose of this code analysis is to review the Mobile Fire Detection (MFD) system and identify deviations from NFPA 72 guidelines. Deviations will be examined and tested, as appropriate, to determine if the MFD system satisfies the intent of the code.	Inspection & Acceptance Test
1-3.3 Intent and meaning of terms.	Generic Issue.	Information only.	
1-4 Definitions	Generic Issue.	Information only.	
Chapter 2: System Fundamentals at the Protected Premises		Heading	
2-1 Installation Requirements		Heading	

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-1.1 Systems	Complies	The Mobile Fire Detection system has been built in a workmanlike manner. This review will determine compliance to NFPA 72 requirements.	Inspection & Acceptance Test
2-1.2 Equipment	Deviates.	The Mobile Fire Detection local panel (Ademco 5140XM) and the Central Receiving Station (Silent Knight 9000) are U.L. listed. The fire detection panel has been modified, however, to accommodate a transfer switch for the standby batteries and the auxiliary battery.	Inspection & Ref. 1 thru 5
2-1.3 Devices and Appliances	Complies.	All devices and appliances are securely mounted so that accidental operation will not be caused by vibration or jarring. In addition, a structural analysis was also performed by S&L.	Inspection & Acceptance Test

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-1.4 Wiring	Deviates.	The multiconductor cable intended to attach to the fire detectors is not labeled for nonpower-limited fire protection signaling service, as required by National Electric Code (NEC) Article 760-17(b). In addition, four conductor cable is needed for two of the proposed detectors.	Inspection & Acceptance Test
2-1.5 Grounding	Complies.	All systems shall test free of grounds.	Acceptance Test
2-1.6 Protection of Control Equipment	Complies.	Automatic fire detection is an integral part of the local Mobile Fire Detection assembly.	Inspection
2-2 Documentation		Heading	
2-2.1 Approval and Acceptance	Complies.	The Mobile Fire Detection system was assembled and installed by POEM Lighting Company. POEM is responsible for submitting as-built drawings and manufacturer data sheets to Commonwealth Edison for their approval. This review was done on the first prototype, while it was still under construction.	Inspection

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-2.2 Certificate of Compliance	Complies with intent.	The acceptance test, along with this NFPA 72 review, will satisfy the intent of the Certificate of Compliance.	Inspection & Acceptance Test
2-2.3 Owner's Manual, Drawings	Complies.	POEM is responsible for providing these documents to CEC Co.	Inspection
2-3 Performance and Limitations		Heading	
2-3.1 Voltage, Temperature, and Humidity Variation	Complies.	The MFD and CRS signaling equipment has been UL tested for environmental exposure conditions. Radiation exposure has been investigated by S&L.	Ref. 1 thru 5
2-3.2 Initiating Devices		Heading	

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-3.2.1 Signal Initiating Devices	Complies.	<p>Two automatic fire detectors will be installed on each Mobile Fire Detector. Current choices for detectors are the following:</p> <ol style="list-style-type: none"> 1) UV Flame Detector, Pyrotector Model 30-2021 - Factory Mutual approved. 2) Photoelectric smoke detector, System Sensor, Model No. 2412 - Underwriters Laboratory, Inc. labeled. 	Inspection & References 3, 4 and 5
2-3.2.2 Manual Stations	Not applicable.	Manual operated stations are not part of the Mobile Fire Detection system.	Inspection
2-4 Signals and Signaling Appliances		Heading	
2-4.1 Presignal Feature	Complies.	The initial fire alarm signal will sound at the CRS in the control room. Operators would then be required to activate the general plant alarm to summon the fire brigade.	Inspection & Acceptance Test
2-4.2 Zone of Origin	Complies.	The Mobile Fire Detection units will be annunciated by coded signal to the digital alarm receiver in the Control Room.	References 1 and 2

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-4.3 Coded Alarm Signal	Complies.	The alarm report code can be repeated a minimum of 8 times, or programmed to call back to the CRS indefinitely.	Reference 2, Inspection, & Test
2-4.4 Coded Supervisory Signal	Complies.	The supervisory report codes can be repeated a minimum of 8 times, or programmed to call back to the CRS indefinitely.	Reference 2, Inspection Test
2-4.5 Combined Coded Alarm and Supervisory Signal Circuits (sprinkler alarms).	Not applicable.	The Mobile Fire Detection system is not used for sprinkler supervision.	Inspection
2-4.6 Visible Zone Alarm Indication	Complies.	Alarm signals are annunciated on the CRS digital alarm receiver using a LED display and a printer. The audible silence button does not disable the signal on the LED display.	Reference 1
2-4.6.1 Annunciation Accessible to Responding Personnel	Complies.	The CRS digital alarm receiver will be installed in the main Control Room.	Inspection
2-4.6.2 Alarms and Signals Distinctively and Descriptively Annunciated	Complies.	Signals on the CRS digital alarm receiver are distinguished by descriptive code on LED display and printer readout.	Inspection & Reference 1

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-4.6.3 Emergency Equipment and Building Systems	Not applicable.	The Mobile Fire Detection system is not used for emergency equipment or building services.	Inspection
2-4.7 Trouble signals		Heading.	
2-4.7.1 General Description	Complies.	The CRS digital alarm receiver will be programmed to give a "Fire" audible annunciation upon receipt of alarm signals. Trouble/supervisory signals are to use a tone alert audible signal.	Acceptance Test
2-4.7.2 Silencing Switch		Heading.	
2-4.7.2.1 General	Complies	Audible trouble/supervisory signals can be silenced by operators at the CRS, however, visual indication will persist until the trouble is corrected.	Reference 1 Inspection, and Acceptance Test
2-4.7.2.2 Audible supervisory signals silencing switch shall not be permitted to prevent subsequent sounding of supervisory signals.	Complies.	Subsequent supervisory signals will sound the audible supervisory alarm.	Ref. 1 and Acceptance Test
2-4.8 Audible Indicating Appliances		Heading.	
2-4.8.1 General	Complies.	A tone alert signal will be used for the supervisory signals.	Acceptance Test

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-4.8.2 Listed appliance	Complies.	Audible indicating appliances are UL listed for fire protection signaling service.	Ref. 5
2-4.8.3 Protection from Environment	Complies.	Audible indicating appliances are integral with both the Mobile Fire Detection system local control panel and the digital alarm receiver in the Control Room. Radiation exposure has been investigated by S&L.	Inspection
2-4.8.4 Additional Requirements for Speakers	Complies.	The speaker to be installed inside Mobile Fire Detection system local control panel is suitable for audible alarms.	Inspection & Acceptance Test
2-4.9 Distribution of Evacuation Signals	Not applicable.	The Mobile Fire Detection system is not intended for evacuation signaling.	Inspection.
2-4.10 Distinctive Signals	Complies.	Fire and supervisory alarm audible signals will be distinctive.	Acceptance Test
2-4.11 Alarm Signal Silencing	Complies.	A silence switch will be provided for the Mobile Fire detection system local control panel and the CRS in the Control Room.	Reference 1 & 2, Inspection, and Acceptance Test

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-4.12 Supervisory Signal Silencing Switch	Complies.	A silence switch will be provided for the Mobile Fire Detection system local control panel and the CRS in the Control Room.	Reference 1 & 2, Inspection, and Acceptance Test
2-5 Testing and Maintenance		Heading	
2-5.1 Acceptance Tests	Complies.	An acceptance test will be performed in accordance with NFPA 72 and 72H.	Acceptance Test
2-5.2 Periodic Tests		Heading	
2-5.2.1 Supervision of Qualified Personnel	Complies.	The tests will be performed in accordance with Commonwealth Edison Quality Assurance standards by qualified personnel.	Periodic Testing
2-5.2.2 Tests Performed and Results Available	Complies.	The test frequencies will be in conformance with NFPA 72. The fire detectors will be tested in accordance with NFPA 72E.	Acceptance & Periodic Tests
2-5.2.3 Engine-driven generator	Complies.	The CRS protective signaling system will be powered by AC in the Control Room.	Inspection
2-5.3 Waterflow Devices	Not applicable.		
2.5.4 Maintenance	Complies.	Maintenance will be performed by qualified personnel.	Maintenance Tests

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-5.5 Alterations	Complies.	Alterations to the signaling system will be reviewed for compliance to NFPA standards.	CECo to implement
2-5.6 Restoration	Complies.	All equipment will be restored to normal as promptly as possible after each test or alarm, and kept in normal condition for operation.	Acceptance and Maintenance Tests, and Operation Procedures
2-5.7 Records	Complies.	Records of tests and operations of the systems will be kept by Commonwealth Edison.	CECo to implement
2-6 Performance of Initiating Device Circuits		Heading.	
2-6.1 Identification of Style	Complies.	The initiating device circuit (between the fire detectors and the local control panel on the Mobile Fire Detection unit) conforms to Style B.	Ref. 1 & 2 and Acceptance Test
2-6.2 Performance and Capacities	Generic Information.	Information only.	
2-6.3 Initiating Device Groups	Complies.	Only fire detectors will be installed on the same initiating device circuit.	Inspection
2-6.4 Loading of Initiating Device Circuits	Complies.	Two detectors will be installed on the initiating device circuits.	Inspection

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NFPA 72-1990 Section	Compliance	Comments	Verification
2-7 Performance of Signaling Line Circuits		Heading.	
2-7.1 Identify Signaling Line Circuits	Deviates.	The signaling line circuit will be telephone lines. Refer to Section 8-7, below, for an evaluation of the digital alarm communicator system.	Inspection
2-7.2 Use of Table 2-7.1	Generic Issue.	Information only.	
2-7.3 Redundant Signaling Line Circuit	Not applicable.	A redundant signaling line circuit will not be used.	Inspection
Chapter 3: Applications of Protective Signaling Systems		Heading.	
3-1 Scope	Generic Issue.	Information only.	
3-2 Manual Fire Alarm System	Not applicable.	Not used.	
3-3 Automatic Fire Detection Systems		Heading.	
3-3.1 Fire Detector Location and Maintenance	Complies.	The fire detectors will be located for specific hazard protection in conformance with NFPA 72E and Fire Protection Program requirements.	Inspection and Operation Procedures
3-3.2 Integral Trouble Contacts	Complies.	The detectors have integral trouble contacts.	References 3 and 4
3-3.3 Alarm Verification Feature	Complies.	The MFD local control panel will initiate an alarm signal to the CRS.	References 1 & 2

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NFPA 72-1990 Section	Compliance	Comments	Verification
3-3.4 Detectors Used to Control Operation of the Alarm System	Complies.	Alarm signals will be sent to the CRS with both detectors on independent initiating circuits in alarm condition.	Acceptance Test and References 1 & 2
3-3.5 Activation by Two Smoke Detectors	Not applicable.	One smoke detector activation will cause transmission of an alarm signal to the CRS in the Control Room.	Acceptance Test and References 1 & 2
3-3.6 Positive Alarm Sequence	Not applicable.	The Mobile Fire Detector system will not have positive alarm features.	Inspection
3-3.7 Remote Alarm Indicator	Not applicable.	A remote alarm indicator is not part of the system.	Inspection
3-4 Sprinkler System Waterflow Alarm and Supervisory Signal System	Not applicable.	Sprinkler system supervision is not part of the system.	Inspection
3-5 Guards Tour Supervisory System	Not applicable.	Guard tour supervision is not part of the system.	Inspection
3-6 Combination Systems		Heading.	

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NFPA 72-1990 Section	Compliance	Comments	Verification
3-6.1 General Description	Generic Issue.	<p>This article contains allowances to provide for sharing a fire protection system with components, equipment, circuitry, and installation wiring with nonfire protective signaling systems. The system contains the following components which also can be used for burglar alarm systems:</p> <ol style="list-style-type: none"> 1) Silent Knight Digital Receiver Model 9000. 2) Ademco fire and burglary system with digital communicator Model 5140XM. 3) Telephone wire and jacks. 	Inspection & References 1 and 2
3-6.2 Wiring Common to Both Types of System	Complies.	Although the control panels have the capacity to monitor non-fire protective signaling equipment, none will be utilized as part of this installation.	Inspection
3-6.3 Integrity of Fire Protective Signaling System Functions	Complies.	The integrity of the fire protective signaling capability will be demonstrated through acceptance and maintenance tests.	Acceptance & Maintenance Tests

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NFPA 72-1990 Section	Compliance	Comments	Verification
3-6.4 Use of Speakers	Complies.	Speakers will be used for the MFD local fire alarm.	Inspection
3-6.5 Operation	Not applicable.	The Mobile Fire Detection systems will not be used for any non-fire protective signaling applications.	Inspection
3-7 Ancillary Alarm Functions	Not applicable.	There will not be any ancillary alarm functions associated with the Mobile Fire Detection system.	Inspection
Chapter 4: System Response to Fault Conditions		Heading.	
4-1 Scope	Generic Issue.	Information only.	
4-2 Monitoring Integrity of Installation Conductors		Heading.	
4-2.1 Interconnecting Equipment	Complies.	The initiating device circuit to the fire detectors will be supervised by the MFD control equipment, which will transmit occurrence of a single open or a single ground trouble condition. Monitoring integrity of the telephone circuit is analyzed in Section 8-7, digital alarm communicator system.	Reference 2 & Acceptance Test

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NFPA 72-1990 Section	Compliance	Comments	Verification
4-2.2 Interconnection Means	Complies.	A single break or a single ground fault will not cause an alarm signal.	Reference 2 & Acceptance Test
4-2.3 Circuit Faults on Installation Conductors	Complies.	An open, ground, or short circuit fault on the installation conductors of one alarm indicating circuit shall not affect the operation of any other alarm indicating circuit.	Reference 2 & Acceptance Test
4-3 Monitoring Integrity of Installation Wiring Connections	Complies.	Installation wiring, alarm initiating devices, fire detectors, will be monitored for integrity. Alarm indicating appliances are integral with the MFD control panels.	Reference 2 & Acceptance Test
4-4 Monitoring Integrity of Speaker Amplifier and Tone Generating Equipment	Complies.	The tone generating and loudspeaker are enclosed as integral parts of the CRS control panel. The MFD utilizes a horn/strobe device.	Inspection
4-5 Monitoring Integrity of Power Supplies		Heading.	
4-5.1 Point of Connection at Equipment	Complies.	AC power is monitored to the CRS and the MFD fire alarm control equipment.	References 1 & 2, and Acceptance Test

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NFPA 72-1990 Section	Compliance	Comments	Verification
4-5.2 Point of Connection of Battery Charger	Complies.	AC power supply is monitored at the MFD's point of connection to the trickle charger.	Reference 2 & Acceptance Test
Chapter 5: System Power Supplies		Heading.	
5-1 Scope	Generic Issue.	Information only.	
5-2 Code Conformance with NFPA 70	Complies.	A water resistance extension cord will be used to provide AC power to the Mobile Fire Detection unit.	Inspection
5-3 Power Sources		Heading.	
5-3.1 Sources of Electrical Power	Deviates.	Normally, the fire alarm control equipment on the Mobile Fire Detection unit is powered by AC or the standby back-up battery. However, where AC power cannot be provided to the MFD, a 675 amp auxiliary battery would be the primary & secondary source of power for the Ademco MFD panel. The CRS Silent Knight system will have a standby battery back-up and an AC power source.	References 1 and 2 & Inspection

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NFPA 72-1990 Section	Compliance	Comments	Verification
5-3.2 Primary Power Supply	Deviates.	The MFD's primary power supply is AC power and is not in conformance with the requirements of Section 5-4. The CRS complies with the intent of primary power supply.	Inspection
5-3.3 Secondary Supply Capacity and Sources	Deviates.	Normal secondary power for the Mobile Fire Detection system local panel will be provided by two 7 amp standby batteries or an alternate 675 amp battery, capable of powering the unit up to 4 weeks. The auxiliary 675 amp battery will be used where AC power is not available. The standby batteries will be on a floating charge when the MFD is powered by AC. The auxiliary battery will not be on a continuous charger. The CRS secondary supply consists of a standby battery.	Inspection & Reference 1 and 2
5-3.4 Trouble Power Supply	Complies.	The MFD trouble power supply is the battery, which is shared with the supervisory power supply, as allowed by the exception.	Inspection & Reference 2

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NFPA 72-1990 Section	Compliance	Comments	Verification
5-3.5 Power Supply for Remotely Located Control Equipment	Not applicable.	Remotely located control equipment is not part of the Mobile Fire Detection system.	Inspection
5-4 Light and Power Service		Heading.	
5-4.1 Reliability of Service	Complies.	A two-wire supply will be used for AC power.	Inspection
5-4.2 Power Supply Connections	Deviates.	A dedicated branch circuit will not be used to power the MFD. AC power for the MFD control panel will be provided by an extension cord to be plugged into the nearest electrical outlet.	Inspection
5-4.3 Circuit Breakers and Engine Stops for Elevators	Not applicable.	Lighting and elevator power will not be connected to the Mobile Fire Detection system.	Inspection
5-5 Storage Batteries		Heading.	
5-5.1 Adequate Facilities	Deviates	The charger in the MFD alarm panel will not be capable of recharging the auxiliary 675 amp battery. This is compensated by the size of the battery, plus the possibility of using separate facilities to charge the battery, when the 675 amp is not in use. The normal 7 amp standby back-up batteries will be the secondary power supply.	Inspection

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NFPA 72-1990 Section	Compliance	Comments	Verification
5-5.2 Location of Storage Batteries	Complies.	The Mobile Fire Detection unit used sealed gel-cell batteries.	Inspection & Reference 2
5-5.3 Method of Battery Charging	Complies.	Integral readily accessible terminal facilities to determine battery voltage and charging current are provided for the normal standby batteries.	Inspection & Ref. 2
5-5.4 Overcurrent Protection	Complies	Based on the CRS and MFD alarm panels being approved for meeting the requirements of U.L. Standard 864, the overcurrent protection for the battery circuit is acceptable.	Reference 1, 2 & 5
5-6 Engine Driven Generator	Complies with intent.	The four hour standby batteries will be used as a back-up for the CRS power supply.	Inspection & Reference 1
Chapter 6: Local Protective Signaling Systems	Not applicable	The local alarms on the Mobile Fire Detection system are not intended for use as evacuation signals.	Inspection
Chapter 7: Auxiliary Protective Signaling	Not applicable		
Chapter 8: Remote Stations Protective Signaling Systems		Heading.	

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NFPA 72-1990 Section	Compliance	Comments	Verification
8-1 Application	Applicable in part	The Mobile Fire Detection system will be connected to the plant proprietary protective signaling system as a supplemental alarm device. Since chapter 8 of NFPA 72 contains guidelines for digital transmission over phone lines, specifically Section 8-7 will be considered in this evaluation.	Inspection
8-2 through 8-6	Not applicable		
8-7 Digital Alarm Communicator System		Heading.	
8-7.1 General		Heading.	
8-7.1.1 Applicable Requirements	Generic Issue.	Information only.	
8-7.1.2 Acceptability	Complies.	The digital alarm communicator transmits over the Zion Plant internal telephone lines. The Mobile Fire Detection unit will be connected to a dedicated jack to be installed on the telephones in the plant. The receiver in the Control Room will have a dedicated phone number to receive the signals.	Inspection & References 1 & 2

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NFPA 72-1990 Section	Compliance	Comments	Verification
8-7.1.3 Compliance to Federal Communications Commission's Rules and Regulations	Complies.	Both the transmitter and receiver comply with FCC rules and regulations.	References 1 & 2
8-7.2 Digital Alarm Communicator Transmitter (DACT)		Heading.	
8-7.2.1 DACT connection	Deviates.	The MFD is connected to a private telephone system, rather than the public phone system specified in this article. However, this is consistent with this being a proprietary protective signaling system.	Inspection
8-7.2.2 Digital code	Complies.	All communication between the MFD and CRS is in digital code. Repetitive codes and signal parity checks are used for signal verification.	References 1 & 2
8-7.2.3 Seizing telephone line	Complies.	The MFD will reportedly seize the telephone line.	Acceptance Test
8-7.2.4 DACT operation	Complies.	The MFD will reportedly have the capability to obtain a dial tone, dial the numbers, transmit the signal, and receive acknowledgement within 30 seconds.	Acceptance Test

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NFPA 72-1990 Section	Compliance	Comments	Verification
8-7.2.5 DACT reset	Complies.	The MFD will reset and retry if the first signal attempt is unsuccessful. The Ademco system can be programmed to call back the CRS up to eight times until the signal is received at the CRS.	Acceptance Test
8-7.2.6 Two separate lines.	Deviates.	The MFD will be connected to only one phone line. This is acceptable because the signal will not leave the protected premises and each Mobile fire Detection unit will be connected to a separate phone jack.	Inspection
8-7.2.7 Failure of phone lines.	Deviates.	Only one phone line will be used.	Inspection
8-7.2.8 DACT programmed to use two separate lines.	Deviates.	Only one phone line will be used.	Inspection
8-7.2.9 Test transmission at least once every 24 hours.	Complies.	The MFD panel will be programmed to send a test signal to the CRS on an hourly basis.	Reference 2 & Acceptance Test
8-7.3 Digital Alarm Communicator Receiver (DACR)		Heading.	
8-7.3.1 Equipment		Heading.	
8-7.3.1.1 Spare DACRs shall be provided.	Deviates.	A spare CRS is not provided in the Control Room.	Inspection

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NFPA 72-1990 Section	Compliance	Comments	Verification
8-7.3.1.2 Number of incoming lines to DACR limited to 8.	Complies.	Only one incoming line will be used by the CRS.	Inspection
8-7.3.2 Operations.		Heading.	
8-7.3.2.1 Required Signal Information.	Complies.	Type of signal, condition, and location will be specifically annunciated at the CRS using audible signals, LED numeric display, and a printer.	Reference 1 & Acceptance Test
8-7.3.2.2 Display and Recording.	Complies.	The CRS can be programmed to provide a constant audible alert tone to warn of trouble conditions or a fire alarm signal.	Reference 1 & Acceptance Test
8-7.3.3 Communication Channel.		Heading.	
8-7.3.3.1 Two separate incoming lines.	Deviates.	Only one incoming phone line will be used by the receiver.	Inspection & Reference 1
8-7.3.3.2 Failure of phone line voltage shall be annunciated.	Complies.	The loss of phone line voltage between the CRS and the PABX telephone center will be annunciated on the CRS. The telephone line to the MFD unit is not supervised for loss of line voltage.	Reference 1

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NFPA 72-1990 Section	Compliance	Comments	Verification
8-7.3.3.3 Loading capacity of hunt group.	Deviates.	The single phone line is not approved for listed configurations and also that there is no signaling traffic other than that associated with fire protection signaling.	Inspection
8-7.3.3.4 Signal received from each DACR line at least one every 24 hours.	Complies.	The MFD units will be programmed to transmit a test signal to the CRS on an hourly basis.	Inspection
8-7.3.3.5 Failure to receive a test signal.	Complies.	Test signals can be automatically logged in the receiver as supervisory/trouble signals. Failure to receive a test signal is not automatically logged, by the CRS, however, a personal computer will be logging all test signals which have been received. Failure to receive a test signal will alert the operators to implement compensatory measures until the MFD unit is restored to service.	Reference 1
8-7.4 Power Supply Sources and Monitoring Integrity.		Heading.	

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NFPA 72-1990 Section	Compliance	Comments	Verification
8-7.4.1 Power supply sources and monitoring integrity shall be in accordance with Section 4-5 and 5-3.	Complies in part.	The CRS and the MFD signaling equipment will have primary (AC) and back-up (battery) power supplies except as noted in Section 5-3.	References 1 and 2
8-7.4.2 Transmitter battery power failure signal.	Complies.	Battery capacity is monitored at each respective panel (CRS & MFD).	Reference 1 and 2
Chapter 9: Proprietary Protective Signaling Systems		Heading.	
9-1 Application.	Generic Issue.	The fire alarm system at Zion Power Plant is considered a proprietary system because the central supervising station is at the protected premises and they are at the under one ownership.	Inspection
9-2 General.		Heading.	
9-2.1 Central supervising station location.	Complies.	The Control Room is used as a central supervising station. It is located in a fire-resistive building, suitably cut-off from hazardous areas.	Inspection
9-2.2 Central supervising station access.	Complies.	Access to the Control Room is restricted.	Inspection
9-2.3 Number of operators.	Complies.	The Control Room has sufficient staffing.	Inspection

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NFPA 72-1990 Section	Compliance	Comments	Verification
9-2.4 Duties of operators.	Complies.	The primary duty of Control Room operators is to monitor safety related equipment.	Inspection
9-3 Retransmission		Heading.	
9-3.1 Notification of fires.	Complies.	The Operators are trained in the proper handling of any emergency signals.	Inspection & Operation Procedures
9-3.2 Means of retransmission.	Complies.	Emergency crews are located on-site to handle fires.	Inspection & Operation Procedures
9-3.3 Retransmission by coded signals.	Not applicable		
9-3.4 Operator response to trouble signals.	Complies.	Control Room operators are trained in the proper response to trouble signals.	Inspection & Operation Procedures
9-4 Drills and Periodic Tests.	Complies.	The MFD system will transmit a test signal on an hourly basis.	Operations Procedures
9-5 Private Radio Signaling	Not applicable.		
9-6 Satellite Station Facilities	Not applicable.		
9-7 Signal Notification.		Heading.	
9-7.1 Application.	Generic Issue.	Information only.	
9-7.2 Suitability and location of indicating appliances.	Complies.	The CRS digital receiver is located in the Control Room. The location is well suited to monitor all signals.	Inspection

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NFPA 72-1990 Section	Compliance	Comments	Verification
9-7.3 Designation of signal origin.	Complies.	Each Mobile Fire Detection unit will be identified by specific codes on the digital CRS.	Operation Procedures & References 1 and 2
9-7.4 Local alarm-indicating devices.	Not applicable.	Audible alarm-indicating devices for evacuation or directing aid will not be connected to the Mobile Fire Detector system.	Inspection
9-8 System Operation.		Heading.	
9-8.1 Signal Redundancy.		Heading.	
9-8.1.1 Means for alerting operators.	Complies.	The audible signal for alarms, supervisory and trouble signals will persist at the CRS until manually acknowledged by the operator.	Reference 1
9-8.1.2 Common audible indicating device.	Not applicable.	Reportedly a separate voice alert signal will be programmed in the CRS for Fire alarm signals. A tone alert signal will be used for supervisory/trouble signals.	Reference 1 & Acceptance Test
9-8.1.3 Receipt of subsequent trouble signals.	Complies.	Silencing audible trouble signals will not prevent the receipt of subsequent trouble signals.	Reference 1 & Acceptance Test

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NFPA 72-1990 Section	Compliance	Comments	Verification
9-8.2 Signal Recording.	Deviates	The CRS uses both a LED numeric display and a printer to indicate changes in status. The date and time of occurrence is recorded on the printer output for each signal, with the exception of a loss of the phone line (from the PABX to the MFD unit). An MFD unit which does not transmit a "System Test" signal will be automatically logged on the CRS personal computer.	References 1 and 2
9-8.3 System Response Time.		Heading.	
9-8.3.1 Maximum time from sensing a fire alarm at an initiating device until it is displayed in the central supervising station.	Complies.	The MFD and CRS has the capacity to display alarms in the Control Room within 90 seconds.	Acceptance Test & References 1 and 2

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NFPA 72-1990 Section	Compliance	Comments	Verification
9-8.3.2 Maximum time for receipt of multiple signals.	Deviates.	<p>Multiple alarm signals may not be received within 90 seconds for 10% of the total number of initiating device circuits. This is due to the limitations of digital alarm transmission over a single phone line.</p> <p>NOTE: The response time for multiple signals will vary depending on the total number of installed MFD units which go into alarm simultaneously.</p>	Acceptance Test
9-8.3.3 Trouble Signals.	Complies.	Trouble signals and their restoration to normal can be automatically indicated and recorded in the Control Room within 200 seconds.	Acceptance Test & References 1 and 2
9-9 Transmission Fault.	Complies.	Telephone line integrity will be monitored as intended for signaling line circuits, leg facilities, or trunk facilities via the phone line integrity for digital alarm communicator signals is considered to be adequately monitored if each transmitter sends a test signal to the receiver at least once every 24 hours (see NFPA 72, Sec. 8-7.4.1 Note).	Inspection & Acceptance Test

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NFPA 72-1990 Section	Compliance	Comments	Verification
9-10 Signal Reports and Disposition.		Heading.	
9-10.1 Arrangements for reports of signals.	Complies.	Signal Reports will be saved for at least one year.	Operation Procedures
9-10.2 Alarms.	Complies	Control Room procedures cover required operator actions after receipt of fire alarm signals.	Operation Procedures
9-10.3 Guard's Tour Delinquency.	Not applicable.	The Mobile fire Detection system will not monitor guard tours.	Inspection
9-10.4 Supervisory Signals.	Complies.	Control Room procedures will cover required operator actions after receipt of supervisory signals.	Operation Procedures
9-10.5 Trouble Signals.	Complies.	Control Room procedures will cover required operator actions after receipt of trouble signals.	Operations Procedures.
Chapter 10: Emergency Voice/Alarm Communication Systems	Not applicable.	The Mobile Fire Detection system is not intended for transmission of information to building occupants.	Inspection
Chapter 11: Referenced Publications	Generic Issue.	Information only.	

ATTACHMENT F

ENVIRONMENTAL AND SEISMIC EVALUATIONS

ATTACHMENT F

ENVIRONMENTAL AND SEISMIC EVALUATIONS

Commonwealth Edison Company

Zion Station - Units 1 & 2

EVALUATION

FOR

POEM MOBILE FLAME DETECTOR UNIT

CMED

Sargent & Lundy