February 11, 1994

Dr. T. E. Murley, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Zion Nuclear Station Units 1 & 2
Revision to Fire Protection Program regarding compensatory fire watches.
NRC Docket Nos 50-295 & 50-304

Reference: Memorandum to NRR Technical Staff from Thomas Murley, dtd September 17, 1993, Cost Beneficial Licensing Actions.

Dear Dr. Murley:

Commonwealth Edison Company, (CECo), is proposing to modify the Fire Protection Program as it relates to the performance of compensatory fire watch activities at Zion Station. Currently, a compensatory fire watch is performed either continuously or hourly, depending on the level of degradation experienced by the installed fire protection features. These compensatory actions are currently being performed at Zion Station by a contracted fire watch service. Due to the significant economic burden incurred by providing compensatory measures in this fashion, Zion Station plans to supplement its fire watch program with an electronic fire watch system (EFWS).

The EFWS will be used in areas other than Containment which require either a continuous or hourly fire watch. When the EFWS is used, the affected areas will be continuously monitored with the use of portable, electronic fire detection units, referred to as fire watch sentries, augmented by twice per 12-hour operating shift fire watch patrols performed at approximately equal intervals. During refueling outages, personnel will continue to perform compensatory fire watches on an hourly basis in both areas which require an hourly compensatory fire watch and areas in which the EFWS is used to eliminate the requirement for a continuous fire watch. All other outages will be reviewed on a case by case basis prior to the outage to evaluate the need for additional human fire watches.

Use of the EFWS in the manner proposed will save Zion Station approximately $50,000 per month in non-outage periods. The savings during outages other than refueling outages will vary depending on the need for additional human fire watches.

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ZCORRRA-FIRE(1)

In a meeting conducted on September 20, 1993, CECo met with the cognizant members of your staff to discuss the use of the EFWS. In this meeting, CECo was informed that it was acceptable to the staff to replace a continuous fire watch with a portable electronic fire detection system augmented by an hourly human fire watch patrol. Other nuclear utilities are already utilizing this approach for eliminating the need for continuous fire watches. However, modification of the hourly human fire watch frequency was left as an issue for future discussion.

The purpose of this letter is to present for staff review and comment CECo's plans to employ the alternative means of providing fire detection capability in the manner described in the attachments to this letter.

Attachment A is a detailed description of the EFWS and its capabilities along with photographs of a fire watch sentry. Also included are copies of the applicable National Fire Alarm Code pages regarding the performance characteristics of supervised detection circuits and initiating devices.

Attachment B provides an evaluation of the EFWS.

Attachment C presents a summary of the safety evaluation performed in support of this activity.

Attachment D provides a summary of the placement details development along with an example placement detail.

Attachment E contains a summary of the NFPA code review.

Attachment F contains the seismic and environmental evaluations performed on the fire watch sentry.

This proposed change modifies a requirement that provides little or no safety benefit yet incurs significant resources. The resource savings from this change is substantial, consequently, CECo requests the proposal be prioritized in accordance with the referenced memorandum as a Cost Beneficial Licensing Action. It is CECo's desire to implement this program by April 30, 1994.

Please direct any questions regarding this matter to this office.

Sincerely,

Richard P. Tuetken

Richard P. Tuetken
Site Vice President
Zion Station

Attachments

cc: J.B. Martin, Regional Administrator - III
C.Y. Shiraki, Project Manager - NRR
J.D. Smith, Senior Resident Inspector - Zion
R. Zimmerman, NRR CBLA Task Force

ZCORRRA-FIRE(2)

ATTACHMENT A

DESCRIPTION OF EFWS

Description

The proposed EFWS is comprised of a fire alarm station (FA), located in the control room, and one or more self-contained, self-sufficient, portable fire watch sentries. The fire watch sentry (FWS) is designed to detect a fire and report it to the FA. Pictures of the FWS are provided in the back of this attachment.

Each FWS is a customized self-contained fire detection system constructed of Underwriters Laboratory (U.L.) listed and Factory Mutual (F.M.) approved components and capable of detecting a fire by means of a flame detector and/or smoke detector. Each FWS consists of three major components: 1) power supply, 2) alarm panel and 3) flame and smoke detectors.

The primary power supply for the FWS is 120VAC which is supplied to the FWS via a retractable power cord. The FWS is equipped with a built-in U.L. listed 12VDC backup supply capable of operating the unit in the event of loss of normal AC power for the required 24 hours in stand-by followed by 15 minutes of alarm. When AC power is restored the built-in charger will recharge the 12VDC backup to its fully charged condition within 48 hours as required by the National Fire Protection Association (NFPA). The power supply is also equipped with a secondary DC supply which acts as the primary source when located in areas where AC power in not available. This secondary source is a 675 ampere battery capable of operating the unit for approximately 4 weeks between charges. Since the U.L. listed, built in charger is not sized to charge this secondary battery, a separate charging facility will recharge these batteries. Maintenance procedures will ensure these batteries are maintained in an operating condition. When AC power, is available each FWS will run a brief battery test every 60 seconds to ensure that the battery is connected and an extended battery test every 24 hours to check the battery's condition. Should these tests find the voltage to be low, it will initiate an alarm locally at the FWS and remotely in the control room.

The second FWS component is the U.L. listed alarm panel which, along with the power supplies, digital dialer, keypad, alarm reset button, horn, etc., is enclosed in a protective metal case. The alarm panel is an Ademco model 5140XM panel which is designed to meet U.L. 864 and NFPA 72 standards for local stations and U.L. 864 and NFPA 71 standards for central stations. This panel has been tested by U.L. for compatibility with the proposed central digital alarm receiver (Silent Knight 9000). It features:

* a built-in supervised dialer capable of immediately transmitting alarms to the FA. It is also capable of transmitting periodic status reports on a user definable frequency (currently set to one hour). Each transmission sent through the dialer to the FA is completed in approximately 18 to 24 seconds. In the event the dialer can not complete a call on the first attempt, the dialer is programmed to continually call back at a frequency of approximately 30 seconds for a minimum of 8 attempts. Following an unsuccessful last attempt the FWS will remain in the alarm mode until locally reset or a new reportable condition arises at which time the FWS will again attempt to transmit to the FA. Each FWS transmission is sent with a unique sentry identification code.

* supervised detection circuit (style B for open and short conditions).

* supervised bell output (style Y).

Note: Copies of pages 72-36, 72-38 and 72-39 from the National Fire Alarm Code are attached which provide the performance and capacities of the various styles of detection circuits and outputs.

* microprocessor based programmable panel with memory.

* compatibility with 4 wire detectors.

FWS alarm panel communications are sent from the digital dialer through a telephone line to the FA. The FWS is connected to the most upstream jack for each telephone line in the area. Therefore, the FWS will seize the telephone line when transmitting to the FA.

The next FWS components are the two detector heads. Fire detectors, regardless of their performance characteristics cannot be expected to provide warning of fires resulting from weak fire protection practices including improper handling of flammable or combustible liquids, explosions, or other safety hazards. These concerns are therefore mitigated by the station's Fire Protection Program which controls the handling, use and transportation of liquids, gases and other hazards.

The most common elements produced by a fire are heat, smoke and light. Because fires develop in different manners based on the hazards characteristics, available air movement, etc., and are often unpredictable in terms of their growth and spread, no one detector is suited for every situation. Therefore, prior to construction of the FWS, consideration was given to each of these elements and the potential for their existence during the initial stages of a fire. This is the reason each FWS was outfitted with the two types of detectors. Each FWS was outfitted with one System Sensor, U.L. listed, photoelectric smoke detector which is capable of providing hazard spot detection. This detector was chosen because it was best suited to detect the smoldering type fires and it provides diversity from the permanently installed ionization detectors and the FWS ultraviolet flame detector which are better at detecting fast, flaming fires.

The second detector is a F.M. approved Pyrotector ultraviolet flame detector. This detector has a cone of vision of 180 degrees with its greatest sensitivity being at 45 degrees on either side of the axis and is capable of responding to a 12 inch gasoline fire in 6 seconds from a distance of 30 feet. The primary function of this detector is to provide rapid detection capability for detecting the carbon based fire characteristics typically associated with high hazard transient combustibles such as lubrication oils and cleaning solutions which may be in the area.

Since rapid detection of a possible fire is an essential element of a nuclear plant's fire protection program, heat detectors were not found to be desirable. This type of detector is best suited for areas where high output fires are expected and are inherently slow at responding to other types of fires. Therefore, the applicability of this detector at Zion Station was considered to be limited.

The FWS alarm panel and power supply are enclosed in a NEMA 12 metal case with a hinged lockable door. The back of the case is mounted to a portable dolly. Also attached to the dolly, on the back side of the case, is an aluminum telescoping boom upon which the detectors are mounted. The boom can adjust the detector height from approximately 6 to 20 feet to accommodate different ceiling heights and other structural or physical obstructions. Mounted on top of the case is the local fire alarm consisting of a light and horn, and two status lights. The status lights indicate whether AC power is on and whether a detector is activated.

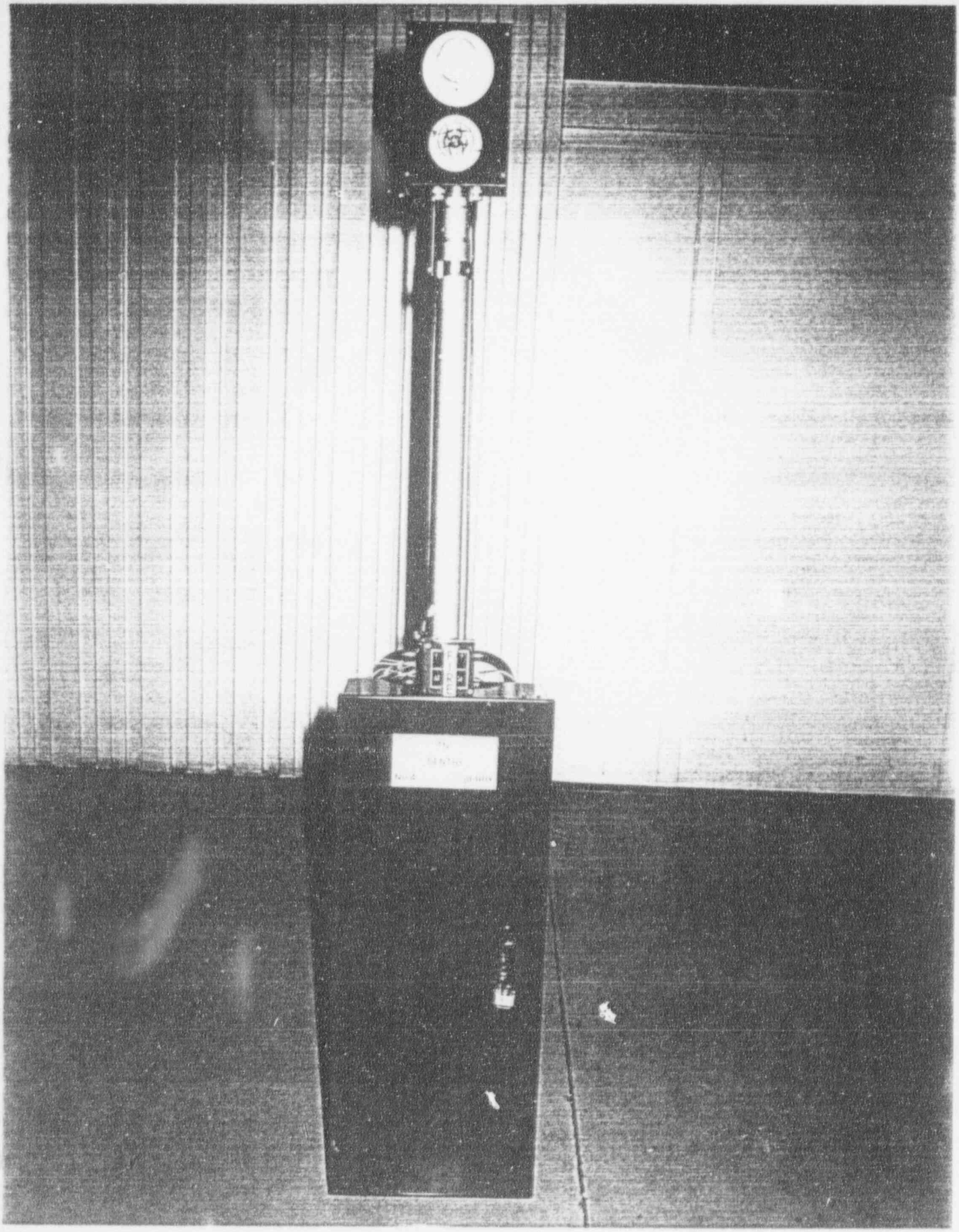
The FA will serve as the central communication station capable of monitoring and receiving communications via a telephone line. The FA is a Silent Knight 9000 digital alarm receiver. This receiver is compatible with the Ademco field panels and has been listed by U.L. and F.M. as an approved central communication station. The FA is attached to a personal computer (PC) with the ability to monitor incoming calls from the FWS. The PC will be programmed to alarm if any FWS does not report in at the scheduled time. The FA via the PC will alert the control room operators of abnormal field conditions such as loss of AC power, loss of DC backup power, loss of communication link (phone line), loss of detection capabilities, and actual fire conditions. The FA is powered by 120VAC power and has a built-in 12VDC back-up power supply capable of operating the unit for 24 hours in standby mode.

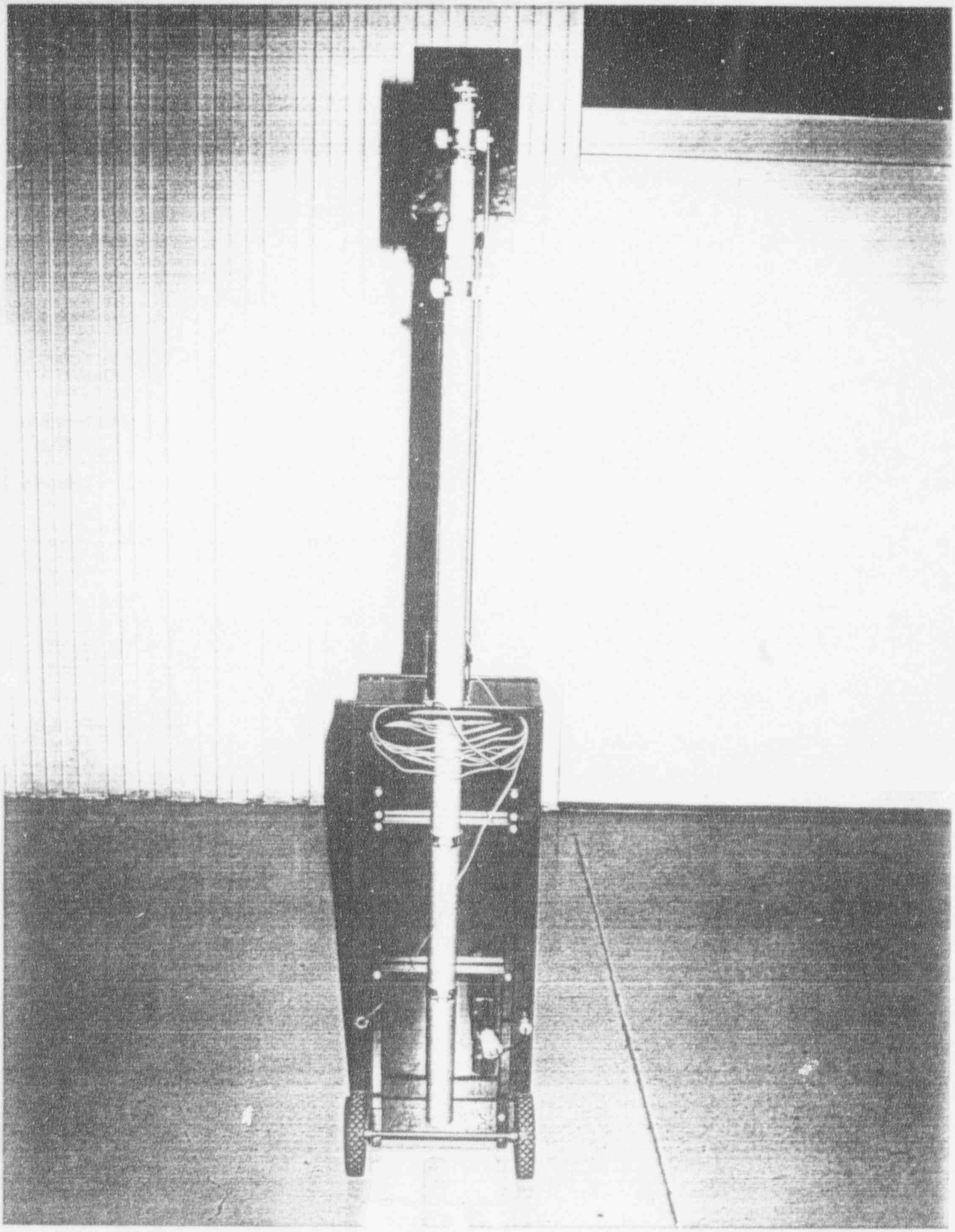
Although this system is not intended to be a permanently installed detection system, it does function on many of the same basic principles. Therefore, in the interest of sound fire protection engineering, the system was reviewed against the latest editions of National Fire Protection Association (NFPA) 72, "Standard for the Installation, Maintenance, and Use of Protective Signaling Systems" and 72E, "Standard on Automatic Fire Detectors." The detailed review of the applicable sections of NFPA 72 and 72E revealed a number of deviations. Each deviation was evaluated to determine the impact on the operation/reliability of the system and suitably justified and/or dispositioned. Where possible, alternate means of meeting the intent of NFPA 72 and 72E were developed. The results of the review are included as Attachment E.

The EFWS has been subjected to radiation and temperature evaluations for the areas outside Containment. These evaluations determined that under normal operating conditions, there were no areas of the plant (outside Containment) which limit the placement of an FWS. In the event of a design basis loss of coolant accident, the evaluation found seven (7) environmental zones which could impact the life of the FWS if continuously exposed to the worst case radiation level. The most limiting accident scenario identified by the analysis limited the use of this FWS to 1.3 days of continuous exposure in environmental zone A15. This zone includes areas such as the RHR Heat Exchanger and the Waste Gas Compressors. The complete evaluation is in Attachment F.

A seismic evaluation of a FWS was also performed. This evaluation outlined the criteria by which each individual component was to be mounted to the dolly and how the FWS's are to be secured in certain plant areas to prevent damage to safety related equipment. The analysis describes in detail how each FWS could be mounted to a wall/floor (permanent mounting detail), to a structural member or other attachment (temporary mounting detail). It also includes a tip over analysis aimed at demonstrating the ability of an unrestrained FWS to withstand a seismic event in some plant areas without causing any damage to safety related equipment. The complete evaluation is in Attachment F.

The proposed system, in conjunction with the approved Fire Protection Program, will provide an economical means of performing compensatory measures without reducing the level of fire protection. This system will be augmented by twice per 12-hour operating shift fire watch patrols and semi-annual testing aimed at ensuring the system's reliability and operating parameters.





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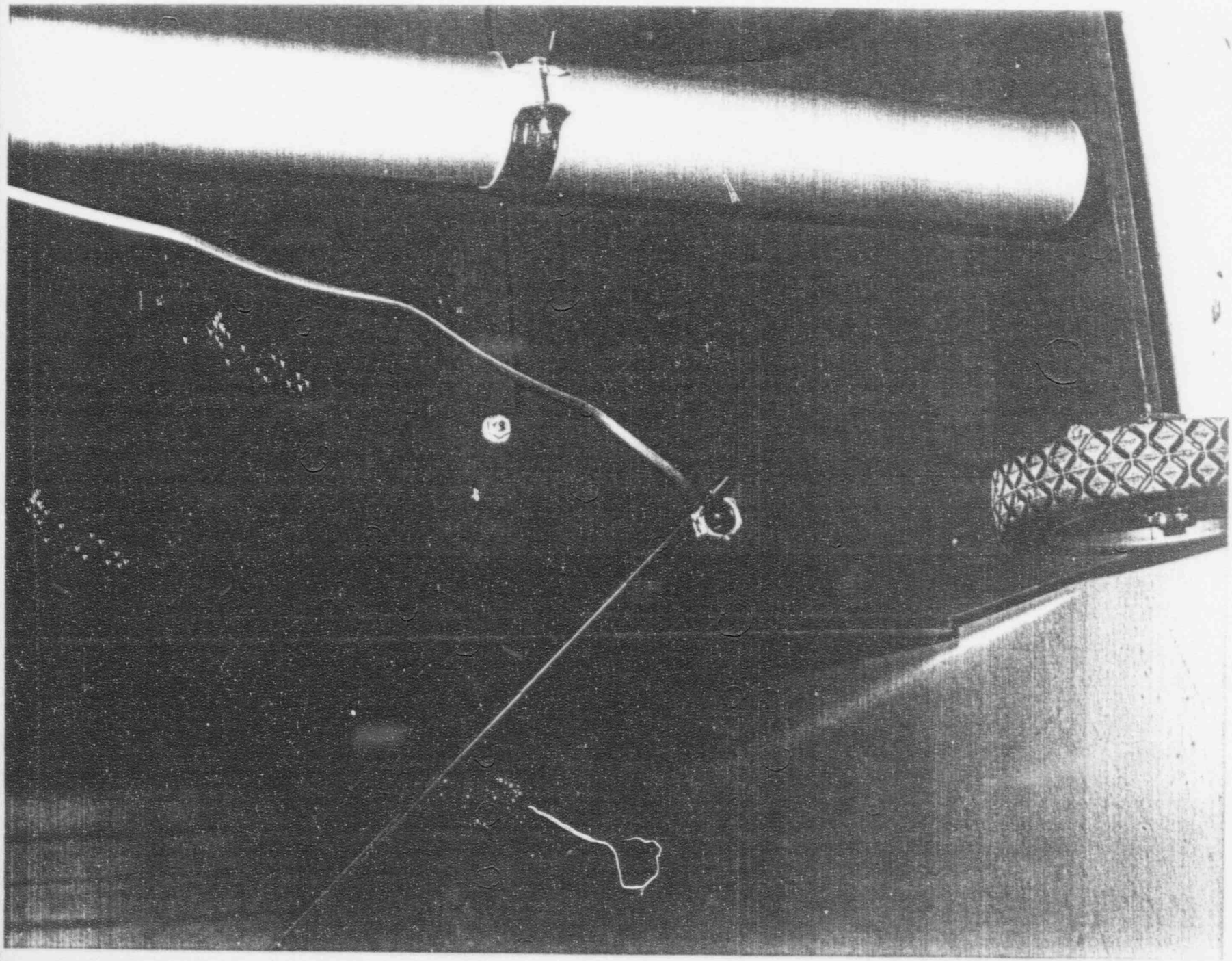

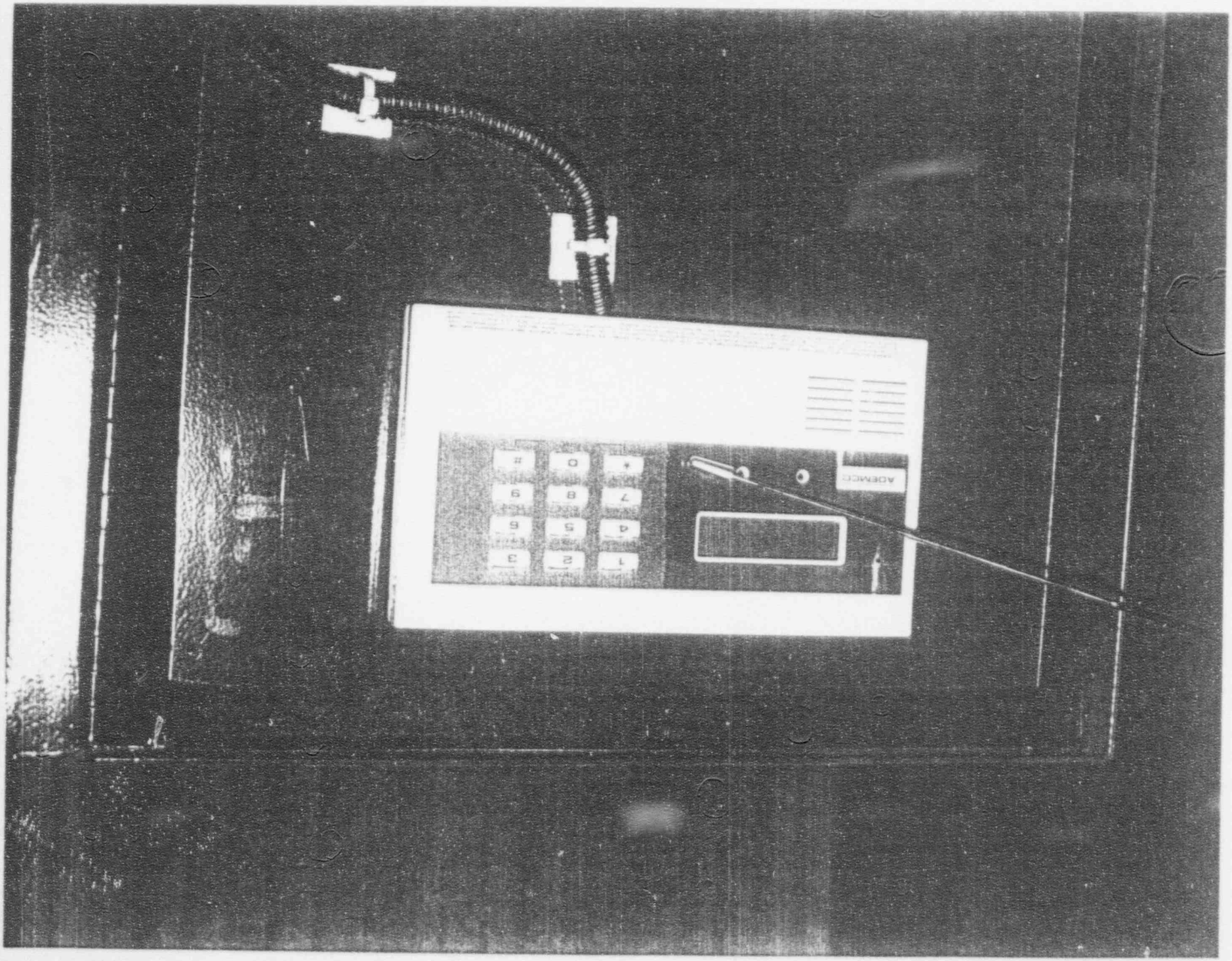
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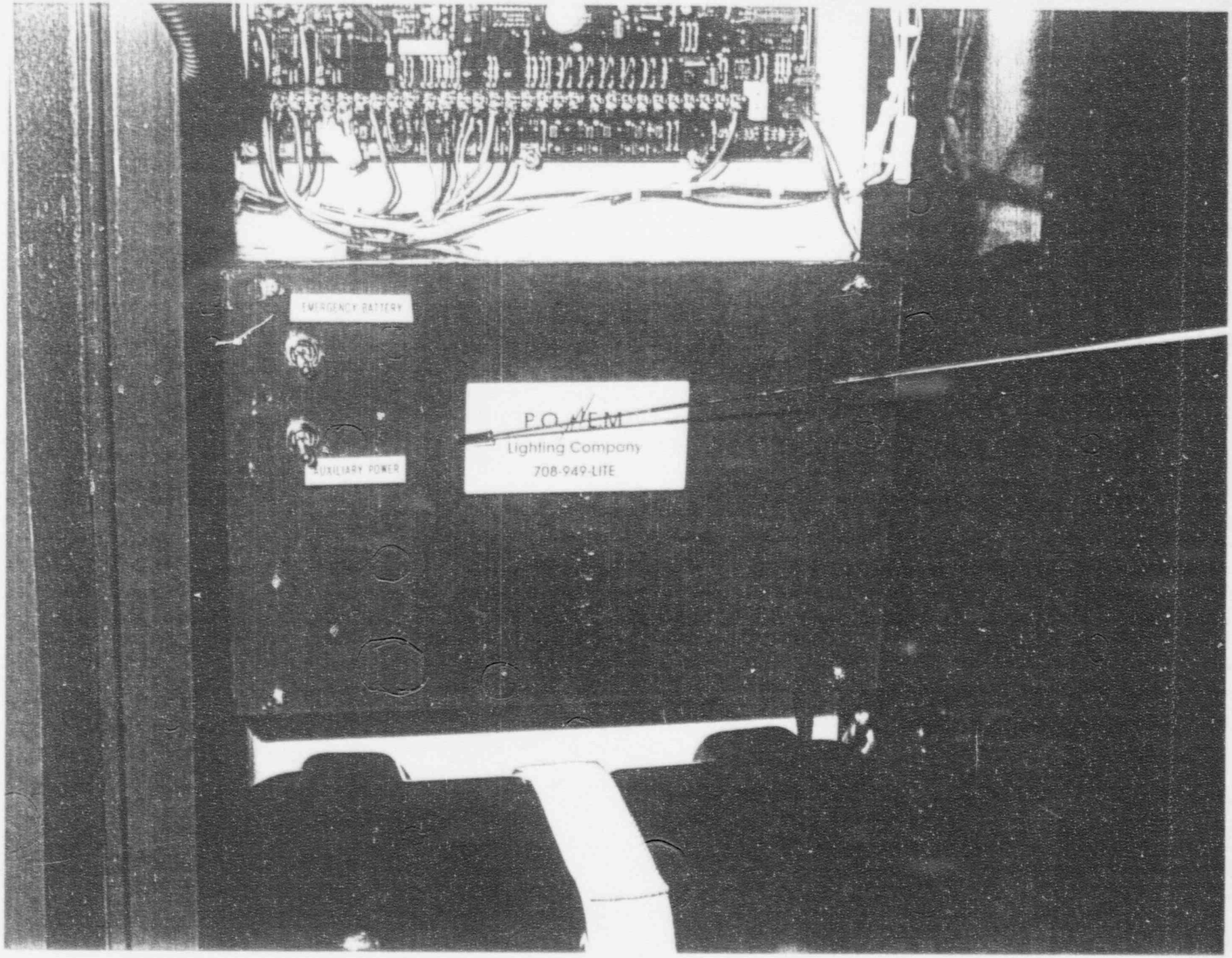
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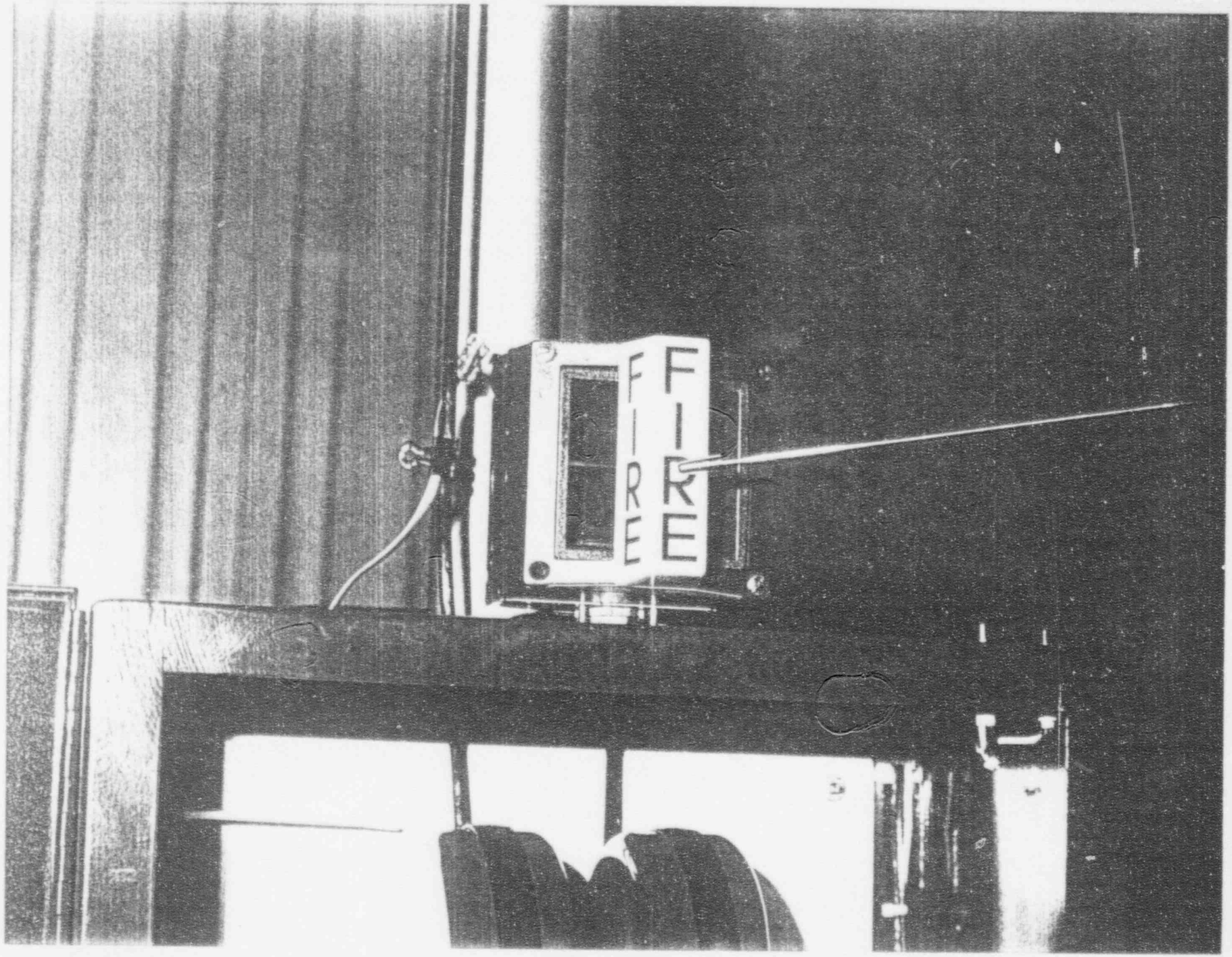
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Table 3-5.1 Performance and Capacities of Initiating Device Circuits (IDC)

Class	B			B			B			A			A		
Style	A			B			C			D			Ex		
G = Systems with ground detection shall indicate systems trouble with a single ground. R = Required capability. X = Indication required at protected premises and as required by Chapter 4. a = Style exceeds minimum requirements for Class A. * = See A-3-5.1.	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition
Abnormal Condition	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A. Single Open		X			X			X			X	X		X	X
B. Single Ground		R			G	R		G	R		G	R		G	R
C. Wire-to-Wire Short	X			X				X		X				X	
D. Loss of Carrier (If Used) Channel Interface								X						X	
Note: The following sections apply only where signals are transmitted to a proprietary supervising station in accordance with Section 4-4															
E. Maximum Quantity per Initiating Device Circuit															
1. Fire Alarm															
(a) Manual Fire Alarm Boxes		2			5			5			25			25	
(b) Water Flow Alarm Devices		1			2			2			5			5	
(c) Discharge Alarm from Other Fire Suppression Systems		1			2			2			5			5	
(d) Automatic Fire Detectors		*			*			*			*			*	
2. Fire Supervisory															
(a) Sprinkler Supervisory Devices		2			4			4			20			20	
(b) Other Fire Suppression Supervisory Devices		2			4			4			20			20	
3. Guard's Tour		1			1			1			1			1	
4. Process, Security, and Other Devices in Combination with 1, 2, and 3 Above		0			0			0			0			0	
5. Process, Security, and Other Devices Not Combined with 1, 2, and 3 Above		5			10			10			20			20	
6. Buildings		1			1			1			1			1	
7. Intermediate Fire Alarm or Fire Supervisory Control Unit		1			1			1			1			1	
F. Maximum Quantity of Initiating Device Circuits per Circuit Interface Between IDC & SLC															
1. Per Limits of E above		10			10			10			10			10	
2. With Following Limitations Fulfilled		10			20			20			50			50	
(a) One Water Flow per IDC															
(b) Maximum of Four Sprinkler Supervisory Devices															
(c) Maximum of Five Process, Security, and Other Devices on a Separate IDC															
(d) Maximum of One Intermediate Fire Alarm or Fire Supervisory Control Unit per IDC															

[From NFPA 72 - 1990, 2-6.2 modified]

Table 3-6.1 Performance and Capacities of Signaling Line Circuits (SLC)

G = Systems with ground detection shall indicate system trouble with a single ground.
M = May be capable of alarm with wire-to-wire short.
R = Required capability.
X = Indication required at protected premises and as required by Chapter 4.
α = Style exceeds minimum requirements for Class A.

Class	B			B			A			B			B			B			B			A			A			A		
Style	0.5			1			2α			3			3.5			4			4.5			5α			6α			7α		
	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition	Alarm	Trouble	Alarm Receipt Capability During Abnormal Condition
Abnormal Condition	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A. Single Open		X			X			X	R		X			X			X			X	R		X	R		X	R		X	R
B. Single Ground		X			G	R		G	R		G	R		X			G	R		X			G	R		G	R		G	R
C. Wire-to-Wire Short									M		X			X			X			X			X			X			X	R
D. Wire-to-Wire Short & Open									M		X			X			X			X			X			X			X	
E. Wire-to-Wire Short & Ground								G	M		X			X			X			X			X			X			X	
F. Open and Ground								X	R		X			X			X			X			X			X	X		X	R
G. Loss of Carrier (If Used)/ Channel Interface														X			X			X			X			X			X	

Note: The following sections apply only where signals are transmitted to a proprietary supervising station in accordance with Section 4-4.

Style	0.5	1	2α	3	3.5	4	4.5	5α	6α	7α
H. Maximum quantity per Signaling Line Circuit β										
1. Initiating Devices (All Types)	250	250	250	500	500	500	500	750	1000	unlimited
2. Buildings	25	25	25	50	50	75	75	75	100	100
I. Maximum Quantity per Proprietary Supervising Station (PSS)										
1. Initiating Device Circuits	500	500	500	1000	1000	1000	1000	1500	2000	2000
2. IDCs with Redundant PSS Control Equipment[1]	1000	1000	1000	2000	2000	2000	2000	3000	unlimited	unlimited
3. Buildings	25	25	25	25	25	50	50	75	400	400
4. Buildings with Redundant PSS Control Equipment[1]	25	25	25	50	50	100	100	150	unlimited	unlimited

Note 1. When the supervisory station multiplex control unit is duplicated and a switchover can be accomplished in not more than 90 seconds with no loss of signals during this period, the capacity of the system is unlimited.
β = See the exception to 3-6.2.

[From NFPA 72 - 1990, 2-7.2 modified]

Table 3-7.1 Notification Appliance Circuits (NAC)

Class	B		B		B		A	
Style	W		X		Y		Z	
G = Systems with ground detection shall indicate system trouble with a single ground. X = Indication required at protected premises.	Trouble Indication at Protected Premises	Alarm Capability During Abnormal Conditions	Trouble Indication at Protected Premises	Alarm Capability During Abnormal Conditions	Trouble Indication at Protected Premises	Alarm Capability During Abnormal Conditions	Trouble Indication at Protected Premises	Alarm Capability During Abnormal Condition
Abnormal Condition	1	2	3	4	5	6	7	8
Single Open	X		X	X	X		X	X
Single Ground	X		X		G	X	G	X
Wire-to-Wire Short	X		X		X		X	

[From NFPA 72 - 1990, 6-4 modified]

3-8.2.2 Automatic alarm initiating devices having integral trouble contacts shall be wired on the initiating device circuit so that a trouble condition within a device does not impair the alarm transmission from any other initiating device.

NOTE: Though a trouble signal is required when a plug-in initiating device is removed from its base, it is not considered as a trouble condition within the device and the requirement of 3-8.2.2 does not apply.

[From NFPA 72 - 1990, 3-3.2]

3-8.2.3* Systems equipped with alarm verification features shall be permitted, provided:

(a) A smoke detector continuously subjected to a smoke concentration above alarm threshold magnitude initiates a system alarm within 1 minute.

(b) Actuation of an alarm initiating device other than a smoke detector shall cause a system alarm signal within 15 seconds.

[From NFPA 72 - 1990, 3-3.3 modified]

3-8.2.4 Where individual alarm initiating devices are used to control the operation of equipment as permitted by 1-5.4.1, this control capability shall remain operable even if all of the initiating devices connected to the same circuit are in an alarm state.

[From NFPA 72 - 1990, 3-3.4 modified]

3-8.2.5 Systems that require the operation of two automatic detection devices to initiate the alarm response shall be permitted, provided:

(a) They are not prohibited by the authority having jurisdiction.

(b) There are at least two automatic detection devices in each protected space.

(c) Automatic detection device area spacing is no more than one-half that determined by the application of Chapter 5.

(d) The alarm verification feature is not used.

[From NFPA 72 - 1990, 3-3.5 modified]

3-8.3 Positive Alarm Sequence.

3-8.3.1 Systems having positive alarm features complying with the following shall be permitted where approved by the authority having jurisdiction.

[From NFPA 72 - 1990, 3-3.6 modified]

3-8.3.1.1 The signal from an automatic fire detection device selected for positive alarm sequence operation shall be acknowledged at the control unit by trained personnel within 15 seconds of annunciation in order to initiate the alarm investigation phase. If the signal is not acknowledged within 15 seconds, all building and remote signals shall be activated immediately and automatically.

[From NFPA 72 - 1990, 3-3.6.1 modified]

3-8.3.1.2 Trained personnel shall have up to 180 seconds during the alarm investigation phase to evaluate the fire condition and reset the system. If the system is not reset during this investigation phase, all building and remote signals shall be activated immediately and automatically.

[From NFPA 72 - 1990, 3-3.6.2 modified]

3-8.3.2 If a second automatic fire detector selected for positive alarm sequence is actuated during the alarm investigation phase, all normal building and remote signals shall be activated immediately and automatically.

[From NFPA 72 - 1990, 3-3.6.3 modified]

3-8.3.3 If any other initiating device is actuated, all building and remote signals shall be activated immediately and automatically.

[From NFPA 72 - 1990, 3-3.6.4 modified]

3-8.3.4* The system shall provide means to bypass the positive alarm sequence.

[From NFPA 72 - 1990, 3-3.6.5]

3-8.4* Concealed Detectors. Where a remote alarm indicator is provided for an automatic fire detector in a concealed location, the location of the detector and the area protected by the detector shall be prominently indicated either at the remote alarm indicator by a permanently attached placard or by other approved means.

[From NFPA 72 - 1990, 3-3.7]

3-8.5 Automatic Drift Compensation. Where automatic drift compensation of sensitivity for a fire detector is provided, the control unit shall give an indication identifying the affected detector when the limit of compensation is reached.

[New paragraph]

ATTACHMENT B

EVALUATION

Introduction

The purpose of this evaluation is to examine the acceptability of performing a compensatory measure fire watch with an electronic fire watch system (EFWS), augmented by fire watch patrols twice per 12-hour operating shift at approximately equal intervals.

Zion Station has Fire Protection Program administrative requirements that specify minimum functional capabilities for operation of select fire protection systems and equipment. In most cases, the Fire Protection Program administrative requirements require that a fire watch be established if the fire protection system or equipment is unable to perform its design function (e.g., loss of fire barrier integrity). The fire watches required are either hourly or continuous, depending on the type and severity of the degradation. Although the Fire Protection Program administrative requirements are not specific on who or how these watches are to be performed, past practice has always been to have personnel perform this duty.

Evaluation

Zion Station intends to supplement the fire watch program with the EFWS when either a compensatory continuous or hourly fire watch is required by the station's Fire Protection Program. During these times the degraded condition requiring a compensatory fire watch will be satisfied with this new system, in conjunction with a twice per 12-hour operating shift fire watch patrol. The EFWS is comprised of a fire alarm station (FA) in the control room which receives signals from the portable electronic fire detection units referred to here as Fire Watch Sentries. The Fire Watch Sentry (FWS) is a self-contained unit consisting of a power supply, alarm panel, smoke detector and flame detector all mounted on a portable dolly. The FWS is designed to detect and report a fire to the FA station via a dedicated phone line. It is intended that the system could be used in any plant area, other than Containment, in which a compensatory human fire watch would have been utilized.

Use of the EFWS will be modified during refueling outages since this is when major plant modification work takes place and increased transient combustibles are normally present. During refueling outages, the EFWS will be augmented with an hourly human fire watch in areas which would have required a continuous fire watch. Fire watches in areas which require a compensatory hourly fire watch will be performed by human fire watches. For all other outages, a pre-outage review will be conducted to evaluate the need for human fire watches.

Fire watches required for specific work activities involving ignition sources or other type of fire hazards will be governed by the station's Fire Protection Program administrative procedures and will always be performed by personnel. These activities include cutting, welding and grinding. In addition, it is the station's practice to have the work crew supply a fire watch for preplanned work activities affecting fire protection systems while the crew is actually working.

The primary duties of a compensatory fire watch are to detect and report a fire. The EFWS can perform these duties with the added benefits of providing continuously monitored surveillance of the affected areas.

Transient combustible control is not a primary function of a fire watch, but an expectation of all personnel within the plant. The station transient fire load program is administered by the Fire Marshal and is the mechanism used to track the accumulation of transients in the plant. All major transient fire loads have to be approved by the Fire Marshal or designee prior to their placement in the plant. In addition, the twice per 12-hour operating shift patrols of the degraded fire area provide a human check of the area for excessive transients or other activities which could lead to a fire. Furthermore, the majority of transients are brought into the plant during refueling outages.

Zion Station has determined that the use of the EFWS is equivalent to a continuous fire watch in that the system will provide continuous detection and reporting capability of a fire in the impaired area. Use of the EFWS instead of an hourly fire watch patrol is advantageous in that the EFWS provides continuous watch and reporting capability in the impaired area while an hourly fire watch is typically in the area a few minutes each hour. In order to ensure the EFWS operates properly, the twice per 12-hour operating shift fire watch patrols will visually check the operation and location of each FWS in the plant. In addition, the EFWS is set up to require each FWS to report its operability each hour via a dedicated phone line. Should the phone line become disconnected, a local alarm would sound on the FWS and the control room would receive an alarm from the FA at the next hourly check in of the disconnected FWS.

The probability of a fire going undetected while utilizing an FWS with a six hour human patrol was compared to the probability of a fire going undetected while using an hourly human fire watch. The calculations showed that the use of the FWS in the proposed manner resulted in a decrease in the probability of an undetected fire by a factor of approximately 22 over the probability when using an hourly fire watch.

To ensure the EFWS is an adequate detection system a review of the system was made against the requirements of the latest editions of NFPA 72 "Standard for the Installation, Maintenance and use of Protective Signaling Systems" and NFPA 72E "Standard on Automatic Fire Detectors." Because the EFWS is not a permanent system, it was not expected to fully comply with these codes. However, the code review determined the EFWS complies with or meets the intent of a majority of the code line items and that the EFWS is a viable means of providing automatic detection. A summary of the code review is contained in Attachment E.

As stated, Zion Station intends to use the EFWS in all plant areas other than Containment in which a human fire watch would be utilized. The FWS was subjected to an evaluation of the effects of temperature and radiation on the unit's operability. The results of the evaluation demonstrated the FWS can reliably operate in all areas of the plant outside the Containment during normal operations.

A seismic evaluation of the FWS was conducted to demonstrate the FWS ability to withstand a seismic event without damaging safety related equipment. The evaluation 1) set the criteria for the mounting of each of the FWS individual components on the portable dolly frame of the FWS, 2) outlined the methods of mounting the FWS to structural members if mounting is necessary in an area to protect safety related equipment and 3) determined the locations within certain areas in which an FWS could safely be placed without restraint. Wheel wedges will be used to prevent an unrestrained FWS from rolling. The results of the seismic evaluation were utilized in determining the guideline placement locations for each fire area.

Actual placement of each FWS in the plant will be determined on a case by case basis. The Fire Marshal, with assistance from System Engineering and a fire protection consultant (SFPE member grade), have created placement details for the FWS on an area wide basis (see Attachment D for more detail). These placement details give suggested numbers, locations, directional positioning, and detector elevations for the FWS. They also give the type of fire expected, primary detection method and the utilities (phone jacks and power outlets) available. The number of FWSs and their locations within an area will be adjusted accordingly based on the hazard, intent of the surveillance, and the Fire Marshal or his designee's judgement. Where necessary based on the results of the seismic evaluation, the FWS will be secured to prevent it from impacting safety related equipment or components. Once placed, the placement location will be marked on the floor for easy identification of proper location. The placement of each FWS will be checked during the twice per 12-hour operating shift fire watch patrols of the impaired area. Plant personnel will be trained that the position of an FWS shall not be changed except by the Fire Marshal or designee in accordance with the FWS placement procedure. Furthermore, a placard will be hung on each FWS placed in the plant which warns personnel not to move the unit.

The FWS case, which contains the power supplies, alarm panel and controls for the FWS, will be locked to prevent unauthorized access to the FWS controls. If any problem is identified with the FWS it will be immediately corrected or a human fire watch stationed as soon as practicable until a new FWS can be placed.

A preoperational test of the EFWS and each FWS has been performed to ensure the system and each detection unit functions as designed. In addition, extensive controls will be put in place to govern the use of the EFWS system. Specifically, plant procedures have been developed to 1) conduct a preoperational test of each FWS prior to placement in the plant, 2) start-up a FWS placed in the field, 3) shutdown a FWS, 4) provide instructions on operation of the EFWS Fire Alarm Panel, 5) provide instructions for the twice per 12-hour operating shift inspection of the FWSs placed in the plant, 6) provide a semiannual surveillance check of all the plant's FWSs, 7) track the location of all FWSs placed in the plant and 8) provide instructions for response to alarm/trouble codes from a FWS and the EFWS fire alarm panel located in the control room. It is important to note that the fire brigade will respond to a FWS fire alarm the same way it does to a fire watch patrol reporting a fire.

While no specific limit will be placed on the time a FWS may be used for each fire protection impairment, a 30 day special report will be submitted to the Station Manager which outlines the cause of the inoperability, actions taken and plans for restoration. Zion Station does not intend the EFWS to become the permanent resolution for any impaired fire protection equipment or barrier. The station's Fire Protection Program impairment procedure requires a work request or modification be initiated for each fire protection system or component taken out of service, impaired or otherwise rendered inoperable. The EFWS may be used when a compensatory fire watch is required by the Fire Protection Program impairment procedure, until the degraded condition is repaired.

The EFWS system has the capability to handle over one hundred FWS units each calling in once an hour. However, Zion will place an administrative limit of 20 on the number of FWS units which may be in place in the plant at any one time. This limit may be adjusted based on operating experience and changing station needs.

In order to detect and report a fire, a fire watch 1) visually observes the area for flames, 2) smells or sees products of combustion, and 3) calls the control room in the event a fire is detected. Each FWS is capable of continuously performing these functions by the use of 1) a flame detector (visual observation), 2) a smoke detector capable of detecting products of combustion, and 3) a digital dialer with a phone line capable of transmitting field conditions to the FA in the control room.

Based on the proposed method of use, the analyses conducted and tests performed, Zion Station has determined that the EFWS is an acceptable compensatory measure to be used in lieu of the current continuous and hourly compensatory human fire watch patrols. A compensatory fire watch's primary function is to detect and report a fire. The EFWS can adequately perform these functions as demonstrated by the preoperational tests.

ATTACHMENT C

SUMMARY OF SAFETY EVALUATION

Summary

The goal of Zion Station's Fire Protection Program is to apply the defense-in-depth philosophy. This philosophy is a three step plan of 1) preventing fires from starting, 2) detecting and suppressing fires, and 3) containing a fire so as to limit the damage, while maintaining the ability to safely shutdown the affected unit. Compliance with this philosophy can be attained by various means, including varying levels of separation of redundant components supplied with or lacking detection or suppression. Compensatory measures (e.g. fire watches) have also been an approved method of applying this philosophy.

Although fire watches do not provide an identical fire protection function as the permanently installed features, they are, as with any other compensatory measure an alternate plan for those instances when it becomes necessary to impair any of the three objectives mentioned above or when any of the three objectives is otherwise degraded. The proposed EFWS is not designed to provide the same level of fire protection as the permanently installed features, however it does provide equivalent fire watch capabilities as those currently being provided by fire watch personnel.

The EFWS, in conjunction with twice per 12-hour operating shift fire watch patrols and administrative procedures, is intended to supplement the fire watch program by performing the functions related to compensatory measures required for inoperable detection or suppression systems, or fire barriers. The level of fire detection will not be reduced because the system will provide fire surveillance duties equivalent to the current human fire watch; fire prevention activities will still be governed by administrative controls; the operation of the FWS will be electronically monitored on an hourly basis; and twice per 12-hour operating shift fire watch patrols will be performed. The purpose of the fire watch patrols is to verify the integrity of the FWS and to provide for an inspection of the area containing the degraded feature.

10CFR50 Appendix R and Appendix A to Branch Technical Position ABCSB 9.5-1 "Guidelines For Fire Protection For Nuclear Power Plants Docketed Prior to July 1, 1976" state that the overall fire protection program be based upon evaluations of potential fire hazards throughout the plant and the effect of postulated design basis fires relative to maintaining the ability to perform safe shutdown functions (by ensuring that at least one train of safe shutdown equipment remains free of fire damage) and minimizing radioactive releases to the environment. Compliance with the design bases is documented in the station's Fire Hazards Analysis (FHA) and the Safe Shutdown Analysis (SSA). The proposed system will not in any way alter the fundamental principles of the defense-in-depth philosophy.

Because of the FWS unique design which includes the complete encasement of the fire alarm panel, batteries, etc., in a locked NEMA 12 case and the use of non combustible materials in the construction of the finished product, the FWS is not considered to be a fire hazard nor will it contribute to the initiation of an accident.

Failure of the EFWS will not jeopardize equipment important to safety, since the system will not interface with any safety related components. The only tie-in to plant equipment is through the phone line. In the event that the phone line is interrupted, an alarm will be received by the FA. The telephone system is not safety related and is not credited in the mitigation of a design basis accident.

A seismic evaluation was conducted on the FWS to ensure the FWS can withstand a seismic event without causing any damage to safety related equipment. Refer to Attachment F for the seismic evaluation.

The operation of the EFWS will in no manner affect the operation of required safety related equipment. No new system interactions and no new failure modes for safety related equipment have been created.

Since the FWS does not provide an ignition source nor fire hazard, the EFWS does not impact any equipment, systems or structures important to safety and does not alter the defense-in-depth of the plant's Fire Protection Program, the probability of occurrence of any accident or equipment malfunction previously evaluated in the Updated Final Safety Analysis Report will remain the same and no new accidents or equipment malfunctions will be created.

The affect on the probability of a fire going undetected in an area while utilizing the EFWS and going to a twice per 12-hour operating shift fire watch patrol was calculated as follows:

Data from the Fire Induced Vulnerability Evaluation (FIVE) methodology for IPEEE shows an estimate for the fire frequency in a switchgear room of 1.5×10^{-2}/yr. This converts to

$(1.5 \times 10^{-2}/\text{yr.}) / (8766 \text{ hr./yr.}) = 1.7 \times 10^{-6}/\text{hr.}$

The Fire Protection Handbook and other books suggest that a reasonable estimate of the failure rate for detectors is 3.5×10^{-6}/hr. Since Zion's detectors are tested every six months, on the average it has been 3 months since the last test. Therefore the probability of detector failure, given a demand is

$(3.5 \times 10^{-6}/\text{hr.}) \times (3 \text{ mo.}) \times (730.5 \text{ hr./mo.}) = 7.7 \times 10^{-3}$

For the current practice of hourly human fire watch patrols the probability of an undetected fire is estimated below, as Case 1:

Case 1--Human Fire Watch at 1-hour Interval

A fire can occur and not be detected for an hour. Therefore, the probability of undetected fire is

$(1.7 \times 10^{-6}/\text{hr.}) \times (1 \text{ hr.}) = 1.7 \times 10^{-6}$

The proposed alternative is to have an EFWS continuously monitor the area with an FWS augmented by a 6 hour human fire watch patrol. The probability of an undetected fire for that situation is estimated as Case 2:

Case 2--Human Fire Watch at 6-hr. Interval, plus a FWS

The period of time between checks by a human is six hours, instead of 1 hour, but for the fire to be undetected, the FWS must also fail.

$[(1.7 \times 10^{-6}/\text{hr.}) \times (6\ \text{hr.})] \times (7.7 \times 10^{-3}) = 7.9 \times 10^{-8}$

Therefore, by substitution of the alternative scheme, the probability of undetected fire is reduced by a factor of approximately 22. This is better than an order-of-magnitude improvement.

This calculation assumes that a detector is tested every six months, and that failures are not detectable in between tests. The FWS has supervisory circuits, such that most kinds of detector failures, power supply failures, etc. are instantly alarmed. Therefore, the FWS is even more reliable than the above calculations indicate.

The operability of the unit will be monitored and reported to the control room on an hourly basis. Furthermore, loss of AC power and interruption of the phone line are immediately annunciated in the control room, as well as locally, except when the phone line is disconnected locally. When the phone line is disconnected locally, the local alarm sounds and the control room will receive a trouble alarm at the FWS's next hourly check in. The control room will also be notified of all failure conditions. When unit failure notification is received by the FA in the control room, the unit will be replaced or an operator dispatched as soon as practical to the affected area. These activities will be governed by plant procedures.

The SSA evaluation assumes that the entire area or component is lost due to a fire. The effects of a fire on a component which has been deemed safety related or safe shutdown related has been previously evaluated in the SSA. Each of these components has been evaluated for its required function during a shutdown scenario, failure modes, impact on other systems, as well as to determine redundant or alternate means of accomplishing the affected component's functions. The design basis for each component will not be degraded nor will the component be required to perform beyond its previously evaluated parameters with the use of the EFWS. The EFWS will not provide any safe shutdown function. The use of the proposed system will not alter the configuration of any area nor will it alter the performance or function of any component. In no case will the application of the EFWS adversely affect either the SSA or the FHA. Therefore, the consequences of an accident or malfunction of equipment important to safety will not increase.

Conclusion

This proposed change will not have any impact on plant operations. Neither the operation nor the function of any system, structure or component will be altered by this change. The intent of this change is only to fulfill the fire watch duties that are currently being performed by fire watch personnel by using an electronic surveillance system, augmented by a twice per 12-hour operating shift fire watch patrol. In addition, the existing plant emergency procedures do not rely on the individuals performing fire watch duties for any mitigative actions during any accident event.

As previously stated, the use of the EFWS does not affect the function of equipment important to safety. Permanently installed plant equipment is not being operated in a new or different manner, and the new electronic system has been evaluated to verify it will not adversely affect equipment important to safety.

The proposed EFWS will not interface with any safety related or safe shutdown related systems. The actions or equipment used to mitigate fire induced malfunctions of safety related or safe shutdown equipment will be the same as previously evaluated. The probability of an accident, in the case of a fire, has not increased as a result of the EFWS, and therefore will not challenge the fire protection aspects of the defense-in-depth philosophy.

10CFR50 Appendix R and Appendix A to BTP APCSB 9.5-1 state that the overall fire protection program be based upon evaluations of potential fire hazards throughout the plant and the effect of postulated design basis fires relative to maintaining the ability to perform safe shutdown functions (by ensuring that at least one train of safe shutdown equipment remains free of fire damage) and minimizing radioactive releases to the environment. The station's compliance to the design bases is documented in the FHA and SSA. The proposed system will not in any way alter the fundamental principles of the defense-in-depth philosophy. Compliance with the three step philosophy will continue to be accomplished by 1) the administrative fire prevention procedures, which control the use of ignition sources, transient combustibles, or other activities which could challenge the installed fire protection features, 2) the permanently installed fire protection systems, which will detect and/or suppress a fire, and 3) the fire containment and safe shutdown capabilities, which mitigate the effects of a fire by limiting the damage and ensuring safe shutdown capabilities can be achieved.

The EFWS, in conjunction with periodic rounds and administrative controls, can be used as a compensatory measure whenever the station is required to establish a compensatory fire watch in response to degradation of a fire protection feature. The operation of the EFWS in conjunction with periodic rounds and administrative procedures provides an equivalent level of fire protection consistent with the Fire Protection Program bases. Use of the EFWS will therefore maintain the margin of safety as described in the bases.

Based on the above evaluation, it has been determined that the EFWS is an acceptable means of providing a fire watch function.

ATTACHMENT D

PLACEMENT DETAILS

INTRODUCTION

The proposed FWS relies on fire detectors to detect and report a fire, therefore, methodology similar to that used in the design and installation of a permanent fire protection system has been utilized in the FWS construction. Since the FWS system is unique in its design, construction, and application, some differences did result. Using the permanent detection system methodology, FWS detector placement details were developed for each area. An example is attached. These details define the FWS location and utilities available for the operation of the detectors. The following is a summary of our methodology.

ASSUMPTIONS

Placement of the FWS took into consideration obstructions created by surrounding plant equipment. Placement details were not provided for areas within the plant containing congested equipment considered to prevent both personnel or transient loads from occupying the area.

Locations for potential transient material staging areas were based on engineering judgement. The placement details provided for these areas took into consideration the FWS detection capabilities. Existing placement of surrounding equipment may create limited areas that will not receive full coverage (e.g., diesel generator room back panel areas while utilizing flame detector). Therefore, when a FWS is utilized in an area, transient combustibles will be placed within view of the FWS flame detector.

The station pre-fire plans were used as the baseline documents for identifying room configurations, hazard types, critical safety-related equipment, and fire protection equipment availability.

The guidelines provided by section 4-4 of NFPA 72 were followed in situations where smoke detectors were selected as the primary means of detection. Detectors were typically placed within beam pockets approximately two feet below the ceiling. The finite adjustment capability of the telescoping boom prevented closer placement to the ceiling in certain situations. Although, this placement is not consistent with sections 4-4.2 and 4-4.7, which require the detectors be placed at the ceiling in beam pockets, it is consistent with section 4-4.1 (specific hazard protection). An attempt has been made to place each detector in position to intercept the smoke from any suspected hazard in accordance with section 4-4.1. The intent of section 4-4.2 and 4-4.7 is also met since each detector will still be placed within the beam pocket.

Flame detector placement adhered to the twenty feet spacing criteria from the assumed pool fire where possible. Some detectors may have exceeded this distance limitation thus affecting the detector response time (e.g., small fires and greater distances normally require greater response times). This delay is not considered a concern because the expected fires in the areas in question would produce a larger fire pool than the assumed six inch diameter fire pool.

PROCEDURE/EVALUATION

The placement of the FWSs for each area was determined during the walkdowns based on the following:

1. Room and Equipment Configuration - FWSs were placed to prevent obstruction to areas or equipment. Consideration was also given to the detector elevation based on the ceiling construction (i.e., beam depths) and height, equipment obstructions (i.e., cable trays) and the primary type of detection method selected. Based on the FWS units being located in areas with sensitive (e.g. safety-related) equipment, consideration was given to the tip-over analysis provided in the seismic evaluation as well as to the possibility for securing the device to structural members or other attachments. Where possible, each FWS was placed far enough away from equipment that the seismic induced tip-over of the FWS would not impact the equipment. Where this was not possible, the FWS was placed in such a manner that it could be secured.

2. Area Primary Combustible Material Hazard Determination - The selection of the primary combustible material hazard was based on the prominent type of in situ combustibles present and the type of transient combustibles which could be expected based on the equipment installed in the area. The method for identifying the types of combustible materials to be expected included a walkdown of each area and the review of the Zion FHA and Pre-Fire Plans.

   An example of area where a primary combustible material hazard was defined follows:

   Auxiliary Building Fire Zone 11.3-0, in the area of the Auxiliary Feed Water Pumps, includes in situ combustible materials of lube oil for bearings. In addition, other combustible liquids might also be present as transient combustible loads during maintenance periods. Therefore, the primary combustible material hazard for this fire zone would be a Class B type fire.

3. Detector Selection - The FWS device has two methods for detecting a fire. The first being a photoelectric type smoke detector for detecting smoke produced by a Class A or C type fire during the incipient stages of the fire. The second is a ultraviolet light type flame detector. This device detects increased ultraviolet light rays produced during the combustion of flammable liquids or Class B type materials.

Areas where the smoke detector was considered the primary source of detection were areas where the primary combustible material were Class A or C. These areas essentially contained electrical components including, switchgear, control panels, batteries, computer mainframes, significant cable spreading raceways, storage areas containing significant quantities of Class A combustibles (i.e., anti-contamination dress areas), and potential staging areas for transient loads of Class A combustible materials.

Areas where the flame detector was considered the primary source of detection included areas in which the primary combustible material was determined to be Class B. These are areas that contain fuel oil storage tanks and/or pumps, lube oil piping, temporary vehicle storage (i.e., fuel handling trackway) and potential staging areas for transient loads of Class B combustible materials.

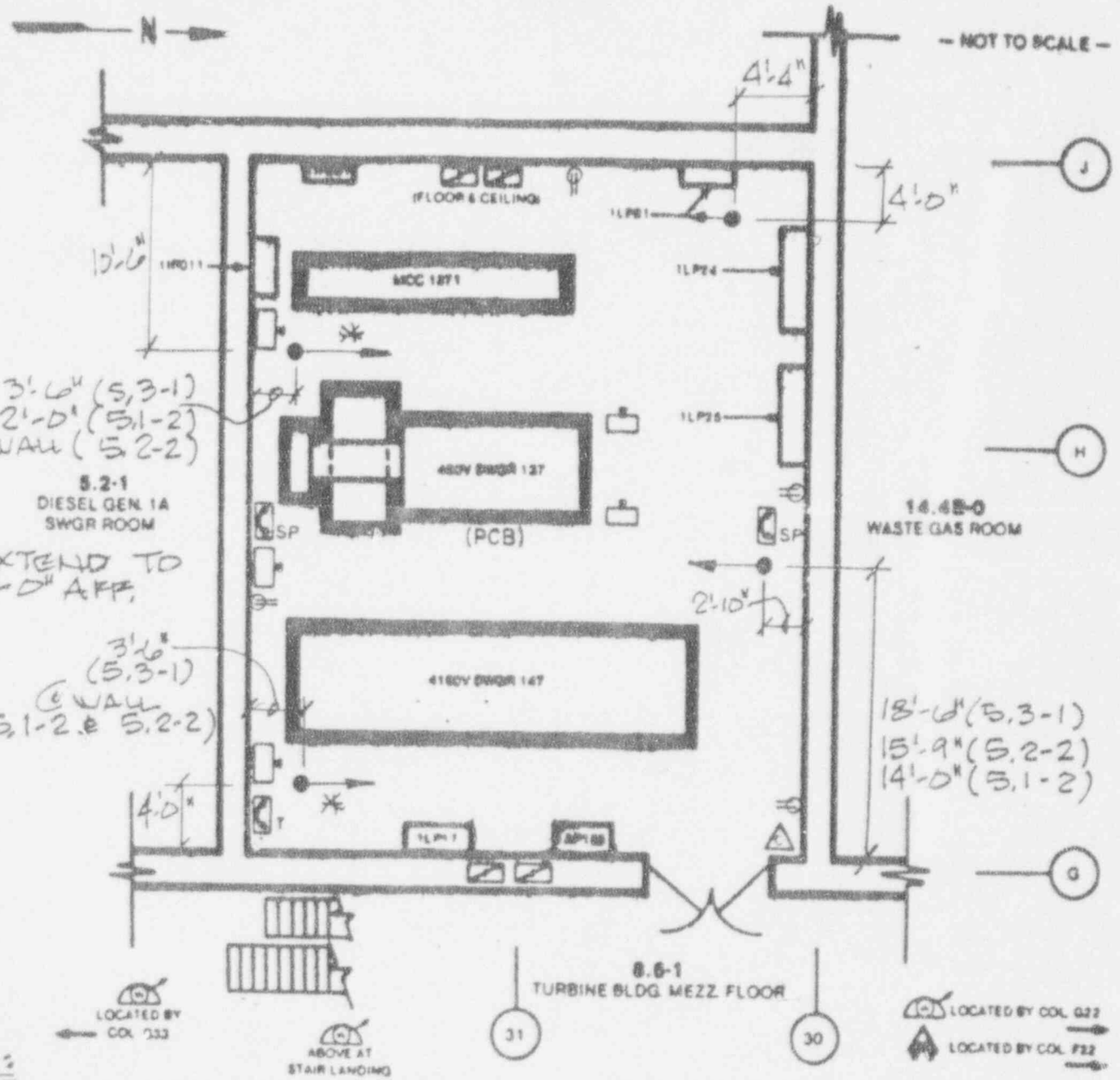
4. Detector Spacing - As discussed under Item 3 above, the FWS includes two methods for detecting a fire. Upon determining the primary method of detection, the following was used in spacing the detection device.

Smoke Detector - The intent regarding placement of smoke detectors is to provide detection for specific hazard spot protection as discussed in NFPA 72E, Section 4-4.1. Air movement was considered for the placement of the detectors in the vicinity of air diffusers as discussed in NFPA 72E, Section 4-5.1.

Flame Detector - The placement of the flame detectors was determined based on the requirements of NFPA 72E, Section 5-4.2.1 and Pyrotector's Instruction Manual 95-8362-1, dated 8/91. This criteria evaluated the assumed fire size and distance from the fire source in order to determine the response time of six seconds for the detector sensitivity. Based on this criteria, the flame detector spacing was designed to respond to a combustible liquid pool fire size of six inches in diameter at a distance of twenty feet from the fire. In addition, consideration was given to the cone of vision for this device. Although this detector has peripheral vision which can view a fire from a 90° angle on either side of the central axis, the detector is most responsive when viewing a fire no greater than a 45° angle from the central axis. Therefore, the flame detectors were placed at the view angle which provided the best response.

EXAMPLE

FIRE ZONE 5.3-1 UNIT 1 DIESEL GENERATOR 0 SWITCHGEAR ROOM DIESEL GENERATOR BUILDING EL. 617'-0"



NOTE:

1. 13'-0" DEEP BEAM CLG.
2. DETECTOR ELEV. LEGEND 11'-0" AFF.
3. PRIMARY DET. SMOKE DET. CLASS A/C FIRE.
4. TYPICAL FOR FIRE ZONES 5.1-2 & 5.2-2

HAZARD
SAFE SHUTDOWN
EMERGENCY LIGHTING
T TELEPHONE WITH FIRE PILOT JACK
SP SOUND POWERED PHONE

HVAC PENETRATION WITH FIRE DAMPER
WATER HOSE STATION
WHEELED DRY CHEMICAL EXTINGUISHER
CARBON DIOXIDE EXTINGUISHER

MOBILE FIRE DET. WITH U.V. DET. DIRECTION.
120VAC POWER SOURCE.

: Z1

APRIL 1990

ATTACHMENT E

NFPA CODE REVIEW