Fire and Life Safety Analysis

UW Medicine Lake Union Phase 3.1
Seattle, WA

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FPE 596 Culminating Project
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Keywords: Fire and Life Safety Analysis, Performance Based Design, Egress, ASET, RSET

Executive Summary

This report provides a summary of the fire protection and life safety features for UW Medicine Lake Union, a research and laboratory building, in accordance with Seattle Building Code (SBC), International Building Code (IBC), and Life Safety Code (NFPA 101).

The objective of this report is to identify if UW Medicine Lake Union meets both the prescriptive and performance based code. The primary fire safety goal is to provide life safety system that reduced the risk of fire-related injuries and loss of life due to fire.

The prescriptive analysis is used to identify the building integrity per code. This evaluates the egress capacity, fire detection, fire suppression and structural fire protection.

The UW Medicine Lake Union includes numerous laboratories that regularly utilize various hazardous materials. According to the literature in the Architectural drawings, the design team worked with the university does that the chemical quantities in these areas would not exceed the limits set forth in the code. With these limits in place, portions of the facility did not need to be classified as hazardous occupancy, and the special provisions associated with a hazardous occupancy.

Although its spaces are used in various ways, the building was able to be classified as business occupancy. Hazardous occupancy areas were not required because hazardous materials were limited to the code-defined exempt quantities. These details helped simplify the overall life safety and egress system, while providing appropriated levels of life safety.

UW Medicine Lake Union Building is high rise building with seven story research and development laboratory and two levels of below grade parking garages. It includes testing and research laboratories, laboratory support, offices and conference room. It is approximately 317,382 square feet in gross area and a building height of 109 feet. It is classified as B occupancy classification. The facility is protected throughout by automatic sprinkler and fire alarm systems.

The building was constructed in 2011 in accordance with the 2009 Seattle Building Code with a Type 1A construction. See 2.6 Type and Description of Construction. The total occupant load is 2797 occupants. See Table 4: Summary of Occupant Loads.

The UW Medicine Lake Union building has six (6) exit discharge. The Main and Back Entrance exit door have 72” doors; P1 (Stair 1), Retail and South exit (stair 3) door have 36” doors, and the garage exit door (stair 4) have 44” door that leads to the public way. See Figure 19: Egress Capacity, Travel Distance & Wall Rating - Level 1 for location of exit discharge.

Stair 1, 3 and 4 have 44” stairs with 36” door. Stair 2 have 62” stairs with 4 doors around it namely (2) 36”,(1) 42” and (1) 48”doors. Stair 15 has 36” stairs with 36” door. The basic requirement for all exit access path is that direct and unobstructed paths to exits are provided through easily identifiable routes.

The Fire Alarm System is comprised of a Notifier NFS2-3030D Fire Alarm Control Panel, smoke detectors, manual pull stations, addressable interface modules, addressable interface relays, Fire Alarm Horn/Strobes (Clear Strobes), Smoke detection are located in transformer, electrical and communication rooms that do not have sprinkler protection, elevator machine rooms and elevator lobbies, within 5 feet of doors leading to pressurized stairways (except at Parking areas) and duct smoke detection. Refer to Chapter 3 Fire Alarm and Detection.

Emergency voice alarm/communication system is provided in accordance with SBC 907.5.2.2. Notification devices are activated by smoke or heat detectors, sprinkler waterflow, or manual pull stations. Audible alarms are provided per SBC 907.5.1 and visible alarms per SBC 907.5.3. A code alternate is provided for Vivarium and BSL3 areas. See 3.2.2.3 Code Alternate for Vivarium and BSL3.

Fire Protection standpipe and automatic fire sprinkler systems are supplied by an electric fire pump with automatic transfer switch to emergency generator power. The fire pump will draw water from an on-site storage tank (secondary water supply) located next to the fire pump room on Basement Level 3. The capacity of the water storage tank is 44,300 gallons with a net usable water capacity of 33,000 gallons. The water storage tank fill will be a 6” diameter water line supplied by a dedicated fire water service connection to the city water control valves and a 6” manual by pass valve. The fire pump room is constructed with 2-hour fire rated construction. Refer to Chapter 4 Fire Suppression Systems.

The performance based design is used to determine how the building will perform under a fire condition. The tenability criteria are: temperature less than 60°C, carbon monoxide less than 1400 ppm, visibility greater than 10 meters and a smoke layer height to be greater than 2 meters off the floor. See Chapter 8 Performance Based Analysis for analysis.

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Abbreviations

AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
APS	Auxiliary Power Supply
ASET	Available Safe Egress Time
CMU	concrete masonry unit
EA	Exhaust Air
EAP	Evacuation Assembly Point
EOL	End of Line
EPSS	Emergency Power Supply System
EVAC	Emergency voice/alarm communication
FACP	Fire Alarm Control Panel
FATC	Fire Alarm Terminal Cabinet
FDS	Fire Dynamic Simulator
FED	Fractional Effective Dose
FM	Factory Mutual
FSD	Fire Smoke dampers
GPM	Gallons Per Minute
GWB	Gypsum Wall Board
HRR	Heat Release Rate
IBC	International Building Code
IDF	Intermediate Distribution Frame
IFC	International Fire Code
ITM	Inspection, Testing and Maintenance
kW	Kilowatts
MNP	Mass Notification Panel
MNS	Mass Notification System
NAC	Notification Appliance Circuit
NFPA	National Fire Protection Association
NIST	National Institute of Technology
ppm	parts per million
psi	Pounds per Square Inch
RA	Return Air
RSET	Required Safe Egress Time
SA	Supply Air
SBC	Seattle Building Code
SFD	Seattle Fire Department
SFPE	Society of Fire Protection Engineers
SFRM	Spray-Applied Resistance material
SLC	Signal Line Circuit
UL	Underwriters Laboratory
UW	University of Washington
VAC	volts alternating current
WA	Washington
WAC	Washington Administrative Code

Chapter 1 General

1.1 Building Description

UW Medicine Lake Union Building Phase 3.1 is located in Seattle, WA. It is high rise building with seven story research and development laboratory and two levels of below grade parking garages. The building height is 109 feet. It includes testing and research laboratories, laboratory support, offices and conference room. It is approximately 317,382 square feet in gross area. The facility is protected throughout by automatic sprinkler and fire alarm systems.

Table 1: Building Summary

Level	Use	Gross SF
Basement 3	Parking , Group S-2	55,660
Basement 2	Parking, Group S-2	55,660
Basement 1	Parking/Mechanical, Group S-2	26,995
Basement 1	Research, Group B	22,685
Basement 1	Loading Dock, Group S-1	5,980
Level 1	General sales and services, eating establishment, Group M	294
Level 1	Assembly, Group A	1,600
Level 1	Research, Group B	16,819
Level 2	Research, Group B	19,828
Level 3	Research, Group B	19,925
Level 4	Research, Group B	19,925
Level 5	Research, Group B	19,963
Level 6	Research, Group B	19,925
Level 7	Research, Group B	19,931
Penthouse	Mechanical, Group S-2	12,192
	TOTAL AREA	317,382

1.2 Site Plan

Shown here is the site plan for UW Medicine Lake Union Phase 3.1 and the future phase 3.2. This will be considered as a single building, although each tower will have its own fire command center. A certain elements of phase 3.1 will have the capacity to serve phase 3.2. These components are the sprinkler water supply, secondary water storage and fire pump. The generator room is sized to accommodate the future generator for 3.2; the generator installed initially will only support the portions built under Phase 3.1.

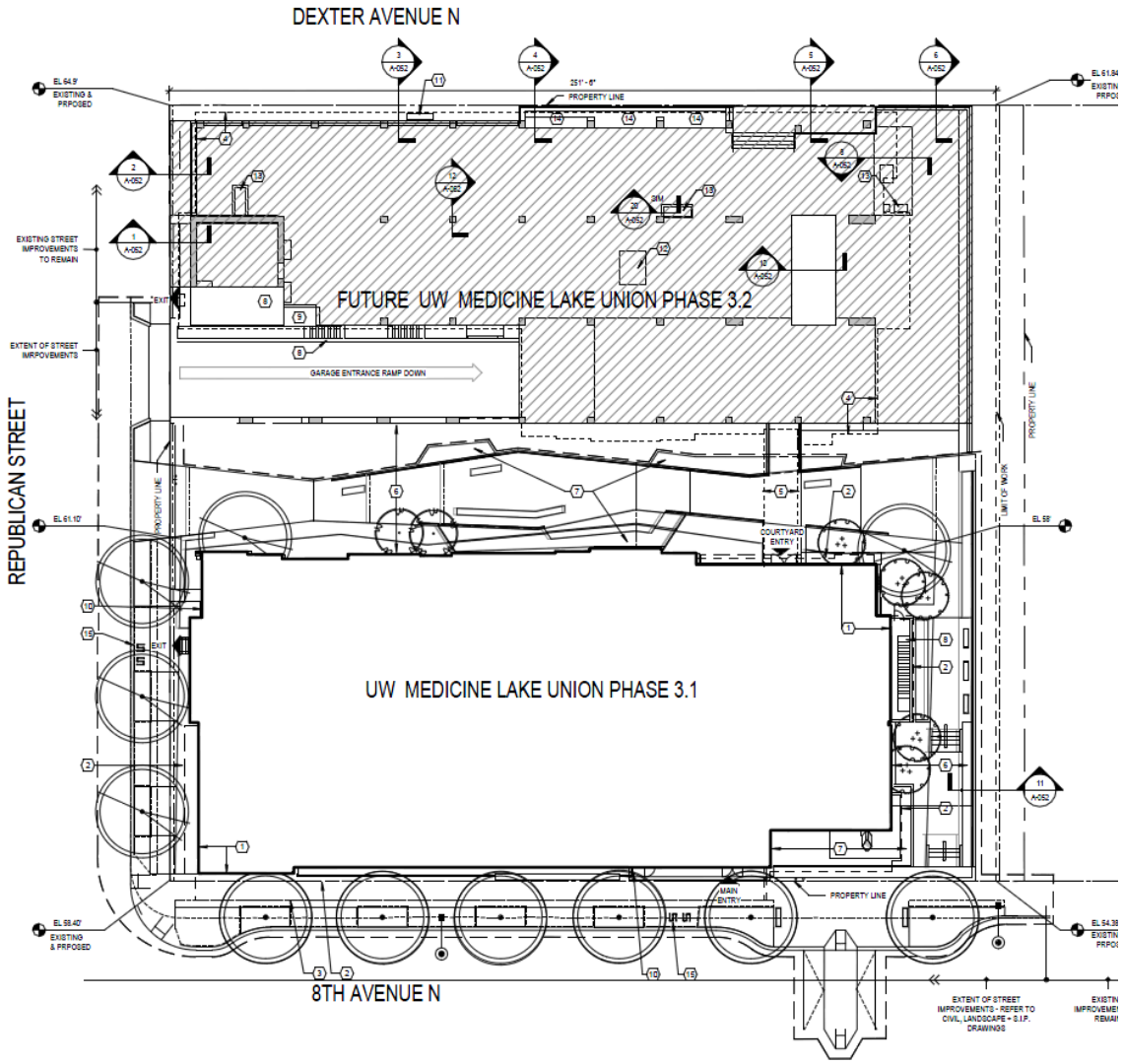

Figure 1: Site Plan

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1.2.1 Section

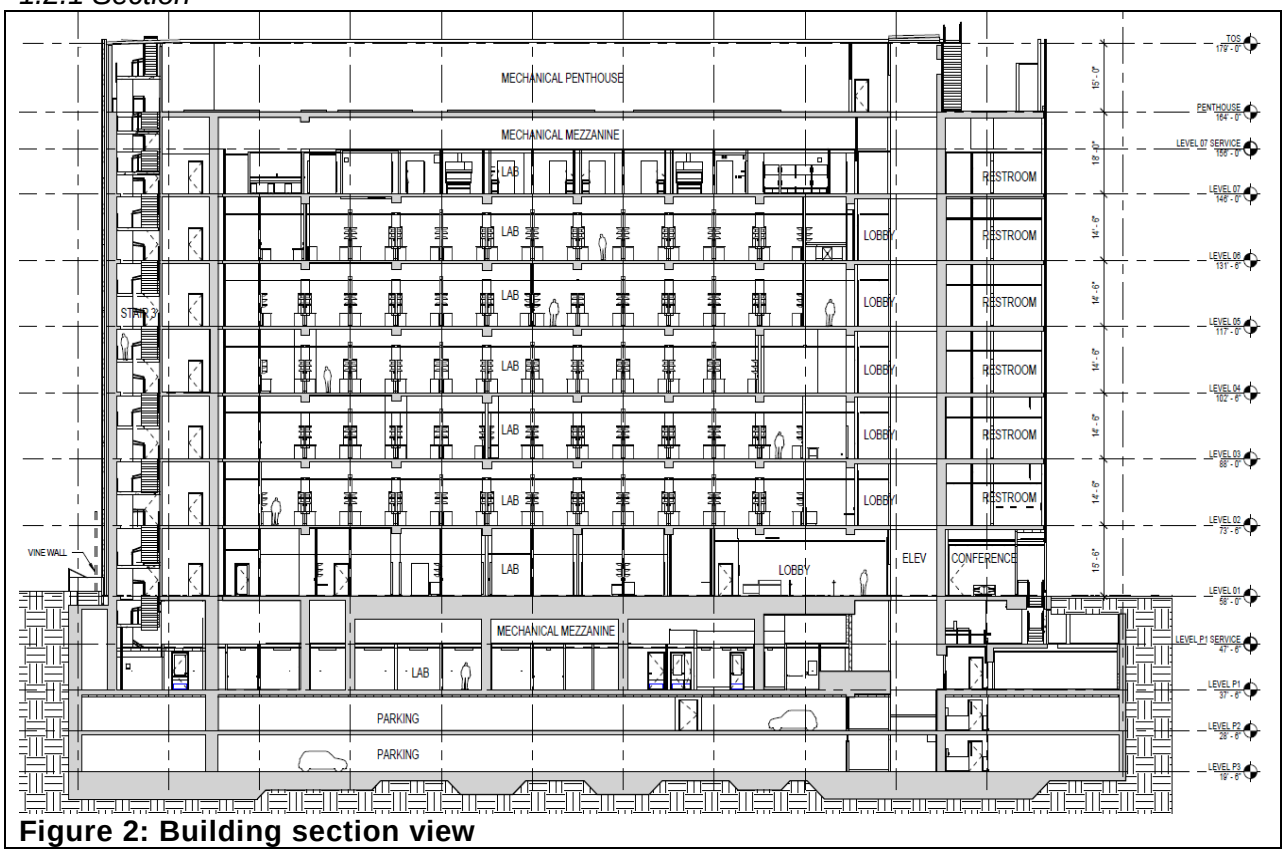


Figure 2: Building section view

1.3 Applicable codes

- 2009 Seattle Building Code
- 2012 International Building Code
- 2012 NFPA 101
- 2010 NFPA 13
- 2010 NFPA 72

1.4 Seattle Building Code for High-Rise Building (Section 403)

Per Seattle Building Code, a pre-design conference should be held at least 60 days prior to application-arrange a predesign conference to; provide documentation /appropriate analyses and schematic drawings two weeks prior to conference; approved predesign meeting minutes are required prior to permit application and shall be inserted into plans as part of the permanent permit record. Here is a copy of the high-rise pre design conference held by Seattle official and the design team.

Table 2 : High-Rise Predesign Conference

Section	2009 Seattle Building Code (SBC)	Pre-design Conference
403.1	Applicability	
	High-rise buildings shall comply with Sections 403.2 through 403.6.	High-rise provisions of 403.1 apply

Section	2009 Seattle Building Code (SBC)	Pre-design Conference
403.1.1	Predesign Conference	
	At least 60 days prior to application, the applicant shall arrange a predesign conference with the design team, the building official and the fire code official, to review the propose emergency life safety systems for the building and the protection of the life safety system,. The purpose of the meeting is to obtain conceptual approval form the building official and fire code official of the proposed systems and to allow for design based upon the latest state-of-the art.	Life-safety systems will be provided. These include: fire protection sprinkler system. Standpipe system, fire pump, and secondary water supply at basement level 3; smoke detection; fire alarm system with voice communication; fire department communication systems with radio enhancement; fire command center; emergency power provided by on-site generator; stair and elevator hoistway pressurization; required signage; elevator recall.
403.1.2	Testing	
	All mechanical and electrical equipment installed according to approved plans and specification pursuant to this section shall be tested and proven to be in proper working condition to the satisfaction of the fire code official before issuance of Certificate of occupancy. Such systems shall be maintained in accordance with the fire code.	Systems commissioning will be performed, including testing and reposting similar to the requirement of SBC 909.18 & 909.19.
403.2.1	Reduction in fire-resistance rating	
	The fire-resistance-rating reductions listed in Sections 403.2.1.1 and 403.2.1.2 shall be allowed in buildings that have sprinkler control valves equipped with supervisory initiating devices and water-flow initiating devices for each floor.	Project does not intend to utilize this provision
403.2.3	Structural integrity of interior exit stairways and elevator hoistway enclosures.	
	For high-rise buildings of Risk Category III or IV in accordance with Section 1604.5, and for all buildings that are more than 420 feet (128 000 mm) in building height, enclosures for interior exit stairways and elevator hoistway enclosures shall comply with Sections 403.2.3.1 through 403.2.3.4.	N/A
403.3	Automatic sprinkler system.	

Section	2009 Seattle Building Code (SBC)	Pre-design Conference
	Buildings and structures shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 and a secondary water supply where required by Section 903.3.5.2.	Combination standpipe/sprinkler risers with minimum 6" pipe will be provide in each stair enclosure, with interconnection and service from two standpipe risers. Floor sprinkler systems connections to each standpipe to have shut-off valves, water flow devices, and check valves. Two four-way SFD connections will be provided on separate streets and will be well separated - a minimum of one to be connected to riser above riser isolation valve. Secondary water supply (33,000 gallons is provided at Basement level 3 and basement level 2. this water supply will also serve the future phase 3.2 building. Adjacent fire pump at basement level 3 is enclosed with 2-hour fire barriers.
403.3.1	Number of sprinkler risers and system design.	
	Each sprinkler system zone in buildings that are more than 420 feet in building height shall be supplied by no fewer than two risers. Each riser shall supply sprinklers on alternate floors. If more than two risers are provided for a zone, sprinklers on adjacent floors shall not be supplied from the same riser.	
403.3.1.1	Riser location.	
	Sprinkler risers shall be placed in interior exit stairways and ramps that are remotely located in accordance with Section 1015.2.	
403.4.1	Smoke detection	
	Smoke detection shall be provided in accordance with Section 907.2.13.1.	• Smoke detection will be provided in accordance with SBC 907.2.13.1 • A non-restorable heat detector shall be provided in the transformer vault • Elevator machine rooms and elevator lobbies • Within 5 feet of doors leading to pressurized stairway (except at parking levels) • Duct detector per SBC 907.13.1.2 and 907.3.1
403.4.2	Fire alarm system	

Section	2009 Seattle Building Code (SBC)	Pre-design Conference
	A fire alarm system shall be provided in accordance with Section 907.2.13.	Notification to be activated by smoke or heat detector, sprinkler water flow, manual fire alarm. Audible alarms provided per SBC 907.5.2.1, visible alarm per SBC 907.5.2.3. Note: code alternate will be provided to reduce the required levels of audibility and visibility in animal holding rooms. SFD have scientific justification for audibility/visibility levels that are below life/safety threshold.
403.4.3	Emergency voice/alarm communication system	
	An emergency voice/alarm communication system shall be provided in accordance with Section 907.5.2.2.	Emergency voice/alarm communication system will be proved in accordance with SBC 907.5.2.2 • System to ne initiated by signal from the fire detector, sprinkler water flow or manual pull station • Automatically sound alert tome followed by approved voice instructions • Fire alarm initiation places the fire floor, floor above and two floors below into alarm per SBC 907.5.2 • Speaker thought the building to provide paging zones for: elevator groups; each exit stairways, each floor
403.4.4	Emergency responder radio coverage	
	Emergency responder radio coverage shall be provided in accordance with Section 510 of the International Fire Code.	Fire department communication to be via radio per Seattle fire code 510 and Appendix J.
403.4.5	Fire command.	
	A fire command center complying with Section 911 shall be provided in a location approved by the fire department.	Fire Command center will be provided in accordance with SBC section 911. Refer to Level 1 plan for location and access. • Minimum of 200 sq. ft, minimum dimension 10 feet. • 1-hour separation from rest of building • To contain all features required by SBC 911.1.5 • To contain elevator status panel per SBC 3017.2

Section	2009 Seattle Building Code (SBC)	Pre-design Conference
403.4.6	Smoke removal	
	Stricken from SBC	
403.4.8	Emergency power systems	
	An emergency power system complying with Chapter 27 and Section 403.4.8.2 shall be provided for emergency power loads specified in Section 403.4.8.1.	Emergency power will be provided by a diesel fuel generator on Basement level 1. Installation follow Director's rule 8-2005. Less than 660 gallons for fuel is located at the generator, so the generator is not separated from the surrounding parking garage.
403.4.8.1	Emergency power loads	
	The following are classified as emergency power loads: 1. Exit signs and means of egress illumination required by Chapter 10; 2. Elevator car lighting; 3. Emergency voice/alarm communications systems; 4. Automatic fire detection systems; 5. Fire alarm systems 6. Electrically powered fire pumps. 7. Power and lighting for mechanical equipment rooms and the fire commence center required by section 403.4.5 8. Ventilation and automatic fire detection equipment for pressurized stairways 9. Smoke control systems 10. A selected elevator in each bank, in accordance with section 3016.6	Generator power will emergency support loads in accordance with SBC 403.14.8.1 • Exit signs and means of egress illumination • Elevator car lighting • Emergency voice/alarm communications • Fire alarm and detection systems • Power and lighting for mechanical equipment rooms and the fire command center • Fire pumps • Ventilation and fire detection equipment for pressurized stairways and elevator hoistway • Smoke control systems • All elevators are to be capable of being run using emergency power, although only one elevator at a time needs to be on emergency power
403.5.1	Means of egress and evacuation.	
	The means of egress in high-rise buildings shall comply with Sections 403.5.1 through 403.5.6.	Separation of exit enclosure exceeds 30 feet. Refer to plans
403.5.2	Additional exit stairway	

Section	2009 Seattle Building Code (SBC)	Pre-design Conference
	For buildings other than Group R-2 that are more than 420 feet (128 000 mm) in building height, one additional exit stairway meeting the requirements of Sections 1009 and 1022 shall be provided in addition to the minimum number of exits required by Section 1021.1. The total width of any combination of remaining exit stairways with one exit stairway removed shall be not less than the total width required by Section 1005.1. Scissor stairs shall not be considered the additional exit stairway required by this section.	N/A
403.5.3	Stairway door operation	
	Stairway doors other than the exit discharge doors shall be permitted to be locked from the stairway side. Stairway doors that are locked from the stairway side shall be capable of being unlocked simultaneously without unlatching upon a signal from the fire command center and shall be capable of being unlocked simultaneously and automatically upon a signal from the fire alarm originating anywhere in the building. When stairway doors are installed that are not locked from the stairway side, wiring shall be installed to facilitate future installations of locking hardware.	Stairway doors will conform to SBC 403.5.3. Doors that are locked on the stairway side will simultaneously and automatically unlock without unlatching upon signal from the fire alarm system or from the fire command center. Stairway door unlock system will include roof access door and hatches.
403.5.3.1	Stairway communication system	
	A telephone or other two-way communications system connected to an approved constantly attended station shall be provided at not less than every fifth floor in each stairway	Stair communication system will be provided in accordance with SBC 403.5.3.1 • Telephone or other two-way system • Connected to approved, constantly-attended station • Located every 5th floor in each stairway.
403.5.3.2	Stairway penthouse	

Section	2009 Seattle Building Code (SBC)	Pre-design Conference
	All required exit stairways shall terminate at the roof in a penthouse with door complying with sections 1008.1 and 1008.1.2. The building official is permitted to approve an alternate design at the pre-design conference.	Roof penthouse is not provided, as they would exceed zoning height limitation. The following design was discussed. Please refer to floor plans. • Stair #3 will extend to Mechanical mezzanine in Level 7S. The stairs will continue to mechanical roof level with roof access provided by an oversized hatch. • Stair#2 will extend to Mechanical mezzanine in Level 7S. Separate access to the mechanical room will be provided by an outdoor stair, accessed directly from stair 2 enclosure.
403.5.4	Smoke Control in exit enclosure and elevator hoistway	
	Every required exit stairway serving floors more than 75 feet above the lowest level of fire department vehicle access shall be a smoke proof enclosure in accordance with Sections 909.20 and 1022.9.. Elevator hoistway shall comply with section 3020.	Stair enclosure and elevator hoistway pressurization is provided by dedicated fans located at the mechanical penthouse. • Fans are provided with emergency power • Supply air intake to be minimum of 20 feet from any exhaust outlet • A minimum of 2 smoke detectors to be installed in the supply duct, to shut down the fan when both detectors activate • A dampered relief opening is to be provided at the top of each pressurized stair enclosure • Pressurization systems are to be activated by fire alarm originating in any part of the building • Equipment wiring and ductwork to be protected in accordance with SBC 909.20.6.1.1
403.5.5	Luminous egress path markings.	

Section	2009 Seattle Building Code (SBC)	Pre-design Conference
	Luminous egress path markings shall be provided in accordance with Section 1024.	Markings to be provided within exit enclosures per SBC 1024.2. At leading edges of steps and landings, at handrails, at perimeter of landings, at obstacles, and at doors from enclosure. Marking will not be provided within lobby at the level of exit discharge.
403.6	Elevators.	
	Elevator installation and operation in high-rise buildings shall comply with Chapter 30and this section. In building with sorties that are located more than 160 feet above the lowest point of the fire department access, access to each floor shall be provided by not less than two elevators served by separate machine rooms.	Fire service is not required (no occupied floor above 120 feet)
403.6.1	Fire service access elevator	
	In buildings with an occupied floor more than 120 feet above the lowest level of fire department vehicle access, no fewer than two fire service access elevators, or all elevators, whichever is less, shall be provided in accordance with this section 3007.	N/A
403.6.2	Occupant evacuation elevators	
	Where installed in accordance with this Section, passenger elevators for general public use shall be permitted to be used for occupant self-evacuation.	The project does not intend elevators will be used of occupant self-evacuation. 1 hour elevator lobbies are not being provided. The Owners' fire safety and evacuation plan will address building egress.
403.7	Emergency operational plan	

Section	2009 Seattle Building Code (SBC)	Pre-design Conference
	Prior to the issuance of a Certificate of occupancy, the owner-occupant of the building shall assign a responsible person as the building's fire safety director to work with the fire code official in establishing an operational plan for the building. The operation plan shall contain the guidelines and procedures to the followed and responsibility of the fire department, building employees and tenants under emergency conditions, including special provisions for persons with disabilities. The plan shall also include procedures for operation, maintenance and testing of the life safety systems and the allowable use and occupancy of each portion of the building. One copy of the operational plan shall be filed with the fire code official and one shall be posted in the central control station prior to issuance of the Certificate of Occupancy.	Operational plan to be developed by University of Washington.

Chapter 2 Building Egress and Life safety features

2.1 Classification of Occupancy

Section 302.1 of the International Building Code (IBC) defines the Occupancy classification for this building. The occupancies include lobby, reception, lounges, conference room, seminar and break room are defined as “Group A” Occupancy; laboratories: testing and research, offices, janitor room are defined as “Group B” Occupancy; Retail as “Group M” Occupancy; mechanical room, electrical room as “Group S-1” Occupancy and storage & restroom as Group S-2” Occupancy

Section 303.1 defines “Group A” as the use of a building or structure for the gathering of persons for purposes. Section 304.1 defines “Group B” as the use of a building or structure, or a portion thereof, for office, professional or service-type transactions, including storage of records and accounts. Section 309.1 defines “Group M” as the use of a building or structure or a portion thereof, for the display and sale of merchandise and involves stocks of goods, wares or merchandise incidental to such purposes and accessible to the public. Section 311.2 defines “Group S-1” as Buildings occupied for storage uses that are not classified as Group S-2. Section 311.3 defines low- hazard storage as “Group S-2”.

303.1 Assembly Group A.

Assembly Group A occupancy includes, among others, the use of a building or structure, or a portion thereof, for the gathering of persons for purposes such as civic, social or religious functions; recreation, food or drink consumption or awaiting transportation include LOBBY, RECEPTION, LOUNGES, CONFERENCE ROOM, SEMINAR, BREAK ROOM

304.1 Business Group B.

Business Group B occupancy includes, among others, the use of a building or structure, or a portion thereof, for office, professional or service-type transactions, including storage of records and accounts. Business occupancies includes LABORATORIES: TESTING AND RESEARCH, OFFICES, JANITOR ROOM

309.1 Mercantile Group M.

Mercantile Group M occupancy includes, among others, the use of a building or structure or a portion thereof, for the display and sale of merchandise and involves stocks of goods, wares or merchandise incidental to such purposes and accessible to the public. Mercantile occupancies include RETAIL.

311.2 Moderate-hazard storage, Group S-1.

Buildings occupied for storage uses that are not classified as Group S-2, includes MECHANICAL ROOM, ELECTRICAL ROOM

311.3 Low-hazard storage, Group S-2.

Includes, among others, buildings used for the storage of noncombustible materials such as products on wood pallets or in paper cartons with or without single thickness divisions; or in paper wrappings. Such products are permitted to have a negligible amount of plastic *trim*, such as knobs, handles or film wrapping. Group S-2 storage include STORAGE, RESTROOM

2.2 Occupant Load Factor

Per SBC and IBC stated that, when determining means of egress requirements, the number of occupants for whom means of egress facilities shall be provided shall be determined in accordance with Section 1004. Where occupants from accessory areas egress through a primary space, the calculated occupant load for the primary space shall include the total occupant load of the primary space plus the number of occupants egressing through it from the accessory area.

$$Occupant\ load = \frac{Area\ of\ the\ space}{Occupant\ load\ factor}$$

Table 3: Occupant load Factor

Use	ft^2/ person	Code Reference
Accessory storage areas, mechanical equipment room	300 gross	IBC 1004.1.2
Assembly without fixed seating (Unconcentrated)	15 net	IBC 1004.1.2
Business Area (With sprinkler Protection)	130 gross	SBC 1004.1.2
Commercial Laboratories	100 gross	SBC 1004.1.2
Mercantile (grade floor areas)	30 gross	IBC 1004.1.2
Parking Garages	200 gross	IBC 1004.1.2
Storage	300 gross	IBC 1004.1.2

See Appendix A: Occupancy Classifications on page 79 for occupant loading in the floor plan.

Figure 5: Occupancy Classification – Basement Level 3
Figure 6: Occupancy Classification – Basement Level 2
Figure 7: Occupancy Classification – Basement Level 1
Figure 8: Occupancy Classification – Basement Level 1S
Figure 9: Occupancy Classification – Level 1
Figure 10: Occupancy Classification – Level 2
Figure 11: Occupancy Classification – Level 7
Figure 12: Occupancy Classification – Level 7S
Figure 13: Occupancy Classification –Penthouse
Figure 14: Occupancy Classification – Roof Level

Table 4 is the summary of the occupancy load in a tabulated form.

Table 4: Summary of Occupant Loads

Space	Area (ft^2)	Use	Reference	Occupant load factor	# of Occupant
BASEMENT LEVEL 3					
Storage	1,044	Storage use	IBC Table 1004.1.2	300	4
Mechanical	172	Mechanical equipment room	IBC Table 1004.1.2	300	1

Space	Area (ft^2)	Use	Reference	Occupant load factor	# of Occupant
Storage	159	Storage use	IBC Table 1004.1.2	300	1
Storage	296	Storage use	IBC Table 1004.1.2	300	1
Storage	125	Storage use	IBC Table 1004.1.2	300	1
Garage	49,790	Parking Garage	IBC Table 1004.1.2	200	249
Mechanical	305	Mechanical equipment room	IBC Table 1004.1.2	300	2
Mechanical	127	Mechanical equipment room	IBC Table 1004.1.2	300	1
Lobby	131	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	9
Mechanical	242	Mechanical equipment room	IBC Table 1004.1.2	300	1
Mechanical	237	Mechanical equipment room	IBC Table 1004.1.2	300	1
					271
BASEMENT LEVEL 2					
Storage	1,220	Storage use	IBC Table 1004.1.2	300	5
Storage	159	Storage use	IBC Table 1004.1.2	300	1
Storage	296	Storage use	IBC Table 1004.1.2	300	1
Storage	125	Storage use	IBC Table 1004.1.2	300	1
Garage	50,043	Parking Garage	IBC Table 1004.1.2	200	251
Mechanical	304	Mechanical equipment room	IBC Table 1004.1.2	300	1
Lobby	131	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	9
Mechanical	130	Mechanical equipment room	IBC Table 1004.1.2	300	1
Mechanical	237	Mechanical equipment room	IBC Table 1004.1.2	300	1
					271
BASEMENT LEVEL 1					
Electrical	4,343	Mechanical equipment room	IBC Table 1004.1.2	300	15
Garage	11,630	Parking Garage	IBC Table 1004.1.2	200	59
Electrical	1,529	Mechanical equipment room	IBC Table 1004.1.2	300	6
Loading Dock	808	Parking Garage	IBC Table 1004.1.2	200	5
Storage	400	Storage use	IBC Table 1004.1.2	300	2
Storage	320	Storage use	IBC Table 1004.1.2	300	2
Storage	300	Storage use	IBC Table 1004.1.2	300	1

Space	Area (ft^2)	Use	Reference	Occupant load factor	# of Occupant
Lobby	256	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	18
Storage	123	Storage use	IBC Table 1004.1.2	300	1
mailing	260	Storage use	IBC Table 1004.1.2	300	1
Break room	171	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	12
Storage	402	Storage use	IBC Table 1004.1.2	300	2
Laboratory Suite	20,939	Accessory storage areas	SBC Table 1004.1.2	100	210
MDF	148	Mechanical equipment room	IBC Table 1004.1.2	300	1
Mechanical	8,362	Mechanical equipment room	IBC Table 1004.1.2	300	28
Storage	340	Storage use	IBC Table 1004.1.2	300	2
					365
BASEMENT 1 SERVICE					
Mech Space	20,965	Mechanical equipment room	IBC Table 1004.1.2	300	70
Fuel Storage	586	Storage use	IBC Table 1004.1.2	300	2
					72
LEVEL 1					
Office	2,617	Business Use (with Sprinkler Protection)	SBC Table 1004.1.2	130	21
Break room	162	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	11
Seminar	1,342	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	90
Mechanical	205	mechanical equipment room	IBC Table 1004.1.2	300	1
Lobby	3143	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	210
Conference	394	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	27
Lounge	415	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	28

Space	Area (ft^2)	Use	Reference	Occupant load factor	# of Occupant
Retail	303	Mercantile (ground Floor)	IBC Table 1004.1.2	30	11
Laboratory	7,629	Commercial Laboratories	SBC Table 1004.1.2	100	77
Electrical	108	Mechanical equipment room	IBC Table 1004.1.2	300	1
Electrical	116	Mechanical equipment room	IBC Table 1004.1.2	300	1
Storage	76	Storage use	IBC Table 1004.1.2	300	1
					479
LEVELS 2-6					
Office	5,448	Business Use (with Sprinkler Protection)	SBC Table 1004.1.2	130	44
Break room	366	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	25
Conference	424	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	29
Laboratory	11,296	Commercial Laboratories	SBC Table 1004.1.2	100	113
IDF	108	Mechanical equipment room	IBC Table 1004.1.2	300	1
Electrical	116	Mechanical equipment room	IBC Table 1004.1.2	300	1
					213
LEVEL 7					
Office	5,137	Business Use (with Sprinkler Protection)	SBC Table 1004.1.2	130	40
Laboratory	9,162	Commercial Laboratories	SBC Table 1004.1.2	100	92
Storage	74	Storage use	IBC Table 1004.1.2	300	1
Break	303	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	21
Storage	114	Storage use	IBC Table 1004.1.2	300	1
Conference	388	Assembly without fixed seating (unconcentrated)	IBC Table 1004.1.2	15	26
Laboratory	2,235	Commercial Laboratories	IBC Table 1004.1.2	100	23
IDF	108	Mechanical equipment room	IBC Table 1004.1.2	300	1

Space	Area (ft^2)	Use	Reference	Occupant load factor	# of Occupant
Electrical	117	Mechanical equipment room	IBC Table 1004.1.2	300	1
					206
LEVEL 7 SERVICE					
Mechanical	9,605	Mechanical equipment room	IBC Table 1004.1.2	300	33
PENTHOUSE					
Mechanical	10,183	Mechanical equipment room	IBC Table 1004.1.2	300	34
Control Room	155	Mechanical equipment room	IBC Table 1004.1.2	300	1
					35
ROOF					
Unoccupied					0
TOTAL BUIILDING OCCUPANT					2797

2.3 Egress capacity

According to Life Safety Code (NFPA 101), every door and every principal entrance required to serve as an exit (or exit access) should be designer and contrasted so that the path of egress travel is obvious and direct.

$$\boldsymbol{Doorway\ capacity} = \frac{\boldsymbol{Door\ width}}{\boldsymbol{Density}}$$

Required widths for stairs are calculated using Table 7.3.3.1 of NFPA 101 2012.

$$\boldsymbol{Stairway\ capacity} = \frac{\boldsymbol{Stair\ width}}{\boldsymbol{Density}}$$

Stairway capacity greater then 44inches, use

$$\boldsymbol{C = 146.7 + \left(\frac{Wn - 44}{0.218}\right)}$$

Table 5: Capacity Factors

Table 7.3.3.1 Capacity Factors

Area	Stairways (width/person)		Level Components and Ramps (width/person)	
	in.	mm	in.	mm
Board and care	0.4	10	0.2	5
Health care, sprinklered	0.3	7.6	0.2	5
Health care, nonsprinklered	0.6	15	0.5	13
High hazard contents	0.7	18	0.4	10
All others	0.3	7.6	0.2	5

Here is the summary of the exit capacity vs occupant load.

BASEMENT LEVEL 3

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 4	36	0.2	180	44	0.3	147	147
Stair 1	36	0.2	180	44	0.3	147	147
							294

294 > 271
exit capacity > occupant load

BASEMENT LEVEL 2

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 4	36	0.2	180	44	0.3	147	147
Stair 1	36	0.2	180	44	0.3	147	147
							294

294 > 271
exit capacity > occupant load

BASEMENT LEVEL 1

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 4	36	0.2	180	44	0.3	147	147
Stair 1	36	0.2	180	44	0.3	147	147
Stair 3	36	0.2	180	44	0.3	147	147
							441

441 > 365
exit capacity > occupant load

BASEMENT 1 SERVICE

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 5	36	0.2	180	36	0.3	120	120
Stair 1	36	0.2	180	44	0.3	147	147
							267

267 > 72
exit capacity > occupant load

LEVEL 1

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
	72	0.2	360				360
	72	0.2	360				360
							867

867 > 479
exit capacity > occupant load

LEVEL 2 (LEVEL 3-6 SIMILAR)

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
Stair 2				62	0.3	229	
Door 1	42	0.2	210				
Door 2	36	0.2	180				180
Door 3	36	0.2	180				
Door 4	48	0.2	240				
							327

327 > 213
exit capacity > occupant load

LEVEL 7

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
Stair 2				62	0.3	229	
Door 1	42	0.2	210				
Door 2	36	0.2	180				180
Door 3	36	0.2	180				
Door 4	48	0.2	240				
							327

327 > 206
exit capacity > occupant load

LEVEL 7 SERVICE

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
Stair 2	36	0.2	180	44	0.3	147	147
							293

293 > 33
exit capacity > occupant load

PENTHOUSE

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
Stair 2	36	0.2	180	36	0.3	110	110
							257

257 > 35
exit capacity > occupant load

2.4 Travel Distance

2.4.1 Exit Access

IBC exit access travel distance is limited in accordance with section 1016. Section 1016 states that exits shall be located on each story such that the maximum length of exit access travel, measured from the most remote point within a story to the entrance to an exit along the path of travel cannot exceed the travel distance in Table 1016.2

Table 6: Exit Access Travel Distance (Table 1016.2)

OCCUPANCY	WITHOUT SPRINKLER SYSTEM (feet)	WITH SPRINKLER SYSTEM (feet)
A, E, F-1, **M**, R, **S-1**	200	**250**
I-1	Not Permitted	250
B	200	**300**
F-2, **S-2**, U	300	**400**
H-1	Not Permitted	75
H-2	Not Permitted	100
H-3	Not Permitted	150c
H-4	Not Permitted	175c
H-5	Not Permitted	200c
I-2, I-3, I-4	Not Permitted	200c

2.4.2 Common Path

The common path of egress travel shall not exceed the common path of egress travel distances in Table 7.

Table 7: Common path of egress travel

OCCUPANCY	WITHOUT SPRINKLER SYSTEM (feet)		WITH SPRINKLER SYSTEM (feet)
	Occupant Load		
	≤ 30	> 30	
B, S	100	75	**100**
U	100	75	75
F	75	75	100
H-1, H-2, H-3	Not Permitted	Not Permitted	25
R-2	75	75	125
R-3	75	75	125
I-3	100	100	100
All others	75	75	**75**

Code reference : IBC Table 1014.3

2.4.3 Dead End

In section 1018.4 of IBC allowed dead-end corridor not to exceed 50 feet because this building is classified as B and it is equipped with automatic sprinkler system.

Here is the summary for the travel distances used in this project.

Table 8: Dead-End Distance

		EXIT ACCESS (Table 1016.2) feet	COMMON PATH (Table 1014.3) feet	DEAD END (Section 1018.4) feet
Assembly	A	250	75	50
Laboratory	B	300	100	50
Retail	M	250	75	50
Parking	S-2	400	100	50
Loading Dock	S-1	250	100	50

2.5 Exits

2.5.1 Separation of Means of Egress

When more than one means of egress is required, doors must be placed at a distance not less than one half the maximum overall diagonal dimension of the space, unless the building has an approved supervised automatic sprinkler, in which, the UW Medicine

Lake Union is fully sprinklered, the distance between the means of egress can be reduced to not less than one third the maximum overall diagonal dimension of the space.

2.5.2 Marking of Means of egress

In spaces required to have two or more exits or exit access paths, the means of egress must be provided with clearly visible and illuminated signs that readily identify the location of the exits and indicate the path of travel to the exits. Life safety code regulates the size, font specifications and location of exit signage in Section 7.10.

Luminous egress path markings to be provided within exit Enclosures per SBC 1024 (except at level 1 lobby area):
a. Stair nosing and leading edges at landings
b .Handrails
c. Perimeters of landings
d. Around exit discharge doors

2.6 Type and Description of Construction

Section 602 of IBC defines the construction classifications that all building will be constructed to and that the fire resistance rating of the building elements will not be less than those indicated in Table 601. Paragraph 602.2 defines Type I and Type II construction (all noncombustible building materials), Paragraph 602.3 defines Type III construction (exterior walls are of noncombustible materials with the interior building elements being of combustible or non-combustible materials), Paragraph 602.4 defines Type IV construction (exterior walls are of non-combustible materials with the interior building elements being of solid or laminated wood without concealed spaces), Paragraph 602.5 defines Type V construction (all building elements of combustible or non-combustible building materials). All construction types except Type IV are subdivided into two sub-classifications "A" and "B". Type "A" means that all structural members of a building or structure has additional fire rated coating or cover by means of sheetrock, spray on, or other approved method. This additional fire rated coating or cover extends the fire resistance rating of structural members at least 1 hour and Type "B" means that all structural members of a building or structure has no additional fire rated coating or cover.

The UW Medicine Lake Union project utilizes primarily non-combustible construction throughout the building. Exposed steel beams are protected with Spray-Applied Fire-Resistive Materials (SFRM). Therefore it is considered that the construction type of Type I-A noncombustible construction per SBC and IBC classifications.

2.7 Height and Area Limitations

Section 202 of the IBC defines the “building height" is defined as the vertical distance from grade plane to the average height of the highest roof surface. The "Area of the Building" is defined as the area included within surrounding exterior walls (or exterior walls and fire walls) exclusive of vent shafts and courts. Areas of the building not provided with surrounding walls shall be included in the building area if such areas are included within the horizontal projection of the roof or floor above.

Chapter 5 of the IBC defines the types of occupancies that all buildings are to be categorized based upon the hazard contents, function of the building and occupant loading. The UW Medicine Lake Union is a high-rise building and consists of seven stories, two level of parking garage and a penthouse, yielding a total building area of 317, 382 square feet within the building envelope. The building height is 109 feet. It is classified as B occupancy classification.

Table 503 of the IBC limits the height and area based upon the occupancy and construction type. Based in Table 503 for Type IA construction under “Group B”, the maximum floor area per story is Unlimited, the maximum number of story is unlimited and the maximum overall building height is unlimited.

Here is an excerpt from Table 503 of IBC:

Table 9: Allowable building heights and areas

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)								
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
M	S	UL	11	4	2	4	2	4	3	1
	A	UL	UL	21,500	12,500	18,500	12,500	20,500	14,000	9,000
S-1	S	UL	11	4	2	3	2	4	3	1
	A	UL	48,000	26,000	17,500	26,000	17,500	25,500	14,000	9,000
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

Code reference: IBC Table 503

2.8 Fire resistance

Fire resistance is a measure of the ability of a building element to resist fire. Fire resistance is most often quantified as the time for which the element can meet certain criteria during exposure to a standard fire-resistance test. Structural fire resistance can also be quantified using the temperature or load capacity of a structural element exposed to fire.

It is important to recognize that individual materials do not possess fire resistance. Fire resistance is a property assigned to building elements which are constructed for a single material or a mixture of materials.

2.8.1 Fire-resistance rating

A fire-resistance rating typically means the duration for which a passive fire protection system can withstand a standard fire resistance test. This can be quantified simply as a measure of time, or it may entail a host of other criteria, involving other evidence of functionality or fitness for purpose.

For Type IA construction, Per IBC 2013 Section 601, Fire-resistance ratings of primary structural frame and bearing walls are 3 hours and it is permitted to be reduced by 1 hour where supporting a roof only. Exterior Nonbearing walls and partitions are 0 hours based upon the separation distance per table 602 IBC 2013. Interior Nonbearing walls and partitions are 0 hours. Floor construction and associated secondary member is 2 hours and for roof construction and associated secondary members is 1.5 hours. See Table 10 for tabulated form.

Table 10: Fire-resistance rating requirements for building elements (hours)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame	**3**	2	1	0	1	0	HT	1	0
Bearing walls									
Exterior	**3**	2	1	0	2	2	2	1	0
Interior	**3**	2	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior	**0**	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary member	**2**	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members	**$1^1/_2$**	1	1	0	1	0	HT	1	0

Code reference: IBC Table 601

2.8.2 Shaft enclosures

Per IBC 713.4, Shaft enclosures shall have a fire-resistance rating of not less than 2 hours where connecting four stories or more, and not less than 1 hour where connecting less than four stories. The number of stories connected by the shaft enclosure shall include any basements but not any mezzanines. Shaft enclosures shall have a fire-resistance rating not less than the floor assembly penetrated, but need not exceed 2 hours. Shaft enclosures shall meet the requirements of Section 703.2.1.

2.8.3 Corridors

Per IBC Section 1018, Corridors shall be fire-resistance rated in accordance with Table 1018.1. The corridor walls required to be fire-resistance rated shall comply with Section

708 for fire partitions. UW Medicine Lake Union Building is an exception because according to Section 1018 (4) A fire-resistance rating is not required for corridors in an occupancy in Group B which is a space requiring only a single means of egress complying with Section 1015.1. And per Table 1018.1, B occupancy with sprinkler system doesn't need a fire-resistance rating. See Table 11. The width of the corridors for this building is at least 72 inches. Refer to Table 1018.2 for the minimum corridor width. See Table 12.

Table 11: Corridor Fire-resistance Rating

OCCUPANCY	OCCUPANT LOAD SERVED BY CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (hours)	
		Without sprinkler system	With sprinkler system
H-1, H-2, H-3	All	Not Permitted	1
H-4, H-5	Greater than 30	Not Permitted	1
A, **B**, E, F, M, S, U	**Greater than 30**	1	**0**
R	Greater than 10	Not Permitted	0.5
I-2, I-4	All	Not Permitted	0
I-1, I-3	All	Not Permitted	1

Code reference: IBC Table 1018.1

Table 12: Minimum Corridor Width

OCCUPANCY	WIDTH (minimum)
Any facilities not listed below	**44 inches**
Access to and utilization of mechanical, plumbing or electrical systems or equipment	24 inches
With a required occupancy capacity less than 50	36 inches
Within a dwelling unit	36 inches
In Group E with a corridor having a required capacity of 100 or more	72 inches
In corridors and areas serving gurney traffic in occupancies where patients receive outpatient medical care, which causes the patient to be incapable of self-preservation	72 inches
Group I-2 in areas where required for bed movement	96 inches

Code reference: IBC Table 1018.2

2.8.4 Exterior wall

The required building separation is derived from Table 602 of the IBC. For "Group B" occupancies having Type IA construction, no fire resistance rating is required for the exterior walls when the separation distance is greater than 30'or greater. And one hour fire resistance rating is required for the exterior walls when the separation distance is less than 30 feet.

The UW Medicine Lake Union consists of a building that has a minimum setback from any side of the building to adjacent structure of a distance greater than 30'-0". This setback exceeds the minimum separation distance of 30'-0" and does not require a fire resistance rating on the exterior walls. See Table 13 for details.

Table 13:Fire-resistance rating requirements for exterior walls based on fire separation distance

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H	OCCUPANCY GROUP F-1, M, S-1	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U
X < 5[c]	All	3	2	1
5 ≤ X < 10	IA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB	2	1	1[d]
	IIB, VB	1	0	0
	Others	1	1	1[d]
X ≥ 30	**All**	**0**	**0**	**0**

Code Reference: IBC Table 602

2.8.5 Horizontal assemblies

Per IBC Section 711.3, the fire-resistance rating of floor and roof assemblies shall not be less than that required by the building type of construction. For this building, the horizontal assemblies have 2 hour fire resistance rating.

2.8.6 Penetrations

Per IBC Section 714, Penetrations into or through fire walls, fire barriers, smoke barrier walls and fire partitions shall comply with sections 714.3.1 through 714.3.3. Penetrations in smoke barrier walls shall also comply with Section 714.5.

2.8.7 Fire Rated Doors

The following requirements for fire rated door should be applied per NFPA 101:

Table 14: Minimum Fire Protection Ratings for Opening Protective in Fire Resistance

Components	Walls and Partitions (hours)	Fire Door Assemblies (hours)
Stairways	2	1½
Elevator hoistways	2	1½
Fire barriers	1	¾

Code Reference: NFPA 101 Table 8.3.4.2

Based upon Table 8.3.4.2, the doors in the stairways are required to have a 90 minute fire resistance rating. The door along the fire barrier walls are required to have 45 minutes fire resistance rating. The door in elevator machine room is required to have 90 minutes fire resistance rating.

See Appendix B: Exit capacity, travel distance and wall rating for floor plans:

Figure 15: Egress Capacity, Travel Distance & Wall Rating - Basement Level 3
Figure 16: Egress Capacity, Travel Distance & Wall Rating - Basement Level 2
Figure 17: Egress Capacity, Travel Distance & Wall Rating - Basement Level 1
Figure 18: Egress Capacity, Travel Distance & Wall Rating - Basement Level 1S
Figure 19: Egress Capacity, Travel Distance & Wall Rating - Level 1
Figure 20: Egress Capacity, Travel Distance & Wall Rating - Level 2-6
Figure 21: Egress Capacity, Travel Distance & Wall Rating - Level 7
Figure 22: Egress Capacity, Travel Distance & Wall Rating - Level 7S
Figure 23: Egress Capacity, Travel Distance & Wall Rating - Penthouse

Chapter 3 Fire Alarm and Detection

3.1 Fire Alarm and Communication Systems

The Fire Alarm System is comprised of a Notifier NFS2-3030D Fire Alarm Control Panel, smoke detectors, manual pull stations, addressable interface modules, addressable interface relays, Fire Alarm Horn/Strobes (Clear Strobes), Smoke detectors are located in the Basement Electrical room and throughout the space on the main floor. Manual pull stations are located at all exits from the building.

The FACP is located on Level 1 in the Fire Command Center. See Figure 24: Fire Command Center for details.

3.2 Fire Signature and detection Devices

3.2.1 Initiating Devices - Pull Stations, Heat Detectors, Smoke Detectors, Duct Smoke Detector, Waterflow Alarm, Tamper Switch

Initiating device is a manual or automatic device that, upon activation, produces an alarm that is intended to notify building occupants of a fire in the building. Initiating devices typically detect the presence of smoke, heat, flame or water flow.

Initiating device covers not only fire detection devices such as manual fire alarm boxes, heat detectors, smoke detectors, and smoke duct detectors, but also gas detectors and other devices that monitor conditions related to fire safety. These devices include sprinkler system waterflow switches, pressure switches, valve tamper switches, building temperature monitoring devices, and any signaling switches used to monitor special extinguishing systems.

Fire alarm pull station is an active fire protection device, usually wall-mounted, that, when activated, initiates an alarm on a fire alarm system. In its simplest form, the user activates the alarm by pulling the handle down, which completes a circuit and locks the handle in the activated position, sending an alarm to the fire alarm control panel.

Smoke detectors are available in conventional, enhanced and air-sampling models. Convectional detectors use either photoelectric or ionization technology. Photoelectric detectors are considered better at detecting smoldering fires and ionization detectors at detecting flaming fires.

For this project, Photoelectric smoke detectors are used.

Duct smoke detector is designed to operate in high-velocity air stream. These can be used for fan shutdown to mitigate smoke migration through buildings. A tube extends out into the duct and captures a portion of the air flowing through the duct. The air transferred through the tube to a chamber with a detector attached to the side of the duct.

Heat detectors are the oldest type of automatic fire detection devices. A sprinkler can be considered a combined heat-activated fire detector and extinguishing device when the sprinkler system is provided with Waterflow indicators connected to the fire alarm control

system. Waterflow indicators detect either the flow of water through the pipes or the subsequent pressure changer upon actuation of the system.

Heat detectors are very reliable and have the lowest false alarm rate of all automatic fire detectors. They are best suited for fire detection in small confined spaces where rapidly building high-heat-output fires are expected, in areas where ambient conditions would not allow the use of other fire detections devices, or where very early warning of fire is not required.

Table 15: Fire Alarm Initiating Devices

Initiating Devices	
Manual Pull Station  The NBG-12LX Addressable Manual Pull Station	Model : Notifier – NBG-12LX - Manual Pull station Initiates an alarm on a fire alarm system. In its simplest form, the user activates the alarm by pulling the handle down, which completes a circuit and locks the handle in the activated position, sending an alarm to the fire alarm control panel.
Smoke detector  FSP-851(A) in B210LP(A) Base	Model : Notifier – FSP-851A -A smoke detector is a device that detects smoke, typically as an indicator of fire.
Heat Detector  	Model : Notifier 5600 Series -Heat detectors are generally located on or near the ceiling and respond primarily to the convected thermal energy of a fire. They operate either when the detecting element reaches a predetermined fixed temperature or when a specific rate of temperature change occurs.

Initiating Devices	
Duct Smoke detector 	Model : Notifier – Innovair Flex - The primary purpose of duct smoke detection is to prevent injury, panic, and property damage by reducing the spread (recirculation) of smoke. The detector samples air currents passing through a duct and gives dependable performance for management of smoke and combination fire smoke dampers. Duct smoke detection can also serve to protect the air conditioning system itself from fire and smoke damage.
Water Flow Switch 	Model : Potter – VSR - water flow switch is to detect water flow in the sprinkler system, usually during a fire event, to signal a local electrical fire alarm, or fire alarm panel to activate the alarm devices in the building and send an alarm signal to a central station or alarm company to alert the fire department.
Tamper switch 	Model : Potter - OSYSU-2 - It is a supervisory device located on the control valves of a fire protection system. The tamper switch is a device which, when connected to an alarm panel or sounder, signals a disturbance (opening or closing) at the control valves of the system.
Pressure Alarm Switch 	Potter – PS10A -A pressure switch is a form of switch that closes an electrical contact when a certain set pressure has been reached on its input. The switch may be designed to make contact either on pressure rise or on pressure fall.

3.2.2 Alarm Notification Appliances

Signaling device is a device that produces an audible and/or visible alarm signal in response to activation of an initiating device.

3.2.2.1 Fire Alarm audibility

The purpose of a fire detection and alarm system is to alert the occupants of a building that an emergency exists and to initiate evacuation. In a high-rise building, it may be desirable to provide the occupants with more information, such as the nature and location of the fire. The purpose of the system is defeated if the signal is not heard and understood by the occupants.

3.2.2.2 Fire alarm visibility

Visual alarm notification is an important part of fire alarm systems. This visual aspect is especially important in cases where the ambient noise level is high, building occupants may be sleeping or building occupants or their visitor may have hearing impairment. In these cases, it should be expected that the visual alarm will be required to alert occupants and initiate evacuation or relocation. As such, one first needs to determine a suitable intensity required to obtain this function.

Table 16: Fire Alarm Notification Devices

Notification Devices	
Wall Strobe 	Model : System Sensor SW
Wall Speaker Strobe 	Model : System Sensor SPSW

Notification Devices	
Ceiling Strobe 	Model : System Sensor SCW
Ceiling Speaker Strobe 	Model : System Sensor SPSCW
Silent-tone Speakers with red lens 	Code Alternate for Vivarium & BSL3

3.2.2.3 Code Alternate for Vivarium and BSL3

A reduce level of audibility and visibility is provided because it might distress the animal and might cause inaccurate research result. They provide a red filter to reduce the impact of visibility.

A minimum of 60 dBA audibility fire alarm signaling is provided throughout the vivarium and BSL3 areas. The performance standard does not require the installation of fire alarm system speakers within the animal holding area, and it is consistent with limiting the maximum should level of 85 dBA per City of Seattle fire marshal.

Visible fire alarm signaling is provided throughout the vivarium and BSL3 areas. Spaces outside animal holding areas shall be provided with standard visible fire alarm signaling. Visible fire alarm signaling in animal holding area is provided with red lens or filter to

reduce the impact of the strobe light on animals. Because the red lens or filter will impede light transmission, the candela rating of visible device obscured by the lens or filter shall be derated by 25% (such that a 15cd device normally rated for 20x20 coverage will be derated to 15x15 coverage per City of Seattle fire marshal.

Here are the fire alarm drawings for clarify and reference. I recreated the fire alarm drawings based on the fire alarm shop drawings.

3.3 Sequence of Operations

Here is the Fire alarm control matrix provided by the Engineer of record. Supply Air (SA), Exhaust Air (EA), Return Air (RA), Fire Smoke dampers (FSD) shall be zoned by shaft and by floor. SA/EA/RA FS dampers shall be grouped on a common zone for a given zone (floor/shaft), the SA/EA/RA FS dampers shall close upon activation of any 1 of the 3 associated duct mounted smoke detector.

See Appendix D: Sequence of Operations.

3.4 Mass Notification Systems

The Fire Alarm / MNS system is powered up and run continuously. It does not require any start up or shut down procedures for normal operation. It is powered up by 120 VAC power and has 72 hours of battery backup. The transfer to and battery backup is automatic.

The following manufacturer operating instructions cover the basic operating procedures, switches, and LED's that apply to this system. In addition to the basic features, this system has the following additional operating features:

1. A microphone (on the MNP) for delivering the selected MNS announcement or a live voice message. This is a basic push to talk microphone. Select a switch to play the desired prerecorded message or push button on mic, and speak.
2. The 8 messages that available are as follows:
    a. CIVIL DISTRUBANCE - A MNS civil disturbance announcement and instructions.
    b. EVACUATION - An MNS evacuation announcement and instructions.
    c. SEEK SHELTER - A MNS seek shelter announcement and instructions.
    d. SEEK SHELTER & HVAC - A MNS seek shelter and shutdown HVAC equipment announcement and instructions.

e. SEVERE WEATHER - A MNS severe weather announcement and instructions.
f. LIVE VOICE - A MNS live voice announcement.
g. EMERGENCY STAND DOWN - An MNS emergency stand down announcement and instructions.
h. TEST - A MNS system test announcement.

Chapter 4 Fire Suppression Systems

4.1 General

Fire Protection standpipe and automatic fire sprinkler systems are supplied by an electric fire pump with automatic transfer switch to emergency generator power. The fire pump will draw water from an on-site storage tank (secondary water supply) located next to the fire pump room on Basement Level 3. The capacity of the water storage tank is 44,300 gallons with a net usable water capacity of 33,000 gallons. The water storage tank fill will be a 6" diameter water line supplied by a dedicated fire water service connection to the city water control valves and a 6" manual by pass valve. The fire pump room is constructed with 2-hour fire rated construction.

4.1.1 Flow Test Data

Static pressure = 102psi
Residual pressure = 20 psi
Flow = 1915 gpm

4.1.2 Types of water-based fire suppression system

4.1.2.1 Dry Systems
- parking levels (Basement Level 3 to Basement Level 1)
- loading dock (Basement Level 1)

4.1.2.2. Wet systems
- Offices, Lobby, Retail, Vivarium, Lab spaces (Basement Level 1-Penthouse)

4.1.3 Stand pipe system
- Dry Standpipe are provided for all the parking levels
- Combination System serves the rest of the building

4.1.4 Fire Department Connections

There are two fire department connections are provided per SBC. FDC are located at the main entrance in 8th Ave N. (east side of the building) and south side of the building at Republican Street.

4.1.5 System Riser

This building has two sprinkler risers which feed from a combined standpipe/sprinkler systems in stairs #2 & #3. A Looped sprinkler system is sprinkler system in which multiple cross mains are tied together to provide more than one path for water to flow to an operating sprinkler and branch lines are not tied together.

4.2 Occupancy Classification and Design Criteria

4.2.1 Occupancy Classification

Parking

Ordinary Hazard Group 1	(Section A.5.3.1)
0.15 gpm/ft^2 over 1500 ft^2	(Figure 11.2.3.1.1)
Hose stream allowance	= 250 gpm (Table 11.2.3.1.2)
Water supply Duration	= 60-90 minutes (Table 11.2.3.1.2)

Offices/Lobby

Light Hazard Group 1	(Section A.5.2)
0.10 gpm/ft^2 over 1500 ft^2	(Figure 11.2.3.1.1)
Hose stream allowance	= 100 gpm (Table 11.2.3.1.2)
Water supply Duration	= 30 minutes (Table 11.2.3.1.2)

Vivarium/Mechanical

Ordinary Hazard Group 1	(Section A.5.3.1)
0.15 gpm/ft^2 over 1500 ft^2	(Figure 11.2.3.1.1)
Hose stream allowance	= 250 gpm (Table 11.2.3.1.2)
Water supply Duration	= 60-90 minutes (Table 11.2.3.1.2)

Lab spaces

Ordinary Hazard Group 2	(Section A.5.3.2)
0.20 gpm/ft^2 over 1500 ft^2	(Figure 11.2.3.1.1)
Hose stream allowance	= 250 gpm (Table 11.2.3.1.2)
Water supply Duration	= 60-90 minutes (Table 11.2.3.1.2)

4.2.2 Design Criteria

Dry System – Remote area is increased by 30% per Section 12.5.2

Wet Systems - Remote area reduction has been utilized. See section 11.2.3.2.3

4.2.2.1 Standpipe Demand

300 gpm flow @ 150 PSI at any single hose valve

500 gpm at 100 psi + 250 gpm for additional standpipe. For a total of 750 gpm at the roof.

4.2.2.2 Hydraulic Design

System is supplied from a 33,000 gal tank located on Basement Level 3.

4.2.2.3 Fire Pump Data

Fire pump rating	: 750 gpm @ 215 psi
Fire pump churn pressure	: 0 gpm @ 245 psi
Head Pressure at pump Suction	: 0 gpm @ 5 psi
Max. pressure @ pump discharge	: 0 gpm @ 250 psi

4.3 Fire Sprinkler Flow Diagram and Floor plan

4.3.1 Sprinkler System Flow Diagram

See Figure 35: Schematic Fire Sprinkler Flow Diagram for more information.

4.3.2 Sprinkler System Floor plan

See Appendix E: Fire Sprinkler Plan for floor plans. I laid out all cross main, branchlines, riser location and occupancy hazards. This is only a representation how the system is laid out. The system need to be coordinated with other trades.

4.4 Hydraulics Calculation (Wet System remote area - Penthouse)

A computer based hydraulic analysis using Autosprink was performed to check the sprinkler demand. Wet system in the most remote area (penthouse level) is verified. Using ordinary hazard group 1 with a density of 0.15 gpm/ft^2 over 1500 ft^2 with a design operation of 130 ft^2 per sprinkler head. This remote area is only for the purpose of this report.

Dry systems remote area and standpipe calculation are not shown in this report.

Chapter 5 Structural Fire Protection

5.1 Rating of Structural Components

Per Table 601 (see Table 10 on page 24), the building elements (structural frame, bearing walls, non-bearing walls, partitions, floor construction, and roof construction) are to be of non-combustible materials and are required to have a fire resistive rating.

UW Medicine Lake Union building flooring for parking garage, loading dock, mechanical, electrical room have a concrete floor. Rooms have tile and sheet carpeting. Most of the walls are made of gypsum wall board which is Class A. All the materials that they used were code compliance according to the Architectural specifications submitted to the city.

5.2Architectural & Structural Components

Wall types:

- Offices, Corridor, Labs are Type 1 (one layer 5/8” gypsum board on each side of single metal studs)
- Break Rooms is Type 2
- Lobby is Type 3 (2 layers 5/8” GWB each side of single metal studs with batt insulation)
- Mechanical room - 9” grouted CMU + framed free standing wall on vivarium side with one layer GWB and insulation in the stud cavity
- Elevator Shaft - CH stud shaft wall construction with 1” core board on the shaft side and 2 layers of 5/8” gypsum board on the room side and batt insulation in the cavity.
- On meeting room side add frame construction with 2 layers of 5/8” gypsum board on the exposed face and batt insulation between studs
- Mechanical shaft - CH stud shaft wall construction with 1” core board on the shaft side and 2 layers of 5/8” gypsum board on the room side and batt insulation in the cavity.

Products are UL rated. Fire-resistance ratings were determined by testing assemblies for fire response per ASTM E119.

The building have mat foundation and the thickness varies from 2'-0" to 6'-0" .Mat foundation is placed atop compacted structural fill in accordance with the geotechnical report. Basement walls is restrained at the top by the first floor structural slab, by basement level 1 slab, by basement level 2 slab, and by mat foundation and is designed to reach the strength prior applying any lateral load to the walls. The foundation sizes are based on 16 ksf bearing capacity. No saw cutting of 24" structural slab due to hydrostatic forces on mat foundation. The mat foundation is designed for maximum water at elevation 29'-0". Below basement level 2 walls and top 12" of mat foundation require waterproof concrete.

Basement Level 2 and Basement Level 1 are post-tension slab, Level 1 has a built-up slab type, Level 2-7 have 8” slab. Penthouse has steel framing.

Columns / girders / beams
Purpose: maintain structural integrity of building and prevent collapse

Walls / floor/ceiling / fire stopping
Purpose: contain fire and prevent spread to adjacent compartments or other buildings

5.3 Walls and Partitions

Load-bearing wall are used in order to carry some loads induced in it by horizontal elements such as floors and roof of the building while non-bearing walls are walls or partitions that do not support any other load other than their own weight while bearing wall is a vertical support system that transmits compressive forces through the wall plane. Here is the summary of the wall and partition types within my building.

For non- bearing walls with one hour rating, UL U465 U420, UL U436 and U469 ratings are used.
For non- bearing walls with two hour rating, UL U411, U420, UL U436 and U438 ratings are used.
For non- bearing walls with three hour rating, UL U436 ratings is used.
For bearing walls with two hour rating, UL U477 rating is used.

UL U906 was used for concrete blocks with two hour rating. This is for both bearing and non-bearing wall. They added gypsum plaster/ portland cement on one side to give 3 hour rating for the transformer room.

See Appendix F: Wall Types for floor plans on page 127

5.4 Classification of Interior Finish

Interior Finishes is to be based upon Chapter 10 of NFPA 101. In Table A.10.2.2, the interior finishes for this project are required to meet the following criteria. Per the footnotes associated with Table A.10.2.2, when a complete standard system of automatic sprinklers is installed, interior wall and ceiling finish with a flame spread rating not exceeding Class C is permitted to be used in any location where Class B is required, and Class B interior wall and ceiling finish is permitted to be used in any location where Class A is required; similarly, Class II interior floor finish is permitted to be used in any location where Class I is required, and no interior floor finish classification is required where Class II is required.

For “Group B” Occupancy, all exits are required to be of “Class A” or “Class B” either I or II, exit access corridors are required to be of “Class A or B”, and all other spaces are required to be either “Class A”, “Class B” or “Class C”.

"Class A" finish materials have a flame spread rating of 0 to 25 with a smoke developed index of 0 to 450, "Class B" finish materials have a flame spread rating of 26 to 75 with a smoke developed index of 0 to 450, and "Class C" finish materials have a flame spread rating of 76 to 200 with a smoke developed index of 0 to 450. “Class I” interior floor finish has the critical radiant flux not less than 0.45 W/cm^2 and
“Class II” interior floor finish has the critical radiant flux not more than 0.22 W/cm^2 but less than 0.45
W/cm^2.

Occupancy	Exits	Exit Access corridors	other space
Assembly	A	A or B I or II	A or B NA
Business	A or B I or II	A or B	A, B or C NA
Mercantile	A or B I or II	A or B	A or B NA
Storage	A or B I or II	A, B or C	A, B or C NA

5.5 Fire protection materials

5.5.1 Gypsum
Gypsum is a noncombustible material, produced in the form of flat board or plaster that consists of approximately 21 percent by weight of chemically combined water. This water content greatly contributes to the gypsum products’ effectiveness as a fire-resistive barrier.

The gypsum board is usually configures to form a protective membrane or envelope, surrounding the structural ember or assembly. In case of a column, a box enclosure is formed with the board, of appropriate thickness and insulation, to achieve the necessary fire resistance required, for floor and roof assembly, gypsum board can be used to provide a thermal barrier to the floor and roof system above the ceiling.

5.5.2 Spray-Applied Resistance material

Spray-on protection is usually the cheapest form of passive fire protection for steel members. Spray-on materials are usually cement based with some form of glass or cellulosic fibrous reinforcing to hold the material together. Spray-on protection is easy to apply to complicated details such as bolted connections or steel brackets. Approved spray-on systems must have proof that they have sufficient stickability to remain in place during fire exposure. The required thickness of proprietary spray-on protection to achieve fire-resistance ratings can be found in individual manufactures' literature or trade publication.

Here are the floor plans showing the areas with Spray-applied Fire Resistive Material (SFRM). SFRM to have minimum bond strength of 430 psf (per 2009 SBC Table 403.2.4).

IBC Section 722.5 steel assemblies states that the provisions of this section contain procedures by which the fire-resistance ratings of steel assemblies are established by calculations.

UL #D723 - 2 HR
SFRM UL #X790 1 1/2 HOUR & 2 HOUR
SFRM UL #S721, 1 1/2 HOUR & 2 HOUR
SFRM UL #X719 1-1/2 HOUR
Firesafing with metal lath per UL recommendations. 1-1/2 HR

Figure 60: SFRM - Lounge
Figure 61: SFRM - Level 2 (Level 3-6 Similar)
Figure 62: SFRM - Level 7
Figure 63: SFRM - Penthouse
Figure 64: SFRM - Details

5.5.3 Concrete

Ordinary Concrete is the heaviest inorganic material, with a density raging from about 100 to 150 lb/ft^3 for lightweight and normal weight aggregates. In addition to its many structural load-bearing applications, concrete often also has served a separate or dual function as a fire protective material.

Gypsum and concrete are good energy-absorbing materials. Each of these energy-absorbing materials also releases water of crystallization when exposed to high protection.

Concrete and the other higher-density spray-on material are more durable as long term fire protection, but there is the expected trade-off in associated weight and costs that has often become the main consideration in this selection.

5.5.4 Masonry

Masonry can be used in much the same way as concrete, for both load-bearing and fire protection application. Similarly, its relative heavy weight and higher costs compared to the lighter SFRM or gypsum products often make masonry a less attractive choice in terms of economy for simple building fire protection needs.

Chapter 6 Inspection, Testing and Maintenance

6.1 Fire alarm Systems

Fire alarm systems can be fairly complex systems that serve vital fire and life safety functions. Consequently, it is important for fire alarm systems to be properly designed, installed, commissioned, operated, inspected, tested and maintained to ensure they perform their intended function (Mowrer & Simonian, Module 10 Slide 71).

See Appendix G: Inspection, Testing and Maintenance – Fire Alarm for more information.

6.1.1 Inspection requirements of NFPA-72:
Visual inspections shall be performed in accordance with the schedules in Table 10.3.1 of NFPA 72 more often if required by the authority having jurisdiction.

Exception: Devices or equipment that are inaccessible for safety considerations shall be inspected during scheduled shutdowns if approved by the authority having jurisdiction. Extended intervals shall not exceed 18 months.

Refer to Table 18: Inspection - Fire Alarm Systems

6.1.1 Testing requirements of NFPA 72

Testing shall be performed in accordance with the schedules in Table 10.4.3, except as modified in other paragraphs of 10.4.3, or more often if required by authority having jurisdiction. Exception: Devices or equipment that is inaccessible for safety considerations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) is to be tested during scheduled shutdowns if approved by the authority having jurisdiction but is not to be tested at intervals exceeding 18 months.

Refer to Table 19: Testing – Fire Alarm Systems

6.2 Fire Suppression Systems
Maintenance procedures are critical, such as those required by NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems which Includes evaluation of the factors that affect system performance. The relation between hazard and protection are, considering the fire hazards to be protected and decision regarding adequacy of the protection for varying conditions of the property and, Assessing whether the originally installed system is adequate for the current fire hazards (Mowrer & Korman, Module 9 Slide 5).

See Appendix H: Inspection, Testing and Maintenance – Fire Sprinkler for information.

Table 20: Inspections – Fire Suppression Systems
Table 21: Testing – Fire Suppression Systems
Table 22: Maintenance - Fire Suppression Systems

Chapter 7 Fire Safety Management Plan

7.1 Fire Safety Management and Evacuation Plans

The main objective of an evacuation plan is to facilitate and organize owner, occupant and emergency responder actions during emergencies (Tubbs & Meacham, 2007, p. 335).

University of Washington has developed emergency evacuation and operations plan (EEOP) guidelines to all the building to address emergencies. Each of their building must develop this plan.

For more information, see http://www.ehs.washington.edu/fsoemerprep/evacplan.shtm for Emergency Planning.

See Appendix I: Fire Safety Management Plan for this building for the purpose of this report.

7.1.1 Evacuation Assembly Points

The Evacuation Assembly Point (EAP) should be an open area away from the building and out of the way of responding emergency personnel. Establish primary and secondary EAPs in case the primary cannot be occupied during or after an evacuation. A separate EAP may be necessary for earthquake evacuation.

Occupants meet after evacuation so that they may be accounted for or lend assistance as needed. There may be more than one assembly point depending on the size of the building and the location of the exits. Some EAPs may be unsuitable for assembly following an earthquake event.

The primary and secondary Evacuation Assembly Points (EAPs) for this building are:

Primary EAP:	Parking along the main Entrance (See Figure 65: Evacuation Assembly Points)
Secondary EAP:	Parking along Courtyard Entrance (See Figure 65: Evacuation Assembly Points)

Building occupants will assemble at the primary EAP following a building evacuation. If the Evacuation Director finds the primary EAP unsuitable, then evacuees will be moved to the secondary EAP. Areas of Safe Refuge should be established inside the building for persons with disabilities or for buildings with more than four levels. Indicate each floor's designated EAPs and Areas of Safe Refuge on each emergency evacuation floor plan.

Note: Evacuation drills are necessary to refine the evacuation procedure.

Areas of Safe Refuge

Occupants should have an area of safe refuge (inside the building) four floors below their floor of origin if the building is designed for partial evacuation (i.e., only fire floor and floor above alarm). Establish areas of safe refuge for persons with disabilities. Maintain a

list of these locations that will be used by persons with disabilities, a system to account for persons with disabilities, and means to communicate with persons taking refuge in these areas.

Evacuation Plans

The attached floor plans identify exits and exit routes for the building. Occupants should go to the nearest exit when the alarm sounds. If access to the nearest exit is obstructed, an alternate exit should be taken. For the purpose of this report, I created an emergency evacuation map for this building. See Appendix J: Evacuation Plan for floor plan.

Chapter 8 Performance Based Analysis

8.1 RSET

Detection, pre-movement and movement are the event development or evacuation process when fire occurs. Detection is the time for detection systems to activate and initiate appropriate notification sequence. Pre-movement is time for occupants to decide to move toward exit and movement is the time for occupants to evacuate through exit or otherwise reach a place of safety.

8.1.1 Detection

The time for detection is the time between the ignition of a fire and the time occupants become aware of the situation.

Events requiring evacuation can be detected through manual means or automatic systems. For manual system, people may need to perform specific actions to warn other such as activating the notification system by actuating a manual alarm station. Notification can be through bells, horns, sirens or speakers. Automatic detection systems are commonly designed and installed to address fire events and hazardous material releases and these systems are required by prescriptive codes for many occupancy classifications (Tubbs & Meacham, 2007, p. 292).

8.1.2 Pre-movement times

The pre-movement time or delay time, starts when occupants receive an emergency cue or notification and ends when they initiate the exiting process. It includes the time it takes occupants to understand the notice.

In some situation, pre-movement times can exceed the evacuation movement times. This section provides guidance for occupant pre-movement times. Before occupants decide to leave a building, he or she may be involve in different non-evacuation related task or just decide to leave. Occupants' actions during pre-movement are often linked to an occupant's activity at the time of alarm (Tubbs & Meacham, 2007, p. 293).

8.1.3 Movement time

People move according to their desired speed and abilities when sufficient space is available for free movement. As crowd density increases, occupants are forced closer to each other and free movement becomes constrained.

Egress doors, aisles, hallways, stairways and the same features restrict occupant movement. At low occupant densities, occupants are able to freely negotiate these components and move at their desired speed. At higher densities; queues develop at these flow-restricting components. (Tubbs & Meacham, 2007, p. 295).

8.2 ASET

82.1 Detach Model

The model Detach-t2 is used to calculate detection times for smoke detectors fir different fire growth rate. The detach t2 model calculates the activation time for a given fire and detector configuration. The smoke detector is assumed to behave like heat detectors but with a much faster response. (SFPE, 2008, p. 5-303)

8.2.2 Tenability Performance Criteria

A key factor in the successful application of ASET/RSET concept in coming to an agreement on the performance criteria that will be used to define untenable conditions. Tenability is defined as providing an environment that supports human life. Life safety criteria may include thermal exposure, inhalation of toxic products of combustion, visibility or combination of these things. Thermal exposure can lead to injury, incapacitation, and death. It can occur from direct exposure to smoke and hot combustion gases (convective exposure) or through thermal radiation exposure. Inhalation of toxic products of combustion can also lead to injury, incapacitation and death. The general effects of toxic products include reduced decision-making capacity and impaired motor activity. Toxic products may include: carbon monoxide, carbon dioxide, hydrogen cyanide, hydrogen chloride and hydrogen bromide. Visibility may affect the ability of occupants to discern or negotiate egress paths. Smoke can obscure paths or reduce an occupant's ability to see through physiological effects irritating the eyes.

Life safety code provides four methods of assessing tenability when performance approaches are used to address egress. Method One is the one I am discussing. In some performance approaches, the system design may anticipate the contamination of egress path with heat, smoke or other toxic or damaging [products of combustion. The fractional effective dose (FED) method can be used to determine if occupants will be able to exit safely through contaminated egress paths. Exposures to lower doses of contaminant over a long period of time may sometimes be as severe as exposure to higher doses for shorter periods. The FED method accounts for both low and high doses (Tubbs & Meacham, 2007, p.286).

8.2.2.1 Quantifying Tenability

Tenability can be quantified in terms of thermal effects, visibility through smoke and smoke toxicity, or limiting impact from falling materials. Sublethal effects should also be considered.

8.2.2.1.1 Thermal Effects

Thermal effects can be evaluated based on the temperature of heated gasses or exposure to flames. Radiant and convective exposures may need to be combined to analyze their effects cumulatively. This can also be done with FED approach. (Tubbs & Meacham, p. 286).

8.2.2.1.2 Visibility

Visibility is a measure of how far occupants can see through smoke. Visibility depends on the density of the smoke, illumination, distance and the physiological effects of smoke on the eyes. Visibility is evaluated in terms of the distance at which an occupant can read an illuminated exit sign or distinguish an exit pathby viewing walls at a distance (Tubbs & Meacham, p. 287).

8.2.2.1.3 Smoke Toxicity

Inhaling combustion products can have toxic effects. The general effects on human include reduced decision-making capacity and impaired motor activity, and can lead to incapacitation or death. Tenability criteria for toxic combustion products are given as parts per million (ppm), density of contaminants (g/m^3), or as percentage concentration for a period of time (Tubbs & Meacham, p. 287).

8.3 Types of Evacuation

8.3.1 Phased Evacuation

Phased Evacuation is way to optimize egress system efficiency. It works because the number of occupants expected to simultaneously evacuate during an event is significantly lower than the total occupant load of the facility. This generally means that the egress system can be developed for the design occupant load located within the designed areas or designated floor (Tubbs & Meacham, p. 101).

8.3.2 Simultaneous Evacuation

Simultaneous evacuation is the norm of many small and uncomplicated facilities under most events, and can be used in larger facilities in cases where entire building is simultaneously impacted, such as in a power outage. As the name implies, the expectation is that all occupants simultaneously evacuate the entire building upon any alarm signal (Tubbs & Meacham, p. 102).

8.4 Design Criteria

8.4.1 Assumptions

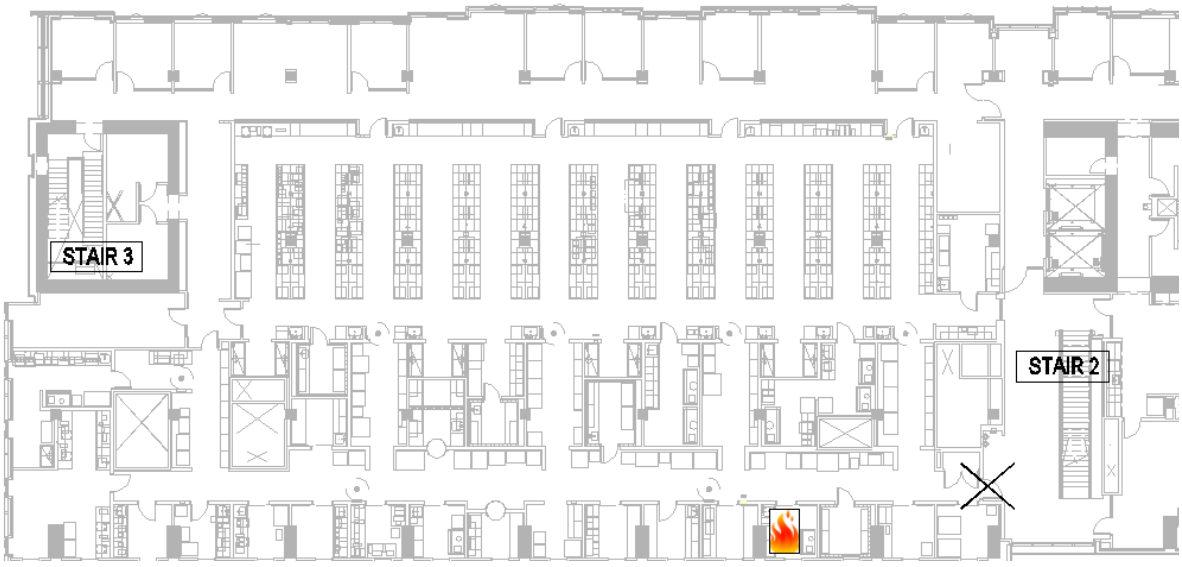
- All occupants will egress at the same time (applies for simultaneous evacuation)
- The population will use all exits in optimum level
- All occupants start to evacuate at time zero
- All occupants are alert , aware and familiar of their surroundings

8.4.2 Tenability Criteria

Criterion	Tenable Limit	Justification
Temperature	< 60°C	Purser's Chapter in SFPE Handbook recommend maximum short-term exposure of 60°C (140°F) for 100% water vapor saturated-air and FED method for convective exposures of less than this limit. Purser also states that water vapor produced by fires may be important in this regard and is often neglected.
Visibility	< 10 m @ 1.8 m AFF	Per SFPE Handbook, Assessment of Hazards to Occupants from Smoke, Toxic gases and heat by David A. Purser, Chapter 2-6 Table 2-6.11
CO	< 1400 ppm	Per SFPE Handbook. The CO incapacitation level from exposure for 30 minutes

8.5 Design Scenarios

8.5.1 Design Fire 1 - Laboratory Fire (Level 6)



8.5.1.1 Base for Design Fire Scenario

For this Design fire scenario, I choose design fire scenario 6 in NFPA 101 stating that the largest fuel load possible in a given occupancy during normal operations, with severe-case fuel types, geometries and configurations: addresses rapidly developing fire with occupant present. No fire suppression is considered.

8.5.1.2 Input Parameters

- The maximum HRR is 2,000 kW
- Data from NISTIR 89-4200 for Chemical Laboratories
- Assumed a t-squared fast growing fire and the maximum HRR is maintained throughout the fire

Acetone			
Heat of combustion	29.7	kJ/g	SFPE Table 3-4.16
Soot yield	0.014	g/g	SFPE Table 3-4.16
CO Yield	0.003	g/g	SFPE Table 3-4.16

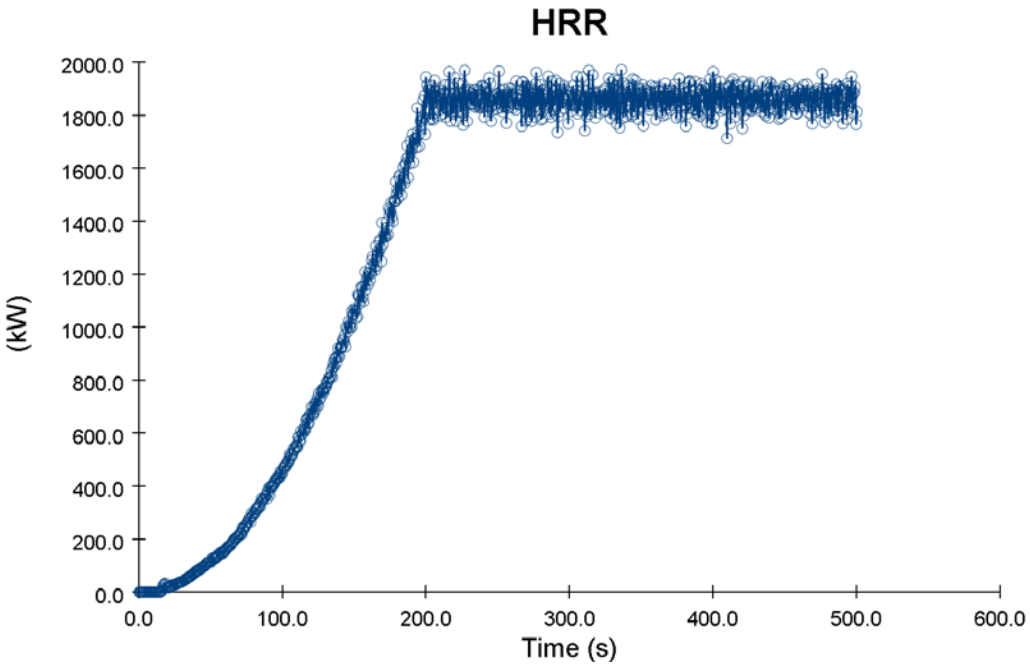
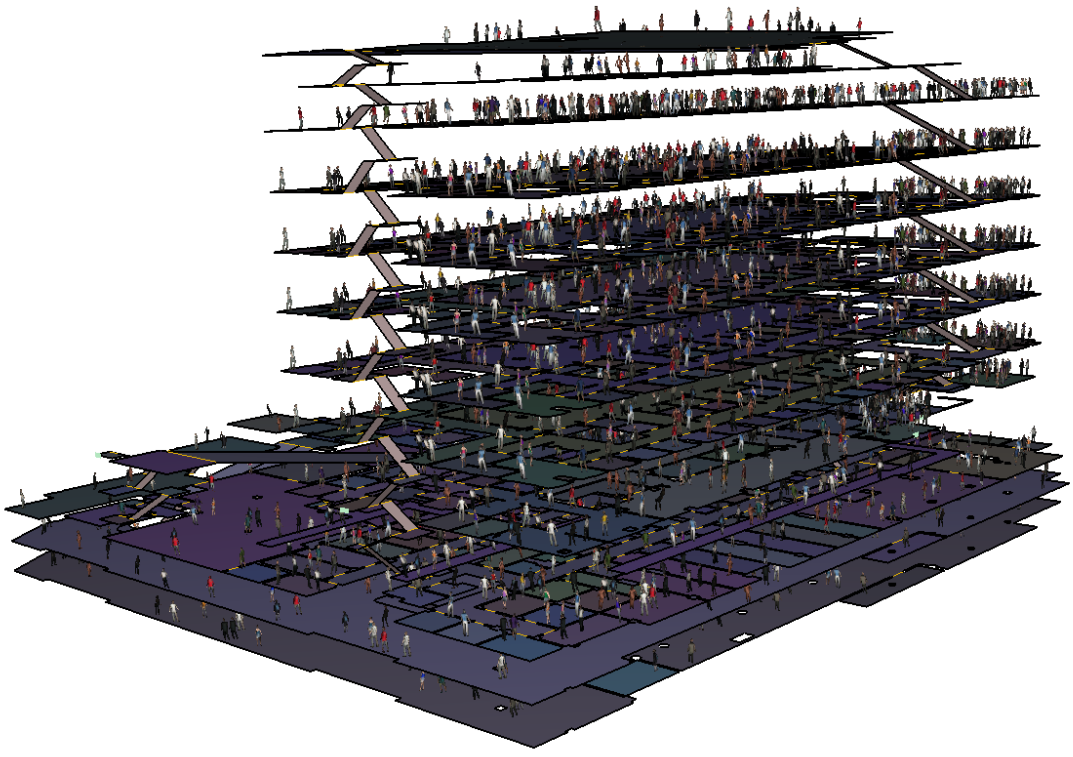


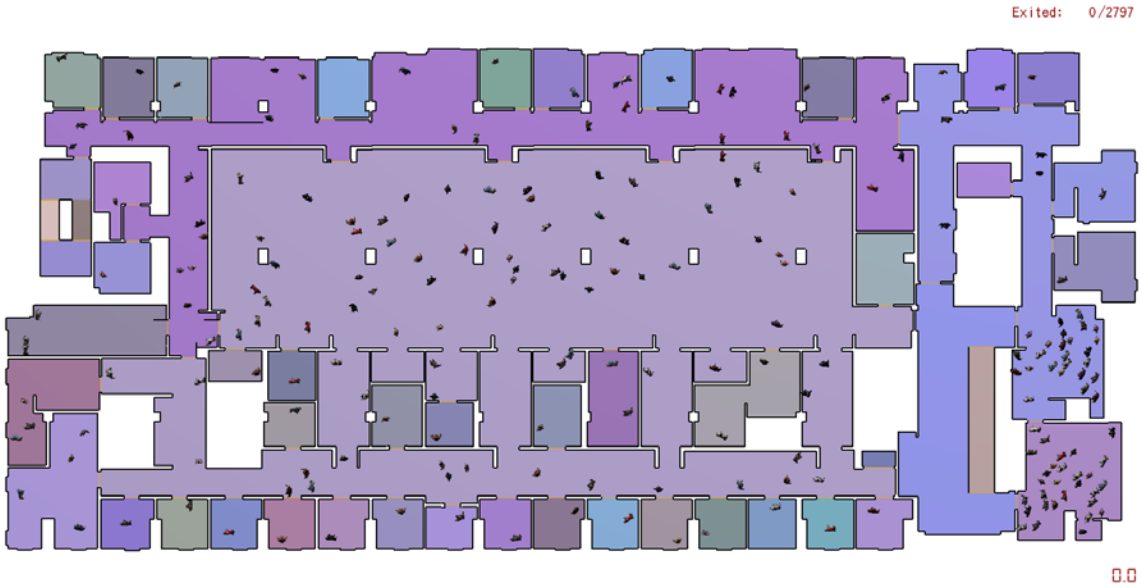
Figure 3: Heat Release Rate Curve for Design Scenario 1

8.5.1.3 Pathfinder result

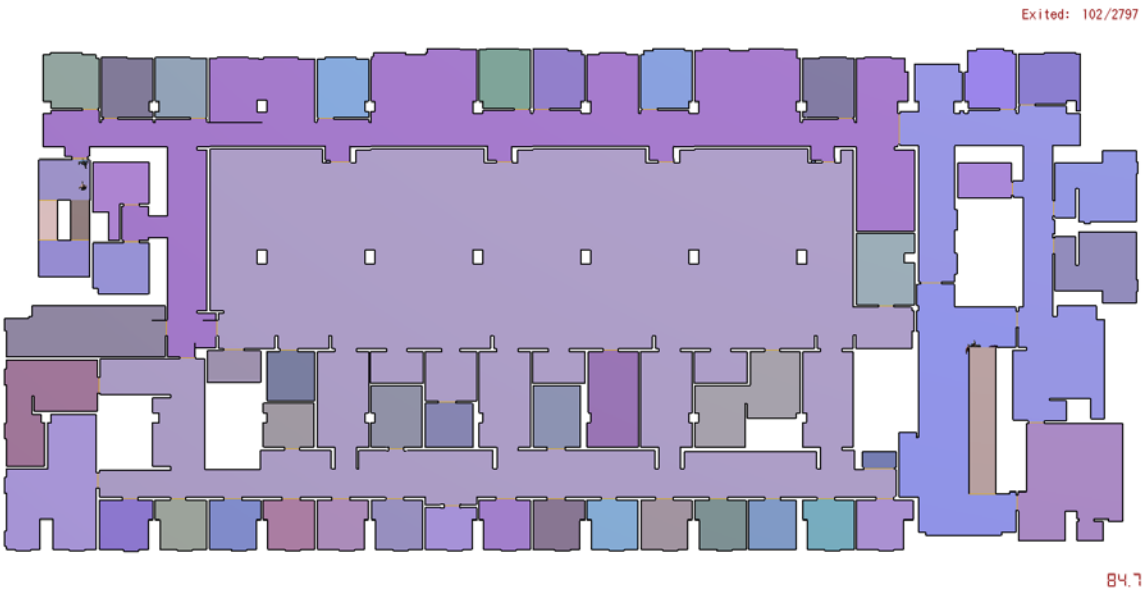


8.5.1.3.1 Phase evacuation

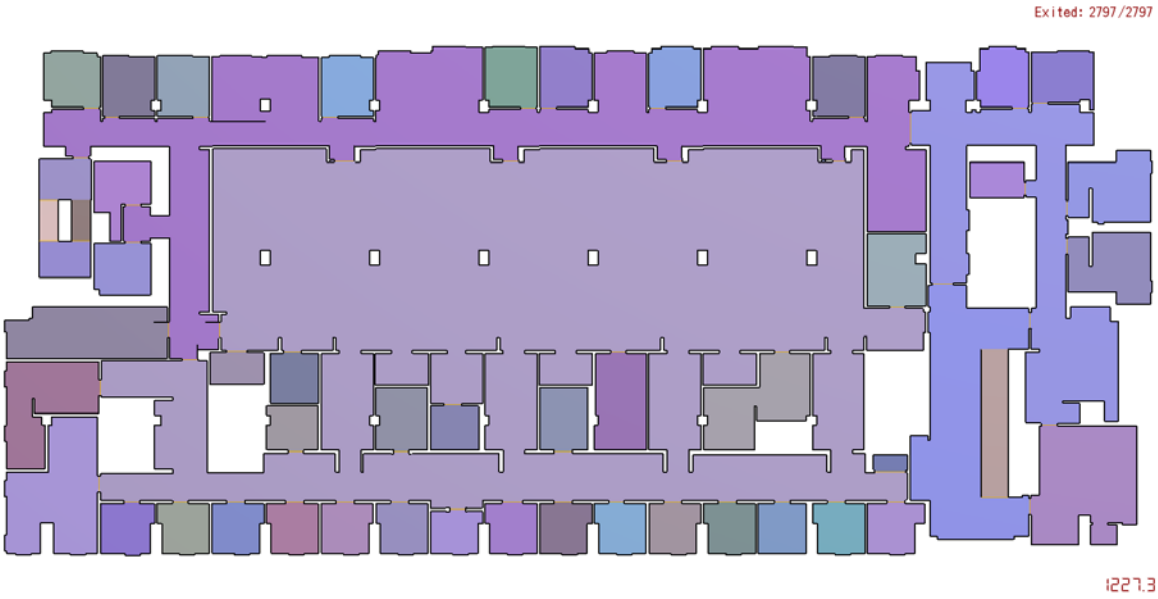
Shown here is the Level 6 evacuation time. There are 213 occupants in Level 6. At time of the alarm, occupants start to evacuate the fire floor.



At 85 seconds, all occupants exited the floor.

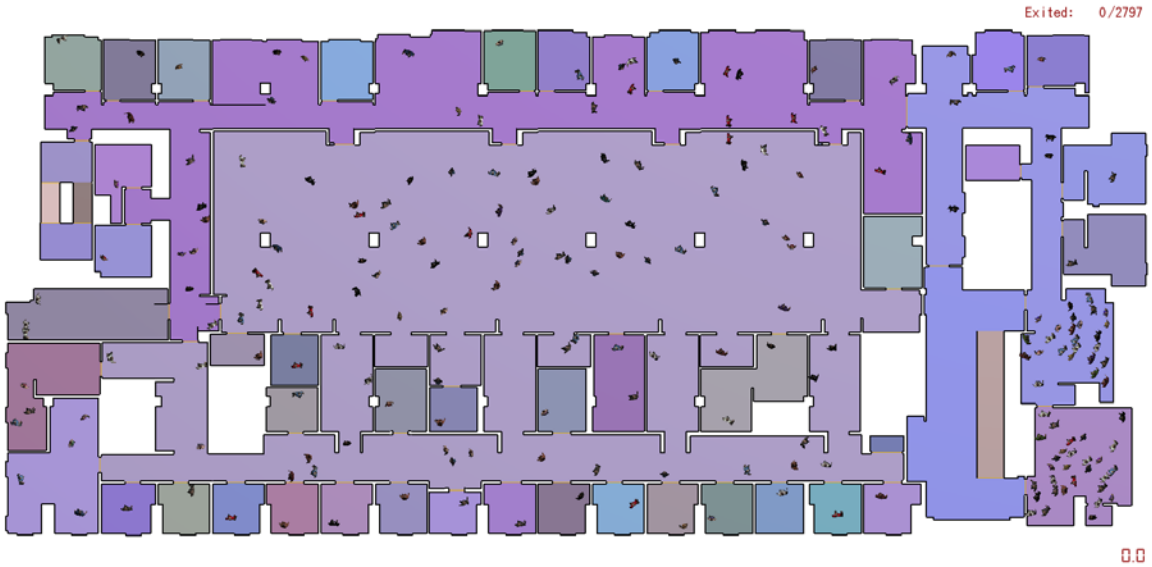


At 1227 sec, all the occupants exited the building.

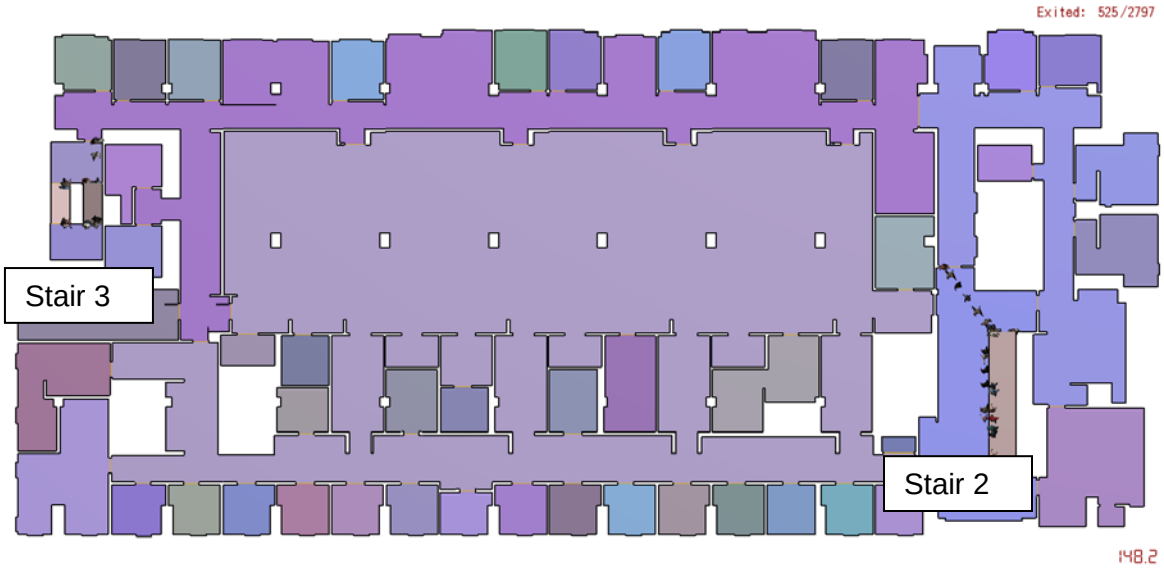


8.5.1.3.2 Simultaneous Evacuation

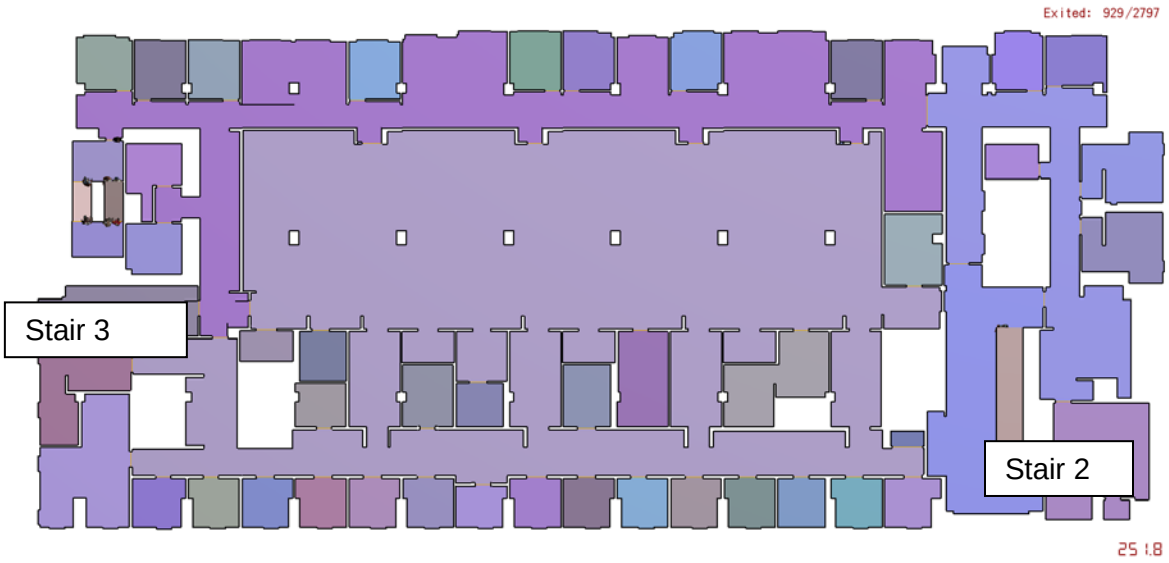
Shown here is the Level 6 evacuation time. There are 213 occupants in Level 6 and 2797 occupant for the entire building. At time of the alarm, occupants start to evacuate.



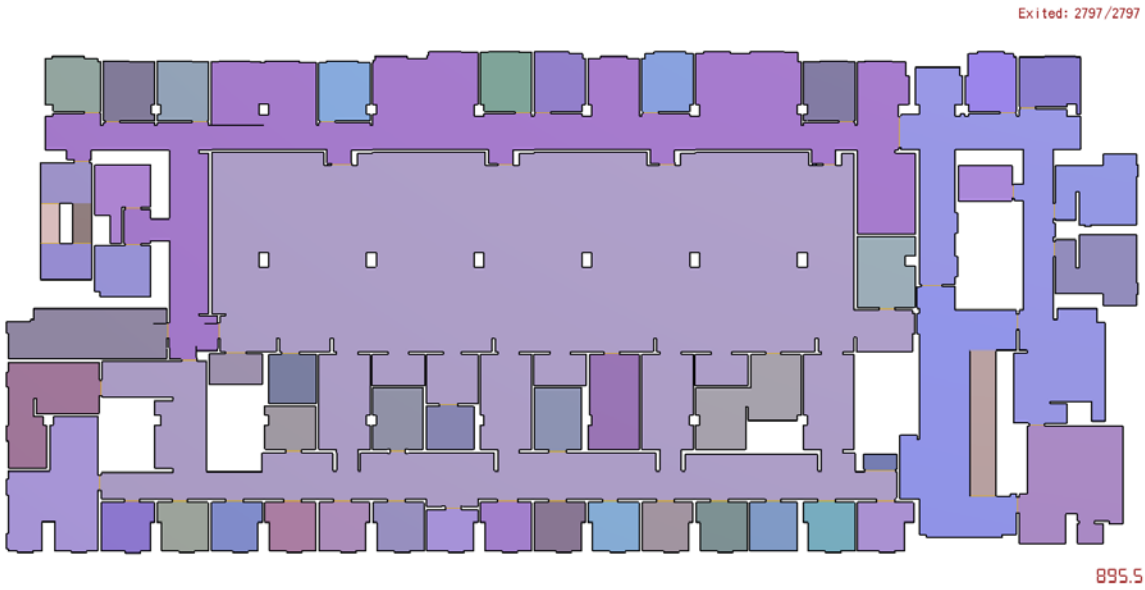
At time 148.2 seconds, the occupant exit Stair 2 in Level 6



At time 251.8 seconds, the last occupant in Level 6 exited Stair 3.



At time 895.5 seconds, all the occupants exited the buidling.



8.5.1.3.2.1 Hand Calculations

FLOORS	OCCUPANT LOAD	Door Width	SFPE		
			SCENARIO 1		
			W_e (in)	W_e (m)	EVACUATION TIME (sec)
BASEMENT LEVEL 3	271	(2) 36"	48	1.22	170.98
BASEMENT LEVEL 2	271	(2) 36"	48	1.22	170.98
BASEMENT LEVEL 1					
west	46	(1)36"	24	0.61	58.05
east	319	(2) 36"	48	1.22	201.27
BASEMENT 1 SERVICE					
west	37	(1)36"	24	0.61	46.69
east	35	(2) 36"	48	1.22	22.08
LEVEL 1	479				
LEVEL 2	213	(3) 36" , (1)42" , (1) 48"	138	3.51	46.74
LEVEL 3	213	(3) 36" , (1)42" , (1) 48"	138	3.51	46.74

FLOORS	OCCUPANT LOAD	Door Width	SFPE		
			SCENARIO 1		
LEVEL 4	213	(3) 36" , (1)42" , (1) 48"	138	3.51	46.74
LEVEL 5	213	(3) 36" , (1)42" , (1) 48"	138	3.51	46.74
LEVEL 6*	213	(3) 36" , (1) 48"	108	2.74	59.73
LEVEL 7	206	(3) 36" , (1)42" , (1) 48"	138	3.51	45.21
LEVEL 7 SERVICE	33	(2) 36"	48	1.22	20.82
PENTHOUSE	35	(2) 36"	48	1.22	22.08
*removed 42" door				**1004.86**	

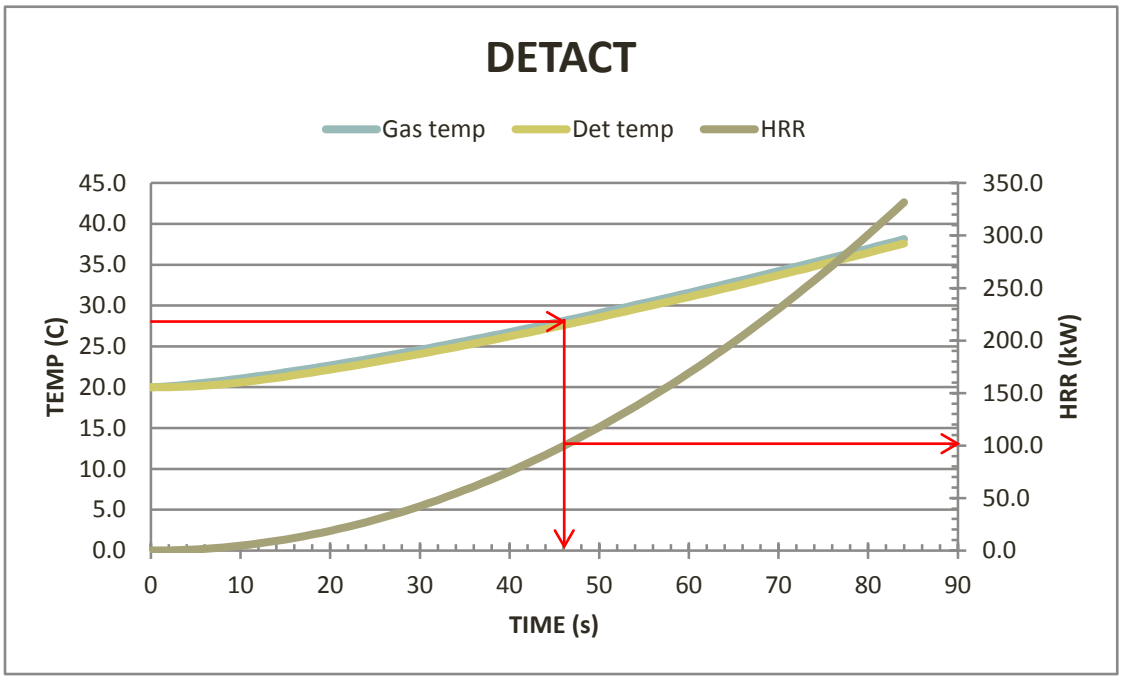
8.5.1.3.2.2 Simultaneous Evacuation: Pathfinder vs. Hand Calculations

Pathfinder result is 895 sec while my hand calculation is 1004.86. There is 109.36 sec difference between the results. Pathfinder occupant characteristics are being directed to go to any exit while my hand calculation occupant characteristic is at an optimum level.

8.5.1.4 DETACH Model

Ceiling Mounted Fire Detector

INPUT PARAMETERS			CALC. PARAMETERS	
Ceiling height (H)	2.73	m	R/H	3.985
Radial distance (R)	10.88	m	dT(cj)/dT(pl)	0.119
Ambient temperature (To)	20	C	u(cj)/u(pl)	0.063
Actuation temperature (Td)	27.2	C	Rep. t2 coeff.	k
Response time index (RTI)	1	(m-s)1/2	Slow	0.003
Fire growth power (n)	2	-	Medium	0.012
Fire growth coefficient (k)	0.047	kW/s^n	Fast	0.047
Time step (dt)	1	s	Ultrafast	0.400



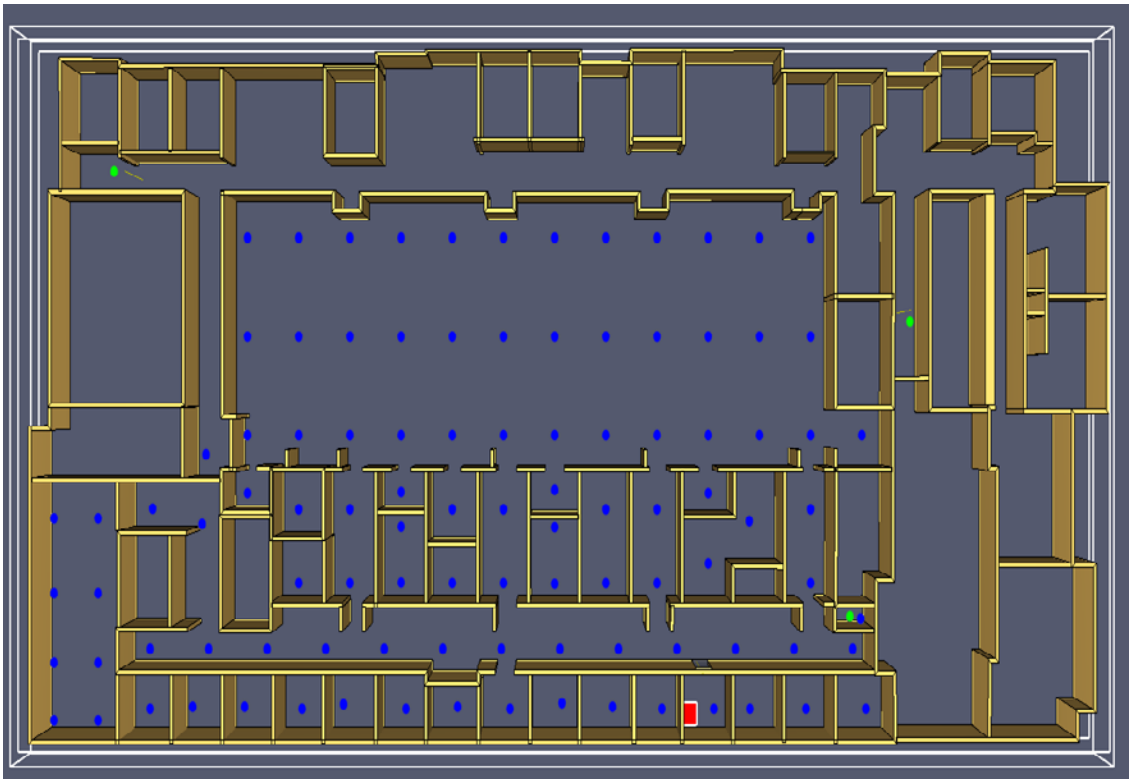
The detector activates 27.2°C at approximately 46 seconds with a heat release rate of 100kW.

FDS output, smoke detector activates at 81.7 sec.

	Fire Scenario 1	
	Detector activation time	
	Time (sec)	HRR (kW)
Detact model	47	105
FDS model	81.7	300

FDS is predicting higher temperature because it includes the accumulation of hot gas layer while detact model doesn't account for this. Detact only account for ceiling jet.

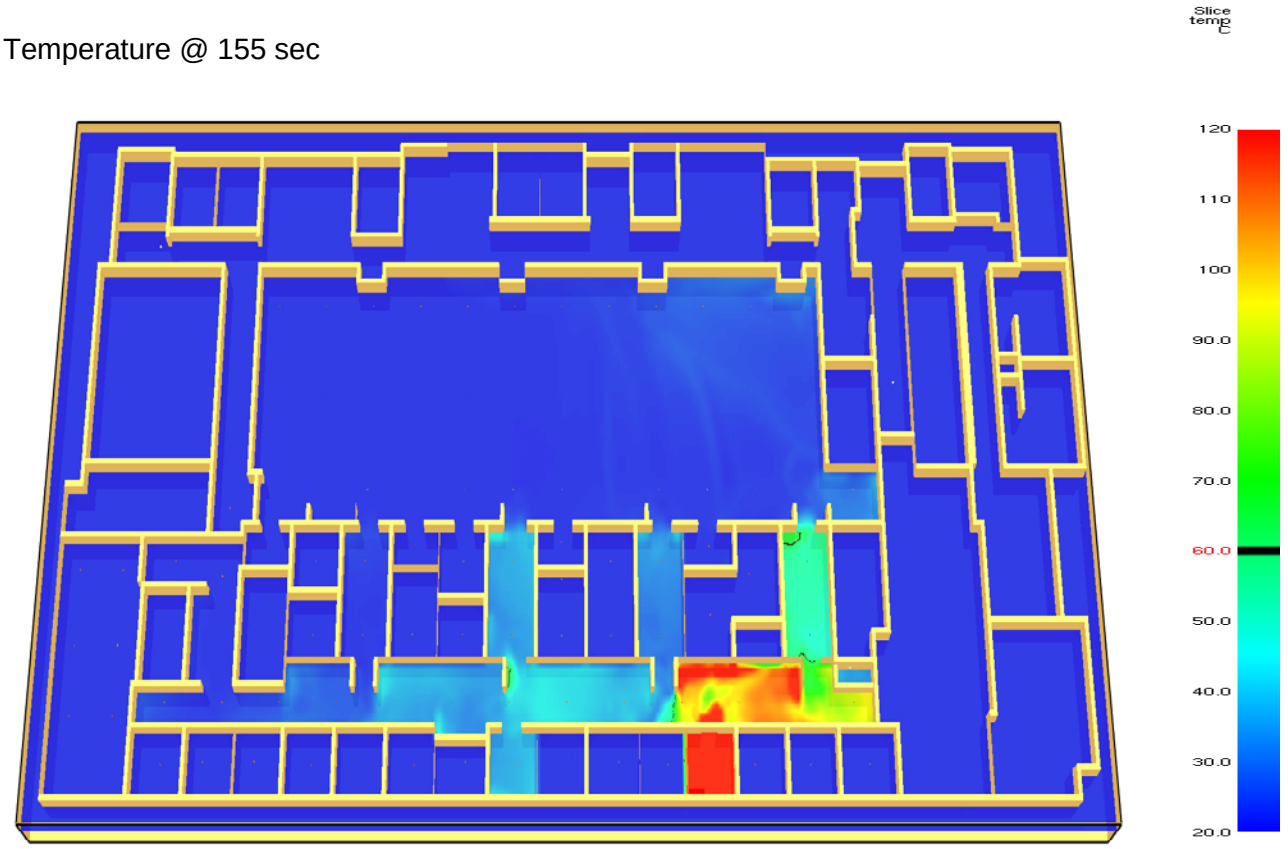
8.5.1.5 FDS



	Evacuation		References
	Phased	Simultaneous	
Detection phase t_d (sec)	0	0	detected by an individual
notification phase t_n (sec)	10	10	NFPA 72 - 10.9.2
pre-evacuation phase t_{p-e} (sec)	60	60	SFPE Table 3-12.2
evacuation phase t_e (sec)	85	252	using Pathfinder Model
RSET (sec)	**155**	**322**	

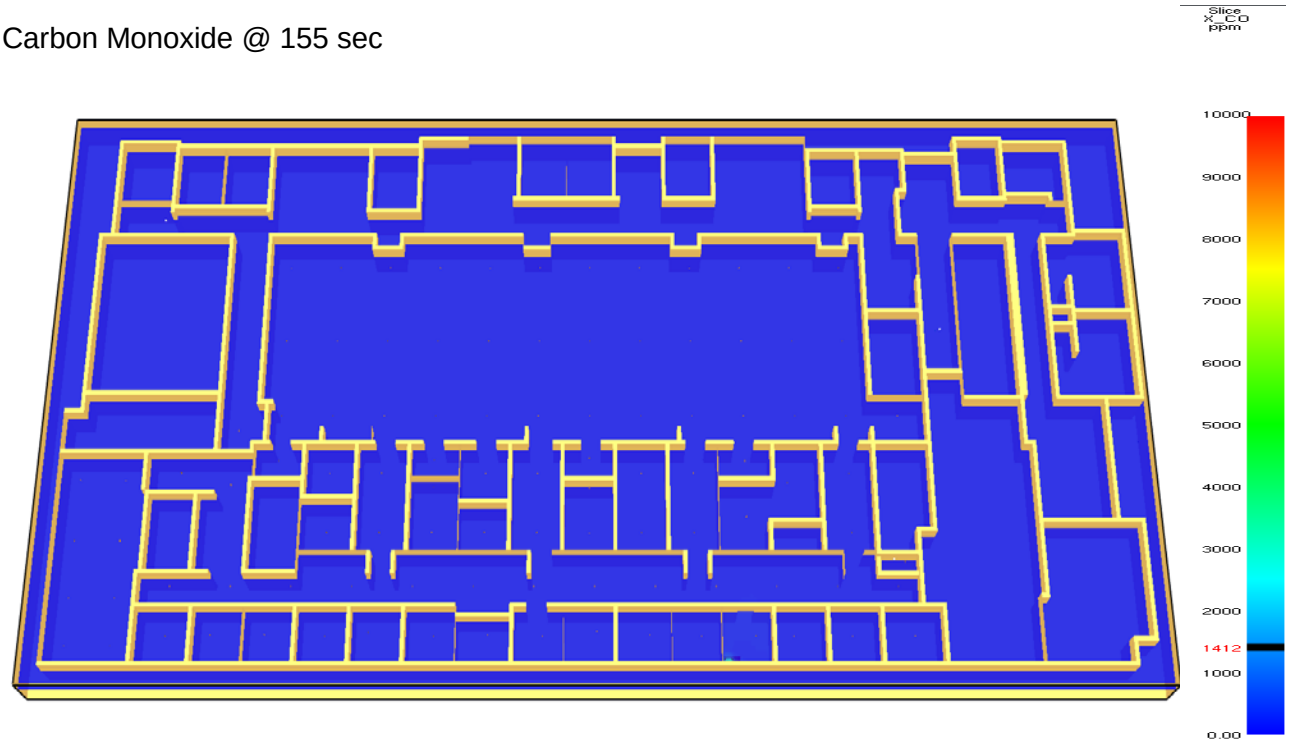
Phased Evacuation

Temperature @ 155 sec



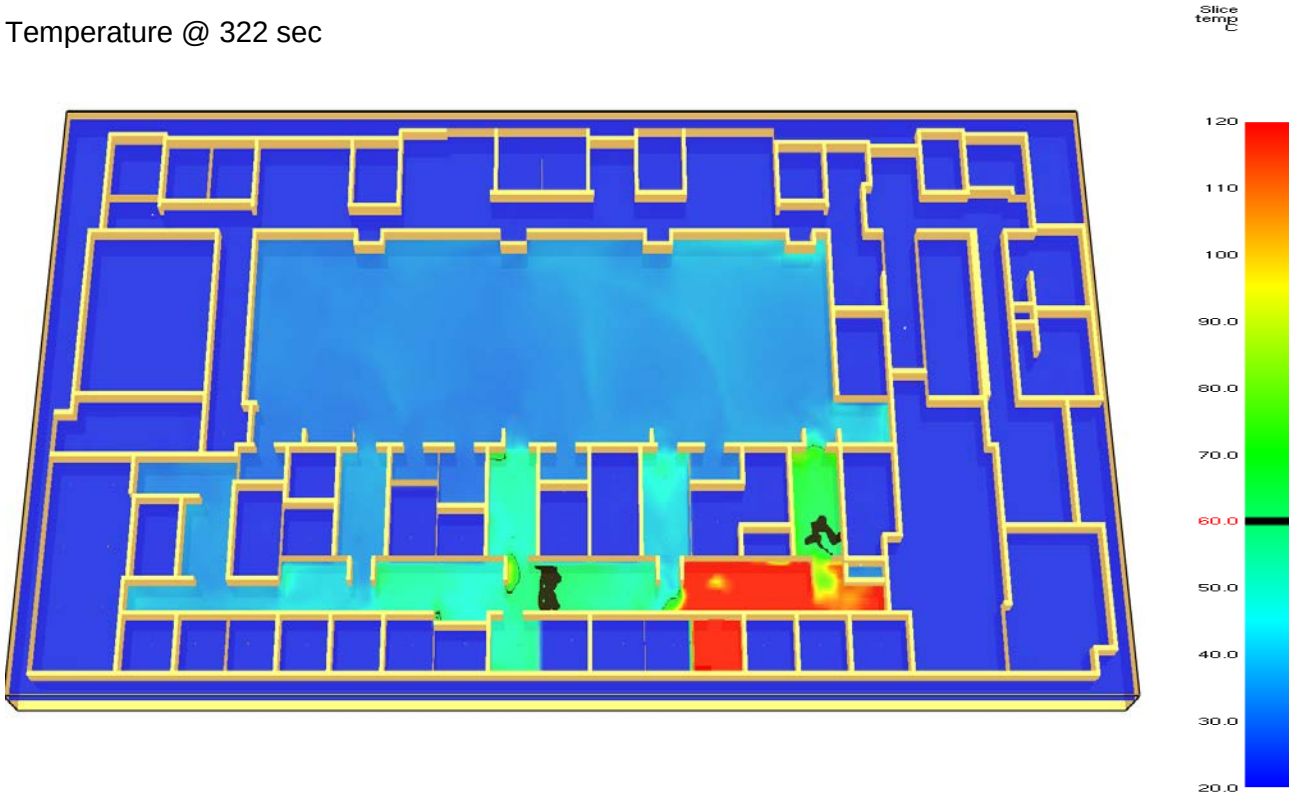
Visibility @ 155 sec

Carbon Monoxide @ 155 sec

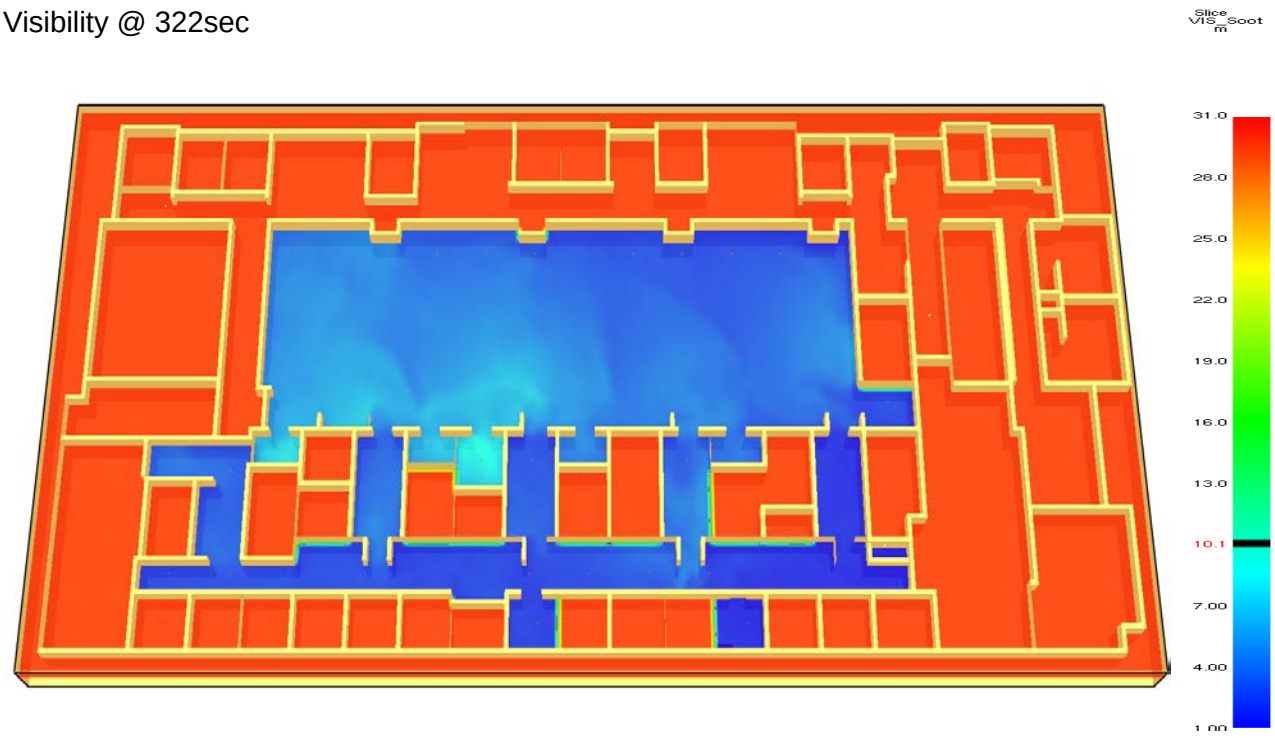


Simultaneous Evacuation

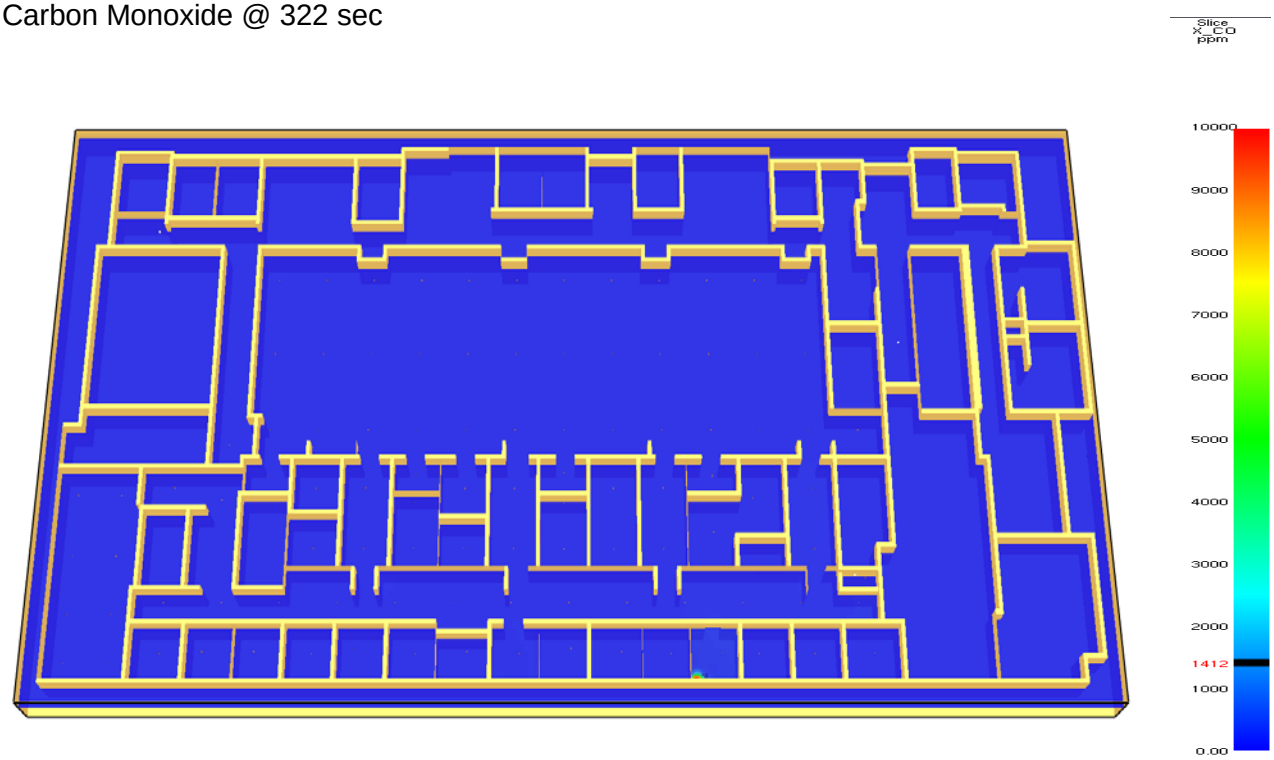
Temperature @ 322 sec



Visibility @ 322sec

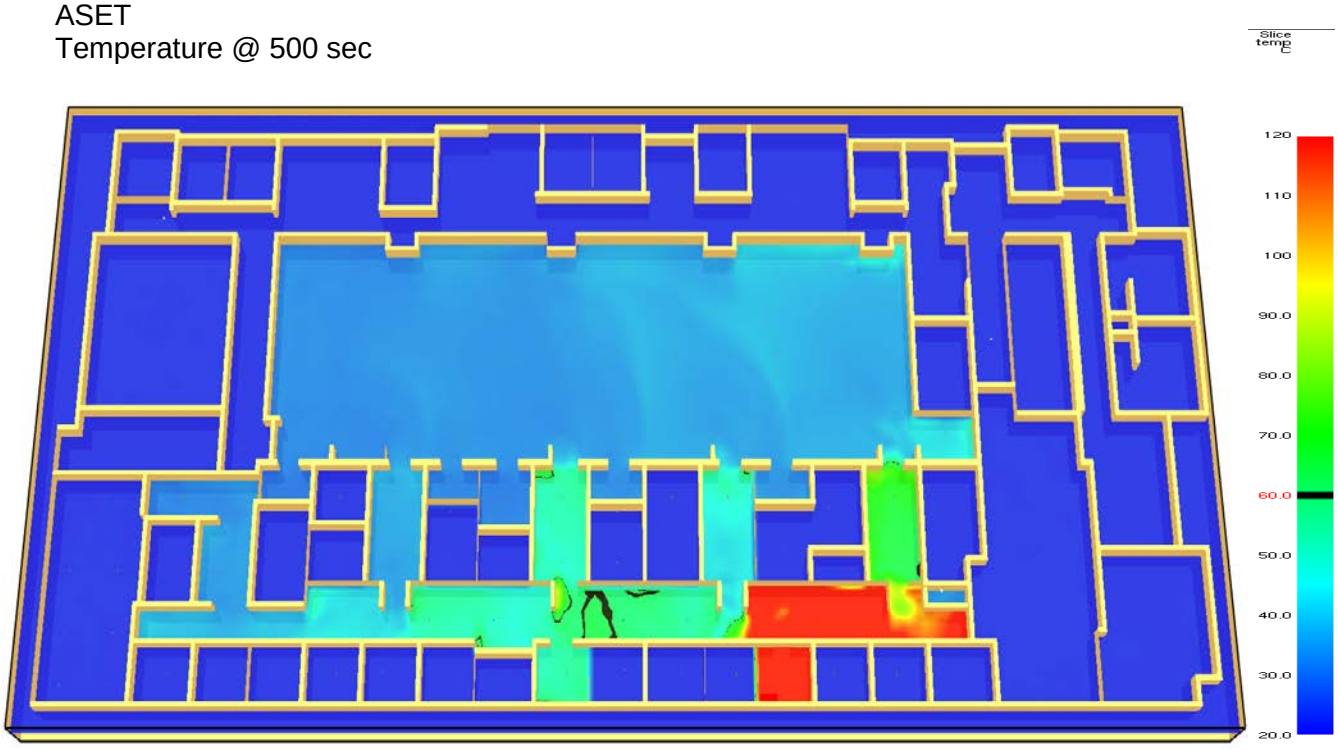


Carbon Monoxide @ 322 sec

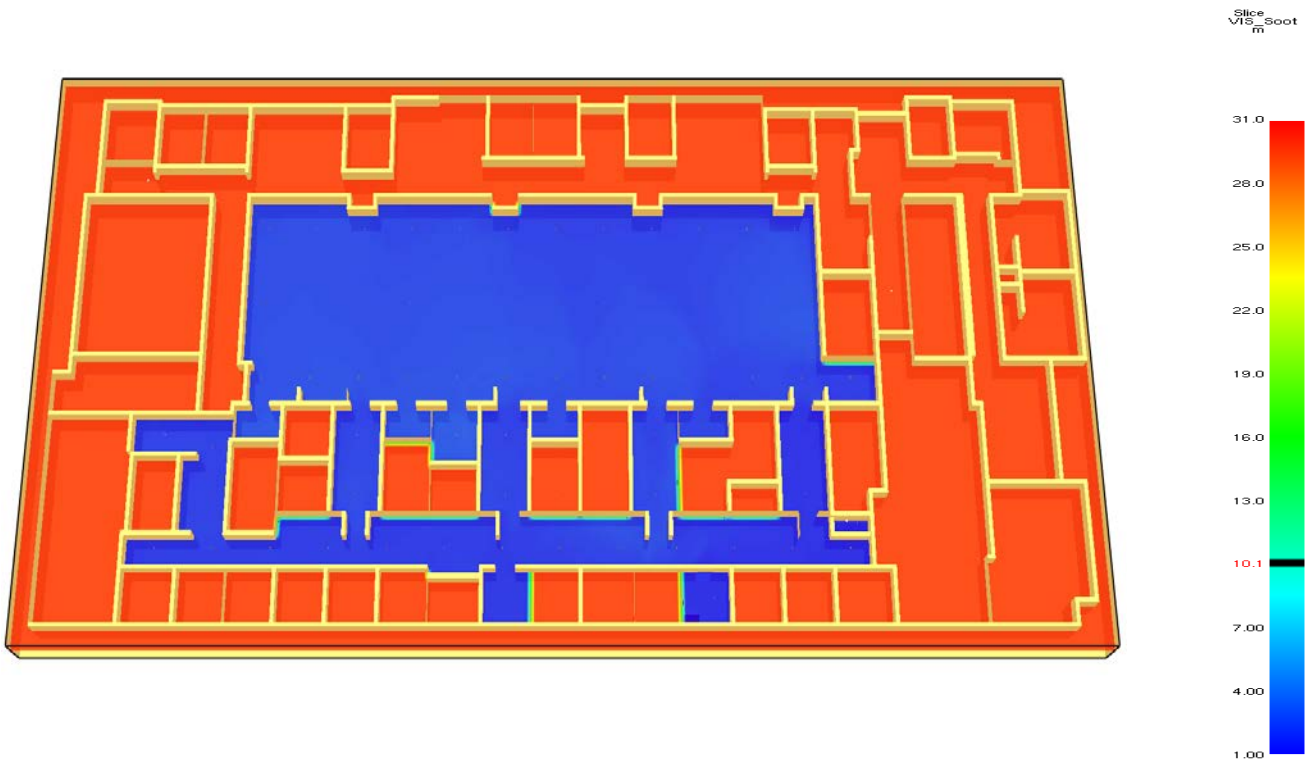


8.5.1.6 Result

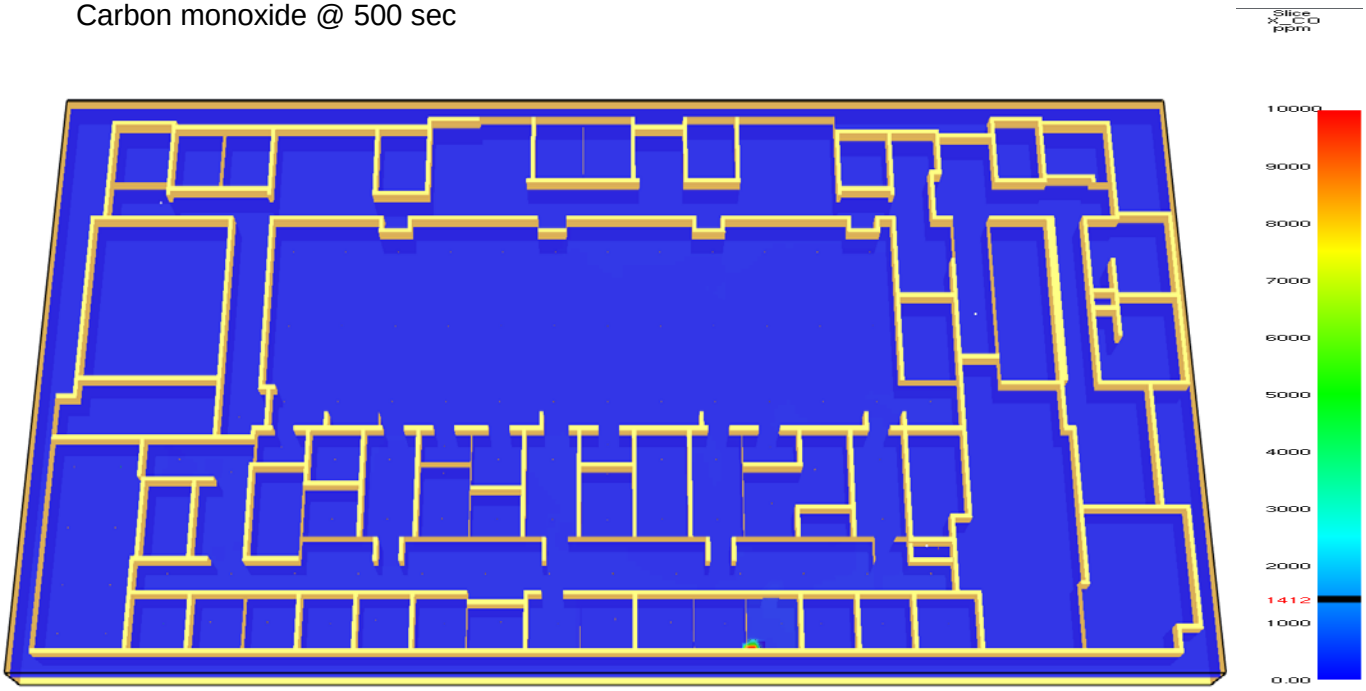
ASET
Temperature @ 500 sec



Visibility @ 500 sec

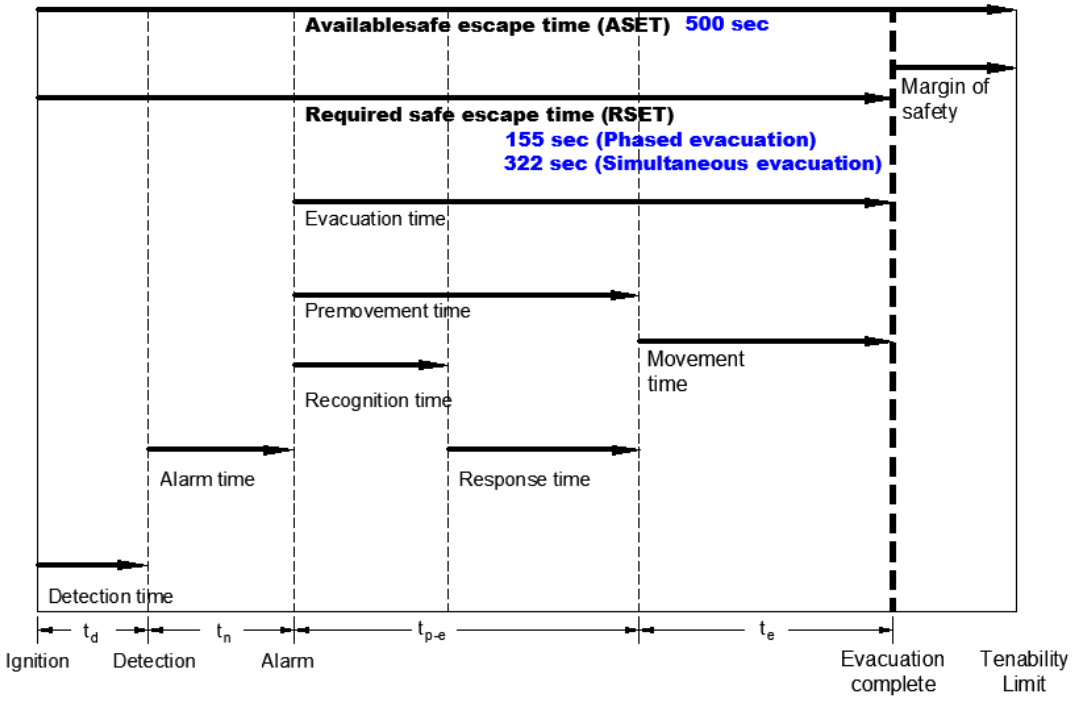


Carbon monoxide @ 500 sec



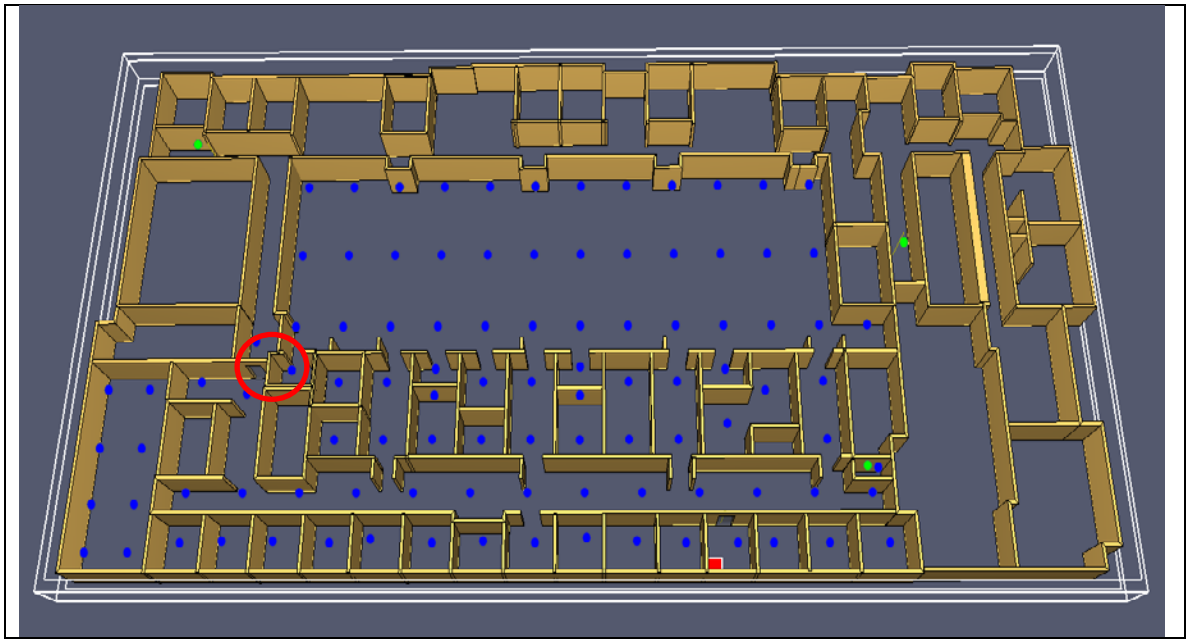
I run my FDS simulation for 500 sec and it shows that the space is still tenable at this time.

SFPE Handbook 4th Edition : Figure 3-1.1



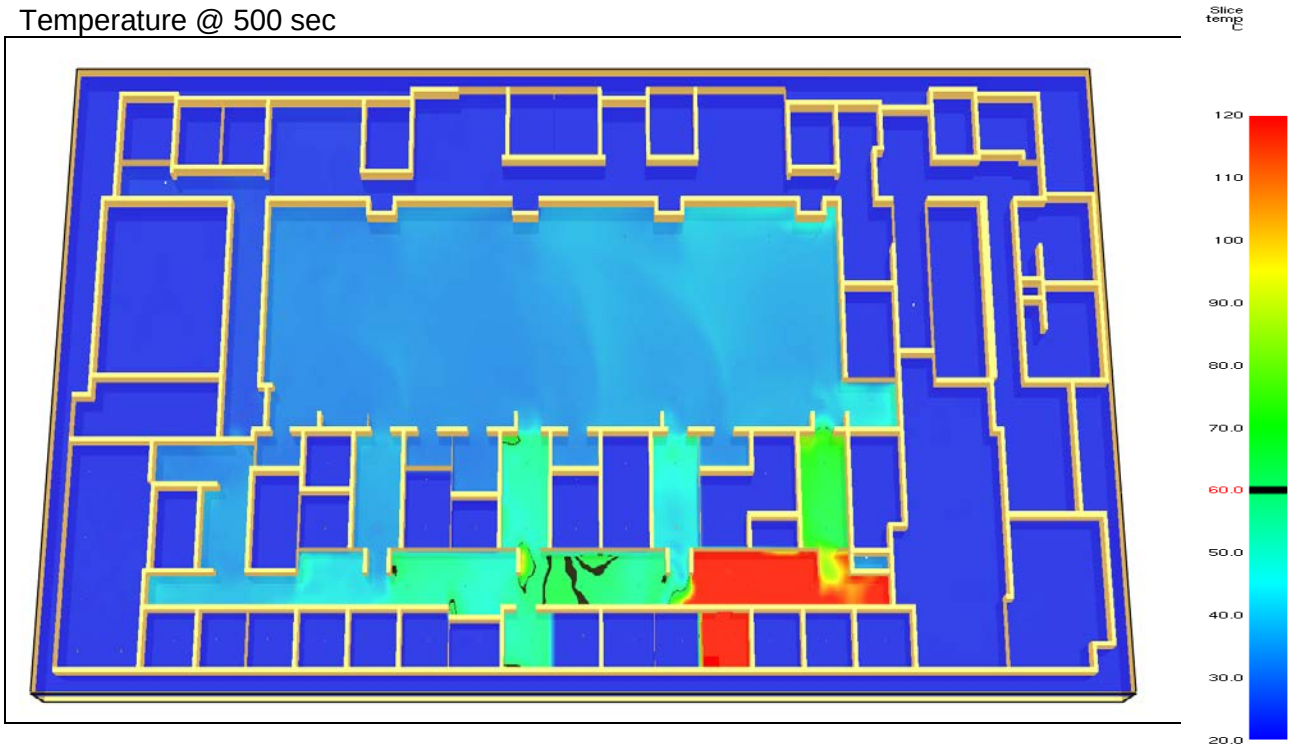
Based on this result ASET > RSET for both the phased and simultaneous evacuation.

8.5.2 Design Fire 2 –Laboratory Fire (Level 6)
The same as Fire Scenario 1 but left the door open in the corridor.

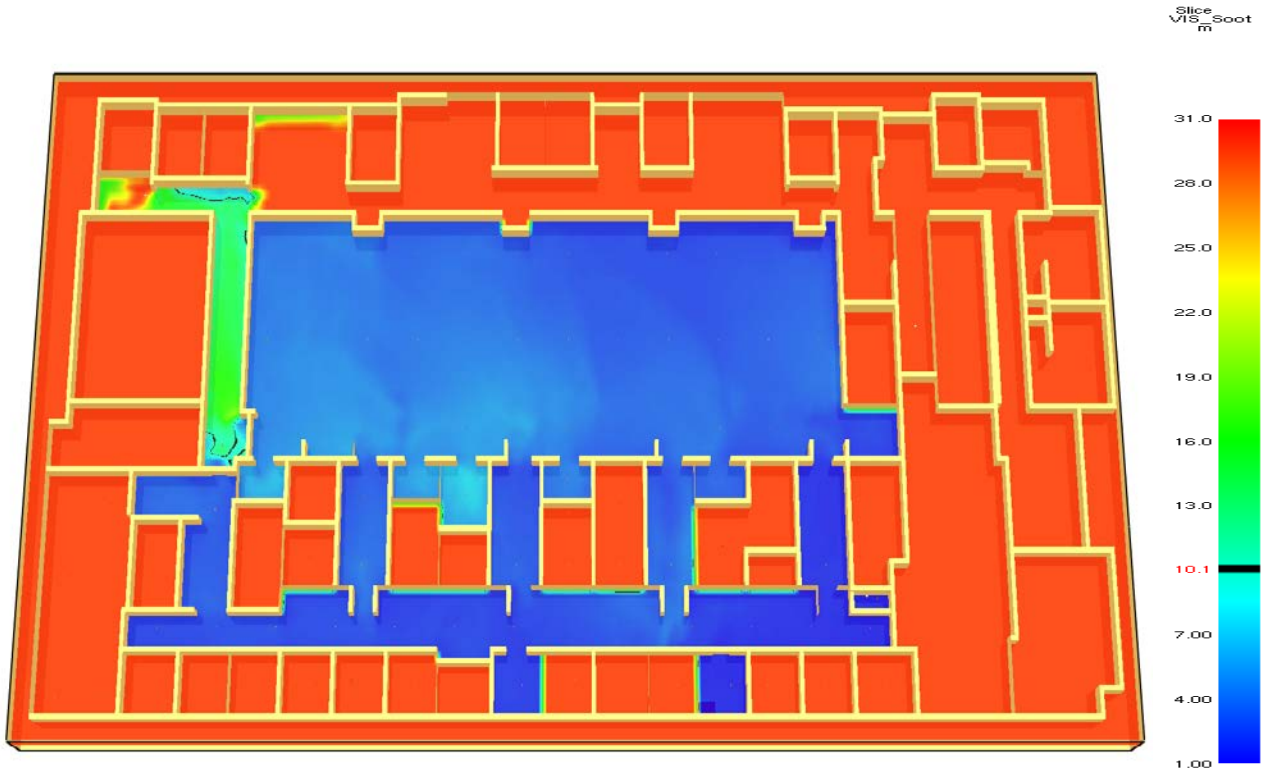


Check ASET :

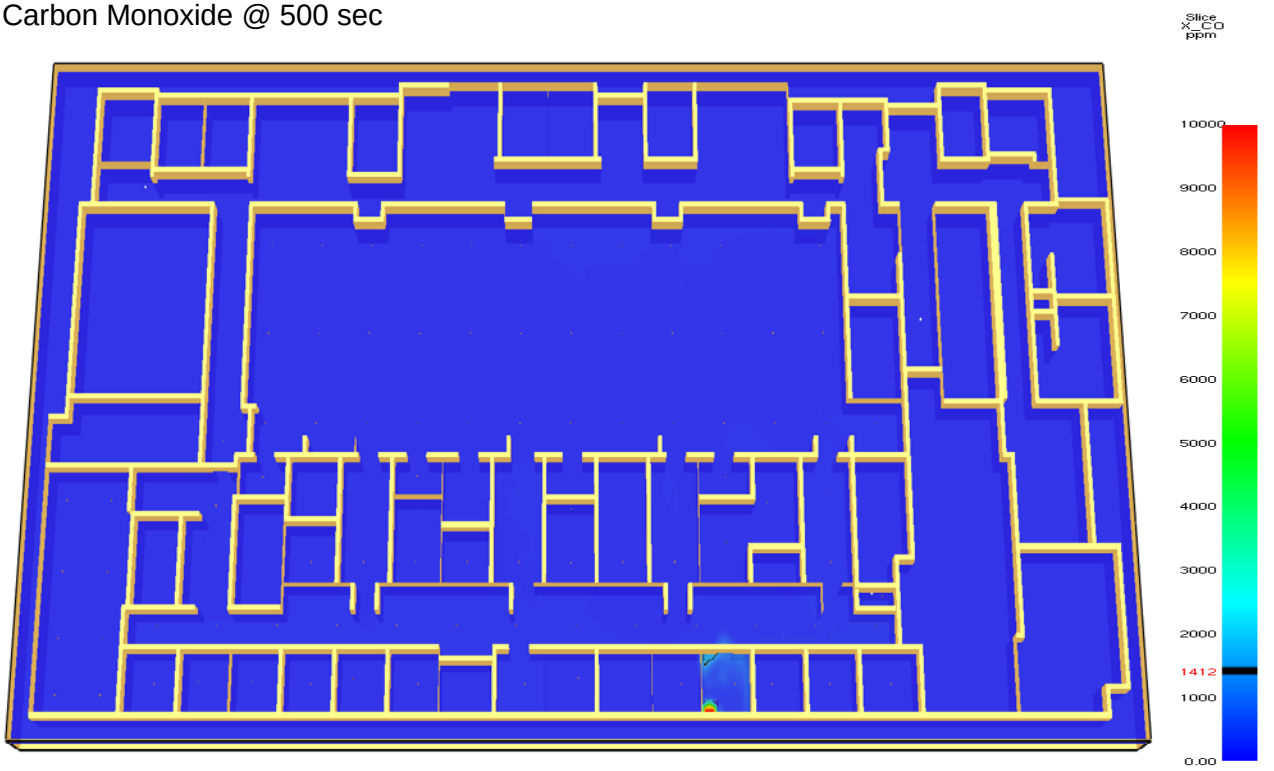
Temperature @ 500 sec



Visibility @ 343.9 sec

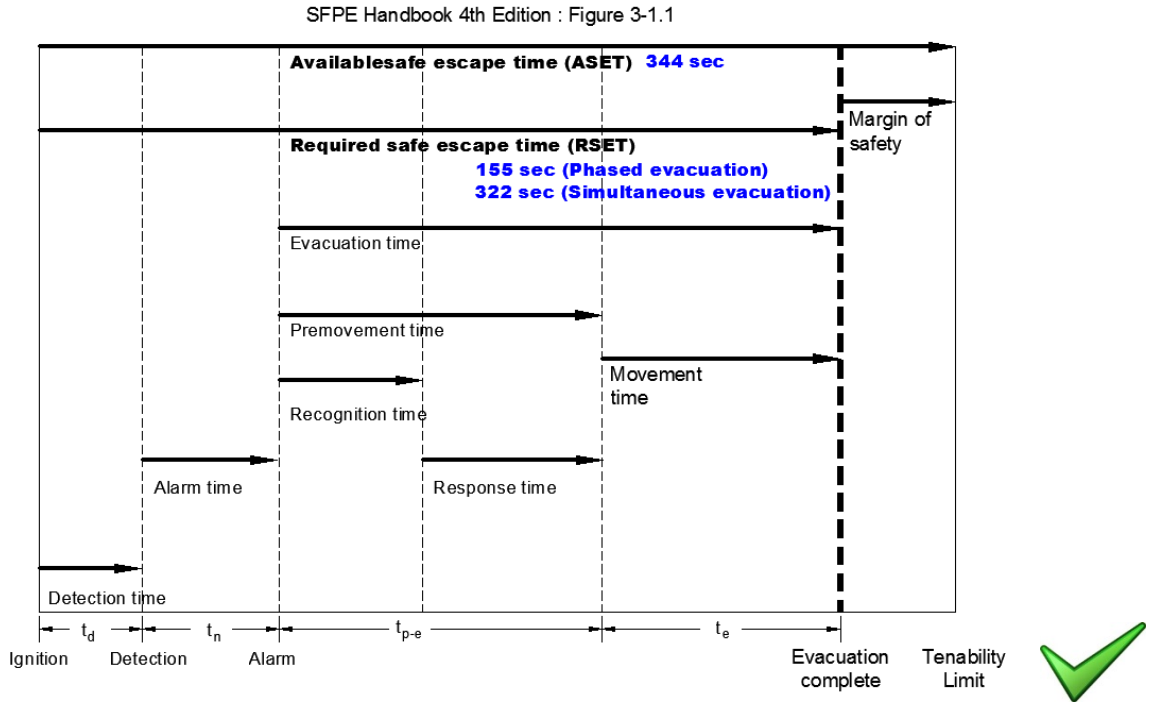


Carbon Monoxide @ 500 sec

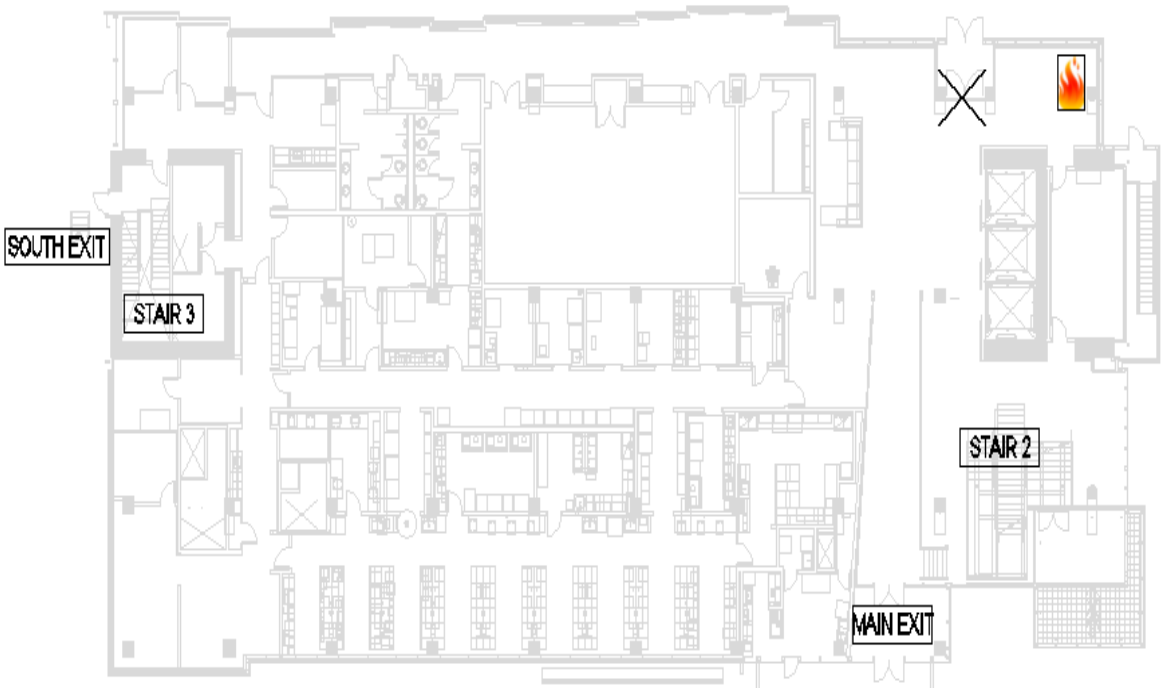


8.5.2.1 Result

This scenario meets the criteria ASET>RSET.



8.5.3 Design Fire 3 - Lobby Fire (Level 1)



8.5.3.1 Base for Design Fire Scenario

For this Design fire scenario, I choose design fire scenario 2 in NFPA 101 stating that Ultrafast-developing fire within the primary means of egress: addresses a reduction in the number of means of egress.

8.5.3.2 Input Parameters

- The maximum HRR is 2,000 kW
- Data from NBSIR 82-2604 – Upholstered furniture HRR
- Assumed a t-squared fast growing fire and the maximum HRR is maintained throughout the fire
- Fire sprinkler activates and controls the fire

Polyurethane (GM21)			
Heat of combustion	26.2	kJ/g	SFPE Table 3-4.16
Soot yield	0.131	g/g	SFPE Table 3-4.16
CO Yield	0.01	g/g	SFPE Table 3-4.16

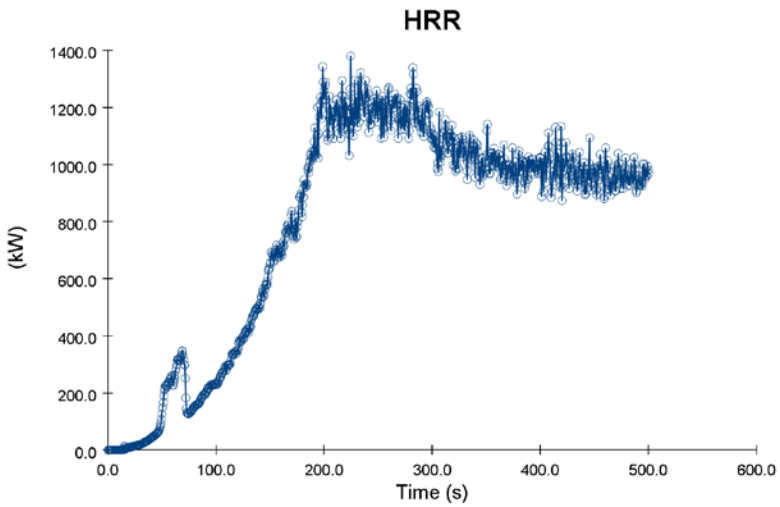


Figure 4: Heat Release Rate Curve for Design Scenario 2

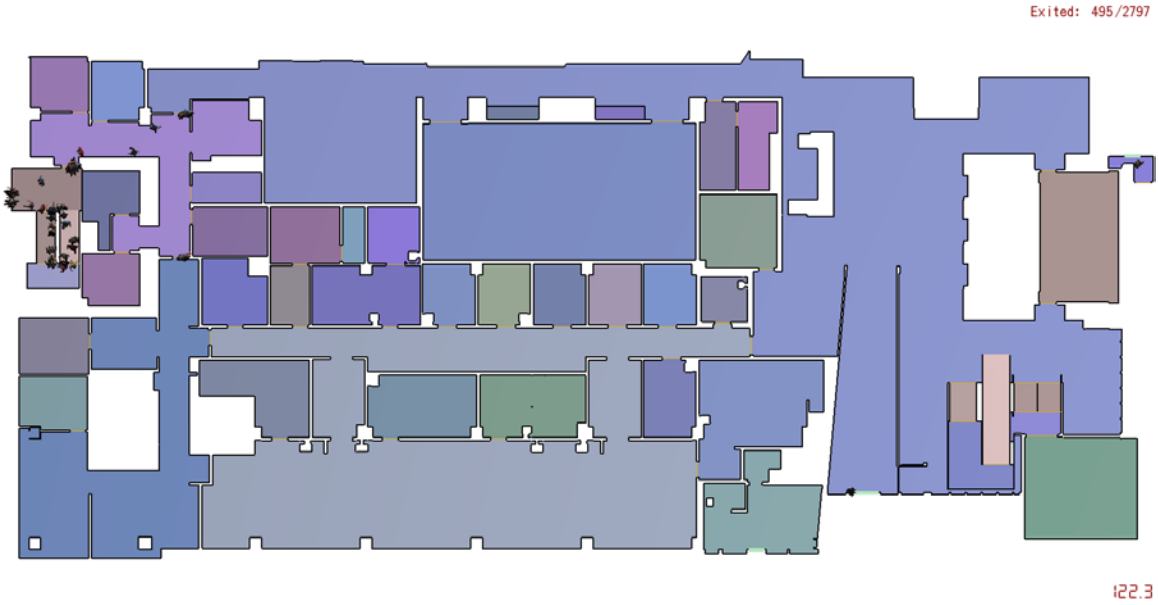
8.5.3.3 Pathfinder results

8.5.3.3.1 Evacuation

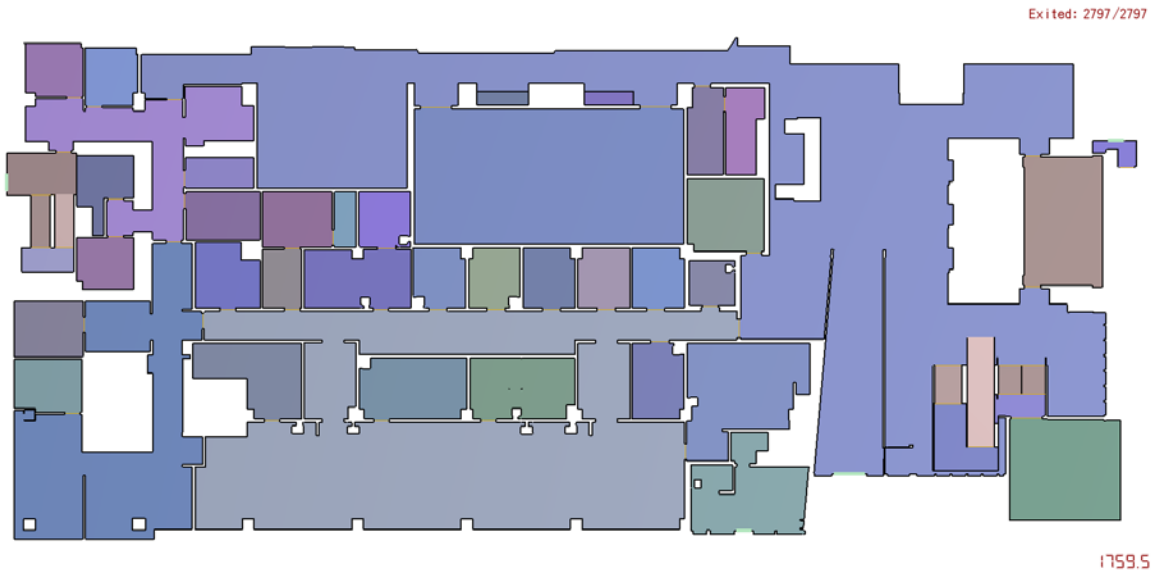
Since this building have an EVAC system and the fire occurred in Level 1, the occupants below this floor are designated to go any exit. Half of Level 1 occupants go to main exit and half to the south exit. Level 2 to penthouse occupants is assigned to use stair 3 to the south exit.

At time 0 sec:

At time 122.3 sec, the occupant exit the main door and evacuation is still occurring at the south exit door.



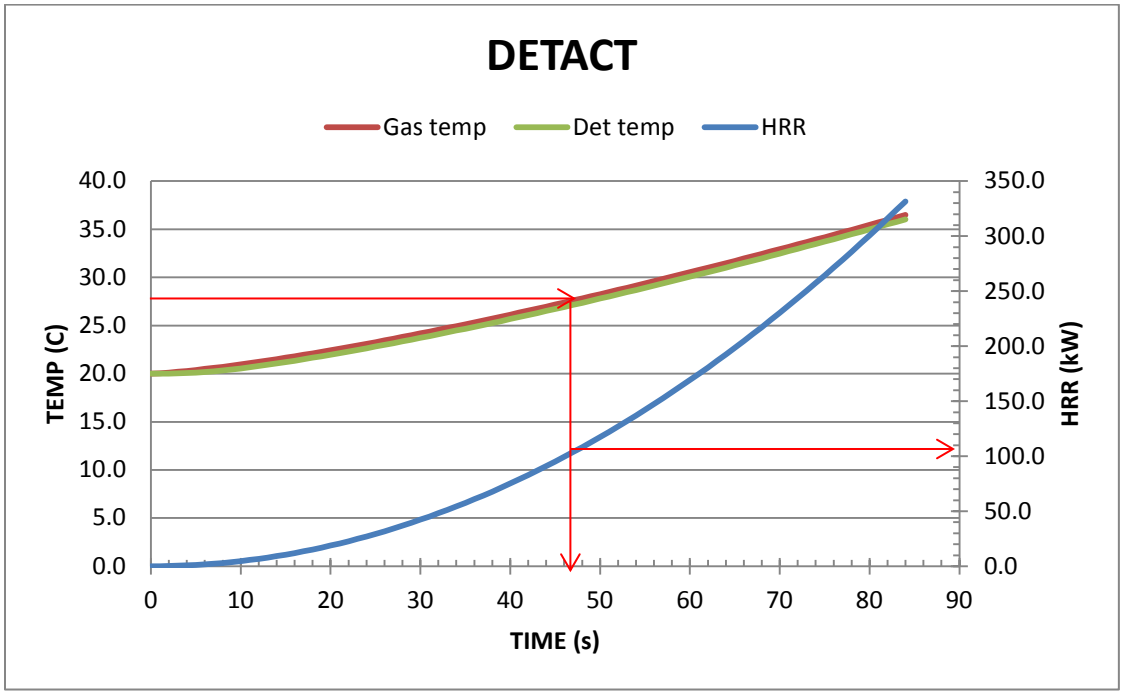
At time 1759.5 sec, all the occupants from the building exited.



8.5.3.4 DETACH Model

8.5.3.4.1 Ceiling Mounted Fire Detectors

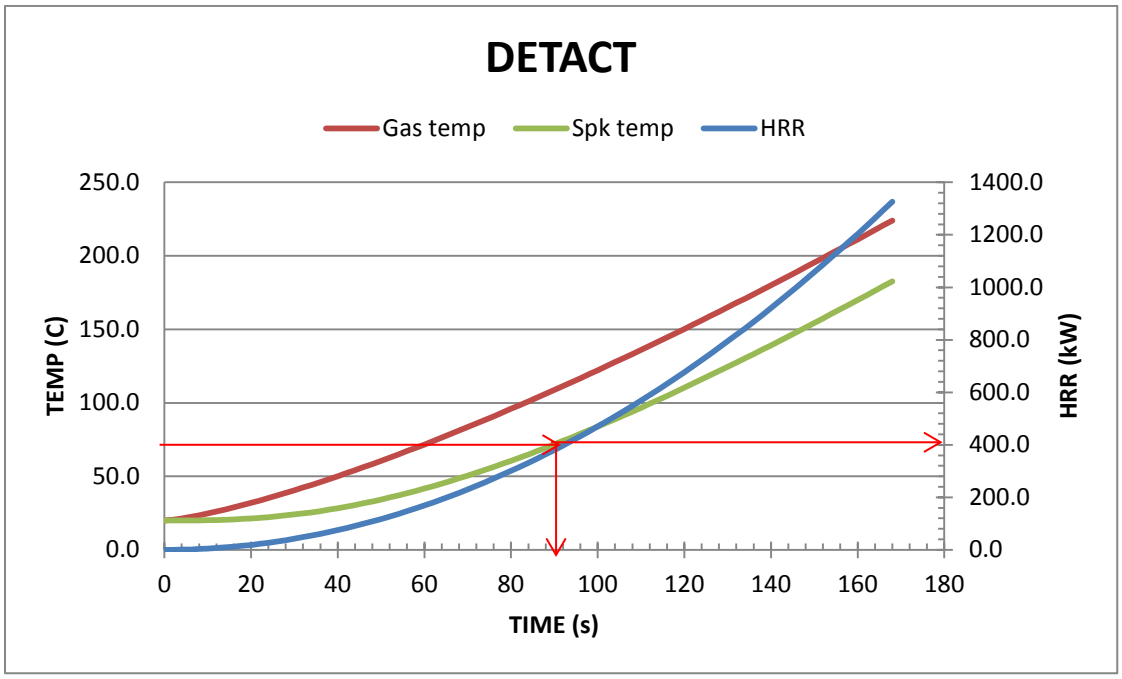
INPUT PARAMETERS			CALC. PARAMETERS	
Ceiling height (H)	3	m	R/H	3.627
Radial distance (R)	10.88	m	dT(cj)/dT(pl)	0.127
Ambient temperature (To)	20	C	u(cj)/u(pl)	0.068
Actuation temperature (Td)	27.2	C	Rep. t2 coeff.	k
Response time index (RTI)	1	(m-s)1/2	Slow	0.003
Fire growth power (n)	2	-	Medium	0.012
Fire growth coefficient (k)	0.047	kW/s^n	Fast	0.047
Time step (dt)	1	s	Ultrafast	0.400



The detector activates 27.2°C at approximately 47 seconds with a heat release rate of 105 kW.

8.5.3.4.2 Ceiling Mounted Fire Sprinklers

INPUT PARAMETERS			CALC. PARAMETERS	
Ceiling height (H)	3	m	R/H	0.333
Radial distance (R)	1.0	m	dT(cj)/dT(pl)	0.624
Ambient temperature (To)	20	C	u(cj)/u(pl)	0.500
Actuation temperature (Td)	68	C	Rep. t2 coeff.	k
Response time index (RTI)	50	(m-s)1/2	Slow	0.003
Fire growth power (n)	2	-	Medium	0.012
Fire growth coefficient (k)	0.047	kW/s^n	Fast	0.047
Time step (dt)	2	s	Ultrafast	0.400



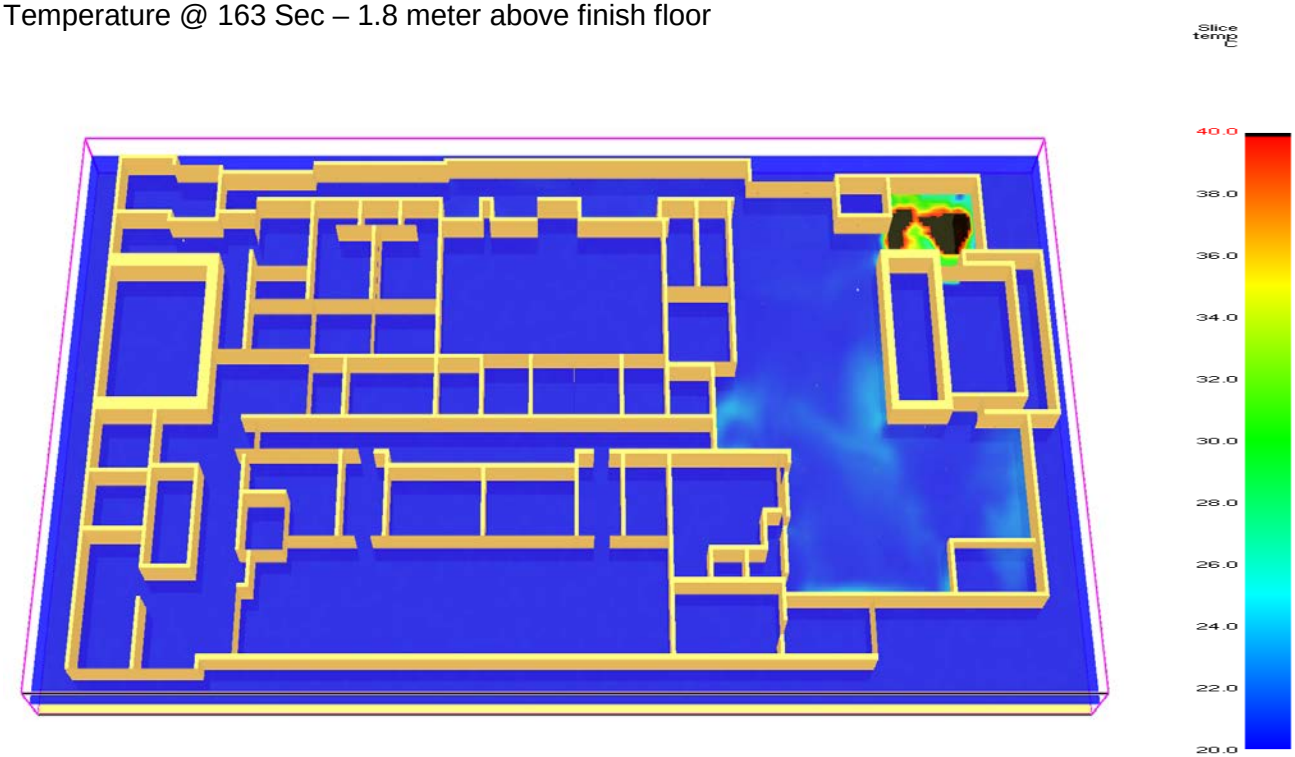
The sprinkler activates 68°C at approximately 88 seconds with a heat release rate of 364 kW.

	Fire Scenario 3			
	Detector activation time		Sprinkler Activation time	
	Time (sec)	HRR (kW)	Time (sec)	HRR (kW)
Detact model	47	105	88	364
FDS model	58	250	68.7	323

8.5.3.5 FDS

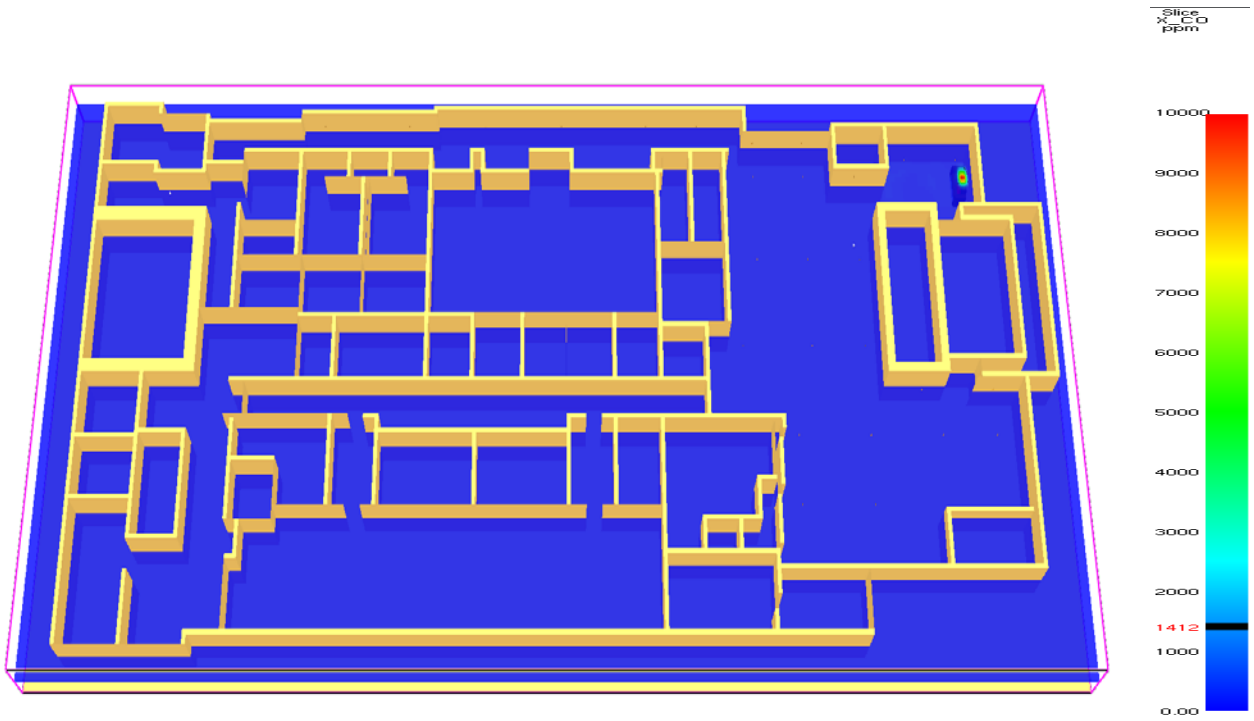
	Evacuation	References
Detection phase t_d (sec)	0	detected by an individual
notification phase t_n (sec)	10	NFPA 72 - 10.9.2
pre-evacuation phase t_{p-e} (sec)	30	SFPE Table 3-12.2
evacuation phase t_e (sec)	123	using Pathfinder Model
RSET (sec)	**163**	

Temperature @ 163 Sec – 1.8 meter above finish floor



Visibility @ 115 sec – 1.8 meters above finish floor

Carbon Monoxide @ 163 Sec – 1.8 meters above finish floor

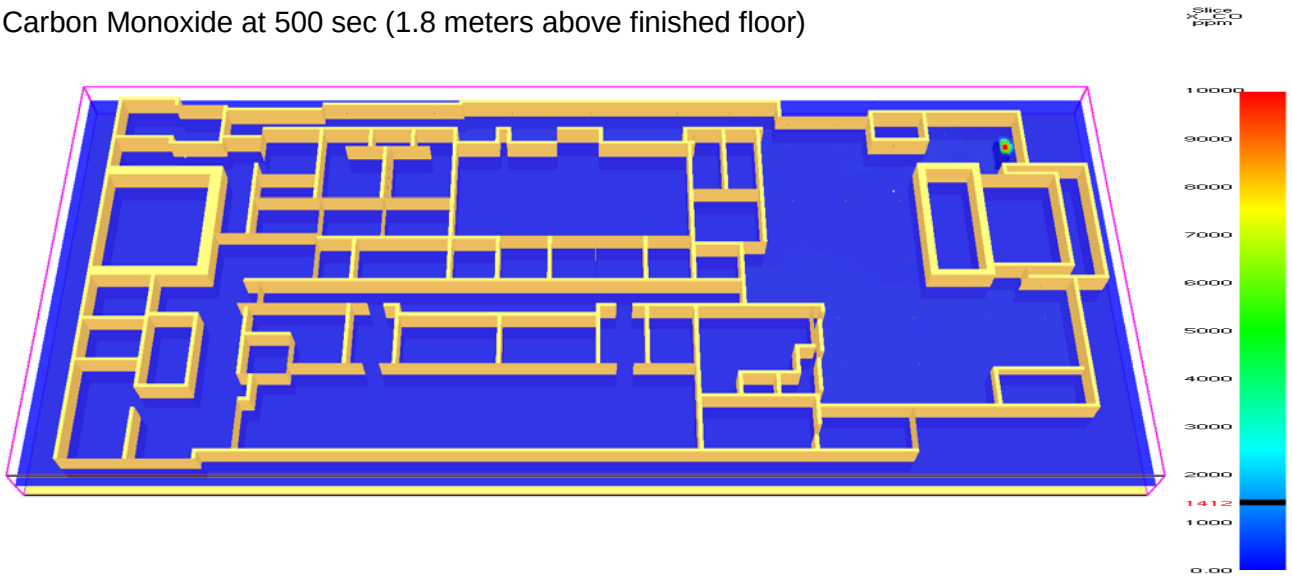


8.5.3.6 Result

ASET
Temperature at 500 sec (1.8 meters above finished floor)

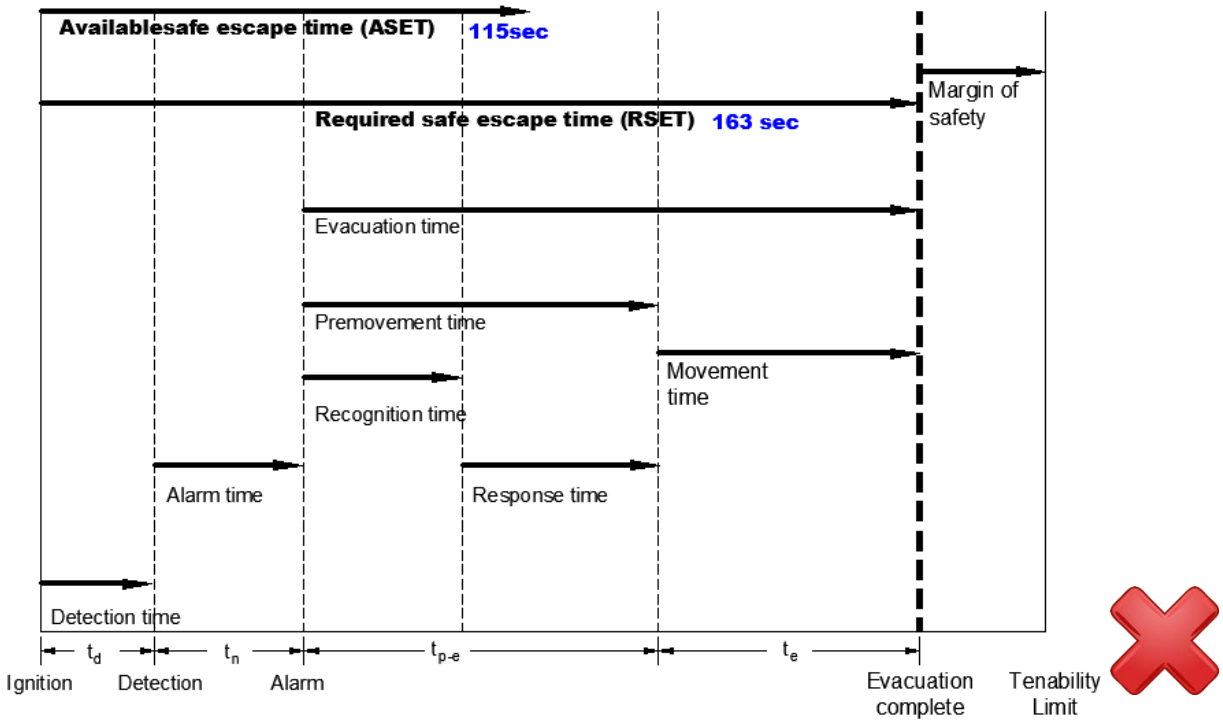
Visibility at 115 sec sec (1.8 meters above finished floor)

Carbon Monoxide at 500 sec (1.8 meters above finished floor)



Visibility controls the tenability for this fire scenario.

SFPE Handbook 4th Edition : Figure 3-1.1



Based on this result ASET < RSET which means, the design scenario failed.

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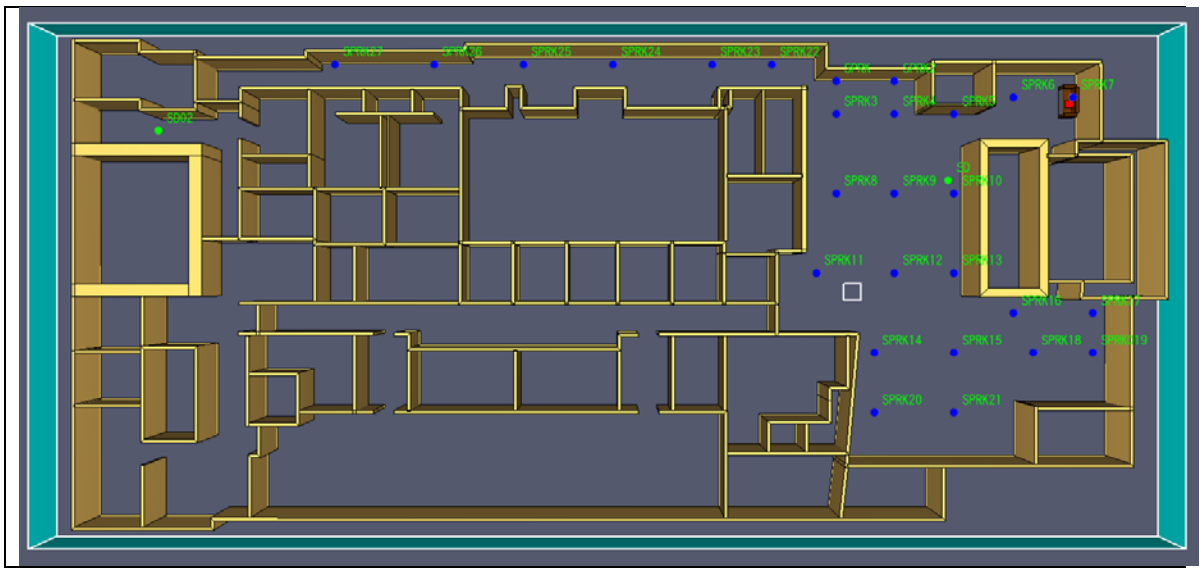
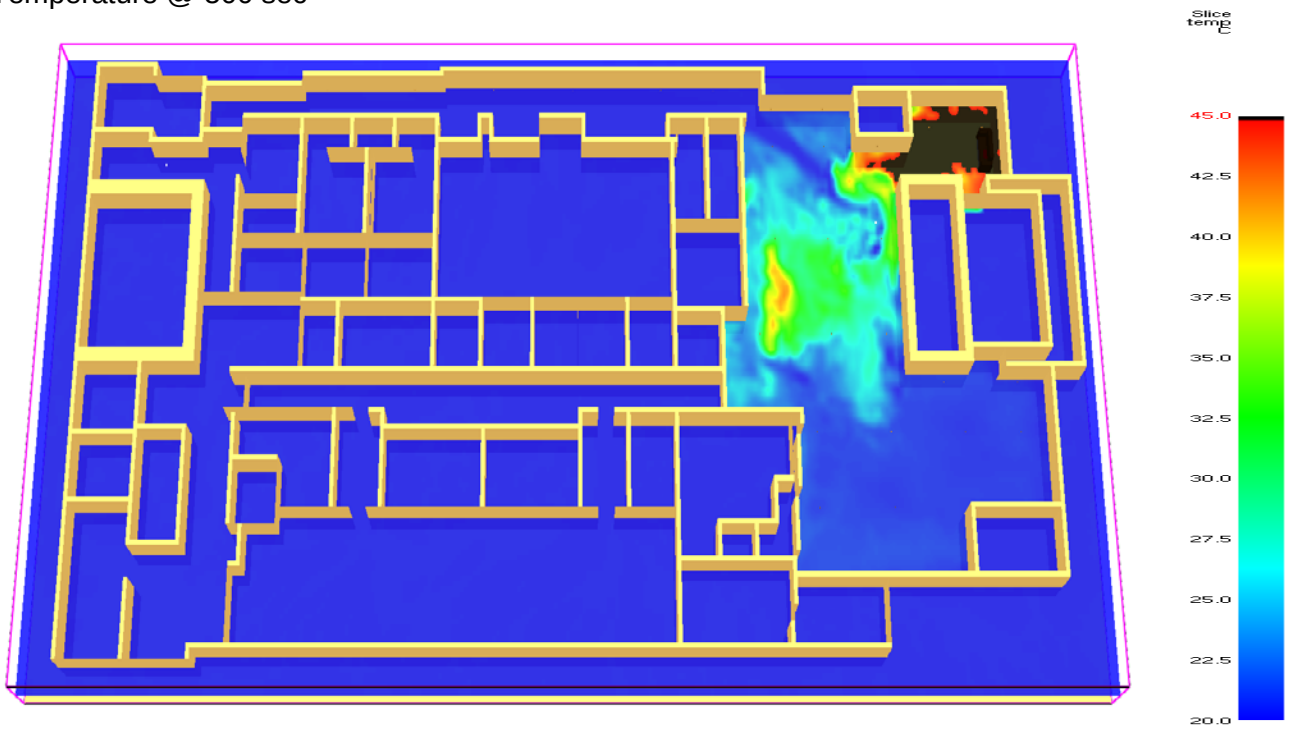
8.5.4 Design Fire 4 - Lobby Fire (Level 1)

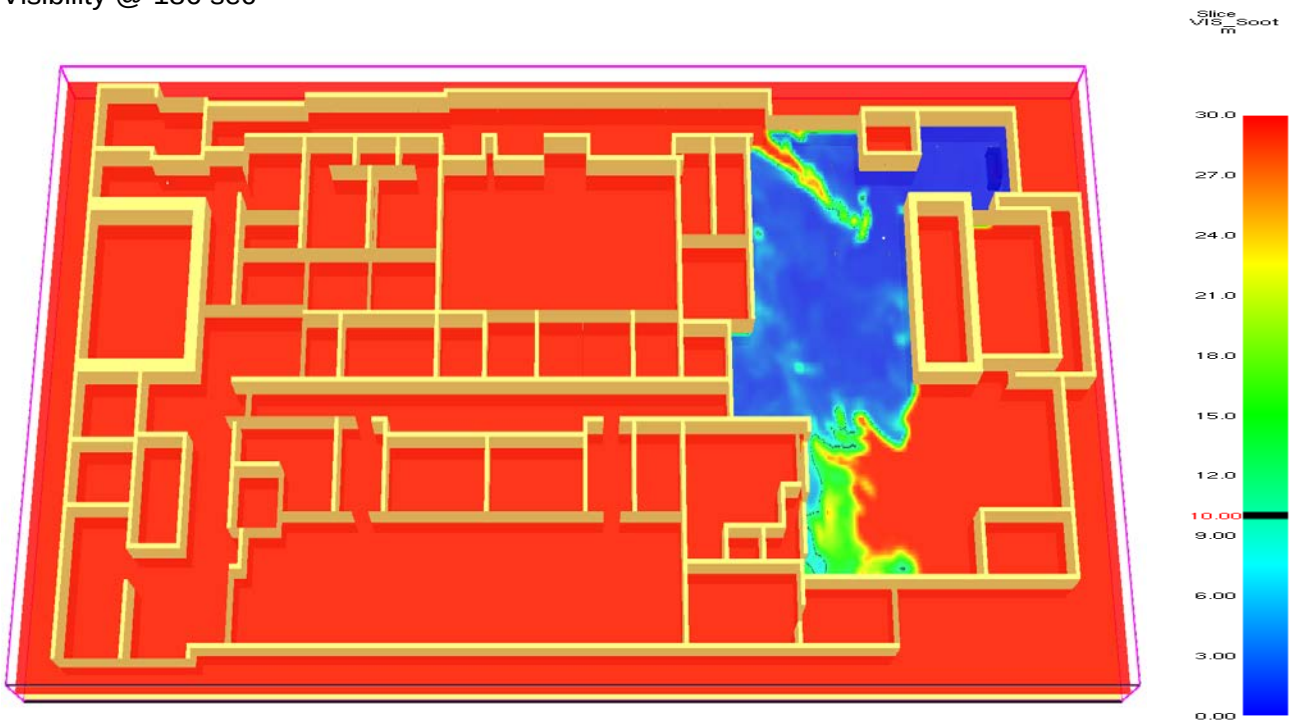
This design scenario is the same as design fire 2 with smoke control since it fails the tenability criteria.



Temperature @ 500 sec



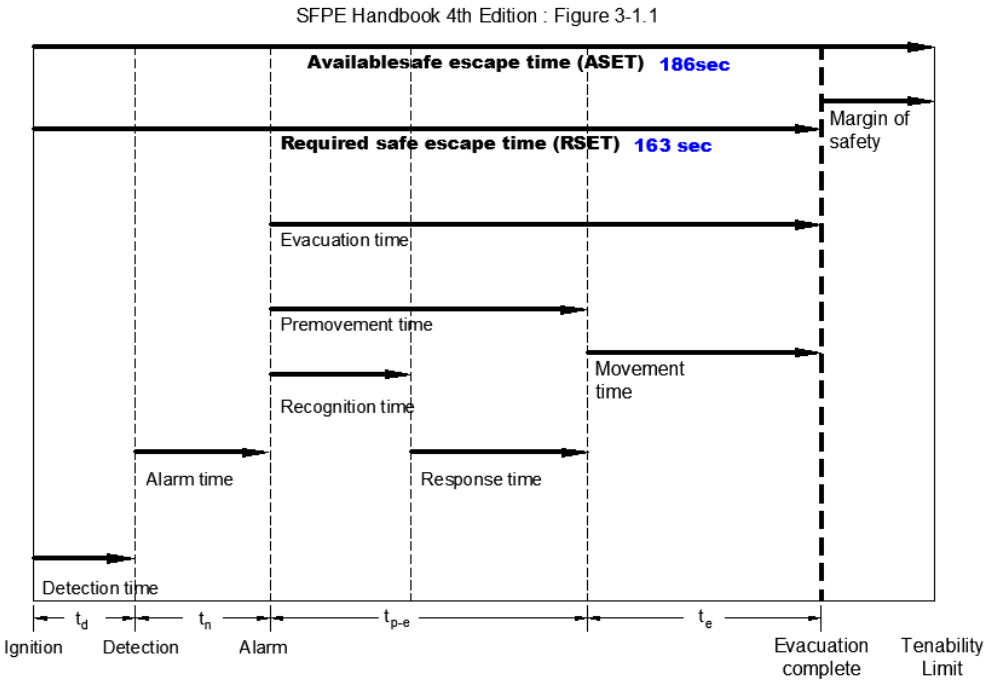
Visibility @ 186 sec



Carbon Monoxide @ 500 sec

8.5.4.1 Result

This scenario meets the criteria ASET>RSET.



Chapter 8 Summary and Recommendation

Based upon this report and review of the architectural drawings, the systems are designed to meet and exceeded the requirements of Seattle Building Code and International Building Code.

Section	2009 Seattle Building Code (SBC)	
403.1	Applicability	✓
403.1.1	Predesign Conference	✓
403.1.2	Testing	✓
403.2.1	Reduction in fire-resistance rating	✓
403.3	Automatic sprinkler system.	✓
403.3.1	Number of sprinkler risers and system design.	✓
403.3.1.1	Riser location.	✓
403.4.1	Smoke detection	✓
403.4.2	Fire alarm system	✓
403.4.3	Emergency voice/alarm communication system	✓
403.4.4	Emergency responder radio coverage	✓
403.4.5	Fire command.	✓
403.4.8	Emergency power systems	✓
403.4.8.1	Emergency power loads	✓
403.5.1	Means of egress and evacuation.	✓
403.5.3	Stairway door operation	✓
403.5.3.1	Stairway communication system	✓
403.5.3.2	Stairway penthouse	✓
403.5.4	Smoke Control in exit enclosure and elevator hoistway	✓
403.5.5	Luminous egress path markings.	✓
403.6	Elevators.	✓
403.6.2	Occupant evacuation elevators	✓
403.7	Emergency operational plan	✓
1001.4	Exiting from multiple levels	✓
1004.5	Egress convergence	✓
1004.8	Outdoor areas	✓
1007.7	Accessible means of egress required	✓
3016.6	Elevator operation on emergency power - recall	✓
3020.1 & 3020.5	Construction of Hoistway, and machine and control rooms	✓
3016.5 & 3016.7	Elevator hoistway	✓

For performance based design, I recommend removing the couch in the lobby area. Adding a smoke control system in this area is not an option even though it will help the space to be tenable. Since this a research laboratory, all the system should be isolated from contamination. All the research is very valuable.

There are still uncertainties in my FDS and Pathfinder model. I have not considered or explored the effects of HVAC, effect of pressurized stairs, sensitivity of FDS grid mesh, fuel characteristics and occupants' characteristics. Further study should take into account.

Chapter 9 References

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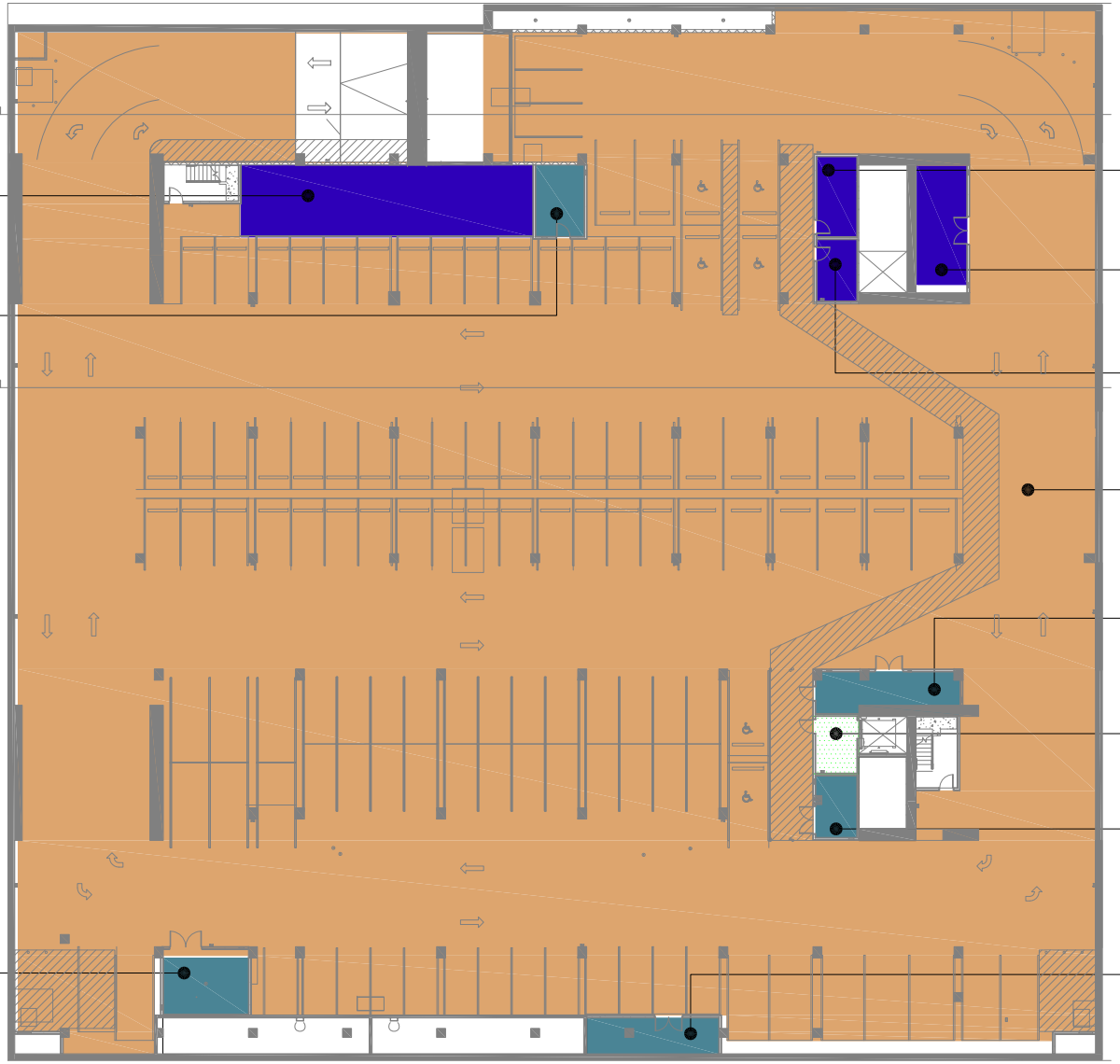
Appendix A: Occupancy Classifications



LEGENDS AND SYMBOLS

XXX	ROOM NAME
000 SQ FT	ROOM AREA
000 | 0	LOAD FACTOR/OCCUPANCY LOAD

- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION BASEMENT LEVEL 3

SCALE : NTS

N

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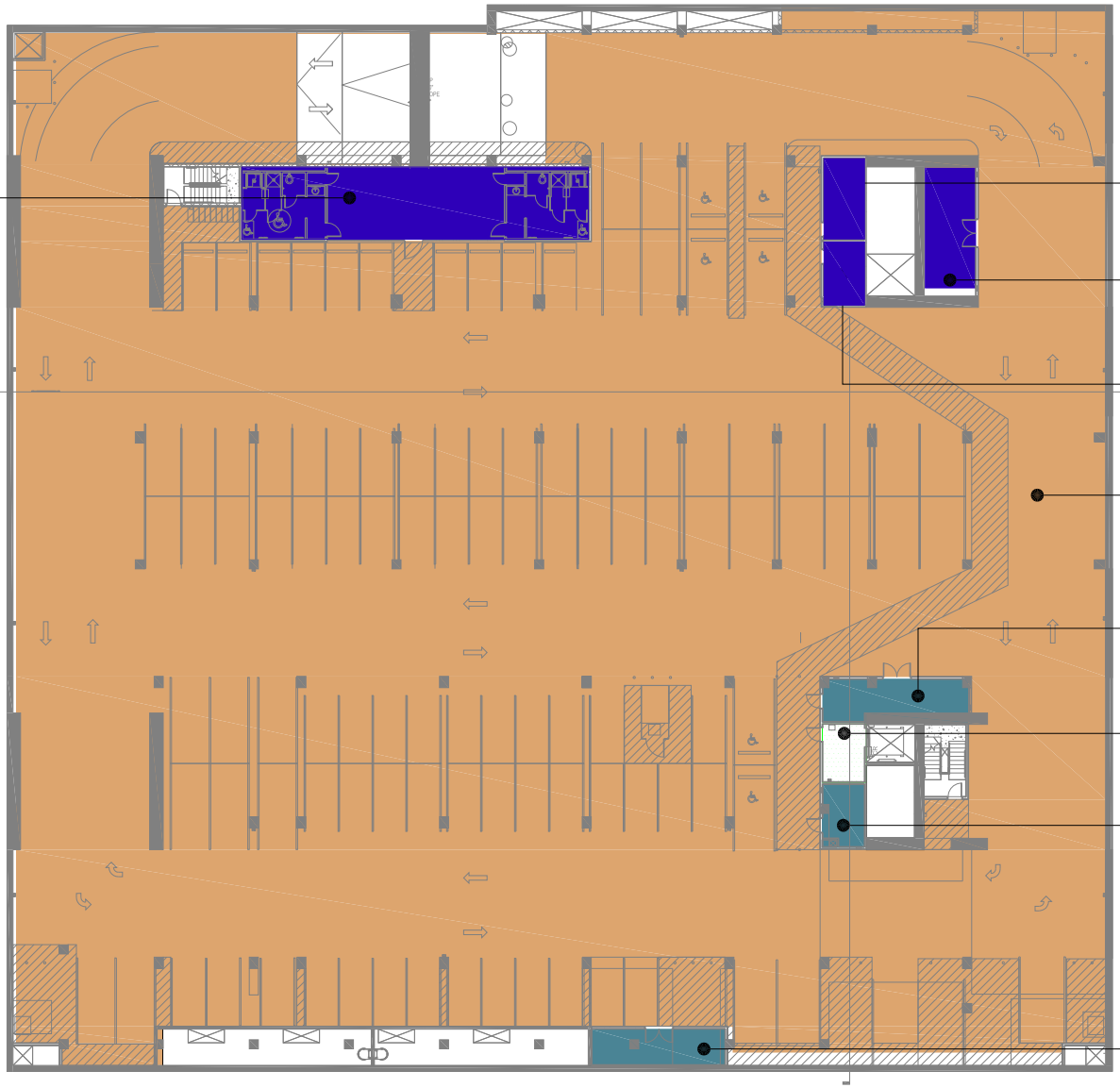
CAL POLY
Fire Protection Engineering



LEGENDS AND SYMBOLS

XXX	ROOM NAME
000 SQ FT	ROOM AREA
000 | 0	LOAD FACTOR/OCCUPANCY LOAD

- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION BASEMENT LEVEL 2

SCALE : NTS

N

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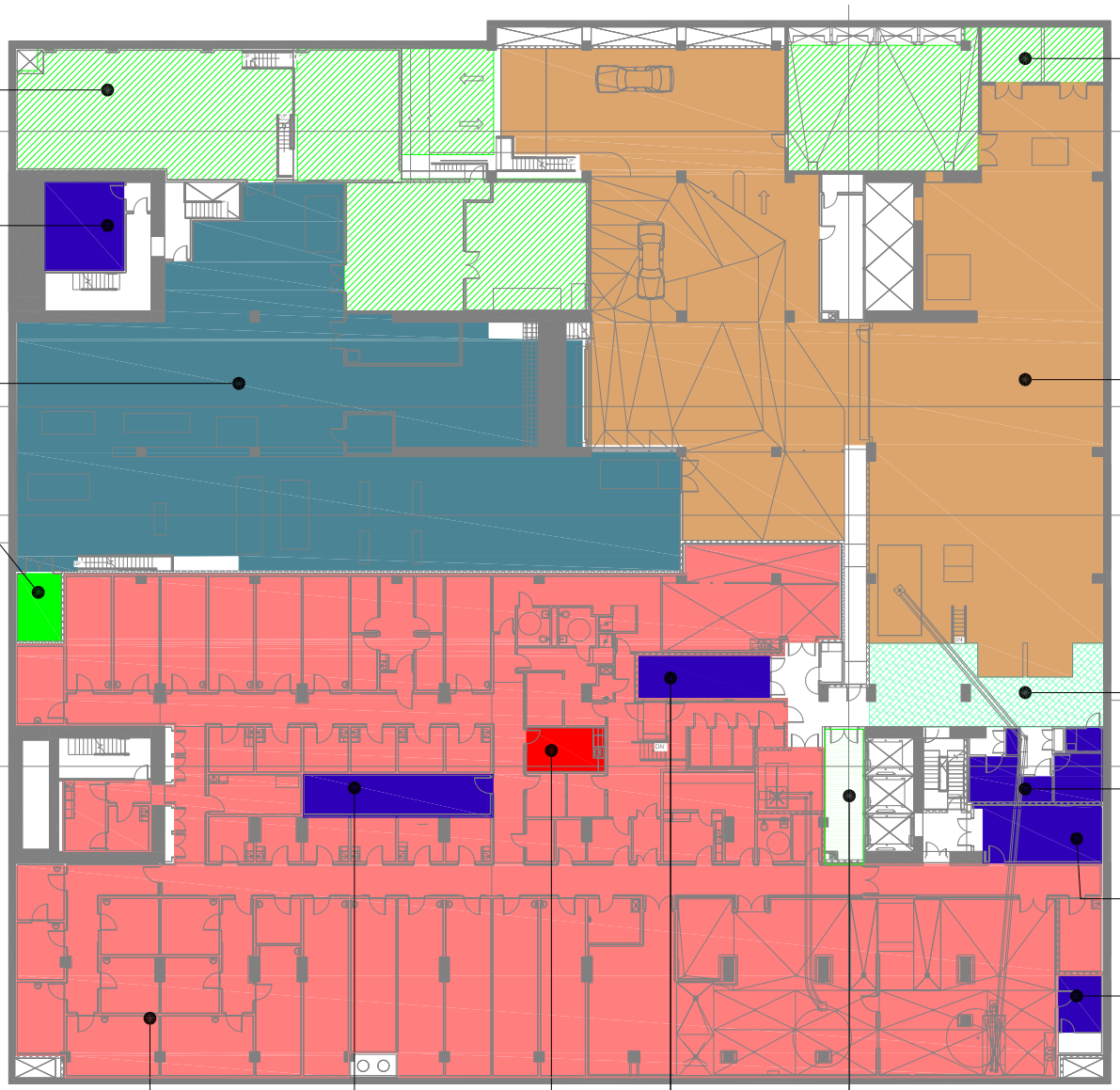

LEGENDS AND SYMBOLS

XXX	ROOM NAME
000 SQ FT	ROOM AREA
000 | 0	LOAD FACTOR/OCCUPANCY LOAD

- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION BASEMENT LEVEL 1

SCALE : NTS

N

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LEGENDS AND SYMBOLS

XXX	ROOM NAME
000 SQ FT	ROOM AREA
000 0	LOAD FACTOR/OCCUPANCY LOAD

- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION BASEMENT LEVEL 1S

SCALE : NTS

N

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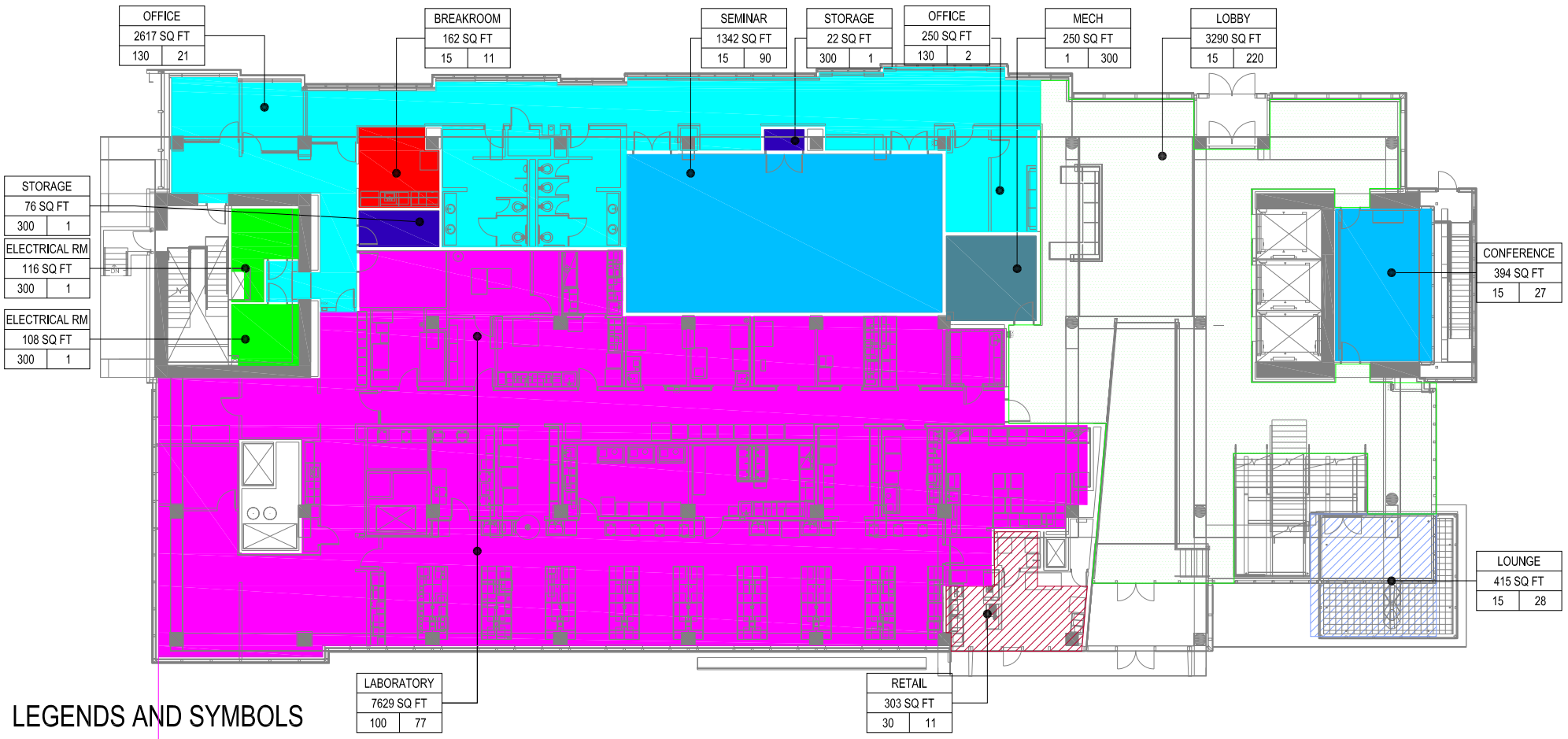

LEGENDS AND SYMBOLS

XXX
000 SQ FT
000 0

ROOM NAME
ROOM AREA
LOAD FACTOR/OCCUPANCY LOAD

- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION LEVEL 1

SCALE : NTS

N

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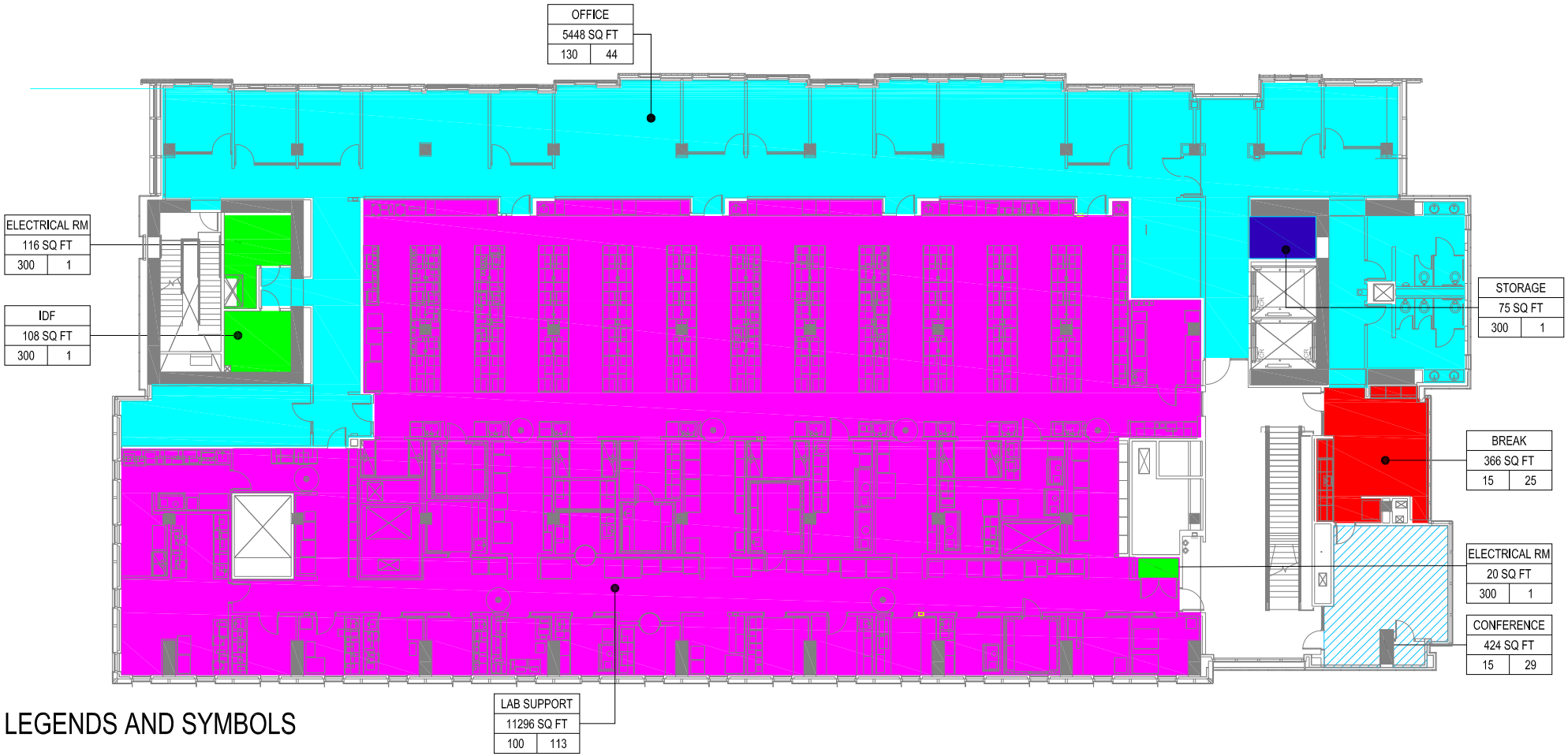

LEGENDS AND SYMBOLS

XXX
000 SQ FT
000 0

ROOM NAME
ROOM AREA
LOAD FACTOR/OCCUPANCY LOAD

- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION LEVEL 2-6

SCALE : NTS

N

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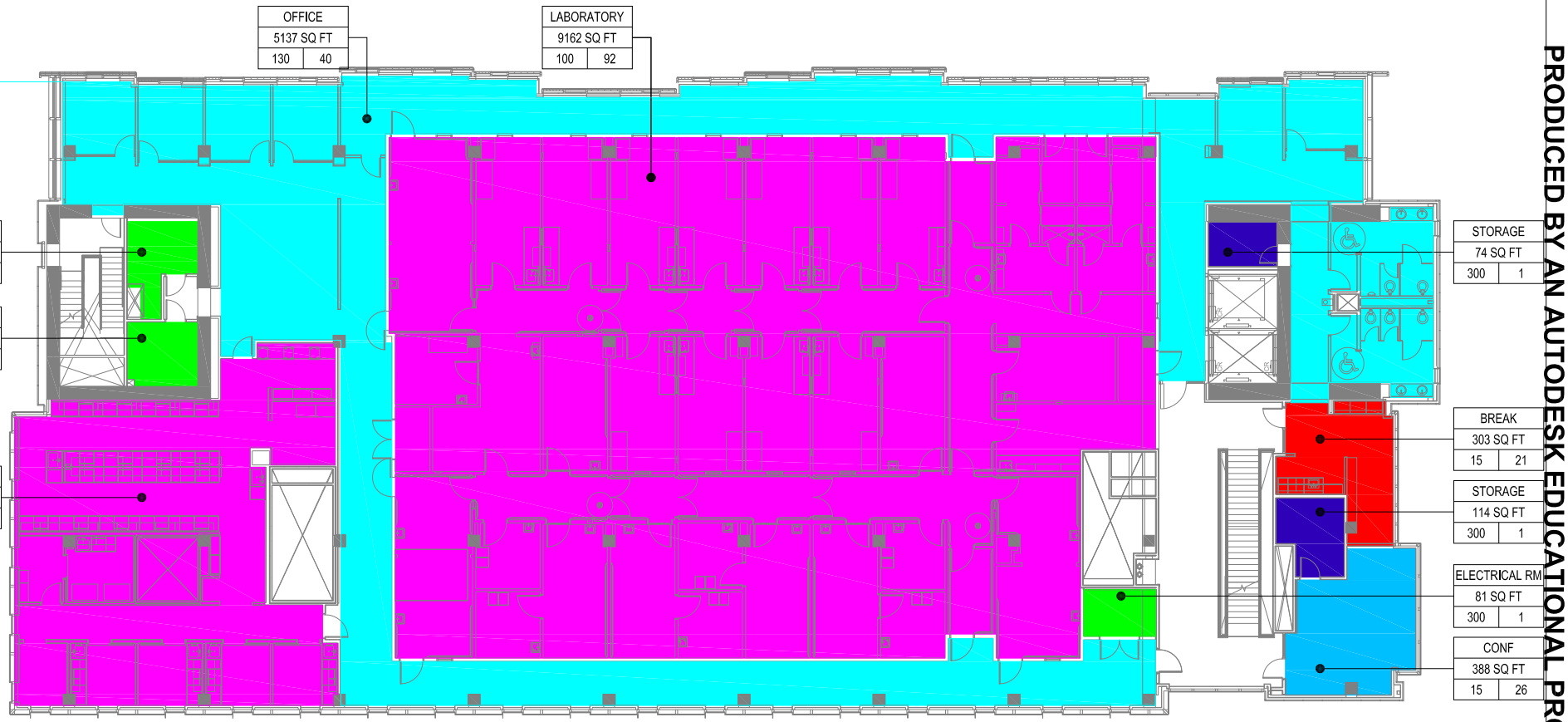

LEGENDS AND SYMBOLS

XXX
000 SQ FT
000 0

ROOM NAME
ROOM AREA
LOAD FACTOR/OCCUPANCY LOAD

- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION LEVEL 7

SCALE : NTS

N

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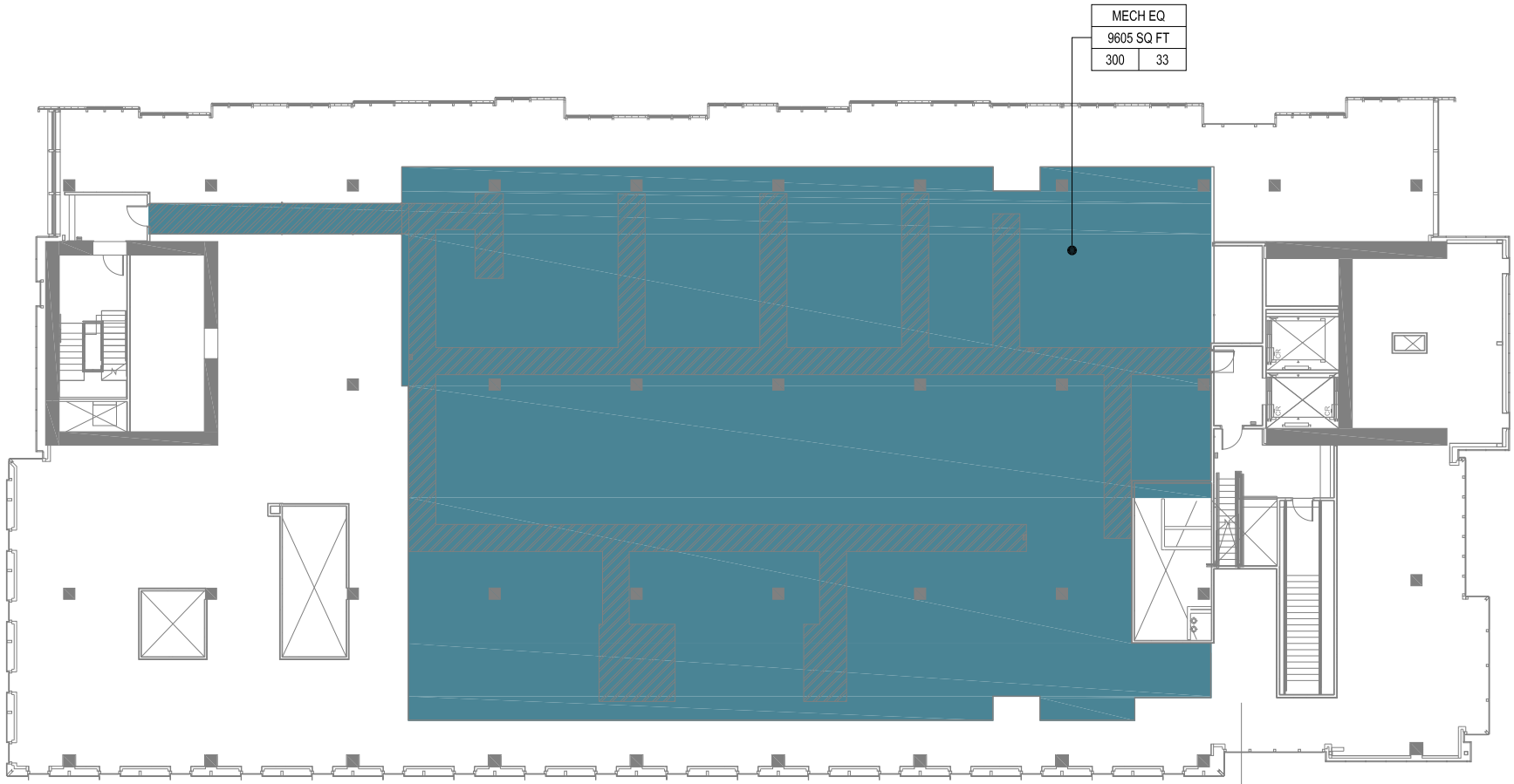

LEGENDS AND SYMBOLS

XXX
000 SQ FT
000 | 0

ROOM NAME
ROOM AREA
LOAD FACTOR/OCCUPANCY LOAD

- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION LEVEL 7S

SCALE : NTS

N

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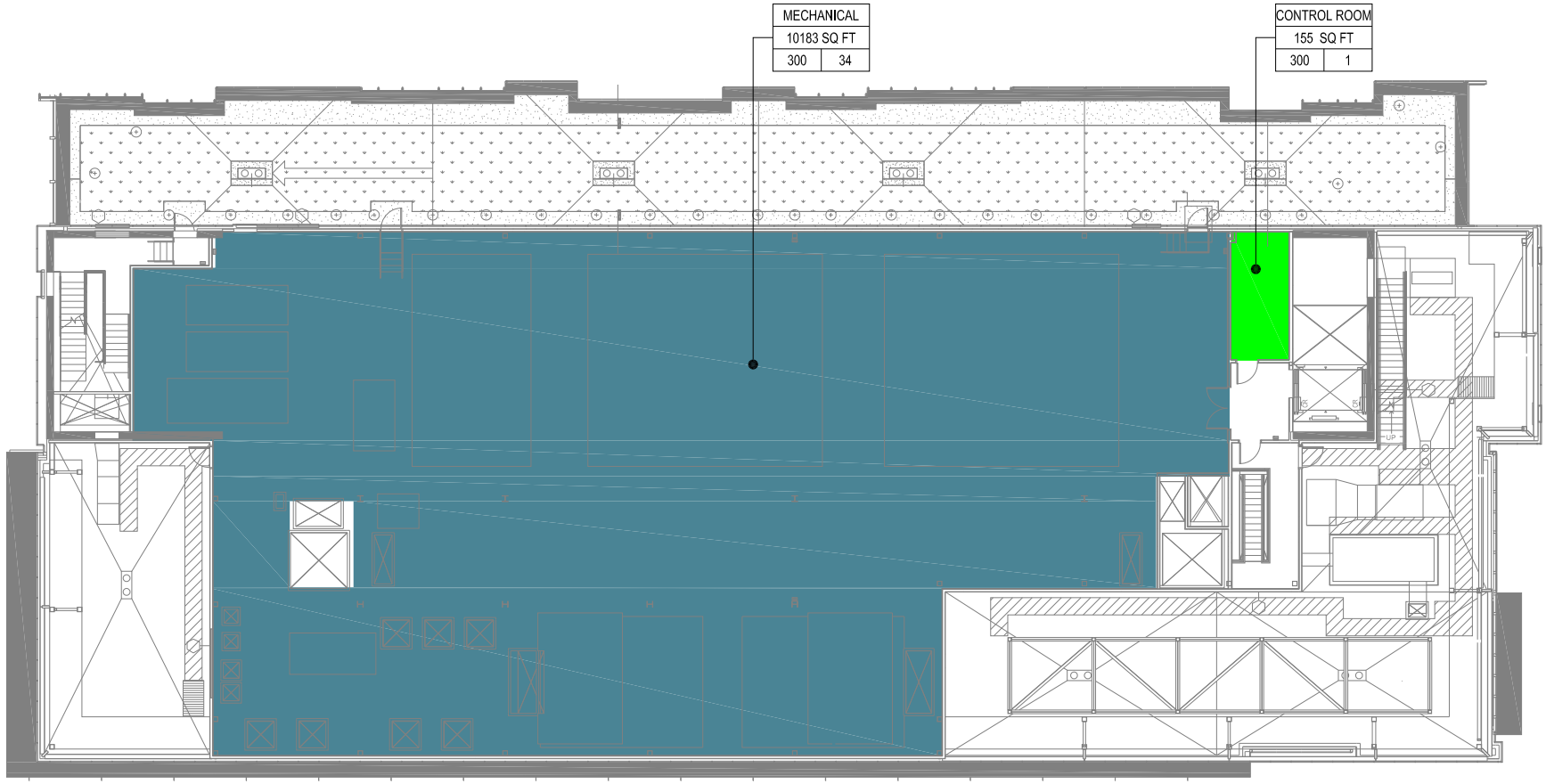
Fire Protection Engineering



LEGENDS AND SYMBOLS

XXX
000 SQ FT
000 | 0

ROOM NAME
ROOM AREA
LOAD FACTOR/OCCUPANCY LOAD

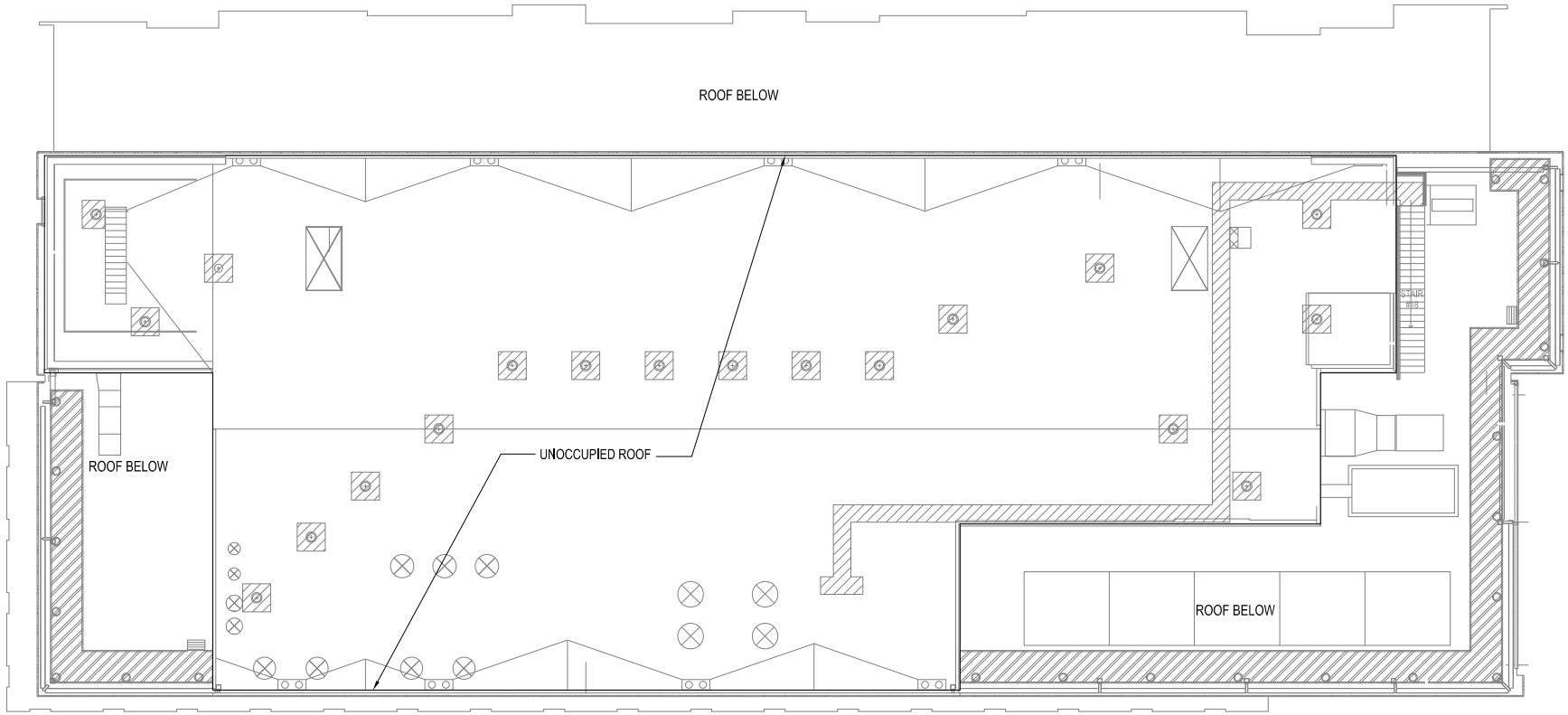
- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION - PENTHOUSE

SCALE : NTS

N

CAL POLY
Fire Protection Engineering



LEGENDS AND SYMBOLS

XXX	
000 SQ FT	
000	0

ROOM NAME
ROOM AREA
LOAD FACTOR/OCCUPANCY LOAD

- CONFERENCE/SEMINAR
- ELECTRICAL ROOM
- GARAGE
- LABORATORY
- LAB SUITE
- LOADING DOCK
- LOBBY/RECEPTION
- LOUNGE
- MECHANICAL ROOM
- OFFICE
- RETAIL
- STORAGE

OCCUPANCY CLASSIFICATION - ROOF

SCALE : NTS

N

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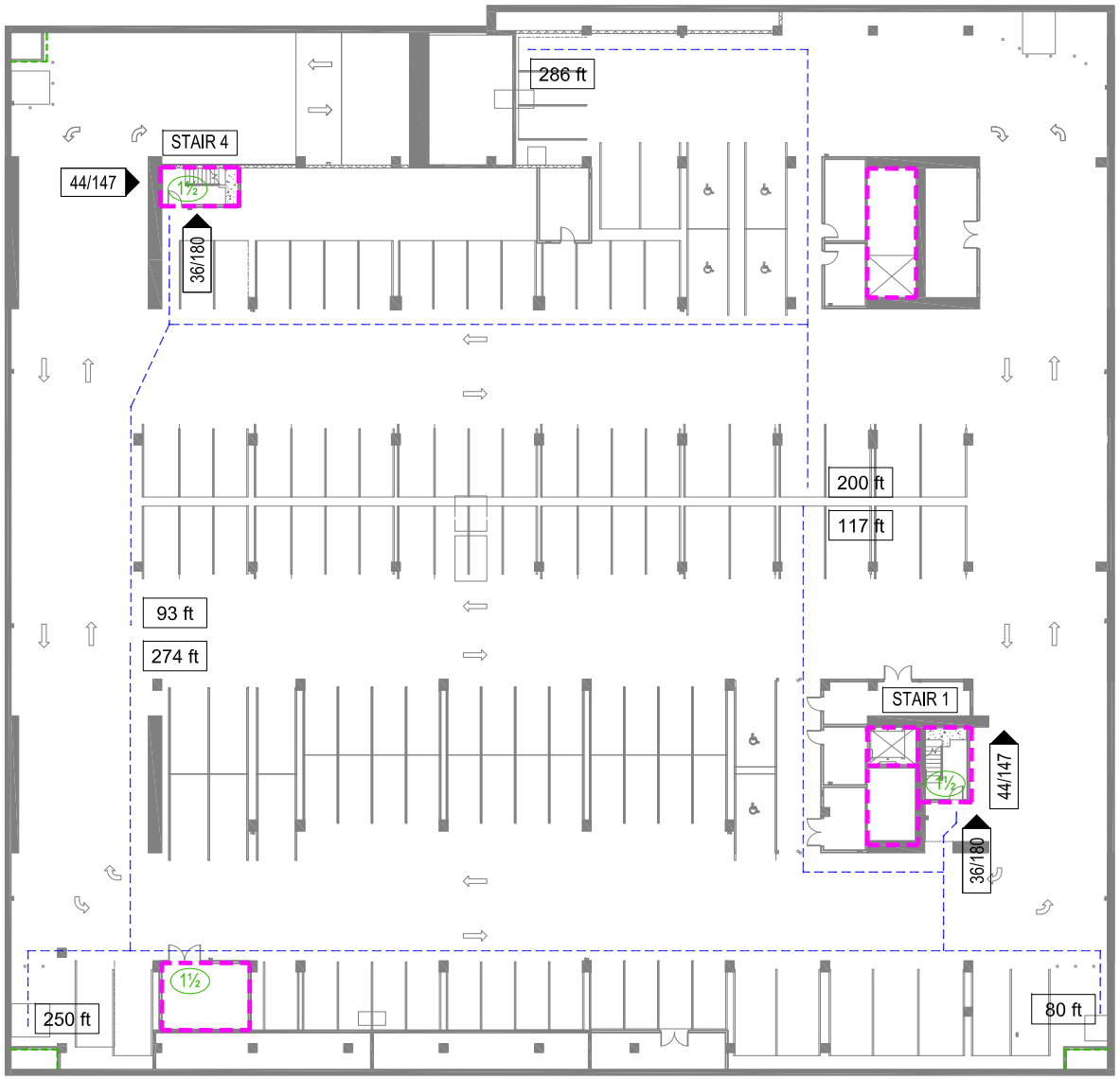
Appendix B: Exit capacity, travel distance and wall rating



TOTAL OCCUPANCY FOR BASEMENT LEVEL 3 : 271

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 4	36	0.2	180	44	0.3	147	147
Stair 1	36	0.2	180	44	0.3	147	147
							294

294 > 271
exit capacity > occupant load

MAXIMUM TRAVEL DISTANCE PER IBC CODE TABLE 1016.2 IS 400FT FOR S-2 OCCUPANCY.

		Required	Provided
Number of exits		2	2
Door Width:	271 X 0.2	54.2 "	72"
Stair Width:	271 X 0.3	81.3 "	88"

LEGENDS AND SYMBOLS

X/X — REQUIRED EXIT/ OCCUPANT LOAD @ EXIT

0' - 0" — PATH OF TRAVEL / TRAVEL DISTANCE

1-HOUR WALL ASSEMBLY

2-HOUR WALL ASSEMBLY

3-HOUR WALL ASSEMBLY

X — DOOR RATING (HOURS)

EXIT CAPACITY, TRAVEL DISTANCE , DOOR AND WALL RATING - BASEMENT LEVEL 3

SCALE : NTS

N

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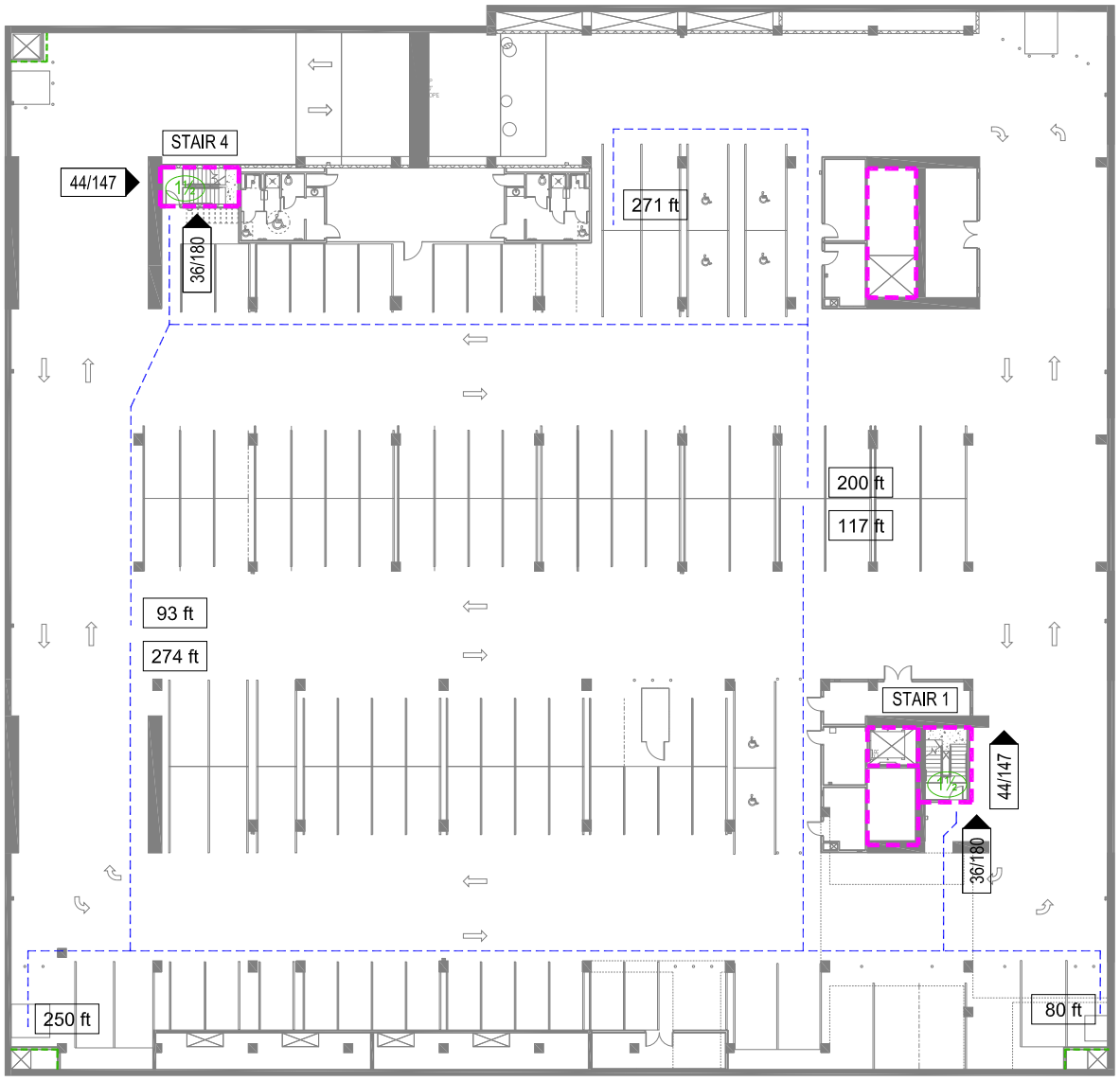

TOTAL OCCUPANCY FOR BASEMENT LEVEL 2 : 271

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 4	36	0.2	180	44	0.3	147	147
Stair 1	36	0.2	180	44	0.3	147	147
							294

294 > 271
exit capacity > occupant load

MAXIMUM TRAVEL DISTANCE PER IBC CODE TABLE 1016.2 IS 400FT FOR S-2 OCCUPANCY.

		Required	Provided
Number of exits		2	2
Door Width:	271 X 0.2	54.2 "	72"
Stair Width:	271 X 0.3	81.3 "	88"

LEGENDS AND SYMBOLS

X/X — REQUIRED EXIT/ OCCUPANT LOAD @ EXIT

0' - 0" — PATH OF TRAVEL / TRAVEL DISTANCE

1-HOUR WALL ASSEMBLY

2-HOUR WALL ASSEMBLY

3-HOUR WALL ASSEMBLY

X — DOOR RATING (HOURS)

EXIT CAPACITY, TRAVEL DISTANCE , DOOR AND WALL RATING - BASEMENT LEVEL 2

SCALE : NTS

N

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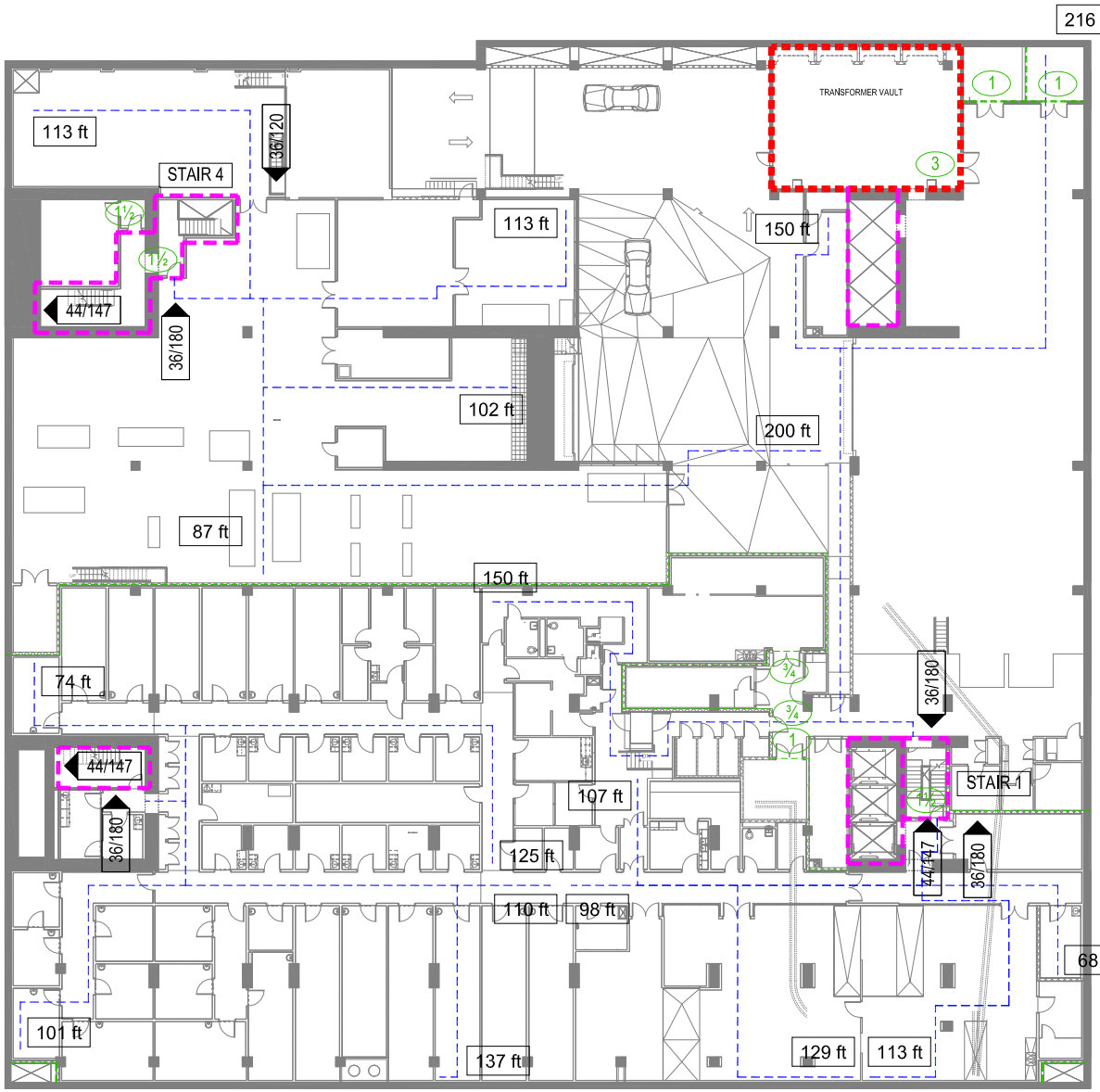


TOTAL OCCUPANCY FOR BASEMENT LEVEL 1 : 365

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 4	36	0.2	180	44	0.3	147	147
Stair 1	36	0.2	180	44	0.3	147	147
Stair 3	36	0.2	180	44	0.3	147	147
							441

441 > 365
exit capacity > occupant load

MAXIMUM TRAVEL DISTANCE PER IBC CODE TABLE 1016.2

S-2 OCCUPANCY IS 400FT.
B OCCUPANCY IS 300 FT

		Required	Provided
Number of exits		2	2
Door Width:	365 X 0.2	73 "	108"
Stair Width:	365 X 0.3	109.5 "	132"

LEGENDS AND SYMBOLS

X/X — REQUIRED EXIT/ OCCUPANT LOAD @ EXIT

0' - 0" — PATH OF TRAVEL / TRAVEL DISTANCE

1-HOUR WALL ASSEMBLY

2-HOUR WALL ASSEMBLY

3-HOUR WALL ASSEMBLY

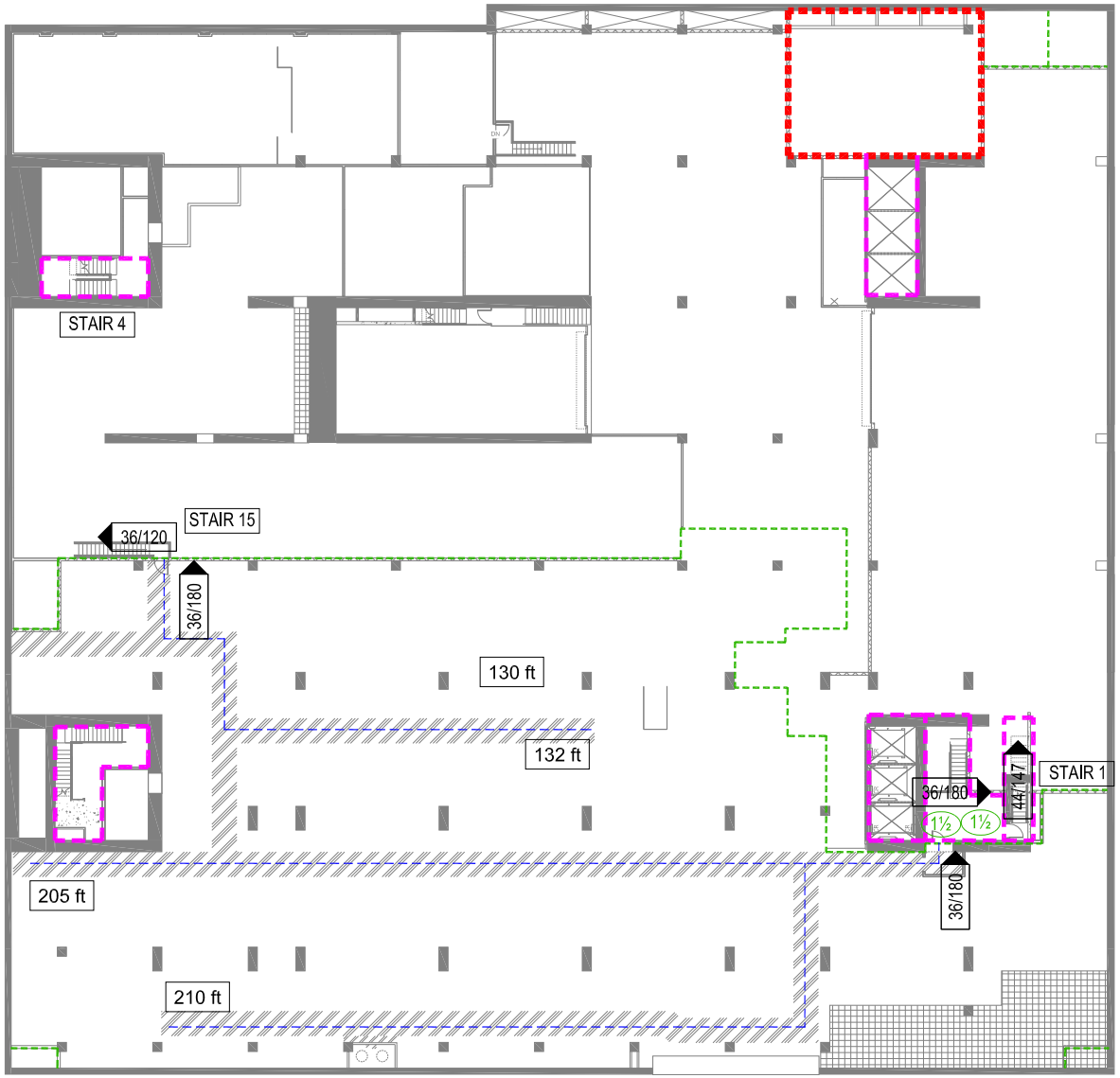
X — DOOR RATING (HOURS)

EXIT CAPACITY, TRAVEL DISTANCE , DOOR AND WALL RATING - BASEMENT LEVEL 1

SCALE : NTS

N

CAL POLY
Fire Protection Engineering



TOTAL OCCUPANCY FOR BASEMENT LEVEL 1 SERVICE : 72

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 5	36	0.2	180	36	0.3	120	120
Stair 1	36	0.2	180	44	0.3	147	147
							267

267 > 72

exit capacity > occupant load

MAXIMUM TRAVEL DISTANCE PER IBC CODE TABLE 1016.2

B OCCUPANCY IS 300 FT

		Required	Provided
Number of exits		2	2
Door Width:	72 X 0.2	14.4 "	72"
Stair Width:	72 X 0.3	21.6 "	80"

LEGENDS AND SYMBOLS

X/X — REQUIRED EXIT/ OCCUPANT LOAD @ EXIT

0' - 0" — PATH OF TRAVEL / TRAVEL DISTANCE

1-HOUR WALL ASSEMBLY

2-HOUR WALL ASSEMBLY

3-HOUR WALL ASSEMBLY

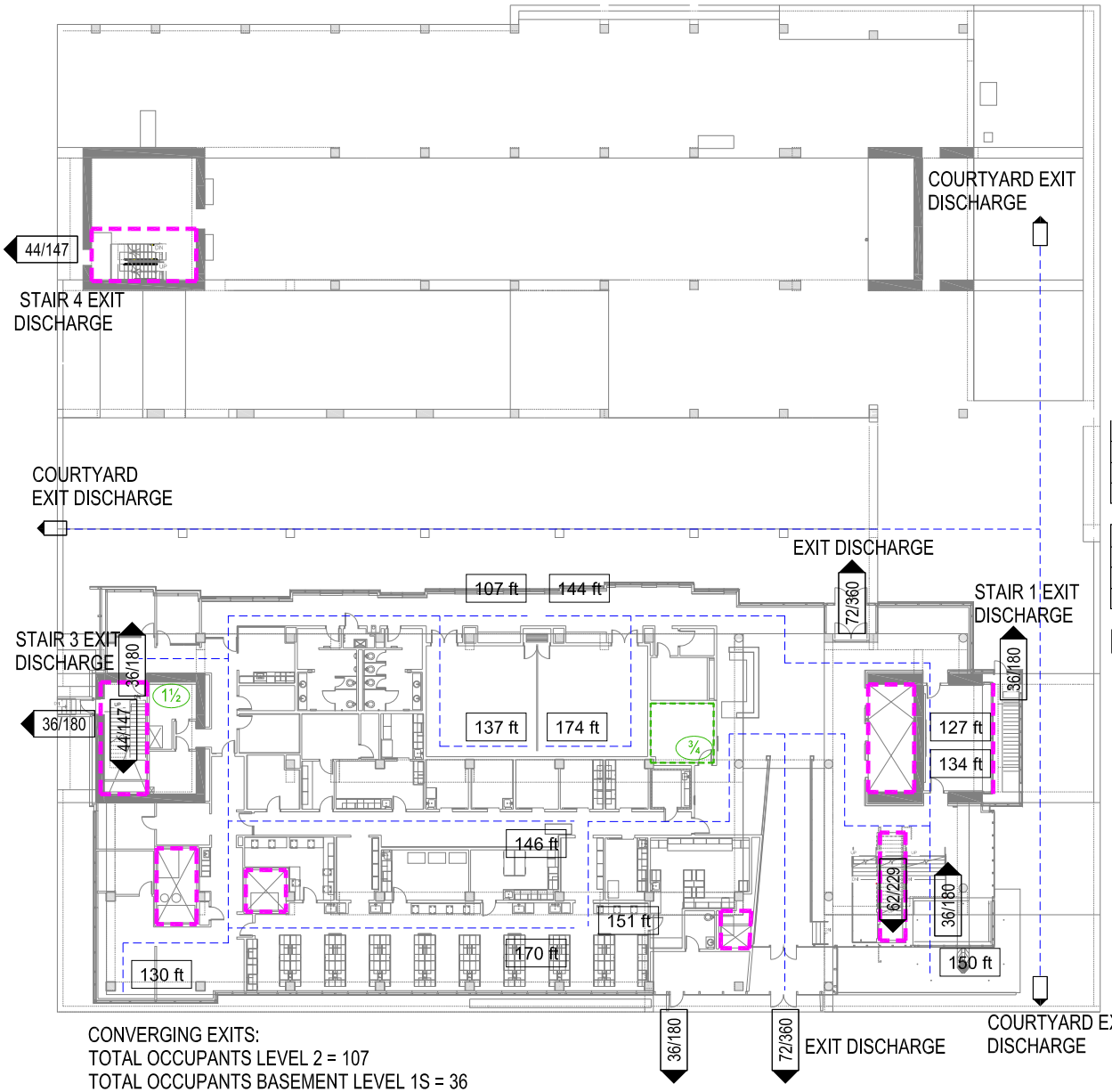
X — DOOR RATING (HOURS)

EXIT CAPACITY, TRAVEL DISTANCE , DOOR AND WALL RATING - BASEMENT LEVEL 1S

SCALE : NTS

N

CAL POLY
Fire Protection Engineering



TOTAL OCCUPANCY FOR LEVEL 1 : 479

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
	72	0.2	360				360
	72	0.2	360				360
							867
						867 >	479

exit capacity > occupant load

MAXIMUM TRAVEL DISTANCE PER IBC CODE TABLE 1016.2

A OCCUPANCY IS 250 FT.
B OCCUPANCY IS 300 FT

		Required	Provided
Number of exits		2	2
Door Width:	479 X 0.2	95.8 "	144"
Stair Width:		N/A	

		Required	Provided
Number of exits		2	2
Door Width:	143 X 0.2	28.5 "	36"
Stair Width:	143 X 0.3	42.75 "	44"

LEGENDS AND SYMBOLS

X/X — REQUIRED EXIT/ OCCUPANT LOAD @ EXIT

0' - 0" — PATH OF TRAVEL / TRAVEL DISTANCE

1-HOUR WALL ASSEMBLY

2-HOUR WALL ASSEMBLY

3-HOUR WALL ASSEMBLY

X — DOOR RATING (HOURS)

EXIT CAPACITY, TRAVEL DISTANCE , DOOR AND WALL RATING - LEVEL 1

SCALE : NTS

N

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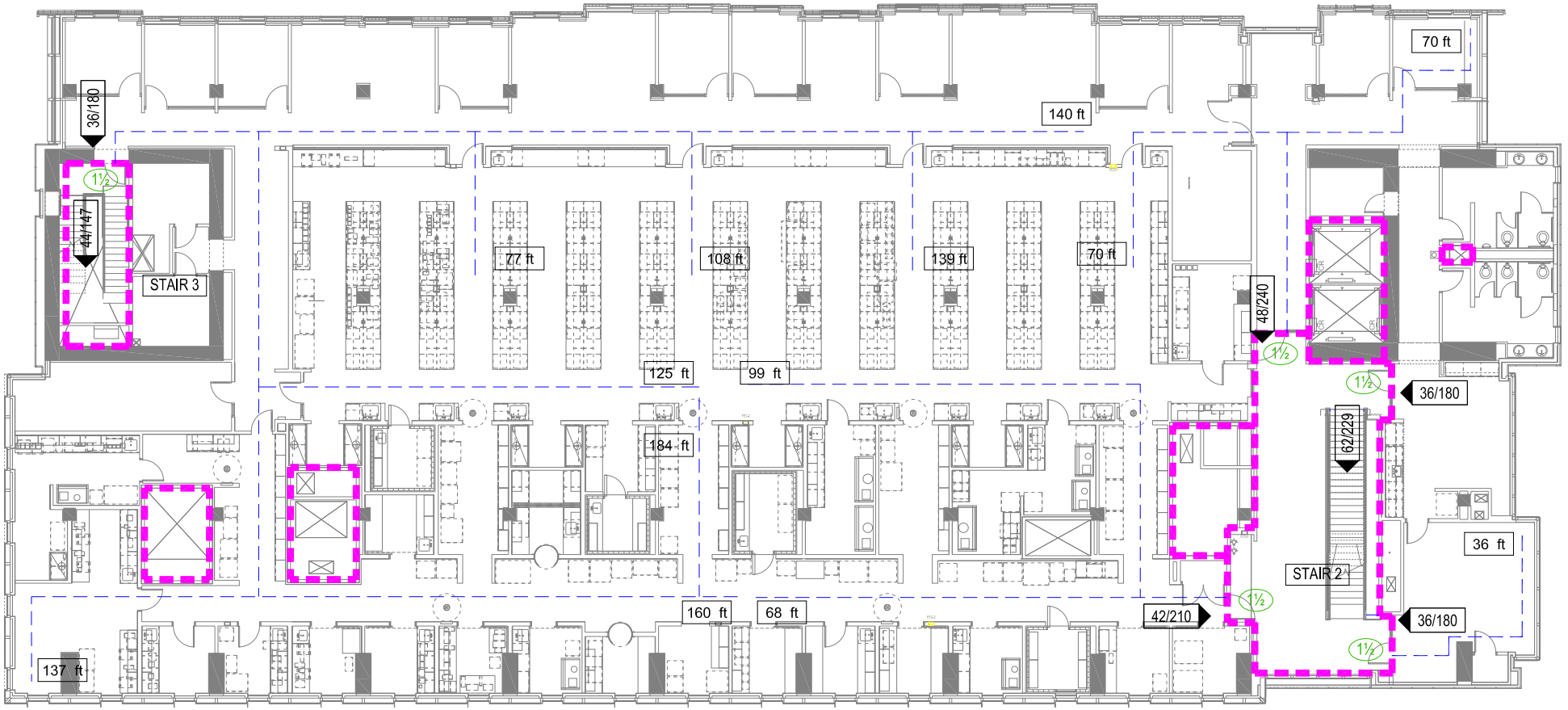
Fire Protection Engineering



TOTAL OCCUPANCY FOR LEVEL 2: 213 (TYP. LEVEL 3-6)

MAXIMUM TRAVEL DISTANCE PER IBC CODE TABLE 1016.2

A OCCUPANCY IS 250 FT.
B OCCUPANCY IS 300 FT

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
Stair 2				62	0.3	229	
Door 1	42	0.2	210				
Door 2	36	0.2	180				180
Door 3	36	0.2	180				
Door 4	48	0.2	240				
							327

327 > 213
exit capacity > occupant load

		Required	Provided
Number of exits		2	2
Door Width:	213 X 0.2	42.6 "	72"
Stair Width:	213 X 0.3	63.9 "	106"

LEGENDS AND SYMBOLS

- X/X — REQUIRED EXIT/ OCCUPANT LOAD @ EXIT
- 0' - 0" — PATH OF TRAVEL / TRAVEL DISTANCE
- 1-HOUR WALL ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- X — DOOR RATING (HOURS)

EXIT CAPACITY, TRAVEL DISTANCE , DOOR AND WALL RATING - LEVEL 2 (LEVEL 3-6 SIMILAR)

SCALE : NTS

N

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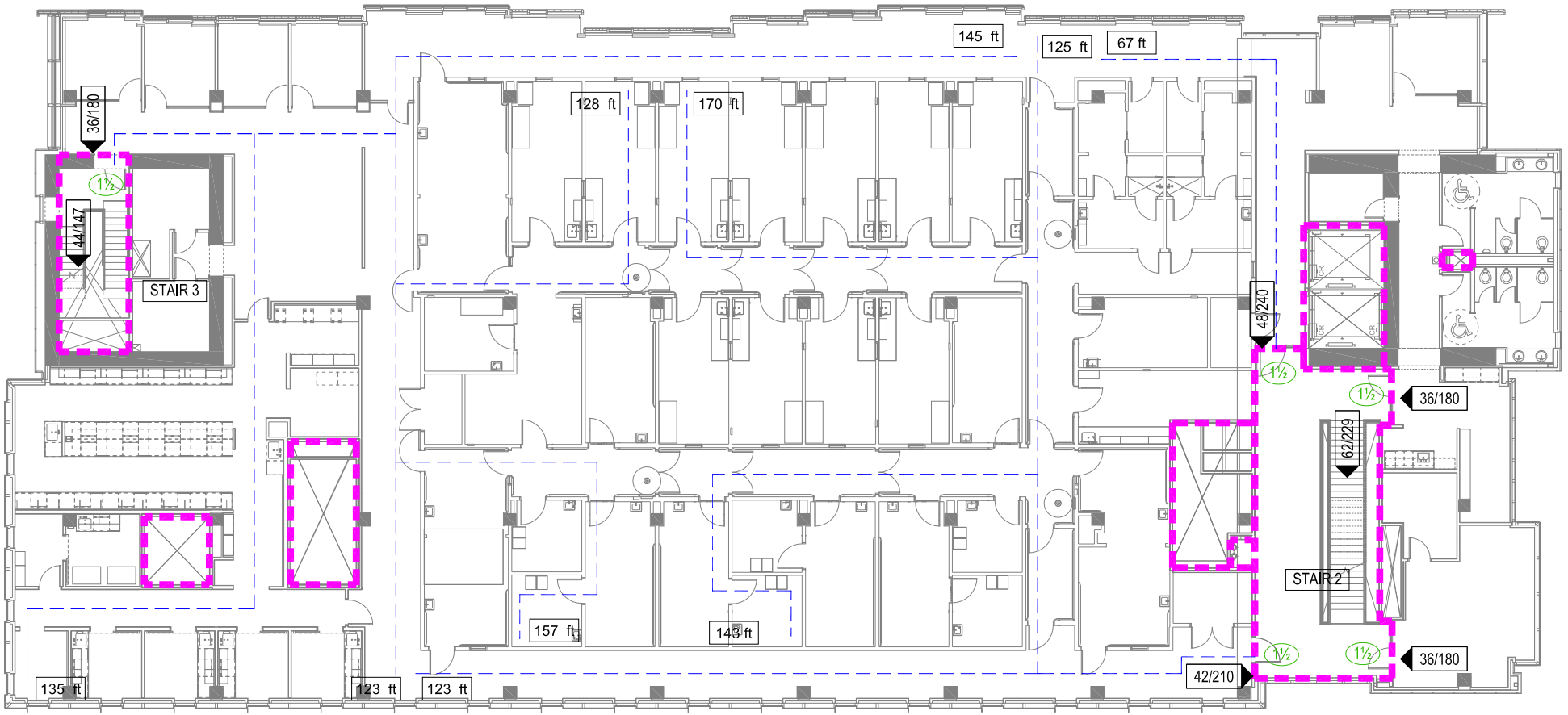
Fire Protection Engineering



TOTAL OCCUPANCY FOR LEVEL 7: 179

MAXIMUM TRAVEL DISTANCE PER IBC CODE TABLE 1016.2

A OCCUPANCY IS 250 FT.
B OCCUPANCY IS 300 FT

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
Stair 2				62	0.3	229	
Door 1	42	0.2	210				
Door 2	36	0.2	180				180
Door 3	36	0.2	180				
Door 4	48	0.2	240				
							327

327 > 206
exit capacity > occupant load

		Required	Provided
Number of exits		2	2
Door Width:	206 X 0.2	41.2 "	72"
Stair Width:	206 X 0.3	61.8 "	106"

LEGENDS AND SYMBOLS

- X/X — REQUIRED EXIT/ OCCUPANT LOAD @ EXIT
- 0' - 0" — PATH OF TRAVEL / TRAVEL DISTANCE
- 1-HOUR WALL ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- X — DOOR RATING (HOURS)

EXIT CAPACITY, TRAVEL DISTANCE , DOOR AND WALL RATING - LEVEL 7

SCALE : NTS

N

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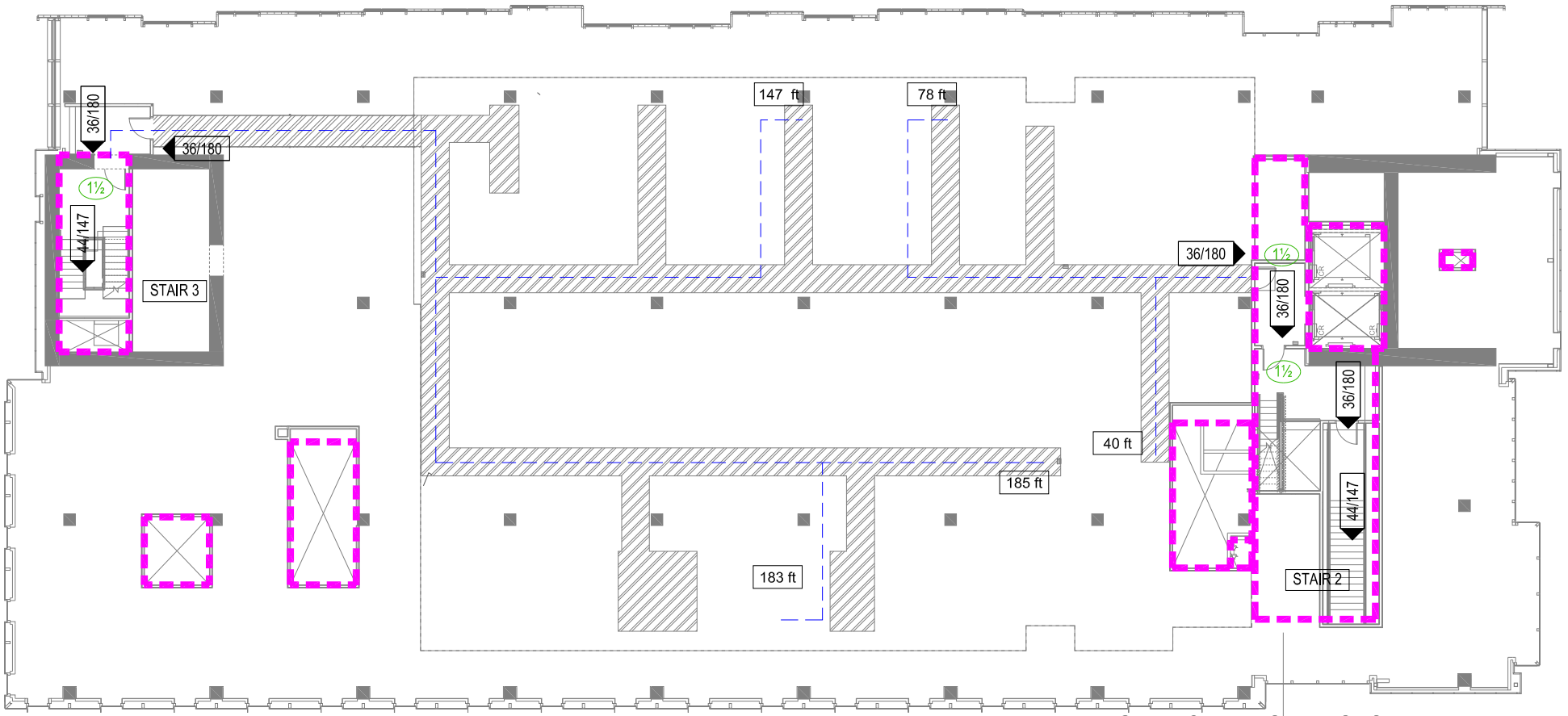
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

CAL POLY
Fire Protection Engineering



TOTAL OCCUPANCY FOR LEVEL 7S: 33

MAXIMUM TRAVEL DISTANCE PER IBC CODE TABLE 1016.2

A OCCUPANCY IS 250 FT.
B OCCUPANCY IS 300 FT

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
Stair 2	36	0.2	180	62	0.3	229	180
							327

327 > 33
exit capacity > occupant load

		Required	Provided
Number of exits		2	2
Door Width:	33 X 0.2	6.6 "	72"
Stair Width:	33 X 0.3	9.9 "	88"

LEGENDS AND SYMBOLS

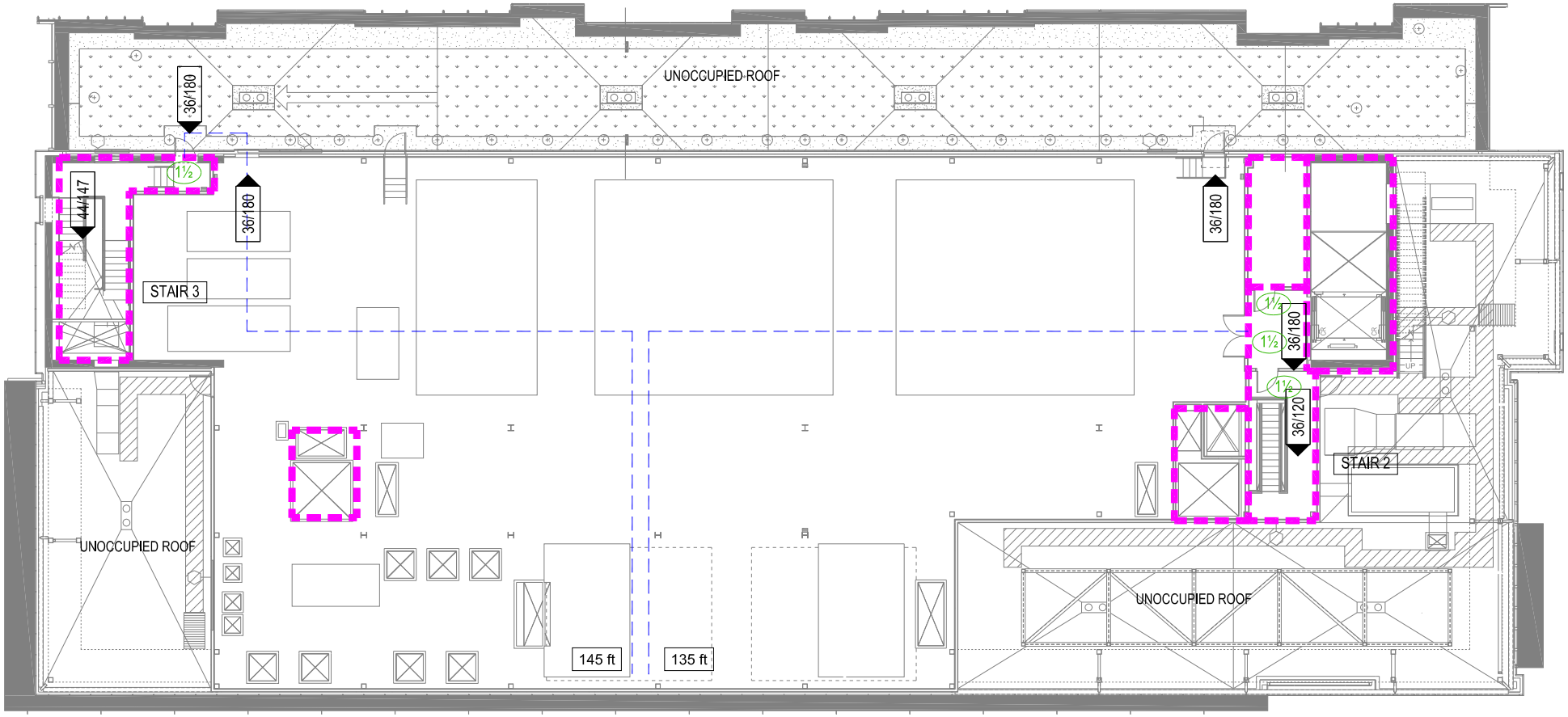
- X/X — REQUIRED EXIT/ OCCUPANT LOAD @ EXIT
- 0' - 0" — PATH OF TRAVEL / TRAVEL DISTANCE
- 1-HOUR WALL ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- X — DOOR RATING (HOURS)

EXIT CAPACITY, TRAVEL DISTANCE , DOOR AND WALL RATING - LEVEL 7S

SCALE : NTS

N

CAL POLY
Fire Protection Engineering



TOTAL OCCUPANCY FOR PENTHOUSE LEVEL : 35

MAXIMUM TRAVEL DISTANCE PER IBC CODE TABLE 1016.2

A OCCUPANCY IS 250 FT.
B OCCUPANCY IS 300 FT

	DOOR			STAIR			LIMIT CAPACITY
	Width	Factor	Capacity	Width	Factor	Capacity	
Stair 3	36	0.2	180	44	0.3	147	147
Stair 2	36	0.2	180	36	0.3	110	110
							257

257 > 35
exit capacity > occupant load

		Required	Provided
Number of exits		2	2
Door Width:	35 X 0.2	7 "	72"
Stair Width:	35 X 0.3	10.5 "	80"

LEGENDS AND SYMBOLS

X/X — REQUIRED EXIT/ OCCUPANT LOAD @ EXIT

0' - 0" — PATH OF TRAVEL / TRAVEL DISTANCE

1-HOUR WALL ASSEMBLY

2-HOUR WALL ASSEMBLY

3-HOUR WALL ASSEMBLY

X — DOOR RATING (HOURS)

EXIT CAPACITY, TRAVEL DISTANCE , DOOR AND WALL RATING - PENTHOUSE

SCALE : NTS

N

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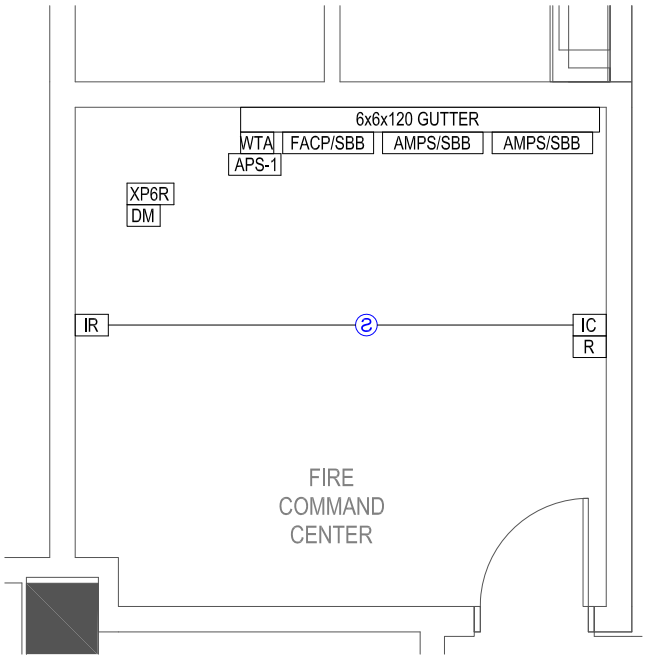
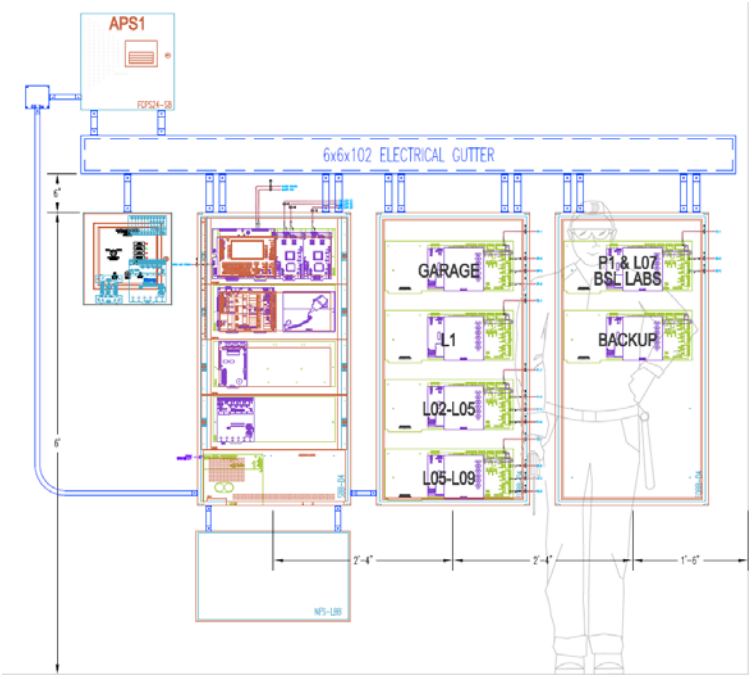
Appendix C: Fire Alarm Floor Plan



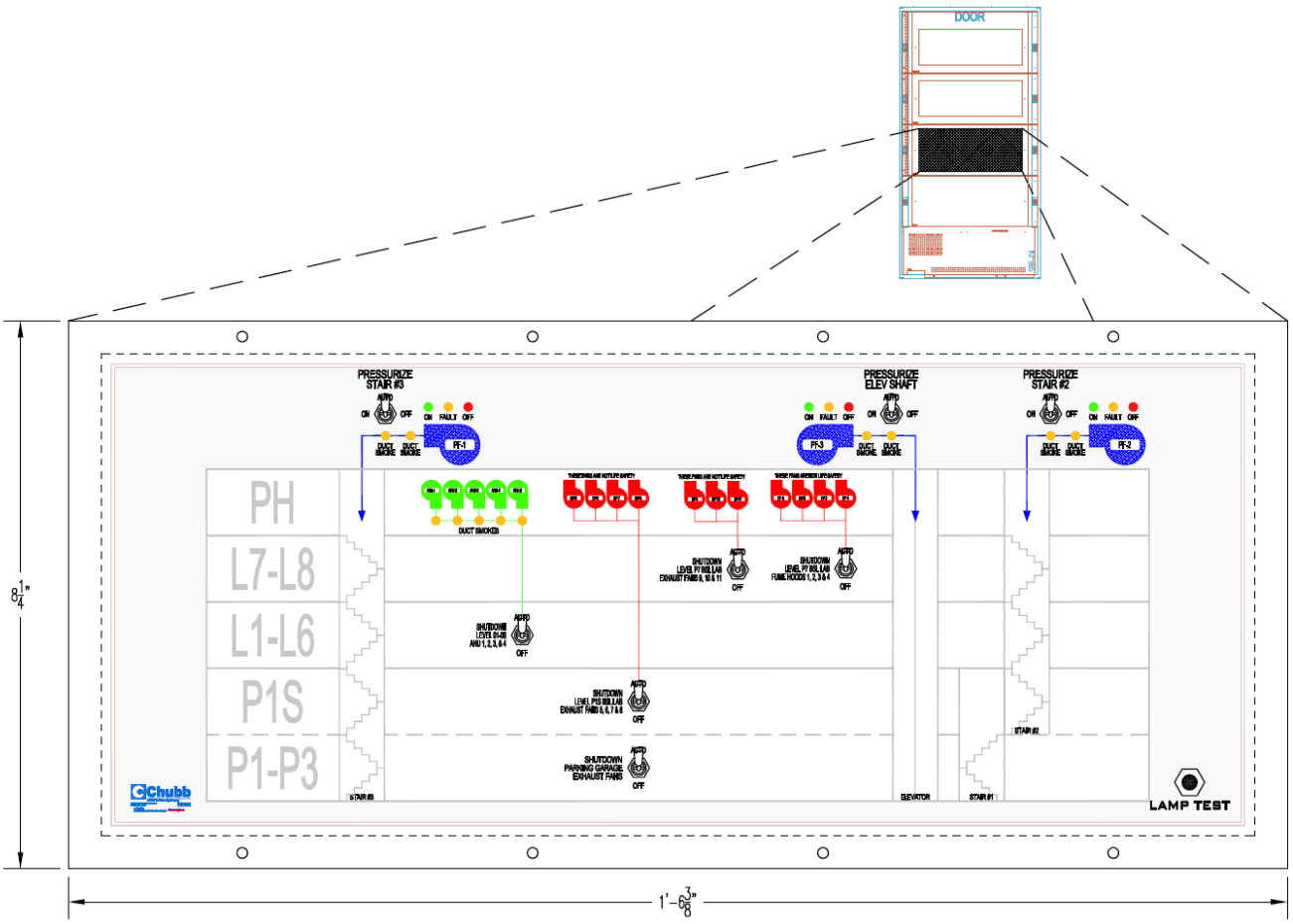
FIRE COMMAND CENTER

SCALE : NTS



FIRE ALARM PANEL LAYOUT

SCALE : NTS



FIREMANS SMOKE CONTROL PANEL (LOCATED IN FACP)

SCALE : NTS

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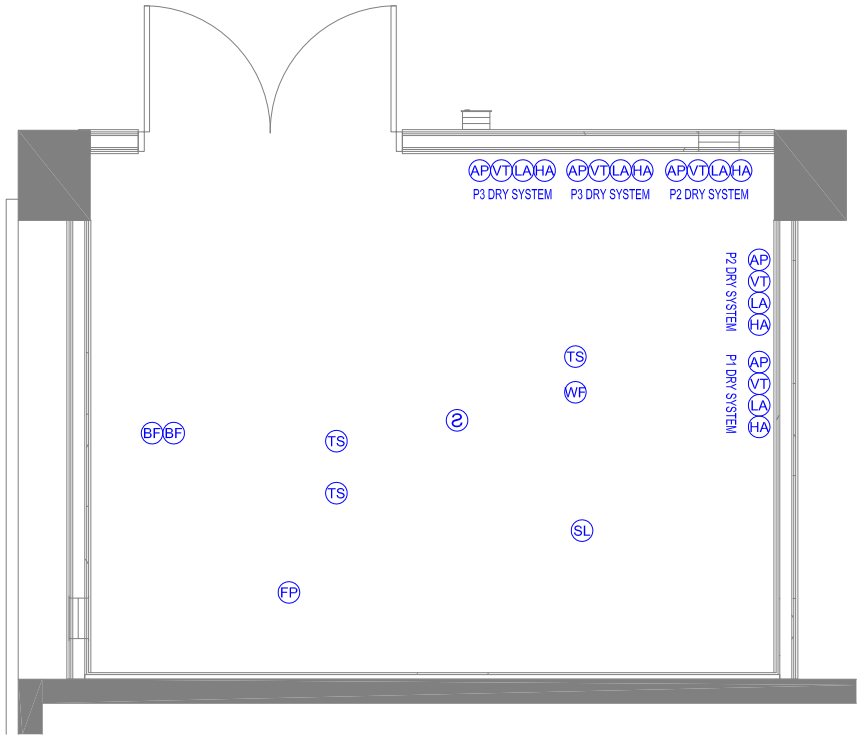


WF FIRE SPRINKLER: WATER FLOW SWITCH

TS FIRE SPRINKLER: TAMPER SWITCH

BF FIRE SPRINKLER: BACKFLOW TAMPER SWITCH

WT FIRE SPRINKLER: WATER TANK MONITORING

AP FIRE SPRINKLER: DRY SYSTEM: ALARM PRESSURE SWITCH

VT FIRE SPRINKLER: DRY SYSTEM: VALVE TAMPER

HA FIRE SPRINKLER: DRY SYSTEM: HIGH PRESSURE SWITCH

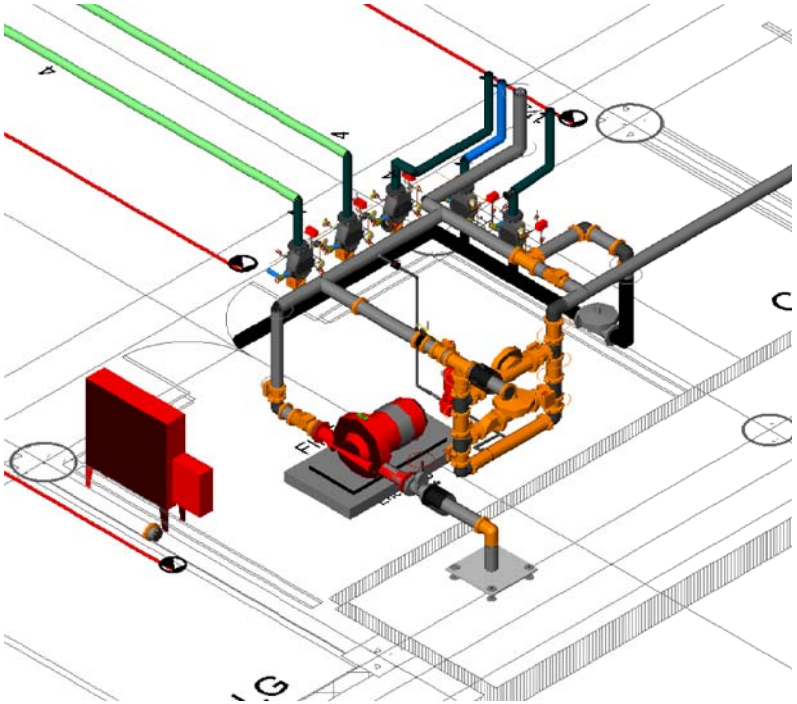
LA FIRE SPRINKLER: DRY SYSTEM: LOW PRESSURE SWITCH

SL FIRE SPRINKLER: DRY SYSTEM: SOLENOID CONTROL

FP FIRE SPRINKLER: FIRE PUMP OR JOCKEY PUMP CONTROLLER

PUMP ROOM

SCALE : NTS



ISOMETRIC PUMP ROOM

SCALE : NTS

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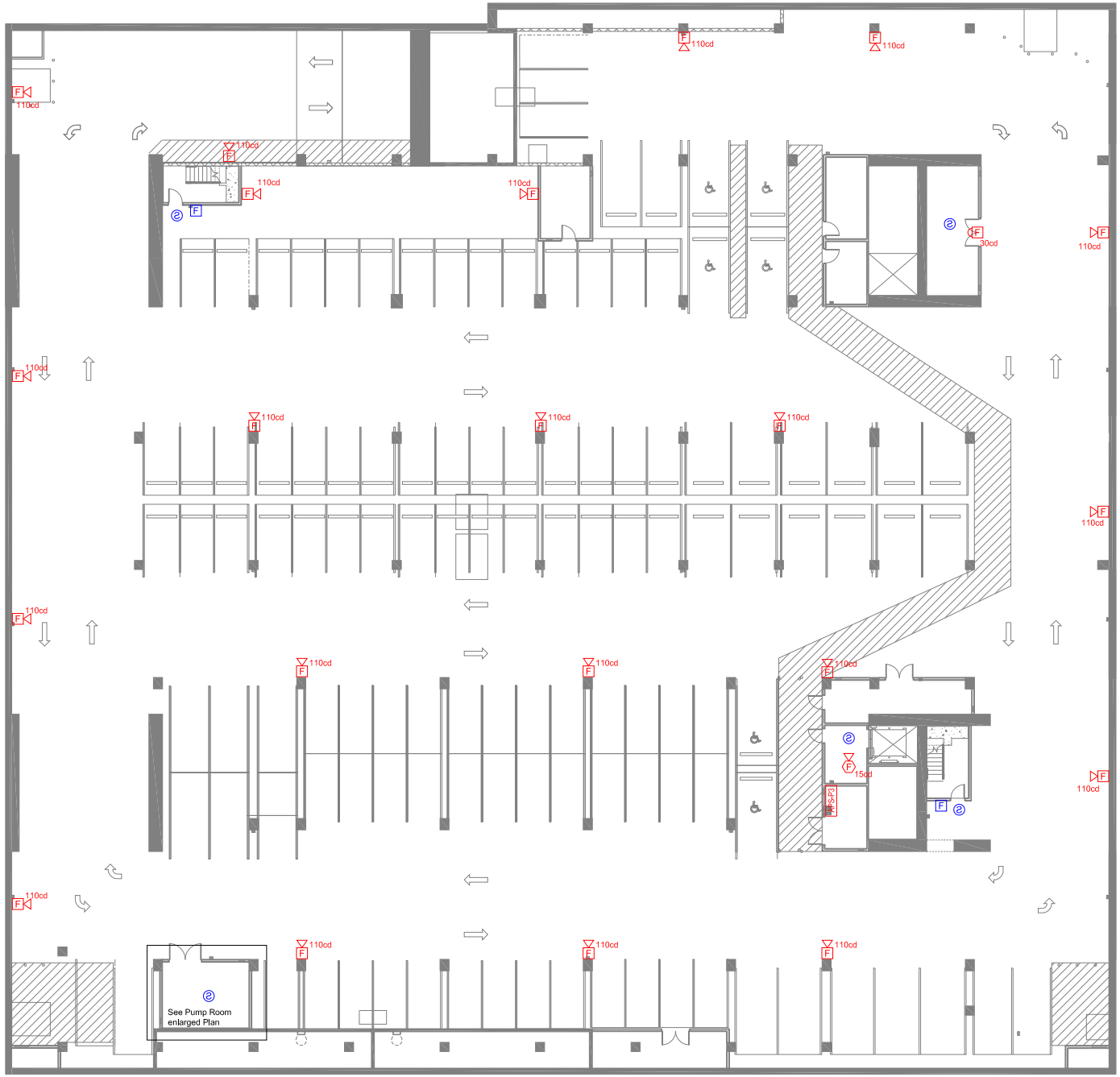

LEGENDS AND SYMBOLS

INITIATING DEVICES

- FIRE ALARM PULL STATION — MOUNTING LOCATION: WALL
- FIRE ALARM HEAT DETECTOR — MOUNTING LOCATION: CEILING
- FIRE ALARM SMOKE DETECTOR — MOUNTING LOCATION: CEILING
- FIRE ALARM SMOKE DUCT DETECTOR — MOUNTING LOCATION: DUCT
- WATER FLOW SWITCH
- TAMPER SWITCH

NOTIFICATION DEVICES

- **cd FIRE ALARM STROBE LENS — MOUNTING LOCATION: WALL
- **cd FIRE ALARM STROBE — MOUNTING LOCATION: WALL
- **cd FIRE ALARM SPEAKER STROBE — MOUNTING LOCATION: WALL
- **cd FIRE ALARM STROBE — MOUNTING LOCATION: CEILING
- **cd FIRE ALARM SPEAKER STROBE — MOUNTING LOCATION: CEILING

N

FIRE ALARM DEVICES - BASEMENT LEVEL 3

SCALE : NTS

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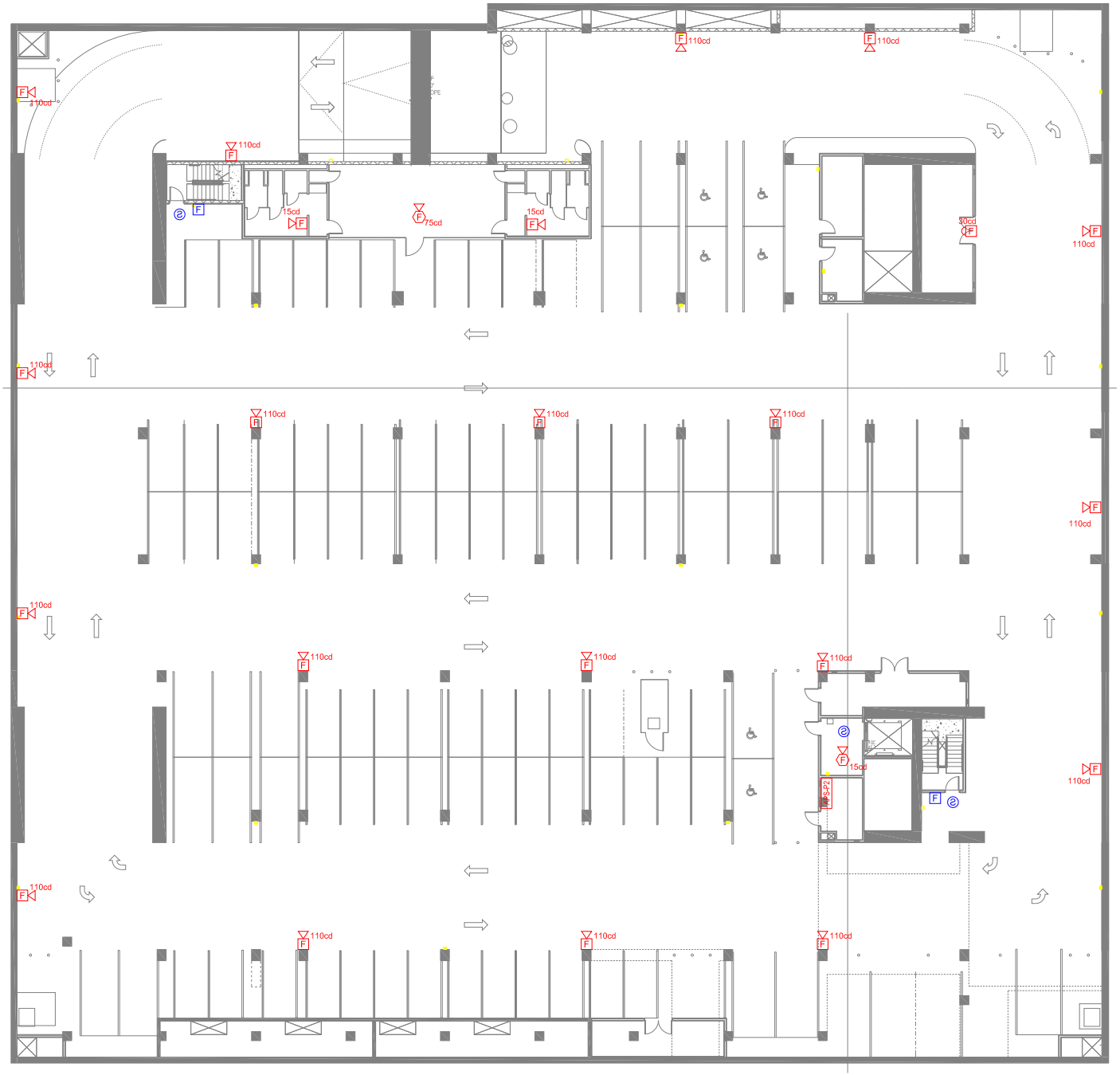

LEGENDS AND SYMBOLS

INITIATING DEVICES

- FIRE ALARM PULL STATION — MOUNTING LOCATION: WALL
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- FIRE ALARM SMOKE DETECTOR — MOUNTING LOCATION: CEILING
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N

FIRE ALARM DEVICES - BASEMENT LEVEL 2

SCALE : NTS

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LEGENDS AND SYMBOLS

INITIATING DEVICES

- F — FIRE ALARM PULL STATION — MOUNTING LOCATION: WALL
- H — FIRE ALARM HEAT DETECTOR — MOUNTING LOCATION: CEILING
- S — FIRE ALARM SMOKE DETECTOR — MOUNTING LOCATION: CEILING
- S — FIRE ALARM SMOKE DUCT DETECTOR — MOUNTING LOCATION: DUCT
- WF — WATER FLOW SWITCH
- TS — TAMPER SWITCH

NOTIFICATION DEVICES

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N

FIRE ALARM DEVICES - BASEMENT LEVEL 1

SCALE : NTS

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LEGENDS AND SYMBOLS

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N

FIRE ALARM DEVICES - BASEMENT LEVEL 1S

SCALE : NTS

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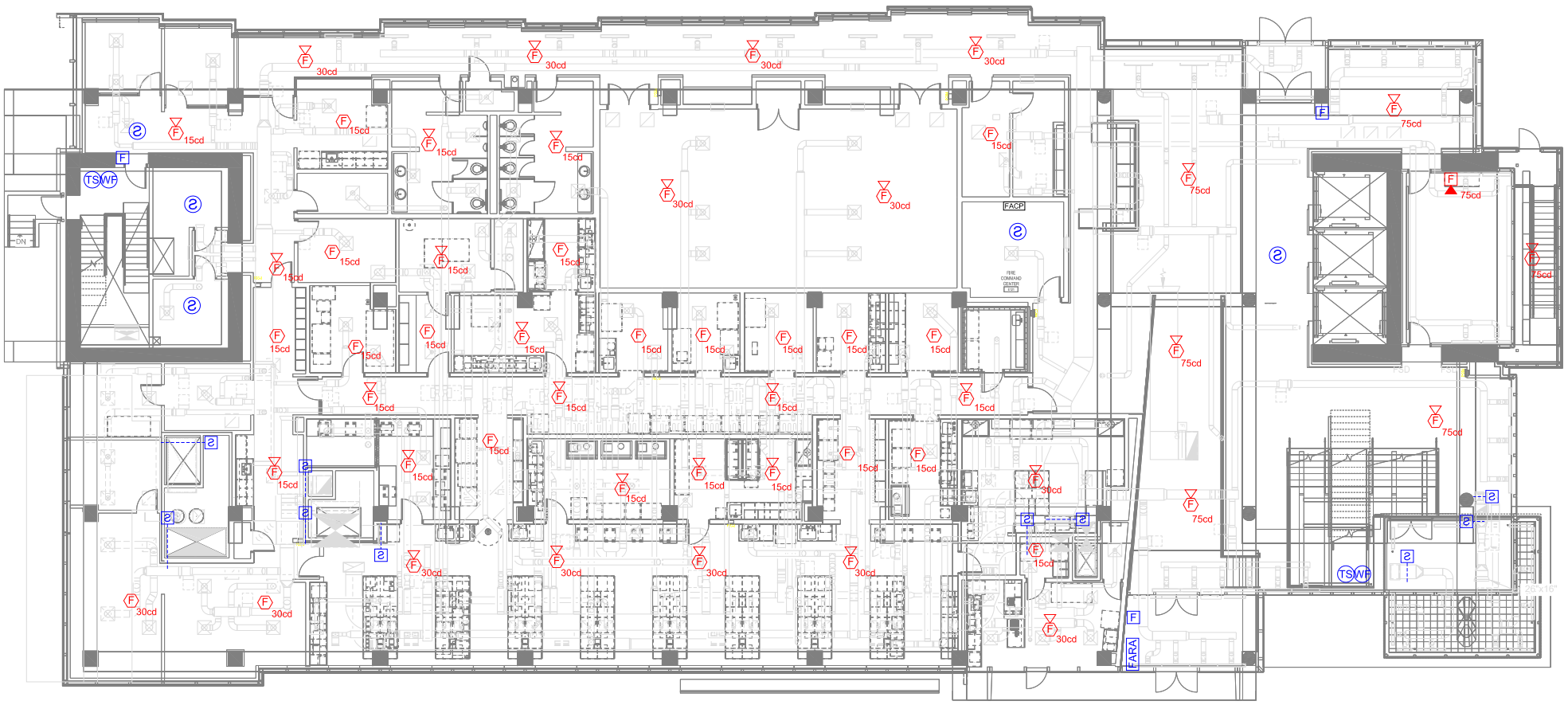

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N

FIRE ALARM DEVICES - LEVEL 1

SCALE : NTS

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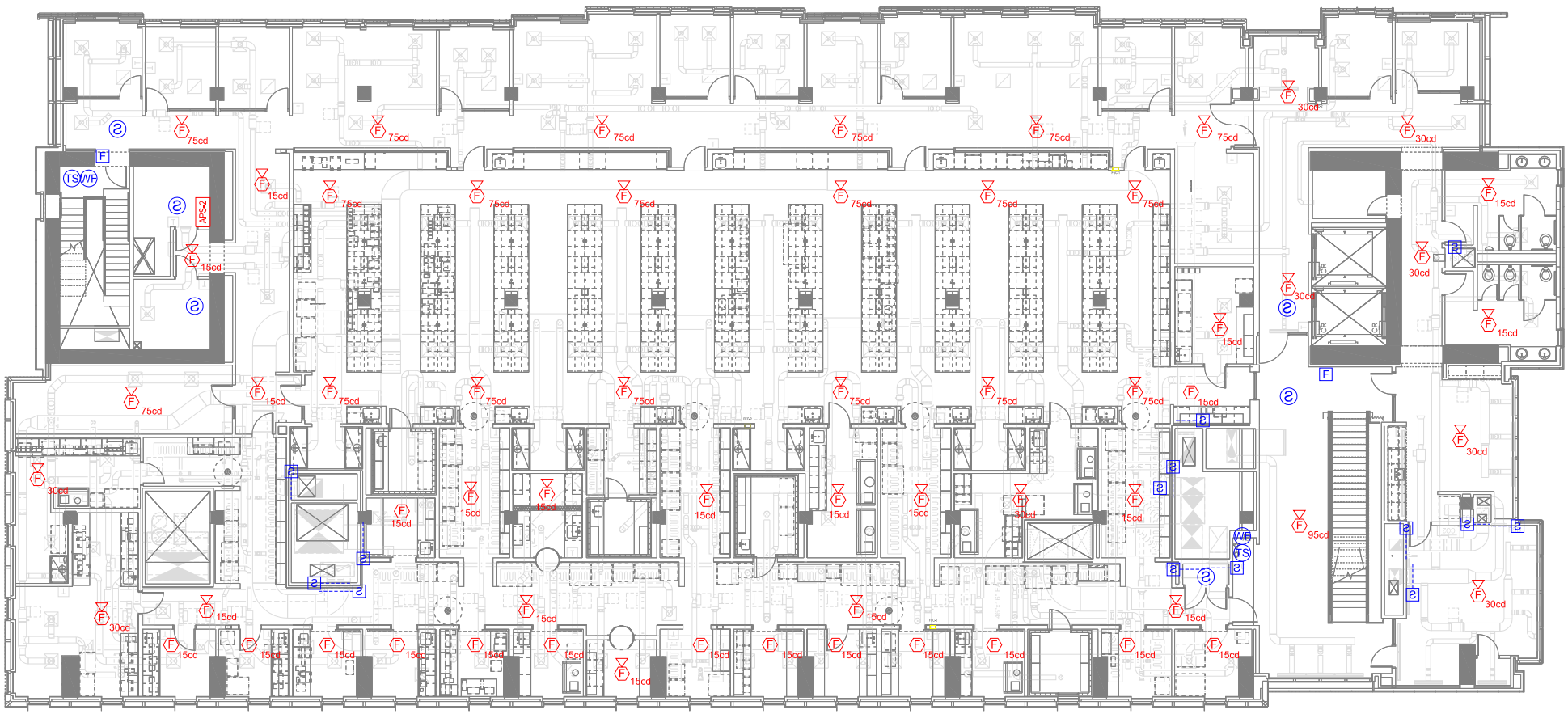

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FIRE ALARM DEVICES - LEVEL 2 (LEVEL 3-6 SIMILAR)

SCALE : NTS

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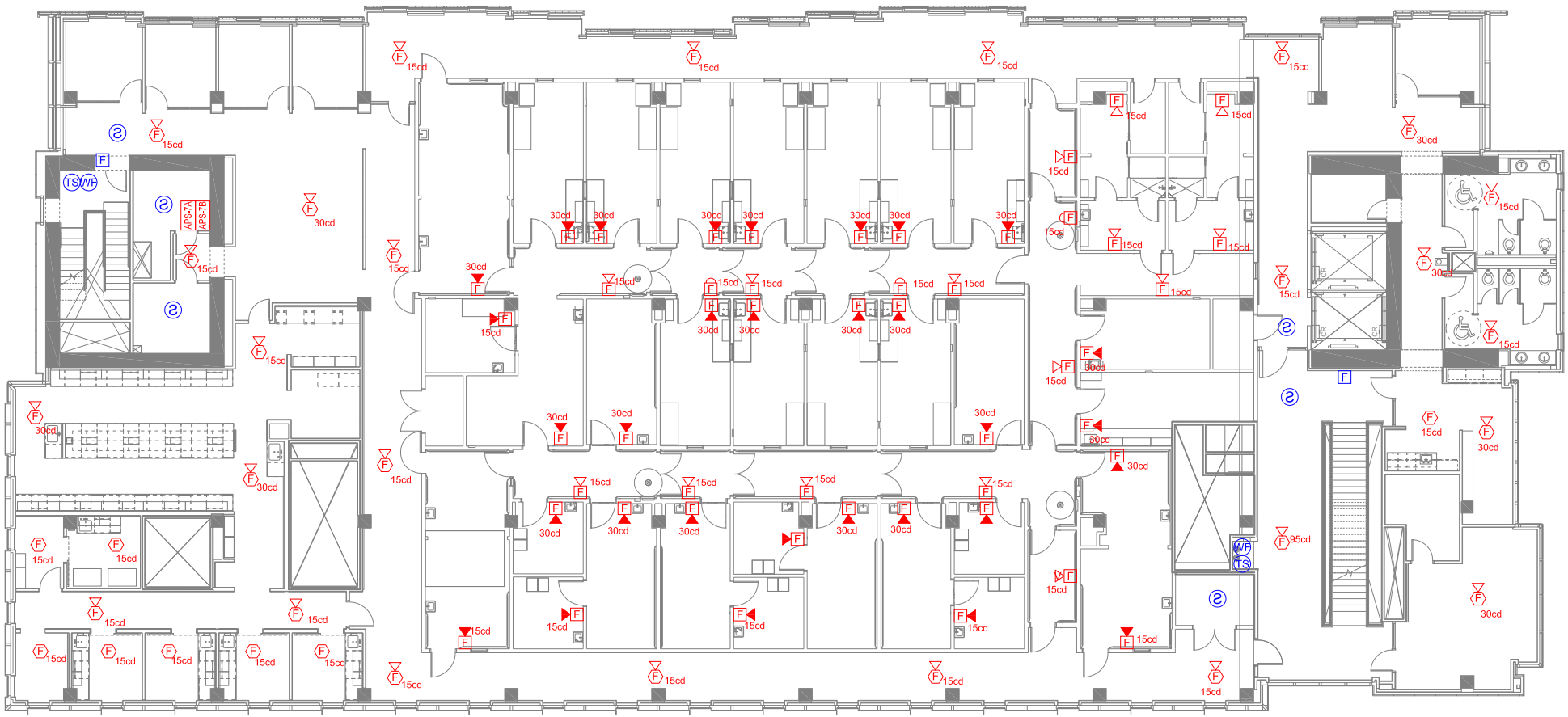

LEGENDS AND SYMBOLS

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NOTIFICATION DEVICES

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- F **cd — FIRE ALARM STROBE
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FIRE ALARM DEVICES - LEVEL7

SCALE : NTS

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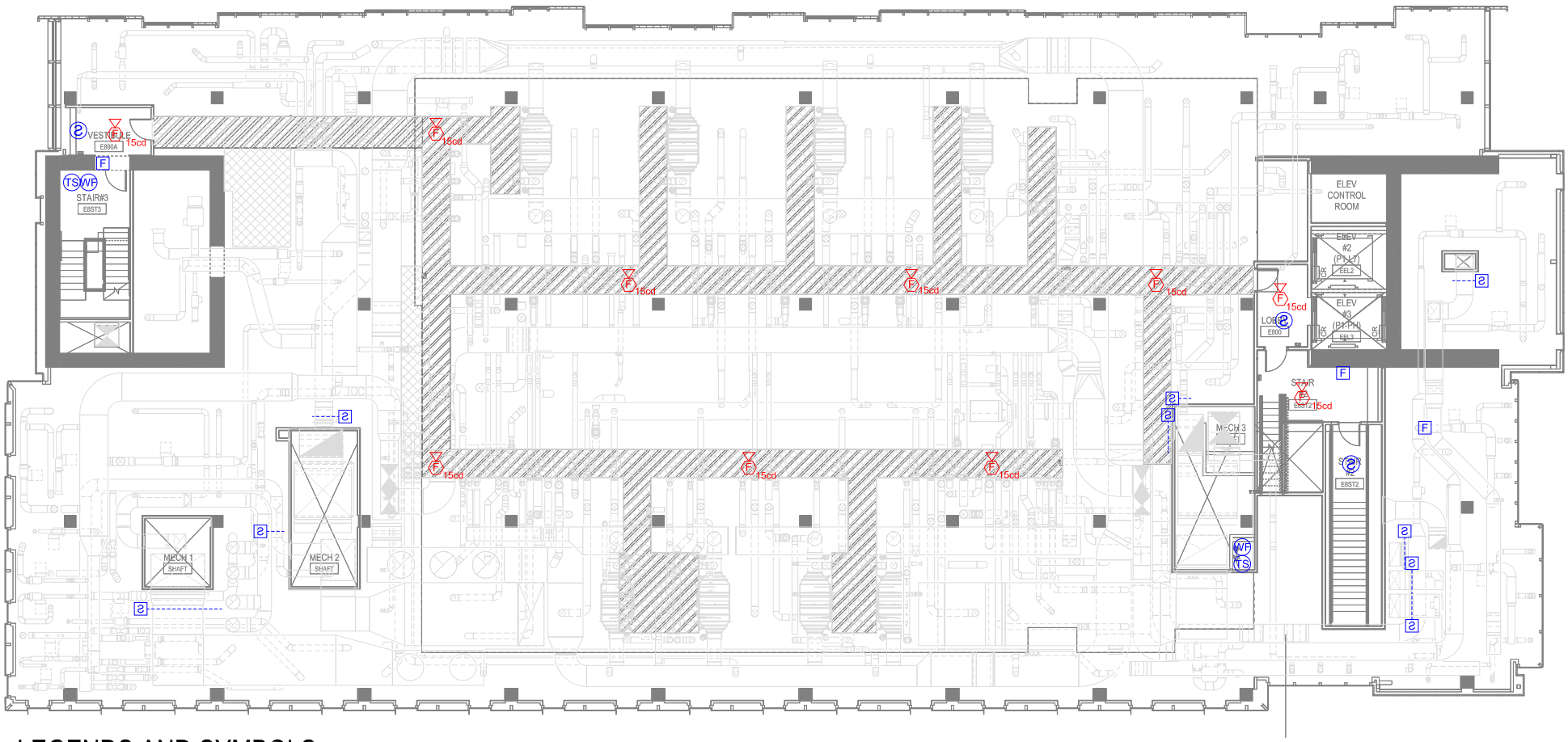

LEGENDS AND SYMBOLS

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  MOUNTING LOCATION: WALL
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  MOUNTING LOCATION: WALL
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  MOUNTING LOCATION: CEILING
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FIRE ALARM DEVICES - LEVEL 7S

SCALE : NTS

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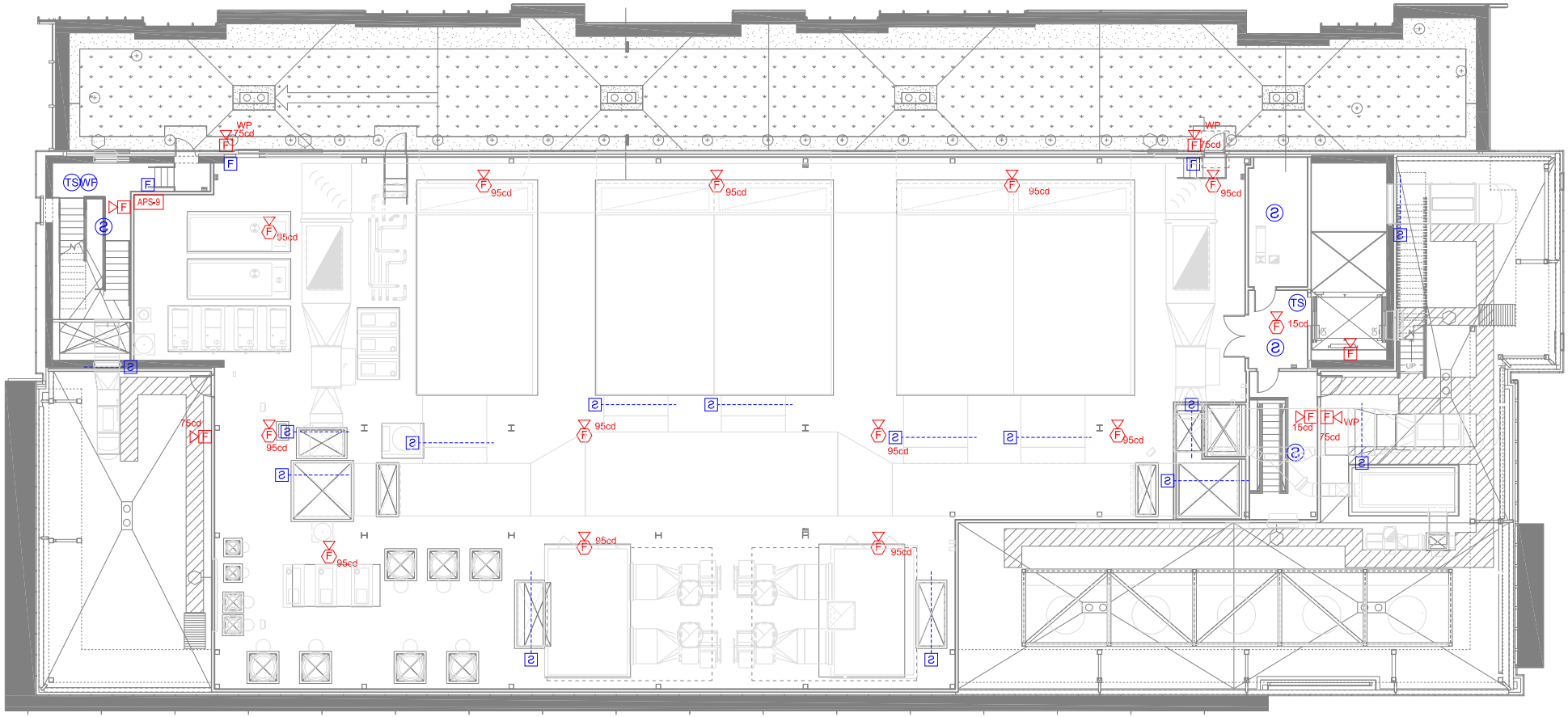

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  MOUNTING LOCATION: CEILING

N

FIRE ALARM DEVICES - PENTHOUSE

SCALE : NTS

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Appendix D: Sequence of Operations

FIRE ALARM CONTROL MATRIX (8)

INITIATION DEVICES	NOTIFICATION: ALARM AT FACP & CENTRAL CONTROL	NOTIFICATION: TROUBLE/ SUPERVISORY AT FACP & CENTRAL CONTROL	NOTIFICATION: A/V ALARM FIRE FLOOR & FLOOR ABOVE/BELOW	RELEASE ALL DOOR HOLD OPENS ON FIRE FLOOR, FLOOR ABCVE/BELOW	UNLOCK SECURITY DOORS (1)	NOTIFY SECURITY	NOTIFY BAS	PRIMARY ELEVATOR RECALL (2)
ELEVATOR LOBBY SMOKE DETECTORS- RECALL FLR (1ST)	X		X	X	X	X	X	
ELEVATOR LOBBY SMOKE DETECTORS - ALL OTHER FLOORS	X		X	X	X	X	X	X
ELEVATOR MACHINE ROOM SMOKE DETECTORS	X		X	X	X	X	X	X
DUCT SMOKE DETECTORS AT AHU DISCHARGE		X					X	
DUCT SMOKE DETECTORS AT SA FSD AT PH FLOOR SLAB		X				X	X	
DUCT SMOKE DETECTORS AT L1 - L7 SA/EA/RA FS DAMPERS		X				X	X	
DUCT SMOKE DETECTORS AT P1 FS DAMPERS		X				X	X	
DUCT SMOKE DETECTORS AT GARAGE SF/EF FSD		X				X	X	
SMOKE DETECTORS AT STAIR OR ELEVATOR PF INTAKES		X				X		
SMOKE DETECTORS-IN ALL OTHER AREAS OF BUILDING	X		X	X	X	X	X	X
MANUAL PULL STATION	X		X	X	X	X	X	X
TRANSFORMER VAULT HEAT DETECTOR	X		X	X	X	X	X	X
MANUAL FAN SHUT DOWN OPERATION (FIRE-FIGHTER'S FIRE ALARM PANEL) (4)								
AHU MANUAL SHUT DOWN FOR AHU 1-5 IN FIRE COMMAND RM.		X				X	X	
EXHAUST MANUAL SHUT DOWN EF 1-11 IN FIRE COMMAND RM.		X				X	X	
FIRE ALARM PANEL PRESSURIZATION FANS FIRE COMMAND RM.		X				X		
FIRE SUPPRESSION FLOW SWITCHES								
WET PIPE SPRINKLER WATER FLOW	X		X	X	X	X	X	X
DRY PIPE SPRINKLER WATER FLOW (GARAGE LEVELS)	X		X	X	X	X	X	X
SUPERVISORY ALARM SIGNALS								
DRY PIPE SYSTEM -TAMPER SWITCH		X						
DRY PIPE SYSTEM -LOW PRESSURE SWITCH		X						
ELEVATOR SHUNT TRIP POWER MONITORING		X						
ELEVATOR MACHINE ROOM SPRINKLER SOLENOID VALVE								
FIRE ALARM SYSTEM RELAY (CONTROLLED BY KEY SWITCH IN FIRE COMMAND ROOM)								
TROUBLE ALARM SIGNALS								
FIRE ALARM (11)		X					X	
HEATRACE MONITOR PANEL		X						

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FIRE ALARM CONTROL MATRIX (8)

INITIATION DEVICES	SECONDARY ELEVATOR RECALL (2)	ELEVATOR MACHINE ROOM SPRINKLER SOLENOID VALVE (N.O.)	ELEVATOR SHAFT PRESSURIZATION START	STAIR SHAFT PRESSURIZATION START AND AHU-8 SHUT DOWN	ELEVATOR AND STAIR SHAFT PRESSURIZATION SHUTDOWN (7)	AHU FANS 1-5 SHUTDOWN (3)	AHU FANS 6,7,8 SHUTDOWN (10)	LEVEL P1 SUITE EXHAUST EF-5-8 SHUT DOWN (5)
ELEVATOR LOBBY SMOKE DETECTORS- RECALL FLR (1ST)	X		X	X				
ELEVATOR LOBBY SMOKE DETECTORS - ALL OTHER FLOORS			X	X				
ELEVATOR MACHINE ROOM SMOKE DETECTORS			X	X				
DUCT SMOKE DETECTORS AT AHU DISCHARGE						X	X	
DUCT SMOKE DETECTORS AT SA FSD AT PH FLOOR SLAB								
DUCT SMOKE DETECTORS AT L1 - L7 SA/EA/RA FS DAMPERS								
DUCT SMOKE DETECTORS AT P1 FS DAMPERS								
DUCT SMOKE DETECTORS AT GARAGE SF/EF FSD								
SMOKE DETECTORS AT STAIR OR ELEVATOR PF INTAKES					X			
SMOKE DETECTORS-IN ALL OTHER AREAS OF BUILDING			X	X				
MANUAL PULL STATION			X	X				
TRANSFORMER VAULT HEAT DETECTOR			X	X				
MANUAL FAN SHUT DOWN OPERATIO								
AHU MANUAL SHUT DOWN FOR AHU 1-5 IN FIRE COMMAND RM.						X		
EXHAUST MANUAL SHUT DOWN EF 1-11 IN FIRE COMMAND RM.								X
FIRE ALARM PANEL PRESSURIZATION FANS FIRE COMMAND RM.			X	X	X			
FIRE SUPPRESSION FLOW SWITCHES								
WET PIPE SPRINKLER WATER FLOW			X	X				
DRY PIPE SPRINKLER WATER FLOW (GARAGE LEVELS)			X	X				
SUPERVISORY ALARM SIGNALS								
DRY PIPE SYSTEM -TAMPER SWITCH								
DRY PIPE SYSTEM -LOW PRESSURE SWITCH								
ELEVATOR SHUNT TRIP POWER MONITORING								
ELEVATOR MACHINE ROOM SPRINKLER SOLENOID VALVE		X						
FIRE ALARM SYSTEM RELAY (CONTROLLED BY KEY SWITCH IN FIRE COMMAND ROOM)		X						
TROUBLE ALARM SIGNALS								
FIRE ALARM (11)								
HEATRACE MONITOR PANEL								

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FIRE ALARM CONTROL MATRIX (8)

INITIATION DEVICES	LEVEL 7 BSL SUITE EXHAUST EF-9-11 (5)	GENERAL FUME EXHAUST FANS EF-1-4 SHUT DOWN (5)	GARAGE FANS EF-16-20 AND SF-8 -12 SHUT DOWN (12)	LEVEL P1 TRANSFORMER VAULT EXHAUST FAN EF-22 SHUTDOWN	CLOSE FS DAMPER IN FIRE COMMAND ROOM ON 1ST FLOOR	CLOSE L1 & L2 FS DAMPERS FEEDING LEVEL P1 (9)	CLOSE FS DAMPERS IN SA DUCT MAINS AT PH FLOOR SLAB (6)	CLOSE SA/EA/RA FIRE SMOKE DAMPERS IN SHAFTS ON FLOORS 1-7
ELEVATOR LOBBY SMOKE DETECTORS- RECALL FLR (1ST)					X			X
ELEVATOR LOBBY SMOKE DETECTORS - ALL OTHER FLOORS					X			X
ELEVATOR MACHINE ROOM SMOKE DETECTORS					X			X
DUCT SMOKE DETECTORS AT AHU DISCHARGE								
DUCT SMOKE DETECTORS AT SA FSD AT PH FLOOR SLAB							X	
DUCT SMOKE DETECTORS AT L1 - L7 SA/EA/RA FS DAMPERS								X(8)
DUCT SMOKE DETECTORS AT P1 FS DAMPERS						X		
DUCT SMOKE DETECTORS AT GARAGE SF/EF FSD			X					
SMOKE DETECTORS AT STAIR OR ELEVATOR PF INTAKES								
SMOKE DETECTORS-IN ALL OTHER AREAS OF BUILDING					X			X
MANUAL PULL STATION					X			X
TRANSFORMER VAULT HEAT DETECTOR					X			X
MANUAL FAN SHUT DOWN OPERATIO								
AHU MANUAL SHUT DOWN FOR AHU 1-5 IN FIRE COMMAND RM.								
EXHAUST MANUAL SHUT DOWN EF 1-11 IN FIRE COMMAND RM.	X	X						
FIRE ALARM PANEL PRESSURIZATION FANS FIRE COMMAND RM.								
FIRE SUPPRESSION FLOW SWITCHES								
WET PIPE SPRINKLER WATER FLOW					X			X
DRY PIPE SPRINKLER WATER FLOW (GARAGE LEVELS)					X			X
SUPERVISORY ALARM SIGNALS								
DRY PIPE SYSTEM -TAMPER SWITCH								
DRY PIPE SYSTEM -LOW PRESSURE SWITCH								
ELEVATOR SHUNT TRIP POWER MONITORING								
ELEVATOR MACHINE ROOM SPRINKLER SOLENOID VALVE								
FIRE ALARM SYSTEM RELAY (CONTROLLED BY KEY SWITCH IN FIRE COMMAND ROOM)								
TROUBLE ALARM SIGNALS								
FIRE ALARM (11)								
HEATRACE MONITOR PANEL								

NOTES:

(1) PER SECURITY PROGRAMMING, FIRE FLOOR, TWO FLOORS BELOW, ONE FLOORS ABOVE. PERTAINS ONLY TO DOORS THAT WOULD PREVENT OCCUPANTS FROM REACHING EXIT STAIRWELLS, ELEVATOR LOBBIES, OR AREAS OF REFUGE.

(2) THE SHUNT TRIP SYSTEM IS NOT CONTROLLED BY THE FIRE ALARM SYSTEM

(3) AHU FANS SERVE COMBINED DISTRIBUTION. ONLY UNIT ASSOCIATED WITH DECTOR IN ALARM SHALL SHUT DOWN. REMAINING FANS SHALL SHUTDOWN AS NEEDED BY BAS SYSTEM TO MAINTAIN SYSTEM PRESSURE. REFER TO SECTION 23 0993. MANUAL CONTROL PROVIDED AT SMOKE CONTROL PANEL FOR FANS > 15,000 CFM.

(4) MANUAL CONTROL SHALL BE VIA A FIRE-FIGHTER'S FIRE ALARM PANEL LOCATED IN THE FIRE COMMAND ROOM

(5) EXHAUST FANS SHALL CONTINUOUSLY OPERATE UNLESS SHUTDOWN MANUALLY AT FIRE ALARM CONTROL PANEL. THERE IS ONE SWITCH FOR EACH GROUPING OF FANS (TOTAL 3).

(6) SUPPLY AIR FIRE SMOKE DAMPERS AT PENTHOUSE FLOOR SLAB SHALL ONLY CLOSE WHEN ASSOICATED DUCT SMOKE DETECTOR IS ACTIVATED. IF ONE FS DAMPER CLOSES THE OTHER FS DAMPER SHALL REMAIN OPEN UNTIL ITS DUCT SMOKE DETECTOR IS ACTIVATED. AHU 1-5 SHALL CONTINUETO OPERATE UNLESS BOTH FS DAMPERS CLOSE. IF BOTH FS DAMPERS CLOSE THE FOLLOWING FANS SHALL SHUT DOWN BY THE BAS; AHU 1-5, RF-1&2, AND EF-3 THRU 8. IF ONE FS DAMPER IS CLOSED AND THE OTHER FS DAMPER IS COMMANDED CLOSED THE CLOSURE WILL BE DELAYED FOR 30 SECONDS TO ALLOW FANS TO RAMP DOWN.

(7) SHUTDOWN FANS ONLY WHEN TWO INTAKE SMOKE DETECTORS ACTIVATE.

(8) SA, EA, RA, FS DAMPERS SHALL BE ZONED BY SHAFT AND BY FLOOR. SA/EA/RA FS DAMPERS SHALL BE GROUPED ON A COMMON ZONE FOR A GIVEN ZONE (FLOOR/SHAFT), THE SA/EA/RA FS DAMPERS SHALL CLOSE UPON ACTIVATION OF ANY 1 OF THE 3 ASSOCIATED DUCT MOUNTED SMOKE DETECTOR.

(9) DAMPERS IN DUCTS ON LEVEL 1 AND LEVEL 2 SERVING LEVEL P1 SHALL BE ON A COMMON ZONE DAMPERS SHALL REMAIN OPEN UNTIL ANY ASSOCIATED DUCT MOUNTED SMOKE DETECTORS ACTIVATED.

(10) SHUTDOWN ONLY AHU WITH ASSOCIATED DISCHARGE DUCT SMOKE DETECTOR.

(11) GENERAL ALARM NOTIFICATION TO BAS.

(12) UPON DETECTION OF SMOKE AT ANY OF THE GARAGE SF/EF DUCT SMOKE DETECTORS, OR ACTIVATION OF ANY GARAGE PULL STATION, OR DETECTION OF GARAGE FIRE PROTECTION WATER FLOW SWITCH ALL GARAGE SUPPLY FANS SHALL SHUT DOWN AND EXHAUST FANS SHALLOPERATE AT 100%. EXHAUST FANS SHALL HAVE MANUAL SHUT DOWN AT FACP. UPON DETECTION OF SMOKE AT ANY OF THE DUCT MOUNTEDSMOKE DETECTORS IN THE GARAGE EXHAUST OR SUPPLY DUCTWORK ASSOCIATED FIRE SMOKE DAMPERS SHALL CLOSE. HARDWIRED STATIC PRESSURE SAFETIES SHALL BE USED TO PROTECT GARAGE SUPPLY AND EXHAUST FANS UPON DAMPER CLOSURE.

SA = SUPPLY AIR, RA = RETURN AIR, EA = EXHAUST AIR, EF = EXHAUST FAN, SF = SUPPLY FAN, RF = RETUIRN FAN, PF = PRESSURIZATION FAN, FS = FIRE SMOKE, FSD = FIRE SMOKE DAMPER, FACP = FIRE ALARM CONTROL PANEL, BAS = BUILDING AUTOMATION SYSTEM, AHU = AIR HANDLING UNIT, PH = PENTHOUSE, FP = FIRE PROTECTION, PS = PULL STATION

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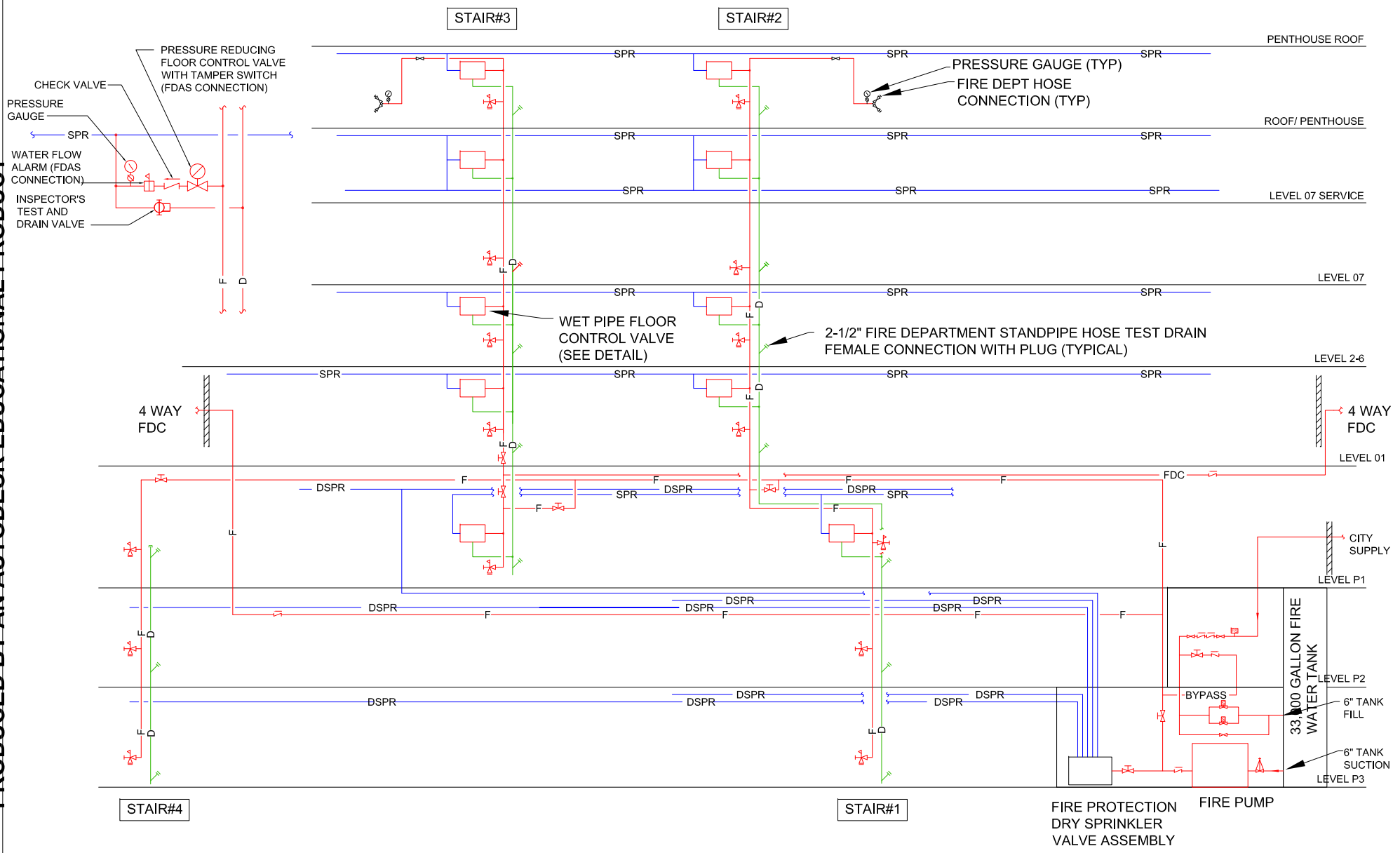
Appendix E: Fire Sprinkler Plan



SPRINKLER SYSTEM FLOW DIAGRAM

SCALE : NTS

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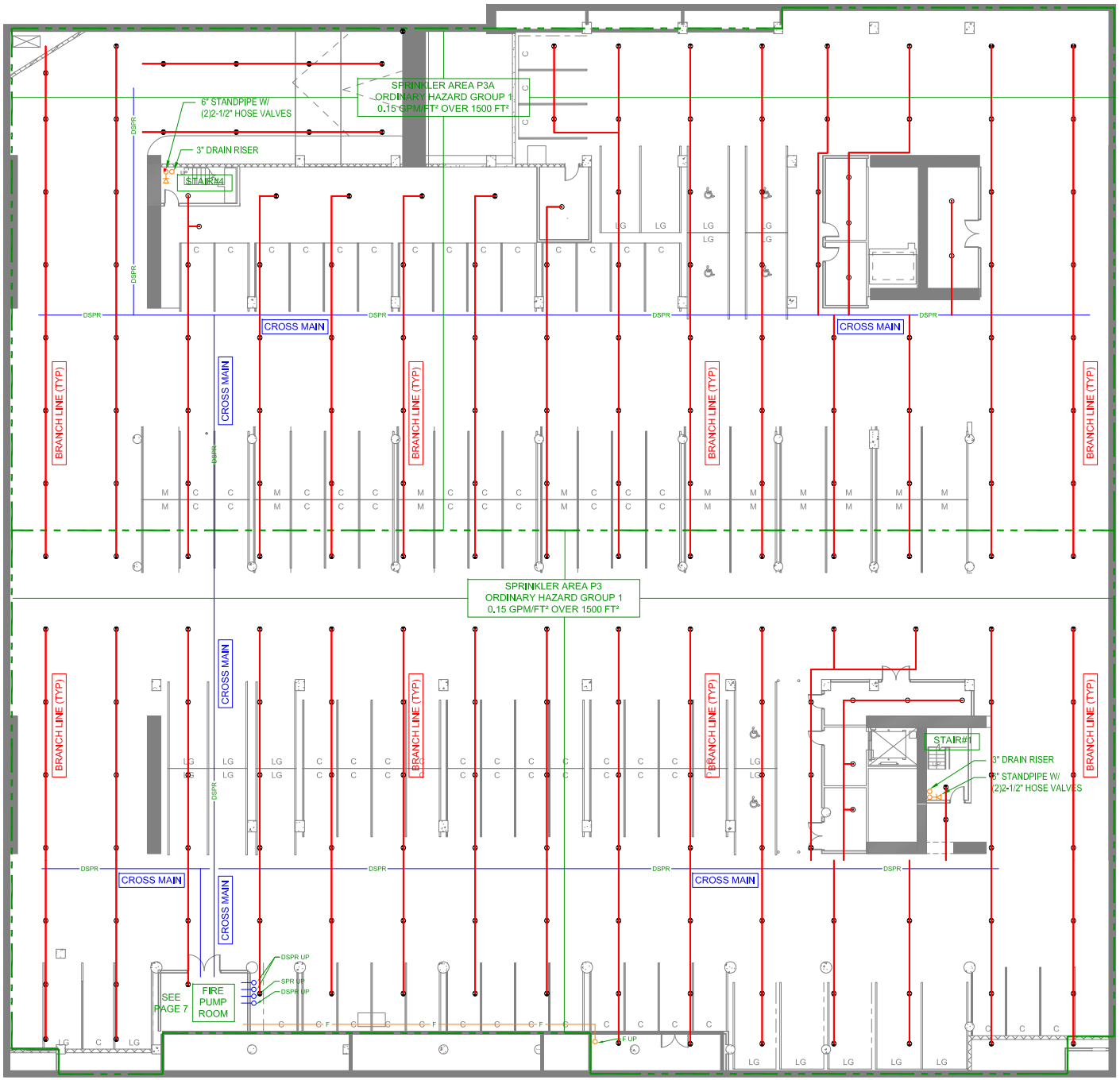

LEGENDS AND SYMBOLS

xxx xx HAZARD xx GPM/FT² OVER xx FT²	SPRINKLER ZONE OCCUPANCY CLASSIFICATION DISCHARGE DENSITY

DSPR	DRY SPRINKLER PIPE
SPR	WET SPRINKLER PIPE
F	FIRE SERVICE
	PIPE UP
	PIPE DN
	UPRIGHT SPRINKLER
	PENDENT SPRINKLER
	SIDE WALL SPRINKLER

CROSS MAIN	= 4"
BRANCH LINE	= 1-1/2" UP TO 4 SPRINKLERS
	= 2" 5 SPRINKLERS AND UP

FIRE SPRINKLER PLAN - BASEMENT LEVEL 3

SCALE : NTS

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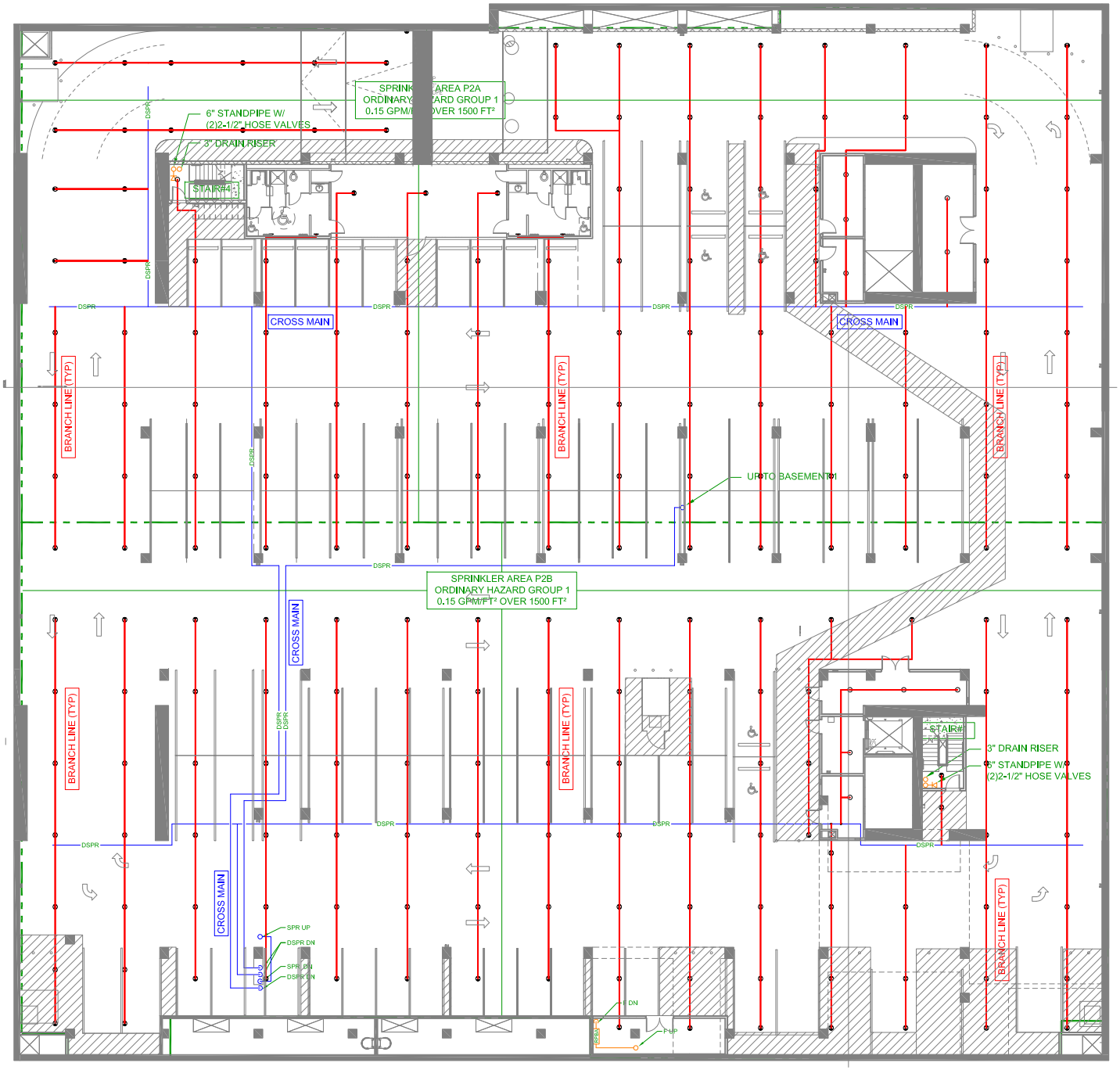

LEGENDS AND SYMBOLS

xxx	SPRINKLER ZONE
xx HAZARD	OCCUPANCY CLASSIFICATION
xx GPM/FT² OVER xx FT²	DISCHARGE DENSITY

DSPR	DRY SPRINKLER PIPE
SPR	WET SPRINKLER PIPE
F	FIRE SERVICE

PIPE UP
PIPE DN

UPRIGHT SPRINKLER
PENDENT SPRINKLER
SIDE WALL SPRINKLER

CROSS MAIN	= 4"
BRANCH LINE	= 1-1/2" UP TO 4 SPRINKLERS
	= 2" 5 SPRINKLERS AND UP

FIRE SPRINKLER PLAN - BASEMENT LEVEL 2

SCALE : NTS

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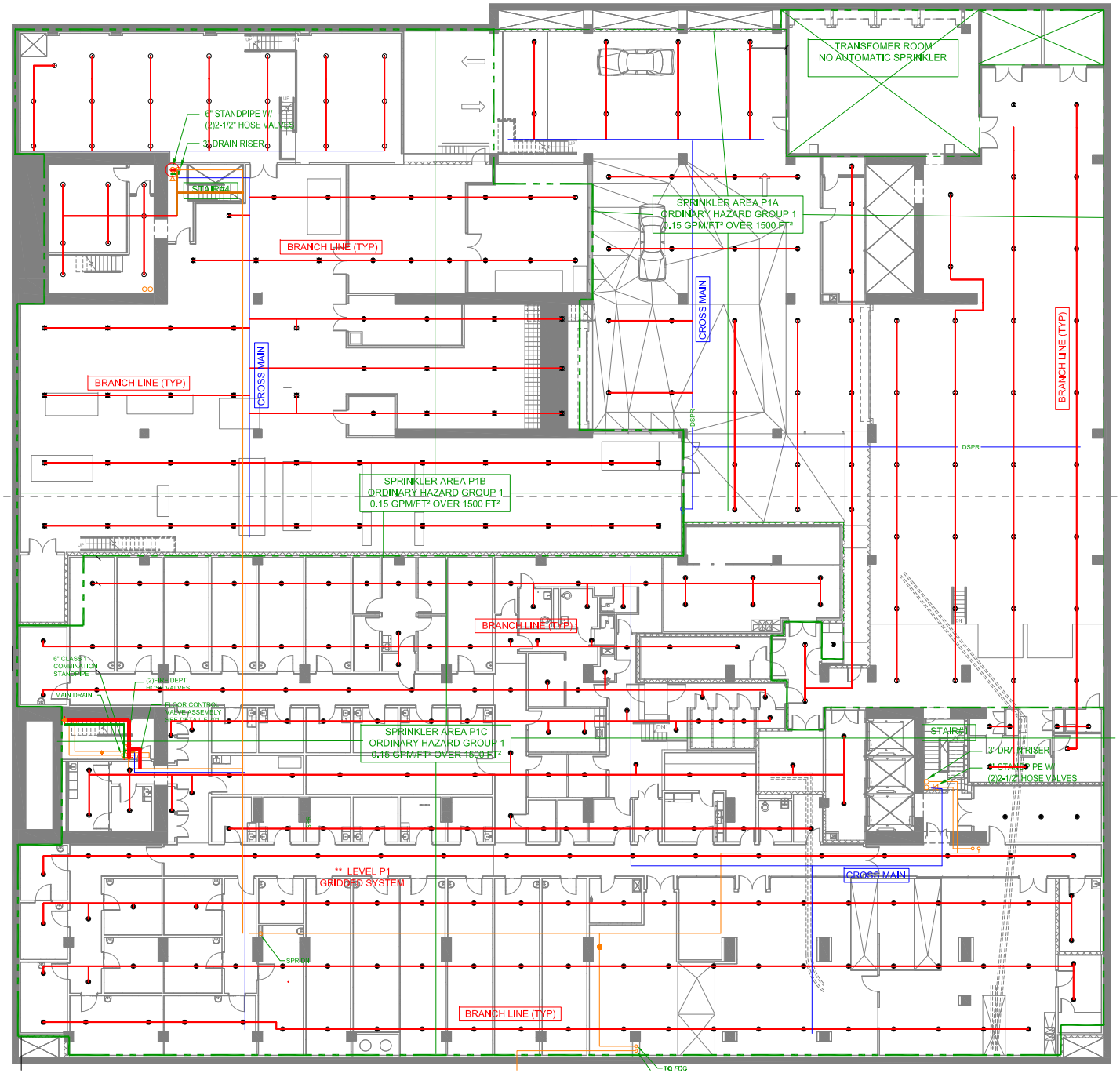

LEGENDS AND SYMBOLS

xxx	SPRINKLER ZONE
xx HAZARD	OCCUPANCY CLASSIFICATION
xx GPM/FT² OVER xx FT²	DISCHARGE DENSITY

DSPR	DRY SPRINKLER PIPE
SPR	WET SPRINKLER PIPE
F	FIRE SERVICE
	PIPE UP
	PIPE DN
	UPRIGHT SPRINKLER
	PENDENT SPRINKLER
	SIDE WALL SPRINKLER

CROSS MAIN = 2-1/2"
BRANCH LINES = 1" UP TO 1 SPRINKLER
= 1-1/4" UP TO 2 SPRINKLER
= 1-1/2" UP TO 5 SPRINKLERS
= 2" , 6 SPRINKLERS AND UP

FIRE SPRINKLER PLAN - BASEMENT LEVEL 1

SCALE : NTS

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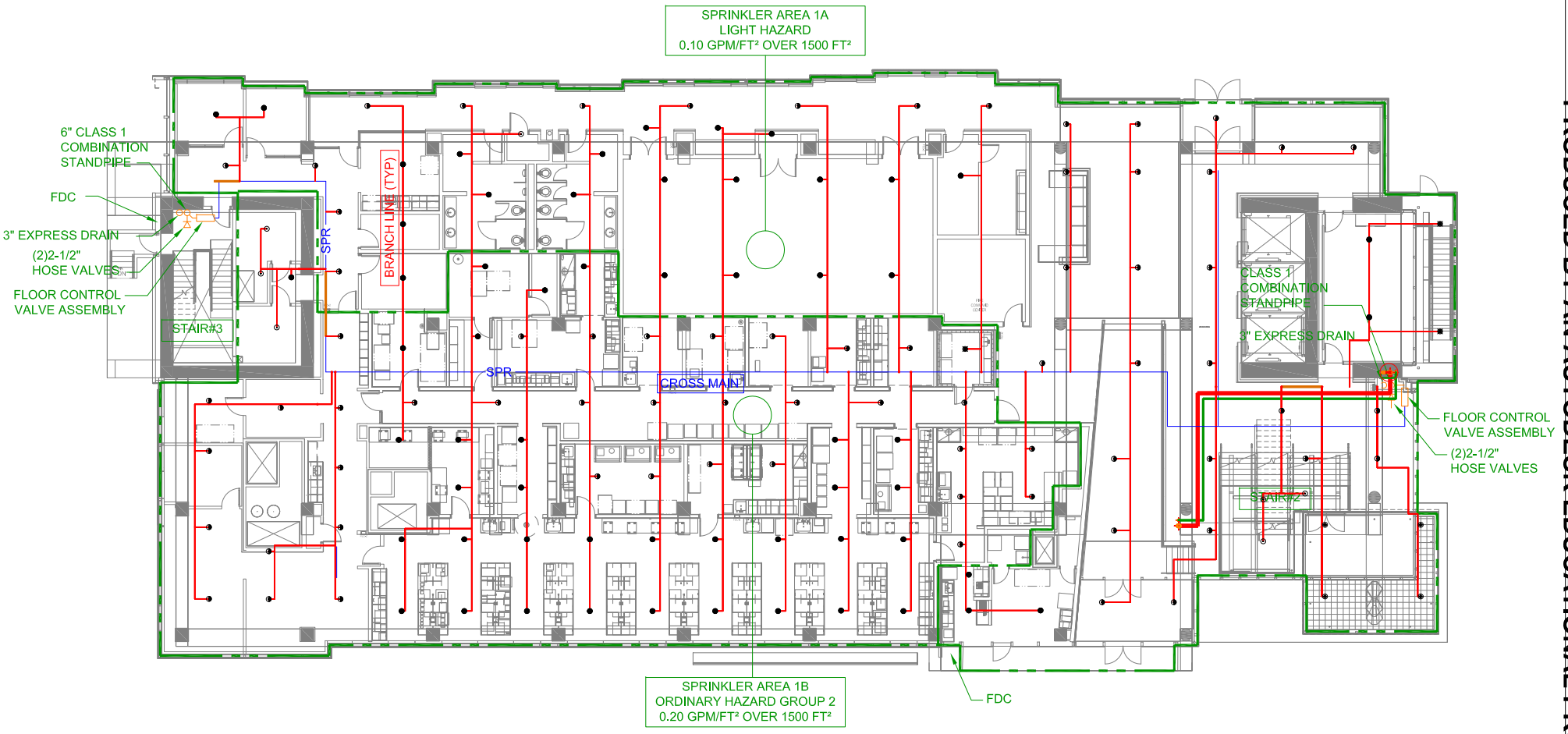

LEGENDS AND SYMBOLS

xxx	SPRINKLER ZONE
xx HAZARD	OCCUPANCY CLASSIFICATION
xx GPM/FT² OVER xx FT²	DISCHARGE DENSITY

SPR — WET SPRINKLER PIPE

F — FIRE SERVICE

PIPE UP

PIPE DN

UPRIGHT SPRINKLER

PENDENT SPRINKLER

SIDE WALL SPRINKLER

FIRE SPRINKLER PLAN - LEVEL 1

SCALE : NTS

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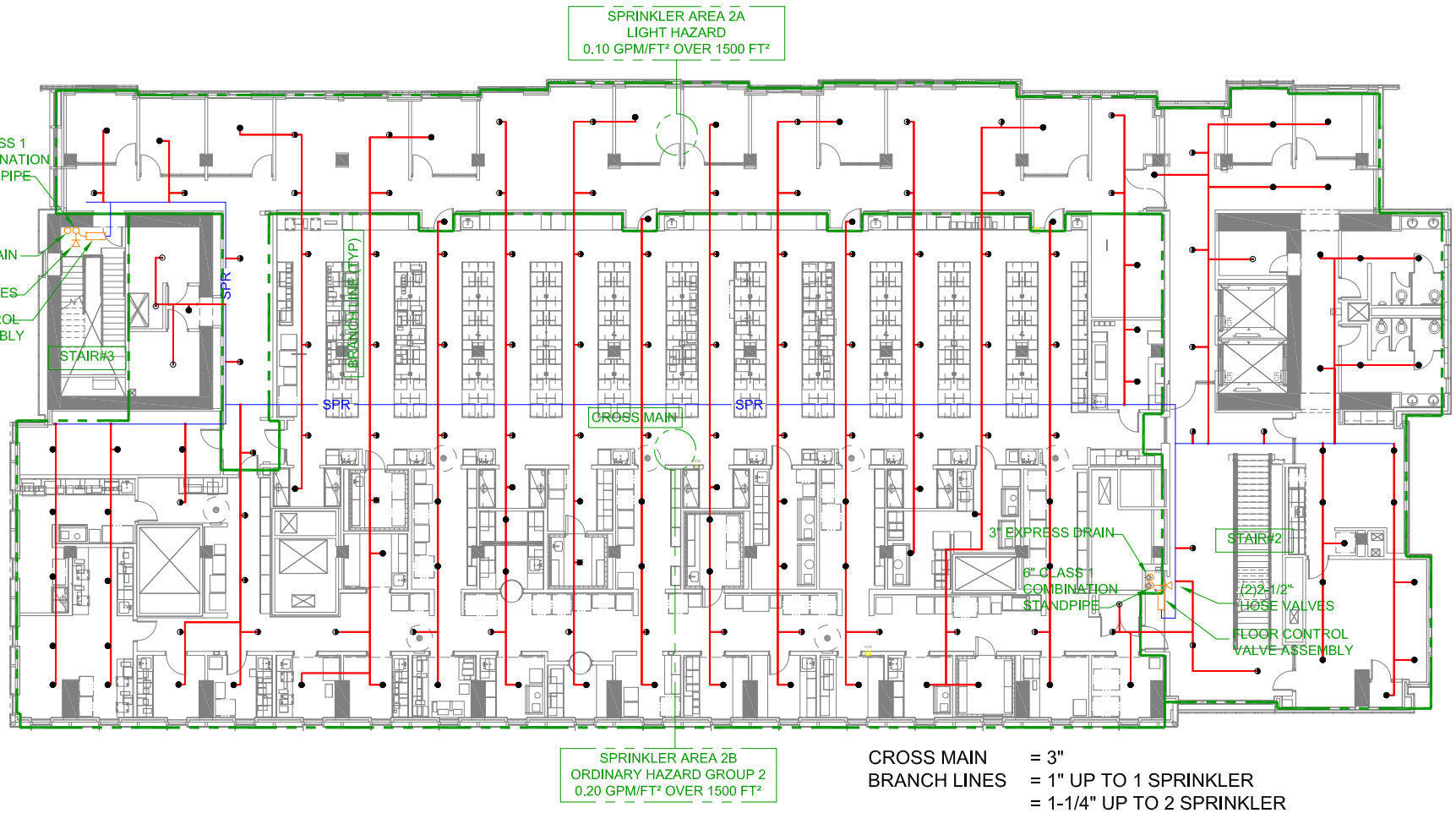

CROSS MAIN	= 3"
BRANCH LINES	= 1" UP TO 1 SPRINKLER
	= 1-1/4" UP TO 2 SPRINKLER
	= 1-1/2" UP TO 5 SPRINKLERS
	= 2" , 6 SPRINKLERS AND UP

LEGENDS AND SYMBOLS

xxx	SPRINKLER ZONE
xx HAZARD	OCCUPANCY CLASSIFICATION
xx GPM/FT² OVER xx FT²	DISCHARGE DENSITY

SPR — WET SPRINKLER PIPE

F — FIRE SERVICE

PIPE UP

PIPE DN

UPRIGHT SPRINKLER

PENDENT SPRINKLER

SIDE WALL SPRINKLER

FIRE SPRINKLER PLAN - LEVEL 2-6

SCALE : NTS

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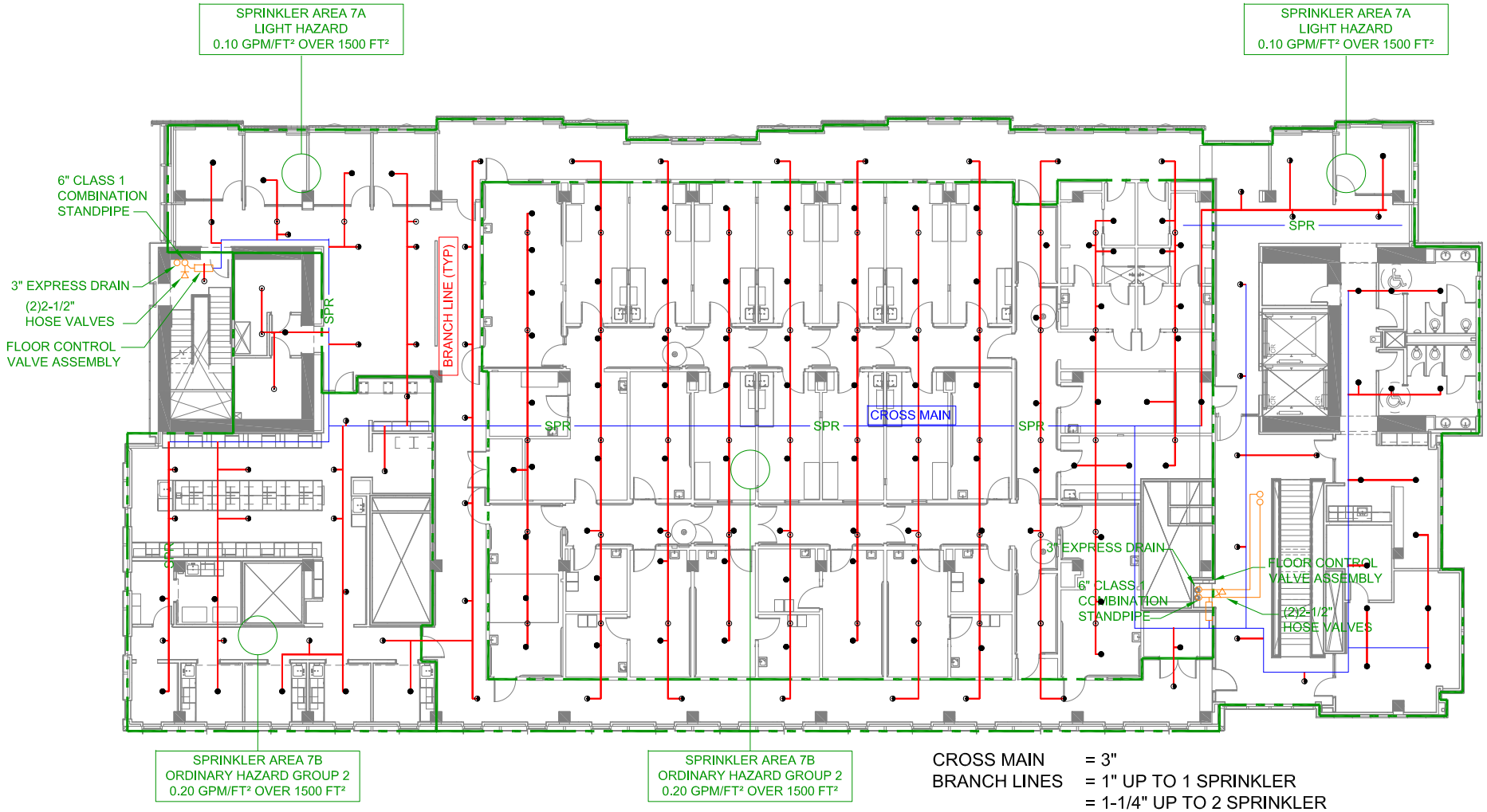

CROSS MAIN = 3"
BRANCH LINES = 1" UP TO 1 SPRINKLER
= 1-1/4" UP TO 2 SPRINKLER
= 1-1/2" UP TO 5 SPRINKLERS
= 2" , 6 SPRINKLERS AND UP

LEGENDS AND SYMBOLS

xxx	SPRINKLER ZONE
xx HAZARD	OCCUPANCY CLASSIFICATION
xx GPM/FT² OVER xx FT²	DISCHARGE DENSITY

SPR — WET SPRINKLER PIPE
F — FIRE SERVICE

PIPE UP
PIPE DN

UPRIGHT SPRINKLER
PENDENT SPRINKLER
SIDE WALL SPRINKLER

FIRE SPRINKLER PLAN - LEVEL 7

SCALE : NTS

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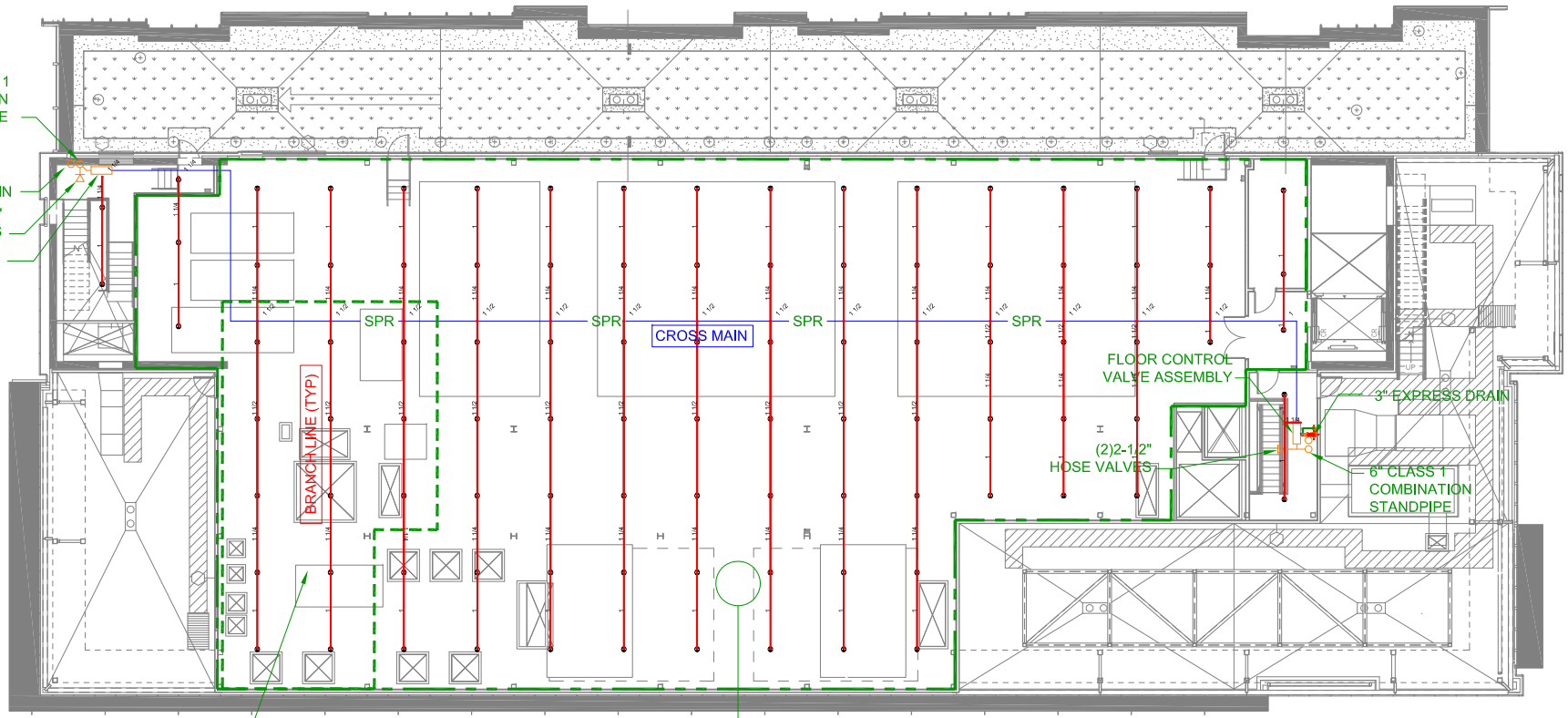

CROSS MAIN = 3"
BRANCH LINES = 1" UP TO 1 SPRINKLER
= 1-1/4" UP TO 2 SPRINKLER
= 1-1/2" UP TO 5 SPRINKLERS
= 2" , 6 SPRINKLERS AND UP

LEGENDS AND SYMBOLS

xxx	SPRINKLER ZONE
xx HAZARD	OCCUPANCY CLASSIFICATION
xx GPM/FT² OVER xx FT²	DISCHARGE DENSITY

SPR — WET SPRINKLER PIPE
F — FIRE SERVICE

PIPE UP
PIPE DN

UPRIGHT SPRINKLER
PENDENT SPRINKLER
SIDE WALL SPRINKLER

FIRE SPRINKLER PLAN - PENTHOUSE

SCALE : NTS

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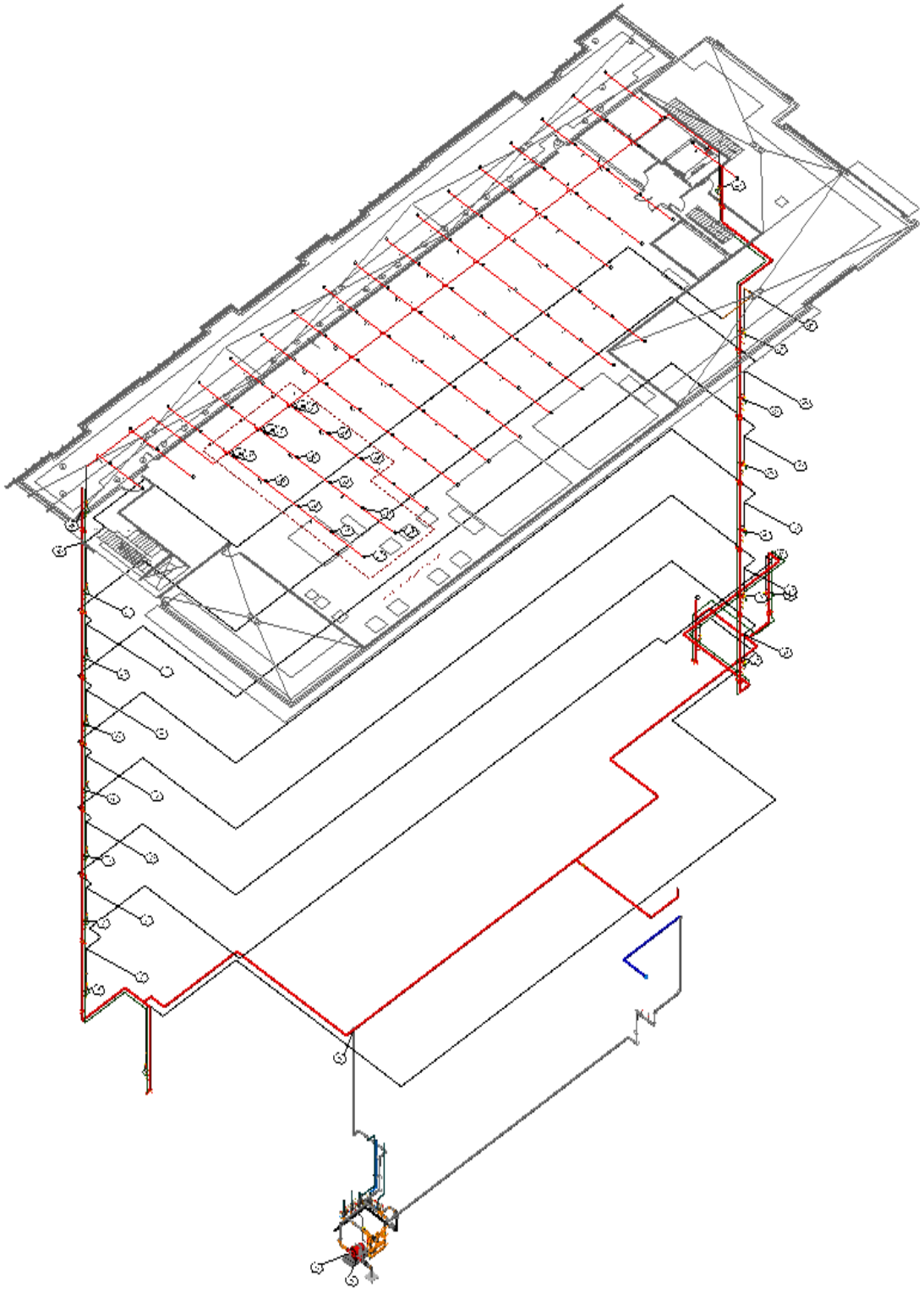

Figure 43: Isometric view - Hydraulic calculations

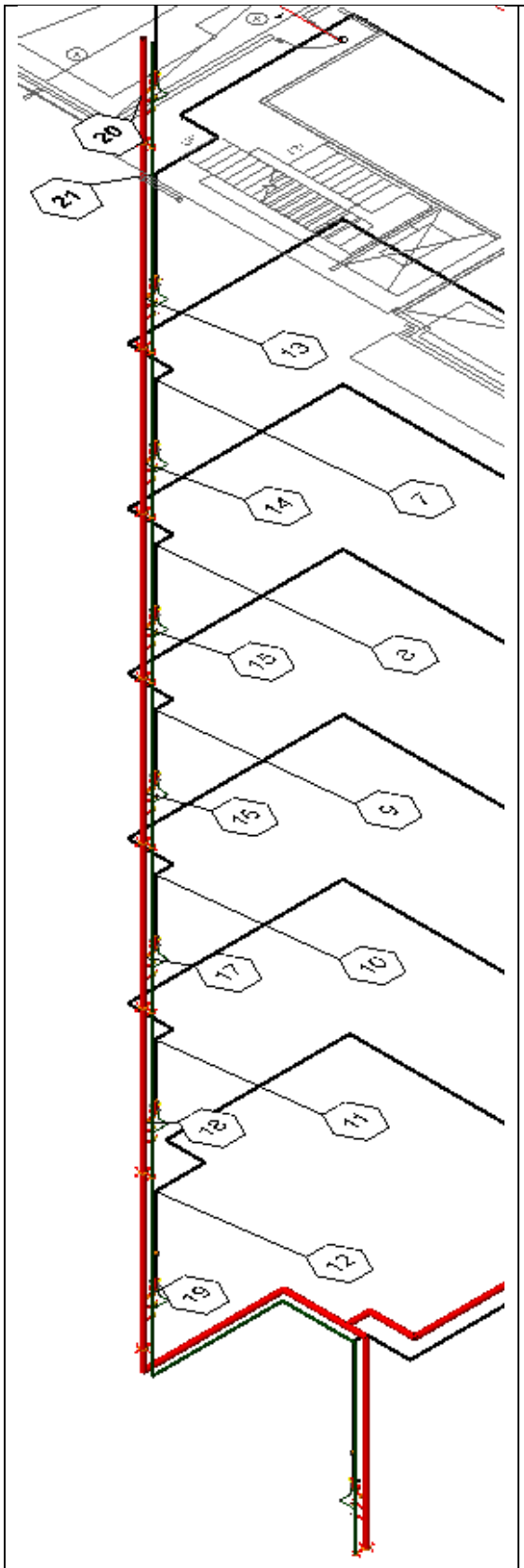

Figure 44: Stair 3 hydraulic nodes

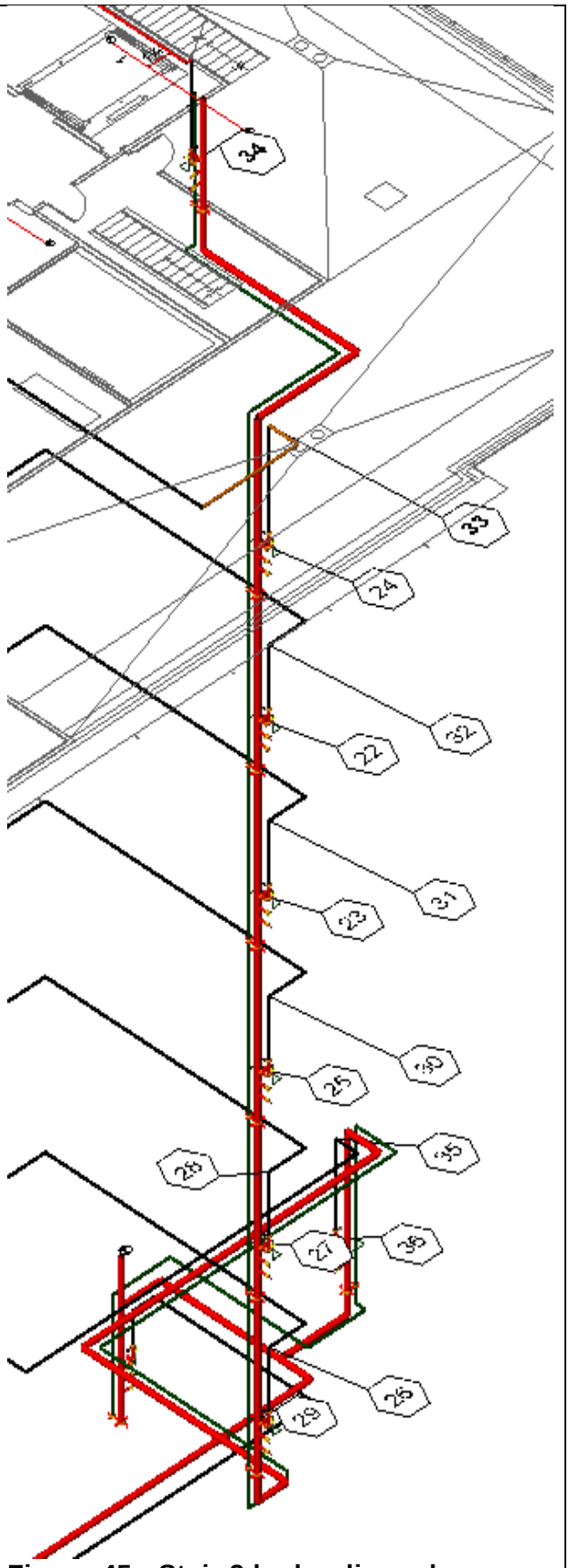

Figure 45 : Stair 2 hydraulic nodes

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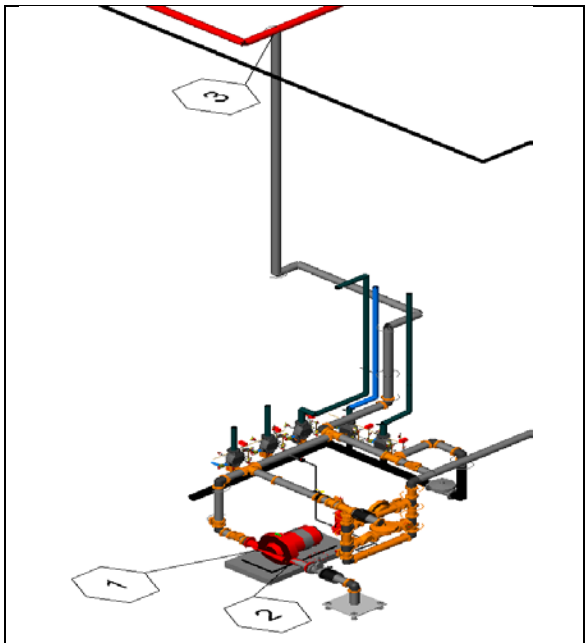


Figure 46: Fire pump hydraulic node

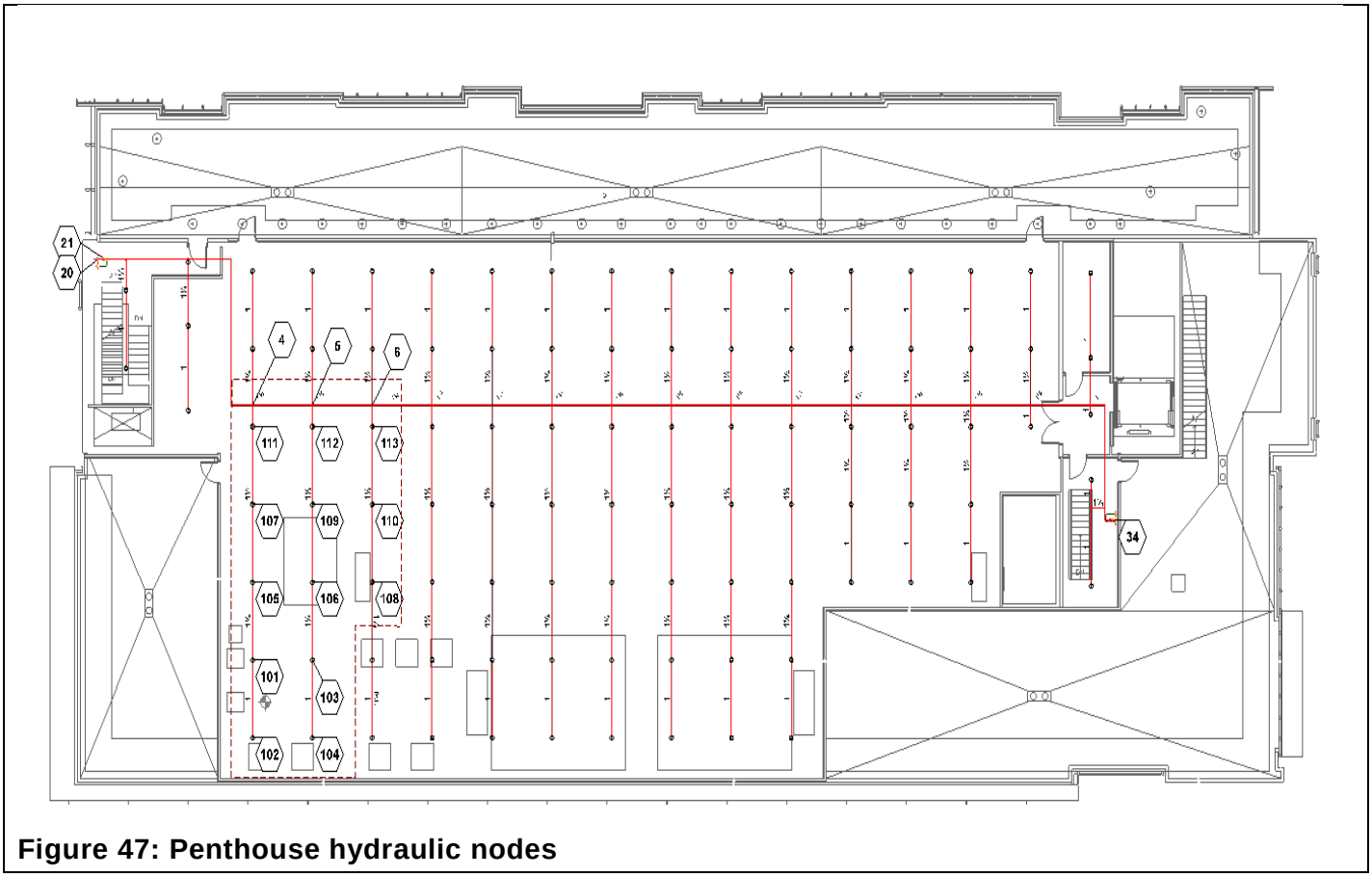


Figure 47: Penthouse hydraulic nodes

Hydraulic Overview

Job

Job Number: FPE 596	Design Engineer: Marge Hong
Job Name: UW Medicine Lake Union Phase 3.1	Phone: / FAX:
Address 1: Seattle,WA	State Certification/License Number:
Address 2:	AHJ: City of Seattle
Address 3:	Job Site/Building:

System

Density: 0.150gpm/ft²	Area of Application: 1500.00ft² (Actual 1508.10ft²)
Most Demanding Sprinkler Data: 5.6 K-Factor 17.32 at 9.571	Hose Streams: 250.00
Coverage Per Sprinkler: 115.50ft²	Number Of Sprinklers Calculated: 13
System Pressure Demand: -44.132	System Flow Demand: 262.94
Total Demand: 512.94 @ -44.132	Pressure Result: +144.235 (144.1%)

Supplies

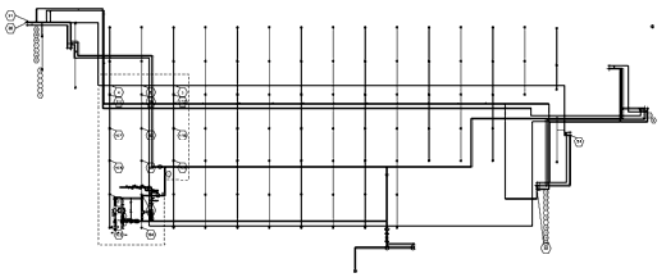
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)
37	Water Supply	1915.00	250.00	102.000	20.000
1		750.00	Pump	245.000	215.000

Pumps: Static = Churn (Pressure @ Zero Flow)

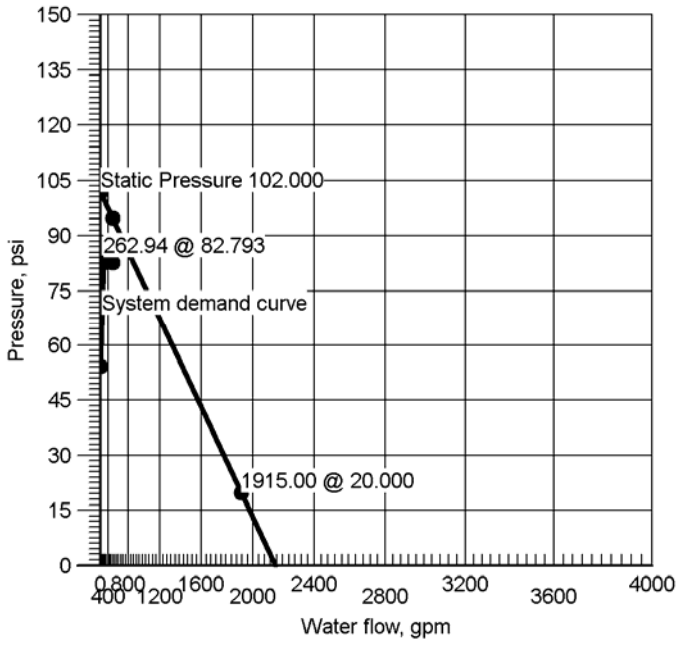
Check Point Gauges

Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)

HYDRAULICS with pump.cad



Water Supply at Node 37 (1915.00, 250.00, 102.000, 20.000)



Hydraulic Summary

Job

Job Number: FPE 596	Design Engineer: Marge Hong
Job Name: UW Medicine Lake Union Phase 3.1	State Certification/License Number:
Address 1: Seattle,WA	AHJ: City of Seattle
Address 2:	Job Site/Building:
Address 3:	Drawing Name: HYDRAULICS with pump.cad

System

Most Demanding Sprinkler Data: 5.6 K-Factor 17.32 at 9.571

Hose Allowance At Source: 250.00

Additional Hose Supplies

Node	Flow(gpm)

Total Hose Streams: 250.00

System Flow Demand	Total Water Required (Including Hose Allowance)
262.94	512.94

Maximum Pressure Unbalance In Loops: 0.000

Maximum Velocity Above Ground: 15.27 between nodes 4 and 111

Maximum Velocity Under Ground	

Volume capacity of Wet Pipes	Volume capacity of Dry Pipes
2895.76gal	

Remote Area(s)

Occupancy	Job Suffix
Ordinary Group I	
Density	**Area of Application**
0.150gpm/ft²	1500.00ft² (Actual 1508.10ft²)
Number Of Sprinklers Calculated	**Coverage Per Sprinkler**
13	115.50ft²

AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area: Right: 76.830

Supplies

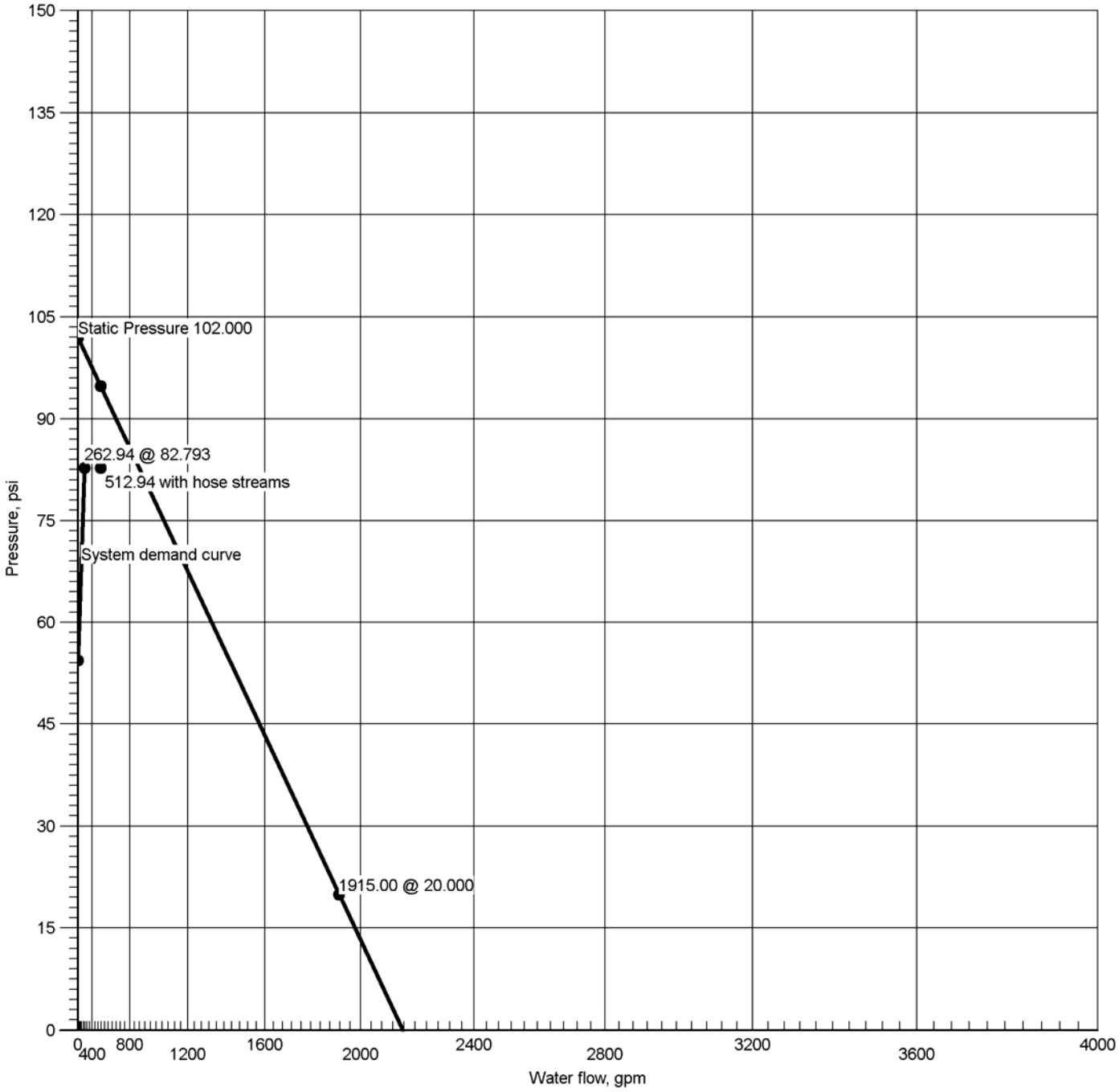
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@ Flow (gpm)	Available (psi)	@ Total Demand (gpm)	Required (psi)	Safety Margin (psi)
37	Water Supply	250.00	102.000	20.000	1915.00	227.029	250.00	82.793	144.235
1		Pump	245.000	215.000	750.00	240.685	262.94	96.450	144.235

Pumps: Static = Churn (Pressure @ Zero Flow)

Contractor

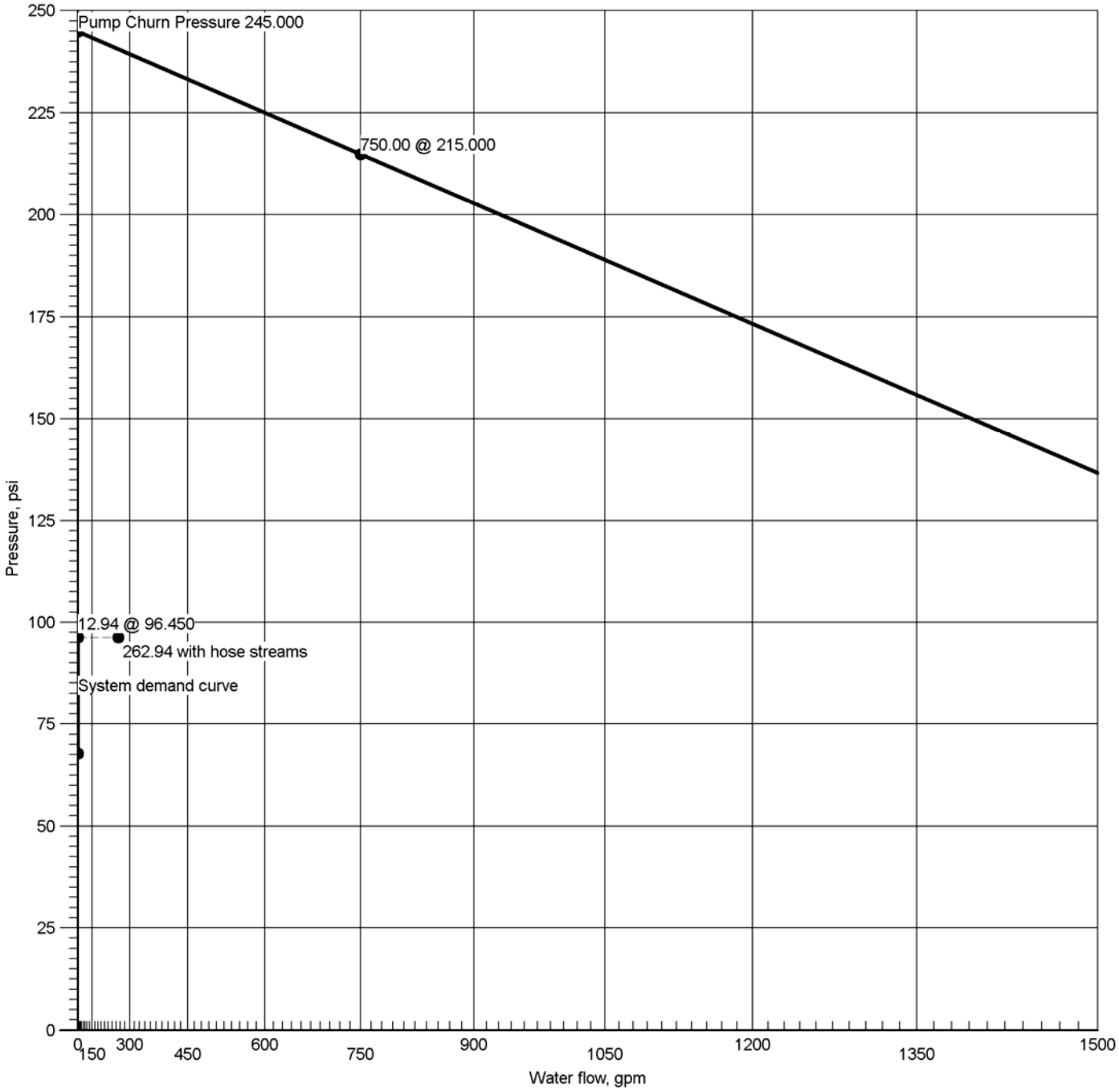
	Contractor Number	Contact Name	Contact Title
Name of Contractor:		Phone	Extension
Address 1		FAX	
Address 2		E-mail	
Address 3		Web-Site	

Water Supply at Node 37



Hydraulic Graph	Water Supply at Node 37
Static: Pressure	102.000
Residual: Pressure	20.000 @ 1915.00
Available Pressure at Time of Test	227.029 @ 250.00
System Demand	-44.132 @ 0.00
System Demand (Including Hose Allowance at Source)	-44.132 @ 250.00

Pump at Node 1



Hydraulic Graph	Static + Churn Pressure	Rated Pump Pressure
Pump at Node 1	245.000	215.000 @ 750.00
Static: Pressure	**Churn Pressure**	
0.000	245.000	
Residual: Pressure		
0.000 @ 0.00		
Available Pressure at Time of Test	**Available Pressure at Pump Discharge**	
0.000 @ 0.00	240.685 @ 262.94	
System Demand		
96.450 @ 262.94		

Summary Of Outflowing Devices

Job Number: FPE 596
Report Description: Ordinary Group I

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
Sprinkler	101	18.34	17.32	5.6	10.728		
Sprinkler	102	17.37	17.32	5.6	9.625		
Sprinkler	103	18.29	17.32	5.6	10.669		
Sprinkler	**104**	**17.32**	**17.32**	**5.6**	**9.571**		
Sprinkler	105	19.26	17.32	5.6	11.828		
Sprinkler	106	19.21	17.32	5.6	11.764		
Sprinkler	107	20.18	17.32	5.6	12.982		
Sprinkler	108	22.87	17.32	5.6	16.674		
Sprinkler	109	20.12	17.32	5.6	12.912		
Sprinkler	110	23.02	17.32	5.6	16.902		
Sprinkler	111	21.72	17.32	5.6	15.039		
Sprinkler	112	21.66	17.32	5.6	14.958		
Sprinkler	113	23.58	17.32	5.6	17.728		

⇨ Most Demanding Sprinkler Data

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
101	178'-0	Spr(-10.728)	10.728	18.34	
102	178'-0	Spr(-9.625)	9.625	17.37	
103	178'-0	Spr(-10.669)	10.669	18.29	
104	178'-0	Spr(-9.571)	9.571	17.32	
105	178'-0	Spr(-11.828)	11.828	19.26	
106	178'-0	Spr(-11.764)	11.764	19.21	
107	178'-0	Spr(-12.982)	12.982	20.18	
108	178'-0	Spr(-16.674)	16.674	22.87	
109	178'-0	Spr(-12.912)	12.912	20.12	
110	178'-0	Spr(-16.902)	16.902	23.02	
111	178'-0	Spr(-15.039)	15.039	21.72	
112	178'-0	Spr(-14.958)	14.958	21.66	
113	178'-0	Spr(-17.728)	17.728	23.58	
1	21'-4	P2(-240.685)	96.450		
3	56'-0	T(37'-8¾)	80.826		
4	177'-0	PO(8'-0)	21.456		
5	177'-0	PO(8'-0)	21.344		
6	177'-0	PO(8'-0)	21.396		
7	142'-5¾	E(9'-5)	43.044		
8	127'-11¾	E(9'-5)	49.341		
9	113'-5¾	E(9'-5)	55.639		
10	98'-11¾	E(9'-5)	61.936		
11	84'-5¾	E(9'-5)	68.233		
12	71'-1¾	E(9'-5)	74.039		
13	150'-4	PO(16'-5¾)	39.632		
14	135'-10	PO(16'-5¾)	45.929		
15	121'-4	PO(16'-5¾)	52.227		
16	106'-10	PO(16'-5¾)	58.525		
17	92'-4	PO(16'-5¾)	64.823		
18	77'-10	PO(16'-5¾)	71.121		
19	62'-4	PO(16'-5¾)	77.855		
20	168'-4	PO(16'-5¾)	31.810		
21	160'-7¼	E(9'-5)	35.182		
22	135'-10	PO(16'-5¾)	45.936		
23	121'-4	PO(16'-5¾)	52.230		
24	150'-4	PO(16'-5¾)	39.645		
25	106'-10	PO(16'-5¾)	58.523		
26	84'-5¾	E(9'-5)	68.226		
27	92'-4	PO(16'-5¾)	64.817		
28	98'-11¾	E(9'-5)	61.932		
29	77'-10	PO(16'-5¾)	71.110		
30	113'-5¾	E(9'-5)	55.637		
31	127'-11¾	E(9'-5)	49.343		
32	142'-5¾	E(9'-5)	43.049		
33	160'-7¼	E(9'-5)	35.190		
34	168'-4	PO(16'-5¾)	31.793		
35	71'-1¾	E(9'-5)	74.071		
36	62'-4	PO(16'-5¾)	77.905		

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
• • • • • Route 1 • • • • •							
BL	1.0490	17.32	6.43	120	0.099775	11'-0	**Pf** 1.098
104	178'-0	17.32	5.6	9.571	Sprinkler		**Pe**
103	178'-0			10.669		11'-0	**Pv**
BL	1.3800	35.62	7.64	120	0.099539	11'-0	**Pf** 1.095
103	178'-0	18.29	5.6	10.669	Sprinkler		**Pe**
106	178'-0			11.764		11'-0	**Pv**
BL	1.6100	54.82	8.64	120	0.104351	11'-0	**Pf** 1.148
106	178'-0	19.21	5.6	11.764	Sprinkler		**Pe**
109	178'-0			12.912		11'-0	**Pv**
BL	1.6100	74.95	11.81	120	0.186077	11'-0	**Pf** 2.047
109	178'-0	20.12	5.6	12.912	Sprinkler		**Pe**
112	178'-0			14.958		11'-0	**Pv**
BL	1.6100	96.60	15.22	120	0.297615	4'-0	**Pf** 5.952
112	178'-0	21.66	5.6	14.958	Sprinkler,	16'-0	**Pe** 0.434
5	177'-0			21.344	T(8'-0), PO(8'-0)	20'-0	**Pv**
CM	2.6350	58.24	3.43	120	0.010596	10'-6	**Pf** 0.111
5	177'-0			21.344			**Pe**
4	177'-0			21.456		10'-6	**Pv**
CM	2.6350	155.11	9.13	120	0.064884	56'-2¼	**Pf** 6.597
4	177'-0	96.87		21.456	Flow (q) from Route 2	45'-5¾	**Pe** 3.757
20	168'-4			31.810	3E(8'-2¾), fE(4'-3½), PO(16'-5¾)	101'-8	**Pv**
ST	6.3570	155.11	1.57	120	0.000890	18'-0	**Pf** 0.016
20	168'-4			31.810			**Pe** 7.807
13	150'-4			39.632		18'-0	**Pv**
ST	6.3570	151.33	1.53	120	0.000851	14'-6	**Pf** 0.012
13	150'-4			39.632			**Pe** 6.284
14	135'-10			45.929		14'-6	**Pv**
ST	6.3570	148.44	1.50	120	0.000821	14'-6	**Pf** 0.012
14	135'-10			45.929			**Pe** 6.286
15	121'-4			52.227		14'-6	**Pv**
ST	6.3570	146.83	1.48	120	0.000804	14'-6	**Pf** 0.012
15	121'-4			52.227			**Pe** 6.286
16	106'-10			58.525		14'-6	**Pv**
ST	6.3570	148.22	1.50	120	0.000818	14'-6	**Pf** 0.012
16	106'-10	1.39		58.525	Flow (q) from Route 6		**Pe** 6.286
17	92'-4			64.823		14'-6	**Pv**
ST	6.3570	150.97	1.53	120	0.000847	14'-6	**Pf** 0.012
17	92'-4	2.74		64.823	Flow (q) from Route 5		**Pe** 6.286
18	77'-10			71.121		14'-6	**Pv**
ST	6.3570	154.77	1.56	120	0.000887	15'-6	**Pf** 0.014
18	77'-10	3.81		71.121	Flow (q) from Route 4		**Pe** 6.720
19	62'-4			77.855		15'-6	**Pv**
ST	6.3570	146.56	1.48	120	0.000802	97'-7¼	**Pf** 0.223
19	62'-4			77.855		181'-0¾	**Pe** 2.748
3	56'-0			80.826	6E(17'-7¼), 2T(37'-8¾)	278'-8	**Pv**
FM	6.3570	262.94	2.66	120	0.002364	65'-11¾	**Pf** 0.596
3	56'-0	116.38		80.826	Flow (q) from Route 3	186'-1	**Pe** 15.028
1	21'-4			96.450	7E(17'-7¼), T(37'-8¾), BV(12'-7), fE(12'-7)	252'-0¾	**Pv**
Pump			**Velocity**				
1		262.94		96.450	Rating: 215.000 @ 750.00		
2		Q=262.94	2.66	-144.235	Churn Pressure: 245.000		
		250.00			Hose Allowance At Source		
2		512.94					
• • • • • Route 2 • • • • •							
BL	1.0490	17.37	6.45	120	0.100290	11'-0	**Pf** 1.103
102	178'-0	17.37	5.6	9.625	Sprinkler		**Pe**
101	178'-0			10.728		11'-0	**Pv**
BL	1.3800	35.72	7.66	120	0.100051	11'-0	**Pf** 1.101
101	178'-0	18.34	5.6	10.728	Sprinkler		**Pe**
105	178'-0			11.828		11'-0	**Pv**
BL	1.6100	54.97	8.66	120	0.104886	11'-0	**Pf** 1.154
105	178'-0	19.26	5.6	11.828	Sprinkler		**Pe**
107	178'-0			12.982		11'-0	**Pv**
BL	1.6100	75.15	11.84	120	0.187027	11'-0	**Pf** 2.057
107	178'-0	20.18	5.6	12.982	Sprinkler		**Pe**
111	178'-0			15.039		11'-0	**Pv**
BL	1.6100	96.87	15.27	120	0.299128	4'-0	**Pf** 5.983
111	178'-0	21.72	5.6	15.039	Sprinkler,	16'-0	**Pe** 0.434
4	177'-0			21.456	T(8'-0), PO(8'-0)	20'-0	**Pv**
• • • • • Route 3 • • • • •							

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
BL	1.6100	22.87	3.60	120	0.020699	11'-0	Pf 0.228
108	178'-0	22.87	5.6	16.674	Sprinkler		Pe
110	178'-0			16.902		11'-0	Pv
BL	1.6100	45.89	7.23	120	0.075091	11'-0	Pf 0.826
110	178'-0	23.02	5.6	16.902	Sprinkler		Pe
113	178'-0			17.728		11'-0	Pv
BL	1.6100	69.47	10.95	120	0.161704	4'-0	Pf 3.234
113	178'-0	23.58	5.6	17.728	Sprinkler,	16'-0	Pe 0.434
6	177'-0			21.396	T(8'-0), PO(8'-0)	20'-0	Pv
CM	2.6350	107.83	6.34	120	0.033116	155'-0½	Pf 6.640
6	177'-0	38.36		21.396	Flow (q) from Route 11	45'-5¾	Pe 3.757
34	168'-4			31.793	3E(8'-2¾), fE(4'-3½), PO(16'-5¾)	200'-6¼	Pv
ST	6.3570	107.83	1.09	120	0.000454	45'-7¾	Pf 0.045
34	168'-4			31.793		52'-9¾	Pe 7.807
24	150'-4			39.645	3E(17'-7¼)	98'-5½	Pv
ST	6.3570	111.61	1.13	120	0.000484	14'-6	Pf 0.007
24	150'-4	3.78		39.645	Flow (q) from Route 10		Pe 6.284
22	135'-10			45.936		14'-6	Pv
ST	6.3570	114.50	1.16	120	0.000508	14'-6	Pf 0.007
22	135'-10	2.89		45.936	Flow (q) from Route 9		Pe 6.286
23	121'-4			52.230		14'-6	Pv
ST	6.3570	116.11	1.17	120	0.000521	14'-6	Pf 0.008
23	121'-4	1.61		52.230	Flow (q) from Route 7		Pe 6.286
25	106'-10			58.523		14'-6	Pv
ST	6.3570	114.72	1.16	120	0.000510	14'-6	Pf 0.007
25	106'-10			58.523			Pe 6.286
27	92'-4			64.817		14'-6	Pv
ST	6.3570	111.98	1.13	120	0.000487	14'-6	Pf 0.007
27	92'-4			64.817			Pe 6.286
29	77'-10			71.110		14'-6	Pv
ST	6.3570	108.17	1.09	120	0.000457	76'-6¾	Pf 0.075
29	77'-10			71.110		88'-0¼	Pe 6.720
36	62'-4			77.905	5E(17'-7¼)	164'-7	Pv
ST	6.3570	116.38	1.18	120	0.000523	185'-5½	Pf 0.173
36	62'-4	8.22		77.905	Flow (q) from Route 8	145'-10¼	Pe 2.748
3	56'-0			80.826	4E(17'-7¼), 2T(37'-8¾)	331'-3½	Pv
• • • • • Route 4 • • • • •							
MS	2.6350	3.81	0.22	120	0.000068	7'-8	Pf 0.002
29	77'-10			71.110	PO(16'-5¾)	20'-9¼	Pe -2.886
26	84'-5¾			68.226	fE(4'-3½)	28'-5	Pv
CM	3.2600	3.81	0.15	120	0.000024	238'-3½	Pf 0.008
26	84'-5¾			68.226	E(9'-5)	75'-3¼	Pe
11	84'-5¾			68.233	7E(9'-5)	313'-6¾	Pv
FM	2.6350	3.81	0.22	120	0.000068	7'-8	Pf 0.002
11	84'-5¾			68.233		20'-9¼	Pe 2.886
18	77'-10			71.121	fE(4'-3½), PO(16'-5¾)	28'-5	Pv
• • • • • Route 5 • • • • •							
MS	2.6350	2.74	0.16	120	0.000037	7'-8	Pf 0.001
27	92'-4			64.817	PO(16'-5¾)	20'-9¼	Pe -2.886
28	98'-11¾			61.932	fE(4'-3½)	28'-5	Pv
CM	3.2600	2.74	0.11	120	0.000013	238'-3½	Pf 0.004
28	98'-11¾			61.932	E(9'-5)	75'-3¼	Pe
10	98'-11¾			61.936	7E(9'-5)	313'-6¾	Pv
FM	2.6350	2.74	0.16	120	0.000037	7'-8	Pf 0.001
10	98'-11¾			61.936		20'-9¼	Pe 2.886
17	92'-4			64.823	fE(4'-3½), PO(16'-5¾)	28'-5	Pv
• • • • • Route 6 • • • • •							
MS	2.6350	1.39	0.08	120	0.000011	7'-8	Pf 0.000
25	106'-10			58.523	PO(16'-5¾)	20'-9¼	Pe -2.886
30	113'-5¾			55.637	fE(4'-3½)	28'-5	Pv
CM	3.2600	1.39	0.05	120	0.000004	238'-3½	Pf 0.001
30	113'-5¾			55.637	E(9'-5)	75'-3¼	Pe
9	113'-5¾			55.639	7E(9'-5)	313'-6¾	Pv
FM	2.6350	1.39	0.08	120	0.000011	7'-8	Pf 0.000
9	113'-5¾			55.639		20'-9¼	Pe 2.886
16	106'-10			58.525	fE(4'-3½), PO(16'-5¾)	28'-5	Pv
• • • • • Route 7 • • • • •							
MS	2.6350	1.61	0.09	120	0.000014	7'-8	Pf 0.000
15	121'-4			52.227	PO(16'-5¾)	20'-9¼	Pe -2.886
8	127'-11¾			49.341	fE(4'-3½)	28'-5	Pv
CM	3.2600	1.61	0.06	120	0.000005	238'-3½	Pf 0.002
8	127'-11¾			49.341	E(9'-5)	75'-3¼	Pe
31	127'-11¾			49.343	7E(9'-5)	313'-6¾	Pv

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt	Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
FM	2.6350	1.61	0.09	120		0.000014	7'-8	Pf 0.000
31	127'-11¾			49.343			20'-9¼	Pe 2.886
23	121'-4			52.230		fE(4'-3½), PO(16'-5¾)	28'-5	Pv
• • • • • Route 8 • • • • •								
MS	2.6350	8.22	0.48	120		0.000283	9'-10	Pf 0.009
19	62'-4			77.855		PO(16'-5¾)	20'-9¼	Pe -3.825
12	71'-1¾			74.039		fE(4'-3½)	30'-7	Pv
CM	3.2600	8.22	0.32	120		0.000100	241'-3¼	Pf 0.033
12	71'-1¾			74.039		E(9'-5)	84'-8	Pe
35	71'-1¾			74.071		8E(9'-5)	325'-11¼	Pv
FM	2.6350	8.22	0.48	120		0.000283	9'-10	Pf 0.009
35	71'-1¾			74.071			20'-9¼	Pe 3.825
36	62'-4			77.905		fE(4'-3½), PO(16'-5¾)	30'-7	Pv
• • • • • Route 9 • • • • •								
MS	2.6350	2.89	0.17	120		0.000041	7'-8	Pf 0.001
14	135'-10			45.929		PO(16'-5¾)	20'-9¼	Pe -2.886
7	142'-5¾			43.044		fE(4'-3½)	28'-5	Pv
CM	3.2600	2.89	0.11	120		0.000015	238'-3½	Pf 0.005
7	142'-5¾			43.044		E(9'-5)	75'-3¼	Pe
32	142'-5¾			43.049		7E(9'-5)	313'-6¾	Pv
FM	2.6350	2.89	0.17	120		0.000041	7'-8	Pf 0.001
32	142'-5¾			43.049			20'-9¼	Pe 2.886
22	135'-10			45.936		fE(4'-3½), PO(16'-5¾)	28'-5	Pv
• • • • • Route 10 • • • • •								
MS	2.6350	3.78	0.22	120		0.000067	11'-3¼	Pf 0.002
13	150'-4			39.632		PO(16'-5¾)	20'-9¼	Pe -4.453
21	160'-7¼			35.182		fE(4'-3½)	32'-0½	Pv
CM	3.2600	3.78	0.15	120		0.000024	235'-4¾	Pf 0.008
21	160'-7¼			35.182		E(9'-5)	95'-5	Pe
33	160'-7¼			35.190		7E(9'-5), PO(20'-2)	330'-10	Pv
FM	2.6350	3.78	0.22	120		0.000067	11'-3¼	Pf 0.002
33	160'-7¼			35.190			20'-9¼	Pe 4.453
24	150'-4			39.645		fE(4'-3½), PO(16'-5¾)	32'-0½	Pv
• • • • • Route 11 • • • • •								
CM	2.6350	38.36	2.26	120		0.004894	10'-6	Pf 0.051
5	177'-0			21.344				Pe
6	177'-0			21.396			10'-6	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}}\right)^{4.87} = \text{Factor}$$

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend

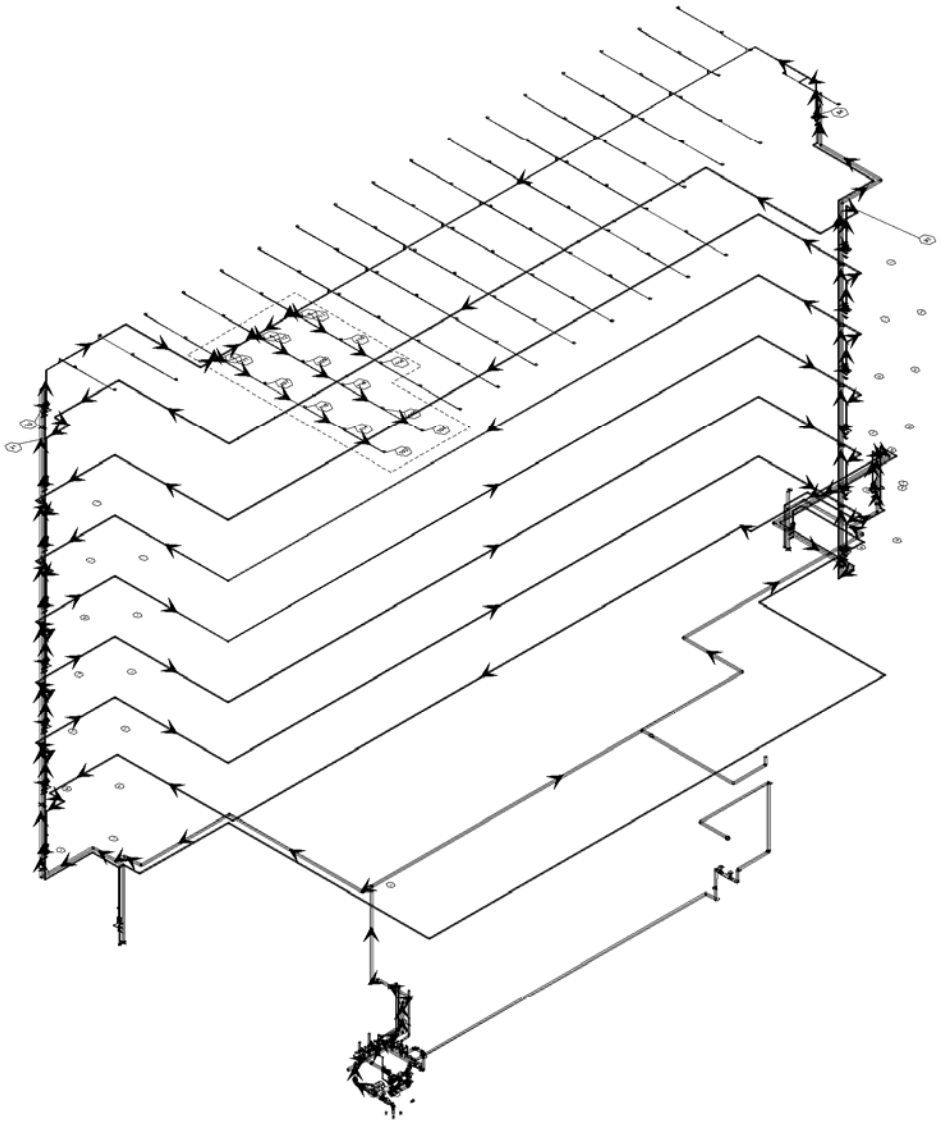
AO	Arm-Over
BL	Branch Line
CM	Cross Main
DN	Drain
DR	Drop
DY	Dynamic
FM	Feed Main
FR	Feed Riser
MS	Miscellaneous
OR	Outrigger
RN	Riser Nipple
SP	Sprig
ST	Stand Pipe
UG	Underground

Units Legend

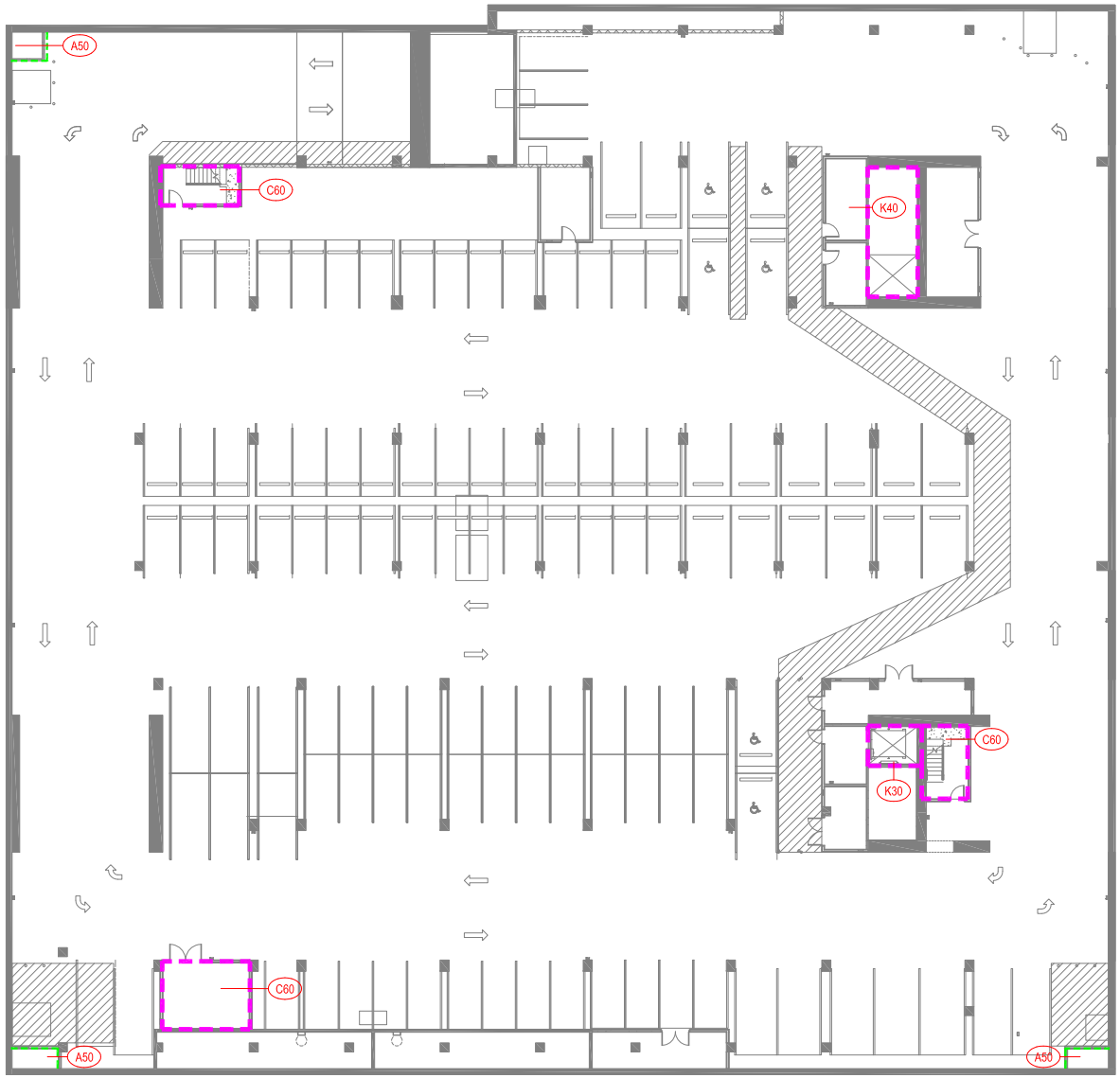
Diameter	Inch
Elevation	Foot
Flow	gpm
Discharge	gpm
Velocity	fps
Pressure	psi
Length	Foot
Friction Loss	psi/Foot
HWC	Hazen-Williams Constant
Pt	Total pressure at a point in a pipe
Pn	Normal pressure at a point in a pipe
Pf	Pressure loss due to friction between points
Pe	Pressure due to elevation difference between indicated points
Pv	Velocity pressure at a point in a pipe

Fittings Legend

ALV	Alarm Valve
AngV	Angle Valve
b	Bushing
BalV	Ball Valve
BFP	Backflow Preventer
BV	Butterfly Valve
C	Cross Flow Turn 90°
cplg	Coupling
Cr	Cross Run
CV	Check Valve
DelV	Deluge Valve
DPV	Dry Pipe Valve
E	90° Elbow
EE	45° Elbow
Ee1	11¼° Elbow
Ee2	22½° Elbow
f	Flow Device
fd	Flex Drop
FDC	Fire Department Connection
fE	90° FireLock(TM) Elbow
fEE	45° FireLock(TM) Elbow
flg	Flange
FN	Floating Node
fT	FireLock(TM) Tee
g	Gauge
GloV	Globe Valve
GV	Gate Valve
Ho	Hose
Hose	Hose
HV	Hose Valve
Hyd	Hydrant
LtE	Long Turn Elbow
mecT	Mechanical Tee
Noz	Nozzle
P1	Pump In
P2	Pump Out
PIV	Post Indicating Valve
PO	Pipe Outlet
PRV	Pressure Reducing Valve
PrV	Pressure Relief Valve
red	Reducer/Adapter
S	Supply
sCV	Swing Check Valve
Spr	Sprinkler
St	Strainer
T	Tee Flow Turn 90°
Tr	Tee Run
U	Union
WirF	Wirsbo
WMV	Water Meter Valve
Z	Cap



Appendix F: Wall Types



LEGENDS AND SYMBOLS

- CONTROL ZONE BOUNDARY (1-HOUR)
- 1-HOUR WALL ASSEMBLY
- 2-HOUR CEILING ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- XXX — WALL TYPE

WALL ASSEMBLY - BASEMENT LEVEL 3

SCALE : NTS

N

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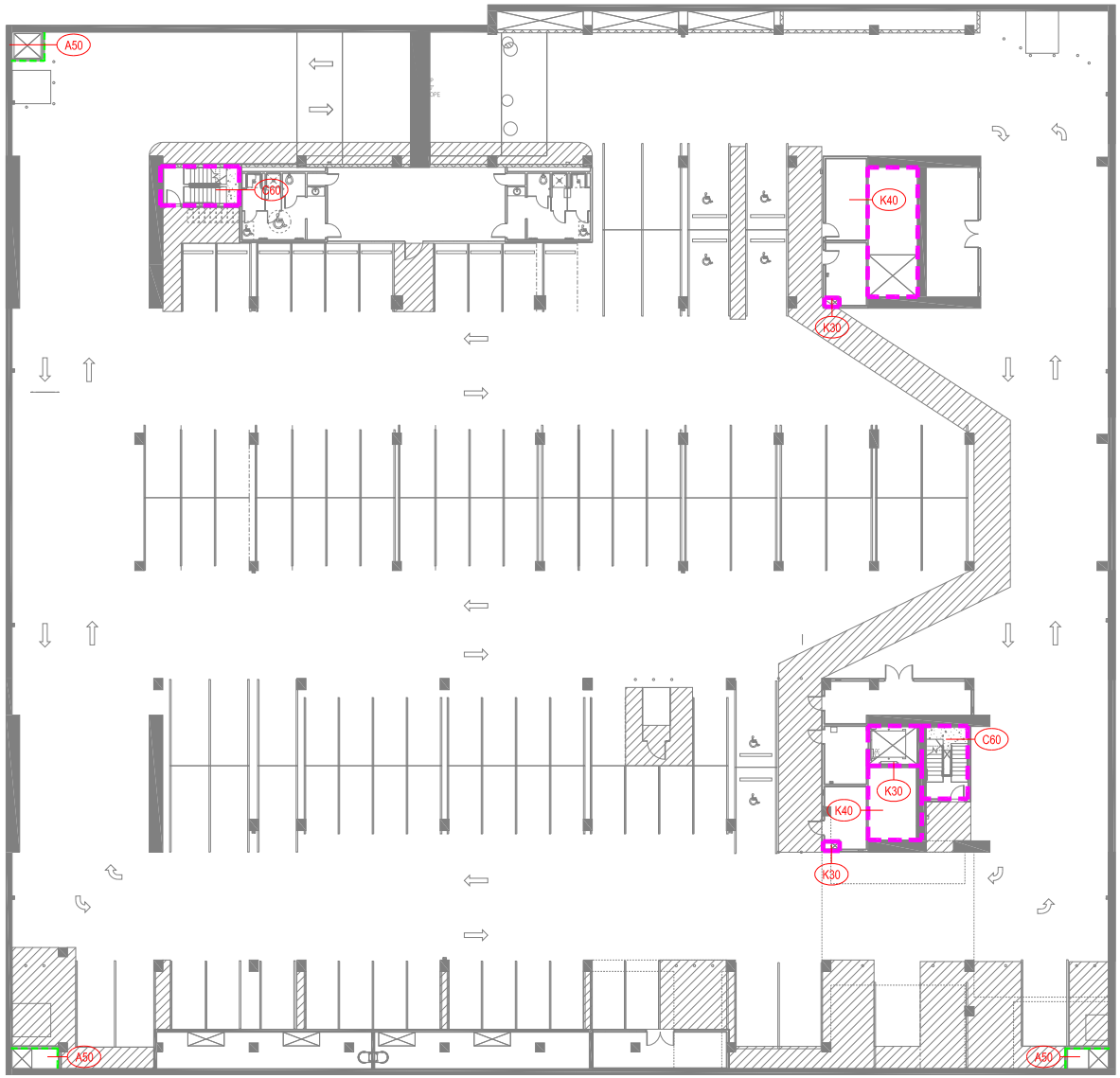
Fire Protection Engineering



LEGENDS AND SYMBOLS

- CONTROL ZONE BOUNDARY (1-HOUR)
- 1-HOUR WALL ASSEMBLY
- 2-HOUR CEILING ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- XXX — WALL TYPE

WALL ASSEMBLY - BASEMENT LEVEL 2

SCALE : NTS

N

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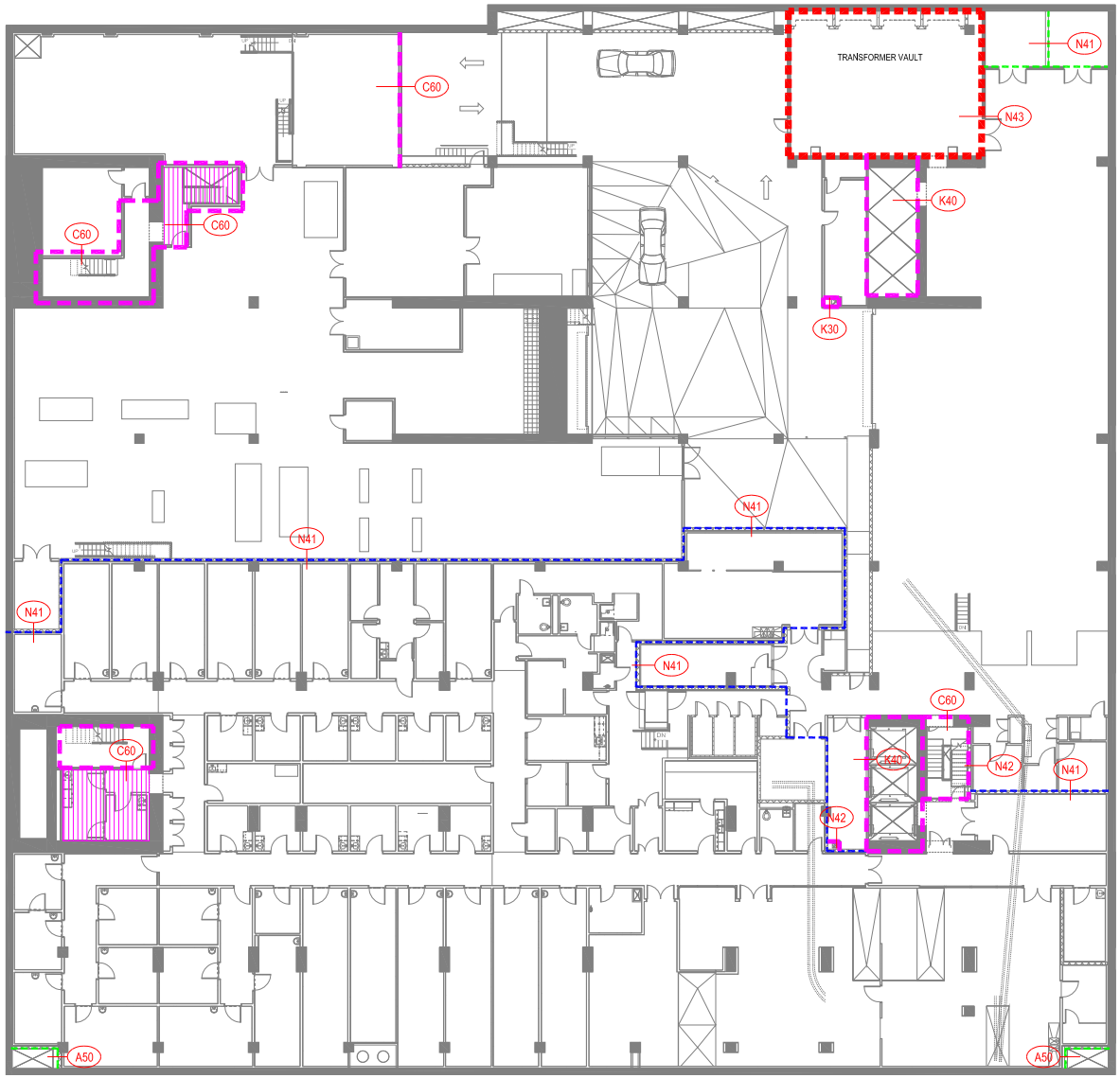

LEGENDS AND SYMBOLS

- CONTROL ZONE BOUNDARY (1-HOUR)
- 1-HOUR WALL ASSEMBLY
- 2-HOUR CEILING ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- XXX — WALL TYPE

WALL ASSEMBLY - BASEMENT LEVEL 1

SCALE : NTS

N

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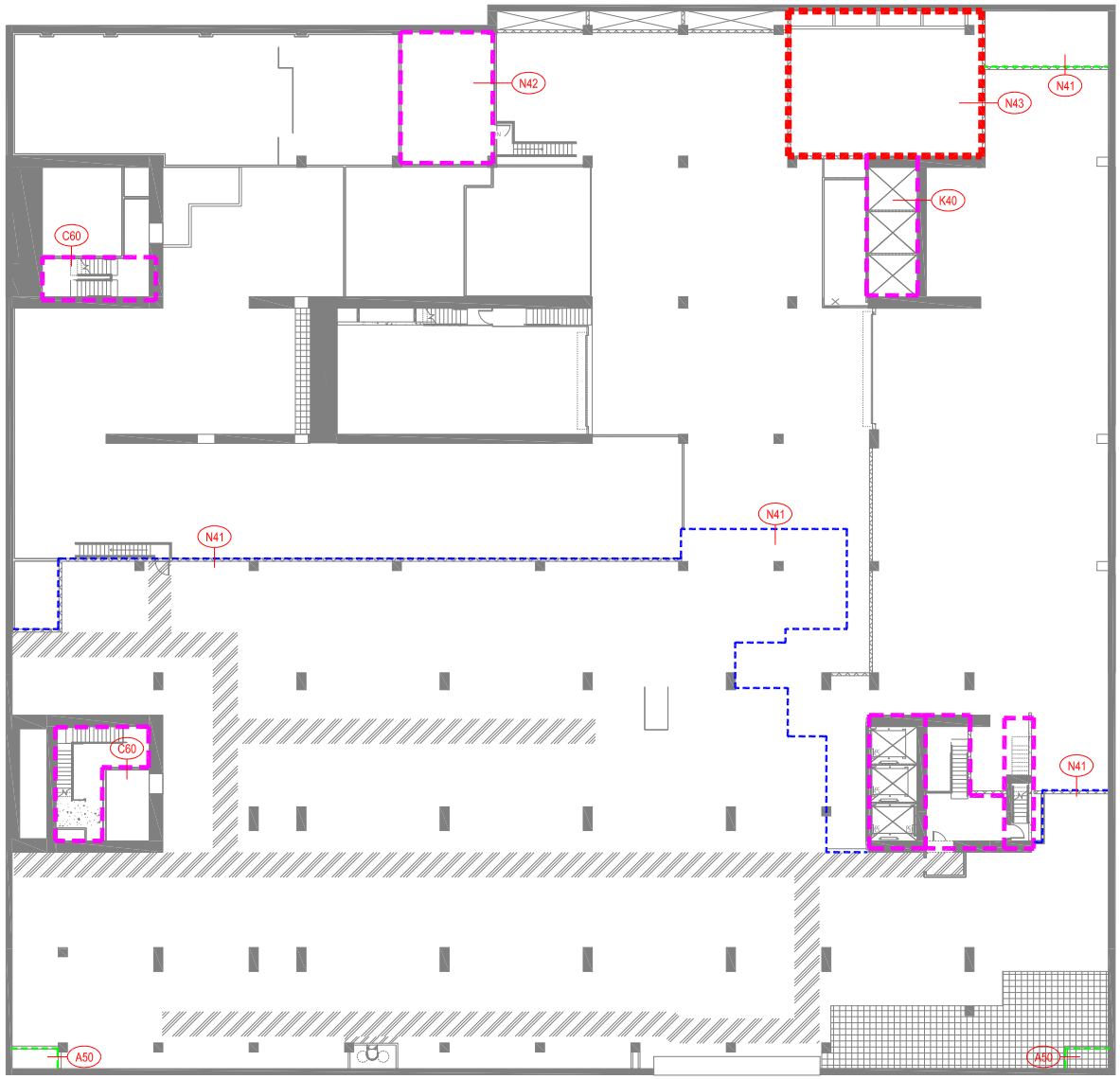

LEGENDS AND SYMBOLS

- CONTROL ZONE BOUNDARY (1-HOUR)
- 1-HOUR WALL ASSEMBLY
- 2-HOUR CEILING ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- XXX — WALL TYPE

WALL ASSEMBLY - BASEMENT LEVEL 1S

SCALE : NTS

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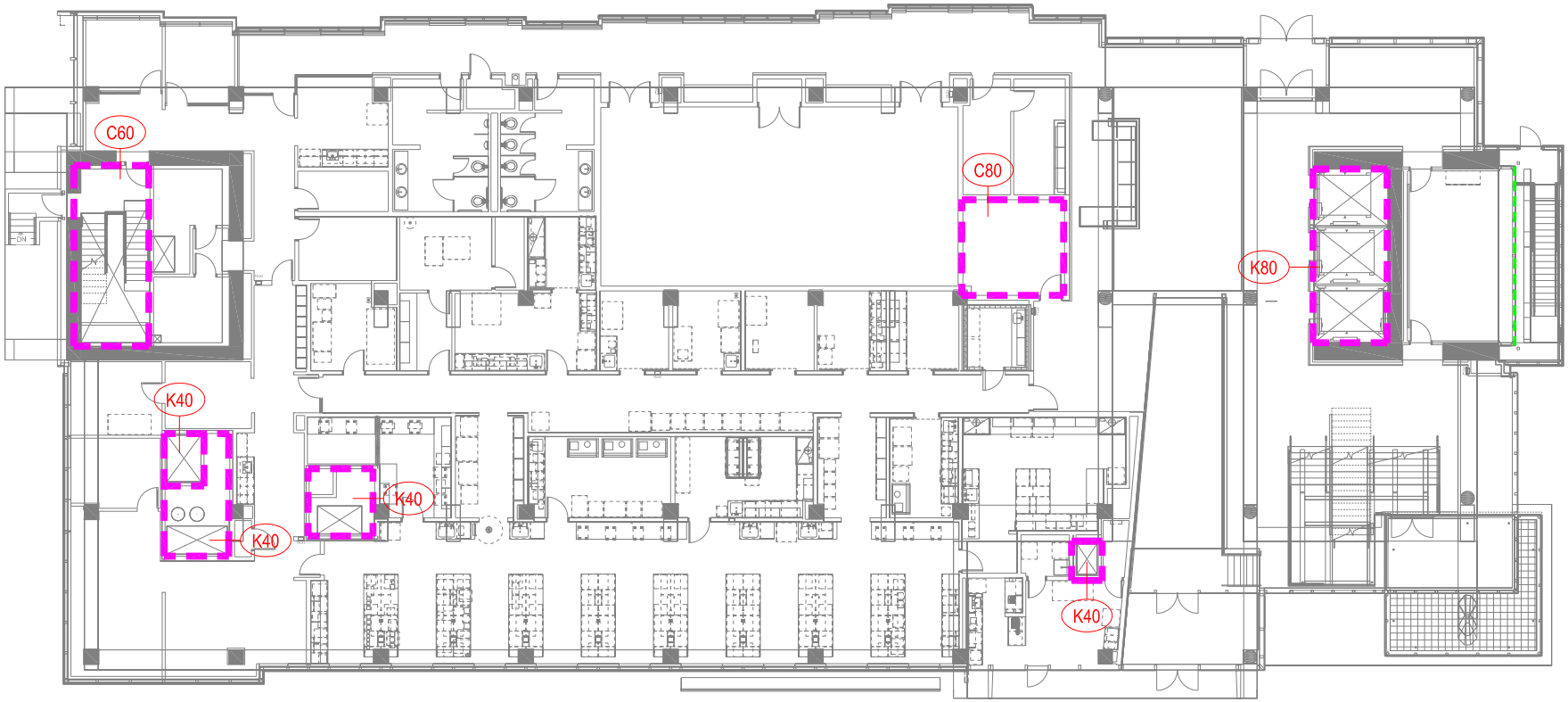

LEGENDS AND SYMBOLS

- CONTROL ZONE BOUNDARY (1-HOUR)
- 1-HOUR WALL ASSEMBLY
- 2-HOUR CEILING ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- XXX — WALL TYPE

WALL ASSEMBLY - LEVEL 1

SCALE : NTS

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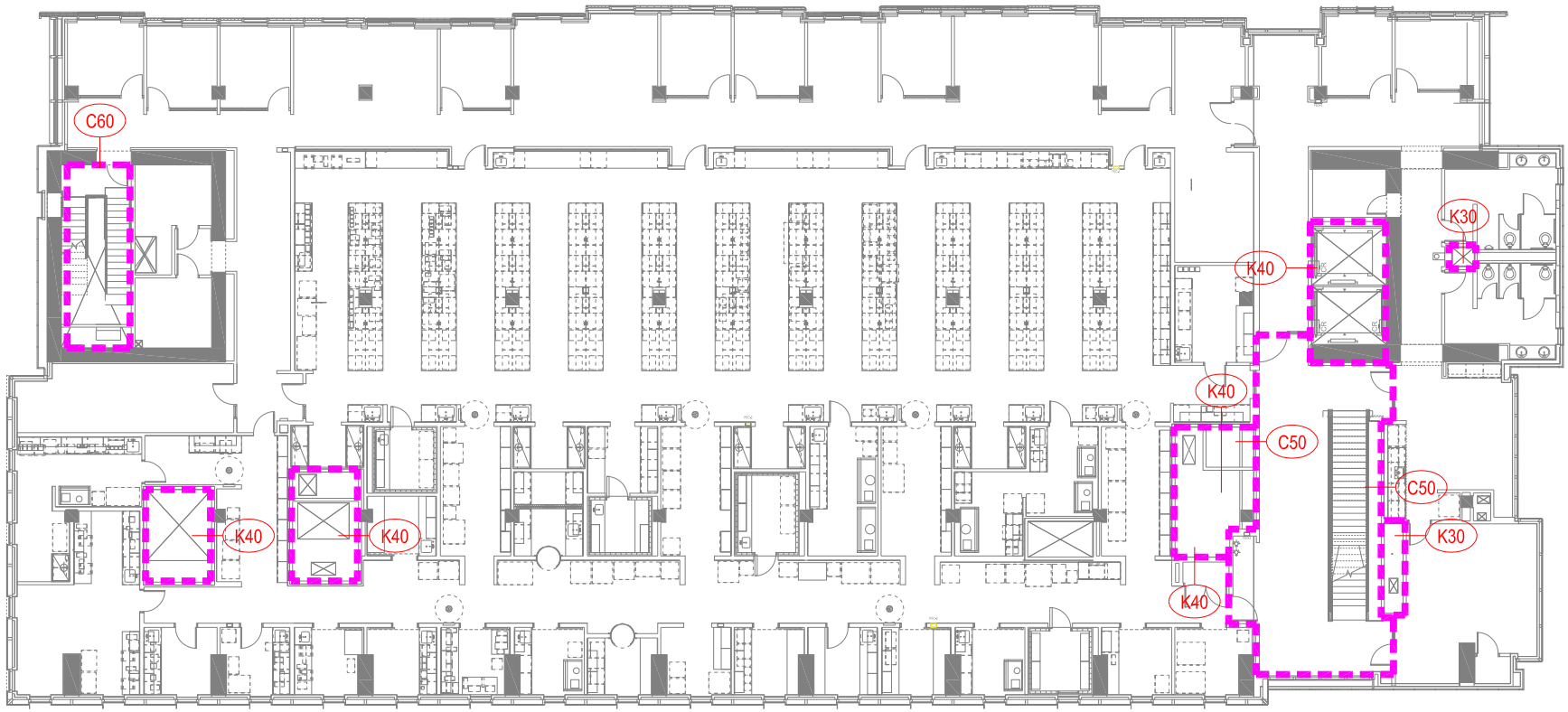

LEGENDS AND SYMBOLS

- CONTROL ZONE BOUNDARY (1-HOUR)
- 1-HOUR WALL ASSEMBLY
- 2-HOUR CEILING ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- XXX — WALL TYPE

WALL ASSEMBLY - LEVEL 2 (SIMILAR FOR LEVEL 3-6)

SCALE : NTS

N

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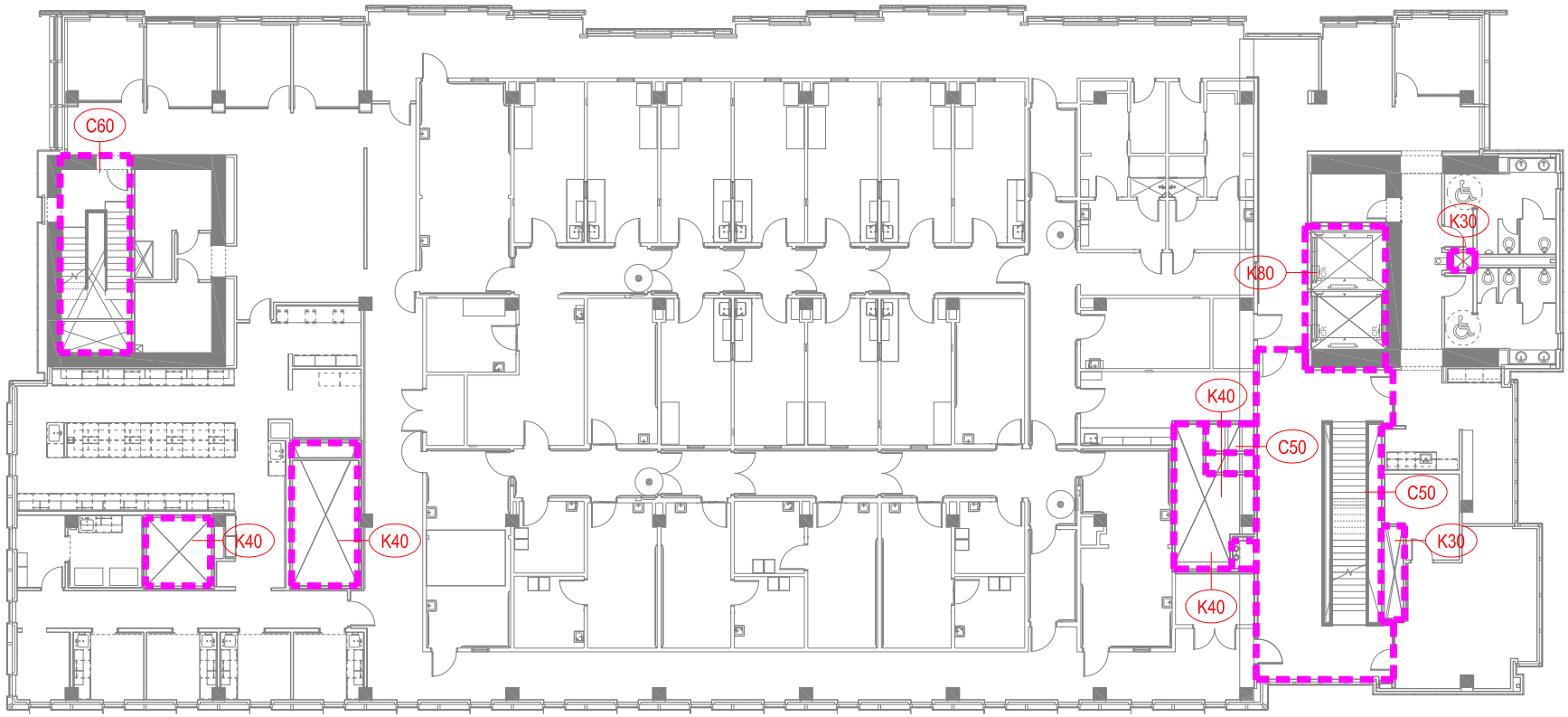

LEGENDS AND SYMBOLS

- CONTROL ZONE BOUNDARY (1-HOUR)
- 1-HOUR WALL ASSEMBLY
- 2-HOUR CEILING ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- XXX — WALL TYPE

WALL ASSEMBLY - LEVEL 7

SCALE : NTS

N

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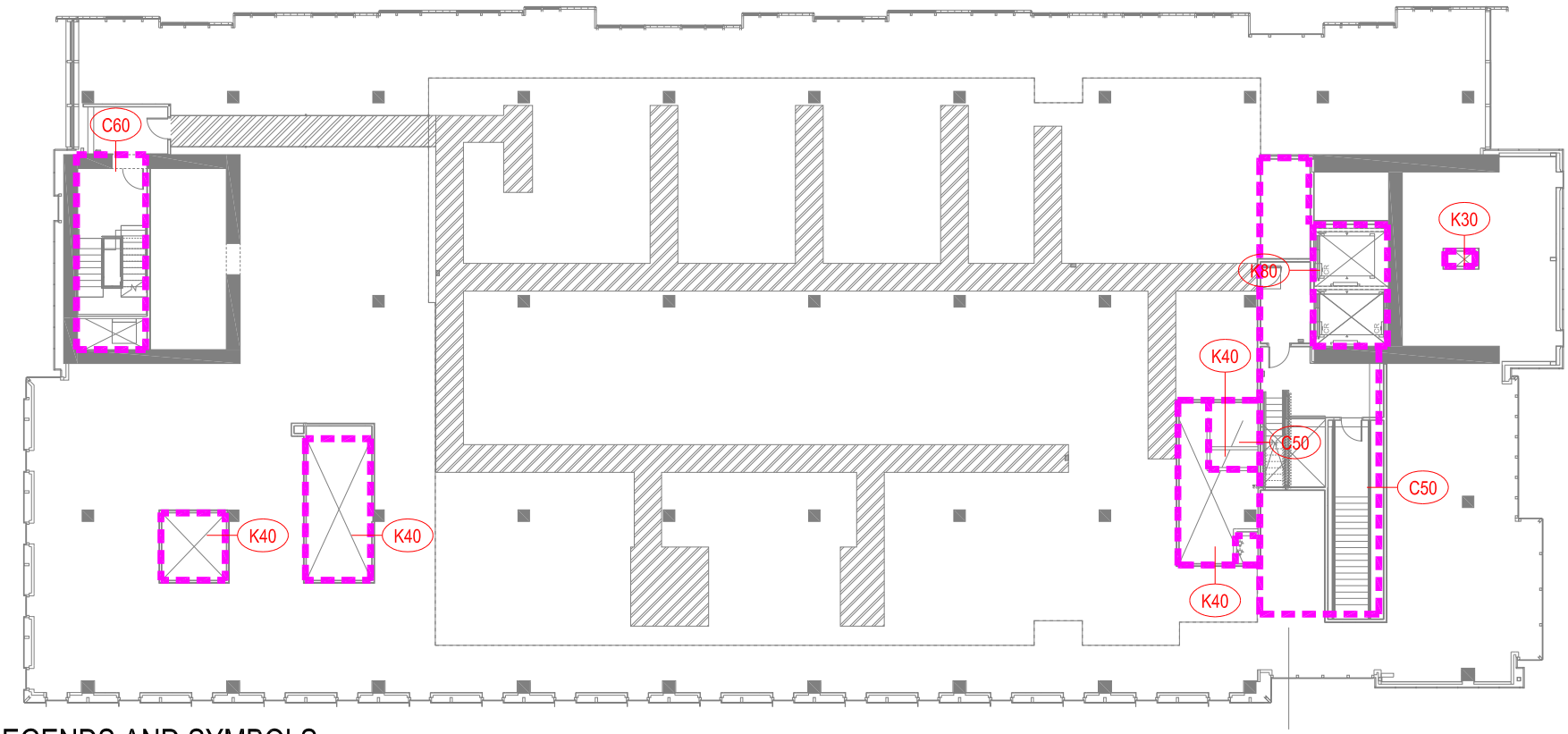

LEGENDS AND SYMBOLS

- CONTROL ZONE BOUNDARY (1-HOUR)
- 1-HOUR WALL ASSEMBLY
- 2-HOUR CEILING ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- XXX — WALL TYPE

WALL ASSEMBLY - LEVEL 7S

SCALE : NTS

N

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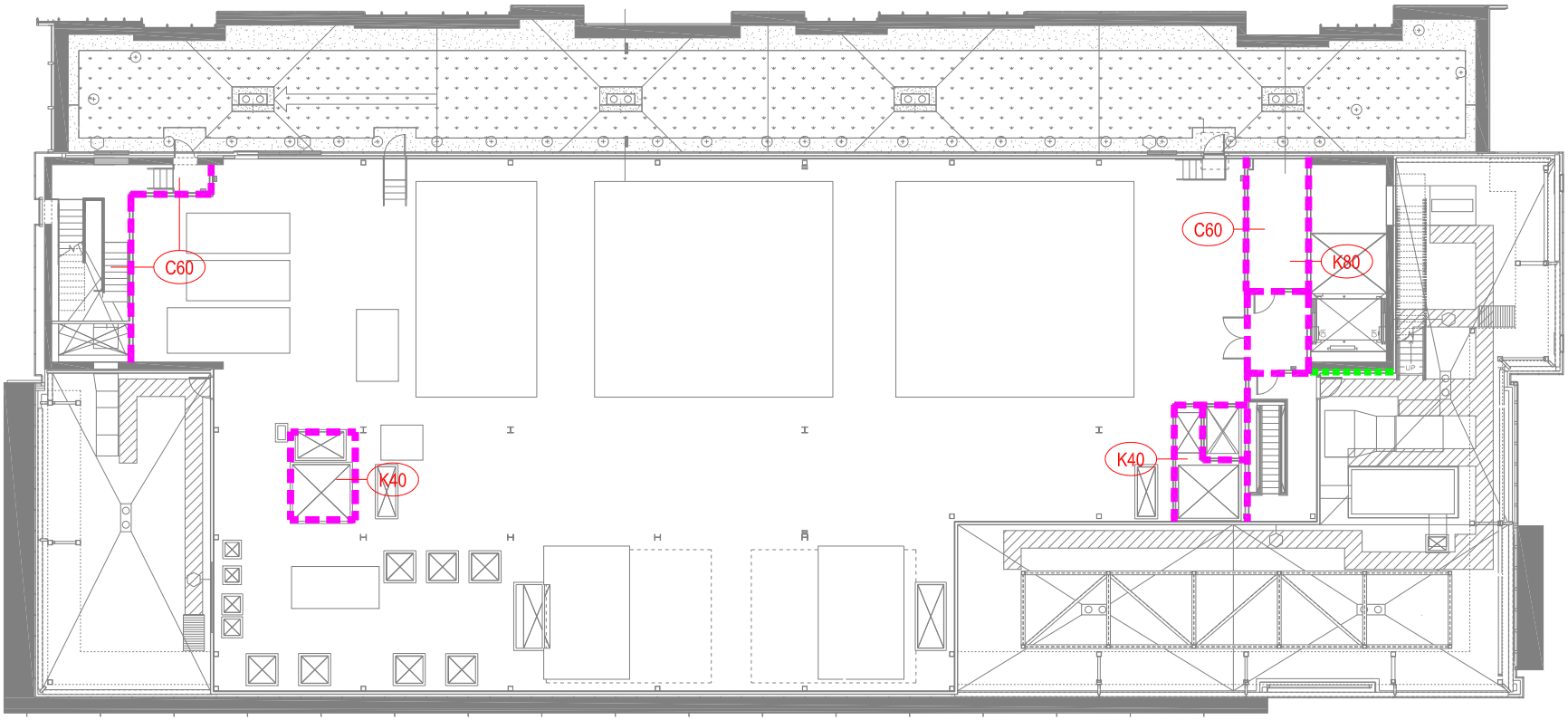
Fire Protection Engineering



LEGENDS AND SYMBOLS

- CONTROL ZONE BOUNDARY (1-HOUR)
- 1-HOUR WALL ASSEMBLY
- 2-HOUR CEILING ASSEMBLY
- 2-HOUR WALL ASSEMBLY
- 3-HOUR WALL ASSEMBLY
- XXX — WALL TYPE

WALL ASSEMBLY - PENTHOUSE

SCALE : NTS

N

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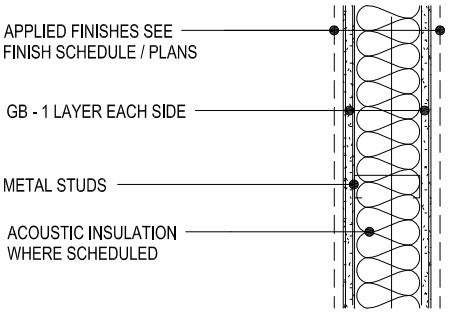
CAL POLY
Fire Protection Engineering

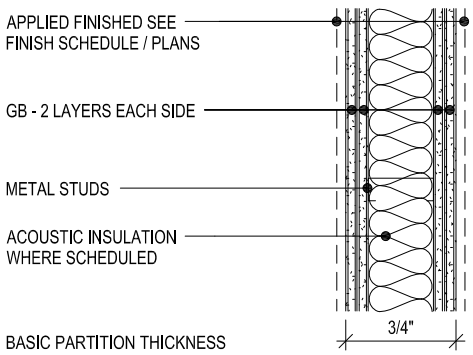


BASIC PARTITION THICKNESS

STUDS TO STRUCTURE ABOVE (SEE DETAILS)				
	1 HR. RATED WITH GB TO STRUCTURE ABOVE		A40	A50
	NON RATED WITH GB TO STRUCTURE ABOVE	A21	A41	A51
	NON RATED WITH GB TO 6" ABOVE CEILING	A22	A42	A52
STUD SIZE		2 1/2"	3 5/8"	4"
GB THICKNESS		5/8"	5/8"	5/8"
BASIC PARTITION THICKNESS		3 3/4"	4 7/8"	5 1/4"
STUD GAUGE (INDICATED OR SEE SPEC)		20, 22, OR 25	20, 22, OR 25	20, 22, OR 25
STUD SPACING (INDICATED OR SEE SPEC)		16" OR 24"	16" OR 24"	16" OR 24"
ACOUSTICAL INSULATION		YES	YES	NO
ACOUSTICAL RATING (STC)		49	49	40
ACOUSTICAL TEST NUMBER		SIM. SA 870717	SIM. USG 870717	
FIRE TEST NUMBER (WHERE APPLICABLE)		N/A	UL DES U465	UL DES U465
LOCAL CODE REQUIREMENT		-	-	-
REMARKS		-	-	-

PARTITION TYPE 'A'

SCALE : NTS



BASIC PARTITION THICKNESS

STUDS TO STRUCTURE ABOVE (SEE DETAILS)					
	2 HR. RATED WITH GB TO STRUCTURE ABOVE	C50	C60	C70	C80
	NON RATED WITH GB TO STRUCTURE ABOVE	C51	C61	C71	C81
	NON RATED WITH GB TO 6" ABOVE CEILING	C52	C62	C72	C82
STUD SIZE		4"	4"	6"	6"
GB THICKNESS		5/8"	5/8"	5/8"	5/8"
BASIC PARTITION THICKNESS		6 1/2"	6 1/2"	8 1/2"	8 1/2"
ACOUSTICAL INSULATION		NO	YES	NO	YES
ACOUSTICAL RATING (STC)		48	56	48	56
ACOUSTICAL TEST NUMBER		SIM. BBN 770408	SIM. USG 840818	SIM. BBN 770408	SIM. USG 840818
FIRE TEST NUMBER (WHERE APPLICABLE)		UL DES U411	UL DES U411	UL DES U411	UL DES U411
REMARKS					

PARTITION TYPE 'C'

SCALE : NTS

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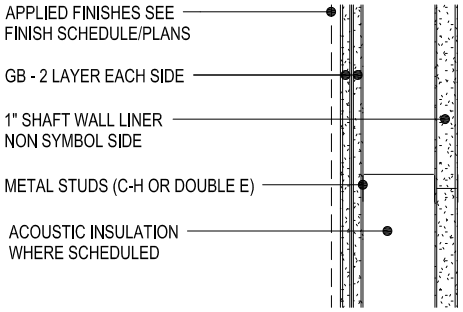
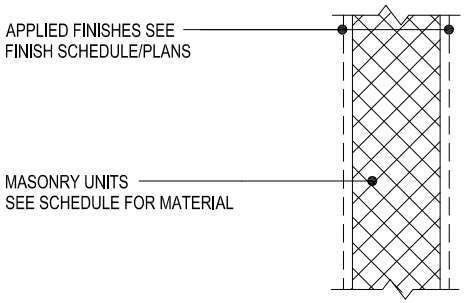


BASIC PARTITION THICKNESS

STUDS TO STRUCTURE ABOVE (SEE DETAILS)	2 HR. RATED WITH GB TO STRUCTURE ABOVE	K30	K40	K80
	NON RATED WITH GB TO STRUCTURE ABOVE			
	NON RATED WITH GB TO 6" ABOVE CEILING			
STUD SIZE ('C-H' OR DOUBLE "E")		4"	4"	6"(2xE)
GB THICKNESS		5/8"	5/8"	5/8"
BASIC PARTITION THICKNESS		5 1/4"	5 1/4"	7 1/4"
ACOUSTICAL INSULATION		NO	YES	YES
ACOUSTICAL RATING (STC)		39	47	47
ACOUSTICAL TEST NUMBER		SIM. USG 750302	SIM. USG 750706	SIM. USG 750706
FIRE TEST NUMBER (WHERE APPLICABLE)		UL DES U438 SIM.	UL DES U438 SIM.	UL DES U438 SIM.
REMARKS				

PARTITION TYPE 'K'

SCALE : NTS



BASIC PARTITION THICKNESS

FIRE RESISTANCE FOR NON-LOAD BEARING PARTITIONS BUILT TO THE STRUCTURE ABOVE.* SEE BELOW FOR EQUIVALENT THICKNESS REQUIRED	RATING NOT REQ'D	N20	N40
	1 HOUR RATING	N21 71.8%	N41 34.1%
	2 HOUR RATING	N22 99.4%	N42 47.3%
	3 HOUR RATING		N43 57.8%
	4 HOUR RATING		N44 66.9%
BASIC PARTITION THICKNESS		3 5/8"	7 5/8"
NOMINAL MASONRY THICKNESS		4"	8"
FIRE TEST NUMBER (WHERE APPLICABLE)		N/A	U906
REMARKS			

PARTITION TYPE 'N'

SCALE : NTS

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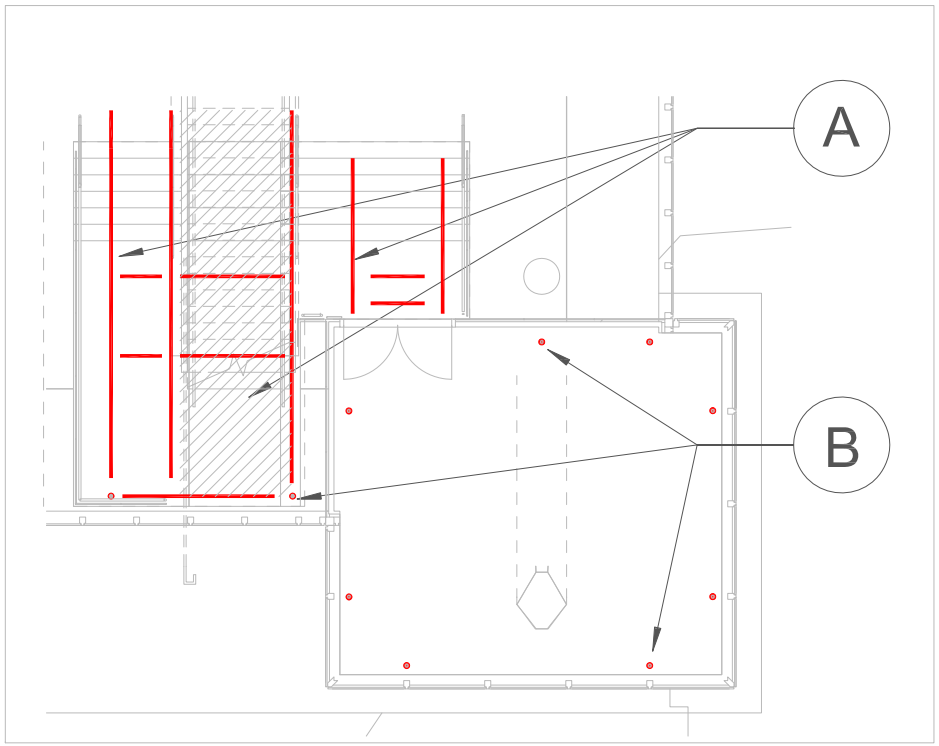
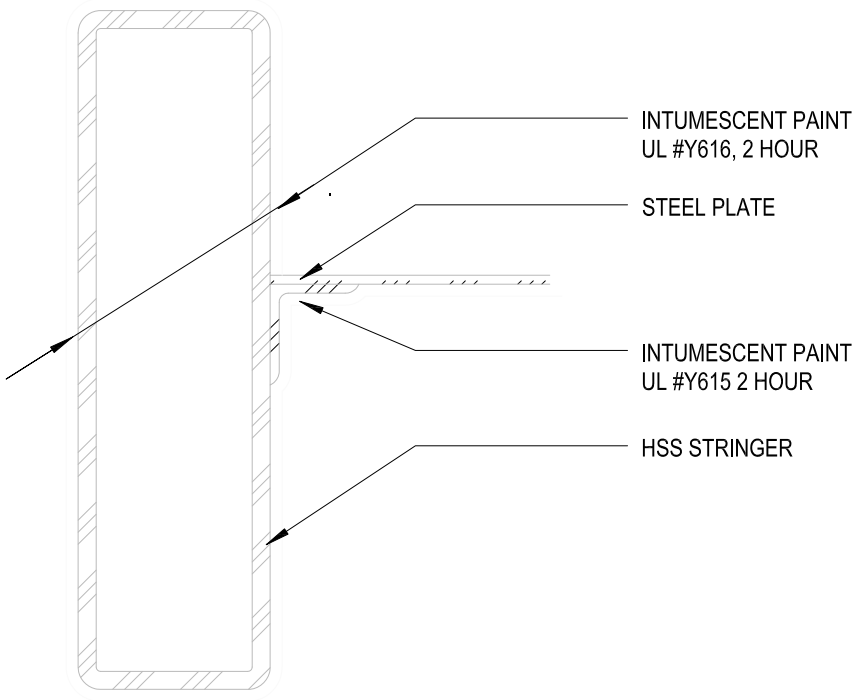
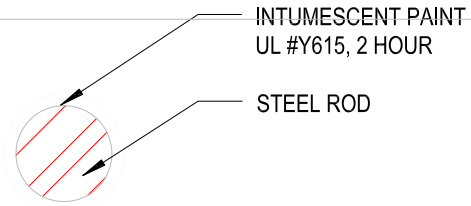




A. STAIR STRINGER - HSS/STEEL PLATE- 2HR INTUM.



B. STEEL ROD HANGER - 2HR INTUM.

STEEL FIREPROOFING - LOUNGE

SCALE : NTS

N

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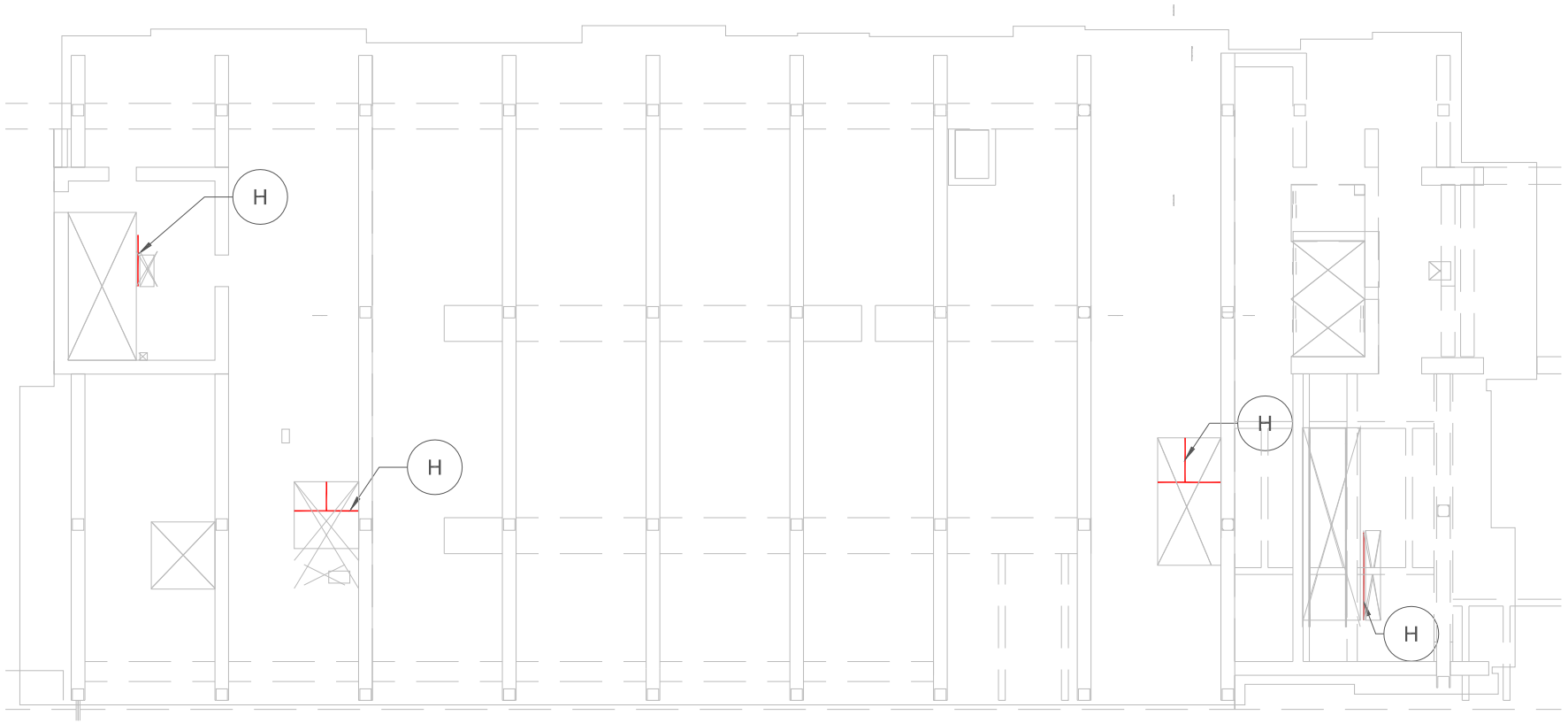

STEEL FIREPROOFING - LEVEL 2 (LEVEL 3-6 SIMILAR)

SCALE : NTS

N

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PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

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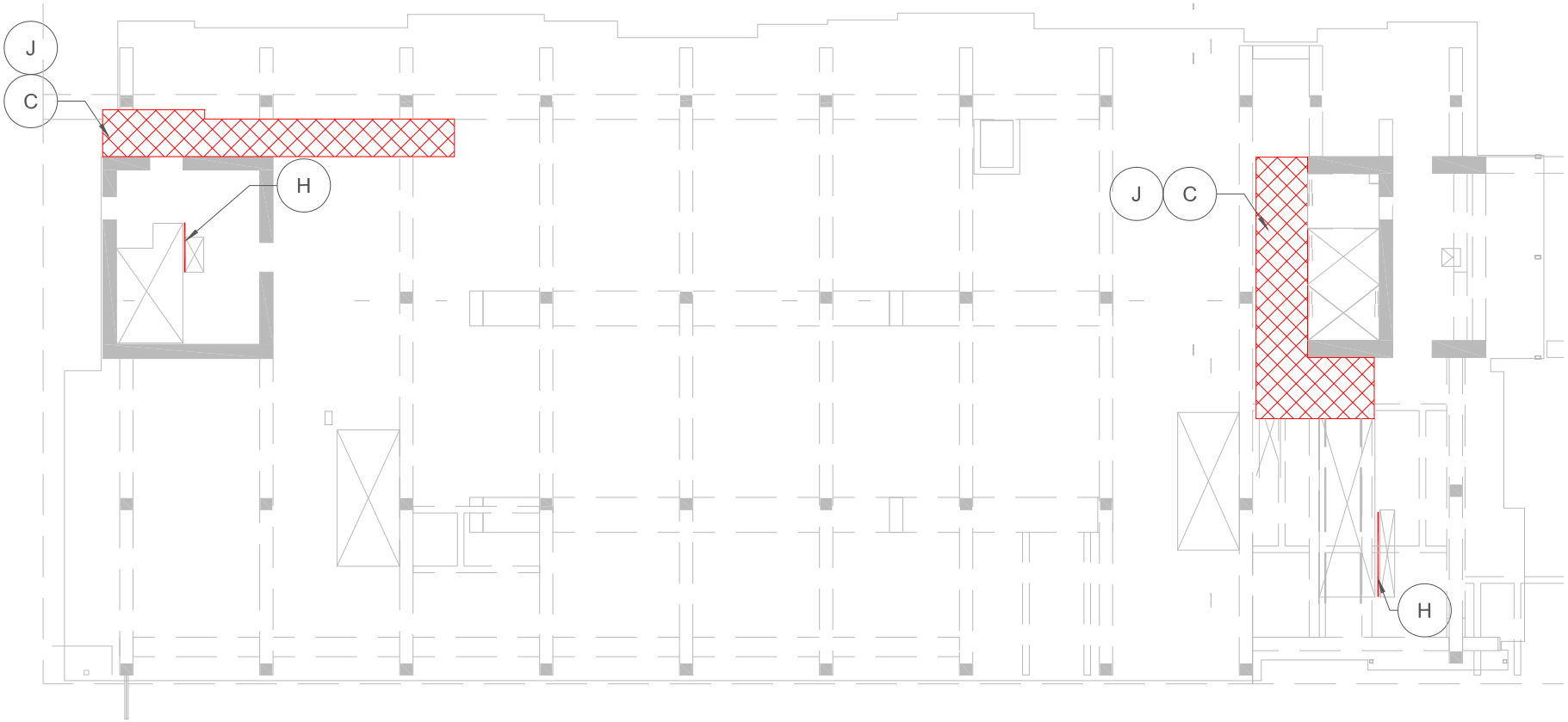

STEEL FIREPROOFING - LEVEL 7

SCALE : NTS

N

CAL POLY
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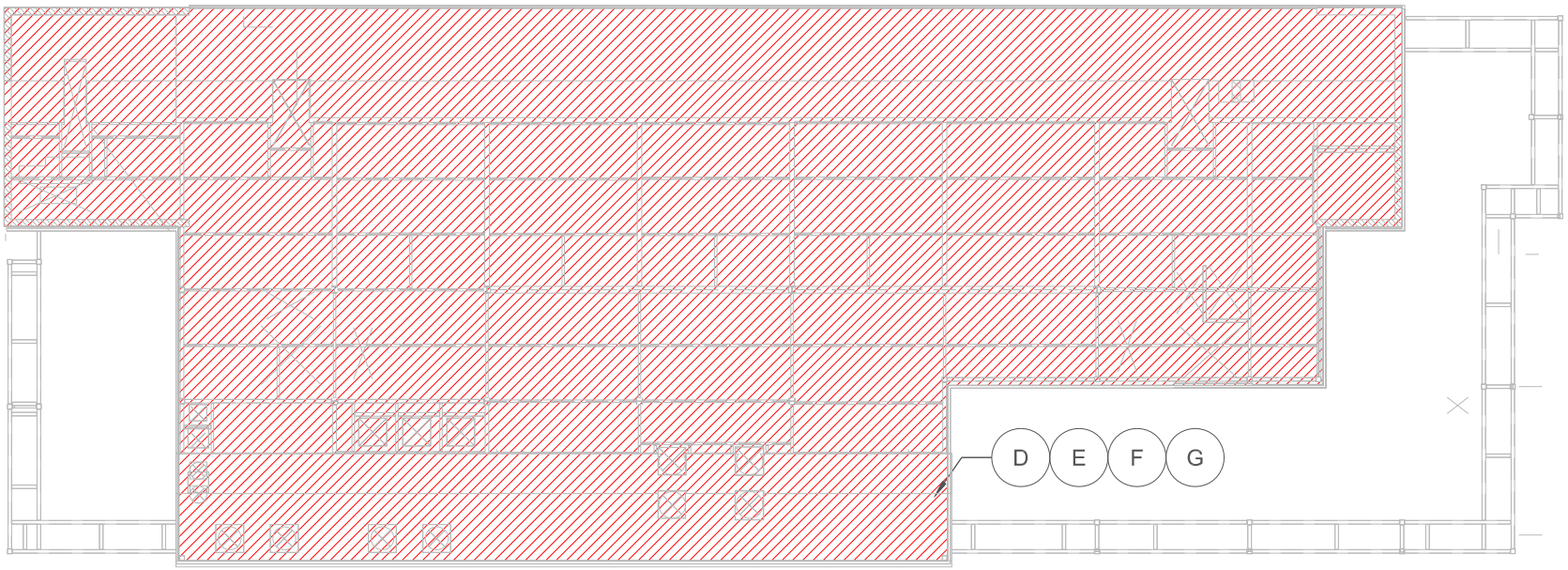
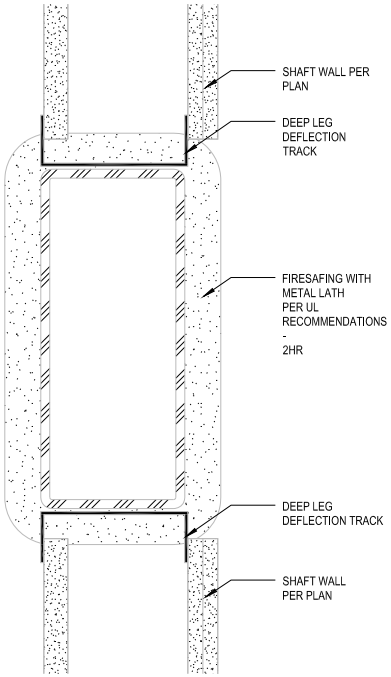


STEEL FIREPROOFING - PENTHOUSE

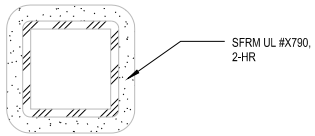
SCALE : NTS

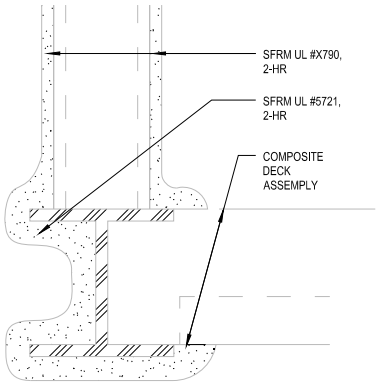
N

CAL POLY
Fire Protection Engineering

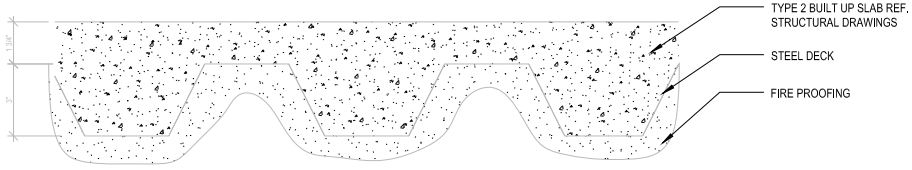


H. SHAFT DIVIDER BEAM

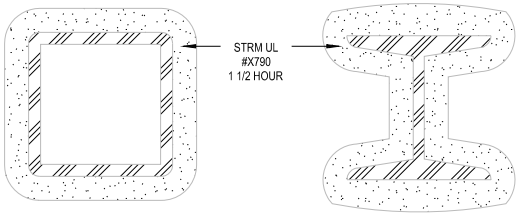




J. SUSPENDED CATWALK

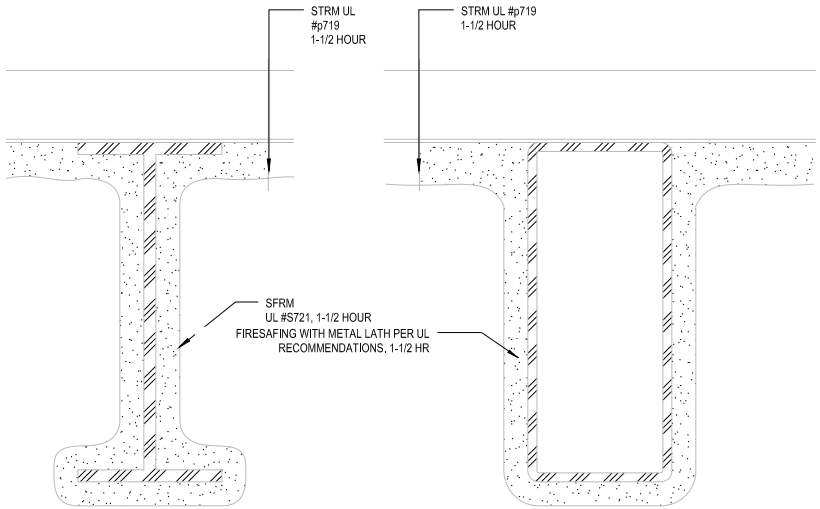


C. COMPOSITE FLOOR ASSEMBLY
UL #D723 - 2 HR



D. ROOF COLUMN

E. ROOF COLUMN



F. W BEAM @ ROOF ASSEMBLY

G. HSS BEAM @ ROOF ASSEMBLY

SFRM - DETAILS

SCALE : NTS

CAL POLY
Fire Protection Engineering

Appendix G: Inspection, Testing and Maintenance – Fire Alarm

Table 18: Inspection - Fire Alarm Systems

INSPECTIONS							
I/R = INITIAL / REACCEPTANCE , W = WEEKLY, M=MONTHLY, Q=QUARTERLY, S-A = SEMI- NNUALLY, A= ANNUALLY							
	COMPONENT	I/R	W	M	Q	S-A	A
1	Control Equipment: Fire Alarm Systems Monitored for Alarm, Supervisory, and Trouble Signals						
(a)	Fuses	x	-	-	-	-	x
(b)	Interfaced equipment	x	-	-	-	-	x
(c)	Lamps and LEDs	x	-	-	-	-	x
(d)	Primary (main) power supply	x	-	-	-	-	x
2	Control Equipment: Fire Alarm Systems Unmonitored for Alarm, Supervisory, and Trouble Signals						
(a)	Fuses	x	x	-	-	-	-
(b)	Interfaced equipment	x	x	-	-	-	-
(c)	Lamps and LEDs	x	x	-	-	-	-
(d)	Primary (main) power supply	x	x	-	-	-	-
3	Batteries						
(a)	Lead-acid	x	-	x	-	-	-
(b)	Nickel-cadmium	x	-	-	-	x	-
(c)	Primary (dry cell)	x	-	x	-	-	-
(d)	Sealed lead-acid	x	-	-	-	x	-
4	Transient suppressors	x	-	-	-	x	-
5	Fire Alarm Control Unit Trouble Signals	x	-	-	-	x	-
6	Fiber-Optic Cable Connections	x	-	-	-	-	x
7	Emergency Voice/Alarm Communications Equipment	x	-	-	-	x	-
8	Remote Annunciators	x	-	-	-	x	-
9	Initiating devices						
(a)	Air sampling	x	-	-	-	x	-
(b)	Duct detectors	x	-	-	-	x	-
(c)	Electromechanical releasing devices	x	-	-	-	x	-
(d)	Fire extinguishing system(s) or suppression system(s) switches	x	-	-	-	x	-
(e)	Manual fire alarm boxes	x	-	-	-	x	-
(f)	Heat detectors	x	-	-	-	x	-
(g)	Radiant energy fire detectors	x	-	-	x	-	-
(h)	Video image smoke and fire detectors	x	-	-	x	-	-
(i)	Smoke detectors	x	-	-	-	x	-
(j)	Projected beam smoke detectors	x	-	-	-	x	-
(k)	Supervisory signal devices	x	-	-	x	-	-
(l)	Waterflow devices	x	-	-	x	-	-

INSPECTIONS							
I/R = INITIAL / REACCEPTANCE , W = WEEKLY, M=MONTHLY, Q=QUARTERLY, S-A = SEMI- NNUALLY, A= ANNUALLY							
	COMPONENT	**I/R**	**W**	**M**	**Q**	**S-A**	**A**
10	Guard's tour equipment	x	-	-	-	x	-
11	Combination systems						
	(a) Fire extinguisher electronic monitoring device/systems	x	-	-	-	x	-
	(b) Carbon monoxide detectors/systems	x	-	-	-	x	-
12	Interface Equipment	x	-	-	-	x	-
13	Alarm Notification Appliances — Supervised	x	-	-	-	x	-
14	Exit marking audible notification appliances	x	-	-	-	x	-
15	Supervising Station Fire Alarm Systems — Transmitters						
	(a) DACT	x	-	-	-	x	-
	(b) DART	x	-	-	-	x	-
	(c) McCulloh	x	-	-	-	x	-
	(d) RAT	x	-	-	-	x	-
16	Special Procedures	x	-	-	-	x	-
17	Supervising Station Fire Alarm Systems — Receivers						
	(a) DACR	x	x	-	-	-	-
	(b) DARR	x	-	-	-	x	-
	(c) McCulloh	x	-	-	-	x	-
	(d) Two-way RF multiplex	x	-	-	-	x	-
	(e) RASSR	x	-	-	-	x	-
	(f) RARS	x	-	-	-	x	-
	(g) Private microwave	x	-	-	-	x	-
18	Public emergency alarm reporting system transmission equipment						
	(a) Publicly accessible alarm box	x	-	-	-	x	-
	(b) Auxiliary box	x	-	-	-	-	x
	(c) Master box						
	(1) Manual operation	x	-	-	-	x	-
	(2) Auxiliary operation	x	-	-	-	-	x

10.5.2 The frequency of maintenance of fire alarm system equipment shall depend on the type of equipment and the local ambient conditions.

Table 19: Testing – Fire Alarm Systems

TESTING						
I/R = INITIAL / REACCEPTANCE , W = WEEKLY, M=MONTHLY, Q=QUARTERLY, S-A = SEMI- NNUALLY, A= ANNUALLY						
COMPONENT	**I/R**	**W**	**M**	**Q**	**S-A**	**A**
1 Control Equipment - Building systems connected to supervising station						
a) Functions	x	-	-	-	-	x
b) Fuses	x	-	-	-	-	x
c) Interfaced equipment	x	-	-	-	-	x
d) Lamps and LEDs	x	-	-	-	-	x
e) Primary (main) power supply	x	-	-	-	-	x
f) Transponders	x	-	-	-	-	x
2 Control equipment - Building systems not connected to supervising station						
a) Functions	-	-	-	x	-	-
b) Fuses	-	-	-	x	-	-
c) Interfaced equipment	-	-	-	x	-	-
d) Lamps and LEDs	-	-	-	x	-	-
e) Primary (main) power supply	-	-	-	x	-	-
f) Transponders	-	-	-	x	-	-
3 Engine-driven generator - Central station facilities and fire alarm systems	x	-	x	-	-	-
4 Engine-driven generator - Public fire alarm reporting systems	x	x	-	-	-	-
5 Batteries - Central station facilities						
a) Lead-acid type						
1. Charger test (replace battery as needed)	x	-	-	-	-	x
2. Discharge test (30 minutes)	x	-	x	-	-	-
3. Load voltage test	x	-	x	-	-	-
4. Specific gravity	x	-	-	-	x	-
b) Nickel-cadmium type						
1. Charger test (replace battery as needed)	x	-	-	x	-	-
2. Discharge test (30 minutes)	x	-	-	-	-	x
3. Load voltage test	x	-	x	-	-	x
c) Sealed lead-acid type						
1. Charger test (replace battery within 5 years after manufacture or more frequently as needed)	-	-	x	x	-	-
2. Discharge test (30 minutes)	x	-	x	-	-	-
3. Load voltage test	x	-	x	-	-	-
6 Batteries - Fire alarm systems						

TESTING						
I/R = INITIAL / REACCEPTANCE , W = WEEKLY, M=MONTHLY, Q=QUARTERLY, S-A = SEMI- NNUALLY, A= ANNUALLY						
COMPONENT	**I/R**	**W**	**M**	**Q**	**S-A**	**A**
a) Lead-acid type						
1. Charger test (replace battery as needed)	x	-	-	-	-	x
2. Discharge test (30 minutes)	x	-	-	-	x	-
3. Load voltage test	x	-	-	-	x	-
4. Specific gravity	x	-	-	-	x	-
b) Nickel-cadmium type						
1. Charger test (replace battery as needed)	x	-	-	-	-	x
2. Discharge test (30 minutes)	x	-	-	-	-	x
3. Load voltage test	x	-	-	-	x	-
c) Primary type (dry cell)						
1. Load voltage test	x	-	x	-	-	-
d) Sealed lead-acid type						
1. Charger test (replace battery within 5 years after manufacture or more frequently as needed)	x	-	-	-	-	x
2. Discharge test (30 minutes)	x	-	-	-	-	x
3. Load voltage test	x	-	-	-	x	-
7 Batteries - Public fire alarm reporting systems						
(From street locations to the communications center)	x (daily)	-	-	-	-	-
a) Lead-acid type						
1. Charger test (replace battery as needed)	x	-	-	-	-	x
2. Discharge test (2 hours)	x	-	-	x	-	-
3. Load voltage test	x	-	-	x	-	-
4. Specific gravity	x	-	-	-	x	-
b) Nickel-cadmium type						
1. Charger test (replace battery as needed)	x	-	-	-	-	x
2. Discharge test (2 hours)	x	-	-	-	-	x
c) Sealed lead-acid type						
1. Charger test (replace battery within 5 years after manufacture or more frequently as needed)	x	-	-	-	-	x
2. Discharge test (2 hours)	x	-	-	-	-	x
3. Load voltage test	x	-	-	-	x	-
8 Fiber-Optic Cable Power	x	-	-	-	-	x
9 Control Unit Trouble Signals	x	-	-	-	-	x
10 Conductors – Metallic	x	-	-	-	-	-
11 Conductors – Nonmetallic	x	-	-	-	-	-

TESTING						
I/R = INITIAL / REACCEPTANCE , W = WEEKLY, M=MONTHLY, Q=QUARTERLY, S-A = SEMI- NNUALLY, A= ANNUALLY						
COMPONENT	**I/R**	**W**	**M**	**Q**	**S-A**	**A**
12 Emergency Voice / Alarm Communications Equipment	x	-	-	-	-	x
13 Retransmission Equipment	x	-	-	-	-	-
14 Remote Annunciators	x	-	-	-	-	-
15 Initiating Devices						
a) Duct detectors	x	-	-	-	-	-
b) Electromechanical releasing device	x	-	-	-	-	x
c) Fire extinguishing system(s) or suppression system(s) switches	x	-	-	-	-	x
d) Fire-gas and other detectors	x	-	-	-	-	x
e) Heat detectors	x	-	-	-	-	x
f) Fire alarm boxes	x	-	-	-	-	x
g) Radiant energy fire detectors	x	-	-	-	x	-
h) System smoke detectors - functional*	x	-	-	-	-	x
i) Smoke detectors - sensitivity**	x	-	-	-	-	x
j) Single and multiple-station smoke alarms	x	-	-	-	-	x
k) Single and multiple-station heat alarms	x	-	-	-	-	-
l) Supervisory signal devices (except valve tamper switches)	x	-	-	x	-	-
m) Waterflow devices	x	-	-	-	x	-
n) Valve tamper switches	x	-	-	-	x	-
16 Guard's tour equipment	x	-	-	-	-	x
17 Interface equipment	x	-	-	-	-	x
18 Special hazard equipment	x	-	-	-	-	x
19 Alarm notification appliances						
a) Audible devices	x	-	-	-	-	x
b) Audible textual notification appliances	x	-	-	-	-	x
c) Visual devices	x	-	-	-	-	x
20 Off-premises transmission equipment	x	-	-	x	-	-
21 Supervising station fire alarm systems – transmitters						
a) Digital alarm communicator transmitter (DACT)	x	-	-	-	-	x
b) Digital alarm radio transmitter (DART)	x	-	-	-	-	x
c) McCulloh transmitter	x	-	-	-	-	x
d) Radio alarm transmitter (RAT)	x	-	-	-	-	x
22 Special procedures	x	-	-	-	-	x
23 Supervising station fire alarm systems – receivers						
a) Digital alarm communicator receiver (DACR)	x	-	x	-	-	-
b) Digital alarm radio receiver (DARR)	x	-	x	-	-	-
c) McCulloh systems	x	-	x	-	-	-
d) Two-way RF multiplex	x	-	x	-	-	-

TESTING						
I/R = INITIAL / REACCEPTANCE , W = WEEKLY, M=MONTHLY, Q=QUARTERLY, S-A = SEMI- NNUALLY, A= ANNUALLY						
COMPONENT	**I/R**	**W**	**M**	**Q**	**S-A**	**A**
e) Radio alarm supervising station receiver (RASSR)	x	-	x	-	-	-
f) Radio alarm repeater station receiver (RARSR)	x	-	x	-	-	-
g) Private microwave	x	-	x	-	-	-

* Specific requirements for smoke detector testing from NFPA-72:

10.4.3.4.1 Two or more detectors shall be tested on each initiating circuit annually.

10.4.3.4.2 Different detectors shall be tested each year, with records kept by the building owner specifying which detectors have been tested.

10.4.3.4.3 Within 5 years, each detector shall have been tested.

** Smoke detector sensitivity testing requirements of NFPA-72:

10.4.3.2.1 Sensitivity of smoke detectors and single- and multiple-station smoke alarms (in other than one- and two-family dwellings) shall be checked within 1 year after installation.

10.4.3.2.2 Sensitivity shall be checked every alternate year thereafter unless otherwise permitted by compliance with 10.4.3.2.3.

10.4.3.2.3 After the second required calibration test, if sensitivity tests indicate that the device has remained within its listed and marked sensitivity range (or 4 percent obscuration gray smoke, if not marked), the length of time between calibration tests shall be permitted to be extended to a maximum of 5 years.

10.4.3.2.3.1 If the frequency is extended, records of nuisance alarms and subsequent trends of these alarms shall be maintained

10.4.3.2.3.2 In zones or in areas where nuisance alarms show any increase over the previous year, calibration tests shall be performed.

Other testing requirements of NFPA-72:

10.4.3.1 If automatic testing is performed at least weekly by a remotely monitored fire alarm control unit specifically listed for the application, the manual testing frequency shall be permitted to be extended to annually. Table 10.4.3 shall apply.

10.4.3.3 Test frequency of interfaced equipment shall be the same as specified by the applicable NFPA standards for the equipment being supervised.

10.4.8 Tests of all circuits extending from the central station shall be made at intervals of not more than 24 hours.

Appendix H: Inspection, Testing and Maintenance – Fire Sprinkler

Table 20: Inspections – Fire Suppression Systems

FIRE SPRINKLER - INSPECTIONS								
W = Weekly, M=Monthly, Q=Quarterly, S-A = Semi- annually, A= Annually, O=Others								
Sprinkler Components	W	M	Q	S-A	A	O	NFPA 25	
Sprinkler Heads					x		5.2.1.1	Sprinklers shall be inspected from the floor level annually.
							5.2.1.1.1	Sprinklers shall not show signs of leakage; shall be free of corrosion, foreign materials, paint, and physical damage; and shall be installed in the correct orientation (e.g., upright, pendent, or sidewall).
							5.2.1.1.3	Any sprinkler that has been installed in the incorrect orientation shall be replaced.
Spare Sprinkler Heads					x		5.2.1.4	The supply of spare sprinklers shall be inspected annually
Pipe & Fittings					x		5.2.2	Sprinkler pipe and fittings shall be inspected annually from the floor level.
							5.2.2.1	Pipe and fittings shall be in good condition and free of mechanical damage, leakage, and corrosion.
							5.2.2.2	Sprinkler piping shall not be subjected to external loads by materials either resting on the pipe or hung from the pipe.
							5.2.2.3	Pipe and fittings installed in concealed spaces such as above suspended ceilings shall not require inspection.
Hangers and Seismic Braces					x		5.2.3	Sprinkler pipe hangers and seismic braces shall be inspected annually from the floor level.
							5.2.3.1	Hangers and seismic braces shall not be damaged or loose
							5.2.3.2	Hangers and seismic braces that are damaged or loose shall be replaced or refastened.
							5.2.3.3	Hangers and seismic braces installed in concealed spaces such as above suspended ceilings shall not require inspection.

FIRE SPRINKLER - INSPECTIONS								
W = Weekly, M=Monthly, Q=Quarterly, S-A = Semi- annually, A= Annually, O=Others								
Sprinkler Components	W	M	Q	S-A	A	O	**NFPA 25**	
Gauges - Wet Pipe Systems		x					5.2.4.1	Gauges on wet pipe sprinkler systems shall be inspected monthly to ensure that they are in good condition and that normal water supply pressure is being maintained.
Gauges - Dry Pipe Systems	x						5.2.4.2	Gauges on dry, preaction, and deluge systems shall be inspected weekly to ensure that normal air and water pressures are being maintained.
		x					5.2.4.3	Where air pressure supervision is connected to a constantly attended location, gauges shall be inspected monthly.
Waterflow Alarm and Supervisory Devices			x				5.2.5	Waterflow alarm and supervisory alarm devices shall be inspected quarterly to verify that they are free of physical damage.
Hydraulic Design Information Sign			x				5.2.6	The hydraulic design information sign for hydraulically designed systems shall be inspected quarterly to verify that it is attached securely to the sprinkler riser and is legible.
standpipe and hose systems					x		6.2.1	Components of standpipe and hose systems shall be visually inspected annually or as specified in Table 6.1.1.2.
Gauges		x					6.2.2.1	Gauges on automatic standpipe systems shall be inspected monthly to ensure that they are in good condition and that normal water supply pressure is being maintained.
		x					6.2.2.3	Where air pressure supervision is connected to a constantly attended location, gauges shall be inspected monthly.
Control Valves						x	13.3.2.1	All valves shall be inspected weekly.
Alarm Valves		x					13.4.1.1	Alarm valves shall be externally inspected monthly.

FIRE SPRINKLER - INSPECTIONS								
W = Weekly, M=Monthly, Q=Quarterly, S-A = Semi- annually, A= Annually, O=Others								
Sprinkler Components	W	M	Q	S-A	A	O	NFPA 25	
Check Valves						x	13.4.2.1	Valves shall be inspected internally ever y 5 years to verify the at all components operate correctly, move freely, and are in good condition.
Pressure Reducing Valves and Relief Valves			x				13.5.1.1	All valves shall be inspected quarterly.
Hose Connection PRV					x		13.5.2	All valves shall be inspected annually.
Hose Rack Assembly Pressure Reducing Valves.					x		13.5.3.1	All valves shall be inspected annually.
Master Pressure Reducing Valves.	x						13.5.4.1	Valves shall be inspected weekly to verify that the valves
Hose Valves			x				13.5.6.1.1	Hose valves shall be inspected quarterly.
							13.5.6.1.2	Hose valves shall be inspected to ensure that hose caps are in place and not damaged.
							13.5.6.1.3	Hose threads shall be inspected for damage.
							13.5.6.1.4	Valve handles shall be present and not damaged.
							13.5.6.1.5	Gaskets shall be inspected for damage or deterioration.
							13.5.6.1.6	Hose valves shall be inspected for leaks.
							13.5.6.1.7	Hose valves shall be inspected to ensure no obstructions are present.
							13.5.6.1.8	Hose valves shall be inspected to ensure that restricting devices are present.

FIRE SPRINKLER - INSPECTIONS								
W = Weekly, M=Monthly, Q=Quarterly, S-A = Semi- annually, A= Annually, O=Others								
Sprinkler Components	W	M	Q	S-A	A	O	**NFPA 25**	
Backflow Prevention Assemblies	x						13.6.1.1	The double check assembly (DCA) valves and double check detector assembly (DCDA) valves shall be inspected weekly to ensure that the OS&Y isolation valves are in the normal open position.
	x						13.6.1.2	Reduced pressure assemblies (RPA) and reduced pressure detector assemblies (RPDA) shall be inspected weekly to ensure that the differential-sensing valve relief port is not continuously discharging and the OS&Y isolation valves are in the normal open position.
		x					13.6.1.2.1	Valves secured with locks or electrically supervised in accordance with applicable NFPA standards shall be inspected monthly.
Fire Department Connections			x				13.7.1	Fire department connections shall be inspected quarterly.
Fire Pump Pressure Relief Valves.	x						13.5.7.1	All circulation relief valves shall be inspected weekly.
Fire pump	x						8.2.2	The pertinent visual observations specified in the following checklists shall be performed weekly
						x	8.1.1.2	Table 8.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.
Water storage tanks						x	9.1.1.2	Table 9.1.1.2 shall be used to determine the minimum required frequencies for inspection,testing, and maintenance.

Table 21: Testing – Fire Suppression Systems

FIRE SPRINKLER - TESTING								
W = Weekly, M=Monthly, Q=Quarterly, S-A = Semi- annually, A= Annually, O=Others								
Sprinkler Components	W	M	Q	S-A	A	O	**NFPA 25**	
Sprinklers						x	5.3.1.1.1	Where sprinklers have been in service for 50 years, they shall be replaced or representative samples from one or more sample areas shall be tested. Test procedures shall be repeated at 10-year intervals.
						x	5.3.1.1.1.6	Dry sprinklers that have been in service for 10 years shall be replaced or representative samples shall be tested and then retested at 10-year intervals.
Gauges						x	5.3.2.1	Gauges shall be replaced every 5 years or tested every 5 years by comparison with a calibrated gauge.
Waterflow Alarm Devices			x				5.3.3.1	Mechanical waterflow alarm devices including, but not limited to, water motor gongs, shall be tested quarterly.
				x			5.3.3.2	Vane-type and pressure switch–type waterflow alarm devices shall be tested semiannually.
Main Drain			x				13.2.5.1	In systems where the sole water supply is through a backflow preventer and/or pressure reducing valves, the main drain test of at least one system downstream of the device shall be conducted on a quarterly basis.
Sprinkler Heads						x	5.3.1.1	Where sprinklers have been in service for 50 years, they shall be replaced or representative samples from one or more sample areas shall be tested.
Control valve					x		13.3.3.1	Each control valve shall be operated annually through its full range and returned to its normal position.
Supervisory Switches				x			13.3.3.5.1	Valve supervisory switches shall be tested semiannually.
Hose Valves					x		13.5.6.2.1	Class I and Class III standpipe system hose valves shall be tested annually by opening and closing the valves.

FIRE SPRINKLER - TESTING								
W = Weekly, M=Monthly, Q=Quarterly, S-A = Semi- annually, A= Annually, O=Others								
Sprinkler Components	W	M	Q	S-A	A	O	NFPA 25	
						x	13.5.6.2.2	Hose valves on hose stations attached to sprinkler systems and Class II standpipe systems shall be tested every 3 years by opening and closing the valves.
Backflow Prevention Assemblies					x		13.6.2.1	All backflow preventers installed in fire protection system piping shall be tested annually by conducting a forward flow test of the system at the designed flow rate, including hose stream demand, where hydrants or inside hose stations are located downstream of thebackflow preventer.
Fire pump		x					8.3.1.2	Electric motor–driven fire pumps shall be operated monthly.
						x	8.1.1.2	Table 8.1.1.2 shall be used to determine the minimum required frequencies for inspection,testing, and maintenance.
Water storage tanks						x	9.1.1.2	Table 9.1.1.2 shall be used to determine the minimum required frequencies for inspection,testing, and maintenance.

Table 22: Maintenance - Fire Suppression Systems

FIRE SPRINKLER - MAINTENANCE								
W = Weekly, M=Monthly, Q=Quarterly, S-A = Semi- annually, A= Annually, O=Others								
Sprinkler Components	W	M	Q	S-A	A	O	NFPA 25	
Sprinkler Heads						x	5.4.1.1	Replacement sprinklers shall have the proper characteristics for the application intended, which include the following: Style , Orifice size and K-factor, Temperature rating, Coating, if any , Deflector type (e.g., upright, pendent, sidewall) and Design requirements
Dry Pipe Systems						x	5.4.2	Dry pipe systems shall be kept dry at all times.
Control Valves					x		13.3.4.1	The operating stems of outside screw and yoke valves shall be lubricated annually.

FIRE SPRINKLER - MAINTENANCE								
W = Weekly, M=Monthly, Q=Quarterly, S-A = Semi- annually, A= Annually, O=Others								
Sprinkler Components	W	M	Q	S-A	A	O	**NFPA 25**	
Alarm Valves						x	13.4.1.3.1	Internal components shall be cleaned/repaired as necessary in accordance with the manufacturer's instructions.
Check Valves						x	13.4.2.2	Internal components shall be cleaned, repaired, or replaced as necessary in accordance with the manufacturer's instructions.
Hose Valves						x	13.5.6.2.1	Hose valves that do not operate smoothly or open fully shall be lubricated, repaired, or replaced.
Backflow Prevention Assemblies						x	13.6.3.1	Maintenance of all backflow prevention assemblies shall be conducted by a trained individual following the manufacturer's instructions in accordance with the procedure and policies of the authority having jurisdiction.
Fire Pump Pressure Relief Valves.						x	13.5.8	All damaged or missing components noted during the inspections specified in 13.5.6.1 through 13.5.6.2.2 shall be repaired or replaced in accordance with the manufacturer's instructions.
standpipe and hose systems						x	6.4.1	Maintenance and repairs shall be in accordance with 6.1.3 and Table 6.1.2.
Fire pump		x					8.3.1.2	Electric motor–driven fire pumps shall be operated monthly.
						x	8.1.1.2	Table 8.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.
Water storage tanks						x	9.1.1.2	Table 9.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

Appendix I: Fire Safety Management Plan

FIRE SAFETY MANAGEMENT PLAN

MISSION
The purpose of this plan is to promote, implement and administer a comprehensive fire prevention and life safety program for UW Medicine Lake Union. The plan provides for and monitors a safe environment for employees, students, patients, researchers and visitors designed and maintained to comply with the most current edition of the Life Safety Code (LSC), NFPA 101, University policy, the Seattle Fire Code, and the Washington Administrative Code (WAC). Design criteria accepted by the Research Laboratories are used when designing the environment of care.

1.0 OBJECTIVES OF THE FIRE SAFETY PLAN

General
Fire safety planning has 3 primary objectives:

1. Fire Hazard Control
2. Fire Protection System Maintenance
3. Emergency Evacuation

Fire Safety Planning prevents the occurrence of fire by the control of fire hazards in the building, ensures operation of fire protection systems by establishing maintenance procedures, and provides a systematic method of safe and orderly evacuation of the building in the event of fire.

Emergency Evacuation Concept
Trained supervisory staff can be of great value in directing, and assisting the orderly movement of people in the event of a fire, and performing fire control until the fire department arrives.

Evacuation procedures relying heavily on supervisory staff are complex, in that such staff require continued training, frequent drilling, and must be continuously on the premises in order to fulfil their responsibilities during an emergency. Following the implementation of the plan, the time required for continued training and drilling, and the coordination necessary to maintain supervisory staff on the premises is extreme.

Based on these facts, the evacuation objective outlined in this guide is met simply and realistically without evacuation control officers or the fire safety director=s involvement in evacuation control.

Evacuation Sequence -
During an emergency, a fire alarm will sound, and all occupants will exit the building via a safe exit. Persons with disabilities should proceed with their assistants (if available) to the nearest safe exit. The Fire Safety Director should be available to respond to the premises after being contacted by the fire department.

The instructions for occupants In Case of Fire, posted prominently on each floor area, provide quickly read information on procedures to follow in the event of a fire. Use of this concept should/will ensure a systematic method of safe and orderly evacuation of the building in the event of fire.

2.0 FIRE SAFETY DIRECTOR & DEPUTIES

The Fire Safety Director is appointed in writing by the building owner. The F.S.D. is not in the building on a continuous basis; however, the F.S.D. should be available to respond to the building on notification of a fire emergency, in order to provide assistance as described in this plan. In the event that the F.S.D. is unavailable, a Deputy Fire Safety Director should be available to perform the obligations of the absent director.

The fire code requires that building fire protection and life safety systems receive a variety of regular inspections, service, and maintenance. The majority of inspections are generally *quick checks* to ensure that the particular system is operational and not in need of service. Some inspections do not require a high degree of technical knowledge of the particular system, but rather the ability to check for a specific problem, and have it corrected. Such inspections could be adequately performed by the F.S.D. where he or she is in the building on a *daily* basis. Annual Inspection, Testing and Maintenance procedures generally involve technical procedures and will be performed by qualified individuals or private contractors specializing in the particular field.

Fire Safety Director Responsibilities
General

- Administering and maintaining the Fire Safety Plan. This should include:
  - Updating the plan when alterations are made to the building.
- Training of Deputy Fire Safety Directors.
- Recording information on the following:

- Fire incidents
- False alarms
- Fire drills
- Discharge or operation of fire equipment
- Training periods
- Name, location, and persons requiring assistance and their volunteer assistants.(specify assistance required)
- Minutes of fire safety meetings (if applicable)

- Ensuring that fire protection systems are inspected, maintained and serviced in accordance with the plan and the fire code, and where an inspection, maintenance or testing procedure is beyond in-house capabilities, it is their responsibility to have qualified personnel complete the procedure.
- Ensuring that additional precautions are taken to offset the hazard to occupants where fire protection systems are inoperable. This should include:

- Checking the fire safety plan and fire code when fire systems are in need of repair.
- Advising the fire department of the system status.

- Ensuring that building maintenance, alteration or renovation does not expose the building or occupants to undue fire hazards, and precautions are taken to ensure building and occupant safety. This should include:

- Checking the fire safety plan and the fire code when such activities take place to ensure that They meet the requirements of the fire safety plan and fire code regulations.

- Ensuring that supervisory staff are available to respond to the premises in the event of notification of an emergency. This should include:

- Notifying the Deputy Fire Safety Director when they will not be available.

- Providing information to occupants on general fire safety and evacuation procedures.

This should include:
- Providing new occupants with Part 11 of the plan.
- Notifying occupants whenever the Fire Safety Director, or Deputy Fire Safety Director changes.

- Resolving any fire hazards which are reported by occupants, guests or the fire department.
- Maintaining familiarity with the building=s fire protection systems.
- Familiarity with fire regulations. This should include:

- Obtaining and reviewing a copy of the Seattle Fire Code.
- Ensuring that the electrical rooms are not used for storage.
- Ensuring that established policies are adhered to.

- Considering other emergency situations which could affect the building such as earthquakes, or natural gas leaks.
- Notifying the alarm monitoring station when the emergency contacts change (when applicable).

Emergency Procedures if on the Premises

IF YOU DISCOVER A FIRE

- ACTIVATE a fire alarm pull station
- PHONE9-1-1 or to report a fire at your address
- FIGHT the fire ONLY if it is SMALL and you are NOT alone
- EVACUATE via the nearest safe exit. DO NOT use the elevator.
- ASSIST persons requiring assistance
- PROCEED to the main entrance (outside) & Report to the fire department

IF YOU HEAR A FIRE ALARM

- EVACUATE via the nearest safe exit. DO NOT use the elevator
- ASSIST persons requiring assistance
- ASSEMBLE clear of the building and arriving fire apparatus
- PHONE9-1-1 or to report a fire at your address

Precautions During Repairs, Alterations & Renovations

Fire Detection & Alarm System
When the system cannot be repaired and returned to full operation, the following precautions should be implemented:

- Notify the Fire Department of the system status.
- Have a person remain at the premises until the system is fully operable.
- Watchperson shall make inspection rounds of all areas of the building every half hour, 24 hours per day.
- Watchperson shall remain on the property between rounds.

Automatic Sprinkler System
Alterations -
It is the responsibility of the sprinkler contractor to test the system in accordance with the Seattle Fire Code following alteration of the system.
Programmed Repairs -
Where operations require the temporary shutting down of sprinkler protection, such operations shall be programmed by the contractor working on the system to enable

completion in the shortest possible time and protection to be restored as promptly as possible.

Additional Precautions during Shut-downs -
During an interruption of normal sprinkler protection, emergency hose lines and portable extinguishers shall be provided, extra watch service shall be placed on duty and temporary water connections shall be made to the sprinkler systems where practicable.

Discontinuance Of Work –
Full sprinkler protection shall be restored or the provisions of additional precautions during shutdowns@ maintained when work on the system is discontinued, as at night time or during holidays.

Identification of Closed Valves -
Closed sprinkler control valves shall be tagged or identified in a manner apparent to the responding fire department.

Portable Fire Extinguishers
Where a service company removes a fire extinguisher from the building for an extended length of time, a fire extinguisher of the same type should be provided temporarily in its place.

Building
During alterations and repairs ensure that the building and its occupants are not exposed to undue fire hazards created by contractors' equipment or supplies which are brought into the building. Frequent inspections of the affected area are suggested in order to ensure the following:

- Exits are free of obstructions.
- Dangerous work areas are inaccessible to the building occupants.
- Contractors have obtained necessary building and operation permits.
- Flammable and combustible liquids are handled and stored safely.
- Heat producing equipment such as welding/cutting equipment and portable heaters are used safely.

Where a problem is suspected the Fire Department should be contacted in order to provide advice or perform an inspection.

Procedures After Fire Safety Equipment has Operated

Fire Detection & Alarm System
Procedure for false alarm:

- ENSURE the fire department is aware of incident.
- DO NOT SILENCE OR RESET the fire alarm system
- When the fire department is satisfied that the alarm was false, RESTORE any activated manual pull stations and RESET the system (if qualified).
- COMPLETE the Incident/Activity Report.

Where a fire has occurred and damaged system wiring and/or detection devices, or you are unsure of the reset procedures, it is likely that trouble will be indicating on the system. In this case a qualified contractor should be contacted to make the necessary repairs.

Wet Automatic Sprinkler System

Where a sprinkler has activated during a fire condition or accidentally through mechanical damage it is necessary to place the system back in operation as soon as possible. This procedure should be conducted by a qualified sprinkler contractor; however, where a contractor is not immediately available, the following procedure could be followed in the interim:

- Ensure that the fire department is aware of the incident.
- Close the zone or main system shut-off valve.
- Open the drain serving the floor.
- Use the special sprinkler wrench and replace the damaged sprinkler with a new one of the same type.
- Close the floor drain.
- Open the floor shut-off valve.
- Perform an inspection and main drain tests.
- Reset the fire alarm system.
- Contact a qualified contractor to check work

Dry Automatic Sprinkler System

Where a sprinkler has activated during a fire condition or accidentally through mechanical damage it is necessary to place the system back in operation as soon as possible. This procedure should be conducted by a qualified contractor however, where a contractor is not immediately available, the following procedure could be followed in the interim:

- Ensure that the fire department is aware of the incident.
- Close the main shut-off valve.
- Turn-off the air compressor.
- Open the 2" main system drain.
- Use the special sprinkler wrench and replace the damaged sprinkler with a new one of the same type.
- Close the main system drain.
- Slowly open the main shut-off valve.
- Perform main drain test.
- Leave the compressor off as the system is fully charged with water. The system should remain this way until properly reset by a qualified contractor.
- Leave the fire alarm system silenced until the system is properly restored by a qualified contractor.
- During freezing weather the system cannot be left charged with water; therefore, the following procedure should be followed:
- Ensure that the fire department is aware of the incident.
- Close the main shut-off valve.
- Turn-off the air compressor.
- Open the 2" main system drain.
- Use the special sprinkler wrench and replace the damaged sprinkler with a new one of the same type.
- Close the main system drain.
- Leave the main shut-off valve closed and tag it@ out of service.
- Leave the compressor off.

- Notify the fire department that the system is down and that the fire department pumper connection outside the building is available for use while awaiting the qualified contractor.
- Leave the fire alarm system silenced until the system is properly restored.
- have a watchperson make tours as discussed previously in this part until the system is fully restored.

Portable Fire Extinguishers
When extinguishers have been used, they should be serviced by qualified personnel.

Fixed Extinguishing System
Following operation, the system shall be restored by a qualified contractor.

Fire System Repair, Service & Emergency Contacts

Fire Safety Equipment	Company Name	Phone Number
Sprinkler System	Patriot Fire	253-926-2290
Fire Alarm	VECA Electric Co.	206-436-5200
Portable Extinguishers	Patriot Fire	253-926-2290
Standpipe System	Patriot Fire	253-926-2290
Emergency Lighting	VECA Electric Co.	206-436-5200
Exhaust ducts	McKinstry	206-762-5900
Heating, Ventilation & Air conditioning	McKinstry	206-762-5900

Fire Drill Procedures
Annually
Once each year the Fire Safety Director should conduct a fire drill. The drill will not test any evacuation skills of the occupants; however, it will provide the Fire Safety director, Deputies, and Occupants with the opportunity to hear the fire alarm gongs, and consider their actions in the event that the fire were real. Use the following procedure when conducting the fire drill:

- Notify occupants of the date and time of the drill.
- Notify the alarm monitoring service (when applicable) and the fire department, on their non-emergency phone numbers, that you are planning to have a non-evacuation fire drill, and that you will call them back when the drill is complete.
- Discuss evacuation procedures with D.F.S.D. and those occupants *willing* to participate.
- Have the D.F.S.D. perform the *If You Discover A Fire* scenario and the *In Case of Fire* procedures for occupants. The F.S.D. should perform his or her duties as detailed in the plan.
- Restore the manual fire alarm pull station, and then reset the fire alarm system.
- Notify the alarm monitoring company (when applicable) and the fire department that the fire drill is complete.
- Discuss drill with occupants in an attempt to identify problems.
- Complete the Incident/Activity Report.

Deputy Fire Safety Director Responsibilities

- Assisting the Fire Safety Director in implementing the fire safety plan.
- Assuming the position of Fire safety director in the absence of the appointed F.S.D.

3.0 INSTRUCTIONS TO OCCUPANTS IN CASE OF FIRE

IF YOU DISCOVER A FIRE...

- ✓ ACTIVATE a fire alarm pull station.
- ✓ PHONE 9-1-1 or to report a fire at your address.
- ✓ FIGHT the fire ONLY if it is SMALL and you are NOT alone.
- ✓ EVACUATE via the nearest safe exit. DO NOT use the elevator.
- ✓ ASSIST persons requiring assistance.
- ✓ PROCEED to the main entrance (outside) & report to the fire department.

IF YOU HEAR A FIRE ALARM...

- ✓ EVACUATE via the nearest safe exit. DO NOT use the elevator.
- ✓ ASSIST persons requiring assistance.
- ✓ ASSEMBLE clear of the building and arriving fire apparatus.
- ✓ PHONE 9-1-1 or to report a fire at your address.

4.0 EMERGENCY EVACUATION PLAN

UW Medicine Lake Union‘s Environmental Health and Safety Department regulates a procedure for Fire Drill & Building Evacuation. This procedure ensures the orderly and complete evacuation of the building in the event of an emergency and/or the activation of alarm system.

Purpose
The purpose of this plan is to establish procedures and duties, to promote planning, and to establish staff training for fire, earthquake, bomb threats, chemical spill, and other emergency evacuations as required by Chapter 4 of the Seattle Fire Code, the Washington Administrative Code (WAC 296-24-567), and the UW All-Hazards Emergency Management Plan.

Scope
This plan applies to all occupants in the UW Medicine Lake Union Phase 3.1

Coordination with Other Emergency Plans

An EEOP is a key component of Departmental Health and Safety Plans and University disaster planning. The EEOP must be coordinated with the following emergency/safety plans.

1. The UW All-Hazards Emergency Management Plan: The EMP provides the management structure, key responsibilities, emergency assignments, and general procedures to follow during and immediately after an emergency. It provides a temporary crisis management structure, which provides for the immediate focus of management on response operations and the early transition to recovery operations. The EMP includes procedures for communicating with

the UW Emergency Operations Center as well as the management structure of the Incident Command System.

Coordination with Departmental Health and Safety Plans
The EEOP reflects the university's emergency response procedures and programs and satisfies an element of the Departmental Health and Safety Plan required by the Department of Labor and Industries (WAC 296-24-567).

Emergency Communications

1. Fire Alarm System: The building fire alarm system is continuously monitored for alarm by a contracted service and, in a backup capacity, by the UWPD Communication Center. All alarms result in an automatic response by Seattle Fire Department, UWPD, and Facilities Services' FOMS unit.

Employee Orientation

New employees must be informed of the EEOP as part of their new employee safety orientation. This initial plan and all significant revisions to the plan should be routed to all personnel. The faculty and staff should be reminded of the plan as necessary and encouraged to discuss the plan with their research groups, students, and visitors. To assure the safety of all building occupants, the Evacuation Director and Evacuation Wardens will work together to assure all departmental employees are aware of the plan, and that students and visitors.

Evacuation Drills
Evacuation drills will be scheduled, conducted, and recorded by the Evacuation Director. Procedures for planning, scheduling, conducting, evaluating, recording, and reporting evacuation drills.

4.1 Fire Emergencies and Building Fire Alarms

A. Procedures for Occupants
    1. When an alarm sounds on your floor or area, begin immediate evacuation following your floor plan. Close doors behind you.

    2. If you discover a fire, activate the nearest pull station and call 9-1-1. Then you may attempt to put it out if it is small (no larger than a wastebasket) and you have called for HELP. If the fire is too large or you are uncomfortable or unfamiliar with the proper use of a fire extinguisher, simply close the door and evacuate.

    3. If the fire alarm does not work, call 9-1-1 and notify occupants verbally of the emergency and the need to evacuate. Evacuation Wardens or another responsible party needs to confirm that all occupants are notified.

Remember that hazardous equipment and processes should be shut down unless doing so presents a greater hazard. Close doors before leaving.

4. If you are on fire, STOP – DROP – ROLL. If another person is on fire, yell "STOP – DROP –ROLL."

5. Evacuate via the nearest stairwell or grade level exit. Do not block exit doors or wedge them in an open position. The doors must remain closed to keep smoke out and maintain safety for evacuation and fire personnel. Leaving doors open makes the stairwells dangerous and unusable. Persons with physical disabilities have several options (see Appendix D).

DO NOT USE THE ELEVATORS!
When an alarm is sounded many of the elevators will be automatically recalled to a pre-determined floor and shut-off.

6. Go to your pre-determined Evacuation Assembly Point (EAP) as outlined in Appendix C. You may have two or more EAP's depending on the size of the building. Immediately report to an Evacuation Warden so that he or she can accurately track which occupants were able to evacuate. Evacuation Wardens will report to the Evacuation Director.

7. If you are trapped by smoke, stay low, cover your mouth with a wet cloth, stay near a window, open it but do not break it, hang something out the window to let fire personnel know you are there and put something in the cracks around the door, phone 9-1-1 if possible.

B. Special Instruction for Evacuation Wardens

a. Begin at the farthest reach of your area and assure that the occupants ahead of you have evacuated. Conduct a quick search as you go to make sure hazardous equipment is shut off, doors are closed and no one is left behind. If there is smoke in the hall, stay low, cover your mouth with a damp cloth or handkerchief, visualize where the exits are, stay close to and use the wall to guide you so you do not become confused. If there is no smoke, you may have trouble getting people to evacuate. Be strong, positive and insistent. Students and visitors who may not be familiar with this plan must be informed of the requirement to evacuate.

b. Direct occupants to the exits and tell them where to reassemble (see Appendix C). If you have helpers, station them in front of the elevator to make sure no one attempts to use it.

c. Do not go to the roof unless it is the only way out; there is often too many obstructions for a helicopter rescue. If a stairway is full of smoke go to another stairway.

d. At the Evacuation Assembly Point (EAP), conduct a headcount by using a checklist (see Appendix I) to account for all occupants in your area of responsibility. Immediately report to the Evacuation Director any missing persons on your list and their last known location.

e. Do not allow the stairway doors and other exit doors to be blocked or wedged open. Leaving stairway doors blocked or held open makes the stairwells dangerous and unusable.

f. Special attention needs to be given to any persons with disabilities, in particular those who are visitors and unfamiliar with the building. A process is necessary to insure they are notified and accounted for. See Appendix D for further details.

4.2. Building Evacuation Plan

Evacuation Assembly Points
The Evacuation Assembly Point (EAP) should be an open area away from the building and out of the way of responding emergency personnel. Establish primary and secondary EAPs in case the primary cannot be occupied during or after an evacuation. A separate EAP may be necessary for earthquake evacuation.

Occupants meet after evacuation so that they may be accounted for or lend assistance as needed. There may be more than one assembly point depending on the size of the building and the location of the exits. Some EAPs may be unsuitable for assembly following an earthquake event.

The primary and secondary Evacuation Assembly Points (EAPs) for this building are:

Primary EAP:	Parking along the main Entrance (Figure 65: Evacuation Assembly Points)
Secondary EAP:	Parking along Courtyard Entrance(Figure 65: Evacuation Assembly Points)

Building occupants will assemble at the primary EAP following a building evacuation. If the Evacuation Director finds the primary EAP unsuitable, then evacuees will be moved to the secondary EAP. Areas of Safe Refuge should be established inside the building for persons with disabilities or for buildings with more than four levels. Indicate each floor's designated EAPs and Areas of Safe Refuge on each emergency evacuation floor plan.

Note: Evacuation drills are necessary to refine the evacuation procedure.

Areas of Safe Refuge
Occupants should have an Area of Safe Refuge (inside the building) four floors below their floor of origin if the building is designed for partial evacuation (i.e., only fire floor and floor above alarm).
Establish areas of safe refuge for persons with disabilities. Maintain a list of these locations that will be used by persons with disabilities, a system to account for persons with disabilities, and means to communicate with persons taking refuge in these areas. See Appendix D for further information.

Evacuation Plans
The attached floor plans (See Appendix J: Evacuation Plan) identify exits and exit routes for the building. Occupants should go to the nearest exit when the alarm sounds. If access to the nearest exit is obstructed, an alternate exit should be taken.

4.3 Emergency Evacuation for Persons with Disabilities

Background

This appendix provides a general guideline of evacuation procedures for persons whose disabilities could make exiting difficult during building evacuations. Faculty, staff, students and visitors with disabilities must develop their own facilities' evacuation plans and identify their primary and secondary evacuation routes from each building they use.

Points of Emphasis

- Be familiar with evacuation options.
- Seek evacuation assistants who are willing to assist in case of an emergency.
- Ask supervisors, instructors, Disability Resources for Students, Disability Services Office, or Environmental Health & Safety about evacuation plans for buildings.

Most UW buildings have accessible exits at the ground level floor that can be used during an emergency. However, in most UW buildings people will need to use stairways to reach building exits. Elevators cannot be used because they have been shown to be unsafe to use in an emergency and in some buildings they are automatically recalled to the ground floor.

Evacuation Directors and Evacuation Wardens need to pre-identify staff, faculty, and students with disabilities and their locations. Determine their evacuation options, identify Areas of Refuge, coordinate obtaining an Assisted Evacuation Device and determine how they will evacuate from the building.

Individuals are also encouraged to sign up for UW Alerts on the UWEM website. UW Alerts will broadcast information electronically during crises or emergencies that may disrupt routine UW campus operations.

Evacuation Options for Persons with Disabilities

Persons without disabilities must evacuate to the nearest exit. Persons with disabilities have five basic evacuation options.

- Horizontal evacuation: Use building exits to the outside ground level or go into unaffected wings of multi-building complexes.
- Stairway evacuation: Use steps to reach ground level exits from the building.
- Stay in Place: Unless danger is imminent, remain in a room with an exterior window, a telephone, and a solid or fire-resistant door. With this approach, the person may keep in contact with emergency services by dialing 911 and reporting his or her location directly. Emergency services will immediately relay this location to on-site emergency personnel, who will determine the necessity for evacuation. Phone lines are expected to remain in service during most building emergencies. If the phone lines fail, the individual can signal from the window by waving a cloth or other visible object.
- Area of Refuge: With an evacuation assistant, move to an area of refuge away from obvious danger. The evacuation assistant(s) will then go to the building evacuation assembly point and notify the on-site emergency personnel of the location of the person with a disability. Emergency personnel will determine if further evacuation is necessary.

- Assisted Evacuation Device: In the event of a major earthquake or other campus-wide event that would prevent first responders from responding quickly, an assisted evacuation device such as a chair, can be used by trained personnel to evacuate mobility disabled persons.

Disability Guidelines

Prior planning and practicing of emergency evacuation routes are important in assuring a safe evacuation. In addition, helpers and others who may assist those with disabilities are reminded to always ask someone with a disability how you can help before attempting any rescue technique or giving assistance. Ask how he or she can best be assisted or moved.

Mobility Impaired: Wheelchair

Persons using wheelchairs should stay in place, or move to an area of refuge with their assistant when the alarm sounds. The evacuation assistant should then proceed to the evacuation assembly point outside the building and tell SFD or UWPD the location of the person with a disability. If the person with a disability is alone, he/she should phone emergency services at 911 with their present location and the area of refuge they are headed to.

If a stair landing is chosen as the area of refuge, please note that many campus buildings have relatively small stair landings, and wheelchair users are advised to wait until the heavy traffic has passed before entering the stairway.

Stairway evacuation of wheelchair users should be conducted by trained professionals (Fire & EMS). Only in situations of extreme danger should untrained people attempt to evacuate wheelchair users. Moving a wheelchair down stairs is never safe.

Evacuation devices such as evacuation chairs may be used when first responders are unavailable. This could occur following a campus-wide emergency such as an earthquake or weapons of mass destruction (WMD) event. The following requirements must be met when using evacuation devices:

- Contact EH&S at 206-616-5519 to identify an appropriate device and determine where to store or place the device. In general, this will apply to departments with a mobility impaired employee whose primary work location is above the ground floor.
- Assign a primary and secondary user of the evacuation device.
- Each user must be a trained Evacuation Warden who has attended the Evacuation Warden training class offered by EH&S.
- Train each user on the proper operation and use of the evacuation device. Coordinate this training with EH&S Building and Fire Safety (206-616-5519).
- Update and document this training annually.
- Install the evacuation device in a location where it cannot impede egress of others from the building. The device will be used only by the assigned users and only when first responders are unavailable to assist a mobility impaired person to evacuate.
- Evacuation devices will be available for use by specially trained Evacuation Wardens only.

- Update the building's Emergency Evacuation and Operations Plan by describing the standard operating procedures for the evacuation device.

4.4 Requirements for High-Rise Buildings

High-rise Evacuation Plans
The Seattle Fire Department requires the development of a printed document that serves as an important resource for building staff and firefighters. Much of the information is already included in this plan. Examples of other information that needs to be addressed include:

- Evacuation specific to high-rise
- Responsibility and Control
- Specific Information about the building that is important for firefighting (fire pumps, emergency power generators, HVAC control, public address systems, etc.)
- High Value Areas
- Post Fire Operations
- Floor Plans
- Utility Information

5.0 INSPECTION, MAINTENANCE & TESTING OF FIRE PROTECTION EQUIPMENT

General
The Seattle Fire Code Regulations require that fire protection installations be maintained in operating condition.

Records
Records of inspection, testing or maintenance of fire protection equipment, which is completed by the Fire Safety Director, qualified person, or a private contractor shall be retained for at least 2 years from the date of the activity. The records shall be located in the Fire Safety Plan for review by the authority having jurisdiction. The activities on the Daily Inspection Report are exempted from this requirement.

Qualified Contractors
Contractors may perform their own unique inspection and testing procedures; however, their procedures must meet the minimum requirements set by the applicable code.

Fixed Extinguishing System
Reference: NFPA 17, Standard for Dry Chemical Extinguishing Systems
Reference: NFPA 17A, Standard for Wet Chemical Extinguishing Systems
Reference: NFPA 12A, Standard on Halon 1301 Fire Extinguishing Systems

Monthly Inspection
Procedure:

- The extinguishing system is in its proper location.
- Manual actuators are unobstructed.
- Tamper indicators and seals are intact.
- Maintenance tag or certificate is in place.
- No obvious physical damage or condition exists that may prevent operation.

- Pressure gauge(s), if provided, are in operable range.
- Nozzle blowoff caps are intact and undamaged.

Record Keeping: Monthly Inspection & Testing Report

Semi-annual Maintenance

Responsibility: Qualified Contractor

Procedure: Contractor to perform maintenance in accordance with the reference standard.

Record Keeping: Semi-Annual Inspection & testing Report

Portable Fire Extinguishers
Reference Standard: NFPA 10, Standard for Portable Fire Extinguishers

An inspection of an extinguisher is a quick check that an extinguisher is available and will operate. It is intended to give reasonable assurance that the extinguisher is fully charged and operable. Maintenance is a thorough check of an extinguisher which is intended to give maximum assurance that an extinguisher will operate effectively and safely, and will normally reveal the need for hydrostatic pressure testing. Recharging is the replacement of the extinguishing agent.

Monthly Inspection
Procedure:
Check portable fire extinguishers for the following:

- Located in designated place
- No obstruction to access or visibility
- Operating instructions on nameplate legible and facing outward
- Seals and tamper indicators not broken or missing
- Determine fullness by weighing or hefting
- Examine for obvious physical damage, corrosion, leakage, or clogged nozzle
- Pressure gauge reading or indicator in the operable range or position

Record Keeping: Monthly Inspection & Testing Report

- Serial number of extinguishers requiring maintenance should be recorded on report for qualified contractor

Fill-out extinguisher tag with following information:

- Date extinguisher was inspected
- Initials of person performing inspection

Annual Maintenance
Procedure:

- Perform maintenance in accordance with the Seattle Fire Code Regulations and NFPA 10, including any necessary hydrostatic pressure testing.

Record Keeping: Annual Inspection & Testing Report

Means of Egress

Daily Inspection
Procedure:

- Doors in fire separations shall be inspected to ensure that they remain closed and latched unless the door is equipped with an acceptable hold open device that will permit the door to close and latch automatically in the event of fire.
- Corridors used by the public and exits shall be maintained free of obstructions
- Exterior passageway and exterior exit stairs shall be maintained free of snow and ice accumulations.

Record Keeping: None

Monthly Inspection
Procedure:

- Doors in fire separations shall be operated to ensure that they are properly maintained. Doors equipped with a hold open device must release automatically in the event of a fire.

Record Keeping: Monthly Inspection & Testing Report

Fire Detection & Alarm System
Reference standard: NFPA 72, National Fire Alarm and Signaling Code
Daily Inspection
Procedure:

- Check Fire Alarm AC power lamp
- Check Fire Alarm trouble lamps

Record Keeping: None
Monthly Testing
Procedure:

- Notify the alarm monitoring company, the fire department and the tenants that you are testing the system. Notify all parties when you have completed testing.
- Under emergency power, one manual alarm initiating device shall be operated on a rotation basis and shall initiate an alarm condition
- Intended function of all alarm audible signal appliances shall be ensured
- The annunciator panel shall be checked to ensure that the tested devices annunciate correctly
- Intended function of the audible and visual trouble signals shall be insured
- Fire alarm batteries shall be checked to ensure that:
    - Terminals are clean and lubricated where necessary
    - Terminal clamps are clean and tight where necessary
    - Electrolyte level and specific gravity, where applicable, are specified by the manufacturer

Record Keeping: Monthly Inspection & Testing Report

Annual Service
Procedure: Contractor shall perform service in accordance with NFPA 72
Record Keeping: Annual Inspection & Testing Report

Sprinkler System
Reference Standard: NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

Notification - Prior notification of waterflow or other tests to be made to a sprinkler system shall be given to parties who could be affected by an alarm.

Daily Inspection
Procedures:

- Dry-pipe valve rooms or enclosures in unheated building shall be inspected at intervals not greater than 24 hours during periods of freezing weather and measures shall be taken to ensure that the temperature of the room or enclosure is maintained above 38 degrees F.

Record Keeping: None

Weekly Inspection
Procedures:

- Valves controlling sprinkler water supplies or alarms shall be inspected at intervals not greater than 7 days to ensure that they are in the open position.

Note: For valves locked in the open position see Monthly Inspection & Test.
For electrical supervised valves see Bi-monthly Test & Inspection.

- Dry pipe system air pressure shall be read at intervals not greater than 7 days and the system shall be maintained at the required pressure.

Record Keeping: Weekly Inspection Report

Monthly Inspection & Tests
Procedures:

- When the alarm line discharge is subject to freezing, waterflow alarm tests using the alarm test connection located at the sprinkler valve shall be performed on sprinkler systems at intervals not greater than one month. (This test operates mechanical or electrical gong.)
- On monitored system, the water flow actuated devices may be tested every two months. See Bi-monthly Test and Inspection.
- On electrically supervised systems, the water flow actuated devices may be tested annually. See Annual Tests and Maintenance.
- Valves which are locked open shall be inspected at intervals not greater than one month.
- Check the priming water supply for dry-pipe systems to ensure that it is at the proper level above the dry-pipe valve.

Record Keeping: Monthly Inspection & Testing Report
Bi-monthly Test and Inspection
Procedures:
All Sprinkler Systems

- Transmitters & water flow actuated devices shall be tested at intervals not greater than 2 months for system connected to electrical supervisory signal service. (example, fire alarm system or central station monitoring service.)
- Inspect all electrically supervised control valves.

Record Keeping: Bi-monthly Testing Report

Semi-annual Tests
Procedures:
All Systems

- Gate valve supervisory switches, tank water level devices, building and tank water temperature supervisory devices and other sprinkler supervisory devices shall be tested at intervals not greater than 6 months.

Record Keeping: Semi-Annual Inspection & Testing Report

Annual Tests & Maintenance
Procedures:
Wet Systems

- Waterflow alarm tests using the inspector=s test connection shall be performed on wet pipe sprinkler systems at intervals not greater than twelve months.

Dry Systems

- Dry-pipe valves shall be trip tested at intervals not greater than 12 months with the control valve partially open. (Dry-pipe valves shall be trip tested at least once every 3 years with the control valve fully open using the inspector=s test valve.)
- Auxiliary drains shall be drained before each winter.

All Systems

- Waterflow tests using the main drain shall be conducted at intervals not greater than 12 months to ensure that water supply available has not deteriorated.
- Drainage facilities shall be tested to ensure that the drains are capable of taking the full flow from the main drain pipe without causing damage.
- Sprinkler control valves are accessible.
- Pits containing sprinkler control valves are free of water and protected from freezing.
- Sprinkler piping and hangers are in good repair.
- Sprinklers are inspected for damage, corrosion or accumulations of grease, paint or other deposits and are replaced where such conditions would impair the operation of the sprinkler.
- Spare sprinklers shall be checked to ensure that the stock on hand is not less than:

- 6 spare sprinklers (not more than 300 sprinklers)
- 12 spare sprinklers (between 301 - 1 000 sprinklers)
- 24 spare sprinklers (more than 1 000 sprinklers)

- Spare sprinklers shall correspond to the types and temperature ratings of the sprinklers in use.
- A sprinkler wrench shall be kept in the cabinet where the spare sprinklers are stored.

Record Keeping: Annual Inspection & Testing Report

Three Year Test
Procedure:
Dry System

- Dry-pipe valve shall be trip tested with the control valve fully open using the inspectors test pipe (dry-pipe valve shall be trip tested annually with the control valve partially open).

Record Keeping: Three Year Testing Report

Fifteen Year Test
Procedure:
Dry System

- Entire system shall be test flushed at intervals not greater than 15 years.
  NOTE: Whenever any of the regularly scheduled testing procedures indicate the presence of possible obstructions in the dry pipe system piping, the entire system shall be flushed of foreign material.

Record Keeping: Fifteen Year Testing Report
Fifty Year Test
Procedure:

- Sample sprinklers from sprinkler systems which have been in service more than 50 years shall be sent to a recognized testing laboratory for testing, and this procedure shall be repeated at intervals not greater than10 years thereafter.
- When sprinklers are required to be tested in conformance with Sentence (1), no fewer than 6 sprinklers of each type shall be tested, except that no fewer than 2 sprinklers per floor per individual system shall be tested.
- All sprinklers shall be replaced in sprinkler systems from which sample sprinklers have been tested and found defective.

Record Keeping: Fifty Year Test Report

Standpipe & Hose System
Reference Standard: NFPA 14, Installation of Standpipe and Hose System.
Alterations - Standpipe systems that have been modified or extended or are being restored to service after a period of disuse exceeding twelve months, shall be flow and pressure tested at the highest and most remote hose connection to ensure the availability of the water supply for which the system was designed.

Monthly Inspection
Procedure:

- Hose cabinets shall be inspected to ensure that the hose is in proper position and that all of the equipment is in place and in operable condition.
- Hose valves shall be checked to ensure they are tight.
- Main shut off valve shall be checked to ensure that it is open.

Record Keeping: Monthly Inspection & Testing Report

Annual Inspection
Procedure:

- All portions of the system shall be inspected.

Record Keeping: Annual Inspection & Testing Report

Five Year Test
Procedure:

- The standpipe system shall be flow tested at intervals not greater than 5 years to ensure that the design flow can be delivered.
- If during the flow test there is an identification of the presence of debris in the piping, the entire system shall be flushed of foreign material.

Record Keeping: Five Year Test Report.

Freezing Protection
Annual Inspection
Procedure:

- Check automatic heat tape to ensure that it is operable

Record Keeping: Annual Inspection and Test Report

Fire Pumps & Reservoirs
Weekly
Procedure:

- The water level in the fire pump reservoir shall be observed at intervals not greater than 7 days and maintained at the proper level.
- Operate internal combustion engine fire pump at rated speed and observe the discharge pressure, suction pressure, lubricating oil level, operative condition of relief valve, and general operating conditions at intervals not greater than 7 days.
- Internal-combustion engine fire pumps shall be operated for a sufficient time to bring the engines up to normal operating temperatures. The storage batteries and fuel supplies shall be maintained at the correct levels.

Record Keeping: Weekly Inspection & Testing Report
Monthly Test
Procedure:

- Test fire pumps driven by electric motor at rated speed until satisfactory performance of the pump, driver and controller is verified at intervals not greater than one month. (An indication of the satisfactory performance of the controller can be obtained by starting the pump by reducing the water pressure in the controller sensing line. The operating conditions of the relief valve, and the discharge and suction pressures, lubricating oil levels and priming water levels, are further indications of the performance of the fire pump and related equipment.)

Record Keeping: Monthly Inspection & Testing Report.
Annual Testing
Procedure:

- Fire pumps shall be tested at full rated capacity at intervals not greater than 12 months to ensure that they are capable of delivering the rated flow.

Record Keeping: Annual Inspection & Testing Report.

<u>Fire Dampers & Fire Stops Flaps</u>

Annual Inspection
Procedure:

- ensure that the fire dampers and fire stops are in place and are not obviously damaged or obstructed.

Record Keeping: Annual Inspection and Testing Report.

<u>Hoods, Ducts & Filters</u>

Weekly Inspection
Procedure:

- Hoods, ducts and filters subject to accumulations of combustible deposits shall be inspected at intervals not greater than 7 days, and shall be cleaned if the accumulation of such deposits creates a fire hazard.
- If necessary hoods and filters shall be cleaned by staff.
- If necessary ducts shall be cleaned by a qualified contractor.

Record Keeping: Weekly Inspection & Testing Report - when equipment is cleaned.

Heating Ventilating & Air Conditioning Systems
Annual Testing and Servicing
Procedure:

- Inspect and service as necessary to ensure that these systems do not create a fire hazard.
- Except for self-contained systems within dwelling units, disconnect switches for mechanical air-conditioning and ventilating systems shall be operated to establish that the system can be shut down in an emergency.

Record Keeping: Annual Inspection & Testing Report.

<u>Fire Department Access to Building</u>

Daily Inspection

- Streets, yards and roadways provided for fire department access shall be maintained so as to be ready for use at all times by fire department vehicles.
- Vehicles shall not be parked to obstruct access of fire department vehicles and signs shall be posted prohibiting such parking.
- Access panels or windows provided to facilitate access for fire fighting operations shall be maintained free of obstructions at all times.

Record Keeping: None

<u>Fire Hydrants</u>

Semi-annual Inspection
Procedure:

- Hydrants shall be inspected to ensure that hydrant caps are in place and caps with worn, rusted or obstructed threads, which might hamper easy removal, are repaired or replaced.
- Hydrant barrels shall be inspected to determine if water has accumulated as a result of a leaking main valve or a plugged or damaged drain valve.
- Main valves which are leaking and drains which are plugged or damaged shall be repaired.

  Exception: Where it is not practical to repair faulty drain valves or where drain valves are intentionally plugged, measures shall be taken to prevent the freezing of accumulated water.

Record Keeping: Semi-annual Inspection & Testing Report.
Annual Flushing
Procedure:

- Semi-annual inspection list previously.
- Hydrants shall be flushed at intervals not greater than 12 months with the main valve and any outlet valves fully opened until the water runs clear.

Record Keeping: Annual Inspection & Testing Report

6.0 OCCUPANT FIRE PREVENTION, PREPAREDNESS & CONTROL

Fire Prevention

- Smoke only within designated areas.
- Use large non-tip ashtrays and empty them only when you are sure the ashes, matches and butts are cold. Make sure that no one, including visitors, has left cigarettes smoldering in waste-baskets or on furniture.
- Be alert around electrical equipment. If electrical equipment is not working properly or if it gives off an unusual odor - often the first sign of a problem that could cause a fire - disconnect the equipment and call an appropriate maintenance contractor.
- Promptly replace any electrical cord that is cracked or has a broken connection.
- When using extension cords, protect them from damage: do not put them across doorways or any place where they will be stepped on or chafed. Check the amperage load specified by the manufacturer or the listing laboratory, and do not exceed it. Do not plug one extension cord into another, and do not plug more than one extension cord into one outlet.
- Keep all heat-producing appliances away from the wall and away from anything that might burn. Leave plenty of space for air to circulate around equipment that normally gives off heat.
- Make sure all appliances in your area - such as coffee makers and hot plates – are turned off when not in use. It's best to assign one person to make this check every day.
- Do your part to keep storage areas, stairway landings and other out-of-way locations free of waste paper, empty cartons, dirty rags and other material that could fuel a fire.
- Report fire hazards to the Fire Safety Director.

Fire Preparedness

- Know the location of the two exits closest to your area. Count the number of doors between you and each of those exits - in case you must escape through a darkened, smoke-filled corridor where you can't read the names on the doors.
- Learn where the nearest pull station is located and how to activate it.
- Post the 9-1-1 or Fire Department Emergency Number on your telephone.
- Learn the sound of your building fire alarm.
- During the annual fire drill which will be conducted by the Fire Safety Director, do the following:
    - Review the basic *IN CASE OF FIRE* procedures posted in the corridors, and Evacuation Procedures.
    - Ensure you know who the Fire Safety Director and Deputies are, and how to contact them.
    - Read the other information provided in Occupant Fire Prevention, Preparedness, & Control
- The cleaning of a smoke alarm with a vacuum cleaner at least twice a year is recommended.
- Volunteer to be one of two designated persons who will assist a person requiring assistance.

Fire Evacuation

- Use a building telephone only if you are safe from the fire
- Do not use the elevator.

- While exiting, walk, do not run. Shut all doors behind you and alert those who have difficulty hearing that an emergency evacuation of the building is under-way.
- Proceed along corridors and through exits in a quiet and orderly manner. High heeled shoes are hazardous while proceeding down stairs, and it is advisable to remove them before entering the stairwell. Do not push or jostle.
- Assist persons requiring assistance to reach the nearest safe exit:
    - try to keep exits clear by permitting others to pass. It may be necessary to hold persons requiring assistance in or near the exit, and wait for fire department assistance.
- If you must use an escape route where there is smoke, stay as low as possible. Crawling lets you breathe the cleaner air near the floor as you move toward the exit.
- Before you open a closed door, feel it with the back of your hand. If it is hot, leave it closed and use your alternate escape route. If it feels normal, brace your body against the door and open it a crack - be prepared to slam it shut if heat or smoke starts to rush in.
- If all exits are blocked by fire or smoke, enter a room preferably with an exterior window, and seal the cracks in the door with available materials to prevent smoke entering the room. Phone 9-1-1 or to report your situation, and attract the attention of someone outside the building by any possible means.
- When you have reached the outside of the building, move away from the exit allowing others behind you to emerge.
- Do not attempt to drive your vehicle from the parking area.
- Do not enter the building again until permitted by a fire department officer or the fire safety director.

Portable Fire Extinguishers

Portable fire extinguishers are useful only if you know how to use them, if they are right for the type of fire you are fighting, and if the fire is discovered immediately. You should not attempt to fight even a small fire until people have been evacuated from the area and the Fire Department has been called. Never attempt to fight a fire if any of the following is true:

- You are uncertain about how to use the extinguisher.
- The fire is spreading beyond the immediate area where it started.
- The fire could block your escape route.
- You are alone.

How To Use A Multi-Purpose Dry Chemical Type Fire Extinguisher

Remember the word: PASS

- PULL the pin
- AIM low... pointing the extinguisher nozzle at the base of the fire
- SQUEEZE the handle... This releases the extinguishing agent
- SWEEP from side to side... at the base of the fire until it appears to be out. Watch the fire area. If fire breaks out again, repeat use of the extinguisher
- REPORT to fire department officer

Most portable fire extinguishers work according to these directions, but some do not. Read and follow the directions on the fire extinguishers within your building.

Fire Hose

Fire hoses are useful only if you know how to use them. You should not attempt to fight even a small fire until people have been evacuated from the area and the Fire Department has been called. Never attempt to fight a fire if any of the following is true:

- You are uncertain about how to use the hose.
- The fire is spreading beyond the immediate area where it started.
- The fire could block your escape route.

How To Use A Fire Hose

- OPEN hose cabinet
- PULL all hose out of rack and remove kinks
- OPEN hose valve FULLY and ensure water flows into hose
- OPEN nozzle and ADJUST to create a wide spray pattern
- APPROACH the fire area
- ADJUST nozzle to produce narrower pattern (NOT a straight stream as this pattern may be less effective)
- DIRECT the water in a circular motion at the base of the flame
- BACK away when the fire appears extinguished, but watch for re-ignition
- REPORT to fire department officer

What to Do in A Severe Earthquake

- STAY WHERE YOU ARE – Don't panic
- SEEK PROTECTION under tables, door frames, stair shafts
- DO NOT SMOKE or use open flames
- If natural gas is leaking follow the Natural Gas Leak Procedures in this manual
- DO NOT use phone to gossip
- Evacuate the building

Natural Gas Leak

- IMMEDIATELY notify the fire department
- PREVENT the operation of electric switches
- PREVENT smoking or open flame
- EVACUATE the building

How to Assist Persons Requiring Assistance

Person requiring assistance may be transported using the following technique:

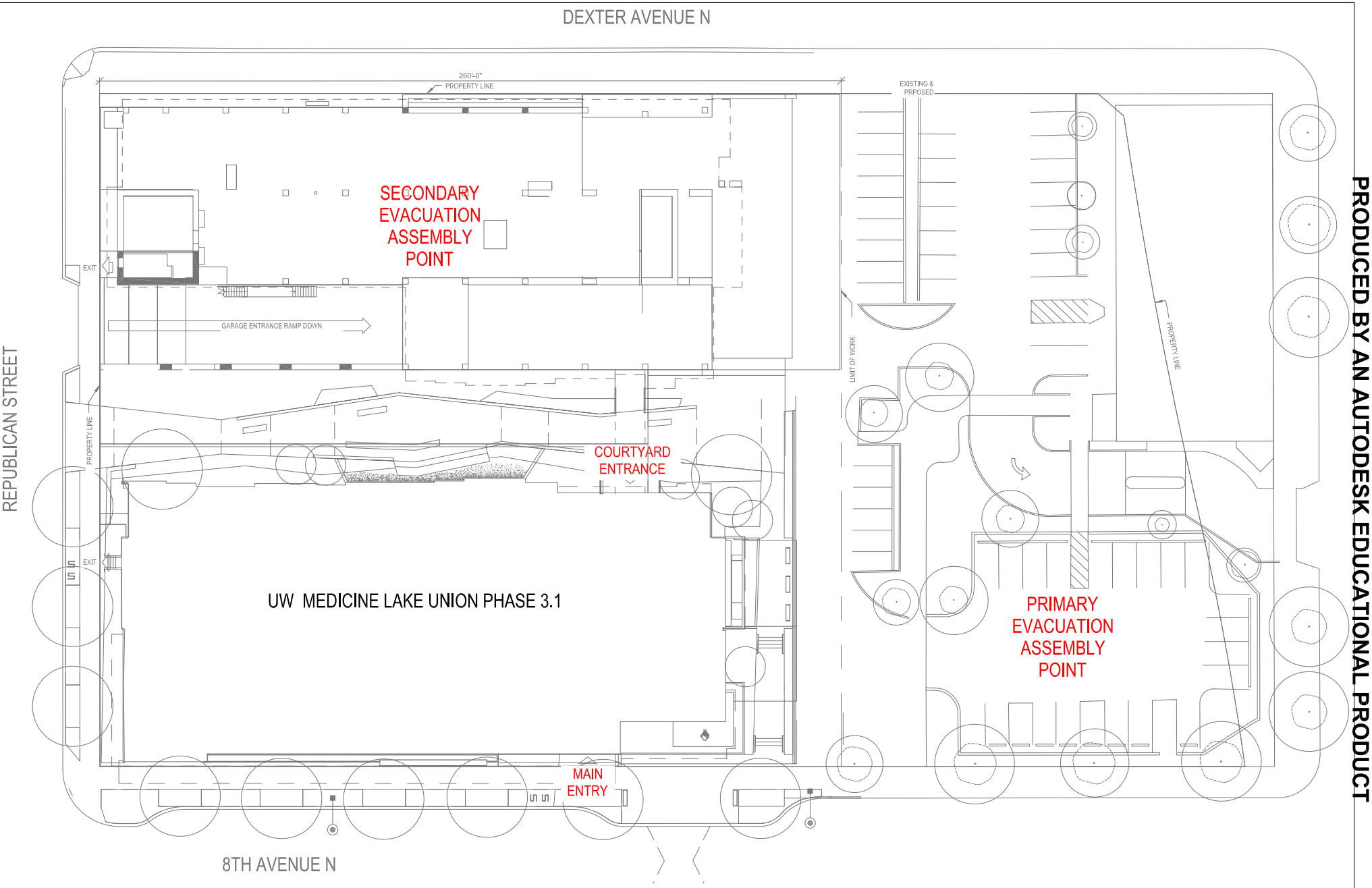
Extremities Carry

- The extremities carry is a two-person carry that is easy to do. The steps are as follows:
- One assistant stands at the head of the person requiring assistance, and the second stands at the feet.
- The assistant at the head kneels and slips the arms under the person requiring assistance arms and around the chest, grasping the person's wrists.
- The assistant at the feet kneels with feet together between the person requiring assistance legs. This assistant grasps the person under or just above the knees.
- The two assistants then stand and carry the person requiring assistance to a place of safety (remember to use your leg muscles when standing up).

7.0 REFERENCES

http://www.ehs.washington.edu/fsoemerprep/evacplan.shtm
http://www.esquimalt.ca/files/pdf/public_safety/fire_safety_plan.pdf
https://www.ehs.washington.edu/fso/
http://www.ehs.washington.edu/ohshsplans/index.shtm

Appendix J: Evacuation Plan



EVACUATION ASSEMBLY POINT

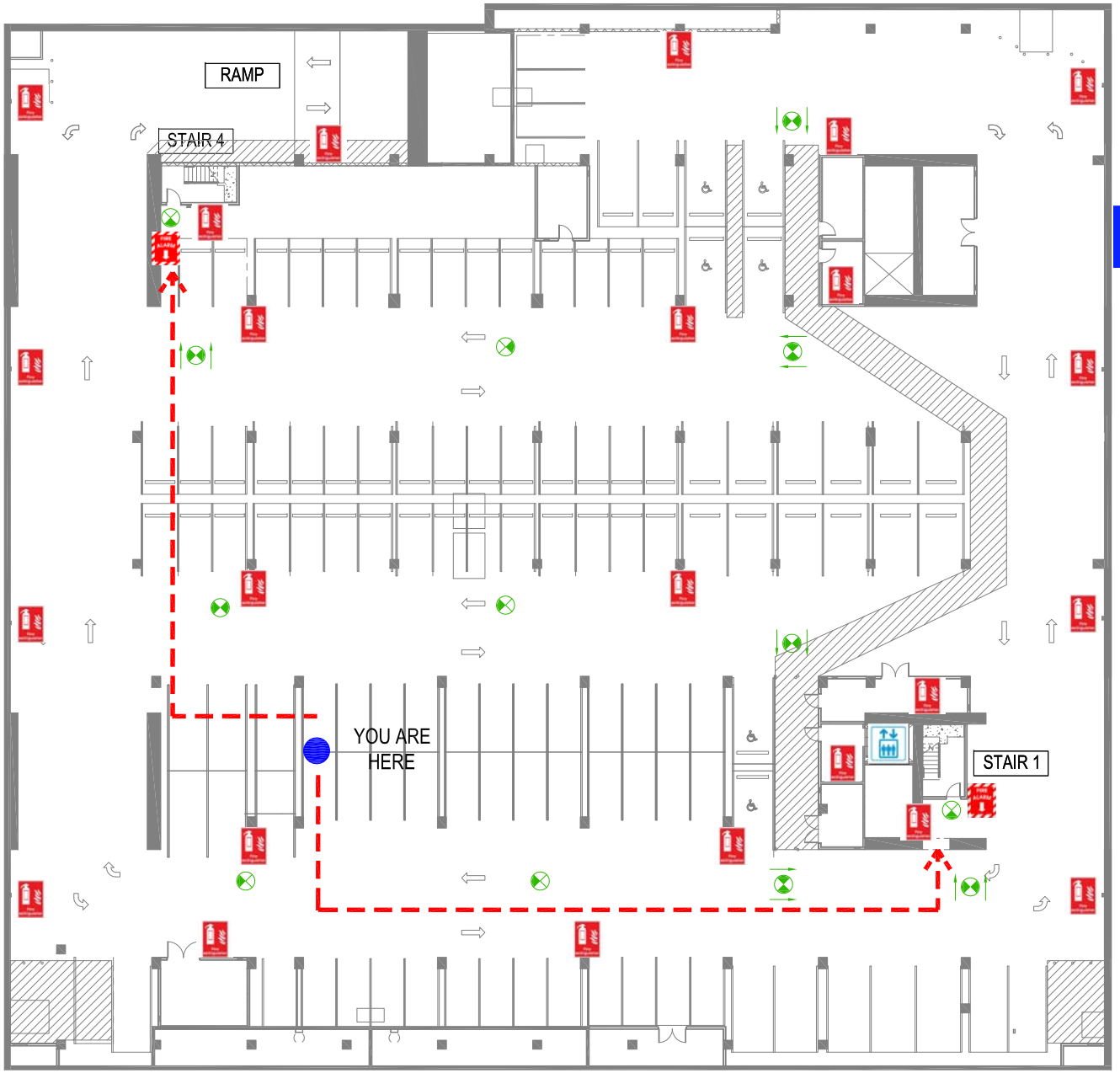
SCALE : NTS

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

CAL POLY
Fire Protection Engineering



KEYPLAN

- YOU ARE HERE
- EVACUATION ROUTE
- EXIT SIGN & DIRECTION
- RESTROOM
- ELEVATOR
- FIRE ALARM
- FIRE EXTINGUISHER
- FACP — FIRE ALARM CONTROL PANEL

IN CASE OF EMERGENCY

- Sound fire alarm
- Assist persons with disabilities
- Exit the building using the nearest exit. DO NOT USE ELEVATORS
- Report to the nearest designated evacuation assembly point
- Do not re-enter until authorized to do so

N

EMERGENCY EVACUATION MAP - BASEMENT LEVEL 3

SCALE : NTS

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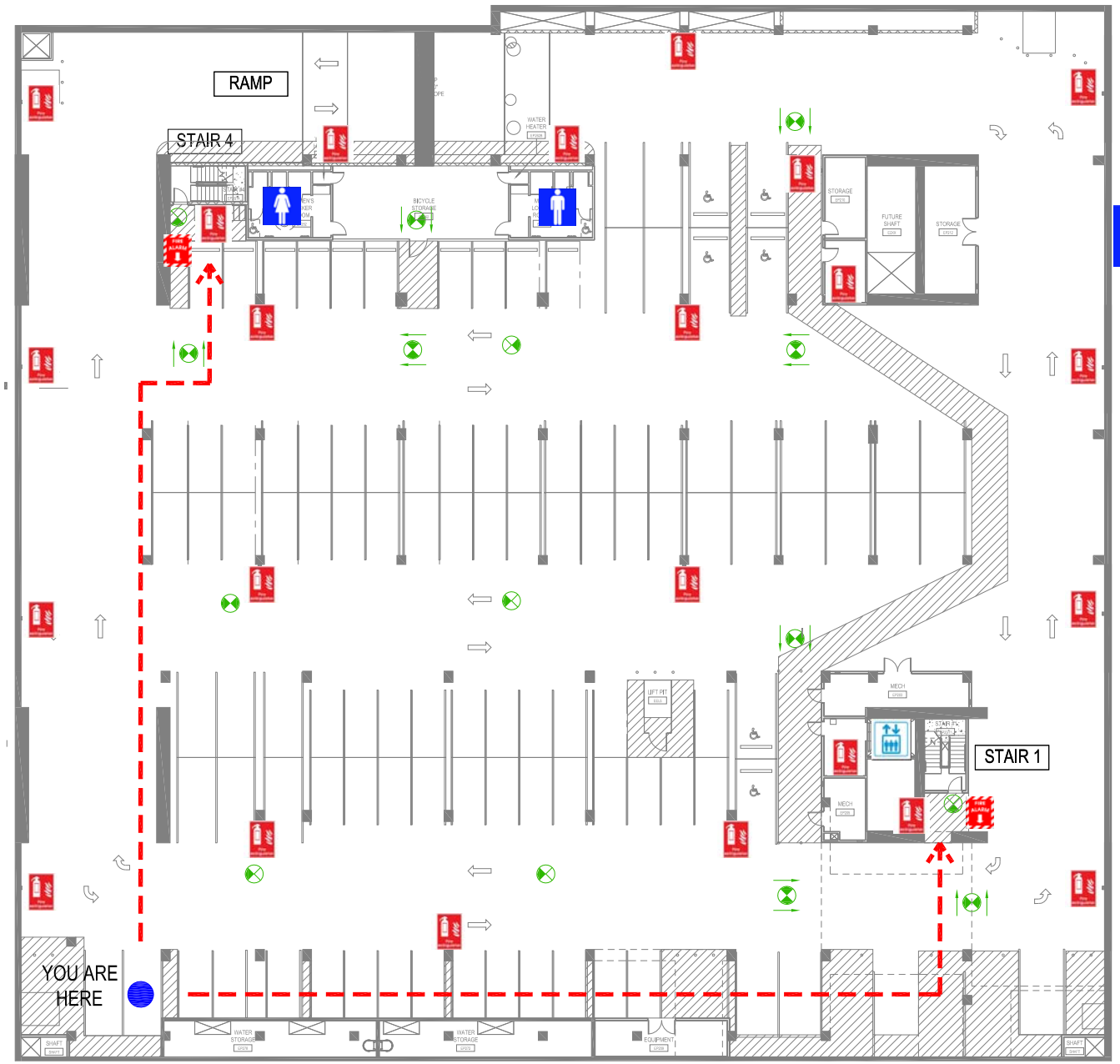

KEYPLAN

- YOU ARE HERE
- EVACUATION ROUTE
- EXIT SIGN & DIRECTION
- RESTROOM
- ELEVATOR
- FIRE ALARM
- FIRE EXTINGUISHER
- FACP — FIRE ALARM CONTROL PANEL

IN CASE OF EMERGENCY

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N

EMERGENCY EVACUATION MAP - BASEMENT LEVEL 2

SCALE : NTS

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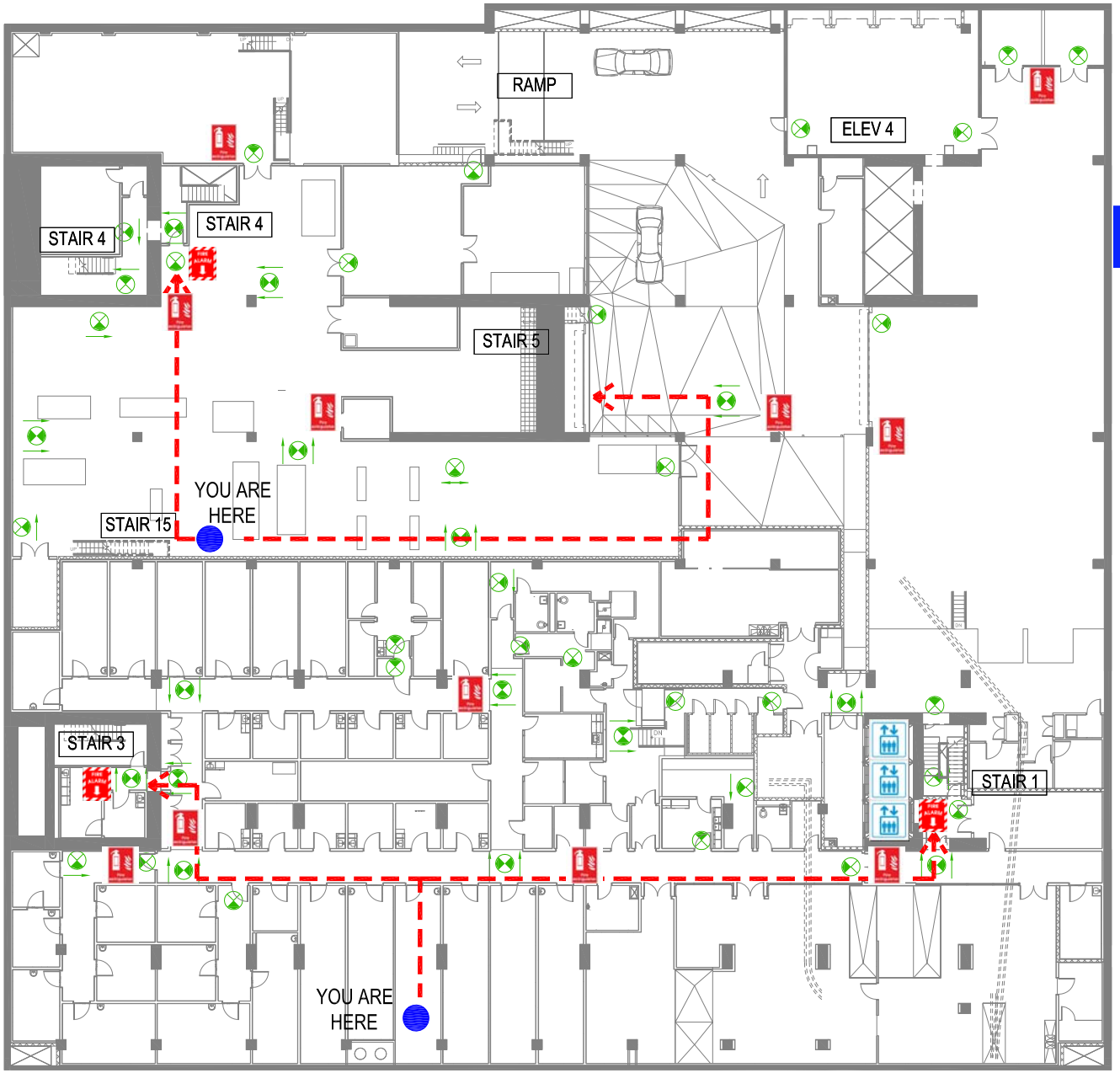

KEYPLAN

- YOU ARE HERE
- EVACUATION ROUTE
- EXIT SIGN & DIRECTION
- RESTROOM
- ELEVATOR
- FIRE ALARM
- FIRE EXTINGUISHER
- FACP — FIRE ALARM CONTROL PANEL

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EMERGENCY EVACUATION MAP - BASEMENT LEVEL 1

SCALE : NTS

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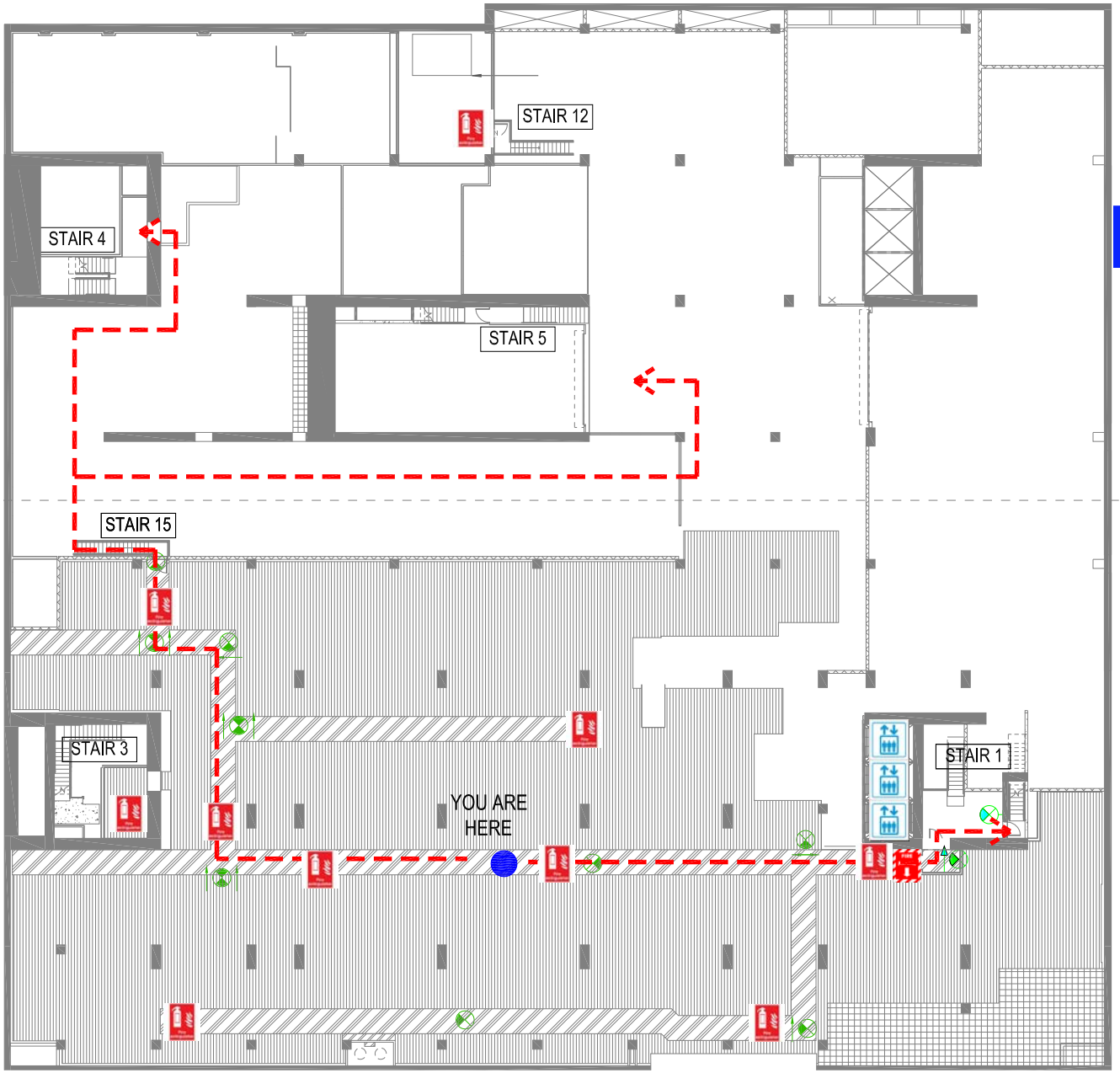

KEYPLAN

- YOU ARE HERE
- EVACUATION ROUTE
- EXIT SIGN & DIRECTION
- RESTROOM
- ELEVATOR
- FIRE ALARM
- FIRE EXTINGUISHER
- FACP — FIRE ALARM CONTROL PANEL

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- Assist persons with disabilities
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N

EMERGENCY EVACUATION MAP - BASEMENT LEVEL 1S

SCALE : NTS

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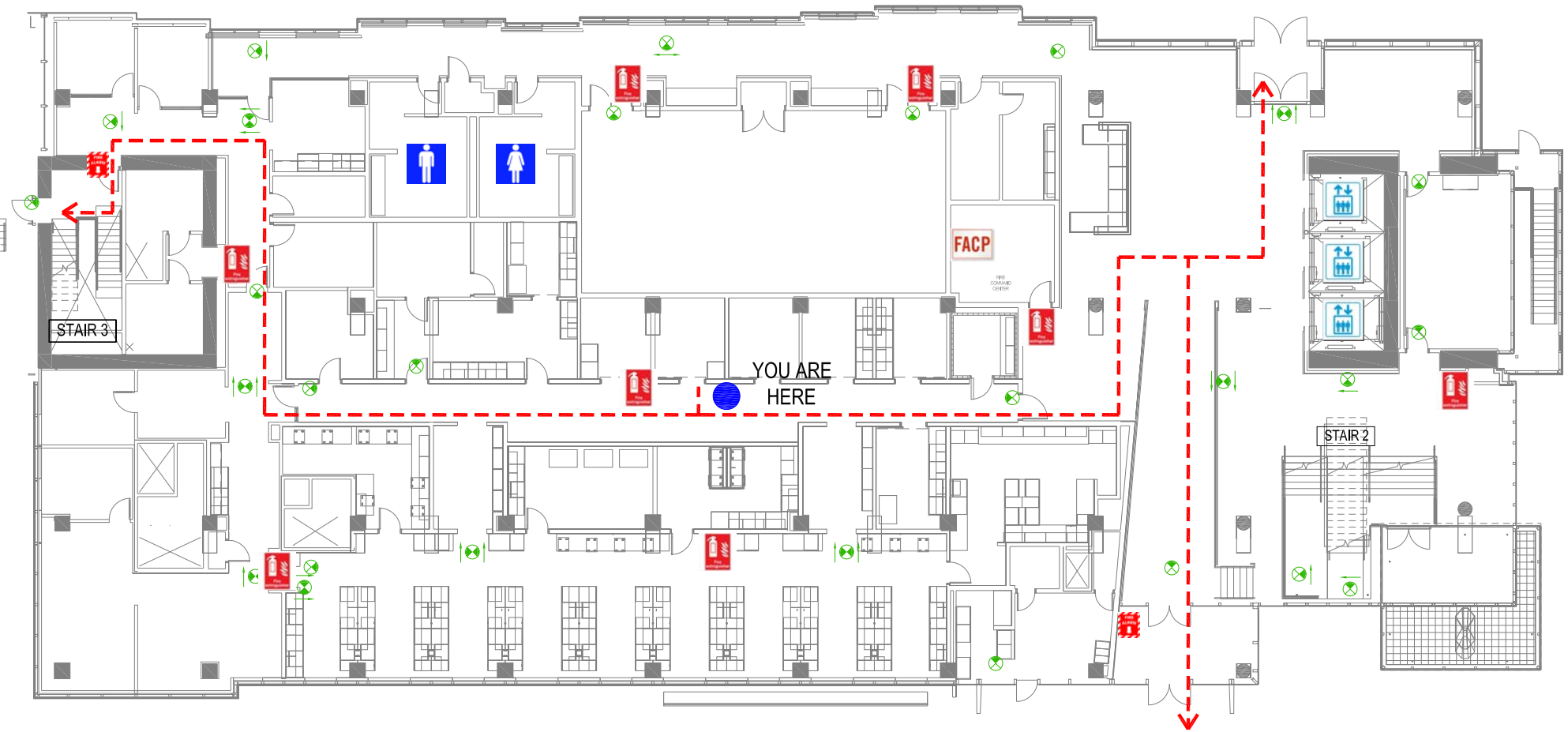

KEYPLAN

- YOU ARE HERE
- EVACUATION ROUTE
- EXIT SIGN & DIRECTION
- RESTROOM
- ELEVATOR
- FIRE ALARM
- FIRE EXTINGUISHER
- FACP — FIRE ALARM CONTROL PANEL

IN CASE OF EMERGENCY

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- Assist persons with disabilities
- Exit the building using the nearest exit. DO NOT USE ELEVATORS
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N

EMERGENCY EVACUATION MAP - LEVEL 1

SCALE : NTS

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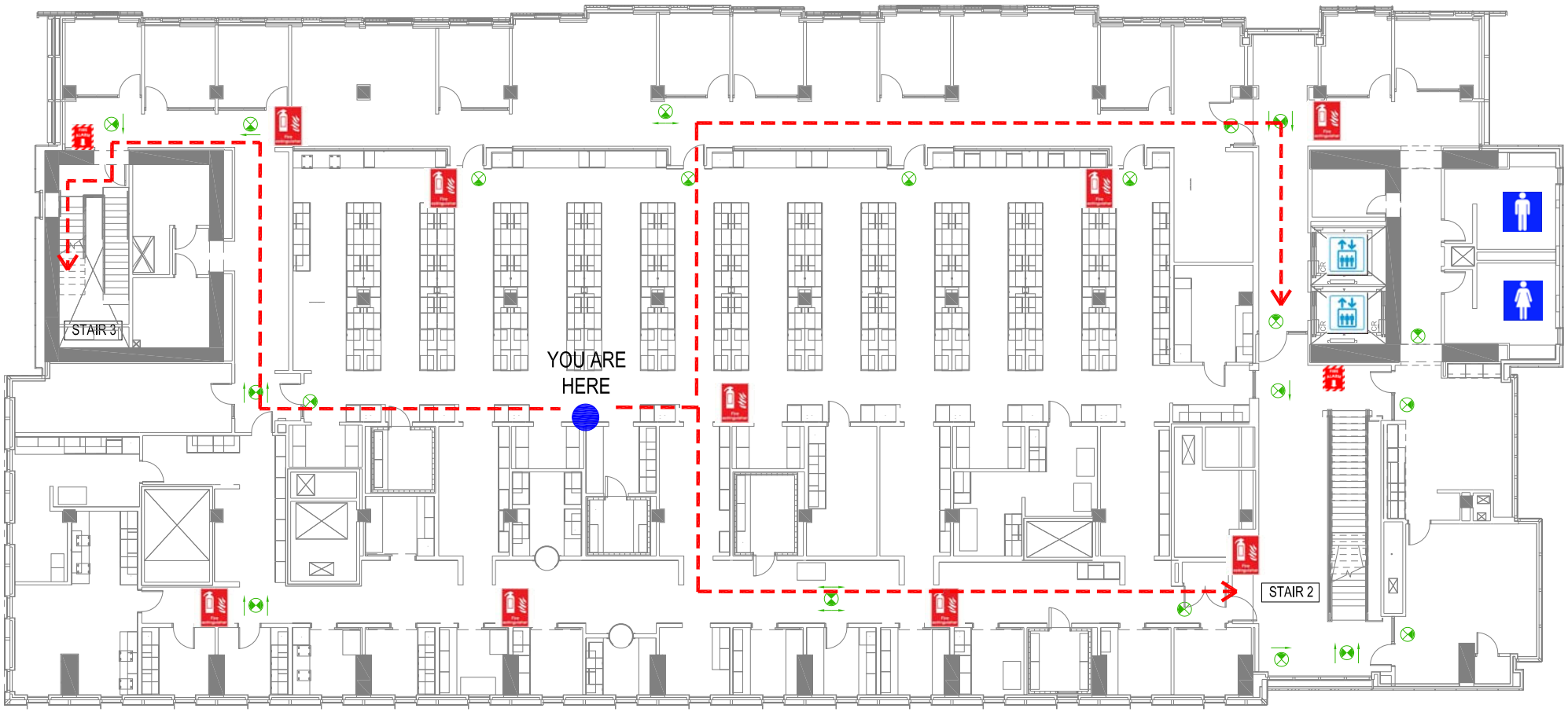

KEYPLAN

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- EVACUATION ROUTE
- EXIT SIGN & DIRECTION
- RESTROOM
- ELEVATOR
- FIRE ALARM
- FIRE EXTINGUISHER
- FACP — FIRE ALARM CONTROL PANEL

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- Sound fire alarm
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N

EMERGENCY EVACUATION MAP - LEVEL 2-6

SCALE : NTS

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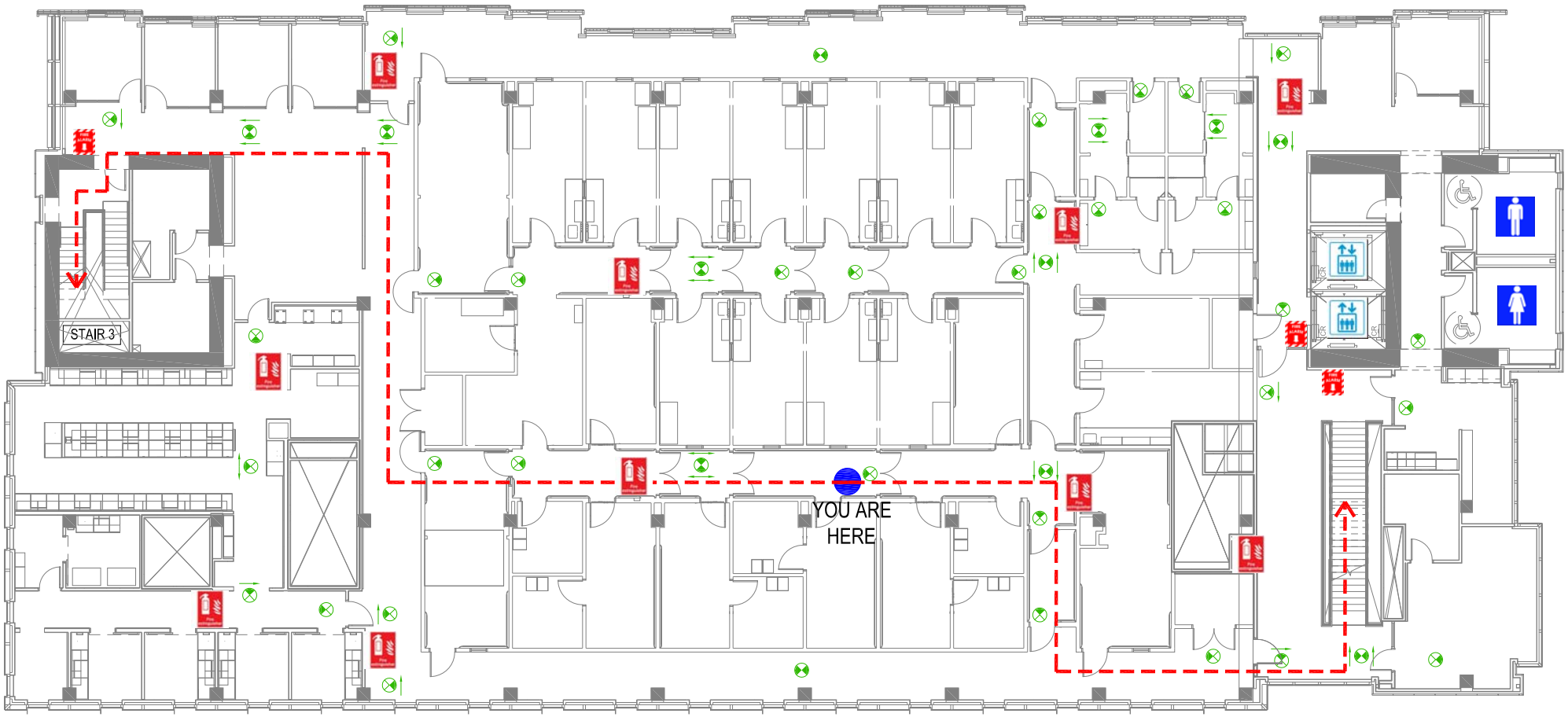
Fire Protection Engineering



KEYPLAN

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- EXIT SIGN & DIRECTION
- RESTROOM
- ELEVATOR
- FIRE ALARM
- FIRE EXTINGUISHER
- FACP — FIRE ALARM CONTROL PANEL

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- Report to the nearest designated evacuation assembly point
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N

EMERGENCY EVACUATION MAP - LEVEL 7

SCALE : NTS

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N

EMERGENCY EVACUATION MAP - LEVEL 7S

SCALE : NTS

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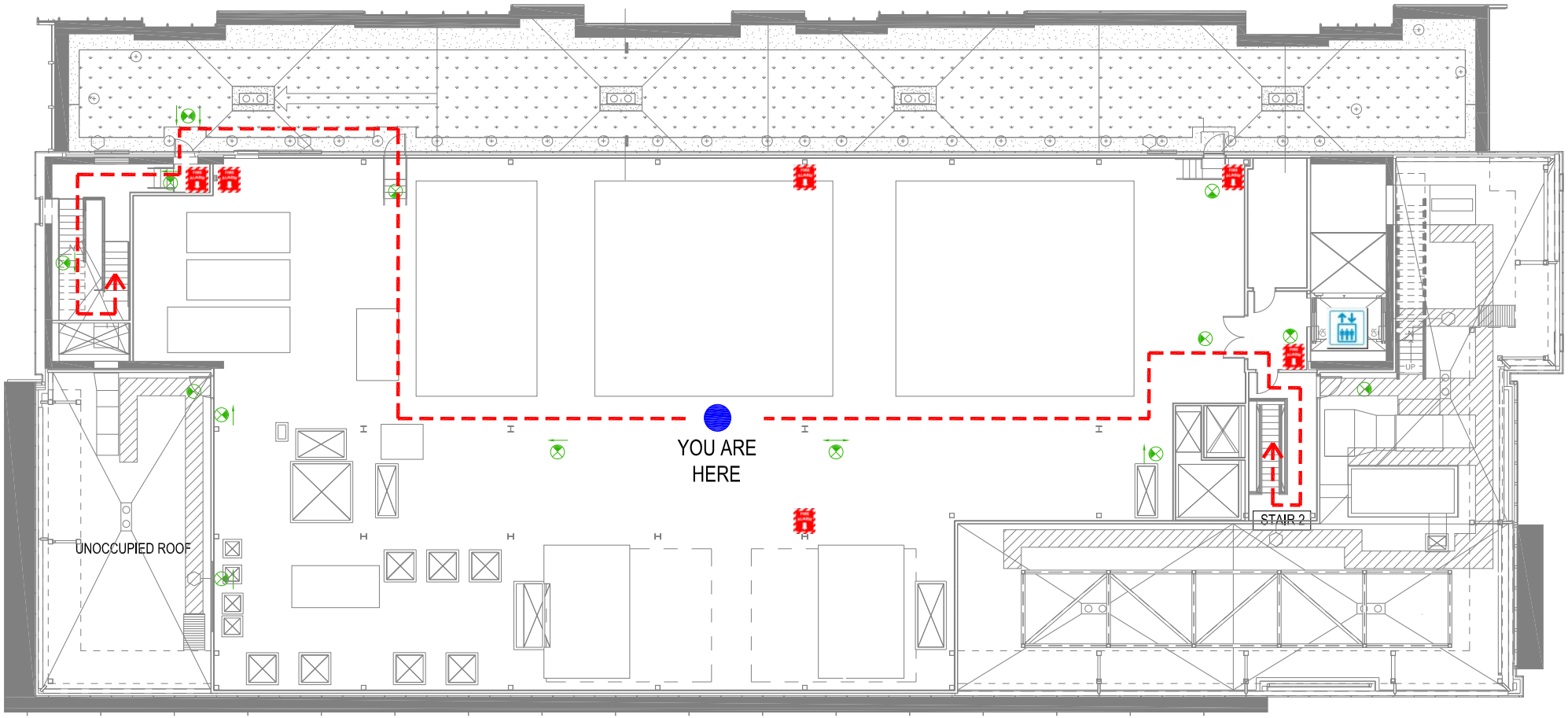

KEYPLAN

- YOU ARE HERE
- EVACUATION ROUTE
- EXIT SIGN & DIRECTION
- RESTROOM
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- FIRE ALARM
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EMERGENCY EVACUATION MAP - PENTHOUSE

N

SCALE : NTS

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