FIRE AND LIFE SAFETY ANALYSIS

BONDERSON ENGINEERING PROJETS CENTER

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FPE Culminating Project

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KEYWORDS

ASET- Available Safe Egress Time

Bonderson Engineering Projects Center

FDS- Fire Dynamics Simulator

Performance Based Analysis

RSET- Required Safe Egress Time

EXECUTIVE SUMMARY

A Fire and Life Safety Analysis was performed as one of the requirements for the Master of Science Degree in Fire Protection Engineering from California Polytechnic State University San Luis Obispo. The Fire and Life Safety Analysis consists of a prescriptive analysis as well as a performance based analysis. These analyses were performed on the Bonderson Engineering Projects Center which is part of Cal Poly San Luis Obispo.

The prescriptive analysis consisted of the four following parts:

- Egress Analysis and Design
- Fire Detection and Alarm Systems
- Water-based Fire Suppression
- Structural Fire Protection

The purpose of the prescriptive analysis was to determine if the Bonderson Engineering Projects Center adhered to the codes and standards applicable to the building. The

prescriptive analysis was performed using primarily the 2013 edition of the California Building Code (CBC) along with the 2013 editions of NFPA codes.

The egress analysis and design met most of the code requirements. One area that the Bonderson Engineering Projects Center did not meet was door swing direction. Room 104 (See Appendix A for building layout) was originally an office classification, but since construction has been utilized as an assembly space. The decreased occupant load factor resulted in a new occupant load which is greater than 50 persons. Per CBC 1008.1.2 exit doors must swing in the direction of egress travel where serving a room or area containing an occupant load of 50 or more persons, which the building does not adhere to. The fire detection and alarm systems analysis was performed primarily utilizing NFPA 72. The building had multiple shortcomings in regards to spacing gaps of the detection devices. These shortcomings were found on the first and second floor, including the lobby, robotics room, project intergration room and computer cluster room. The water-based fire suppression system analysis was performed primarily utilizing NFPA 13 and NFPA 25. The water supply and sprinkler system are acceptable. The structural fire protection analysis was performed primarily utilizing the CBC. The main shortcoming discovered was in relation to the atrium. The building must have a 1 hour fire barrier separating atrium spaces from adjacent spaces or it must provide an acceptable smoke control system. The building provides neither of these provisions.

The performance based analysis was performed in order to ascertain the ability for the occupant of a building to evacuate safely in the event of a fire. Two separate fire scenarios were evaluated using Fire Dynamics Simulator (FDS) and Pathfinder. Tenability criteria was determined and used in conjunction with FDS in order to determine the available safe egress time (ASET). This was compared against the required safe egress time (RSET) which was determined using Pathfinder. The RSET time was greater than the ASET time, meaning occupants would not be able to safely evacuate the building in the event of an emergency.

INTRODUCTION

The Fire and Life Safety Analysis performed on the Bonderson Engineering Projects Center will consist of a prescriptive and performance based analysis. The prescriptive analysis will evaluate the egress design, fire detection and alarm systems, the automatic sprinkler system and the structural fire protection. The performance based analysis will compare ASET to RSET to determine if occupants can safely evacuate in the event of a fire.

Applicable Codes

The following is a list of the codes and standards which were used to perform a life safety analysis of the Bonderson Engineering Projects Center:

- California Building Code (CBC), 2013 Edition

- California Fire Code (CFC), 2013 Edition
- NFPA 13 Standard for the Installation of Sprinkler Systems, 2013 Edition
- NFPA 25 Water-Based Fire Protection Systems Handbook, Fourth Edition
- NFPA 72 National Fire Alarm and Signaling Code, 2013 Edition
- NFPA Fire Protection Handbook, 3rd Edition
- SFPE Handbook of Fire Protection Engineering, Fourth Edition

Building Description

The Bonderson Engineering Projects Center is a building that is part of California Polytechnic State University San Luis Obispo and is located on the North East side of campus. The location of the building relative to the campus of Cal Poly can be seen in Figure 1.

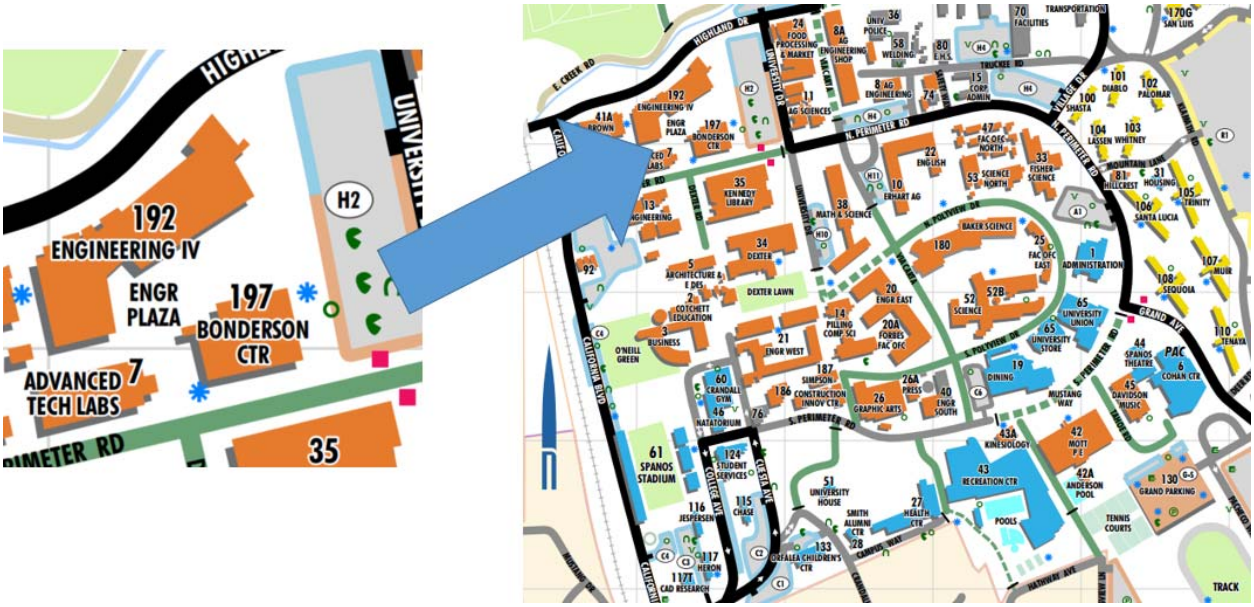

Figure 1: Map of Bonderson Engineering Projects Center

The Bonderson Engineering Projects Center is a two-story building with business occupancy which consists of offices, classrooms, mechanical equipment, storage, school shops and vocational rooms. The building has an area of 18,575 ft², with the ground floor being 12,240 ft² at a height of 14'-1" and the second floor being 6,335 ft² at a height of 29'.

The other distinctive features of the Bonderson Engineering Projects Center are summarized below:

- Concrete Slab and Steel Frame Construction
- Type II-B Construction
- Fully Sprinklered
- Equipped with Fire Detection and Alarm

- Mixed Use Occupancy
- Atrium at Entry

EGRESS ANALYSIS AND DESIGN

Use and Occupancy Classification

The Bonderson Engineering Projects Center is a multiple occupancy building which is considered as nonseperated occupancies per CBC 508.3. The nonseperated occupancies must be individually classified in accordance with CBC 302.1. The building consists of offices, classrooms, mechanical equipment, storage, school shops and vocational rooms. An occupancy classification per CBC 302.1 was given to each type of room, as well as a corresponding occupant load factor per CBC Table 1004.1.2 which will determine the total occupancy of the building. The occupancy classification and corresponding occupant load factor are summarized in Table 1.

Table 1: Occupancy Classification and Occupant Load Factor

Type of Room	Occupancy Classification	Occupant Load Factor (ft^2 per occupant)
Classrooms	B	20
Shop and Vocational Rooms	F-1	50
Offices	B	100
Storage Areas	S-2	300
Mechanical Equipment Rooms	F-1	300

Occupant Load

The occupant load of the building was calculated using the occupant load factors (Table 1) in conjunction with the area of each room. The area of each room was divided by the occupant load factor to determine the number of occupants for whom means of egress facilities must be provided for.

$$Occupant\ Load = \frac{Area\ of\ Room\ (ft^2)}{Occupant\ Load\ Factor\ (ft^2\ per\ ocupant)}$$

The total occupant of each floor and the subsequent total occupant load of the building can be calculated by adding the occupant load of each room. The area and occupant load for each floor and the total building are summarized in Table 2.

Table 2: Occupant Load

	Area (ft^2)	Total Occupant Load (persons)
First Floor	12,240	240
Second Floor	6,335	171
Total	18,575	411

Exit Capacity

The exit capacity of each floor must exceed the occupant load of each floor. The exit capacity was determined using the egress capacity factors summarized in Table 3.

Table 3: Egress Capacity Factor

Component	Egress Capacity Factor (inch per person)
Stairways	0.3
Other egress components	0.2

The egress capacity of each egress component is determined by dividing the egress component's width by the egress capacity factor.

$$Egress\ Capacity = \frac{Egress\ Component's\ Width\ (inches)}{Egress\ Capacity\ Factor}$$

The egress capacity per floor is summarized in Table 4. The building's egress capacity per floor exceeds the occupant load per floor.

Table 4: Egress Capacity

	Occupant Load	Egress Capacity
First Floor	171	240
Second Floor	320	1,620

Exits

Per CBC 1021.1, the occupant load per story dictates the minimum number of exits or access to exits from story. An occupant load of 1 to 500 persons requires a minimum of 2 exits. The building has a minimum of 2 exits per story. The minimum number of exits per occupant load is summarized in Table 5.

Table 5: Number of Exits

Occupant Load per Story	Minimum Number of Exits
1-500	2

The second floor of the building utilizes an interior exit stairway as one of the required exits. The interior exit stairway is permitted by CBC 1009.5 Exception 5, which states the portion of exit access travel must not be greater than 200 feet. The distance from the stairs to an exterior exit is less than 200 feet.

Per CBC 1008.1.2 exit doors must swing in the direction of egress travel where serving a room or area containing an occupant load of 50 or more persons. Room 104 on Level 1 of the building has an occupant load of 120 persons, therefore it is required to have a minimum of 2 exits which swing in the direction of egress travel. The door indicated in the red box in Figure 2 does not swing in the direction of egress travel.

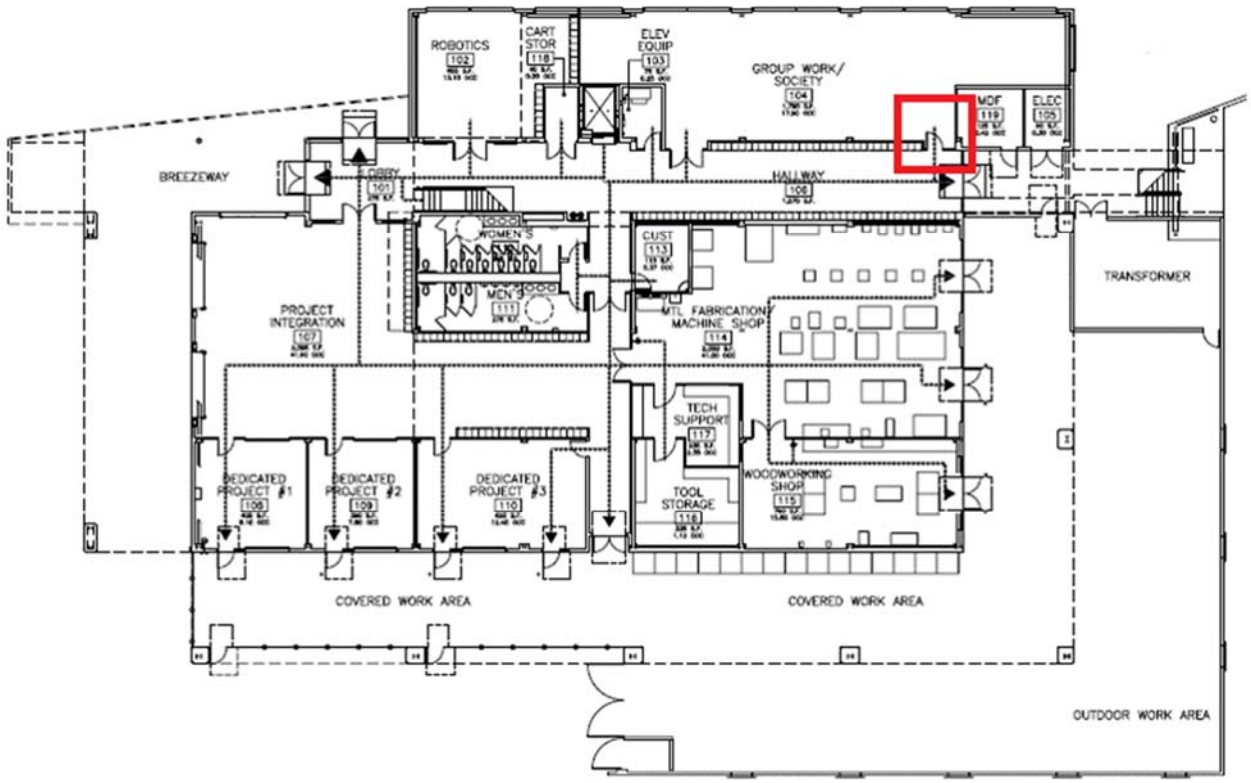

Figure 2: Inward Swinging Door Location

The travel distance within the exit access portion of the means of egress system must not exceed the maximum values in Table 6.

Table 6: Exit Access Travel Distance

Occupancy	Exit Access Travel Distance (feet)
A, F-1	250
B	300
S-2	400

The common path of egress travel must not exceed the maximum values in Table 7.

Table 7: Common Path of Egress Travel

Occupancy	Common Path of Egress Travel (feet)
B	100
A, F, S	75

Neither the exit access travel distance nor the common path of egress travel maximum distances were exceeded in the building.

FIRE DETECTION AND ALARM SYSTEMS

The Bonderson Engineering Projects Center is equipped with an automatic and manual fire alarm system. It includes elevator recall/shunt, duct detector monitoring and is equipped with ADA compliant notification. The fire alarm control panel (FACP) is located on the first floor and is a Notifier model NFS-640 (See Appendix B for datasheet). The building is not equipped with a mass notification system. A full layout of the fire detection and alarm system can be found in Appendix C.

Types of Fire Detection Devices

The building's fire detection devices consist of a combination of smoke detectors and heat detectors. The four devices utilized are summarized below. See Appendix B for complete datasheets of the fire detection devices.

- NOTIFIER FAPT-851: The Notifier FAPT-851 is a combination photoelectric smoke detector and a heat detector. It is especially useful in schools and college campuses because it automatically adjusts its sensitivity to the environment. The Notifier FAPT-851 has a fixed-temperature setpoint of 135°F, which makes it an ordinary temperature classification (NFPA 72 Table 17.6.2.1).

Figure 3: Notifier FAPT-851

- NOTIFIER FSH-751: The Notifier FAPT-851 is a photoelectric smoke detector that provides early warning smoke detection in hostile environments where traditional smoke detectors are not practical. Twelve of these smoke detectors are used in machine shops, wood shops and the janitor's closet. The Notifier FAPT-851 uses a small intake fan and a high-performance replaceable filter, where air and smoke are drawn into a photoelectric sensing chamber, while unwanted airborne particulate and water mist are removed. It is in compliance with NFPA 72, and is permitted to be spaced 30 feet apart.

Figure 4: Notifier FSH-751

- NOTIFIER FSD-751P: The Notifier FSD-751P is a photoelectric air duct smoke detector combined with a detection technology that samples air passing through the duct. The Bonderson Engineering Project Center uses two of these in its air ducts.

Figure 5: Notifier FSD-751P

- NOTIFIER FST-851: The Notifier FST-851 is a heat detector that has a fixed temperature of 135°F, which makes it an ordinary temperature classification (NFPA 72 Table 17.6.2.1). It also has rate-of-rise detection which is set to 15°F per minute. The Bonderson Engineering Project Center uses two of these heat detectors in the elevator machine rooms.

Figure 6: Notifier FST-851

Location, Spacing and Placement of Fire Detection Devices

The symbol key and location of all fire detection devices can be seen in Table 8 and Figures 7 and 8. The placement of these fire detection devices were evaluated using NFPA 72.

Table 8: Key for Location of Fire Detection Devices

SYMBOL	COLOR	QUANTITY	DESCRIPTION	PART NUMBER
		36	ACCLIMATE SMOKE DETECTOR	NOTIFIER FAPT-851
		12	HARSH SMOKE DETECTOR	NOTIFIER FSH-751
		2	DUCT SMOKE DETECTOR	NOTIFIER FSD-751P
		2	HEAT DETECTOR	NOTIFIER FST-851

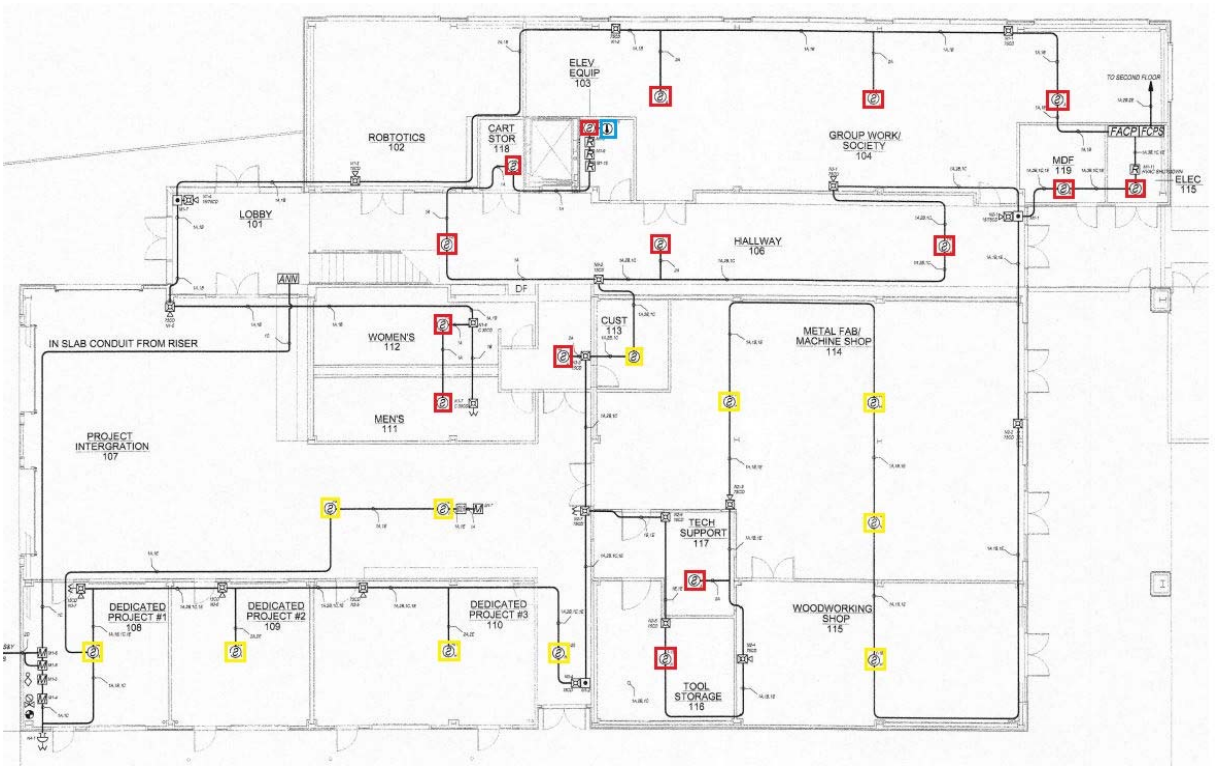

Figure 7: Level 1, Location of Fire Detection Devices

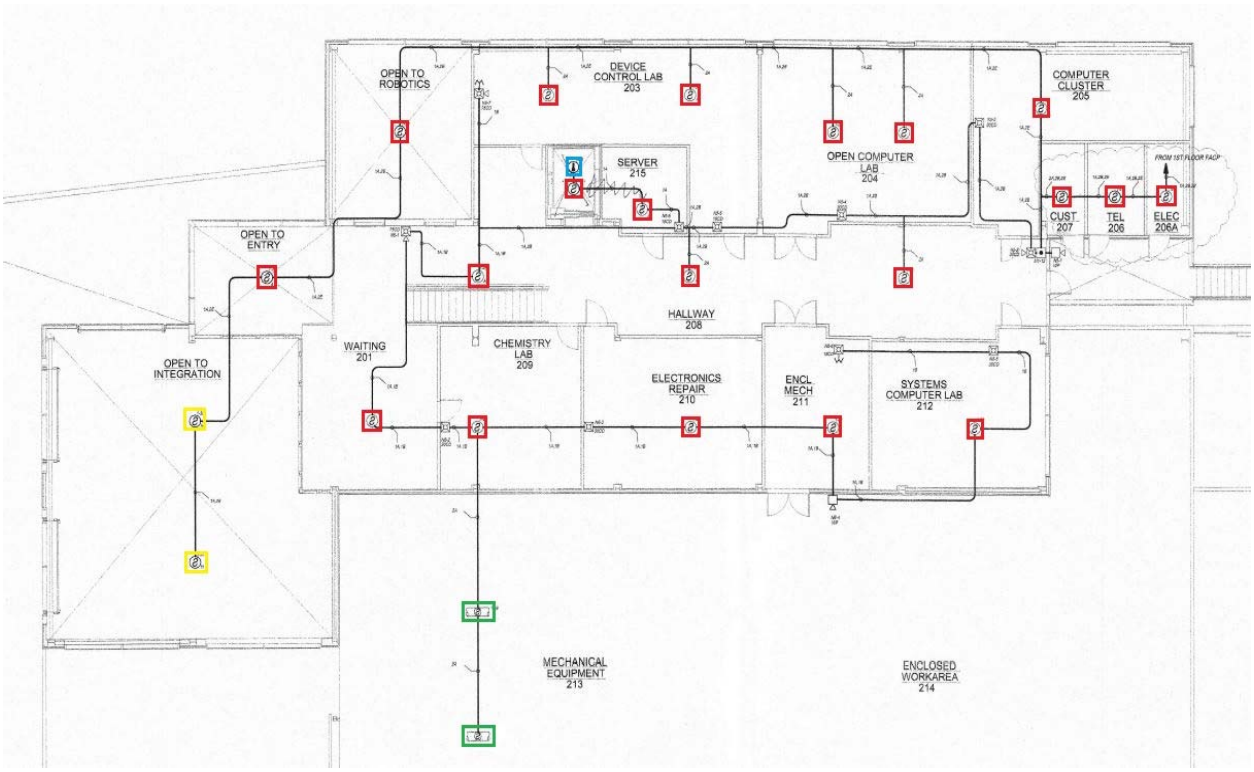

Figure 8: Level 2, Location of Fire Detection Devices

NFPA 72 17.7.3.2.3.1 describes the proper spacing and placement of spot-type smoke detectors. In the case of the Bonderson Engineering Project Center, the distance between smoke detectors does not exceed a nominal spacing of 30 ft and there are detectors within a distance of one-half the nominal spacing, measured at right angles from all walls or partitions. The Bonderson Engineering Project Center has a fairly simple design, and does not contain any complex geometry. In this case, it would still comply with the requirements of NFPA 72 17.7.3.2.3.1 (2) which states that all points on the ceiling shall have a detector within a distance equal to or less than 0.7 times the nominal 30 ft spacing. The Harsh Smoke Detectors (Notifier FSH-751) that are used are in compliance with NFPA 72 can be spaced 30 feet apart.

Most of the first story complies with NFPA 72. The rooms without an apparent fire detection device are the Lobby (101), Robotics (102) and Project Intergration (107). All of these room's ceilings extend to the second story, which creates new location, spacing and placement requirements.

The Lobby, Robotics and Project Intergration rooms all have a ceiling height of 29 feet. NFPA 72 gives spacing data for high ceilings that is essentially equivalent to that which would exist with detectors on a 10 ft ceiling. By using NFPA 72 Table 17.6.3.5.1 (Figure 9) an equivalent spacing can be obtained.

TABLE 17.6.3.5.1 Heat Detector Spacing Reduction Based on Ceiling Height

Ceiling Height Greater than (>)		Up to and Including		Multiply Listed Spacing by
ft	m	ft	m	
0	0	10	3.0	1.00
10	3.0	12	3.7	0.91
12	3.7	14	4.3	0.84
14	4.3	16	4.9	0.77
16	4.9	18	5.5	0.71
18	5.5	20	6.1	0.64
20	6.1	22	6.7	0.58
22	6.7	24	7.3	0.52
24	7.3	26	7.9	0.46
26	7.9	28	8.5	0.40
28	8.5	30	9.1	0.34

Figure 9: Equivalent Spacing Table

In conjunction with Figure 9, NFPA 72 17.6.3.5.2 limits the spacing multiplier to 0.4 times the height of the ceiling. Therefore, a new spacing can be determined using this multiplier.

$$29\ feet\ \times 0.4\ = 11.6\ feet$$

Neither the Lobby, Robotics nor the Project Intergration room meets the new spacing requirements, which states that between smoke detectors must not exceed a spacing of 11.6 ft and there must be detectors within a distance of one-half the nominal spacing, measured at right angles from all walls or partition. Even with a 5% cushion, allowed by NFPA 72 A.17.7.3.2.3.1, the spacing exceeds the requirements.

Two more rooms on the first floor that do not comply with NFPA 72 are the Dedicated Project 3 room (110) and the Woodworking Shop (115). These rooms are 32 ft and 40 ft wide respectively. With 14 ft high ceilings, the smoke detector spacing is decreased to 23.1 ft, while the detector distance from walls or partitions is decreased to 11.55 ft.

With the width of these two rooms, it is not possible to be within 11.5 ft of both walls. However, NFPA 72 Annex B allows a design method to provide for alternate automatic fire detector spacing.

From the reconstructed drawings of the Lobby, Robotics and Project Intergration room (Figures 10, 11 and 12) it is apparent that none of them comply with NFPA 72, which in this case allows a spacing of 11.6 feet and a distance from walls or partitions of 5.8 ft. All of the drawings below show distances of a greater than 5.8 ft from walls. In these scenarios, NFPA 72 Annex B provides design methods for alternate automatic fire detector spacing.

The current automatic fire detector spacing in the aforementioned rooms must meet one of the design methods in NFPA 72 Annex B.

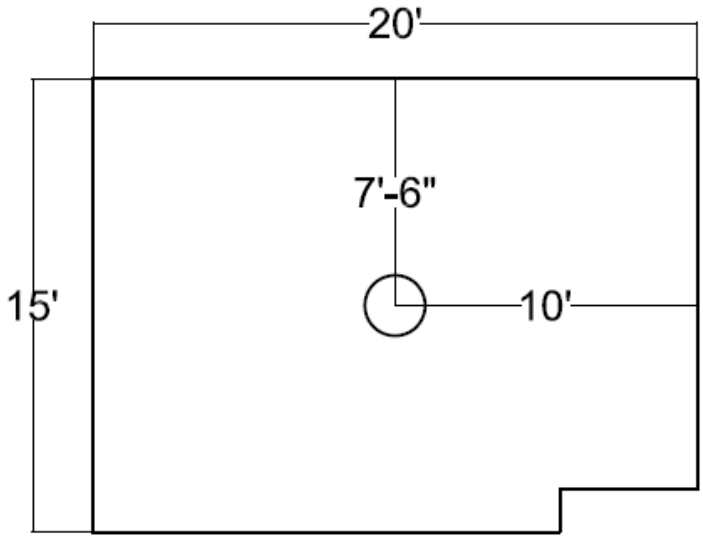

Figure 10: Lobby Fire Detection Device Location

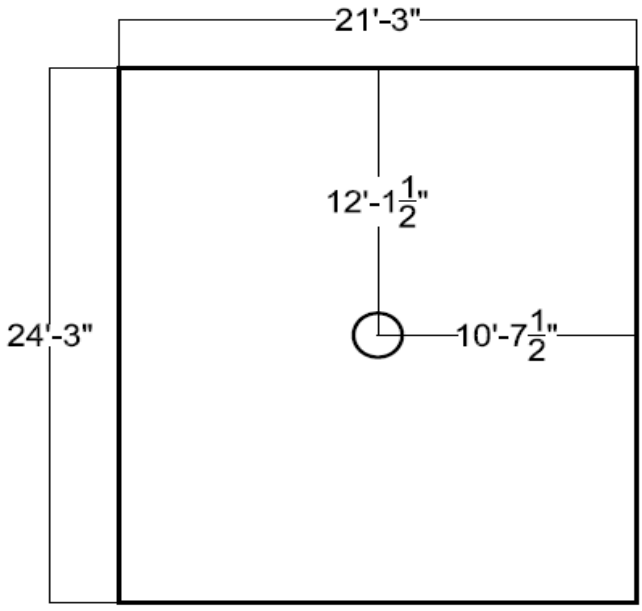

Figure 11: Robotics Fire Detection Device Location

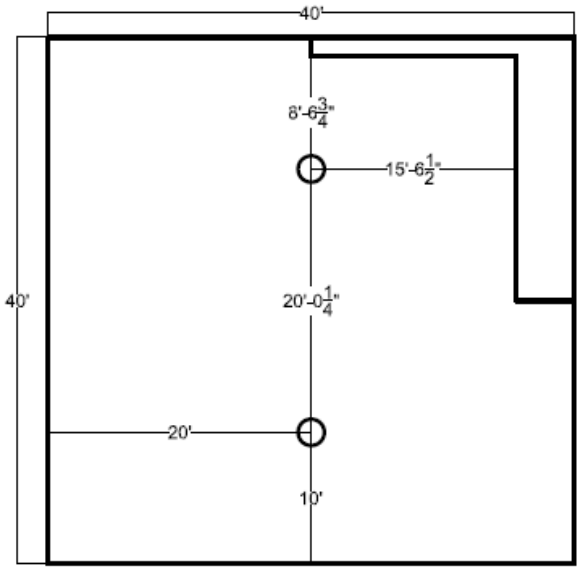

Figure 12: Project Intergration Fire Detection Device Location

The second story has similar problems as the first floor. While most rooms comply with NFPA 72, the Computer Cluster room (205) does not. The ceiling in this room is 15 ft high, therefore the smoke detector spacing is decreased to 23.1 ft, while the detector distance from walls or partitions is decreased to 11.55 ft. The Computer Cluster room is 45 ft wide, therefore with only 1 smoke detector it is not possible to be within 11.55 ft of both walls. Again, NFPA 72 Annex B allows a design method to provide for alternate automatic fire detector spacing.

Type of Alarm and Fire Alarm Devices

The Bonderson Engineering Project Center is a protected premises that activates local audible and visible alarm notification appliances to notify the occupants that they must evacuate the protected building. When activated, the signal is sent to a central station service, which in this case is the local police station.

The alarm and alarm relay is activated when the Fire Alarm Control Panel receives alarm, supervisory and trouble signals. When the FACP receives one of these signals, it uses its built-in alarm, trouble and supervisory relay. The initiating devices that can activate an alarm signal or trouble signal can be seen in Figure 13.

FIRE ALARM SYSTEM SEQUENCE OF OPERATION

	Manual Pull Station	Area Smoke Detector	Area Heat Detector	Duct Smoke Detector	*Elevator Smoke Detectors	**Elevator Heat Detectors	Sprinkler Flow Switch	Sprinkler Tamper Switch	Interruption Of Normal Power
Annunciate Alarm Signal At FACP	YES	YES	YES	YES	YES	YES	YES	NO	NO
Annunciate Trouble Signal At FACP	YES	YES	YES	YES	YES	YES	YES	YES	YES
Transmit Signal To Central Station Via Digital Communicator	YES	YES	YES	YES	YES	YES	YES	YES	YES
Transmit Signal To BMS	YES	YES	YES	YES	YES	YES	YES	YES	YES
Initiate Building Audible Alarm Signal	YES	YES	YES	YES	YES	YES	YES	NO	NO
Initiate Building Visual Alarm Signal	YES	YES	YES	YES	YES	YES	YES	NO	NO
Shutdown Associated Air Handling Systems	NO	YES	YES	YES	YES	YES	YES	NO	NO
Activate Associated Fire Smoke Dampers	NO	YES	YES	YES	YES	YES	YES	NO	NO
Recall Elevators To Designated Level	NO	NO	NO	NO	YES	NO	NO	NO	NO
Recall Elevators To Alternate Level	NO	NO	NO	NO	YES	NO	NO	NO	NO
Disconnect Power To Elevator Controllers	NO	NO	NO	NO	NO	YES	NO	NO	NO

Figure 13: Fire Alarm Sequence of Operation

The Fire Alarm Control Panel initiates different signals depending on the type of alarm it receives. The different signals are summarized below:

- Alarm Signals: The actuation of alarm notification appliances, emergency control functions, and annunciation at the protected premises must occur within 10 seconds. The audible and visible alarm signal at the control unit only shall automatically reactivate every 24 hours or less until alarm signal conditions are restored to normal. The audible and visible alarm must operate until it is manually silenced or acknowledged.
- Supervisory Signals: For self-restoring and latching supervisory signal indication, visible and audible indication of this signal shall be indicated within 90 seconds. The 90 second requirement is adequate because supervisory signals do no represent immediate life-threatening conditions. The audible and visible supervisory signal at the control unit only shall automatically reactivate every 24 hours or less until

supervisory signal conditions are restored to normal. The audible and visible alarm must operate until it is manually silenced or acknowledged. A supervisory signal can be deactivated provided that the means to do so shall be key-operated, located within a locked cabinet, or arranged to provide equivalent protection against unauthorized use.

- Trouble Signals: Trouble signals and their restoration to normal shall be indicated within 200 seconds. An audible trouble signal can be intermittent, provided that it sounds at least once every 10 seconds, with a minimum duration of 0.5 seconds. The trouble signal can have a single audible trouble signal for multiple fault conditions. The audible trouble notification appliances must be located in an area where they can be heard. The actuated notification appliance must continue to operate unless manually silenced. The audible and visible trouble signal must automatically reactuate at the control unit every 24 hours or less until trouble signal conditions are restored to normal. A trouble signal can be deactivated provided that the means to do so shall be key-operated, located within a locked cabinet, or arranged to provide equivalent protection against unauthorized use.

The Bonderson Engineering Project Center is equipped with four different alarm notification devices. These devices are summarized below. See Appendix B for complete datasheets of the fire alarm devices.

- Wheelock MB-G10-24-R: Wheelock's Series MB Motor Bells have a high dBA, low current draw, built-in trimplate for semi-flushing mounting, low frequency aluminum shells and low RFI noise. The motors are a durable, high torque permanent magnet motor

Figure 14: Wheelock MB-G10-24-$

- System Sensor P1224MCW: System Sensor's SpectrAlert Selectable Output Strobe and Horn/Strobes have a low current draw, are easily mounted and meet UL 1971, NFPA 72 and ADA signaling requirements. They can operate in either 12V or 24V and have an easy candela (luminosity intensity) selection.

Figure 15: System Sensor P1224MCW

- System Sensor S1224MCW: System Sensor's SpectrAlert Selectable Output Strobe and Horn/Strobes have a low current draw, are easily mounted and meet UL 1971, NFPA 72 and ADA signaling requirements. They can operate in either 12V or 24V and have an easy candela (luminosity intensity) selection.

Figure 16: System Sensor S1224MCW

- System Sensor SC2430W: System Sensor's SpectrAlert Ceiling Mount Series Strobes and Horn/Strobes have a low current draw and a large candela (luminosity intensity) selection. They have a ceiling-specific shape, profile and aesthetics and their round shape offers greater placement flexibility.

Figure 17: System Sensor SC2430W

Location, Spacing and Placement of Fire Alarm Notification Devices

The symbol key and location of all fire alarm notification devices can be seen in Table 9 Figures 18 and 19. The placement of these fire detection devices were evaluated using NFPA 72.

Table 9: Key for Locations of Fire Alarm Notification Devices

SYMBOL	COLOR	QUANTITY	DESCRIPTION	PART NUMBER
		2	WEATHERPROOF HORN	WHEELOCK MB-G10-24-R
		14	WALL MOUNT HORN STROBE	SYSTEM SENSOR P1224MCW
		15	WALL MOUNT STROBE	SYSTEM SENSOR S1224MCW
		2	CEILING MOUNT STROBE	SYSTEM SENSOR SC2430W

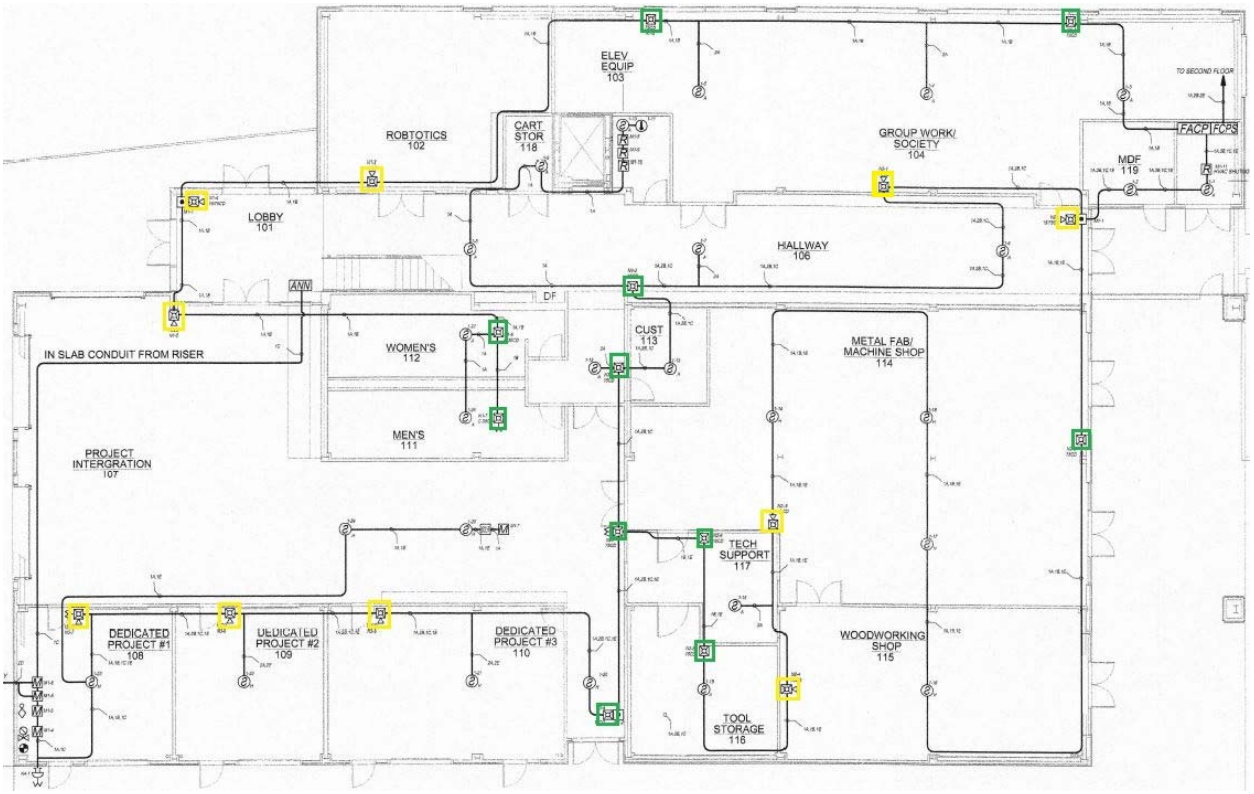

Figure 18: Level 1, Location of Fire Alarm Notification Devices

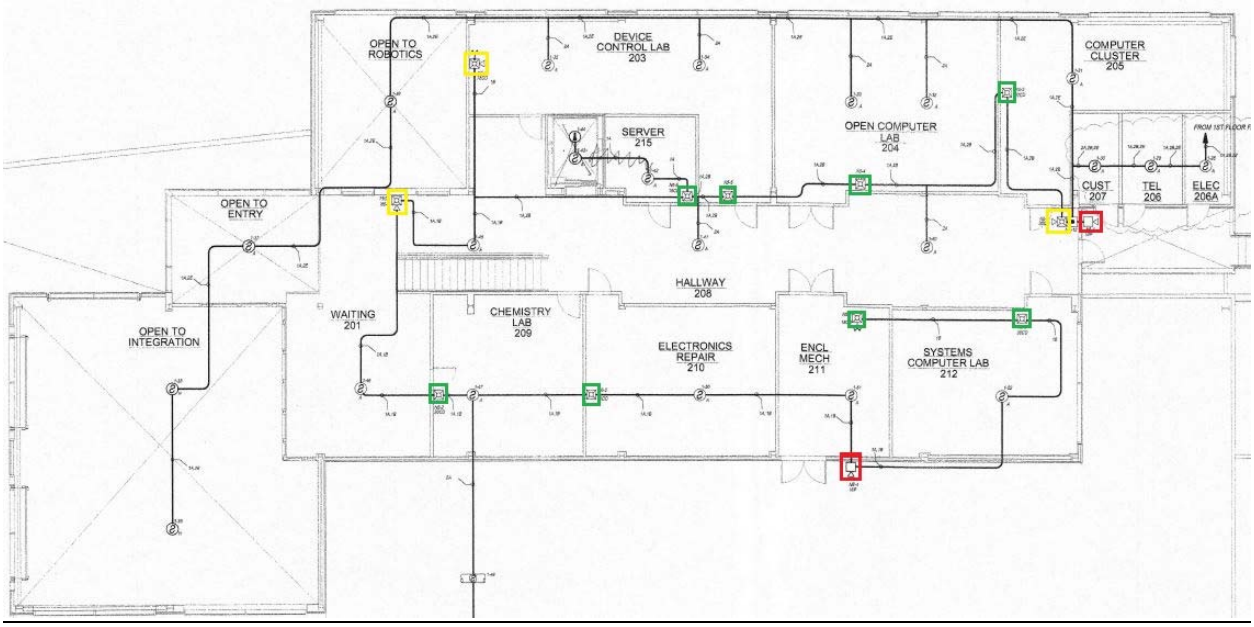

Figure 19: Level 2, Location of Fire Alarm Notification Devices

Per NFPA 72 18.4.3.1, to ensure that audible public signals are clearly heard, they shall have a sound level at least 15 dB above the average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 ft above the floor.

However, the total sound pressure level produced by combining the ambient sound pressure level with all audible notification appliances operating shall not exceed 110 dBA at the minimum hearing distance.

The average ambient sound level according to location can be estimated using NFPA 72 Table A.18.4.3 (Figure 20). The Bonderson Engineering Project Center contains many occupancies including Business, Educational, Mechanical Rooms and Storage.

***TABLE A.18.4.3** Average Ambient Sound Level According to Location*

Location	*Average Ambient Sound Level (dBA)*
Business occupancies	55
Educational occupancies	45
Industrial occupancies	80
Institutional occupancies	50
Mercantile occupancies	40
Mechanical rooms	85
Piers and water-surrounded structures	40
Places of assembly	55
Residential occupancies	35
Storage occupancies	30
Thoroughfares, high-density urban	70
Thoroughfares, medium-density urban	55
Thoroughfares, rural and suburban	40
Tower occupancies	35
Underground structures and windowless buildings	40
Vehicles and vessels	50

Figure 20: Average Ambient Sound Level

To determind if the Bonderson Engineering Project Center complies with NFPA 72, the 6 dB rule of thumb method can be used. Everytime the distance from the sound source doubles, the sound level decreases by about 6 dB. A visual example of this rule can be seen in Figure 21.

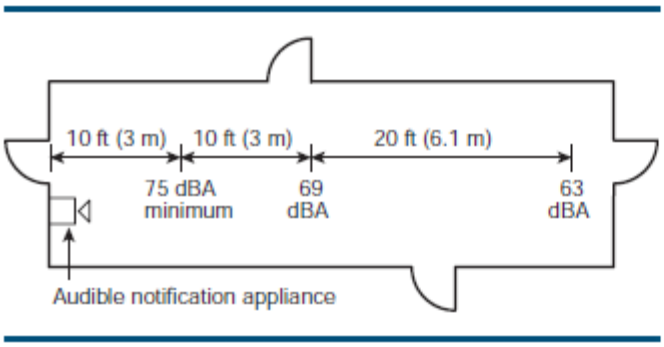

EXHIBIT 18.11

Estimating Audible Levels Using 6 dB Rule of Thumb Method. (Source: R. P. Schifiliti Associates, Inc., Reading, MA)

Figure 21: 6 dB Rule of Thumb Method

It is important to note that audible notification appliances are typically rated by manufacturers' and testing agencies at 10 ft from the appliance.

The building comes equiped with audible devices capable of producing up to 86 dB. At this level, the audible device can produce an audible level of 68 dB at 80 feet.

The 6 dB Rule of Thumb Method for the Bonderson Engineering Project Center

10 feet: 86 dB

20 feet: 80 dB

40 feet: 74 dB

80 feet: 68 dB

68 dB exceeds the educational occupancy ambient dB level by the required 15 dB. No educational occupancy room has a distance exceeding 80 feet from the source, so all rooms comply with NFPA 72. At 80 feet, the dB level almost exceeds the business occupancy dB level by 15 dB (13 dB above ambient). No business ocupancy room has a distance that comes close to 80 feet (45 feet is the longest distance), so all rooms comply with NFPA 72.

SpectrAlert Horn Sound Measurements (dBA)

Selectable Horn Tones			8-17.5V	16-33V
Temporal	Low Volume	Electromechanical	67	75
		3000 Hz Interrupted	68	75
	High Volume	Electromechanical	71	80
		3000 Hz Interrupted	72	81
Non-Temporal	Low Volume	Electromechanical	71	79
		3000 Hz Interrupted	72	79
	High Volume	Electromechanical	76	84
		3000 Hz Interrupted	77	86

Figure 22: Sound Measurements of Fire Alarm Notification Devices

The average ambient sound level of the Bonderson Engineer Project Center's mechanical rooms are 85 dB. The audible devices located in the Bonderson Engineering Project Center can only reach 86 dB. This does not comply with the required 15 dB above ambient sound level. However, there are other ways for these mechanical rooms to comply with NFPA 72. NFPA 72 A.18.4.3.1 explains that occupancies such as machine shops can integrate the fire alarm with the power source, which could shut off noise producing machines during a fire alarm. Care must be exercised in the design to ensure that the removal of power to the noise source does not create some other hazard. Other alerting techniques such as a visible notification may also be used in very high noise areas.

The location, spacing and placement of the visual alarm notification devices installed in the Bonderson Engineering Project Center comply with the requirements of NFPA 72.

All wall-mounted appliances are mounted such that the entire lens is not less than 80 in and not greater than 96 in above the finished floor. Per NFPA 72, the spacing for Wall-Mounted Visible Appliances must meet Table 18.5.5.4.1 (Figure 23).

TABLE 18.5.5.4.1(a) Room Spacing for Wall-Mounted Visible Appliances

Maximum Room Size		*Minimum Required Light Output [Effective Intensity (cd)]*	
ft	*m*	*One Light per Room*	*Four Lights per Room (One Light per Wall)*
20 × 20	6.10 × 6.10	15	NA
28 × 28	8.53 × 8.53	30	NA
30 × 30	9.14 × 9.14	34	NA
40 × 40	12.2 × 12.2	60	15
45 × 45	13.7 × 13.7	75	19
50 × 50	15.2 × 15.2	94	30
54 × 54	16.5 × 16.5	110	30
55 × 55	16.8 × 16.8	115	30
60 × 60	18.3 × 18.3	135	30
63 × 63	19.2 × 19.2	150	37
68 × 68	20.7 × 20.7	177	43
70 × 70	21.3 × 21.3	184	60
80 × 80	24.4 × 24.4	240	60
90 × 90	27.4 × 27.4	304	95
100 × 100	30.5 × 30.5	375	95
110 × 110	33.5 × 33.5	455	135
120 × 120	36.6 × 36.6	540	135
130 × 130	39.6 × 39.6	635	185

Figure 23: Room Spacing Requirements for Wall-Mounted Visual Appliances

All rooms in the Bonderson Engineering Project Center meet this requirement. For example, the Chemistry Lab (209) is 20’ by 20’3” and has a single visible device with an effective intensity of 30 cd. A single visible device with an effective intensity of 30 cd can have a maximum room size of 30 ft by 30 ft, therefore this room complies with the requirements of NFPA 72.

Additionally, all visible devices are mounted such that the entire lens is not less than 80 in and not greater than 96 in above the finished floor.

Mass Notification System

The Bonderson Engineering Project Center does not have a mass notification system, nor does it have the ability to have one with its current equipment. While the Fire Alarm Control Panel does have solid state message generation and a hard-wired voice control module, the audible devices only have the ability to produce two separate tones with two audibility options and has the option to switch between a temporal 3 pattern and a non-temporal continuous pattern. These horns do not have the ability to relay voice recordings or active voices.

Secondary Power Supply

The building's secondary power supply was determined to be adequate by performing a battery calculation in accordance with NFPA 72 10.6.7.2.2 (Figure 24).

Item	Description	Standby Current Per Unit (Amps)		QTY		Standby Current Per Unit (Amps)	Alarm Current Per Unit (Amps)		QTY		System Alarm Current (Amps)
A	FACU	0.25	X	1	=	0.25	1.405	X	1	=	1.405
B	Acclimate Smoke Detector	0.03	X	36	=	1.08	0.067	X	36	=	2.412
C	Harsh Smoke Detector	0.027	X	12	=	0.324	0.06	X	12	=	0.72
D	Duct Smoke Detector	0.026	X	2	=	0.052	0.087	X	2	=	0.174
E	Heat Detector	0.03	X	2	=	0.06	0.07	X	2	=	0.14
F	Weatherproof Horn	0	X	2	=	0	0.03	X	2	=	0.06
G	Wall Mount Horn Strobe	0	X	14	=	0	0.176	X	14	=	2.464
H	Wall Mount Strobe	0	X	15	=	0	0.09	X	15	=	1.35
I	Ceiling Mount Strobe	0	X	2	=	0	0.134	X	2	=	0.268

Total System Standby Current (Amps)	1.766
Total System Alarm Current (Amps)	8.993

REQUIRED OPERATING TIME OF SECONDARY POWER SOURCE FROM NFPA 72 10.6.7.2.1

STANDBY: 24 HOURS ALARM: 5 MINUTES × 1/60 0.0833 HOURS

Required Standby Time (Hours)		Total System Standby Current (Amps)		Required Standby Capacity (Amp-Hours)		Required Alarm Time (Hours)		Total System Alarm Current (Amps)		Required Alarm Current (Amp-Hours)
24	X	1.766	=	42.384		0.0833	X	8.993	=	0.7491169

Required Standby Capacity (Amp-Hours)		Required Alarm Capacity (Amp-Hours)		Total Required Capacity (Amp-Hours)		Factor of Safety		Required Battery Capacity (Amp-Hours)
42.384	+	0.749	=	43.133	X	1.2	=	51.7596

Figure 24: Battery Calculations

Inspection, Maintenance and Testing

Inspection

The purpose for inspections is to ensure compliance with the approved design documents and to ensure installation is in accordance with NFPA 72 and other required installation standards. Visual inspections shall be performed in accordance with the schedules that can be found in NFPA 72 Table 14.3.1 or more often if required by authority having jurisdiction. Figure 25 shows a portion of this table regarding initiating devices.

17.	Initiating devices			Verify location and condition (all devices).	
	(a) Air sampling				
	(1) General	X	Semiannual	Verify that in-line filters, if any, are clean.	17.7.3.6
	(2) Sampling system piping and sampling ports	X		Verify that sampling system piping and fittings are installed properly, appear airtight, and are permanently fixed. Confirm that sampling pipe is conspicuously identified. Verify that sample ports or points are not obstructed.	17.7.3.6
	(b) Duct detectors				
	(1) General	X	Semiannual	Verify that detector is rigidly mounted. Confirm that no penetrations in a return air duct exist in the vicinity of the detector. Confirm the detector is installed so as to sample the airstream at the proper location in the duct.	17.7.5.5
	(2) Sampling tube	X		Verify proper orientation. Confirm the sampling tube protrudes into the duct in accordance with system design.	17.7.5.5
	(c) Electromechanical releasing devices	X	Semiannual		
	(d) Fire extinguishing system(s) or suppression system(s) switches	X	Semiannual		
	(e) Manual fire alarm boxes	X	Semiannual		
	(f) Heat detectors	X	Semiannual		
	(g) Radiant energy fire detectors	X	Quarterly	Verify no point requiring detection is obstructed or outside the detector's field of view.	17.8
	(h) Video image smoke and fire detectors	X	Quarterly	Verify no point requiring detection is obstructed or outside the detector's field of view.	17.7.7; 17.11.5
	(i) Smoke detectors (excluding one- and two-family dwellings)	X	Semiannual		
	(j) Projected beam smoke detectors	X	Semiannual	Verify beam path is unobstructed.	
	(k) Supervisory signal devices	X	Quarterly		
	(l) Waterflow devices	X	Quarterly		

Figure 25: Inspection for Initiating Devices

Testing

System and associated equipment shall be tested according to NFPA Table 14.4.3.2. Other testing descriptions for initiating devices and alarm notification devices can be found below

Initiating Devices

Heat Detectors: Heat detectors are tested using a heat source to simulate the flow of heated air and smoke beneath the ceiling across the detector surface. NFPA 72 requires heat detectors to be tested by heating them in a manner required by the manufacturer and verifying an alarm within one minute.

Smoke Detectors: When inspected, all smoke detectors must meet three general criteria

1. Smoke can enter the sensing "chamber" of the detector.

2. The detector attains the alarm state at the smoke concentration for which the detector was listed.

3. The detector alarm signal is received and processed by the fire alarm system control panel.

Sprinkler System Waterflow Alarms: Sprinkler system waterflow alarm initiating devices are tested by operating the valve controlling the flow through the inspector's test connection. The waterflow alarm initiating device must transmit a signal to the fire alarm control panel within 90 seconds of the start of waterflow.

Manually Activated Alarm Initiating Devices: Two aspects of a manually activated alarm initiating device must be tested. First, the mechanical portion of the unit should be inspected and the operability should be verified. Secondly, the manually actuated alarm initiating devices should be actuated to verify that the internal switch contact is electrically operative.

Alarm Notification Devices

Audible Notification Appliances: Alarm notification devices must meet two requirements. First, the system must produce a sound pressure level of 15 dBA above average ambient and 5 dBA above the maximum sound pressure level having a duration of at least 60 seconds, measured 5.0 ft above the floor in the occupiable area. The pressure reading is taken at a location furthest from the audible appliance with a sound meter that complies with ANSI S1.42 (Design Response of Weighting Networks for Acoustical Measurements). Secondly, the maximum allowed pressure level at the closest occupiable location to the audible appliance cannot exceed 110 dBA.

Visible Notification Appliances: Visible notification appliances are inspected and tested to verify that they are still capable of achieving the design objectives of the fire alarm system. A light meter similar to the sound-level meter is not in common usage. Instead, the inspecting and testing methods are limited to the procedures recommended by the manufacturer. Also, particular attention must be paid to any object that may interfere with clear line of sight to the visible notification appliances.

Maintenance

System equipment must be maintained in accordance with the manufacturer's published instructions. The frequency of maintenance of system equipment will depend on the type of equipment and the local ambient conditions. The frequency of cleaning of system equipment will also depend on the type of equipment and the local ambient conditions. All apparatus requiring resetting to maintain normal operation shall be reset as promptly as possible after each test and alarm.

Water-Based Fire Suppression

Automatic Sprinkler System Overview

The Bonderson Engineering Projects Center is protected by a wet-pipe, quick response sprinkler system that consists of 270 sprinklers. The quick response sprinklers have a 5.6 K-Factor and an activation temperature of 200°F. The building includes light hazard and ordinary hazard 1 classifications. Public areas, offices and classrooms are light hazard while storage rooms, equipment rooms, maintenance rooms, vocational rooms and school shops are ordinary hazard 1. The sprinkler system has adequate water supply and does not utilize a fire pump.

Water Supply

The Bonderson Engineering Projects Center is located on the California Polytechnic State University San Luis Obispo property and utilizes it's closed loop water supply. The water supply details are provided by a water flow test which is summarized in Table 10.

Table 10: Water Flow Test

Category	Value
Static Pressure	80 psi
Residual Pressure	60 psi
Water Flow	1,210 gpm

Sprinkler System Design Criteria

The design criteria for the building is determined by the sprinkler system occupancy classification. The building utilizes both light hazard and ordinary hazard I classification. The design criteria determined by these classifications are summarized in Table 11.

Table 11: Sprinkler System Design Criteria

Classification	Density (gpm/ft²)	Original Area of Sprinkler Operation (ft²)	*Reduced Area of Sprinkler Operation (ft²)	Hose Stream Allowance (gpm)	Duration (minutes)
Light Hazard	0.1	1500	990	100	30
Ordinard Hazard I	0.15	1500	990	250	60
*Area of Sprinkler Operation permited to be reduced without revising density per NFPA 13 11.2.3.2.3.1					

The area of sprinkler operation and density are determined from NFPA 13 using the lowest possible area of sprinkler operation. Figure 26 shows the different design criterions, while the blue arrows indicate the criterions used by this building.

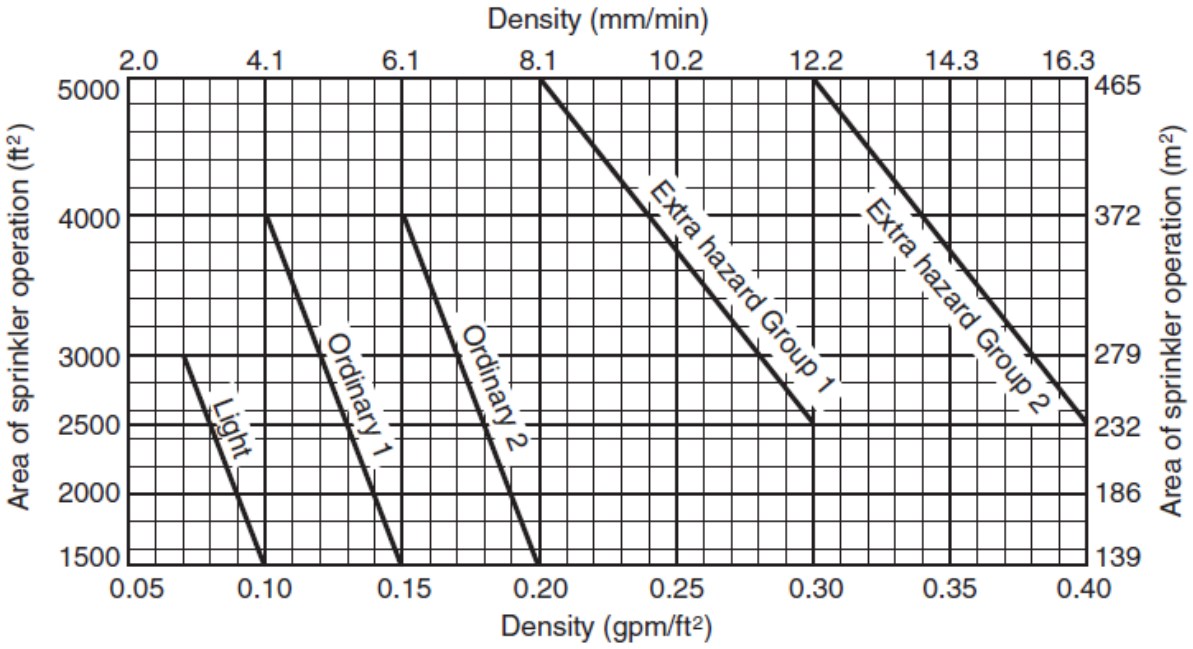

Figure 26: NFPA 13 Design Criteria

Sprinkler System Location, Size and Specifications

A full sprinkler system layout can be found in Appendix D.

Standpipe and Riser

The building is supplied by a 12” water main which tees off into 6 “ pipe complete with a double check valve backflow preventer and a fire department connection. The 6” pipe then supplies a 4 inch riser.

Piping

The building utilizes two different piping with a size range between 1” and 4”. The 1” to 2” piping is schedule 30 with threaded fitings and the 2.5” to 4” piping is schulde 10 with grooved fittings.

Sprinkler Heads

The sprinkler heads utilized in the building are summarized in Table 12 and 13. A diagram of the sprinkler heads used can be found in Appendix E.

Table 12: First Floor Sprinkler Heads

MODEL	FINISH	K-FACTOR	QUANTITY
1/2" TYCO TY-FRB UPRIGHT	BRASS	5.6	36
1/2" TYCO TY-FRB PENDANT ON 1" Drop	CHROME	5.6	9
1/2" TYCO TY-FRB UPRIGHT ON 10" SPRIG	BRASS	5.6	111
TOTAL SPRINKLERS GROUND FLOOR			156

Table 13: Second Floor Sprinkler Heads

MODEL	FINISH	K-FACTOR	QUANTITY
1/2" TYCO TY-FRB PENDANT ON 1" DROP	CHROME	5.6	15
1/2" TYCO TY-FRB UPRIGHT ON 8" SPRING	BRASS	5.6	97
1/2" TYCO TY-UPRIGHT	BRASS	5.6	2
TOTAL SPRINKLERS ON SECOND FLOOR			114

Hydraulic Calculations

To analyze the sprinkler system in the building a hydraulic calculation was performed on the most remote area of the building relative to the sprinkler layout. The design area measured 10 ft by 12.375 ft and utilized 8 sprinklers. This design area adheres to a reduced area of sprinkler operation, allowed by NFPA 13 Figure 11.2.3.2.3.1 and shown in Figure 27.

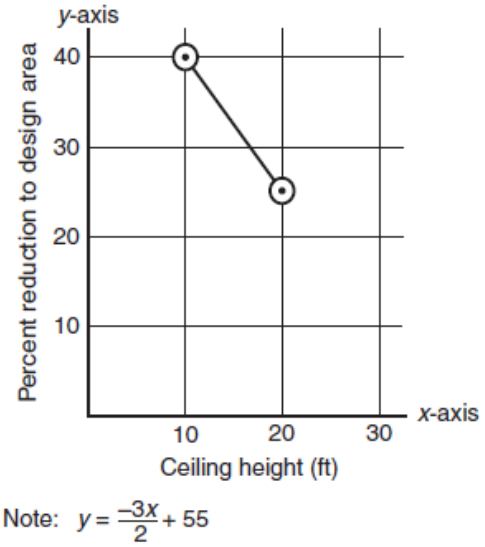

Figure 27: NFPA 13 Figure 11.2.3.2.3.1 Area of Sprinkler Operation Reduction

Taking advantage of the area of sprinkler operation reduction, a new area of 992 ft² was applied. The calculations for this new reduced area can be seen below:

$$\text{Ceiling Height} = 14'1"$$

$$\text{Y} = \frac{-3(14'1")}{2} + 55$$

$$\text{Y} = 33.875$$

$$\text{New Area} = 1500\ \text{ft}^2\ \text{X}\ (100\% - 33.875\%)$$

$$\text{New Area} = \ 992\ \text{ft}^2$$

This area utilized a light hazard classification, therefore a density of 0.1 gpm/ft² and a design area of 1,500 ft² was used, but reduced to 992 ft². A detailed image of the design area utilized can be found in Appendix F.

The hydraulic calculations yielded a discharge rate of 128.1 gpm with a pressure of 37.8 psi. The hydraulic calculations were performed manually using Microsoft Excel and can be found in Appendix G.

The discharge rate, pressure and hose stream allowance can be applied to the flow test summary sheet to be compared against the water supply. The flow test summary sheet with the aforementioned data applied can be found in Appendix H. After analyzing the flow test summary sheet, it can be summarized that the water supply is more than adequate for this system, even with a 10% safety factor. This building does not need a water pump.

Inspection Testing and Maintenance

Sprinkler Heads

Sprinklers have routine testing, but non-routine testing should be conducted to address unusual conditions. (NFPA 25 A.5.3.1)

Sprinklers should first be given a visual inspection for signs of mechanical damage, cleaning, painting, leakage in service, severe loading or corrosion. Then, sprinklers should be laboratory tested for sensitivity and functionality.

Sprinklers in this building (quick response sprinklers) shall be tested after 20 years in service, and then retested at 10 year intervals. (NFPA 25 5.3.1.1.1.3)

For testing, this building must use a representative sample of no less than four sprinklers (NFPA 25 5.3.1.2). If one sprinkler within the representative sample fails to meet the test requirement, all sprinklers within the area represented by that sample shall be replaced (NFPA 5.3.1.3).

Sprinklers should be replaced if they show any signs of contamination, corrosion or paint. This building requires no less than four replacement sprinklers on site.

Standpipe System

Standpipe systems should be flow tested every 5 years at the most remote connection to verify that the system can supply the required flow and pressure.

During commissioning the standpipe system must be hydrostatically tested at 200 psi for 2 hours.

Pressure Gauge

Pressure gauges must undergo a calibration test. During the calibration test gauges must be accurate to within 3 percent of the full scale. If it does not meet this requirement, the gauge must be recalibrated or replaced (NFPA 25 5.3.2.2). The normal life expectancy of a gauge is between 10 and 15 years (NFPA A.5.3.2).

Fire Department Connection

Inspect each fire department connection to make sure caps are in place, threads are in good condition, the ball drip or drain is in order and the check valve is not leaking. A hydrostatic test should be conducted periodically on old fire department connection piping to ensure that it will withstand the required pressure.

Waterflow Alarms

Waterflow alarm testing shall be accomplished by opening the inspector's test connection.

Maintenance Schedule

The maintenance schedule of additional components is summarized in Table 14.

Table 14: Maintenance Schedule

Parts	Activity	Frequency
Flushing Piping	Test	5 years
Fire Department Connections	Inspection	Monthly
Control Valves	Inspection	Monthly
Control Valves	Maintenance	Yearly
Main Drain	Flow Test	Quarterly
Sprinklers	Test	50 Years
Sprinklers- High Temp	Test	20 Years
Waterflow Alarms	Test	Quarterly
Quick Opening Devices	Test	Semiannually

STRUCTURAL FIRE PROTECTION

Type of Construction

The Bonderson Engineering Projects Center has a Type II-B construction. It consists of concrete slab and steel frame construction. The type of construction dictates many of the requirements for the building elements, which are summarized in this section.

Allowable Height and Area

The allowable height and area is determined by the type of construction and occupancy classification. The building is treated as having nonseparated occupancies, consequently the most restrictive group must be used. The allowable height and area for each contruction type and occupancy group in the building are summarized in Table 15. The allowable height and area used are highlighted in yellow.

Table 15: Allowable Height and Area

Group		Type of Construction								
		Type I		Type II		Type III		Type IV	Type V	
		A	B	A	B	A	B	HT	A	B
	Height (feet)	UL	160	65	55	65	55	65	50	40
		Stories (S) Area (A)								
Group A-3	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
Group B	S	UL	11	5	3	5	3	5	3	2
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
Group F-1	S	UL	11	4	2	3	2	4	2	1
	A	UL	UL	25,000	15,500	19,000	12,000	33,500	14,000	8,500
Group S-2	S	UL	11	5	3	4	3	5	4	2
	A	UL	79,000	39,000	26,000	39,000	26,000	38,500	21,000	13,500

The area of the first floor is 12,240 ft², which is more than allowed by Table 15. The allowable area is allowed to be increased when 25% of the perimeter of the building is open to a public way or open space. The calculation used to increase area is summarized below:

$$I_f = [\frac{F}{P} - 0.25]\frac{W}{30}$$

$$I_f = [1.0 - 0.25]\frac{30}{30}$$

$$I_f = 75\%\ Increase$$

Additionally, when the building is equipped with an approved automatic sprinkler system the allowable area per story is allowed to be increased by an additional 200%. The increased allowable area per story is summarized in Table 16, which indicates an allowable area per story which is greater than the building's area per floor.

Table 16: Allowable Area Per Floor Increase

Original Allowable Area Per Story	9,500 ft²
Frontage Increase	7,125 ft²
Automatic Sprinkler Increase	19,000 ft²
Allowable Area Per Story	35,625 ft²

Fire Resistant Ratings

The building and building's elements must have a fire resistance rating not be less than what is specified in Table 17 (CBC Table 601).

Table 17: Fire Resistance Rating Requirements

Building Element	Fire-Resistance Rating Requirement (Hours)
Primary Structural frame	0
Bearing walls (exterior)	0
Bearing walls (interior)	0
Nonbearing walls and partitions (interior)	0
Floor construction and associated secondary members	0
Roof construction and associated secondary members	0

The fire resistance rating requirements for exterior walls must not be less than what is specified in Table 18 (CBC Table 602). The building does not have a fire separation distance which is less than 10 feet, therefore it does not need rated exterior walls.

Table 18: Fire Resistance Rating Requirements for Exterior Walls

Fire Separation Distance - X (feet)	Fire-Resistance Rating Requirement for Exterior Walls (Hours)	
	Group F-1	Group A, B, S-2
X < 5	2	1
5 ≤ X < 10	1	1
10 ≤ X < 30	0	0
X ≥ 30	0	0

The fire resistance ratings required for the separations of occupancies must not be less than what is specified in Table 19 (CBC Table 508.4). The building does not adhere to all of these fire ratings, therefore it must be treated as nonseperated occupancies.

Table 19: Required Separation of Occupancies

Occupancy	A	S-2	B, F-1
A	0	0	1
S-2		0	1
B, F-1			0

The fire resistance ratings required for corridors must not be less than what is specified in Table 20 (CBC Table 1018.1).

Table 20: Corridor Fire-Resistance Rating Requirement

Occupancy	Required Fire-Resistance Rating
A, B, S, F	0

A 1 hour fire barrier must separate atrium spaces from adjacent spaces (CBC 404.6). The building does not have a 1 hour fire barrier separating atrium spaces from adjacent spaces (See Appendix I for fire barrier layout). If the building does not have this provision, it must provide an approved smoke control system (CBC 404.6 Exception 3). As seen in the performance based analysis section, the building does not employ an acceptable smoke control system.

Interior Finish

The interior finishes of the building must not be less than what is specified in Table 21 (CBC Table 803.9). The ratings used in Table 21 are summarized below:

Class A: Flame spread index 0-25; smoke-developed index 0-450

Class B: Flame spread index 26-75; smoke-developed index 0-450

Class C: Flame spread index 76-200; smoke-developed index 0-450

The interior finish classifications are determined using ASTM E84, also known as the Tunnel Test.

Table 21: Interior Finish Requirements

Group	Interior exit stairways, interior exit ramps and exit passageways	Corridors and enclosure for exit access stairways and exit access ramps	Room and enclosed spaces
A-3	B	B	C
B	B	C	C
F	C	C	C
S	C	C	C

PERFORMANCE BASED ANALYSIS

Executive Summary

The performance based analysis provides the parameters, criteria and results utilized in the Fire Dynamics Simulator (FDS) results. The pass/fail criteria derived from the SFPE handbook were used to analyze the building to determine if occupants had a safe amount of time for evacuation in the case of a fire.

Computational fluid dynamic computer modeling was performed using FDS. The simulations reflect the worst likely case fire scenarios within the Bonderson Engineering Projects Center. Specifically, two design fire scenarios were simulated which indicated that the building was built inadequately in the case of a fire.

Maintaining a tenable environment is dependant upon the tenability criteria including visibility greater than 33 feet, temperature below 272°F and a Carbon Monoxide (CO) concentration of less than 8,000 ppm. The fire modeling results demonstrated that the tenability criteria were not achieved for the duration of the calculated egress time.

Tenability Criteria

For the evaluation of the Bonderson Engineering Projects Center, the performance objective was to maintain for the duration of the evacuation time.

Specific design criteria was developed to provide threshold values in engineering terms, such as visibility, temperature and toxicity. These values provide a means to quantify the analysis and their values at an elevation of 6 feet (1.8m) above the walking surface. The design criteria, and the engineering basis for this design criterion, are described below. This criterion was used to evaluate conditions for building occupants that are not in the

immediate vicinity of the fire. Tenable conditions in the immediate vicinity of the fire will not be maintained.

Visibility

Research has been conducted by many fire science researchers during the 20th century on the allowable smoke density that permits safe egress. The proposed visibility required for safe escape ranges from 1.2 meters to 20 meters. In the chapter on "Visibility and Human Behavior in Fire Smoke" in the SFPE Handbook of Fire Protection Engineering (4th Edition) written by Tadahisa Jin it is proposed that occupants unfamiliar with the interior geometry of a building requires 13 meters of visibility to escape safely. Additionally, Jin states that occupants familiar with the interior geometry of the building require 4 meters of visibility to safely escape. Based upon the SFPE Handbook, a conservative visibility value of 10 meters was utilized.

Temperature

The second performance criteria related to exposure was temperature. Incapacitation due to heat exposure from increased temperatures in the smoke layer can be calculated using an equation developed by Purser. Purser provides an equation to follow a worst-case 100% humidity line. The equation is presented below:

$$t = (5\ x\ 10^{7})(T^{-3.4})$$

Where: t = time to incapacitation (min)

T = temperature (°C)

Rearranging:

$$T = \sqrt[3.4]{5\ x\ 10^{7}/_{3}}$$

T = 133°C

An exposure time of 3 minutes was used for this evaluation (t = 3 minutes). Based on this assumed exposure time, the temperature criterion value was calculated to be 272°F

(133°C). The calculated temperature criterion can be Figure 28 (SFPE Handbook 2-6.27) to confirm accuracy.

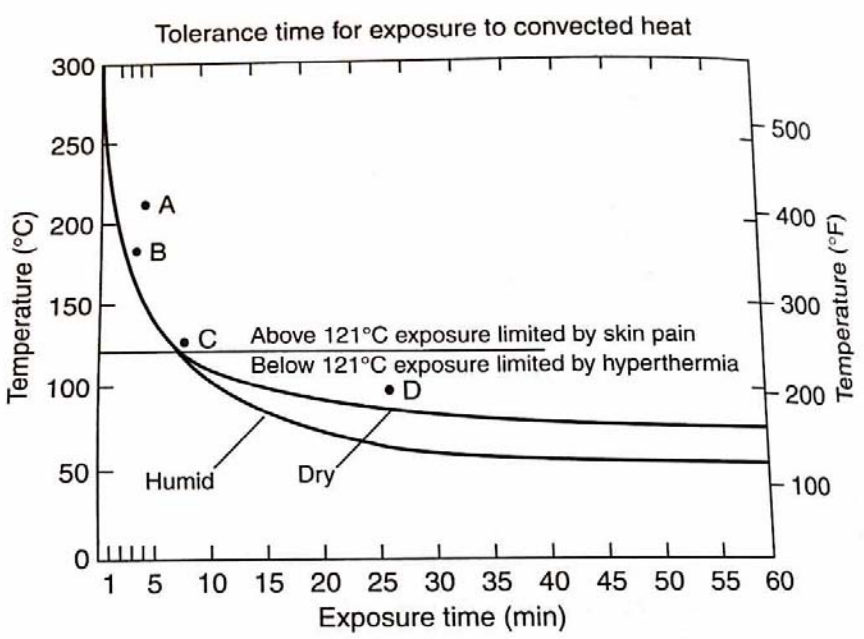

Figure 28: Temperature Limits

Toxicity

Toxicity levels in smoke are an important factor in maintaining the tenability conditions in a building fire. Generally, the toxicity of gaseous elements is taken to be an allowable exposure level over a specified amount of time. If a person is expected to be exposed to a toxin over a very long period of time, the acceptable exposure levels may be extremely low. Conversely, the allowable exposure level to toxins may be higher if the exposure is for a very brief period of time. The primary toxins encountered in a fire scenario include carbon monoxide (CO) and hydrogen cyanide (HCN). The approach to addressing carbon monoxide exposure outlined below is appropriate to also account for the minimal HCN exposure.

Exposure to CO is dangerous because it combines with hemoglobin in the blood to form carboxyhemoglobin (COHb). COHb results in toxic narcosis by reducing the amount of oxygen supplied to the tissues of the body. As occupants are exposed to CO in the air, the level of COHb in the blood increases, which eventually leads to a loss of consciousness and eventually death. Death is predicted at concentrations of COHb between 50% and 70%. Loss of consciousness is typically predicted at COHb concentrations of about 40%, although loss of consciousness can occur at COHb concentrations as low as 30%. To maintain a conservative analysis, the lower threshold of COHb concentrations that could cause unconsciousness (30%) was used to determine an acceptable CO concentration in the air for the time period described previously. The level of COHb in the blood is related to

the CO exposure concentration, the exposure time, and the volume of air breathed by the occupants. An exposure time of 3 minutes was used to determine a maximum toxicity level.

In order to use Purser's equation to determine the maximum CO concentration, an accurate volume of air breather and a percent COHb must be selected for the building. Table 22 shows three different activity levels with their associated volume of air breathed and percent COHb values. For the purposes of this report, an activity level of "light work: walking to escape" was chosen.

Table 22: Toxicity Calculation Values

Activity Level of Subject	**V (L/min)**	**D (percent COHb)**
Resting or sleeping	8.5	40
Light work- walking to escape	25	30
Heavy work- slow running, walking up stairs	50	20

Purser presented the equation below for predicting the effect of CO exposure based upon the factors listed above:

$\%COHb = (3.317x10^{-5}) \times (ppm\ CO)^{1.036} \times (RMV) \times (t)$

Where:

%COHb = Percentage of COHb in the blood

ppm CO = CO concentration in the air

RMV = Volume of air breathed (L/min)

RMV = 25 L/min for a person doing light work (such as walking)

t = exposure time (min) = 3 minutes

Rearranging:

$ppm\ CO = [\%COHb / \{(3.317x10^{-5}) \times (RMV) \times (t)\}]^{0.965}$

$ppm\ CO = [30 / \{(3.317x10^{-5}) \times (25) \times (3)\}]^{0.965}$

CO Concentration Criterion for a 3 Minute Exposure = 8,680 ppm

The CO concentration criterion was rounded down to 8,000 ppm in order to remain conservative and to stay within the maximum bounds of Figure 29 (SFPE Handbook Figure 2-6.5), which shows a maximum CO concentration of 8,000 ppm.

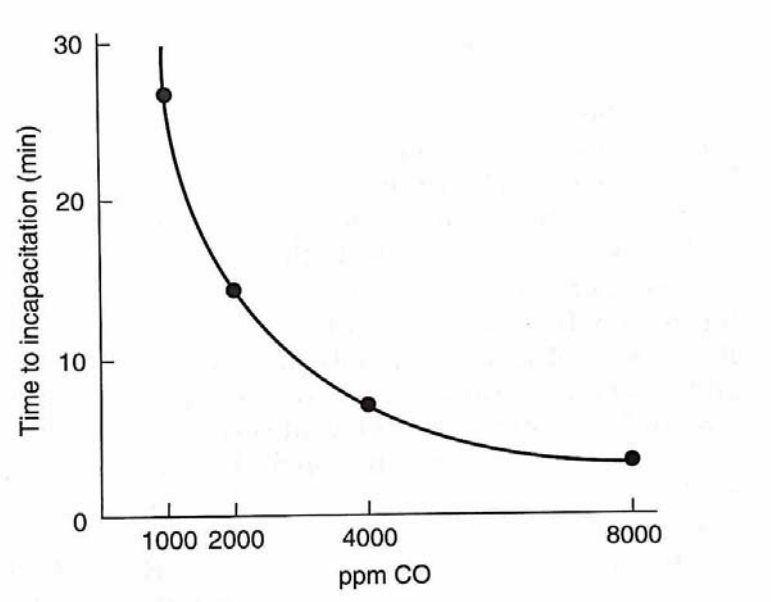

Figure 29: CO Concentration Limits

Summary of Tenability Criteria

As noted in the preceding paragraphs, generally accepted engineering references and calculations were utilized to determine the appropriate tenability limits for occupants exposed to fire conditions. The tenable limits established for visibility, temperature, and toxicity and are summarized in the Table 23.

Table 23: Tenability Criteria Summary

Tenability Criteria	Metric Units	Imperial Units
Visibility	10 meters	33 feet
Temperature	133°C	272°F
Toxicity (CO)	8,000 ppm	8,000 ppm

Fuel Assumption

Design Fire 1

For design fire 1, a corridor fire on the first floor of the building was considered. It is not uncommon in the building for one of the room doors to be held open by a trashcan. This trashcan is typically full which presents an accurate fuel load for design fire 1. The heat release rate (HRR) utilized for design fire 1 is derived from Figure 30 (SFPE Handbook Figure 3-1.96).

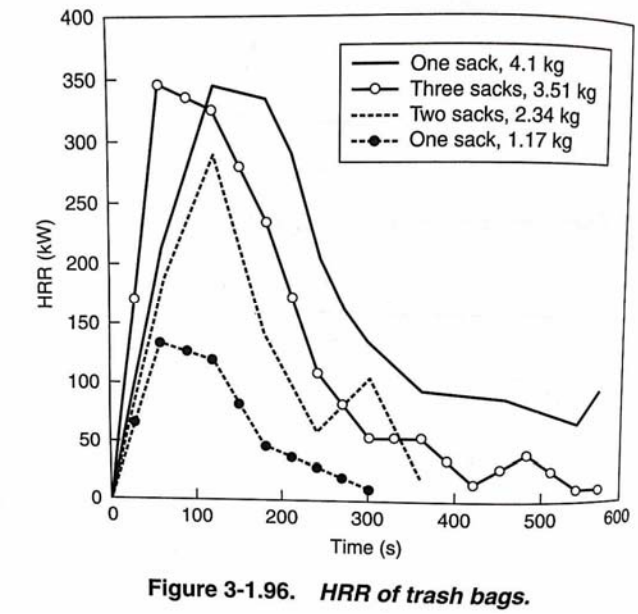

Figure 30: Trashcan Fire Heat Release Rate

To remain conservative, it is assumed that the design fire begins at peak HRR and does not decay (it remains at 350 kW for the duration of the FDS run). It is also assumed that the sprinkler system does not activate and therefore does not help diminish the HRR curve. The sprinkler system was modeled, but it did not activate before approximately 50 seconds. At approximately 50 seconds the model is already at peak HRR therefore the sprinkler system would not be needed to stop fire growth. The actual HRR curve produced by FDS can be seen in Figure 31.

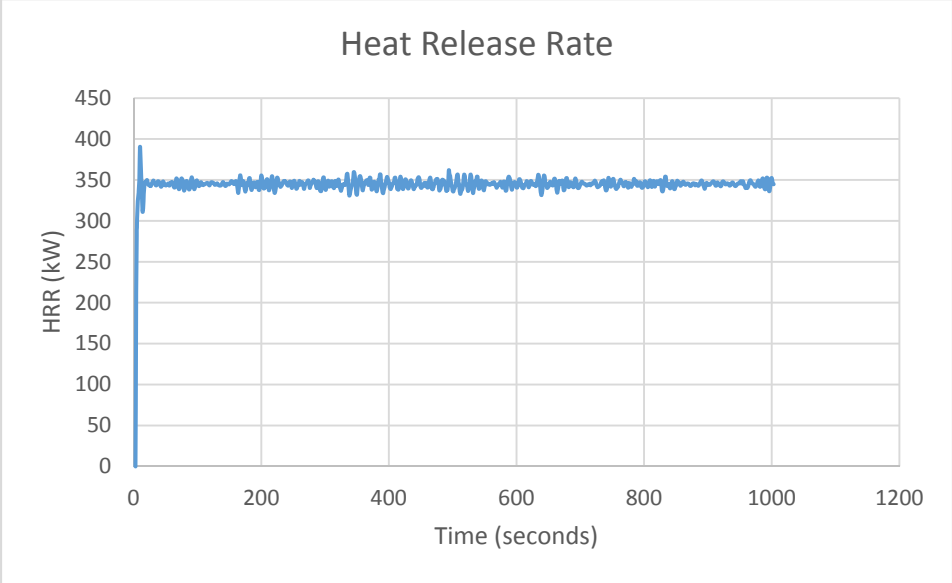

Figure 31: HRR Curve produced by FDS

The location of the fire can be seen in Figure 32.

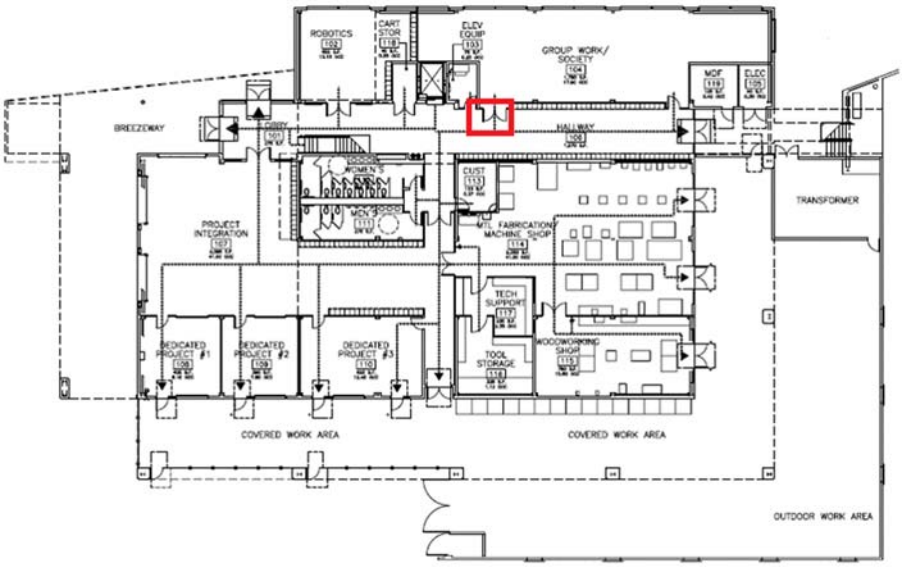

Figure 32: First Floor Fire Location for Design Fire 1

Design Fire 2

For design fire 2, a fire in the project integration room was considered. This room is used for a multitude of events, which poses a difficult task of estimating an accurate fuel load. The project integration room is used as an assembly area for events, which adds an influx of stackable chairs. Figure 33 shows a heat release rate graph of metal-frame, upholstered stacking chairs. The HRR curve utilized is the "8 chairs in one stack". This HRR curve starts almost instantaneously at 400 kW, and then begins to decline around the 300 second mark.

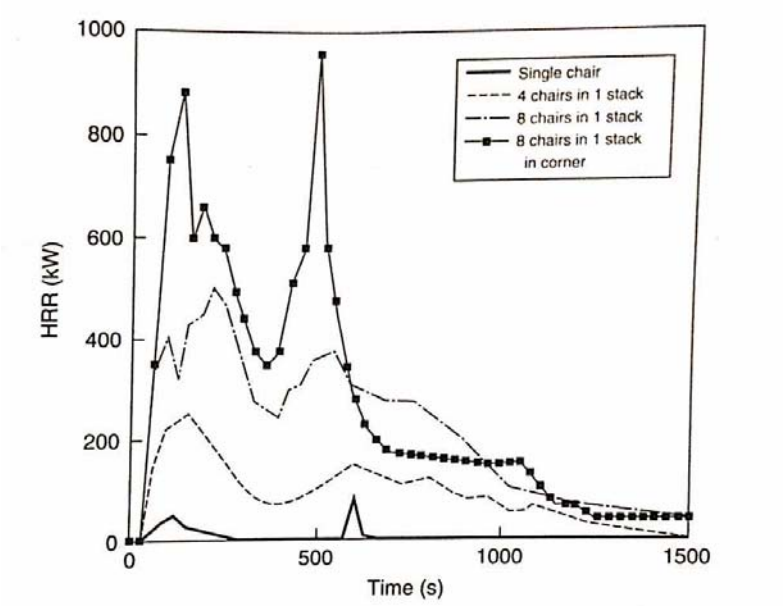

Figure 33: HRR of metal-frame, upholstered stacking chairs

The project integration room is also used for different student projects, which often include moveable work stations. Figure 34 shows a heat release rate graph of various workstations. These workstations grow slowly, and do not exceed 400 kW in the first 180 seconds. Our model is only run out to 180 seconds, therefore the high HRR curves are negligible past this point. While workstations were considered and evaluated as part of design fire 2, the stackable chairs pose a greater hazard and were therefore used in the FDS model.

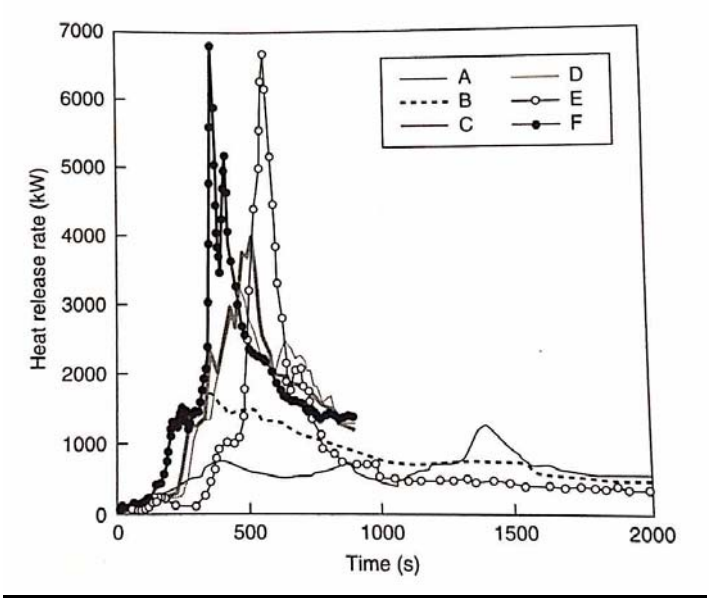

Figure 34: HRR of office workstations

To remain conservative, it is assumed that the design fire begins at peak HRR and does not decay (it remains at 400 kW for the duration of the FDS run). It is also assumed that the sprinkler system does not activate and therefore does not help diminish the HRR curve. As previously mentioned, the peak HRR is almost instantaneous therefore the sprinkler system cannot be utilized to halt the HRR growth. The actual HRR curve produced by FDS can be seen in Figure 35.

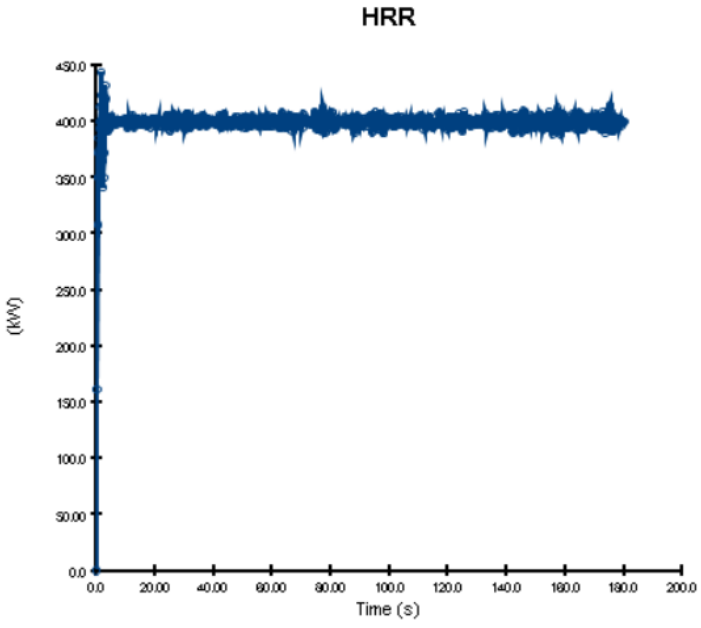

Figure 35: FDS HRR for Design Fire 2

The location of the fire can be seen in Figure 36.

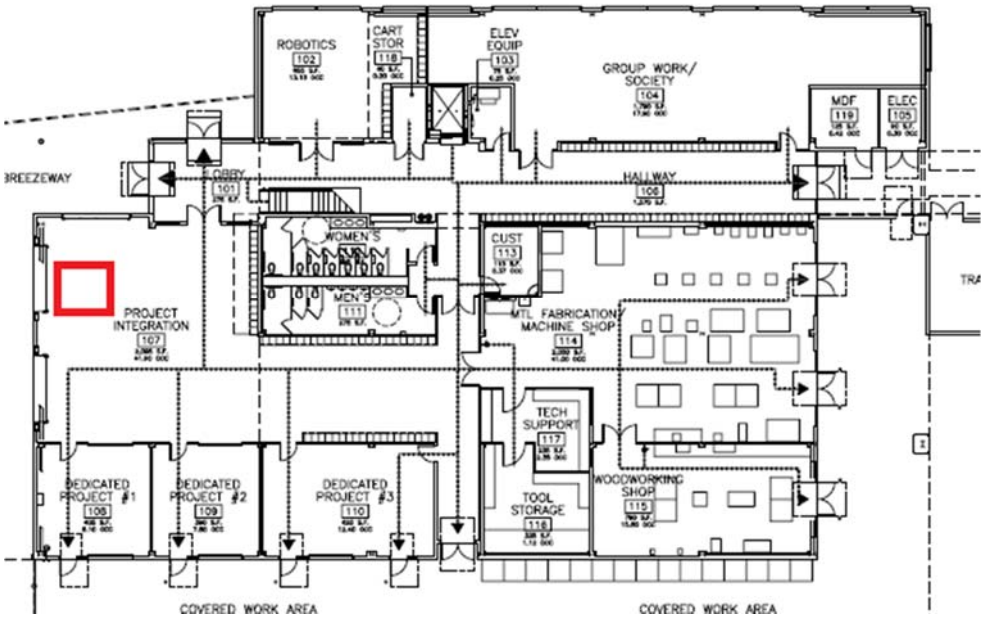

Figure 36: First Floor Fire Location for Design Fire 1

Characteristics of Occupants

Before evaluating evacuation times, the characteristics of a building and how it effects an occupants evacuation must be examined. Some of the building characteristics which alter an occupants evacuation time are summarized below:

Type of Warning System

The usual basic warning system is the fire alarm, however occupants will take the longest to respond to this warning system if they have received no training or if there is often false alarms. Prerecorded messages are rarely effective in making occupants start to leave. Informative live messages are the best way to initiate a fast response. When a fire alarm goes off in the Bonderson Engineering Projects Center it could be conceived as a false alarm and delay evacuation time.

Building Layout and Wayfinding

The organization of a floor has an impact on the possibility for an occupant to have developed a mental map of the space. Occupants are likely to spend more time obtaining

information in a building where wayfinding is difficult. The Bonderson Engineering Projects Center is fairly small and straightforward, so I do not predict that this would cause a significant increase in calculated evacuation times.

Visual Access

If a building does not provide visual access to the behavior of others, which could be on important source of information for people, then egress time could be delayed. The Bonderson Engineering Projects Center has windows in most doors so I do not predict that this would cause a significant increase in calculated evacuation times.

Focal Point

Buildings that require occupants to focus their attention onto a screen must have to stop and full lighting should resume for occupants to pay attention to the fire situation. This could occur in the Bonderson Engineering Projects Center during a presentation of class. This could increase calculated evacuation times.

Training

Training is an essential part of fast occupant response. With evacuation drills and training I do not expect training to significantly increase calculated evacuation times. Additionally, most occupants of the Bonderson Engineering Projects Center have gone through many school systems that should have conducted fire drills.

Frequency of False Alarms

The more false alarms the less credibility an actual fire alarm has. If the false alarm rate is high it could increase evacuation times.

Timed Egress Analysis

The goal of this evaluation is to show whether occupants in the Bonderson Engineering Projects Center will be able to evacuate (RSET) prior to being exposed to untenable conditions (ASET). RSET is defined as the “Required Safe Egress Time” and defines the time required for occupants to safely complete their evacuation. ASET is defined as the “Available Safe Egress Time” and defines the amount of time between the ignition of a fire and the time at which tenability is lost. In order for the building to be deemed tenable during a fire ASET must exceed the RSET.

The calculations utilized in this analysis for determining egress times are based upon those described in Chapter 3-13, *Emergency Movement* of the *SFPE Handbook of Fire Protection Engineering, 4th Edition*. The egress time is determined by adding the calculated unimpeded travel time to reach an exit door and the queuing (waiting) time experienced by occupants to travel through egress elements, such as doors and paths of travel. Waiting times are determined based on the number of occupants, the width of the egress component, and the allowable flow (in units of persons/minute/foot) of the egress element. Flow values are selected depending on the crowd conditions; minimum, moderate, optimum, and crush, of which crush has the largest density of occupants per area.

The calculations simulate occupant movement toward exits similar to fluid flow, based on occupant movement speeds and flow rates over and through doors, stairs, and other egress components. Occupants move toward exits under the constraints defined in the above referenced SFPE Handbook chapter. In general, as more occupants arrive at and exit through specific egress elements, the speed with which they exit across these elements will decrease.

The egress calculations also assume that all occupants begin to evacuate at the same instant, travel at the same rates of speed and do not delay their evacuation based on decision-making once they begin to evacuate. The movement rates are based upon evacuation drills and observations in various building types. It is assumed that occupant's decision-making does not affect the egress time once evacuation has started.

The overall egress time from a space can be approximated by the equation below, defined in Chapter 3-13 of the *SFPE Handbook of Fire Protection Engineering, 4th Edition*:

$$RSET = t_d + t_n + t_{p\text{-}e}(s_f) + t_e(s_f)$$

Where :

RSET	=	Total Evacuation Time
t_d	=	Time from fire ignition to detection
t_n	=	Time from detection to notification of occupants of a fire emergency
$t_{p\text{-}e}$	=	Time from notification until evacuation commences
t_e	=	Time from the start of evacuation until it is completed
s_f	=	Safety factor

The ASET compared to the RSET and associated parameters is summarized in Figure 37 (SFPE Handbook Figure 3-12.1).

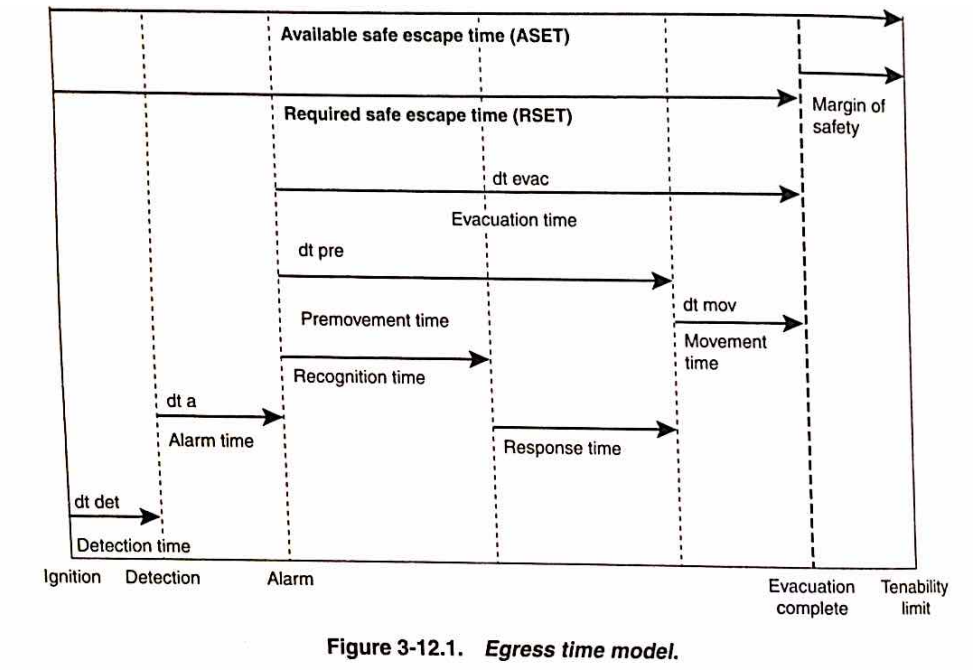

Figure 3-12.1. ***Egress time model.***

Figure 37: ASET versus RSET Chart

To determine the time from fire ignition to detection (t_d) was determined using a smoke detector in FDS. The smoke detectors in the Bonderson Engineering Projects Center were input into FDS, which activate in the event of smoke detection. This detection time was utilized in the egress calculations. Figure 38 depicts a smoke detector being activated at 9.6 seconds during design fire 1.

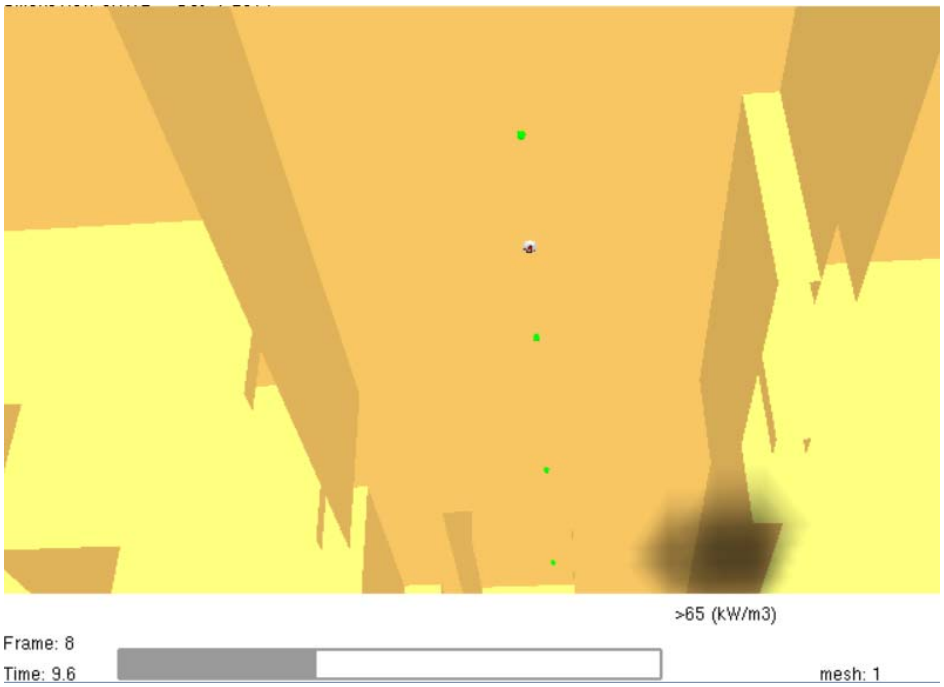

Figure 38: Smoke Detector Activation Design Fire 1

It was assumed that it took 10 seconds from the detection of the fire until the fire alarm devices were activated. This value was used for the time from detection to notification of occupants of a fire emergency (t_n).

The time from notification until evacuation commences (t_{n-e}) is a value derived from controversial studies of occupant behaviors. Figure 39 (SFPE Handbook Table 3-12.3) summarizes different occupant alertness, which ranges from the most alert category A, to the least alert occupant group E.

Category	Occupant Alertness	Occupant Familiarity	Occupant Density	Enclosure/ Complexity	Examples of Occupancy Types
A	Awake	Familiar	Low	One or many	Office or industrial
B1	Awake	Unfamiliar	High	One or few	Shop, restaurant, circulation space
B2	Awake	Unfamiliar	High	One with focal point	Cinema, theatre
	Asleep	Familiar	Low	Few	Dwelling
Ci	Long term, individual occupancy				Without 24 hr on-site management
Cii	Managed occupancy				Serviced flats, halls of residence, etc.
Ciii	Asleep	Unfamiliar	Low	Many	Hotel, hostel
D	Medical care	Unfamiliar	Low	Many	Residential (institutional)
E	Transportation	Unfamiliar	High	Many	Railway station/airport

Figure 39: Design Behavioral Scenarios and Occupancy Types

The category A occupants have the smallest t_{n-e} value, while the category E occupants have the largest t_{n-e} value. However, all researchers in the field of human behavior are hesitant in suggestion actual numbers because of the limited research findings in this area. For the purposes of this performance based analysis instantaneous evacuation was assumed. Therefore the t_{n-e} value used was 0 seconds.

The time from the start of evacuation until it is completed (t_e) was determined using Pathfinder. Pathfinder is an agent based egress and human movement simulator. It provides a graphical interface for simulation design and execution. The geometry, egress component specifications and occupant loads were input into Pathfinder in order to determine the t_e value. Figure 40 shows a screenshot of the Pathfinder model when the building is fully occupied, while Figure 41 and 42 shows the building right as the last person evacuates from the first and second floor respectively.

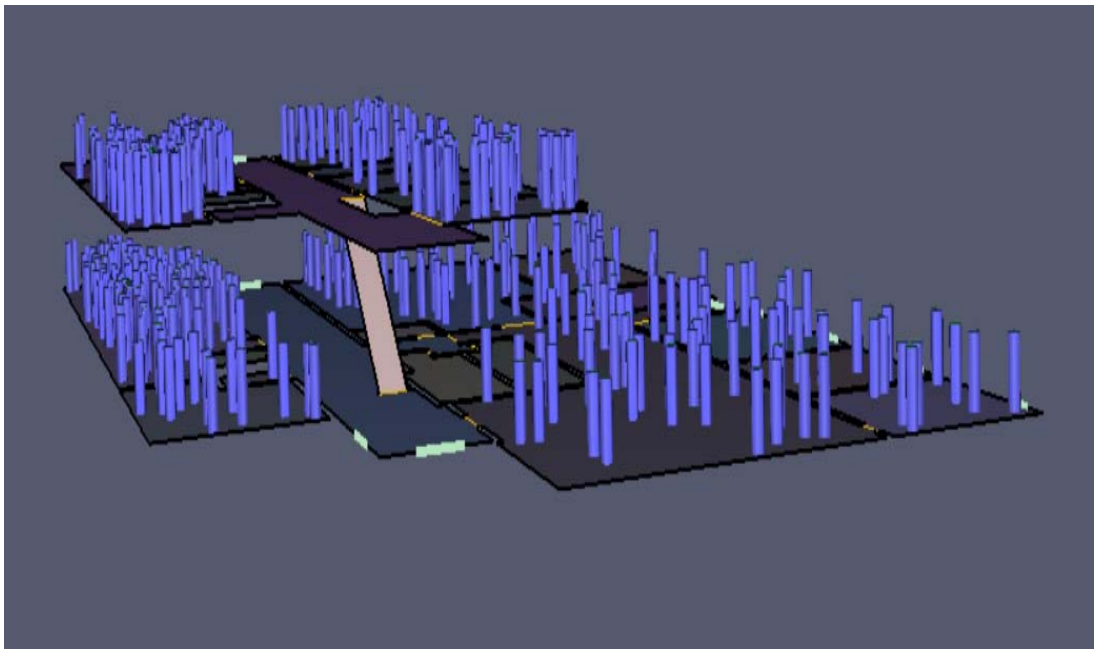

Figure 40: Pathfinder Screenshot when fully occupied

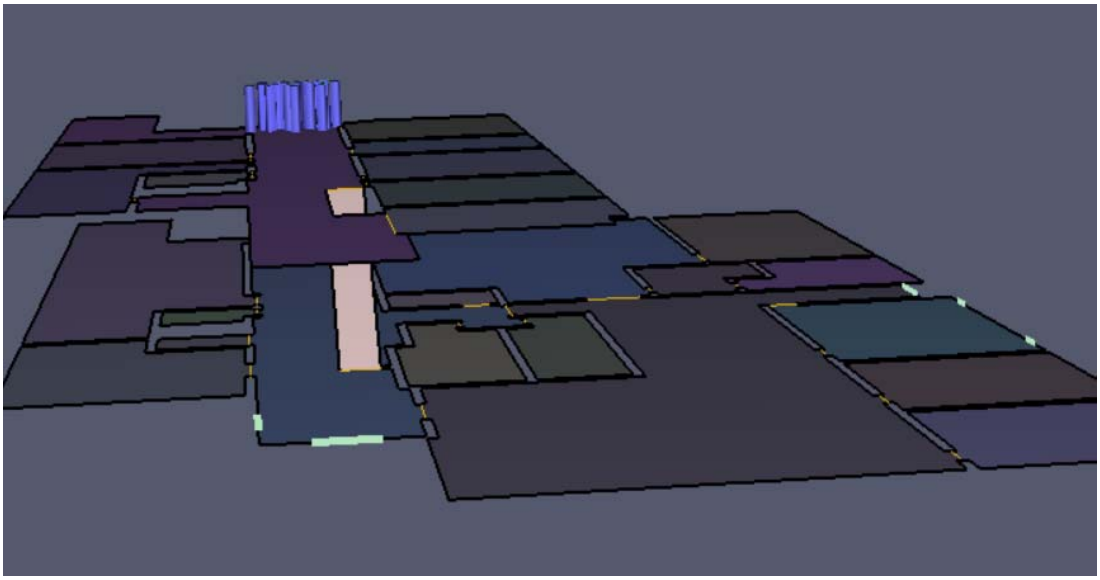

Figure 41: Pathfinder Screenshot when First Floor is fully evacuated

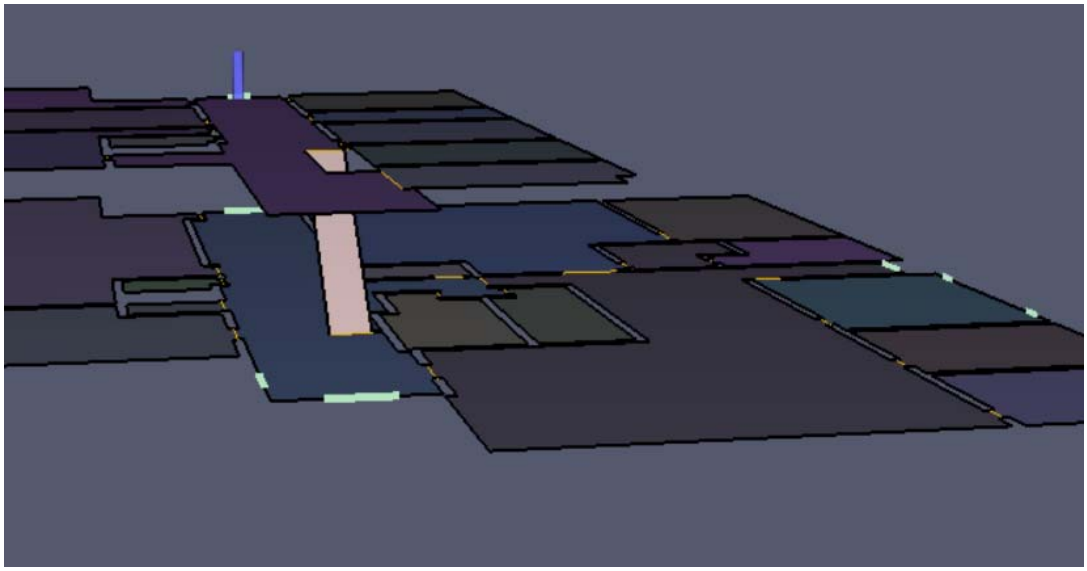

Figure 42: Pathfinder Screenshot when Second Floor is fully evacuated

The t_e value determined using Pathfinder was 94.3 seconds.

A safety factor of 1.5 times egress time was used for the purpose of the egress calculations. This value complies with the duration of operation of a smoke control system (CBC 909.4.6).

After combining all the RSET components it is possible to determine the total RSET time, which is summarized below:

$$RSET = t_d + t_n + t_{p\text{-}e}(s_f) + t_e(s_f)$$

RSET =Total Evacuation Time

t_d = 9.6 seconds

t_n = 10 seconds

$t_{p\text{-}e}$ = 0 seconds

t_e = *76.4 and* 94.3 seconds

s_f =1.5

Total RSET First Floor = 135 Seconds

Total RSET Second Floor = 161 Seconds

The RSET time was rounded to 3 minutes for tenability requirements in order to remain conservative.

FDS Results- Design Fire 1

The FDS model calculates the results of the visibility, temperature, and toxicity through slices taken at six feet above the walking surface. For the purposes of this report, any increase above the tenability requirements for temperature and toxicity is considered failing. Any decrease below the tenability requirement for visibility is considered failing.

Visibility

The visibility dropped below the tenability criteria on the first floor at 30 seconds as seen in Figure 43. Figure 44 shows the entire first floor corridor failing at 135 seconds.

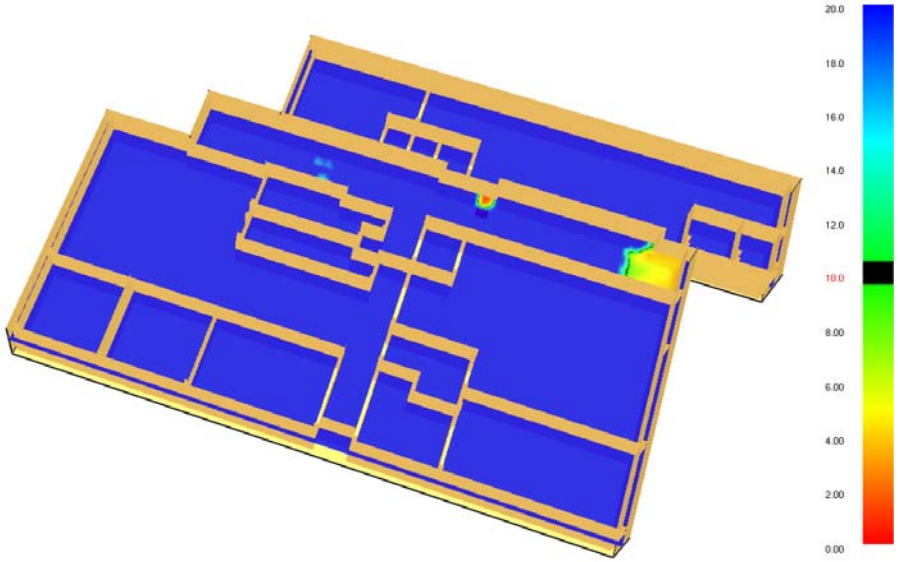

Figure 43: First Floor Visibility at 30 Seconds

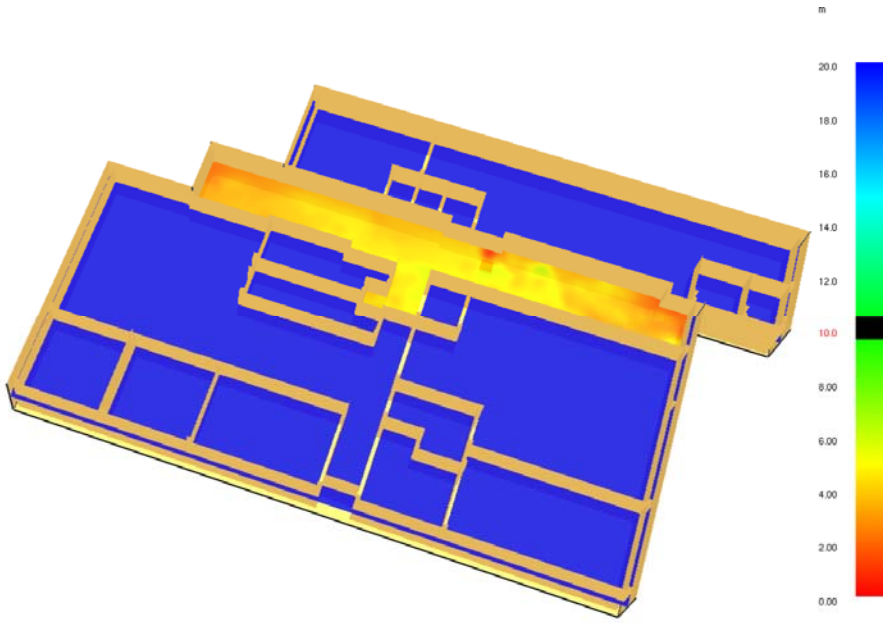

Figure 44: First Floor Visibility at 135 Seconds

The visibility on the second floor fails at 161 seconds, which can be seen in Figure 45.

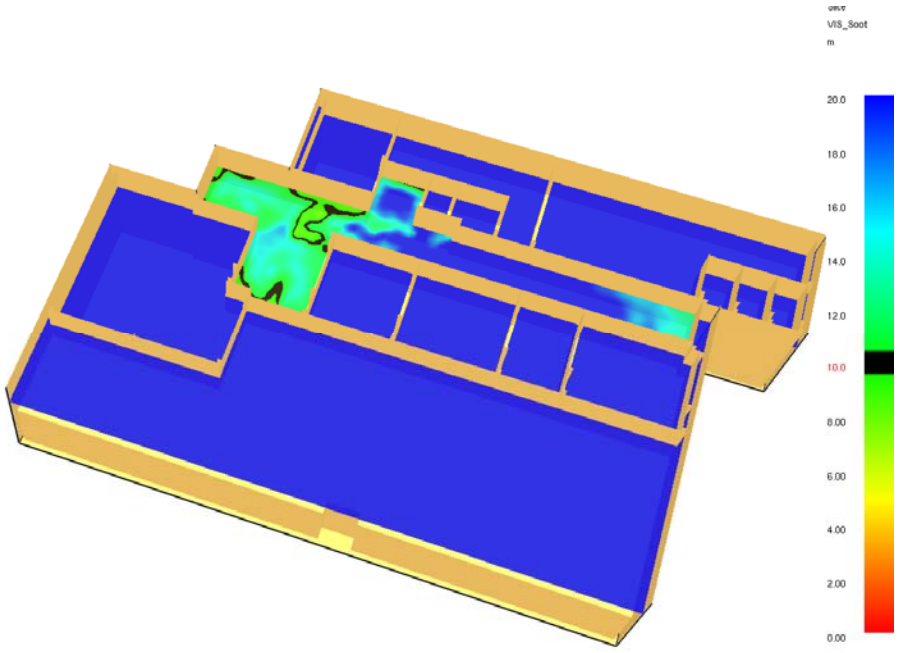

Figure 45: Second Floor Visibility at 161 Seconds

Temperature

The temperature does not rise above the tenability criteria during the 3 minute run time of the model. Figures 46 and 47 show a temperature slice file of the first and second floor at 3 minutes (180 seconds).

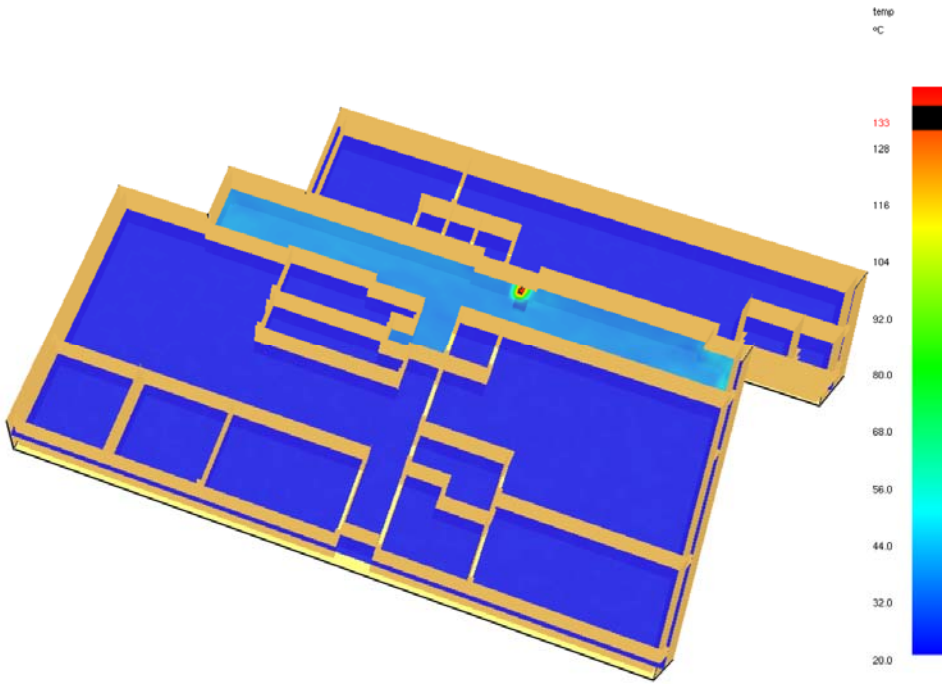

Figure 46: First Floor Temperature at 180 Seconds

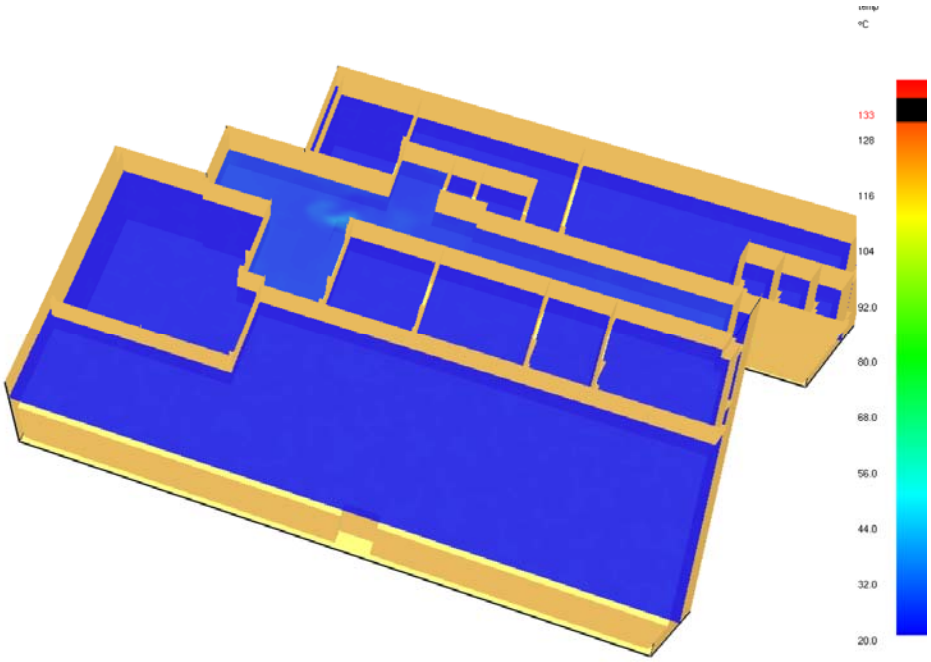

Figure 47: Second Floor Temperature at 180 Seconds

Toxicity

The toxicity does not rise above the tenability criteria during the 3 minute run time of the model. Figures 48 and 49 show a toxicity slice file of the first and second floor at 3 minutes (180 seconds).

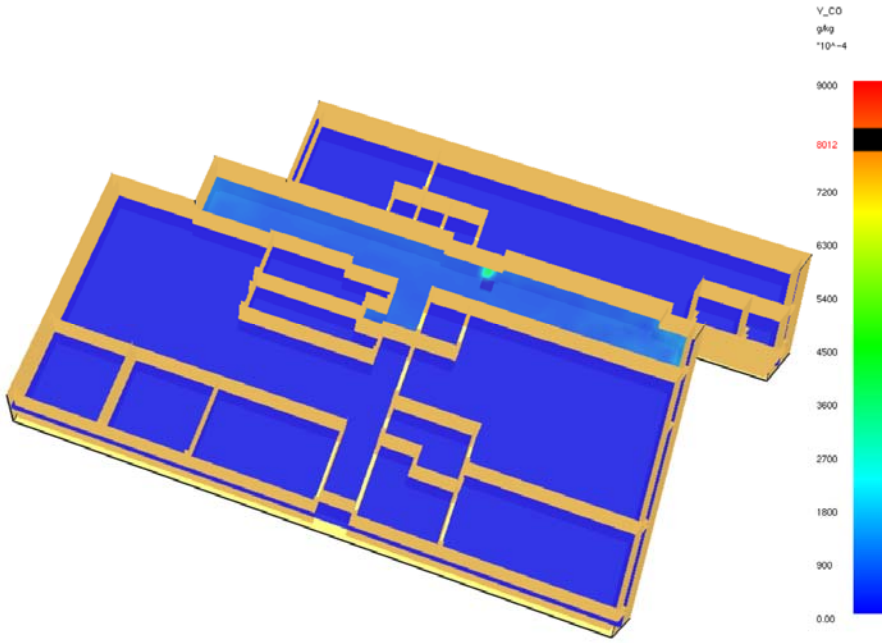

Figure 48: First Floor Toxicity at 180 Seconds

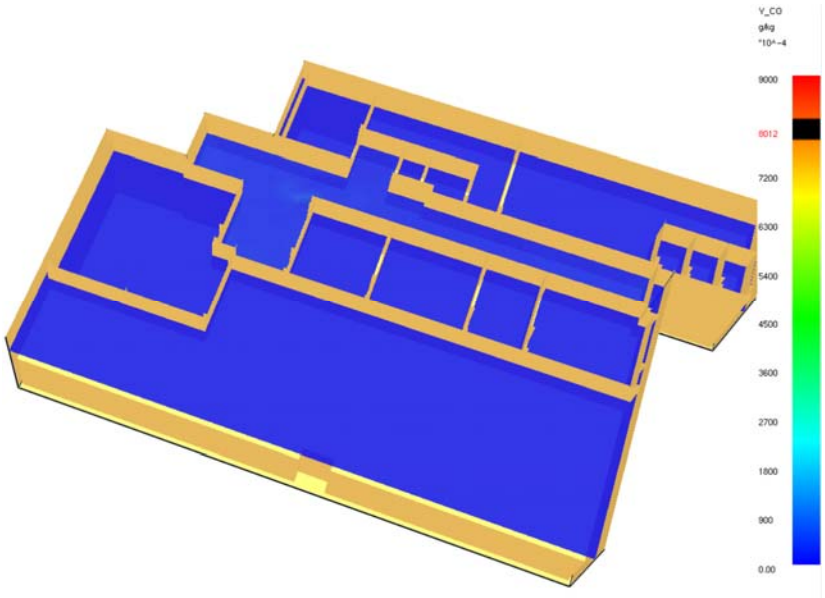

Figure 49: Second Floor Toxicity at 180 Seconds

FDS Results- Design Fire 2

The FDS model calculates the results of the visibility, temperature, and toxicity through slices taken at six feet above the walking surface. For the purposes of this report, any increase above the tenability requirements for temperature and toxicity is considered failing. Any decrease below the tenability requirement for visibility is considered failing.

Visibility

The visibility dropped below the tenability criteria on the first floor at 120 seconds as seen in Figure 50.

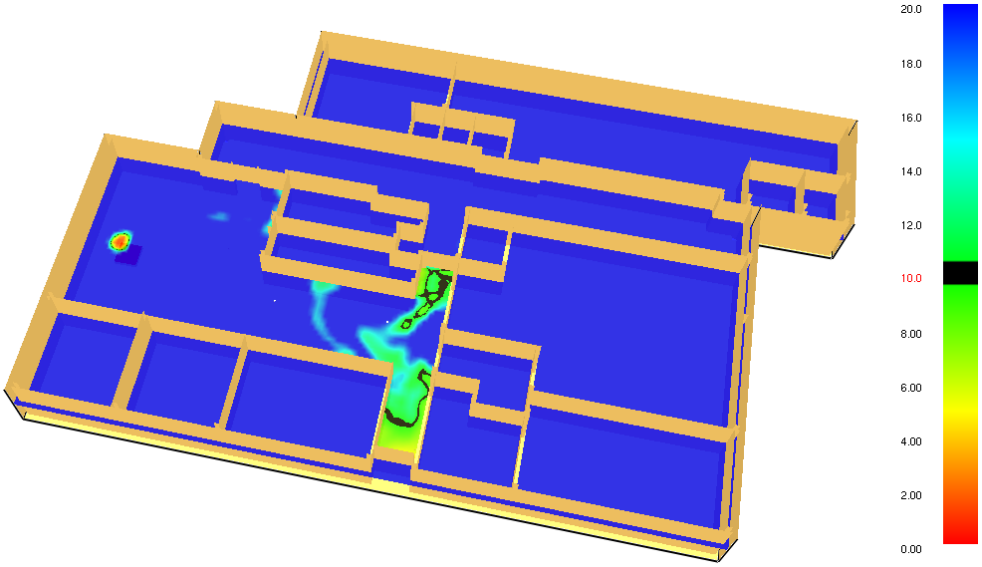

Figure 50: First Floor Visibility at 120 Seconds

The visibility on the second floor fails does not go below the tenability requirement at any time during the 3 minute run time of the model, as seen in Figure 51.

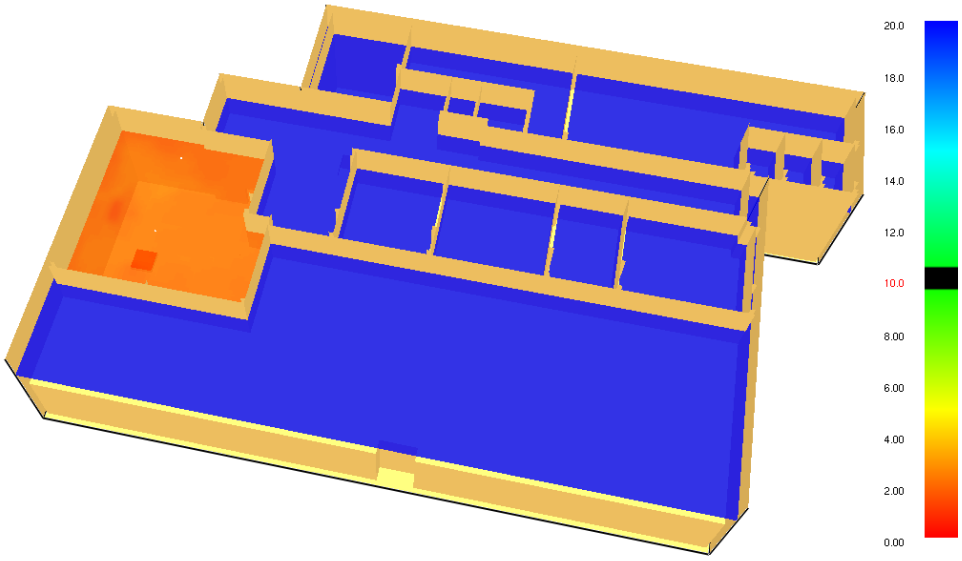

Figure 51: Second Floor Visibility at 161 Seconds

Temperature

The temperature does not rise above the tenability criteria during the 3 minute run time of the model. Figures 52 and 53 show a temperature slice file of the first and second floor at 3 minutes (180 seconds).

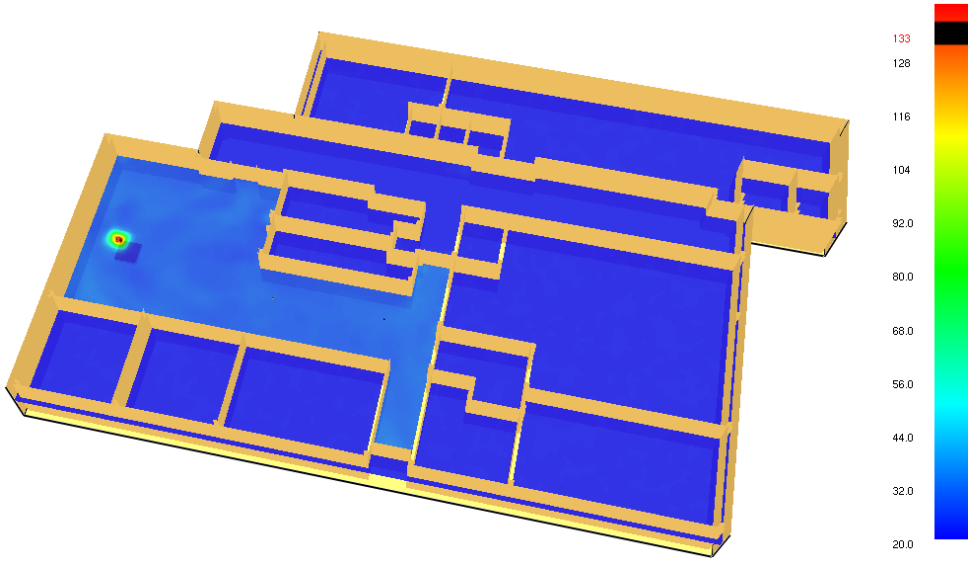

Figure 52: First Floor Temperature at 180 Seconds

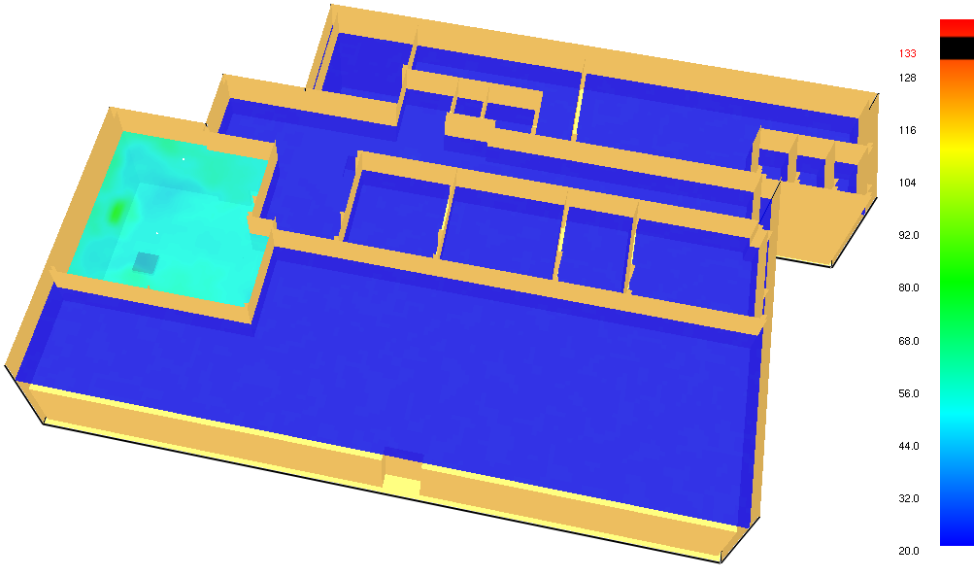

Figure 53: Second Floor Temperature at 180 Seconds

Toxicity

The toxicity does not rise above the tenability criteria during the 3 minute run time of the model. Figures 54 and 55 show a toxicity slice file of the first and second floor at 3 minutes (180 seconds).

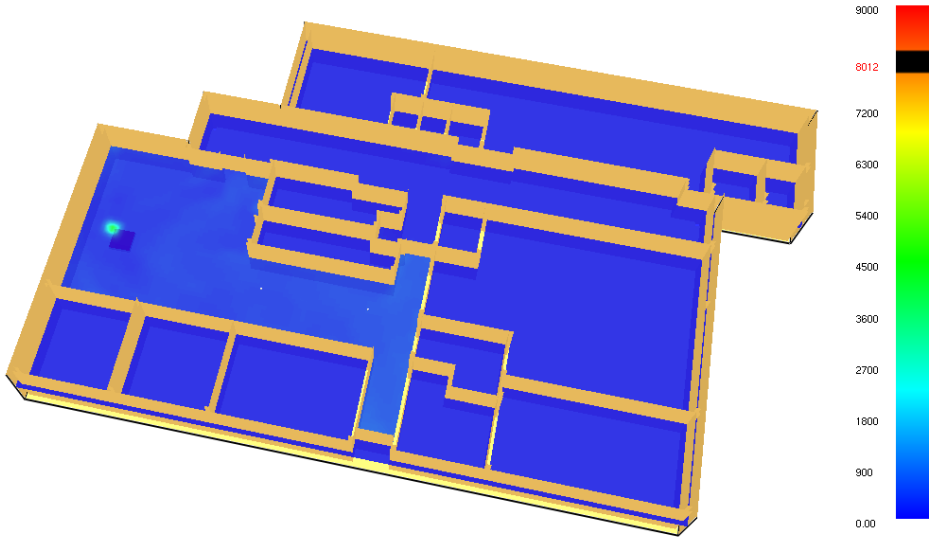

Figure 54: First Floor Toxicity at 180 Seconds

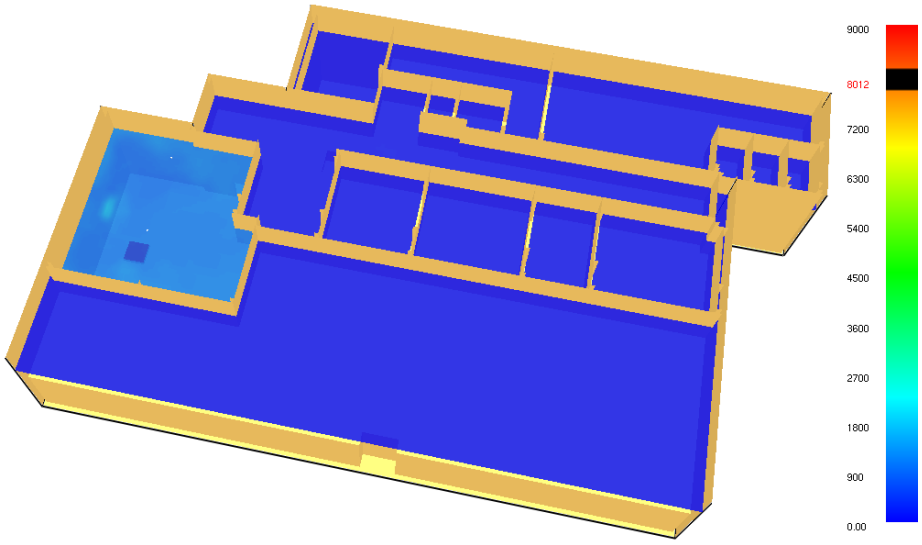

Figure 55: Second Floor Toxicity at 180 Seconds

Conclusion

The visibility on the first floor failed at 30 seconds in design fire 1 and at 120 seconds in design fire 2. This indicates that the building will fail in the event of a fire and the occupants will not be able to evacuate safely. The tenability results are summarized in Table 24 and 25.

Table 24: Summary of Tenability Results Design Fire 1

Floor Level	RSET Time	Visibility	Temperature	Toxicity
Level 1	135 Seconds	Fail at 30 seconds	Pass	Pass
Level 2	161 Seconds	Pass	Pass	Pass

Table 25: Summary of Tenability Results Design Fire 2

Floor Level	RSET Time	Visibility	Temperature	Toxicity
Level 1	135 Seconds	Fail at 120 seconds	Pass	Pass
Level 2	161 Seconds	Pass	Pass	Pass

The ASET duration is less than the RSET duration, making this building unsafe for occupants to utilize. The two available options are to design and implement a smoke control system or to separate the atrium from the remaining parts of the building by a 1 hour fire barrier. It is conceivable that this building does not pass the performance based analysis because it was not built with a smoke control system, and was not required to have a 1 hour fire barrier separating the atrium under the code is was built under. In addition to the performance based analysis, the prescriptive analysis revealed rooms being used as different occupancies than were originally designed as. These occupancy uses must be revisited to adhere to the corresponding code, including but not limited to door swing. The rest of the Bonderson Engineering Projects Center adheres to the 2012 CBC in regards to Fire Protection elements.

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APPENDICES

Appendix A: Building Layout

Appendix B: Fire Alarm Control Panel and Detection Devices Specifications Sheet

Appendix C: Fire Alarm Layout

Appendix D: Fire Sprinkler System Layout

Appendix E: Diagram of Sprinkler Heads

Appendix F: Sprinkler System Design Area

Appendix G: Hydraulic Calculations

Appendix H: Flow Test Summary Sheet

Appendix I: Fire Rated Wall Locations

Appendix A

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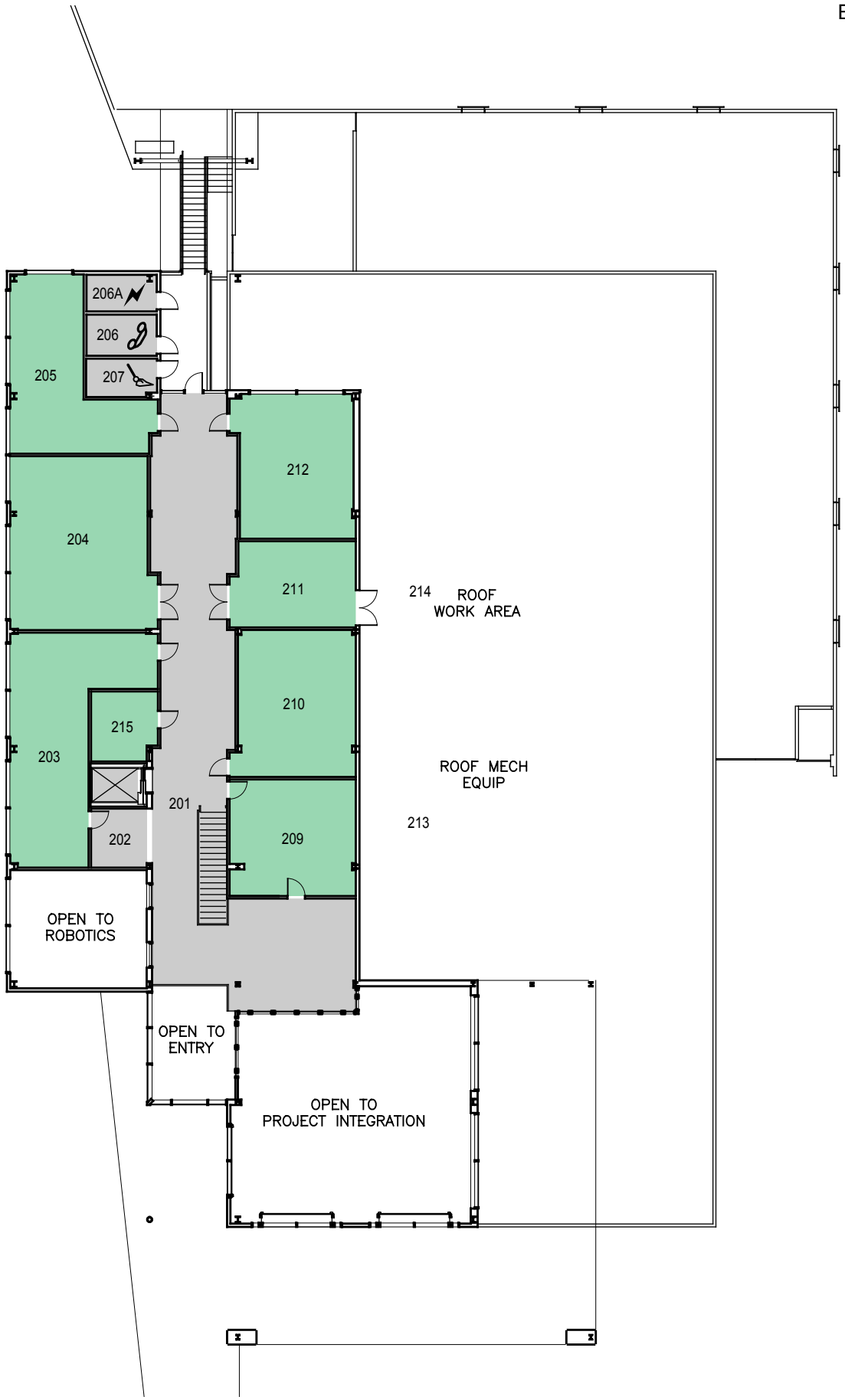
Floor 1

CAGR	CLA	
CARCH	CSM	UNIV
CBUS		ADMIN
CENGR	NON STATE	NON ASSIGNABLE

August 2013

1"=25'



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August 2013

1"=25'

Appendix B

NFS-640

Intelligent Addressable Fire Alarm System

NOTIFIER® by Honeywell

Intelligent Fire Alarm Control Panels

General

The NFS-640 intelligent Fire Alarm Control Panel is part of the ONYX® Series of Fire Alarm Controls from NOTIFIER.

As a stand-alone small-to-large system, or as a large network, the ONYX® Series of products meets virtually every application requirement.

Designed with modularity and for ease of system planning, the NFS-640 can be configured with just a few devices for small building applications, or for a large campus or high-rise application. Simply add additional peripheral equipment to suit the application.

Features

- One, expandable to two, isolated intelligent Signaling Line Circuit (SLC) Style 4, 6 or 7.
- Up to 159 detectors (any mix of ion, photo, thermal, or multi-sensor) and 159 modules (N.O. manual stations, two-wire smoke, notification, or relay) per SLC. 318 devices per loop/636 per FACP or network node.
- Standard 80-character display, 640-character large display, or display-less (a node on a network).
- Network option – 103 nodes supported (NFS-640, NCA Network Annunciator, or NCS Network Control Station) using wire or fiber-optic connections.
- 6.0 amp switch mode power supply with four Class A/B built-in Notification Appliance Circuits (NAC). Selectable System Sensor strobe synchronization.
- Built-in Alarm, Trouble, and Supervisory relays.
- Up to 64 output circuits per FACP or network node; circuits configurable online.
- ***VeriFire® Tools*** offline program option. Sort Maintenance Reports by compensation value (dirty detector), peak alarm value, or address.
- Autoprogramming and Walk Test reports.
- Optional universal 636-point DACT.
- 80-character remote annunciators (up to 32).
- EIA-485 annunciators, including custom graphics.
- Printer interface (80-column and 40-column printers).
- History file with 800-event capacity in nonvolatile memory, plus separate 200-event alarm-only file.
- Alarm Verification selection per point, with tally.
- Autoprogramming and Walk Test reports.
- Positive Alarm Sequence (PAS) Presignal.
- Silence inhibit and Auto Silence timer options.
- March time / temporal / California two-stage coding / strobe synchronization.
- Field-programmable on panel or on PC, with ***VeriFire® Tools*** program check, compare, simulate.
- Full QWERTY keypad.
- Charger for up to 90 hours of standby power.
- Non-alarm points for lower priority functions.
- Remote ACK/Signal Silence/System Reset/Drill via monitor modules.
- Automatic time control functions, with holiday exceptions.
- Surface Mount Technology (SMT) electronics.
- Extensive, built-in transient protection.

NFS-640 shown in CAB-B4 with NCA 640-character display.

- Powerful Boolean logic equations.

NCA 640-CHARACTER DISPLAY FEATURES:

- Backlit, 640-character display.
- Supports SCS Series smoke control system in both HVAC or FSCS modes (not UL-Listed for FSCS).
- Printer and CRT EIA-232 ports.
- EIA-485 annunciator and terminal mode ports.
- Alarm, Trouble, Supervisory, and Security relays.

FLASHSCAN® INTELLIGENT FEATURES:

- Poll 318 devices in less than two seconds.
- Activate up to 159 outputs in less than five seconds.
- Multicolor LEDs blink device address during Walk Test.
- Fully digital, high-precision protocol (U.S. Patent 5,539,389).
- Manual sensitivity adjustment — nine levels.
- Pre-alarm intelligent sensing — nine levels.
- Day/Night automatic sensitivity adjustment.
- Sensitivity windows:
  - **Ion –** 0.5 to 2.5%/foot obscuration.
  - **Photo –** 0.5 to 2.35%/foot obscuration.
  - **Laser (VIEW®) –** 0.02 to 2.0%/foot obscuration.
  - **Acclimate Plus™ –** 0.5 to 4.0%/foot obscuration.
  - **HARSH™ –** 0.5 to 2.35%/foot obscuration.
- Drift compensation (U.S. Patent 5,764,142).
- Degraded mode — in the unlikely event that the CPU-640 microprocessor fails, FlashScan® detectors revert to degraded operation and can activate the CPU-640 NAC circuits and alarm relay. Each of the four built-in panel circuits includes a Disable/Enable switch for this feature.

- Multi-detector algorithm involves nearby detectors in alarm decision (U.S. Patent 5,627,515).
- Automatic detector sensitivity testing.
- Maintenance alert (two levels).
- Self-optimizing pre-alarm.

VIEW® (VERY INTELLIGENT EARLY WARNING) SMOKE DETECTION TECHNOLOGY:

- Revolutionary spot laser design.
- Advanced intelligent sensing algorithms differentiate between smoke and non-smoke signals (U.S. Patent 5,831,524).
- Addressable operation pinpoints the fire location.
- No moving parts to fail or filters to change.
- Early warning performance comparable to the best aspiration systems at a fraction of the lifetime cost.

ACCLIMATE PLUS™ LOW-PROFILE INTELLIGENT MULTI-SENSOR:

- Detector automatically adjusts sensitivity levels without operator intervention or programming. Sensitivity increases with heat.
- Microprocessor-based technology; combination photo and thermal technology.
- FlashScan® or classic mode compatible with NFS-640.
- Low-temperature warning signal at 40°F ± 5°F (4.44°C ± 2.77°C).

HARSH™ HOSTILE-AREA SMOKE HEAD:

- Provides early warning of smoke detection in environment where traditional smoke detectors are not practical.
- The detector's filters remove particulates down to 30 microns in size.
- Intake fan draws air into photo chamber, while airborne particles and water mist are removed.
- Requires auxiliary 24 VDC from system or remote power supply.

RELEASING FEATURES:

- Ten independent hazards.
- Sophisticated cross-zone (three options).
- Delay timer and Discharge timers (adjustable).
- Abort (four options).
- Low-pressure CO_2 listed.

VOICE AND TELEPHONE FEATURES:

- Solid state message generation.
- Hard-wired voice control module options.
- Firefighter telephone option.
- 30- to 120-watt high-efficiency amplifiers (AA Series).
- Backup tone generator and amplifier option.
- Multichannel voice transponder (XPIQ).

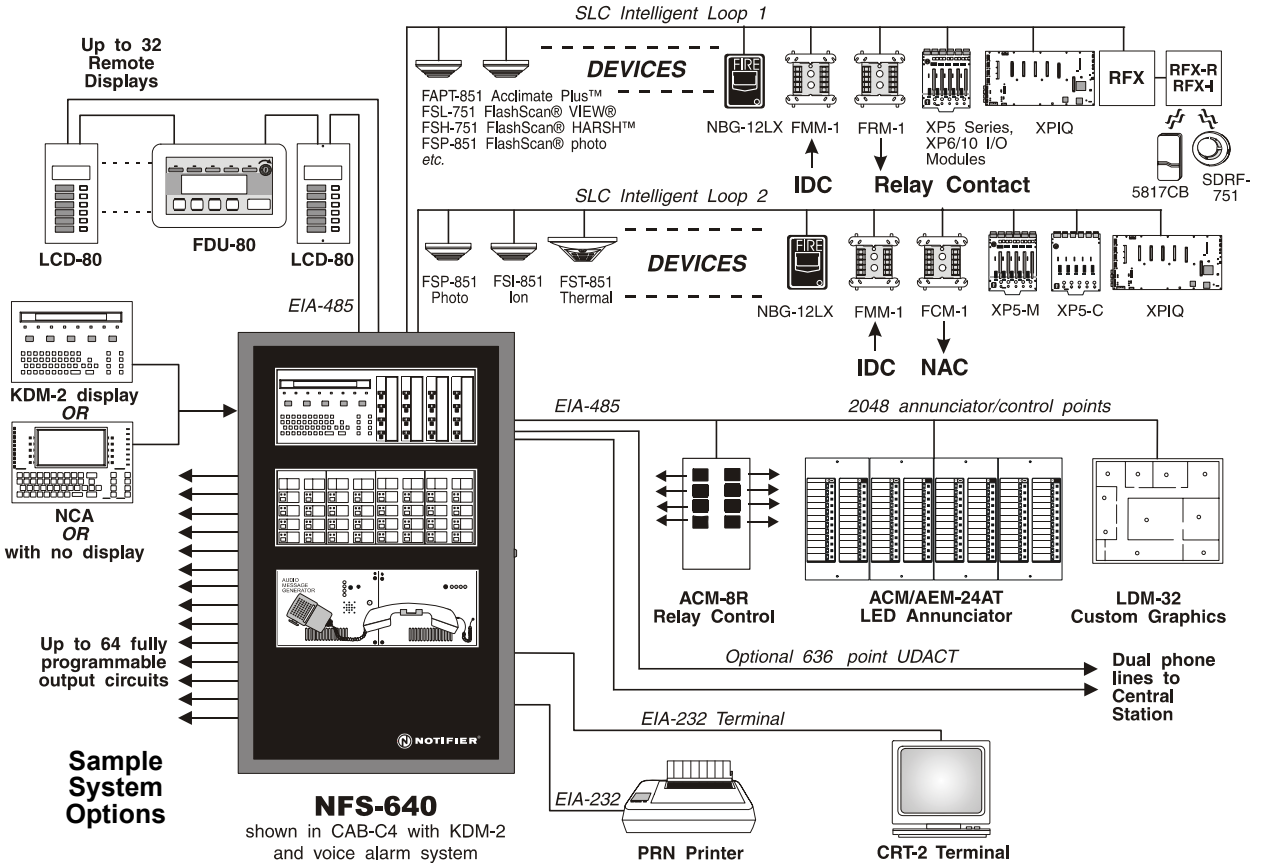
HIGH-EFFICIENCY OFFLINE SWITCHING 3.0 AMP POWER SUPPLY (6.0 A IN ALARM):

- 120 or 220/240 VAC.
- Displays battery current/voltage on panel (with display).

FlashScan® Exclusive World-Leading Detector Protocol

At the heart of the NFS-640 is a set of detection devices and device protocol — FlashScan® (U.S. Patent 5,539,389). FlashScan® is an all-digital protocol that gives superior precision and high noise immunity.

In addition to providing quick identification of an active input device, this protocol can also activate many output devices in a fraction of the time required by competitive protocols. This high



speed also allows the NFS-640 to have the largest device per loop capacity in the industry — 318 points — yet every input and output device is sampled in less than two seconds. The microprocessor-based FlashScan® detectors have bicolor LEDs that can be coded to provide diagnostic information, such as device address during Walk Test.

Intelligent Sensing

Intelligent sensing is a set of software algorithms that provide the NFS-640 with industry-leading smoke detection capability. These complex algorithms require many calculations on each reading of each detector, and are made possible by the very-high-speed microcomputer used by the NFS-640.

Drift Compensation and Smoothing: Drift compensation allows the detector to retain its original ability to detect actual smoke, and resist false alarms, even as dirt accumulates. It reduces maintenance requirements by allowing the system to automatically perform the periodic sensitivity measurements required by NFPA 72. Smoothing filters are also provided by software to remove transient noise signals, such as those caused by electrical interference.

Maintenance Warnings: When the drift compensation performed for a detector reaches a certain level, the performance of the detector may be compromised, and special warnings are given. There are three warning levels: (1) Low Chamber value, usually indicative of a hardware problem in the detector; (2) Maintenance Alert, indicative of dust accumulation that is near but below the allowed limit; (3) Maintenance Urgent, indicative of dust accumulation above the allowed limit.

Sensitivity Adjust: Nine sensitivity levels are provided for alarm detection. These levels can be set manually, or can change automatically between day and night. Nine levels of pre-alarm sensitivity can also be selected, based on predetermined levels of alarm. Pre-alarm operation can be latching or self-restoring, and can be used to activate special control functions.

Self-Optimizing Pre-Alarm: Each detector may be set for "Self-Optimizing" pre-alarm. In this special mode, the detector "learns" its normal environment, measuring the peak analog readings over a long period of time, and setting the pre-alarm level just above these normal peaks.

Cooperating Multi-Detector Sensing: A patented feature of this intelligent sensing is the ability of a smoke sensor to consider readings from nearby sensors in making alarm or pre-alarm decisions. Without statistical sacrifice in the ability to resist false alarms, it allows a sensor to increase its sensitivity to actual smoke by a factor of almost two to one.

Field Programming Options

Autoprogram is a timesaving feature of the NFS-640. It is a special software routine that allows the NFS-640 to "learn" what devices are physically connected and automatically load them in the program with default values for all parameters. Requiring less than one minute to run, this routine allows the user to have almost immediate fire protection in a new installation, even if only a portion of the detectors are installed.

Keypad Program Edit (with KDM-2) The NFS-640, like all NOTIFIER intelligent panels, has the exclusive feature of program creation and editing capability from the front panel keypad, ***while continuing to provide fire protection***. The architecture of the NFS-640 software is such that each point entry carries its own program, including control-by-event links to other points. This allows the program to be entered with independent per-point segments, while the NFS-640 simultaneously monitors other (already installed) points for alarm conditions.

VeriFire® Tools is an offline programming and test utility that can greatly reduce installation programming time, and increase confidence in the site-specific software. It is Windows® based and provides technologically advanced capabilities to aid the installer. The installer may create the entire program for the NFS-640 in the comfort of the office, test it, store a backup file, then bring it to the site and download from a laptop into the panel.

```
ENTER PROG OR STAT PASSWORD, THEN ENTER
<ESCAPE TO ABORT> *****
```

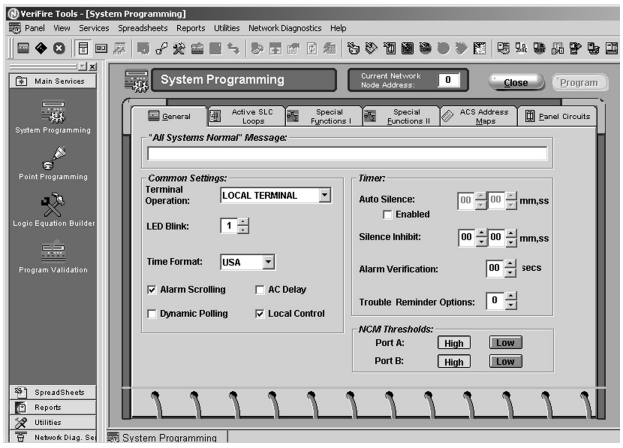
```
0=CLR 1= AUTO 2=POINT 3=PASSWORD 4=MESSAGE
```

Above: Keypad program editing.

Below: Autoprogram function.

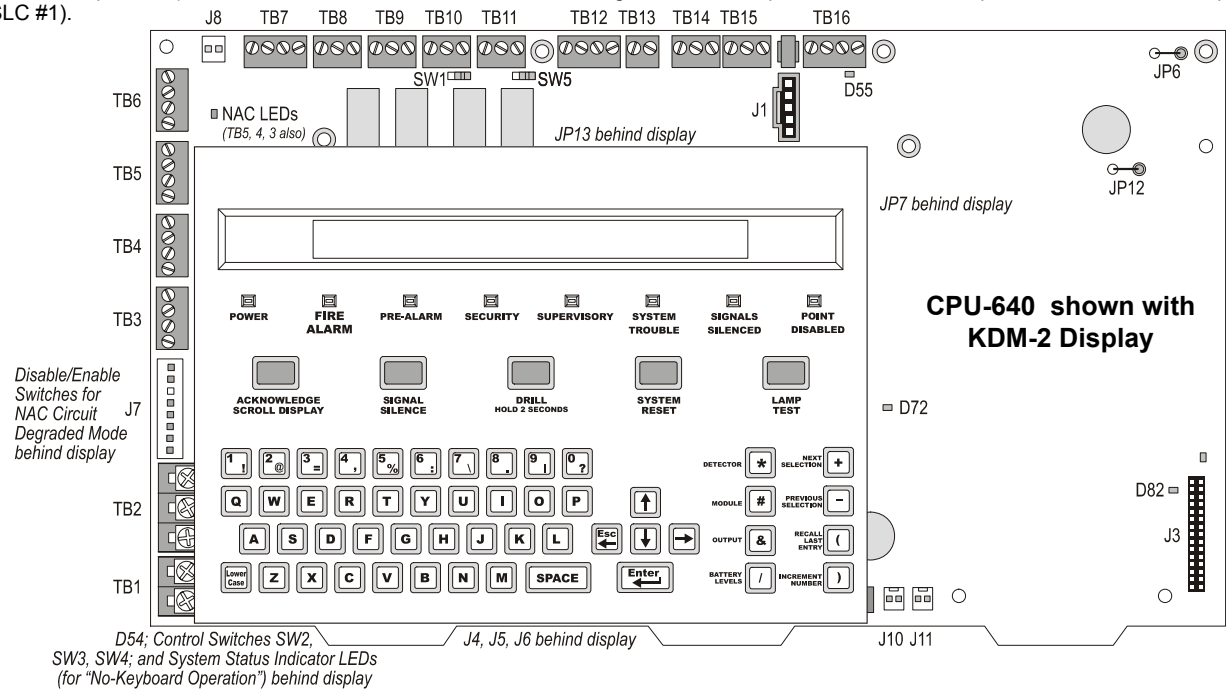
```
AUTOPROGRAM   PLEASE WAIT
```

```
L1:80 DETS, 15 MODS L2:93 DETS, 35 MODS
 PANEL OUTPUTS:24      BELLS:  04
```



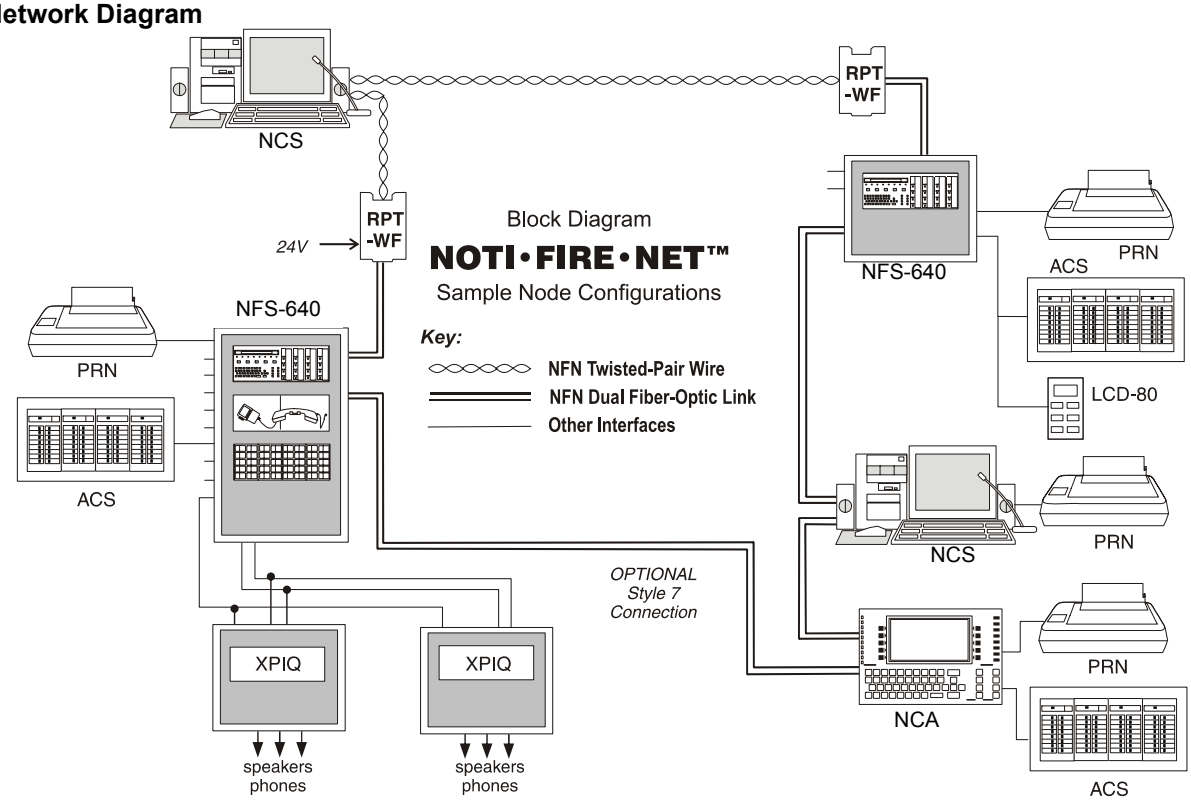
VeriFire ToolsSystem Programming screen

TOP, LEFT to RIGHT: **J8** Zone Code Input; **TB7** DC Power (24 VDC power-limited, both resettable and non-resettable available); **TB8** Alarm Relay; **TB9** Trouble Relay; **TB10** Supervisory Relay; **TB11** Security Relay; **SW1**, **SW5** Relay Switches; **JP13** General Board Earth Fault Jumper; **TB12** EIA-485 Terminal Mode (supervised); **TB13** EIA-485 ACS Mode (supervised); **TB14** EIA-232 Printer; **TB15** EIA-232 PC Terminal; **J1** NUP (network/service connection: power-limited, supervised); **TB16** SLC #1 Connections (detectors, modules; supervised); **D55** Main SLC Ground Fault LED; **JP7** Charger Disable Jumper; **JP12** 200MA Jumper; **JP6** Earth Fault Jumper (SLC #1).



LEFT SIDE, TOP to BOTTOM: **TB6** NAC #1, **TB5** NAC #2, **TB4** NAC #3, **TB3** NAC #4 (all NAC circuits power-limited and supervised, and each NAC TB has an NAC LED to the right of it); **J7** Accessory Power; Disable/Enable Switches for Degraded Mode; **TB2** AC Power Connection; **TB1** Battery Connection (overcurrent protected). ***BOTTOM, LEFT to RIGHT:*** D54 AC On LED; System Status Indicator LEDs for "No-Keyboard Operation"; System Switches **SW2** (Acknowledge), **SW3** (Silence), **SW4** (Reset) for "No-Keyboard Operation"; **J4** KDM-2 Connector; **J5**, **J6** Panel Circuits (ONYX® Panel Output Modules, supervised); **D72** General Board Ground Fault LED; **J10** Security Tamper Switch; **J11** Auxiliary Trouble Input; **D82** AC Power LED; **J3** LEM-320 Connector (SLC Loop #2).

Network Diagram



Placement of Equipment in Chassis and Cabinet

The following guidelines outline the NFS-640's flexible system design.

Rows: The first row of equipment in the cabinet mounts in chassis **CHS-M2**. Mount the second, third, or fourth rows of equipment in chassis **CHS-4MB** (see NFS-640 Installation Manual regarding panel output modules) or **CHS-4L** (for voice components, see Voice Alarm System Manual).

Wiring: When designing the cabinet layout, consider separation of power-limited and non-power-limited wiring as discussed in the NFS-640 Installation Manual.

Positions: A chassis offers four basic side-by-side positions for components; the number of modules that can be mounted in each position depends on the chassis model and the size of the individual module. There are a variety of standoffs and hardware items available for different combinations and configurations of components.

It is critical that all mounting holes of the NFS-640 are secured with a screw or standoff to ensure continuity of Earth Ground.

Layers: The CHS-M2 accepts four layers of equipment, including the control panel. The **CPU-640** fills three positions (left to right) in the first-installed layer (the back of the chassis); its integral power supply occupies (the left) two positions in the next two layers; the optional display occupies (the left) two positions at the front, flush with the door. Panel output modules can be mounted in several layers with standoffs or an L-bracket as required. Some equipment, such as the **NCA**, may be door-mounted directly in front of the control panel. The NCA mounts onto the DP-DISP or ADP-4B. The NCA can be used as a primary display for the NFS-640 by directly connecting their network ports (required in Canadian stand-alone applications).

Expansion: Installing an **LEM-320** Loop Expander Module adds a second SLC loop to the control panel. The LEM-320 is mounted onto the CPU-640, occupying the middle-right, second (back) slot on the chassis. If networking two or more control panels, each unit requires a **NCM-W** (wire) or **NCM-F** (fiber) Network Control Module. The NCM-W/-F can be installed in any panel output module position (see manual); the default position is at the back of the chassis next to the control panel. **Option boards** can be mounted in front of the LEM-320 or NCM modules; for ease of access, complete installation of those devices before mounting another layer.

KDM-2 Controls and Indicators

Program Keypad: QWERTY type (keyboard layout).

8 LED indicators: Power; Fire Alarm; Pre-Alarm; Security; Supervisory; System Trouble; Signals Silenced; Points Disabled.

Membrane Switch Controls: Acknowledge/Scroll Display; Signal Silence; Drill; System Reset; Lamp Test.

LCD Display: 80 characters (2 x 40) with long-life LED backlight.

Configuration Guidelines

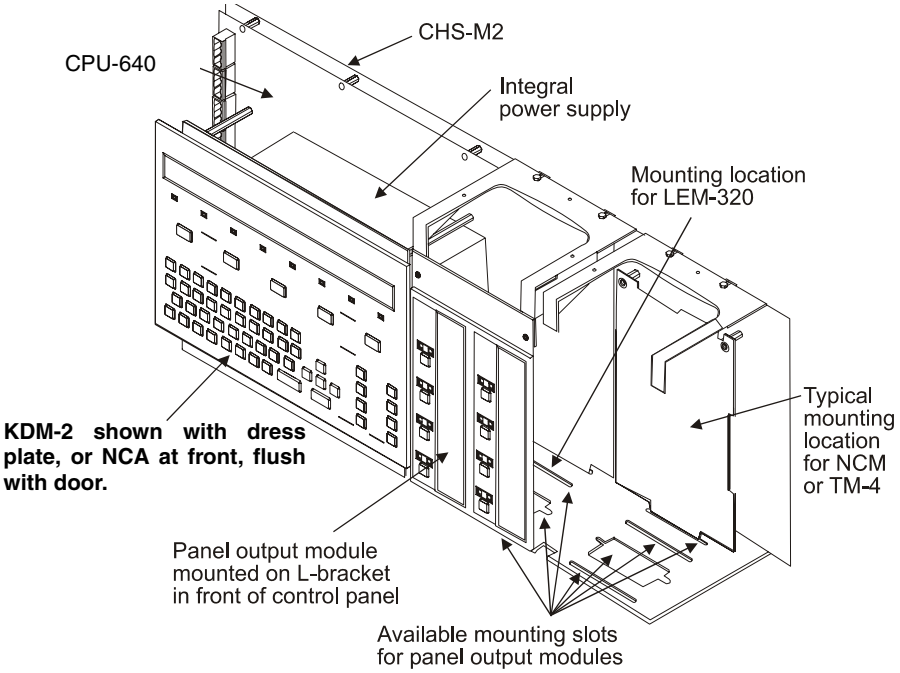
Stand-alone and network systems require a main display. On single-CPU systems (one CPU-640/-640E), display options are the KDM-2 or the NCA. On network systems (two or more CPU-640/-640Es), at least one NCA or NCS annunciation device is required. Other options listed as follows:

KDM-2: 80-character backlit LCD display with QWERTY programming and control keypad. Order two BMP-1 blank modules and DP-DISP mounting plate separately. *Requires top row of a cabinet. Required for each stand-alone 80-character display system. The KDM-2 may mount in network nodes to display "local" node information as long as at least one NCA or NCS network display is on the system to display network information.*

NCA: Network Control Annunciator, 640 characters. On single CPU-640/-640E systems, the NCA is the Primary Display for the panel and connects directly to the CPU-640/-640E. On network systems (two or more CPU-640/-640Es), one network display (either NCA or NCS) is required for every system. On network systems, the NCA connects (and requires) an NCM network communications module. Mounts in a row of FACP node or in two annunciator positions. Mounting options include the DP-DISP, ADP-4B, or in an annunciator box, such as the ABS-2D. In CAB-4 top-row applications, a DP-DISP and two BMP-1 blank modules are required for mounting. *See NCA data sheet DN-6858.*

CPU-640: Central processing unit with integral 3.0 amp (6.0 A in alarm) power supply for an NFS-640 system. Includes CPU; one Signaling Line Circuit expandable to two; installation, programming and operating manuals. *Order one per system or as necessary (up to 103 network nodes) on a network system.*

CPU-640E: Same as CPU-640 but requires 220 VAC, 1.5 amp, (3.0 A in alarm).



CHS-M2: Mounting chassis for CPU-640. One required for each CPU-640/-640E.

DP-DISP: Dress panel for top row in cabinet with CPU-640/-640E installed.

BMP-1: Blank module for unused module positions.

System Modules

The NFS-640 includes the ability to communicate with up to eight conventional modules each with up to eight circuits. Any mix of notification, relay, speaker, or telephone may be used. Choose any combination of up to eight output modules: ICM/ICE, CRM/CRE, DCM-4 or VCM/VCE. Panel modules mount on either: the two far-right positions of the DP-DISP (next to the primary display); or on any of the four positions on the CHS-4N chassis (CHS-4MN kit required).

NOTES: *1) These modules/expanders are NOT to be used for releasing applications. 2) For additional information on these panel output modules and expanders, see data sheet DN-6859.*

CHS-4MB: Expansion Chassis. Mounts up to four modules. Includes CHS-4N, MP-1B (Module Dress Panel), and Expander Ribbon Cable.

ICM-4RK: Notification Appliance Circuit Module, provides four Style Y (Class B) or Style Z (Class A) alarm Notification Appliance Circuits. Maximum signaling current is 3.0 amps per circuit or 6.0 amps per module, subject to power supply limitations (includes auxiliary power harness, ELRs and slide-in labels).

Includes ON/OFF controls and ON/OFF LEDs.

ICE-4: Notification Appliance Circuit Expander, expands ICM-4 to provide a total of eight Style Y or Style Z alarm Notification Appliance Circuits. Circuit ratings are same as ICM-4.

NOTE: *Maximum of one per ICM-4RK. May also be used to add four Notification Appliance Circuits to VCM-4.*

CRM-4RK: Control Relay Module, four Form-C relay contacts, rated at 5.0 A, 120 VAC or 28 VDC (resistive) per circuit. Includes manual ON/OFF controls and LEDs.

CRE-4: Control Relay Expander, expands CRM-4 to provide a total of eight Form-C relay contacts. Note: maximum of one per CRM-4RK. May also be connected to add four relays to ICM-4, TCM-2, TCM-4, or VCM-4.

VCM-4RK: Voice Control Module provides four Style Y (25 and 70 Vrms) and Style Z (25 Vrms only) speaker circuits, eight manual select switches and indicators, slide-in labels, and plug-in terminal blocks. Move jumper to convert to telephone circuits with remote ring signal and local call-in flash. May be expanded to eight circuits with VCE-4, ICE-4, or CRE-4.

VCE-4: Voice Control Expander adds four circuits to VCM-4. Note: VCM-4/ VCE-4 combination must be eight speaker or eight phone circuits.

DCM-4RK: Dual Channel Module pro-vides four Class B (Style Y, 25 & 70 Vrms) or Class A (Style Z, 25 Vrms only) speaker circuits plus four channel A/B select relays. Not expandable.

OTHER OPTION MODULES

ARM-4: Auxiliary Relay Module, four Form-C relays controlled by a relay module (CRM-4 or CRE-4). N.O. contacts rated 20 amps; N.C. contacts rated 10 amps at 125 VAC and 30 VDC.

NOTE: *Maximum of one for each CRM-4 or CRE-4.*

VCC-1B: Voice Control Center. Provides a variety of user-selectable tones on a single channel. Up to two different tones or messages may be selected on a single channel. Also provides optional digital voice message capability and **on-site** programmable voice messages. Includes Audio Message Generator (AMG-1) microphone, cables, dress panels, and instructions.

VTCC-1B: Voice/Telephone Control Center. Provides all that the VCC-1 provides plus two-way Fire Fighters Telephone (FFT-7) capability.

TCC-1B: Telephone Control Center. Provides a stand-alone two-way Fire Fighters telephone (FFT-7S).

Includes cables, dress panel and instructions.

RM-1/RM-1SA: Remote microphone assemblies, mount on ADP-4 (RM-1) dress panel or CAB-RM/-RMR (RM-1SA) stand-alone cabinets. *See DN-6728.*

AMG-E: Audio Message Generator (without microphone). Order in addition to VCC-1 or VTCC-1 if two-channel system is required.

FFT-7/FFT-7S: Fire Fighters Telephone control with master handset.

FTM-1: Firephone Control Module connects a remote firefighter telephone to a centralized telephone console. Reports status to panel. Wiring to jacks and handsets is supervised.

AA-30: Audio Amplifier, 30 watts. Switch-mode power. Includes amplifier and audio input supervision, backup input, and automatic switchover, power supply, cables. *See AA Series data sheet, DN-3224.*

AA-120/AA-100: Audio Amplifier provides up to 120 watts of 25 Vrms audio power for the NFS-640. The amplifier contains an integral chassis for mounting to a CAB-B4, -C4, or -D4 backbox (consumes one row). Switch-mode power. Includes audio input and amplified output supervision, backup input, and automatic switchover to backup tone. Order the AA-100 for 70.7 Vrms systems and 100 watts of power. *See AA Series data sheet, DN-3224.*

VROM-(n): Factory-programmed message for installation in AMG-1. Provides up to 24 seconds of evacuation message on nonvolatile memory chip. Choose one of many standard messages available. Up to two of these messages may be installed in one AMG. Includes VROM, instructions for installation and operation, and written text of message. *See VROM data sheet, DN-3576.*

VRAM-1: Field-programmed memory to be installed in AMG-1. Provides up to 24 seconds of field-programmable evacuation message on nonvolatile memory chip. Message is programmed from microphone or cassette tape. Up to two of these nonvolatile memory chips may be installed in one AMG. Includes VRAM and instructions for installation and operation.

APS-6R: Auxiliary Power Supply (expander). Provides up to 6.0 amperes of regulated power for compatible Notification appliance circuits. Includes battery input and transfer relay, and overcurrent protection. Mounts on one of four positions on a CHS-4L or CHS-4 chassis. *See APS-6R data sheet, DN-5952.*

ACPS-2406: 6.0 amp addressable charger power supply. *See ACPS-2406 data sheet, DN-6834.*

FCPS-24: The FCPS-24 is a remote six-amp (four-amp continuous) repeater/power supply. *See FCPS-24 data sheet, DN-5132.*

FCPS-24S6/-24S8: Remote six-amp and eight-amp power supplies with battery charger. *See FCPS-24S6/-24S8 datasheet, DN-6927.*

UZC-256: Programmable Universal Zone Coder provides positive non-interfering successive zone coding. Microprocessor-controlled, field-programmable from IBM®-compatible PCs (requires optional programming kit). *See UZC-256 data sheet, DN-3404.*

LCD-80/LCD-80TM/FDU-80: 80-character, backlit LCD display. Mounts up to 6,000 ft. (1828.8 m) from panel. Up to 32 per NFS-640. *See LCD-80/-80TM (DN-3198) and FDU-80 (DN-6820) data sheets.*

ACS: Annunciator Control Modules ACM-16AT, AEM-16AT, ACM-32A, and AEM-32A. *See data sheets, DN-0524 and DN-6862..*

AFM: Annunciator Fixed Modules AFM-16A, AFM-16AT, and AFM-32A. *See AFM data sheet, DN-0056.*

LDM: Lamp Driver Modules LDM-32, LDM-E32, and LDM-R32. *See LDM data sheet, DN-0551.*

ACM-8R: Remote Relay Module with eight Form-C contacts. Can be located up to 6,000 ft. (1828.8 m) from panel on four wires. *See ACM-8R data sheet, DN-3558.*

SCS: Smoke control station; eight (expandable to 16) circuits. *See SCS data sheet, DN-4818.*

RPT-485: Repeats EIA-485 over twisted pair or converts to fiber-optic medium. *See RPT data sheet, DN-4737.*

XP5: The XP5-M and XP5-C provide FlashScan® transponder points. *See XP5 data sheet, DN-6625.*

XP: The XP Series Transponder provides conventional monitor and control points (CLIP mode only). *See XP Series data sheet, DN-0759.*

XPIQ: The XPIQ quad intelligent voice transponder for distributed multichannel voice evacuation systems, an integrated audio amplification and distribution subsystem controlled by FACP. Capable of playing up to four simultaneous messages. Accepts up to four 25-watt amplifiers. *See XPIQ data sheet, DN-6823.*

CHS-4: Chassis for mounting up to four APS-6Rs.

CHS-4L: Low-profile four-position Chassis. Mounts two AA-30 amplifiers or one AMG-E and one AA-30.

DP-1B: Blank Dress panel. Provides dead-front panel for unused tiers or to cover AA-30, AA-120, or one AMG-E and one AA-30.

CAB-4 Series: The CAB-4 Series cabinets are fabricated from 16-gauge steel with unique full-front LEXAN®, reverse-silk-screened for durability. The cabinet assembly consists of two basic parts: a Backbox (SBB-_4), and a Locking Door (DR-_4) that may hinge right or left. Cabinets are available in four sizes, "A" through "D", with one to four tiers. A trim ring option is available for semi-flush mounting. *See CAB-4 Series data sheet, DN-6857.*

CAB-M Series: Marine cabinets required for Lloyd's Register or U.S. Coast Guard listed use. *See DN-5063.*

COMPATIBLE DEVICES, EIA-232 PORTS

PRN-5: 80-column printer. *See DN-6769.*

PRN-6: 80-column printer. *See DN-6956.*

VS4095/S2: Printer, 40-column, 24 V. Mounted in external backbox. *Order from Keltron, Inc. See DN-3260.*

CRT-2: Video display terminal. *See DN-3756.*

COMPATIBLE DEVICES, EIA-485 PORTS

ACS Series: Remote serial annunciator/control systems. *See DN-0524.*

FDU-80: Remote LCD display, 80 characters, with LEDs. *See DN-6820.*

LCD-80: Remote LCD display, 80 characters. *See DN-3198.*

LCD-80TM: Remote LCD display, 80 characters, terminal mode. *See DN-3198.*

LDM Series: Remote custom graphic driver modules. S*ee DN-0551.*

ACM-8R: Remote relay module. 8 Form-C relays. *See DN-3558.*

RPT-485 Series: Repeater, isolator and/or fiber-optic modem. *See DN-4737.*

UDACT: Universal Digital Alarm Communicator Transmitter, 636 channel. *See DN-4867.*

UZC-256: Zone Coder. Up to 256 programmable codes. *See DN-3404.*

COMPATIBLE INTELLIGENT DEVICES

BEAMHK: Heating kit for transmitter/receiver unit of FSB-200(S) below. *See DN-6985.*

BEAMHRK: Heating kit for use with the reflector of FSB-200(S) below. *See DN-6985.*

BEAMLRK: Long-range accessory kit, FSB-200(S) below.

BEAMMRK: Multi-mount kit, FSB-200(S) below.

BEAMSMK: Surface-mount kit, FSB-200(S) below.

FSB-200: Intelligent beam smoke detector. *See DN-6985.*

FSB-200S: Intelligent beam smoke detector with integral sensitivity test. *See DN-6895.*

FSI-851: Low-profile FlashScan® ionization detector, will replace FSI-751. *See DN-6934.*

FSI-751: Low-profile FlashScan® ionization detector. *See DN-6714.*

FSP-851: Low-profile FlashScan® photoelectric detector, will replace FSP-751. *See DN-6935.*

FSP-751: Low-profile FlashScan® photoelectric detector. *See DN-6714.*

FSP-851T: Low-profile FlashScan® photoelectric detector with 135°F (57°C) thermal, will replace FSP-751T. *See DN-6935.*

FSP-751T: Low-profile FlashScan® photoelectric detector with 135°F (57°C) thermal. *See DN-6714.*

FST-851: FlashScan® thermal detector 135°F (57°C), will replace FST-751. *See DN-6936.*

FST-751: FlashScan® thermal detector 135°F (57°C). *See DN-6716.*

FST-851R: FlashScan® thermal detector 135°F (57°C) with rate-of-rise, will replace FST-751R. *See DN-6936.*

FST-751R: FlashScan® thermal detector 135°F (57°C) with rate-of-rise. *See DN-6716.*

FST-851H: FlashScan® 190°F (88°C) high-temperature thermal detector. *See DN-6936.*

FSD-751P: FlashScan® photo duct detector with housing. *See DN-6821.*

FSD-751PL: Low-flow FlashScan® photo duct detector with housing, will replace FSD-751P. *See DN-6955.*

FSD-751RP: FlashScan® photo duct detector with relay and housing.

FSD-751RPL: Low-flow FlashScan® photo duct detector with relay and housing, will replace FSD-751RP. *See DN-6955.*

FAPT-851: FlashScan® Acclimate Plus™ low-profile multi-sensor detector, will replace FAPT-751. *See DN-6937.*

FAPT-751: Acclimate Plus™ low-profile multisensor detector. *See DN-6833.*

FSH-751: FlashScan® HARSH™ Hostile Area Smoke Head. *See DN-6875.*

FSL-751: FlashScan® VIEW® laser photo detector, will replace LPX-751. *See DN-6886.*

LPX-751: Low-profile VIEW® laser photo detector. *See DN-5306.*

B224RB: Low-profile relay base.

B224BI: Isolator base for low-profile detectors.

B710LP: Low-profile base. Standard U.S. style.

B501: European-style, 4" (10.16 cm) base.

B501BH: Sounder base, includes B501 base above. Constant tone.

B501BHT: Sounder base, includes B501 base above. Temporal three tone.

FMM-1: FlashScan® monitor module. *See DN-6720.*

FDM-1: FlashScan® dual monitor module. *See DN-6720.*

FZM-1: FlashScan® two-wire detector monitor module. *See DN-6720.*

FMM-101: FlashScan® miniature monitor module. *See DN-6720.*

FCM-1: FlashScan® NAC control module. *See DN-6724.*

FRM-1: FlashScan® relay module. *See DN-6724.*

FSM-101: FlashScan® pull station monitor module.

NBG-12LX: Manual fire alarm station, addressable. *See DN-6726.*

ISO-X: Isolator module. *See DN-2243.*

XP Series: Transponder. *See DN-0759.*

XP5-M: FlashScan® transponder, five monitor points. *See DN-6625.*

XP5-C: FlashScan® transponder, five control points or Form-C relays. *See DN-6625.*

XP6-C: FlashScan® six-circuit supervised control module. *See DN-6924.*

XP6-MA: FlashScan® six-zone interface module; connects intelligent alarm system to two-wire conventional detection zone. *See DN-6925.*

XP6-R: FlashScan® six-relay (Form-C) control module. *See DN-6926.*

XP10-M: FlashScan® ten-input monitor module. *See DN-6923.*

XPIQ: Intelligent quad transponder. *See DN-6823.*

OTHER OPTIONS

DPI-232: Direct Panel Interface, specialized modem for extending serial data links to remotely located FACPs and/or peripherals. *See DN-6870.*

LEM-320: Loop Expander Module. Expands each 640 to two Signaling Line Circuits. *See DN-6881.*

TM-4: Transmitter Module. Includes three reverse-polarity circuits and one municipal box circuit. Mounts in panel module position (single-address-style) or in CHS-M2 position. *See DN-6860.*

NCM-W: Network Communications Module, Wire. Order one NCM per network node (CPU-640 or NCA). *See DN-6861.*

NCM-F: Network Communications Module, Fiber. Order one NCM per network node (CPU-640 or NCA). *See DN-6861.*

NCS5-W-ONYX: Network Control Station, Wire. UL-Listed graphics PC with mouse, 17" color flat-screen LCD monitor. Order as necessary for network systems. Each NCS consumes one of 103 network addresses. *See DN-6868 (previous NCS-W), ONYX® DN-6869.*

NCS5-F-ONYX: Network Control Station, Fiber. UL-Listed graphics PC with mouse, 17" color flat-screen LCD monitor. Order as necessary for network systems. Each NCS consumes one of 103 network addresses. *See DN-6868 (previous NCS-F), ONYX® DN-6869.*

VeriFire-TCD: VeriFire® Tools CD-ROM. Contains programming software for the NFS-640, NCA, and XPIQ. Includes local panel connection cable. Programming PC requires a serial port connection. *See DN-6871.*

ACM-24AT: ONYX® Series ACS annunciator – up to 96 points of annunciation with Alarm or Active LED, Trouble LED, and switch per circuit. Active/Alarm LEDs can be programmed (by powered-up switch selection) by point to be red, green, or yellow; the Trouble LED is always yellow. *See DN-6862.*

AEM-24AT: Same LED and switch capabilities as ACM-24AT, expands the ACM-24AT to 48, 72, or 96 points. *See DN-6862.*

ACM-48A: ONYX® Series ACS annunciator – up to 96 points of annunciation with Alarm or Active LED per circuit. Active/Alarm LEDs can be programmed (by powered-up switch selection) in groups of 24 to be red, green, or yellow. Expandable to 96 points with one AEM-48A. *See DN-6862.*

AEM-48A: Same LED capabilities as ACM-48A, expands the ACM-48A to 96 points. *See DN-6862.*

BAT Series: Batteries. NFS-640 utilizes two 12 volt, 12 to 55 AH batteries. *See DN-6933.*

PS Series: Batteries. NFS-640 utilizes two 12 volt, 12 to 55 AH batteries. *See DN-1109.*

NFS-LBB: Battery Box (required for batteries over 25 AH).

BR: Same as above but red.

SYSTEM SPECIFICATIONS

System Capacity

- Intelligent Signaling Line Circuits .....1 expandable to 2
- Intelligent detectors .....159 per loop
- Addressable monitor/control modules .....159 per loop
- Programmable internal hardware and output circuits (4 standard) 68
- Programmable software zones 99
- Special programming zones 14
- LCD annunciators per CPU-640/-640E and NCA *(observe power)*.....32
- ACS annunciators per CPU-640/-640E .....32 address x 64 points
- ACS annunciators per NCA .....32 address x 64 or 96 points

NOTE: *The* NCA *supports up to 96 annunciator address points per ACM-24/48.*

Specifications

- Primary input power, **CPU-640 board:** 120 VAC, 50/60 Hz, 3.0 amps. **CPU-640E board:** 220/240 VAC, 50/60 Hz, 1.5 Amps.
- **Total** output 24 V power: 6.0 A in alarm.

NOTE: *The power supply has a total of 6.0 Amps of available power. This is shared by all internal modules.*

- Standard notification circuits (4): 2.5 A each.
- Four-wire detector power: 1.25 A.
- Non-resettable regulated power outputs: 1.25 A each.
- Battery charger range: 12 AH – 55 AH. Use separate cabinet for batteries over 25 AH.
- Optional high-capacity (25 – 120 AH) battery charger: CHG-120 (see CHG-120 data sheet, DN-6040).
- Float rate: 27.6 V.

Temperature and Humidity Ranges

This system meets NFPA requirements for operation at 0 – 49ºC/32 – 120ºF and at a relative humidity 93% ± 2% RH (noncondensing) at 32ºC ± 2ºC (90ºF ± 3ºF). However, the useful life of the system's standby batteries and the electronic components may be adversely affected by extreme temperature ranges and humidity. Therefore, it is recommended that this system and its peripherals be installed in an environment with a normal room temperature of 15 – 27ºC/60 – 80ºF.

Agency Listings and Approvals

The listings and approvals below apply to the basic NFS-640 control panel. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL:** S635
- **ULC:** CS118
- **FM APPROVED** *Exceptions – CPU-640E, PRN-5, Proprietary service*
- **CSFM:** 7165-0028:214, 7170-0028:216
- **MEA:** 317-01-E
- **City of Chicago**
- **City of Denver**
- **Lloyd's Register:** 02/60007
- **U.S. Coast Guard:** 161.002/42/1
- **China Classification Society (CCS):** #NL05T00001 *(NFS-640E)*
- **CCCF:** Certif. # 2003081801600815

Standards

The NFS-640 complies with the following UL Standards and NFPA 72 Fire Alarm Systems requirements :

- **UL 864** (Fire)
- **UL 1076** (Burglary)
- **LOCAL** (Automatic, Manual, Waterflow and Sprinkler Supervisory).
- **AUXILIARY** (Automatic, Manual and Waterflow) (requires 4XTMF).
- **REMOTE STATION** (Automatic, Manual and Waterflow) (requires 4XTMF).
- **PROPRIETARY** (Automatic, Manual and Waterflow). *Not applicable for FM.*
- **EMERGENCY VOICE/ALARM**.

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For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

FAPT-851(A)

Acclimate® Plus™ Multi-Sensor
Low-Profile Intelligent Detector

NOTIFIER® by Honeywell

Intelligent/Addressable Devices

General

The Notifier FAPT-851(A) Acclimate® Plus™ detector is an intelligent, addressable, multi-sensing, low-profile detector designed for use with Notifier Notifier Onyx and CLIP series Fire Alarm Control Panels (FACPs).

The Acclimate Plus detector uses a combination of photoelectric and thermal sensing technologies to increase immunity to false alarms. Unlike traditional intelligent detectors, the Acclimate Plus detector has a microprocessor in the detector head that processes alarm data. As a result, the Acclimate Plus detector adjusts its sensitivity automatically, without operator intervention or control panel programming.

Areas where the Acclimate Plus detector is especially useful include office complexes, schools, college campuses, manufacturing and industrial facilities, and anywhere else the use of a particular area may change. The Acclimate Plus detector automatically adjusts its sensitivity to the environment.

FlashScan® (U.S. Patent 5,539,389) is a communication protocol developed to greatly enhance the speed of communication between analog intelligent devices and compatible systems. Intelligent devices communicate in a grouped fashion. If one of the devices within the group has new information, the panel's CPU stops the group poll and concentrates on single points. The net effect is response speed greater than five times that of earlier designs.

Features

- Automatically adjusts sensitivity levels without operator intervention or programming. Sensitivity increases with heat.
- Microprocessor-based, combination photo and thermal technology.
- Compatible with all Notifier Onyx and CLIP series Fire Alarm Control Panels (FACPs).
- Addressable-analog communication.
- Sleek, low-profile design.
- Two-wire SLC connection.
- Rotary, decimal addressing (1-99 on CLIP systems, 1-159 on FlashScan systems).
- Addresses can be viewed and changed without electronic programmers.
- Dual bi-color LED design provides 360° viewing angle.
- LEDs lock red when in alarm. In FlashScan, LEDs flash green in standby for normal condition.
- Built-in tamper-resistant feature.
- Constructed of off-white fire-resistant plastic, designed to commercial standards, and offers an attractive appearance.
- SEMS screws for wiring of the separate base.
- Several base options, including relay, isolator, and sounder.
- Built-in functional test switch activated by external magnet.
- Listed to UL 268.
- Capable of heat-only alarm mode, enabled by a special command from the panel. Smoke alarms are ignored.
- Low-temperature signal at 45°F +/– 10°F (7.22°C +/– 5.54°C).

FAPT-851 with B210.png

FAPT-851(A) in B210LP(A) Base

Specifications

Sensitivity: *auto-adjusting levels*: 1 to 2%/ft. and 2 to 4%/ft. with classic CLIP systems; 1 to 2, 2 to 3, and 3 to 4%/ft. with systems; *fixed-sensitivity levels:* 1, 2, and 4%/ft. with classic CLIP systems; 0.5, 1, 2, 3, and 4%/ft. with FlashScan systems.

Size: 2.0" (5.3 cm) high; base determines diameter.

- **B210LP(A):** 6.1" (15.5 cm) diameter.
- **B501(A):** 4.1" (10.4 cm) diameter.
- **B200S(A):** 6.875" (17.46 cm) diameter.
- **B200SR(A):** 6.875" (17.46 cm) diameter.
- **B224RB(A):** 6.2" (15.748 cm) diameter.

Shipping weight: 5.2 oz. (147 g).

Operating temperature: 0°C to 38°C (32°F to 100°F).

UL-Listed velocity range: 0 – 4000 ft./min. (1219.2 m/min.), suitable for installation in ducts.

Relative humidity: 10% – 93% noncondensing.

Thermal sensing rating: fixed-temperature setpoint 135°F (57°C).

ELECTRICAL SPECIFICATIONS

Voltage range: 15 – 32 volts DC peak.

Standby current (max. avg.): 300 µA.

Loop resistance: 50 ohms maximum; varies according to control panel used. Refer to panel installation manuals.

LED current (max.): 6.5 mA @ 24 VDC ("ON").

Installation

The FAPT-851(A) plug-in detector uses a separate base to simplify installation, service, and maintenance. A special tool allows maintenance personnel to plug-in and remove detectors without using a ladder. Suitable mounting base boxes include:

- 4.0" (10.16 cm) square box.
- 3.5" (8.89 cm) or 4.0" (10.16 cm) octagonal box.
- Single-gang box (except relay or isolator base).

NOTE: *The FAPT-851(A) detector has the unique ability to adjust sensitivity according to the environment, based on heat and smoke levels. Avoid installing these detectors in locations that are susceptible to rapid and high temperature changes. An example of an incorrect application would be near or in line with the output of a self-contained heater.*

Agency Listings and Approvals

These listings and approvals apply to the modules specified in this. In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. *Consult factory for latest listing status.*

- **UL Listed:** S1115.
- **ULC Listed:** S1115.
- **MEA Listed:** 225-02-E.
- **FM Approved.**
- **CSFM:** 7272-0028:0206.
- **U.S. Coast Guard:** 161.002/42/1 (NFS-640); 161.002/50/0 (NFS2-640/NFS-320/NFS-320C, excluding B210LP(A)).
- **Lloyd's Register:** 11/600013 (NFS2-640, NFS-320/NFS-320C, excluding B210LP(A)).
- **Maryland State Fire Marshal:** Permit # 2122.

Ordering Information

NOTE: *"A" suffix indicates ULC Listed model.*

FAPT-851: Low-profile intelligent multi-sensor detector.

FAPT-851A: Same as FAPT-851 but with ULC Listing.

INTELLIGENT BASES

NOTE: *"A" suffix indicates ULC Listed model.*

NOTE: *For details about intelligent bases and their mounting, see DN-60054.*

B210LP(A): Plug-in detector base; standard U.S. flanged low-profile mounting base.

B210LPBP: Bulk pack of B210LP; package contains 10.

B501(A): Flangeless mounting base.

B501BP: Bulk pack of B501; package contains 10.

B200S(A): Intelligent, programmable sounder base capable of producing sound output in high or low volume with ANSI Temporal 3, ANSI Temporal 4, continuous tone, marching tone, and custom tone.

B200SR(A): Intelligent sounder base capable of producing sound output with ANSI Temporal 3 or continuous tone. Replaces B501BH series bases in retrofit applications.

B224RB(A): Relay base Screw terminals: up to 14 AWG (2.0 mm^2). Relay type Form-C. Rating: 2.0 A @ 30 VDC resistive; 0.3 A @ 110 VDC inductive; 1.0 A @ 30 VDC inductive.

B224BI(A): Isolator base. Maximum: 25 devices between isolator bases.

ACCESSORIES

F110: Retrofit flange to convert B210LP to match the B710LP profile, or to convert older high-profile bases to low-profile.

F110BP: Bulk pack of F110; package contains 15.

F210: Replacement flange for B210LP(A) base.

RA100Z(A): Remote LED annunciator. 3 – 32 VDC. Fits U.S. single-gang electrical box. Supported by B210LP(A) and B501(A) bases only.

SMB600: Surface mounting kit for use with B210LP(A).

M02-04-00: Test magnet.

M02-09-00: Test magnet with telescoping handle.

XR2B: Detector removal tool. Allows installation and/or removal of FlashScan® Series detector heads from base in high ceiling installations.

T55-127-010: Detector removal tool without pole.

XP-4: Extension pole for XR2B. Comes in three 5-foot (1.524 m) sections.

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FSH-751

HARSH™ Hostile-Area Smoke Head Addressable Detector with FlashScan©

NOTIFIER® by Honeywell

Intelligent/Addressable Devices

General

Notifier's HARSH™ (Hostile-Area Smoke Head) FSH-751 smoke detector provides early warning smoke detection in hostile environments where traditional smoke detectors are not practical. Using a small air intake fan and a high-performance replaceable filter, air and smoke are drawn into a photoelectric sensing chamber, while unwanted airborne particulate and water mist are removed. This feature allows the FSH-751 to operate in difficult applications, such as textile or paper mills, which due to environmental conditions tend to cause nuisance alarms with standard smoke detectors.

FlashScan® (U.S. Patent 5,539,389) is a communication protocol developed by Notifier Engineering that greatly enhances the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices within the group has new information, the panel's CPU stops the group poll and concentrates on single points. The net effect is response speed greater than five times that of earlier designs.

FSH-751

Features

- Analog intelligent communications.
- High-performance filter removes particulates down to 32 microns (32-micron inner filter and replaceable outer filter).
- Air delivery system is separately powered and fully supervised.
- Filter is easily field replaceable.
- Tolerant of external air velocity.
- Resistant to water vapor in applications where occasional non-direct water spray is performed.
- Optional remote LED annunciator.
- Rotary DECADE address switches. Set 01 – 99 on legacy systems and 01 – 159 on FlashScan® systems (NFS-640, or NFS-3030).
- Dual bi-color (red/green) LEDs flash green when Normal and are steady red in Alarm (systems with FlashScan® only).
- Compatible with the NFS-3030, AM2020, AFP1010, NFS-640, AFP-400, AFP-300, AFP-200, and AFP-100 (all software releases).
- Requires auxiliary 24 VDC from system or remote power supply.

Specifications

Size: 2.875" (7.303 cm) high, 3.375" (8.573 cm) high in base; diameter 4.0" (10.16 cm), 6.125" (15.558 cm) diameter in base.

Weight: 7.3 oz. (207 g).

Current draw, SLC: Detector; 300 µA @ 24 VDC (one communication every 5 seconds with LED enabled).

Current draw, auxiliary 24 VDC: (15 to 30 VDC filtered; ripple voltage may not drop below 15 volts): 123 mA maximum, 27 mA average. For battery calculation purposes, average standby current is 27 mA.

Operating voltage range: 15 – 32 volts DC peak.

Operating temperature range: 0°C to 49°C (32°F to 120°F).

Relative humidity: 10% – 93%, non-condensing.

Air velocity: 4,000 ft/1219.2 meters per minute maximum.

Maximum altitude: 4,000 feet (1219.2 meters).

Detector spacing: Space detectors in compliance with NFPA 72. In low-air-flow applications with smooth ceilings, space detectors 30 feet (9.114 m) apart. For specific information regarding sensor spacing, placement, and special applications, refer to NFPA 72 or the Guide to Proper Use of System Smoke Detectors, available from systemsensor.com.

Agency Listings and Approvals

Listing information not available. Consult panel manuals for lists of compatible UL-Listed devices. In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

HARSH Operation Overview

Normal Operation

A miniature fan is pulsed on and off under microprocessor control to conserve power, yet provide good smoke response. The system uses two filters (one replaceable) that remove particulates while allowing smoke to pass.

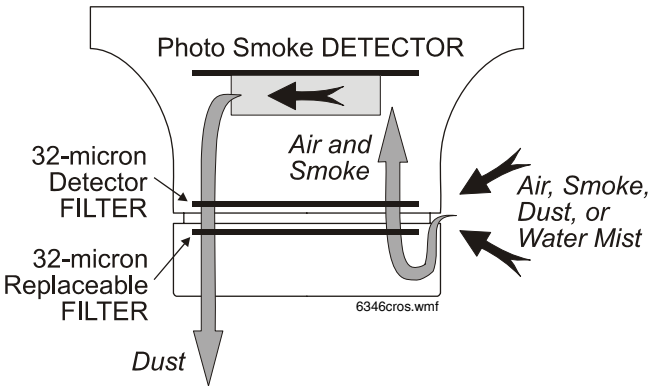
Filter Supervision

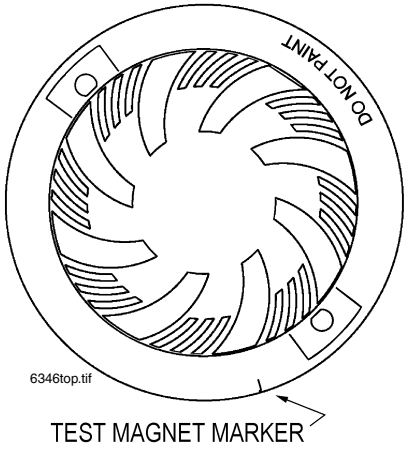
Periodically, the filter system is tested for blockage using a special thermal airflow sensor. In reasonably clean environments, the filter is expected to last at least as long as the smoke-entry test period required by NFPA 72. In very dirty environments, the filter may need replacement more frequently.

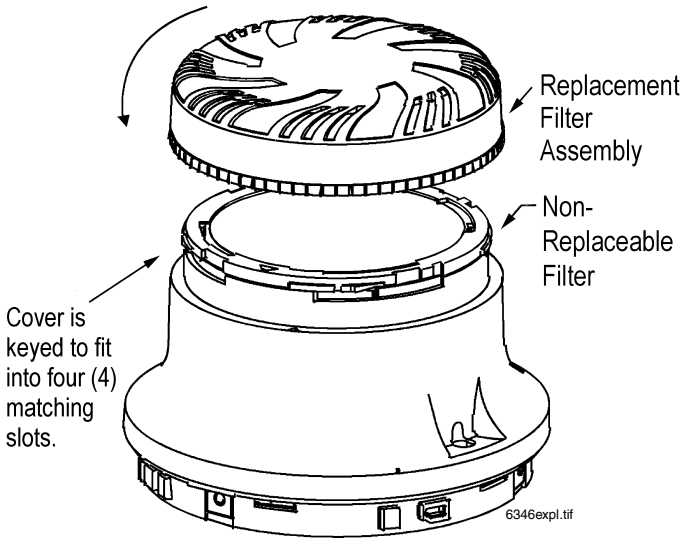
Filter Trouble Reporting

If HARSH determines that filter blockage is imminent, a warning trouble is indicated to the panel, followed by a return to normal. 72 hours after this warning, the detector will disconnect, giving a continuous trouble signal.

OPERATION OVERVIEW DIAGRAM:

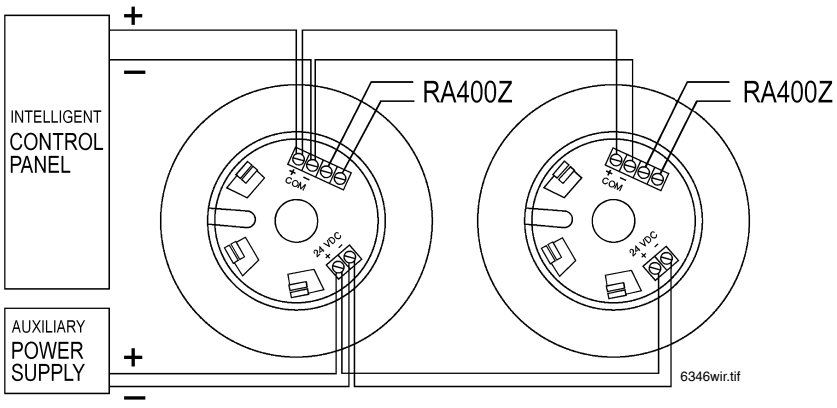






The HARSH detector contains both a permanent and a replaceable filter, a supervised fan, and a photoelectric detector; to fit into a flanged adapter base.

Wiring Diagram



Product Line Information

FSH-751: Hostile-environment smoke detector head.

FSH-751A: Canadian model.

B710HD: Flanged adapter base, 6.125" (15.558 cm) diameter.

RF-FTX: Replacement outer filter cover assembly, box of 6.

RA400Z: Remote LED annunciator, 3 – 32 VDC, fits U.S. single-gang electrical box.

M02-04-01: Test magnet.

M02-09-00: Test magnet with telescope stick.

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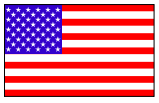

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March 24, 2005 DN-6821 • H-215

FSD-751P and FSD-751RP

Intelligent Photoelectric Duct Smoke Detectors with FlashScan®

Section: Intelligent Addressable Devices

GENERAL

An HVAC system supplies conditioned air to virtually every area of a building. Smoke introduced into this air duct system is thus distributed to the entire building. Smoke detectors for use in air duct systems sense the presence of smoke in the duct.

The FSD-751P air duct smoke detector is a photoelectric detector, combining this detection technology with an efficient housing design that samples air passing through the duct, allowing detection of a developing hazardous condition. When sufficient smoke is sensed, an alarm signal is initiated at the fire control panel monitoring the detector, and appropriate action can be taken to shut off fans and blowers and change over air handling systems, etc. This can isolate toxic smoke and fire gases or prevent their distribution throughout the areas served by the duct system.

Two LEDs on each detector can be programmed by the system control panel to provide a local alarm indication. A remote alarm output is provided for use with auxiliary devices. The FSD-751P has remote test capability with the RTS451/RTS451KEY Remote Test Station.

Traditional panels support addresses of 0 – 99. The FlashScan® protocol supports addresses of 0 – 159. Patented **FlashScan®** is a new communication protocol developed by NOTIFIER Engineering that greatly enhances the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices within the group has new information, the panel stops the group poll and concentrates on single points. The net effect is response speed ***greater than five times*** that of earlier designs.

APPLICATIONS

Duct smoke detectors have specific limitations.

Duct smoke detectors are:

- ***NOT*** a substitute for open area smoke detectors.
- ***NOT*** a substitute for early warning detection.
- ***NOT*** a replacement for a building's regular fire detection system.

Call NOTIFIER for a copy of System Sensor's application guide, *Proper Use of Smoke Detectors in Duct Applications*, (A05-1004-00).

INSTALLATION

Wiring: For signal wiring (the wiring between detectors or from detectors to auxiliary devices), it is recommended that single conductor wire be no smaller than 18 AWG (0.75 mm²). The duct smoke detector terminals accommodate wire sizes up to 12 AWG (3.25 mm²). Flexible conduit is recommended for the last foot (30.48 cm) of conduit; solid conduit connections may be used if desired.

Smoke detectors and alarm system control panels have specifications for Signaling Line Circuit (SLC) wiring. Consult the control panel specifications for wiring requirements before wiring the detector loop. The FSD-751P/FSD-751RP detector is designed for ease of wiring; the housing provides a terminal strip with clamping plates.

LED Features: If programmed with the system control panel, two LEDs on each duct smoke detector light to provide local visible indication. Remote LED annunciator capability is available as an option. Each duct smoke detector can only be wired to one remote accessory.

NOTIFIER panels offer different feature sets across different panel models. As a result, certain features of the FSD-751P/FSD-751RP may be available on some control panels, but not on others. Possible features, if supported by the control panel are:

- Panel controls the LED operation on sensor. Operational modes are: RED blink, RED continuous, GREEN blink, GREEN continuous, and OFF.

FlashScan® is a registered trademark of NOTIFIER.

UL LISTED S1115

ULC CS308 *(FSD-751PA, FSD-751RPA)*

MEA 143-00-E *(FSD-751P)* 389-00-E *(FSD-751RP)*

FM APPROVED

U.S. Coast Guard
161.002/42/1 *(NFS-640)*
161.002/27/3 *(AFP1010/AM2020, FSD-751P)*
161.002/23/3 *(AFP-200)*

California State Fire Marshal
3240-0028:205

MARYLAND State Fire Marshal
Permit #2036 *(FSD-751P)*
Permit #2060 *(FSD-751RP)*

SPECIFICATIONS

FSD-751P

Operating voltage range: 15 to 32 VDC.

Standby current: 300 µA @ 24 VDC (one communication every 5 seconds with LED blink enabled).

Operating temperature range: 32° to 131°F (0° to 55°C).

Humidity range: 10% to 93% (non-condensing).

Duct air velocity: 500 to 4,000 feet/min. (152.4 to 1219.2 meters/min.).

Dimensions: 14.375" (365.125 mm) wide x 5.500" (13.970 mm) high x 2.750" (69.850 mm) deep.

Options: RTS-451, RTS-451KEY, RA400Z. Separate auxiliary power not required.

Listed to UL 268A.

FSD-751RP

Operating voltage range: 15 to 32 VDC *(comm. line voltage)* and 24 VAC/VDC or 120/240 VAC auxiliary power* *(separate source)*. ***NOTE:** The FSD-751RP **requires** a separate auxiliary source.*

Standby current: 300 µA @ 24 VDC (one communication every 5 seconds with LED blink enabled).

Auxiliary power current draw (@ 24 VDC): 26 mA *(standby)*, 87 mA *(alarm)*.

Options: RTS-451, RTS-451KEY, RA400Z, APA451.

NOTIFIER® is a Honeywell company.
This document is not intended to be used for installation purposes. We try to keep our product information up-to-date and accurate. We cannot cover all specific applications or anticipate all requirements. All specifications are subject to change without notice. For more information, contact **NOTIFIER.**Phone: (203) 484-7161 FAX: (203) 484-7118

NOTIFIER® 12 Clintonville Road, Northford, Connecticut 06472

ISO 9001 CERTIFIED ENGINEERING & MANUFACTURING QUALITY SYSTEMS

Operating temperature range: 32° to 131°F (0° to 55°C).

Humidity range: 10% to 93% (non-condensing).

Duct air velocity: 500 to 4,000 feet/min. (152.4 to 1219.2 meters/min.).

Dimensions: 14.375" (365.125 mm) wide x 5.500" (13.970 mm) high x 2.750" (69.850 mm) deep.

Relay contact ratings: 2 Form-C, DPDT, 10 A @ 250 VAC, 10 A @ 30 VDC (resistive). *Minimum switching current* of 100 mA @ 5 VDC.

Listed to UL 268A.

Programming specifications/requirements for intelligent system control panels:

The number of devices that can have their LEDs programmed to illuminate is limited by the features of the panel and the individual devices. The actual number of devices is determined by the control panel and its ability to supply LED current. Refer to the control panel installation manual for details.

INLET TUBE SELECTION

6821inlt.tbl

Outside Duct Width	Inlet Tube*
Up to 2 feet (0.6096 m)	ST-1.5
2 to 4 feet (0.6096 to 1.2192 m)	ST-3
4 to 8 feet (1.2192 to 2.4384 m)	ST-5
8 to 12 feet (2.4384 to 3.6576 m)	ST-10

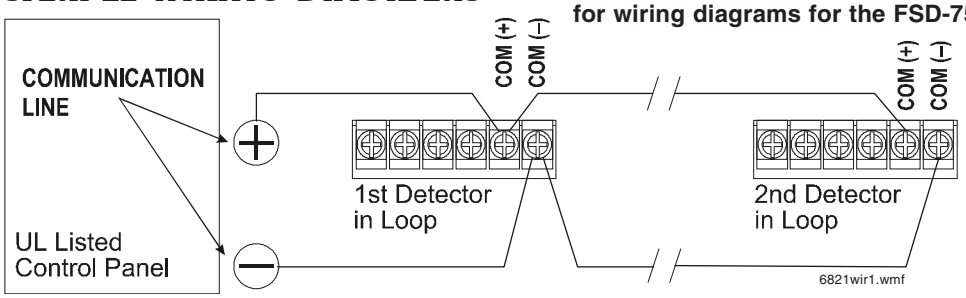
***NOTE:** Inlet tube is required and must be purchased separately. Order one inlet tube for each duct smoke detector ordered.*

PRODUCT LINE INFORMATION

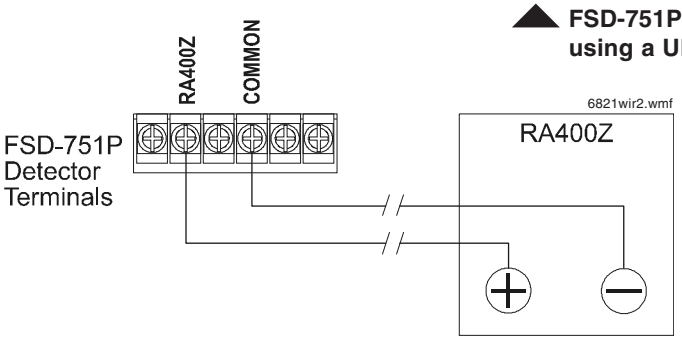
FSD-751P	Duct detector housing with FlashScan® photoelectric smoke detector.
FSD-751RP	Duct detector housing with FlashScan® photoelectric smoke detector, DPDT relay.
ST-1.5	Metal sampling tube, duct widths 1' to 2' (*see table at left for metric lengths).*
ST-3	Metal sampling tube, duct widths 2' to 4'.
ST-5	Metal sampling tube, duct widths 4' to 8'.
ST-10	Metal sampling tube, duct widths 8' to 12'.
RA400Z	Remote annunciator alarm LED.
RTS451	Remote test station. Mounts in single-gang box. Includes red alarm LED and magnet test switch.
RTS451KEY	Key-activated remote test station.
F36-09-00	Replacement filters.
M02-04-00	Replacement test magnet.
S08-39-01	Replacement photo insect screen.
P48-55-00	Replacement end cap for plastic sampling tube.
P48-21-00	Replacement end cap for metal sampling tube.
A5053FS	Replacement photoelectric sensor board.
A5067	Replacement power board (without relay).
A5060	Replacement power board (with relay).

SAMPLE WIRING DIAGRAMS

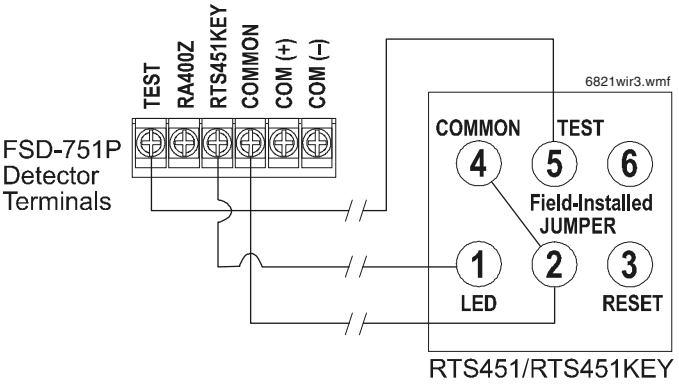
See product *Installation Intructions* for wiring diagrams for the FSD-751RP.



FSD-751P Duct Smoke Detector using a UL Listed control panel



FSD-751P Duct Smoke Detector with optional RA400Z



FSD-751P Duct Smoke Detector with RTS451/ RTS451KEY

NOTE: ***For RTS451,*** Terminal 3 is not used. RTS451 does not have a Terminal 6.

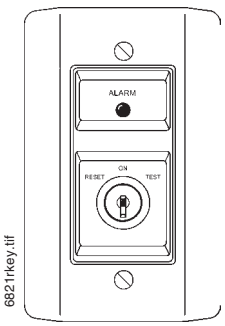
For RTS451KEY, Terminals 3 and 6 are not used.

3242ra4z.jpg

The RA400Z

3242rts4.jpg

The RTS451



6821rkey.tif

The RTS451KEY

FST-851(A) Series

Intelligent Thermal (Heat) Detectors with FlashScan®

NOTIFIER® by Honeywell

Intelligent / Addressable Devices

General

Notifier FST-851(A) Series intelligent plug-in thermal detectors with integral communication has features that surpass conventional detectors. Point ID capability allows each detector's address to be set with rotary, decimal address switches, providing exact detector locations. FST-851(A) Series thermal detectors use an innovative thermistor sensing circuit to produce 135°F/57°C fixed-temperature (FST-851/A) and rate-of-rise thermal detection (FST-851R/A) in a low-profile package. FST-851H(A) provides fixed high-temperature detection at 190°F/88°C. These thermal detectors provide effective, intelligent property protection in a variety of applications. FST-851(A) Series detectors are compatible with Notifier Onyx and CLIP series Fire Alarm Control Panels (FACPs).

FlashScan® (U.S. Patent 5,539,389) is a communication protocol developed by Notifier Engineering that greatly enhances the speed of communication between analog intelligent devices and certain NOTIFIER systems. Intelligent devices communicate in a grouped fashion. If one of the devices within the group has new information, the panel's CPU stops the group poll and concentrates on single points. The net effect is response speed greater than five times that of earlier designs.

Features

- Sleek, low-profile, stylish design.
- State-of-the-art thermistor technology for fast response.
- Rate-of-rise model (FST-851R/A), 15°F (8.3°C) per minute.
- Factory preset fixed temperature at 135°F (57°C); high-temperature model fixed at 190°F (88°C).
- Addressable by device.
- Compatible with FlashScan® and CLIP protocol systems.
- Rotary, decimal addressing (1-99 on CLIP systems, 1-159 on FlashScan systems).
- Two-wire SLC connection.
- Visible LEDs "blink" every time the unit is addressed.
- 360°-field viewing angle of the visual alarm indicators (two bi-color LEDs). LEDs blink green in Normal condition and turn on steady red in Alarm.
- Integral communications and built-in device-type identification.
- Remote test feature from the panel.
- Built-in functional test switch activated by external magnet.
- Walk test with address display (an address of 121 will blink the detector LED 12-(pause)-1).
- Low standby current.
- Backward-compatible.
- Built-in tamper-resistant feature.
- Designed for direct-surface or electrical-box mounting.
- Sealed against back pressure.
- Plugs into separate base for ease of installation and maintenance. Separate base allows interchange of photoelectric, ionization and thermal sensors.
- SEMS screws for wiring of the separate base.
- Constructed of off-white fire-resistant plastic, designed to commercial standards, and offers an attractive appearance.

B210-2251.jpg

FST-851(A) in B210LP(A) Base

- 94-5V plastic flammability rating.
- Remote LED output connection to optional RA100Z(A) remote LED annunciator.
- Optional sounder, relay, and isolator bases.
- Optional flanced surface mounting kit.

Specifications

Size: 2.1" (5.3 cm) high; base determines diameter.

- **B210LP(A):** 6.1" (15.5 cm) diameter.
- **B501(A):** 4.1" (10.4 cm) diameter.
- **B200S(A):** 6.875" (17.46 cm) diameter.
- **B200SR(A):** 6.875" (17.46 cm) diameter.
- **B224RB(A):** 6.2" (15.748 cm) diameter.
- **B224BI(A):** 6.2" (15.748 cm) diameter.

Shipping weight: 4.8 oz. (137 g).

Operating temperature range: FST-851(A) Series, FST-851R(A): –20°C to 38°C (–4°F to 100°F); FST-851H(A): –20°C to 66°C (–4°F to 150°F).

Detector spacing: UL approved for 50 ft. (15.24 m) center to center. FM approved for 25 x 25 ft. (7.62 x 7.62 m) spacing.

Relative humidity: 10% – 93% noncondensing.

Thermal ratings: fixed-temperature setpoint 135°F (57°C), rate-of-rise detection 15°F (8.3°C) per minute, high temperature heat 190°F (88°C).

ELECTRICAL SPECIFICATIONS

Voltage range: 15 - 32 volts DC peak.

Standby current (max. avg.): 300 µA @ 24 VDC (one communication every 5 seconds with LED enabled).

LED current (max.): 6.5 mA @ 24 VDC ("ON").

Applications

Use thermal detectors for protection of property. For further information, go to systemsensor.com for manual I56-407-00, Applications Manual for System Smoke Detectors, which provides detailed information on detector spacing, placement, zoning, wiring, and special applications.

Installation

The FST Series plug-in intelligent thermal detectors use a separate base to simplify installation, service, and maintenance. Installation instructions are shipped with each detector. A special tool allows maintenance personnel to plug in and remove detectors without using a ladder

Mount base (all base types) on an electrical backbox which is at least 1.5" (3.81 cm) deep. For a chart of compatible junction boxes, see *DN-60054*.

NOTE: 1) *Because of the inherent supervision provided by the SLC loop, end-of-line resistors are not required. Wiring "T-taps" or branches are permitted for Style 4 (Class "B") wiring.* ***2)*** *When using relay or sounder bases, consult the ISO-X(A) installation sheet I56-1380 for device limitations between isolator modules and isolator bases.*

Agency Listings and Approvals

These listings and approvals apply to the modules specified in this document.In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. *Consult factory for latest listing status.*

- **UL Listed:** S747.
- **ULC Listed:** S6978.
- **MEA Listed:** 383-02-E.
- **FM Approved.**
- **CSFM:** 7270-0028:0196.
- **BSMI:** CI313066760025.
- **CCCF:** Certif. # 2004081801000018.
- **U.S. Coast Guard:** 161.002/42/1 (NFS-640); 161.002/50/0 (NFS2-640/NFS-320/NFS-320C, excluding B210LP(A)).
- **Lloyd's Register:** 11/600013 (NFS2-640/NFS-320/NFS-320C, excluding B210LP(A)).

Product Line Information

NOTE: *"A" suffix indicates ULC Listed model.*

FST-851: Intelligent thermal detector. Must be mounted to one of the bases listed below.

FST-851A: Same as FST-851 but with ULC Listing.

FST-851R: Intelligent thermal detector with rate-of-rise feature.

FST-851RA: Same as FST-851R but with ULC Listing.

FST-851H: Intelligent high-temperature thermal detector.

FST-851HA: Same as FST-851H but with ULC Listing.

INTELLIGENT BASES

NOTE: *"A" suffix indicates ULC Listed model.*

NOTE: *For details about intelligent bases and their mounting, see DN-60054.*

B210LP(A): Standard U.S. flanged low-profile mounting base.

B210LPBP: Bulk pack of B210LP; package contains 10.

B501(A): Standard European flangeless mounting base.

B501BP: Bulk pack of B501; package contains 10.

B200S(A): Addressable Intelligent, programmable sounder base capable of producing sound output in high or low volume with ANSI Temporal 3, ANSI Temporal 4, continuous tone, marching tone, and custom tone.

B200SR(A): Intelligent sounder base capable of producing sound output with ANSI Temporal 3 or continuous tone. Replaces B501BH series bases in retrofit applications.

B224RB(A): Intelligent relay base. Screw terminals: up to 14 AWG (2.0 mm²). Relay type: Form-C. Rating: 2.0 A @ 30 VDC resistive; 0.3 A @ 110 VDC inductive; 1.0 A @ 30 VDC inductive.

B224BI(A): Intelligent isolator base. Isolates SLC from loop shorts. Maximum: 25 devices between isolator bases; see Note 2 under Installation.

ACCESSORIES

F110: Retrofit flange to convert B210LP(A) to match the B710LP(A) profile, or to convert older high-profile bases to low-profile.

F110BP: Bulk pack of F110; package contains 15.

F210: Replacement flange for B210LP(A) base.

RA100Z(A): Remote LED annunciator. 3 – 32 VDC. Fits U.S. single-gang electrical box. Supported by B210LP(A) and B501(A) bases only.

SMB600: Surface mounting kit, flanged.

M02-04-00: Test magnet.

M02-09-00: Test magnet with telescoping handle.

XR2B: Detector removal tool. Allows installation and/or removal of FlashScan® Series detector heads from base in high ceiling installations. Includes T55-127-010.

T55-127-010: Detector removal tool without pole.

XP-4: Extension pole for XR2B. Comes in three 5-foot (1.524 m) sections.

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ISO 9001 CERTIFIED ENGINEERING & MANUFACTURING QUALITY SYSTEMS

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Made in the U.S. A.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

Wheelock MB Series
Motor Bells

Description

Wheelock's Series MB Motor Bells provide a better engineered motor bell for fire and life safety alarm systems. The Wheelock Series MB Bells include higher dBA, low current draw, built-in trimplate for semi-flush mounting, low frequency aluminum shells, and low RFI noise. The motor for Series MB Bells is a durable, high torque permanent magnet motor selected for its high performance and long life.

Series RSSP Sync/Non-Sync retrofit plates are used in conjunction with the Series MB Motor Bell when combination appliances are required. The Series RSSP retrofit plates are available with either Multi-Candela or single candela strobes and easily mount to a 4" square or Wheelock SBL-2 backbox. All Series RSSP strobe appliances meet or exceed the requirements of NFPA 72 (National Fire Alarm Code), ANSI 117.1 (American National Standard for Accessible and Usable Buildings and Facilities), ADA (Americans with Disabilities Act) and UL Standard 1971 (Signaling Devices for the Hearing Impaired).

The Series RSSP retrofit plates may be synchronized when installed with the Wheelock Series SM, DSM, Sync Modules or a Power Supply with Wheelock's patented sync protocol. Wheelock's synchronized strobes offer an easy way to comply with ADA requirements concerning photo-sensitive epilepsy.

Engineer's Specification

The alarm appliances shall be Wheelock Series MB vibrating Motor Bells or approved equal. They shall be UL Standard 464 Listed for Fire Protective Service. Shells shall be aluminum in 6" or 10" diameter. Sound output at 10 feet shall be 92 dBA. The bells shall incorporate a permanent magnet motor and suppression circuitry to minimize RFI. They shall include a built-in trimplate for semi-flush mounting to a standard 4" square backbox, or surface mounting to Wheelock's indoor BB backbox or outdoor WBB backbox. For bell strobe applications, retrofit plates Wheelock Series RSSP with Multi-Candela or Single Candela strobes shall be used. All bell models shall be polarized for line supervision and shall have screw terminals for in-out field wiring of #12 to #18 AWG wire. Operating voltage shall be nominal 24 VDC or 12 VDC. Finish on all models shall be red enamel.

Features

- High sound output with low current draw.
- Low frequency aluminum shells for better audibility through walls, doors and other structures.
- 6" and 10" shell sizes in 12 or 24 VDC models.
- Integral RFI suppression to minimize included noise on the NAC circuit.
- Mounting options for surface, semi-flush, outdoor, and concealed conduit installation.
- Built-in trimplate makes semi-flush mounting simpler and less expensive
- Polarized for DC supervision of NAC circuits.
- Operates on filtered or unfiltered DC.

Listings

Listings and approvals below apply to Wheelock MB Series Motor Bells. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- UL Listed: file E5946
- ULC Listed: file CS243
- FM approved.
- MEA approved: file 151-92-E.
- CSFM approved: files 7135-0785:113.

Gamewell™
A 150-Year Tradition
A Honeywell Company

Ordering Information

MODEL NUMBER	SHELL SIZE	INPUT VOLTAGE (VDC)	INPUT CURRENT
MB-G6-12-R	6"	12	0.060
MB-G6-24-R	6"	24	0.030
MB-G10-12-R	10"	12	0.060
MB-G10-24-R	10"	24	0.030

NOTES:
1. Typical dBA at 10 feet is 92, measured in an anechoic chamber.
2.Mounting options are: D,E,J,K,N,R,S,Z
3. For bells at 12 VDC models are UL rated for 9.0 to 15.6 VDC and all 24 VDC models for 18.0 to 31.0

MODEL NUMBER	NOMINAL VOLTAGE (VDC)	STROBE CANDELA	AVERAGE CURRENT (amps) @ LISTED VDC
RSSP-24MCW-FR	24	15/30/75/110	.050/.081/.133/.161
RSSP-241575W-FR	24	15 (75 on axis)	0.065
RSSP-121575W-FR	12	15 (75 on axis)	0.170

1. Mounting options are: D,E,Z

2. Average current per actual Wheelock product testing at listed VDC. For rated average and peak current across UL regulated voltage range for both filtered DC and unfiltered VRMS, see Installation instructions.

SYNC MODELS/POWER SUPPLY			
MODEL NUMBER	**INPUT VOLTAGE (VDC)**	**AVERAGE MEAN CURRENT @ 24 VDC**	**MOUNTING OPTIONS****
SM-12/24-R	24	.028	W
DSM-12/24-R	24	.035	W

SM Sync Module is rated for 3.0 amperes @ 24VDC.

DSM Sync Module is rated for 3.0 amperes per circuit. The maximum number of interconnected DSM modules is twenty (20).

** Refer to mounting options data sheet.

Wiring Diagram

Fig. 1 Bell Models

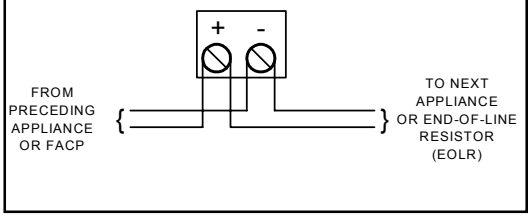
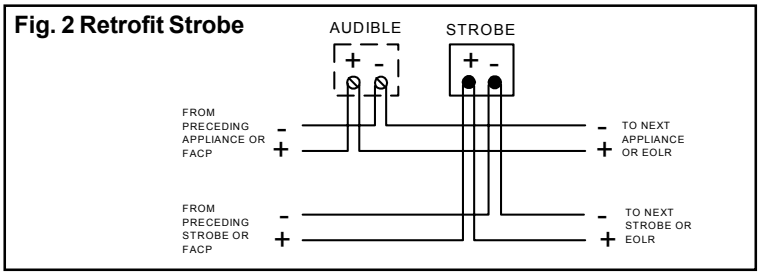


Fig. 2 Retrofit Strobe



Wheelock products must be used within their published specifications and must be PROPERLY specified, applied, installed, operated, maintained and operationally tested in accordance with their installation instructions at the time of installation and at least twice a year or more often and in accordance with local, state and federal codes, regulations and laws. Specification, application, installation, operation, maintenance and testing must be performed by qualified personnel for proper operation in accordance with all of the latest National Fire Protection Association (NFPA), Underwriters' Laboratories (UL), National Electrical Code (NEC), Occupational Safety and Health Administration (OSHA), local, state, county, province, district, federal and other applicable building and fire standards, guidelines, regulations, laws and codes including, but not limited to, all appendices and amendments and the requirements of the local authority having jurisdiction (AHJ).

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WARNING

PLEASE READ THESE SPECIFICATIONS AND ASSOCIATED INSTALLATION INSTRUCTIONS CAREFULLY BEFORE USING, SPECIFYING OR APPLYING THIS PRODUCT. FAILURE TO COMPLY WITH ANY OF THESE INSTRUCTIONS, CAUTIONS OR WARNINGS COULD RESULT IN IMPROPER APPLICATION, INSTALLATION AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE, AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

Specifications and wiring information are provided for information only and are believed to be accurate. Gamewell assumes no responsibility for their use. Data and design are subject to change without notice. Installation and wiring instructions shipped with the product shall always be used for actual installation. For more information, contact Gamewell.

SPECTRAlert®

Selectable Output Strobe and Horn/Strobes

SYSTEM SENSOR®

Models Available

Strobes

Red	White
S1224MC	S1224MCW
S1224MCP	S1224MCPW
S1224MCK	
S1224MCSP	

Horn/Strobes

Red	White
P1224MC	P1224MCW
P1224MCP	P1224MCPW
P1224MCK	
P1224MCSP	

Horns

Red	White
H12/24	H12/24W
H12/24K	

Product Overview

Operates on either 12V or 24V

Widest range of candela options:
12V: 15 and 15/75 candela
24V: 15, 15/75, 30, 75, 110 candela

Easy candela selection

Lower current draw

Easy DIP switch selection for horn options

Easy mounting with QuickClick™

Synchronizable with MDL Sync•Circuit™ module

Meets UL1971, NFPA72, and ADA signaling requirements

All strobe and horn/strobe models incorporate a new patented voltage booster design that has a more consistent flash bulb voltage over the range of candela selections. The benefit to the customer is a high quality strobe device.

7125-1209:222
7135-1209:223

LISTED
S5512
S4011

FM APPROVED
3014150

MEA approved
122-02-E
126-02-E

SpectrAlert® Selectable Output Horns, Strobes, and Horn/Strobes offer enhanced features that include the widest range of candela options available and the capability to recognize and self-adjust for either 12 or 24 volt operation. With an overall feature set that combines performance, installation ease, flexibility, and a consistent, aesthetically pleasing appearance, the SpectrAlert Selectable Output devices provide both the innovation and efficiency synonymous with the SpectrAlert name.

Performance. SpectrAlert selectable output wall-mount horns, strobes, and horn/strobes offer key performance features long associated with the SpectrAlert name. The selectable candela strobes and horn/strobes offer average current draws that are not only lower than conventional fixed-candela SpectrAlert products, but also lower than similar selectable candela products. By consuming less current, the ability to connect even more devices per loop is possible, resulting in a lower installed cost.

Installation. SpectrAlert selectable output horns, strobes, and horn/strobes offer the same installation-friendly features synonymous with the SpectrAlert name, such as the option of 2- and 4-wire operation; the ability to use standard size backboxes with no encroachment into the box; and universal mounting incorporating the labor-saving QuickClick™ feature. Such labor-savings features make wire connections simple and fast, further reducing installed cost.

Flexibility. SpectrAlert selectable output strobes and horn/strobes offer the broadest range of candela options. In addition, the selectable output strobes and horn/strobes can operate on either 12V or 24V, with no setting required; the device recognizes and self-adjusts to the correct current automatically. Temporal 3 or Continuous tone options continue to be available, in either an Electromechanical or 3kHz pattern.

Aesthetics. SpectrAlert selectable output horns, strobes, and horn/strobes incorporate the same stylish, low profile design of the conventional SpectrAlert products, for a consistent and aesthetically pleasing appearance across the entire product line.

Engineering Specifications

General

SpectrAlert horns, strobes and horn/strobes shall be capable of mounting to a standard 4″ × 4″ × 1 1/2″ back box or a single gang 2″ × 4″ × 1 7/8″ back box using the universal mounting plate included with each SpectrAlert product. Also, SpectrAlert products, when used in conjunction with the accessory Sync•Circuit Module, shall be powered from a non-coded power supply and shall operate on 12 or 24 volts. 12 volt rated devices shall have an operating voltage range of 9–17.5 volts. 24-volt rated devices shall have an operating voltage range or 17–33 volts. SpectrAlert products shall have an operating temperature of 32° to 120°F and operate from a regulated DC or full wave rectified, unfiltered power supply.

Strobe

Strobe shall be a System Sensor SpectrAlert Model _____ listed to UL 1971 and be approved for fire protective service. The strobe shall be wired as a primary signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

Horn/Strobe Combination

Horn/Strobe shall be a System Sensor SpectrAlert Model _____ listed to UL 1971 and UL 464 and shall be approved for fire protective service. Horn/strobe shall be wired as a primary signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall have two tone options, two audibility options (at 24 volts) and the option to switch between a temporal 3 pattern and a non-temporal continuous pattern. Strobes shall be powered independently of the sounder with the removal of factory installed jumper wires. The horn on horn/strobe models shall operate on a coded or non-coded power supply (the strobe must be powered continuously).

Synchronization Module

Module shall be a System Sensor Sync•Circuit _____ listed to UL 464 and shall be approved for fire protective service. The module shall synchronize SpectrAlert strobes at 1Hz and horns at temporal 3. Also, the module shall silence the horns on horn/strobe models, while operating the strobes, over a single pair of wires. The module shall be capable of mounting to a 4 11/16″ × 4 11/16″ × 2 1/8″ back box and shall control two Style Y (class B) or one Style Z (class A) circuit. Module shall be capable of multiple zone synchronization by daisy chaining multiple modules together and re-synchronizing each other along the chain. The module shall not operate on a coded power supply.

Specifications

Walk Test
SpectrAlert horn/strobe and horn only work on "walk tests" with time durations of 4 seconds or greater

Input Terminals
12 to 18 AWG

Dimensions
Strobe and horn/strobe with universal plate
5″ × 5 5/8″ × 2 15/16″

Strobe and horn/strobe with small footprint plate
3 3/8″ × 5 5/8″ × 2 5/16″

Horn with universal mounting plate
5″ × 5 5/8″ × 1 5/16″

Horn without mounting plate
2 15/16″ × 5 5/16″ × 1 5/16″

Weight, horn only
7.2 oz.

Weight, strobe and horn/strobe
8.8 oz.

Mounting
4″ × 4″ × 1 1/2″ or 2″ × 4″ × 1 7/8″ standard boxes

Operating Temperature (Indoor)
32°F to 120°F (0°C to 49°C)

Maximum humidity (Indoor)
95% as tested per UL464

Outdoor (K Series) Operating Temperature
–40°F to 151°F
(–40°C to 66°C)

Outdoor rating
NEMA 3R (per UL 50)

Voltages
12 or 24VDC and FWR[1] unfiltered

Operating voltage range
12V: 8–17.5V; 24V: 16–33V

Operating voltage range (with Sync•Circuit module, MDL)[2]
12V: 9–17.5V; 24V: 17–33V

U.S. Patent Numbers
5,593,569
5,914,665
6,049,446

Notes:
1. Full Wave Rectified (FWR) voltage is a non-regulated, time-varying power source that is used on some power supply and panel outputs.
2. The MDL causes a one-volt voltage drop in the notification appliance circuit.

Table 1-A: SpectrAlert Strobe UL Max. Current Draw

Candela Setting	FWR Operating Current–Strobe (mA RMS)		DC Operating Current–Strobe (mA RMS)	
	8-17.5V	16-33V	8-17.5V	16-33V
15	112	64	127	59
15/75	135	74	127	69
30		93		90
75		158		160
110		208		209

Table 1-B: Horn UL Max. Current Draw Measurements (mA RMS)

Selectable Horn Tones			DC		FWR	
			8-17.5V	16-33V	8-17.5V	16-33V
Temporal	Low Volume	Electromechanical	15	23	13	23
		3000 Hz Interrupted	15	33	13	23
	High Volume	Electromechanical	36	53	20	44
		3000 Hz Interrupted	43	57	21	40
Non-Temporal	Low Volume	Electromechanical	16	37	19	29
		3000 Hz Interrupted	16	32	18	33
	High Volume	Electromechanical	38	49	46	49
		3000 Hz Interrupted	44	56	42	58

Table 1-C: 12VDC Horn/Strobe UL Max. Current Draw Measurements (mA RMS)

	Temporal			
	Low Volume		High Volume	
Candela Setting	Electromechanical	3000 Hz	Electromechanical	3000 Hz
15	111	111	112	112
15/75	127	127	126	129
	Non-Temporal			
15	113	112	114	115
15/75	128	128	130	134

Table 1-D: 24VDC Horn/Strobe UL Max. Current Draw Measurements (mA RMS)

	Temporal			
	Low Volume		High Volume	
Candela Setting	Electromechanical	3000 Hz	Electromechanical	3000 Hz
15	71	70	73	75
15/75	86	85	87	88
30	99	98	100	100
75	166	166	167	170
110	209	209	210	213
	Non-Temporal			
15	74	74	79	82
15/75	86	88	93	96
30	101	101	107	110
75	167	167	173	176
110	213	213	218	222

Explanation of Published Voltage, Current, and SPL Specifications

In May 2004 Underwriters Laboratories changed standard UL 1971 to require that operating current measuremments are made using RMS (root mean square) instead of peak or average values. RMS measurements more accurately predict the power consumption of a device since they take into account the entire current draw profile including surge, repetitive surge, and peak values. The published RMS current is the maximum operating current of that device within its operating voltage range. This current maximum may or may not occur at the endpoints of the voltage range.

Similarly, UL tests the audibility of devices in accordance with UL 464 by measuring them across the operating voltage range to determine the minimum sound pressure level produced at any particular setting.

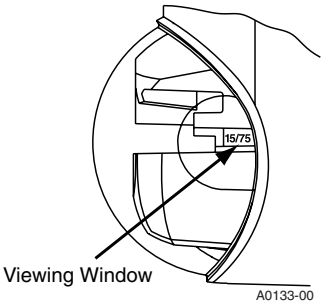
During May 2004, UL also changed the way they list the voltage range of a device. All 12V products will be listed between 8 – 17.5V and all 24V products will be listed between 16 – 33V. Those devices are considered “regulated”. Any product that does not operate within these ranges will be listed as a “special application” with its operating voltage specified on the device.

Notes

1. Current draw for strobe-only products is shown in Table 1-A.
2. Current draw for horn-only products is shown in Table 1-B.
3. 12VDC 2-wire horn/strobe current is shown in Table 1-C.
4. 24VDC 2-wire horn/strobe current draw is shown in Table 1-D.
5. Current draw for other horn/strobe power supplies can be calculated by adding the strobe current in Table 1-A to the horn current in Table 1-B from the chosen settings.

SpectrAlert Strobe Candela Selections

For strobe candela selection, adjust slide switch located on the rear of the product while watching the viewing window on the side of the reflector.



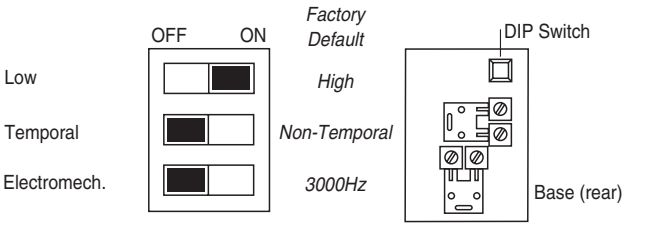
Permissible Candela Settings

Candela Setting	Operating Voltage	
	12V	24V
15	OK	OK
15/75	OK	OK
30		OK
75		OK
110		OK

SpectrAlert Horn Sound Measurements (dBA)

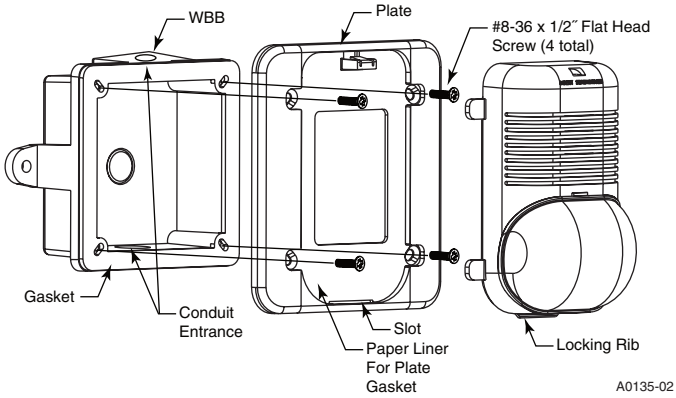
Selectable Horn Tones			8-17.5V	16-33V
Temporal	Low Volume	Electromechanical	67	75
		3000 Hz Interrupted	68	75
	High Volume	Electromechanical	71	80
		3000 Hz Interrupted	72	81
Non-Temporal	Low Volume	Electromechanical	71	79
		3000 Hz Interrupted	72	79
	High Volume	Electromechanical	76	84
		3000 Hz Interrupted	77	86

DIP Switch Operation on P1224MC



A0110-00

Typical weatherproof mounting with universal plate



A0135-02

SpectrAlert Ordering Information

Model	Description
P1224MC	Selectable Output Horn/Strobe, 12/24 volt, red
P1224MCW	Selectable Output Horn/Strobe, 12/24 volt, white
P1224MCP	Selectable Output Horn/Strobe, 12/24 volt, red, plain housing
P1224MCPW	Selectable Output Horn/Strobe, 12/24 volt, white, plain housing
P1224MCK	Selectable Output Horn/Strobe, 12/24 volt, red, outdoor
P1224MCSP	Selectable Output Horn/Strobe, 12/24 volt, red, "FUEGO" housing
S1224MC	Selectable Output Strobe, 12/24 volt, red
S1224MCW	Selectable Output Strobe, 12/24 volt, white
S1224MCP	Selectable Output Strobe, 12/24 volt, red, plain housing
S1224MCPW	Selectable Output Strobe, 12/24 volt, white, plain housing
S1224MCK	Selectable Output Strobe, 12/24 volt, red, outdoor
S1224MCSP	Selectable Output Strobe, 12/24 volt, red, "FUEGO" housing

Model	Description
H12/24	Horn, 12/24 volt, red
H12/24W	Horn, 12/24 volt, white
H12/24K	Horn, 12/24 volt, red, outdoor
Accessories	
MDL	Sync•Circuit Module, red
MDLW	Sync•Circuit Module, white
MDLWA	Sync•Circuit Module, white, Canadian model
S-MP	Small Footprint Mounting Plate, red, for single-gang back box
S-MPW	Small Footprint Mounting Plate, white, for single-gang back box
BBS	Surface Mount Back Box Skirt, red
BBSW	Surface Mount Back Box Skirt, white
D-MP	Universal Mounting Plate (replacement), red
D-MPW	Universal Mounting Plate (replacement), white
WBB	Weatherproof Back Box

Notes

All of these SpectrAlert products are designed for wall mount only. All outdoor models must use weatherproof back box model WBB. Installation of less than 75 candela strobes may be permissible under the equivalent facilitation clause of the ADAAG (Sec. 2.2). However, it is the responsibility of the person or entity designing the fire alarm system to determine the acceptability of less than 75 candela strobes. All 15/75 candela strobes or horn/strobes are recommended for 20′ × 20′ rooms or less.

System Sensor Sales and Service

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System Sensor in Singapore
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Fx: 65.6273.2610

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Fx: 613.54.281.172

System Sensor – India
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Fx: 91.124.237.3118

System Sensor – Russia
Ph: 70.95.937.7982
Fx: 70.95.937.7983

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A05-0325-006•9/05•#1526

A U D I B L E / V I S I B L E N O T I F I C A T I O N

SPECTRAlert®

Ceiling Mount Series Strobes and Horn/Strobes

SYSTEM SENSOR®

Models Available

Strobe Models

White	Red
SC2415W	SC2415
SC241575W	SC241575
SC2430W	SC2430
SC2475W	SC2475
SC2495W	SC2495
SC24115W	SC24115
SC24177W	SC24177

Horn/Strobe Models

White	Red
PC2415W	PC2415
PC241575W	PC241575
PC2430W	PC2430
PC2475W	PC2475
PC2495W	PC2495
PC24115W	PC24115
PC24177W	PC24177

Accessory Mounting Plates

White	Red
BBSCW	BBSC

SC241575W

PC2475W


BBSCW

Product Overview

Lower current draw

Available in 15, 15/75, 30, 75, 95, 115, and 177 candela

Horn/strobe models include a three position switch for field-selecting horn tones:
- **Electromechanical/3KHz**
- **Temporal/Non-temporal**
- **High/Low dBA output**

Ceiling-specific shape, profile, and aesthetics

Synchronizable with MDL Sync•Circuit™ module

Mounts to 4″× 4″× 1½″ back box

Round shape offers greater placement flexibility

S5512
S4011

7125-1209:201
7135-1209:204

FM APPROVED
3006566

MEA approved
61-00-E
144-00-E

System Sensor's SpectrAlert® ceiling mount series strobes and horn/strobes offer a fresh approach to addressing the unique needs for ceiling mount applications.

Technology. Like the original SpectrAlert, the SpectrAlert ceiling mount series offer significant current draw reductions over other ceiling mount strobes and horn/strobes.

Installation. SpectrAlert's compact design also offers installation savings. The strobe and horn/strobe models mount to a 4″×4″×1½″ back box, and take up little room in the back box, making connections easier. And with SpectrAlert's round shape, it is not necessary to align the back box with the room's walls. SpectrAlert always lines up.

Flexibility. SpectrAlert ceiling mount strobes and horn/strobes are available in seven different candelas, including 177 candela for sleeping areas. The horn/strobe's tones are field-selectable through the use of a three position switch located on the back of the unit. Selections include electromechanical and 3 KHz tones, temporal and non-temporal patterns, and high and low volume.

Aesthetics. SpectrAlert ceiling strobes and horn/strobes offer a design that is sensitive to the aesthetic demands of ceiling mount applications. The round shape maintains a low profile appearance, similar to that of a smoke detector and provides clearly visible "FIRE" identification from all angles.

Engineering Specifications

Strobe

Strobe shall be a System Sensor SpectrAlert Model _____ listed to UL 1971 and be approved for fire protective service where ceiling mount strobes are permitted. The strobe shall be wired as a primary signaling notification appliance and shall flash at 1Hz over the strobe's entire operating range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

Horn/Strobe Combination

Horn/strobe shall be a System Sensor SpectrAlert Model _____ listed to UL 1971 and UL 464 and be approved for fire protective service where ceiling mount horn/strobes are permitted. The horn/strobe shall be wired as a primary signaling notification appliance and shall flash at 1Hz over its entire operating range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall have two tone options, two audibility options, and the option to switch between a temporal and a non-temporal continuous pattern. These options shall be selected by a multi-position switch. Strobes shall be powered independently of the sounder with the removal of factory installed jumper wires. The horn on horn/strobe models shall operate on a coded or non-coded power supply.

Note: The strobes must be powered continuously for the horn to operate.

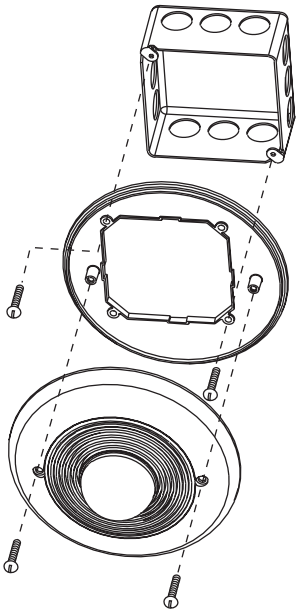
General Specifications

Dimensions	Indoor Operating Temperature	Weight
6.8″ diameter	32° to 120° F (0° to 49°C)	5.3 oz. (150 grams)

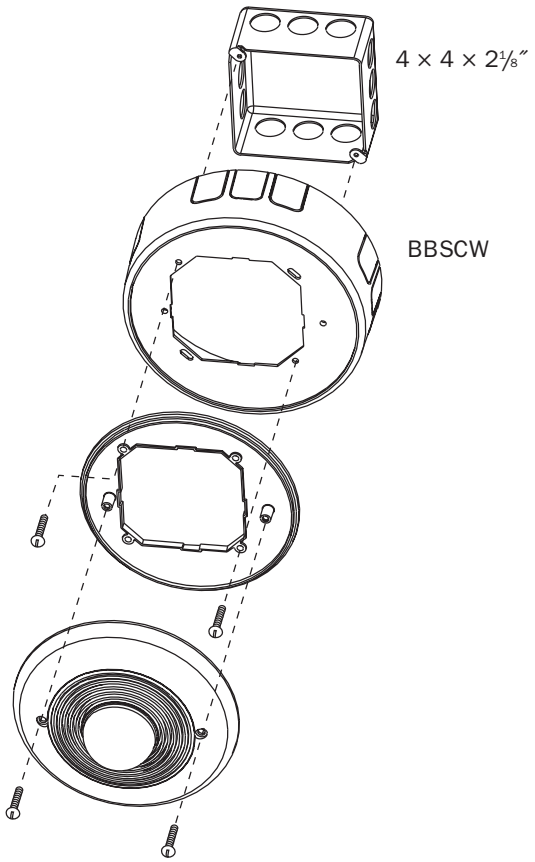
Mounting

4″× 4″× 1½″ back box or
4″× 4″× 2⅛″ back box (with skirt)

SpectrAlert Mounting Diagrams



Strobe or Horn/Strobe with Mounting Plate



Strobe or Horn/Strobe with Accessory Back Box Skirt

Electrical Specifications

Operating Voltage
24 VDC and FWR[1] unfiltered

Input Terminals
12 to 18 AWG

Operating Voltage Range
16–33 V

Operating Voltage Range w/Sync•Circuit Module[2]
17-33 V

U.S. Patent Numbers
6,049,446
6,057,778
D424,465

Notes:
1. Full Wave Rectified (FWR) voltage is a non-regulated, time-varying power source that is used on some power supply and panel outputs.
2. The MDL causes a one-volt voltage drop in the notification appliance circuit.

Table 1-A: SpectrAlert Strobe UL Max. Current Draw (mA RMS)

Strobe Setting	16-33V FWR Operating Current – Strobe (mA RMS)	16-33V DC Operating Current – Strobe (mA RMS)
15	68	64
15/75	77	78
30	107	113
75	197	205
95	239	274
115	298	325
177	399	489

Table 1-B: Horn UL Max. Current Draw Measurements (mA RMS)

			16-33V (DC)	16-33V (FWR)
Temporal	Low Volume	Electromechanical	23	23
		3000 Hz Interrupted	33	23
	High Volume	Electromechanical	53	44
		3000 Hz Interrupted	57	40
Non-Temporal	Low Volume	Electromechanical	37	29
		3000 Hz Interrupted	32	33
	High Volume	Electromechanical	49	49
		3000 Hz Interrupted	56	58

Table 1-C: 24V DC Horn/Strobe UL Max. Current Draw Measurements (mA RMS)

	Temporal				Non-Temporal			
	Low Volume		High Volume		Low Volume		High Volume	
Candela Setting	Electromechanical	3000 Hz	Electromechanical	3000 Hz	Electromechanical	3000 Hz	Electromechanical	3000 Hz
15	73	73	76	78	75	75	81	86
15/75	89	89	91	92	89	90	96	98
30	126	125	128	128	125	125	131	134
75	225	222	222	222	219	219	221	222
95	272	270	271	271	266	265	269	270
115	297	297	296	296	291	290	292	293
177	512	504	501	496	491	493	491	496

Explanation of Published Voltage, Current, and SPL Specifications

In May 2004 Underwriters Laboratories changed standard UL 1971 to require that operating current measuremments are made using RMS (root mean square) instead of peak or average values. RMS measurements more accurately predict the power consumption of a device since they take into account the entire current draw profile including surge, repetitive surge, and peak values. The published RMS current is the maximum operating current of that device within its operating voltage range. This current maximum may or may not occur at the endpoints of the voltage range.

Similarly, UL tests the audibility of devices in accordance with UL 464 by measuring them across the operating voltage range to determine the minimum sound pressure level produced at any particular setting.

During May 2004, UL also changed the way they list the voltage range of a device. All 12V products will be listed between 8 – 17.5V and all 24V products will be listed between 16 – 33V. Those devices are considered “regulated”. Any product that does not operate within these ranges will be listed as a “special application” with its operating voltage specified on the device.

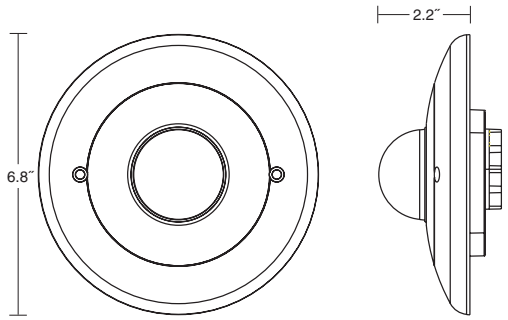
Notes

1. Current draw for strobe-only products is shown in Table 1-A.
2. 24VDC 2-wire horn/strobe current draw is shown in Table 1-C.
3. Current draw for other horn/strobe power supplies can be calculated by adding the strobe current in Table 1-A to the horn current in Table 1-B from the chosen settings.

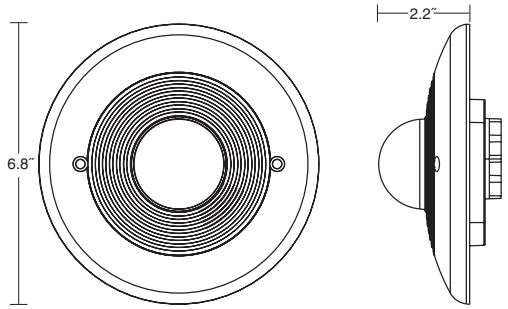
Horn Sound Measurements (dBA)

Selectable Horn Tones			16-33V
Temporal	Low Volume	Electromechanical	75
		3000 Hz Interrupted	75
	High Volume	Electromechanical	80
		3000 Hz Interrupted	81
Non-Temporal	Low Volume	Electromechanical	79
		3000 Hz Interrupted	79
	High Volume	Electromechanical	84
		3000 Hz Interrupted	86

SpectrAlert Dimensions



SpectrAlert Ceiling Mount Strobe



SpectrAlert Ceiling Mount Horn/Strobe

Ordering Information

Model No.	Description
SC2415	Ceiling-mount strobe, 24 volt, 15 candela, red
SC2415W	Ceiling-mount strobe, 24 volt, 15 candela, white
SC241575	Ceiling-mount strobe, 24 volt, 15/75 candela, red
SC241575W	Ceiling-mount strobe, 24 volt, 15/75 candela, white
SC2430	Ceiling-mount strobe, 24 volt, 30 candela, red
SC2430W	Ceiling-mount strobe, 24 volt, 30 candela, white
SC2475	Ceiling-mount strobe, 24 volt, 75 candela, red
SC2475W	Ceiling-mount strobe, 24 volt, 75 candela, white
SC2495	Ceiling-mount strobe, 24 volt, 95 candela, red
SC2495W	Ceiling-mount strobe, 24 volt, 95 candela, white
SC24115	Ceiling-mount strobe, 24 volt, 115 candela, red
SC24115W	Ceiling-mount strobe, 24 volt, 115 candela, white
SC24177	Ceiling-mount strobe, 24 volt, 177 candela, red
SC24177W	Ceiling-mount strobe, 24 volt, 177 candela, white
PC2415	Ceiling-mount horn/strobe, 24 volt, 15 candela, red
PC2415W	Ceiling-mount horn/strobe, 24 volt, 15 candela, white
PC241575	Ceiling-mount horn/strobe, 24 volt, 15/75 candela, red
PC241575W	Ceiling-mount horn/strobe, 24 volt, 15/75 candela, white
PC2430	Ceiling-mount horn/strobe, 24 volt, 30 candela, red
PC2430W	Ceiling-mount horn/strobe, 24 volt, 30 candela, white
PC2475	Ceiling-mount horn/strobe, 24 volt, 75 candela, red
PC2475W	Ceiling-mount horn/strobe, 24 volt, 75 candela, white
PC2495	Ceiling-mount horn/strobe, 24 volt, 95 candela, red
PC2495W	Ceiling-mount horn/strobe, 24 volt, 95 candela, white
PC24115	Ceiling-mount horn/strobe, 24 volt, 115 candela, red
PC24115W	Ceiling-mount horn/strobe, 24 volt, 115 candela, white
PC24177	Ceiling-mount horn/strobe, 24 volt, 177 candela, red
PC24177W	Ceiling-mount horn/strobe, 24 volt, 177 candela, white
Accessories	
MDL	Sync•Circuit™ Module, red
MDLW	Sync•Circuit™ Module, white
BBSC	Surface-mount back box skirt, red
BBSCW	Surface-mount back box skirt, white

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Fx: 44.1403.276501

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Fx: 86.29.8832.5119

System Sensor in Singapore
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Fx: 65.6273.2610

System Sensor – Far East
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Fx: 85.22.736.6580

System Sensor – Australia
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Fx: 613.54.281.172

System Sensor – India
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Fx: 91.124.237.3118

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A05-1025-008•9/05•#1530

Appendix C

CAL POLY
BONDERSON ENGINEERING PROJECTS CENTER
SAN LUIS OBISPO, CA

PROJECT DATA:

CONSTRUCTION TYPE:	***TYPE II - N***
OCCUPANCY GROUP:	***B/F***
SPRINKLERED:	***FULLY SPRINKLERED***

TYPE OF SYSTEM:
AUTOMATIC AND MANUAL FIRE ALARM SYSTEM W/ ELEVATOR RECALL/SHUNT, DUCT DETECTOR MONITORING, AND ADA COMPLIANT NOTIFICATION.

APPLICABLE CODES
CALIFORNIA BUILDING CODE 2001 - EDITION
CALIFORNIA FIRE CODE- 2001 EDITION
NFPA 70 NATIONAL ELECTRIC CODE - 1999 EDITION
NFPA 72 FIRE ALARM CODE - 1999 EDITION

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SANTA MONICA CA 90404
310 453 1620

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP
23901 CALABASAS RD STE. 1068
CALABASAS CA 91302
818 224 2700

ELECTRICAL ENGINEER
LLANES ENGINERING INC.
4022 FOUNTAIN AVE STE. 201
LOS ANGELES CA 90029
323 661 7745

FIRE ALARM DESIGNER
ALPHA FIRE ALARM CORPORATION
650 SWEENEY LANE
SAN LUIS OBISPO, CA
LIC. # C-10, C-16, #761360

GENERAL CONTRACTOR
MAINO CONSTRUCTION
1122 LAUREL LANE
SAN LUIS OBISPO CA 93401
805 543 7411

MECHANICAL CONTRACTOR
J. R. BARTO INC.
414 NORTH O ST.
LOMPOC CA 93438
805 736 5160

ELECTRICAL CONTRACTOR
ELECTRICRAFT INC.
205 SOUTH ST.
SAN LUIS OBISPO CA 93401
805 544 8224

FIRE ALARM INSTALLING CONTRACTOR
ALPHA FIRE ALARM CORPORATION
650 SWEENEY LANE
SAN LUIS OBISPO, CA
LIC. # C-10, C-16, #761360

SYMBOL	QTY	DESCRIPTION	PART NUMBER	CSFM LISTING NUMBER
FACP	1	FIRE ALARM CONTROL PANEL	NOTIFIER NFS-640	7165-0028:214
FCPS1	1	FIRE ALARM POWER SUPPLY	NOTIFIER ACPS 2406	7315-0028:213
ANN	1	REMOTE ANNUNCIATOR	NOTIFIER FDU 80	7120-0028:209
M	4	MONITOR MODULE	NOTIFIER FMM 1 OR FMM 101	7300-0028:202
R	4	RELAY MODULE	NOTIFIER FRM 1	7300-0028:202
	36	ACCLIMATE SMOKE DETECTOR	NOTIFIER FAPT-851	7272-0028:208
	12	HARSH SMOKE DETECTOR	NOTIFIER FSH-751	7272-0028:206
	4	MANUAL PULL STATION	NOTIFIER NBG 12LX	7150-0028199
	2	DUCT SMOKE DETECTOR	NOTIFIER FSD-751P	3240-0028:205
	2	HEAT DETECTOR	NOTIFIER FST-851	7270-0028:196
	1	SPRINKLER WATERFLOW SWITCH	PROVIDED BY OTHERS	BY OTHERS
	1	SPRINKLER CONTROL VALVE SWITCH	POTTER OSYSU-1	7770-0328:010
	2	OS&Y VALVES	PROVIDED BY OTHERS	BY OTHERS
	1	MOTORIZED BELL	WHEELOCK MB-G10-24-R	7135-1076:127
	1	SPRINKLER RISER	PROVIDED BY OTHERS	BY OTHERS
	2	WEATHERPROOF HORN	WHEELOCK AH24-WP	7135-1209:143
	14	WALL MOUNT HORN STROBE	SYSTEM SENSOR P1224MCW	7135-1209:223
	15	WALL MOUNT STROBE	SYSTEM SENSOR S1224MCW	7125-1209:222
	2	CEILING MOUNT STROBE	SYSTEM SENSOR SC2430W	7125-1209:201
FSD	1	FIRE SMOKE DAMPER	PROVIDED BY OTHERS	BY OTHERS
	1	END OF LINE RELAY	PAM-2	7300-1004:101

WIRE DESIGNATION	DESCRIPTION
A	16/2 FPL SIGNALING LINE CIRCUIT (SLC) CABLE
B	14/2 FPL NOTIFICATION APPLIANCE CIRCUIT (NAC) CABLE
C	3 - 16/2 FPL ANNUNCIATOR CABLES
D	16/2 FPL INITIATING CIRCUIT CABLE
E	14/2 FPL 24VDC RESETTABLE POWER CABLE
F	14/2 FPL 24VDC NON-RESETTABLE POWER CABLE

1. PRIMARY POWER SOURCE (120VAC) MUST BE ON A DEDICATED BRANCH CIRCUIT. FIRE ALARM CIRCUIT BREAKER MUST BE CLEARLY MARKED AND MECHANICALLY SECURED TO PREVENT ANY UNAUTHORIZED TAMPERING.

2. THE FIRE ALARM SYSTEM SHALL CONFORM TO ARTICLE 760 OF THE NATIONAL ELECTRIC CODE, AND ALL APPLICABLE SECTIONS OF THE CALIFORNIA BUILDING CODE AND NFPA STANDARDS.

3. ALL EQUIPMENT SHALL BE U.L. AND CALIFORNIA STATE FIRE MARSHALL LISTED.

4. ALL TESTING SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 7-1.6 OF 1999 NFPA 72.

GENERAL NOTES
NO SCALE

[X] NO EXCEPTIONS TAKEN [ ] FURNISH AS CORRECTED
[ ] SUBMIT SPECIFIC ITEM [ ] REVISE AND RESUBMIT
[ ] REJECTED

Review is only for general conformance with the design concept of the project and general compliance with the information included in the Contract Documents. Any action shown is subject to the requirements of the drawings and specifications. Contractor is responsible for: correlating and confirming dimensions at the job site, choice of fabrication processes and techniques of construction, coordination of his work with that of other trades, and performing his work in a safe and satisfactory manner.

Date 3/16/06

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY
Reviewed by: Fire & Life Safety South
APR 11 2006
Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times.

MAINO CONSTRUCTION COMPANY, INCORPORATED
Job Name Bonderson Engineering Project
Submittal No. 61.2 Spec Section 13851
"I have reviewed this submittal according to my responsibilities under the Contract Documents."
Signed ______ Date 03.13.06

REV#	DATE	SUBMITTED FOR:
1	6/1/2005	A.H.J. APPROVAL
2	03/06/2006	A.H.J. APPROVAL
3		

DRAWN BY
WALLACE SIMS

ALPHA FIRE ALARM CORPORATION
LIC C-10, C-16 761360
650 Sweeney Lane
San Luis Obispo, CA 93401

CAL POLY
BONDERSON ENGINEERING BLDG
SAN LUIS OBISPO, CA
SFM #E-40-03-0001-000-370-0

STATE:
IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICES
AC ____ FLS ____ SS ____
DATE ____

JOB #	523-05
START DATE	6/1/2005

SHEET
FA-1

ELEV EQUIP 103
ROBTOTICS 102
CART STOR 118
GROUP WORK/ SOCIETY 104
TO SECOND FLOOR
FACP FCPS
MDF 119
HVAC SHUTDOWN
ELEC 115
LOBBY 101
HALLWAY 106
ANN
DF
IN SLAB CONDUIT FROM RISER
WOMEN'S 112
MEN'S 111
CUST 113
METAL FAB/ MACHINE SHOP 114
TRANSFORMER
PROJECT INTERGRATION 107
TECH SUPPORT 117
WOODWORKING SHOP 115
DEDICATED PROJECT #1 108
DEDICATED PROJECT #2 109
DEDICATED PROJECT #3 110
TOOL STORAGE 116
UNDERGROUND TO OS&Y
PROVIDED BY OTHERS
COVERED WORK AREA
OUTDOOR WORK AREA

NO EXCEPTIONS TAKEN ☐ FURNISH AS CORRECTED
☐ SUBMIT SPECIFIC ITEM ☐ REVISE AND RESUBMIT
☐ REJECTED

Review is only for general conformance with the design concept of the project and general compliance with the information included in the Contract Documents. Any action shown is subject to the requirements of the drawings and contract. Contractor is responsible for confirming and correlating all quantities and dimensions, for fabrication processes and techniques of construction, coordination of his work with that of all trades, and for performing his work in a safe and satisfactory manner.

Alameda Engineering Group
Deputy Reviewing Engineer
Date 3/16/06

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY
Reviewed by: Life Safety South
APR 11 2006
Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times.

FIRE ALARM FLOOR PLAN FIRST FLOOR
1/8" = 1'

REV# | DATE | SUBMITTED FOR:
1 | 6/1/2005 | A.H.J. APPROVAL
2 | 03/06/2006 | A.H.J. APPROVAL
3

DRAWN BY
WALLACE SIMS

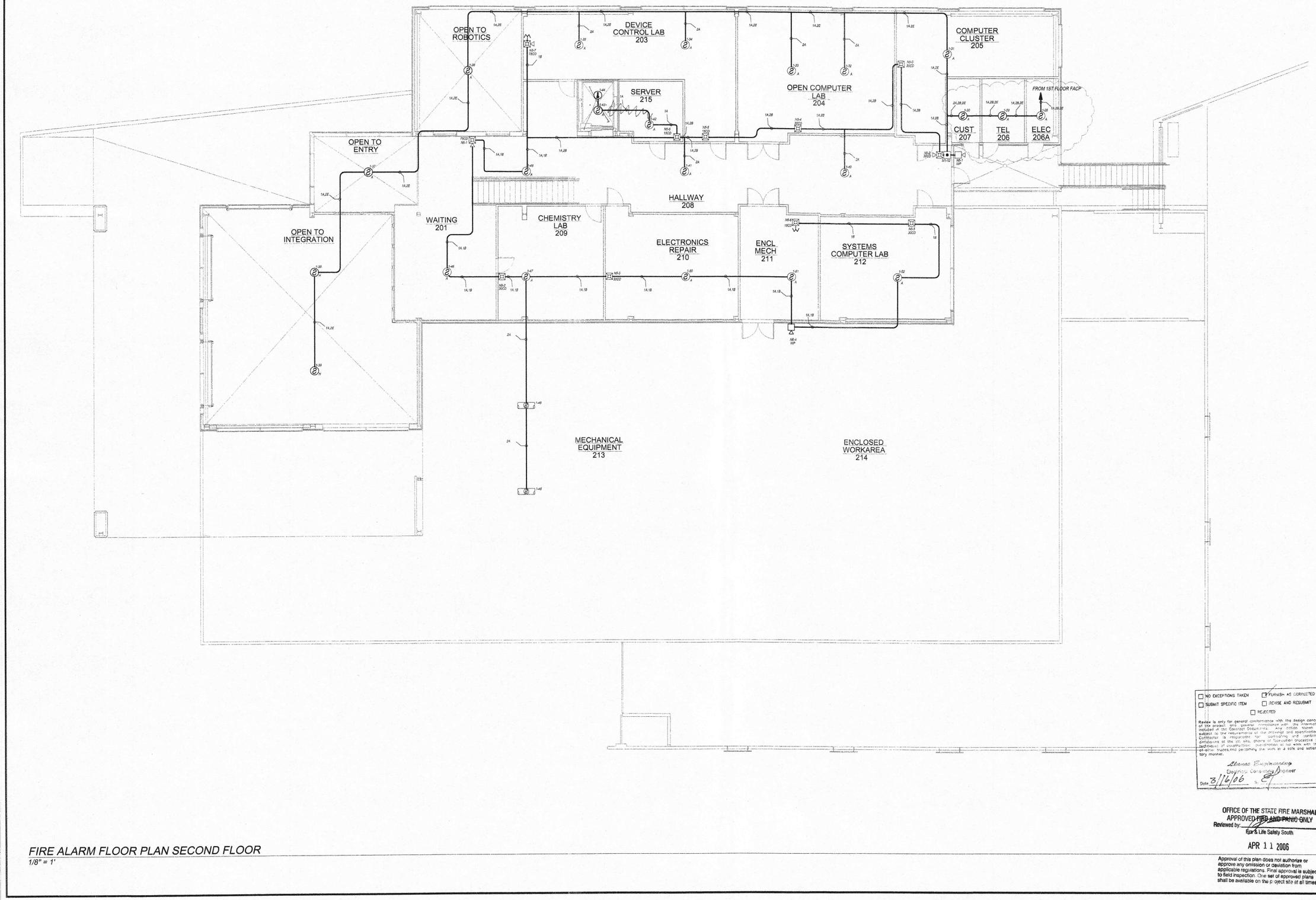
ALPHA FIRE
ALARM CORPORATION
LIC. C-10, C-16 761560
ACO#5365
650 SWEENEY LANE
SAN LUIS OBISPO, CA 93405
(805) 541-2527 FAX: 781-0868

CAL POLY
BONDERSON ENGINEERING BLDG
SAN LUIS OBISPO, CA
SFM ——

STATE:
IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICES
AC ____ FLS ____ SS ____
DATE ____

JOB #	523-05
START DATE	6/1/2005

SHEET
FA-2



FIRE ALARM FLOOR PLAN SECOND FLOOR

1/8" = 1'

NO EXCEPTIONS TAKEN ☐ FURNISH AS CORRECTED
SUBMIT SPECIFIC ITEM ☐ REVISE AND RESUBMIT
☐ REJECTED

Review is only for general conformance with the design concept of the project and general compliance with the information included in the Contract Documents. Any action shown is subject to the requirements of the project and specifications. Contractor is responsible for confirming and correlating all dimensions at the job site, phasing of construction sequence and coordination of information, coordination of his work with that of other trades and performing the work in a safe and satisfactory manner.

Electrical Consulting Engineer

Date 3/16/06

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY
Reviewed by: Fire & Life Safety South
APR 11 2006

Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times.

REV#	DATE	SUBMITTED FOR:
1	6/1/2005	A.H.J. APPROVAL
2	03/06/2006	A.H.J. APPROVAL
3		

DRAWN BY
WALLACE SIMS

ALPHA FIRE
ALARM CORPORATION
LIC. C-10, C-16 761560 ACO#5565
650 SERENITY LANE
SAN LUIS OBISPO, CA 93401
(805) 541-2527 FAX: 781-0868

CAL POLY
BONDERSON ENGINEERING BLDG
SAN LUIS OBISPO, CA

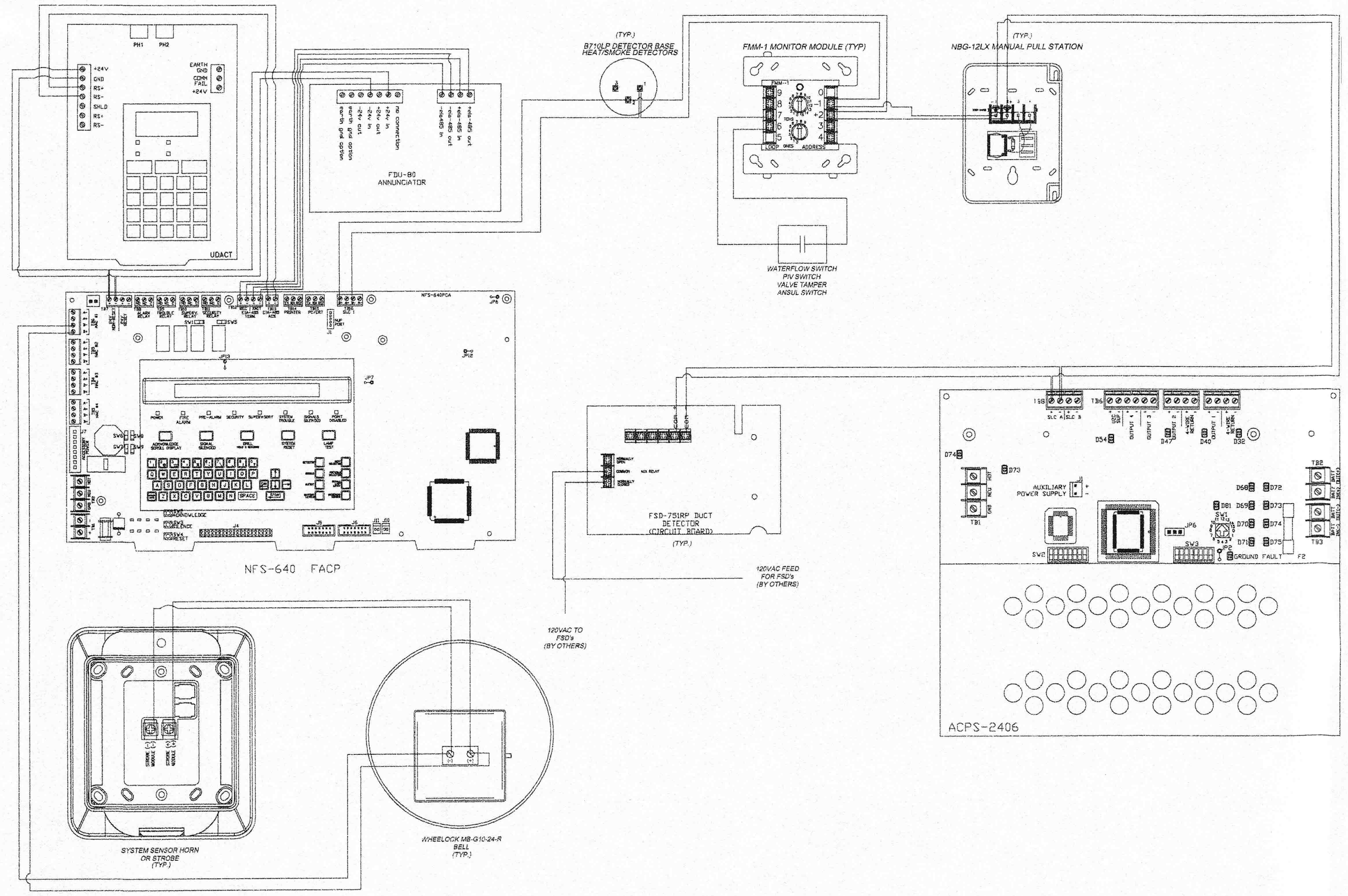
SFM ——

STATE:

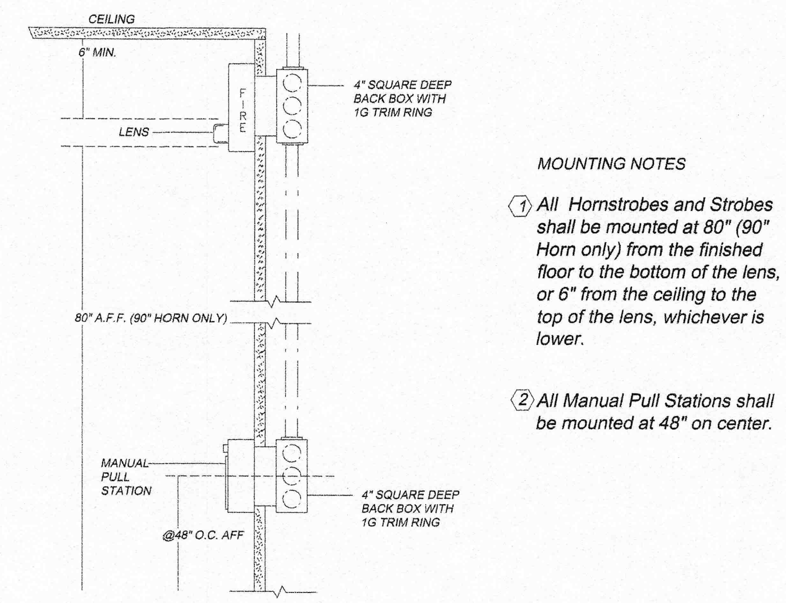
IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICES
AC ____ FLS ____ SS ____
DATE ____

JOB #	523-05
START DATE	6/1/2005

SHEET
FA-3



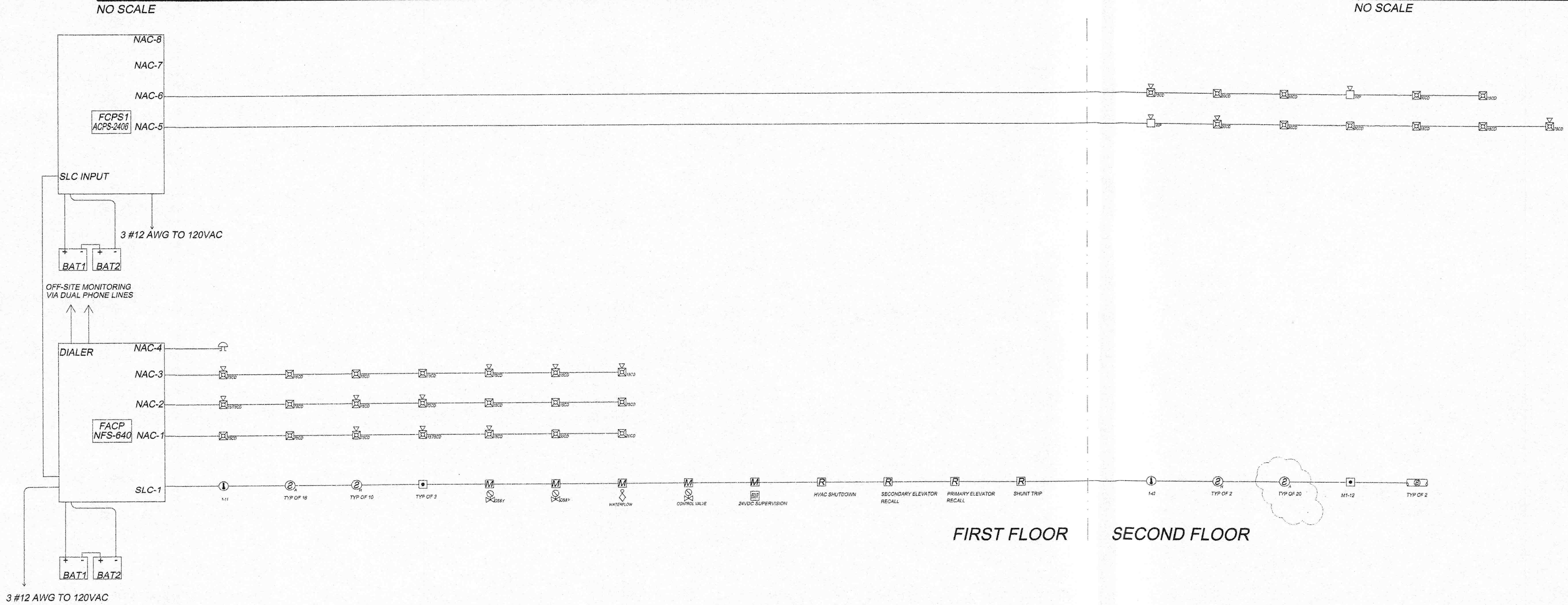
POINT TO POINT
NO SCALE



MOUNTING DETAIL
NO SCALE

MOUNTING NOTES

1. All Hornstrobes and Strobes shall be mounted at 80" (90" Horn only) from the finished floor to the bottom of the lens, or 6" from the ceiling to the top of the lens, whichever is lower.
2. All Manual Pull Stations shall be mounted at 48" on center.



FIRST FLOOR | SECOND FLOOR

RISER DIAGRAM
NO SCALE

☑ NO EXCEPTIONS TAKEN ☐ FURNISH AS CORRECTED
☐ SUBMIT SPECIFIC ITEM ☐ REVISE AND RESUBMIT
☐ REJECTED

Review is only for general conformance with the design concept of the project and general compliance with the information included in the Contract Documents. [illegible] ... in a safe and satisfactory manner.

Electrical Consulting Engineer
Date 3/16/06 By [signature]

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY
Reviewed by: [signature]
Fire & Life Safety South
APR 11 2006

Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times.

REV#	DATE	SUBMITTED FOR:
1	6/1/2005	A.H.J. APPROVAL
2	03/06/2006	A.H.J. APPROVAL
3		

DRAWN BY
WALLACE SIMS

ALPHA FIRE ALARM CORPORATION
LIC C-10, C-16 761540 ACO#5565
650 Sweeney Lane
San Luis Obispo, CA 93401
(805) 541-2527 FAX: 784-0868

CAL POLY
BONDERSON ENGINEERING BLDG
SAN LUIS OBISPO, CA
SFM ____

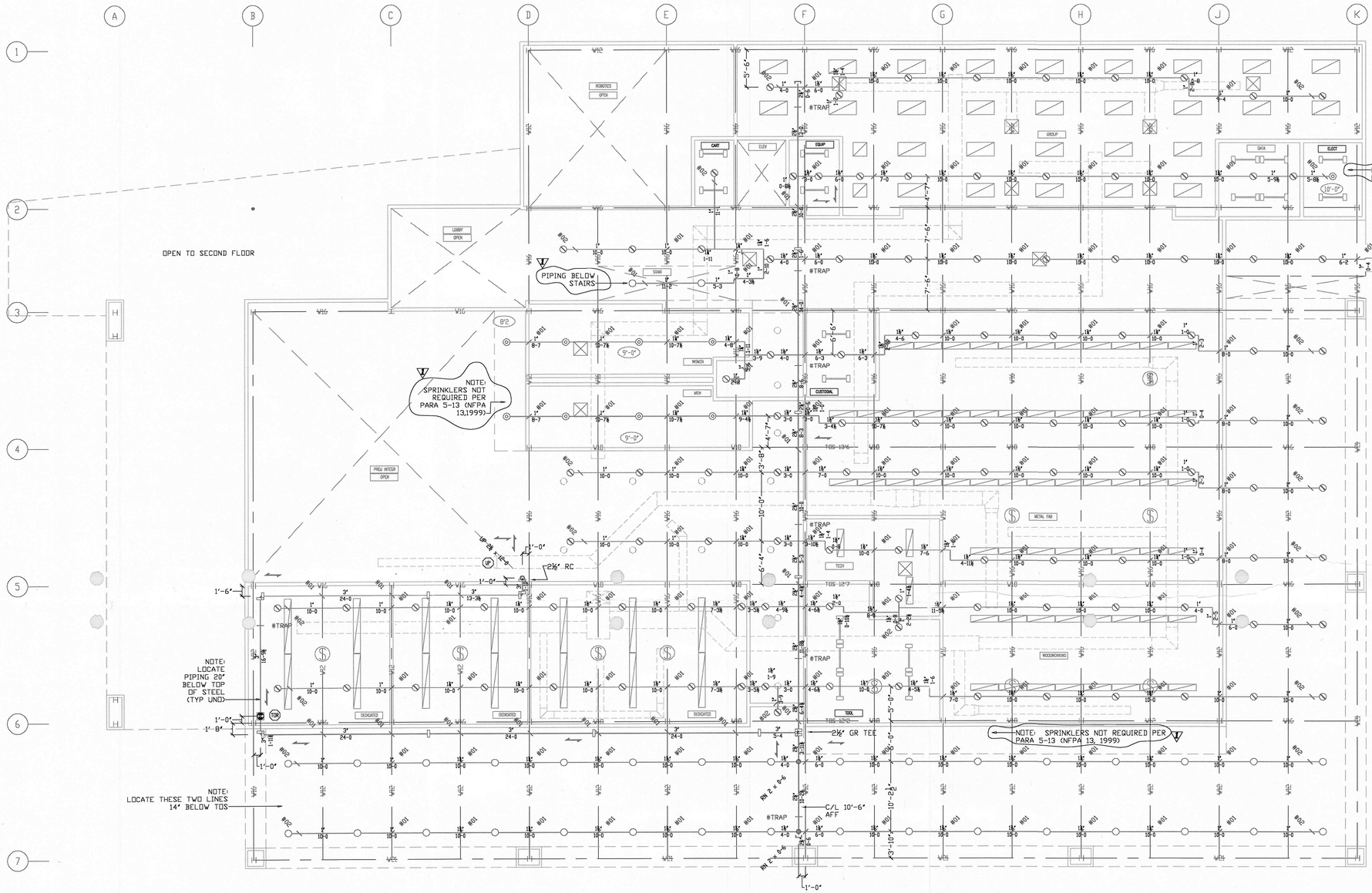
STATE:

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICES
AC ____ FLS ____ SS ____
DATE ____

JOB #	523-05
START DATE	6/1/2005

SHEET
FA-4

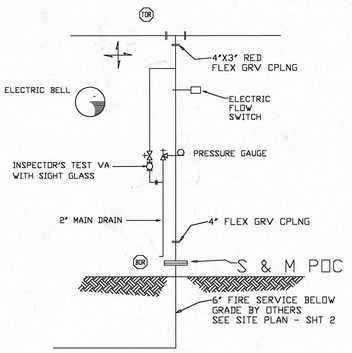
Appendix D



GROUND LEVEL FLOOR PLAN

FF = 0'-0"

SCALE: 1/8" = 1'-0"



4" RISER ASSY

NO SCALE

DESIGN

	PUBLIC AREAS, CLASSROOMS	STORAGE, EQUIPMENT, MAINTAINANCE
OCCUPANACY:	LIGHT HAZARD	ORD HAZARD GP 1
DENSITY:	.10 GPM/SF	.15 GPM/SF
MAX HEAD SPACING:	225 SF	130 GPM/SF
REMOTE AREA:	SEE FLOOR PLAN (PARA 7-2.3.2.4)	

PIPING: 2 1/2"-4" - SCHED 10 WITH GRVD FITTINGS
1"-2" - SCHED 30 WITH C I THREADED FITTINGS

LATERAL BRACE
MAX SPACING: 40 FT

LONGITUDINAL BRACE
MAX SPACING: 80 FT

SWAY BRACING

NO SCALE

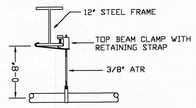
"FIG C" - TABLE 4-14.4.3.5.6

SPRINKLER PIPING LOADS

DIA	TYPE	LENGTH	1/2 WT/FT	1/2 TOTAL WT
1"	SCH 30	50 FT	1.03 LB	51.5 LB
1¼"	SCH 30	50 FT	1.47 LB	73.5 LB
1½"	SCH 30	100 FT	1.81 LB	181 LB
2½"	SCH 10	60 FT	2.95 LB	177 LB

TOTAL 1/2 WT OF PIPING 483 LB
FITTINGS ALLOW 15% 73 LB
TOTAL 556 LB

LICENSED FIRE PROTECTION CONTRACTOR
S & M FIRE PROTECTION
C-16
LICENSE No. 713250
STATE OF CALIFORNIA



HANGER 01

NO SCALE

Reviewed
Rejected
Furnish as Corrected
Revise and Resubmit
Submit Specified Item

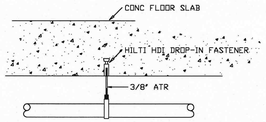
This review is only for general conformance with the design concept and the information shown on the Construction Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the plans and specifications. Review of a specific item shall not include review of an assembly of which the item is a component. The contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all other trades and performing all Work in a safe and satisfactory manner.

See Attached Comment Sheet

South Coast Engineering Group, Inc.
Reviewed by
01/10/06
Date

APPROVAL FROM LOCAL FIRE MARSHAL REQUIRED.

MAINO CONSTRUCTION COMPANY, INCORPORATED
Job Name: Bonderson
Submittal No.: 21.1 Spec Section: 13915
"I have reviewed this submittal according to my responsibilities under the Contract Documents."
Signed: Date: 12-8-05



HANGER 02

NO SCALE

GENERAL NOTES

1. THE SPACING AND DETAILS OF THE SUPPORT AND BRACING OF THE FIRE SPRINKLER PIPING SHALL COMPLY WITH THE 1999 EDITION OF NFPA 13.
2. INSTALLATION OF THE SPRINKLER SYSTEM SHALL NOT BE STARTED UNTIL COMPLETE PLANS AND SPECIFICATIONS (INCLUDING WATER SUPPLY INFORMATION) HAVE BEEN APPROVED BY THE STATE FIRE MARSHAL. DRAWINGS AND CALCULATIONS SHALL BE STAMPED AND SIGNED BY A LICENSED C-16 FIRE PROTECTION CONTRACTOR.
3. AT VARIOUS STAGES AND UPON COMPLETION, THE SYSTEM MUST BE TESTED IN THE PRESENCE OF THE ENFORCING AGENCY.
4. PENETRATIONS OF RATED ASSEMBLIES SHALL BE FIRE-STOPPED. FIRE STOPPING SHALL BE AN APPROVED MATERIAL AS PRESCRIBED IN CALIFORNIA BUILDING CODE, SECTION 714.
5. ALL FIRE SPRINKLER DESIGN AND INSTALLATION SHALL COMPLY WITH THE 1999 EDITION OF NFPA 13
6. HEADS LOCATED ON PLAN ARE FOR VISUAL REFERENCE ONLY AND ARE NOT NECESSARILY CENTER LINE OF TILE.
7. THE LENGTH OF AN UNSUPPORTED ARMOVER TO A SPRINKLER SHALL NOT EXCEED 24 IN.
8. ALL PIPING SHALL BE HYDROSTATICALLY TESTED AT 200 PSI FOR 2 HRS PER NFPA 13 (1999) PARA 10-2.2.1
9. A SUPPLY OF SPARE SPRINKLERS SHALL BE PROVIDED PER NFPA 13 (1999) PARA 3-2.9

N

HANGERS

- HANGER - SEE DETAIL

REVISIONS			
NO.	DATE	BY	REVISION
1	6 Oct,2005	TPL	Per South Coast Engr Plan Review
2			
3			
4			
5			

SYMBOLS

- UPRIGHT ON LINE
- PENDANT ON LINE
- UPRIGHT ON 1" SPRIG
- PENDANT ON 1" DROP
- UPRIGHT OVER PENDANT
- OTHER
- SIDEWALL ON 1/2" OUTLET
- 1/2" DRY PENDANT

SYMBOLS

- SWAY BRACING

SYMBOLS

- PIPE UP/DOWN
- GRVD COUPLING (FLEX)
- GRVD COUPLING (RIGID)
- SPRINKLER RISER
- HYDRAULIC CALC NODE PT
- LINE NO
- MAIN PIECE NO

SPRINKLERS

MFG / MODEL	SIN	FINISH	K	SYMB	DEGREE	QTY
1/2" TYCO TY-FRB UPRIGHT	TY3131	BRASS	5.6	○	200	36
1/2" TYCO TY-FRB PENDANT ON 1" DROP	TY3231	CHROME	5.6	◎	155	9
1/2" TYCO TY-FRB UPRIGHT ON 10" SPRIG	TY3131	BRASS	5.6	○	200	111
TOTAL SPRINKLERS THIS SHEET:						156

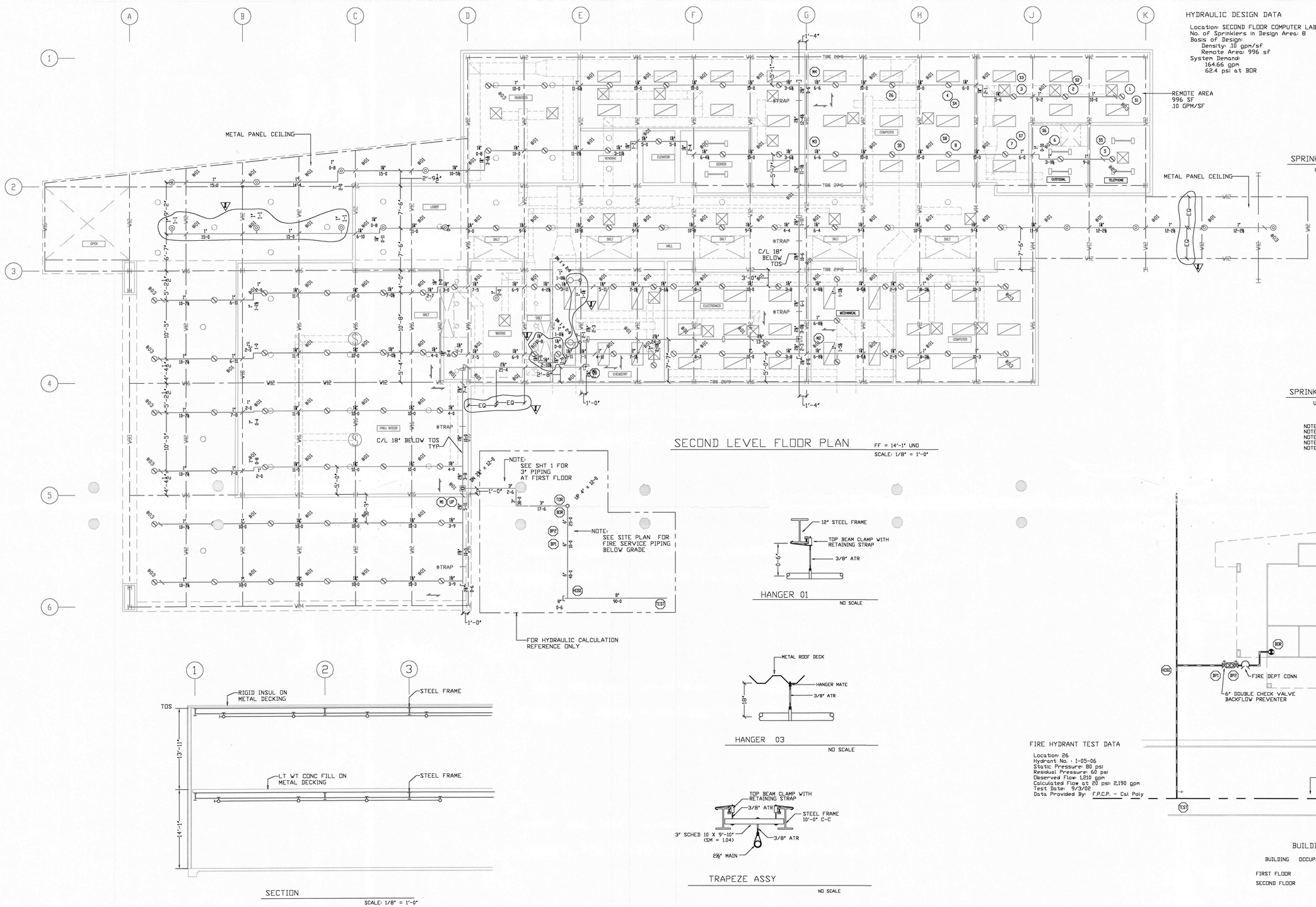
NOTE: THESE DRAWINGS ARE THE PROPERTY OF S & M FIRE PROTECTION, INC. ALL DESIGN, HYDRAULIC CALCULATIONS AND OTHER INFORMATION ON THE DRAWINGS ARE FOR USE ON THE SPECIFIED PROJECT BY S & M FIRE PROTECTION ONLY, AND SHALL NOT BE USED OTHERWISE.

BONDERSON PROJECTS CENTER
COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA

JTA JOB NO: 0309
PROJECT NO: PR 04-600

S & M FIRE PROTECTION, INC.
3523 S. Higuera St. Unit D
San Luis Obispo, CA 93401
C-16 713250
PHONE: (805) 541-4566

JOB: 05C- 728
DRAWN BY: LOVERIN
SCALE: NOTED
DATE: 8 July 2005



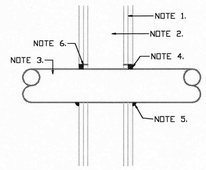
SECOND LEVEL FLOOR PLAN

FF = 14'-1" UNO

SCALE: 1/8" = 1'-0"

HYDRAULIC DESIGN DATA

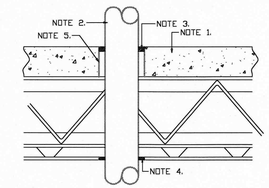
Location: SECOND FLOOR COMPUTER LAB
No. of Sprinklers in Design Area: 8
Basis of Design:
Density: .10 gpm/sf
Remote Area: 996 sf
System Demand:
164.66 gpm
62.4 psi at BDR



SPRINKLER PIPE THROUGH 1 HR OR 2 HR GYPSUM WALL ASSY

U.L. SYSTEM NO. W-L-1290 — NO SCALE

NOTE 1. GYPSUM WALL ASSY (1 HR OR 2 HR FIRE RATING)
NOTE 2. WOOD OR STEEL WALL STUDS
NOTE 3. MAX 4" NOM DIA STEEL PIPE (SCHED 10 OR HEAVIER)
NOTE 4. MINIMUM 5/8" DEPTH HILTI CP 606 FIRESTOP SEALANT
NOTE 5. MINIMUM 1/2" BEAD HILTI CP 606 FIRESTOP SEALANT
NOTE 6. MAX DIA OF OPENING 5" - MAX ANNULAR SPACE 1/2"



SPRINKLER PIPE THROUGH 1 HR CONC FLOOR/CEILING ASSY

U.L. SYSTEM NO. F-E-1004 — NO SCALE

NOTE 1. CONCRETE AND STEEL FLOOR/CEILING ASSY (1 HR FIRE RATING)
NOTE 2. MAX 6" NOM DIA STEEL PIPE (SCHED 40)
NOTE 3. MINIMUM 1/2" DEPTH HILTI FS-ONE FIRESTOP SEALANT
NOTE 4. MINIMUM 3/8" DEPTH HILTI FS-ONE FIRESTOP SEALANT
NOTE 5. DIAMETER OF OPENING TO BE MAX 1" LARGER THAT OD OF STEEL PIPE
ANNULAR SPACE = MIN 1/4", MAX 3/4"

SECTION

SCALE: 1/8" = 1'-0"

HANGER 01

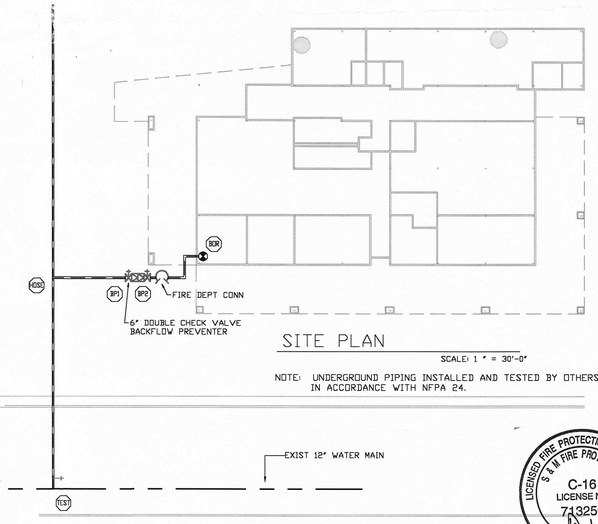
NO SCALE

HANGER 03

NO SCALE

TRAPEZE ASSY

NO SCALE



SITE PLAN

SCALE: 1 " = 30'-0"

NOTE: UNDERGROUND PIPING INSTALLED AND TESTED BY OTHERS IN ACCORDANCE WITH NFPA 24.

FIRE HYDRANT TEST DATA

Location: 26
Hydrant No.: I-05-06
Static Pressure: 80 psi
Residual Pressure: 60 psi
Observed Flow: 1,210 gpm
Calculated Flow at 20 psi: 2,190 gpm
Test Date: 9/3/02
Data Provided By: F.P.C.P. - Cal Poly

LICENSED FIRE PROTECTION CONTRACTOR
S & M FIRE PROTECTION
C-16
LICENSE No.
713250
STATE OF CALIFORNIA

BUILDING CODE ANALYSIS

BUILDING	OCCUPANCY GROUP	CONST TYPE	HEIGHT	AREA
FIRST FLOOR	B/F	II-N SPRINK	14'-1"	12,240 SF
SECOND FLOOR	B/F	II-N SPRINK	29'	6,335 SF

HANGERS

- HANGER - SEE DETAIL

SYMBOLS

- O UPRIGHT ON LINE
- ⊗ PENDANT ON LINE
- ◉ UPRIGHT ON 1" SPRIG
- ◎ PENDANT ON 1" DROP
- ✪ UPRIGHT OVER PENDANT
- ✱ OTHER
- ▷ SIDEWALL ON 1/2" OUTLET
- ● 1/2" DRY PENDANT

SYMBOLS

- SWAY BRACING

SYMBOLS

- PIPE UP/DOWN
- GRVD COUPLING (FLEX)
- GRVD COUPLING (RIGID)
- SPRINKLER RISER
- HYDRAULIC CALC NODE PT
- LINE NO
- MAIN PIECE NO

REVISIONS

NO.	DATE	BY	REVISION
1	6 Oct, 2005	TPL	Per South Coast Engr Plan Review
2			
3			
4			
5			

SPRINKLERS

MFG / MODEL	SIN	FINISH	K	SYMB	DEGREE	QTY
1/2" TYCO TY-FRB PENDANT ON 1" DROP	TY3231	CHR	5.6	◎	155	15
1/2" TYCO TY-FRB UPRIGHT ON 8" SPRIG	TY3131	BRASS	5.6	⦸	200	97
1/2" TYCO TY-FRB UPRIGHT 1	TY3131	BRASS	5.6	○	200	2
TOTAL SPRINKLERS THIS SHEET:						114

NOTE: THESE DRAWINGS ARE THE PROPERTY OF S & M FIRE PROTECTION, INC. ALL DESIGN, HYDRAULIC CALCULATIONS AND OTHER INFORMATION ON THE DRAWINGS ARE FOR USE ON THE SPECIFIED PROJECT BY S & M FIRE PROTECTION ONLY, AND SHALL NOT BE USED OTHERWISE.

BONDERSON PROJECTS CENTER

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA

JTA JOB NO: 0309
PROJECT NO: PR 04-600

S & M FIRE PROTECTION, INC.
3523 S. Higuera St. Unit D
San Luis Obispo, CA 93401
C-16 713250
PHONE: (805) 541-4566

JOB: 05C- 728
DATE: 8 July 2005
DRAWN BY: LOVERIN
SCALE: NOTED

Appendix E

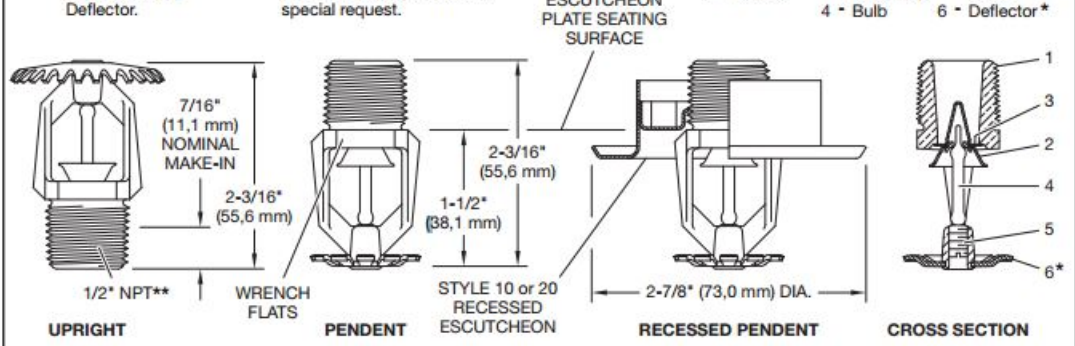
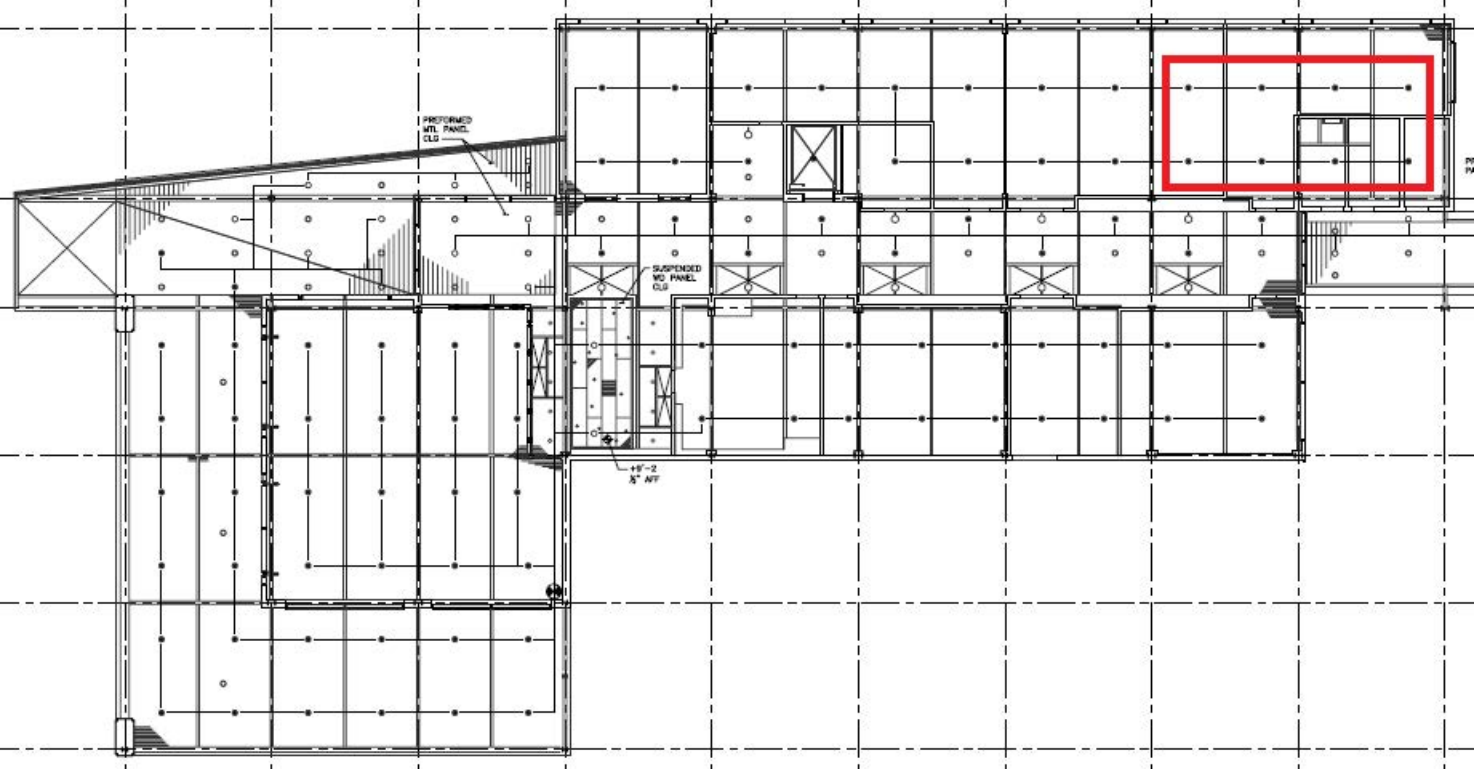


FIGURE 3
QUICK RESPONSE SERIES TY-FRB UPRIGHT (TY3131) AND PENDENT (TY3231) SPRINKLERS
5.6 K-FACTOR, 1/2 INCH NPT

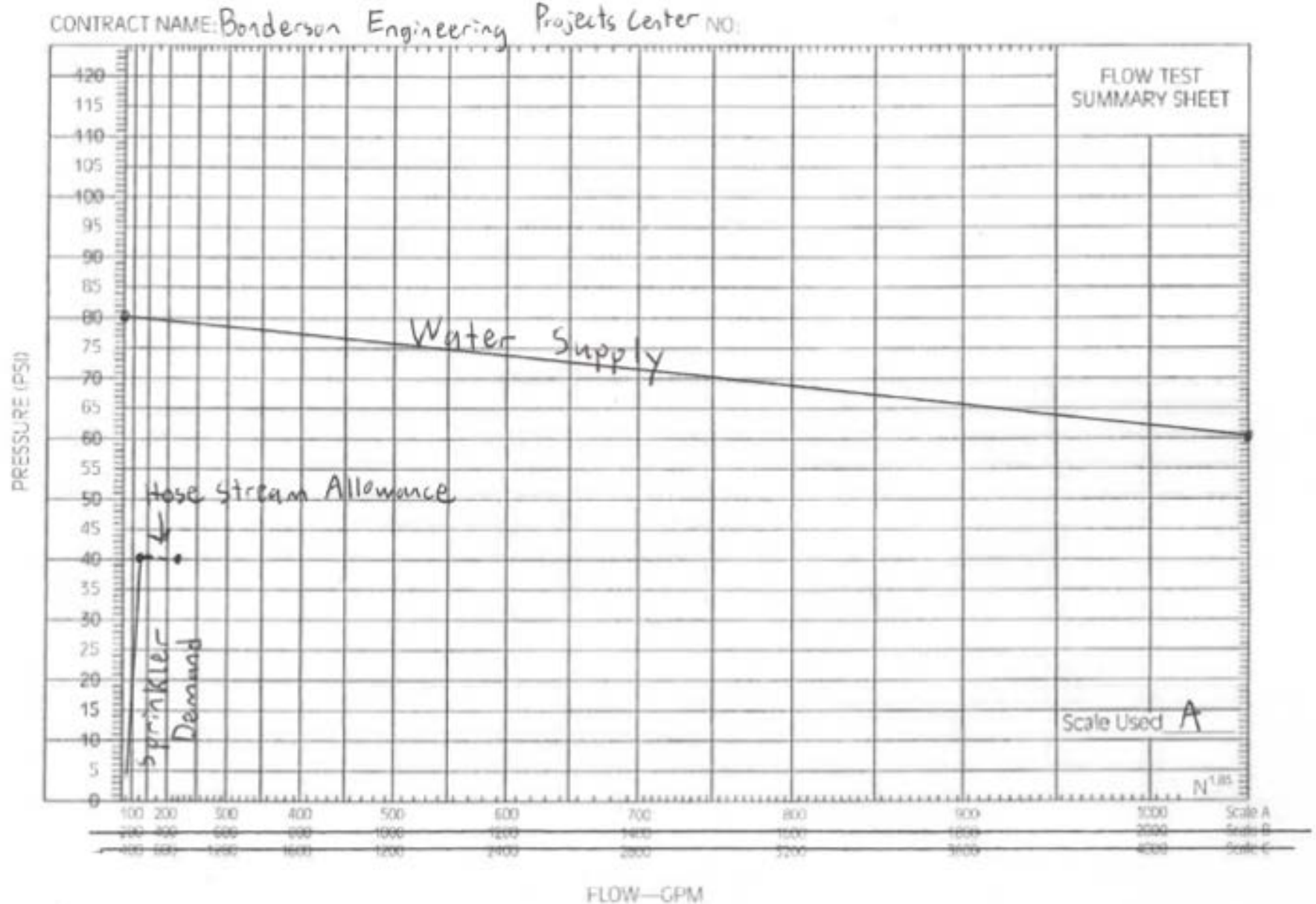
Appendix F


PREFORMED
MTL PANEL
CLG
SUSPENDED
WD PANEL
CLG
+8'-2
A.F.F.

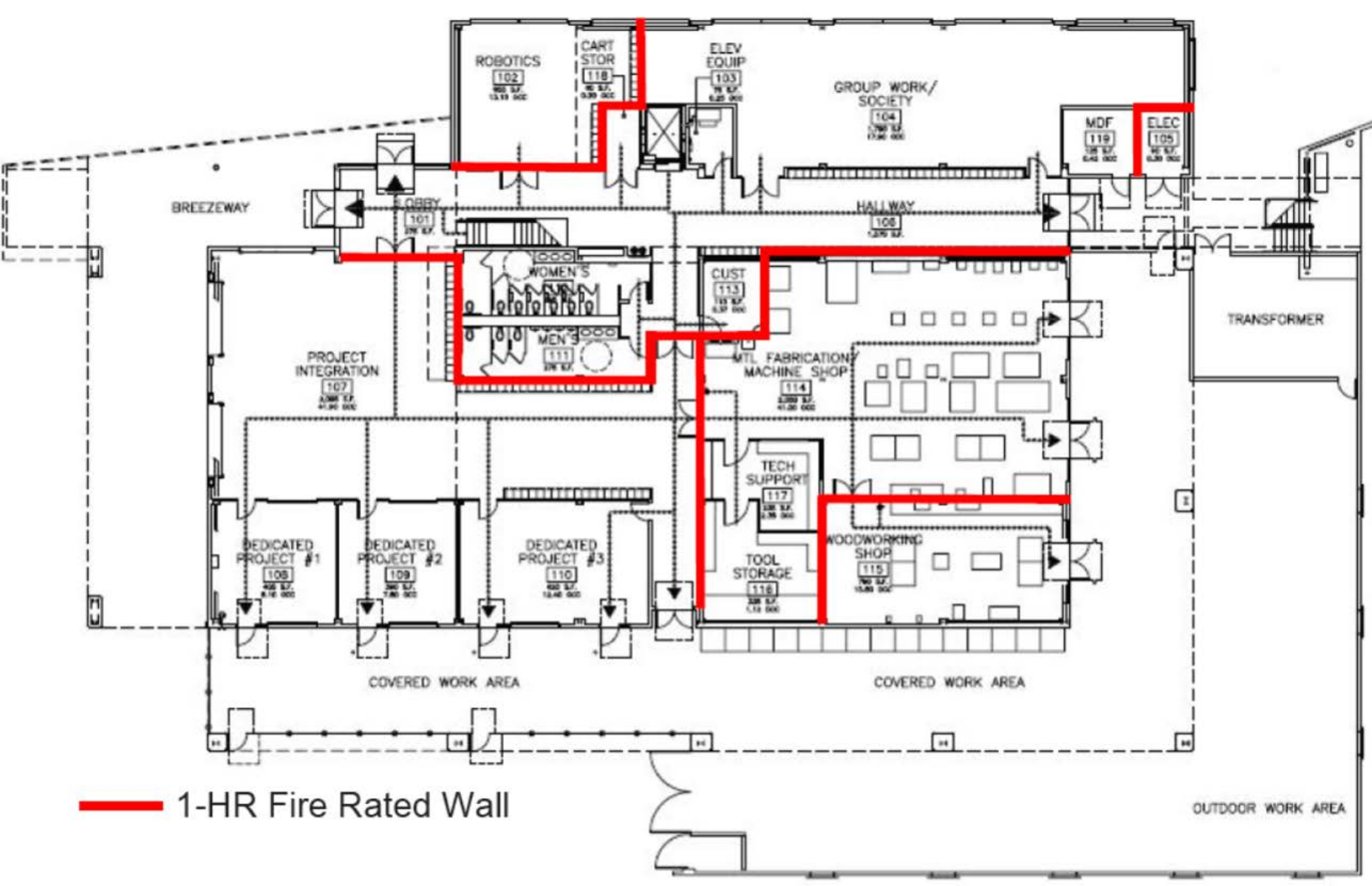
Appendix G

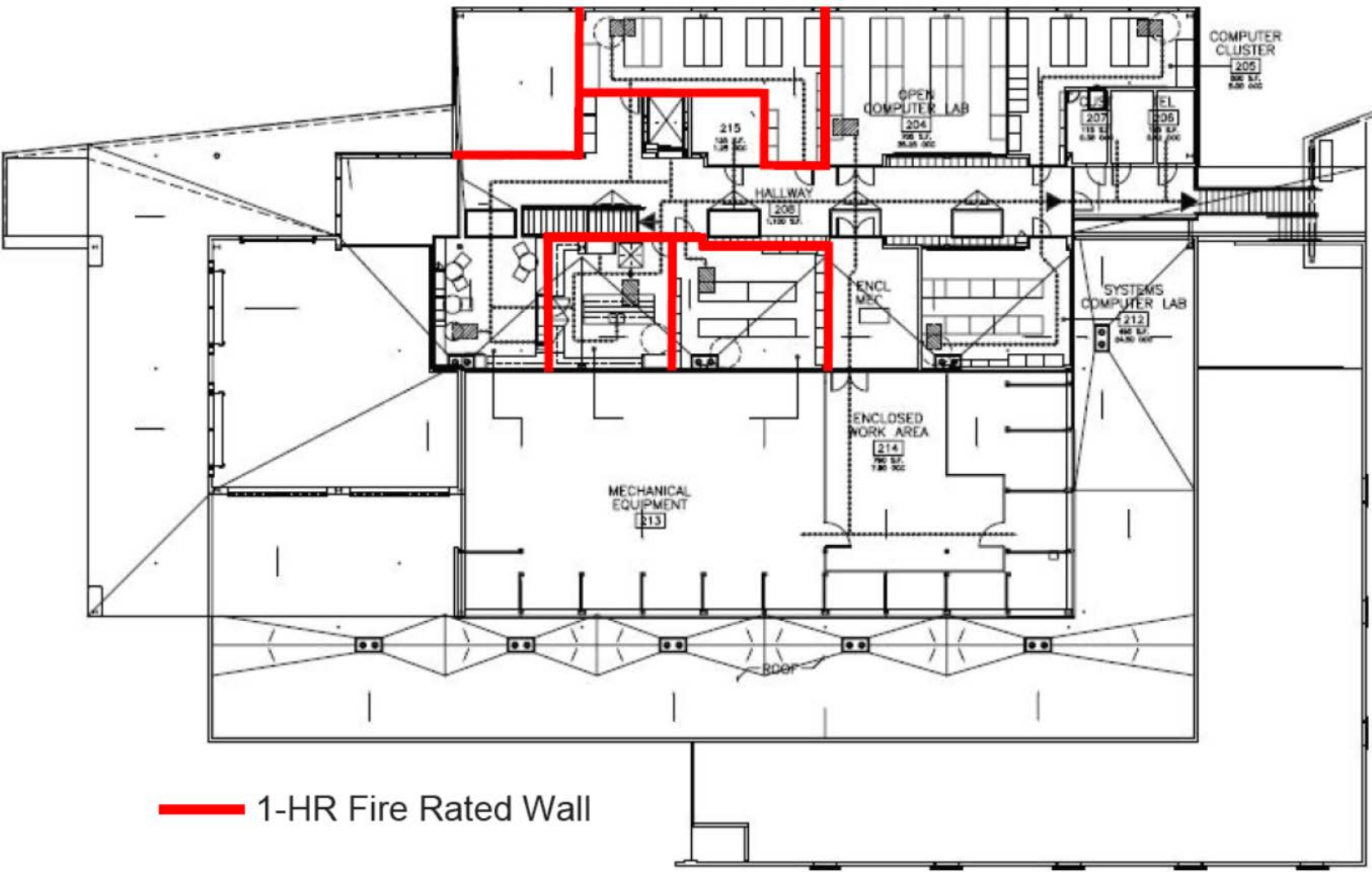
Step No.	Nozzle Ident and Location		Flow in gpm		Pipe size	Pipe Fittings and Devices	Equivalent Pipe Length			Friction loss (psi/ft)		Pressure Summary		Normal Pressure		Notes	
1	1	BL-1	q				L	10	C=	120	Pt	7.0	Pt		k=	5.6
							F				Pe		Pv		Q=	123.75 x 0.10
			Q	12.4	1.049		T	10	pf	0.054	Pf	0.5	Pn		Pt=	(12.4/5.6)^2
2	2		q	15.4			L	9.167	C=	120	Pt	7.5	Pt		k=	5.6
							F				Pe		Pv			
			Q	27.8	1.049		T	9.167	pf	0.239	Pf	2.2	Pn			
3	3		q	17.5			L	13.583	C=	120	Pt	9.7	Pt		k=	5.6
						2-90 Elbow	F	8			Pe		Pv			
			Q	45.2	1.61		T	21.583	pf	0.073	Pf	1.6	Pn			
4	4	DN	q	18.8			L	27.833	C=	120	Pt	11.3	Pt		k=	5.6
		RN				2-Tees	F	16			Pe	0.4	Pv			
			Q	64.1	1.61		T	43.833	pf	0.139	Pf	6.1	Pn			
5		CM	q	0.0			L	12.375	C=	120	Pt	17.8	Pt		k=	5.6
		To					F				Pe		Pv			
		BL-2	Q	64.1	2.635		T	12.375	pf	0.013	Pf	0.2	Pn			
6		BL-2	q	64.0		3-Tees	L	125.142	C=	120	Pt	18.0	Pt		k=	15.1
		CM				3-90 Elbow	F	54			Pe	5.2	Pv		Pe=	12 x 0.433
			Q	128.1	2.635		T	179.142	pf	0.046	Pf	8.2	Pn			
7		CM	q	0.0			L	58	C=	120	Pt	31.3	Pt		k=	15.1
		to				3-90 Elbow	F	21			Pe		Pv			
		TOR	Q	128.1	3.26		T	79	pf	0.016	Pf	1.3	Pn			
8		TOR	q				L	12	C=	120	Pt	32.6	Pt			
		to					F				Pe	5.2	Pv		Pe=	12 x 0.433
		BOR	Q	128.1	4.26		T		pf	0.004	Pf	0.0	Pn			
			q	0.0			L		C=		Pt	37.8	Pt			

Appendix H


CONTRACT NAME: Borderson Engineering Projects Center NO:
FLOW TEST SUMMARY SHEET
PRESSURE (PSI)
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Water Supply
Hose Stream Allowance
Sprinkler Demand
Scale Used A
N^1.85
100 200 300 400 500 600 700 800 900 1000
Scale A
Scale B
Scale C
FLOW—GPM

Appendix I


ROBOTICS
102
CART STOR
118
ELEV EQUIP
103
GROUP WORK/ SOCIETY
104
MDF
119
ELEC
105
BREEZEWAY
LOBBY
101
HALLWAY
106
WOMEN'S
MEN'S
111
CUST
113
TRANSFORMER
PROJECT INTEGRATION
107
MTL FABRICATION/ MACHINE SHOP
114
TECH SUPPORT
117
DEDICATED PROJECT #1
108
DEDICATED PROJECT #2
109
DEDICATED PROJECT #3
110
TOOL STORAGE
116
WOODWORKING SHOP
115
COVERED WORK AREA
COVERED WORK AREA
1-HR Fire Rated Wall
OUTDOOR WORK AREA


COMPUTER CLUSTER
205
OPEN COMPUTER LAB
204
215
207
EL
206
HALLWAY
208
ENCL MEC
SYSTEMS COMPUTER LAB
212
ENCLOSED WORK AREA
214
MECHANICAL EQUIPMENT
213
ROOF
1-HR Fire Rated Wall