FPE 596 Culminating Project
Warren J. Baker Center for Science and Mathematics
California Polytechnic State University, San Luis Obispo Campus

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Key words:

Warren J. Baker Center for Science and Mathematics, California Polytechnic State University, San Luis Obispo, Cal Poly, Fire Protection Engineering, life safety, sprinkler system, fire suppression, fire alarm, structural fire protection, smoke control, performance based design, design fire, NFPA 13, NFPA 14, NFPA 20, NFPA 25, NFPA 70, NFPA 72.

Index

Abstract

The purpose of this report is to analyze the Warren J Baker Center for Science and Math on the California Polytechnic State University, San Luis Obispo campus. Baker Science is primarily used for classroom and laboratory instruction of college students, with study spaces, faculty offices, and assembly spaces. There are mechanical, electrical, and storage spaces ancillary to the main building functions. The building comprises six floors that are between 23,000 and 44,000 ft^2. The first floor contains classrooms, faculty offices, mechanical/electrical spaces, and an auditorium with fixed seating. An atrium connects floors two through five. There are walkways running down the center of the atrium with openings on both sides. These floors all contain a mix of classrooms, laboratories, faculty offices, study spaces, and supporting mechanical, electrical, and storage rooms.

The prescriptive analysis of the Baker Science building determines if the building construction complies with the applicable codes and standards. These codes and standards cover life safety, fire suppression, fire alarm and detection, and structural requirements. The life safety section analyzes the ability of the building to safely evacuate occupants in a timely manner. This is accomplished with code-specified stair and door widths, exit locations, and exit fire rating requirements. The building is protected throughout with an automatic wet pipe sprinkler system, fed from a fire pump on the first floor. The fire pump is supplied from a city water loop to the north of the building. All sprinklers in the building are quick response K-5.6 sprinklers. The fire suppression system activates the fire alarm system in the event of a fire. The alarm system can also be activated with smoke alarms, heat alarms, and manual pull stations. The generation of any part of the fire alarm system in the atrium will activate the passive smoke control system. This system opens roof vents that allow smoke to escape, and also opens doors at the bottom of the atrium to provide makeup air. Doors to the wings of the building are released and closed to reduce the travel of smoke to the east and west wings. The structural fire protection codes provide occupancy separation requirements, and limit building height and area based on construction type.

The performance based analysis seeks to determine how well the building systems can handle a real-life fire scenario, with a focus on building occupants being able to safely evacuate the building in the event of a fire. The ability to safely exit the building is based upon the requirement for tenability to be maintained in the egress route for the entire time it takes for evacuation to be completed. The performance analysis in this report centers around two design fires: one in the atrium, and one in the lobby outside the assembly space. The design fires represent scenarios that would challenge the fire protection capabilities of the building, while still having a probability of occurring. Small fires or fires in unoccupied spaces were not analyzed since they would be unlikely to test the limits of the building's fire protection systems. The design fire in the atrium exposed occupants to smoke and combustion products, and activated the atrium smoke control system. The smoke venting was inadequate to remove the smoke created by this design fire, resulting in smoke accumulation that limited the visibility of occupants egressing on the sixth floor. The available safe egress time is 3.23 min after ignition, based on the minimum visibility of 4 m being lost on the sixth floor, while that floor has a required safe egress time of 3.96 min. The design fire in the lobby outside the auditorium also exposed occupants to smoke, limiting visibility. The available safe egress time in the lobby is 2.00 min, at which point the 13 m visibility limit is

no longer maintained. The required safe egress time is 8.64 min from the time of ignition, significantly longer than the time available to occupants.

Prescriptive analysis of the Baker Science building determined that the building was adequately built to the relevant life safety and fire codes. The performance based analysis discovered some shortcomings in the building design. These faults were primarily centered around tenability time for evacuating occupants in the building. On the sixth floor in the atrium, occupants experienced reduced visibility that could impede their ability to safely find the exits and safely escape. The cause of the reduced visibility was the buildup of smoke from the fire, which in turn was caused by inadequate smoke removal by the smoke control system. As a passive system without fans, the smoke can only be removed at a limited rate. One solution to this would be to install additional passive smoke vents. A better solution would be to install powered smoke vents with a rating capable of evacuating adequate smoke from a challenging design fire. Inadequate visibility was also the conclusion of the second design fire. The tall ceiling outside the auditorium filled with smoke, limiting the visibility of evacuating occupants. Installing smoke control capability in the lobby could remedy this deficiency. An easier solution would be to install doors in the auditorium that do not egress into the lobby. This would allow auditorium occupants to avoid the smoke entirely, while reducing the congestion in the lobby for people evacuating from other parts of the first floor. The Baker Science building serves as an example of properly executed code implementation, with failings that can be exposed with demanding design fires.

Introduction

The goal of this report is to perform an analysis of the fire protection systems in the Baker Science building on the Cal Poly campus. Various aspects of building construction and design will be evaluated for prescriptive design, including life safety, fire suppression, fire alarm, and structural design. The building construction documents will be compared to applicable building and fire protection codes to determine if the requirements are achieved. Additionally, a performance based analysis will be conducted with two design fires to determine how well the building would achieve life safety goals in the event of real fire scenarios. This report will present a summary of relevant code sections and how the building complies with them, performance based analysis scenarios and conclusions, and recommendations based on these.

Background

The Warren J. Baker Center for Science and Mathematics (Building 180) was constructed in 2013 to serve the expanding needs of the Cal Poly campus. The building contains classrooms, lecture halls, science laboratories, faculty offices, study spaces, and mechanical/electrical rooms. The new building was necessary to replace Building 52, also known as the “spider building,” which was built in the 1940’s. Building 52 was not large enough for a growing campus, and lacked modern technology commonly used in science labs today. Figures 1 and 2 show different views of the exterior of the building.

Figure 1. West side of Baker Science with first floor entrance.

Figure 2. South side of Baker Science.

Layout

Baker Science has six separate floors, although no part of the building is more than five stories tall, due to being built on a hill. The first floor of the building has a large auditorium, some classrooms, and faculty offices. There are also mechanical/electrical spaces on the first floor. The first floor has one main entrance with three double doors, the vast majority of the traffic into and out of the first floor is through here. Design Fire 2 was chosen due to the proximity to the primary exit and to a large occupancy auditorium. A large fire near a familiar exit would force people to find secondary exits. The ceiling above the lobby in this space is 37 ft tall, extending to the third floor. The height of the ceiling would delay the time to sprinkler activation, allowing the fire to grow larger than a fire in a smaller space.

Floors two through six are connected by a two-sided atrium that is split by a walkway. This atrium is a major fire concern for this building, and is the focus of Design Fire 1. There are two major exits to the second floor on opposite sides of the atrium. Halls extend east and west from the main lobby, providing additional ground-level exits.

The third floor has a similar footprint as the second floor, but has a walkway separating the two sides of the atrium, and no ground level exits. There are two exit stairs in the atrium: the southern one is enclosed by walls, and the northern one is open to the atrium. Floors three through six all have stairs on the east wing. The third floor has two stairs on the west wing and the fourth floor has one stair on the west wing. There is no west wing for floors five and six. Floors four through six have comparable layouts to the third floor, except each subsequent floor does not extend as far to the west (above the first floor). The smaller footprints of the higher floors keep any part of the building from being greater than five stories tall. Floor layouts are shown in Figures 3 through 9, with more detail of occupancy and exits shown in Appendix A. Exit doors in these images are circled in red and stairways are highlighted in red.

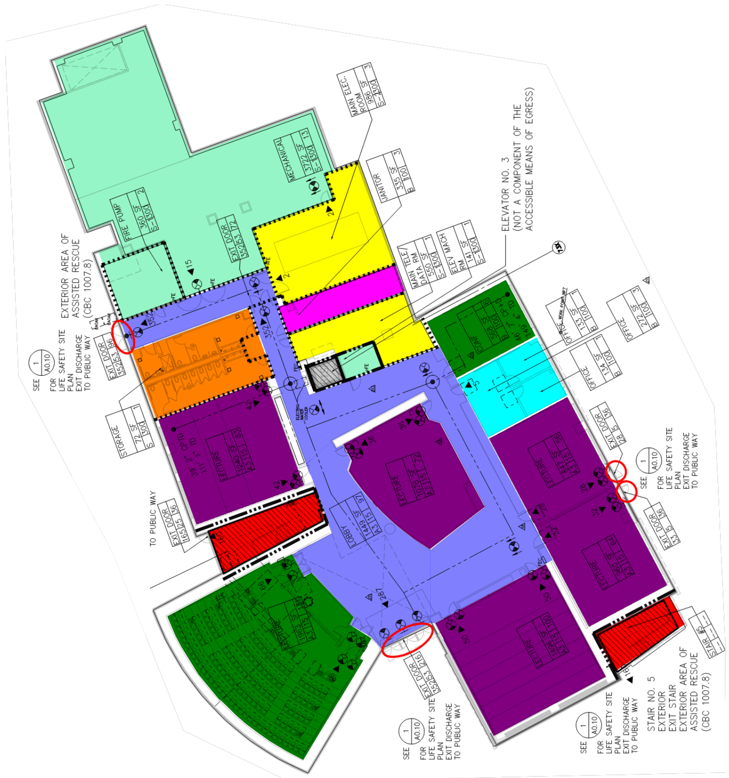


Figure 3. First floor.

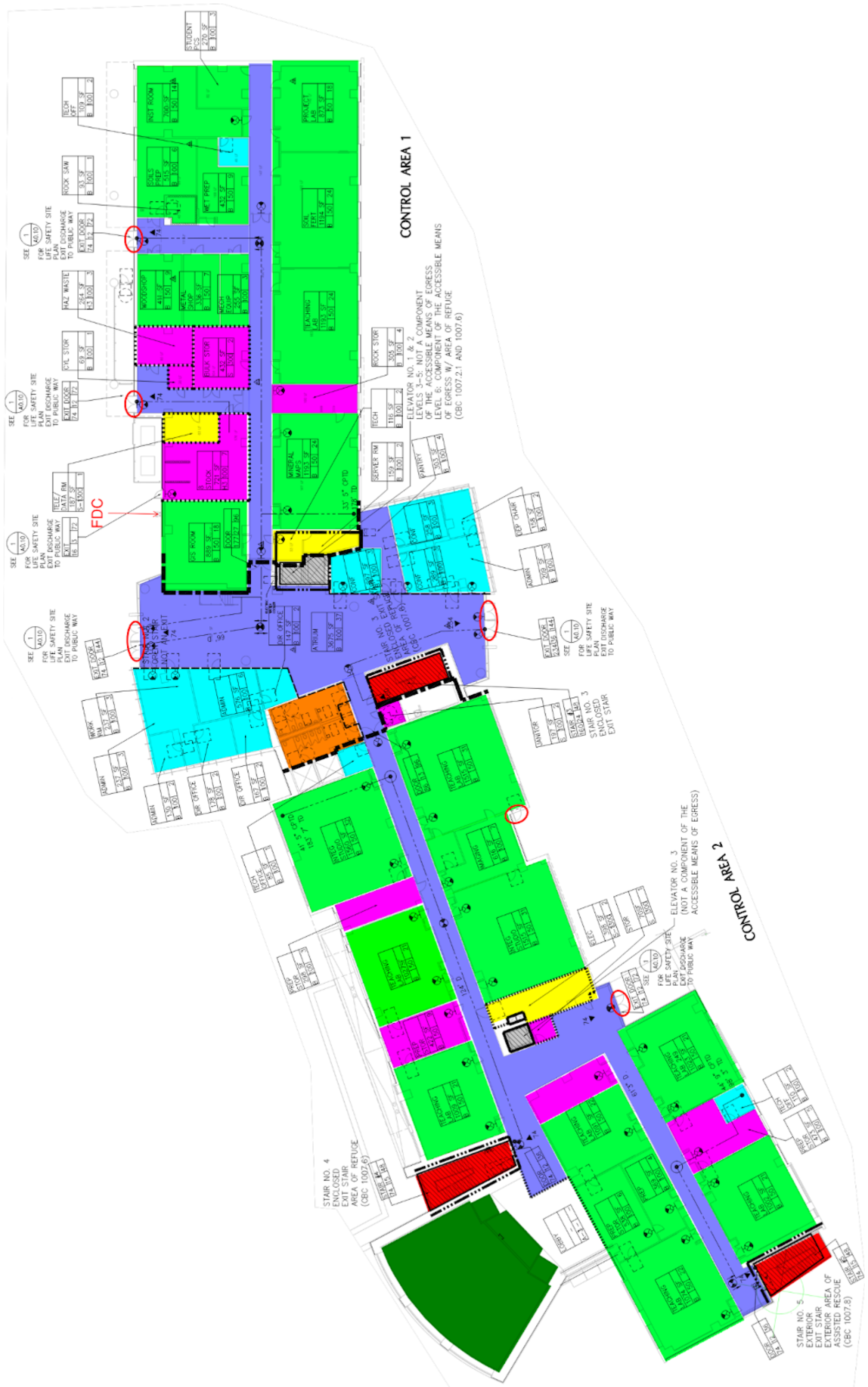


Figure 4. Second floor.

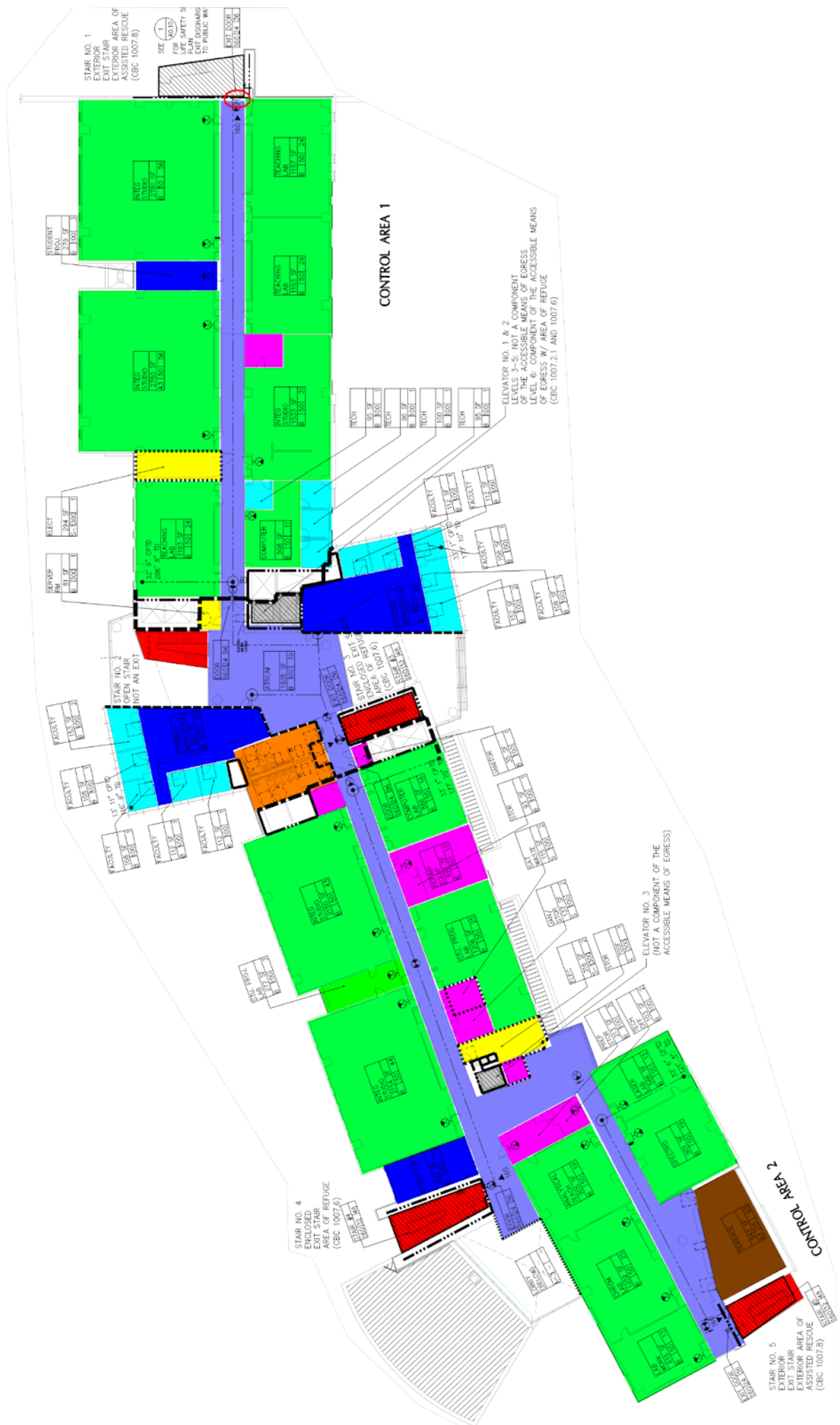


Figure 5. Third floor.

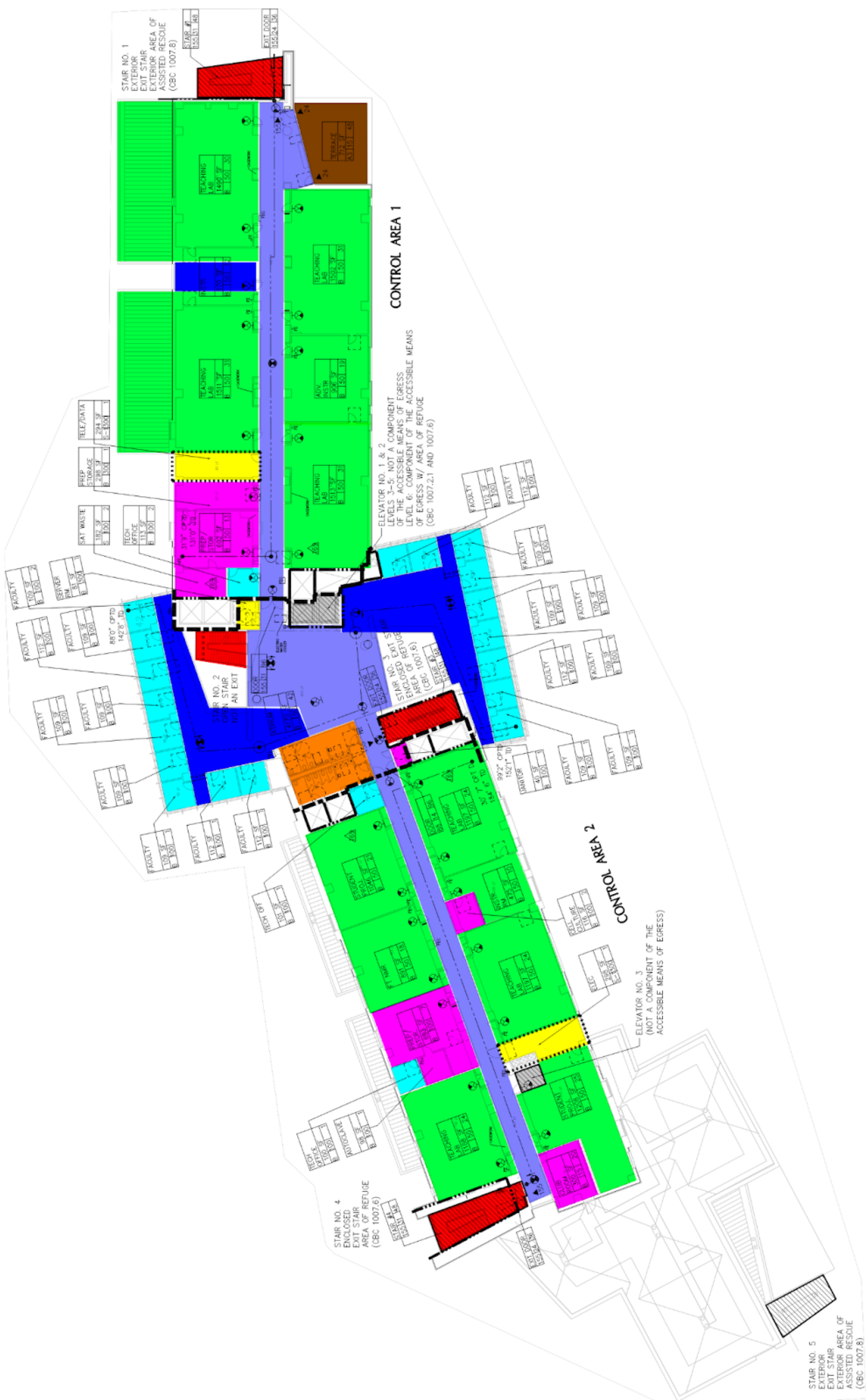


Figure 6. Fourth floor.

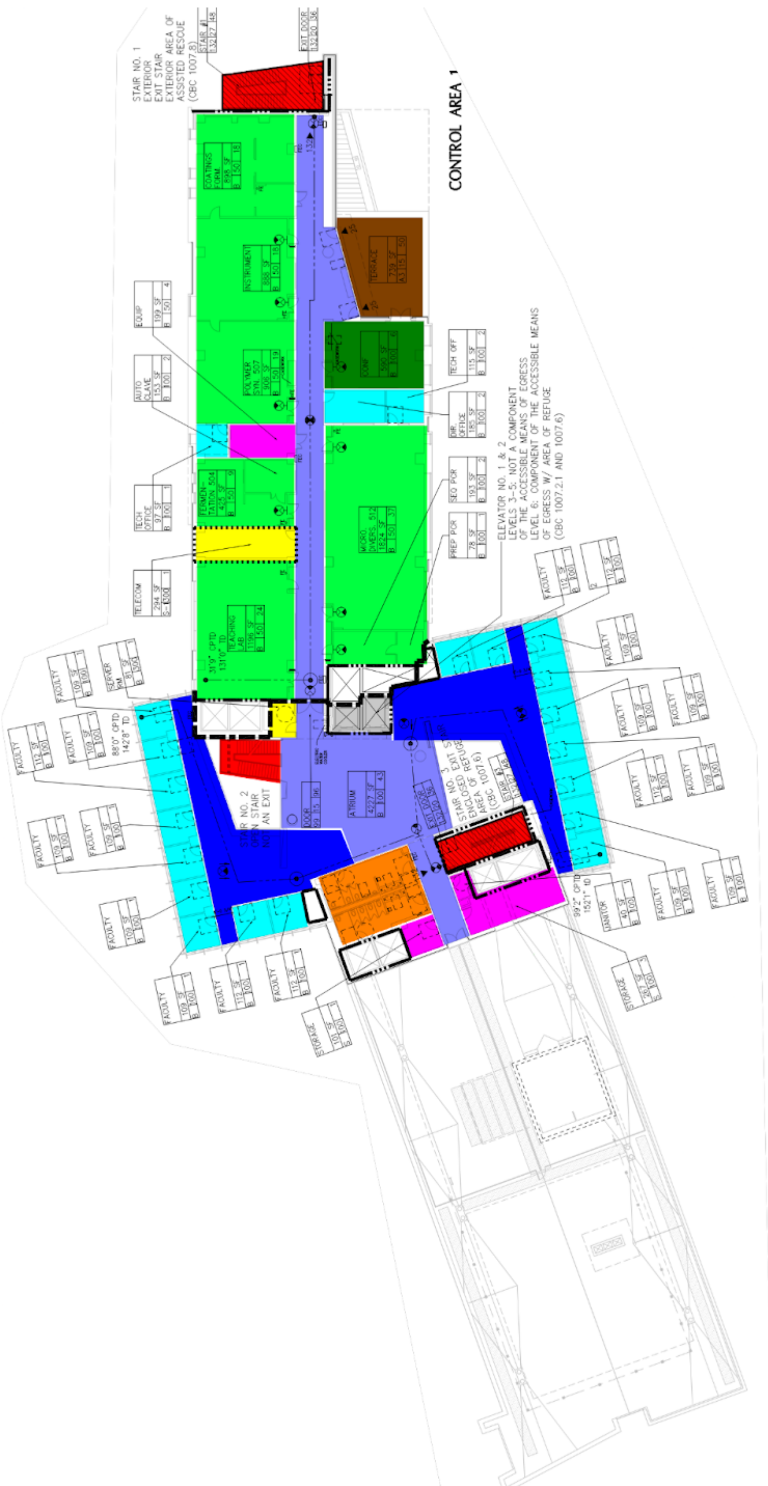


Figure 7. Fifth floor.

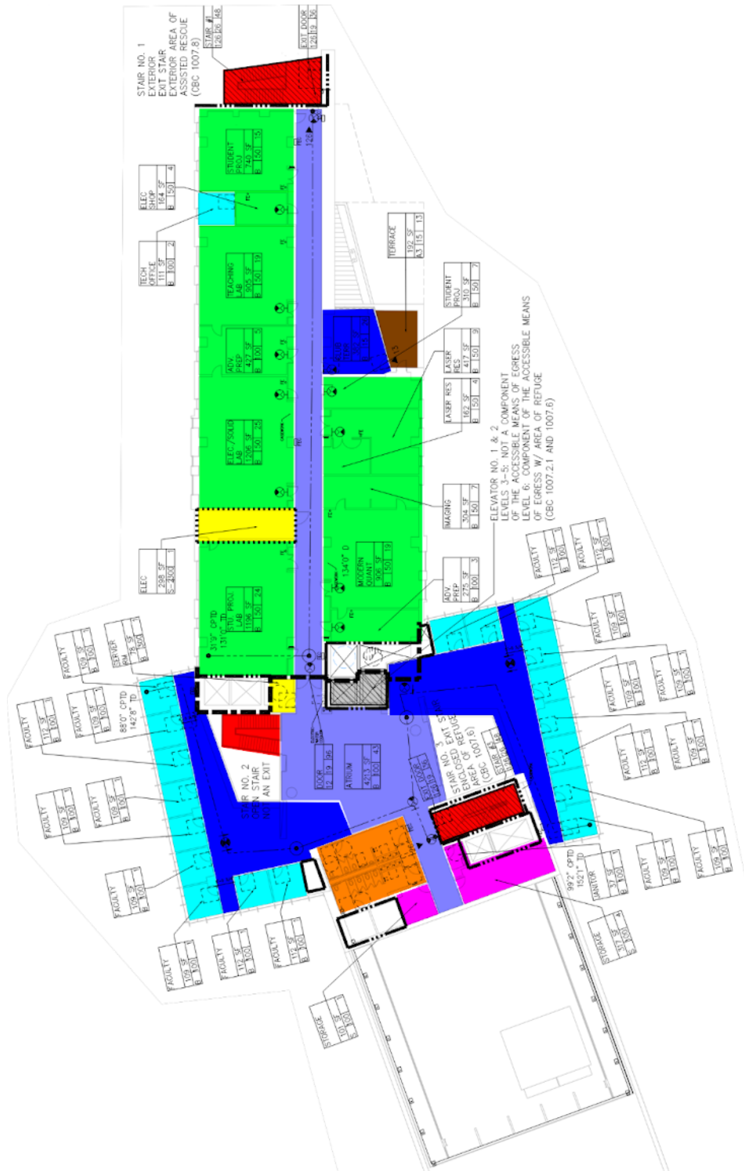


Figure 8. Sixth floor.

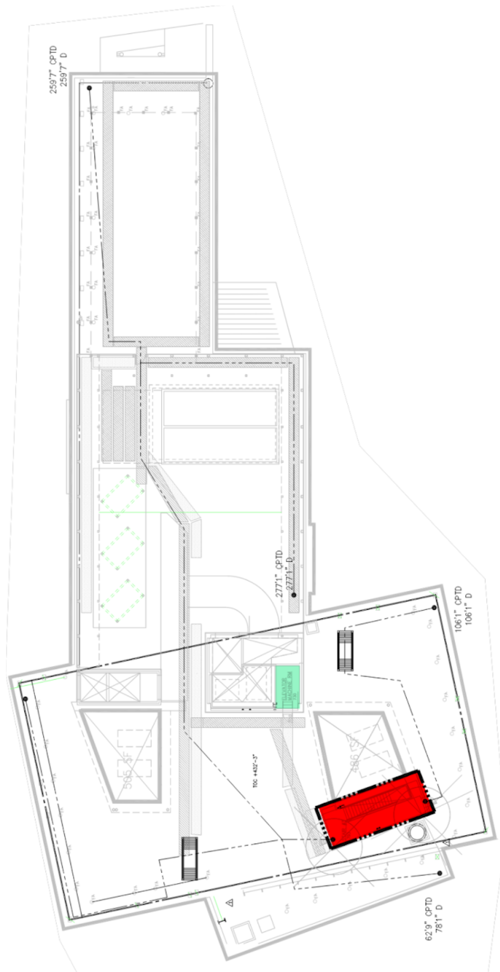


Figure 9. Roof.

Prescriptive Analysis

Codes Used

The following codes were used for the construction of this building:

- CBC, California Building Code, 2007
- NFPA 13, Standard for Installation of Sprinkler Systems, 2007
- NFPA 14, Standpipe and Hose Systems, 2004
- NFPA 20, Stationary Pumps for Fire Protection, 2003
- NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 2002
- NFPA 70, National Electric Code, 2005
- NFPA 72, National Fire Alarm and Signaling Code, 2007

Life Safety

Exit Considerations

Each space and floor is required to have an egress capacity greater than the rated occupancy. To calculate egress capacity, exit door and stair widths need to be known. Occupancy rating is based on occupancy load factor and area of each space. For an entire floor of a building the occupancy rating for each space is added to arrive at the total occupancy for the floor. The exits for each floor in the building and the calculated egress capacity are listed below. CBC 1005.3.1 requires an egress capacity for stairs of 0.2" of width per occupant in a sprinklered building with an emergency voice/alarm system. CBC 1005.3.2 gives an egress capacity for components other than stairs (such as doors) of 0.15" per occupant in a sprinklered building with an emergency voice/alarm system. Stairs 1, 2, 4, and 5 have a tread width of 3' 11", and stair 3 has a width of 3' 6". Stair 2 is not included as an exit, as it is exposed to the atrium and does not comply with the requirements of a protected means of egress. All doors leading to and from the stairs are 36" wide, with a clear width of 33.5". An example egress calculation for each is shown below for Stair 1:

Stair: $C = \frac{47"}{.2"/person} = 235\ people$

Door: $C = \frac{33.5"}{.15"/person} = 223\ people$

For stairs 1, 4, and 5, the door is the more limiting factor, with 223 people. For stair 3, the narrower stair is the more limiting means of egress, with a capacity of 210 people. The more limiting value is always used to calculate egress capacity where there are two or more implements of egress in a row. Formula 7.3.3.1 will be used for doors of all widths for the building. The exit data calculation results are summarized below.

1st floor

Independent exit path, not connected to other floors except elevators.
Main exit, 3x63"
Stairway exit door, 34.5"
95" doors by mechanical room
Egress capacity for the floor: 1928

2nd floor

Atrium: 4x70", north and south
Two 69" exits on north side of east wing
69" exit on south side of west wing
Two 33.5" doors to stairways in west wing
34.5" door from 261
Egress capacity for the floor: 2878

3rd floor

34.5" door to 47" stair on east, center, and two to the west
Egress capacity for the floor: 720

4th floor

34.5” door to 47” stair on east, center, and west

Egress capacity for the floor: 680

5th floor

34.5” door to 47” stair on east and center

Egress capacity for the floor: 453

6th floor

34.5” door to 47” stair on east and center

Egress capacity for the floor: 453

Roof

34.5” door to 47” stair

Egress capacity for the floor: 235

Color-coded map

Submitted with this report is a color-coded map of the various spaces, shown in Appendix A. A campus PDF map was obtained, then highlighted to show the use assigned to each space in the building. Exit doors were circled in red. A legend for the color-coded occupancy uses is shown in Figure 10.

Figure 10. Map color legend.

Occupancy and Exit Capacity

The main uses of the building are classroom, lab, storage, office, and assembly. Table 1 summarizes occupancy, floor exit capacity, and number of exits for each floor of the building. Notice that the exit capacity of each floor exceeds the rated occupancy. The egress data for each individual space was also calculated, and every room and space in the building has adequate egress capacity for its occupancy.

Table 1. Summary of area, use, occupancy, exit capacity, and number of exits.

Floor	Area (ft^2)	Uses	Occupancy	Exit capacity	No of exits	Req no of exits
1	23146	Assembly, mech/elec, storage	639	1982	5	3
2	43458	Business, storage, assembly	524	3840	8	3
3	43209	Business, storage, assembly	701	879	4	3
4	33307	Business, storage, assembly	464	656	3	2
5	25294	Business, storage, assembly	263	433	2	2
6	19958	Business, storage, assembly	251	433	2	2
Roof	20236	Mech/elec	6	223	1	1

Arrangements of Exits

Business and assembly spaces or rooms with greater than 49 occupants must have more than one exit, from CBC Table 1006.2.1. CBC Table 1006.3.1 requires storeys with occupancy up to 500 to have two exits, occupancy between 501 and 1000 to have three exits, and greater than 1000 to have four exits. Table 1 above shows the required and actual number of exits for each floor of the building. Baker Science was designed with an adequate number of exits for all spaces and floors. Per CBC 1007.1.1, the minimum separation distance between exits (in a sprinklered space) shall not be less than one third the maximum diagonal distance of the space. For all of the spaces that require more than one exit, the exits are arranged to exceed the minimum required distance of one third the building diagonal measurement. This minimum spacing is achieved for all individual rooms, such as the auditorium on the first floor, all labs and classrooms, and the entire stories as a whole. A summary of storey diagonal distance, required exit spacing, and actual spacing is shown in Table 2.

Table 2. Exit spacing data.

Floor	Diagonal Distance (ft)	1/3 Diagonal distance (ft)	Exit spacing (ft)
1	248	83	160
2	481	160	413
3	481	160	451
4	407	136	344
5	248	83	220
6	248	83	220

Dead Ends and Travel Distances

Per CBC Table 1017.2, the total travel distance limit for a sprinklered business occupancy is 300 ft. This limit is not reached anywhere in the building. Table 1006.2.1 provides limits for common paths of travel. In a sprinklered business occupancy, the limit is 100 ft. This limit is approached (~96 ft) on the fourth, fifth, and sixth floors near the office areas, but is not exceeded. The maximum dead end travel distance in sprinklered business occupancies is 50 ft, from CBC 1020.4. This limit is exceeded by 3' on the east side of the second floor, as shown in Figure 11.

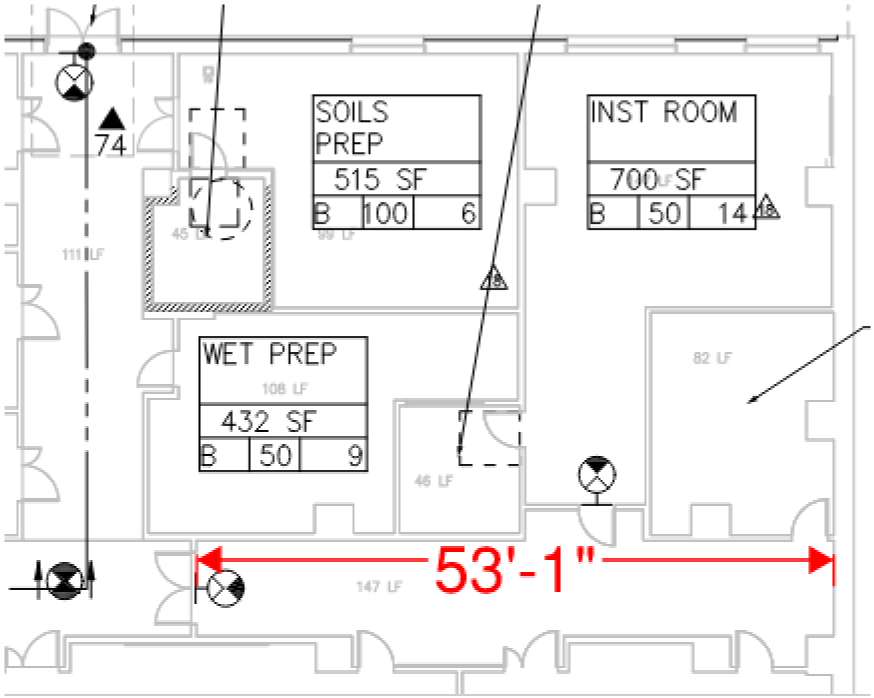


Figure 11. Dead end travel distance is exceeded on the second floor.

Fire Ratings

This building has fire rated walls to meet a variety of code requirements. The east and west wings of the building are separated from the atrium with horizontal exits. These horizontal exits create control areas, which require 2 hour fire separation, per CBC 414.2.4. The vertical exit enclosures require two hour fire ratings, in accordance with CBC 1020.1, since Baker Science is more than four storeys tall. Examples of these fire ratings are shown in Figure 12 with the horizontal exits highlighted in red and the vertical exit highlighted in green. Individual occupancies need to be separated from adjacent occupancies per CBC Table 508.3.3. A one hour fire rating is required between business, assembly, storage, and high hazard group occupancies. Baker Science complies with all required fire rating requirements for exits and occupancy separation.

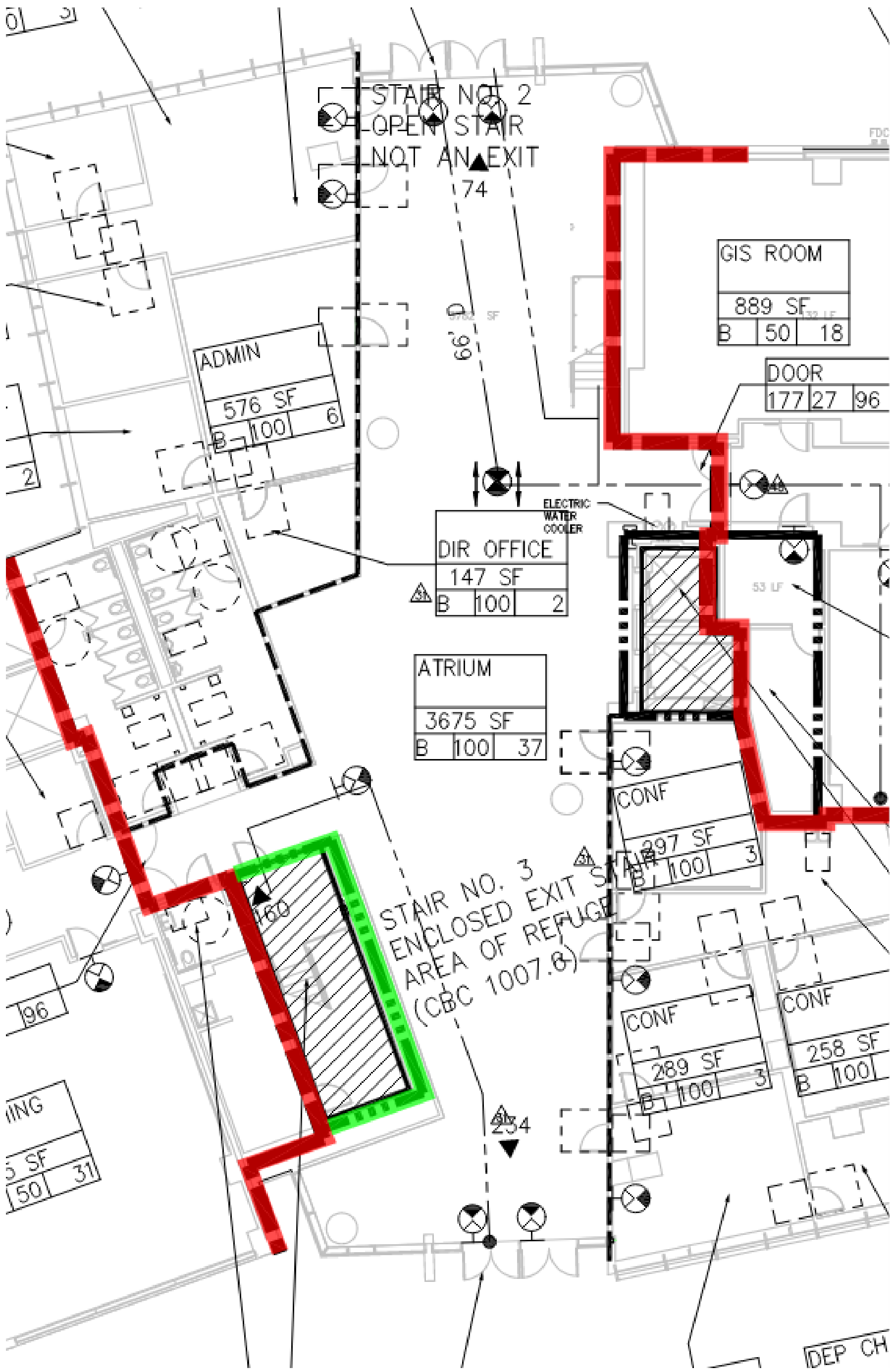


Figure 12. Example of fire ratings separating control areas (red) and area of refuge (green).

Exit Signs

Marking of means of egress is required by CBC 1013.1. Placement of exit signs is important to help people unfamiliar with the building safely escape during a fire, and for people trying to find a safe exit path in heavy smoke. This section of the code states that an exit sign must be visible from 100 ft or less in an exit passageway. These exit signs must be illuminated at all times. The farthest distance from an exit sign is in the east wings of floors three and six. Two exit signs in the corridors are 173 ft apart, so standing halfway between the signs is 86.5 ft from the nearest sign.

Occupancy Characteristics

This building will serve students and faculty in lab, classroom, and office settings. There are also storage, mechanical, electrical, and service spaces. These spaces will primarily be used by the building staff. The people who use the building will likely be familiar with the layout, aiding in their ability to evacuate efficiently if necessary.

Since most of the capacity consists of classrooms and labs, students are expected to comprise most of the people in the building. If a fire were to occur, they would likely be led to evacuate by a professor. Many of the students would take the time to pick up their notes, computers, and backpacks. Cluttered aisles between desks could create tripping hazards and slow egress slightly. The laboratories could have open flames or experiments with dangerous chemicals. Students and faculty may need to place their work in a safe condition prior to leaving the room. This is another factor that could delay egress time by a minute or two.

Students or faculty working on computers may take time to save work to a flash drive or the internet prior to evacuating. This is due to experience with false fire alarms, and perceived value for their work. Saving work prior to leaving could delay a person by a couple of minutes.

Pre-movement Response

There are many ways occupants could be alerted to a fire. The way most occupants of a building would be alerted would be audible, in the form of a fire alarm. Other audible methods would be hearing someone shout “fire” if they were the one to discover it. A large number of people evacuating would cause a commotion that could likely be heard. The fire alarm system also includes strobes that would provide visual cues for people who are hard of hearing or listening to headphones. Another way occupants could discover the fire would be through heat or smell. These would likely occur if the fire started in an unoccupied space.

Once it has been established that there is a fire, people in the building need to evacuate. In some buildings (such as a movie theater) occupants only enter through one door. As a result, they are more likely to use the same door to exit. In a school building, students and professors know that there are multiple entrances/exits, and likely use different ones depending on where they are traveling from or to. This increases the odds that people exiting will use the closest unobstructed exit instead of leaving through a main exit they typically use.

Egress Time

A reliable estimation of egress time is necessary to determine if tenability will be maintained in occupied spaces for a given design fire. A second order hydraulic calculation was performed to determine the time occupants would need to egress from the Baker Science building when it was at rated occupancy. For this calculation it was assumed the occupants would exit through the stairway in the section of the building where they were when the alarm sounded. The building is separated into three sections: the west wing, the atrium, and the east wing. An egress calculation was performed for each section since this calculation assumes the egress of each will occur separately. A summary of egress times is shown in Table 3, with a detailed hydraulic egress calculation provided in Appendix B. Some parts of the table are left blank where that floor of the building does not have that section of the building. Also note that floors 2 and 3 for the east wing, and the first floor of the west wing are independent of egress from higher floors, yielding a lower egress time. The time for the entire building to be evacuated is 13.62 minutes.

Table 3. Summary of egress times from different parts of Baker Science.

	West Wing		Atrium		East Wing	
	Time to evacuate	Time to reach next floor	Time to evacuate	Time to reach next floor	Time to evacuate	Time to reach next floor
6th			1.79	2.12	4.56	4.93
5th			3.18	3.51	8.64	9.02
4th	4.46	4.84	4.51	4.85	13.25	13.62
3rd	7.71	8.09	7.74	8.08	5.40	
2nd	9.52	10.04	8.66		2.61	
1st	5.07					

Egress time is calculated starting when occupants begin to move. To determine the time from ignition of the fire to total evacuation, time to alarm and pre-movement time must also be included. Time to alarm is dependent on the specific fire scenario, and the SFPE Handbook can provide an estimate of pre-movement time. The SFPE Handbook provides estimated pre-movement times for various types of buildings. The building type that most closely represents Baker Science is a high-rise office building. While Baker Science narrowly misses the definition of a high-rise building, the occupants would be familiar with the building, and it would typically be occupied during working hours. Table 64.4 provides a pre-movement time of 1.2 minutes for a high-rise building.

The primary purpose of the life safety analysis is to ensure occupants can safely exit the building in the case of an emergency. In order to accomplish this, occupants must be able to find and traverse through exits in a timely manner. The Baker Science building can be completely evacuated in less than 14 minutes in the event of a fire. Exit signage will efficiently lead people to the nearest exit, which needs to have sufficient capacity, based on door and stair width. Baker Science meets or exceeds the life safety requirements of the California Building Code. Proper quantity and locations of exits will allow egress to occur in a timely manner. Safe egress time can be extended by reducing growth rate and size of a fire through automatic suppression.

Fire Suppression

System Description

The Baker Science building contains wet pipe sprinklers throughout the entire building. The whole building is sprinklered from a single wet pipe sprinkler riser which is fed from a fire pump. NFPA 13 8.2.1 gives a maximum floor area limit that can be protected by one sprinkler zone of 52,000 ft^2 for light and ordinary hazard occupancies. The second floor has the greatest area at 43,458 ft^2, allowing the building to be served by a single sprinkler riser. Four standpipes, located in the egress stairwells, deliver water to the upper floors. A fire pump, located on the first floor, is provided due to the height of the building.

Water Supply

The fire protection water supply comes from a looped domestic water main to the north of the building. There were two hydrant flow tests performed, one with flow from hydrant #63 and static pressure from hydrant #64, and another test with flow from hydrant #64 and static pressure from #63. The locations of the fire loop and hydrants #63 and #64 are shown in red on Figure 13, with the Baker Science Building outlined in Blue. The results of the flow tests are shown in Figures 14 and 15. Hydrant #63 is located much closer to the supply main for Building 180 and was selected for the hydraulic calculations as a result. Figure 16 shows the city water supply curve for the building, adjusted for the height of the pump inlet. In order to be conservative, the test pressures were reduced by 10% when performing sprinkler system calculations.

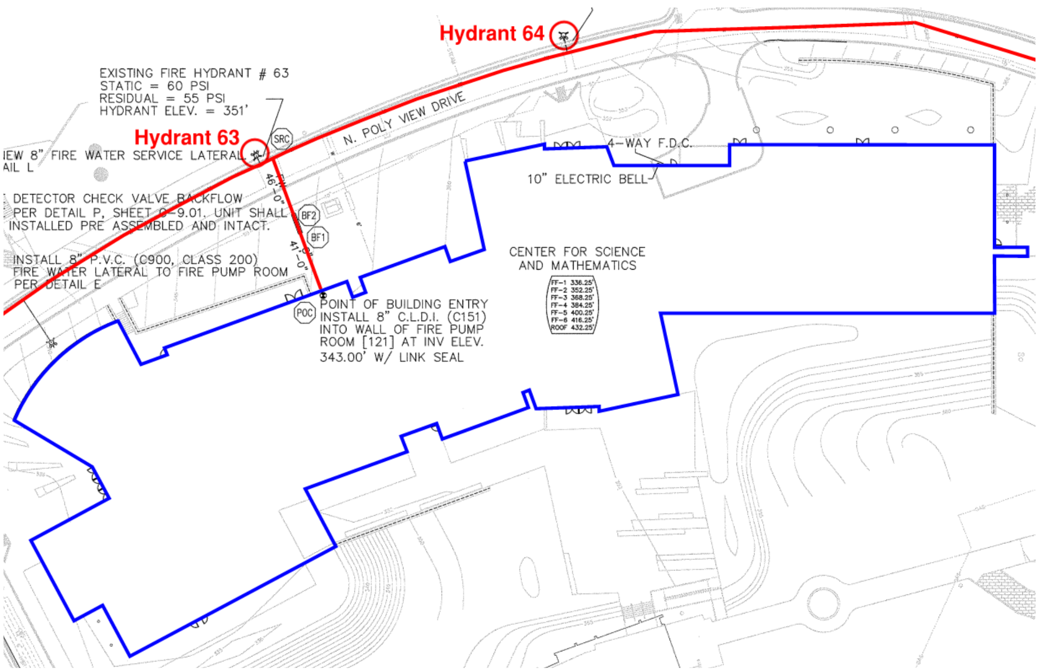


Figure 13. Location of test hydrants.

Flowing Hydrant(s)	Concurrent Flow			Residual Hydrant	
	# 1	# 2	# 3		
Hydrant #	64			Hydrant #	63
Static Pressure (psi)	63			Static Pressure (psi)	60
Test Gauge #	2			Residual Pressure (psi)	55
Pitot Pressure (psi)	35			Test Gauge #	1
Test Gauge #	1a			Tested by	R.Ellison
Nozzle Size (inches)	2.5				
Nozzle Coefficient					
Hydrant Flow (gpm)	914				
Tested by	R.Ellison				
Projected Flow @ 20 psi	2270.288	#DIV/0!	#DIV/0!		

Figure 14. Hydrant flow test, hydrant #63.

Flowing Hydrant(s)	Concurrent Flow			Residual Hydrant	
	# 1	# 2	# 3		
Hydrant #	63			Hydrant #	64
Static Pressure (psi)	64			Static Pressure (psi)	63
Test Gauge #	2			Residual Pressure (psi)	58
Pitot Pressure (psi)	40			Test Gauge #	1
Test Gauge #	1a			Tested by	R.Ellison
Nozzle Size (inches)	2.5				
Nozzle Coefficient					
Hydrant Flow (gpm)	974				
Tested by	R.Ellison				
Projected Flow @ 20 psi	2862.1147	#DIV/0!	#DIV/0!		

Figure 15. Hydrant flow test, hydrant #64.

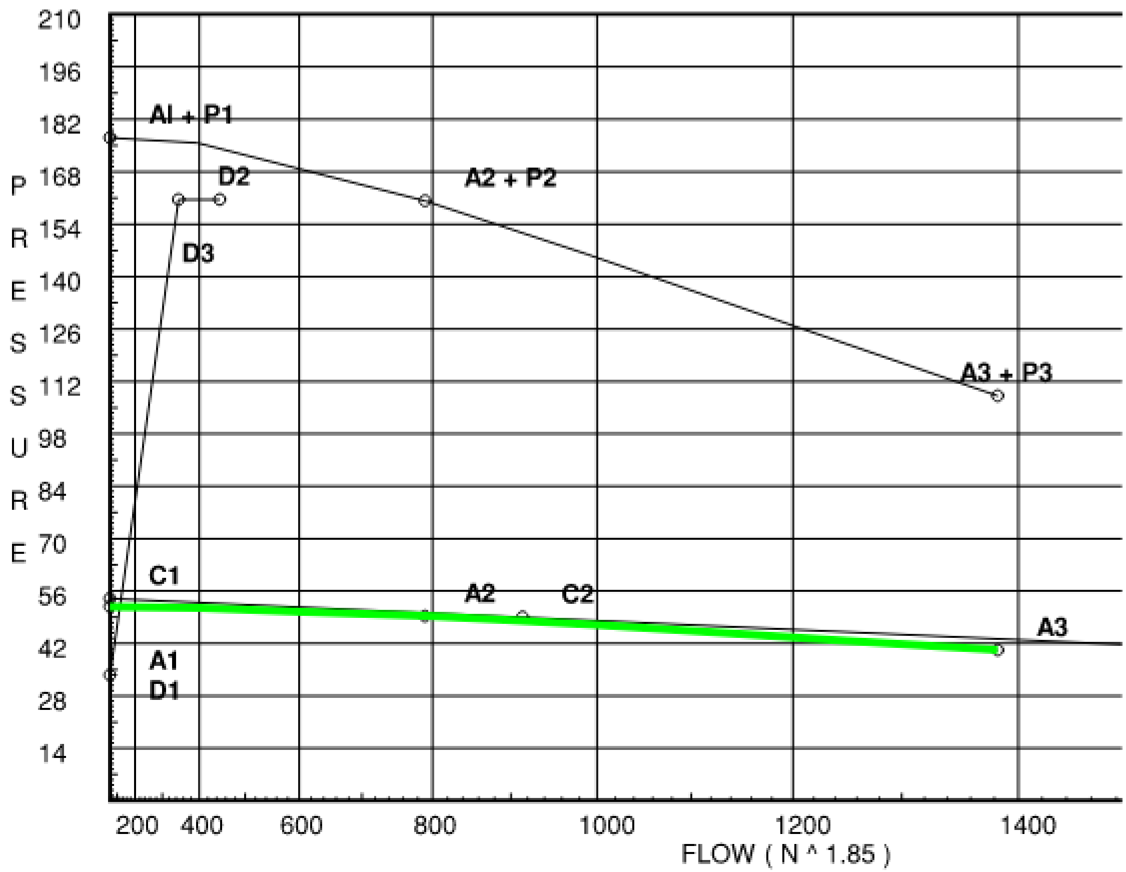


Figure 16. Building water supply curve.

The domestic water loop connects to the building with an 8” cement lined ductile iron pipe. The fire water system is separated from the city water main with a backflow preventer. NFPA 13 requires fire water systems to be isolated from the water main to prevent contamination of drinking water. This sprinkler system uses a Wilkins 350ADA double check detector assembly. This consists of two check valves with isolation valves on either side. The isolation valves are 8” OS&Y valves, and have tamper monitor switches that connect to the fire alarm system. The tamper monitors activate a supervisory condition at the fire alarm control unit if either of the isolation valves is moved from the open position. This is important since one of these valves being shut would prevent the sprinkler system from operating in the event of a fire. One design consideration when using backflow preventers is the pressure loss across the check valves. This is dependent on the system waterflow and the size of the backflow preventer. This pressure loss needs to be included in the hydraulic calculations in order for them to provide an accurate representation of available system flow. Figure 17 is the double check assembly installed in the building water supply, and Figure 18 is the double check assembly pressure loss graph. This double check assembly is installed above ground due to the moderate temperatures experienced in San Luis Obispo. In a climate with freezing weather the backflow preventer would most likely be installed in the building, in a heated space.

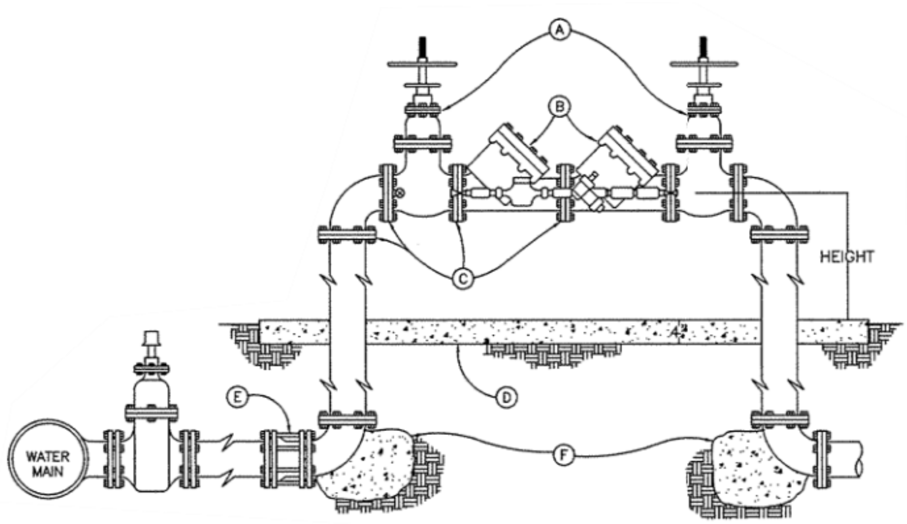


Figure 17. Double check assembly.

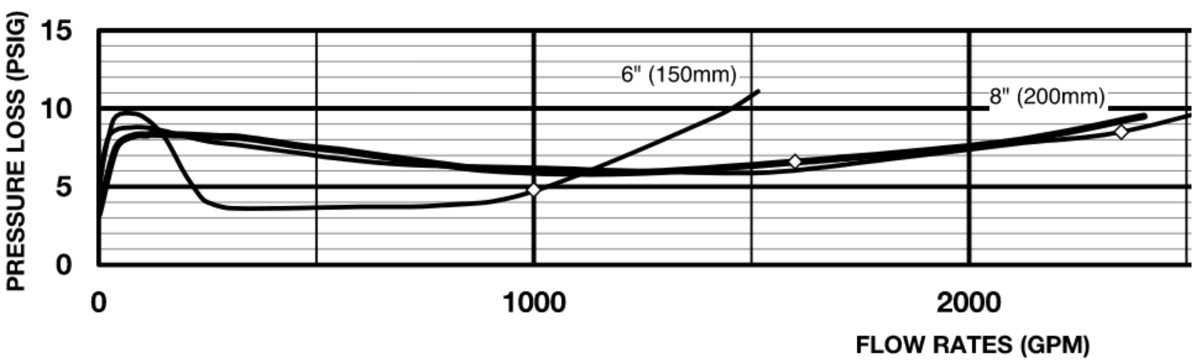


Figure 18. Pressure loss based on flow for Wilkins 350ADA backflow preventer.

Fire pump

The height of the building combined with the available water supply necessitates a fire pump. The pump is located on the first floor in the fire riser room. The pump is a Peerless 6PVF10 electric fire pump. Each storey in the Baker Science building is 16 ft, meaning the 6th floor ceiling is 80 ft higher than the 1st floor ceiling. In order to supply water to the sixth floor, an additional 34.6 psi is required to supply water compared to the first floor. $P = \left(\frac{80\,ft}{0.433\,psi/ft}\right) = 34.6\,psi$. When a sprinkler opens, releasing water, a pressure switch at the discharge of the pump senses the difference in pressure and activates the fire pump. To maintain pressure at the discharge of the fire pump a pressure maintenance pump, commonly called a "jockey pump," is provided in parallel to the fire pump. Small decreases in pressure due to system leaks will trigger the pressure maintenance pump to activate and increase the pressure in the sprinkler piping. The pressure maintenance pump has a much smaller capacity than the fire pump and can activate and deactivate itself with the pressure switch. The jockey pump activates at 155 psi and deactivates at 165 psi, but the fire pump does not activate until pressure reaches 150 psi. This ensures pressure in the sprinkler piping is normally maintained by the jockey pump. The fire pump deactivates at 191 psi to ensure the piping does not become overpressurized. The Peerless pump curve is shown in Figure 19, and a summary of pump pressure settings is provided in Figure 20.

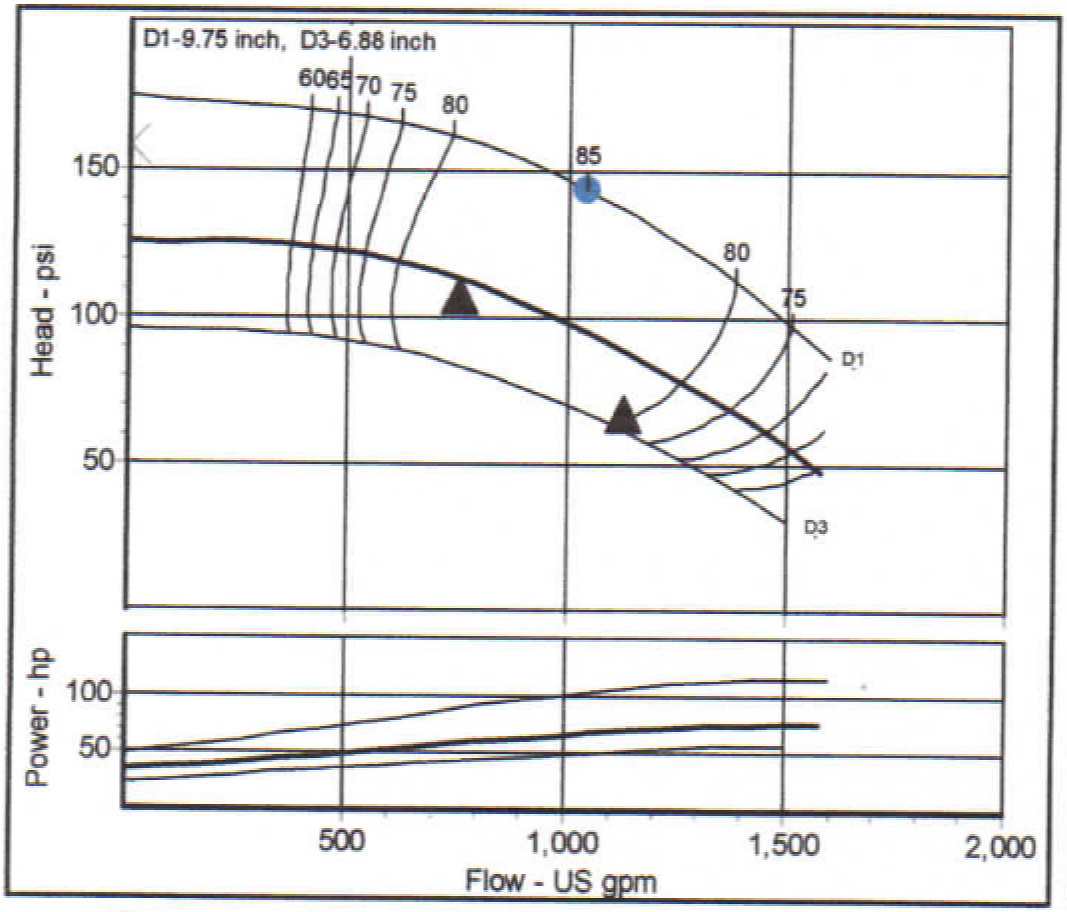


Figure 19. Peerless pump flow curve.

FIRE PUMP SETTINGS :

FIRE PUMP MAXIMUM CHURN = 191 PSI

JOCKEY PUMP STOP = 165 PSI
JOCKEY PUMP START = 155 PSI
FIRE PUMP START = 150 PSI

Figure 20. Fire pump and pressure maintenance pump setpoints.

Standpipes

Standpipes are provided in this building in accordance with NFPA 14, Standard for Installation of Sprinkler Systems. A standpipe is installed in each egress stairway, with a fire hose valve on each landing of the egress stair. The standpipe in stair 1 has a 6” pipe, and has a fire hose valve on the roof of Baker Science. Stair 3 is fully enclosed and also has a 6” standpipe. There is also a fire hose connection valve in the roof dog house at the top of stair 3. Stair 4 has a 4” standpipe with a hose valve on the roof, even with level 5. Stair 5 is not enclosed, and has a 4” standpipe. It does not extend to the roof. Figure 21 shows the locations of the standpipes in Baker Science. The standpipe system is capable of supplying a total of 1000 gpm, with 500 gpm at 100 psi at the highest outlets. A plot of standpipe demand pressure is shown in Figure 22, where the fire pump supplies 1000 gpm at 143.7 psi. Hydraulic calculations were performed for the standpipes and are shown in Appendix C.

Figure 21. Building layout with standpipes.

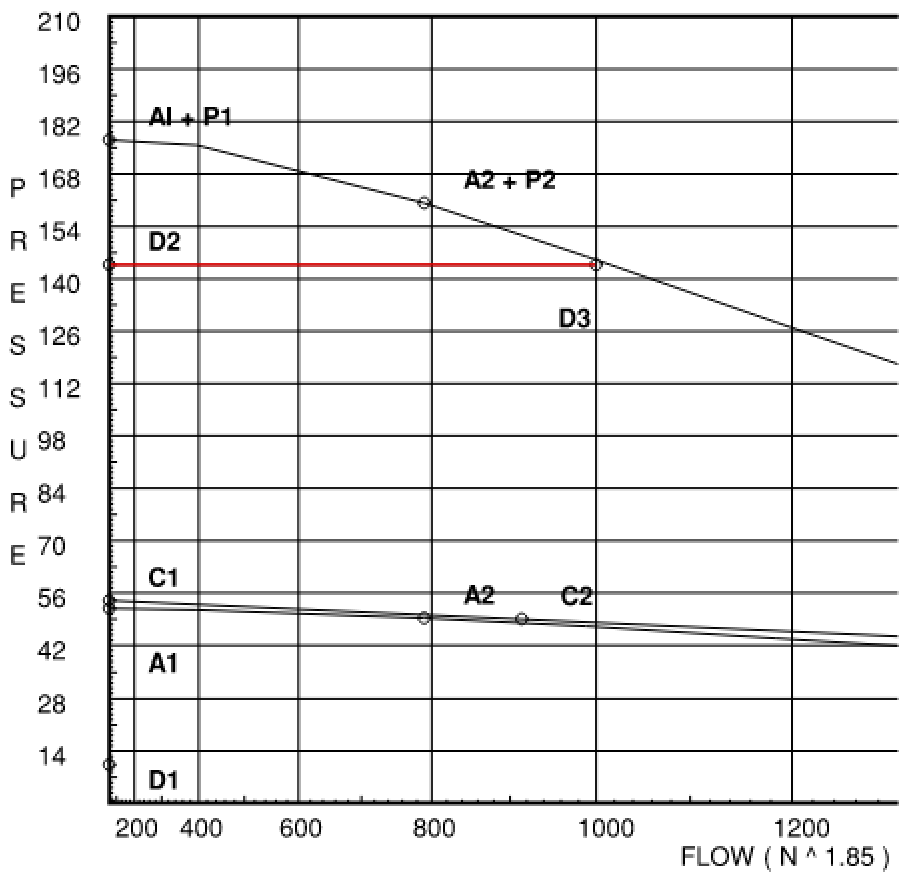


Figure 22. Standpipe pressure demand plot for calculation #5, highlighted in red.

Commodity Classification

The biggest hazard in this building are the laboratories with chemicals in them. Chapter 22 of NFPA 13 determines the hazard classification of labs based on the laboratory class as defined in NFPA 45. NFPA 45 4.2.2.2 states that educational laboratory units shall be classified as Class D. NFPA 13 22.8.1 (2) says that Class C and D laboratories shall be classified as ordinary hazard (Group 1). The design criteria for ordinary hazard (Group 1) is 0.15 gpm/ft^2 over 1500 ft^2, from Figure 11.2.3.1.1 of NFPA 13. The quick response sprinklers used in this building allow for a reduction of area in accordance with 11.2.3.2.3.1 of NFPA 13. The reduction is 40% for ceilings 10 ft tall, giving a design area of $1500\,ft^2 * 60\% = 900ft^2$.

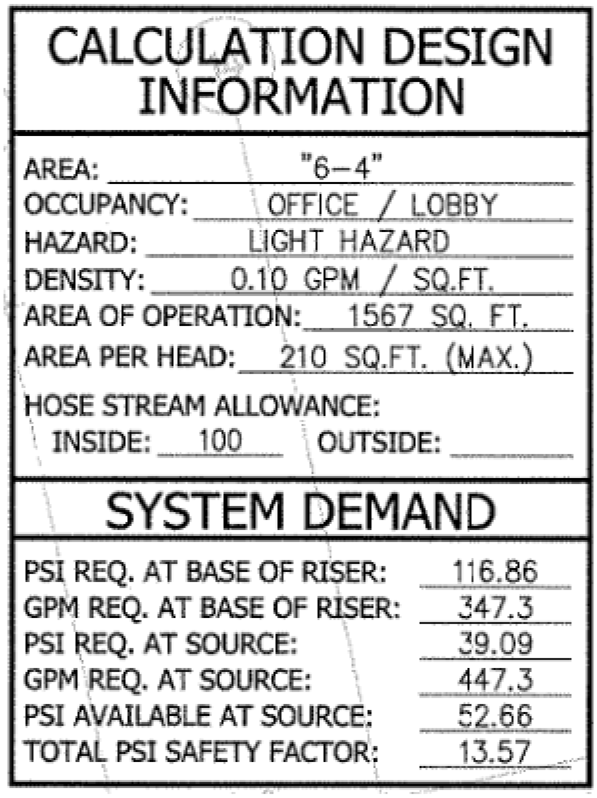
System Design Area

The sprinkler system designers used many different design areas to show the water supply was adequate for the sprinkler systems in this building. Many of the calculated design areas are on the sixth floor.

The highest calculated demand area, labeled 6-4, is in the atrium outside the faculty offices. The calculated area is 1500 ft^2 and light hazard, 0.10 gpm/ft^2. The total demand for this area is 347 gpm at 117 psi at the base of the riser. The sprinkler designers did not use the ceiling height area reduction for design area 6-4, although this would be permitted. An outline of area 6-4 is shown in Figure 23 and a summary of the hydraulic information is shown in Figure 24. Appendix D contains drawings with sprinkler pipe layouts. The fire pump will have the most difficulty providing water to the highest floor in the building. The design area has fourteen Tyco TY-FRB K-5.6 quick response sprinklers with 155°F ratings. The spec sheet is provided in Appendix C. Each sprinkler in the design area has a maximum area of 112 ft^2. This requires 16.8 gpm per sprinkler, giving a minimum supply pressure of

$$P = \left(\frac{Q}{K}\right)^2 = \left(\frac{16.8}{5.6}\right)^2 = 9\ psi\,.$$

Figure 23. Atrium design area.



CALCULATION DESIGN INFORMATION

AREA: "6–4"
OCCUPANCY: OFFICE / LOBBY
HAZARD: LIGHT HAZARD
DENSITY: 0.10 GPM / SQ.FT.
AREA OF OPERATION: 1567 SQ. FT.
AREA PER HEAD: 210 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: ______

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	116.86
GPM REQ. AT BASE OF RISER:	347.3
PSI REQ. AT SOURCE:	39.09
GPM REQ. AT SOURCE:	447.3
PSI AVAILABLE AT SOURCE:	52.66
TOTAL PSI SAFETY FACTOR:	13.57

Figure 24. Design area 6-4 hydraulic summary.

Baker Science connects to the school's domestic water loop with an 8" underground supply line. The sprinkler system is fed from a pump rated for 750 gpm at 113 psi. Figure 25 shows an elevation view of the pump and riser room. The product data sheet for the pump is provided in Appendix C. The discharge of the pump feeds 6" mains that supply water to four 6" standpipes, located in the stairwells. The mains on the floors are 2½" with 1" or 1¼" branch lines supplying the sprinklers.

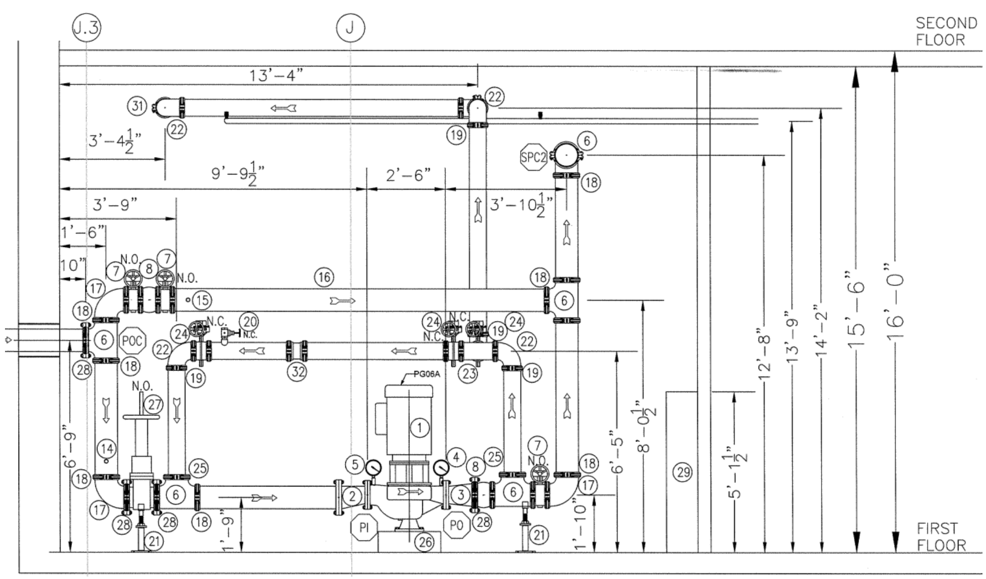


Figure 25. Elevation view of pump and riser room.

Hydraulic Calculations

A program called Hydracalc was used to perform hydraulic calculations for this system. Details about each part of the sprinkler system were put into the program. The sprinklers and branch lines were input in the system, then connected to the main on the sixth floor. Each pipe length, number and type of fittings, material, and elevation are included, as this information is required for an accurate calculation of pressure and flow for a system. The flowing sprinklers are included, and the program runs calculations to balance flow between them as would occur if the system were really activated.

Hydracalc uses the Hazen-Williams formula to calculate pressure loss through a pipe. The factors that influence pressure loss are flow, pipe roughness coefficient, inside pipe diameter, and length of pipe. Pipe elbows, valves, and other fittings also contribute to pressure loss. This is accounted for with an "equivalent length" of pipe. An equivalent length represents the length of pipe that could be installed in a pipe segment that would create the same pressure loss as the fitting. This information can be found on data sheets for the fittings, and allows for easier pressure loss calculations.

The Hazen-Williams formula is shown below. The output of the formula is the pressure loss per length (psi/ft) for a section of pipe. This is multiplied by the length of pipe, including equivalent lengths of fittings, to calculate the total pressure loss for a pipe section. The hydraulic calculations are provided in Appendix C. The Hazen-Williams formula is provided in NFPA 13, 23.4.2.1.1:

$$p = \frac{4.52Q^{1.85}}{C^{1.85}d^{4.87}}$$

p = frictional resistance (psi/ft of pipe)
Q = flow (gpm)
C = friction loss coefficient
d = actual internal diameter of pipe (in)

Multiple design areas are calculated in Hydracalc, as an engineer may not immediately be able to determine what the most hydraulically remote area is at first glance. In the hydraulic calculations for Baker Science, area 6-4 was the most hydraulically remote. This remote area is located on the sixth floor, has an area of operation of 1567 ft^2 with a density of 0.10 gpm/ft^2, and requires 347 gpm at 117 psi. Figure 26 shows a plot with pressure vs flow for the city water supply (green), the pump discharge pressure (red), and the most remote area demand (blue). The most remote area includes the 100 gpm hose demand. The demand for the most remote area is below the pump pressure curve, indicating the supply is adequate to protect the most remote area. Other remote areas were calculated, and all required less pressure and flow than area 6-4.

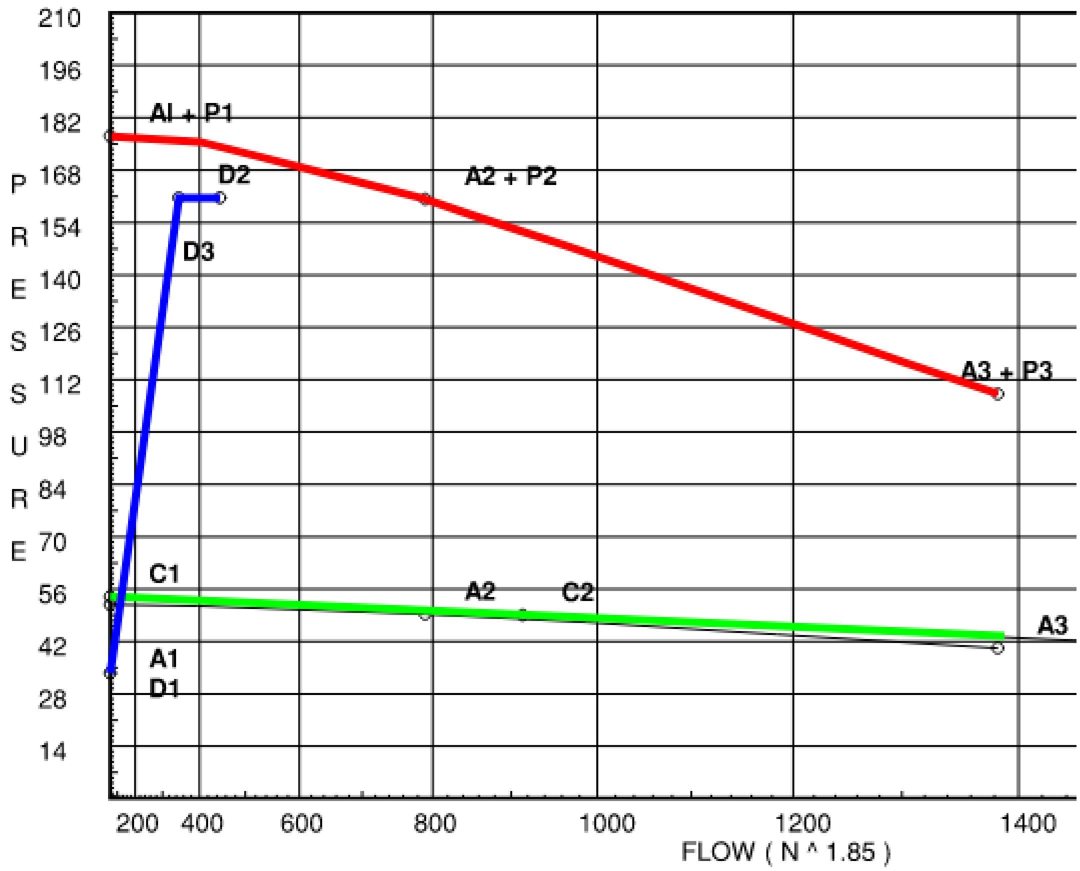


Figure 26. Pressure vs flow plot with city water pressure (green), pump discharge pressure (red) and most remote area (blue).

Inspection, Testing, and Maintenance

The inspection, testing, and maintenance requirements for the fire suppression system are outlined in NFPA 25. Systems must be tested in accordance with original acceptance tests when a component or subsystem is adjusted, repaired, or replaced. Any sprinkler found to not be in compliance must be repaired or replaced to comply with code requirements. Table 5.1.1.2 in NFPA 25 provides frequencies for inspection, testing, and maintenance for different types of sprinkler equipment. Pressure gauges, waterflow switches, and valve supervisory signal devices must be inspected quarterly. Sprinklers must be visually inspected annually from the floor level annually for leakage, corrosion, damage, paint, or other factors that could be detrimental to sprinkler operation. Representative samples of the quick response sprinklers must be tested after 20 years, and ten years thereafter. Compliance with the inspection, testing, and maintenance requirements from NFPA 25 will help ensure proper operation of the fire suppression system.

The fire suppression system in Baker Science is adequately designed and sized, capable of providing 347 gpm of water to the most remote sprinkler design area, with a pressure of 117 psi at the base of the riser. There is also enough capacity to supply the standpipes with 100 gpm of hose demand. The fire suppression system is connected to another vital safety system, the fire alarm and notification equipment. Upon activation of a sprinkler, the fire alarm system would activate, alerting occupants and emergency services that a fire had occurred.

Fire Alarm System

System Description

Baker Science is protected throughout with an automatic fire detection and alarm system in accordance with NFPA 72. The purpose of the system is to detect a fire, and notify occupants to evacuate and emergency personnel to respond to the building. The fire alarm system also activates or deactivates building equipment in response to detection of a fire.

Fire Alarm Control Unit

The Baker Science building has a central fire alarm control unit that can take a variety of input signals and send the appropriate output signals. The fire alarm control unit is a Notifier NSF2-640, shown in Figure 27. This report will use the phrase “fire alarm control unit” and “FACU” to match the nomenclature of NFPA 72, although the construction documents use “fire alarm control panel” and “FACP.” The fire alarm control unit is located on the first floor, in the Main Electrical/Transformer Room, Room 122. Figure 28 shows the location of the FACU (labeled FACP) on the first floor. The unit is a Notifier NSF2-640, and takes alarm signals from throughout the building, and provides appropriate output signals. The sequence of operations matrix is shown below, in Figure 29. This matrix shows what signal outputs the FACU creates for all possible alarm inputs. The FACU alerts the receiving station of conditions in the building in order to get emergency response, as well as activate notification devices to alert occupants to evacuate. The receiving station is the campus police station, and is monitored at all times. Upon receiving a signal, the campus police will dispatch the local fire department to the building. There are three main classes of signals the FACU can create: alarm, supervisory, and trouble signals.

Figure 27. Notifier NSF2-640 Fire Alarm Control Unit.

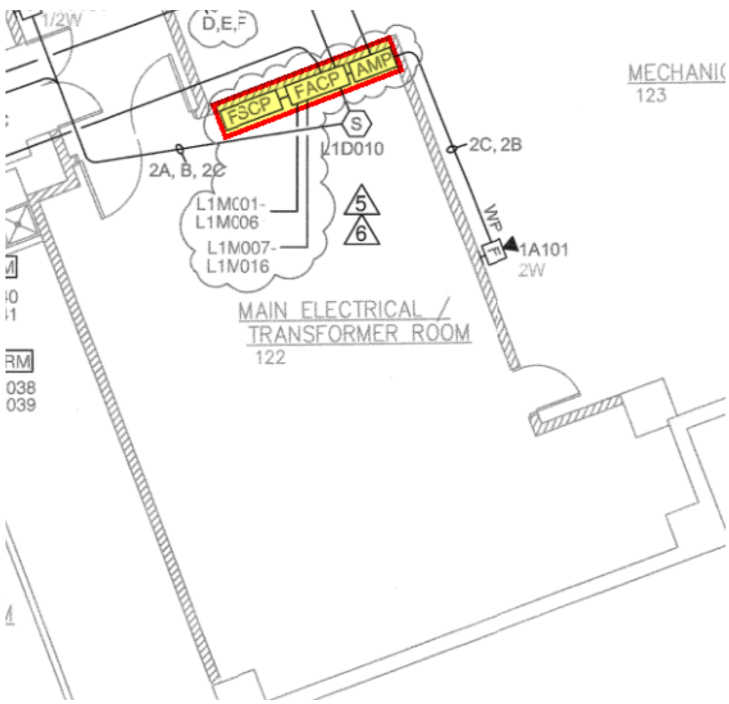


Figure 28. Location of fire alarm control unit in main electrical room.

EVENT \ ACTION	SUPERVISORY CONDITION AT FACU	TROUBLE CONDITION AT FACU	ALARM CONDITION AT FACU	ACTIVATE FIRE ALARM AUDIO/VISUAL DEVICES AND VOICE ALARM COMMUNICATION	DISPLAY TEXT ON LCD ANNUNCIATOR	ACTIVATE SHUNT TRIP RELAY	SHUTDOWN AIR HANDLER UNIT	ACTIVATE ELEVATOR RECALL	SHUTDOWN INDIVIDUAL ASSOCIATED DAMPERS	DEACTIVATE MAGNETIC DOOR HOLDERS	ACTIVATE SUPERVISORY SIGNAL TO RECEIVING STATION (CAMPUS POLICE)	ACTIVATE TROUBLE SIGNAL TO RECEIVING STATION (CAMPUS POLICE)	ACTIVATE ALARM DIALER SIGNAL TO RECEIVING STATION (CAMPUS POLICE)	BYPASS ALL ALARM OUTPUTS (NOTIFICATION, SHUNTS, RELAY OUTPUTS) FOR TESTING	OPEN ATRUIM DOORS WITH MOTORIZED DOOR OPERATORS	ACTIVATE ATRIUM PASSIVE SMOKE EVACUATION SYSTEM
FIRE ALARM CONTROL UNIT																
PANEL SUPERVISORY CONDITION (TEST BYBASS) ON ACM-24 AT	X				X						X			X		
PANEL TROUBLE CONDITION (AC POWER FAIL, LOW BATTERY, OPEN CIRCUIT, GROUND FAULT, ETC.)		X			X							X				
PANEL ALARM CONDITION			X	X	X		X			X			X			
MANUAL PULL STATION ACTIVATION			X	X	X					X			X			
SPOT SMOKE DETECTOR ACTIVATION			X	X	X					X			X			
DUCT SMOKE DETECTOR ACTIVATION			X	X	X				X	X			X			
AIR HANDLING UNIT DUCT SMOKE DETECTOR ACTIVATION			X	X	X		X						X			
SPRINKLER TAMPER SWITCH	X				X						X		X			
SPRINKLER WATER FLOW ACTIVATION			X	X	X					X			X			
FIRE PUMP RUNNING			X	X	X					X			X			
FIRE PUMP LOSS OF PH ASE	X				X						X					
FIRE PUMP PHASE REVERSAL	X				X						X		X			
HEAT DETECTOR ACTIVATION (ELEVATOR EQUIPMENT)			X	X	X	X				X			X			
ELEVATOR LOBBY/ EMR SMOKE / ELEVATOR HOISTWAYS			X	X	X			X		X			X			
SHUNT TRIP POWER SUPERVISION	X				X						X					
GENERAL ALARM (ANYWHERE WITHIN THE BUILDING)			X	X	X		X			X			X			
ATRIUM SMOKE CONTORL SYSTEM ALARM			X	X	X					X			X		X	X
BEAM SMOKE DETECTION WITHIN ATRIUM			X	X	X					X			X		X	X
PULL STATION WITHIN ATRIUM			X	X	X					X			X		X	X
SPRINKLER WATER FLOW WITHIN ATRIUM			X	X	X					X			X		X	X

Figure 29. Fire alarm action matrix.

NFPA 72 defines an alarm condition as “an abnormal condition that poses an immediate threat to life, property, or mission” (3.3.58.1.1). The alarm signals that can activate this are water flow alarms, fire pump running or phase reversal signal, manual pull stations, heat detectors, and beam/duct/spot smoke alarms. An alarm signal will activate audio/visual devices, alerting occupants to evacuate the building.

A supervisory condition is “an abnormal condition in connection with the supervision of other systems, processes, or equipment” (NFPA 72 3.3.58.1.3). A supervisory signal is generated by activation of a sprinkler tamper switch, fire pump loss of phase or phase reversal, shunt trip power supervision.

A trouble condition is defined as “an abnormal condition in a system due to a fault” (NFPA 72 3.3.58.1.4). A trouble condition is activated when there is an AC power failure, low battery signal, open circuit, or a ground fault.

Alarm Activation Devices

Fire alarm activation in the Baker Science building is accomplished through a variety of devices: different types of smoke and heat detectors, fire pump running signal, fire riser flow switch, and manual pull stations. The building is fully sprinklered, so the primary fire detection in most of the building is through activation of a sprinkler. Once heat from a fire breaks the bulb of a sprinkler, water flows out. This flow of water activates a waterflow switch in the fire riser, sending an alarm signal to the FACU. The decrease in pressure at the output of the pump would also trigger the pump to run, activating the fire pump running signal, which also activates an alarm on the FACU.

In addition to sprinklers throughout the building, there are also smoke detectors in the HVAC ducting, the elevator shaft, elevator lobbies, and heat detectors in the elevator machinery room. Photoelectric smoke detectors are installed above vital fire alarm equipment such as the FACU and RNPS and in elevator lobbies and machinery rooms. The spot smoke detectors installed in Baker Science are Notifier

FSP-851, while the heat detectors are FST-851. An example of a Notifier smoke detector is shown in Figure 30.

Figure 30. Notifier FSP-851 photoelectric smoke detector, with base.

Duct smoke detectors are installed in HVAC systems to send a signal to shut down associated air handling equipment to prevent the spread of smoke from one space to another. NFPA 90A requires duct smoke detectors in any ventilation system that flows greater than 2000 cfm and is capable of spreading smoke to another space. The duct detectors installed in Baker Science are System Sensor DNR.

Additionally, there are manual pull stations at the exits of the building, and next to stairway entrances. This allows an evacuating occupant to activate the fire alarm system as they leave. This would be helpful when a small fire starts, but does not activate smoke detectors or a sprinkler system. The manual pull stations used in this building are Notifier NBG-12LX, and are a dual-acting design. This means that two movements are required to activate the alarm. The pull stations are addressable, which means the exact pull station that was activated is identified for emergency personnel to respond to. An example of a pull station is shown in Figure 31.

Figure 31. Example of manual pull station.

The passive smoke venting system in the atrium can be activated in three different ways. There are beam smoke detectors at all levels of the atrium, waterflow switches dedicated to the atrium sprinklers, and manual pull stations in the atrium that all activate the passive smoke control system. This allows a fire in the atrium to be detected without the delay of the smoke reaching six stories up to the top of the atrium. The beam detectors in the atrium consist of an emitter (Xtralis OSE-SPW) and an imager (Xtralis OSI-90). One imager can receive inputs from up to seven emitters, although no imager receives more than three emitter signals. This configuration is used on the south side of the atrium on floors 4, 5, and 6. The Xtralis beam detectors use two wavelengths (IR and UV) to distinguish between smoke and dust. An Xtralis imager is shown in Figure 32, the emitter looks similar.

Figure 32. Xtralis OSI-90 beam smoke detection imager.

Alarm Notification Appliances

Notification in the Baker Science building is accomplished with visual and audible devices. The visual devices are strobes, while the audible devices are speakers. System Sensor SPSWL speaker/strobe combinations are used throughout the building. Speaker only and strobe only devices are also installed where required for adequate audible and visual coverage. The strobes have adjustable candela settings to provide adequate visual coverage for their space. In smaller spaces a lower candela setting can be used to reduce the required current when the device is activated.

All notification devices in this building are wall mounted. The strobes are placed in hallways, classrooms, labs, and bathrooms. NFPA 72 does not require visual coverage in spaces that are not normally occupied by more than one person. Examples of spaces where strobes are omitted are single offices, mechanical/electrical rooms, and storage rooms. One of the general notes states “Wall mount audio/visual devices shall be mounted 80” AFF to bottom of the strobe lens.” This complies with the lower limit for strobe mounting height given in Chapter 18 of NFPA 72, but the drawing does not mention the 96” upper limit that is also required. The speakers are used for the voice evacuation system. There is also a water motor gong near the fire department connection outside the building.

There are a number of rooms in Baker Science that do not have adequate visual coverage of notification devices. Most of the spaces have an adequate device, but it is not centrally aligned. Moving the devices to the center of their space would provide adequate coverage. The following is a list of spaces that to not comply with code: Lecture room (CLA 05), Integrated studio (265), Intro teaching lab (276), Mineral/maps/geology (233), Teaching lab (237), GIS room (230), Chem stock (232), Teaching lab (461).

Voltage Drop Calculations

Voltage drop calculations are performed to ensure adequate voltage for signaling device circuits. The nominal voltage rating for the system is 24 VDC, but NFPA 72 10.3.5 requires equipment to function at 85% of its rated voltage. A voltage drop calculation is performed for each notification circuit in the building. The drop in voltage occurs because of resistance in the wiring to the notification devices. To calculate the voltage drop, the engineer sums the current draw for all notification devices on each segment of a circuit. The notification device data sheets provide the current draw based on candela and decibel settings for each appliance. The wiring length for the circuit is measured and multiplied by the resistance per length for the wiring, typically listed in Ohms per 1000 ft. Note that the length of wire is twice the distance between each notification device in order for there to be a path back for the current to travel through. This product of resistance per length and total circuit length gives the total resistance for the circuit, which can be multiplied by the current drawn by the appliances, yielding the total voltage drop. Figure 33 shows a voltage drop calculation for one of the circuits in Baker Science. UL listed devices will have an operating voltage of 16 VDC. A 24 VDC system at 85% (20.4 VDC) can have a total voltage drop of 4.4 VDC. If the voltage drop is excessive, appliances can be moved to another circuit, or a heavier gauge wire with less resistance per 1000 ft can be selected. All of the signaling line circuits have a voltage drop of less than 4.4 V, which complies with the NFPA 72 requirements. Full voltage drop calculations for all signaling lines circuits are provided in Appendix E.

	Fire Alarm Voltage Drop Calculations
Project Name	Cal Poly Building 52: Computer Math and Science
Panel / Circuit #	Notifier FACP- Circuit 1V1
Area Covered	1st Floor West

		Wire Gauge	Ohm's Per 1000
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.016		
Distance from source to 1st device	30	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
1V101	30	23.81	0.187	0.78%	0.066	System Sensor	SCR	ST	15
1V102	20	23.70	0.304	1.27%	0.066	System Sensor	SCR	ST	15
1V103	30	23.53	0.467	1.94%	0.066	System Sensor	SCR	ST	15
1V104	50	23.28	0.718	2.99%	0.066	System Sensor	SCR	ST	15
1V105	50	23.05	0.949	3.95%	0.210	System Sensor	SCR	ST	115
1V106	35	22.93	1.065	4.44%	0.094	System Sensor	SCR	ST	30
1V107	30	22.85	1.148	4.78%	0.158	System Sensor	SCR	ST	75
1V108	35	22.79	1.210	5.04%	0.066	System Sensor	SCR	ST	15
1V109	40	22.74	1.265	5.27%	0.066	System Sensor	SCR	ST	15
1V110	35	22.70	1.299	5.41%	0.158	System Sensor	SCR	ST	75
END		22.70	1.299	5.41%	0.000				
END		22.70	1.299	5.41%	0.000				
END		22.70	1.299	5.41%	0.000				
Totals	355	End of Line Voltage		**22.70**	1.016				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.016	355	**1.30**
End of Line Voltage		**22.70**
Percent Drop		5.41%

Standard Wire Resistance in Ohms per 1000 feet.

18=7.77 16=4.89 14=3.07 12=1.98 10=1.24

18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:

Wire resistance is doubled in the calculations for two wires (Positive and Negative)

The voltage calculated to the last device must not be lower than

the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Figure 33. Voltage drop calculation for circuit 1V1.

Secondary Power Supply

Fire alarm systems require a primary and secondary power supply. The primary supply is standard 120 V electricity from the grid. The secondary power is supplied with batteries. Appliances such as the fire alarm control unit and smoke detectors use power at all times, requiring standby current. Appliances like speakers and strobes only use current during alarm conditions. NFPA 72 10.6.7.2.1.2 requires an EVACS system to operate in standby for 24 hours and in alarm for an additional 15 minutes. 10.6.7.2.1.1 requires an additional 20 percent safety margin in battery capacity. Based on these requirements, the batteries are sized to provide 24 hours of standby current and 15 minutes of alarm current, with an additional 20 percent safety margin. To calculate this the engineer needs to know standby and alarm currents for all devices as well as the quantity of each device. The FACU cannot power all the notification devices in the building, so there are many remote notification power supplies in the building. Each of these has its own secondary power supply and associated battery calculation. An example of battery sizing calculations is shown in Figure 34. Note that each type of appliance that uses electric power is listed, along with the quantity, standby current, and alarm current. The total standby current is multiplied by 24 hours, and the total amount of alarm current is multiplied by 0.25 hours (for the 15 minute requirement. These two amp-hour values are combined, then increased by 20 percent to determine the required battery capacity for the panel being calculated. The FACU and all remote notification power supplies each have their own battery backups, and associated amp-hour calculations.

Fire Alarm Control Panel Battery Calculation

Battery Calculations for:	FACP Notifier NFS-640	Project:	Cal Poly Building 52

ITEM	DESCRIPTION	STANDBY CURRENT PER UNIT (AMPS)		QTY		TOTAL STANDBY CURRENT PER ITEM	ALARM CURRENT PER UNIT (AMPS)		QTY		TOTAL ALARM CURRENT PER ITEM
FACP	Fire Alarm Control Unit	0.2850	X	1	=	0.2850	0.2850	X	1	=	0.2850
UDACT	Universal Dialer	0.0400	X	1	=	0.0400	0.1000	X	1	=	0.1000
FDU-80	Remote Annunciator	0.0643	X	2	=	0.1286	0.0643	X	2	=	0.1286
APS-6	Power Supply Amp	0.0000	X	1	=	0.0000	0.0250	X	1	=	0.0250
OSE-SPV	Beam Smoke Emitter	0.0035	X	10	=	0.0350	0.0035	X	10	=	0.0350
OSI-90	Beam Smoke Imager	0.0310	X	10	=	0.3100	0.0310	X	10	=	0.3100
PULL	Manual Pull (addressable)	0.0004	X	29	=	0.0116	0.0004	X	29	=	0.0116
FRM-1	Relay Module	0.0017	X	9	=	0.0153	0.0022	X	9	=	0.0198
FSP-851	Smoke Detector	0.0003	X	16	=	0.0048	0.0003	X	16	=	0.0048
FDM-1	Dual Monitor Module	0.0008	X	18	=	0.0144	0.0064	X	18	=	0.1152
SPK	Speaker Only	0.0000	X	3	=	0.0000	0.0008	X	3	=	0.0024
SR	Strobe Only 15CD	0.0000	X	7	=	0.0000	0.0660	X	7	=	0.4620
SR	Strobe Only 30CD	0.0000	X	6	=	0.0000	0.0940	X	6	=	0.5640
SR	Strobe Only 75CD	0.0000	X	2	=	0.0000	0.1580	X	2	=	0.3160
FTM-1	Fire Fighter Phone Jack	0.0075	X	12	=	0.0900	0.0075	X	12	=	0.0900
XP6-R	Six Relay Control Module	0.0015	X	1	=	0.0015	0.0320	X	1	=	0.0320
XP10-M	10-Input Monitor Module	0.0035	X	1	=	0.0035	0.0550	X	1	=	0.0550
SPSR	Speaker Strobes 15CD	0.0000	X	3	=	0.0000	0.0710	X	3	=	0.2130
SPSR	Speaker Strobes 30CD	0.0000	X	14	=	0.0000	0.0960	X	14	=	1.3440
SPSR	Speaker Strobes 75CD	0.0000	X	14	=	0.0000	0.1530	X	14	=	2.1420
SPSR	Speaker Strobes 95CD	0.0000	X	3	=	0.0000	0.1760	X	3	=	0.5280
SPSR	Speaker Strobes 115CD	0.0000	X	16	=	0.0000	0.2050	X	16	=	3.2800
FST-851	Heat Detector (addresable)	0.0004	X	4	=	0.0016	0.0004	X	4	=	0.0016
FMM-1	Monitor Module	0.0037	X	19	=	0.0703	0.0037	X	19	=	0.0703
FDRM-1	Dual Relay/Monitor Module	0.0013	X	64	=	0.0832	0.0240	X	64	=	1.5360
DNR	Duct Smoke Detectors	0.0003	X	64	=	0.0192	0.0003	X	64	=	0.0192
	TOTAL SYSTEM STANDBY CURRENT (AMPS)					1.1140	TOTAL SYSTEM ALARM CURRENT (AMPS)				11.6905

REQUIRED STANDBY TIME (HRS)		TOTAL SYSTEM STANDBY CURRENT (AMPS)		REQUIRED STANDBY CAPACITY (AMP-HOURS)	REQUIRED ALARM TIME (HOURS)		TOTAL SYSTEM ALARM CURRENT (AMPS)		REQUIRED ALARM CAPACITY (AMP-HOURS)
24	X	1.1140	=	26.7348	0.250	X	11.6905	=	2.9226

REQUIRED STANDBY CAPACITY (AMP-HOURS)		REQUIRED ALARM CAPACITY (AMP-HOURS)		TOTAL CAPACITY (AMP-HOURS)	TOTAL CAPACITY (AMP-HOURS)		SAFETY FACTOR (%)		ADJUSTED BATTERY CAPACITY (AMP-HOURS)
26.73	+	2.9226	=	29.6574	29.6574	+	20%	=	35.6

Figure 34. Battery sizing calculation for the FACU.

Emergency Communication System

The Baker Science building provides an emergency voice/alarm communication system. Speakers are distributed throughout the building for voice communication in the case of an emergency. Standard, prerecorded evacuation messages are programmed for certain alarm conditions from the fire alarm control panel. Live voice messages can also be broadcast from the building's FACP or from a remote location. Emergencies such as an active shooter may necessitate building occupants to shelter in place with specific instructions that could be provided for that specific situation.

Inspection and Test Requirements

Inspection and testing of the fire alarm equipment is important to ensure the system operates as intended in the case of emergency. To verify everything is operating properly the system components are inspected with specific frequency. Details of these requirements are found in Chapter 14 of NFPA 72. Inspections of fuses, power supplies, and trouble signals for all fire alarm systems are performed annually. Batteries are inspected semiannually to ensure they are not expired. The battery connections are checked for tightness and to be free of corrosion and leakage. Building notification appliances such as speakers and strobes are inspected semiannually.

The fire alarm and notification system in Baker Science is designed to detect a fire and notify both occupants and emergency personnel. Fire detection is accomplished with waterflow switches, smoke and heat detection, and manual pull stations. The detection activates voice and visual notification for occupants to evacuate. With the exception of some visual notification deficiencies noted previously, the fire alarm and notification requirements are achieved to comply with the requirements of the code. Prompt detection of a fire will allow firefighters to respond to fight the fire, limiting permanent damage to the interior finishes and the structure.

Structural Fire Protection

Required Occupancy Separation

Bakes Science is type 1B construction, CBC Table 601. Type 1B construction requires 2 hour fire resistance rating for the primary structural frame, interior and exterior walls, and floor construction and associated members. Roof construction and associated members have a 1 hour fire resistance rating requirement, and nonbearing walls have no requirement. CBC Table 705.8 provides allowable area limits for exterior wall openings, based on fire separation distance and whether or not the building is sprinklered. Baker Science has a fire separation distance of 20'-25' to the centerline of N Poly View Dr, which means the allowable area for exterior wall openings is unlimited. This building does not qualify as a high-rise building because no floor used for human occupancy is more than 75 ft above the lowest floor having building access. While Baker Science is a six storey building, the first floor only comprises the western half of the building footprint. The sixth floor is only on the eastern half of the building, so no part of the structure is more than four floors above the ground access below it. With each floor 16 ft above the floor below it, the sixth floor is 64 ft above the second floor. At no point in the building is the sixth floor directly above any part of the first floor.

Table 504.3 provides height limits based on occupancy classification, construction type, and if the building is sprinklered. For business occupancies of Type 1B construction, a building is limited to a height of 180 ft above the grade plane. Baker Science is 112 ft from the grade plane to the highest roof surface, well below the 180 ft limit. The limit to the number of storeys is shown in Table 504.4 of the CBC. For Baker Science's construction type, occupancy, and sprinkler system, the limit is 12 storeys above grade plane. Baker Science is six storeys tall, well below the limit. The next consideration for building limits is building area. Table 506.2 states these limits, again based on occupancy, construction type, and whether the building is sprinklered. The building area for Baker Science is unlimited.

CBC Table 803.5.5 provides required occupancy separations between different occupancy types. A summary of separation is shown in Figure 35. No portion of the building requires greater than 1 hour fire rating separating different occupancy types.

B TO A-3:	1-HOUR
B TO H-3:	1-HOUR
B TO S-1:	NO SEPARATION REQUIRED
B TO S-2:	1-HOUR
S-1 TO H-3:	1-HOUR
S-1 TO S-2:	1-HOUR

Figure 35. Required separation of occupancies.

Part of the Baker Science building juts out and is about 32 ft from the next building. CBC Table 602 requires 30 ft to a separating line between buildings in order for the exterior to not be fire rated. These two buildings are closer than that to the separating line, so the exterior of Baker Science has a two hour fire rating where the buildings are the closest. The nearby building is shown in Figure 36.

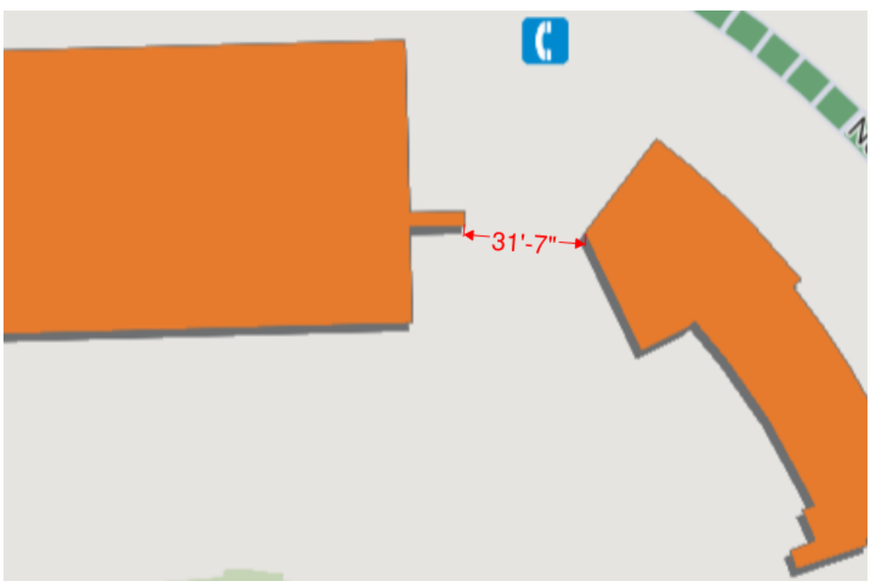


Figure 36. A building near Baker Science to the east.

Interior Finishes

Baker Science contains A-3, B, S-1, and S-2 occupancies. Per CBC Table 803.5, each occupancy group has an interior finish requirement for exit enclosures, corridors, and rooms/enclosed spaces. Since this entire building is sprinklered the interior finish requirements are less restrictive than they would be in an unsprinklered building. Most of the building has Class C interior finish requirements. The exception to this is in places where large groups of people may need to egress, such as exit enclosures and corridors serving many occupants. The requirements for interior finishes are shown in Figure 37.

The interior finish class is based on the flame spread index of the materials used. Class A has a flame spread index of 0-25, but is not required in this building. Class B interior finish materials have a flame spread index 26-75, and Class C materials have a flame spread index of 76-200. All three finish classes have a smoke developed index of 0-450.

GROUP	EXIT ENCLOSURES AND EXIT PASSAGEWAYS SPRINKLER	CORRIDORS SPRINKLED	ROOMS AND ENCLOSED SPACES SPRINKLED
A–3	B	B	C
B	B	C	C
S–1	C	C	C
S–2	C	C	C

Figure 37. Interior finish requirements based on occupancy and room type.

Enclosed Areas of Refuge

The Baker Science building employs enclosed areas of refuge. The egress stairways are enclosed areas of refuge, per CBC 1007.6. Stair 3 has a two hour fire rating, highlighted in green. The separation between the atrium and the east and west wings is highlighted in red, shown in Figure 38 below.

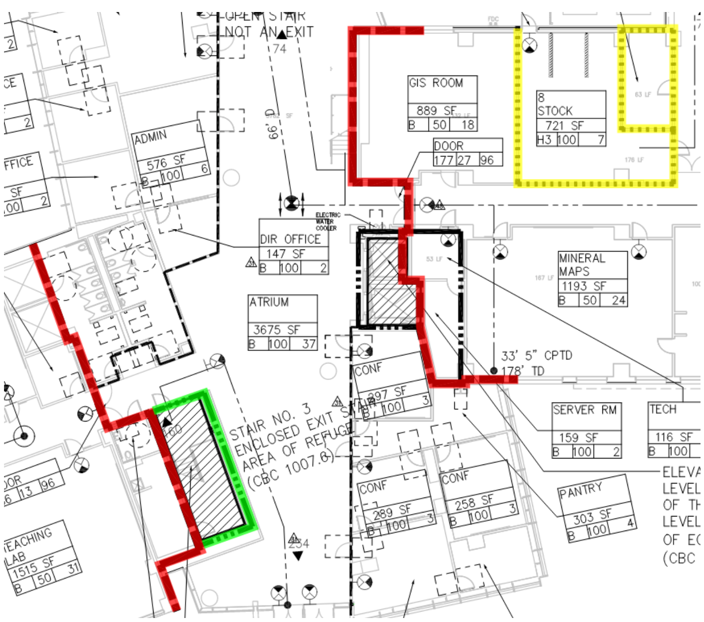


Figure 38. Examples of fire rating enclosed areas of refuge.

Fire Resistance Analysis

This building uses steel construction with wide-flange steel beams. These beams are used for horizontal and vertical support. Common sizes are W24x207 and W24x250, as shown in Figure 39.

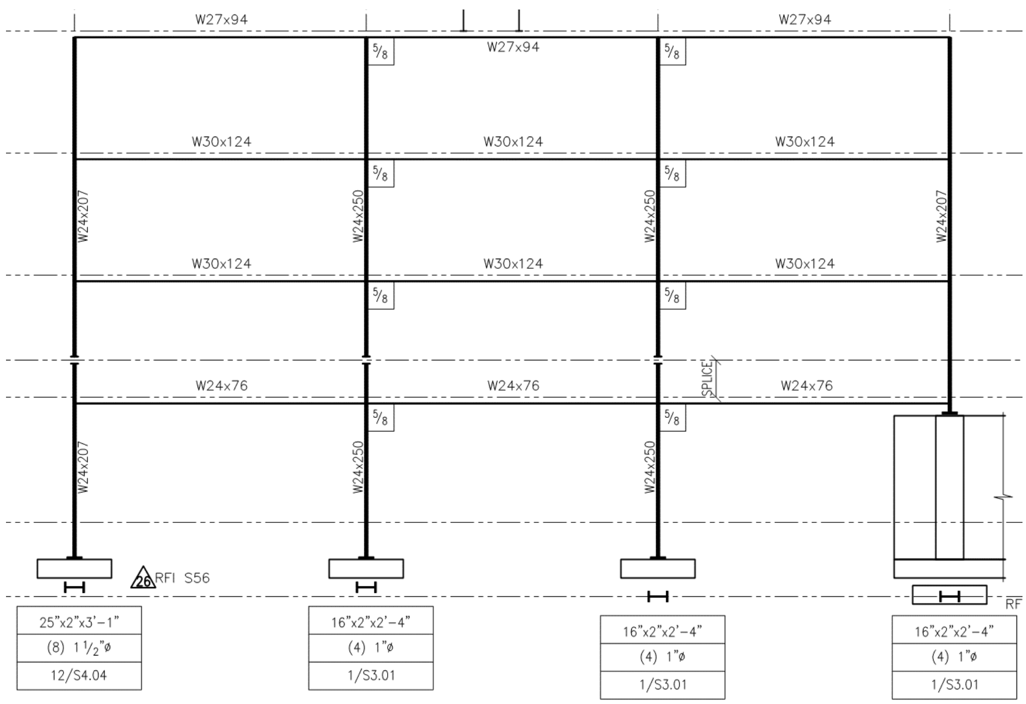


Figure 39. Beam details from C/S3.10.

The floor assemblies are concrete and metal deck, which is supported by the steel beam. A detail view of the concrete and metal deck is shown in Figure 40. The stories at ground-level have concrete slabs as floors.

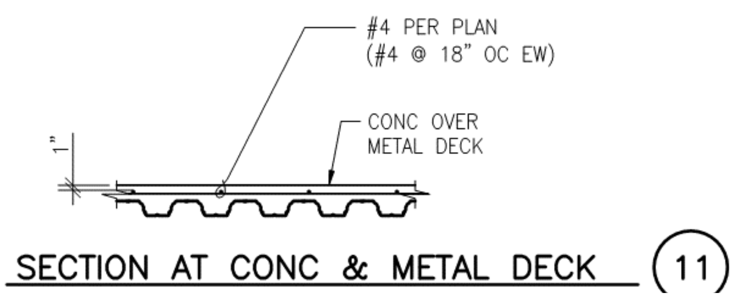


Figure 40. Floor detail, 11/S4.02.

The joints between the columns are welded and bolted. Detailed views are given for various ways of joining beams, along with schedules for the number of bolts and weld sizes for each connection type, see Figure 41 and Figure 42.

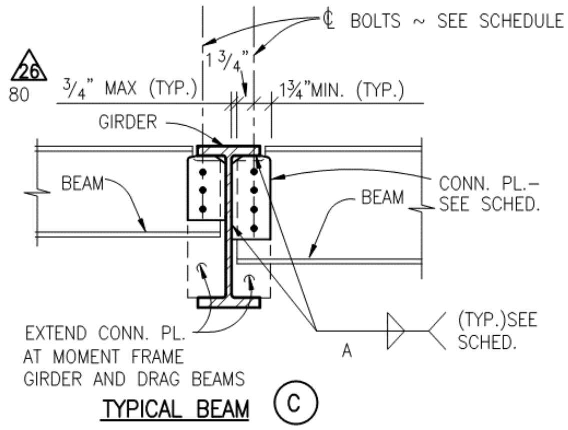


Figure 41. Beam joining detail.

SIMPLE BEAM CONNECTION SCHEDULE			
SHEAR PL CONNECTION			
MEMBER (DEPTH)	# OF BOLTS 1"ø A325	CONN PL t	WELD SIZE A
< 8"	2	3/8"	1/4"
8" – 10"	2	3/8"	1/4"
12" – 14"	3	3/8"	1/4"
15" – 16"	4	1/2"	5/16"
18"	5	1/2"	5/16"
20" & 21"	5	1/2"	3/8"
24"	6	5/8"	3/8"
27"	7	5/8"	3/8"
30" & 33"	8	5/8"	3/8"
36"	10	5/8"	3/8"
40"	11 (2 ROWS)	3/4"	CJP

Figure 42. Beam connection schedule.

Fire Resistance Requirements

The Baker Science building contains a variety of occupancy classifications: business, assembly, storage, and hazard 3. Table 508.4 of the CBC, shown in Figure 43, shows the required separation of occupancies, with highlighted fields between relevant occupancies. Appendix A shows occupancy classifications of the different rooms in Baker science, along with fire resistance requirements between rooms. A red line represents a 1 hour fire rating. Where a line is omitted there is no fire resistance requirement.

TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)[f]

OCCUPANCY	A, E		I-1[a], I-3, I-4		I-2		R[a]		F-2, S-2[b], U		B[e], F-1, M, S-1		H-1		H-2		H-3, H-4		H-5	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3	2	NP
I-1[a], I-3, I-4	—	—	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
I-2	—	—	—	—	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP	2	NP
R[a]	—	—	—	—	—	—	N	N	1[c]	2[c]	1	2	NP	NP	3	NP	2	NP	2	NP
F-2, S-2[b], U	—	—	—	—	—	—	—	—	N	N	1	2	NP	NP	3	4	2	3	2	NP
B[e], F-1, M, S-1	—	—	—	—	—	—	—	—	—	—	N	N	NP	NP	2	3	1	2	1	NP
H-1	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	NP	NP	NP	NP	NP	NP
H-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	1	NP	1	NP
H-3, H-4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1[d]	NP	1	NP
H-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP

Figure 43. CBC occupancy separation requirements.

The Baker Science building complies with the structural fire protection requirements. Many of these requirements will be implemented on the architectural and structural engineering drawings. It is important for a fire protection engineer to be familiar with these requirements, and check the drawings from other disciplines to verify the fire protection requirements are achieved. In addition to verifying structural code compliance, the fire protection engineer will also have input on building configuration related to other systems, such as smoke control.

Smoke Control System

The Baker Science building has a large atrium extending from the second floor to the sixth floor. Walkways connecting the east and west wings extend through the middle of the atrium. The north side opening has an exposed stairway, and the south side has a stairway enclosed in fire rated walls. With such a tall ceiling (~75'), a fire in the atrium may not set off sprinklers and be suppressed with water. The smoke will continue to build up, reducing tenability time in the top floors of the atrium and making egress more difficult.

To combat this, the building has a passive smoke control system installed. The main function of this system is a "night purge," used for temperature control. When the temperature in the building exceeds the outside temperature by 3°F or greater, vents at the top of the atrium and windows lower in the atrium open to allow the warm, buoyant air to naturally exhaust, being replaced by cooler outside air. The dampers stay open until the atrium temperature setpoint is reached, when all the dampers close. There is an interlock to prevent operation when it is raining. There are four vents at the top of the atrium, two on the north side and two on the south side. The brand is Greenheck, and all four dampers are 60"x120". The vents are at the top of elevated roof sections. The elevated roof sections provide space for smoke to build up before the smoke extends into the egress paths on the top floor of the atrium. A construction drawing of the smoke control vents is shown in Figure 44, and a satellite view of the vents is shown in Figure 45.

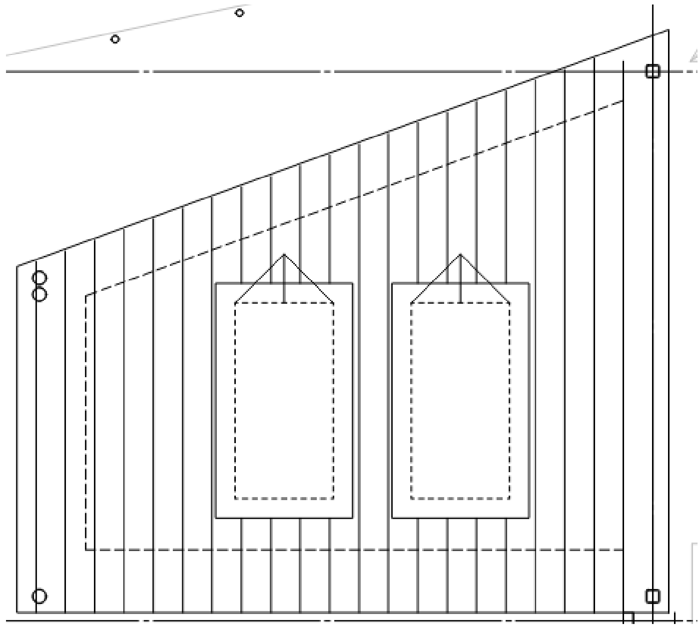


Figure 44. North atrium smoke control vents.

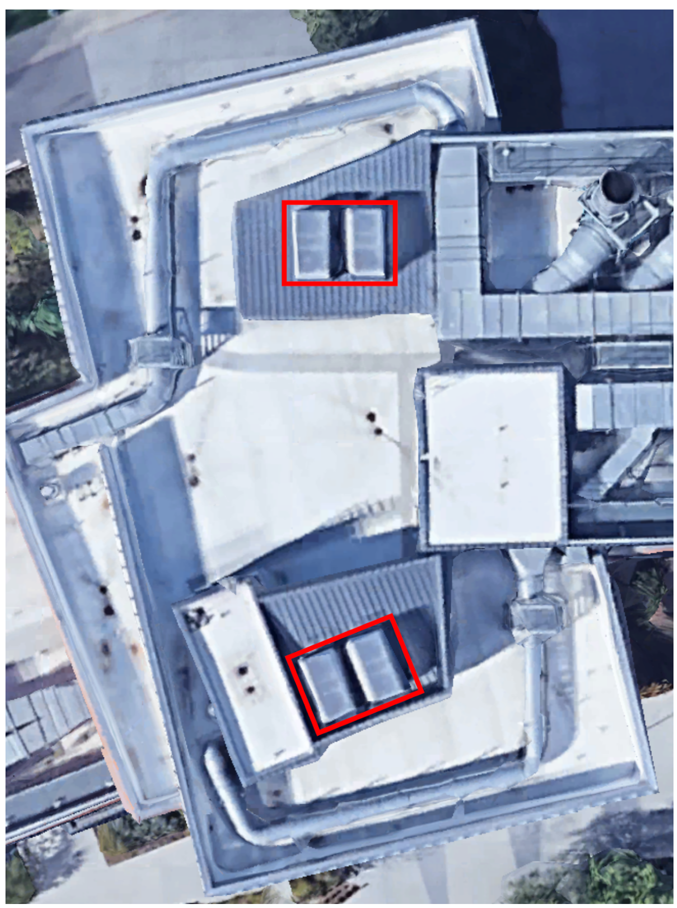


Figure 45. Smoke control vents highlighted in satellite view.

The night purge system uses the same principles to vent smoke in the case of a fire. If a fire is detected in the atrium the roof dampers and the atrium doors open to allow smoke to vent out of the top of the atrium, increasing the time occupants have to egress the atrium without smoke overwhelming them. When the smoke control system activates all the doors to the east and west wings close. This is accomplished by the fire alarm system stopping power to the magnetic door holders. This allows the makeup air to be supplied from the outside through the bottom of the atrium. The smoke control system can be activated by a waterflow switch for sprinklers in the atrium, a manual pull station in the atrium, or a beam smoke detector in the atrium. Detection in other parts of the building do not trigger the smoke control system.

Design fire 1 takes place in the atrium, and was designed to activate the smoke control system. Figure 46 shows a vector slice file at the smoke control vents above the fire. The colored vectors indicate the smoke is escaping at about 2.5 m/s. With each vent having an area of 4.62 m^2, the vents on this side are venting approximately 23.1 m^3/s of smoke.

There is a night purge system installed in the tall ceiling in the first floor lobby, however it is not connected to the fire alarm system to act as a smoke control system. This is not necessary since occupants will not evacuate through the fire plume above the fire in the event of an emergency.

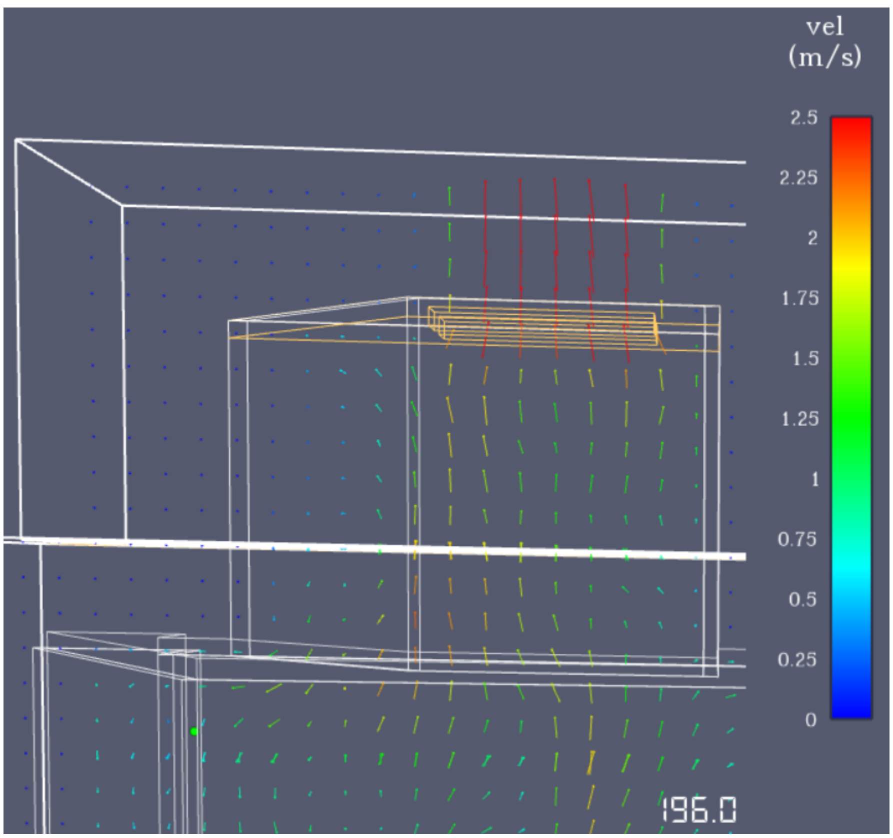


Figure 46. Vector slice file of velocity of venting smoke.

Utilizing the night purge function for smoke control was an upgrade to the Baker Science building that required little additional equipment to achieve some benefit. Since this type of system needs to be specific to the building in which it is installed, the California Building Code does not dictate how a smoke control system needs to be sized and configured. In order to verify adequate smoke venting capability, the engineer must know the required safe egress time as well as the characteristics of a design fire, including smoke production. With this information, a performance based review can be conducted in order to properly size the smoke control system.

Performance Based Review

Design Fire Goals

The goal of the performance based review is to verify the tenability time for occupants in Baker Science exceeds the evacuation time, for the selected design fires. The design fires were chosen to represent challenging, but plausible, fires that could occur in the building. Each design fire will have specified parameters, such as heat release rate, growth rate, fuel source, and toxic gas production. These values will be based on materials that are likely to be in the building and published fire data for the materials. These variables will be used to model the fire outputs, such as temperature, sprinkler activation time, toxic gas concentration, radiant flux, detector activation time, and occupant visibility. The model outputs will be used to determine the tenability time for occupants. The amount of time that occupants can safely egress through the building is also called the available safe egress time, or ASET. This is compared to the required safe egress time, or RSET. The goal is for the available safe egress time to exceed the required safe egress time. RSET starts at ignition time and consists of time to detection, time to alarm after detection, the premovement time, and the travel time. Occupants will not know to evacuate until an alarm is activated. After this occurs, there is premovement time while the occupants gather belongings and decide to evacuate. For a building like Baker Science, this is about 1.2 minutes, from the SFPE Handbook, 64.4. Figure 47 shows a visual comparison of ASET and RSET.

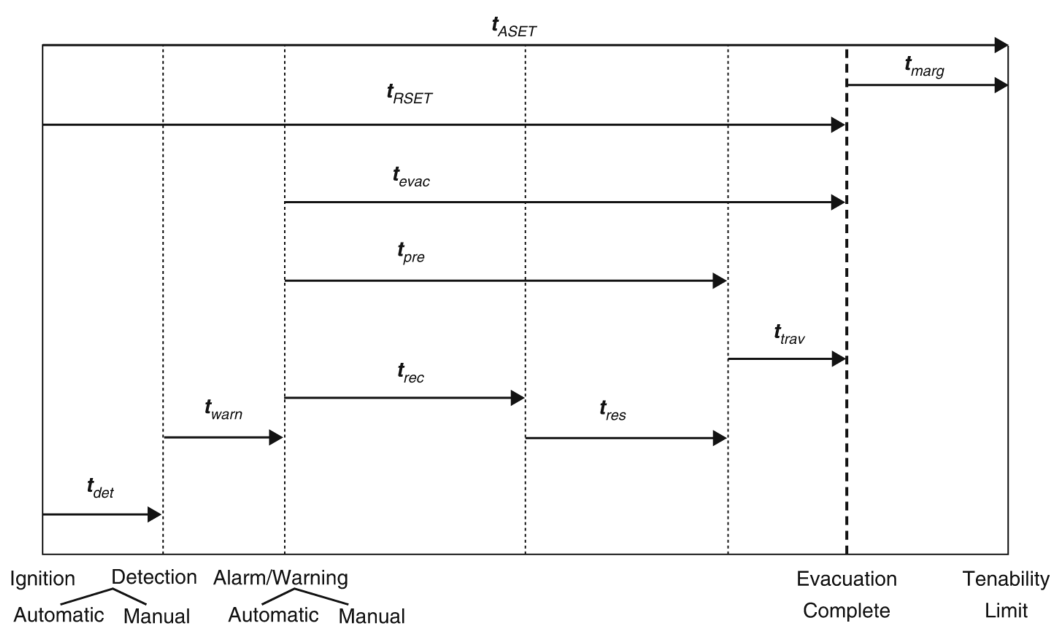


Figure 47. Comparison of ASET and RSET for tenability time.

How to analyze design fires

In order to accurately find the tenability time for occupants given likely fire scenarios, a number of steps must be followed. The building must be analyzed to determine where a fire is most likely to negatively impact building egress. This will be based on where occupants are concentrated, and the paths they will take when evacuating the building in case of an emergency. Consideration must also be given to fuels that are likely to be found in the building, and their locations. A fire that occurs in a building space that could expose egressing occupants to heat, smoke, or toxic gasses may justify a design fire.

Once the location of the fire is determined, the next step is to define the fire. Potential fuel loading for the space must be found, both to find the type and amount of fuel. The type of flammable substance will determine the products of combustion. Both pieces of data will be used to estimate the heat release rate, growth rate, and how long the fire will burn. A plausible ignition source should be identified. Since fires are typically low probability, but high consequence, some creativity may be used when finding an ignition source.

PyroSim Model Creation

A PyroSim model is created to match the size and shape of the structure. PyroSim is a program that provides the user with an interface for Fire Dynamics Simulator (FDS), to make it easier to create and analyze models. Construction documents are used to make a floor plan similar to the space being analyzed. Walls, floors, and ceilings are assigned realistic material properties to accurately reflect how heat and fire would interact with the boundaries of the space. Heat capacity, thermal conductivity, reflectivity, and thickness are some of the considerations when building the boundaries.

The design fire must also be defined in PyroSim. The location, size, and shape are input to the model. The fire characteristics such as growth and decay rates, maximum heat release rate, and burn time are included in the fire information. The type of material burning is also specified, along with products of combustion. The products of combustion will be used in later analysis when finding visibility and toxicity for the egressing occupants.

A PyroSim model works by creating a mesh of imaginary blocks of space in the model. Each block interacts with the blocks next to it. Model outputs such as air and smoke flow, temperature, and radiation are calculated for each block of the mesh. Determining the correct mesh size is important for the model to provide accurate outputs in a reasonable amount of time. A coarse mesh, with too few blocks, will not provide adequate resolution for the model, yielding potentially inaccurate results. A fine mesh, with too many blocks, will take too long to calculate without providing better model outputs. FDS is computationally intensive, with a full-size model taking many hours to complete. Reducing mesh dimensions by half doubles the number of nodes in the X, Y, and Z dimensions, drastically increasing computation time. A coarse mesh is often used to test the model and provide outputs with less calculation time, and an adequately fine mesh is used to create the final output for analysis. Multiple mesh sizes can be used throughout the model. A finer mesh can be specified for areas of higher activity or interest in the model. For example, the space directly above the fire and near the ceiling where the smoke will collect may justify a finer mesh for the analysis. Air/smoke movement in these areas will be increased, and higher resolution for the output would be justified, at the expense of a longer calculation time. Areas farther from the fire, or where smoke and heat effects will be minimal can be calculated with a more coarse mesh in order to reduce calculation time.

There are dozens of outputs available in a PyroSim model. The ones most valuable for analyzing ASET are temperature, visibility, toxic gas concentration, and radiation. Air flow rate was also used in this report to measure required smoke evacuation capability of the smoke control system. The model can be programmed to output points where relevant data is measured, as well as slices with a color-coded visual representation of a plane in the model. Additionally, there are spreadsheets to show how a parameter (such as temperature) changed over time at a given point. All of this is useful when determining how long occupants have to evacuate a space.

Once the PyroSim model has been analyzed to determine how long occupants have to safely egress before being exposed to untenable conditions, this information is compared to the required safe egress time that was calculated with the hydraulic egress calculations. If the available safe egress time is less than the required safe egress time, the building does not provide adequate protection to the occupants.

Tenability Criteria

A primary concern for occupants as they escape a burning building is tenability time. Many factors can make a building untenable: temperature, visibility, carbon monoxide, and heat flux. These are the tenability criteria that will be explored in this report. There are other criteria, such as different toxic gasses, but the analysis methods demonstrated can be applied to other tenability measurements. The SFPE Handbook provides limits for the tenability criteria. The SFPE Handbook provides tolerance times for exposures to hot air in Table 63.17. For dry air the tolerance time is 25 minutes for a temperature of 110°C. Figure 63.28 shows a graph of the temperature limit based on exposure time for both dry and humid air. If the 110 °C limit is reached, this graph can be used to determine if tenability is exceeded for the given temperature conditions. SFPE Handbook Table 61.3 provides two thresholds for visibility limits, depending on the familiarity of the occupant with the building. An occupant familiar with the building is considered to be capable of safely escaping a building with 4 m of visibility, while an occupant unfamiliar with the building will need 13 m of visibility to safely evacuate. For carbon monoxide exposure, a limit of 30,000 ppm-min is considered to be the incapacitation limit for light activity, from SFPE Handbook Table 63.9. Heat flux exposure is limited to 2.5 kW/m^2 for exposure greater than 5 minutes, as outlined in Table 63.20.

Design Fire 1

The first design fire takes place in the atrium on the second floor, which is the lowest storey of the atrium. To make this fire more challenging, the flammable material is not located under a sprinklered ceiling, but closer to the center of the atrium with the tall ceiling above it. This is a fire scenario that necessitates the beam smoke detectors that were installed in the atrium. With such a tall atrium, smoke venting and occupant egress of higher floors are major concerns. Smoke at the top of a five storey atrium will not be hot enough to set off sprinklers and suppress the fire. The basis of this design fire assumes sprinklers do not locally suppress the fire, due to the fact that the fire does not occur directly under the sprinklered walkway. Since the fire will continue to burn, the smoke will likely need to be exhausted from the space to maintain tenability at the higher floors. Figure 48 shows the location of the fire in the atrium. Figure 49 indicates the location of the fire on the map. Note the highlighted yellow areas where the atrium extends upward.

Figure 48. North side of the atrium where design fire 1 occurs.

Figure 49. Location of atrium fire on map.

A fire on the north side of the atrium was selected since the stairway is exposed on that side. The stair on the south side of the atrium is enclosed and protected from smoke and heat. A fire on the north part of the atrium would prevent use of the north atrium stairway and the north exit of the main lobby. Upon the fire alarm sounding, occupants of the building may see the smoke in the atrium and select exits at the ends of the wings of the building. With fewer people using the main staircases, the other exit paths would need to accommodate more people. The fire could have been placed on the south side of the atrium, limiting egress from the south stairway to the south atrium door, but then occupants likely would have used the exposed north stairway for egress. A fire on either side of the atrium creates unique egress problems.

The fuel source of this design fire is polyurethane foam decorations for a concrete canoe. Cal Poly competes in concrete canoe design competitions, and the canoes are often displayed in buildings on campus. The concrete canoe in Figure 48 above does not have any artistic additions, but Figure 50 shows an example of a canoe with foam on the supports. For the purpose of this design fire, the canoe and foam artwork are illuminated with lights for display. The ignition source for the fire would be a failure of the lights, setting the foam on fire.

Figure 50. Example of a concrete canoe with foam decorations.

The foam burns as an αt^2 fire with a growth constant of α_g=0.052 kW/s^2, a fast burning fire. The SFPE Handbook Table 38.2 lists growth times for various fuels to reach 1000 kW, and classifies the growth as slow, medium, fast, or ultra-fast. The fast fire growth rate applies to cartons on pallets and some furniture, and has an equivalent growth constant of α_g=0.044 kW/s^2. “Heat Release Rates of Burning Items in Fires” by Kim and Lilley gives growth constants and maximum heat release rates for numerous types of foam furniture. The values vary greatly , but many of them are in the range of a fast growth fire. A growth constant slightly faster than a fast growth fire was selected to ensure a challenging design fire. A chair would be approximately the same size as the foam bases of the canoe, so the heat release rate was set to be similar to the burning chairs listed by Kim and Lilley. The maximum heat release rate is 1500 kW, achieved after 170 s of fire growth. A graph of heat release vs time is shown in Figure 51.

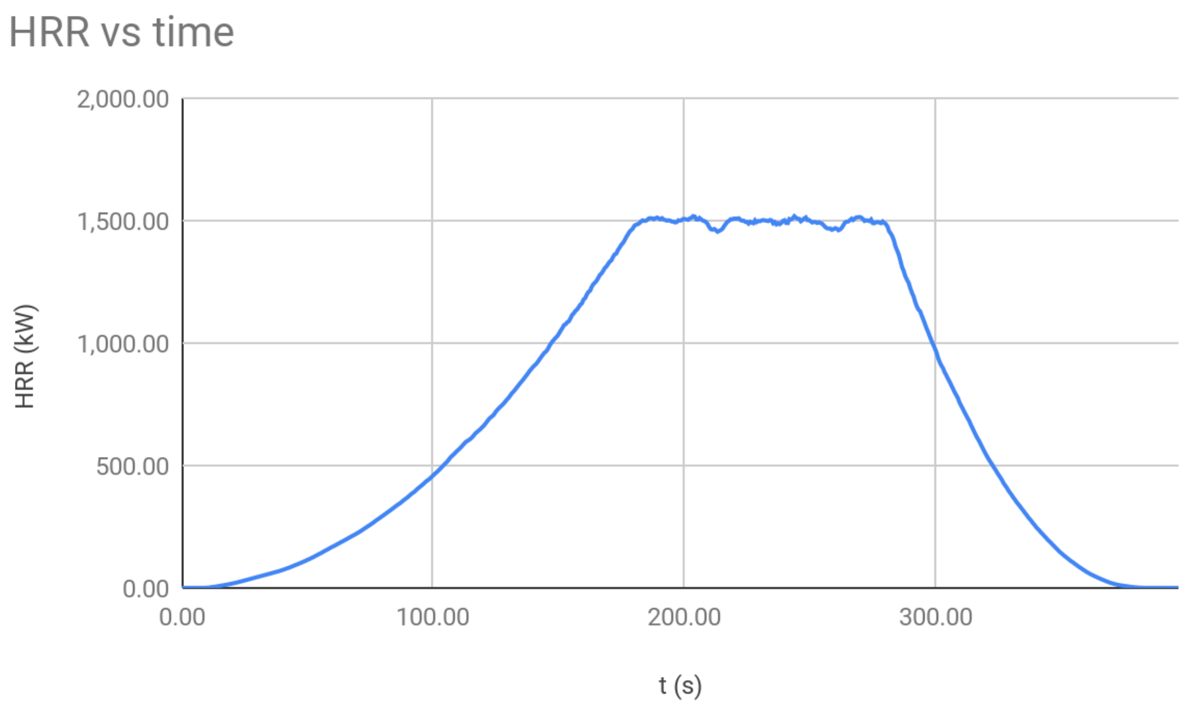


Figure 51. Heat release rate of polyurethane foam vs time.

Floors three through six all have walkways that overlook the atrium on both sides. Each side of the atrium has a raised ceiling section for smoke to accumulate prior to the smoke venting. Figure 52 shows the high ceiling of the atrium with the smoke venting area outlined in red.

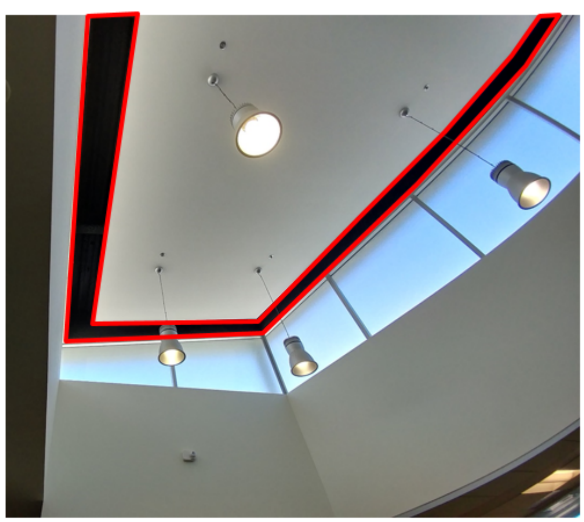


Figure 52. Smoke extraction system, highlighted in red.

As the fire burns, the plume will rise to the ceiling, expanding as it does so. Once it reaches the ceiling, the smoke layer will begin to lower as smoke fills the highest sections of the roof. In order to prevent smoke from filling the atrium of the higher floors, smoke must be vented from the building. To ensure the smoke layer does not continue to lower to the level where people would be, the same amount of smoke that is produced would need to be vented. There are three common methods to calculate the volume of smoke produced by the fire: Zukoski, Heskestad, and McCaffrey. The Heskestad method uses a virtual origin based on the size of the fuel being burned. For this design fire the fuel is 1 m in diameter. This virtual origin simulates if the fuel were at a point above or below the floor, depending on the size of the fuel. For this design fire, the virtual origin is approximately 0.5 m above the floor. A larger fire would yield a virtual origin below ground level. The smoke extraction required by the three methods is summarized in Table 4. Detailed calculations are provided in Appendix F. Makeup air must also be supplied in order for the smoke to be exhausted. This is accomplished with motorized door openers that open the atrium doors when the smoke control system is activated. With two pairs of double doors at the north and south ends of the atrium, makeup air will not limit the rate of smoke evacuation.

Table 4. Required smoke extraction for three methods.

	m^3/s
Zukoski	184
Heskestad	150
McCaffrey	187

This design fire was deliberately located away from sprinklers that would effectively suppress the fire. This was to provide a challenging fire that could test the capabilities of the smoke control system. A fire such as this would need to be extinguished by emergency response crews or allowed to burn out on its own. While there are sprinklers at the top of the atrium (seen in Figure 52 above), the smoke at the high ceiling will not reach the 155°C required to activate them. The smoke control system can be activated by a waterflow switch for sprinklers in the atrium, a manual pull station in the atrium, or a beam smoke detector in the atrium. Of these methods, the beam detectors are the most likely to be activated for this design fire.

Beam detector activation can be estimated with calculated smoke output and beam detector setpoint. The Xtralis beam detectors are set to trip at 25% light obscuration. The Lambert-Beer Law is used to correlate light attenuation to smoke mass concentration (equation below). Once enough smoke is present to notably diminish light received from the detector source, the alarm is activated.

$$\frac{I_T}{I_O} = e^{-\kappa CL}$$

Where I_O is initial light intensity, I_T is final light intensity, κ is smoke extinction coefficient, C is smoke mass concentration, and L is optical length. The 25% smoke obscuration is the ratio of final light intensity to initial light intensity. Using a common smoke extinction coefficient and optical length, the smoke mass concentration can be calculated. Iteration is used to determine smoke density at different times during the burning of the fire. According to the calculation, the alarm is tripped at 210 s, at which point the smoke vents and exterior atrium doors would open to remove smoke from the space and supply makeup air. The Lambert-Beer calculation does not align very closely with the PyroSim model. This is likely due to the calculation taking place where smoke collects at the top, while the PyroSim model is tripped by a lower beam detector that passes through the smoke plume, reaching the alarm setpoint sooner.

The required safe time egress for the atrium and design fire 1 is 10.81 minutes. This consists of 58 seconds until a beam smoke detector on the sixth floor alarms in PyroSim, 1.2 minutes pre-movement time from the SFPE Handbook, and 8.66 minutes for the atrium to be fully evacuated once occupants begin moving from the egress calculations. This egress model assumes occupants egress through the same section of the building that they start in. The entire building will take longer to evacuate, 15.77 minutes from time of ignition. The occupants in the east and west wings do not have direct exposure to the smoke or fire, and are afforded more time to escape.

Tenability

Due to the high ceiling and large volume, the plume temperatures in occupied spaces never exceed tenability conditions. Figure 53 below shows a cut section from PyroSim with temperature at the 6th floor, where the highest temperatures are experienced. The temperature never exceeds that of a warm day and will not have an effect of tenability.

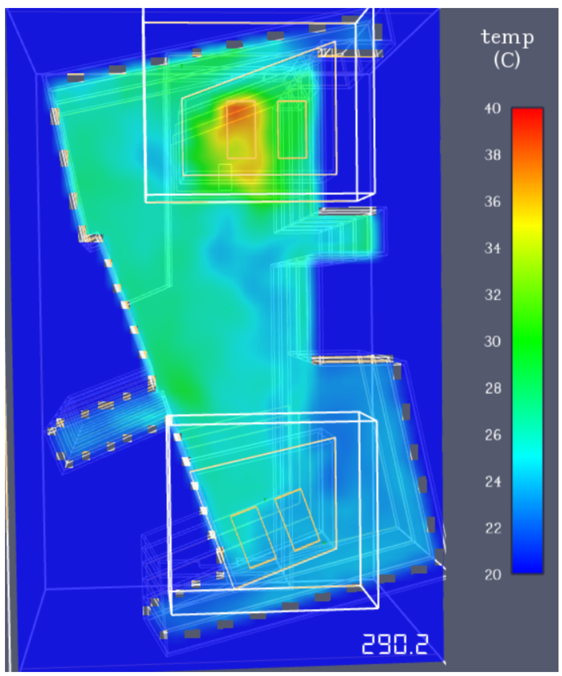


Figure 53. Temperature on the sixth floor.

Visibility is another concern for this sort of fire. The smoke plume extends up to the upper floors, obscuring occupant vision. Thes SFPE Handbook provides a minimum visibility limit of 4 m for occupants familiar with the building, and a limit of 13 m for occupants not familiar with the building. Figure 54 below shows when visibility limits are exceeded for both 13 m and 4 m, which occur at burn time of 94 s and 190 s, respectively. Note that ignition happens 10 s into the simulation, so timestamps in the images are not aligned with burn time. With 58 s until alarm activation, and 1.2 minutes of premovement time, this does not provide enough egress time for occupants of the upper floors to leave without losing visibility. The sixth floor requires 3.96 min of tenable conditions to get into the stairwell, and this is not achieved near the offices on the north side.

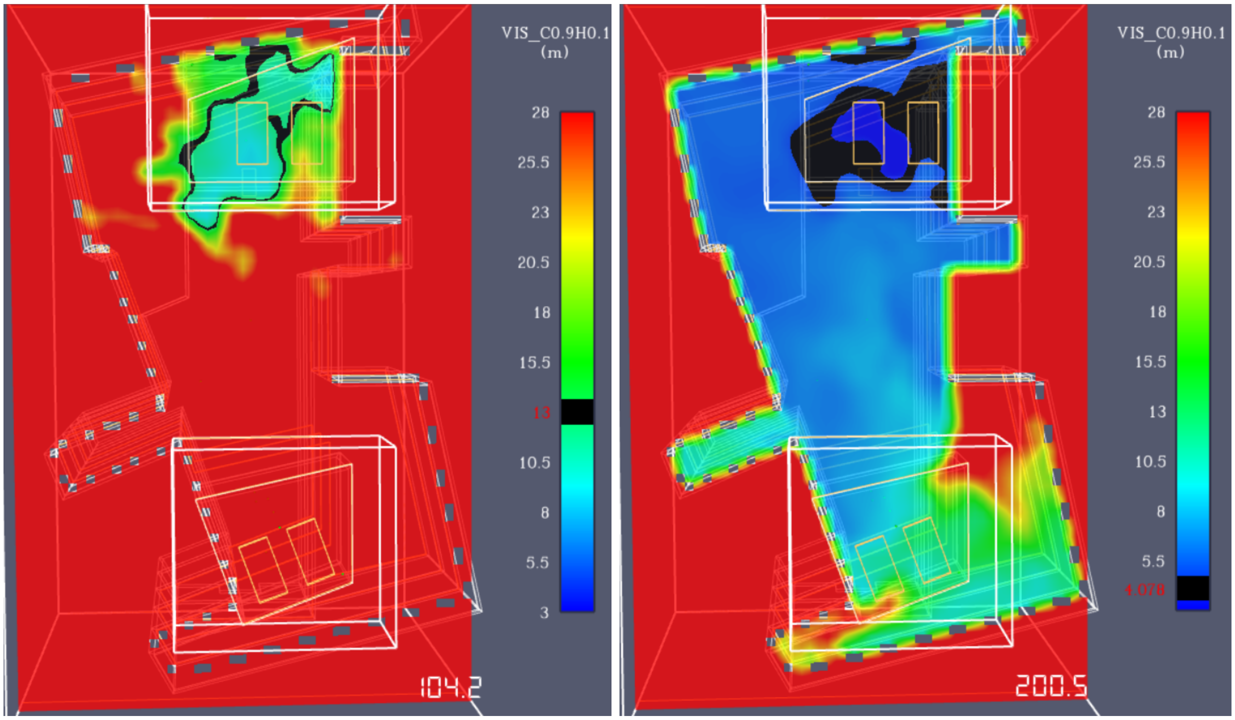


Figure 54. PyroSim visibility plots, 13 m (left) and 4 m (right).

Another concern for occupants trying to evacuate the building is toxic gas inhalation. Carbon monoxide is a common product of combustion, and prolonged exposure can incapacitate a person, preventing them from safely leaving the building.

Haber's Rule was used to determine CO tenability. Haber's Rule is a guideline that provides a limit for the product of concentration of a toxin and time of exposure. Since carbon monoxide builds up in a person's blood, and takes hours to recover from, this rule assumes a short exposure time. A person is estimated to be incapacitated at 30,000 ppm-min CO. From the PyroSim model, the highest concentration of CO for this design fire is 40 ppm. Figure 55 shows a slice file at head height on the sixth floor. Concentration is highest in the plume directly above the fire, and lower on the walkway where occupants would evacuate. The longest egress in the building is less than 20 minutes, so the worst exposure is 800 ppm min, far below the level required for incapacitation. The carbon monoxide concentration takes time to build up to 40 ppm, but this conservative calculation illustrates that the CO limit is never approached. Tenability is not limited by CO.

The method of using Haber's Rule for estimating tenability time based on toxic gas concentration can be used for other toxic combustion products. Each toxic gas will have a short term exposure limit, measured in ppm-min, that should not be exceeded. The combustion output of each toxic gas can be programmed into PyroSim, and slice files or gas detectors can be placed in the model to measure the gas concentration.

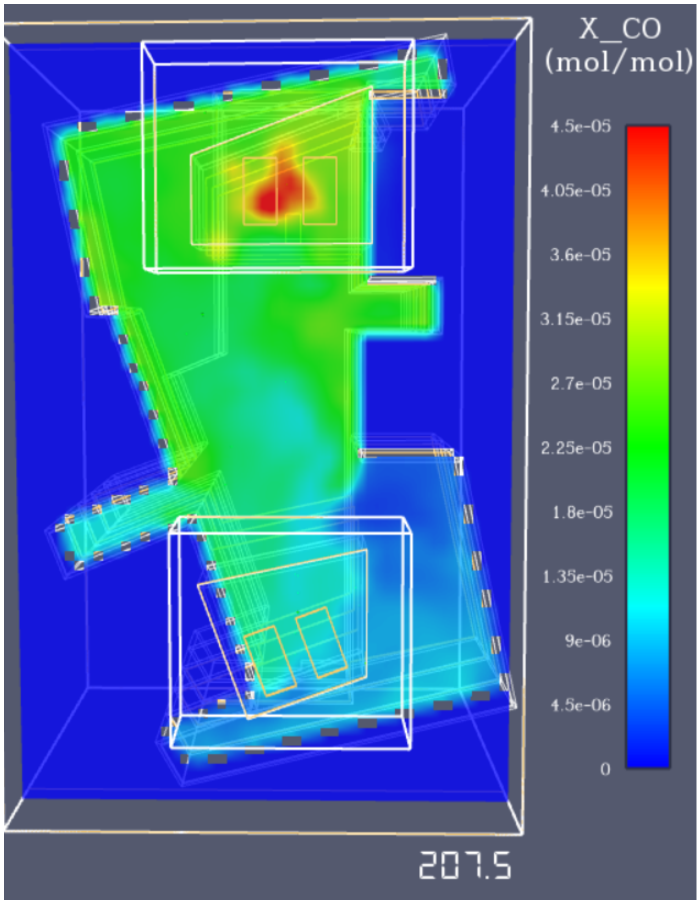


Figure 55. Sixth floor slice file with carbon monoxide concentration.

Radiant heat flux is another factor that could prevent safe egress of occupants. A limit of 2.5 kW/m^2 is provided as an upper limit for safe egress of occupants. Multiple heat flux detectors were placed throughout the Baker Science building to see where heat flux was the most limiting. The highest heat flux experienced at head level in the building occurred on the sixth floor, which aligns with the results of the previously discussed potentially limiting factors. As the fire plume rises to the ceiling, the smoke, heat, and combustion products spread out and begin to fill the sixth floor. Figure 56 shows a graph of radiant heat flux over time at the highest measured spot on the sixth floor. The baseline value is greater than zero since the building and all objects in it radiate heat due to being above absolute zero. The heat flux experienced by an occupant is less than 0.50 kW/m^2. This is below the limit of 2.5 kW/m^2, and half of what is experienced outside on a sunny day, about 1.0 kW/m^2. Radiant heat flux is not a limiting factor for evacuating occupants in design fire 1.

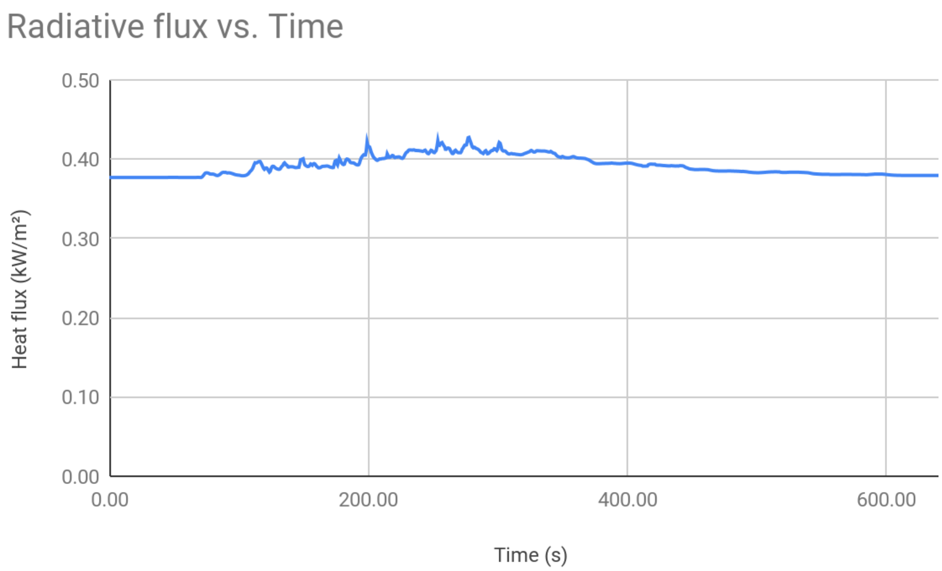


Figure 56. Radiant heat flux over time.

The Baker Science building was unable to provide adequate safe egress time for occupants on the sixth floor in regards to visibility. All other tenability factors did not approach limiting factors. Visibility would be improved with an adequately-sized smoke control system. The smoke control system is not likely to be replaced, but there are other options to improve egress of occupants when exposed to smoke. Additional illuminated signs could be installed every 2 m in the egress path from the sixth floor offices, meaning occupants would not require a full 4 m of visibility.

Another option would be to paint lines with egress directions on the floor to guide occupants to safety. A person could look at the ground 2 m ahead and safely follow the lines to safety. In this case visibility could be reduced to 2 m, which would not be exceeded in the egress time.

Design Fire 2

The second design fire takes place in the lobby of the first floor, outside the large auditorium. Figures 57 and 54 show the location of design fire 2 in the lobby outside the auditorium. The entrance of the lobby has a tall ceiling that extends up to be even with the ceiling of the third floor. In the event of a fire, this space would collect smoke from below. The red outline in Figure 58 indicates the shape of the ceiling above the lobby that can collect smoke. The area of this space is approximately 68 m^2. The two zone model can be used to calculate the time the fire takes to fill the space with smoke to the level of the regular first floor ceiling.

Figure 57. Location of fire outside auditorium.

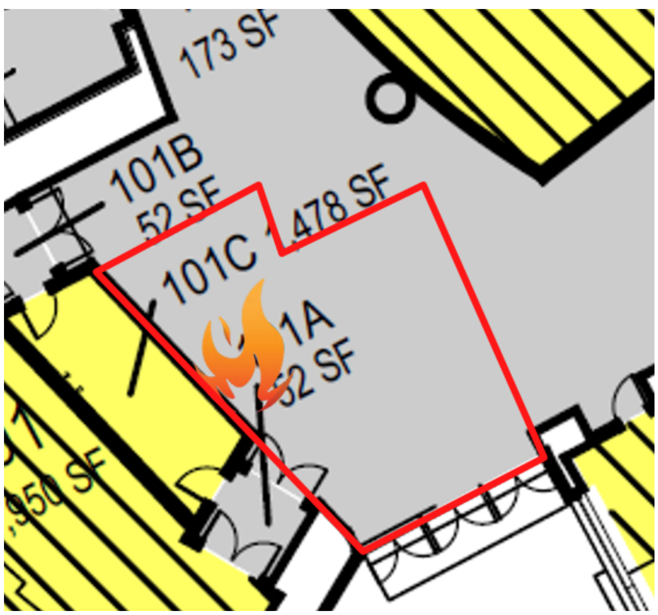


Figure 58. Location of lobby fire on first floor.

A fire outside the first floor auditorium creates a number of unique problems. The auditorium has fixed seating, and is the room in this building most likely to have occupants unfamiliar with the layout. Also, the density of occupants is the greatest in the building. This means egress will not be as efficient as other spaces in the building. The high ceiling in the space would delay the time to activation for the sprinklers, allowing the fire to grow larger than it would in a space with a lower ceiling.

The fuel source of this design fire is a large couch. California Technical Bulletin 133 (TB 133) provides limits for the maximum heat release rate and total energy released in the first ten minutes for upholstered furniture in public spaces. The limits are a maximum heat release rate of 80 kW and total energy release in the first ten minutes of 25 MJ. However, this technical bulletin has been repealed, meaning public buildings in California no longer need to use TB 133 compliant furniture. For this design fire, a non-TB 133 couch is placed on the first floor, next to the auditorium. The couch burns as an αt^2 fire with a growth constant of α_g=0.05 kW/s^2, a fast burning fire. The maximum heat release rate is 3000 kW. This heat release rate is significantly higher than what would be allowed by TB 133 compliant furniture and constitutes a worst-case scenario. The couch is ignited by a laptop placed on the couch cushion while the owner steps away for some time. The laptop fan is blocked, allowing heat to build up and eventually start a fire.

The values for growth constant and heat release rate were taken from “Heat Release Rates of Burning Items in Fires” by Kim and Lilley. The fuel source specified for this fire would reach maximum heat release rate at just over four minutes (245 s). The couch maintains 3 MW for one minute, then decays to nothing at just under ten minutes. A decay constant of α_d=0.04 kW/s^2. A graph of heat release vs time is shown in Figure 59.

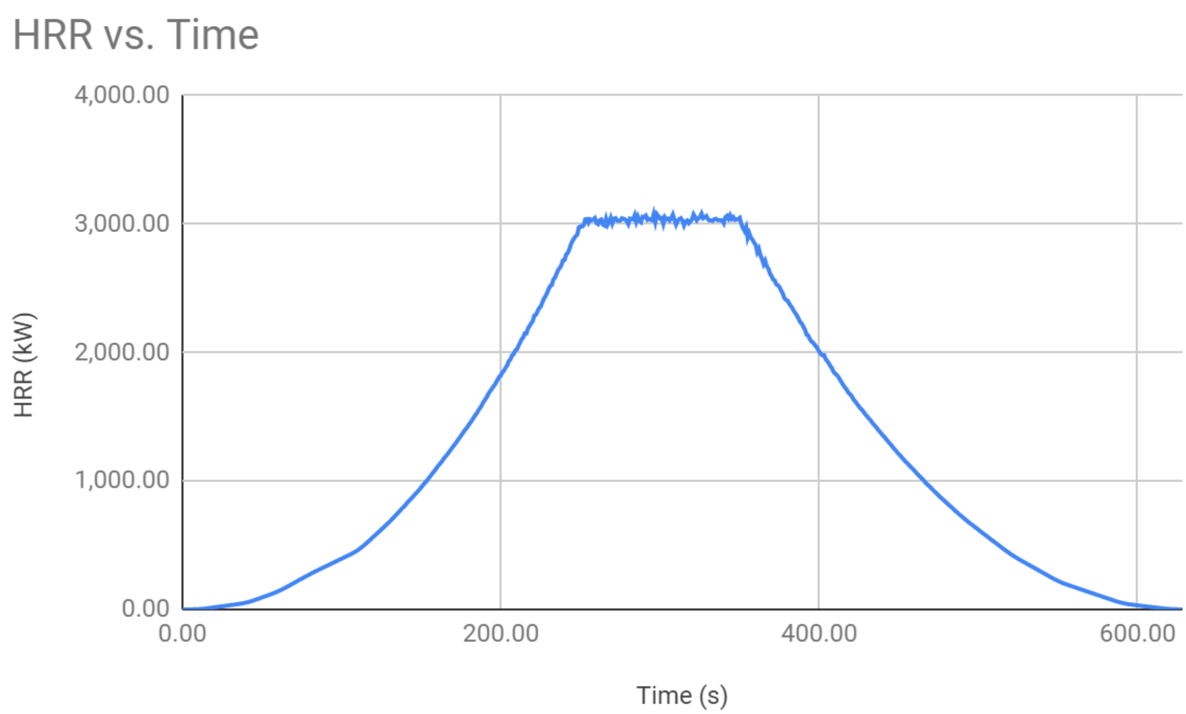


Figure 59. HRR of foam couch (loveseat) vs time.

There are other exits for this floor of the building, but a majority of people only use the three double doors at the front. With a fire in the main lobby, these doors could be compromised, pushing people to unfamiliar exits. Figure 60 shows a ground-level view of the fire location, along with a visual of how smoke would fill the ceiling space. Note that the flame is used to represent the fuel source, the art on the wall is not what is burning.

Figure 60. Location of design fire 3 and ceiling area that smoke would fill.

While the couch burns, smoke will collect in the space above the lobby, which is three stories tall. A hallway in the third floor of the building has windows that overlook the first floor lobby, as shown in Figure 61, note the sprinklers above the first floor lobby.

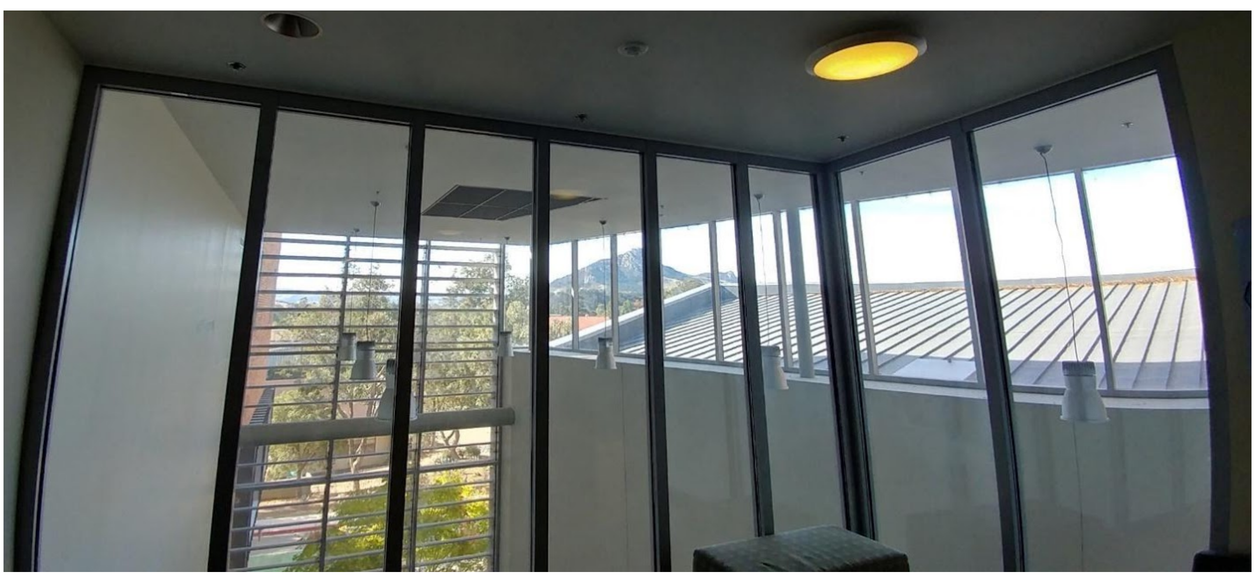


Figure 61. Third floor overlooks the first floor lobby.

The space with the red outline has an area of about 68 m^2, yielding a volume of 788 m^3 until smoke extends to the rest of the first floor with the shorter ceiling. The portion of the ceiling even with the second and third floors will fill up with smoke in 85 s given the constraints of this design fire. This is calculated using the two zone model, based on the smoke output of the fire. As the αt^2 fire grows, the smoke output also grows. An iterative model can calculate the mass and temperature of smoke produced. My model used 5 s increments for iteration, and calculated power, mass of entrained air, smoke temperature, smoke density, mass of collected smoke, and height of smoke. Each of these pieces of data is calculated in 5 s increments.

The PyroSim model estimates that the fire sets off a sprinkler at 142 s, triggering alarm and beginning pre-movement time, which again is estimated at 1.2 min. The egress time for the first floor after movement is started is 5.07 minutes, giving a total egress time of 8.64 minutes from the moment of ignition.

Tenability

The first factor to be considered for tenability is temperature. For design fire 2, occupants in the auditorium will exit through doors that pass near the fuel source. Since the doors are not blocked by the fuel source, people will be able to exit into the lobby, and through the doors to get outside to safety. The temperature limit for egressing occupants is 110°C, with a limit of 25 minutes. This limit is intermittently reached at head height near one of the lobby doors. 115°C is never reached at head height, and Figure 63.28 from the SFPE Handbook shows that people can be exposed to that temperature in humid air for 8 minutes, longer than it takes to egress the first floor. Tenability is not exceeded based on temperature exposure. Figure 62 shows a temperature slice file for the first floor of Baker Science. Notice the small black band where temperature slightly exceeds the 110°C limit.

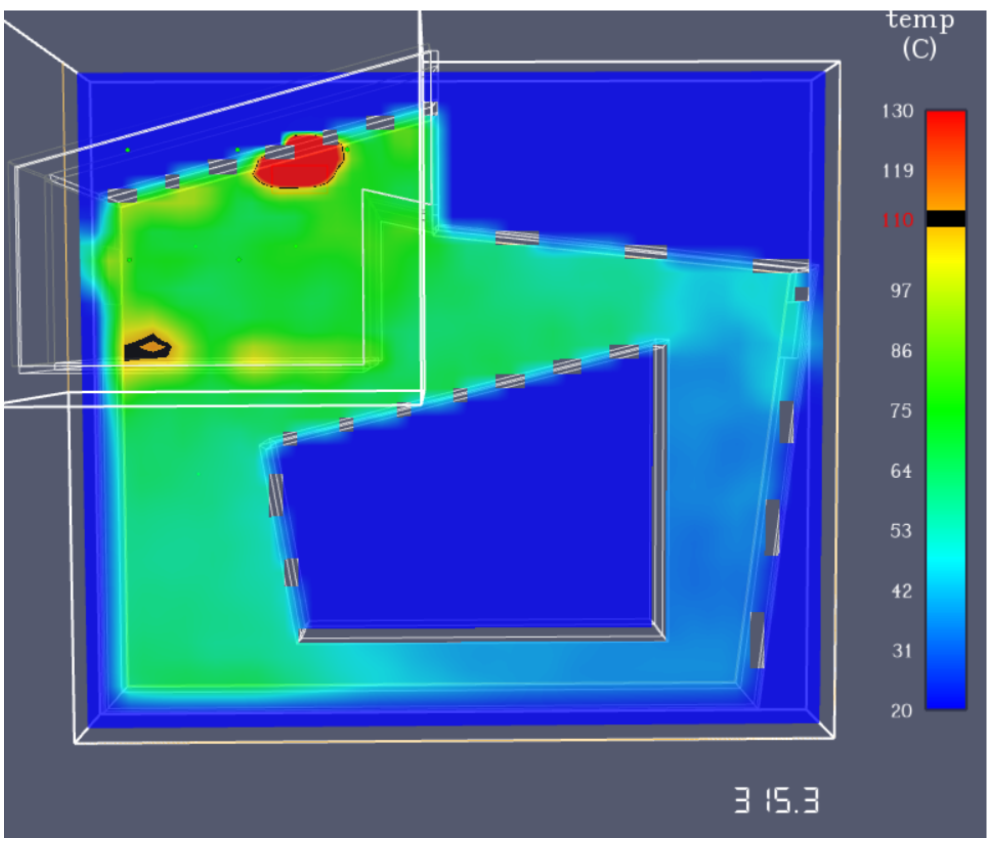


Figure 62. Temperature plot of first floor lobby.

Visibility is also a primary concern for occupants trying to evacuate a burning building. The visibility limits for this fire should be at 13 m since the large auditorium near the lobby is likely to be filled with occupants who are unfamiliar with the building. The 4 m visibility limit for the offices on the sixth floor was justified since each office is assigned to a staff member. A fixed seating auditorium will frequently be used by people unfamiliar with the building. Visibility drops below 13 meters 120 s after ignition, before any of the sprinklers even activate. This is partially due to the high ceiling allowing the smoke plume to entrain cooler air before reaching the sprinklers, delaying activation. Figure 63 is a slice file of visibility at head height in the lobby.

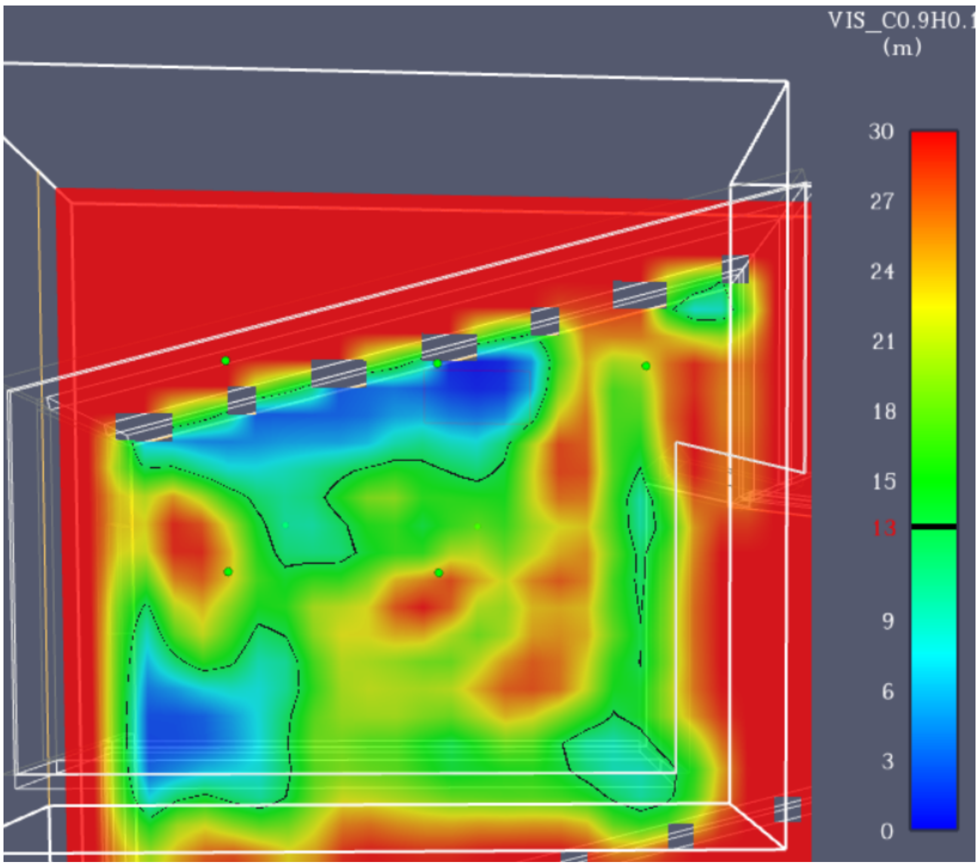


Figure 63. Lobby visibility at 120 s after ignition.

If the ceiling continues to fill up with smoke, 68.3°C will be reached 155 s after the fire starts, activating the sprinklers. It is likely that all of the sprinklers would activate within a short period of time, unlike a fire with a smoke jet crossing a single sprinkler. This is due to the fact that the entire space fills up with smoke at once, surrounding all sprinklers. With all sprinklers activated, the couch would be unlikely to reach its maximum heat release rate.

With building occupants evacuating through the room where the fire occurs, exposure to toxic gasses is a concern. Carbon monoxide begins to build up in the lobby as the fire burns. To calculate the accumulated exposure occupants would experience during egress Haber's rule was used again. A device was placed in the PyroSim model to measure CO concentration. After the model was complete, the output file with CO concentration was used to calculate the incremental exposure to CO by multiplying the concentration at a time by the time step. These products were sequentially added, then graphed on a plot with time as the X axis. This graph is shown in Figure 64. It indicates that carbon monoxide exposure gradually increases shortly after 200 s. As the CO concentration stabilizes around 400 s, the graph increases linearly. Sixteen minutes into the model, the calculated concentration of CO is still below 8000 ppm-min. This is far below the limit of 30,000 ppm-min CO. Carbon monoxide concentration does not limit tenability for this design fire.

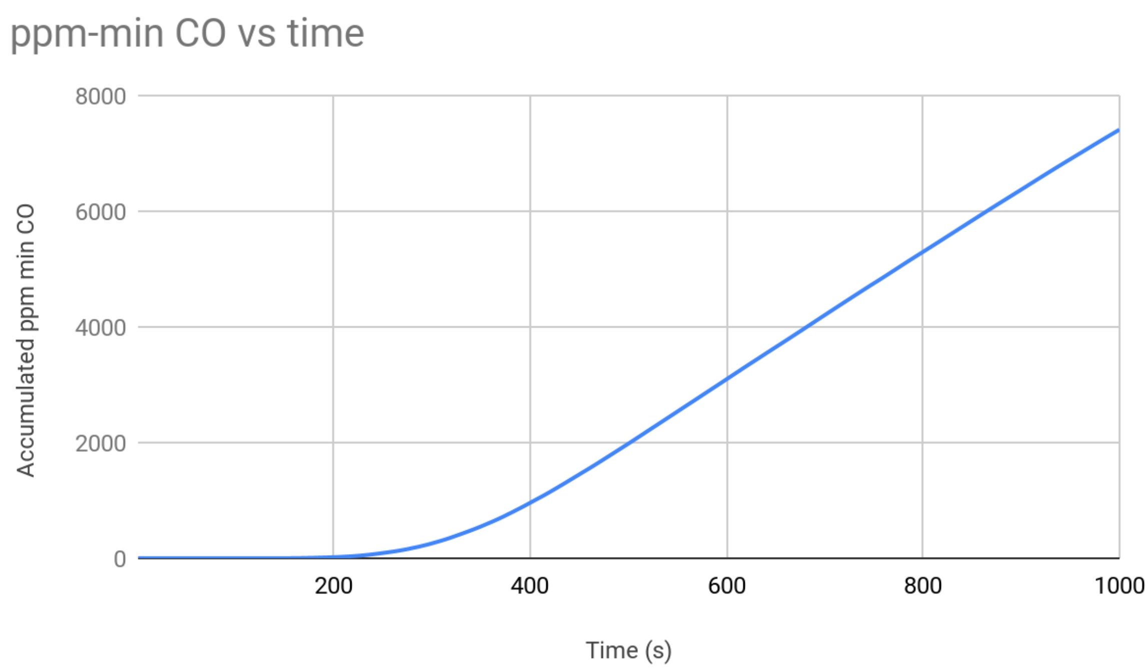


Figure 64. Accumulated carbon monoxide in first floor lobby vs time.

Radiant heat flux is another factor that could prevent safe egress of occupants. A limit of 2.5 kW/m^2 is provided as an upper limit for safe egress of occupants. As in design fire 1, multiple heat flux detectors were placed throughout the first floor lobby to see where heat flux was the most limiting. The part of the lobby exposed to the highest heat flux at head level was near the fuel source. This is logical since the detector would receive heat flux from the hot gasses at the ceiling as well as the plume rising from the burning fuel. Figure 65 shows a graph of radiant heat flux over time. The heat flux experienced by an occupant is less than 0.85 kW/m^2. Again, this is below the limit of 2.5 kW/m^2. Radiant heat flux is not a limiting factor for evacuating occupants in design fire 2.

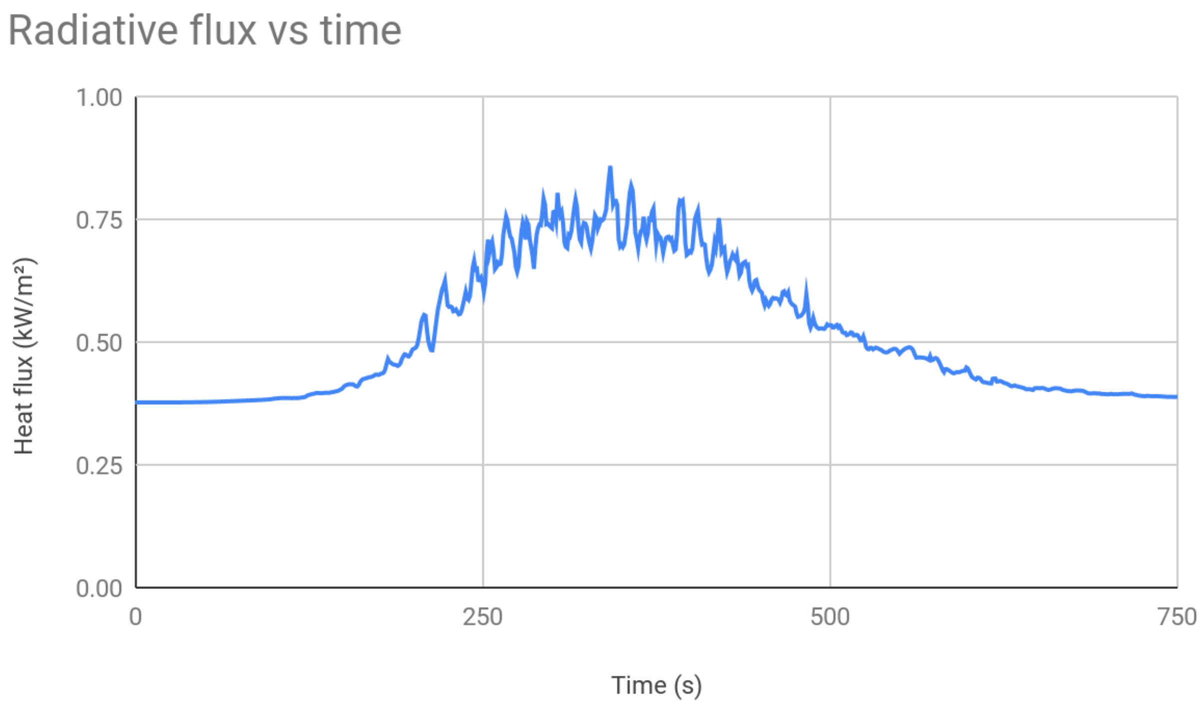


Figure 65. Radiative heat flux vs time in first floor lobby.

The egress for the first floor of Baker Science is mostly separated from the egress of the rest of the building. The time to evacuate the first floor when at full capacity is 7.22 minutes.

Other Possible Design Fires

Other fires were also considered for this report. The mechanical/electrical room on the first floor would be of concern due to the value of equipment and the higher probability of a fire in the space. This design fire was ultimately not selected due to the low occupancy of a machinery space, and the fire rating of the room would likely prevent the fire from spreading. Like the mechanical space on the first floor, the equipment on the roof could also catch fire. This fire was not selected for the same reason as the machinery room fire. Baker Science also has chemical storage rooms to supply the chemistry labs. While a fire in a chemical storage room could grow quickly, egress from the storage room would be nearly immediate, providing less of a risk to life safety.

Recommendations

The Baker Science Center has room for improvement in its design. The smoke venting is not adequate to maintain visibility for the design fire investigated in the atrium. Larger vents, or a greater number of them could possibly improve this. Another option would be to install a powered smoke control system with fans rated at an adequate capacity.

The design fire outside the auditorium on the first floor created untenable visibility conditions before egress could be completed. This creates an especially high danger in a space that is likely to be occupied by people unfamiliar with the building. Since both of the auditorium exits lead to the lobby, this creates a danger if a fire occurs in the lobby. One possible method to increase visibility in the lobby would be to configure the lobby night purge function to a smoke venting system, similar to the smoke venting in the atrium. Another solution to this is to install an additional egress door in the auditorium, one that does not force occupants into a smoke-filled lobby. It could either egress occupants into the stairwell to the east, or directly to the outside to the west. Possible locations for the additional exits are shown in Figure 66.

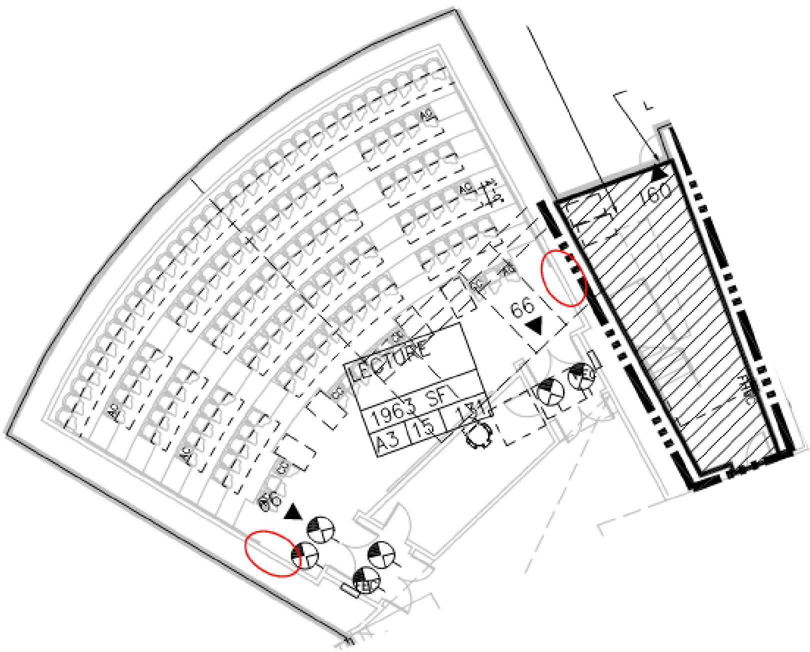


Figure 66. Suggested locations for additional exits from first floor auditorium.

This building is built with fire rated walls separating the atrium from the east and west wings. To decrease the egress time for one area of the building, voice messages could direct occupants out of and away from the section of the building where a fire occurs. The current fire alarm system does not utilize horizontal exits, but this could easily be implemented to increase evacuation speed.

Conclusion

Baker Science was intended to meet the needs of a growing, modern campus. This building achieves these goals by providing a variety of uses, including laboratories, offices, study areas, and assembly spaces. This building design has a few unique design considerations, such as a five storey atrium and a smoke control system.

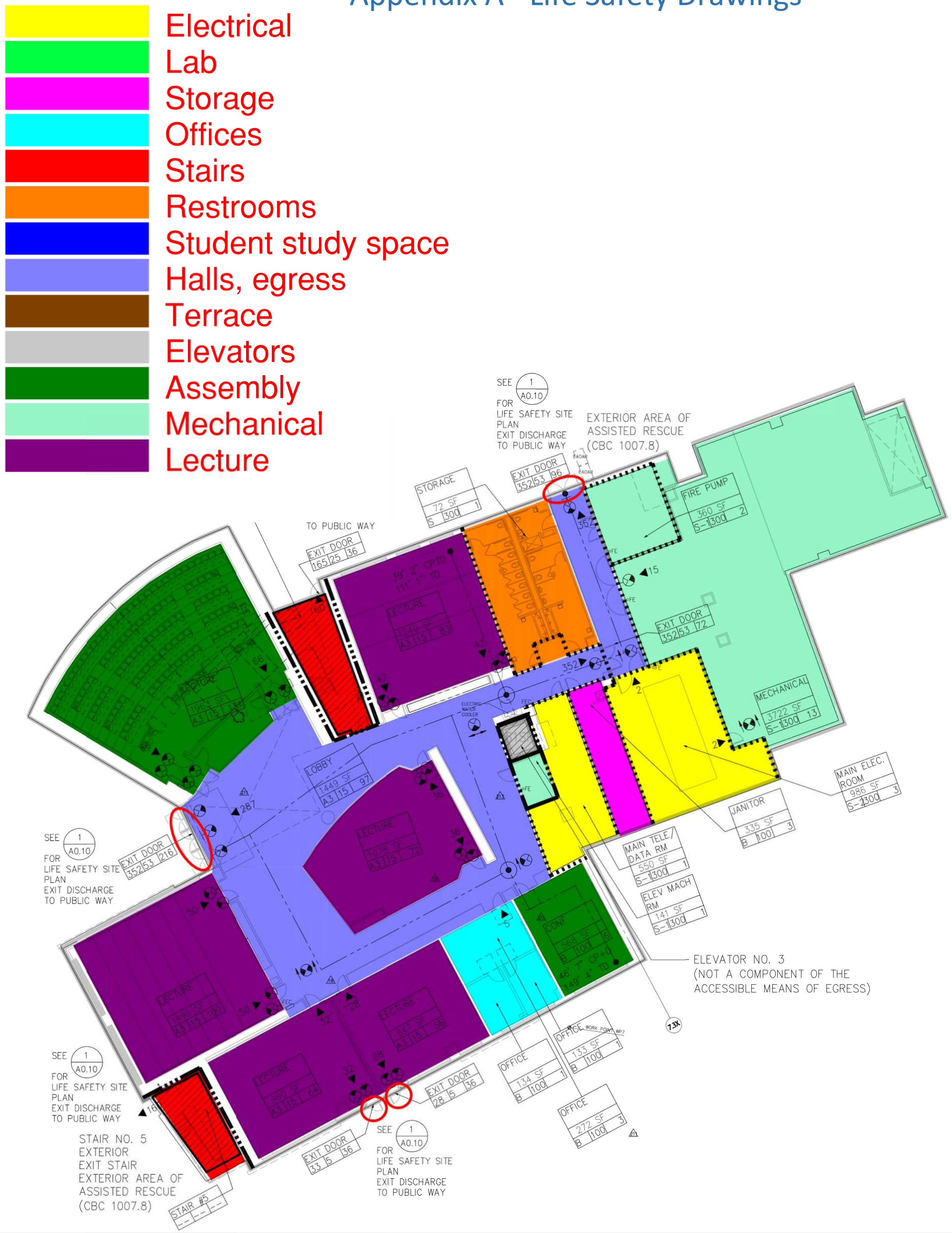
The life safety design is capable of evacuating the maximum rated building capacity of 2848 occupants in 13.62 minutes after egress has started. The 13.62 minutes is for the east wing, while the west wing would only need 10.04 minutes, and the atrium would take 8.66 minutes. Fire suppression is supplied from a city water loop and pressurized with a fire pump capable of supplying the most remote sprinkler design area with 347 gpm pressurized to 117 gpm at the pump discharge. The entire building is protected with K-5.6 quick response sprinklers that would activate the fire alarm system in the event of a fire. The fire alarm and voice notification system alerts the occupants and emergency personnel when a fire occurs. Fire detection is provided throughout the building with sprinklers, heat detectors, beam smoke detectors, and spot smoke detectors. The building's type 1B construction and sprinkler system allows it to be six storeys tall with more than 44,000 ft^2 on some floors.

The performance based design analysis for Baker Science revealed shortcomings that were not apparent based on the prescriptive design. The egress capabilities of the building were adequate from a code standpoint, but the visibility was reduced prior to a full evacuation for both of the design fires selected. The atrium fire produced smoke that limited ASET for the sixth floor to 3.23 min, based on 4 m minimum visibility. This is inadequate compared to the RSET of 3.96 min for that storey. The recommendation to improve this problem is to increase smoke extraction in the atrium. The lobby fire exceeded the visibility limit of 13 m, yielding an ASET of 2.00 min, far less than the RSET of 8.64 min for the first floor. The way to solve this issue is to install additional exits in the auditorium. The lesson is to consider possible fire scenarios during building design, in order to anticipate deficiencies overlooked by application of the code. Viewing a building as a whole, and not just a sum of different design disciplines, will allow an engineer to produce a superior design.

References

1. CBC, California Building Code, 2007 edition.
2. NFPA 13, Standard for Installation of Sprinkler Systems, 2007 edition.
3. NFPA 14, Standpipe and Hose Systems, 2004 edition.
4. NFPA 20, Stationary Pumps for Fire Protection, 2003 edition.
5. NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 2002 edition.
6. NFPA 70, National Electric Code, 2005 edition.
7. NFPA 72, National Fire Alarm and Signaling Code, 2007 edition.
8. SFPE Handbook, 5th Edition, 2016.
9. Kim, Hyeong-Jin, and Lilley, David G., Heat Release Rates of Burning Items in Fires, 2000.

Appendix A - Life Safety Drawings



STATE OF CALIFORNIA—THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, Governor

OFFICE OF THE STATE FIRE MARSHAL
Fire & Life Safety Division - South
602 East Huntington Drive, Suite A
Monrovia, CA 91016.

Office (626) 305-1908
Fax: (626) 962-1678
Web Site: www.fire.ca.gov

LOCAL FIRE AUTHORITY – ACCESS & WATER FLOW REVIEW

Project:

CSFM File Number:

Pursuant to Title 19, California Code of Regulations, Article 3, Section 3.05, Fire Department Access and Egress, we would appreciate your input relative to fire department access and water-flow for the above project. It is important to us, as the plan review authority, that these issues are addressed to your satisfaction.

Please return this form with all sections filled in completely. Without this form, California State Fire Marshal approval may be delayed. If you have any questions, please contact the California State Fire Marshal Plan Review Unit at (626) 305-1908.

The local fire authority is to consider the following items,

ACCEPTABLE	YES	NO
Location of fire department connection if provided.		
Number, location and size of fire hydrants.		
Fire department access.		

Local Fire Authority: ______________________________
Address: ______________________________
City/State/ZIP: ______________________________

Approval issued by: ______________________________
Rank/Title: ______________________________
Phone Number: ______________________________
Signature: ______________________________

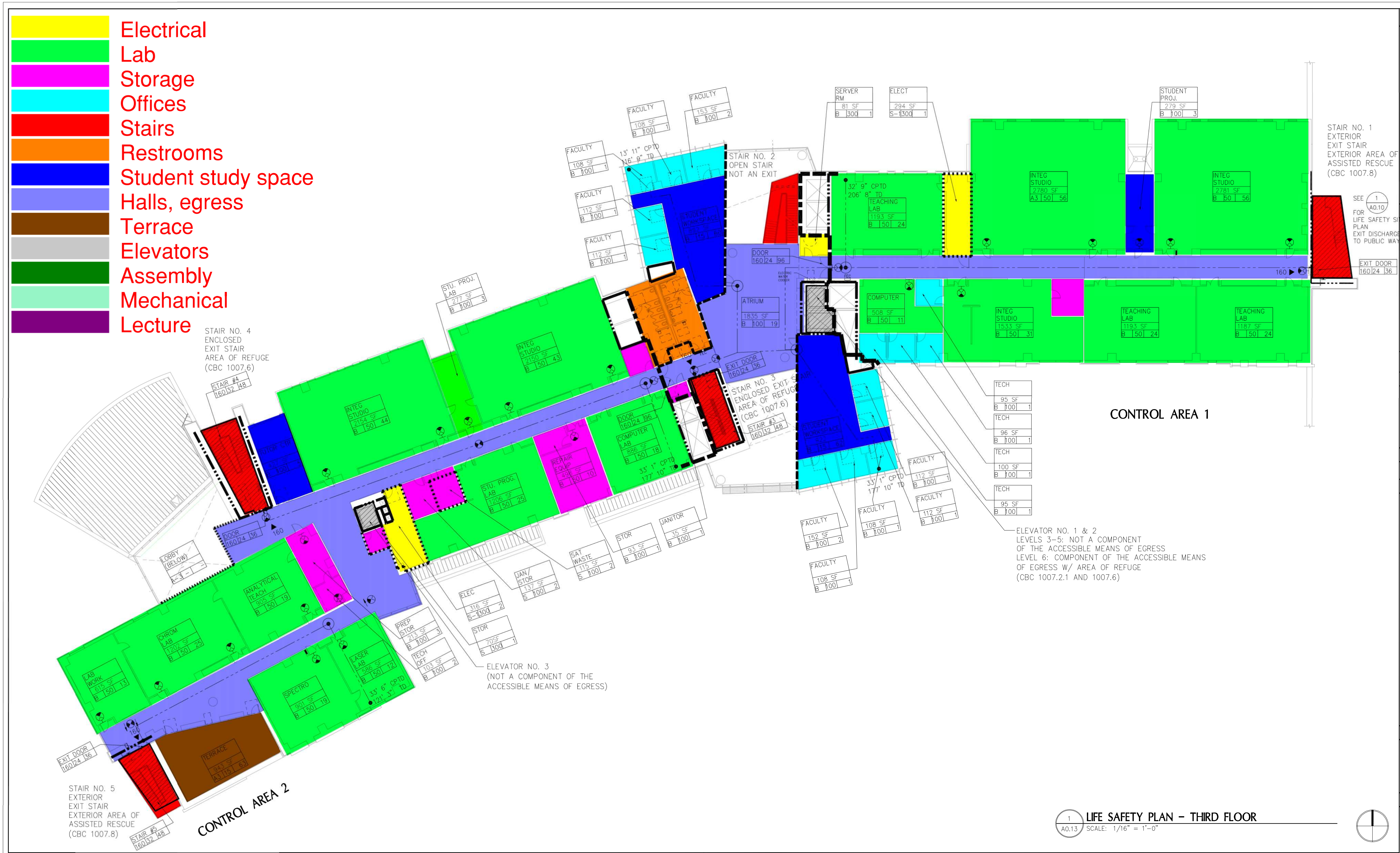
CONSERVATION IS WISE— KEEP CALIFORNIA GREEN AND GOLDEN

TABLE 414.2.5(2)
MAXIMUM ALLOWABLE QUANTITY OF FLAMABLE AND COMBUSTIBLE LIQUIDS IN WHOLESALE AND RETAIL SALES OCCUPANCIES PER CONTROL AREA

TYPE OF LIQUID	Class:	Organic Store:	Vault Store:	Gen Chem:	Haz Waste/gen chem:	Haz waste/Organic:	MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA (gallons) Sprinklered
Class 1A							
Acetonitrile	1A	4	8	0			
Diethyl ether	1A	20	90	1			
Petroleum Ether	1A	20	60	0			
Subtotal (liters)		44	158	1			
Subtotal (gallons) (liter x 0.264)		12	42	0			60
Class 1B, IC, II AND IIIA							
Acetone	1B	40	100	2			
Butanol	1C	5	8	0			
Cyclohexane	1B	4	25	1			
Ethanol	1B	8	40	1			
Ethyl Acetate	1B	20	44	4			
Hexane	1B	20	44	0			
isopropanol	1B	10	24	2			
methanol	1B	20	28	0			
Tetrahydrofuran	1B	8	16	0			
Toluene	1B	20	20	0			
Xylenes	1C	4	28	0			
Heptane	1B	4	20	0			
Subtotal (liters)		163	397	10			
Subtotal (gallons) (liter x 0.264)		43	105	3			7,500
Class IIIB							
Other flammables:	IIIB	4	5	5	12 L	100	
Subtotal (liters)		4	5	5	12	20	
Subtotal (gallons) (liter x 0.264)		1	1	1	3	5	Unlimited

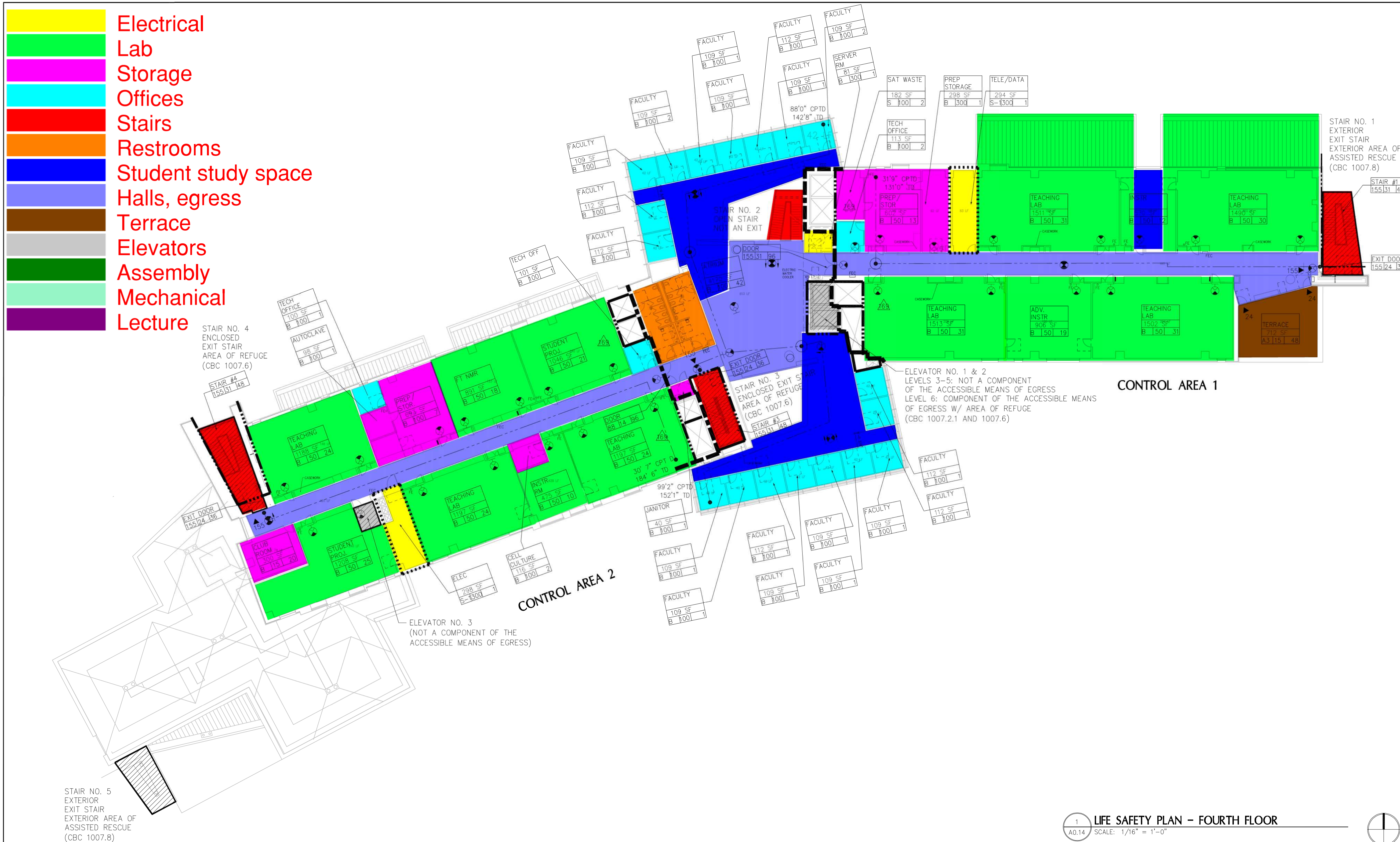
1 A0.11 LIFE SAFETY PLAN - FIRST FLOOR
SCALE: 1/16" = 1'-0"

Electrical
Lab
Storage
Offices
Stairs
Restrooms
Student study space
Halls, egress
Terrace
Elevators
Assembly
Mechanical
Lecture
FDC
CONTROL AREA 1
CONTROL AREA 2
STAIR NO. 4 ENCLOSED EXIT STAIR AREA OF REFUGE (CBC 1007.6)
STAIR NO. 3 ENCLOSED EXIT STAIR AREA OF REFUGE (CBC 1007.6)
STAIR NO. 3 ENCLOSED EXIT STAIR
STAIR NO. 2 OPEN STAIR NOT AN EXIT
STAIR NO. 5 EXTERIOR EXIT STAIR EXTERIOR AREA OF ASSISTED RESCUE (CBC 1007.8)
ELEVATOR NO. 1 & 2 LEVELS 3–5: NOT A COMPONENT OF THE ACCESSIBLE MEANS OF EGRESS LEVEL 6: COMPONENT OF THE ACCESSIBLE MEANS OF EGRESS W/ AREA OF REFUGE (CBC 1007.2.1 AND 1007.6)
ELEVATOR NO. 3 (NOT A COMPONENT OF THE ACCESSIBLE MEANS OF EGRESS)
SEE 1 A0.10 FOR LIFE SAFETY SITE PLAN EXIT DISCHARGE TO PUBLIC WAY
1 A0.12 LIFE SAFETY PLAN – SECOND FLOOR
SCALE: 1/16" = 1'-0"



LIFE SAFETY PLAN – THIRD FLOOR

SCALE: 1/16" = 1'-0"

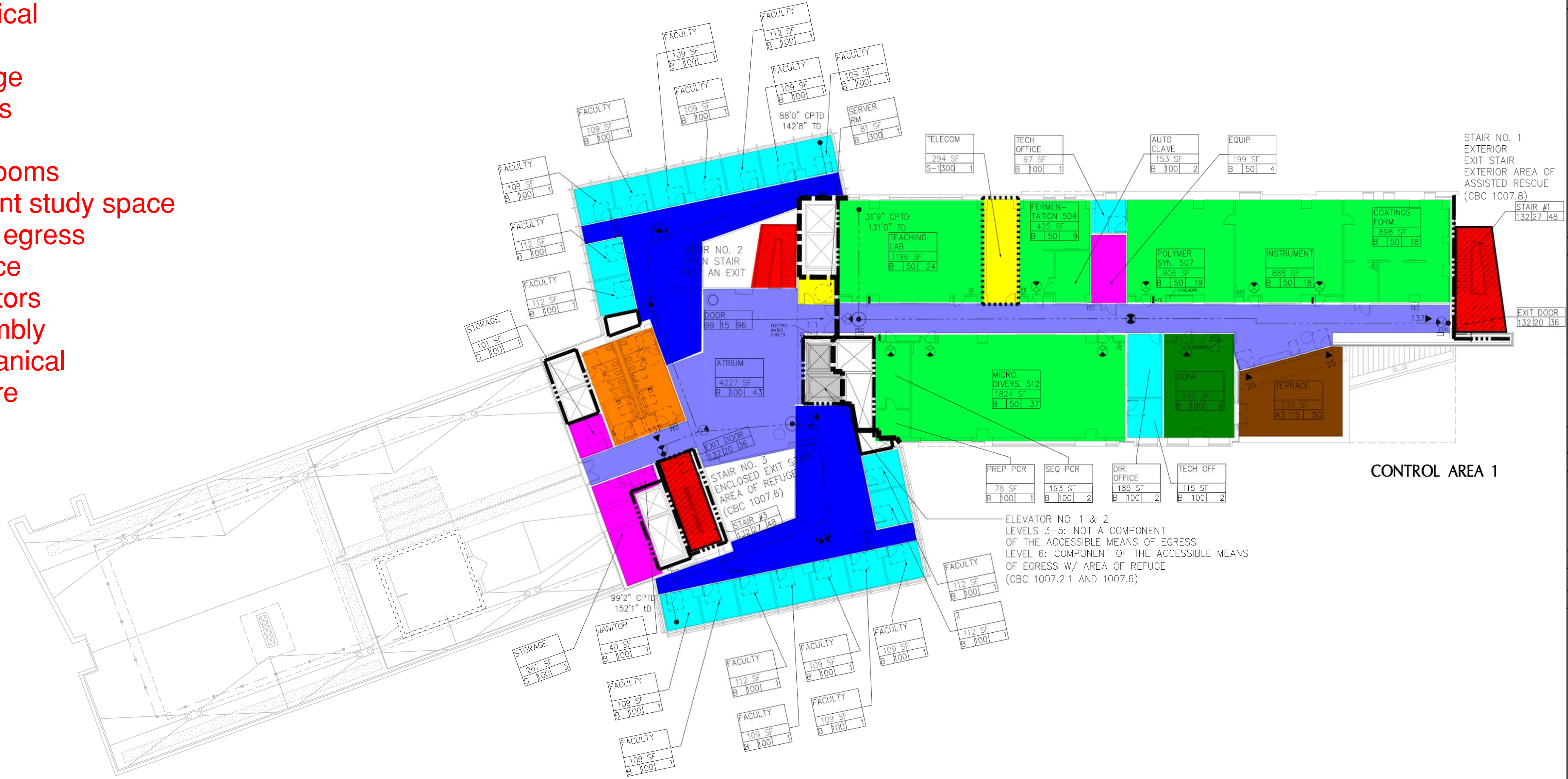


LIFE SAFETY PLAN - FOURTH FLOOR

SCALE: 1/16" = 1'-0"

1 A0.14

Electrical
Lab
Storage
Offices
Stairs
Restrooms
Student study space
Halls, egress
Terrace
Elevators
Assembly
Mechanical
Lecture



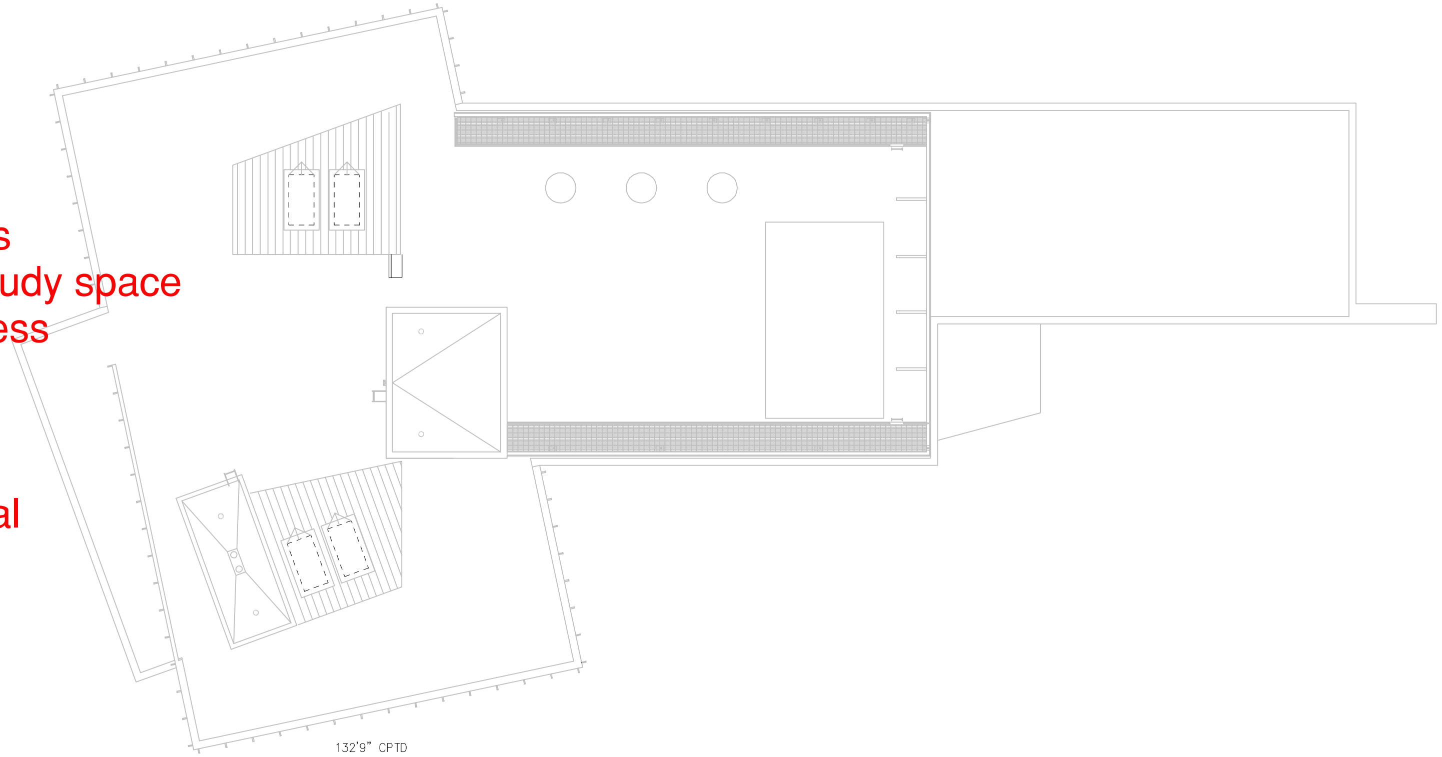
1 A0.15 LIFE SAFETY PLAN – FIFTH FLOOR
SCALE: 1/16" = 1'-0"

- Electrical
- Lab
- Storage
- Offices
- Stairs
- Restrooms
- Student study space
- Halls, egress
- Terrace
- Elevators
- Assembly
- Mechanical
- Lecture

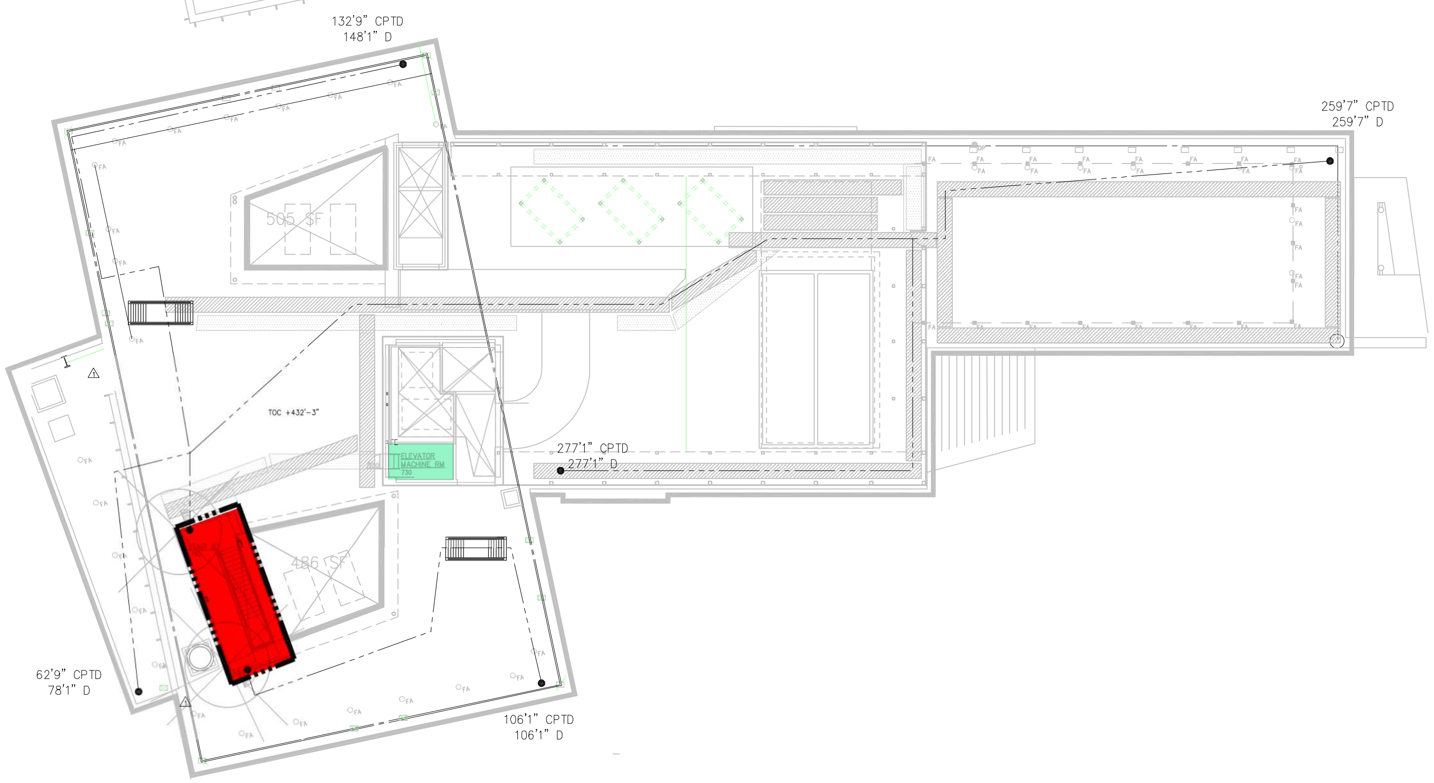
1 A0.16 LIFE SAFETY PLAN - SIXTH FLOOR

SCALE: 1/16" = 1'-0"

- Electrical
- Lab
- Storage
- Offices
- Stairs
- Restrooms
- Student study space
- Halls, egress
- Terrace
- Elevators
- Assembly
- Mechanical
- Lecture



1 A0.17 LIFE SAFETY PLAN – UPPER ROOF
SCALE: 1/16" = 1'-0"



21,227 SF
(–) 991 SHAFTS =
20,236 SF

2 A0.17 LIFE SAFETY PLAN – ROOF
SCALE: 1/16" = 1'-0"

Appendix B

Example hydraulic egress calculation, Atrium 3rd floor

Density in egress route

$D = \frac{P}{A} = \frac{155\ people}{920\ ft^2} = 0.168 \frac{people}{ft^2}$

$D = density,\ \frac{people}{ft^2}$

$A = area,\ ft^2$

$P\ = number\ of\ people$

Speed of occupants in egress route

$S = k - akD = 275 - 2.86 * 275 * 0.168 = 142.5\ ft/min$

$k_1 = 275\ for\ flat\ corridor$

$a = 2.86$

Time to travel egress route to door

$t = \frac{d}{S} = \frac{117}{142.5} = 0.82\ min$

Specific flow, corridor

$F_s = (1 - aD)kD$

$F_s = (1 - 2.86 * 275)\ 275 * 0.168 = 24.0\ person/(min\ ft)$

Calculated flow, corridor

$F_{c,\ corridor} = (1 - aD)kDW_e = (1 - 2.86 * 0.168)\ 275 * 0.168 * 7 = 168.0\ person/min$

Specific flow, door

$F_{s,\ door} = \frac{F_{s,\ corridor} W_{e,\ corridor}}{W_{e,\ door}} = \frac{168.0*7}{2} = 84.0\ person/(min\ ft)$

Use $F_{sm} = 24\ person/(min\ ft)$ from Table 59.5

Flow rate, door

$F_{c,\ door} = F_{s,\ door} W_{e,\ door} = 24 * 2.0 = 48.0\ person/min$

Queuing rate

$Q_{door} = F_{c,\ corridor} - F_{c,\ door} = 168 - 48 = 120\ people/min$

Specific flow, stair

$F_{s,\ stair} = \frac{F_{s,\ door} W_{e,\ door}}{W_{e,\ stair}} = \frac{48.0*2.0}{3.2} = 15.0\ per/(min\ ft)$

From Table 59.5, $F_s = 18.5\ persons/(min\ ft)$ after stair flows merge

Flow rate, stair

$$F_{c,\,stair} = F_{s,\,stair} W_{e,\,stair} = 15.0 * 3.2 = 48.0\ person/min$$

Stair density

From Figure 59.8, $D_{stair} = 0.98\ persons/ft^2$

Stair speed

$$S = k - akD$$

$$S = 212 - 2.86 * 212 * 0.098 = 152.5\ ft/min$$

$$k_1 = 212\ for\ 7/11\ stairs$$

Stair travel time

$$t_{stair\ to\ next\ floor} = \frac{d}{S} = \frac{50.6}{152.5} = 0.33\ min$$

People in stair

$$P_{stair} = F_{c,\,stair} * t_{stair\ to\ next\ floor} = 48.0 * 0.33 = 16\ people$$

Flow rate, door

$$F_{c,\,door} = F_{s,\,door} W_{e,\,door} = 24 * 2 = 48.0\ person/min$$

People queued at door

$$P_{queued} = P_{floor} - P_{stair} = 155 - 16 = 139\ people$$

Time to egress previous floor

$$t_{egress\ previous\ floor} = 4.85\ min$$

Time to egress queued

$$t_{egress\ queued} = \frac{F_{c,\,door}}{P_{queued}} = \frac{48.0}{139} = 2.90\ min$$

Time to evacuate floor

$$t_{evacuate\ floor} = t_{egress\ queued} + t_{egress\ previous\ floor} + t_{stair\ to\ next\ floor} = 2.90 + 4.85 + 0.33 = 8.08\ min$$

HYDRAULIC CALCULATIONS SUBMITTAL

SECTION:

DIVISION 21 – FIRE SUPPRESSION

21 0500 ; 21 1200 ; 21 1300 ; 21 3000

PROJECT:

CAL POLY CENTER FOR SCIENCE
1 GRAND AVE., BUILDING #70
SAN LUIS OBISPO, CA 93407

FOR THE:

GILBANE BUILDING COMPANY
1 GRAND AVE., BUILDING #70
SAN LUIS OBISPO, CA 93407

AS PRESENTED BY:

Aero Automatic Sprinkler Company

21605 North Central Ave.

Phoenix, AZ 85024

623-580-7800 623-434-3420 (fax)

This submittal has been reviewed by Aero Automatic Sprinkler Co. and approved with respect to the means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incidental thereto. Aero Automatic Sprinkler Co. also warrants that this submittal complies with the Contract Documents and comprises no variation to.

By: Neal Larsen

Date: 9-29-2011

Gilbane
Cal Poly Center for Science
Gilbane Project #: 174338010

REVIEWED

Building Name/#: Cal Poly CFS
Bid Package No: 21A
Submittal No: 003
Spec. Section: 21 05 00
Reviewed By: Scott Gurley
Date: 10/3/11

This review does not constitute nor does it assume design responsibility nor does it relieve the trade contractor/supplier from complying with the contract requirements, coordinating their work with other trade contractors and verifying field dimensions.

Gilbane
Cal Poly Center for Science
Gilbane Project #: 174338010

REVIEWED

Building Name/#: Cal Poly CFS
Bid Package No: 21A
Submittal No: 002
Spec. Section: 21 12 00
Reviewed By: Scott Gurley
Date: 10/3/11

This review does not constitute nor does it assume design responsibility nor does it relieve the trade contractor/supplier from complying with the contract requirements, coordinating their work with other trade contractors and verifying field dimensions.

Gilbane
Cal Poly Center for Science
Gilbane Project #: 174338010

REVIEWED

Building Name/#: Cal Poly CFS
Bid Package No: 21A
Submittal No: 002
Spec. Section: 21 13 00
Reviewed By: Scott Gurley
Date: 10/3/11

This review does not constitute nor does it assume design responsibility nor does it relieve the trade contractor/supplier from complying with the contract requirements, coordinating their work with other trade contractors and verifying field dimensions.

Gilbane
Cal Poly Center for Science
Gilbane Project #: 174338010

REVIEWED

Building Name/#: Cal Poly CFS
Bid Package No: 21A
Submittal No: 002
Spec. Section: 21 30 00
Reviewed By: Scott Gurley
Date: 10/3/11

This review does not constitute nor does it assume design responsibility nor does it relieve the trade contractor/supplier from complying with the contract requirements, coordinating their work with other trade contractors and verifying field dimensions.

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HYDRAULIC CALCULATIONS

PROJECT:

CAL POLY CENTER FOR SCIENCE
1 GRAND AVE., BUILDING #70
SAN LUIS OBISPO, CA 93407

FOR THE:

GILBANE BUILDING COMPANY
1 GRAND AVE., BUILDING #70
SAN LUIS OBISPO, CA 93407

AS PRESENTED BY:

AERO

Aero Automatic Sprinkler Company

21605 North Central Ave.

Phoenix, AZ 85024

623-580-7800

623-434-3420 fax

---SECTION 210500---
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL
1.8.3 SHOP DRAWINGS

---SECTION 211200---
FIRE SUPRESSION STANDPIPES

PART 1 GENERAL
1.4.3 SHOP DRAWINGS

---SECTION 211300---
FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL
1.4.3 SHOP DRAWINGS

---SECTION 213000---
FIRE PUMP

PART 1 GENERAL
1.4.3 SHOP DRAWINGS

REGISTERED PROFESSIONAL ENGINEER
GEORGE PROVENCHER
FP 693
exp 12-31-11
FIRE PROTECTION
- STATE OF CALIFORNIA -

09/29/11

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HYDRAULIC CALCULATION
TABLE OF CONTENTS

Aero Automatic Sprinkler Company
21605 North Central Ave.
Phoenix, AZ 85024
623-580-7800 623-434-3420 fax

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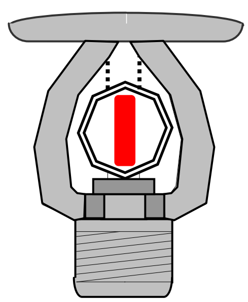
1



Flow Test, Fire Pump Curve, Pressure Reducing Va. (1 st. Floor Only), Dbl. Detector Assembly

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FLUID RESOURCE MANAGEMENT
FIRE HYDRANT FLOW TEST WORKSHEET

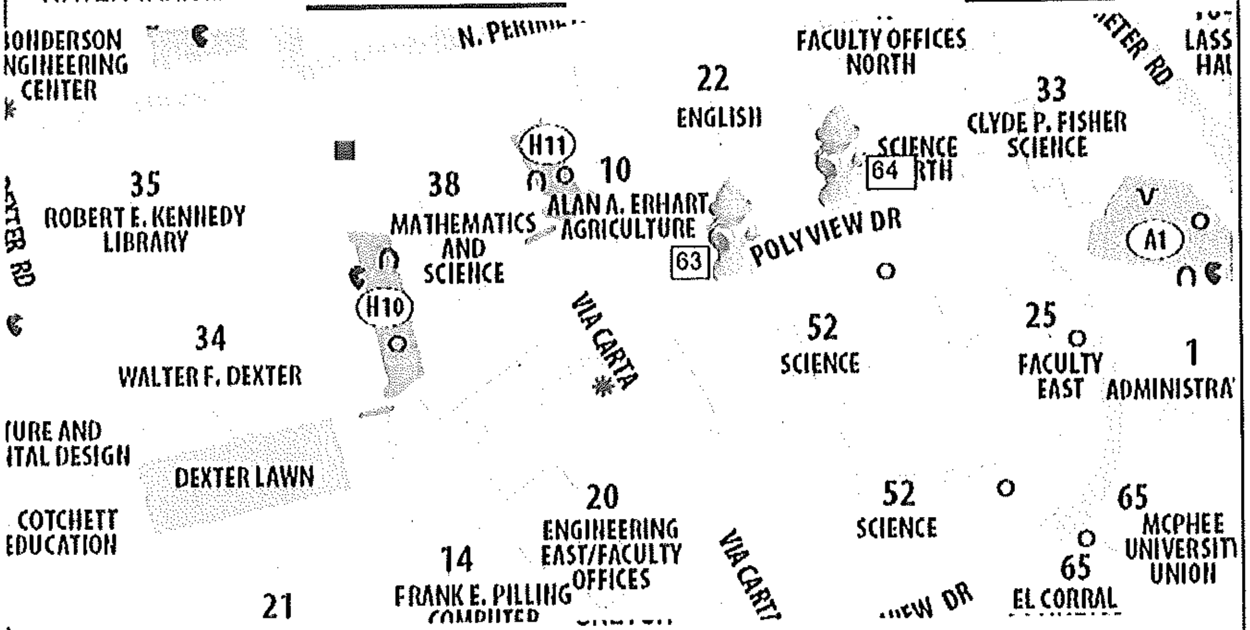
WATER SYSTEM Cal Poly Math and Science

DATE 8/19/2011

TIME 9:12am

WATER TANK LEVELS Full

PUMP LEVELS Booster



Flowing Hydrant(s)	Concurrent Flow #1	#2	#3
Hydrant #	64		
Static Pressure (psi)	63		
Test Gauge #	2		
Pitot Pressure (psi)	35		
Test Gauge #	1a		
Nozzle Size (inches)	2.5		
Nozzle Coefficient			
Hydrant Flow (gpm)	914		
Tested by	R.Ellison		
Projected Flow @ 20 psi	2270.288	#DIV/0!	#DIV/0!

Residual Hydrant	
Hydrant #	63
Static Pressure (psi)	60
Residual Pressure (psi)	55
Test Gauge #	1
Tested by	R.Ellison

Comments :

FLUID RESOURCE MANAGEMENT
FIRE HYDRANT FLOW TEST WORKSHEET

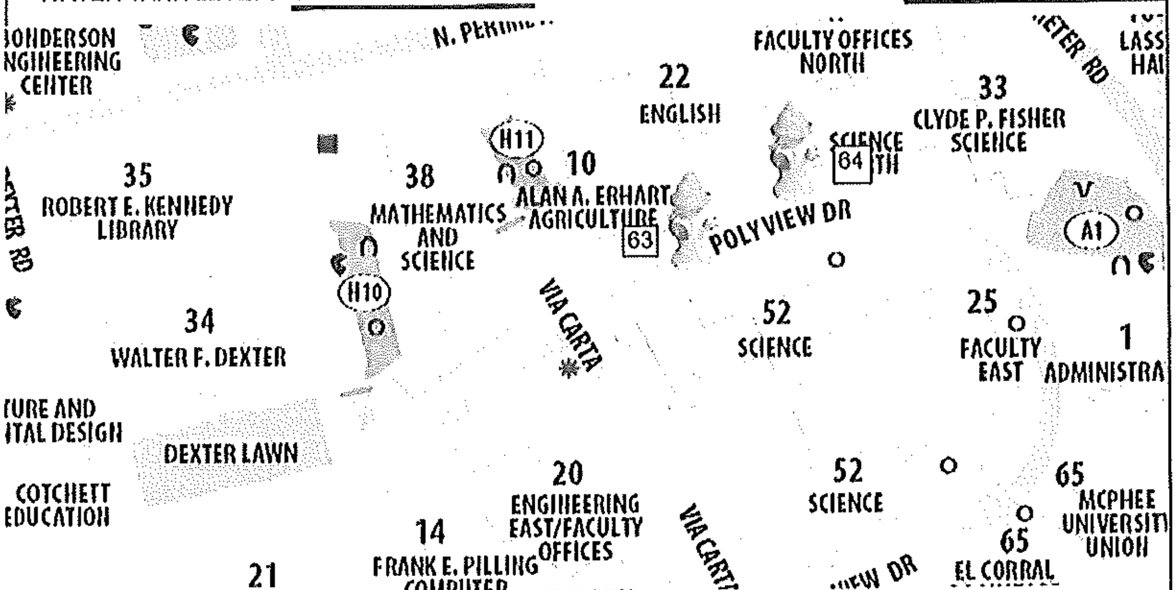
WATER SYSTEM Cal Poly Math and Science

DATE August 19,2011

TIME 9:28am

WATER TANK LEVELS Full

PUMP LEVELS Fed from City line



Flowing Hydrant(s)	Concurrent Flow #1	#2	#3
Hydrant #	63		
Static Pressure (psi)	64		
Test Gauge #	2		
Pitot Pressure (psi)	40		
Test Gauge #	1a		
Nozzle Size (inches)	2.5		
Nozzle Coefficient			
Hydrant Flow (gpm)	974		
Tested by	R.Ellison		
Projected Flow @ 20 psi	2862.1147	#DIV/0!	#DIV/0!

Residual Hydrant	
Hydrant #	64
Static Pressure (psi)	63
Residual Pressure (psi)	58
Test Gauge #	1
Tested by	R.Ellison

Comments :

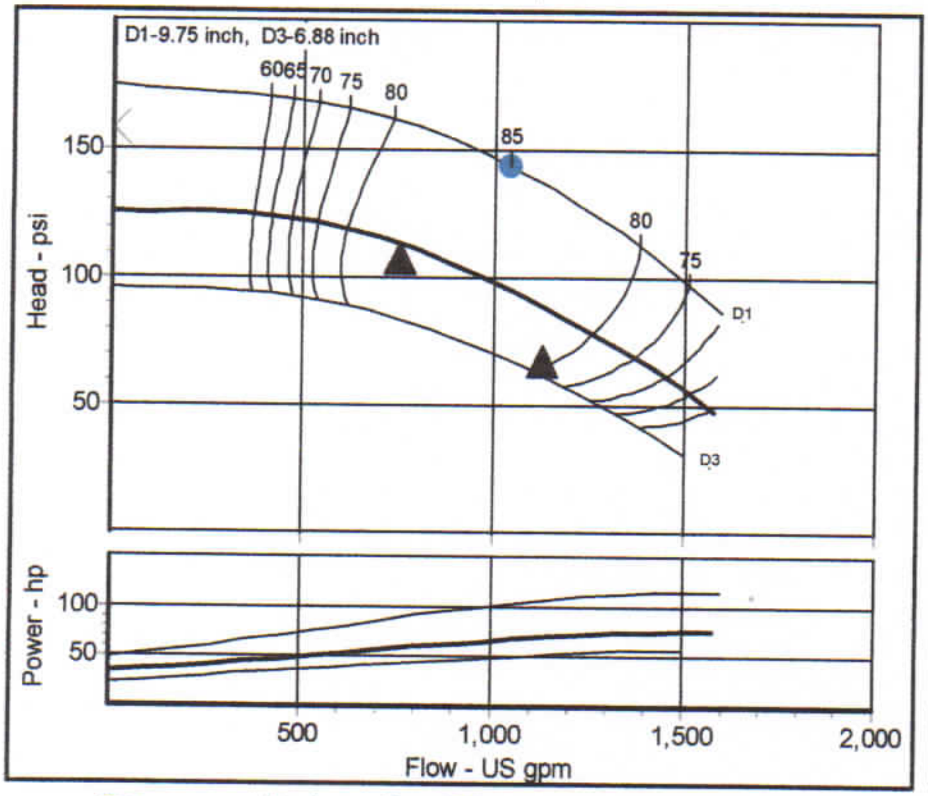
PEERLESS PUMP Reliability | When It Matters

Approved Fire Pumps

1151 N. Pomona Rd., Ste. B Corona, Ca 92882
Dena Mueller
Phone 951-738-9100
Fax 951-7389191

Project :	Cal Poly Center for Science				
Quote Ref. :	UK-999999-1	**Page No : 1**		**Date :**	Monday, February 28, 2011

Type:	**PG - In-Line Close Coupled Fire**	Item :	**1**
Pump Model:	**6PVF10**	Impeller No.:	2699332
Pump Op. Speed:	**3550 RPM, 60 Hz Electric**	Liquid:	**Water**
Impeller Dia.:	**8.24** inch	Temperature:	**59** °F
Curve No.:	**3116186**	Viscosity:	**1.14** cSt
Market :	**FM/UL/ULC Listed Fire Pump**	Sp. Gravity:	**1.00**
		Your Ref. :	



Rated Flow	**750** US gpm
Rated Head	**113** psi
Imp. Dia.	**8.24** inch
Rated Power Required	**58.1** hp
Rated Efficiency	**85.3** %

NFPA Limits:

140% Head at shutoff	**158.2** psi
65% Head at 150% flow	**73.4** psi
Flow at 150%	**1125** US gpm
Head at 150	**89** psi
Power Req. at 150%	**69.3** hp
Efficiency at 150%	**84.5** %
Peak Power	**75.4** hp
Closed Valve Pressure	**125.2** psi
Approval	**UL**

Comments

Performance curve represents typical performance. NPSH data is

Flow (US gpm)	Head (psi)	Pump Efficiency (%)	Power Required (hp)	NPSH Required (ft)
0.0	125.2	0.0	34.7	
197.6	125.2	36.6	39.5	
395.1	124.2	62.8	45.7	
592.7	119.6	78.8	52.6	
790.2	110.9	86.2	59.5	
987.8	98.9	87.0	65.7	
1185.3	84.4	82.8	70.7	
1382.9	67.9	74.2	74.0	
1580.4	48.2	59.1	75.4	

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Field Adjustable Pressure Reducing (URFA)

Elkhart's URFA valve is a true pressure reducing valve, operated automatically by inner hydraulic controls. While the valves are preset at the factory, they are field adjustable — allowing you to tailor the pressure to your needs. They feature manual valve open and close, as well as pressure adjustment — all of which require extremely low torque to change due to the patent pending design. Inlet pressure up to 400 psi (27.58 bar) is controlled under all flow and no-flow conditions.

Valve size and weight permit installation in significantly tighter areas and smaller hose cabinets (those used for 1½" or 2½" valves) — allowing savings of both space and money. The URFA also functions as a floor control valve in automatic sprinkler systems as well as a standpipe valve or hose valve for Class I and Class III systems.

INLET SIZE	OUTLET SIZES		TYPE		CERT.	DIMENSIONS (INCHES)									FINISH					
2½" F NPT*	2½" F (NPT)*	2½" M(NHT)	Angled	Straight	UL Listed	Closed A	Closed B	Open A	Open B	C	D	E	F	Integral Superv. Switch	Brass Cast	Brass Pol	Chrome Pol	Wt. (Lbs.)	MODEL	FIGURE
~~•~~	~~•~~		~~•~~		~~•~~	~~13⅝~~	~~11⅝~~	~~14¼~~	~~12¼~~	~~2⅝~~	~~3¼~~	~~5~~	~~4¼~~	~~o~~	~~s~~	~~o~~	~~o~~	~~18½~~	~~URFA-20-2.5~~	~~1~~
•		•	•		•	13⅝	11⅝	14¼	12¼	2⅝	3⅝	5	4¼	o	s	o	o	18½	URFA-25-2.5	2
•	•			•	•	14½	11 29/32	15⅛	12¼	3½	4	5	4¼	o	s	o	o	26½	URFA-20S-2.5	3

KEY s = standard o = option

* Grooved connection available for inlet or outlet use — add 1.44" per connection.

Figure 1

URFA-20-2.5

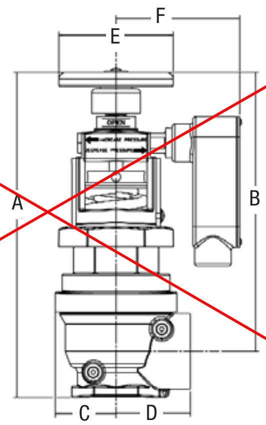


Fig. 1

Figure 2

URFA-25-2.5

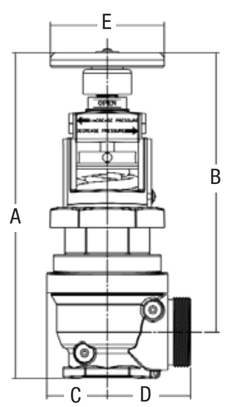


Fig. 2

Figure 3

URFA-20S-2.5

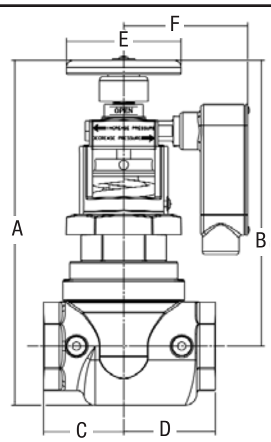


Fig. 3

PRODUCT HIGHLIGHTS

URFA features include:

- Manual open-close requires less than 15 lbs. of torque
- Pressure rated up to 400 psi (27.58 bar)
- Flow rated up to 500 gpm (1893 lpm)
- Open-Close indication from 2 view directions
- Color-coded pressure reduction label
- Tapped for pressure gauge on both inlet and outlet side of valve
- Tamper-resistant protection
- UL Listed as a check valve for use in dual riser systems
- Optional integral supervisory switch (alarm) mounts directly to valve with no bracket required
- Optional integral supervisory switch (alarm) is available either “OPEN TO SIGNAL” or “CLOSE TO SIGNAL”
  - With the valve in the open position, to close an electrical circuit and send the signal is defined as “OPEN TO SIGNAL”
  - With the valve in the closed position, to close an electrical circuit and send a signal is defined as “CLOSE TO SIGNAL”

ADDITIONAL INFORMATION

Includes adjustment rod.

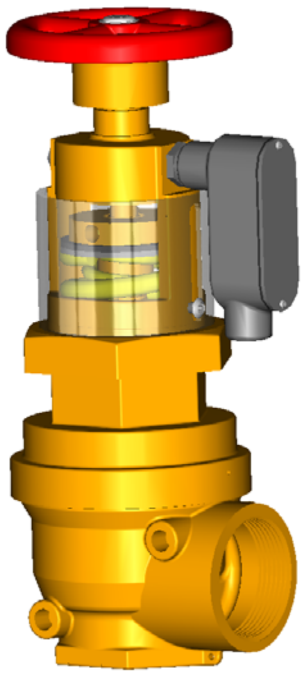
THREADS

- *Valve inlet information is NPT unless otherwise specified. Special threads available through adapter use.*
- *See index T-12 for alternative outlet thread options.*

Elkhart Brass
Fire Fighting Equipment

URFA –20S-2.5”
URFA-20-2.5”
URFA-25-2.5”

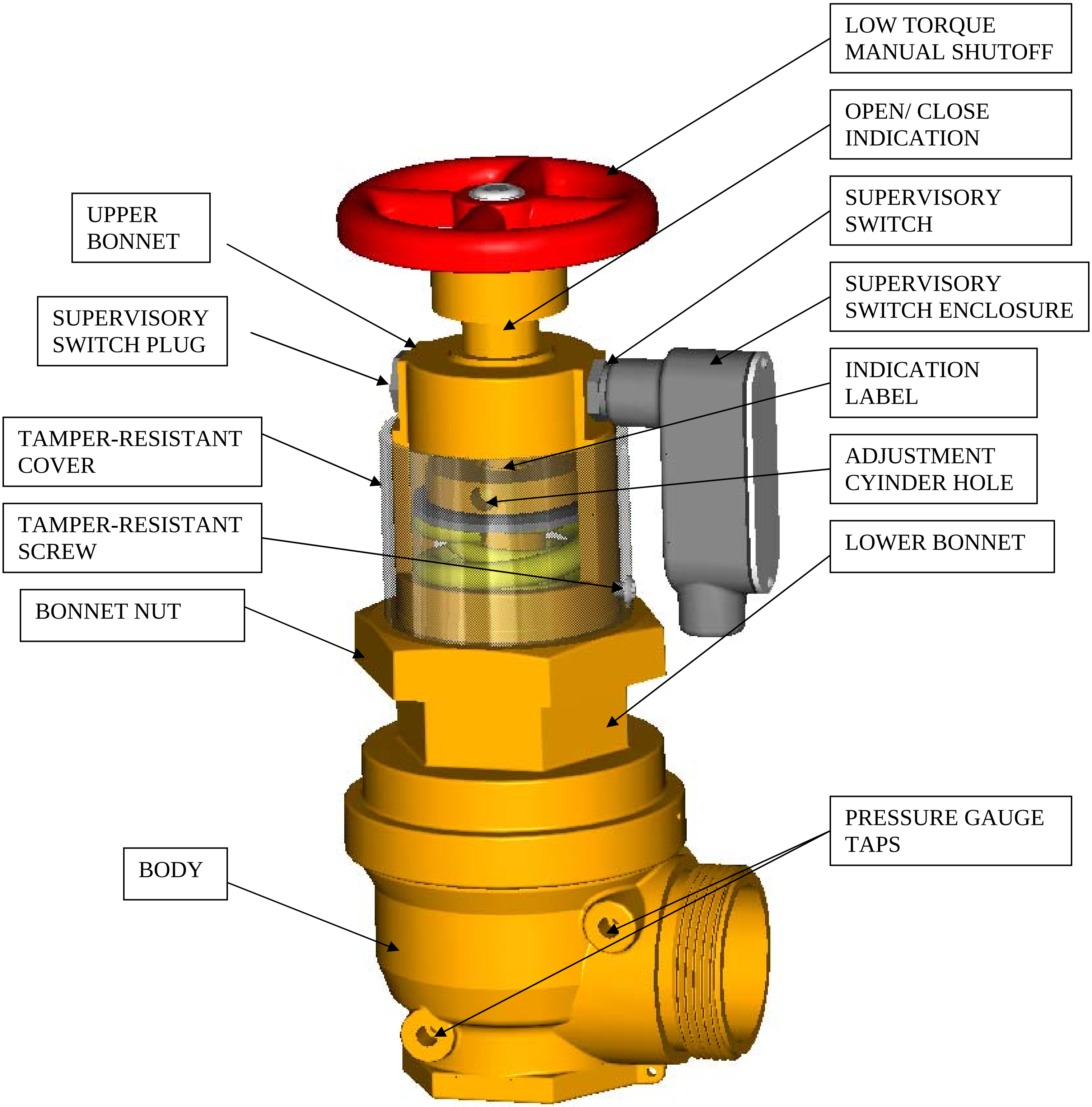
INSTALLATION AND OPERATING INSTRUCTIONS FOR FIELD ADJUSTABLE PRESSURE REDUCING/ CONTROLLING VALVES



(URFA-20-2.5 MODEL SHOWN)

98042000 Rev-C

URFA VALVE MAJOR COMPONENTS



SPECIFICATIONS

- Pressure rated up to 400 psi.
- Flow rated up to 500 GPM
- Open-Close indication from 2 view directions
- Pressure reduction can be field adjusted
- Pressure reduction adjustment can be easily determined by indication label
- Pressure reduction adjustment has tamper resistant feature
- Low-torque manual close handwheel
- Built-in automatic check valve
- Regulates pressure under both flow and no-flow conditions
- Tapped for pressure gauge on both inlet and outlet side of valve
- Optional integral supervisory switch (For Indoor Use Only)

INLET – OUTLET CONNECTIONS

VALVE MODEL	INLET THREAD	OUTLET THREAD
~~URFA-20-2.5~~	~~2-1/2" FEMALE NPT~~	~~2-1/2" FEMALE NPT~~
URFA-20S-2.5	2-1/2" FEMALE NPT	2-1/2" FEMALE NPT
URFA-25-2.5	2-1/2" FEMALE NPT	2-1/2" MALE HOSE

APPLICATION

A. AUTOMATIC SPRINKLER SYSTEMS

The models URFA-20S-2.5 and URFA-20-2.5 valves are most commonly used in automatic sprinkler systems as floor control valves in high-rise buildings where supply riser pressures exceed 175 psi. The URFA valves are Listed by Underwriters Laboratories as “Special System Water Control Valves – Pressure Reducing and Pressure Control Type (VLMT)”, and also meet the listing requirements for indicating valves. Installation requirements for pressure reducing valves in automatic sprinkler systems are given in Section 4-6.1.2 of NFPA 13, Standard for the installation of Sprinkler Systems, 1999 Edition. When designing URFA pressure reducing valves into a sprinkler system a maximum flow rate of 400 GPM should be observed.

URFA Pressure Reducing Valves are also listed as checking devices, which eliminates the need for a separate check valve. When sprinklers on a given floor are fed from dual risers, the URFA valve acts as a check valve to prevent loss of sprinkler water supply in the event of one riser sustaining damage.

Requirements for Alarm Attachments are given in Section 5-15.1.6 of NFPA 13, Standard for the installation of Sprinkler Systems, 1999 Edition. An integral, listed supervisory alarm switch is available on URFA pressure reducing valves as option number “01” when ordering.

B. STANDPIPE SYSTEM

The models URFA-25-2.5 and URFA-20-2.5 valves are most commonly used in standpipe systems. The URFA-25-2.5 valves have a male hose thread outlet for connecting to fire suppression hose. When hose racks are used, the URFA-20-2.5 can be utilized along with a special hose nipple for support of the rack. The URFA valves are Listed by Underwriters Laboratories as Standpipe Equipment Pressure Reducing Devices (VUTX). Requirements for installation of pressure reducing valves in standpipe systems are given in Section 5-8 of NFPA-14, Standard for the Installation of Standpipe Hose Systems, 1993 Edition.

INSTALLATION REQUIREMENTS

A. AUTOMATIC SPRINKLER SYSTEM

1. To permit easy replacement or repair of valve, pipe unions or rubber gasket mechanical couplings should be installed immediately upstream or downstream of each URFA valve.
2. A relief valve of not less then ½ inch size is to be installed on the downstream side of each URFA valve
3. Pressure gauges are to be installed on the inlet and outlet side of each pressure-reducing valve
4. Valve adjustment setting should be selected to provide an outlet pressure not exceeding 165 psi at the maximum inlet pressure
5. Upon system completion, each Valve must be tested under both flow and no-flow conditions to verify that static residual outlet pressures and flow rates satisfy system design requirements. See Section 8-2.5 NFPA 13 for more information on mandatory flow and no-flow test requirements.

B. STANDPIPE SYSTEM

1. The URFA-25-2.5 can be used for both Class I and Class III service.
2. NFPA 14 requires that hose valve outlet pressures for Class I and Class III service be no greater then 175 psi. and no less then 100 psi. When permitted by the authority having jurisdiction, pressures less then 100 psi may be allowed, but in no cases shall the valve discharge pressure be less then 65 psi
3. Upon system completion, each valve must be tested under both flow and no-flow conditions to verify that static and residual outlet pressures and flow rates satisfy system design requirements. See Section 8-5.5 of NFPA 14 for more information on required flow and no-flow testing.

CONSTRUCTION & OPERATING PRINCIPLE

The URFA is a field adjustable pressure-reducing valve, which utilizes a hydraulic piston and cylinder assembly within the valve lower bonnet to allow the valve to self-throttle in response to the pressure on the downstream side of the valve. Because the piston, main stem and valve seat float freely from the manual valve stem and handwheel assembly, the valve is able to self-close under static conditions and maintains a reduced pressure both under no-flow and flowing conditions Valve discharge pressure is transmitted to the top side of the piston through pressure passages in the main stem. The presence of the piston results in a net area differential, which produces a hydraulic balancing force in the closed direction. The magnitude of this balancing force is in direct proportion to the hydraulic area of the piston.

The Field Adjustable feature of the valve is controlled by a spring within the valve upper bonnet. The spring adds an opening force to the main stem so that pressure reduction may be changed as the spring force is changed. This feature allows for the valve to satisfy all expected inlet/outlet pressure ratios. The Field Adjustable feature allows for one type of valve to be specified for all locations in a structure. Once installed the valves can be adjusted to the correct pressure reduction ratio based on their locations.

The URFA valves feature a patent pending manual close design that allows for extremely low torque of the handwheel while manually opening and closing the valve. The unique design allows for the for independent operation of the valve stem from the manual close push-rod; this allows for the operator to bypass the large torque required to overcome the stiffness of the adjustment spring.

INSTALLATION OF VALVE

- The valve should first be plumbed into the system
- The upper bonnet may be rotated for optimized access to adjustment window
    - Loosen Bonnet Nut
    - Rotate Upper Bonnet to desired location of adjustment window
    - Apply service removable thread lock to the Bonnet Nut threads
    - Tighten the Bonnet Nut firmly
- See wire diagram for proper installation of supervisory switch
- The system should be slowly filled with water and purged of air
- The system should then be flushed to remove any debris

VALVE SETTING SELECTION

The URFA valves have settings of A, B, C, D, and E. Each valve setting corresponds to a pressure reduction graph located at the end of this manual. The valve setting is determined by where the top of the adjustment cylinder lines up on the Adjustment Identification Label located on the main stem (refer to Figure 1). To determine the correct setting for each URFA valve in the system design please use the following step.

1. Determine the standpipe or sprinkler riser residual pressure for each valve location. This is the inlet pressure at each valve under design flow conditions. In order to accurately determine these pressures, complete water supply data will be required, including results of municipal supply, flow test, and the pump performance curve. The URFA inlet pressure will be equal to the sum of the pump discharge pressure and the

municipal supply pressure at the design flow rate, less piping friction loss and elevation loss.

2. Turn to the appropriate valve performance chart. The valve model and flow range for each graph is indicated in the title at the top of the graph. Be sure to use the correct graph for the designed flow rate through the valve.
3. Locate the valve inlet residual pressure on the vertical axis of the chart and draw a line from the pressure horizontally across the chart.
4. Locate the desired valve outlet residual pressure on the chart horizontal axis and draw a vertical line from this pressure across the chart
5. From the intersection of the inlet and outlet pressure lines constructed in (3) and (4) above, move horizontally to the nearest valve performance curve (actually straight diagonal lines). This will be the appropriate valve setting for the chosen location.
6. Determine the valve static inlet pressure. This will be the sum of the municipal supply static pressure plus the pump churn pressure, less the elevation loss.
7. To determine the valve static outlet pressure, refer to the appropriate static chart. Locate the valve static inlet pressure on the vertical axis of the chart. Follow across to the appropriate valve curve and drop down to the horizontal axis to read valve outlet static pressure.
8. If static outlet pressure is found to exceed the maximum outlet pressure allowed by NFPA 13 or NPFA 14, it will be necessary to re-select a valve setting to the left of the originally chosen type.

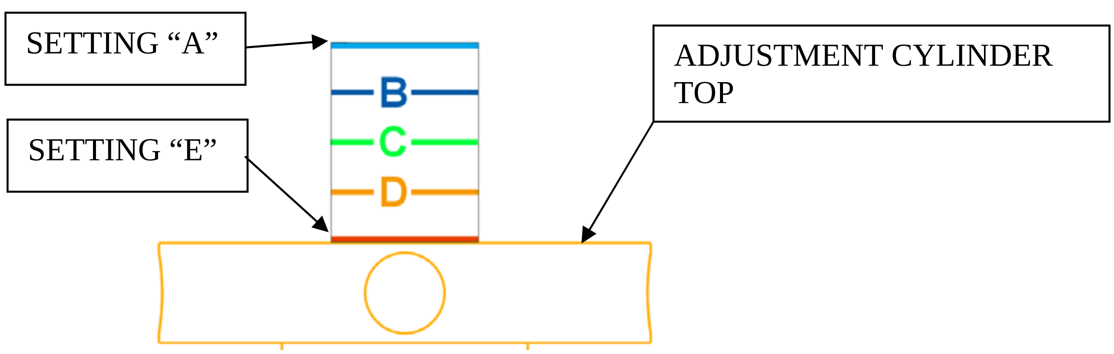


Figure - 1

SETTING PRESSURE REDUCTION

1. Remove the tamper-resistant screw from the clear cover by means of tamper-resistant Allen wrench provided with valve.
2. Insert adjustment tool provided with valve through the slot in the clear cover into the hole in the adjustment cylinder.
3. Rotate adjustment cylinder until the top of the adjustment cylinder is aligned with desired mark on the Indication Label (refer to Figure 1).
4. Once rotation limit is reached during adjustment remove the adjustment tool from the adjustment cylinder hole and re-insert the adjustment tool into the next available hole.

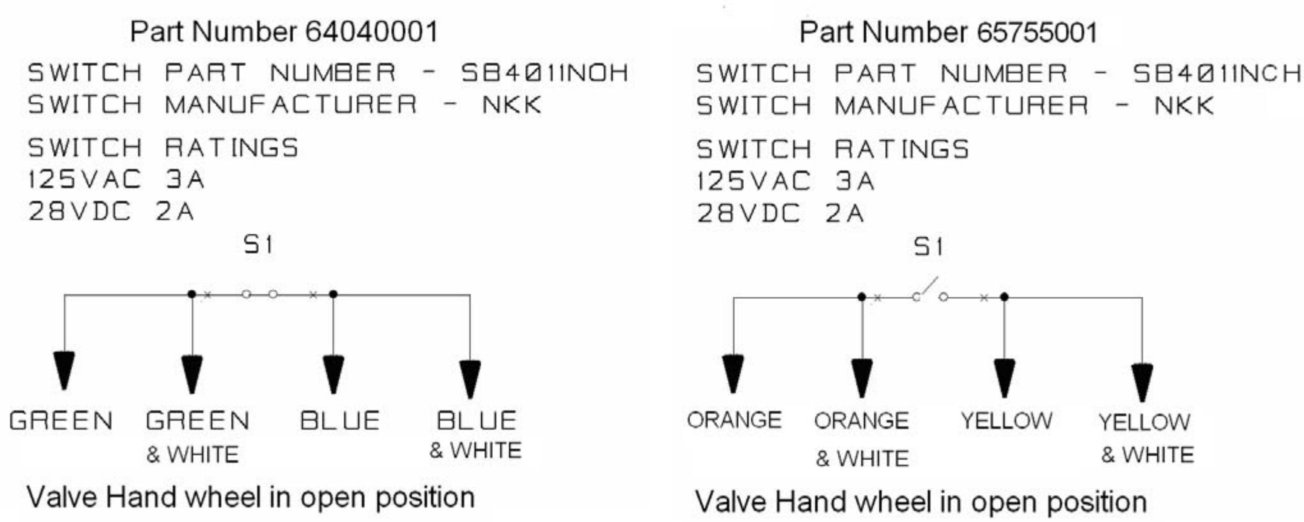
5. Once the proper adjustment is obtained verify the outlet pressure is correct with pressure gauges both upstream and downstream of the valve during both flow and no-flow pressure testing; make adjustments as needed. See Section 8-2.5 of NFPA 13 for more details on required flow and no-flow testing.
6. Once the valve is properly adjusted replace the tamper-resistant screw that was removed in step 2.
7. A tamper-resistant allen wrench and adjustment tool should be stored in a special location for Fire Department use.

NOTE: Rotating the adjustment cylinder clockwise will increase outlet pressure. Conversely, rotating the adjustment cylinder counter-clockwise will decrease outlet pressure.

SUPERVISORY SWITCH

Pressure reducing/ controlling valves that are to be used as part of a sprinkler system should include a supervisory switch to signal when a valve is not manually in the fully opened position (refer to NFPA 13 for more details on supervisory requirements). An optional supervisory switch assembly with UL approval for use with URFA valves is available on all models. The supervisory switch may be mounted to either side of the upper bonnet in the ¾ inch tapped holes provided. A cap plug is secured in the upper bonnet tapped holes when the supervisory switch is not installed. A UL Listed conduit elbow is utilized as a water-resistant enclosure for the electronic switch. The conduit elbow provides an opening for fastening conduit to the enclosure, and a lid may be removed to gain access for wiring connections. The lid is attached with two pin-in-hex security screws. A key is provided for installation access into the conduit enclosure. Two switch options are available for the supervisory switch assembly. The first, part number 64040001, will provide a closed circuit when the valve hand wheel is in the full open position. The second option, part number 65755001, will provide an open circuit when the valve hand wheel is in the full open position. Please specify the required switch configuration when ordering. Figure 2 describes wiring details. The two switch options have different colored leads for easy identification. Part number 64040001, the closed circuit switch, has blue and green wire leads. Part number 65755001, the open circuit switch, has yellow and orange wire leads. The solid colored wires act as a primary wiring configuration and the striped wires act as a secondary or back up wiring configuration.

Figure - 2



Note: Supervisory switch rated for Indoor Use Only.

The supervisory switch enclosure may be positioned with the conduit enclosure at various angles so to better meet space requirements (see Figure 3). To reposition the conduit enclosure angle, hold rotation on the hex adaptor fastened to the upper bonnet with the use of an open box wrench. While insuring the hex adaptor remains fully threaded against the upper bonnet, position the conduit enclosure to the desired angle. When completed the hex adaptor MUST be fully threaded against the upper bonnet to insure proper function. If the hex adaptor becomes unthreaded the supervisory switch will send an opened signal. Also ensure that the manual handwheel may be fully closed without interference from the supervisory switch assembly.

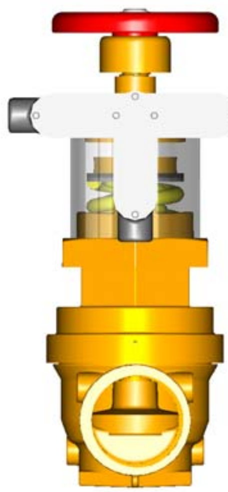


Figure - 3

VALVE CARE & MAINTENANCE

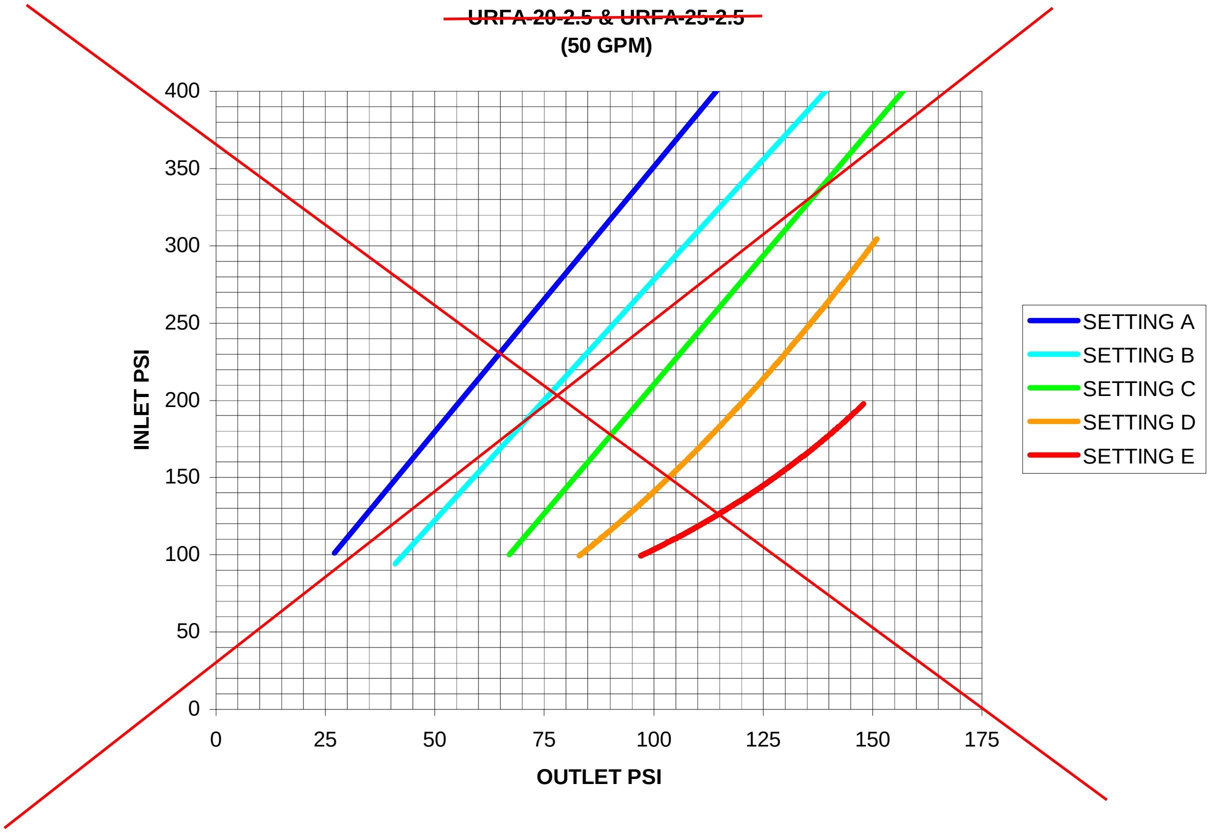
URFA valves require minimal maintenance. However, a routine inspection and test program is essential for any fire protection system to insure that it is in proper operating condition. NFPA 25, standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems should be consulted for a determination of required test frequency and methods.

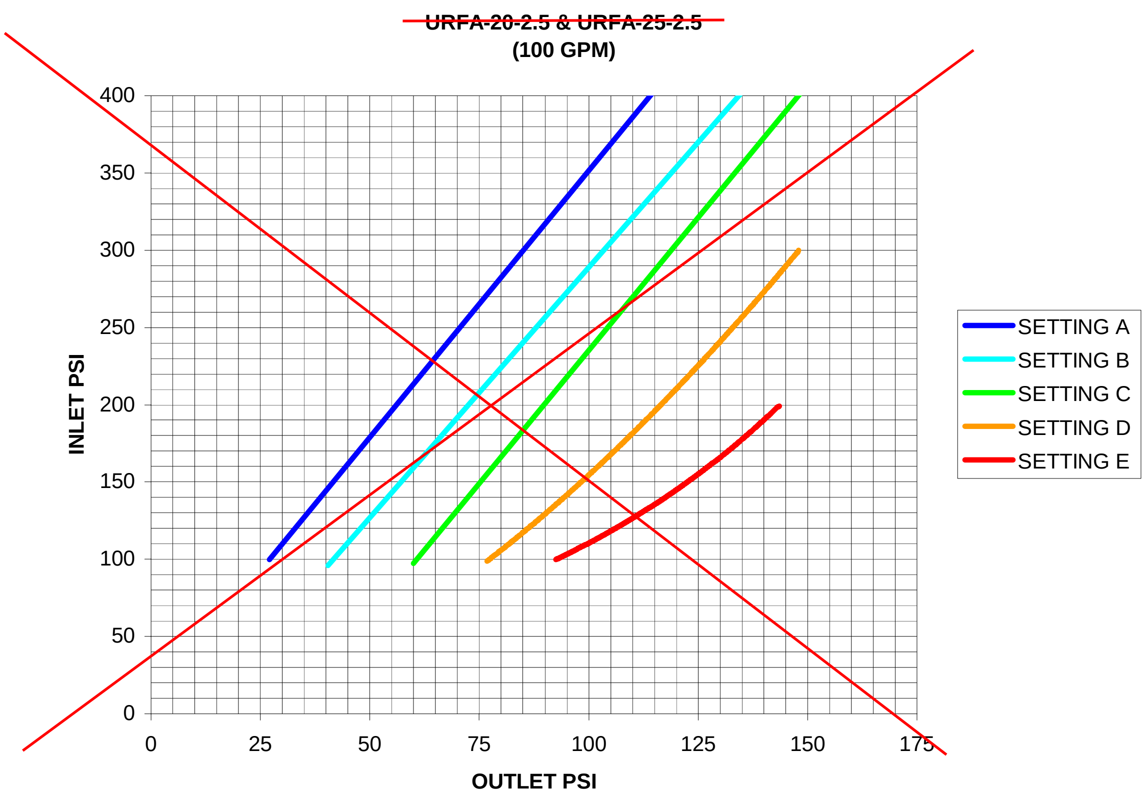
Below is a summary of the required frequency of inspections and testing for pressure reducing valves:

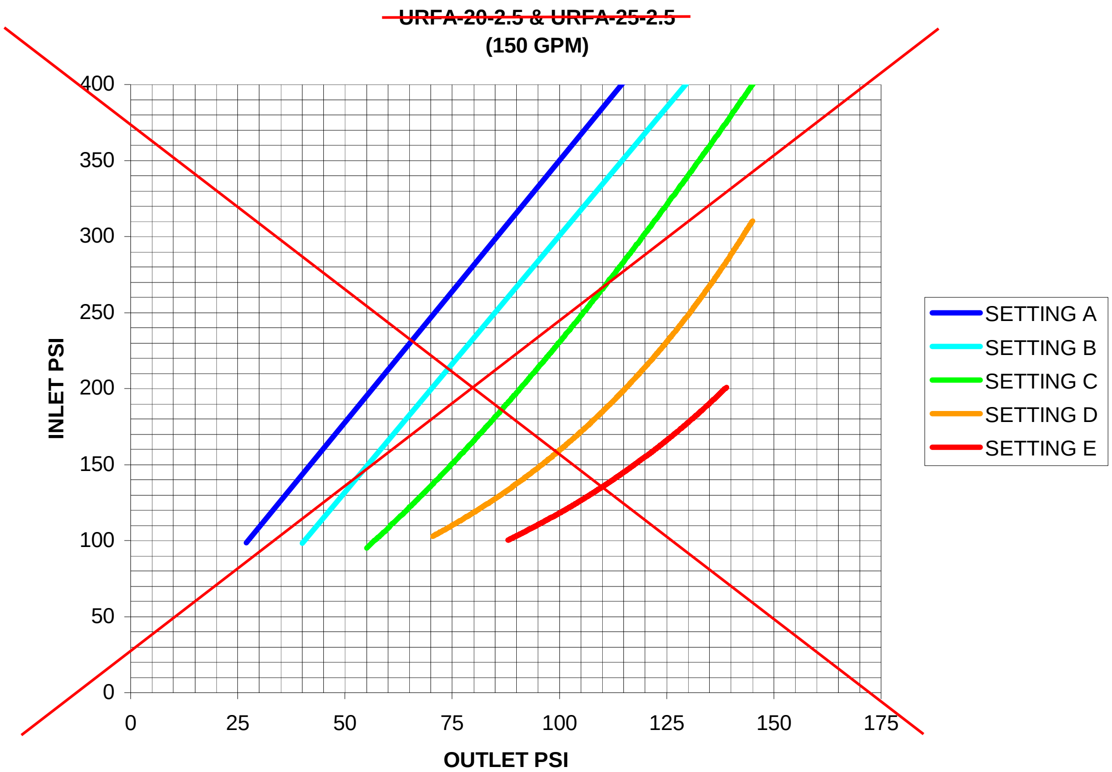
Valve Application	Inspection	Flow Test
Sprinkler System Pressure Regulating Control Valve	Quarterly	Annually
Hose Connection and Hose Rack Assembly Pressure Regulating Valve	Quarterly	5-Years

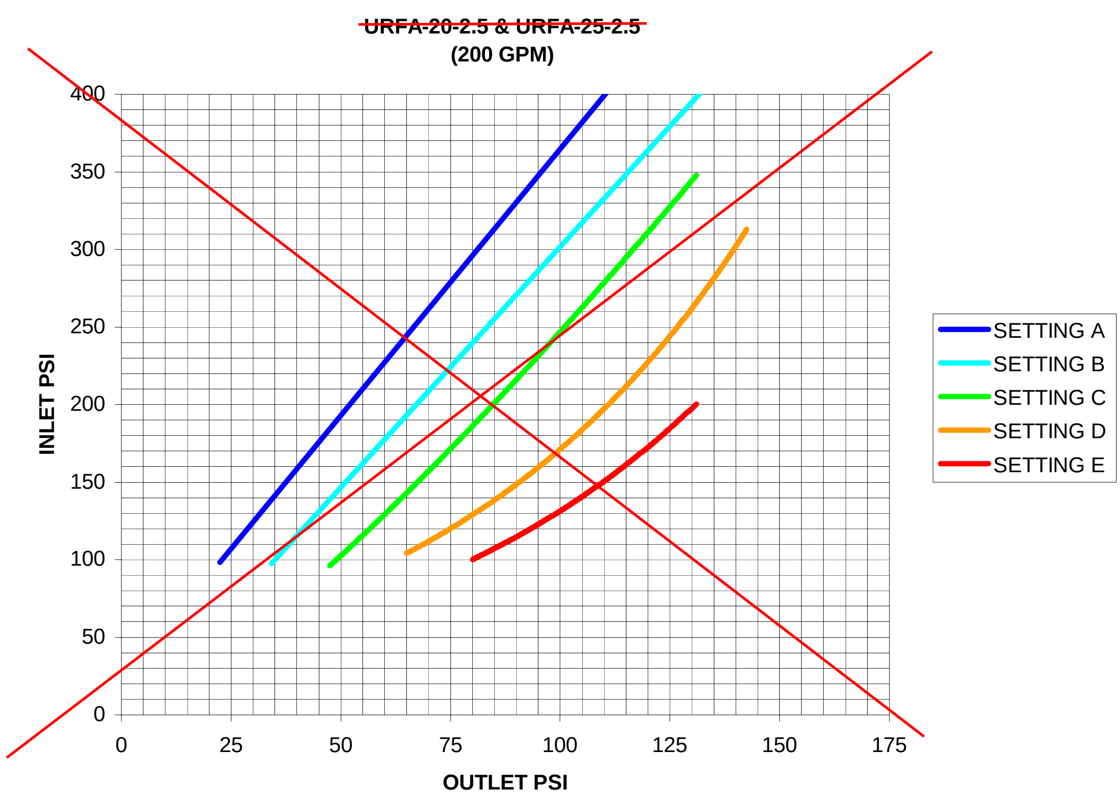
Quarterly inspections should verify that the tamper-resistant cover is properly secured and compare actual valve adjustment settings to documented correct adjustment settings for each valve. If a valve is found to have incorrect valve setting it should be reset to the proper setting and undergo flow and no-flow testing to verify proper pressure reduction is obtained.

Flow test results should be compared to previous test results, and to system performance criteria. If the valve adjustment settings match the original and correct settings for each valve then no significant variance should occur from the original flow testing data.


URFA-20-2.5 & URFA-25-2.5
(50 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E


URFA-20-2.5 & URFA-25-2.5
(100 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E


URFA-20-2.5 & URFA-25-2.5
(150 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E


URFA-20-2.5 & URFA-25-2.5
(200 GPM)
INLET PSI
OUTLET PSI
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50
100
150
200
250
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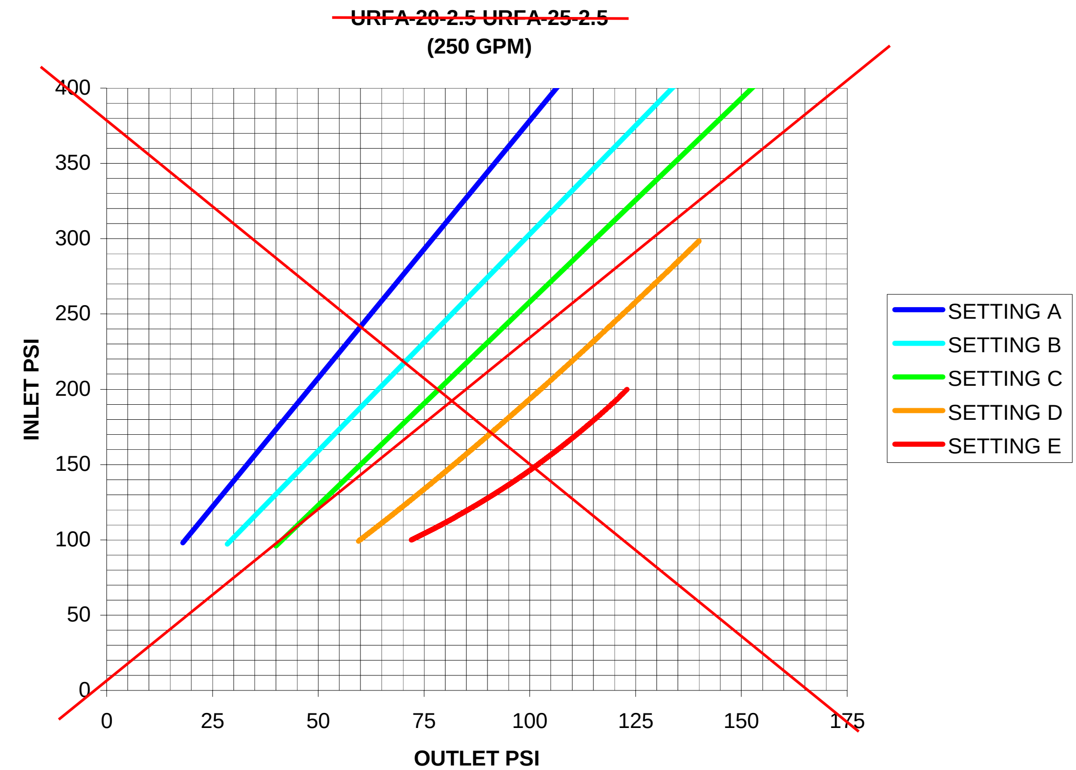
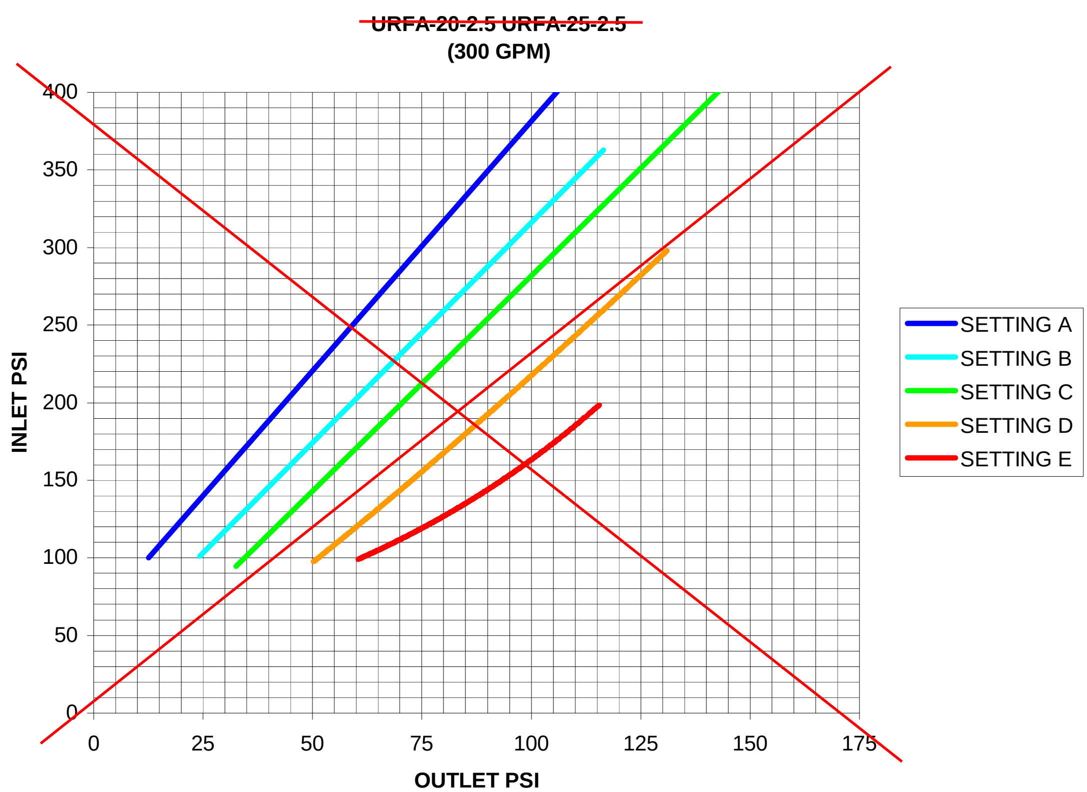
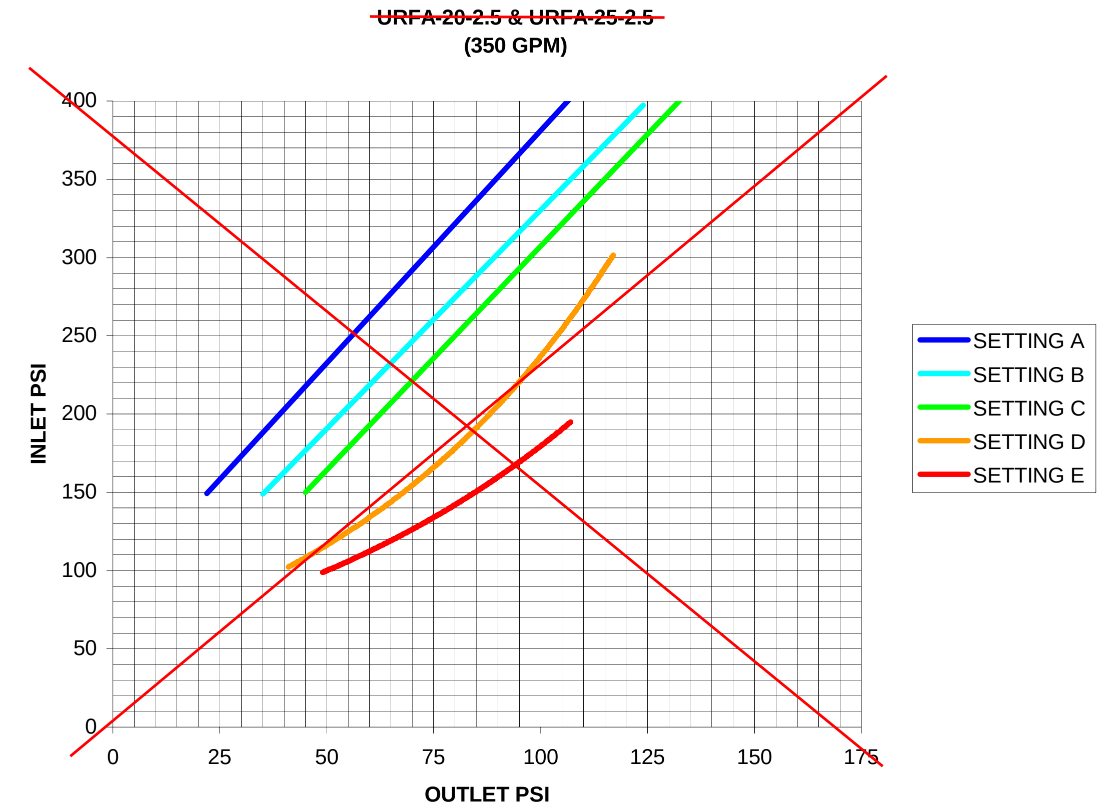
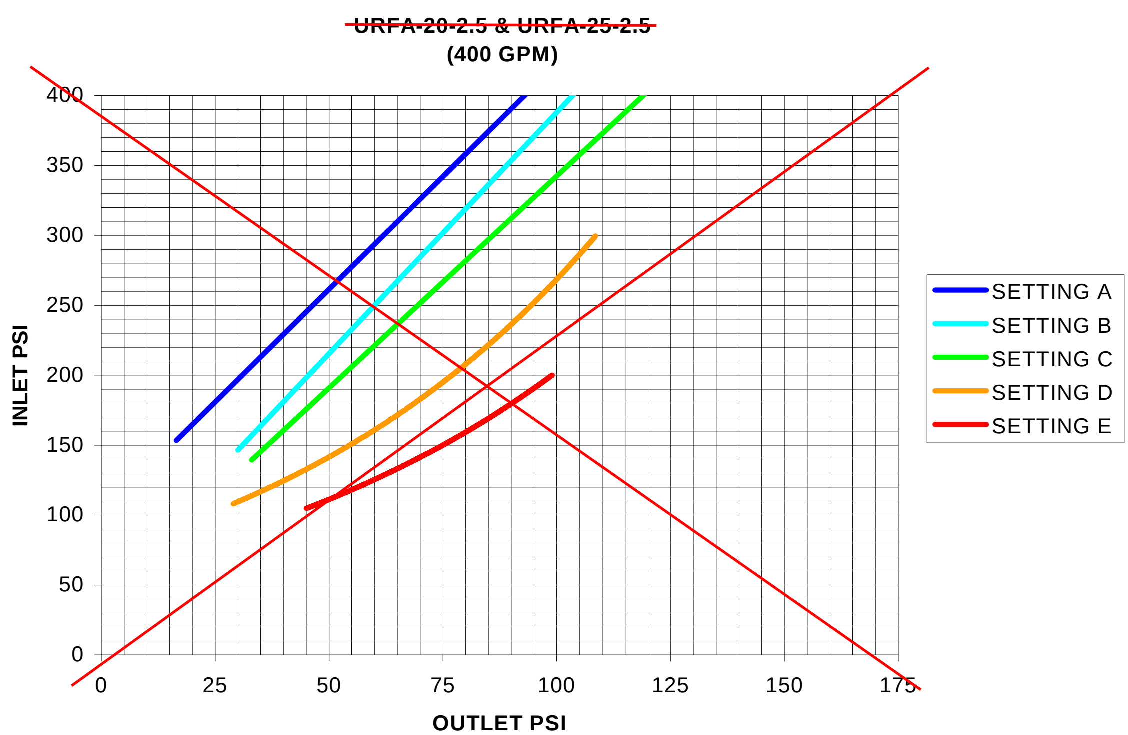
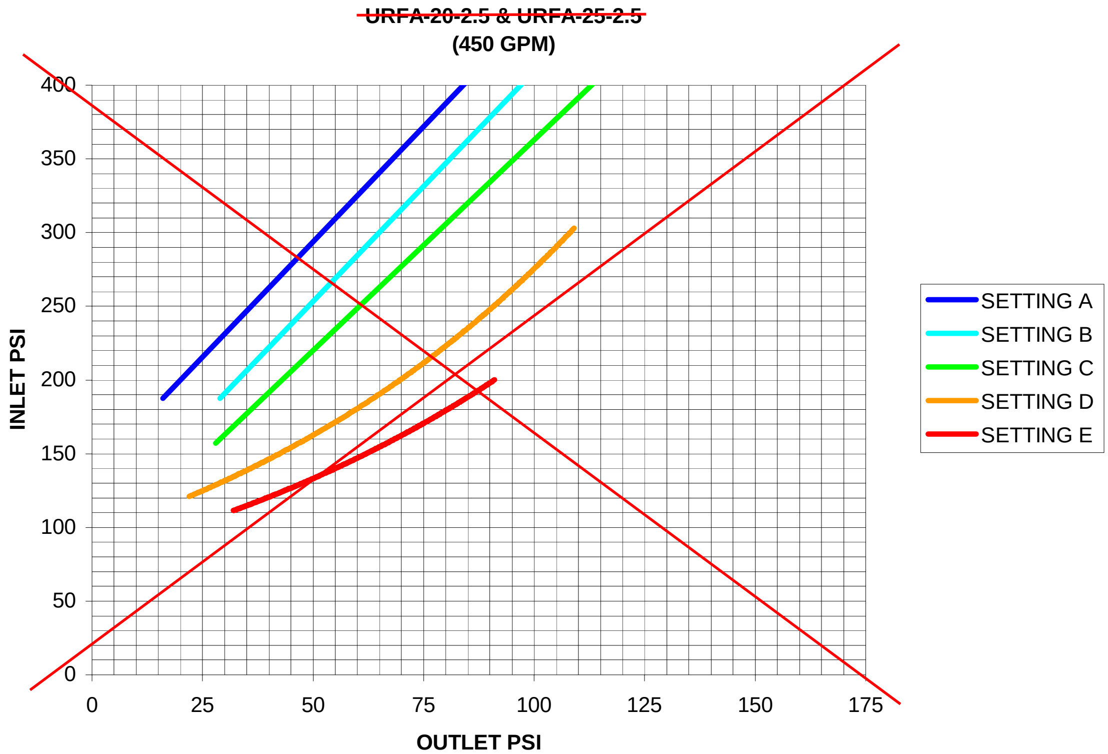
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E


URFA-20-2.5 URFA-25-2.5
(250 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E

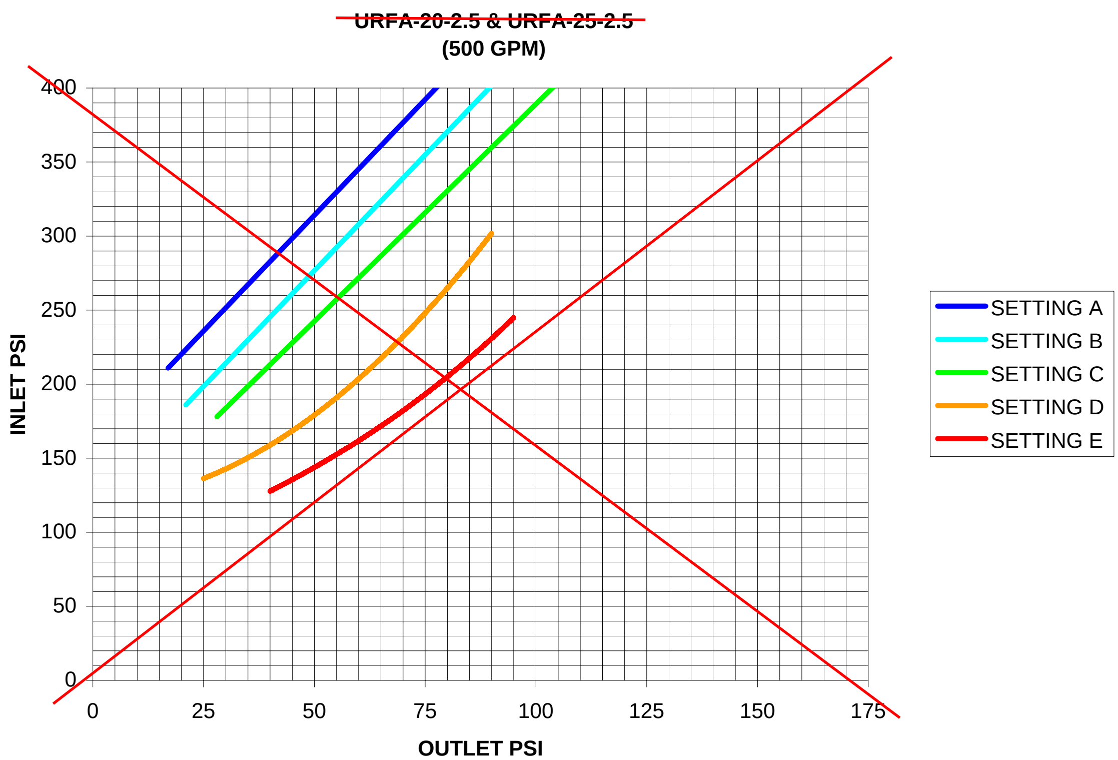

URFA-20-2.5 URFA-25-2.5
(300 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E


URFA-20-2.5 & URFA-25-2.5
(350 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E

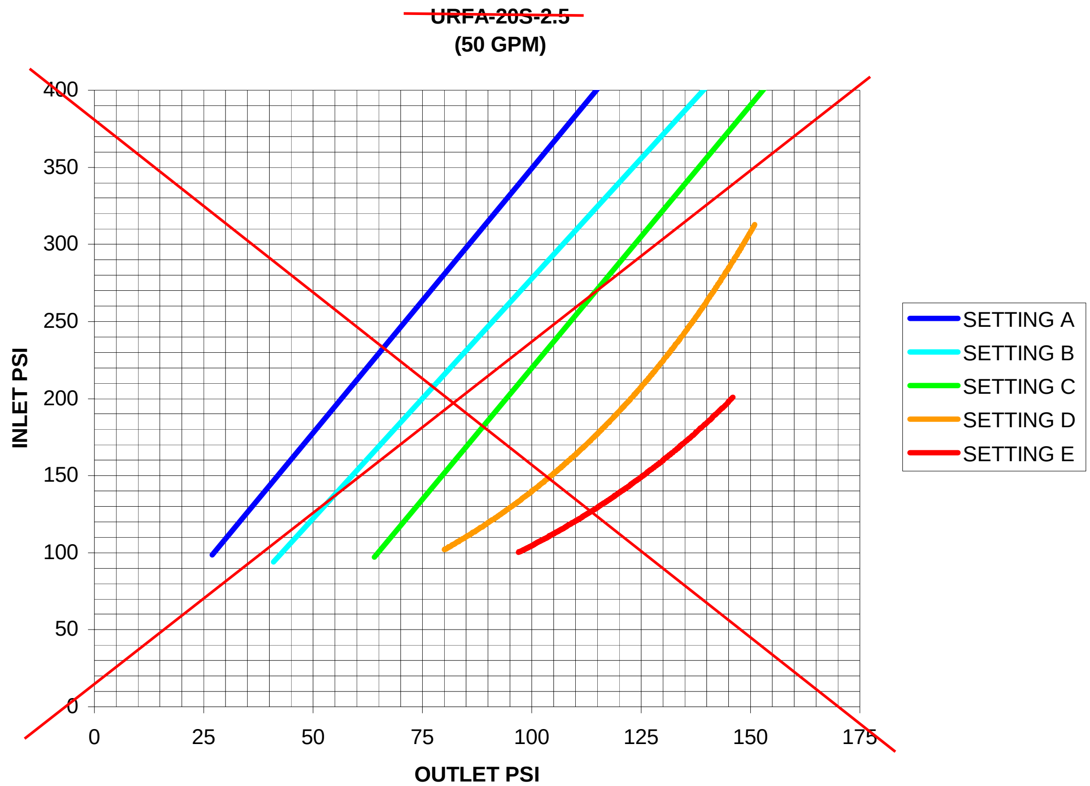

URFA-20-2.5 & URFA-25-2.5
(400 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E

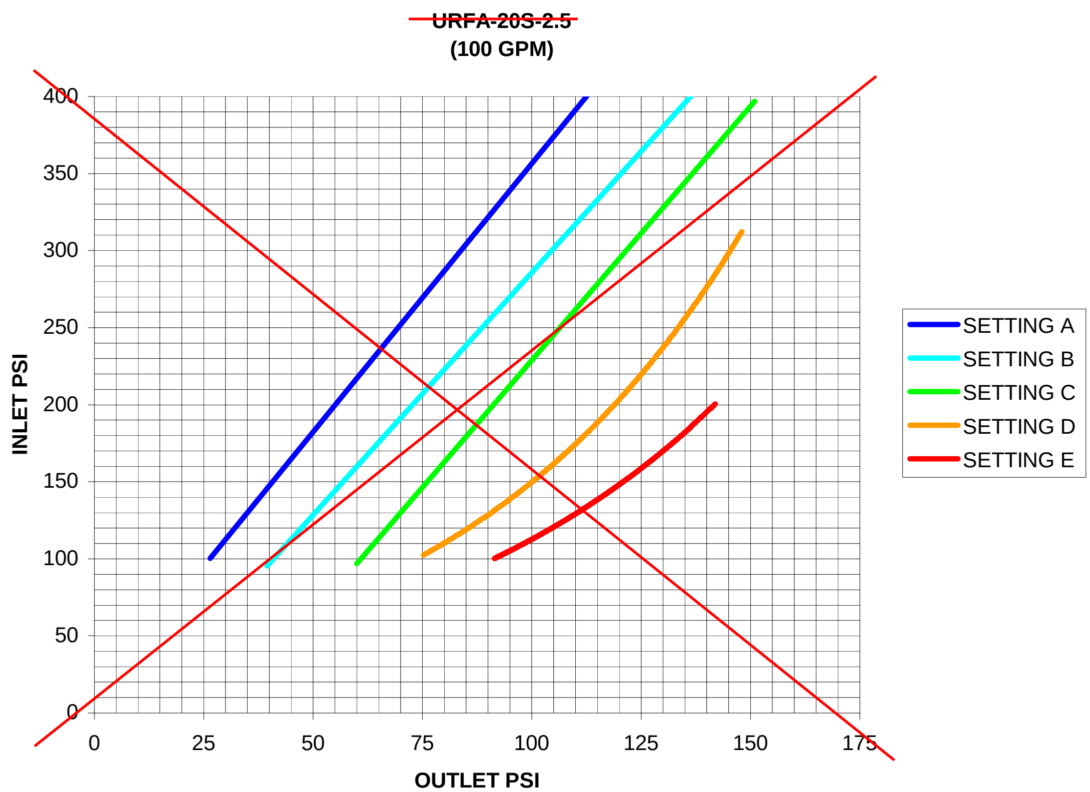


URFA-20-2.5 & URFA-25-2.5
(450 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E



URFA-20-2.5 & URFA-25-2.5
(500 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E


URFA-20S-2.5
(50 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E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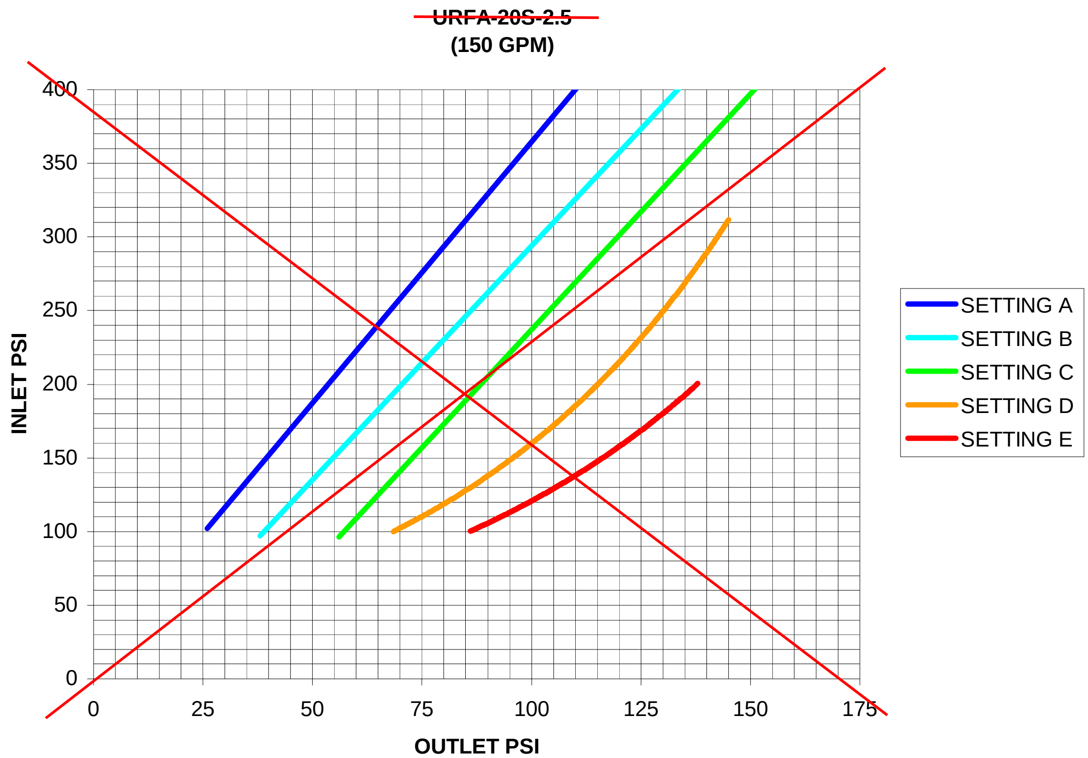
(100 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E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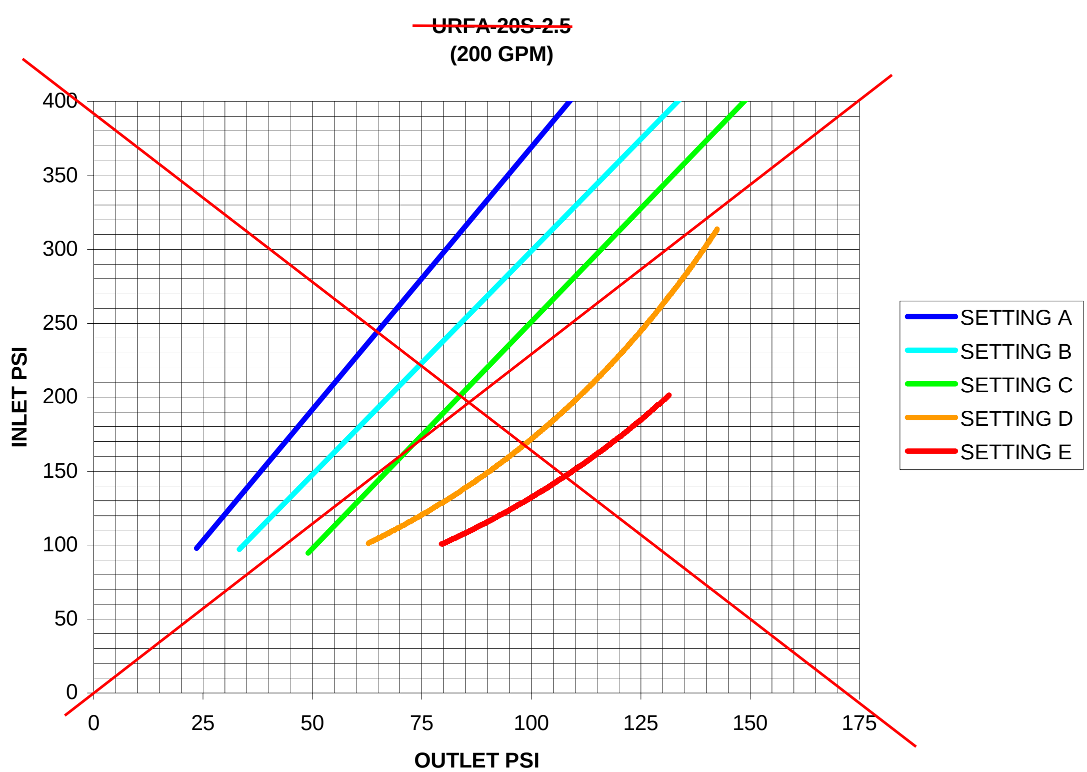
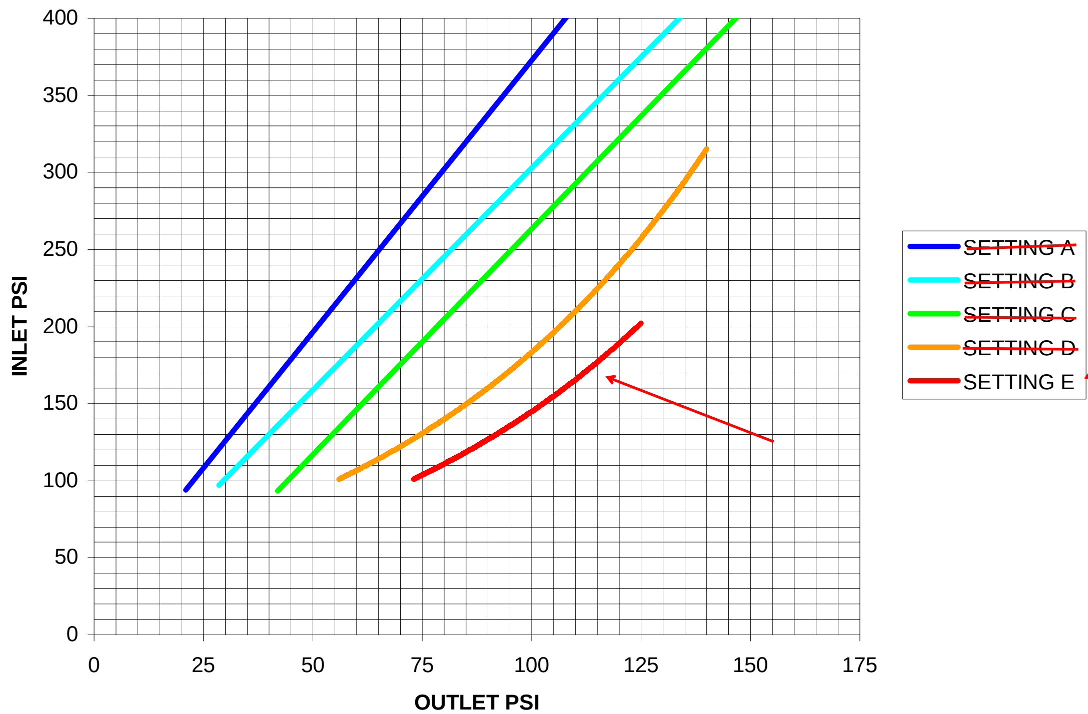
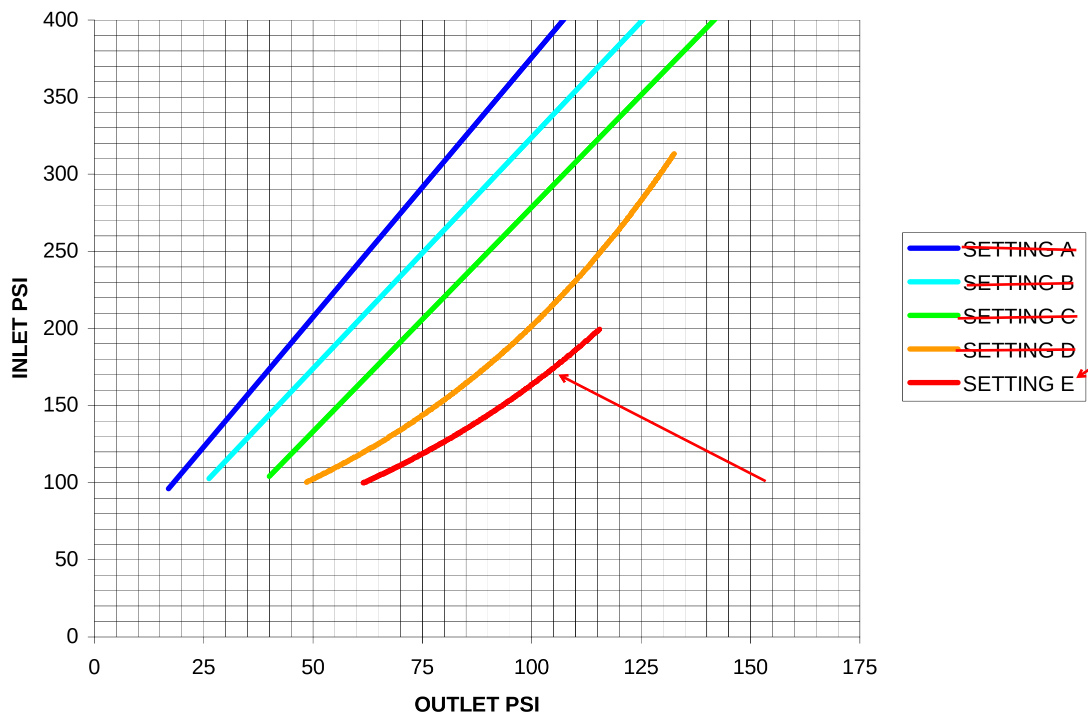
(150 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E

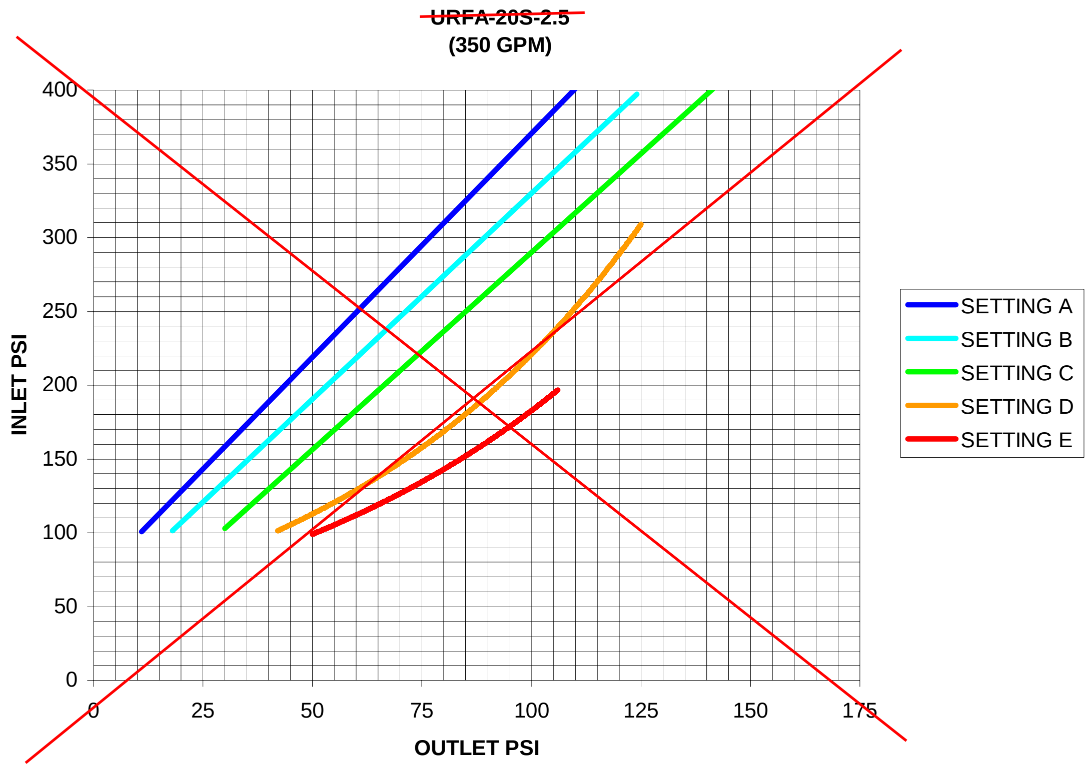

URFA-20S-2.5
(200 GPM)
INLET PSI
OUTLET PSI
0
50
100
150
200
250
300
350
400
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E

URFA-20S-2.5
(250 GPM)



URFA-20S-2.5
(300 GPM)

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(350 GPM)
INLET PSI
OUTLET PSI
400
350
300
250
200
150
100
50
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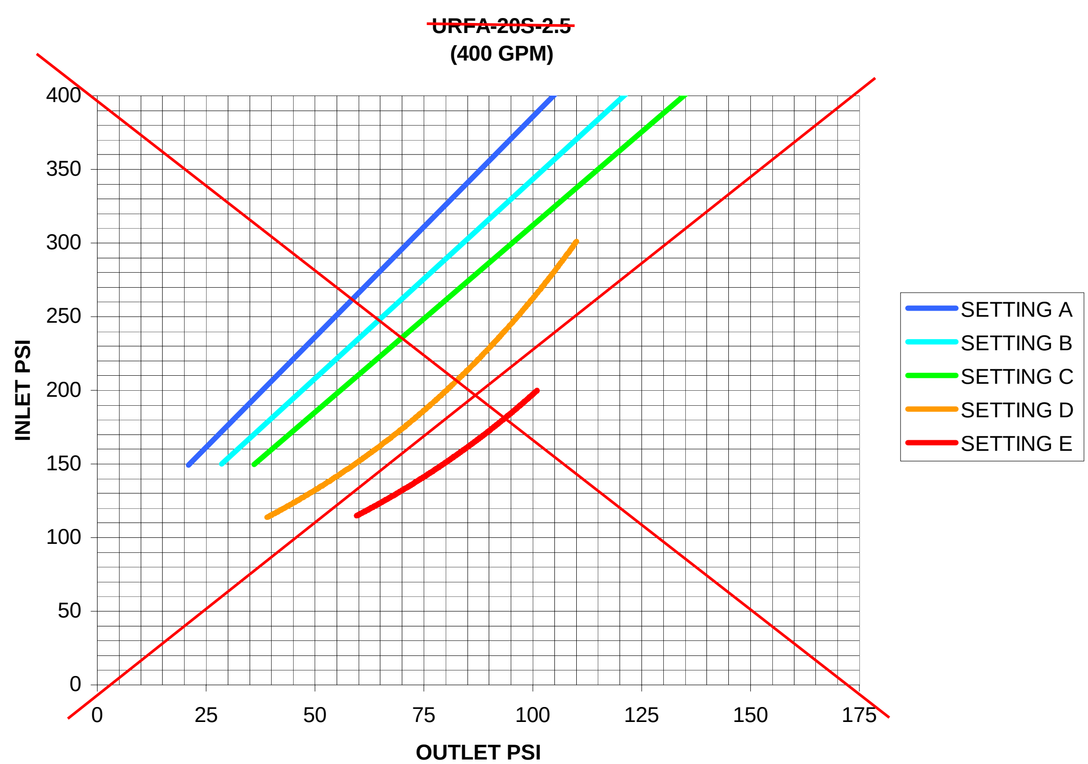
0
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E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(400 GPM)
INLET PSI
OUTLET PSI
400
350
300
250
200
150
100
50
0
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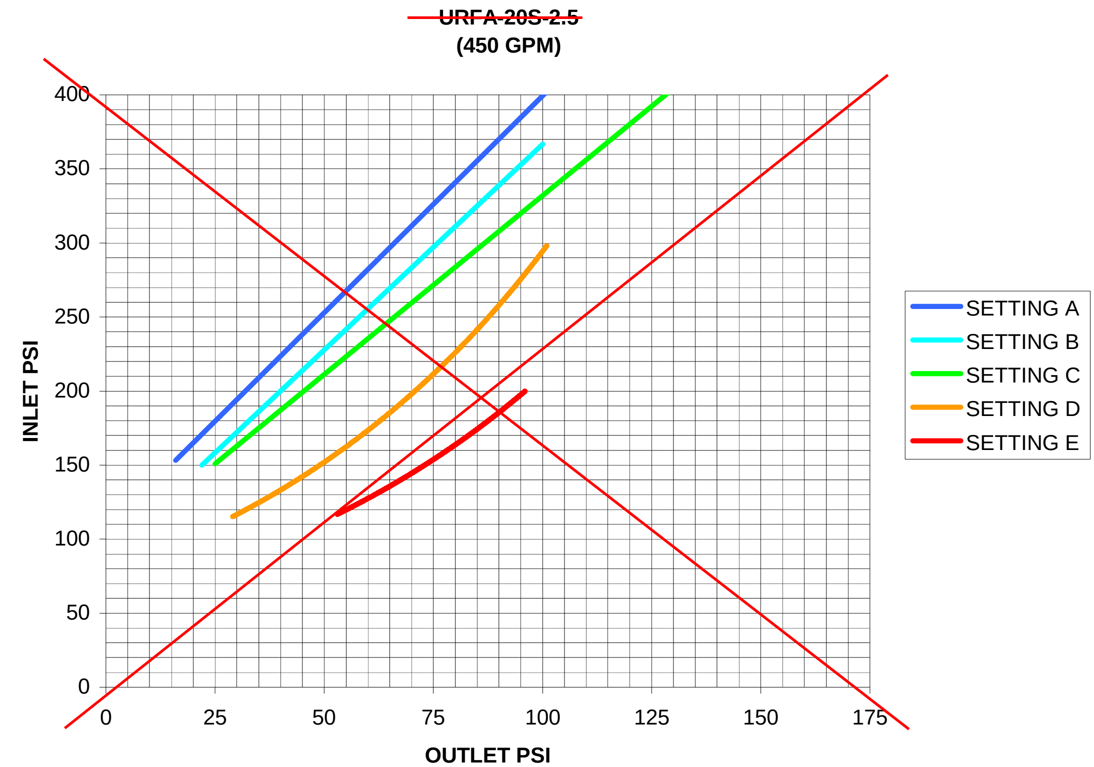
25
50
75
100
125
150
175
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E


URFA-20S-2.5
(450 GPM)
400
350
300
250
200
150
100
50
0
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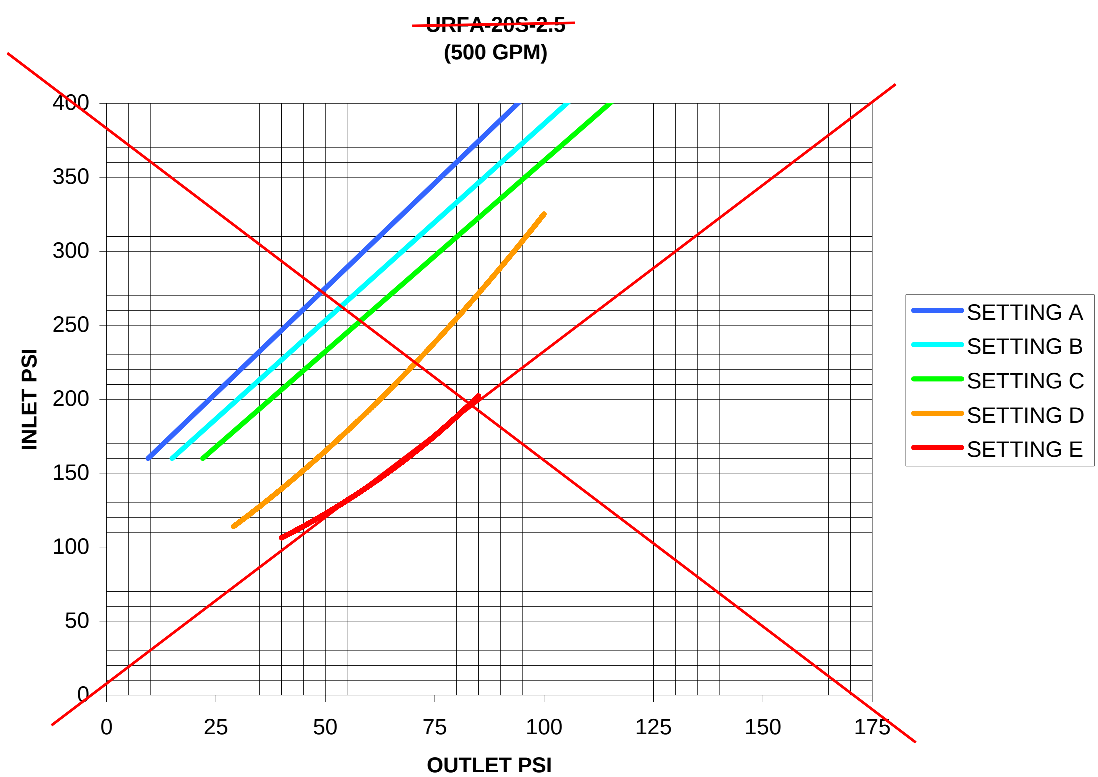
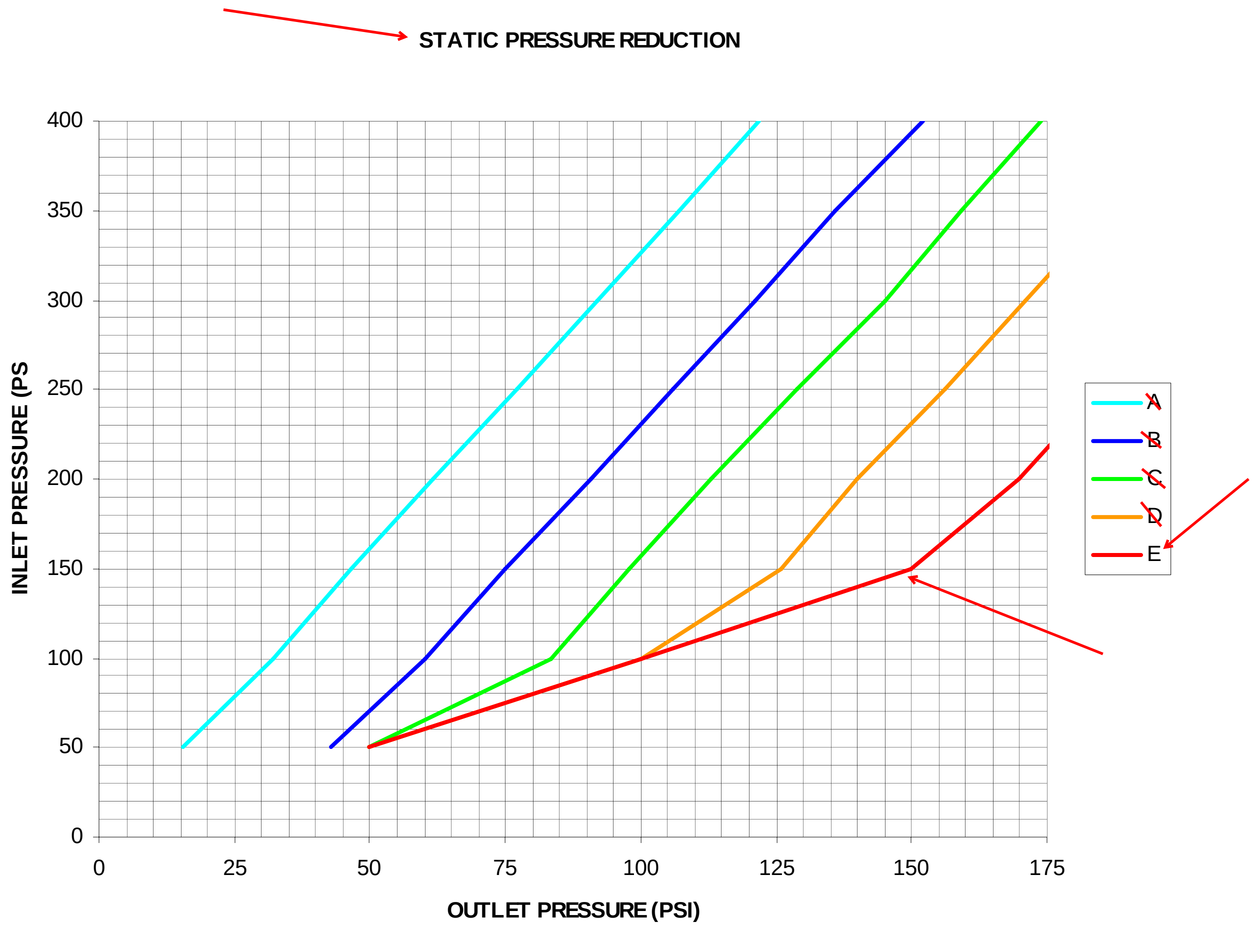
25
50
75
100
125
150
175
INLET PSI
OUTLET PSI
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E


URFA-20S-2.5
(500 GPM)
400
350
300
250
200
150
100
50
0
0
25
50
75
100
125
150
175
INLET PSI
OUTLET PSI
SETTING A
SETTING B
SETTING C
SETTING D
SETTING E


STATIC PRESSURE REDUCTION
INLET PRESSURE (PS
OUTLET PRESSURE (PSI)
400
350
300
250
200
150
100
50
0
0
25
50
75
100
125
150
175
A
B
C
D
E

Elkhart Brass

Fire Fighting Equipment

Elkhart Brass Mfg. Co., Inc.
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P.O. Box 1127
Elkhart, IN 46515 USA
Shipping Address:
1302 W. Beardsley Ave.
Elkhart, IN 46514 USA
Tel. 1-574-295-8330
1-800-346-0250
Fax 1-574-293-9914
e-mail: info@elkhartbrass.com

www.elkhartbrass.com

Elkhart Brass
Fire Fighting Equipment

URFA Valve Calculator

Project Name	Cal Poly Center for Science
Floor Location	First Floor
Static Inlet Pressure (PSI) *	183
Residual Inlet Pressure (PSI) *	174.5
Design Static Outlet Pressure	
Design Residual Outlet Pressure	
Flow Rate (GPM) *	250
Valve Body Style	URFA-20S-2.5 (IN-LINE BODY)

Indicator Setting	Static Outlet Pressure (PSI)	Residual Outlet Pressure (PSI)
~~A~~	~~56.40~~	~~43.77~~
~~B~~	~~85.56~~	~~55.34~~
~~C~~	~~107.90~~	~~69.71~~
~~D~~	~~135.24~~	~~96.64~~
E	163.20	113.60

PRESSURE LOSS ACROSS VALVE IS

174.5 PSI - 113.6 PSI = 60.9 PSI
@ 250 GPM

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Elkhart Brass
Fire Fighting Equipment

URFA Valve Calculator

Project Name	Cal Poly Center for Science
Floor Location	First Floor [R/A=2]
Static Inlet Pressure (PSI) *	183
Residual Inlet Pressure (PSI) *	169
Design Static Outlet Pressure	
Design Residual Outlet Pressure	
Flow Rate (GPM) *	328
Valve Body Style	URFA-20S-2.5 (IN-LINE BODY)

Indicator Setting	Static Outlet Pressure (PSI)	Residual Outlet Pressure (PSI)
~~A~~	~~56.40~~	~~36.38~~
~~B~~	~~85.56~~	~~45.66~~
~~C~~	~~107.90~~	~~54.23~~
~~D~~	~~135.24~~	~~83.89~~
→ E	163.20	98.86 ←

PRESSURE LOSS ACROSS VALVE IS

169 psi − 98.86 psi = 70.14 psi

@ 328 GPM

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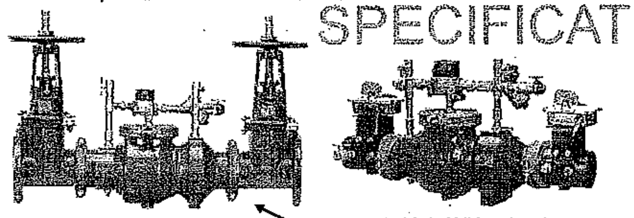
WILKINS
a ZURN® company

Model 350ADA
Double Check Detector Assembly

SPECIFICATION SUBMITTAL SHEET


(with OS&Y gates) (with BGVIC valves)

FEATURES

Sizes: ☐ 2 1/2"* ☐ 3"* ☐ 4" ☐ 6" ☒ 8" ☐ 10"

Maximum working water pressure	175 PSI
Maximum working water temperature	140°F
Hydrostatic test pressure	350 PSI
End connections (Grooved for steel pipe)	AWWA C606
(Flanged)	ANSI B16.1 Class 125

*2 1/2" & 3" sizes use 4" body & reducer couplings

OPTIONS

(Suffixes can be combined)

- ☐ - with flanged end OS & Y gate valves (standard)
- ☐ L - less shut-off valves (grooved body connections)
- ☐ LM - less water meter
- ☐ - with remote reading meter
- ☐ - with gpm meter (standard)
- ☐ - with cu ft/min meter
- ☐ G - with grooved end OS&Y gate valves
- ☐ FG - with flanged inlet gate connection and grooved outlet gate connection
- ☐ PI - with Post Indicator Gate Valves (4"-10")
- ☐ BGVIC - with grooved end butterfly valves

ACCESSORIES

- ☐ Repair kit (rubber only)
- ☐ Thermal expansion tank (Model XT)
- ☐ OS & Y Gate valve tamper switch (OSY-40)
- ☐ Test Cock Lock (Model TCL24)

APPLICATION

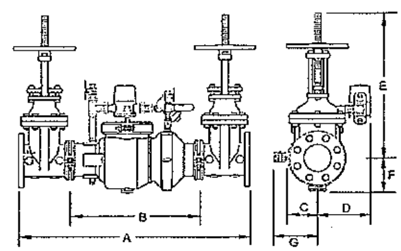
Designed for installation on potable water lines connections in fire sprinkler systems to protect against both backsiphonage and backpressure of polluted water into the potable water supply. Model 350ADA shall provide protection where a potential health hazard does not exist. Incorporates metered by-pass to detect leaks and unauthorized water use.

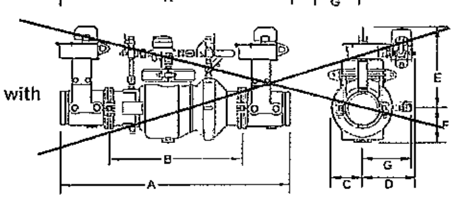
STANDARDS COMPLIANCE (HORIZONTAL & VERTICAL)

- ASSE® Listed 1048
- AWWA Compliant C510 (with gates only)
- CSA® Certified (4" - 8")
- UL® Classified
- C-UL® Classified
- FM® Approved
- Approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California
- NYC MEA 221-04M-2 (2 1/2" - 8")

MATERIALS

Main valve body	Ductile Iron ASTM A 536 Grade 4
Access covers	Ductile Iron ASTM A 536 Grade 4
Coatings	FDA Approved electrostatic epoxy finish
Internals	Stainless steel, 300 Series NORYL™, NSF Listed
Fasteners & springs	Stainless Steel, 300 Series
Elastomers	EPDM (FDA approved) Buna Nitrile (FDA approved)
Polymers	NORYL™, NSF Listed


MODEL 350ADA with OS&Y option


MODEL 350ADA with BGVIC option

DIMENSIONS & WEIGHTS (do not include pkg.)

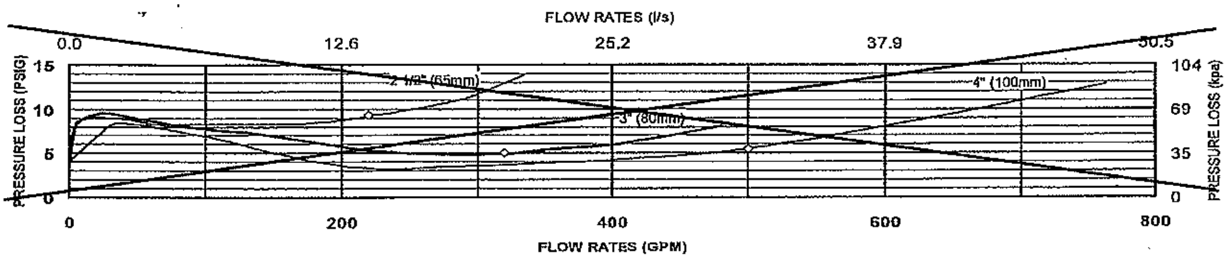
MODEL 350ADA SIZE		WEIGHT							
		WITHOUT GATES		WITH OS&Y GATES (GXF)		WITH OS&Y GATES (GXG)		WITH BUTTERFLY VALVES (GXG)	
in.	mm	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg
2 1/2	65	105	47.5	207	94	199	90.3	123.8	56.2
3	80	104	47	224	101.5	214	97	124.4	56.5
4	100	91	41.3	245	111	219	99.4	123	55.8
6	150	141	64	377	171	347	158	193	87.6
8	200	302	137	778	353.2	754	342.3	410	186
10	250	355	161	1040	472.7	916	416.5	527	239.3

MODEL 350 ADA SIZE		DIMENSION (approximate)																			
		A		A WITH BUTTERFLY VALVES		B LESS GATE VALVES		C		D		E OS&Y OPEN		E OS&Y CLOSED		E WITH BUTTERFLY VALVES		F		G	
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
2 1/2	65	35 1/8	892	32 1/8	816	20 1/8	511	4 1/2	114	9	229	16 3/8	416	13 7/8	352	8	203	6	152	7 1/4	184
3	80	36 1/8	918	33	838	20 1/8	511	4 1/2	114	9	229	18 7/8	479	15 5/8	397	8	203	6	152	7 1/4	184
4	100	38 1/4	972	33 1/4	845	19 7/8	505	4 1/2	114	9	229	22 3/4	578	16 1/4	404	9 1/8	232	6	152	8	203
6	150	47 1/4	1200	40 1/4	1022	25 7/8	657	5 1/2	140	10 1/2	267	30 1/8	765	23 3/4	603	10 1/8	257	7	178	10	254
8	200	62	1575	55	1397	38 1/2	978	10	254	12	305	37 3/4	959	29 1/4	743	11 15/16	303	8 1/2	216	11	279
10	250	64 5/8	1642	58 1/2	1485	38 1/2	978	10	254	12	305	45 3/4	1162	35 3/8	899	13 5/16	338	8 1/2	216	12	305

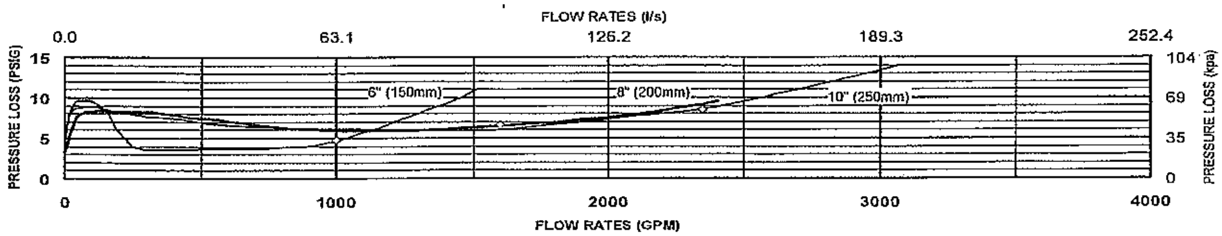
Attention: Model 350ADA (grooved body) and Model 350DA (flange body) have different lay lengths.

FLOW CHARACTERISTICS

MODEL 350ADA 2 1/2", 3" & 4" (STANDARD & METRIC)



MODEL 350ADA 6", 8" & 10" (STANDARD & METRIC)

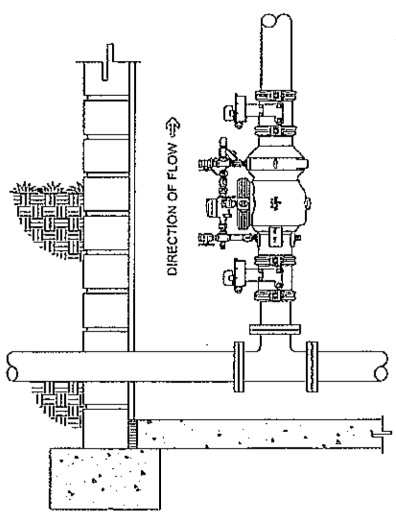


◇ Rated Flow (Established by approval agencies)

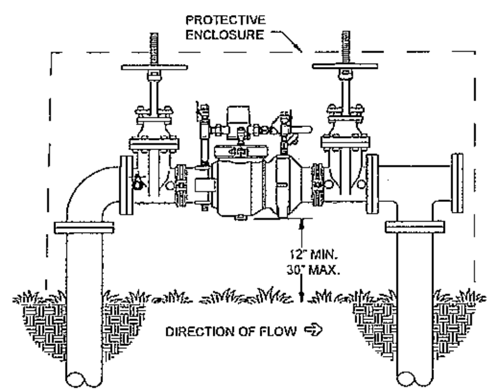
TYPICAL INSTALLATION

Local codes shall govern installation requirements. Unless otherwise specified, the assembly shall be mounted at a minimum of 12" (305mm) and a maximum of 30" (762mm) above adequate drains with sufficient side clearance for testing and maintenance. The installation shall be made so that no part of the unit can be submerged.

Capacity thru Schedule 40 Pipe (GPM)				
Pipe size	5 ft/sec	7.5 ft/sec	10ft/sec	15 ft/sec
~~2 1/2"~~	~~75~~	~~112~~	~~149~~	~~224~~
~~3"~~	~~115~~	~~173~~	~~230~~	~~346~~
~~4"~~	~~198~~	~~298~~	~~397~~	~~595~~
~~6"~~	~~450~~	~~675~~	~~900~~	~~1351~~
8"	780	1169	1559	2339
~~10"~~	~~1229~~	~~1843~~	~~2458~~	~~3687~~
~~12"~~	~~1763~~	~~2644~~	~~3525~~	~~5288~~



MODEL 350ADABGVIC (VERTICAL INSTALLATION)

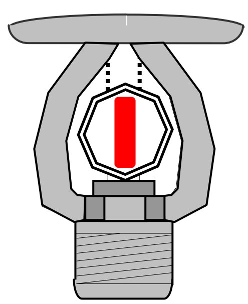


MODEL 350ADA (OUTDOOR INSTALLATION)

SPECIFICATIONS

The Double Check Detector Backflow Prevention Assembly shall be ASSE® Listed 1048, and supplied with full port gate valves. The main body and access cover shall be epoxy coated ductile iron (ASTM A 536 Grade 4), the seat ring and check valve shall be Noryl™ (NSF Listed), the stem shall be stainless steel (ASTM A 276) and the seat disc elastomers shall be EPDM. The first and second check valves shall be accessible for maintenance without removing the device from the line. The Double Check Detector Backflow Prevention Assembly shall be a WILKINS Model 350ADA.

2



LEVEL 1 R/A # 1 & 2

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AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science LVL 1 [R/A=1]
Building	:	FP-6.01W
Location	:	San Luis Obispo, Ca.
System	:	1-1
Contract	:	10034
Data File	:	Cal Poly CFS LVL 1-1.WXF

HYDRAULIC CALCULATIONS
for

Project name: Cal Poly Center For Science
Location: San Luis Obispo, Ca.
Drawing no: FP-6.01W
Date: 9-25-2011

Design

- ***Remote area number:*** 1-1
- ***Remote area location:*** 1 st. Floor Lecture
- ***Occupancy classification:*** Light Hazard
- ***Density:*** 0.10 - Gpm/SqFt
- ***Area of application:*** 1500 - SqFt
- ***Coverage per sprinkler:*** 168 - SqFt
- ***Type of sprinklers calculated:*** Tyco; Mod. TY-FRB; 1/2"; 1/2";K=5.6; 155 Deg
- ***No. of sprinklers calculated:*** 12
- ***In-rack demand:*** N/A - GPM
- ***Hose streams:*** 100 - GPM
- ***Total water required (including hose streams):*** 350.6 - GPM @ 7.27 - Psi
- ***Type of system:*** WET
- ***Volume of dry or preaction system:*** N/A - Gal

Water supply information

- ***Date:*** 8-19-2011
- ***Location:*** N. Poly View Drive
- ***Source:*** Fluid Resource Management

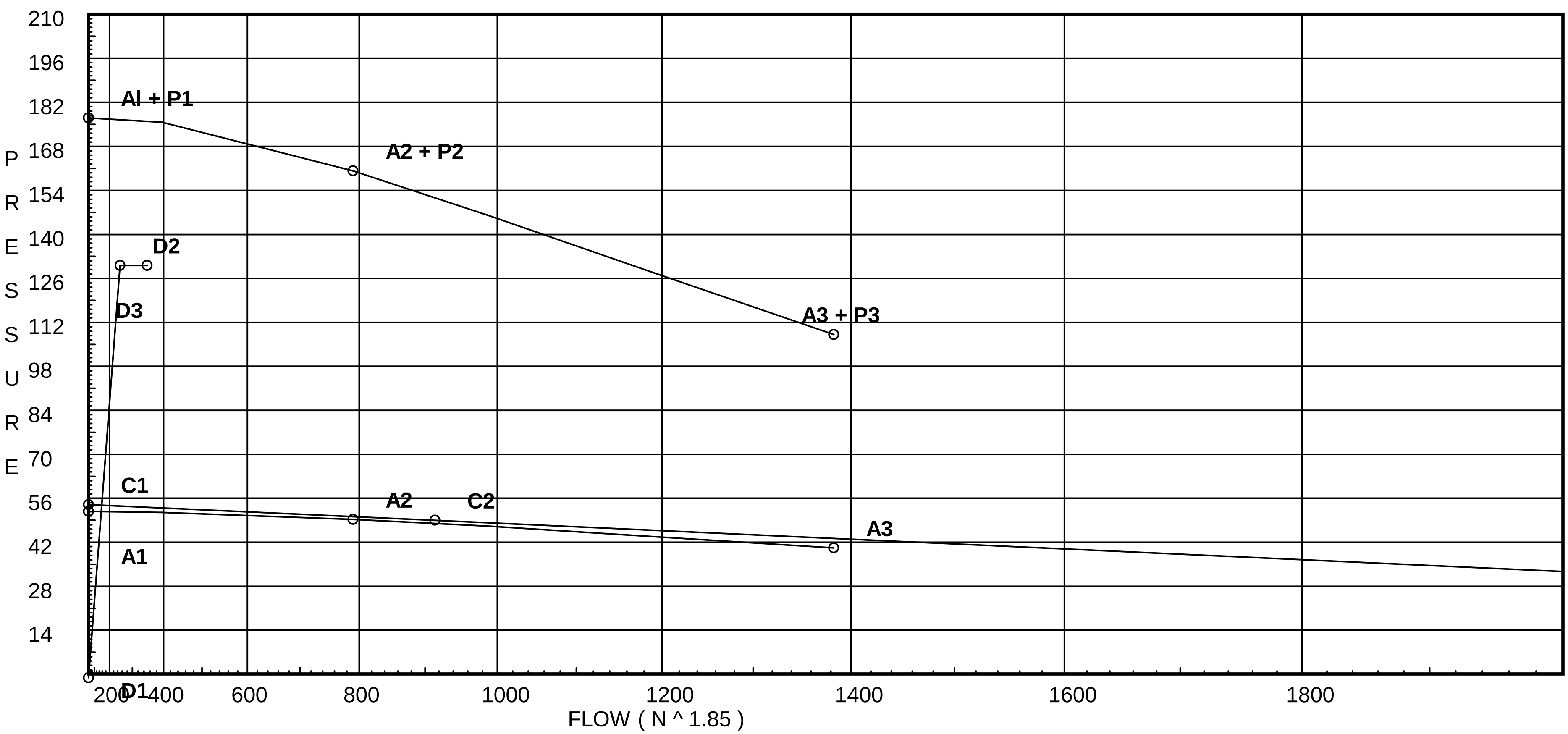
Name of contractor: Aero Automatic Sprinkler Co.
Address: 21605 N. Central Ave. Phoenix, Az. 85024
Phone number: 623-580-7847
Name of designer: Neal Larsen
Authority having jurisdiction: C.S.F.M.
Notes: (Include peaking information or gridded systems here.) Flow Test Information :
Hydrant # 63; Static = 60 psi; Res.= 55 psi {Elev.=351.0'}
Hydrant # 64; Flow = 914 gpm
FLOW TEST USED IN HYD. CALCS REDUCED BY 10 % [STATIC=54psi; RES.=49psi]

Water Supply Curve (C)

Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 1 [R/A=1]

Page 2
Date 9-25-11

City Water Supply:			Pump Data:			Demand:		
C1 - Static Pressure	:	54	P1 - Pump Churn Pressure	:	125.2	D1 - Elevation	:	-1.083
C2 - Residual Pressure:		49	P2 - Pump Rated Pressure	:	110.9	D2 - System Flow	:	250.608
C2 - Residual Flow	:	914	P2 - Pump Rated Flow	:	790.2	D2 - System Pressure	:	130.164
			P3 - Pump Pressure @ Max Flow	:	67.9	Hose (Adj City)	:	________
City Water Adjusted to Pump Inlet for Pf - Elev - Hose Flow			P3 - Pump Max Flow	:	1382.9	Hose (Demand)	:	100
			City Residual Flow @ 0	=	3307.91	D3 - System Demand	:	350.608
A1 - Adjusted Static:		51.872	City Residual Flow @ 20	=	2576.03	Safety Margin	:	45.876
A2 - Adj Resid	:	49.314 @ 790.2	City Water @ 150% of Pump	=	43.24			
A3 - Adj Resid	:	40.224 @ 1382.9						



Fittings Used Summary

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
H	45' Ell Grvd-Vic #11	0	0	1	1.5	2	2	3	3	3.5	3.5	4.5	5	6.5	8.5	10	18	20	23	25	30
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Aero Automatic Sprinkler Co. Page 4
Cal Poly Center for Science LVL 1 [R/A=1] Date 9-25-11

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
S101	10.5	5.6	9.0	na	16.8	0.1	168	7.0
S102	10.5	5.6	10.12	na	17.81	0.1	168	7.0
S103	10.5	5.6	14.14	na	21.05	0.1	168	7.0
S104	10.5	5.6	23.3	na	27.03	0.1	168	7.0
S105	10.5	5.6	9.1	na	16.89	0.1	168	7.0
S106	10.5	5.6	10.23	na	17.91	0.1	168	7.0
S107	10.5	5.6	14.29	na	21.17	0.1	168	7.0
S108	10.5	5.6	23.55	na	27.18	0.1	168	7.0
S109	10.5	5.6	9.46	na	17.23	0.1	168	7.0
S110	10.5	5.6	10.64	na	18.26	0.1	168	7.0
S111	10.5	5.6	14.84	na	21.58	0.1	168	7.0
S112	10.5	5.6	24.45	na	27.69	0.1	168	7.0
L101	12.167		8.62	na				
L102	13.167		9.77	na				
L103	13.167		14.08	na				
L104	13.167		23.89	na				
L105	12.167		8.73	na				
L106	13.167		9.89	na				
L107	13.167		14.24	na				
L108	13.167		24.16	na				
L109	12.167		9.1	na				
L110	13.167		10.32	na				
L111	13.167		14.84	na				
L112	13.167		25.12	na				
M101	13.167		25.82	na				
M102	13.167		26.11	na				
M103	13.167		27.13	na				
M104	13.167		41.43	na				
M105	13.167		51.6	na				
TR01	13.167		60.33	na				
BR01	3.0		126.68	na				
SPC1	12.667		125.17	na	100.0			
SPC2	12.667		125.36	na				
PO	1.833		130.16	na				
PI	1.75		51.68	na				
POC	6.75		49.6	na				
BF1	13.0		46.98	na				
BF2	13.0		53.01	na				
SRC	13.0		53.15	na				

The maximum velocity is 21.19 and it occurs in the pipe between nodes L111 and M103

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*FLOWING SPRINKLER R/A # 1 #										
S101	10.500	5.60	16.80	1	1E	2.0	1.667	120	9.000	
to						0.0	2.000		-0.722	
L101	12.167		16.8	1.049		0.0	3.667	0.0944	0.346	Vel = 6.24
			0.0							
L101			16.80						8.624	K Factor = 5.72
S102	10.500	5.60	17.81	1	1T	5.0	2.667	120	10.119	
to						0.0	5.000		-1.155	
L102	13.167		17.81	1.049		0.0	7.667	0.1050	0.805	Vel = 6.61
			0.0							
L102			17.81						9.769	K Factor = 5.70
S103	10.500	5.60	21.05	1	1T	5.0	2.667	120	14.135	
to						0.0	5.000		-1.155	
L103	13.167		21.05	1.049		0.0	7.667	0.1431	1.097	Vel = 7.81
			0.0							
L103			21.05						14.077	K Factor = 5.61
S104	10.500	5.60	27.03	1	1T	5.0	2.667	120	23.303	
to						0.0	5.000		-1.155	
L104	13.167		27.03	1.049		0.0	7.667	0.2272	1.742	Vel = 10.03
			0.0							
L104			27.03						23.890	K Factor = 5.53
S105	10.500	5.60	16.89	1	1E	2.0	1.667	120	9.100	
to						0.0	2.000		-0.722	
L105	12.167		16.89	1.049		0.0	3.667	0.0952	0.349	Vel = 6.27
			0.0							
L105			16.89						8.727	K Factor = 5.72
S106	10.500	5.60	17.91	1	1T	5.0	2.667	120	10.231	
to						0.0	5.000		-1.155	
L106	13.167		17.91	1.049		0.0	7.667	0.1060	0.813	Vel = 6.65
			0.0							
L106			17.91						9.889	K Factor = 5.70
S107	10.500	5.60	21.17	1	1T	5.0	2.667	120	14.288	
to						0.0	5.000		-1.155	
L107	13.167		21.17	1.049		0.0	7.667	0.1446	1.109	Vel = 7.86
			0.0							
L107			21.17						14.242	K Factor = 5.61
S108	10.500	5.60	27.18	1	1T	5.0	2.667	120	23.551	
to						0.0	5.000		-1.155	
L108	13.167		27.18	1.049		0.0	7.667	0.2294	1.759	Vel = 10.09
			0.0							
L108			27.18						24.155	K Factor = 5.53
S109	10.500	5.60	17.23	1	1E	2.0	1.667	120	9.464	
to						0.0	2.000		-0.722	
L109	12.167		17.23	1.049		0.0	3.667	0.0987	0.362	Vel = 6.40
			0.0							
L109			17.23						9.104	K Factor = 5.71
S110	10.500	5.60	18.26	1	1T	5.0	2.667	120	10.637	
to						0.0	5.000		-1.155	
L110	13.167		18.26	1.049		0.0	7.667	0.1100	0.843	Vel = 6.78

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
L110			18.26						10.325	K Factor = 5.68
S111	10.500	5.60	21.58	1	1T	5.0	2.667	120	14.844	
to						0.0	5.000		-1.155	
L111	13.167		21.58	1.049		0.0	7.667	0.1497	1.148	Vel = 8.01
			0.0							
L111			21.58						14.837	K Factor = 5.60
S112	10.500	5.60	27.69	1	1T	5.0	2.667	120	24.448	
to						0.0	5.000		-1.155	
L112	13.167		27.69	1.049		0.0	7.667	0.2376	1.822	Vel = 10.28
			0.0							
L112			27.69						25.115	K Factor = 5.53
*BRANCH LINES R/A # 1										
L101	12.167		16.80	1	2E	4.0	12.750	120	8.624	
to						0.0	4.000		-0.433	
L102	13.167		16.8	1.049		0.0	16.750	0.0942	1.578	Vel = 6.24
L102	13.167		17.81	1		0.0	12.000	120	9.769	
to						0.0	0.0		0.0	
L103	13.167		34.61	1.049		0.0	12.000	0.3590	4.308	Vel = 12.85
L103	13.167		21.06	1	1T	5.0	8.583	120	14.077	
to						0.0	5.000		0.0	
M101	13.167		55.67	1.049		0.0	13.583	0.8647	11.745	Vel = 20.67
			0.0							
M101			55.67						25.822	K Factor = 10.96
L104	13.167		27.03	1	1T	5.0	3.500	120	23.890	
to						0.0	5.000		0.0	
M101	13.167		27.03	1.049		0.0	8.500	0.2273	1.932	Vel = 10.03
			0.0							
M101			27.03						25.822	K Factor = 5.32
L105	12.167		16.89	1	2E	4.0	12.750	120	8.727	
to						0.0	4.000		-0.433	
L106	13.167		16.89	1.049		0.0	16.750	0.0952	1.595	Vel = 6.27
L106	13.167		17.91	1		0.0	12.000	120	9.889	
to						0.0	0.0		0.0	
L107	13.167		34.8	1.049		0.0	12.000	0.3627	4.353	Vel = 12.92
L107	13.167		21.17	1	1T	5.0	8.583	120	14.242	
to						0.0	5.000		0.0	
M102	13.167		55.97	1.049		0.0	13.583	0.8734	11.864	Vel = 20.78
			0.0							
M102			55.97						26.106	K Factor = 10.95
L108	13.167		27.18	1	1T	5.0	3.500	120	24.155	
to						0.0	5.000		0.0	
M102	13.167		27.18	1.049		0.0	8.500	0.2295	1.951	Vel = 10.09
			0.0							
M102			27.18						26.106	K Factor = 5.32
L109	12.167		17.23	1	2E	4.0	12.750	120	9.104	
to						0.0	4.000		-0.433	
L110	13.167		17.23	1.049		0.0	16.750	0.0987	1.654	Vel = 6.40

Node1	Elev1	K	Qa	Nom	Fitting		Pipe	CFact	Pt	******* Notes ******
to					or		Ftng's		Pe	
Node2	Elev2	Fact	Qt	Act	Eqv.	Ln.	Total	Pf/Ft	Pf	
L110	13.167		18.26	1		0.0	12.000	120	10.325	
to						0.0	0.0		0.0	
L111	13.167		35.49	1.049		0.0	12.000	0.3760	4.512	Vel = 13.17
L111	13.167		21.58	1	1T	5.0	8.583	120	14.837	
to						0.0	5.000		0.0	
M103	13.167		57.07	1.049		0.0	13.583	0.9053	12.297	Vel = 21.19
			0.0							
M103			57.07						27.134	K Factor = 10.96
L112	13.167		27.69	1	1T	5.0	3.500	120	25.115	
to						0.0	5.000		0.0	
M103	13.167		27.69	1.049		0.0	8.500	0.2375	2.019	Vel = 10.28
			0.0							
M103			27.69						27.134	K Factor = 5.32
*FEED MAIN										
M101	13.167		82.70	2.5		0.0	14.000	120	25.822	
to						0.0	0.0		0.0	
M102	13.167		82.7	2.635		0.0	14.000	0.0203	0.284	Vel = 4.87
M102	13.167		83.15	2.5		0.0	14.000	120	26.106	
to						0.0	0.0		0.0	
M103	13.167		165.85	2.635		0.0	14.000	0.0734	1.028	Vel = 9.76
M103	13.167		84.76	2.5	1T	16.474	74.250	120	27.134	
to						0.0	16.474		0.0	
M104	13.167		250.61	2.635		0.0	90.724	0.1576	14.299	Vel = 14.74
M104	13.167		0.0	2.5	1H	4.119	43.917	120	41.433	
to					1T	16.474	20.593		0.0	
M105	13.167		250.61	2.635		0.0	64.510	0.1576	10.168	Vel = 14.74
M105	13.167		0.0	3	4I	26.879	109.083	120	51.601	
to					1T	20.159	47.038		0.0	
TR01	13.167		250.61	3.26		0.0	156.121	0.0559	8.727	Vel = 9.63
TR01	13.167		0.0	3	1I	6.72	10.167	120	60.328	
to						0.0	6.720		65.403	* Fixed loss = 61
BR01	3		250.61	3.26		0.0	16.887	0.0559	0.944	Vel = 9.63
BR01	3		0.0	3	2I	13.44	14.333	120	126.675	
to					1T	20.159	33.599		-4.187	
SPC1	12.667		250.61	3.26		0.0	47.932	0.0559	2.680	Vel = 9.63
SPC1	12.667	H100	100.00	6	1T	30.0	7.833	120	125.168	
to						0.0	30.000		0.0	
SPC2	12.667		350.61	6.065		0.0	37.833	0.0051	0.192	Vel = 3.89
SPC2	12.667		0.0	8	1I	13.0	14.750	120	125.360	
to					1B	12.0	70.000		4.692	
PO	1.833		350.61	7.981	1C	45.0	84.750	0.0013	0.112	Vel = 2.25
			0.0							
PO			350.61						130.164	K Factor = 30.73

System Demand Pressure	130.164
Safety Margin	45.876
Continuation Pressure	176.040
Pressure @ Pump Outlet	176.040
Pressure From Pump Curve	-124.362
Pressure @ Pump Inlet	51.678

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
PI	1.750		0.0	8	1G	4.0	14.000	120	51.678	
to					1I	13.0	52.000		-2.166	
POC	6.750		350.61	7.981	1T	35.0	66.000	0.0013	0.088	Vel = 2.25
POC	6.750		0.0	8	2E	56.936	41.000	140	49.600	
to						0.0	56.936		-2.707	
BF1	13		350.61	8.27		0.0	97.936	0.0008	0.083	Vel = 2.09
BF1	13		0.0	8	1Zic	0.0	4.000	120	46.976	
to						0.0	0.0		6.031	* Fixed loss = 6.031
BF2	13		350.61	7.981		0.0	4.000	0.0012	0.005	Vel = 2.25
BF2	13		0.0	8	2E	56.936	46.000	140	53.012	
to					1G	6.326	118.616		0.0	
SRC	13		350.61	8.27	1T	55.354	164.616	0.0008	0.138	Vel = 2.09
			0.0							
SRC			350.61						53.150	K Factor = 48.09

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AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science LVL 1 [R/A=2]
Building	:	FP-6.01W
Location	:	San Luis Obispo, Ca.
System	:	1-2
Contract	:	10034
Data File	:	Cal Poly CFS LVL 1-2.WXF

HYDRAULIC CALCULATIONS
for

Project name: Cal Poly Center For Science
Location: San Luis Obispo, Ca.
Drawing no: FP-6.01W
Date: 9-25-2011

Design

- ***Remote area number:*** 1-2
- ***Remote area location:*** 1 st. Floor Lecture
- ***Occupancy classification:*** Light Hazard
- ***Density:*** 0.10 - Gpm/SqFt
- ***Area of application:*** 1500 - SqFt
- ***Coverage per sprinkler:*** 163 - SqFt
- ***Type of sprinklers calculated:*** Tyco; Mod. TY-FRB; 1/2"; 1/2";K=5.6; 155 Deg
- ***No. of sprinklers calculated:*** 16
- ***In-rack demand:*** N/A - GPM
- ***Hose streams:*** 100 - GPM
- ***Total water required (including hose streams):*** 428.4 - GPM @ 45.59 - Psi
- ***Type of system:*** WET
- ***Volume of dry or preaction system:*** N/A - Gal

Water supply information

- ***Date:*** 8-19-2011
- ***Location:*** N. Poly View Drive
- ***Source:*** Fluid Resource Management

Name of contractor: Aero Automatic Sprinkler Co.
Address: 21605 N. Central Ave. Phoenix, Az. 85024
Phone number: 623-580-7847
Name of designer: Neal Larsen
Authority having jurisdiction: C.S.F.M.
Notes: (Include peaking information or gridded systems here.) Flow Test Information :
Hydrant # 63; Static = 60 psi; Res.= 55 psi {Elev.=351.0'}
Hydrant # 64; Flow = 914 gpm
FLOW TEST USED IN HYD. CALCS REDUCED BY 10 % [STATIC=54psi; RES.=49psi]

Water Supply Curve (C)

Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 1 [R/A=2]

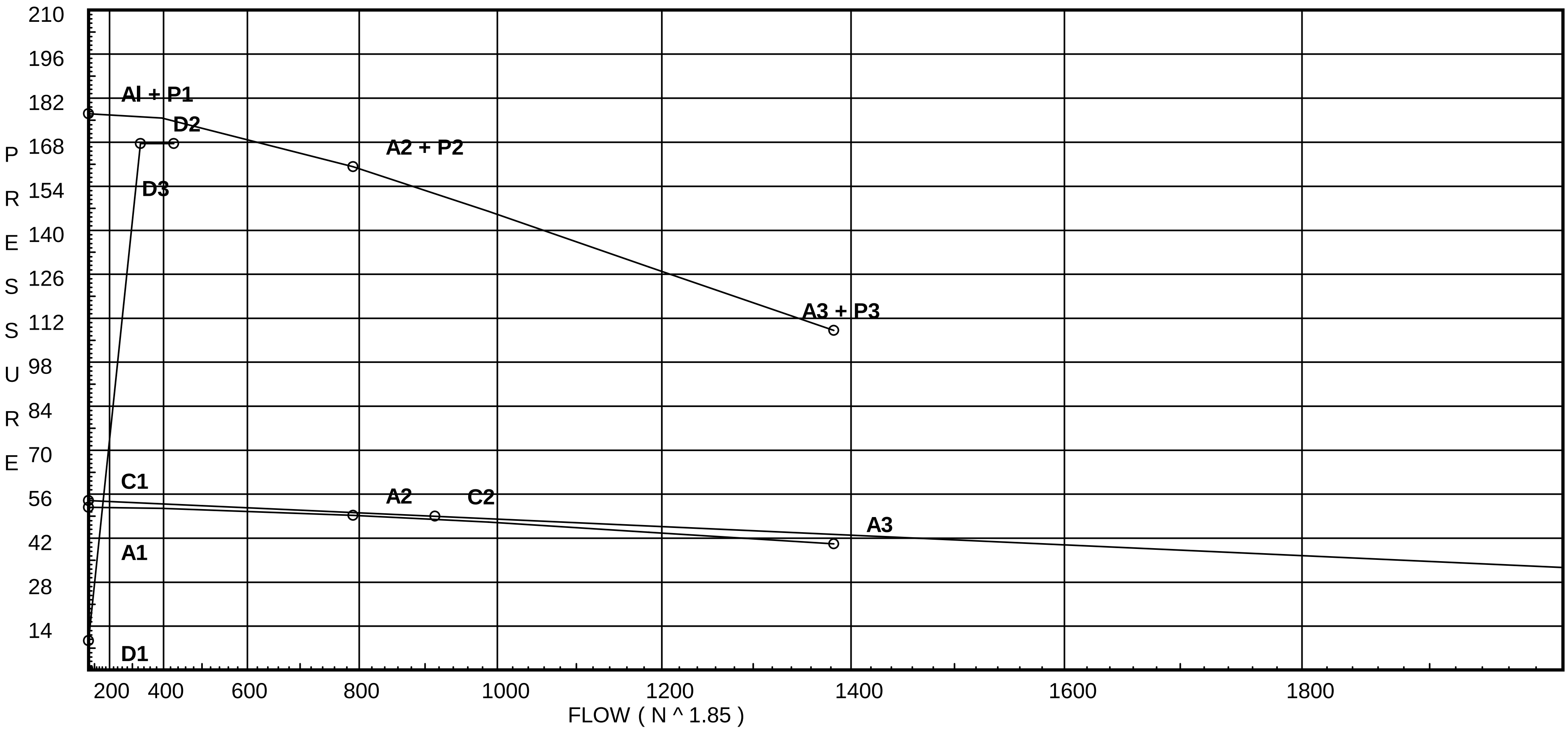
Date 9-25-11

City Water Supply:
C1 - Static Pressure : 54
C2 - Residual Pressure: 49
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
A1 - Adjusted Static: 51.872
A2 - Adj Resid : 49.314 @ 790.2
A3 - Adj Resid : 40.224 @ 1382.9

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 790.2
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 1382.9
City Residual Flow @ 0 = 3307.91
City Residual Flow @ 20 = 2576.03
City Water @ 150% of Pump = 43.24

Demand:
D1 - Elevation : 9.420
D2 - System Flow : 328.401
D2 - System Pressure : 167.582
Hose (Adj City) : ________
Hose (Demand) : 100
D3 - System Demand : 428.401
Safety Margin : 7.179



Fittings Used Summary

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
H	45' Ell Grvd-Vic #11	0	0	1	1.5	2	2	3	3	3.5	3.5	4.5	5	6.5	8.5	10	18	20	23	25	30
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
S121	34.75	5.6	7.0	na	14.82	0.1	117	7.0
S122	34.75	5.6	7.93	na	15.77	0.1	124	7.0
S123	34.75	5.6	11.11	na	18.67	0.1	124	7.0
S124	34.75	5.6	12.56	na	19.84	0.1	124	7.0
S125	28.833	5.6	10.5	na	18.15	0.1	143	7.0
S126	28.833	5.6	11.19	na	18.73	0.1	143	7.0
S127	28.833	5.6	14.14	na	21.06	0.1	143	7.0
S128	25.833	5.6	11.6	na	19.07	0.1	143	7.0
S129	25.833	5.6	12.13	na	19.5	0.1	143	7.0
S130	25.833	5.6	15.36	na	21.95	0.1	143	7.0
S131	22.833	5.6	13.67	na	20.71	0.1	143	7.0
S132	22.833	5.6	14.36	na	21.22	0.1	163	7.0
S133	22.833	5.6	18.06	na	23.8	0.1	163	7.0
S134	19.833	5.6	17.51	na	23.43	0.1	143	7.0
S135	19.833	5.6	19.32	na	24.61	0.1	114	7.0
S136	19.833	5.6	23.35	na	27.06	0.1	114	7.0
L121	36.917		6.37	na				
L122	36.917		7.59	na				
L123	36.917		11.0	na				
L124	36.917		12.54	na				
L125	36.0		8.4	na				
L126	36.0		10.01	na				
L127	36.0		13.44	na				
L128	34.5		9.12	na				
L129	34.5		10.59	na				
L130	34.5		14.36	na				
L131	33.0		11.38	na				
L132	33.0		12.71	na				
L133	33.0		17.08	na				
L134	31.5		16.04	na				
L135	31.5		17.74	na				
L136	31.5		22.43	na				
M121	36.917		14.67	na				
M122	36.0		15.16	na				
M123	34.5		16.22	na				
M124	33.0		19.23	na				
M125	31.5		24.65	na				
M105	13.167		71.73	na				
TR01	13.167		86.12	na				
BR01	3.0		162.22	na				
SPC1	12.667		162.45	na	100.0			
SPC2	12.667		162.73	na				
PO	1.833		167.58	na				
PI	1.75		51.42	na				
POC	6.75		49.38	na				
BF1	13.0		46.8	na				
BF2	13.0		52.57	na				
SRC	13.0		52.77	na				

The maximum velocity is 19.32 and it occurs in the pipe between nodes M125 and M105

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*FLOWING SPRINKLER R/A # 2										
S121	34.750	5.60	14.82	1	1E	2.0	2.167	120	7.000	
to						0.0	2.000		-0.939	
L121	36.917		14.82	1.049		0.0	4.167	0.0749	0.312	Vel = 5.50
			0.0							
L121			14.82						6.373	K Factor = 5.87
S122	34.750	5.60	15.77	1	1T	5.0	2.167	120	7.930	
to						0.0	5.000		-0.939	
L122	36.917		15.77	1.049		0.0	7.167	0.0840	0.602	Vel = 5.85
			0.0							
L122			15.77						7.593	K Factor = 5.72
S123	34.750	5.60	18.67	1	1T	5.0	2.167	120	11.113	
to						0.0	5.000		-0.939	
L123	36.917		18.67	1.049		0.0	7.167	0.1147	0.822	Vel = 6.93
			0.0							
L123			18.67						10.996	K Factor = 5.63
S124	34.750	5.60	19.84	1	1T	5.0	2.167	120	12.555	
to						0.0	5.000		-0.939	
L124	36.917		19.84	1.049		0.0	7.167	0.1284	0.920	Vel = 7.37
			0.0							
L124			19.84						12.536	K Factor = 5.60
S125	28.833	5.60	18.15	1	1E	2.0	7.167	120	10.504	
to						0.0	2.000		-3.104	
L125	36		18.15	1.049		0.0	9.167	0.1088	0.997	Vel = 6.74
			0.0							
L125			18.15						8.397	K Factor = 6.26
S126	28.833	5.60	18.73	1	1E	2.0	9.667	120	11.192	
to					1T	5.0	7.000		-3.104	
L126	36		18.73	1.049		0.0	16.667	0.1153	1.921	Vel = 6.95
			0.0							
L126			18.73						10.009	K Factor = 5.92
S127	28.833	5.60	21.06	1	1E	2.0	9.750	120	14.144	
to					1T	5.0	7.000		-3.104	
L127	36		21.06	1.049		0.0	16.750	0.1432	2.399	Vel = 7.82
			0.0							
L127			21.06						13.439	K Factor = 5.74
S128	25.833	5.60	19.07	1	1E	2.0	8.667	120	11.601	
to						0.0	2.000		-3.754	
L128	34.500		19.07	1.049		0.0	10.667	0.1192	1.271	Vel = 7.08
			0.0							
L128			19.07						9.118	K Factor = 6.32
S129	25.833	5.60	19.50	1	1E	2.0	10.833	120	12.127	
to					1T	5.0	7.000		-3.754	
L129	34.500		19.5	1.049		0.0	17.833	0.1242	2.215	Vel = 7.24
			0.0							
L129			19.50						10.588	K Factor = 5.99
S130	25.833	5.60	21.95	1	1E	2.0	10.833	120	15.361	
to					1T	5.0	7.000		-3.754	
L130	34.500		21.95	1.049		0.0	17.833	0.1546	2.757	Vel = 8.15

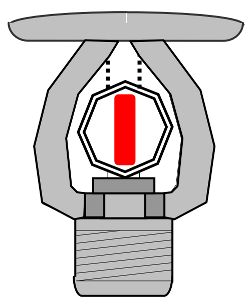
Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
L130			21.95						14.364	K Factor = 5.79
S131	22.833	5.60	20.71	1	1T	5.0	10.167	120	13.674	
to						0.0	5.000		-4.403	
L131	33		20.71	1.049		0.0	15.167	0.1388	2.105	Vel = 7.69
			0.0							
L131			20.71						11.376	K Factor = 6.14
S132	22.833	5.60	21.22	1	1E	2.0	11.917	120	14.362	
to					1T	5.0	7.000		-4.403	
L132	33		21.22	1.049		0.0	18.917	0.1452	2.747	Vel = 7.88
			0.0							
L132			21.22						12.706	K Factor = 5.95
S133	22.833	5.60	23.80	1	1E	2.0	12.083	120	18.057	
to					1T	5.0	7.000		-4.403	
L133	33		23.8	1.049		0.0	19.083	0.1794	3.424	Vel = 8.84
			0.0							
L133			23.80						17.078	K Factor = 5.76
S134	19.833	5.60	23.44	1	1E	2.0	13.500	120	17.512	
to					1T	5.0	7.000		-5.053	
L134	31.500		23.44	1.049		0.0	20.500	0.1745	3.577	Vel = 8.70
			0.0							
L134			23.44						16.036	K Factor = 5.85
S135	19.833	5.60	24.61	1	1T	5.0	13.167	120	19.319	
to						0.0	5.000		-5.053	
L135	31.500		24.61	1.049		0.0	18.167	0.1911	3.471	Vel = 9.14
			0.0							
L135			24.61						17.737	K Factor = 5.84
S136	19.833	5.60	27.06	1	1T	5.0	13.167	120	23.350	
to						0.0	5.000		-5.053	
L136	31.500		27.06	1.049		0.0	18.167	0.2276	4.135	Vel = 10.05
			0.0							
L136			27.06						22.432	K Factor = 5.71
*BRANCH LINES R/A # 2										
L121	36.917		14.82	1	1E	2.0	14.333	120	6.373	
to						0.0	2.000		0.0	
L122	36.917		14.82	1.049		0.0	16.333	0.0747	1.220	Vel = 5.50
L122	36.917		15.77	1		0.0	11.917	120	7.593	
to						0.0	0.0		0.0	
L123	36.917		30.59	1.049		0.0	11.917	0.2856	3.403	Vel = 11.36
L123	36.917		18.67	1	1T	5.0	0.333	120	10.996	
to						0.0	5.000		0.0	
M121	36.917		49.26	1.049		0.0	5.333	0.6895	3.677	Vel = 18.29
			0.0							
M121			49.26						14.673	K Factor = 12.86
L124	36.917		19.84	1	1T	5.0	11.667	120	12.536	
to						0.0	5.000		0.0	
M121	36.917		19.84	1.049		0.0	16.667	0.1282	2.137	Vel = 7.37

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
M121			19.84						14.673	K Factor = 5.18
L125	36		18.15	1		0.0	14.833	120	8.397	
to						0.0	0.0		0.0	
L126	36		18.15	1.049		0.0	14.833	0.1087	1.612	Vel = 6.74
L126	36		18.73	1	1T	5.0	7.750	120	10.009	
to						0.0	5.000		0.0	
M122	36		36.88	1.049		0.0	12.750	0.4038	5.148	Vel = 13.69
			0.0							
M122			36.88						15.157	K Factor = 9.47
L127	36		21.06	1	1T	5.0	7.000	120	13.439	
to						0.0	5.000		0.0	
M122	36		21.06	1.049		0.0	12.000	0.1432	1.718	Vel = 7.82
			0.0							
M122			21.06						15.157	K Factor = 5.41
L128	34.500		19.07	1		0.0	12.333	120	9.118	
to						0.0	0.0		0.0	
L129	34.500		19.07	1.049		0.0	12.333	0.1192	1.470	Vel = 7.08
L129	34.500		19.51	1	1T	5.0	7.833	120	10.588	
to						0.0	5.000		0.0	
M123	34.500		38.58	1.049		0.0	12.833	0.4387	5.630	Vel = 14.32
			0.0							
M123			38.58						16.218	K Factor = 9.58
L130	34.500		21.95	1	1T	5.0	7.000	120	14.364	
to						0.0	5.000		0.0	
M123	34.500		21.95	1.049		0.0	12.000	0.1545	1.854	Vel = 8.15
			0.0							
M123			21.95						16.218	K Factor = 5.45
L131	33		20.71	1		0.0	9.583	120	11.376	
to						0.0	0.0		0.0	
L132	33		20.71	1.049		0.0	9.583	0.1388	1.330	Vel = 7.69
L132	33		21.22	1	1T	5.0	7.750	120	12.706	
to						0.0	5.000		0.0	
M124	33		41.93	1.049		0.0	12.750	0.5118	6.526	Vel = 15.57
			0.0							
M124			41.93						19.232	K Factor = 9.56
L133	33		23.80	1	1T	5.0	7.000	120	17.078	
to						0.0	5.000		0.0	
M124	33		23.8	1.049		0.0	12.000	0.1795	2.154	Vel = 8.84
			0.0							
M124			23.80						19.232	K Factor = 5.43
L134	31.500		23.44	1		0.0	9.750	120	16.036	
to						0.0	0.0		0.0	
L135	31.500		23.44	1.049		0.0	9.750	0.1745	1.701	Vel = 8.70
L135	31.500		24.61	1	1T	5.0	5.500	120	17.737	
to						0.0	5.000		0.0	
M125	31.500		48.05	1.049		0.0	10.500	0.6586	6.915	Vel = 17.84

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
M125			48.05						24.652	K Factor = 9.68
L136	31.500		27.06	1	1T	5.0	4.750	120	22.432	
to						0.0	5.000		0.0	
M125	31.500		27.06	1.049		0.0	9.750	0.2277	2.220	Vel = 10.05
			0.0							
M125			27.06						24.652	K Factor = 5.45
*FEED MAIN										
M121	36.917		69.10	2.5		0.0	6.000	120	14.673	
to						0.0	0.0		0.397	
M122	36		69.1	2.635		0.0	6.000	0.0145	0.087	Vel = 4.07
M122	36		57.94	2.5		0.0	9.167	120	15.157	
to						0.0	0.0		0.650	
M123	34.500		127.04	2.635		0.0	9.167	0.0448	0.411	Vel = 7.47
M123	34.500		60.52	2.5	1T	16.474	9.167	120	16.218	
to						0.0	16.474		0.650	
M124	33		187.56	2.635		0.0	25.641	0.0922	2.364	Vel = 11.03
M124	33		65.73	2.5	1H	4.119	9.083	120	19.232	
to					1T	16.474	20.593		0.650	
M125	31.500		253.29	2.635		0.0	29.676	0.1607	4.770	Vel = 14.90
M125	31.500		75.11	2.5	2T	32.948	92.917	120	24.652	
to					3I	24.711	57.659		7.940	
M105	13.167		328.4	2.635		0.0	150.576	0.2599	39.134	Vel = 19.32
M105	13.167		0.0	3	4I	26.879	109.083	120	71.726	
to					1T	20.159	47.038		0.0	
TR01	13.167		328.4	3.26		0.0	156.121	0.0922	14.391	Vel = 12.62
TR01	13.167		0.0	3	1I	6.72	10.167	120	86.117	
to						0.0	6.720		74.543	* Fixed loss = 70.14
BR01	3		328.4	3.26		0.0	16.887	0.0922	1.557	Vel = 12.62
BR01	3		0.0	3	2I	13.44	14.333	120	162.217	
to					1T	20.159	33.599		-4.187	
SPC1	12.667		328.4	3.26		0.0	47.932	0.0922	4.419	Vel = 12.62
SPC1	12.667	H100	100.00	6	1T	30.0	7.917	120	162.449	
to						0.0	30.000		0.0	
SPC2	12.667		428.4	6.065		0.0	37.917	0.0073	0.278	Vel = 4.76
SPC2	12.667		0.0	8	1I	13.0	14.750	120	162.727	
to					1B	12.0	70.000		4.692	
PO	1.833		428.4	7.981	1C	45.0	84.750	0.0019	0.163	Vel = 2.75
			0.0							
PO			428.40						167.582	K Factor = 33.09
System Demand Pressure						167.582				
Safety Margin						7.179				
Continuation Pressure						174.761				
Pressure @ Pump Outlet						174.761				
Pressure From Pump Curve						-123.339				
Pressure @ Pump Inlet						51.422				
PI	1.750		0.0	8	1G	4.0	14.000	120	51.422	
to					1I	13.0	52.000		-2.166	
POC	6.750		428.4	7.981	1T	35.0	66.000	0.0019	0.127	Vel = 2.75

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
POC	6.750		0.0	8	2E	56.936	41.000	140	49.383	
to						0.0	56.936		-2.707	
BF1	13		428.4	8.27		0.0	97.936	0.0012	0.120	Vel = 2.56
BF1	13		0.0	8	1Zic	0.0	4.000	120	46.796	
to						0.0	0.0		5.766	* Fixed loss = 5.766
BF2	13		428.4	7.981		0.0	4.000	0.0018	0.007	Vel = 2.75
BF2	13		0.0	8	2E	56.936	46.000	140	52.569	
to					1G	6.326	118.616		0.0	
SRC	13		428.4	8.27	1T	55.354	164.616	0.0012	0.200	Vel = 2.56
			0.0							
SRC			428.40						52.769	K Factor = 58.97

3



Level 3 R/A # 1 & 2

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AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science LVL 3 [R/A=1]
Building	:	FP-6.03W
Location	:	San Luis Obispo, Ca.
System	:	3-1
Contract	:	10034
Data File	:	Cal Poly CFS LVL 3-1.WXF

HYDRAULIC CALCULATIONS
for

Project name: Cal Poly Center For Science
Location: San Luis Obispo, Ca.
Drawing no: FP-6.03W
Date: 9-25-2011

Design

Remote area number: 3-1
Remote area location: 3 rd. Floor Laboratory
Occupancy classification: Ordinary Hazard Gr. 1
Density: 0.15 - Gpm/SqFt
Area of application: 967 - SqFt
Coverage per sprinkler: 120 - SqFt
Type of sprinklers calculated: Tyco; Mod. TY-FRB; 1/2"; 1/2";K=5.6; 155 Deg
No. of sprinklers calculated: 12
In-rack demand: N/A - GPM
Hose streams: 250 - GPM
Total water required (including hose streams): 502.75 - GPM @ -0.88 - Psi
Type of system: WET
Volume of dry or preaction system: N/A - Gal

Water supply information

Date: 8-19-2011
Location: N. Poly View Drive
Source: Fluid Resource Management

Name of contractor: Aero Automatic Sprinkler Co.
Address: 21605 N. Central Ave. Phoenix, Az. 85024
Phone number: 623-580-7847
Name of designer: Neal Larsen
Authority having jurisdiction: C.S.F.M.
Notes: (Include peaking information or gridded systems here.) Flow Test Information :
Hydrant # 63; Static = 60 psi; Res.= 55 psi {Elev.=351.0'}
Hydrant # 64; Flow = 914 gpm
FLOW TEST USED IN HYD. CALCS REDUCED BY 10 % [STATIC=54psi; RES.=49psi]
NOTE : REMOTE AREA REDUCED BY 39.25% [Q.R HEADS & C.H.=10'-6"] 912 SQ.FT. MIN.

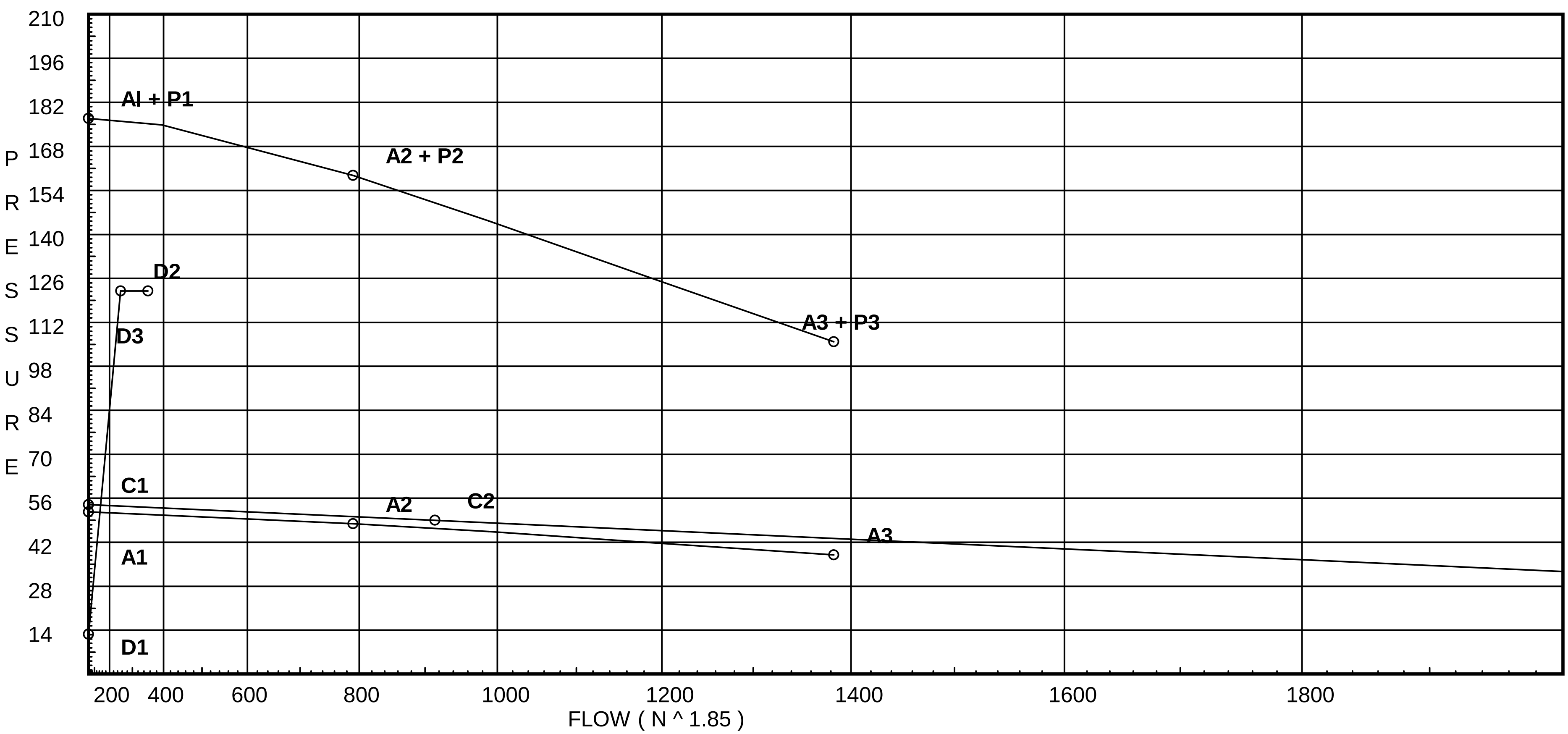
Water Supply Curve (C)

City Water Supply:
C1 - Static Pressure : 54
C2 - Residual Pressure: 49
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
A1 - Adjusted Static: 51.696
A2 - Adj Resid : 47.866 @ 790.2
A3 - Adj Resid : 37.967 @ 1382.9

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 790.2
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 1382.9
City Residual Flow @ 0 = 3307.91
City Residual Flow @ 20 = 2576.03
City Water @ 150% of Pump = 43.24

Demand:
D1 - Elevation : 12.776
D2 - System Flow : 252.757
D2 - System Pressure : 121.999
Hose (Adj City) : 150
Hose (Demand) : 100
D3 - System Demand : 352.757
Safety Margin : 53.231



Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 3 [R/A=1]

Date 9-25-11

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
S301	42.5	5.6	10.33	na	18.0	0.15	120	7.0
S302	42.5	5.6	11.14	na	18.7	0.15	120	7.0
S303	42.5	5.6	14.18	na	21.09	0.15	120	7.0
S304	42.5	5.6	21.23	na	25.81	0.15	120	7.0
S305	42.5	5.6	10.42	na	18.08	0.15	120	7.0
S306	42.5	5.6	11.24	na	18.78	0.15	120	7.0
S307	42.5	5.6	14.31	na	21.18	0.15	120	7.0
S308	42.5	5.6	21.42	na	25.92	0.15	120	7.0
S309	42.5	5.6	10.69	na	18.31	0.15	120	7.0
S310	42.5	5.6	11.53	na	19.01	0.15	120	7.0
S311	41.5	5.6	14.93	na	21.64	0.15	120	7.0
S312	42.5	5.6	21.98	na	26.25	0.15	120	7.0
L301	43.083		10.68	na				
L302	43.083		11.53	na				
L303	43.083		14.73	na				
L304	43.083		22.14	na				
L305	43.083		10.77	na				
L306	43.083		11.64	na				
L307	43.083		14.86	na				
L308	43.083		22.34	na				
L309	43.083		11.05	na				
L310	43.083		11.94	na				
L311	43.083		15.24	na				
L312	43.083		22.93	na				
MN30	44.0		28.7	na				
MN31	44.0		28.95	na				
MN32	44.0		29.74	na				
MN35	43.083		88.29	na				
TOR3	43.083		92.48	na				
BOR3	36.0		102.61	na				
HV1	99.75		76.68	na				
HV2	99.75		76.68	na				
SPRF	99.75		78.43	na				
SP16	85.0		84.82	na				
SP15	69.0		91.75	na				
SP14	53.0		98.68	na				
SP13	37.0		105.61	na				
HV3	101.0		75.51	na				
SPR3	101.0		77.26	na				
SP36	85.0		84.19	na				
SP35	69.0		91.12	na				
SP34	53.0		98.05	na	50.0			
SP33	37.0		104.98	na	50.0			
SP32	21.0		112.1	na				
SP05	29.167		108.57	na				
SP01	45.0		102.14	na				
SP02	27.917		109.54	na				
SP03	29.167		109.0	na				
SP04	28.083		109.81	na				
SPC1	12.667		117.0	na				
SPC2	12.667		117.19	na				
PO	1.833		122.0	na				
PI	1.75		50.88	na				
POC	6.75		48.8	na				
BF1	13.0		46.18	na				
BF2	13.0		52.21	na				
SRC	13.0		52.35	na	150.0			

The maximum velocity is 21.89 and it occurs in the pipe between nodes L311 and L312

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*FLOWING SPRINKLER R/A # 1										
S301	42.500	5.60	18.00	1	1T	5.0	0.583	120	10.332	
to						0.0	5.000		-0.252	
L301	43.083		18.0	1.049		0.0	5.583	0.1069	0.597	Vel = 6.68
			0.0							
L301			18.00						10.677	K Factor = 5.51
S302	42.500	5.60	18.70	1	1T	5.0	0.583	120	11.145	
to						0.0	5.000		-0.252	
L302	43.083		18.7	1.049		0.0	5.583	0.1148	0.641	Vel = 6.94
			0.0							
L302			18.70						11.534	K Factor = 5.51
S303	42.500	5.60	21.09	1	1T	5.0	0.583	120	14.184	
to						0.0	5.000		-0.252	
L303	43.083		21.09	1.049		0.0	5.583	0.1435	0.801	Vel = 7.83
			0.0							
L303			21.09						14.733	K Factor = 5.49
S304	42.500	5.60	25.80	1	1T	5.0	0.583	120	21.234	
to						0.0	5.000		-0.252	
L304	43.083		25.8	1.049		0.0	5.583	0.2083	1.163	Vel = 9.58
			0.0							
L304			25.80						22.145	K Factor = 5.48
S305	42.500	5.60	18.08	1	1T	5.0	0.583	120	10.424	
to						0.0	5.000		-0.252	
L305	43.083		18.08	1.049		0.0	5.583	0.1078	0.602	Vel = 6.71
			0.0							
L305			18.08						10.774	K Factor = 5.51
S306	42.500	5.60	18.78	1	1T	5.0	0.583	120	11.244	
to						0.0	5.000		-0.252	
L306	43.083		18.78	1.049		0.0	5.583	0.1157	0.646	Vel = 6.97
			0.0							
L306			18.78						11.638	K Factor = 5.50
S307	42.500	5.60	21.18	1	1T	5.0	0.583	120	14.309	
to						0.0	5.000		-0.252	
L307	43.083		21.18	1.049		0.0	5.583	0.1445	0.807	Vel = 7.86
			0.0							
L307			21.18						14.864	K Factor = 5.49
S308	42.500	5.60	25.92	1	1T	5.0	0.583	120	21.416	
to						0.0	5.000		-0.252	
L308	43.083		25.92	1.049		0.0	5.583	0.2101	1.173	Vel = 9.62
			0.0							
L308			25.92						22.337	K Factor = 5.48
S309	42.500	5.60	18.31	1	1T	5.0	0.583	120	10.686	
to						0.0	5.000		-0.252	
L309	43.083		18.31	1.049		0.0	5.583	0.1105	0.617	Vel = 6.80
			0.0							
L309			18.31						11.051	K Factor = 5.51
S310	42.500	5.60	19.01	1	1T	5.0	0.583	120	11.526	
to						0.0	5.000		-0.252	
L310	43.083		19.01	1.049		0.0	5.583	0.1184	0.661	Vel = 7.06

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
L310			19.01						11.935	K Factor = 5.50
S311	41.500	5.60	21.64	1	1T	5.0	1.583	120	14.930	
to						0.0	5.000		-0.686	
L311	43.083		21.64	1.049		0.0	6.583	0.1507	0.992	Vel = 8.03
			0.0							
L311			21.64						15.236	K Factor = 5.54
S312	42.500	5.60	26.25	1	1T	5.0	0.583	120	21.978	
to						0.0	5.000		-0.252	
L312	43.083		26.25	1.049		0.0	5.583	0.2153	1.202	Vel = 9.74
			0.0							
L312			26.25						22.928	K Factor = 5.48
*BRANCH LINES R/A # 1										
L301	43.083		18.00	1		0.0	8.000	120	10.677	
to						0.0	0.0		0.0	
L302	43.083		18.0	1.049		0.0	8.000	0.1071	0.857	Vel = 6.68
L302	43.083		18.70	1		0.0	8.000	120	11.534	
to						0.0	0.0		0.0	
L303	43.083		36.7	1.049		0.0	8.000	0.3999	3.199	Vel = 13.62
L303	43.083		21.09	1		0.0	8.000	120	14.733	
to						0.0	0.0		0.0	
L304	43.083		57.79	1.049		0.0	8.000	0.9265	7.412	Vel = 21.45
L304	43.083		25.80	1.25	1E	3.0	5.417	120	22.145	
to					1T	6.0	9.000		-0.397	
MN30	44		83.59	1.38		0.0	14.417	0.4824	6.955	Vel = 17.93
			0.0							
MN30			83.59						28.703	K Factor = 15.60
L305	43.083		18.08	1		0.0	8.000	120	10.774	
to						0.0	0.0		0.0	
L306	43.083		18.08	1.049		0.0	8.000	0.1080	0.864	Vel = 6.71
L306	43.083		18.78	1		0.0	8.000	120	11.638	
to						0.0	0.0		0.0	
L307	43.083		36.86	1.049		0.0	8.000	0.4032	3.226	Vel = 13.68
L307	43.083		21.18	1		0.0	8.000	120	14.864	
to						0.0	0.0		0.0	
L308	43.083		58.04	1.049		0.0	8.000	0.9341	7.473	Vel = 21.55
L308	43.083		25.92	1.25	1E	3.0	5.417	120	22.337	
to					1T	6.0	9.000		-0.397	
MN31	44		83.96	1.38		0.0	14.417	0.4863	7.011	Vel = 18.01
			0.0							
MN31			83.96						28.951	K Factor = 15.60
L309	43.083		18.31	1		0.0	8.000	120	11.051	
to						0.0	0.0		0.0	
L310	43.083		18.31	1.049		0.0	8.000	0.1105	0.884	Vel = 6.80
L310	43.083		19.01	1		0.0	8.000	120	11.935	
to						0.0	0.0		0.0	
L311	43.083		37.32	1.049		0.0	8.000	0.4126	3.301	Vel = 13.85

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
L311	43.083		21.64	1		0.0	8.000	120	15.236	
to						0.0	0.0		0.0	
L312	43.083		58.96	1.049		0.0	8.000	0.9615	7.692	Vel = 21.89
L312	43.083		26.25	1.25	1E	3.0	5.417	120	22.928	
to					1T	6.0	9.000		-0.397	
MN32	44		85.21	1.38		0.0	14.417	0.4998	7.206	Vel = 18.28
			0.0							
MN32			85.21						29.737	K Factor = 15.63
*FEED MAIN										
MN30	44		83.59	2.5		0.0	12.000	120	28.703	
to						0.0	0.0		0.0	
MN31	44		83.59	2.635		0.0	12.000	0.0207	0.248	Vel = 4.92
MN31	44		83.96	2.5		0.0	10.500	120	28.951	
to						0.0	0.0		0.0	
MN32	44		167.55	2.635		0.0	10.500	0.0749	0.786	Vel = 9.86
MN32	44		85.21	2.5	6I	49.423	280.833	120	29.737	
to					2T	32.948	82.371		0.397	
MN35	43.083		252.76	2.635		0.0	363.204	0.1601	58.157	Vel = 14.87
MN35	43.083		0.0	2.5	2I	16.474	9.667	120	88.291	
to						0.0	16.474		0.0	
TOR3	43.083		252.76	2.635		0.0	26.141	0.1601	4.186	Vel = 14.87
TOR3	43.083		0.0	2.5	1C	19.22	7.083	120	92.477	
to					1B	9.61	37.067		3.068	
BOR3	36		252.76	2.635	1I	8.237	44.150	0.1601	7.069	Vel = 14.87
BOR3	36		0.0	2.5	1T	16.474	1.000	120	102.614	
to						0.0	16.474		-0.433	
SP33	37		252.76	2.635		0.0	17.474	0.1601	2.798	Vel = 14.87
			0.0							
SP33			252.76						104.979	K Factor = 24.67
*S/P # 1										
HV1	99.750	.0	0.0	2.5	1T	12.0	0.250	120	76.680	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
			0.0							
SPRF			0.0						78.430	K Factor = 0
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	76.680	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750	.0	0.0	6	4I	40.0	30.000	120	78.430	
to						0.0	40.000		6.388	
SP16	85		0.0	6.065		0.0	70.000	0	0.0	Vel = 0
SP16	85	.0	0.0	6		0.0	16.000	120	84.818	
to						0.0	0.0		6.930	
SP15	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP15	69	.0	0.0	6		0.0	16.000	120	91.747	
to						0.0	0.0		6.930	
SP14	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SP14	53	.0	0.0	6	1T	30.0	8.500	120	98.677	
to						0.0	30.000		3.465	
SP01	45		0.0	6.065		0.0	38.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						102.142	K Factor = 0
SP13	37	.0	0.0	6	1T	30.0	7.500	120	105.607	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						102.142	K Factor = 0
*S/P # 3										
HV3	101	.0	0.0	2.5	2E	12.0	1.750	120	75.508	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	101		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SPR3	101	.0	0.0	6		0.0	16.000	120	77.258	
to						0.0	0.0		6.930	
SP36	85		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP36	85	.0	0.0	6		0.0	16.000	120	84.188	
to						0.0	0.0		6.930	
SP35	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP35	69	.0	0.0	6		0.0	16.000	120	91.118	
to						0.0	0.0		6.930	
SP34	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP34	53	H50	50.00	6		0.0	16.000	120	98.047	
to						0.0	0.0		6.930	
SP33	37		50.0	6.065		0.0	16.000	0.0001	0.002	Vel = 0.56
SP33	37	H50	302.76	6	1T	30.0	8.417	120	104.979	
to						0.0	30.000		3.392	
SP05	29.167		352.76	6.065		0.0	38.417	0.0051	0.197	Vel = 3.92
			0.0							
SP05			352.76						108.568	K Factor = 33.86
SP32	21	.0	0.0	6	1T	30.0	7.583	120	112.105	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167		352.76	6	1I	10.0	34.167	120	108.568	
to					1B	10.0	50.000		0.0	
SP03	29.167		352.76	6.065	1T	30.0	84.167	0.0051	0.431	Vel = 3.92
			0.0							
SP03			352.76						108.999	K Factor = 33.79
*STANDPIPE FEED										
SP01	45	.0	0.0	6	1B	10.0	34.417	120	102.142	
to					6I	60.0	70.000		7.399	
SP02	27.917		0.0	6.065		0.0	104.417	0	0.0	Vel = 0
SP02	27.917	.0	0.0	6	2I	20.0	235.417	120	109.540	
to						0.0	20.000		-0.541	
SP03	29.167		0.0	6.065		0.0	255.417	0	0.0	Vel = 0
SP03	29.167		352.76	6	4I	40.0	27.500	120	108.999	
to						0.0	40.000		0.469	
SP04	28.083		352.76	6.065		0.0	67.500	0.0051	0.346	Vel = 3.92

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SP04	28.083		0.0	6	2I	20.0	79.330	120	109.814	
to						0.0	20.000		6.677	
SPC1	12.667		352.76	6.065		0.0	99.330	0.0051	0.508	Vel = 3.92
SPC1	12.667		0.0	6	1T	30.0	7.833	120	116.999	
to						0.0	30.000		0.0	
SPC2	12.667		352.76	6.065		0.0	37.833	0.0051	0.194	Vel = 3.92
SPC2	12.667		0.0	8	1I	13.0	14.750	120	117.193	
to					1B	12.0	70.000		4.692	
PO	1.833		352.76	7.981	1C	45.0	84.750	0.0013	0.114	Vel = 2.26
			0.0							
PO			352.76						121.999	K Factor = 31.94
System Demand Pressure						121.999				
Safety Margin						53.231				
Continuation Pressure						175.230				
Pressure @ Pump Outlet						175.230				
Pressure From Pump Curve						-124.353				
Pressure @ Pump Inlet						50.877				
PI	1.750		0.0	8	1G	4.0	14.000	120	50.877	
to					1I	13.0	52.000		-2.166	
POC	6.750		352.76	7.981	1T	35.0	66.000	0.0013	0.089	Vel = 2.26
POC	6.750		0.0	8	2E	56.936	41.000	140	48.800	
to						0.0	56.936		-2.707	
BF1	13		352.76	8.27		0.0	97.936	0.0008	0.083	Vel = 2.11
BF1	13		0.0	8	1Zic	0.0	4.000	120	46.176	
to						0.0	0.0		6.024	* Fixed loss = 6.024
BF2	13		352.76	7.981		0.0	4.000	0.0015	0.006	Vel = 2.26
BF2	13		0.0	8	2E	56.936	46.000	140	52.206	
to					1G	6.326	118.616		0.0	
SRC	13		352.76	8.27	1T	55.354	164.616	0.0009	0.140	Vel = 2.11
			150.00							Qa = 150.00
SRC			502.76						52.346	K Factor = 69.49

AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name : Cal Poly Center for Science LVL 3 [R/A=2]
Building : FP-6.03E
Location : San Luis Obispo, Ca.
System : 3-2
Contract : 10034
Data File : Cal Poly CFS LVL 3-2.WXF

HYDRAULIC CALCULATIONS
for

Project name: Cal Poly Center For Science
Location: San Luis Obispo, Ca.
Drawing no: FP-6.03E
Date: 9-25-2011

Design

Remote area number: 3-2
Remote area location: 3 rd. Floor Laboratory
Occupancy classification: Oridinary Hazard Gr. 1
Density: 0.15 - Gpm/SqFt
Area of application: 1135 - SqFt
Coverage per sprinkler: 130 - SqFt
Type of sprinklers calculated: Tyco; Mod. TY-FRB; 1/2"; 1/2";K=5.6; 155 Deg
No. of sprinklers calculated: 10
In-rack demand: N/A - GPM
Hose streams: 250 - GPM
Total water required (including hose streams): 483.54 - GPM @ 3.22 - Psi
Type of system: WET
Volume of dry or preaction system: N/A - Gal

Water supply information

Date: 8-19-2011
Location: N. Poly View Drive
Source: Fluid Resource Management

Name of contractor: Aero Automatic Sprinkler Co.
Address: 21605 N. Central Ave. Phoenix, Az. 85024
Phone number: 623-580-7847
Name of designer: Neal Larsen
Authority having jurisdiction: C.S.F.M.
Notes: (Include peaking information or gridded systems here.) Flow Test Information :
Hydrant # 63; Static = 60 psi; Res.= 55 psi {Elev.=351.0'}
Hydrant # 64; Flow = 914 gpm
FLOW TEST USED IN HYD. CALCS REDUCED BY 10 % [STATIC=54psi; RES.=49psi]

Water Supply Curve (C)

Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 3 [R/A=2]

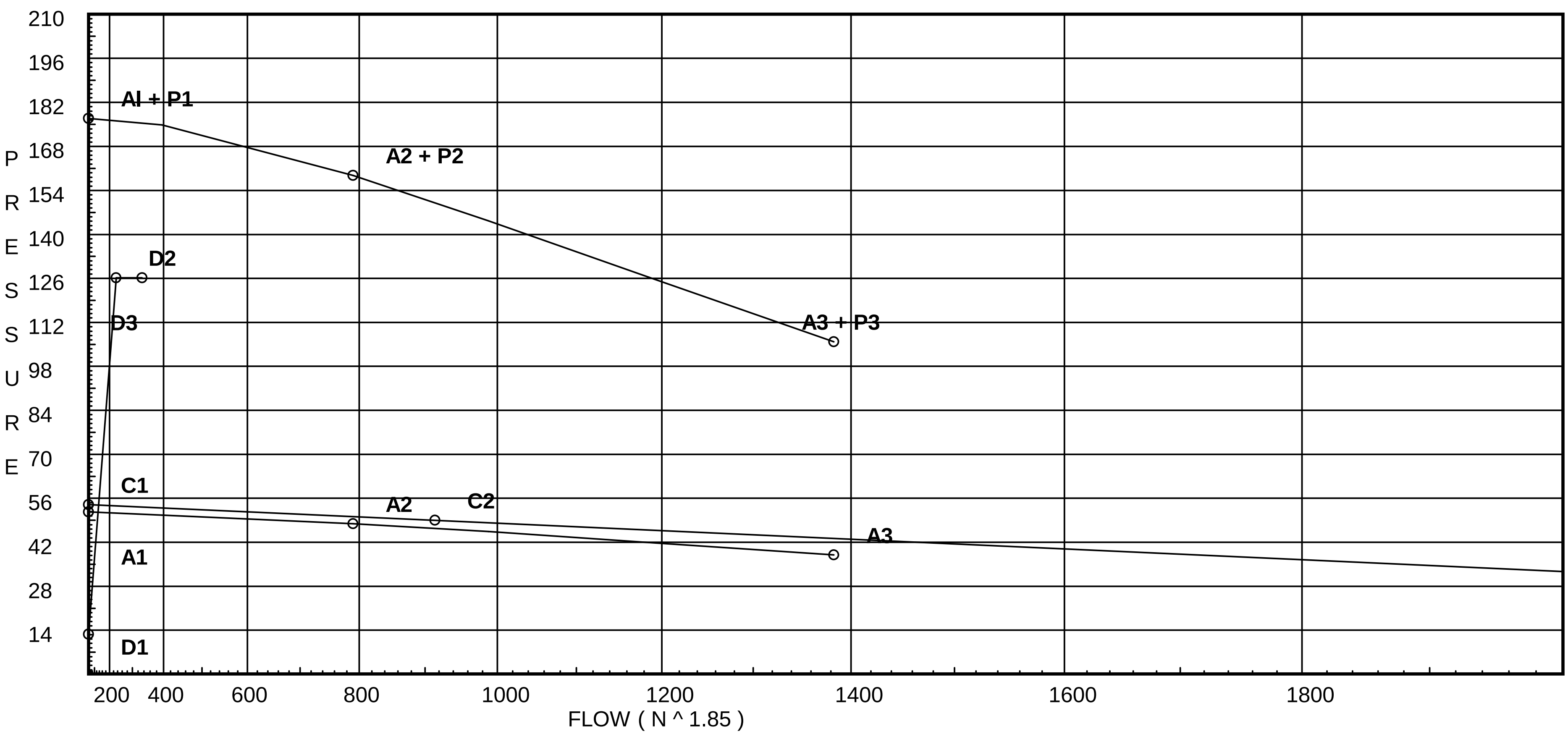
Page 2
Date 9-25-11

City Water Supply:
C1 - Static Pressure : 54
C2 - Residual Pressure: 49
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
A1 - Adjusted Static: 51.696
A2 - Adj Resid : 47.866 @ 790.2
A3 - Adj Resid : 37.967 @ 1382.9

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 790.2
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 1382.9
City Residual Flow @ 0 = 3307.91
City Residual Flow @ 20 = 2576.03
City Water @ 150% of Pump = 43.24

Demand:
D1 - Elevation : 12.776
D2 - System Flow : 233.543
D2 - System Pressure : 126.159
Hose (Adj City) : 150
Hose (Demand) : 100
D3 - System Demand : 333.543
Safety Margin : 49.232



Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
S321	42.5	5.6	10.33	na	18.0	0.15	120	7.0
S322	42.5	5.6	11.35	na	18.86	0.15	120	7.0
S323	42.5	5.6	15.18	na	21.82	0.15	120	7.0
S324	42.5	5.6	24.25	na	27.58	0.15	120	7.0
S325	42.5	5.6	29.12	na	30.22	0.15	120	7.0
S326	42.5	5.6	10.44	na	18.09	0.15	120	7.0
S327	42.5	5.6	11.46	na	18.96	0.15	120	7.0
S328	42.5	5.6	15.33	na	21.93	0.15	120	7.0
S329	42.5	5.6	24.49	na	27.71	0.15	120	7.0
S330	42.5	5.6	29.41	na	30.37	0.15	120	7.0
L321	43.083		10.68	na				
L322	43.083		11.75	na				
L323	43.083		15.78	na				
L324	43.083		25.32	na				
L325	43.083		30.43	na				
L326	43.083		10.79	na				
L327	43.083		11.87	na				
L328	43.083		15.94	na				
L329	43.083		25.56	na				
L330	43.083		30.73	na				
MN40	44.0		47.34	na				
MN41	44.0		47.8	na				
MN35	43.083		94.54	na				
TOR3	43.083		98.16	na				
BOR3	36.0		107.33	na				
HV1	99.75		80.95	na				
HV2	99.75		80.95	na				
SPRF	99.75		82.7	na				
SP16	85.0		89.09	na				
SP15	69.0		96.02	na				
SP14	53.0		102.95	na				
SP13	37.0		109.88	na				
HV3	101.0		79.84	na				
SPR3	101.0		81.59	na				
SP36	85.0		88.52	na				
SP35	69.0		95.45	na				
SP34	53.0		102.38	na	50.0			
SP33	37.0		109.32	na	50.0			
SP32	21.0		116.42	na				
SP05	29.167		112.88	na				
SP01	45.0		106.42	na				
SP02	27.917		113.81	na				
SP03	29.167		113.27	na				
SP04	28.083		114.05	na				
SPC1	12.667		121.19	na				
SPC2	12.667		121.36	na				
PO	1.833		126.16	na				
PI	1.75		50.96	na				
POC	6.75		48.87	na				
BF1	13.0		46.24	na				
BF2	13.0		52.33	na				
SRC	13.0		52.46	na	150.0			

The maximum velocity is 25.11 and it occurs in the pipe between nodes L330 and MN41

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*FLOWING SPRINKLER R/A # 2										
S321	42.500	5.60	18.00	1	1T	5.0	0.583	120	10.332	
to						0.0	5.000		-0.252	
L321	43.083		18.0	1.049		0.0	5.583	0.1069	0.597	Vel = 6.68
			0.0							
L321			18.00						10.677	K Factor = 5.51
S322	42.500	5.60	18.86	1	1T	5.0	0.583	120	11.348	
to						0.0	5.000		-0.252	
L322	43.083		18.86	1.049		0.0	5.583	0.1168	0.652	Vel = 7.00
			0.0							
L322			18.86						11.748	K Factor = 5.50
S323	42.500	5.60	21.82	1	1T	5.0	0.583	120	15.181	
to						0.0	5.000		-0.252	
L323	43.083		21.82	1.049		0.0	5.583	0.1528	0.853	Vel = 8.10
			0.0							
L323			21.82						15.782	K Factor = 5.49
S324	42.500	5.60	27.58	1	1T	5.0	0.583	120	24.251	
to						0.0	5.000		-0.252	
L324	43.083		27.58	1.049		0.0	5.583	0.2357	1.316	Vel = 10.24
			0.0							
L324			27.58						25.315	K Factor = 5.48
S325	42.500	5.60	30.22	1	1T	5.0	0.583	120	29.121	
to						0.0	5.000		-0.252	
L325	43.083		30.22	1.049		0.0	5.583	0.2792	1.559	Vel = 11.22
			0.0							
L325			30.22						30.428	K Factor = 5.48
S326	42.500	5.60	18.09	1	1T	5.0	0.583	120	10.438	
to						0.0	5.000		-0.252	
L326	43.083		18.09	1.049		0.0	5.583	0.1080	0.603	Vel = 6.72
			0.0							
L326			18.09						10.789	K Factor = 5.51
S327	42.500	5.60	18.96	1	1T	5.0	0.583	120	11.464	
to						0.0	5.000		-0.252	
L327	43.083		18.96	1.049		0.0	5.583	0.1179	0.658	Vel = 7.04
			0.0							
L327			18.96						11.870	K Factor = 5.50
S328	42.500	5.60	21.93	1	1T	5.0	0.583	120	15.333	
to						0.0	5.000		-0.252	
L328	43.083		21.93	1.049		0.0	5.583	0.1542	0.861	Vel = 8.14
			0.0							
L328			21.93						15.942	K Factor = 5.49
S329	42.500	5.60	27.71	1	1T	5.0	0.583	120	24.490	
to						0.0	5.000		-0.252	
L329	43.083		27.71	1.049		0.0	5.583	0.2377	1.327	Vel = 10.29
			0.0							
L329			27.71						25.565	K Factor = 5.48
S330	42.500	5.60	30.37	1	1T	5.0	0.583	120	29.406	
to						0.0	5.000		-0.252	
L330	43.083		30.37	1.049		0.0	5.583	0.2816	1.572	Vel = 11.27

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
L330			30.37						30.726	K Factor = 5.48
*BRANCH LINES R/A # 2										
L321	43.083		18.00	1		0.0	10.000	120	10.677	
to						0.0	0.0		0.0	
L322	43.083		18.0	1.049		0.0	10.000	0.1071	1.071	Vel = 6.68
L322	43.083		18.86	1		0.0	10.000	120	11.748	
to						0.0	0.0		0.0	
L323	43.083		36.86	1.049		0.0	10.000	0.4034	4.034	Vel = 13.68
L323	43.083		21.82	1		0.0	10.000	120	15.782	
to						0.0	0.0		0.0	
L324	43.083		58.68	1.049		0.0	10.000	0.9533	9.533	Vel = 21.78
L324	43.083		27.58	1.25		0.0	10.000	120	25.315	
to						0.0	0.0		0.0	
L325	43.083		86.26	1.38		0.0	10.000	0.5113	5.113	Vel = 18.50
L325	43.083		30.22	1.25	1E	3.0	10.417	120	30.428	
to					1T	6.0	9.000		-0.397	
MN40	44		116.48	1.38		0.0	19.417	0.8913	17.306	Vel = 24.99
			0.0							
MN40			116.48						47.337	K Factor = 16.93
L326	43.083		18.09	1		0.0	10.000	120	10.789	
to						0.0	0.0		0.0	
L327	43.083		18.09	1.049		0.0	10.000	0.1081	1.081	Vel = 6.72
L327	43.083		18.96	1		0.0	10.000	120	11.870	
to						0.0	0.0		0.0	
L328	43.083		37.05	1.049		0.0	10.000	0.4072	4.072	Vel = 13.75
L328	43.083		21.93	1		0.0	10.000	120	15.942	
to						0.0	0.0		0.0	
L329	43.083		58.98	1.049		0.0	10.000	0.9623	9.623	Vel = 21.89
L329	43.083		27.72	1.25		0.0	10.000	120	25.565	
to						0.0	0.0		0.0	
L330	43.083		86.7	1.38		0.0	10.000	0.5161	5.161	Vel = 18.60
L330	43.083		30.36	1.25	1E	3.0	10.417	120	30.726	
to					1T	6.0	9.000		-0.397	
MN41	44		117.06	1.38		0.0	19.417	0.8995	17.466	Vel = 25.11
			0.0							
MN41			117.06						47.795	K Factor = 16.93
*FEED MAIN										
MN40	44		116.48	2.5		0.0	12.000	120	47.337	
to						0.0	0.0		0.0	
MN41	44		116.48	2.635		0.0	12.000	0.0382	0.458	Vel = 6.85
MN41	44		117.06	2.5	4I	32.948	252.667	120	47.795	
to					3T	49.423	82.371		0.397	
MN35	43.083		233.54	2.635		0.0	335.038	0.1383	46.348	Vel = 13.74
MN35	43.083		0.0	2.5	2I	16.474	9.667	120	94.540	
to						0.0	16.474		0.0	
TOR3	43.083		233.54	2.635		0.0	26.141	0.1383	3.616	Vel = 13.74

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
TOR3	43.083		0.0	2.5	1C	19.22	7.083	120	98.156	
to					1B	9.61	37.067		3.068	
BOR3	36		233.54	2.635	1I	8.237	44.150	0.1383	6.107	Vel = 13.74
BOR3	36		0.0	2.5	1T	16.474	1.000	120	107.331	
to						0.0	16.474		-0.433	
SP33	37		233.54	2.635		0.0	17.474	0.1383	2.417	Vel = 13.74
			0.0							
SP33			233.54						109.315	K Factor = 22.34
*S/P # 1										
HV1	99.750	.0	0.0	2.5	1T	12.0	0.250	120	80.954	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
			0.0							
SPRF			0.0						82.704	K Factor = 0
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	80.954	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750	.0	0.0	6	4I	40.0	30.000	120	82.704	
to						0.0	40.000		6.388	
SP16	85		0.0	6.065		0.0	70.000	0	0.0	Vel = 0
SP16	85	.0	0.0	6		0.0	16.000	120	89.092	
to						0.0	0.0		6.930	
SP15	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP15	69	.0	0.0	6		0.0	16.000	120	96.021	
to						0.0	0.0		6.930	
SP14	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP14	53	.0	0.0	6	1T	30.0	8.500	120	102.951	
to						0.0	30.000		3.465	
SP01	45		0.0	6.065		0.0	38.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						106.416	K Factor = 0
SP13	37	.0	0.0	6	1T	30.0	7.500	120	109.881	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						106.416	K Factor = 0
*S/P # 3										
HV3	101	.0	0.0	2.5	2E	12.0	1.750	120	79.844	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	101		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SPR3	101	.0	0.0	6		0.0	16.000	120	81.594	
to						0.0	0.0		6.930	
SP36	85		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP36	85	.0	0.0	6		0.0	16.000	120	88.524	
to						0.0	0.0		6.930	
SP35	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP35	69	.0	0.0	6		0.0	16.000	120	95.454	
to						0.0	0.0		6.930	
SP34	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0

Final Calculations - Hazen-Williams - 2007

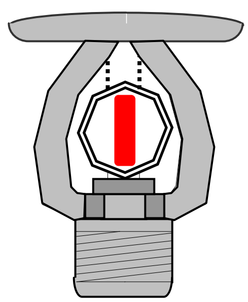
Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 3 [R/A=2]

Page 8
Date 9-25-11

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SP34	53	H50	50.00	6		0.0	16.000	120	102.383	
to						0.0	0.0		6.930	
SP33	37		50.0	6.065		0.0	16.000	0.0001	0.002	Vel = 0.56
SP33	37	H50	283.54	6	1T	30.0	8.417	120	109.315	
to						0.0	30.000		3.392	
SP05	29.167		333.54	6.065		0.0	38.417	0.0046	0.178	Vel = 3.70
			0.0							
SP05			333.54						112.885	K Factor = 31.39
SP32	21	.0	0.0	6	1T	30.0	7.583	120	116.422	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167		333.54	6	1I	10.0	34.167	120	112.885	
to					1B	10.0	50.000		0.0	
SP03	29.167		333.54	6.065	1T	30.0	84.167	0.0046	0.388	Vel = 3.70
			0.0							
SP03			333.54						113.273	K Factor = 31.34
*STANDPIPE FEED										
SP01	45	.0	0.0	6	1B	10.0	34.417	120	106.416	
to					6I	60.0	70.000		7.399	
SP02	27.917		0.0	6.065		0.0	104.417	0	0.0	Vel = 0
SP02	27.917	.0	0.0	6	2I	20.0	235.417	120	113.814	
to						0.0	20.000		-0.541	
SP03	29.167		0.0	6.065		0.0	255.417	0	0.0	Vel = 0
SP03	29.167		333.54	6	4I	40.0	27.500	120	113.273	
to						0.0	40.000		0.469	
SP04	28.083		333.54	6.065		0.0	67.500	0.0046	0.312	Vel = 3.70
SP04	28.083		0.0	6	2I	20.0	79.330	120	114.054	
to						0.0	20.000		6.677	
SPC1	12.667		333.54	6.065		0.0	99.330	0.0046	0.458	Vel = 3.70
SPC1	12.667		0.0	6	1T	30.0	7.833	120	121.189	
to						0.0	30.000		0.0	
SPC2	12.667		333.54	6.065		0.0	37.833	0.0046	0.175	Vel = 3.70
SPC2	12.667		0.0	8	1I	13.0	14.750	120	121.364	
to					1B	12.0	70.000		4.692	
PO	1.833		333.54	7.981	1C	45.0	84.750	0.0012	0.103	Vel = 2.14
			0.0							
PO			333.54						126.159	K Factor = 29.70
System Demand Pressure						126.159				
Safety Margin						49.232				
Continuation Pressure						175.391				
Pressure @ Pump Outlet						175.391				
Pressure From Pump Curve						-124.434				
Pressure @ Pump Inlet						50.957				
PI	1.750		0.0	8	1G	4.0	14.000	120	50.957	
to					1I	13.0	52.000		-2.166	
POC	6.750		333.54	7.981	1T	35.0	66.000	0.0012	0.081	Vel = 2.14
POC	6.750		0.0	8	2E	56.936	41.000	140	48.872	
to						0.0	56.936		-2.707	
BF1	13		333.54	8.27		0.0	97.936	0.0008	0.075	Vel = 1.99

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
BF1	13		0.0	8	1Zic	0.0	4.000	120	46.240	
to						0.0	0.0		6.090	* Fixed loss = 6.09
BF2	13		333.54	7.981		0.0	4.000	0.0012	0.005	Vel = 2.14
BF2	13		0.0	8	2E	56.936	46.000	140	52.335	
to					1G	6.326	118.616		0.0	
SRC	13		333.54	8.27	1T	55.354	164.616	0.0008	0.126	Vel = 1.99
			150.00							Qa = 150.00
SRC			483.54						52.461	K Factor = 66.76

4



LEVEL 6 R/A # 1,2,3 &4

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AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science LVL 6 [R/A=1]
Building	:	FP-6.06E
Location	:	San Luis Obispo, Ca.
System	:	6-1
Contract	:	10034
Data File	:	Cal Poly CFS LVL 6-1.WXF

HYDRAULIC CALCULATIONS
for

Project name: Cal Poly Center For Science
Location: San Luis Obispo, Ca.
Drawing no: FP-6.06E
Date: 9-25-2011

Design

Remote area number: 6-1
Remote area location: 6 th. Floor Laboratory
Occupancy classification: Ordinary Hazard Gr. 1
Density: 0.15 - Gpm/SqFt
Area of application: 940 - SqFt
Coverage per sprinkler: 130 - SqFt
Type of sprinklers calculated: Tyco; Mod. TY-FRB; 1/2"; 1/2";K=5.6; 155 Deg
No. of sprinklers calculated: 10
In-rack demand: N/A - GPM
Hose streams: 250 - GPM
Total water required (including hose streams): 483.15 - GPM @ 12.35 - Psi
Type of system: WET
Volume of dry or preaction system: N/A - Gal

Water supply information

Date: 8-19-2011
Location: N. Poly View Drive
Source: Fluid Resource Management

Name of contractor: Aero Automatic Sprinkler Co.
Address: 21605 N. Central Ave. Phoenix, Az. 85024
Phone number: 623-580-7847
Name of designer: Neal Larsen
Authority having jurisdiction: C.S.F.M.
Notes: (Include peaking information or gridded systems here.) Flow Test Information :
Hydrant # 63; Static = 60 psi; Res.= 55 psi {Elev.=351.0'}
Hydrant # 64; Flow = 914 gpm
FLOW TEST USED IN HYD. CALCS REDUCED BY 10 % [STATIC=54psi; RES.=49psi]
NOTE : REMOTE AREA REDUCED BY 39.25% [Q.R HEADS & C.H.=10'-6"] 912 SQ.FT. MIN.

Water Supply Curve (C)

Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 6 [R/A=1]

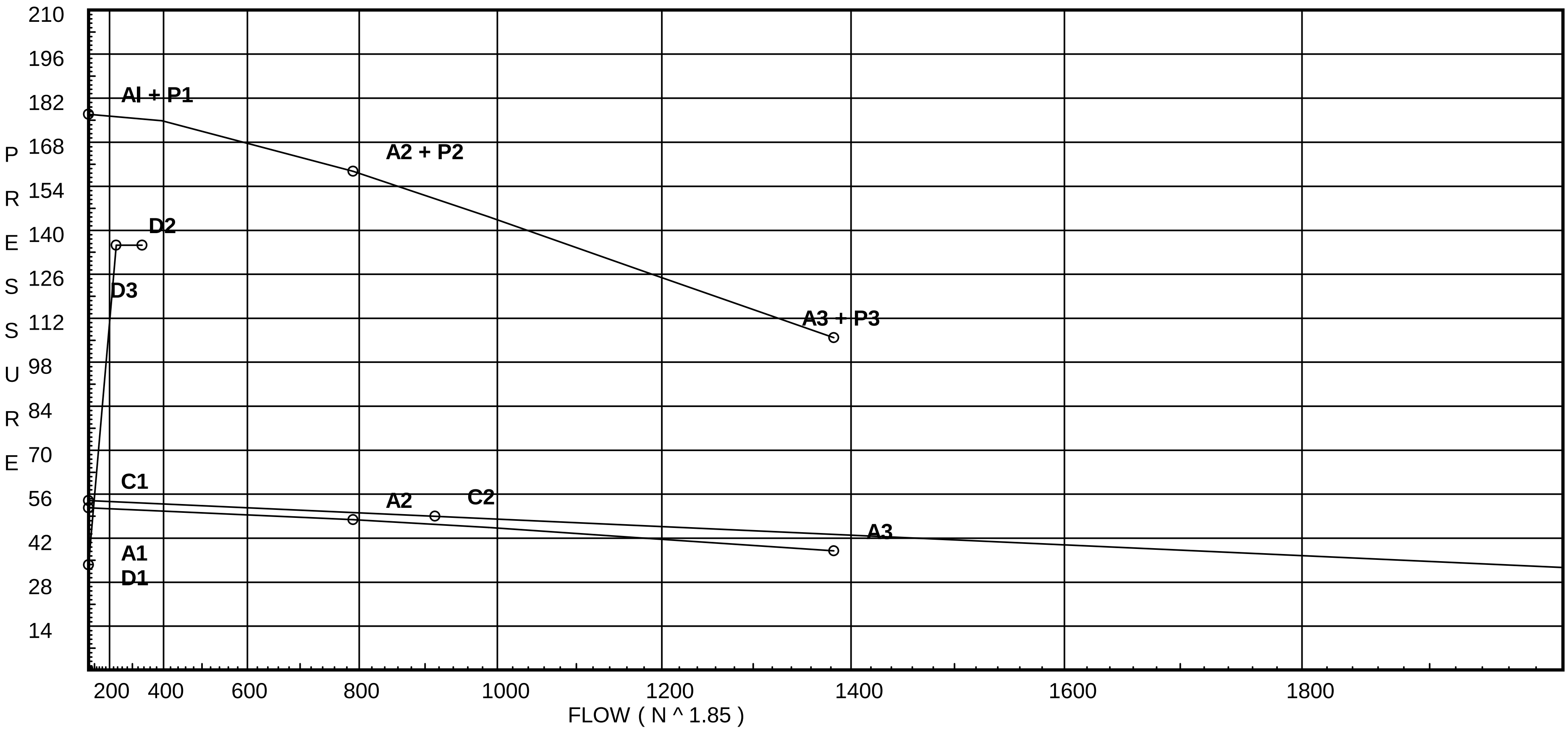
City Water Supply:
C1 - Static Pressure : 54
C2 - Residual Pressure: 49
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow

A1 - Adjusted Static: 51.696
A2 - Adj Resid : 47.866 @ 790.2
A3 - Adj Resid : 37.967 @ 1382.9

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 790.2
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 1382.9
City Residual Flow @ 0 = 3307.91
City Residual Flow @ 20 = 2576.03
City Water @ 150% of Pump = 43.24

Demand:
D1 - Elevation : 33.565
D2 - System Flow : 233.159
D2 - System Pressure : 135.285
Hose (Adj City) : 150
Hose (Demand) : 100
D3 - System Demand : 333.159
Safety Margin : 40.106



Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Aero Automatic Sprinkler Co. | Page 4
Cal Poly Center for Science LVL 6 [R/A=1] | Date 9-25-11

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
S601	90.5	5.6	12.12	na	19.5	0.15	130	7.0
S602	90.5	5.6	13.07	na	20.25	0.15	130	7.0
S603	90.5	5.6	16.6	na	22.81	0.15	130	7.0
S604	90.5	5.6	24.77	na	27.87	0.15	130	7.0
S605	90.5	5.6	12.24	na	19.6	0.15	130	7.0
S606	90.5	5.6	13.2	na	20.34	0.15	130	7.0
S607	90.5	5.6	16.76	na	22.92	0.15	130	7.0
S608	90.5	5.6	25.01	na	28.0	0.15	130	7.0
S609	90.5	5.6	20.5	na	25.35	0.15	130	7.0
S610	90.5	5.6	22.4	na	26.5	0.15	130	7.0
L601	91.0		12.59	na				
L602	91.0		13.58	na				
L603	91.0		17.29	na				
L604	91.0		25.88	na				
L605	91.0		12.72	na				
L606	91.0		13.72	na				
L607	91.0		17.46	na				
L608	91.0		26.13	na				
L609	91.0		21.59	na				
L610	91.0		23.61	na				
MN01	92.0		35.21	na				
MN02	92.0		35.21	na				
MN03	92.0		35.41	na				
MN04	92.0		35.54	na				
MN05	92.0		36.08	na				
MN06	92.0		36.45	na				
MN07	92.0		37.52	na				
MN08	92.0		37.69	na				
MN09	92.0		39.17	na				
MN10	92.0		39.34	na				
MN11	92.0		41.0	na				
MN12	93.333		65.62	na				
MN13	93.333		73.55	na				
MN14	91.083		82.72	na				
TOR6	91.083		86.32	na				
BOR6	84.0		95.48	na				
HV1	99.75		90.08	na				
HV2	99.75		90.08	na				
SPRF	99.75		91.83	na				
SP16	85.0		98.22	na				
SP15	69.0		105.15	na				
SP14	53.0		112.08	na				
SP13	37.0		119.01	na				
HV3	101.0		88.77	na				
SPR3	101.0		90.52	na				
SP36	85.0		97.45	na	50.0			
SP35	69.0		104.44	na	50.0			
SP34	53.0		111.44	na				
SP33	37.0		118.44	na				
SP32	21.0		125.55	na				
SP05	29.167		122.01	na				
SP01	45.0		115.54	na				
SP02	27.917		122.94	na				
SP03	29.167		122.4	na				
SP04	28.083		123.18	na				
SPC1	12.667		130.32	na				
SPC2	12.667		130.49	na				
PO	1.833		135.28	na				
PI	1.75		50.96	na				
POC	6.75		48.87	na				
BF1	13.0		46.24	na				
BF2	13.0		52.34	na				

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
SRC	13.0		52.46	na	150.0			

The maximum velocity is 23.34 and it occurs in the pipe between nodes L607 and L608

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*FLOWING SPRINKLER R/A # 1 #										
S601	90.5	5.60	19.50	1	1T	5.0	0.500	120	12.125	
to						0.0	5.000		-0.217	
L601	91		19.5	1.049		0.0	5.500	0.1244	0.684	Vel = 7.24
			0.0							
L601			19.50						12.592	K Factor = 5.50
S602	90.5	5.60	20.24	1	1T	5.0	0.500	120	13.070	
to						0.0	5.000		-0.217	
L602	91		20.24	1.049		0.0	5.500	0.1331	0.732	Vel = 7.51
			0.0							
L602			20.24						13.585	K Factor = 5.49
S603	90.5	5.60	22.81	1	1T	5.0	0.500	120	16.598	
to						0.0	5.000		-0.217	
L603	91		22.81	1.049		0.0	5.500	0.1660	0.913	Vel = 8.47
			0.0							
L603			22.81						17.294	K Factor = 5.49
S604	90.5	5.60	27.87	1	1T	5.0	0.500	120	24.772	
to						0.0	5.000		-0.217	
L604	91		27.87	1.049		0.0	5.500	0.2405	1.323	Vel = 10.35
			0.0							
L604			27.87						25.878	K Factor = 5.48
S605	90.5	5.60	19.60	1	1T	5.0	0.500	120	12.245	
to						0.0	5.000		-0.217	
L605	91		19.6	1.049		0.0	5.500	0.1255	0.690	Vel = 7.28
			0.0							
L605			19.60						12.718	K Factor = 5.50
S606	90.5	5.60	20.34	1	1T	5.0	0.500	120	13.198	
to						0.0	5.000		-0.217	
L606	91		20.34	1.049		0.0	5.500	0.1344	0.739	Vel = 7.55
			0.0							
L606			20.34						13.720	K Factor = 5.49
S607	90.5	5.60	22.92	1	1T	5.0	0.500	120	16.758	
to						0.0	5.000		-0.217	
L607	91		22.92	1.049		0.0	5.500	0.1676	0.922	Vel = 8.51
			0.0							
L607			22.92						17.463	K Factor = 5.48
S608	90.5	5.60	28.00	1	1T	5.0	0.500	120	25.008	
to						0.0	5.000		-0.217	
L608	91		28.0	1.049		0.0	5.500	0.2427	1.335	Vel = 10.39
			0.0							
L608			28.00						26.126	K Factor = 5.48
S609	90.5	5.60	25.35	1	1T	5.0	1.500	120	20.496	
to						0.0	5.000		-0.217	
L609	91		25.35	1.049		0.0	6.500	0.2018	1.312	Vel = 9.41
			0.0							
L609			25.35						21.591	K Factor = 5.46
S610	90.5	5.60	26.50	1	1T	5.0	1.500	120	22.401	
to						0.0	5.000		-0.217	
L610	91		26.5	1.049		0.0	6.500	0.2192	1.425	Vel = 9.84

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
L610			26.50						23.609	K Factor = 5.45
*BRANCH LINES R/A # 1										
L601	91		19.50	1		0.0	8.000	120	12.592	
to						0.0	0.0		0.0	
L602	91		19.5	1.049		0.0	8.000	0.1241	0.993	Vel = 7.24
L602	91		20.24	1		0.0	8.000	120	13.585	
to						0.0	0.0		0.0	
L603	91		39.74	1.049		0.0	8.000	0.4636	3.709	Vel = 14.75
L603	91		22.82	1		0.0	8.000	120	17.294	
to						0.0	0.0		0.0	
L604	91		62.56	1.049		0.0	8.000	1.0730	8.584	Vel = 23.22
L604	91		27.87	1.25	1E	3.0	8.500	120	25.878	
to					1T	6.0	9.000		-0.433	
MN02	92		90.43	1.38		0.0	17.500	0.5580	9.765	Vel = 19.40
			0.0							
MN02			90.43						35.210	K Factor = 15.24
L605	91		19.60	1		0.0	8.000	120	12.718	
to						0.0	0.0		0.0	
L606	91		19.6	1.049		0.0	8.000	0.1252	1.002	Vel = 7.28
L606	91		20.34	1		0.0	8.000	120	13.720	
to						0.0	0.0		0.0	
L607	91		39.94	1.049		0.0	8.000	0.4679	3.743	Vel = 14.83
L607	91		22.93	1		0.0	8.000	120	17.463	
to						0.0	0.0		0.0	
L608	91		62.87	1.049		0.0	8.000	1.0829	8.663	Vel = 23.34
L608	91		28.00	1.25	1E	3.0	8.500	120	26.126	
to					1T	6.0	9.000		-0.433	
MN04	92		90.87	1.38		0.0	17.500	0.5630	9.852	Vel = 19.49
			0.0							
MN04			90.87						35.545	K Factor = 15.24
L609	91		25.35	1		0.0	10.000	120	21.591	
to						0.0	0.0		0.0	
L610	91		25.35	1.049		0.0	10.000	0.2018	2.018	Vel = 9.41
L610	91		26.51	1	1E	2.0	10.500	120	23.609	
to					1T	5.0	7.000		-0.433	
MN06	92		51.86	1.049		0.0	17.500	0.7583	13.271	Vel = 19.25
			0.0							
MN06			51.86						36.447	K Factor = 8.59
*FEED MAIN										
MN01	92	.0	0.0	2.5		0.0	3.833	120	35.210	
to						0.0	0.0		0.0	
MN02	92		0.0	2.635		0.0	3.833	0	0.0	Vel = 0
MN02	92		90.43	2.5		0.0	8.167	120	35.210	
to						0.0	0.0		0.0	
MN03	92		90.43	2.635		0.0	8.167	0.0240	0.196	Vel = 5.32
MN03	92		0.0	2.5		0.0	5.833	120	35.406	
to						0.0	0.0		0.0	
MN04	92		90.43	2.635		0.0	5.833	0.0238	0.139	Vel = 5.32

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
MN04	92		90.87	2.5		0.0	6.167	120	35.545	
to						0.0	0.0		0.0	
MN05	92		181.3	2.635		0.0	6.167	0.0866	0.534	Vel = 10.67
MN05	92		0.0	2.5		0.0	4.250	120	36.079	
to						0.0	0.0		0.0	
MN06	92		181.3	2.635		0.0	4.250	0.0866	0.368	Vel = 10.67
MN06	92		51.86	2.5		0.0	7.750	120	36.447	
to						0.0	0.0		0.0	
MN07	92		233.16	2.635		0.0	7.750	0.1379	1.069	Vel = 13.72
MN07	92		0.0	2.5		0.0	1.250	120	37.516	
to						0.0	0.0		0.0	
MN08	92		233.16	2.635		0.0	1.250	0.1376	0.172	Vel = 13.72
MN08	92		0.0	2.5		0.0	10.750	120	37.688	
to						0.0	0.0		0.0	
MN09	92		233.16	2.635		0.0	10.750	0.1380	1.483	Vel = 13.72
MN09	92		0.0	2.5		0.0	1.250	120	39.171	
to						0.0	0.0		0.0	
MN10	92		233.16	2.635		0.0	1.250	0.1376	0.172	Vel = 13.72
MN10	92		0.0	2.5		0.0	12.000	120	39.343	
to						0.0	0.0		0.0	
MN11	92		233.16	2.635		0.0	12.000	0.1379	1.655	Vel = 13.72
MN11	92		0.0	2.5	2I	16.474	149.750	120	40.998	
to					1T	16.474	32.948		-0.577	
MN12	93.333		233.16	2.635		0.0	182.698	0.1379	25.197	Vel = 13.72
MN12	93.333		0.0	2.5	1I	8.237	32.833	120	65.618	
to					1T	16.474	24.711		0.0	
MN13	93.333		233.16	2.635		0.0	57.544	0.1379	7.936	Vel = 13.72
MN13	93.333		0.0	2.5	2I	16.474	26.417	120	73.554	
to					1T	16.474	32.948		0.974	
MN14	91.083		233.16	2.635		0.0	59.365	0.1379	8.188	Vel = 13.72
MN14	91.083		0.0	2.5	2I	16.474	9.667	120	82.716	
to						0.0	16.474		0.0	
TOR6	91.083		233.16	2.635		0.0	26.141	0.1379	3.605	Vel = 13.72
TOR6	91.083		0.0	2.5	1C	19.22	7.083	120	86.321	
to					1B	9.61	37.067		3.068	
BOR6	84		233.16	2.635	1I	8.237	44.150	0.1379	6.088	Vel = 13.72
BOR6	84		0.0	2.5	1T	16.474	1.000	120	95.477	
to						0.0	16.474		-0.433	
SP36	85		233.16	2.635		0.0	17.474	0.1379	2.410	Vel = 13.72
			0.0							
SP36			233.16						97.454	K Factor = 23.62
*S/P # 1										
HV1	99.750	.0	0.0	2.5	1T	12.0	0.250	120	90.082	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
			0.0							
SPRF			0.0						91.832	K Factor = 0

Node1	Elev1	K	Qa	Nom	Fitting		Pipe	CFact	Pt	******* Notes ******
to					or		Ftng's		Pe	
Node2	Elev2	Fact	Qt	Act	Eqv.	Ln.	Total	Pf/Ft	Pf	
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	90.082	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750	.0	0.0	6	4I	40.0	30.000	120	91.832	
to						0.0	40.000		6.388	
SP16	85		0.0	6.065		0.0	70.000	0	0.0	Vel = 0
SP16	85	.0	0.0	6		0.0	16.000	120	98.220	
to						0.0	0.0		6.930	
SP15	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP15	69	.0	0.0	6		0.0	16.000	120	105.150	
to						0.0	0.0		6.930	
SP14	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP14	53	.0	0.0	6	1T	30.0	8.500	120	112.080	
to						0.0	30.000		3.465	
SP01	45		0.0	6.065		0.0	38.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						115.545	K Factor = 0
SP13	37	.0	0.0	6	1T	30.0	7.500	120	119.009	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						115.544	K Factor = 0
*S/P # 3										
HV3	101	.0	0.0	2.5	2E	12.0	1.750	120	88.774	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	101		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SPR3	101	.0	0.0	6		0.0	16.000	120	90.524	
to						0.0	0.0		6.930	
SP36	85		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP36	85	H50	283.16	6		0.0	16.000	120	97.454	
to						0.0	0.0		6.930	
SP35	69		283.16	6.065		0.0	16.000	0.0034	0.054	Vel = 3.14
SP35	69	H50	50.00	6		0.0	16.000	120	104.438	
to						0.0	0.0		6.930	
SP34	53		333.16	6.065		0.0	16.000	0.0046	0.074	Vel = 3.70
SP34	53		0.0	6		0.0	16.000	120	111.442	
to						0.0	0.0		6.930	
SP33	37		333.16	6.065		0.0	16.000	0.0046	0.073	Vel = 3.70
SP33	37		0.0	6	1T	30.0	8.417	120	118.445	
to						0.0	30.000		3.392	
SP05	29.167		333.16	6.065		0.0	38.417	0.0046	0.177	Vel = 3.70
			0.0							
SP05			333.16						122.014	K Factor = 30.16
SP32	21	.0	0.0	6	1T	30.0	7.583	120	125.551	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167		333.16	6	1I	10.0	34.167	120	122.014	
to					1B	10.0	50.000		0.0	
SP03	29.167		333.16	6.065	1T	30.0	84.167	0.0046	0.388	Vel = 3.70

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
SP03			333.16						122.402	K Factor = 30.11
*STANDPIPE FEED										
SP01	45	.0	0.0	6	1B	10.0	34.417	120	115.544	
to					6I	60.0	70.000		7.399	
SP02	27.917		0.0	6.065		0.0	104.417	0	0.0	Vel = 0
SP02	27.917	.0	0.0	6	2I	20.0	235.417	120	122.943	
to						0.0	20.000		-0.541	
SP03	29.167		0.0	6.065		0.0	255.417	0	0.0	Vel = 0
SP03	29.167		333.16	6	4I	40.0	27.500	120	122.402	
to						0.0	40.000		0.469	
SP04	28.083		333.16	6.065		0.0	67.500	0.0046	0.311	Vel = 3.70
SP04	28.083		0.0	6	2I	20.0	79.330	120	123.182	
to						0.0	20.000		6.677	
SPC1	12.667		333.16	6.065		0.0	99.330	0.0046	0.457	Vel = 3.70
SPC1	12.667		0.0	6	1T	30.0	7.833	120	130.316	
to						0.0	30.000		0.0	
SPC2	12.667		333.16	6.065		0.0	37.833	0.0046	0.174	Vel = 3.70
SPC2	12.667		0.0	8	1I	13.0	14.750	120	130.490	
to					1B	12.0	70.000		4.692	
PO	1.833		333.16	7.981	1C	45.0	84.750	0.0012	0.103	Vel = 2.14
			0.0							
PO			333.16						135.285	K Factor = 28.64
System Demand Pressure						135.285				
Safety Margin						40.106				
Continuation Pressure						175.391				
Pressure @ Pump Outlet						175.391				
Pressure From Pump Curve						-124.435				
Pressure @ Pump Inlet						50.956				
PI	1.750		0.0	8	1G	4.0	14.000	120	50.956	
to					1I	13.0	52.000		-2.166	
POC	6.750		333.16	7.981	1T	35.0	66.000	0.0012	0.081	Vel = 2.14
POC	6.750		0.0	8	2E	56.936	41.000	140	48.871	
to						0.0	56.936		-2.707	
BF1	13		333.16	8.27		0.0	97.936	0.0008	0.075	Vel = 1.99
BF1	13		0.0	8	1Zic	0.0	4.000	120	46.239	
to						0.0	0.0		6.093	* Fixed loss = 6.093
BF2	13		333.16	7.981		0.0	4.000	0.0012	0.005	Vel = 2.14
BF2	13		0.0	8	2E	56.936	46.000	140	52.337	
to					1G	6.326	118.616		0.0	
SRC	13		333.16	8.27	1T	55.354	164.616	0.0008	0.125	Vel = 1.99
			150.00							Qa = 150.00
SRC			483.16						52.462	K Factor = 66.71

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AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science LVL 6 [R/A=2]
Building	:	FP-6.06E
Location	:	San Luis Obispo, Ca.
System	:	6-2
Contract	:	10034
Data File	:	Cal Poly CFS LVL 6-2.WXF

HYDRAULIC CALCULATIONS
for

Project name: Cal Poly Center For Science
Location: San Luis Obispo, Ca.
Drawing no: FP-6.06E
Date: 9-25-2011

Design

Remote area number: 6-2
Remote area location: 6 th. Cooridor
Occupancy classification: Light Hazard
Density: 0.10 - Gpm/SqFt
Area of application: 5 Heads - SqFt
Coverage per sprinkler: 225 - SqFt
Type of sprinklers calculated: Tyco; Mod. TY-FRB; 1/2"; 1/2";K=5.6; 155 Deg
No. of sprinklers calculated: 5
In-rack demand: N/A - GPM
Hose streams: 100 - GPM
Total water required (including hose streams): 213.09 - GPM @ -51.52 - Psi
Type of system: WET
Volume of dry or preaction system: N/A - Gal

Water supply information

Date: 8-19-2011
Location: N. Poly View Drive
Source: Fluid Resource Management

Name of contractor: Aero Automatic Sprinkler Co.
Address: 21605 N. Central Ave. Phoenix, Az. 85024
Phone number: 623-580-7847
Name of designer: Neal Larsen
Authority having jurisdiction: C.S.F.M.
Notes: (Include peaking information or gridded systems here.) Flow Test Information :
Hydrant # 63; Static = 60 psi; Res.= 55 psi {Elev.=351.0'}
Hydrant # 64; Flow = 914 gpm
FLOW TEST USED IN HYD. CALCS REDUCED BY 10 % [STATIC=54psi; RES.=49psi]

Water Supply Curve (C)

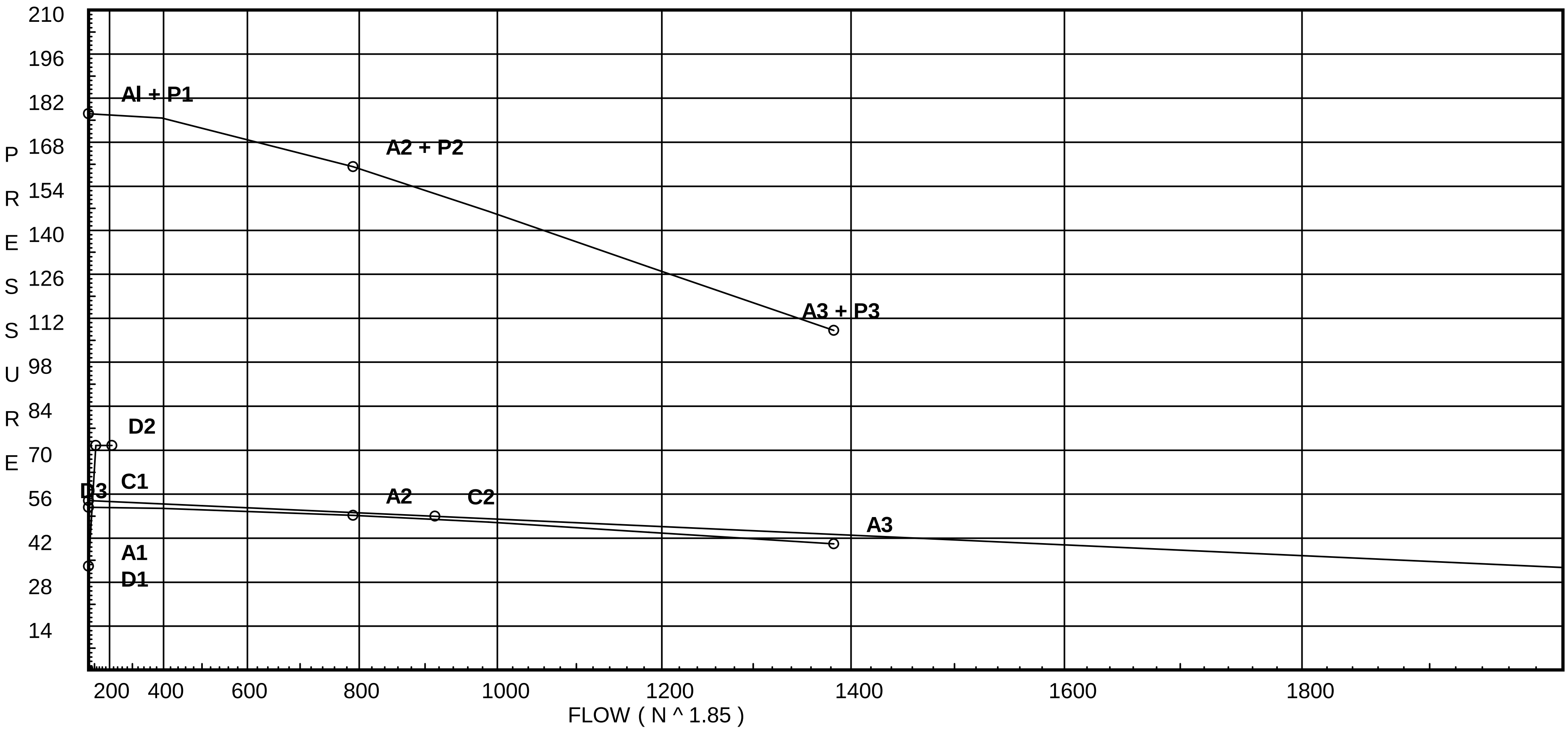
Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 6 [R/A=2]

City Water Supply:
C1 - Static Pressure : 54
C2 - Residual Pressure: 49
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
A1 - Adjusted Static: 51.872
A2 - Adj Resid : 49.314 @ 790.2
A3 - Adj Resid : 40.224 @ 1382.9

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 790.2
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 1382.9
City Residual Flow @ 0 = 3307.91
City Residual Flow @ 20 = 2576.03
City Water @ 150% of Pump = 43.24

Demand:
D1 - Elevation : 33.132
D2 - System Flow : 113.099
D2 - System Pressure : 71.563
Hose (Adj City) : ________
Hose (Demand) : 100
D3 - System Demand : 213.099
Safety Margin : 105.185



Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 6 [R/A=2]

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 6 [R/A=2]

Date 9-25-11

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
S621	89.5	5.6	16.14	na	22.5	0.1	225	7.0
S622	89.5	5.6	16.16	na	22.51	0.1	225	7.0
S623	89.5	5.6	16.24	na	22.56	0.1	225	7.0
S624	89.5	5.6	16.39	na	22.67	0.1	225	7.0
S625	89.5	5.6	16.65	na	22.85	0.1	225	7.0
MN01	92.0		16.68	na				
MN02	92.0		16.69	na				
MN03	92.0		16.7	na				
MN04	92.0		16.74	na				
MN05	92.0		16.78	na				
MN06	92.0		16.84	na				
MN07	92.0		16.95	na				
MN08	92.0		16.98	na				
MN09	92.0		17.23	na				
MN10	92.0		17.28	na				
MN11	92.0		17.71	na				
MN12	93.333		23.74	na				
MN13	93.333		25.82	na				
MN14	91.083		28.95	na				
TOR6	91.083		29.89	na				
BOR6	84.0		34.56	na				
HV1	99.75		26.95	na				
HV2	99.75		26.95	na				
SPRF	99.75		28.7	na				
SP16	85.0		35.09	na				
SP15	69.0		42.02	na				
SP14	53.0		48.94	na				
SP13	37.0		55.88	na				
HV3	101.0		26.08	na				
SPR3	101.0		27.82	na				
SP36	85.0		34.76	na	50.0			
SP35	69.0		41.7	na	50.0			
SP34	53.0		48.67	na				
SP33	37.0		55.63	na				
SP32	21.0		62.64	na				
SP05	29.167		59.1	na				
SP01	45.0		52.41	na				
SP02	27.917		59.81	na				
SP03	29.167		59.27	na				
SP04	28.083		59.87	na				
SPC1	12.667		66.75	na				
SPC2	12.667		66.83	na				
PO	1.833		71.56	na				
PI	1.75		51.9	na				
POC	6.75		49.77	na				
BF1	13.0		47.1	na				
BF2	13.0		53.61	na				
SRC	13.0		53.66	na				

The maximum velocity is 8.48 and it occurs in the pipe between nodes S625 and MN09

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	 Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*FLOWING SPRINKLER R/A # 2										
S621	89.500	5.60	22.50	1	1E	2.0	3.000	120	16.143	
to					1T	5.0	7.000		-1.083	
MN01	92		22.5	1.049		0.0	10.000	0.1619	1.619	Vel = 8.35
			0.0							
MN01			22.50						16.679	K Factor = 5.51
S622	89.500	5.60	22.51	1	1E	2.0	3.000	120	16.163	
to					1T	5.0	7.000		-1.083	
MN03	92		22.51	1.049		0.0	10.000	0.1620	1.620	Vel = 8.36
			0.0							
MN03			22.51						16.700	K Factor = 5.51
S623	89.500	5.60	22.56	1	1E	2.0	3.000	120	16.235	
to					1T	5.0	7.000		-1.083	
MN05	92		22.56	1.049		0.0	10.000	0.1627	1.627	Vel = 8.37
			0.0							
MN05			22.56						16.779	K Factor = 5.51
S624	89.500	5.60	22.67	1	1E	2.0	3.000	120	16.389	
to					1T	5.0	7.000		-1.083	
MN07	92		22.67	1.049		0.0	10.000	0.1641	1.641	Vel = 8.42
			0.0							
MN07			22.67						16.947	K Factor = 5.51
S625	89.500	5.60	22.85	1	1E	2.0	3.000	120	16.650	
to					1T	5.0	7.000		-1.083	
MN09	92		22.85	1.049		0.0	10.000	0.1666	1.666	Vel = 8.48
			0.0							
MN09			22.85						17.233	K Factor = 5.50
*FEED MAIN										
MN01	92		22.50	2.5		0.0	3.833	120	16.679	
to						0.0	0.0		0.0	
MN02	92		22.5	2.635		0.0	3.833	0.0018	0.007	Vel = 1.32
MN02	92		0.0	2.5		0.0	8.167	120	16.686	
to						0.0	0.0		0.0	
MN03	92		22.5	2.635		0.0	8.167	0.0017	0.014	Vel = 1.32
MN03	92		22.51	2.5		0.0	5.833	120	16.700	
to						0.0	0.0		0.0	
MN04	92		45.01	2.635		0.0	5.833	0.0067	0.039	Vel = 2.65
MN04	92		0.0	2.5		0.0	6.167	120	16.739	
to						0.0	0.0		0.0	
MN05	92		45.01	2.635		0.0	6.167	0.0065	0.040	Vel = 2.65
MN05	92		22.57	2.5		0.0	4.250	120	16.779	
to						0.0	0.0		0.0	
MN06	92		67.58	2.635		0.0	4.250	0.0141	0.060	Vel = 3.98
MN06	92		0.0	2.5		0.0	7.750	120	16.839	
to						0.0	0.0		0.0	
MN07	92		67.58	2.635		0.0	7.750	0.0139	0.108	Vel = 3.98
MN07	92		22.67	2.5		0.0	1.250	120	16.947	
to						0.0	0.0		0.0	
MN08	92		90.25	2.635		0.0	1.250	0.0240	0.030	Vel = 5.31

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
MN08	92		0.0	2.5		0.0	10.750	120	16.977	
to						0.0	0.0		0.0	
MN09	92		90.25	2.635		0.0	10.750	0.0238	0.256	Vel = 5.31
MN09	92		22.85	2.5		0.0	1.250	120	17.233	
to						0.0	0.0		0.0	
MN10	92		113.1	2.635		0.0	1.250	0.0360	0.045	Vel = 6.65
MN10	92		0.0	2.5		0.0	12.000	120	17.278	
to						0.0	0.0		0.0	
MN11	92		113.1	2.635		0.0	12.000	0.0362	0.434	Vel = 6.65
MN11	92		0.0	2.5	2I	16.474	149.750	120	17.712	
to					1T	16.474	32.948		-0.577	
MN12	93.333		113.1	2.635		0.0	182.698	0.0362	6.608	Vel = 6.65
MN12	93.333		0.0	2.5	1I	8.237	32.833	120	23.743	
to					1T	16.474	24.711		0.0	
MN13	93.333		113.1	2.635		0.0	57.544	0.0362	2.081	Vel = 6.65
MN13	93.333		0.0	2.5	2I	16.474	26.417	120	25.824	
to					1T	16.474	32.948		0.974	
MN14	91.083		113.1	2.635		0.0	59.365	0.0362	2.148	Vel = 6.65
MN14	91.083		0.0	2.5	2I	16.474	9.667	120	28.946	
to						0.0	16.474		0.0	
TOR6	91.083		113.1	2.635		0.0	26.141	0.0362	0.946	Vel = 6.65
TOR6	91.083		0.0	2.5	1C	19.22	7.083	120	29.892	
to					1B	9.61	37.067		3.068	
BOR6	84		113.1	2.635	1I	8.237	44.150	0.0361	1.596	Vel = 6.65
BOR6	84		0.0	2.5	1T	16.474	1.000	120	34.556	
to						0.0	16.474		-0.433	
SP36	85		113.1	2.635		0.0	17.474	0.0362	0.632	Vel = 6.65
			0.0							
SP36			113.10						34.755	K Factor = 19.18
*S/P # 1										
HV1	99.750	.0	0.0	2.5	1T	12.0	0.250	120	26.948	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
			0.0							
SPRF			0.0						28.698	K Factor = 0
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	26.948	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750	.0	0.0	6	4I	40.0	30.000	120	28.698	
to						0.0	40.000		6.388	
SP16	85		0.0	6.065		0.0	70.000	0	0.0	Vel = 0
SP16	85	.0	0.0	6		0.0	16.000	120	35.086	
to						0.0	0.0		6.930	
SP15	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP15	69	.0	0.0	6		0.0	16.000	120	42.016	
to						0.0	0.0		6.930	
SP14	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SP14	53	.0	0.0	6	1T	30.0	8.500	120	48.945	
to						0.0	30.000		3.465	
SP01	45		0.0	6.065		0.0	38.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						52.410	K Factor = 0
SP13	37	.0	0.0	6	1T	30.0	7.500	120	55.875	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						52.410	K Factor = 0
*S/P # 3										
HV3	101	.0	0.0	2.5	2E	12.0	1.750	120	26.075	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	101		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SPR3	101	.0	0.0	6		0.0	16.000	120	27.825	
to						0.0	0.0		6.930	
SP36	85		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP36	85	H50	163.10	6		0.0	16.000	120	34.755	
to						0.0	0.0		6.930	
SP35	69		163.1	6.065		0.0	16.000	0.0012	0.019	Vel = 1.81
SP35	69	H50	50.00	6		0.0	16.000	120	41.704	
to						0.0	0.0		6.930	
SP34	53		213.1	6.065		0.0	16.000	0.0020	0.032	Vel = 2.37
SP34	53		0.0	6		0.0	16.000	120	48.666	
to						0.0	0.0		6.930	
SP33	37		213.1	6.065		0.0	16.000	0.0020	0.032	Vel = 2.37
SP33	37		0.0	6	1T	30.0	8.417	120	55.628	
to						0.0	30.000		3.392	
SP05	29.167		213.1	6.065		0.0	38.417	0.0020	0.078	Vel = 2.37
			0.0							
SP05			213.10						59.098	K Factor = 27.72
SP32	21	.0	0.0	6	1T	30.0	7.583	120	62.635	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167		213.10	6	1I	10.0	34.167	120	59.098	
to					1B	10.0	50.000		0.0	
SP03	29.167		213.1	6.065	1T	30.0	84.167	0.0020	0.169	Vel = 2.37
			0.0							
SP03			213.10						59.267	K Factor = 27.68
*STANDPIPE FEED										
SP01	45	.0	0.0	6	1B	10.0	34.417	120	52.410	
to					6I	60.0	70.000		7.399	
SP02	27.917		0.0	6.065		0.0	104.417	0	0.0	Vel = 0
SP02	27.917	.0	0.0	6	2I	20.0	235.417	120	59.809	
to						0.0	20.000		-0.541	
SP03	29.167		0.0	6.065		0.0	255.417	0	0.0	Vel = 0
SP03	29.167		213.10	6	4I	40.0	27.500	120	59.267	
to						0.0	40.000		0.469	
SP04	28.083		213.1	6.065		0.0	67.500	0.0020	0.137	Vel = 2.37

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SP04	28.083		0.0	6	2I	20.0	79.330	120	59.873	
to						0.0	20.000		6.677	
SPC1	12.667		213.1	6.065		0.0	99.330	0.0020	0.200	Vel = 2.37
SPC1	12.667		0.0	6	1T	30.0	7.833	120	66.750	
to						0.0	30.000		0.0	
SPC2	12.667		213.1	6.065		0.0	37.833	0.0020	0.076	Vel = 2.37
SPC2	12.667		0.0	8	1I	13.0	14.750	120	66.826	
to					1B	12.0	70.000		4.692	
PO	1.833		213.1	7.981	1C	45.0	84.750	0.0005	0.045	Vel = 1.37
			0.0							
PO			213.10						71.563	K Factor = 25.19
System Demand Pressure						71.563				
Safety Margin						105.185				
Continuation Pressure						176.748				
Pressure @ Pump Outlet						176.748				
Pressure From Pump Curve						-124.845				
Pressure @ Pump Inlet						51.903				
PI	1.750		0.0	8	1G	4.0	14.000	120	51.903	
to					1I	13.0	52.000		-2.166	
POC	6.750		213.1	7.981	1T	35.0	66.000	0.0005	0.035	Vel = 1.37
POC	6.750		0.0	8	2E	56.936	41.000	140	49.772	
to						0.0	56.936		-2.707	
BF1	13		213.1	8.27		0.0	97.936	0.0003	0.033	Vel = 1.27
BF1	13		0.0	8	1Zic	0.0	4.000	120	47.098	
to						0.0	0.0		6.507	* Fixed loss = 6.507
BF2	13		213.1	7.981		0.0	4.000	0.0005	0.002	Vel = 1.37
BF2	13		0.0	8	2E	56.936	46.000	140	53.607	
to					1G	6.326	118.616		0.0	
SRC	13		213.1	8.27	1T	55.354	164.616	0.0003	0.055	Vel = 1.27
			0.0							
SRC			213.10						53.662	K Factor = 29.09

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AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave.
Phoenix, Arizona 85024

623.580.7800
Fax 623.434.3154

AZ-L16-234798
AZ-C16-234797
UT-S370-6690455-5501

CA-C16-901529
NV-C41-69370
NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science LVL 6 [R/A=3]
Building	:	FP-6.06E
Location	:	San Luis Obispo, Ca.
System	:	6-3
Contract	:	10034
Data File	:	Cal Poly CFS LVL 6-3.WXF

HYDRAULIC CALCULATIONS
for

Project name: Cal Poly Center For Science
Location: San Luis Obispo, Ca.
Drawing no: FP-6.06E
Date: 9-25-2011

Design

Remote area number: 6-3
Remote area location: 6 th. Floor Laboratory
Occupancy classification: Ordinary Hazard Gr. 1
Density: 0.15 - Gpm/SqFt
Area of application: 920 - SqFt
Coverage per sprinkler: 130 - SqFt
Type of sprinklers calculated: Tyco; Mod. TY-FRB; 1/2"; 1/2";K=5.6; 155 Deg
No. of sprinklers calculated: 12
In-rack demand: N/A - GPM
Hose streams: 250 - GPM
Total water required (including hose streams): 523.39 - GPM @ 26.71 - Psi
Type of system: WET
Volume of dry or preaction system: N/A - Gal

Water supply information

Date: 8-19-2011
Location: N. Poly View Drive
Source: Fluid Resource Management

Name of contractor: Aero Automatic Sprinkler Co.
Address: 21605 N. Central Ave. Phoenix, Az. 85024
Phone number: 623-580-7847
Name of designer: Neal Larsen
Authority having jurisdiction: C.S.F.M.
Notes: (Include peaking information or gridded systems here.) Flow Test Information :
Hydrant # 63; Static = 60 psi; Res.= 55 psi {Elev.=351.0'}
Hydrant # 64; Flow = 914 gpm
FLOW TEST USED IN HYD. CALCS REDUCED BY 10 % [STATIC=54psi; RES.=49psi]
NOTE : REMOTE AREA REDUCED BY 39.25% [Q.R HEADS & C.H.=10'-6"] 912 SQ.FT. MIN.

Water Supply Curve (C)

Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 6 [R/A=3]

Page 2
Date 9-25-11

City Water Supply:

C1 - Static Pressure	:	54
C2 - Residual Pressure	:	49
C2 - Residual Flow	:	914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow

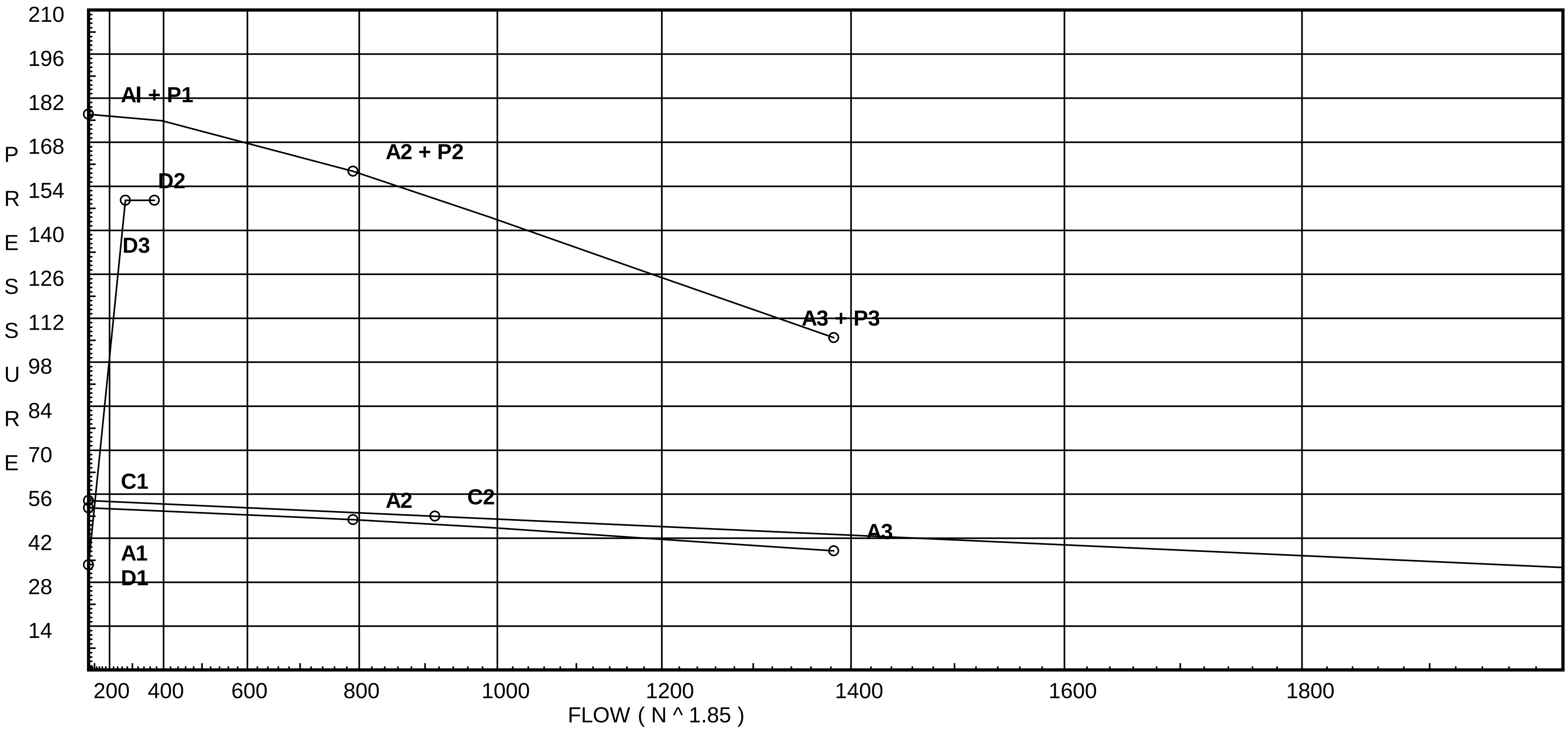
A1 - Adjusted Static:		51.696	
A2 - Adj Resid	:	47.866	@ 790.2
A3 - Adj Resid	:	37.967	@ 1382.9

Pump Data:

P1 - Pump Churn Pressure	:	125.2
P2 - Pump Rated Pressure	:	110.9
P2 - Pump Rated Flow	:	790.2
P3 - Pump Pressure @ Max Flow	:	67.9
P3 - Pump Max Flow	:	1382.9
City Residual Flow @ 0	=	3307.91
City Residual Flow @ 20	=	2576.03
City Water @ 150% of Pump	=	43.24

Demand:

D1 - Elevation	:	33.565
D2 - System Flow	:	273.395
D2 - System Pressure	:	149.546
Hose (Adj City)	:	150
Hose (Demand)	:	100
D3 - System Demand	:	373.395
Safety Margin	:	25.499



Fittings Used Summary

Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 6 [R/A=3]

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Aero Automatic Sprinkler Co. Page 4
Cal Poly Center for Science LVL 6 [R/A=3] Date 9-25-11

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
S631	90.5	5.6	12.12	na	19.5	0.15	130	7.0
S632	90.5	5.6	13.07	na	20.25	0.15	130	7.0
S633	90.5	5.6	16.6	na	22.81	0.15	130	7.0
S634	90.5	5.6	24.77	na	27.87	0.15	130	7.0
S635	90.5	5.6	12.23	na	19.58	0.15	130	7.0
S636	90.5	5.6	13.18	na	20.33	0.15	130	7.0
S637	90.5	5.6	16.74	na	22.91	0.15	130	7.0
S638	90.5	5.6	24.97	na	27.99	0.15	130	7.0
S639	90.5	5.6	12.6	na	19.88	0.15	130	7.0
S640	90.5	5.6	13.58	na	20.64	0.15	130	7.0
S641	90.5	5.6	17.24	na	23.25	0.15	130	7.0
S642	90.5	5.6	25.7	na	28.39	0.15	130	7.0
L631	91.0		12.59	na				
L632	91.0		13.58	na				
L633	91.0		17.29	na				
L634	91.0		25.88	na				
L635	91.0		12.7	na				
L636	91.0		13.7	na				
L637	91.0		17.44	na				
L638	91.0		26.09	na				
L639	91.0		13.09	na				
L640	91.0		14.12	na				
L641	91.0		17.96	na				
L642	91.0		26.86	na				
MN01	92.0		35.21	na				
MN02	92.0		35.21	na				
MN03	92.0		35.21	na				
MN04	92.0		35.21	na				
MN05	92.0		35.21	na				
MN06	92.0		35.21	na				
MN07	92.0		35.21	na				
MN08	92.0		35.21	na				
MN09	92.0		35.47	na				
MN10	92.0		35.5	na				
MN11	92.0		36.54	na				
MN12	93.333		69.78	na				
MN13	93.333		80.44	na				
MN14	91.083		92.4	na				
TOR6	91.083		97.24	na				
BOR6	84.0		108.49	na				
HV1	99.75		104.1	na				
HV2	99.75		104.1	na				
SPRF	99.75		105.85	na				
SP16	85.0		112.24	na				
SP15	69.0		119.17	na				
SP14	53.0		126.1	na				
SP13	37.0		133.02	na				
HV3	101.0		102.61	na				
SPR3	101.0		104.36	na				
SP36	85.0		111.29	na	50.0			
SP35	69.0		118.29	na	50.0			
SP34	53.0		125.31	na				
SP33	37.0		132.33	na				
SP32	21.0		139.48	na				
SP05	29.167		135.94	na				
SP01	45.0		129.56	na				
SP02	27.917		136.96	na				
SP03	29.167		136.42	na				
SP04	28.083		137.27	na				
SPC1	12.667		144.51	na				
SPC2	12.667		144.73	na				
PO	1.833		149.55	na				

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
PI	1.75		50.78	na				
POC	6.75		48.72	na				
BF1	13.0		46.1	na				
BF2	13.0		52.06	na				
SRC	13.0		52.22	na	150.0			

The maximum velocity is 23.67 and it occurs in the pipe between nodes L641 and L642

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*FLOWING SPRINKLER R/A # 3										
S631	90.5	5.60	19.50	1	1T	5.0	0.500	120	12.125	
to						0.0	5.000		-0.217	
L631	91		19.5	1.049		0.0	5.500	0.1244	0.684	Vel = 7.24
			0.0							
L631			19.50						12.592	K Factor = 5.50
S632	90.5	5.60	20.24	1	1T	5.0	0.500	120	13.070	
to						0.0	5.000		-0.217	
L632	91		20.24	1.049		0.0	5.500	0.1331	0.732	Vel = 7.51
			0.0							
L632			20.24						13.585	K Factor = 5.49
S633	90.5	5.60	22.81	1	1T	5.0	0.500	120	16.598	
to						0.0	5.000		-0.217	
L633	91		22.81	1.049		0.0	5.500	0.1660	0.913	Vel = 8.47
			0.0							
L633			22.81						17.294	K Factor = 5.49
S634	90.5	5.60	27.87	1	1T	5.0	0.500	120	24.772	
to						0.0	5.000		-0.217	
L634	91		27.87	1.049		0.0	5.500	0.2405	1.323	Vel = 10.35
			0.0							
L634			27.87						25.878	K Factor = 5.48
S635	90.5	5.60	19.58	1	1T	5.0	0.500	120	12.228	
to						0.0	5.000		-0.217	
L635	91		19.58	1.049		0.0	5.500	0.1253	0.689	Vel = 7.27
			0.0							
L635			19.58						12.700	K Factor = 5.49
S636	90.5	5.60	20.33	1	1T	5.0	0.500	120	13.180	
to						0.0	5.000		-0.217	
L636	91		20.33	1.049		0.0	5.500	0.1342	0.738	Vel = 7.55
			0.0							
L636			20.33						13.701	K Factor = 5.49
S637	90.5	5.60	22.91	1	1T	5.0	0.500	120	16.736	
to						0.0	5.000		-0.217	
L637	91		22.91	1.049		0.0	5.500	0.1673	0.920	Vel = 8.50
			0.0							
L637			22.91						17.439	K Factor = 5.49
S638	90.5	5.60	27.99	1	1T	5.0	0.500	120	24.974	
to						0.0	5.000		-0.217	
L638	91		27.99	1.049		0.0	5.500	0.2424	1.333	Vel = 10.39
			0.0							
L638			27.99						26.090	K Factor = 5.48
S639	90.5	5.60	19.88	1	1T	5.0	0.500	120	12.601	
to						0.0	5.000		-0.217	
L639	91		19.88	1.049		0.0	5.500	0.1287	0.708	Vel = 7.38
			0.0							
L639			19.88						13.092	K Factor = 5.49
S640	90.5	5.60	20.64	1	1T	5.0	0.500	120	13.580	
to						0.0	5.000		-0.217	
L640	91		20.64	1.049		0.0	5.500	0.1378	0.758	Vel = 7.66

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
L640			20.64						14.121	K Factor = 5.49
S641	90.5	5.60	23.25	1	1T	5.0	0.500	120	17.235	
to						0.0	5.000		-0.217	
L641	91		23.25	1.049		0.0	5.500	0.1720	0.946	Vel = 8.63
			0.0							
L641			23.25						17.964	K Factor = 5.49
S642	90.500	5.60	28.39	1	1T	5.0	0.500	120	25.705	
to						0.0	5.000		-0.217	
L642	91		28.39	1.049		0.0	5.500	0.2489	1.369	Vel = 10.54
			0.0							
L642			28.39						26.857	K Factor = 5.48
*BRANCH LINES R/A # 3										
L631	91		19.50	1		0.0	8.000	120	12.592	
to						0.0	0.0		0.0	
L632	91		19.5	1.049		0.0	8.000	0.1241	0.993	Vel = 7.24
L632	91		20.24	1		0.0	8.000	120	13.585	
to						0.0	0.0		0.0	
L633	91		39.74	1.049		0.0	8.000	0.4636	3.709	Vel = 14.75
L633	91		22.82	1		0.0	8.000	120	17.294	
to						0.0	0.0		0.0	
L634	91		62.56	1.049		0.0	8.000	1.0730	8.584	Vel = 23.22
L634	91		27.87	1.25	1E	3.0	8.500	120	25.878	
to					1T	6.0	9.000		-0.433	
MN08	92		90.43	1.38		0.0	17.500	0.5580	9.765	Vel = 19.40
			0.0							
MN08			90.43						35.210	K Factor = 15.24
L635	91		19.58	1		0.0	8.000	120	12.700	
to						0.0	0.0		0.0	
L636	91		19.58	1.049		0.0	8.000	0.1251	1.001	Vel = 7.27
L636	91		20.33	1		0.0	8.000	120	13.701	
to						0.0	0.0		0.0	
L637	91		39.91	1.049		0.0	8.000	0.4672	3.738	Vel = 14.82
L637	91		22.91	1		0.0	8.000	120	17.439	
to						0.0	0.0		0.0	
L638	91		62.82	1.049		0.0	8.000	1.0814	8.651	Vel = 23.32
L638	91		27.99	1.25	1E	3.0	8.500	120	26.090	
to					1T	6.0	9.000		-0.433	
MN10	92		90.81	1.38		0.0	17.500	0.5623	9.840	Vel = 19.48
			0.0							
MN10			90.81						35.497	K Factor = 15.24
L639	91		19.88	1		0.0	8.000	120	13.092	
to						0.0	0.0		0.0	
L640	91		19.88	1.049		0.0	8.000	0.1286	1.029	Vel = 7.38
L640	91		20.64	1		0.0	8.000	120	14.121	
to						0.0	0.0		0.0	
L641	91		40.52	1.049		0.0	8.000	0.4804	3.843	Vel = 15.04

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
L641	91		23.24	1		0.0	8.000	120	17.964	
to						0.0	0.0		0.0	
L642	91		63.76	1.049		0.0	8.000	1.1116	8.893	Vel = 23.67
L642	91		28.40	1.25	1E	3.0	8.500	120	26.857	
to					1T	6.0	9.000		-0.433	
MN11	92		92.16	1.38		0.0	17.500	0.5778	10.112	Vel = 19.77
			0.0							
MN11			92.16						36.536	K Factor = 15.25
*FEED MAIN										
MN01	92	.0	0.0	2.5		0.0	3.833	120	35.210	
to						0.0	0.0		0.0	
MN02	92		0.0	2.635		0.0	3.833	0	0.0	Vel = 0
MN02	92	.0	0.0	2.5		0.0	8.167	120	35.210	
to						0.0	0.0		0.0	
MN03	92		0.0	2.635		0.0	8.167	0	0.0	Vel = 0
MN03	92	.0	0.0	2.5		0.0	5.833	120	35.210	
to						0.0	0.0		0.0	
MN04	92		0.0	2.635		0.0	5.833	0	0.0	Vel = 0
MN04	92	.0	0.0	2.5		0.0	6.167	120	35.210	
to						0.0	0.0		0.0	
MN05	92		0.0	2.635		0.0	6.167	0	0.0	Vel = 0
MN05	92	.0	0.0	2.5		0.0	4.250	120	35.210	
to						0.0	0.0		0.0	
MN06	92		0.0	2.635		0.0	4.250	0	0.0	Vel = 0
MN06	92	.0	0.0	2.5		0.0	7.750	120	35.210	
to						0.0	0.0		0.0	
MN07	92		0.0	2.635		0.0	7.750	0	0.0	Vel = 0
MN07	92	.0	0.0	2.5		0.0	1.250	120	35.210	
to						0.0	0.0		0.0	
MN08	92		0.0	2.635		0.0	1.250	0	0.0	Vel = 0
MN08	92		90.43	2.5		0.0	10.750	120	35.210	
to						0.0	0.0		0.0	
MN09	92		90.43	2.635		0.0	10.750	0.0239	0.257	Vel = 5.32
MN09	92		0.0	2.5		0.0	1.250	120	35.467	
to						0.0	0.0		0.0	
MN10	92		90.43	2.635		0.0	1.250	0.0240	0.030	Vel = 5.32
MN10	92		90.81	2.5		0.0	12.000	120	35.497	
to						0.0	0.0		0.0	
MN11	92		181.24	2.635		0.0	12.000	0.0866	1.039	Vel = 10.66
MN11	92		92.16	2.5	2I	16.474	149.750	120	36.536	
to					1T	16.474	32.948		-0.577	
MN12	93.333		273.4	2.635		0.0	182.698	0.1851	33.825	Vel = 16.09
MN12	93.333		0.0	2.5	1I	8.237	32.833	120	69.784	
to					1T	16.474	24.711		0.0	
MN13	93.333		273.4	2.635		0.0	57.544	0.1851	10.654	Vel = 16.09
MN13	93.333		0.0	2.5	2I	16.474	26.417	120	80.438	
to					1T	16.474	32.948		0.974	
MN14	91.083		273.4	2.635		0.0	59.365	0.1852	10.992	Vel = 16.09

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
MN14	91.083		0.0	2.5	2I	16.474	9.667	120	92.404	
to						0.0	16.474		0.0	
TOR6	91.083		273.4	2.635		0.0	26.141	0.1851	4.840	Vel = 16.09
TOR6	91.083		0.0	2.5	1C	19.22	7.083	120	97.244	
to					1B	9.61	37.067		3.068	
BOR6	84		273.4	2.635	1I	8.237	44.150	0.1851	8.174	Vel = 16.09
BOR6	84		0.0	2.5	1T	16.474	1.000	120	108.486	
to						0.0	16.474		-0.433	
SP36	85		273.4	2.635		0.0	17.474	0.1851	3.235	Vel = 16.09
			0.0							
SP36			273.40						111.288	K Factor = 25.92
*S/P # 1										
HV1	99.750	.0	0.0	2.5	1T	12.0	0.250	120	104.098	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
			0.0							
SPRF			0.0						105.848	K Factor = 0
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	104.098	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750	.0	0.0	6	4I	40.0	30.000	120	105.848	
to						0.0	40.000		6.388	
SP16	85		0.0	6.065		0.0	70.000	0	0.0	Vel = 0
SP16	85	.0	0.0	6		0.0	16.000	120	112.236	
to						0.0	0.0		6.930	
SP15	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP15	69	.0	0.0	6		0.0	16.000	120	119.166	
to						0.0	0.0		6.930	
SP14	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP14	53	.0	0.0	6	1T	30.0	8.500	120	126.096	
to						0.0	30.000		3.465	
SP01	45		0.0	6.065		0.0	38.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						129.561	K Factor = 0
SP13	37	.0	0.0	6	1T	30.0	7.500	120	133.025	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						129.560	K Factor = 0
*S/P # 3										
HV3	101	.0	0.0	2.5	2E	12.0	1.750	120	102.608	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	101		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SPR3	101	.0	0.0	6		0.0	16.000	120	104.358	
to						0.0	0.0		6.930	
SP36	85		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP36	85	H50	323.40	6		0.0	16.000	120	111.288	
to						0.0	0.0		6.930	
SP35	69		323.4	6.065		0.0	16.000	0.0043	0.069	Vel = 3.59

Node1 / to / Node2	Elev1 / Elev2	K / Fact	Qa / Qt	Nom / Act	Fitting or Eqv.	Ln.	Pipe / Ftng's / Total	CFact / Pf/Ft	Pt / Pe / Pf	******* Notes ******
SP35	69	H50	50.00	6		0.0	16.000	120	118.287	
to						0.0	0.0		6.930	
SP34	53		373.4	6.065		0.0	16.000	0.0057	0.091	Vel = 4.15
SP34	53		0.0	6		0.0	16.000	120	125.308	
to						0.0	0.0		6.930	
SP33	37		373.4	6.065		0.0	16.000	0.0056	0.090	Vel = 4.15
SP33	37		0.0	6	1T	30.0	8.417	120	132.328	
to						0.0	30.000		3.392	
SP05	29.167		373.4	6.065		0.0	38.417	0.0057	0.219	Vel = 4.15
			0.0							
SP05			373.40						135.939	K Factor = 32.03
SP32	21	.0	0.0	6	1T	30.0	7.583	120	139.476	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167		373.40	6	1I	10.0	34.167	120	135.939	
to					1B	10.0	50.000		0.0	
SP03	29.167		373.4	6.065	1T	30.0	84.167	0.0057	0.479	Vel = 4.15
			0.0							
SP03			373.40						136.418	K Factor = 31.97
*STANDPIPE FEED										
SP01	45	.0	0.0	6	1B	10.0	34.417	120	129.560	
to					6I	60.0	70.000		7.399	
SP02	27.917		0.0	6.065		0.0	104.417	0	0.0	Vel = 0
SP02	27.917	.0	0.0	6	2I	20.0	235.417	120	136.959	
to						0.0	20.000		-0.541	
SP03	29.167		0.0	6.065		0.0	255.417	0	0.0	Vel = 0
SP03	29.167		373.40	6	4I	40.0	27.500	120	136.418	
to						0.0	40.000		0.469	
SP04	28.083		373.4	6.065		0.0	67.500	0.0057	0.384	Vel = 4.15
SP04	28.083		0.0	6	2I	20.0	79.330	120	137.271	
to						0.0	20.000		6.677	
SPC1	12.667		373.4	6.065		0.0	99.330	0.0057	0.564	Vel = 4.15
SPC1	12.667		0.0	6	1T	30.0	7.833	120	144.512	
to						0.0	30.000		0.0	
SPC2	12.667		373.4	6.065		0.0	37.833	0.0057	0.215	Vel = 4.15
SPC2	12.667		0.0	8	1I	13.0	14.750	120	144.727	
to					1B	12.0	70.000		4.692	
PO	1.833		373.4	7.981	1C	45.0	84.750	0.0015	0.127	Vel = 2.39
			0.0							
PO			373.40						149.546	K Factor = 30.53
System Demand Pressure						149.546				
Safety Margin						25.499				
Continuation Pressure						175.045				
Pressure @ Pump Outlet						175.045				
Pressure From Pump Curve						-124.263				
Pressure @ Pump Inlet						50.782				
PI	1.750		0.0	8	1G	4.0	14.000	120	50.782	
to					1I	13.0	52.000		-2.166	
POC	6.750		373.4	7.981	1T	35.0	66.000	0.0015	0.099	Vel = 2.39

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
POC to BF1	6.750 13		0.0 373.4	8 8.27	2E	56.936 0.0 0.0	41.000 56.936 97.936	140 0.0009	48.715 -2.707 0.093	 Vel = 2.23
BF1 to BF2	13 13		0.0 373.4	8 7.981	1Zic	0.0 0.0 0.0	4.000 0.0 4.000	120 0.0015	46.101 5.955 0.006	 * Fixed loss = 5.955 Vel = 2.39
BF2 to SRC	13 13		0.0 373.4	8 8.27	2E 1G 1T	56.936 6.326 55.354	46.000 118.616 164.616	140 0.0009	52.062 0.0 0.155	 Vel = 2.23
 SRC			150.00 523.40						 52.217	Qa = 150.00 K Factor = 72.43

AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science LVL 6 [R/A=4]
Building	:	FP-6.06E
Location	:	San Luis Obispo, Ca.
System	:	6-4
Contract	:	10034
Data File	:	Cal Poly CFS LVL 6-4.WXF

HYDRAULIC CALCULATIONS
for

Project name: Cal Poly Center For Science
Location: San Luis Obispo, Ca.
Drawing no: FP-6.06E
Date: 9-25-2011

Design

Remote area number: 6-4
Remote area location: 6 th. Floor Office/Lobby
Occupancy classification: Light Hazard
Density: 0.10 - Gpm/SqFt
Area of application: 1500 - SqFt
Coverage per sprinkler: 210 - SqFt
Type of sprinklers calculated: Tyco; Mod. TY-FRB; 1/2"; 1/2";K=5.6; 155 Deg
No. of sprinklers calculated: 14
In-rack demand: N/A - GPM
Hose streams: 100 - GPM
Total water required (including hose streams): 447.28 - GPM @ 39.09 - Psi
Type of system: WET
Volume of dry or preaction system: N/A - Gal

Water supply information

Date: 8-19-2011
Location: N. Poly View Drive
Source: Fluid Resource Management

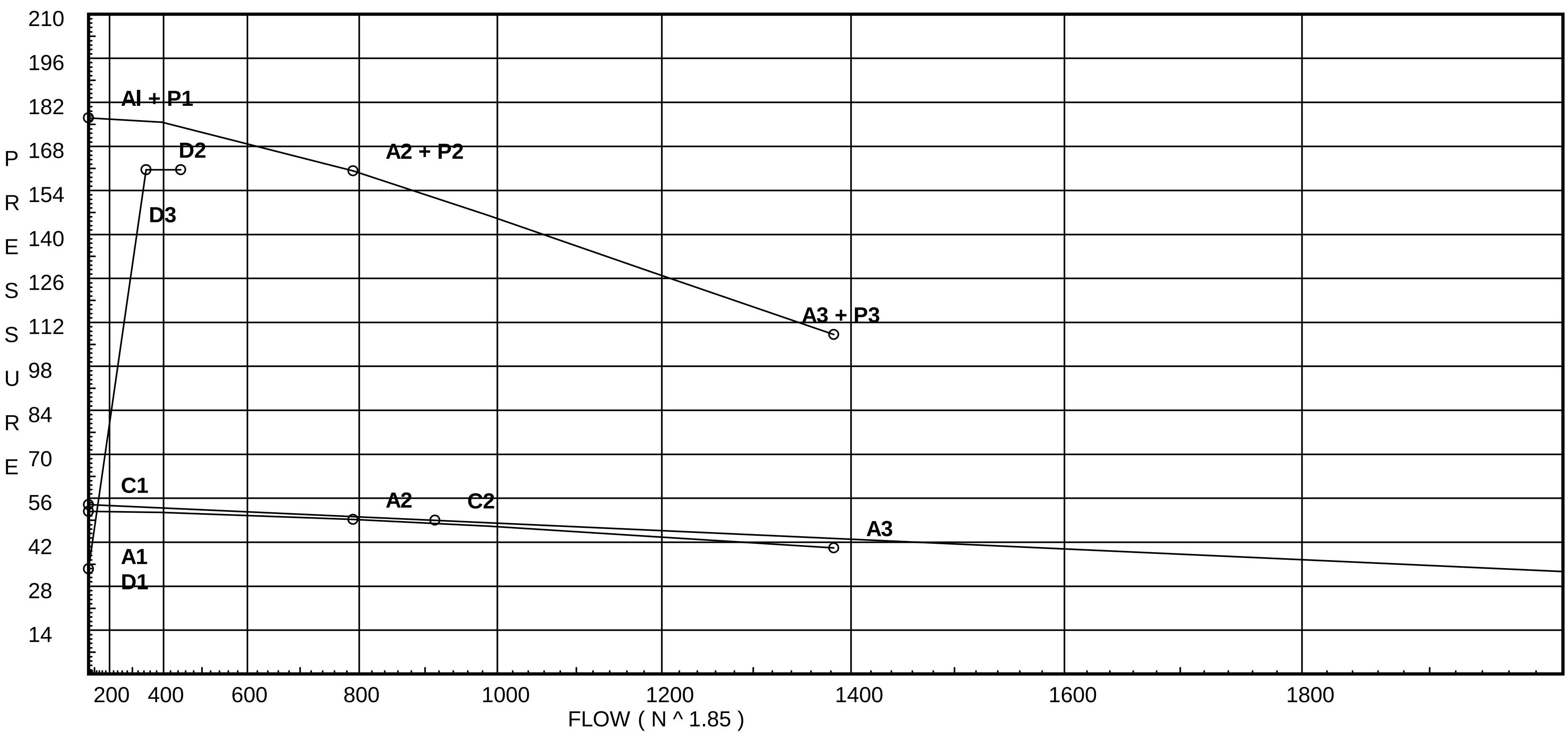
Name of contractor: Aero Automatic Sprinkler Co.
Address: 21605 N. Central Ave. Phoenix, Az. 85024
Phone number: 623-580-7847
Name of designer: Neal Larsen
Authority having jurisdiction: C.S.F.M.
Notes: (Include peaking information or gridded systems here.) Flow Test Information :
Hydrant # 63; Static = 60 psi; Res.= 55 psi {Elev.=351.0'}
Hydrant # 64; Flow = 914 gpm
FLOW TEST USED IN HYD. CALCS REDUCED BY 10 % [STATIC=54psi; RES.=49psi]

Water Supply Curve (C)

Aero Automatic Sprinkler Co.
Cal Poly Center for Science LVL 6 [R/A=4]

Page 2
Date 9-25-11

City Water Supply:		Pump Data:		Demand:	
C1 - Static Pressure	: 54	P1 - Pump Churn Pressure	: 125.2	D1 - Elevation	: 33.565
C2 - Residual Pressure:	49	P2 - Pump Rated Pressure	: 110.9	D2 - System Flow	: 347.282
C2 - Residual Flow	: 914	P2 - Pump Rated Flow	: 790.2	D2 - System Pressure	: 160.618
		P3 - Pump Pressure @ Max Flow	: 67.9	Hose (Adj City)	: ________
City Water Adjusted to Pump Inlet for Pf - Elev - Hose Flow		P3 - Pump Max Flow	: 1382.9	Hose (Demand)	: 100
		City Residual Flow @ 0	= 3307.91	D3 - System Demand	: 447.282
A1 - Adjusted Static:	51.872	City Residual Flow @ 20	= 2576.03	Safety Margin	: 13.576
A2 - Adj Resid	: 49.314 @ 790.2	City Water @ 150% of Pump	= 43.24		
A3 - Adj Resid	: 40.224 @ 1382.9				



Fittings Used Summary

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
S651	90.5	5.6	7.06	na	14.88	0.1	112	7.0
S652	90.5	5.6	7.0	na	14.82	0.1	143	7.0
S653	90.5	5.6	9.47	na	17.23	0.1	112	7.0
S654	90.5	5.6	11.3	na	18.82	0.1	154	7.0
S655	90.5	5.6	13.46	na	20.55	0.1	112	7.0
S656	90.5	5.6	14.84	na	21.57	0.1	180	7.0
S657	90.5	5.6	18.84	na	24.3	0.1	112	7.0
S658	90.5	5.6	20.38	na	25.28	0.1	150	7.0
S659	90.5	5.6	33.1	na	32.22	0.1	112	7.0
S660	90.5	5.6	27.64	na	29.44	0.1	168	7.0
S661	90.5	5.6	28.46	na	29.87	0.1	112	7.0
S662	90.5	5.6	34.26	na	32.78	0.1	210	7.0
S663	90.5	5.6	36.85	na	33.99	0.1	210	7.0
S664	90.5	5.6	31.71	na	31.53	0.1	168	7.0
L651	92.417		6.93	na				
L653	92.417		9.84	na				
L654	92.417		11.88	na				
L655	92.417		14.28	na				
L656	92.417		16.2	na				
L657	92.417		20.26	na				
L658	92.417		21.99	na				
L660	92.417		30.93	na				
MN01	92.0		59.45	na				
MN02	92.0		59.45	na				
MN03	92.0		59.45	na				
MN04	92.0		59.45	na				
MN05	92.0		59.45	na				
MN06	92.0		59.45	na				
MN07	92.0		59.45	na				
MN08	92.0		59.45	na				
MN09	92.0		59.45	na				
MN10	92.0		59.45	na				
MN11	92.0		59.45	na				
MN40	92.417		35.2	na				
MN41	92.417		35.21	na				
MN42	92.417		35.7	na				
MN43	92.417		38.45	na				
MN44	92.417		43.22	na				
MN45	92.417		48.23	na				
MN12	93.333		58.87	na				
MN13	93.333		75.45	na				
MN14	91.083		93.54	na				
TOR6	91.083		101.07	na				
BOR6	84.0		116.86	na				
HV1	99.75		114.66	na				
HV2	99.75		114.66	na				
SPRF	99.75		116.41	na				
SP16	85.0		122.8	na				
SP15	69.0		129.73	na				
SP14	53.0		136.66	na				
SP13	37.0		143.59	na				
HV3	101.0		112.79	na				
SPR3	101.0		114.54	na				
SP36	85.0		121.47	na	50.0			
SP35	69.0		128.5	na	50.0			
SP34	53.0		135.56	na				
SP33	37.0		142.61	na				
SP32	21.0		149.85	na				
SP05	29.167		146.31	na				
SP01	45.0		140.12	na				
SP02	27.917		147.52	na				
SP03	29.167		146.98	na				

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
SP04	28.083		147.98	na				
SPC1	12.667		155.45	na				
SPC2	12.667		155.75	na				
PO	1.833		160.62	na				
PI	1.75		51.35	na				
POC	6.75		49.32	na				
BF1	13.0		46.74	na				
BF2	13.0		52.45	na				
SRC	13.0		52.67	na				

The maximum velocity is 24.81 and it occurs in the pipe between nodes L658 and MN41

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*FLOWING SPRINKLER R/A # 4										
S651	90.5	5.60	14.88	1	2E	4.0	5.333	120	7.057	
to						0.0	4.000		-0.830	
L651	92.417		14.88	1.049		0.0	9.333	0.0752	0.702	Vel = 5.52
			0.0							
L651			14.88						6.929	K Factor = 5.65
S652	90.5	5.60	14.82	1	1E	2.0	3.167	120	7.000	
to					1T	5.0	7.000		-0.830	
L651	92.417		14.82	1.049		0.0	10.167	0.0747	0.759	Vel = 5.50
			0.0							
L651			14.82						6.929	K Factor = 5.63
S653	90.5	5.60	17.23	1	1E	2.0	5.083	120	9.471	
to					1T	5.0	7.000		-0.830	
L653	92.417		17.23	1.049		0.0	12.083	0.0988	1.194	Vel = 6.40
			0.0							
L653			17.23						9.835	K Factor = 5.49
S654	90.5	5.60	18.82	1	1E	2.0	5.167	120	11.299	
to					1T	5.0	7.000		-0.830	
L654	92.417		18.82	1.049		0.0	12.167	0.1163	1.415	Vel = 6.99
			0.0							
L654			18.82						11.884	K Factor = 5.46
S655	90.5	5.60	20.54	1	1E	2.0	5.083	120	13.460	
to					1T	5.0	7.000		-0.830	
L655	92.417		20.54	1.049		0.0	12.083	0.1367	1.652	Vel = 7.62
			0.0							
L655			20.54						14.282	K Factor = 5.44
S656	90.5	5.60	21.57	1	2E	4.0	5.667	120	14.836	
to					1T	5.0	9.000		-0.830	
L656	92.417		21.57	1.049		0.0	14.667	0.1497	2.195	Vel = 8.01
			0.0							
L656			21.57						16.201	K Factor = 5.36
S657	90.5	5.60	24.30	1	1E	2.0	5.083	120	18.835	
to					1T	5.0	7.000		-0.830	
L657	92.417		24.3	1.049		0.0	12.083	0.1866	2.255	Vel = 9.02
			0.0							
L657			24.30						20.260	K Factor = 5.40
S658	90.5	5.60	25.28	1	1E	2.0	5.167	120	20.376	
to					1T	5.0	7.000		-0.830	
L658	92.417		25.28	1.049		0.0	12.167	0.2007	2.442	Vel = 9.38
			0.0							
L658			25.28						21.988	K Factor = 5.39
S659	90.5	5.60	32.22	1	1E	2.0	2.333	120	33.098	
to					1T	5.0	7.000		-0.830	
MN40	92.417		32.22	1.049		0.0	9.333	0.3143	2.933	Vel = 11.96
			0.0							
MN40			32.22						35.201	K Factor = 5.43
S660	90.5	5.60	29.44	1	2E	4.0	6.500	120	27.635	
to					1T	5.0	9.000		-0.830	
L660	92.417		29.44	1.049		0.0	15.500	0.2661	4.124	Vel = 10.93

Node1	Elev1	K	Qa	Nom	Fitting		Pipe	CFact	Pt	******* Notes ******
to					or		Ftng's		Pe	
Node2	Elev2	Fact	Qt	Act	Eqv.	Ln.	Total	Pf/Ft	Pf	
			0.0							
L660			29.44						30.929	K Factor = 5.29
S661	90.5	5.60	29.87	1	1E	2.0	5.083	120	28.456	
to					1T	5.0	7.000		-0.830	
L660	92.417		29.87	1.049		0.0	12.083	0.2734	3.303	Vel = 11.09
			0.0							
L660			29.87						30.929	K Factor = 5.37
S662	90.500	5.60	32.78	1	1T	5.0	2.000	120	34.263	
to						0.0	5.000		-0.830	
MN42	92.417		32.78	1.049		0.0	7.000	0.3246	2.272	Vel = 12.17
			0.0							
MN42			32.78						35.705	K Factor = 5.49
S663	90.500	5.60	33.99	1	1T	5.0	2.000	120	36.846	
to						0.0	5.000		-0.830	
MN43	92.417		33.99	1.049		0.0	7.000	0.3471	2.430	Vel = 12.62
			0.0							
MN43			33.99						38.446	K Factor = 5.48
S664	90.500	5.60	31.53	1	3E	6.0	24.833	120	31.709	
to					2T	10.0	16.000		-0.830	
MN44	92.417		31.53	1.049		0.0	40.833	0.3021	12.337	Vel = 11.70
			0.0							
MN44			31.53						43.216	K Factor = 4.80
*BRANCH LINES R/A # 4										
L651	92.417		29.69	1		0.0	10.750	120	6.929	
to						0.0	0.0		0.0	
L653	92.417		29.69	1.049		0.0	10.750	0.2703	2.906	Vel = 11.02
L653	92.417		17.24	1		0.0	3.250	120	9.835	
to						0.0	0.0		0.0	
L654	92.417		46.93	1.049		0.0	3.250	0.6305	2.049	Vel = 17.42
L654	92.417		18.82	1.25		0.0	7.750	120	11.884	
to						0.0	0.0		0.0	
L655	92.417		65.75	1.38		0.0	7.750	0.3094	2.398	Vel = 14.10
L655	92.417		20.55	1.25		0.0	3.750	120	14.282	
to						0.0	0.0		0.0	
L656	92.417		86.3	1.38		0.0	3.750	0.5117	1.919	Vel = 18.51
L656	92.417		21.57	1.25		0.0	5.250	120	16.201	
to						0.0	0.0		0.0	
L657	92.417		107.87	1.38		0.0	5.250	0.7731	4.059	Vel = 23.14
L657	92.417		24.30	1.5		0.0	3.250	120	20.260	
to						0.0	0.0		0.0	
L658	92.417		132.17	1.61		0.0	3.250	0.5317	1.728	Vel = 20.83
L658	92.417		25.28	1.5	1T	8.0	10.000	120	21.988	
to						0.0	8.000		0.0	
MN41	92.417		157.45	1.61		0.0	18.000	0.7347	13.224	Vel = 24.81
			0.0							
MN41			157.45						35.212	K Factor = 26.53
L660	92.417		59.31	1.25	1T	6.0	10.750	120	30.929	
to						0.0	6.000		0.0	
MN41	92.417		59.31	1.38		0.0	16.750	0.2557	4.283	Vel = 12.72

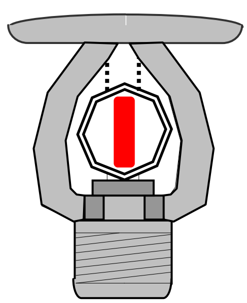
Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
MN41			59.31						35.212	K Factor = 9.99
*FEED MAIN										
MN01	92	.0	0.0	2.5		0.0	3.833	120	59.446	
to						0.0	0.0		0.0	
MN02	92		0.0	2.635		0.0	3.833	0	0.0	Vel = 0
MN02	92	.0	0.0	2.5		0.0	8.167	120	59.446	
to						0.0	0.0		0.0	
MN03	92		0.0	2.635		0.0	8.167	0	0.0	Vel = 0
MN03	92	.0	0.0	2.5		0.0	5.833	120	59.446	
to						0.0	0.0		0.0	
MN04	92		0.0	2.635		0.0	5.833	0	0.0	Vel = 0
MN04	92	.0	0.0	2.5		0.0	6.167	120	59.446	
to						0.0	0.0		0.0	
MN05	92		0.0	2.635		0.0	6.167	0	0.0	Vel = 0
MN05	92	.0	0.0	2.5		0.0	4.250	120	59.446	
to						0.0	0.0		0.0	
MN06	92		0.0	2.635		0.0	4.250	0	0.0	Vel = 0
MN06	92	.0	0.0	2.5		0.0	7.750	120	59.446	
to						0.0	0.0		0.0	
MN07	92		0.0	2.635		0.0	7.750	0	0.0	Vel = 0
MN07	92	.0	0.0	2.5		0.0	1.250	120	59.446	
to						0.0	0.0		0.0	
MN08	92		0.0	2.635		0.0	1.250	0	0.0	Vel = 0
MN08	92	.0	0.0	2.5		0.0	10.750	120	59.446	
to						0.0	0.0		0.0	
MN09	92		0.0	2.635		0.0	10.750	0	0.0	Vel = 0
MN09	92	.0	0.0	2.5		0.0	1.250	120	59.446	
to						0.0	0.0		0.0	
MN10	92		0.0	2.635		0.0	1.250	0	0.0	Vel = 0
MN10	92	.0	0.0	2.5		0.0	12.000	120	59.446	
to						0.0	0.0		0.0	
MN11	92		0.0	2.635		0.0	12.000	0	0.0	Vel = 0
MN11	92	.0	0.0	2.5	2l	16.474	149.750	120	59.446	
to					1T	16.474	32.948		-0.577	
MN12	93.333		0.0	2.635		0.0	182.698	0	0.0	Vel = 0
			0.0							
MN12			0.0						58.869	K Factor = 0
MN40	92.417		32.22	2.5		0.0	3.083	120	35.201	
to						0.0	0.0		0.0	
MN41	92.417		32.22	2.635		0.0	3.083	0.0036	0.011	Vel = 1.90
MN41	92.417		216.76	2.5		0.0	3.167	120	35.212	
to						0.0	0.0		0.0	
MN42	92.417		248.98	2.635		0.0	3.167	0.1557	0.493	Vel = 14.65
MN42	92.417		32.78	2.5		0.0	14.000	120	35.705	
to						0.0	0.0		0.0	
MN43	92.417		281.76	2.635		0.0	14.000	0.1958	2.741	Vel = 16.58

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	 Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
MN43	92.417		33.99	2.5	1I	8.237	11.500	120	38.446	
to						0.0	8.237		0.0	
MN44	92.417		315.75	2.635		0.0	19.737	0.2417	4.770	Vel = 18.58
MN44	92.417		31.53	2.5	1T	16.474	0.917	120	43.216	
to						0.0	16.474		0.0	
MN45	92.417		347.28	2.635		0.0	17.391	0.2882	5.012	Vel = 20.43
MN45	92.417		0.0	2.5	3I	24.711	13.583	120	48.228	
to						0.0	24.711		-0.397	
MN12	93.333		347.28	2.635		0.0	38.294	0.2882	11.037	Vel = 20.43
MN12	93.333		0.0	2.5	1I	8.237	32.833	120	58.868	
to					1T	16.474	24.711		0.0	
MN13	93.333		347.28	2.635		0.0	57.544	0.2882	16.585	Vel = 20.43
MN13	93.333		0.0	2.5	2I	16.474	26.417	120	75.453	
to					1T	16.474	32.948		0.974	
MN14	91.083		347.28	2.635		0.0	59.365	0.2882	17.111	Vel = 20.43
MN14	91.083		0.0	2.5	2I	16.474	9.667	120	93.538	
to						0.0	16.474		0.0	
TOR6	91.083		347.28	2.635		0.0	26.141	0.2882	7.534	Vel = 20.43
TOR6	91.083		0.0	2.5	1C	19.22	7.083	120	101.072	
to					1B	9.61	37.067		3.068	
BOR6	84		347.28	2.635	1I	8.237	44.150	0.2882	12.724	Vel = 20.43
BOR6	84		0.0	2.5	1T	16.474	1.000	120	116.864	
to						0.0	16.474		-0.433	
SP36	85		347.28	2.635		0.0	17.474	0.2882	5.036	Vel = 20.43
			0.0							
SP36			347.28						121.467	K Factor = 31.51
*S/P # 1										
HV1	99.750	.0	0.0	2.5	1T	12.0	0.250	120	114.659	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
			0.0							
SPRF			0.0						116.409	K Factor = 0
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	114.659	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750	.0	0.0	6	4I	40.0	30.000	120	116.409	
to						0.0	40.000		6.388	
SP16	85		0.0	6.065		0.0	70.000	0	0.0	Vel = 0
SP16	85	.0	0.0	6		0.0	16.000	120	122.797	
to						0.0	0.0		6.930	
SP15	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP15	69	.0	0.0	6		0.0	16.000	120	129.726	
to						0.0	0.0		6.930	
SP14	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP14	53	.0	0.0	6	1T	30.0	8.500	120	136.656	
to						0.0	30.000		3.465	
SP01	45		0.0	6.065		0.0	38.500	0	0.0	Vel = 0
			0.0							

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SP01			0.0						140.121	K Factor = 0
SP13	37	.0	0.0	6	1T	30.0	7.500	120	143.586	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						140.121	K Factor = 0
*S/P # 3										
HV3	101	.0	0.0	2.5	2E	12.0	1.750	120	112.788	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	101		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SPR3	101	.0	0.0	6		0.0	16.000	120	114.538	
to						0.0	0.0		6.930	
SP36	85		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP36	85	H50	397.28	6		0.0	16.000	120	121.467	
to						0.0	0.0		6.930	
SP35	69		397.28	6.065		0.0	16.000	0.0064	0.102	Vel = 4.41
SP35	69	H50	50.00	6		0.0	16.000	120	128.499	
to						0.0	0.0		6.930	
SP34	53		447.28	6.065		0.0	16.000	0.0079	0.127	Vel = 4.97
SP34	53		0.0	6		0.0	16.000	120	135.556	
to						0.0	0.0		6.930	
SP33	37		447.28	6.065		0.0	16.000	0.0079	0.126	Vel = 4.97
SP33	37		0.0	6	1T	30.0	8.417	120	142.612	
to						0.0	30.000		3.392	
SP05	29.167		447.28	6.065		0.0	38.417	0.0080	0.306	Vel = 4.97
			0.0							
SP05			447.28						146.310	K Factor = 36.98
SP32	21	.0	0.0	6	1T	30.0	7.583	120	149.847	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167		447.28	6	1I	10.0	34.167	120	146.310	
to					1B	10.0	50.000		0.0	
SP03	29.167		447.28	6.065	1T	30.0	84.167	0.0079	0.668	Vel = 4.97
			0.0							
SP03			447.28						146.978	K Factor = 36.89
*STANDPIPE FEED										
SP01	45	.0	0.0	6	1B	10.0	34.417	120	140.121	
to					6I	60.0	70.000		7.399	
SP02	27.917		0.0	6.065		0.0	104.417	0	0.0	Vel = 0
SP02	27.917	.0	0.0	6	2I	20.0	235.417	120	147.519	
to						0.0	20.000		-0.541	
SP03	29.167		0.0	6.065		0.0	255.417	0	0.0	Vel = 0
SP03	29.167		447.28	6	4I	40.0	27.500	120	146.978	
to						0.0	40.000		0.469	
SP04	28.083		447.28	6.065		0.0	67.500	0.0079	0.536	Vel = 4.97
SP04	28.083		0.0	6	2I	20.0	79.330	120	147.983	
to						0.0	20.000		6.677	
SPC1	12.667		447.28	6.065		0.0	99.330	0.0079	0.789	Vel = 4.97

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SPC1	12.667		0.0	6	1T	30.0	7.833	120	155.449	
to						0.0	30.000		0.0	
SPC2	12.667		447.28	6.065		0.0	37.833	0.0079	0.300	Vel = 4.97
SPC2	12.667		0.0	8	1I	13.0	14.750	120	155.749	
to					1B	12.0	70.000		4.692	
PO	1.833		447.28	7.981	1C	45.0	84.750	0.0021	0.177	Vel = 2.87
			0.0							
PO			447.28						160.618	K Factor = 35.29
System Demand Pressure						160.618				
Safety Margin						13.576				
Continuation Pressure						174.194				
Pressure @ Pump Outlet						174.194				
Pressure From Pump Curve						-122.847				
Pressure @ Pump Inlet						51.347				
PI	1.750		0.0	8	1G	4.0	14.000	120	51.347	
to					1I	13.0	52.000		-2.166	
POC	6.750		447.28	7.981	1T	35.0	66.000	0.0021	0.138	Vel = 2.87
POC	6.750		0.0	8	2E	56.936	41.000	140	49.319	
to						0.0	56.936		-2.707	
BF1	13		447.28	8.27		0.0	97.936	0.0013	0.130	Vel = 2.67
BF1	13		0.0	8	1Zic	0.0	4.000	120	46.742	
to						0.0	0.0		5.700	* Fixed loss = 5.7
BF2	13		447.28	7.981		0.0	4.000	0.0020	0.008	Vel = 2.87
BF2	13		0.0	8	2E	56.936	46.000	140	52.450	
to					1G	6.326	118.616		0.0	
SRC	13		447.28	8.27	1T	55.354	164.616	0.0013	0.217	Vel = 2.67
			0.0							
SRC			447.28						52.667	K Factor = 61.63

5



Standpipe # 1 [1000 & 750]

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AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science SP 1-1 [1000 GPM]
Building	:	Center for Science
Location	:	San Luis Obispo, Ca.
System	:	S/P # 1
Contract	:	10034
Data File	:	Cal Poly CFS SP 1-1.WXF

HYDRAULIC DESIGN INFORMATION SHEET

```
Name - Cal Poly Center For Science                       Date - 9-25-2011
Location - San Luis Obispo,  Ca.
Building - Center for Science                   System No. - S/P # 1
Contractor - Aero Automatic Sprinkler Co.       Contract No. - 10034
Calculated By - Neal Larsen                     Drawing No. -
Occupancy - Light / Ordinary Hazard Gr. 1

S   (X)NFPA 14     Number of Standpipes  ( )1 ( )2 ( )3 (X)4 ( )
Y   ( )Other
S   ( )Specific Ruling                  Made by            Date
T
E    Flow at Top Most Outlet          - 500   Gpm         System Type
M    Pres. at Top Most Outlet         - 100   Psi    (X) Wet       ( ) Dry
     Flow For Ea. Additional Standpipe - 500   Gpm
D    Total Additional Flow            - 1000  Gpm
E    Elevation at Highest Outlet      - 69'-0" Feet
S    Hose Valve Connection    ( )1 1/2"    (X)2 1/2"
I    Class Service    (X)I    ( )II    (X)III
G    Note:At 5 th level there are three (3) standpipes available.
N    {Standpipe # 1, 3 & 4}

Calculation   Gpm Required 1000     Psi Required 47.18    At SRC
Summary       C-Factor Used:         Overhead 120          Underground 140

W   Water Flow Test:              Pump Data:          Tank or Reservoir:
A   Date of Test   - 9-19-2011                         Cap.  N/A
T   Time of Test   - 9:12 a.m.   Rated Cap. 750      Elev. N/A
E   Static (Psi)   - 60 [54]     @ Psi      113
R   Residual (Psi) - 55 [49]     Elev.      1'-9"           Well
    Flow (Gpm)     - 914                               Proof Flow Gpm N/A
S   Elevation      - 13'-0"
U
P   Location: Static & Residual pressures taken from Hydratn # 63.  Flow taken
P   from Hydrant # 64 along N. Poly View Drive
L   Source of Information: Fluid Resource Management  {R. Ellison}
Y   Note : Flow test used in Hyd. Calculations was reduced by 10 %
```

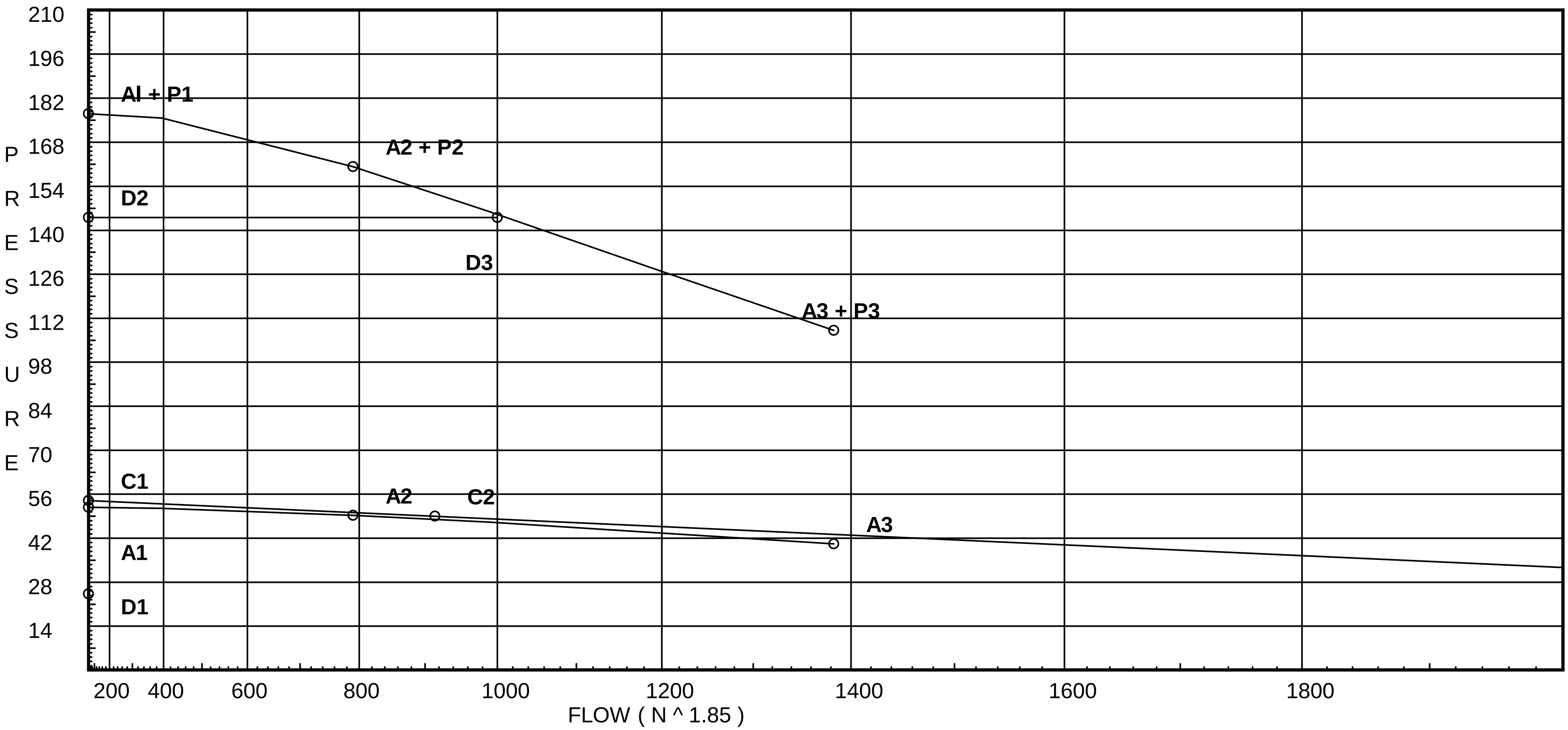
Aero Automatic Sprinkler Co.
Cal Poly Center for Science SP 1-1 [1000 GPM]

City Water Supply:
- C1 - Static Pressure : 54
- C2 - Residual Pressure: 49
- C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
- A1 - Adjusted Static: 51.872
- A2 - Adj Resid : 49.314 @ 790.2
- A3 - Adj Resid : 40.224 @ 1382.9

Pump Data:
- P1 - Pump Churn Pressure : 125.2
- P2 - Pump Rated Pressure : 110.9
- P2 - Pump Rated Flow : 790.2
- P3 - Pump Pressure @ Max Flow : 67.9
- P3 - Pump Max Flow : 1382.9
  - City Residual Flow @ 0 = 3307.91
  - City Residual Flow @ 20 = 2576.03
  - City Water @ 150% of Pump = 43.24

Demand:
- D1 - Elevation : 24.254
- D2 - System Flow : ________
- D2 - System Pressure : 144.081
- Hose (Adj City) : ________
- Hose (Demand) : 1000
- D3 - System Demand : 1000
- Safety Margin : 0.911



Fittings Used Summary

Aero Automatic Sprinkler Co.
Cal Poly Center for Science SP 1-1 [1000 GPM]

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Aero Automatic Sprinkler Co. Page 4
Cal Poly Center for Science SP 1-1 [1000 GPM] Date 9-25-11

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
HV1	99.75		91.19	na				
HV2	99.75		91.19	na				
SPRF	99.75		92.94	na				
SP16	85.0		99.33	na				
HV4	69.0		100.0	na	250.0			
HV5	53.0		106.97	na	250.0			
SP15	69.0		106.26	na				
SP14	53.0		113.23	na				
SP13	37.0		120.53	na				
HV3	101.0		88.52	na	250.0			
SPR3	101.0		95.82	na				
SP36	85.0		102.8	na				
HV6	69.0		108.02	na				
HV7	53.0		114.99	na				
SP35	69.0		109.77	na				
SP34	53.0		116.74	na				
SP33	37.0		123.71	na				
SP32	21.0		130.75	na				
SP05	29.167		127.21	na				
SP01	45.0		117.07	na				
SP02	27.917		125.49	na				
SP03	29.167		127.44	na				
SP04	28.083		129.3	na				
SPC1	12.667		137.82	na				
SPC2	12.667		138.61	na	250.0			
PO	1.833		144.08	na				
PI	1.75		46.96	na				
POC	6.75		45.4	na				
BF1	13.0		43.27	na				
BF2	13.0		47.13	na				
SRC	13.0		48.1	na				

The maximum velocity is 16.75 and it occurs in the pipe between nodes HV4 and SP15

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*S/P # 1 REMOTE ROOF HOSE VALVES										
HV1	99.750	.0	0.0	2.5	1T	12.0	0.250	120	91.188	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
			0.0							
SPRF			0.0						92.938	K Factor = 0
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	91.188	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750	.0	0.0	6	4I	40.0	30.000	120	92.938	
to						0.0	40.000		6.388	
SP16	85		0.0	6.065		0.0	70.000	0	0.0	Vel = 0
SP16	85	.0	0.0	6		0.0	16.000	120	99.326	
to						0.0	0.0		6.930	
SP15	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
			0.0							
SP15			0.0						106.256	K Factor = 0
HV4	69	H250	250.00	2.5	1T	12.0	2.917	120	100.000	
to					1E	6.0	18.000		1.750	* Fixed loss = 1.75
SP15	69		250.0	2.469		0.0	20.917	0.2154	4.506	Vel = 16.75
			0.0							
SP15			250.00						106.256	K Factor = 24.25
HV5	53	H250	250.00	2.5	1T	12.0	2.917	120	106.973	
to					1E	6.0	18.000		1.750	* Fixed loss = 1.75
SP14	53		250.0	2.469		0.0	20.917	0.2154	4.506	Vel = 16.75
			0.0							
SP14			250.00						113.229	K Factor = 23.49
SP15	69		250.00	6		0.0	16.000	120	106.256	
to						0.0	0.0		6.930	
SP14	53		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78
SP14	53		250.00	6	1T	30.0	8.500	120	113.229	
to						0.0	30.000		3.465	
SP01	45		500.0	6.065		0.0	38.500	0.0097	0.375	Vel = 5.55
			0.0							
SP01			500.00						117.069	K Factor = 46.21
SP13	37	.0	0.0	6	1T	30.0	7.500	120	120.534	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						117.069	K Factor = 0
*S/P # 3										
HV3	101	H250	250.00	2.5	2E	12.0	1.750	120	88.525	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	101		250.0	2.469		0.0	25.750	0.2154	5.547	Vel = 16.75
SPR3	101		0.0	6		0.0	16.000	120	95.822	
to						0.0	0.0		6.930	
SP36	85		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SP36	85		0.0	6		0.0	16.000	120	102.795	
to						0.0	0.0		6.930	
SP35	69		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78
			0.0							
SP35			250.00						109.768	K Factor = 23.86
HV6	69	.0	0.0	2.5	2E	12.0	1.750	120	108.018	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SP35	69		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
			0.0							
SP35			0.0						109.768	K Factor = 0
HV7	53	.0	0.0	2.5	2E	12.0	1.750	120	114.990	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SP34	53		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
			0.0							
SP34			0.0						116.740	K Factor = 0
SP35	69		250.00	6		0.0	16.000	120	109.768	
to						0.0	0.0		6.930	
SP34	53		250.0	6.065		0.0	16.000	0.0026	0.042	Vel = 2.78
SP34	53		0.0	6		0.0	16.000	120	116.740	
to						0.0	0.0		6.930	
SP33	37		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78
SP33	37		0.0	6	1T	30.0	8.417	120	123.713	
to						0.0	30.000		3.392	
SP05	29.167		250.0	6.065		0.0	38.417	0.0027	0.105	Vel = 2.78
			0.0							
SP05			250.00						127.210	K Factor = 22.17
SP32	21	.0	0.0	6	1T	30.0	7.583	120	130.747	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167		250.00	6	1I	10.0	34.167	120	127.210	
to					1B	10.0	50.000		0.0	
SP03	29.167		250.0	6.065	1T	30.0	84.167	0.0027	0.228	Vel = 2.78
			0.0							
SP03			250.00						127.438	K Factor = 22.15
*STANDPIPE FEED										
SP01	45		500.00	6	6I	60.0	34.417	120	117.069	
to					1B	10.0	70.000		7.399	
SP02	27.917		500.0	6.065		0.0	104.417	0.0098	1.019	Vel = 5.55
SP02	27.917		0.0	6	2I	20.0	235.417	120	125.487	
to						0.0	20.000		-0.541	
SP03	29.167		500.0	6.065		0.0	255.417	0.0098	2.492	Vel = 5.55
SP03	29.167		250.00	6	4I	40.0	27.500	120	127.438	
to						0.0	40.000		0.469	
SP04	28.083		750.0	6.065		0.0	67.500	0.0207	1.395	Vel = 8.33
SP04	28.083		0.0	6	1I	10.0	79.330	120	129.302	
to						0.0	10.000		6.677	
SPC1	12.667		750.0	6.065		0.0	89.330	0.0207	1.845	Vel = 8.33

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SPC1 to SPC2	12.667 12.667		0.0 750.0	6 6.065	1T	30.0 0.0 0.0	7.833 30.000 37.833	120 0.0207	137.824 0.0 0.782	 Vel = 8.33
SPC2 to PO	12.667 1.833	H250	250.00 1000.0	8 7.981	1I 1B 1C	13.0 12.0 45.0	14.750 70.000 84.750	120 0.0092	138.606 4.692 0.783	 Vel = 6.41
 PO			0.0 1000.00						 144.081	 K Factor = 83.31
System Demand Pressure Safety Margin Continuation Pressure						144.081 0.911 144.992				
Pressure @ Pump Outlet Pressure From Pump Curve Pressure @ Pump Inlet						144.992 -98.034 46.958				
PI to POC	1.750 6.750		0.0 1000.0	8 7.981	1G 1I 1T	4.0 13.0 35.0	14.000 52.000 66.000	120 0.0093	46.958 -2.166 0.611	 Vel = 6.41
POC to BF1	6.750 13		0.0 1000.0	8 8.27	2E	56.936 0.0 0.0	41.000 56.936 97.936	140 0.0058	45.403 -2.707 0.572	 Vel = 5.97
BF1 to BF2	13 13		0.0 1000.0	8 7.981	1Zic	0.0 0.0 0.0	4.000 0.0 4.000	120 0.0090	43.268 3.829 0.036	 * Fixed loss = 3.829 Vel = 6.41
BF2 to SRC	13 13		0.0 1000.0	8 8.27	2E 1G 1T	56.936 6.326 55.354	46.000 118.616 164.616	140 0.0058	47.133 0.0 0.962	 Vel = 5.97
 SRC			0.0 1000.00						 48.095	 K Factor = 144.19

AUTOMATIC
SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science SP 1-2 [750 GPM]
Building	:	Center for Science
Location	:	San Luis Obispo, Ca.
System	:	S/P # 1
Contract	:	10034
Data File	:	Cal Poly CFS SP 1-2.WXF

HYDRAULIC DESIGN INFORMATION SHEET

```
Name - Cal Poly Center For Science                      Date - 9-25-2011
Location - San Luis Obispo,  Ca.
Building - Center for Science                      System No. - S/P # 1
Contractor - Aero Automatic Sprinkler Co.          Contract No. - 10034
Calculated By - Neal Larsen                        Drawing No. -
Occupancy - Light / Ordinary Hazard Gr. 1

S   (X)NFPA 14     Number of Standpipes  ( )1 ( )2 ( )3 (X)4 ( )
Y   ( )Other
S   ( )Specific Ruling                  Made by            Date
T
E    Flow at Top Most Outlet          - 500   Gpm          System Type
M    Pres. at Top Most Outlet         - 100   Psi    (X) Wet       ( ) Dry
     Flow For Ea. Additional Standpipe - 500   Gpm
D    Total Additional Flow            - 1000  Gpm
E    Elevation at Highest Outlet      - 99'-9" Feet
S    Hose Valve Connection    ( )1 1/2"    (X)2 1/2"
I    Class Service    (X)I    ( )II    (X)III
G    Note:At Roof level there are two (2) standpipes available.
N    {Standpipe # 1 & 3}

Calculation   Gpm Required 750      Psi Required 44.73    At SRC
Summary       C-Factor Used:         Overhead 120          Underground 140

W   Water Flow Test:              Pump Data:          Tank or Reservoir:
A   Date of Test   - 9-19-2011                         Cap.  N/A
T   Time of Test   - 9:12 a.m.   Rated Cap. 750      Elev. N/A
E   Static (Psi)   - 60 [54]     @ Psi      113
R   Residual (Psi) - 55 [49]     Elev.      1'-9"             Well
    Flow (Gpm)     - 914                               Proof Flow Gpm N/A
S   Elevation      - 13'-0"
U
P   Location: Static & Residual pressures taken from Hydratn # 63.  Flow taken
P   from Hydrant # 64 along N. Poly View Drive
L   Source of Information: Fluid Resource Management  {R. Ellison}
Y   Note : Flow test used in Hyd. Calculations was reduced by 10 %
```

Water Supply Curve (C)

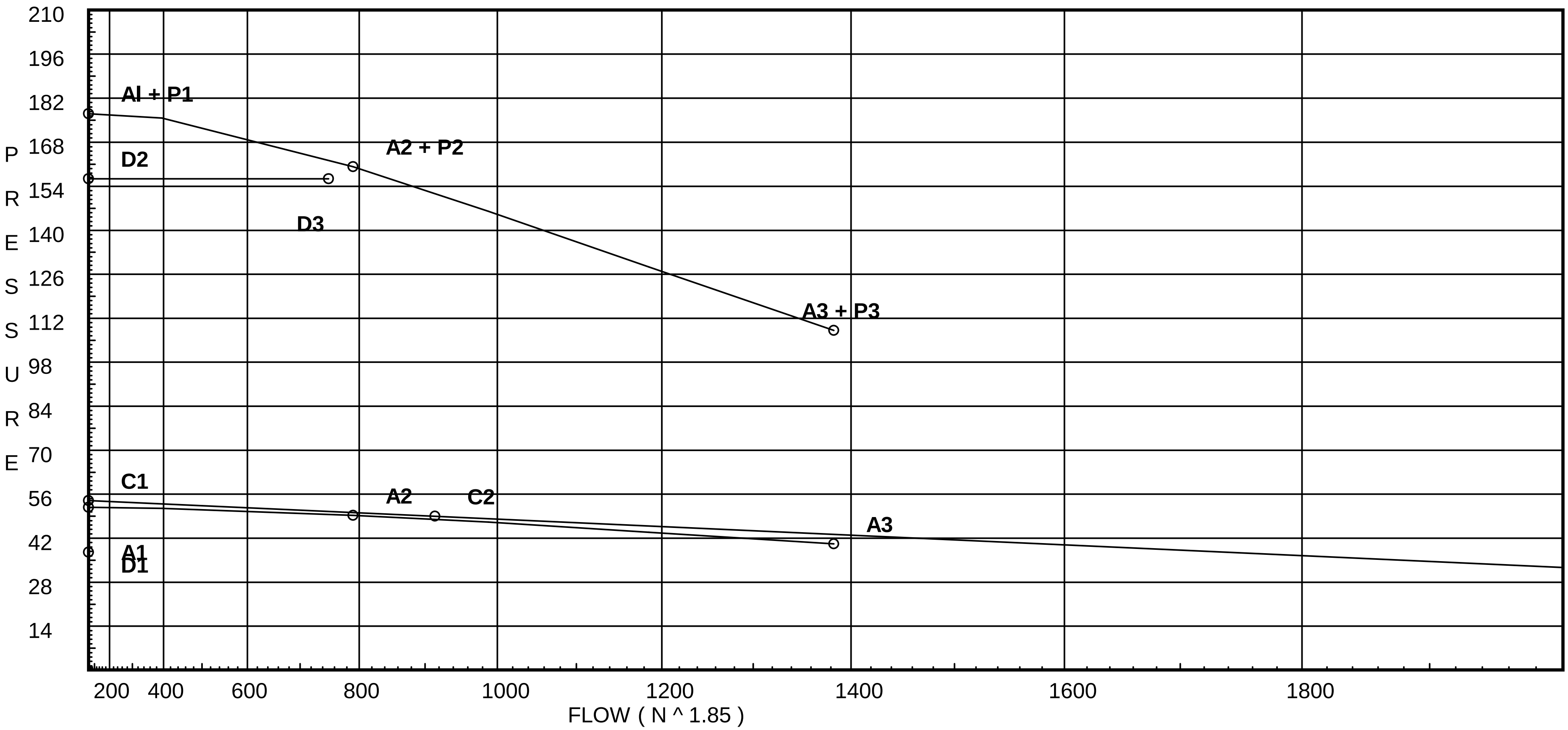
Aero Automatic Sprinkler Co.
Cal Poly Center for Science SP 1-2 [750 GPM]

City Water Supply:
- C1 - Static Pressure : 54
- C2 - Residual Pressure: 49
- C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
- A1 - Adjusted Static: 51.872
- A2 - Adj Resid : 49.314 @ 790.2
- A3 - Adj Resid : 40.224 @ 1382.9

Pump Data:
- P1 - Pump Churn Pressure : 125.2
- P2 - Pump Rated Pressure : 110.9
- P2 - Pump Rated Flow : 790.2
- P3 - Pump Pressure @ Max Flow : 67.9
- P3 - Pump Max Flow : 1382.9
  - City Residual Flow @ 0 = 3307.91
  - City Residual Flow @ 20 = 2576.03
  - City Water @ 150% of Pump = 43.24

Demand:
- D1 - Elevation : 37.571
- D2 - System Flow : ________
- D2 - System Pressure : 156.367
- Hose (Adj City) : ________
- Hose (Demand) : 750
- D3 - System Demand : 750
- Safety Margin : 5.795



Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Aero Automatic Sprinkler Co. Page 4
Cal Poly Center for Science SP 1-2 [750 GPM] Date 9-25-11

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
HV1	99.75		100.0	na	250.0			
HV2	99.75		100.0	na	250.0			
SPRF	99.75		104.39	na				
SP16	85.0		111.46	na				
SP15	69.0		118.55	na				
SP14	53.0		125.63	na				
SP13	37.0		132.94	na				
HV3	101.0		100.93	na	250.0			
SPR3	101.0		108.22	na				
SP36	85.0		115.2	na				
SP35	69.0		122.17	na				
SP34	53.0		129.14	na				
SP33	37.0		136.12	na				
SP32	21.0		143.15	na				
SP05	29.167		139.61	na				
SP01	45.0		129.47	na				
SP02	27.917		137.89	na				
SP03	29.167		139.84	na				
SP04	28.083		141.71	na				
SPC1	12.667		150.43	na				
SPC2	12.667		151.22	na				
PO	1.833		156.37	na				
PI	1.75		49.6	na				
POC	6.75		47.8	na				
BF1	13.0		45.43	na				
BF2	13.0		49.97	na				
SRC	13.0		50.53	na				

The maximum velocity is 16.75 and it occurs in the pipe between nodes HV1 and SPRF

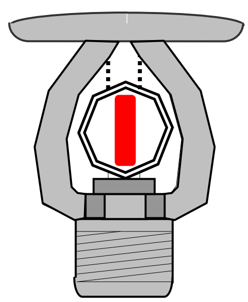
Node1	Elev1	K	Qa	Nom	Fitting		Pipe	CFact	Pt	******* Notes ******
to					or		Ftng's		Pe	
Node2	Elev2	Fact	Qt	Act	Eqv.	Ln.	Total	Pf/Ft	Pf	
*S/P # 1 REMOTE ROOF HOSE VALVES										
HV1	99.750	H250	250.00	2.5	1T	12.0	0.250	120	100.000	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		250.0	2.469		0.0	12.250	0.2154	2.639	Vel = 16.75
			0.0							
SPRF			250.00						104.389	K Factor = 24.47
HV2	99.750	H250	250.00	2.5	1T	12.0	0.250	120	100.000	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		250.0	2.469		0.0	12.250	0.2154	2.639	Vel = 16.75
SPRF	99.750		250.00	6	4I	40.0	30.000	120	104.389	
to						0.0	40.000		6.388	
SP16	85		500.0	6.065		0.0	70.000	0.0098	0.683	Vel = 5.55
SP16	85		0.0	6		0.0	16.000	120	111.460	
to						0.0	0.0		6.930	
SP15	69		500.0	6.065		0.0	16.000	0.0098	0.156	Vel = 5.55
SP15	69		0.0	6		0.0	16.000	120	118.546	
to						0.0	0.0		6.930	
SP14	53		500.0	6.065		0.0	16.000	0.0098	0.156	Vel = 5.55
SP14	53		0.0	6	1T	30.0	8.500	120	125.632	
to						0.0	30.000		3.465	
SP01	45		500.0	6.065		0.0	38.500	0.0097	0.375	Vel = 5.55
			0.0							
SP01			500.00						129.472	K Factor = 43.94
SP13	37	.0	0.0	6	1T	30.0	7.500	120	132.937	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						129.472	K Factor = 0
*S/P # 3										
HV3	101	H250	250.00	2.5	2E	12.0	1.750	120	100.928	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	101		250.0	2.469		0.0	25.750	0.2154	5.547	Vel = 16.75
SPR3	101		0.0	6		0.0	16.000	120	108.225	
to						0.0	0.0		6.930	
SP36	85		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78
SP36	85		0.0	6		0.0	16.000	120	115.198	
to						0.0	0.0		6.930	
SP35	69		250.0	6.065		0.0	16.000	0.0026	0.042	Vel = 2.78
SP35	69		0.0	6		0.0	16.000	120	122.170	
to						0.0	0.0		6.930	
SP34	53		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78
SP34	53		0.0	6		0.0	16.000	120	129.143	
to						0.0	0.0		6.930	
SP33	37		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78
SP33	37		0.0	6	1T	30.0	8.417	120	136.116	
to						0.0	30.000		3.392	
SP05	29.167		250.0	6.065		0.0	38.417	0.0027	0.105	Vel = 2.78

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
SP05			250.00						139.613	K Factor = 21.16
SP32	21	.0	0.0	6	1T	30.0	7.583	120	143.150	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167		250.00	6	1I	10.0	34.167	120	139.613	
to					1B	10.0	50.000		0.0	
SP03	29.167		250.0	6.065	1T	30.0	84.167	0.0027	0.228	Vel = 2.78
			0.0							
SP03			250.00						139.841	K Factor = 21.14
*STANDPIPE FEED										
SP01	45		500.00	6	1B	10.0	34.417	120	129.472	
to					6I	60.0	70.000		7.399	
SP02	27.917		500.0	6.065		0.0	104.417	0.0098	1.019	Vel = 5.55
SP02	27.917		0.0	6	2I	20.0	235.417	120	137.890	
to						0.0	20.000		-0.541	
SP03	29.167		500.0	6.065		0.0	255.417	0.0098	2.492	Vel = 5.55
SP03	29.167		250.00	6	4I	40.0	27.500	120	139.841	
to						0.0	40.000		0.469	
SP04	28.083		750.0	6.065		0.0	67.500	0.0207	1.395	Vel = 8.33
SP04	28.083		0.0	6	2I	20.0	79.330	120	141.705	
to						0.0	20.000		6.677	
SPC1	12.667		750.0	6.065		0.0	99.330	0.0206	2.051	Vel = 8.33
SPC1	12.667		0.0	6	1T	30.0	7.833	120	150.433	
to						0.0	30.000		0.0	
SPC2	12.667		750.0	6.065		0.0	37.833	0.0207	0.782	Vel = 8.33
SPC2	12.667		0.0	8	1I	13.0	14.750	120	151.215	
to					1B	12.0	70.000		4.692	
PO	1.833		750.0	7.981	1C	45.0	84.750	0.0054	0.460	Vel = 4.81
			0.0							
PO			750.00						156.367	K Factor = 59.98
System Demand Pressure						156.367				
Safety Margin						5.795				
Continuation Pressure						162.162				
Pressure @ Pump Outlet						162.162				
Pressure From Pump Curve						-112.559				
Pressure @ Pump Inlet						49.603				
PI	1.750		0.0	8	1G	4.0	14.000	120	49.603	
to					1I	13.0	52.000		-2.166	
POC	6.750		750.0	7.981	1T	35.0	66.000	0.0054	0.359	Vel = 4.81
POC	6.750		0.0	8	2E	56.936	41.000	140	47.796	
to						0.0	56.936		-2.707	
BF1	13		750.0	8.27		0.0	97.936	0.0034	0.336	Vel = 4.48
BF1	13		0.0	8	1Zic	0.0	4.000	120	45.425	
to						0.0	0.0		4.520	* Fixed loss = 4.52
BF2	13		750.0	7.981		0.0	4.000	0.0055	0.022	Vel = 4.81
BF2	13		0.0	8	2E	56.936	46.000	140	49.967	
to					1G	6.326	118.616		0.0	
SRC	13		750.0	8.27	1T	55.354	164.616	0.0034	0.565	Vel = 4.48

Final Calculations - Hazen-Williams - 2007

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
SRC			0.0 750.00						50.532	K Factor = 105.51

6



Standpipe # 4 [1000]

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AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science SP 4 [1000 GPM]
Building	:	Center for Science
Location	:	San Luis Obispo, Ca.
System	:	S/P # 4
Contract	:	10034
Data File	:	Cal Poly CFS SP 1-3.WXF

HYDRAULIC DESIGN INFORMATION SHEET

```
Name - Cal Poly Center For Science                         Date - 9-25-2011
Location - San Luis Obispo,  Ca.
Building - Center for Science                     System No. - S/P # 4
Contractor - Aero Automatic Sprinkler Co.         Contract No. - 10034
Calculated By - Neal Larsen                       Drawing No. -
Occupancy - Light / Ordinary Hazard Gr. 1
```

```
S   (X)NFPA 14     Number of Standpipes  ( )1 ( )2 ( )3 (X)4 ( )
Y   ( )Other
S   ( )Specific Ruling                  Made by            Date
T
E    Flow at Top Most Outlet          - 500   Gpm         System Type
M    Pres. at Top Most Outlet         - 100   Psi    (X) Wet       ( ) Dry
     Flow For Ea. Additional Standpipe - 500   Gpm
D    Total Additional Flow            - 1000  Gpm
E    Elevation at Highest Outlet      - 67'-9" Feet
S    Hose Valve Connection    ( )1 1/2"    (X)2 1/2"
I    Class Service    (X)I    ( )II    (X)III
G    Note:At 5 th level (Roof) there are three (3) standpipes available.
N    {Standpipe # 1, 3 & 4}
```

```
Calculation   Gpm Required 1000     Psi Required 45.85    At SRC
Summary       C-Factor Used:         Overhead 120         Underground 140
```

```
W   Water Flow Test:              Pump Data:          Tank or Reservoir:
A   Date of Test   - 9-19-2011                       Cap.  N/A
T   Time of Test   - 9:12 a.m.   Rated Cap. 750      Elev. N/A
E   Static (Psi)   - 60 [54]     @ Psi      113
R   Residual (Psi) - 55 [49]     Elev.      1'-9"           Well
    Flow (Gpm)     - 914                             Proof Flow Gpm N/A
S   Elevation      - 13'-0"
U
P   Location: Static & Residual pressures taken from Hydratn # 63.  Flow taken
P   from Hydrant # 64 along N. Poly View Drive
L   Source of Information: Fluid Resource Management  {R. Ellison}
Y   Note : Flow test used in Hyd. Calculations was reduced by 10 %.
```

Water Supply Curve (C)

Aero Automatic Sprinkler Co.
Cal Poly Center for Science SP 4 [1000 GPM]

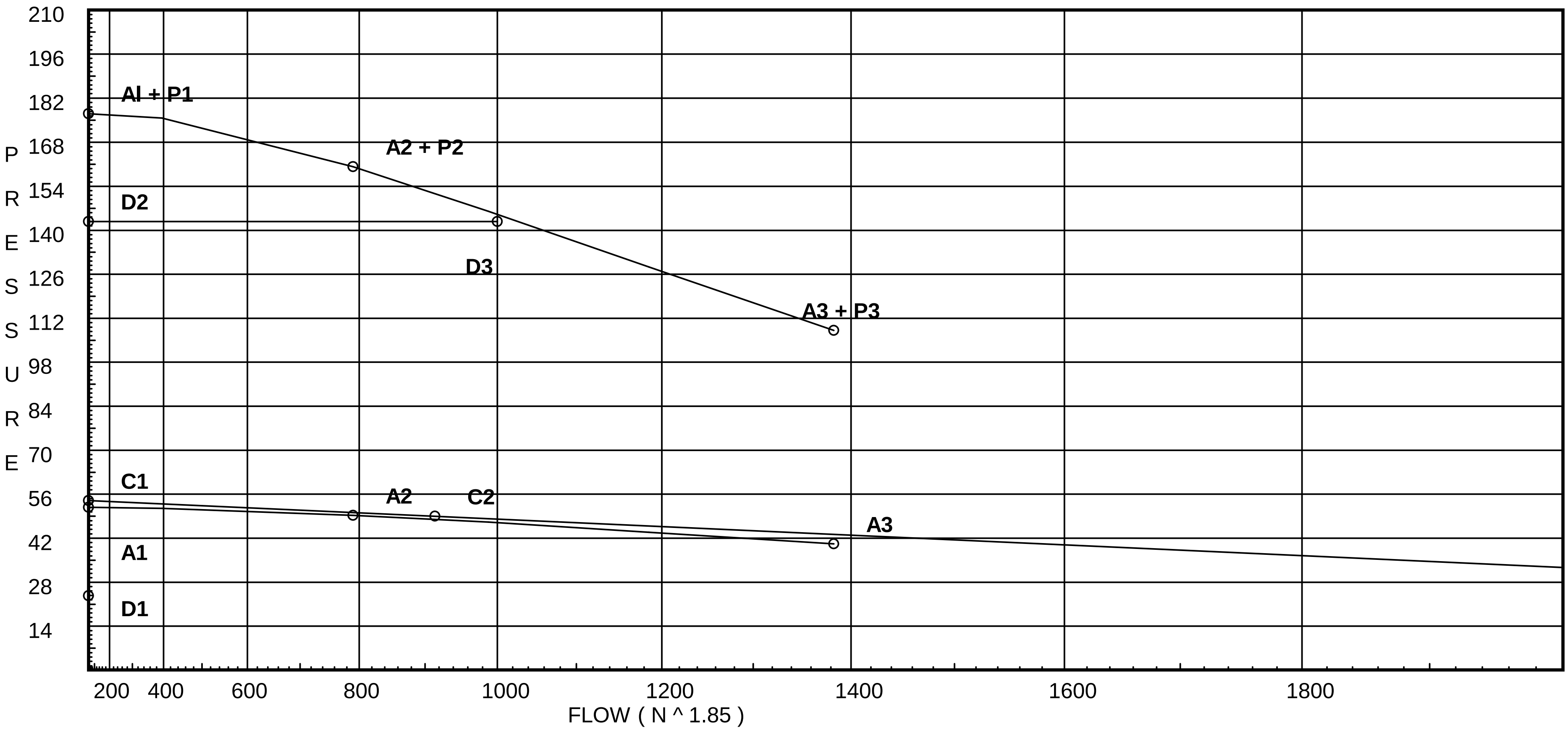
Page 2
Date 9-25-11

City Water Supply:
C1 - Static Pressure : 54
C2 - Residual Pressure: 49
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
A1 - Adjusted Static: 51.872
A2 - Adj Resid : 49.314 @ 790.2
A3 - Adj Resid : 40.224 @ 1382.9

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 790.2
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 1382.9
City Residual Flow @ 0 = 3307.91
City Residual Flow @ 20 = 2576.03
City Water @ 150% of Pump = 43.24

Demand:
D1 - Elevation : 23.712
D2 - System Flow : ________
D2 - System Pressure : 142.748
Hose (Adj City) : ________
Hose (Demand) : 1000
D3 - System Demand : 1000
Safety Margin : 2.244



Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
HV1	99.75		93.26	na	250.0			
HV2	99.75		95.9	na				
SPRF	99.75		97.65	na				
SP16	85.0		104.23	na				
SP15	69.0		111.2	na				
SP14	53.0		118.17	na				
SP13	37.0		125.21	na				
HV3	99.0		97.58	na				
SPR3	99.0		99.33	na				
SP36	85.0		105.39	na				
SP35	69.0		112.32	na				
SP34	53.0		119.25	na				
SP33	37.0		126.18	na				
SP32	21.0		133.11	na				
SP05	29.167		129.57	na				
HV8	67.75		100.0	na	250.0			
HV9	67.75		100.0	na	250.0			
SPR4	67.75		104.39	na				
SP44	53.0		111.84	na				
SP43	37.0		119.91	na				
SP42	21.0		127.99	na				
SP41	5.0		136.88	na				
HV10	37.0		111.24	na	250.0			
SP53	37.0		118.54	na				
HV11	21.0		124.04	na				
SP52	21.0		125.79	na				
SP51	5.0		133.28	na				
SPC5	12.5		130.04	na				
SPC4	13.75		133.09	na				
SPC3	12.667		134.08	na				
SP01	45.0		121.74	na				
SP02	27.917		129.42	na				
SP03	29.167		129.57	na				
SP04	28.083		130.22	na				
SPC1	12.667		137.17	na				
SPC2	12.667		137.27	na				
PO	1.833		142.75	na				
PI	1.75		46.96	na				
POC	6.75		45.4	na				
BF1	13.0		43.27	na				
BF2	13.0		47.13	na				
SRC	13.0		48.09	na				

The maximum velocity is 16.75 and it occurs in the pipe between nodes HV1 and SPRF

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*S/P # 1 REMOTE ROOF HOSE VALVES										
HV1	99.750	H250	250.00	2.5	1T	12.0	0.250	120	93.260	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		250.0	2.469		0.0	12.250	0.2154	2.639	Vel = 16.75
			0.0							
SPRF			250.00						97.649	K Factor = 25.30
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	95.899	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750		250.00	6	4I	40.0	30.000	120	97.649	
to						0.0	40.000		6.388	
SP16	85		250.0	6.065		0.0	70.000	0.0027	0.190	Vel = 2.78
SP16	85		0.0	6		0.0	16.000	120	104.227	
to						0.0	0.0		6.930	
SP15	69		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78
SP15	69		0.0	6		0.0	16.000	120	111.200	
to						0.0	0.0		6.930	
SP14	53		250.0	6.065		0.0	16.000	0.0026	0.042	Vel = 2.78
SP14	53		0.0	6	1T	30.0	8.500	120	118.172	
to						0.0	30.000		3.465	
SP01	45		250.0	6.065		0.0	38.500	0.0027	0.104	Vel = 2.78
			0.0							
SP01			250.00						121.741	K Factor = 22.66
SP13	37	.0	0.0	6	1T	30.0	7.500	120	125.206	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						121.741	K Factor = 0
*S/P # 3										
HV3	99	.0	0.0	2.5	2E	12.0	1.750	120	97.578	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	99		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SPR3	99	.0	0.0	6		0.0	16.000	120	99.328	
to						0.0	0.0		6.063	
SP36	85		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP36	85	.0	0.0	6		0.0	16.000	120	105.391	
to						0.0	0.0		6.930	
SP35	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP35	69	.0	0.0	6		0.0	16.000	120	112.321	
to						0.0	0.0		6.930	
SP34	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP34	53	.0	0.0	6		0.0	16.000	120	119.251	
to						0.0	0.0		6.930	
SP33	37		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP33	37	.0	0.0	6	1T	30.0	8.417	120	126.180	
to						0.0	30.000		3.392	
SP05	29.167		0.0	6.065		0.0	38.417	0	0.0	Vel = 0

Node1	Elev1	K	Qa	Nom	Fitting		Pipe	CFact	Pt	******* Notes ******
to					or		Ftng's		Pe	
Node2	Elev2	Fact	Qt	Act	Eqv.	Ln.	Total	Pf/Ft	Pf	
			0.0							
SP05			0.0						129.572	K Factor = 0
SP32	21	.0	0.0	6	1T	30.0	7.583	120	133.110	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167	.0	0.0	6	1I	10.0	34.167	120	129.573	
to					1B	10.0	50.000		0.0	
SP03	29.167		0.0	6.065	1T	30.0	84.167	0	0.0	Vel = 0
			0.0							
SP03			0.0						129.573	K Factor = 0
*S/P # 4										
HV8	67.750	H250	250.00	2.5	1T	12.0	0.250	120	100.000	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPR4	67.750		250.0	2.469		0.0	12.250	0.2154	2.639	Vel = 16.75
			0.0							
SPR4			250.00						104.389	K Factor = 24.47
HV9	67.750	H250	250.00	2.5	1T	12.0	0.250	120	100.000	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPR4	67.750		250.0	2.469		0.0	12.250	0.2154	2.639	Vel = 16.75
SPR4	67.750		250.00	4		0.0	14.750	120	104.389	
to						0.0	0.0		6.388	
SP44	53		500.0	4.026		0.0	14.750	0.0718	1.059	Vel = 12.60
SP44	53		0.0	4		0.0	16.000	120	111.836	
to						0.0	0.0		6.930	
SP43	37		500.0	4.026		0.0	16.000	0.0718	1.148	Vel = 12.60
SP43	37		0.0	4		0.0	16.000	120	119.914	
to						0.0	0.0		6.930	
SP42	21		500.0	4.026		0.0	16.000	0.0718	1.148	Vel = 12.60
SP42	21		0.0	4	1T	20.0	7.250	120	127.992	
to						0.0	20.000		3.140	
SPC4	13.750		500.0	4.026		0.0	27.250	0.0718	1.956	Vel = 12.60
			0.0							
SPC4			500.00						133.088	K Factor = 43.34
SP41	5	.0	0.0	4	1T	20.0	8.750	120	136.878	
to						0.0	20.000		-3.790	
SPC4	13.750		0.0	4.026		0.0	28.750	0	0.0	Vel = 0
			0.0							
SPC4			0.0						133.088	K Factor = 0
*S/P # 5										
HV10	37	H250	250.00	2.5	2E	12.0	1.750	120	111.241	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SP53	37		250.0	2.469		0.0	25.750	0.2154	5.547	Vel = 16.75
SP53	37		0.0	4		0.0	16.000	120	118.538	
to						0.0	0.0		6.930	
SP52	21		250.0	4.026		0.0	16.000	0.0199	0.318	Vel = 6.30
			0.0							
SP52			250.00						125.786	K Factor = 22.29

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	 Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
HV11	21	.0	0.0	2.5	2E	12.0	1.750	120	124.036	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SP52	21		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SP52	21		250.00	4	1T	20.0	8.500	120	125.786	
to						0.0	20.000		3.681	
SPC5	12.500		250.0	4.026		0.0	28.500	0.0199	0.568	Vel = 6.30
			0.0							
SPC5			250.00						130.035	K Factor = 21.92
SP51	5	.0	0.0	4	1T	20.0	7.500	120	133.283	
to						0.0	20.000		-3.248	
SPC5	12.500		0.0	4.026		0.0	27.500	0	0.0	Vel = 0
			0.0							
SPC5			0.0						130.035	K Factor = 0
*STANDPIPES # 4 & 5 FEED										
SPC5	12.500		250.00	4	1B	12.0	139.667	120	130.035	
to					5I	35.0	67.000		-0.072	
SPC3	12.667		250.0	4.026	1T	20.0	206.667	0.0199	4.114	Vel = 6.30
			0.0							
SPC3			250.00						134.077	K Factor = 21.59
SPC4	13.750		500.00	6	3I	30.0	13.333	120	133.088	
to					1B	10.0	40.000		0.469	
SPC3	12.667		500.0	6.065		0.0	53.333	0.0098	0.520	Vel = 5.55
SPC3	12.667		250.00	6	2I	20.0	104.667	120	134.077	
to					1T	30.0	50.000		0.0	
SPC2	12.667		750.0	6.065		0.0	154.667	0.0207	3.196	Vel = 8.33
			0.0							
SPC2			750.00						137.273	K Factor = 64.01
*STANDPIPES # 1 & 3 FEED										
SP01	45		250.00	6	6I	60.0	34.417	120	121.741	
to					1B	10.0	70.000		7.399	
SP02	27.917		250.0	6.065		0.0	104.417	0.0027	0.283	Vel = 2.78
SP02	27.917		0.0	6	2I	20.0	235.417	120	129.423	
to						0.0	20.000		-0.541	
SP03	29.167		250.0	6.065		0.0	255.417	0.0027	0.691	Vel = 2.78
SP03	29.167		0.0	6	4I	40.0	27.500	120	129.573	
to						0.0	40.000		0.469	
SP04	28.083		250.0	6.065		0.0	67.500	0.0027	0.183	Vel = 2.78
SP04	28.083		0.0	6	2I	20.0	79.330	120	130.225	
to						0.0	20.000		6.677	
SPC1	12.667		250.0	6.065		0.0	99.330	0.0027	0.268	Vel = 2.78
SPC1	12.667		0.0	6	1T	30.0	7.833	120	137.170	
to						0.0	30.000		0.0	
SPC2	12.667		250.0	6.065		0.0	37.833	0.0027	0.103	Vel = 2.78
SPC2	12.667		750.00	8	1I	13.0	14.750	120	137.273	
to					1B	12.0	70.000		4.692	
PO	1.833		1000.0	7.981	1C	45.0	84.750	0.0092	0.783	Vel = 6.41
			0.0							

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
PO			1000.00						142.748	K Factor = 83.70
System Demand Pressure						142.748				
Safety Margin						2.244				
Continuation Pressure						144.992				
Pressure @ Pump Outlet						144.992				
Pressure From Pump Curve						-98.033				
Pressure @ Pump Inlet						46.959				
PI	1.750		0.0	8	1G	4.0	14.000	120	46.959	
to					1I	13.0	52.000		-2.166	
POC	6.750		1000.0	7.981	1T	35.0	66.000	0.0092	0.610	Vel = 6.41
POC	6.750		0.0	8	2E	56.936	41.000	140	45.403	
to						0.0	56.936		-2.707	
BF1	13		1000.0	8.27		0.0	97.936	0.0058	0.572	Vel = 5.97
BF1	13		0.0	8	1Zic	0.0	4.000	120	43.268	
to						0.0	0.0		3.829	* Fixed loss = 3.829
BF2	13		1000.0	7.981		0.0	4.000	0.0092	0.037	Vel = 6.41
BF2	13		0.0	8	2E	56.936	46.000	140	47.134	
to					1G	6.326	118.616		0.0	
SRC	13		1000.0	8.27	1T	55.354	164.616	0.0058	0.961	Vel = 5.97
			0.0							
SRC			1000.00						48.095	K Factor = 144.19

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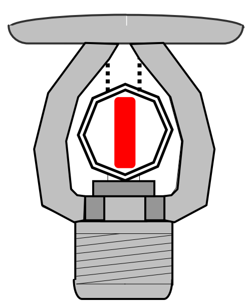
7



Standpipe # 5 [1000]

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AUTOMATIC
SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name : Cal Poly Center for Science SP 5 [1000 GPM]
Building : Center for Science
Location : San Luis Obispo, Ca.
System : S/P # 5
Contract : 10034
Data File : Cal Poly CFS SP 1-4.WXF

HYDRAULIC DESIGN INFORMATION SHEET

```
Name - Cal Poly Center For Science                         Date - 9-25-2011
Location - San Luis Obispo,  Ca.
Building - Center for Science                     System No. - S/P # 5
Contractor - Aero Automatic Sprinkler Co.         Contract No. - 10034
Calculated By - Neal Larsen                       Drawing No. -
Occupancy - Light / Ordinary Hazard Gr. 1
```

```
S   (X)NFPA 14     Number of Standpipes  ( )1 ( )2 ( )3 (X)4 ( )
Y   ( )Other
S   ( )Specific Ruling                  Made by             Date
T
E    Flow at Top Most Outlet           - 500   Gpm         System Type
M    Pres. at Top Most Outlet          - 100   Psi    (X) Wet       ( ) Dry
     Flow For Ea. Additional Standpipe - 500   Gpm
D    Total Additional Flow             - 1000  Gpm
E    Elevation at Highest Outlet       - 37'-0" Feet
S    Hose Valve Connection    ( )1 1/2"    (X)2 1/2"
I    Class Service    (X)I    ( )II    (X)III
G    Note:At 3 rd. level there are four (4) standpipes available.
N    {Standpipe # 1, 3, 4 & 5}
```

```
Calculation   Gpm Required 1000     Psi Required 46.80    At SRC
Summary       C-Factor Used:         Overhead 120          Underground 140
```

```
W   Water Flow Test:              Pump Data:          Tank or Reservoir:
A   Date of Test   - 9-19-2011                         Cap.  N/A
T   Time of Test   - 9:12 a.m.   Rated Cap. 750      Elev. N/A
E   Static (Psi)   - 60 [54]     @ Psi      113
R   Residual (Psi) - 55 [49]     Elev.      1'-9"           Well
    Flow (Gpm)     - 914                               Proof Flow Gpm N/A
S   Elevation      - 13'-0"
U
P   Location: Static & Residual pressures taken from Hydratn # 63.  Flow taken
P   from Hydrant # 64 along N. Poly View Drive
L   Source of Information: Fluid Resource Management  {R. Ellison}
Y   Note : Flow test used in Hyd. Calculations was reduced by 10 %.
```

Water Supply Curve (C)

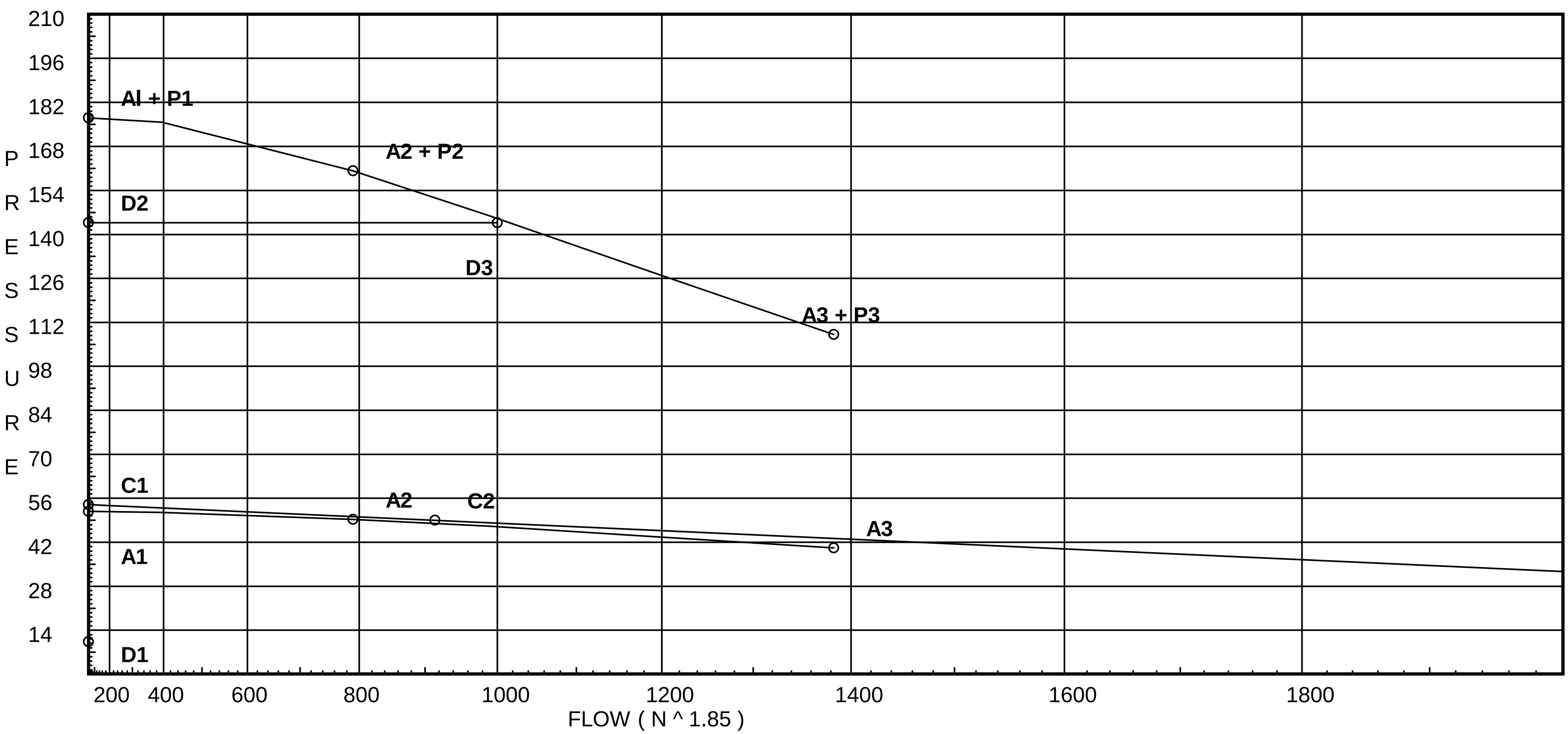
Aero Automatic Sprinkler Co.
Cal Poly Center for Science SP 5 [1000 GPM]

City Water Supply:
C1 - Static Pressure : 54
C2 - Residual Pressure: 49
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
A1 - Adjusted Static: 51.872
A2 - Adj Resid : 49.314 @ 790.2
A3 - Adj Resid : 40.224 @ 1382.9

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 790.2
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 1382.9
City Residual Flow @ 0 = 3307.91
City Residual Flow @ 20 = 2576.03
City Water @ 150% of Pump = 43.24

Demand:
D1 - Elevation : 10.394
D2 - System Flow : ________
D2 - System Pressure : 143.705
Hose (Adj City) : ________
Hose (Demand) : 1000
D3 - System Demand : 1000
Safety Margin : 1.287



Fittings Used Summary

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Aero Automatic Sprinkler Co. | Page 4
Cal Poly Center for Science SP 5 [1000 GPM] | Date 9-25-11

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
HV1	99.75		94.22	na	250.0			
HV2	99.75		96.86	na				
SPRF	99.75		98.61	na				
SP16	85.0		105.18	na				
SP15	69.0		112.16	na				
SP14	53.0		119.13	na				
SP13	37.0		126.16	na				
HV3	99.0		98.54	na				
SPR3	99.0		100.28	na				
SP36	85.0		106.35	na				
SP35	69.0		113.28	na				
SP34	53.0		120.21	na				
SP33	37.0		127.14	na				
SP32	21.0		134.07	na				
SP05	29.167		130.53	na				
HV8	67.75		105.17	na	250.0			
HV9	67.75		107.81	na				
SPR4	67.75		109.56	na				
SP44	53.0		116.24	na				
SP43	37.0		123.49	na				
SP42	21.0		130.74	na				
SP41	5.0		138.21	na				
HV10	37.0		100.0	na	250.0			
SP53	37.0		107.3	na				
HV11	21.0		107.25	na	250.0			
SP52	21.0		114.54	na				
SP51	5.0		123.52	na				
SPC5	12.5		120.27	na				
SPC4	13.75		134.42	na				
SPC3	12.667		135.04	na				
SP01	45.0		122.7	na				
SP02	27.917		130.38	na				
SP03	29.167		130.53	na				
SP04	28.083		131.18	na				
SPC1	12.667		138.13	na				
SPC2	12.667		138.23	na				
PO	1.833		143.71	na				
PI	1.75		46.96	na				
POC	6.75		45.4	na				
BF1	13.0		43.27	na				
BF2	13.0		47.13	na				
SRC	13.0		48.09	na				

The maximum velocity is 16.75 and it occurs in the pipe between nodes HV1 and SPRF

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*S/P # 1 REMOTE ROOF HOSE VALVES										
HV1	99.750	H250	250.00	2.5	1T	12.0	0.250	120	94.217	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		250.0	2.469		0.0	12.250	0.2154	2.639	Vel = 16.75
			0.0							
SPRF			250.00						98.606	K Factor = 25.18
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	96.856	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750		250.00	6	4I	40.0	30.000	120	98.606	
to						0.0	40.000		6.388	
SP16	85		250.0	6.065		0.0	70.000	0.0027	0.190	Vel = 2.78
SP16	85		0.0	6		0.0	16.000	120	105.184	
to						0.0	0.0		6.930	
SP15	69		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78
SP15	69		0.0	6		0.0	16.000	120	112.157	
to						0.0	0.0		6.930	
SP14	53		250.0	6.065		0.0	16.000	0.0027	0.043	Vel = 2.78
SP14	53		0.0	6	1T	30.0	8.500	120	119.130	
to						0.0	30.000		3.465	
SP01	45		250.0	6.065		0.0	38.500	0.0027	0.104	Vel = 2.78
			0.0							
SP01			250.00						122.699	K Factor = 22.57
SP13	37	.0	0.0	6	1T	30.0	7.500	120	126.163	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						122.698	K Factor = 0
*S/P # 3										
HV3	99	.0	0.0	2.5	2E	12.0	1.750	120	98.535	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	99		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SPR3	99	.0	0.0	6		0.0	16.000	120	100.285	
to						0.0	0.0		6.063	
SP36	85		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP36	85	.0	0.0	6		0.0	16.000	120	106.349	
to						0.0	0.0		6.930	
SP35	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP35	69	.0	0.0	6		0.0	16.000	120	113.278	
to						0.0	0.0		6.930	
SP34	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP34	53	.0	0.0	6		0.0	16.000	120	120.208	
to						0.0	0.0		6.930	
SP33	37		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP33	37	.0	0.0	6	1T	30.0	8.417	120	127.137	
to						0.0	30.000		3.392	
SP05	29.167		0.0	6.065		0.0	38.417	0	0.0	Vel = 0

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
SP05			0.0						130.529	K Factor = 0
SP32	21	.0	0.0	6	1T	30.0	7.583	120	134.067	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167	.0	0.0	6	1I	10.0	34.167	120	130.530	
to					1B	10.0	50.000		0.0	
SP03	29.167		0.0	6.065	1T	30.0	84.167	0	0.0	Vel = 0
			0.0							
SP03			0.0						130.530	K Factor = 0
*S/P # 4										
HV8	67.750	H250	250.00	2.5	1T	12.0	0.250	120	105.172	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPR4	67.750		250.0	2.469		0.0	12.250	0.2153	2.638	Vel = 16.75
			0.0							
SPR4			250.00						109.560	K Factor = 23.88
HV9	67.750	.0	0.0	2.5	1T	12.0	0.250	120	107.810	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPR4	67.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPR4	67.750		250.00	4		0.0	14.750	120	109.560	
to						0.0	0.0		6.388	
SP44	53		250.0	4.026		0.0	14.750	0.0199	0.294	Vel = 6.30
SP44	53		0.0	4		0.0	16.000	120	116.242	
to						0.0	0.0		6.930	
SP43	37		250.0	4.026		0.0	16.000	0.0199	0.318	Vel = 6.30
SP43	37		0.0	4		0.0	16.000	120	123.490	
to						0.0	0.0		6.930	
SP42	21		250.0	4.026		0.0	16.000	0.0199	0.319	Vel = 6.30
SP42	21		0.0	4	1T	20.0	7.250	120	130.739	
to						0.0	20.000		3.140	
SPC4	13.750		250.0	4.026		0.0	27.250	0.0199	0.542	Vel = 6.30
			0.0							
SPC4			250.00						134.421	K Factor = 21.56
SP41	5	.0	0.0	4	1T	20.0	8.750	120	138.211	
to						0.0	20.000		-3.790	
SPC4	13.750		0.0	4.026		0.0	28.750	0	0.0	Vel = 0
			0.0							
SPC4			0.0						134.421	K Factor = 0
*S/P # 5										
HV10	37	H250	250.00	2.5	2E	12.0	1.750	120	100.000	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SP53	37		250.0	2.469		0.0	25.750	0.2154	5.547	Vel = 16.75
SP53	37		0.0	4		0.0	16.000	120	107.297	
to						0.0	0.0		6.930	
SP52	21		250.0	4.026		0.0	16.000	0.0199	0.318	Vel = 6.30
			0.0							
SP52			250.00						114.545	K Factor = 23.36

Aero Automatic Sprinkler Co.
Cal Poly Center for Science SP 5 [1000 GPM]

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	 Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
HV11	21	H250	250.00	2.5	2E	12.0	1.750	120	107.248	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SP52	21		250.0	2.469		0.0	25.750	0.2154	5.547	Vel = 16.75
SP52	21		250.00	4	1T	20.0	8.500	120	114.545	
to						0.0	20.000		3.681	
SPC5	12.500		500.0	4.026		0.0	28.500	0.0718	2.046	Vel = 12.60
			0.0							
SPC5			500.00						120.272	K Factor = 45.59
SP51	5	.0	0.0	4	1T	20.0	7.500	120	123.520	
to						0.0	20.000		-3.248	
SPC5	12.500		0.0	4.026		0.0	27.500	0	0.0	Vel = 0
			0.0							
SPC5			0.0						120.272	K Factor = 0
*STANDPIPES # 4 & 5 FEED										
SPC5	12.500		500.00	4	1B	12.0	139.667	120	120.272	
to					5I	35.0	67.000		-0.072	
SPC3	12.667		500.0	4.026	1T	20.0	206.667	0.0718	14.835	Vel = 12.60
			0.0							
SPC3			500.00						135.035	K Factor = 43.03
SPC4	13.750		250.00	6	3I	30.0	13.333	120	134.421	
to					1B	10.0	40.000		0.469	
SPC3	12.667		250.0	6.065		0.0	53.333	0.0027	0.145	Vel = 2.78
SPC3	12.667		500.00	6	2I	20.0	104.667	120	135.035	
to					1T	30.0	50.000		0.0	
SPC2	12.667		750.0	6.065		0.0	154.667	0.0207	3.195	Vel = 8.33
			0.0							
SPC2			750.00						138.230	K Factor = 63.79
*STANDPIPES # 1 & 3 FEED										
SP01	45		250.00	6	6I	60.0	34.417	120	122.699	
to					1B	10.0	70.000		7.399	
SP02	27.917		250.0	6.065		0.0	104.417	0.0027	0.282	Vel = 2.78
SP02	27.917		0.0	6	2I	20.0	235.417	120	130.380	
to						0.0	20.000		-0.541	
SP03	29.167		250.0	6.065		0.0	255.417	0.0027	0.691	Vel = 2.78
SP03	29.167		0.0	6	4I	40.0	27.500	120	130.530	
to						0.0	40.000		0.469	
SP04	28.083		250.0	6.065		0.0	67.500	0.0027	0.183	Vel = 2.78
SP04	28.083		0.0	6	2I	20.0	79.330	120	131.182	
to						0.0	20.000		6.677	
SPC1	12.667		250.0	6.065		0.0	99.330	0.0027	0.269	Vel = 2.78
SPC1	12.667		0.0	6	1T	30.0	7.833	120	138.128	
to						0.0	30.000		0.0	
SPC2	12.667		250.0	6.065		0.0	37.833	0.0027	0.102	Vel = 2.78
SPC2	12.667		750.00	8	1I	13.0	14.750	120	138.230	
to					1B	12.0	70.000		4.692	
PO	1.833		1000.0	7.981	1C	45.0	84.750	0.0092	0.783	Vel = 6.41
			0.0							

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
PO			1000.00						143.705	K Factor = 83.42
System Demand Pressure						143.705				
Safety Margin						1.287				
Continuation Pressure						144.992				
Pressure @ Pump Outlet						144.992				
Pressure From Pump Curve						-98.033				
Pressure @ Pump Inlet						46.959				
PI	1.750		0.0	8	1G	4.0	14.000	120	46.959	
to					1I	13.0	52.000		-2.166	
POC	6.750		1000.0	7.981	1T	35.0	66.000	0.0092	0.610	Vel = 6.41
POC	6.750		0.0	8	2E	56.936	41.000	140	45.403	
to						0.0	56.936		-2.707	
BF1	13		1000.0	8.27		0.0	97.936	0.0058	0.572	Vel = 5.97
BF1	13		0.0	8	1Zic	0.0	4.000	120	43.268	
to						0.0	0.0		3.829	* Fixed loss = 3.829
BF2	13		1000.0	7.981		0.0	4.000	0.0092	0.037	Vel = 6.41
BF2	13		0.0	8	2E	56.936	46.000	140	47.134	
to					1G	6.326	118.616		0.0	
SRC	13		1000.0	8.27	1T	55.354	164.616	0.0058	0.961	Vel = 5.97
			0.0							
SRC			1000.00						48.095	K Factor = 144.19

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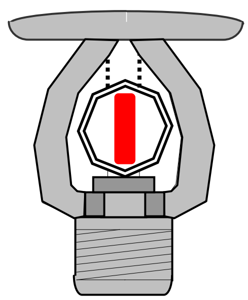
8



Standpipe Static & Flow for Pressure Reducing Valve Setting 'e'

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AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science SP - STATIC
Building	:	Center for Science
Location	:	San Luis Obispo, Ca.
System	:	S/P # 1,3,4,5
Contract	:	10034
Data File	:	Cal Poly CFS SP 1-1-STATIC.WXF

HYDRAULIC DESIGN INFORMATION SHEET

```
Name - Cal Poly Center For Science                           Date - 9-25-2011
Location - San Luis Obispo,  Ca.
Building - Center for Science                       System No. - S/P # 1,3,4,5
Contractor - Aero Automatic Sprinkler Co.           Contract No. - 10034
Calculated By - Neal Larsen                         Drawing No. -
Occupancy - Light / Ordinary Hazard Gr. 1

S   (X)NFPA 14     Number of Standpipes  ( )1 ( )2 ( )3 (X)4 ( )
Y   ( )Other
S   ( )Specific Ruling                  Made by             Date
T
E    Flow at Top Most Outlet          - 0.05  Gpm         System Type
M    Pres. at Top Most Outlet         - N/A   Psi    (X) Wet       ( ) Dry
     Flow For Ea. Additional Standpipe - N/A   Gpm
D    Total Additional Flow            - 0.05  Gpm
E    Elevation at Highest Outlet      - 101-0 Feet
S    Hose Valve Connection    ( )1 1/2"    (X)2 1/2"
I    Class Service    (X)I    ( )II    (X)III
G    Note:This is a static Calculation to determine were Pressure Reducing Va.
N    are required (only three (3) on 1 st. floor)

Calculation   Gpm Required 0.05     Psi Required 59.99    At SRC
Summary       C-Factor Used:         Overhead 120          Underground 140

W   Water Flow Test:              Pump Data:          Tank or Reservoir:
A   Date of Test   - 9-19-2011                         Cap.  N/A
T   Time of Test   - 9:12 a.m.   Rated Cap. 750      Elev. N/A
E   Static (Psi)   - 60          @ Psi      113
R   Residual (Psi) - 55          Elev.      1'-9"            Well
    Flow (Gpm)     - 914                               Proof Flow Gpm N/A
S   Elevation      - 13'-0"
U
P   Location: Static & Residual pressures taken from Hydratn # 63.  Flow taken
P   from Hydrant # 64 along N. Poly View Drive
L   Source of Information: Fluid Resource Management  {R. Ellison}
Y   Note : Full Flow test was used in this Static Hyd. Calculation.
```

Water Supply Curve (C)

Aero Automatic Sprinkler Co.
Cal Poly Center for Science SP - STATIC

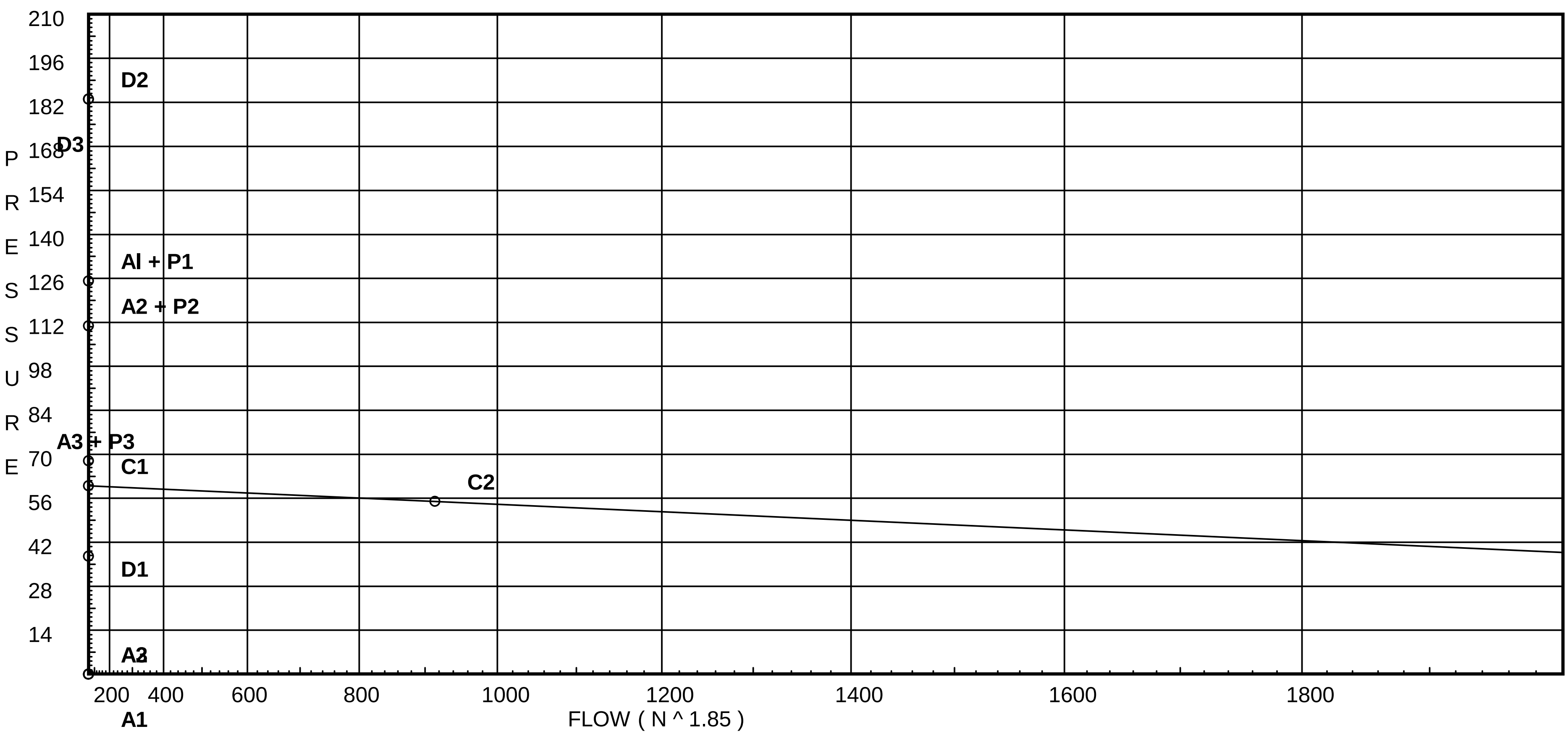
Page 2
Date 9-25-11

City Water Supply:
C1 - Static Pressure : 60
C2 - Residual Pressure: 55
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
A1 - Adjusted Static: 0
A2 - Adj Resid : 0 @ 0
A3 - Adj Resid : 0 @ 0

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 0
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 0
City Residual Flow @ 0 = 3501.77
City Residual Flow @ 20 = 2812.57
City Water @ 150% of Pump = 60.00
Pump flow terminated at adjusted curve 0 psi

Demand:
D1 - Elevation : 37.571
D2 - System Flow : ________
D2 - System Pressure : 183.028
Hose (Adj City) : ________
Hose (Demand) : 0.05
D3 - System Demand : 0.05
Safety Margin : 0.008



Fittings Used Summary

Aero Automatic Sprinkler Co.
Cal Poly Center for Science SP - STATIC

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
HV1	99.75		138.87	na	0.05			
HV2	99.75		138.87	na				
SPRF	99.75		140.62	na				
SP16	85.0		147.01	na				
SP15	69.0		153.94	na				
SP14	53.0		160.87	na				
SP13	37.0		167.8	na				
HV3	99.0		139.2	na				
SPR3	99.0		140.94	na				
SP36	85.0		147.01	na				
SP35	69.0		153.94	na				
SP34	53.0		160.87	na				
SP33	37.0		167.8	na				
SP32	21.0		174.73	na				
SP05	29.167		171.19	na				
HV8	67.75		152.73	na				
HV9	67.75		152.73	na				
SPR4	67.75		154.48	na				
SP44	53.0		160.87	na				
SP43	37.0		167.8	na				
SP42	21.0		174.73	na				
SP41	5.0		181.66	na				
HV10	37.0		166.05	na				
SP53	37.0		167.8	na				
HV11	21.0		172.98	na				
SP52	21.0		174.73	na				
SP51	5.0		181.66	na				
SPC5	12.5		178.41	na				
SPC4	13.75		177.87	na				
SPC3	12.667		178.34	na				
SP01	45.0		164.33	na				
SP02	27.917		171.73	na				
SP03	29.167		171.19	na				
SP04	28.083		171.66	na				
SPC1	12.667		178.34	na				
SPC2	12.667		178.34	na				
PO	1.833		183.03	na				
PI	1.75		57.87	na				
POC	6.75		55.71	na				
BF1	13.0		53.0	na				
BF2	13.0		60.0	na				
SRC	13.0		60.0	na				

The maximum velocity is 0 and it occurs in the pipe between nodes and

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
*S/P # 1 REMOTE ROOF HOSE VALVES										
HV1	99.750	H0.05	0.05	2.5	1T	12.0	0.250	120	138.870	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.05	2.469		0.0	12.250	0	0.0	Vel = 0
			0.0							
SPRF			0.05						140.620	K Factor = 0
HV2	99.750	.0	0.0	2.5	1T	12.0	0.250	120	138.870	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPRF	99.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPRF	99.750		0.05	6	4I	40.0	30.000	120	140.620	
to						0.0	40.000		6.388	
SP16	85		0.05	6.065		0.0	70.000	0	0.0	Vel = 0
SP16	85		0.0	6		0.0	16.000	120	147.008	
to						0.0	0.0		6.930	
SP15	69		0.05	6.065		0.0	16.000	0	0.0	Vel = 0
SP15	69		0.0	6		0.0	16.000	120	153.938	
to						0.0	0.0		6.930	
SP14	53		0.05	6.065		0.0	16.000	0	0.0	Vel = 0
SP14	53		0.0	6	1T	30.0	8.500	120	160.868	
to						0.0	30.000		3.465	
SP01	45		0.05	6.065		0.0	38.500	0	-0.001	Vel = 0
			0.0							
SP01			0.05						164.332	K Factor = 0
SP13	37	.0	0.0	6	1T	30.0	7.500	120	167.797	
to						0.0	30.000		-3.465	
SP01	45		0.0	6.065		0.0	37.500	0	0.0	Vel = 0
			0.0							
SP01			0.0						164.332	K Factor = 0
*S/P # 3										
HV3	99	.0	0.0	2.5	2E	12.0	1.750	120	139.195	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SPR3	99		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SPR3	99	.0	0.0	6		0.0	16.000	120	140.945	
to						0.0	0.0		6.063	
SP36	85		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP36	85	.0	0.0	6		0.0	16.000	120	147.008	
to						0.0	0.0		6.930	
SP35	69		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP35	69	.0	0.0	6		0.0	16.000	120	153.938	
to						0.0	0.0		6.930	
SP34	53		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP34	53	.0	0.0	6		0.0	16.000	120	160.868	
to						0.0	0.0		6.930	
SP33	37		0.0	6.065		0.0	16.000	0	0.0	Vel = 0
SP33	37	.0	0.0	6	1T	30.0	8.417	120	167.797	
to						0.0	30.000		3.392	
SP05	29.167		0.0	6.065		0.0	38.417	0	0.0	Vel = 0

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
			0.0							
SP05			0.0						171.189	K Factor = 0
SP32	21	.0	0.0	6	1T	30.0	7.583	120	174.727	
to						0.0	30.000		-3.537	
SP05	29.167		0.0	6.065		0.0	37.583	0	0.0	Vel = 0
SP05	29.167	.0	0.0	6	1I	10.0	34.167	120	171.190	
to					1B	10.0	50.000		0.0	
SP03	29.167		0.0	6.065	1T	30.0	84.167	0	0.0	Vel = 0
			0.0							
SP03			0.0						171.190	K Factor = 0
*S/P # 4										
HV8	67.750	.0	0.0	2.5	1T	12.0	0.250	120	152.729	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPR4	67.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
			0.0							
SPR4			0.0						154.479	K Factor = 0
HV9	67.750	.0	0.0	2.5	1T	12.0	0.250	120	152.729	
to						0.0	12.000		1.750	* Fixed loss = 1.75
SPR4	67.750		0.0	2.469		0.0	12.250	0	0.0	Vel = 0
SPR4	67.750	.0	0.0	4		0.0	14.750	120	154.479	
to						0.0	0.0		6.388	
SP44	53		0.0	4.026		0.0	14.750	0	0.0	Vel = 0
SP44	53	.0	0.0	4		0.0	16.000	120	160.868	
to						0.0	0.0		6.930	
SP43	37		0.0	4.026		0.0	16.000	0	0.0	Vel = 0
SP43	37	.0	0.0	4		0.0	16.000	120	167.797	
to						0.0	0.0		6.930	
SP42	21		0.0	4.026		0.0	16.000	0	0.0	Vel = 0
SP42	21	.0	0.0	4	1T	20.0	7.250	120	174.727	
to						0.0	20.000		3.140	
SPC4	13.750		0.0	4.026		0.0	27.250	0	0.0	Vel = 0
			0.0							
SPC4			0.0						177.867	K Factor = 0
SP41	5	.0	0.0	4	1T	20.0	8.750	120	181.656	
to						0.0	20.000		-3.790	
SPC4	13.750		0.0	4.026		0.0	28.750	0	0.0	Vel = 0
			0.0							
SPC4			0.0						177.866	K Factor = 0
*S/P # 5										
HV10	37	.0	0.0	2.5	2E	12.0	1.750	120	166.047	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SP53	37		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SP53	37	.0	0.0	4		0.0	16.000	120	167.797	
to						0.0	0.0		6.930	
SP52	21		0.0	4.026		0.0	16.000	0	0.0	Vel = 0
			0.0							
SP52			0.0						174.727	K Factor = 0

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
HV11	21	.0	0.0	2.5	2E	12.0	1.750	120	172.977	
to					1T	12.0	24.000		1.750	* Fixed loss = 1.75
SP52	21		0.0	2.469		0.0	25.750	0	0.0	Vel = 0
SP52	21	.0	0.0	4	1T	20.0	8.500	120	174.727	
to						0.0	20.000		3.681	
SPC5	12.500		0.0	4.026		0.0	28.500	0	0.0	Vel = 0
			0.0							
SPC5			0.0						178.408	K Factor = 0
SP51	5	.0	0.0	4	1T	20.0	7.500	120	181.656	
to						0.0	20.000		-3.248	
SPC5	12.500		0.0	4.026		0.0	27.500	0	0.0	Vel = 0
			0.0							
SPC5			0.0						178.408	K Factor = 0
*STANDPIPES # 4 & 5 FEED										
SPC5	12.500	.0	0.0	4	1B	12.0	139.667	120	178.408	
to					5I	35.0	67.000		-0.072	
SPC3	12.667		0.0	4.026	1T	20.0	206.667	0	0.0	Vel = 0
			0.0							
SPC3			0.0						178.336	K Factor = 0
SPC4	13.750	.0	0.0	6	3I	30.0	13.333	120	177.867	
to					1B	10.0	40.000		0.469	
SPC3	12.667		0.0	6.065		0.0	53.333	0	0.0	Vel = 0
SPC3	12.667	.0	0.0	6	2I	20.0	104.667	120	178.336	
to					1T	30.0	50.000		0.0	
SPC2	12.667		0.0	6.065		0.0	154.667	0	0.0	Vel = 0
			0.0							
SPC2			0.0						178.336	K Factor = 0
*STANDPIPES # 1 & 3 FEED										
SP01	45		0.05	6	6I	60.0	34.417	120	164.332	
to					1B	10.0	70.000		7.399	
SP02	27.917		0.05	6.065		0.0	104.417	0	0.0	Vel = 0
SP02	27.917		0.0	6	2I	20.0	235.417	120	171.731	
to						0.0	20.000		-0.541	
SP03	29.167		0.05	6.065		0.0	255.417	0	0.0	Vel = 0
SP03	29.167		0.0	6	4I	40.0	27.500	120	171.190	
to						0.0	40.000		0.469	
SP04	28.083		0.05	6.065		0.0	67.500	0	0.0	Vel = 0
SP04	28.083		0.0	6	2I	20.0	79.330	120	171.659	
to						0.0	20.000		6.677	
SPC1	12.667		0.05	6.065		0.0	99.330	0	0.0	Vel = 0
SPC1	12.667		0.0	6	1T	30.0	7.833	120	178.336	
to						0.0	30.000		0.0	
SPC2	12.667		0.05	6.065		0.0	37.833	0	0.0	Vel = 0
SPC2	12.667		0.0	8	1I	13.0	14.750	120	178.336	
to					1B	12.0	70.000		4.692	
PO	1.833		0.05	7.981	1C	45.0	84.750	0	0.0	Vel = 0
			0.0							

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
PO			0.05						183.028	K Factor = 0
System Demand Pressure						183.028				
Safety Margin						0.008				
Continuation Pressure						183.036				
Pressure @ Pump Outlet						183.036				
Pressure From Pump Curve						-125.164				
Pressure @ Pump Inlet						57.872				
PI	1.750		0.0	8	1G	4.0	14.000	120	57.872	
to					1I	13.0	52.000		-2.166	
POC	6.750		0.05	7.981	1T	35.0	66.000	0	0.0	Vel = 0
POC	6.750		0.0	8	2E	56.936	41.000	140	55.706	
to						0.0	56.936		-2.707	
BF1	13		0.05	8.27		0.0	97.936	0	0.001	Vel = 0
BF1	13		0.0	8	1Zic	0.0	4.000	120	53.000	
to						0.0	0.0		7.000	* Fixed loss = 7
BF2	13		0.05	7.981		0.0	4.000	0	0.0	Vel = 0
BF2	13		0.0	8	2E	56.936	46.000	140	60.000	
to					1G	6.326	118.616		0.0	
SRC	13		0.05	8.27	1T	55.354	164.616	0	0.0	Vel = 0
			0.0							
SRC			0.05						60.000	K Factor = 0.01

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AUTOMATIC SPRINKLER CO.

21605 North Central Ave.
Phoenix, Arizona 85024

623.580.7800
Fax 623.434.3154

AZ-L16-234798
AZ-C16-234797
UT-S370-6690455-5501

CA-C16-901529
NV-C41-69370
NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name	:	Cal Poly Center for Science 1 st. flr. Riser [250 gpm]
Building	:	Center for Science
Location	:	San Luis Obispo, Ca.
System	:	1 st floor
Contract	:	10034
Data File	:	Cal Poly CFS LVL 1-250.WXF

HYDRAULIC DESIGN INFORMATION SHEET

```
Name - Cal Poly Center For Science                       Date - 9-25-2011
Location - San Luis Obispo,  Ca.
Building - Center for Science                   System No. - 1 st floor
Contractor - Aero Automatic Sprinkler Co.       Contract No. - 10034
Calculated By - Neal Larsen                     Drawing No. -
Occupancy - Light / Ordinary Hazard Gr. 1
```

```
S   (X)NFPA 14     Number of Standpipes  ( )1 ( )2 ( )3 (X)4 ( )
Y   ( )Other
S   ( )Specific Ruling                  Made by             Date
T
E    Flow at Top Most Outlet           - 250   Gpm        System Type
M    Pres. at Top Most Outlet          - N/A   Psi    (X) Wet       ( ) Dry
     Flow For Ea. Additional Standpipe - N/A   Gpm
D    Total Additional Flow             - 250   Gpm
E    Elevation at Highest Outlet       - 3'-0" Feet
S    Hose Valve Connection    ( )1 1/2"    (X)2 1/2"
I    Class Service    (X)I    ( )II    (X)III
G    Note:This is a flow Calculation for 250 gpm @ 1 st. flr riser to determine
N    the residual pressure for setting the Pressure Reducing Va. [Setting 'E']
```

```
Calculation   Gpm Required 250      Psi Required 59.54    At SRC
Summary       C-Factor Used:         Overhead 120         Underground 140
```

```
W   Water Flow Test:              Pump Data:          Tank or Reservoir:
A   Date of Test   - 9-19-2011                        Cap.  N/A
T   Time of Test   - 9:12 a.m.   Rated Cap. 750      Elev. N/A
E   Static (Psi)   - 60          @ Psi      113
R   Residual (Psi) - 55          Elev.      1'-9"            Well
    Flow (Gpm)     - 914                              Proof Flow Gpm N/A
S   Elevation      - 13'-0"
U
P   Location: Static & Residual pressures taken from Hydratn # 63.  Flow taken
P   from Hydrant # 64 along N. Poly View Drive
L   Source of Information: Fluid Resource Management  {R. Ellison}
Y   Note : Full Flow test was used in this Static Hyd. Calculation.
```

Water Supply Curve (C)

Aero Automatic Sprinkler Co.
Cal Poly Center for Science 1 st. flr. Riser [250 gpm]

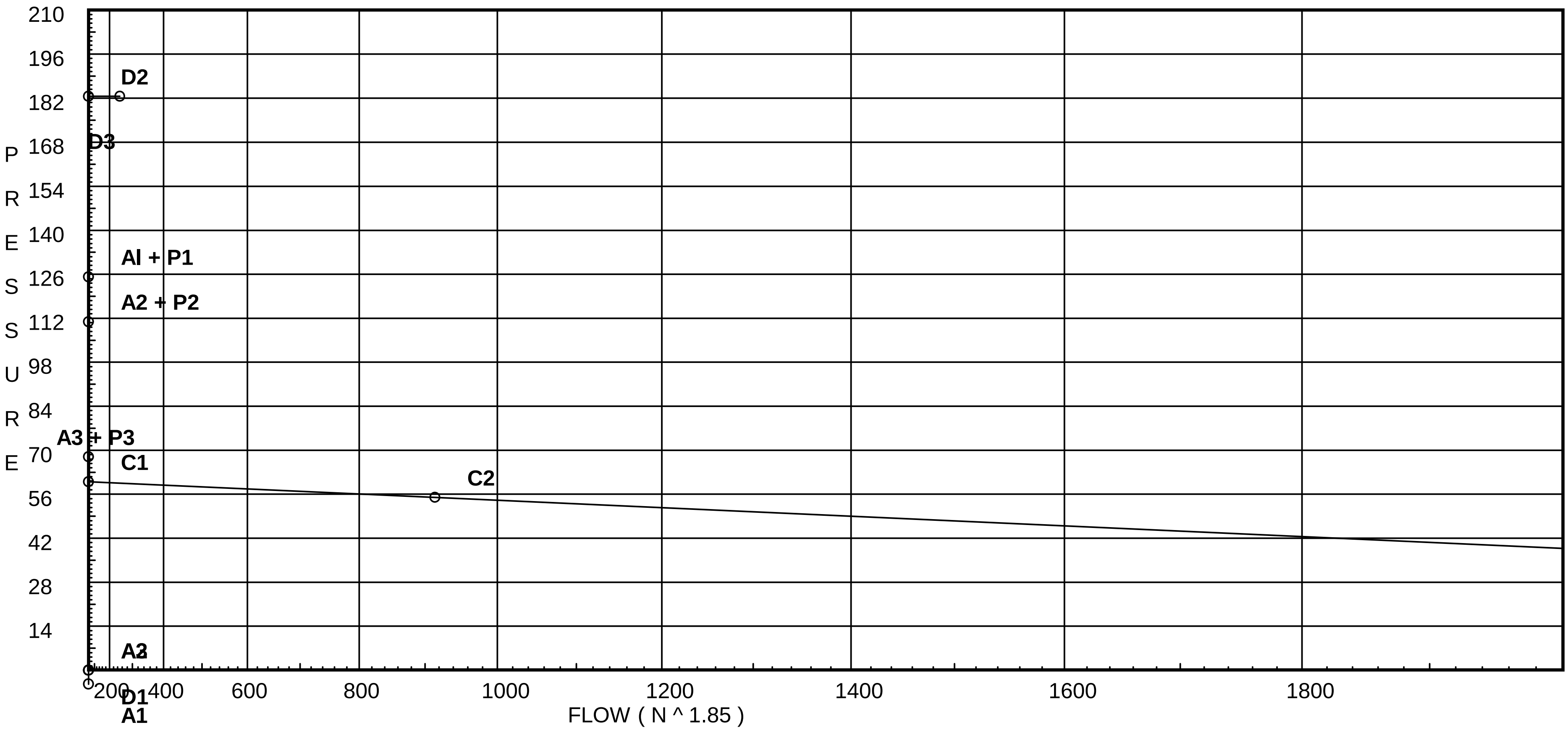
Page 2
Date 9-25-11

City Water Supply:
C1 - Static Pressure : 60
C2 - Residual Pressure: 55
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
A1 - Adjusted Static: 0
A2 - Adj Resid : 0 @ 0
A3 - Adj Resid : 0 @ 0

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 0
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 0
City Residual Flow @ 0 = 3501.77
City Residual Flow @ 20 = 2812.57
City Water @ 150% of Pump = 60.00
Pump flow terminated at adjusted curve 0 psi

Demand:
D1 - Elevation : -4.331
D2 - System Flow : ________
D2 - System Pressure : 182.606
Hose (Adj City) : ________
Hose (Demand) : 250
D3 - System Demand : 250
Safety Margin : ________



Fittings Used Summary

Aero Automatic Sprinkler Co. Page 3
Cal Poly Center for Science 1 st. flr. Riser [250 gpm] Date 9-25-11

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
BR01	3.0		174.52	na	250.0			
SPC1	12.667		177.75	na				
SPC2	12.667		177.85	na				
PO	1.833		182.61	na				
PI	1.75		57.87	na				
POC	6.75		55.75	na				
BF1	13.0		53.09	na				
BF2	13.0		59.47	na				
SRC	13.0		59.55	na				

The maximum velocity is 14.71 and it occurs in the pipe between nodes BR01 and SPC1

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	******* Notes ******
BR01	3	H250	250.00	2.5	2I	16.474	14.333	120	174.519	
to					1T	16.474	32.948		-4.187	
SPC1	12.667		250.0	2.635		0.0	47.281	0.1569	7.419	Vel = 14.71
SPC1	12.667		0.0	6	1T	30.0	7.917	120	177.751	
to						0.0	30.000		0.0	
SPC2	12.667		250.0	6.065		0.0	37.917	0.0027	0.103	Vel = 2.78
SPC2	12.667		0.0	8	1I	13.0	14.750	120	177.854	
to					1B	12.0	70.000		4.692	
PO	1.833		250.0	7.981	1C	45.0	84.750	0.0007	0.060	Vel = 1.60
			0.0							
PO			250.00						182.606	K Factor = 18.50
System Demand Pressure						182.606				
Safety Margin						0.0				
Continuation Pressure						182.606				
Pressure @ Pump Outlet						182.606				
Pressure From Pump Curve						-124.735				
Pressure @ Pump Inlet						57.871				
PI	1.750		0.0	8	1G	4.0	14.000	120	57.871	
to					1I	13.0	52.000		-2.166	
POC	6.750		250.0	7.981	1T	35.0	66.000	0.0007	0.047	Vel = 1.60
POC	6.750		0.0	8	2E	56.936	41.000	140	55.752	
to						0.0	56.936		-2.707	
BF1	13		250.0	8.27		0.0	97.936	0.0005	0.045	Vel = 1.49
BF1	13		0.0	8	1Zic	0.0	4.000	120	53.090	
to						0.0	0.0		6.379	* Fixed loss = 6.379
BF2	13		250.0	7.981		0.0	4.000	0.0008	0.003	Vel = 1.60
BF2	13		0.0	8	2E	56.936	46.000	140	59.472	
to					1G	6.326	118.616		0.0	
SRC	13		250.0	8.27	1T	55.354	164.616	0.0004	0.074	Vel = 1.49
			0.0							
SRC			250.00						59.546	K Factor = 32.40

AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

Fire Protection by Computer Design

Aero Automatic Sprinkler Co.
21605 N. Central Ave.
Phoenix, Arizona 85024
623-580-7800

Job Name : Cal Poly Center for Science 1 st. flr. Riser [328 gpm]
Building : Center for Science
Location : San Luis Obispo, Ca.
System : 1 st floor
Contract : 10034
Data File : Cal Poly CFS LVL 1-328.WXF

HYDRAULIC DESIGN INFORMATION SHEET

```
Name - Cal Poly Center For Science                          Date - 9-25-2011
Location - San Luis Obispo,  Ca.
Building - Center for Science                         System No. - 1 st floor
Contractor - Aero Automatic Sprinkler Co.             Contract No. - 10034
Calculated By - Neal Larsen                           Drawing No. -
Occupancy - Light / Ordinary Hazard Gr. 1
```

```
S   (X)NFPA 14     Number of Standpipes  ( )1 ( )2 ( )3 (X)4 ( )
Y   ( )Other
S   ( )Specific Ruling                  Made by              Date
T
E    Flow at Top Most Outlet            - 328   Gpm         System Type
M    Pres. at Top Most Outlet           - N/A   Psi    (X) Wet       ( ) Dry
     Flow For Ea. Additional Standpipe  - N/A   Gpm
D    Total Additional Flow              - 328   Gpm
E    Elevation at Highest Outlet        - 3'-0" Feet
S    Hose Valve Connection    ( )1 1/2"    (X)2 1/2"
I    Class Service    (X)I    ( )II    (X)III
G    Note:This is a flow Calculation for 328 gpm @ 1 st. flr riser to determine
N    the residual pressure for setting the Pressure Reducing Va. [Setting 'E']
```

```
Calculation   Gpm Required 328      Psi Required 59.24    At SRC
Summary       C-Factor Used:         Overhead 120          Underground 140
```

```
W   Water Flow Test:              Pump Data:           Tank or Reservoir:
A   Date of Test   - 9-19-2011                         Cap.  N/A
T   Time of Test   - 9:12 a.m.   Rated Cap. 750      Elev. N/A
E   Static (Psi)   - 60          @ Psi      113
R   Residual (Psi) - 55          Elev.      1'-9"            Well
    Flow (Gpm)     - 914                               Proof Flow Gpm N/A
S   Elevation      - 13'-0"
U
P   Location: Static & Residual pressures taken from Hydratn # 63.  Flow taken
P   from Hydrant # 64 along N. Poly View Drive
L   Source of Information: Fluid Resource Management  {R. Ellison}
Y   Note : Full Flow test was used in this Static Hyd. Calculation.
```

Water Supply Curve (C)

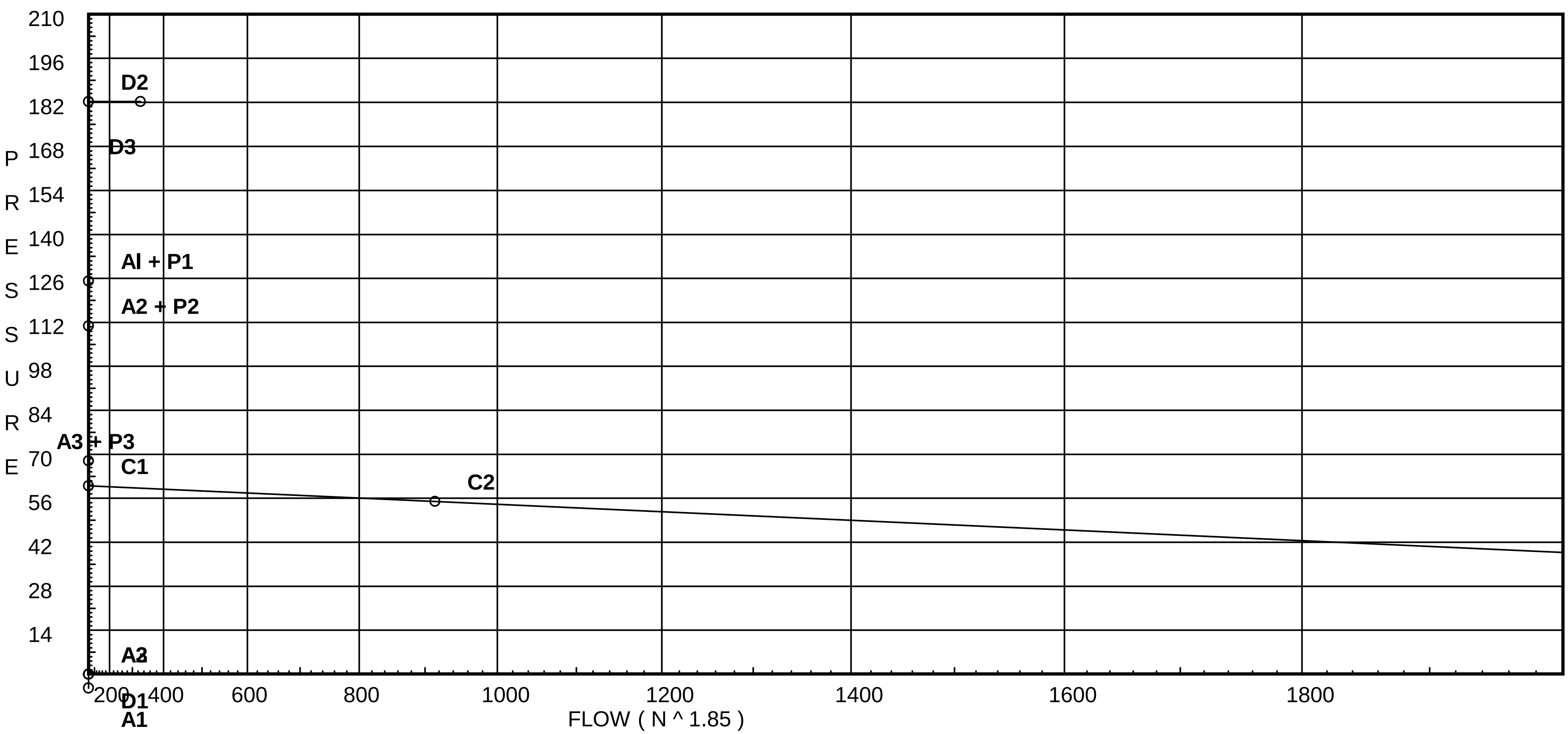
Aero Automatic Sprinkler Co.
Cal Poly Center for Science 1 st. flr. Riser [328 gpm]

City Water Supply:
C1 - Static Pressure : 60
C2 - Residual Pressure: 55
C2 - Residual Flow : 914

City Water Adjusted to Pump Inlet
for Pf - Elev - Hose Flow
A1 - Adjusted Static: 0
A2 - Adj Resid : 0 @ 0
A3 - Adj Resid : 0 @ 0

Pump Data:
P1 - Pump Churn Pressure : 125.2
P2 - Pump Rated Pressure : 110.9
P2 - Pump Rated Flow : 0
P3 - Pump Pressure @ Max Flow : 67.9
P3 - Pump Max Flow : 0
City Residual Flow @ 0 = 3501.77
City Residual Flow @ 20 = 2812.57
City Water @ 150% of Pump = 60.00
Pump flow terminated at adjusted curve 0 psi

Demand:
D1 - Elevation : -4.331
D2 - System Flow : ________
D2 - System Pressure : 182.189
Hose (Adj City) : ________
Hose (Demand) : 328
D3 - System Demand : 328
Safety Margin : ________



Fittings Used Summary

Aero Automatic Sprinkler Co.
Cal Poly Center for Science 1 st. flr. Riser [328 gpm]

Page 3
Date 9-25-11

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	Generic Butterfly Valve	0	0	2.25	2	2.5	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
C	Generic Check Vlv	4	5	5	7	9	11	14	16	19	22	27	32	45	55	65	76	87	98	109	130
E	90' Standard Elbow	2	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	Generic Gate Valve	0	0	0	1	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Ell Grvd-Vic #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
T	90' Flow Thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zic	Wilkens 350ADA	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
BR01	3.0		169.15	na	328.0			
SPC1	12.667		177.23	na				
SPC2	12.667		177.4	na				
PO	1.833		182.19	na				
PI	1.75		57.73	na				
POC	6.75		55.65	na				
BF1	13.0		53.01	na				
BF2	13.0		59.13	na				
SRC	13.0		59.25	na				

The maximum velocity is 19.3 and it occurs in the pipe between nodes BR01 and SPC1

Node1 / to / Node2	Elev1 / Elev2	K / Fact	Qa / Qt	Nom / Act	Fitting / or / Eqv.	Ln.	Pipe / Ftng's / Total	CFact / Pf/Ft	Pt / Pe / Pf	******* Notes ******
BR01	3	H328	328.00	2.5	2I	16.474	14.333	120	169.154	
to					1T	16.474	32.948		-4.187	
SPC1	12.667		328.0	2.635		0.0	47.281	0.2593	12.261	Vel = 19.30
SPC1	12.667		0.0	6	1T	30.0	7.917	120	177.228	
to						0.0	30.000		0.0	
SPC2	12.667		328.0	6.065		0.0	37.917	0.0045	0.169	Vel = 3.64
SPC2	12.667		0.0	8	1I	13.0	14.750	120	177.397	
to					1B	12.0	70.000		4.692	
PO	1.833		328.0	7.981	1C	45.0	84.750	0.0012	0.100	Vel = 2.10
			0.0							
PO			328.00						182.189	K Factor = 24.30
System Demand Pressure						182.189				
Safety Margin						0.0				
Continuation Pressure						182.189				
Pressure @ Pump Outlet						182.189				
Pressure From Pump Curve						-124.455				
Pressure @ Pump Inlet						57.734				
PI	1.750		0.0	8	1G	4.0	14.000	120	57.734	
to					1I	13.0	52.000		-2.166	
POC	6.750		328.0	7.981	1T	35.0	66.000	0.0012	0.078	Vel = 2.10
POC	6.750		0.0	8	2E	56.936	41.000	140	55.646	
to						0.0	56.936		-2.707	
BF1	13		328.0	8.27		0.0	97.936	0.0007	0.073	Vel = 1.96
BF1	13		0.0	8	1Zic	0.0	4.000	120	53.012	
to						0.0	0.0		6.110	* Fixed loss = 6.11
BF2	13		328.0	7.981		0.0	4.000	0.0012	0.005	Vel = 2.10
BF2	13		0.0	8	2E	56.936	46.000	140	59.127	
to					1G	6.326	118.616		0.0	
SRC	13		328.0	8.27	1T	55.354	164.616	0.0007	0.122	Vel = 1.96
			0.0							
SRC			328.00						59.249	K Factor = 42.61

SHOP DRAWINGS SUBMITTAL

SECTION:

DIVISION 21 – FIRE SUPPRESSION

21 0500 ; 21 1200 ; 21 1300 ; 21 3000

PROJECT:

CAL POLY CENTER FOR SCIENCE
1 GRAND AVE., BUILDING #70
SAN LUIS OBISPO, CA 93407

FOR THE:

GILBANE BUILDING COMPANY
1 GRAND AVE., BUILDING #70
SAN LUIS OBISPO, CA 93407

AS PRESENTED BY:

Aero Automatic Sprinkler Company

21605 North Central Ave.

Phoenix, AZ 85024

623-580-7800   623-434-3420 (fax)

This submittal has been reviewed by Aero Automatic Sprinkler Co. and approved with respect to the means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incidental thereto. Aero Automatic Sprinkler Co. also warrants that this submittal complies with the Contract Documents and comprises no variation to.

By: Neal Larsen

Date: 9-29-2011

Gilbane

Cal Poly Center for Science
Gilbane Project #: 174338010

REVIEWED

Building Name/#: Cal Poly CFS
Bid Package No: 21A
Submittal No: 003
Spec. Section: 21 05 00
Reviewed By: Scott Gurley
Date: 10/3/11

This review does not constitute nor does it assume design responsibility nor does it relieve the trade contractor/supplier from complying with the contract requirements, coordinating their work with other trade contractors and verifying field dimensions.

Gilbane

Cal Poly Center for Science
Gilbane Project #: 174338010

REVIEWED

Building Name/#: Cal Poly CFS
Bid Package No: 21A
Submittal No: 002
Spec. Section: 21 12 00
Reviewed By: Scott Gurley
Date: 10/3/11

This review does not constitute nor does it assume design responsibility nor does it relieve the trade contractor/supplier from complying with the contract requirements, coordinating their work with other trade contractors and verifying field dimensions.

Gilbane

Cal Poly Center for Science
Gilbane Project #: 174338010

REVIEWED

Building Name/#: Cal Poly CFS
Bid Package No: 21A
Submittal No: 002
Spec. Section: 21 13 00
Reviewed By: Scott Gurley
Date: 10/3/11

This review does not constitute nor does it assume design responsibility nor does it relieve the trade contractor/supplier from complying with the contract requirements, coordinating their work with other trade contractors and verifying field dimensions.

Gilbane

Cal Poly Center for Science
Gilbane Project #: 174338010

REVIEWED

Building Name/#: Cal Poly CFS
Bid Package No: 21A
Submittal No: 002
Spec. Section: 21 30 00
Reviewed By: Scott Gurley
Date: 10/3/11

This review does not constitute nor does it assume design responsibility nor does it relieve the trade contractor/supplier from complying with the contract requirements, coordinating their work with other trade contractors and verifying field dimensions.

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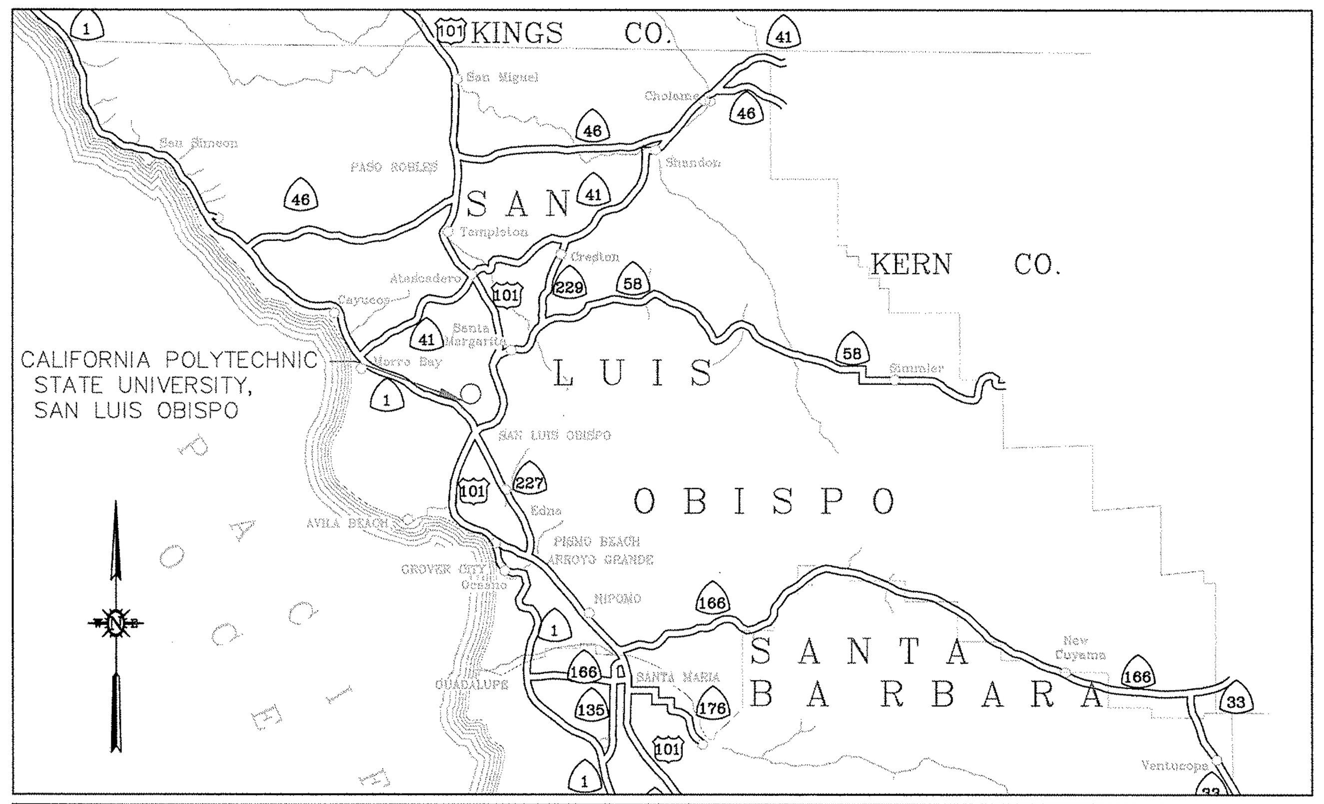
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

DESIGNED AND INSTALLED
BY

AERO AUTOMATIC SPRINKLER CO.

—SECTION 210500— COMMON WORK RESULTS FOR FIRE SUPPRESSION
PART 1 GENERAL 1.8.3 SHOP DRAWINGS
—SECTION 211200— FIRE SUPPRESSION STANDPIPES
PART 1 GENERAL 1.4.3 SHOP DRAWINGS
—SECTION 211300— FIRE SUPPRESSION SPRINKLER SYSTEMS
PART 1 GENERAL 1.4.3 SHOP DRAWINGS
—SECTION 213000— FIRE PUMP
PART 1 GENERAL 1.4.3 SHOP DRAWINGS



REGIONAL MAP N.T.S.

PROJECT DIRECTORY

OWNER — CALIFORNIA STATE POLYTECHNIC UNIVERSITY
FACILITIES PLANNING & CAPITAL PROJECTS
BUILDING 70
SAN LUIS OBISPO, CA 93047
TEL- (805) 756-2581
FAX- (805) 756-7566

ARCHITECT — ZIMMER GUNSUL FRASCA ARCHITECTS, LLP
515 SOUTH FLOWER ST.
SUITE 3700
LOS ANGELES, CA 90071
TEL- (213) 617-1901
FAX- (213) 617-0047

STRUCTURAL ENGINEER — JOHN A. MARTIN & ASSOCIATES
950 S. GRAND AVENUE
4TH FLOOR
LOS ANGELES, CA 90015
TEL- (213) 483-6490
FAX- (213) 483-3084

MECHANICAL/ PLUMBING ENGINEER — RUMSEY ENGINEERS
99 LINDEN STREET
OAKLAND, CA 94607
TEL- (510) 663-2070
FAX- (510) 663-2080

ELECTRICAL ENGINEER — INTEGRATED DESIGN ASSOCIATES
1084 FOXWORTHY AVENUE, SUITE 150
SAN JOSE, CA 95118
TEL- (408) 448-6300
FAX- (408) 448-6301

CIVIL ENGINEER — CANNON ASSOCIATES
364 PACIFIC STREET
SAN LUIS OBISPO, CA 93401
TEL- (805) 544-7407
FAX- (805) 544-3863

LANDSCAPE ARCHITECT — KATHERINE SPITZ ASSOCIATES
4212 1/2 GLENCOE AVENUE
MARINA DEL REY, CA 90292
TEL- (310) 574-4460
FAX- (310) 574-4462

LABORATORY CONSULTANT — RESEARCH FACILITIES DESIGN
3965 FIFTH AVENUE, SUITE 300
SAN DIEGO, CA. 92103-3107
TEL- (619) 297-0159
FAX- (619) 294-4901

LIGHTING DESIGN — DAVID NELSON AND ASSOCIATES, LLC
P.O. BOX 270254
LITTLETON, CO 80127
TEL- (720) 981-4560
FAX- (303) 484-3230

PROJECT DATA

NEW BUILDING DATA
NUMBER OF STORIES: SIX (6) STORIES
ZGF PROJECT NUMBER: L40302
TYPE CONSTRUCTION: 1B, FIRE-RESISTIVE
BUILDING OCCUPANCY: GROUP B, BUSINESS OCCUPANCY, CONTAINING THE FOLLOWING USES:

USE	OCCUPANCY
LOBBIES/ LECTURE	A-3
OFFICES:	B
CONFERENCE ROOMS: (LESS THAN 50 OCCUPANTS)	B
LABORATORIES:	B
ELECTRICAL AND TELEPHONE / DATA	S-1
MECHANICAL ROOMS:	S-1
STORAGE	H-3
STORAGE	S-2

FIRE PROTECTION: FULLY FIRE SPRINKLERED
HEIGHT: 108'
FLOOR AREA:

FLOOR	SQ FT
LEVEL ONE:	23,146 G.S.F.
LEVEL TWO:	43,458 G.S.F.
LEVEL THREE:	43,209 G.S.F.
LEVEL FOUR:	33,307 G.S.F.
LEVEL FIVE:	25,294 G.S.F.
LEVEL SIX:	19,958 G.S.F.
TOTAL:	188,372 G.S.F.

BUILDING CODES:
2007 (CBC) CALIFORNIA BUILDING CODE
2007 (CFC) CALIFORNIA FIRE CODE
2007 (CMC) CALIFORNIA MECHANICAL CODE
2007 (CPC) CALIFORNIA PLUMBING CODE
2006 (NFPA 70) NATIONAL ELECTRICAL CODE
2006 (NFPA 101) LIFE SAFETY CODE
ADA STANDARDS FOR ACCESSIBLE DESIGN
ADA ACCESSIBILITY GUIDELINES FOR BUILDINGS AND FACILITIES (ADAAG) [28 CFR PART 36, APPENDIX A]
NFPA 13 - AUTOMATIC SPRINKLER SYSTEMS, 2007 EDITION.
NFPA 14 - STANDPIPE AND HOSE SYSTEMS, 2004 EDITION.
NFPA 20 - STATIONARY PUMPS FOR FIRE PROTECTION, 2003 EDITION.

FIRE PROTECTION SYMBOLS

SYMBOL	DESCRIPTION
●	RECESSED PENDENT SPRINKLER
●200	HIGH TEMPERATURE PENDENT SPRINKLER
○	UPRIGHT SPRINKLER
⊗	EXT. COVERAGE PENDENT SPRINKLER
◎	UPRIGHT SPRINKLER ON SPRIG UP
◁	HORZ. SIDEWALL SPRINKLER
	RISE OR DROP IN PIPING w/ TEE
	RISE OR DROP IN PIPING w/ ELBOW
	PIPE HANGER LOCATIONS
	PIPE HANGER LOCATION W/ STIFFNER
	FIRE SPRINKLER RISER
	INSPECTOR'S TEST CONNECTION
	NEW PIPING
	EXISTING PIPING
XX	HYDRAULIC REFERENCE POINT
LAT	LATERAL SWAY BRACE
LONG	LONGITUDAL SWAY BRACE
× BLR	BRANCH LINE RESTRAINT (BLR)
	4 WAY SWAY BRACE
*3'-1 1/2"	DECK TO CENTERLINE
10'-4" AFF	CENTERLINE ABOVE FINISH FLOOR
✳	DENOTES EXISTING 1" OUTLET

SCOPE OF WORK / HAZARD ANALYSIS

PROVIDE A COMPLETE WET PIPE FIRE SPRINKLER SYSTEM FOR A NEW 6-STORY CLASSROOM/LABRATORY BUILDING WITH FIRE PUMP & CLASS 1 STANDPIPE SYSTEM.
ALL SPRINKLERS TO BE QUICK RESPONSE TYPE UNLESS NOTED OTHERWISE.
SPRINKLERS IN FINISHED CEILINGS TO BE RECESSED CHROME PENDENT SPRINKLERS.
SPRINKLERS IN EXPOSED AREAS TO BE CHROME UPRIGHT OR PENDENT SPRINKLERS.
PIPING TO BE BLACK STEEL SCHEDULE 10 AND SCHEDULE 40.

DESIGN CRITERIA:
OCCUPANCY CLASSIFICATION

◇	OCCUPANCY	HAZARD	MAX SPACING	DESIGN	HOSE
A-3	LOBBIES/LECTURE	LIGHT HAZARD	225	.10/1500	100/0
B	OFFICE/CONFERENCE RM	LIGHT HAZARD	130	.10/1500	100/0
B	LABORATORIES	O.H. GR. 1	130	.15/1500	100/150
S-1	STORAGE/MECH/ELECT RM	O.H. GR. 1	130	.15/1500	100/150

FLOW TEST INFORMATION:

	ACTUAL	REDUCED 10 PERCENT
STATIC:	60 psi	54 psi
RESIDUAL:	55 psi	49 psi
FLOW:	914 gpm	914 gpm

TEST DATE: 8-19-2011 9:12 AM
ORIFICE SIZE: 2-1/2"
ORIFICE COEFFICIENT: 0.90

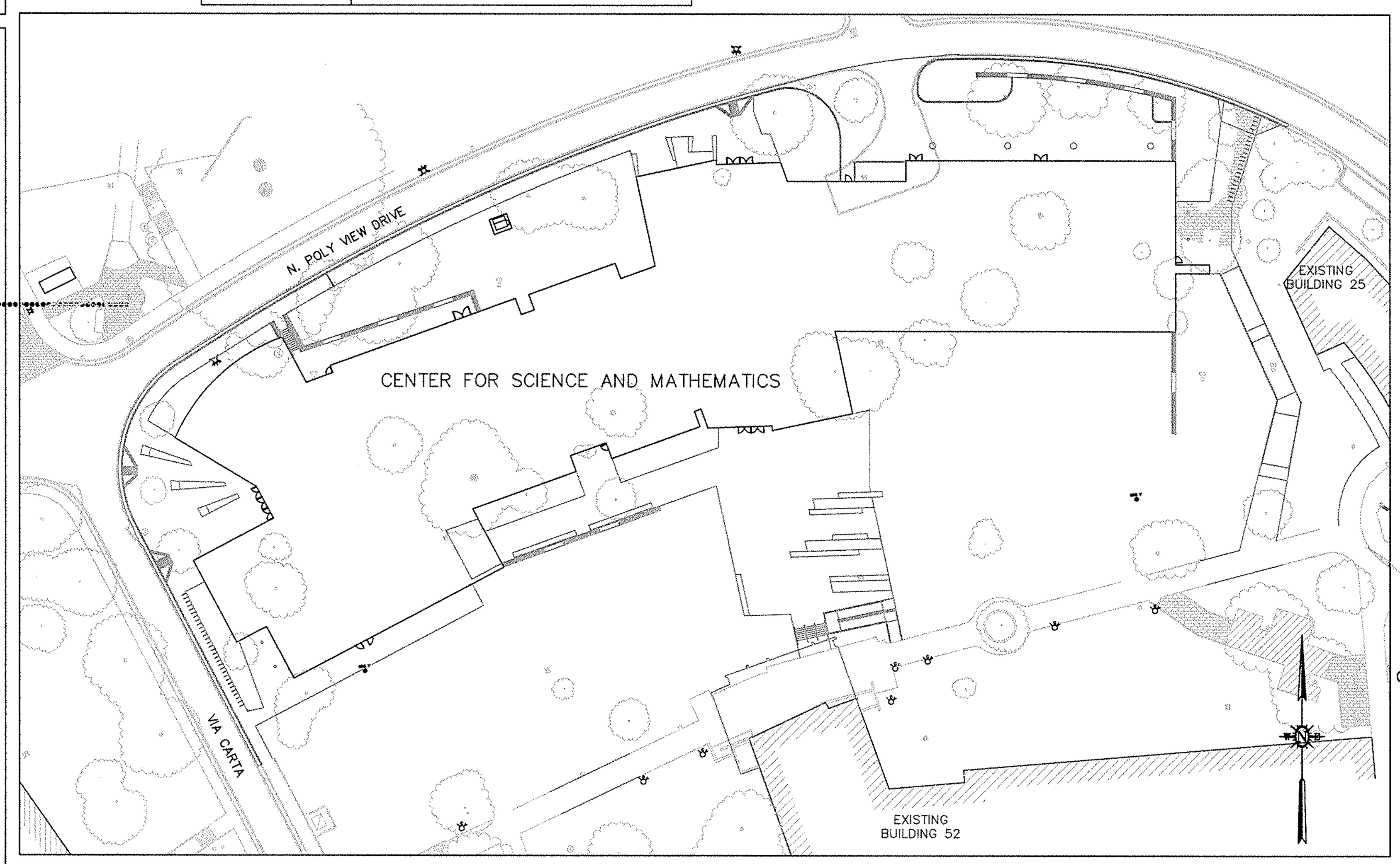
FLOW TEST PERFORMED BY FLUID RESOURCE MANAGEMENT
NOTE: FLOWING HYDRANT # 64 WITH STATIC & RESIDUAL PRESSURE FROM HYDRANT # 63

GENERAL SYSTEM NOTES:

1. ALL SYSTEM PIPING SHALL BE HYDROSTATICALLY TESTED AT 200 PSI OR AT 50 PSI ABOVE THE OPERATIONAL STATIC PRESSURE OF THE SYSTEM, WHICHEVER IS GREATER FOR TWO HOURS.
2. EACH VALVE SHALL HAVE A PERMANENTLY AFFIXED SIGN INDICATING ITS FUNCTION. ALL SPRINKLER SYSTEM CONTROL VALVE HANDLES TO BE LOCATED 7'-0" MAX. A.F.F.
3. A STOCK OF SPARE SPRINKLERS OF EACH STYLE AND TEMPERATURE RATING, WITH A SPRINKLER WRENCH, SHALL BE LOCATED NEAR THE RISER WHERE THE TEMPERATURE TO WHICH THEY
4. SPRINKLERS SHALL BE QUICK RESPONSE
WITH CHROME RECESSED ESCUTCHEONS U.O.N. AND SHALL BE IN ALIGNMENT AND PARALLEL TO CEILING GRIDS
SPRINKLERS IN UNFINISHED AREAS TO BE TYCO MODEL TY-FRB QUICK RESPONSE BRASS UPRIGHT
5. MAIN PIPING FOR THIS SYSTEM SHALL BE SCHEDULE 10 PIPE WITH GROOVED ENDS WITH APPLICABLE FITTINGS.
BRANCH LINE CONNECTIONS TO THE MAIN SHALL BE PRE-DRILLED WITH SHOP WELDED OUTLETS.
THREADED PIPING 1" TO 2" TO BE BLACK STEEL BMT SCHEDULE 40 WITH BLACK CAST IRON OR DUCTILE IRON FITTINGS
1 1/4" AND LARGER BRANCH LINE & MAIN PIPING TO BE SCHEDULE 10 PIPE WITH GROOVED ENDS WITH GROOVED FITTINGS.
6. ALL MATERIALS USED IN THE INSTALLATION OF THESE SYSTEMS SHALL BE NEW AND OF CURRENT ISSUE, AND APPROVED BY U.L. (UNDERWRITERS LAB) AND/OR FM (FACTORY MUTUAL). ALL MATERIALS SHALL BE IN CONFORMANCE WITH NFPA-13, 2007 AS WELL AS THE AUTHORITY HAVING JURISDICTION.
7. SYSTEM PIPING WILL BE SUPPORTED WITH HANGERS IN ACCORDANCE WITH NFPA-13, 2007.
8. SPACING AND DETAILS OF THE SUPPORT AND BRACING OF FIRE SPRINKLER PIPING SHALL COMPLY WITH THE 2007 EDITION OF NFPA 13.
9. PAINTING OF THE SYSTEM PIPING AND COMPONENTS IS NOT PART OF THIS SCOPE AND, IF REQUIRED, IT SHALL BE PERFORMED BY OTHERS
10. UNDERGROUND PIPING IS NOT PART OF THIS SCOPE. FIRE PROTECTION CONTRACT TO START AT FLANGE (BY OTHERS) AT 6" ABOVE FINISHED FLOOR.
11. WIRING OF WATERFLOW SWITCH & CONTROL VALVE TAMPER SWITCHES BY OTHERS. ALL OTHER ALARM DEVICES TO BE PROVIDED, INSTALLED AND TESTED BY OTHERS

Sheet List Table

Sheet Number	Sheet Title
FP-1.0	COVER SHEET
FP-2.0	FIRE SPRINKLER SITE PLAN
FP-3.0	FIRE PUMP PLAN
~~FP-4.9~~	~~TEMP. STANDPIPE~~
FP-4.0	STANDPIPE - OVERALL ISOMETRIC
FP-4.1	STANDPIPE # 1 DETAILS
FP-4.2	STANDPIPE # 3 DETAILS
FP-4.3	STANDPIPE # 4 DETAILS
FP-4.4	STANDPIPE # 5 DETAILS
FP-5.0	HANGER & E.Q. DETAILS
FP-6.01W	FIRE SPRINKLER PLAN LEVEL 1 WEST
FP-6.02W	FIRE SPRINKLER PLAN LEVEL 2 WEST
FP-6.02E	FIRE SPRINKLER PLAN LEVEL 2 EAST
FP-6.03W	FIRE SPRINKLER PLAN LEVEL 3 WEST
FP-6.03E	FIRE SPRINKLER PLAN LEVEL 3 EAST
FP-6.04W	FIRE SPRINKLER PLAN LEVEL 4 WEST
FP-6.04E	FIRE SPRINKLER PLAN LEVEL 4 EAST
FP-6.05E	FIRE SPRINKLER PLAN LEVEL 5 EAST
FP-6.06E	FIRE SPRINKLER PLAN LEVEL 6 EAST
FP-7.01W	FIRE SPRINKLER RCP LEVEL 1 WEST
FP-7.02W	FIRE SPRINKLER RCP LEVEL 2 WEST
FP-7.02E	FIRE SPRINKLER RCP LEVEL 2 EAST
FP-7.03W	FIRE SPRINKLER RCP LEVEL 3 WEST
FP-7.03E	FIRE SPRINKLER RCP LEVEL 3 EAST
FP-7.04W	FIRE SPRINKLER RCP LEVEL 4 WEST
FP-7.04E	FIRE SPRINKLER RCP LEVEL 4 EAST
FP-7.05E	FIRE SPRINKLER RCP LEVEL 5 EAST
FP-7.06E	FIRE SPRINKLER RCP LEVEL 6 EAST



VICINITY MAP

1 INCH = 50 FEET

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECH
OFFICE OF REGULATION SERVICES
APPL 01-110181

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 exp 12-31-11 STATE OF CALIFORNIA 09/29/11

SPRINKLER HEAD LEGEND: SYM. | MFG. | MODEL | SIN | RESP. | STYLE | FINISH | N.P.T. | ORIFICE | K | TEMP. | ESCUTCHEON: ESC. TYPE | FINISH | TEMP. | QTY.
TOTAL SPRINKLERS THIS SHEET

REVISIONS: # | DATE | BY | DESCRIPTION
9-28-2011 | NRL | SUBMITTAL TO GENERAL CONTRACTOR

NORTH

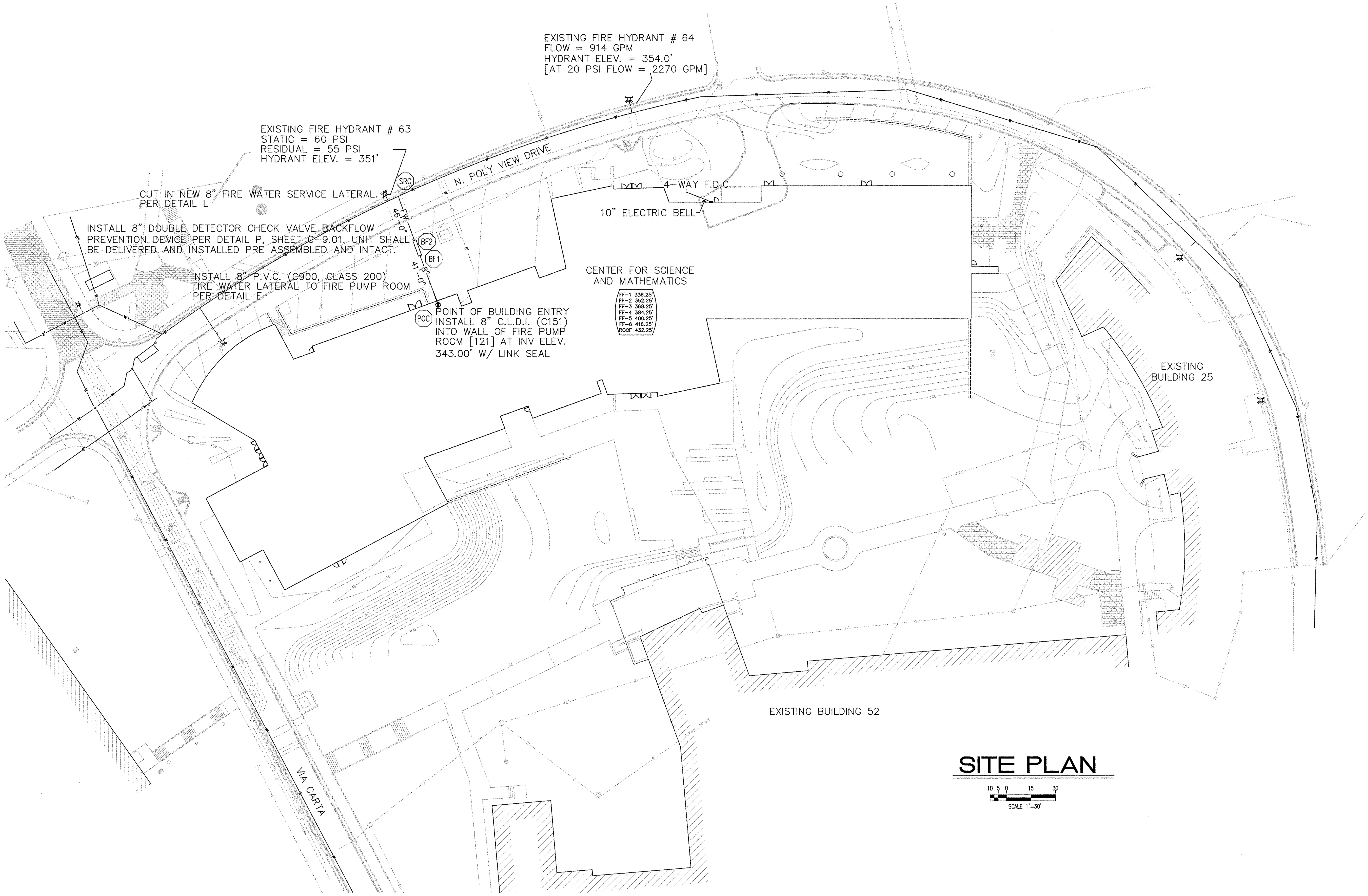
AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. Phoenix, Arizona 85024
623.580.7800 Fax 623.434.3154
AZ-L16-234798 AZ-C16-234797 UT-S370-6690455-5501
CA-C16-901529 NV-C41-69370 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: COVER SHEET

DRAWN BY:	NRL
SCALE:	AS NOTED
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-1.0



SITE PLAN

SCALE 1"=30'

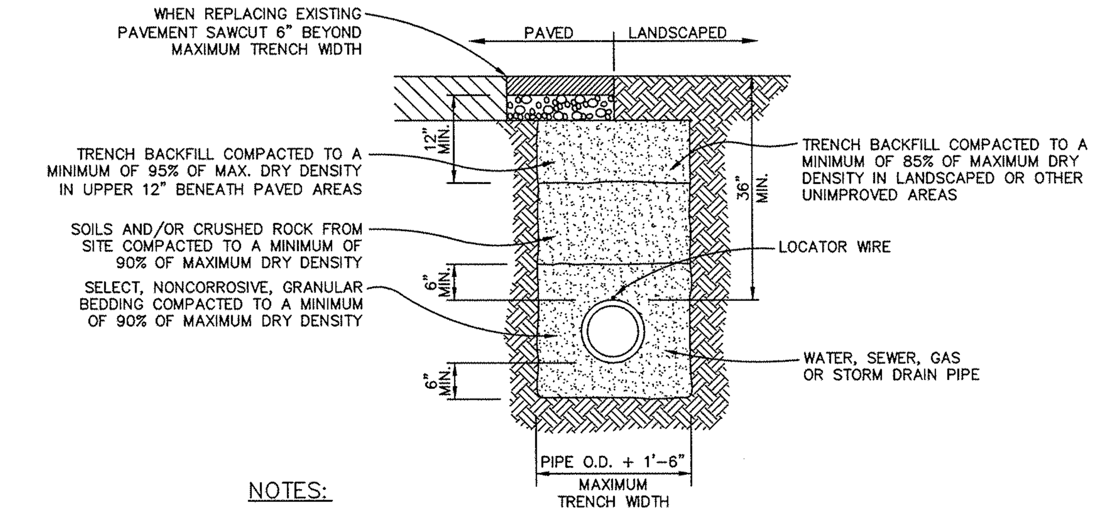
FLOW TEST SUMMARY

STATIC PSI	60
RESIDUAL PSI	55
PITOT PSI	35
ORIFICE DIAMETER	2 1/2
COEFFICIENT OF DISCHARGE	0.9
GPM	914
DATE	8-19-2011
LOCATION	N. POLY VIEW DRIVE
BY WHO	FLUID RESOURCE MANAGEMENT, INC.

ADJUSTED FLOW
10 % REDUCTION

STATIC PSI	54
RESIDUAL PSI	49
GPM	914

STATIC & RESIDUAL TAKEN FROM HYD. # 63
FLOW TAKEN FROM HYD. # 64



NOTES:

A. ALL MATERIAL USED AS TRENCH BACKFILL SHALL BE FREE OF DEBRIS, TRASH, OLD PAVEMENT AND ORGANIC MATERIAL AND SHALL BE CLEANED OF ANY ROCKS AND IRREDUCIBLE MATERIAL LARGER THAN 3 INCHES.

B. WHEN BACKFILL MATERIAL INCLUDES ROCKS, THE ROCKS SHALL BE PLACED IN A SUFFICIENT SOIL MATRIX TO ENSURE THAT VOIDS CAUSED BY NESTING OF THE ROCKS WILL NOT OCCUR AND THAT THE FILL CAN BE PROPERLY COMPACTED.

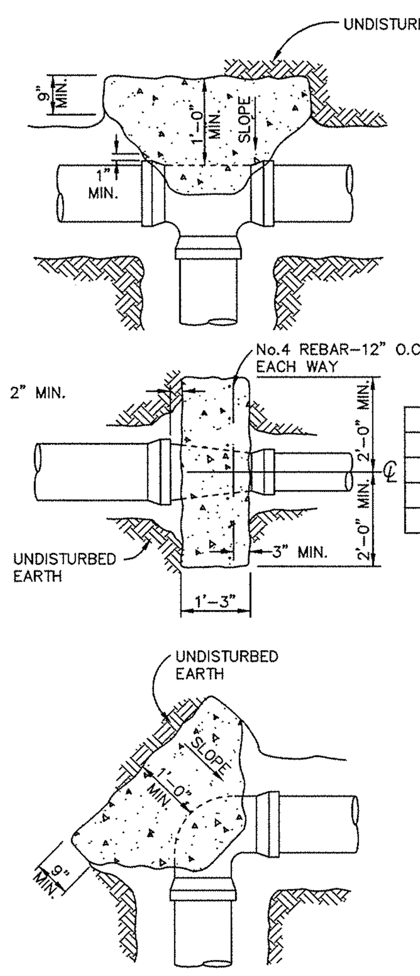
C. SELECT BEDDING SHALL NOT CONTAIN ANY ROCKS.

D. THE PAVEMENT AND LANDSCAPED AREAS SHALL BE INSTALLED PER APPROPRIATE PLANS AND SPECIFICATIONS.

E. No. 12 AWG LOCATOR WIRE SHALL BE TAPED TO THE TOP OF ALL PIPES.

(E) PIPE IN TRENCH DETAIL
N.T.S.

NOTE: UTILITY PLAN PREVIOUSLY APPROVED BY THE OFFICE OF STATE FIRE MARSHAL (FIRE and PANIC ONLY) ON NOV. 10, 2009. THESE DETAILS ARE ALL FROM THAT CIVIL PACKAGE.



PIPE SIZE	BEARING SIZE
12"	15 S.F.
10"	11 S.F.
8"	7 S.F.
6"	4 S.F.
4"	2 S.F.

REDUCER SIZE		
LARGE END	SMALL END	BEARING AREA
12"	8"	9 S.F.
12"	10"	5 S.F.
8"	6"	4 S.F.

NOTE:
BEARING AREA SHALL BE AGAINST UNDISTURBED EARTH

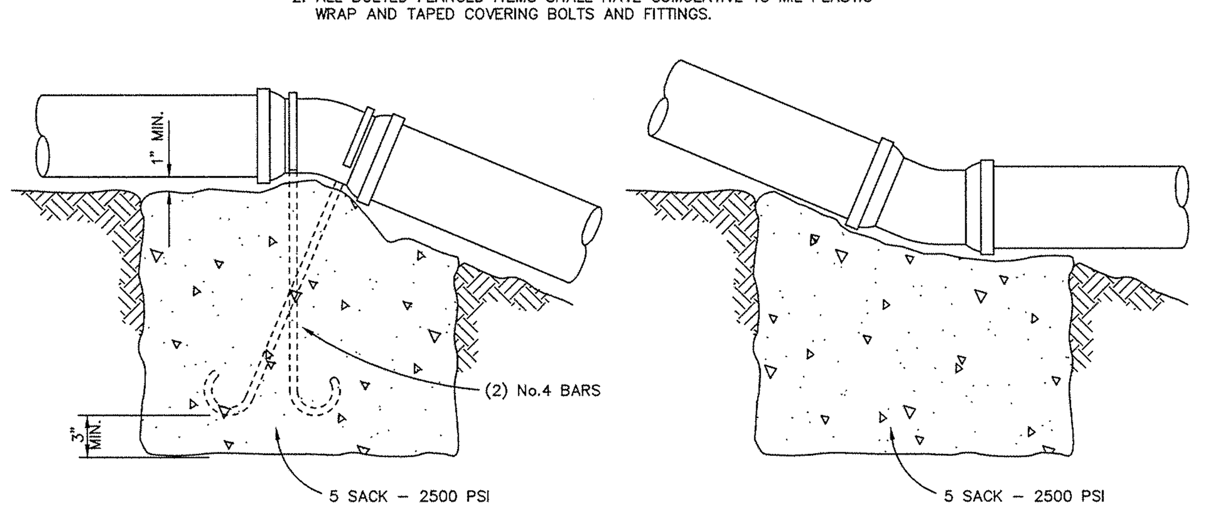
ALL BOLTS AND FITTINGS SHALL BE COVERED AND TAPED WITH PLASTIC WRAP, CUMULATIVE 15 MIL.

CONCRETE SHALL BE 5-SACK, 2500 PSI

	BEARING AREA			
PIPE SIZE	11-1/4° BEND	22-1/2° BEND	45° BEND	90° BEND
12"	3 S.F.	6 S.F.	12 S.F.	21 S.F.
10"	2 S.F.	4 S.F.	8 S.F.	15 S.F.
8"	2 S.F.	3 S.F.	5 S.F.	10 S.F.
6"	1 S.F.	2 S.F.	3 S.F.	4 S.F.
4"	1 S.F.	1 S.F.	1 S.F.	2 S.F.

(N) THRUST BLOCK DETAIL
N.T.S.

NOTE:
1. CONCRETE BLOCK SHOULD BE APPROX. EQUAL IN ALL DIMENSIONS.
2. ALL BOLTED FLANGED ITEMS SHALL HAVE CUMULATIVE 15 MIL PLASTIC WRAP AND TAPED COVERING BOLTS AND FITTINGS.

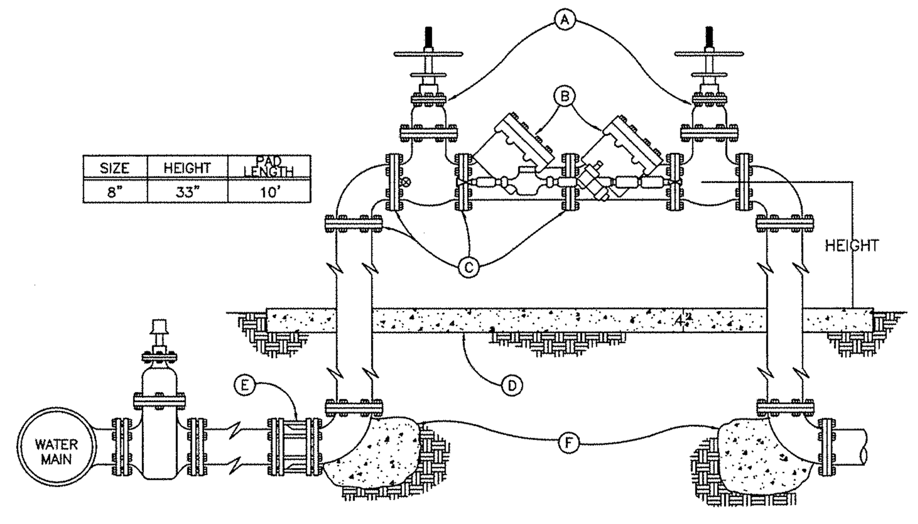


	CONCRETE VOLUMES		
PIPE SIZE	11-1/4° BEND	22-1/2° BEND	45° BEND
12"	1 YD	3 YDS	6 YDS
10"	1 YD	2 YDS	4 YDS
8"	0.5 YD	1 YD	2 YDS

	BEARING AREA			
PIPE SIZE	11-1/4° BEND	22-1/2° BEND	45° BEND	90° BEND
12"	3 S.F.	6 S.F.	12 S.F.	21 S.F.
10"	2 S.F.	4 S.F.	8 S.F.	15 S.F.
8"	2 S.F.	3 S.F.	5 S.F.	10 S.F.
6"	1 S.F.	2 S.F.	3 S.F.	4 S.F.
4"	1 S.F.	1 S.F.	1 S.F.	2 S.F.

(O) VERTICAL THRUST BLOCK DETAIL
N.T.S.

SIZE	HEIGHT	PAD LENGTH
8"	33"	10'



(A) 8" O.S.&Y. GATE VALVES WITH FULLY-ENCAPSULATED RESILIENT SEAT - Dresser or Kennedy (CONFORMING TO LATEST EDITION OF AWWA STANDARD C509-80.

(B) U.S.C. APPROVED DOUBLE DETECTOR CHECK VALVE BACKFLOW PREVENTION ASSEMBLY, WITH 3/4" NON-VALVED BYPASS METER ASSEMBLY.
[8" WILKINS MODEL 350ADA]

(C) ALL RISERS AND ABOVE-GROUND MAINLINE FITTINGS SHALL BE FLANGE-TYPE.

(D) P.C.C. PAD, 12" MIN. AROUND RISERS, 5-SACK.

(E) M.J. x FLANGE ADAPTOR.

(F) P.C.C. THRUST BLOCKS, 5-SACK.

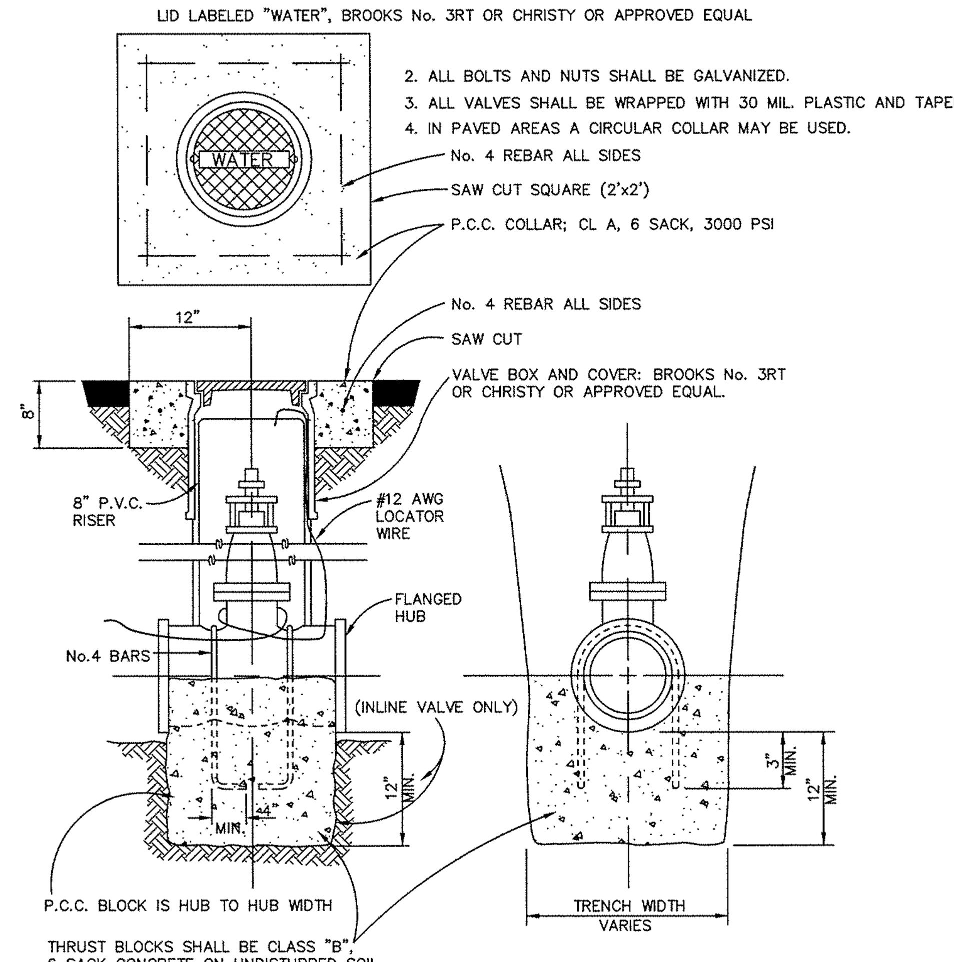
(G) 2-2 1/2" FDC ON DOWN STREAM SIDE OF BACKFLOW PREVENTION DEVICE.

(H) DOUBLE CHECK ASSEMBLY SHALL BE PROVIDED PER THE COUNTY OF SAN LUIS OBISPO APPROVED BACK FLOW DEVICES LIST.
[8" WILKINS MODEL 350ADA]

(P) DOUBLE CHECK ASSEMBLY
N.T.S.

LID LABELED "WATER", BROOKS No. 3RT OR CHRISTY OR APPROVED EQUAL

2. ALL BOLTS AND NUTS SHALL BE GALVANIZED.
3. ALL VALVES SHALL BE WRAPPED WITH 30 MIL. PLASTIC AND TAPED.
4. IN PAVED AREAS A CIRCULAR COLLAR MAY BE USED.



(L) GATE VALVE BOX & ANCHOR
N.T.S.

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DIV. OF THE STATE ARCHITECH
OFFICE OF REGULATION SERVICES
APPL 01-110181

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA
09/29/11

ESC.	TYPE	FINISH	TEMP.	QTY.

ESCUTCHEON

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.

SPRINKLER HEAD LEGEND

TOTAL SPRINKLERS THIS SHEET

#	DATE	BY	DESCRIPTION
	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

NORTH

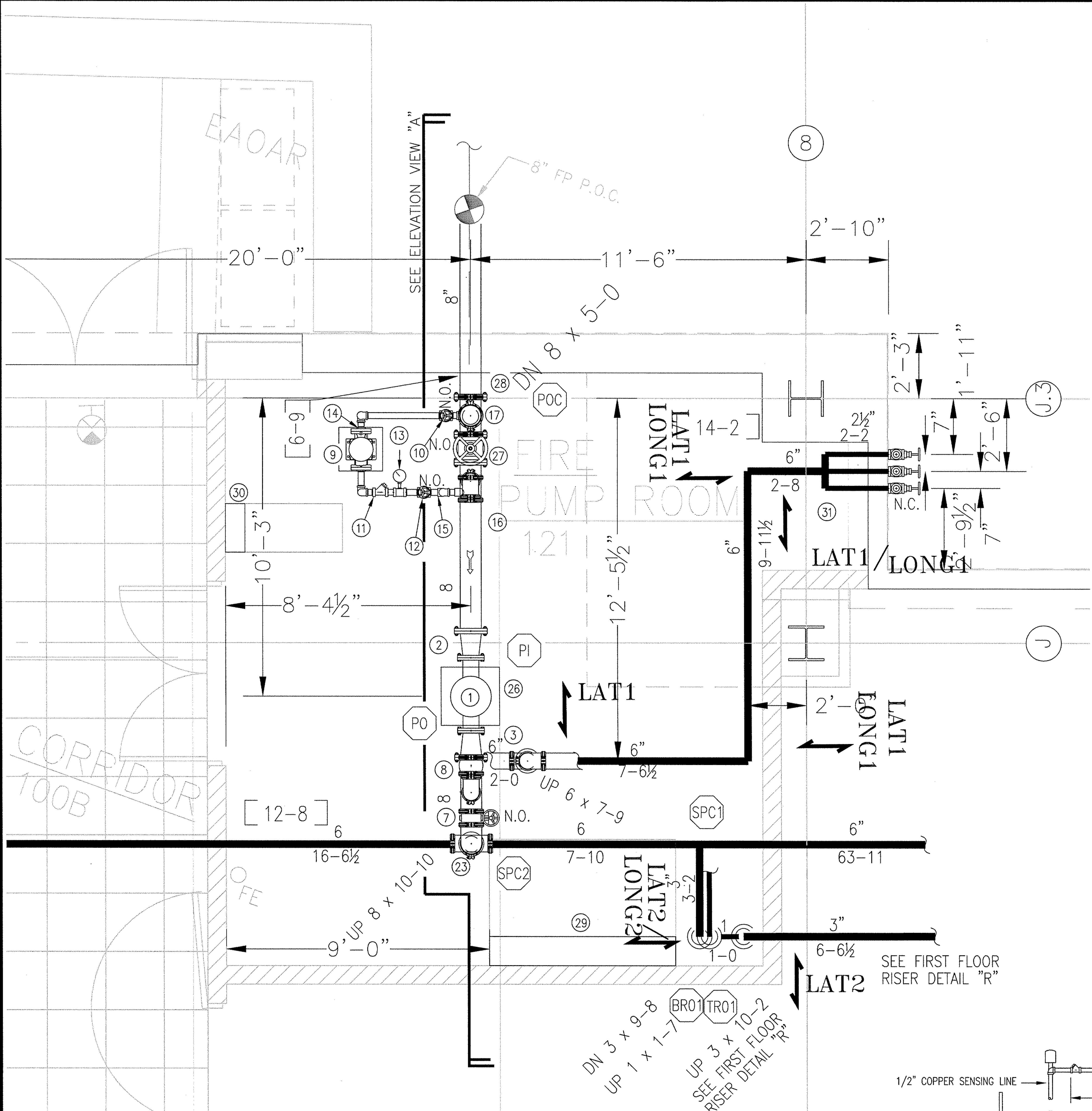
AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER SITE PLAN

DRAWN BY:	NRL
SCALE:	AS NOTED
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-2.0



FIRE PUMP ROOM

SCALE 1/2"=1'-0"

FIRE PUMP KEY NOTES

1– VERTICAL INLINE FIRE PUMP RATED 113 P.S.I. @ 750 GPM W/ELECTRIC MOTOR DRIVE (60 H.P.)
2– 8"x6" ECCENTRIC FLANGED REDUCER
3– 8"X6" CONCENTRIC FLANGED INCREASER
4– DISCHARGE GUAGE
5– SUCTION GAGE
6– 8" GROOVED TEE
7– 8" GROOVED BUTTERFLY VA. W/ TAMPER SWITCH
8– 8" GROOVED CHECK VALVE. (250 PSI)
9– JOCKEY PUMP (CRN 3–11 [2.0 H.P.])
10– 1 1/4" THREADED O.S.& Y. VALVE
11– 1 1/4" THREADED CHECK VALVE
12– 1 1/4" THREADED H.D. O.S.& Y. VALVE
13– WATER GAGE ON 1/4" 3–WAY VALVE
14– 1 1/4" TO JOCKEY PUMP
15– 1 1/4" FROM JOCKEY PUMP
16– 8" CITY BYPASS
17– 8" GROOVED 90° ELBOW
18– 8" GROOVED COUPLING FLEXIBLE
19– 6" GROOVED COUPLING FLEXIBLE
20– 1" AIR RELEASE VALVE
21– 2" PIPE STAND.
22– 6" GROOVED 90° ELBOW.
23– 6" GROOVED TEE.
24– 6" GROOVED BUTTERFLY VA. W/ TAMPER SWITCH.
25– 8" X 6" GROOVED REDUCING COUPLING.
26– 24" X 24" X 8" FIRE PUMP HOUSEKEEPING PAD
27– 8" O.S.&Y. W/ TAMPER SWITCH
28– 8" GROOVED FLANGE
29– FIRE PUMP CONTROL PANEL WITH AUTOMATIC TRANSFER SWITCH.
30– JOCKEY PUMP CONTROL PANEL.
31– 6" TEST HEADER W/ THREE (3) 2 1/2" HOSE VA.
32– 6" FLOW METER [GROOVED]

FLOW TEST SUMMARY

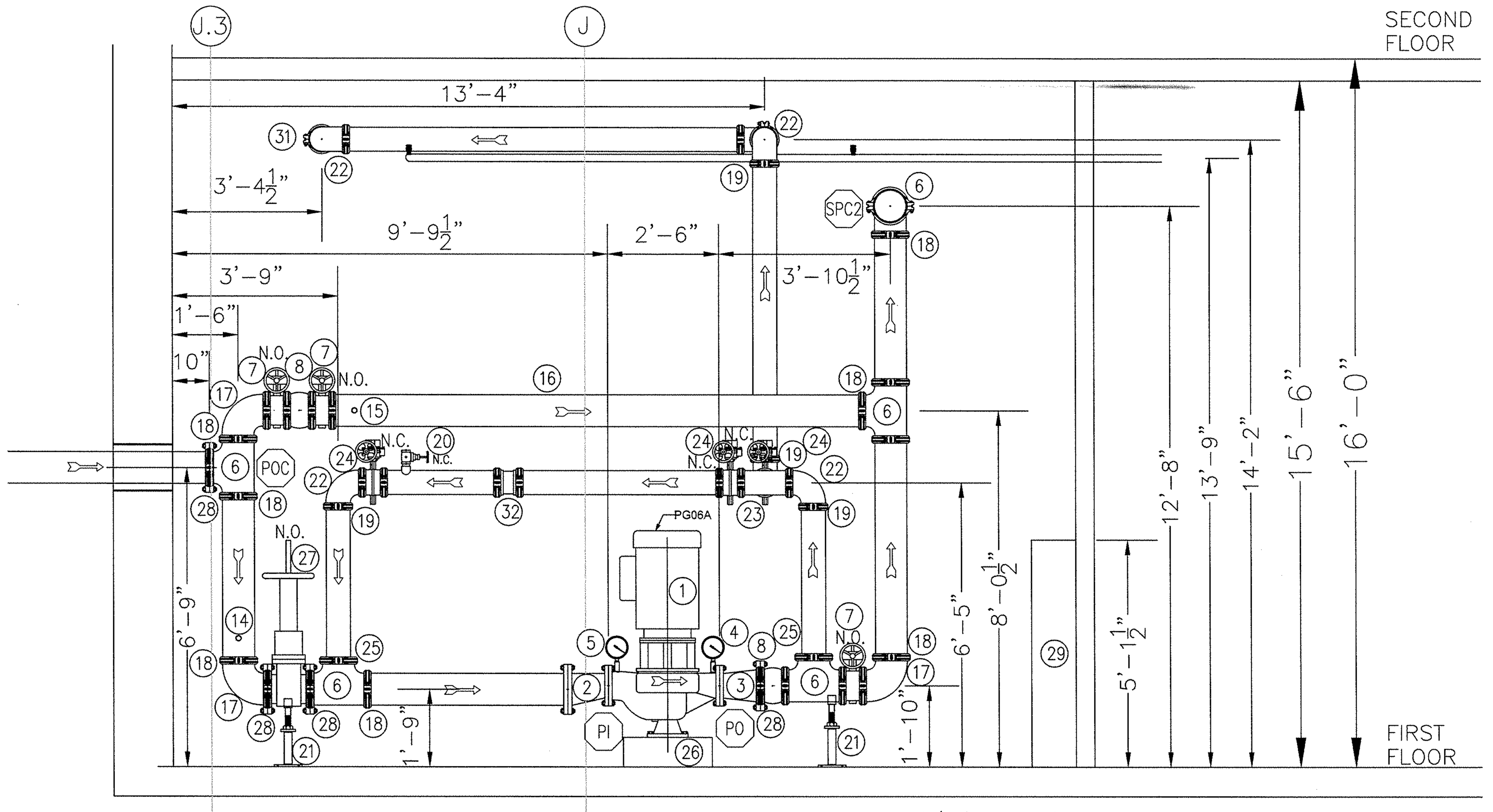
STATIC PSI	60
RESIDUAL PSI	55
PITOT PSI	35
ORIFICE DIAMETER	2 1/2
COEFFICIENT OF DISCHARGE	0.9
GPM	914
DATE	8–19–2011
LOCATION	N. POLY VIEW DRIVE
BY WHO	FLUID RESOURCE MANAGEMENT, INC.

ADJUSTED FLOW

10 % REDUCTION

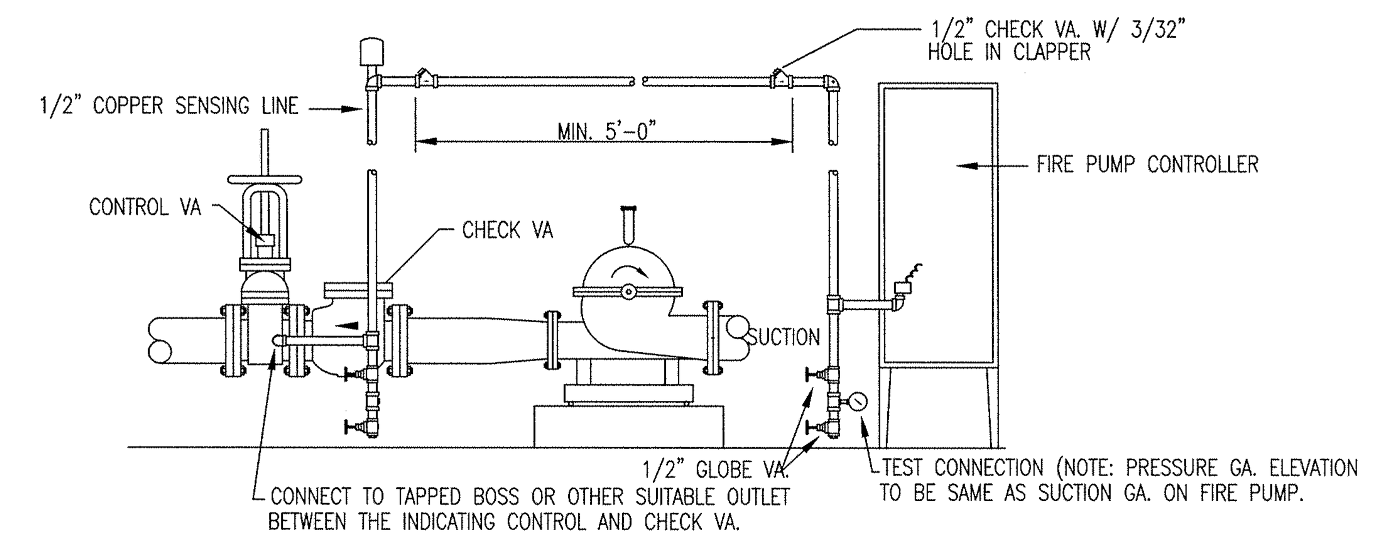
STATIC PSI	54
RESIDUAL PSI	49
GPM	914

STATIC & RESIDUAL TAKEN FROM HYD. # 63
FLOW TAKEN FROM HYD. # 64



ELEVATION VIEW "A"

SCALE 1/2"=1'-0"



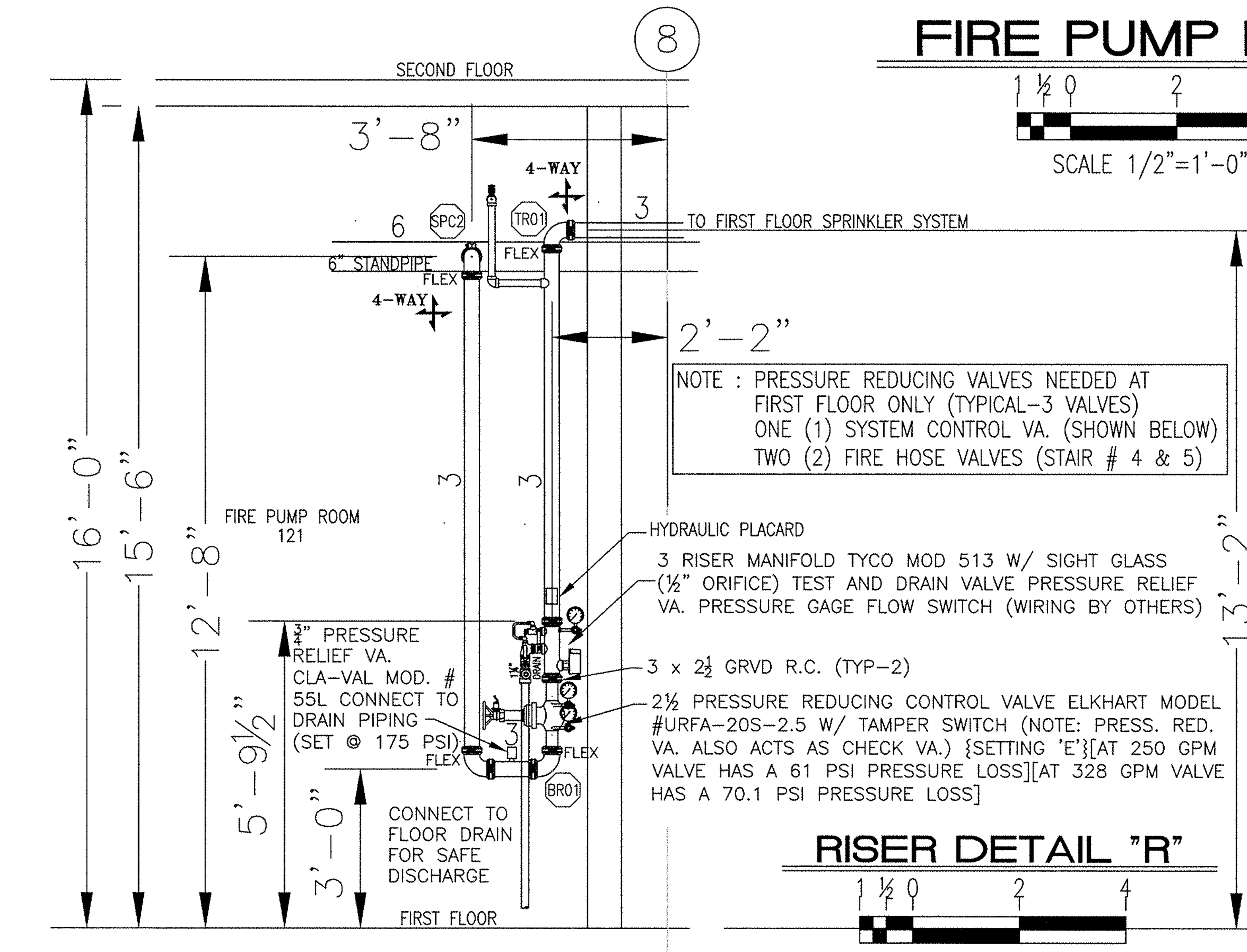
(NOTE: EACH OF THE TWO (2) FIRE PUMPS AND JOCKEY PUMP SHALL HAVE SEPARATE SENSING LINES AS SHOWN)

GENERAL FIRE PUMP NOTES:

1. ALL PIPING TO BE INSTALLED AND TESTED PER NFPA–13 2007 EDITION & NFPA–20 2003 EDITION.
2. ALL HANGERS AND SUPPORTS TO BE STANDARD AS PER NFPA–13 2010 EDITION.
3. ALL GROOVED COUPLINGS SHALL BE FLEX. (TYCO) OR EQUAL. ALL COUPLINGS AND FITTINGS ON DISCHARGE SIDE OF PUMP SHALL 175# RATED.
4. ALL MATERIALS TO BE U.L. LISTED.
5. ALL VALVES TO BE MONITORED WITH TAMPER SWITCHES.
6. MATERIALS SHALL BE U.S. MANUFACTURE.
7. PUMP ROOM TO BE PROVIDED WITH SUFFICIENT HEAT AND VENTILATION TO MAINTAIN A MINIMUM TEMPERATURE OF 40°F.
8. ALL ELECTRICAL WIRING TO BE PROVIDED BY OTHERS.
9. ALL PAINTING OF PIPING TO BE PROVIDED BY OTHERS.
10. ALL CONCRETE PADS, FOUNDATIONS, ETC., TO BE PROVIDED BY OTHERS.
11. ADEQUATE CLEARANCE SHALL BE PROVIDED AROUND ALL PUMPS AND VALVES.

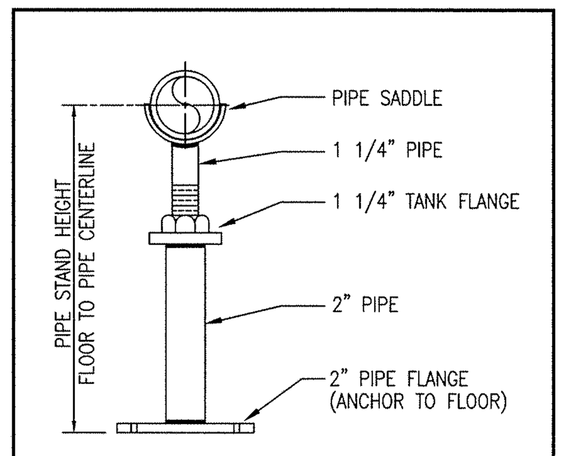
SPECIFIC FIRE PUMP NOTES:

1. ALL 1" THRU 2" PIPE SHALL BE BLACK SCHEDULE 40 W/DUCTILE IRON SCREWED FITTINGS.
2. 8" PIPE ON SUCTION SIDE OF PUMP SHALL BE GALVANIZED SCH 40 WITH CUT GROOVED OR WELDED, W/GROOVED, FLANGED AND WELDED FITTINGS.
3. ALL 6" & 8" DISCHARGE PIPE SHALL BE BLACK SCHEDULE 40 WITH EITHER GROOVED OR FLANGED FITTING/COUP.
4. CITY FLOW TEST: STATIC=60 psi; RESIDUAL=55 psi; FLOW=914 gpm
5. PUMP DESIGN CURVE: CHURN––125 PSI @ 0 GPM
   DESIGN––113 PSI @ 750 GPM
   150%––– 86 PSI @ 1125 GPM
6. PUMP SHALL BE PERFORMANCE TESTED TO THE THREE (3) POINTS LISTED IN NOTE 5, PER NFPA–20, PARAGRAPH 14.2.7.2 CONTROLLER SHALL BE TESTED WITH SIX (6) AUTOMATIC STARTS, AND SIX (6) MANUAL STARTS; EACH SHALL HAVE A MINIMUM OF FIVE (5) MINUTES OF PUMP OPERATION, PER NFPA–20, PARAGRAPH 14.2.8.1, 14.2.8.2 TOTAL PUMP OPERATION SHALL BE A MINIMUM OF ONE (1) HOUR, PER NFPA–20, PARAGRAPH 14.2.12.



RISER DETAIL "R"

SCALE 1/2"=1'-0"



STOCKLIST AS LOOSE MATERIAL

TYPICAL PIPE STAND

NO SCALE

FIRE PUMP SETTINGS :

FIRE PUMP MAXIMUM CHURN = 191 PSI
JOCKEY PUMP STOP = 165 PSI
JOCKEY PUMP START = 155 PSI
FIRE PUMP START = 150 PSI

PROVIDE AUX. DRAINS FOR ALL TRAPPED PORTIONS OF PUMPROOM PIPING
SUPPORT ALL PIPE WITH PIPE STANDS OR FROM CONCRETE STRUCTURE AS APPROPRIATE.
FIELD VERIFY ALL INCOMING SPIGOT LOCATIONS AND ADJUST PIPING AS REQUIRED TO COMPENSATE FOR ACTUAL FIELD DIMENSIONS

IDENTIFICATION STAMP
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OFFICE OF REGULATION SERVICES
APPL 01-110181

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ–L16–234798 CA–C16–901529
AZ–C16–234797 NV–C41–69370
UT–S370–6690455–5501 NM–MS 12–354807

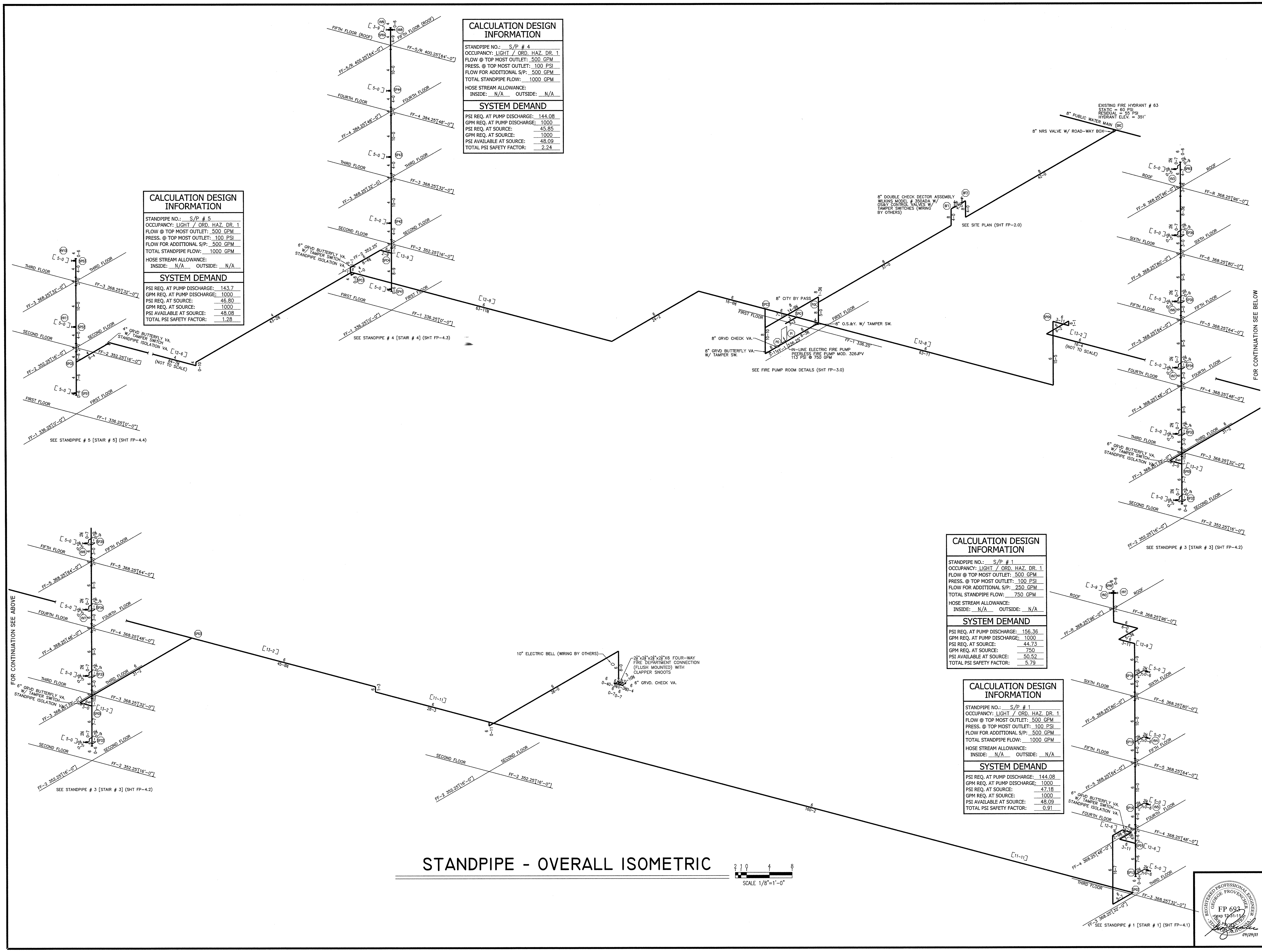
PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE PUMP PLAN

DRAWN BY:	NRL
SCALE:	AS NOTED
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-3.0

09/29/11



CALCULATION DESIGN INFORMATION

STANDPIPE NO.:	S/P # 4
OCCUPANCY:	LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET:	500 GPM
PRESS. @ TOP MOST OUTLET:	100 PSI
FLOW FOR ADDITIONAL S/P:	500 GPM
TOTAL STANDPIPE FLOW:	1000 GPM
HOSE STREAM ALLOWANCE: INSIDE:	N/A
OUTSIDE:	N/A

SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE:	144.08
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	45.85
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.09
TOTAL PSI SAFETY FACTOR:	2.24

CALCULATION DESIGN INFORMATION

STANDPIPE NO.:	S/P # 5
OCCUPANCY:	LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET:	500 GPM
PRESS. @ TOP MOST OUTLET:	100 PSI
FLOW FOR ADDITIONAL S/P:	500 GPM
TOTAL STANDPIPE FLOW:	1000 GPM
HOSE STREAM ALLOWANCE: INSIDE:	N/A
OUTSIDE:	N/A

SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE:	143.7
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	46.80
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.08
TOTAL PSI SAFETY FACTOR:	1.28

CALCULATION DESIGN INFORMATION

STANDPIPE NO.:	S/P # 1
OCCUPANCY:	LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET:	500 GPM
PRESS. @ TOP MOST OUTLET:	100 PSI
FLOW FOR ADDITIONAL S/P:	250 GPM
TOTAL STANDPIPE FLOW:	750 GPM
HOSE STREAM ALLOWANCE: INSIDE:	N/A
OUTSIDE:	N/A

SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE:	156.36
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	44.73
GPM REQ. AT SOURCE:	750
PSI AVAILABLE AT SOURCE:	50.52
TOTAL PSI SAFETY FACTOR:	5.79

CALCULATION DESIGN INFORMATION

STANDPIPE NO.:	S/P # 1
OCCUPANCY:	LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET:	500 GPM
PRESS. @ TOP MOST OUTLET:	100 PSI
FLOW FOR ADDITIONAL S/P:	500 GPM
TOTAL STANDPIPE FLOW:	1000 GPM
HOSE STREAM ALLOWANCE: INSIDE:	N/A
OUTSIDE:	N/A

SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE:	144.08
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	47.18
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.09
TOTAL PSI SAFETY FACTOR:	0.91

STANDPIPE - OVERALL ISOMETRIC

SCALE 1/8"=1'-0"

NORTH

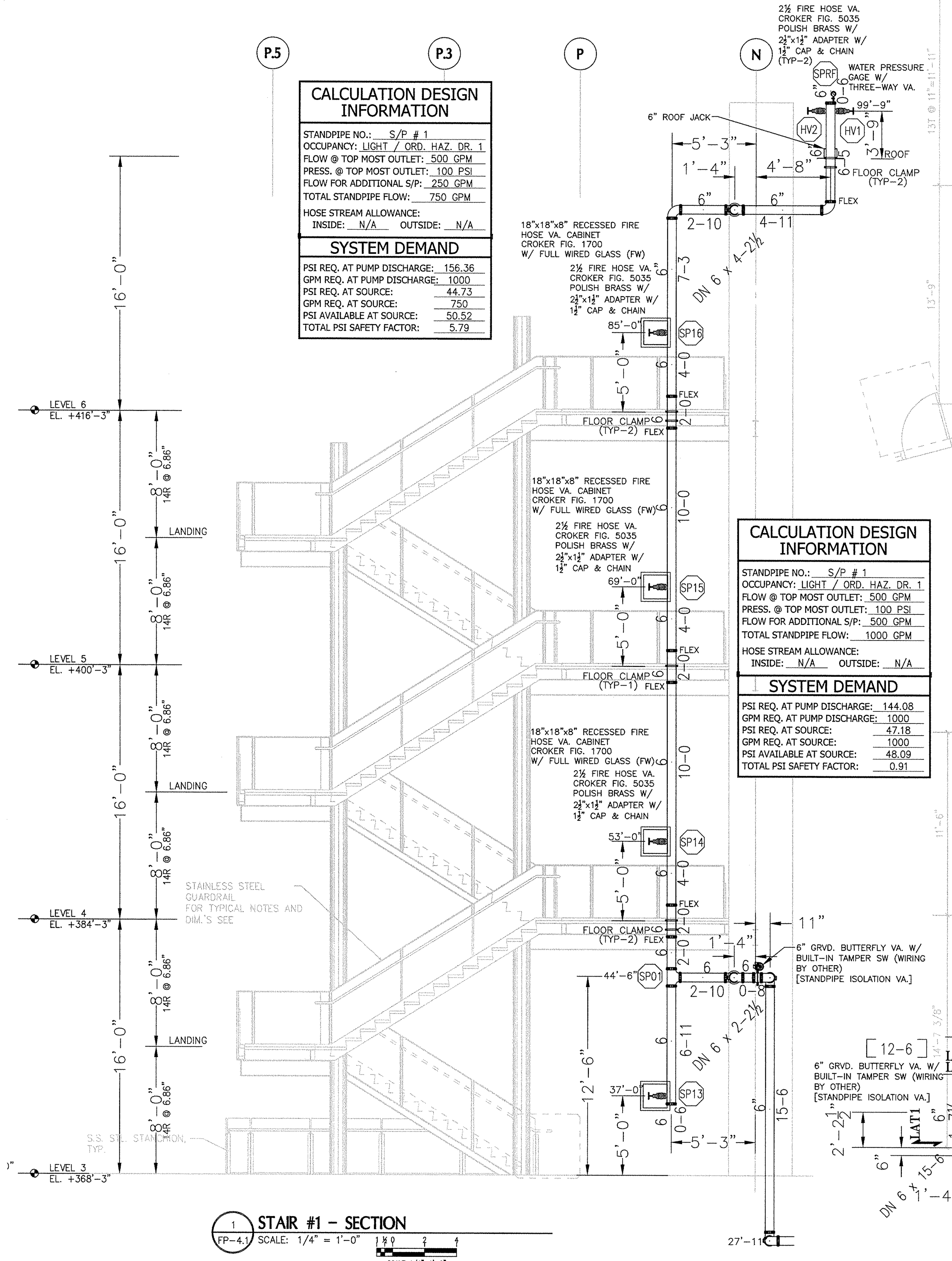
AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: STANDPIPE - OVERALL ISOMETRIC

DRAWN BY:	----
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-4.0



1 / FP-4.1 **STAIR #1 - SECTION**
SCALE: 1/4" = 1'-0"

CALCULATION DESIGN INFORMATION

STANDPIPE NO.:	S/P # 1
OCCUPANCY:	LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET:	500 GPM
PRESS. @ TOP MOST OUTLET:	100 PSI
FLOW FOR ADDITIONAL S/P:	250 GPM
TOTAL STANDPIPE FLOW:	750 GPM
HOSE STREAM ALLOWANCE: INSIDE:	N/A
OUTSIDE:	N/A

SYSTEM DEMAND

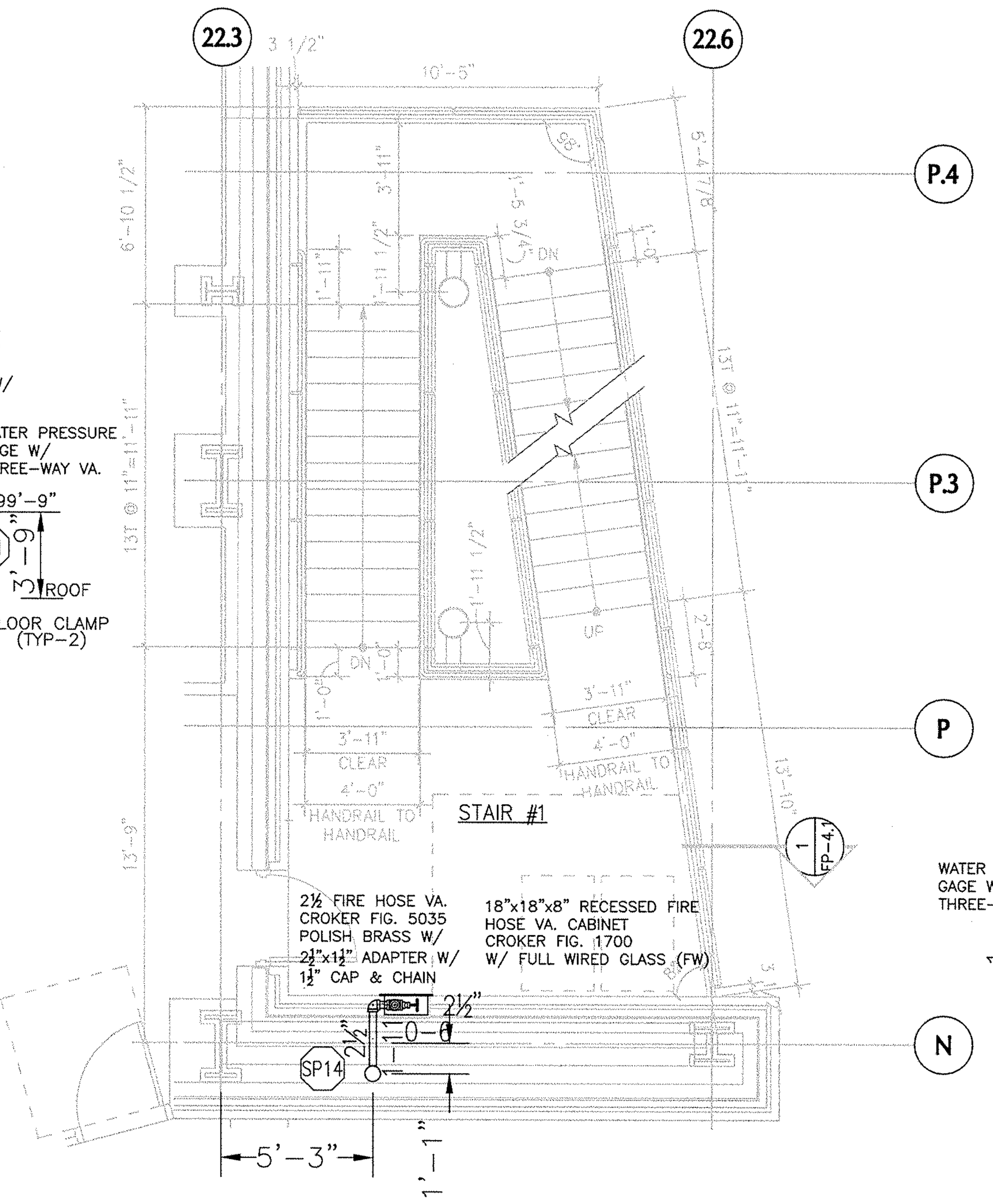
PSI REQ. AT PUMP DISCHARGE:	156.36
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	44.73
GPM REQ. AT SOURCE:	750
PSI AVAILABLE AT SOURCE:	50.52
TOTAL PSI SAFETY FACTOR:	5.79

CALCULATION DESIGN INFORMATION

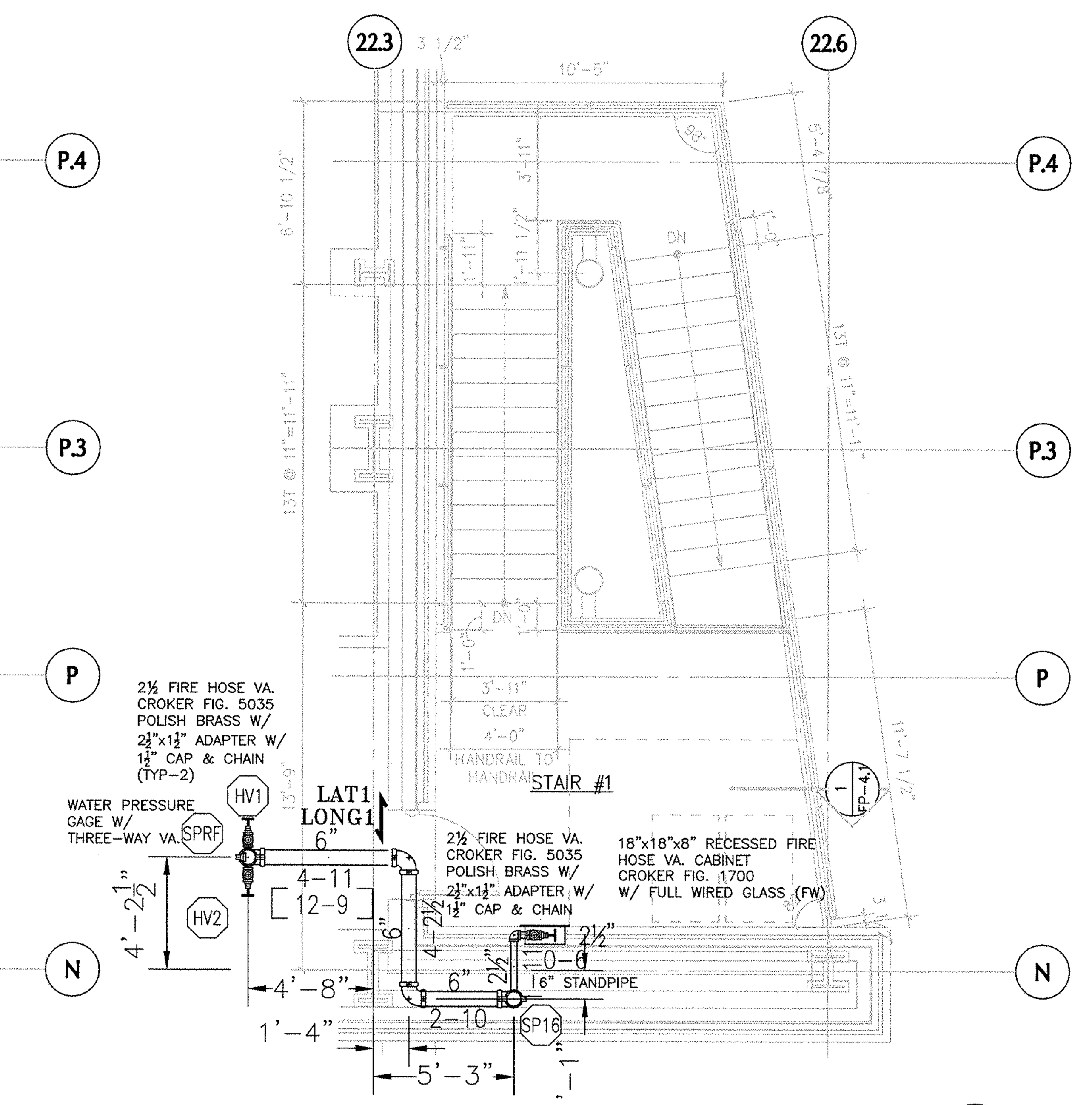
STANDPIPE NO.:	S/P # 1
OCCUPANCY:	LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET:	500 GPM
PRESS. @ TOP MOST OUTLET:	100 PSI
FLOW FOR ADDITIONAL S/P:	500 GPM
TOTAL STANDPIPE FLOW:	1000 GPM
HOSE STREAM ALLOWANCE: INSIDE:	N/A
OUTSIDE:	N/A

SYSTEM DEMAND

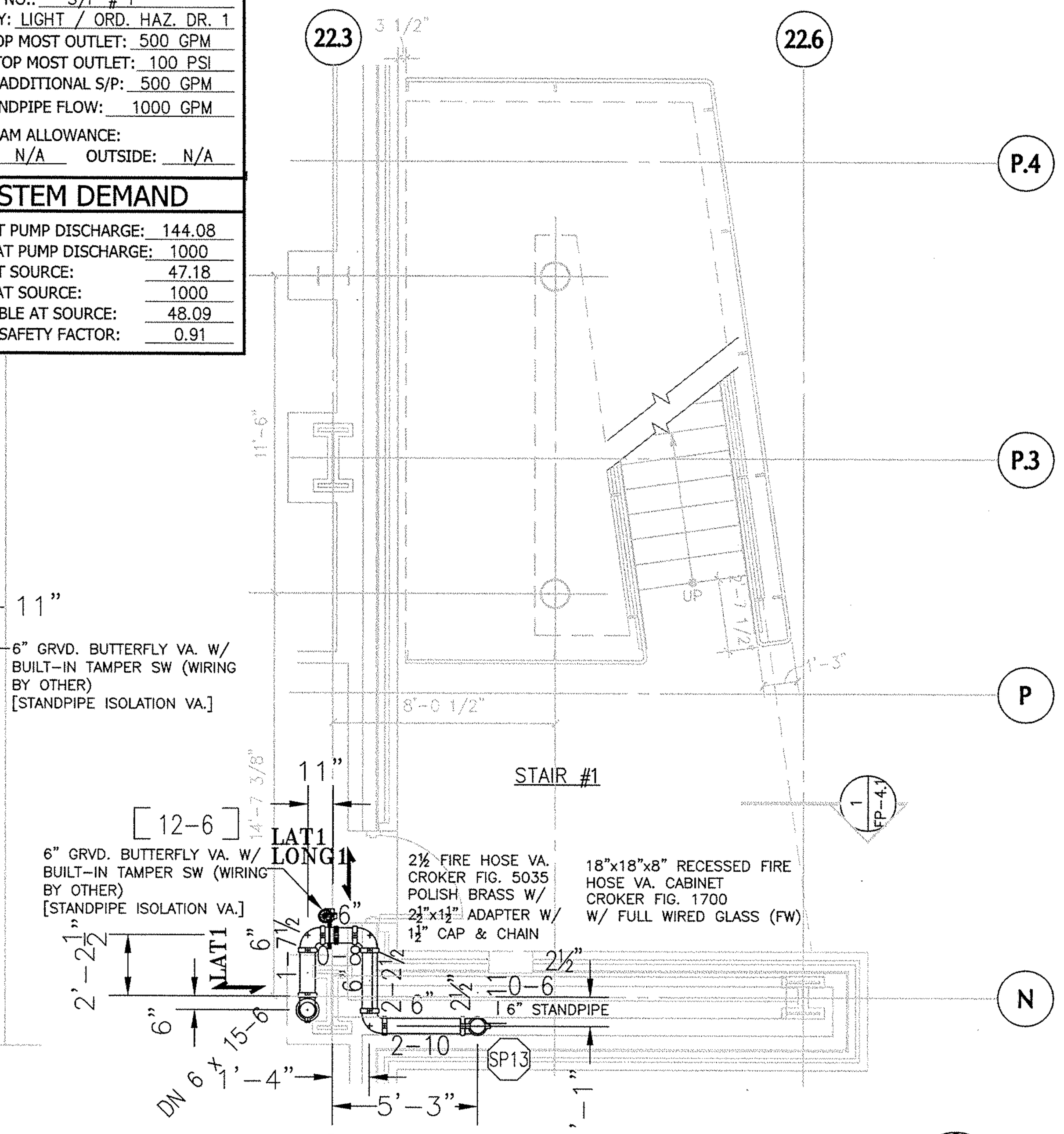
PSI REQ. AT PUMP DISCHARGE:	144.08
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	47.18
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.09
TOTAL PSI SAFETY FACTOR:	0.91



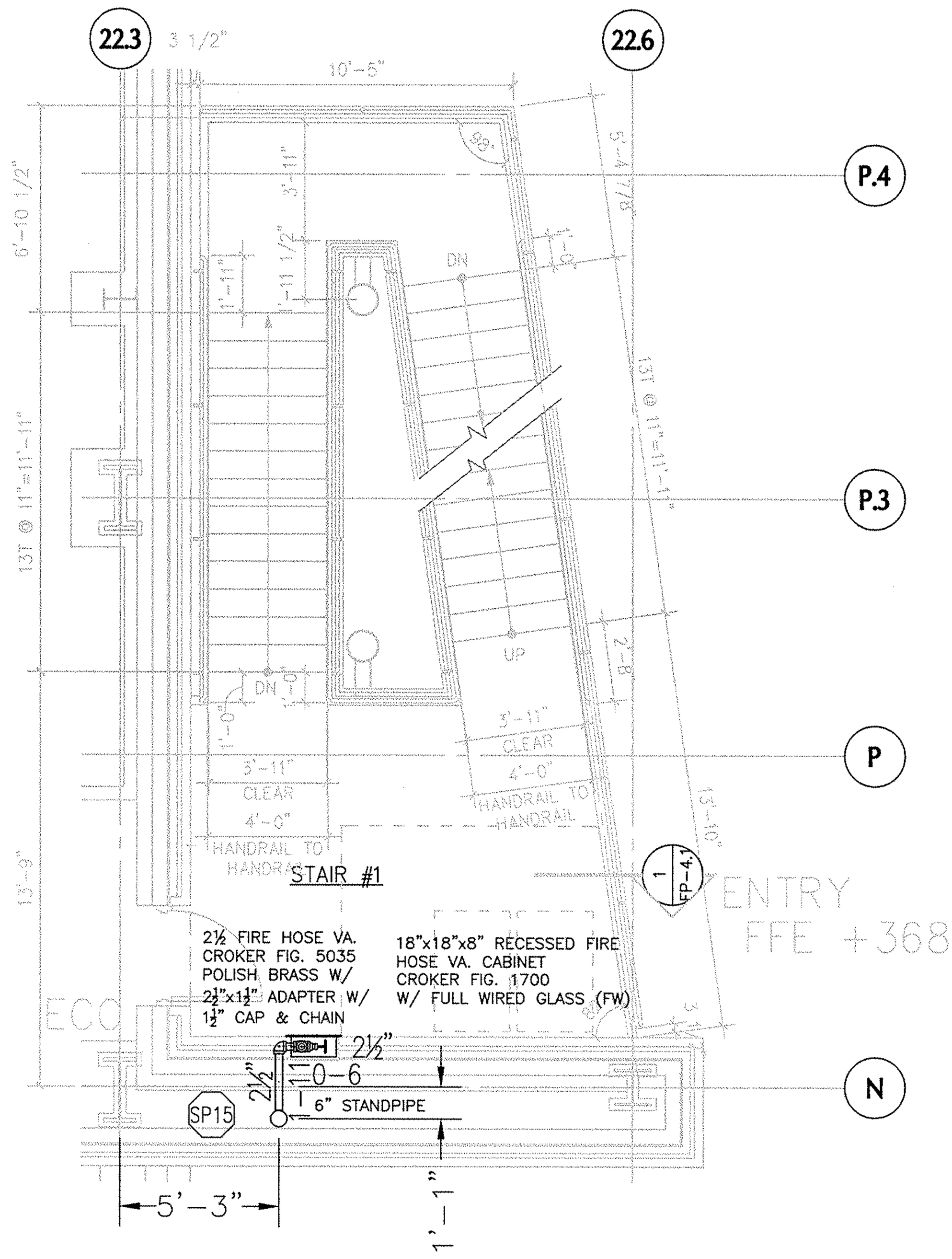
1B / FP-4.1 **STAIR #1 - LEVEL 4**
SCALE: 1/4" = 1'-0"



1D / FP-4.1 **STAIR #1 - LEVEL 6**
SCALE: 1/4" = 1'-0"



1A / FP-4.1 **STAIR #1 - LEVEL 3**
SCALE: 1/4" = 1'-0"



1C / FP-4.1 **STAIR #1 - LEVEL 5**
SCALE: 1/4" = 1'-0"

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.

TOTAL SPRINKLERS THIS SHEET

REVISIONS

#	DATE	BY	DESCRIPTION	QTY
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR	

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. Phoenix, Arizona 85024
623.580.7800 Fax 623.434.3154

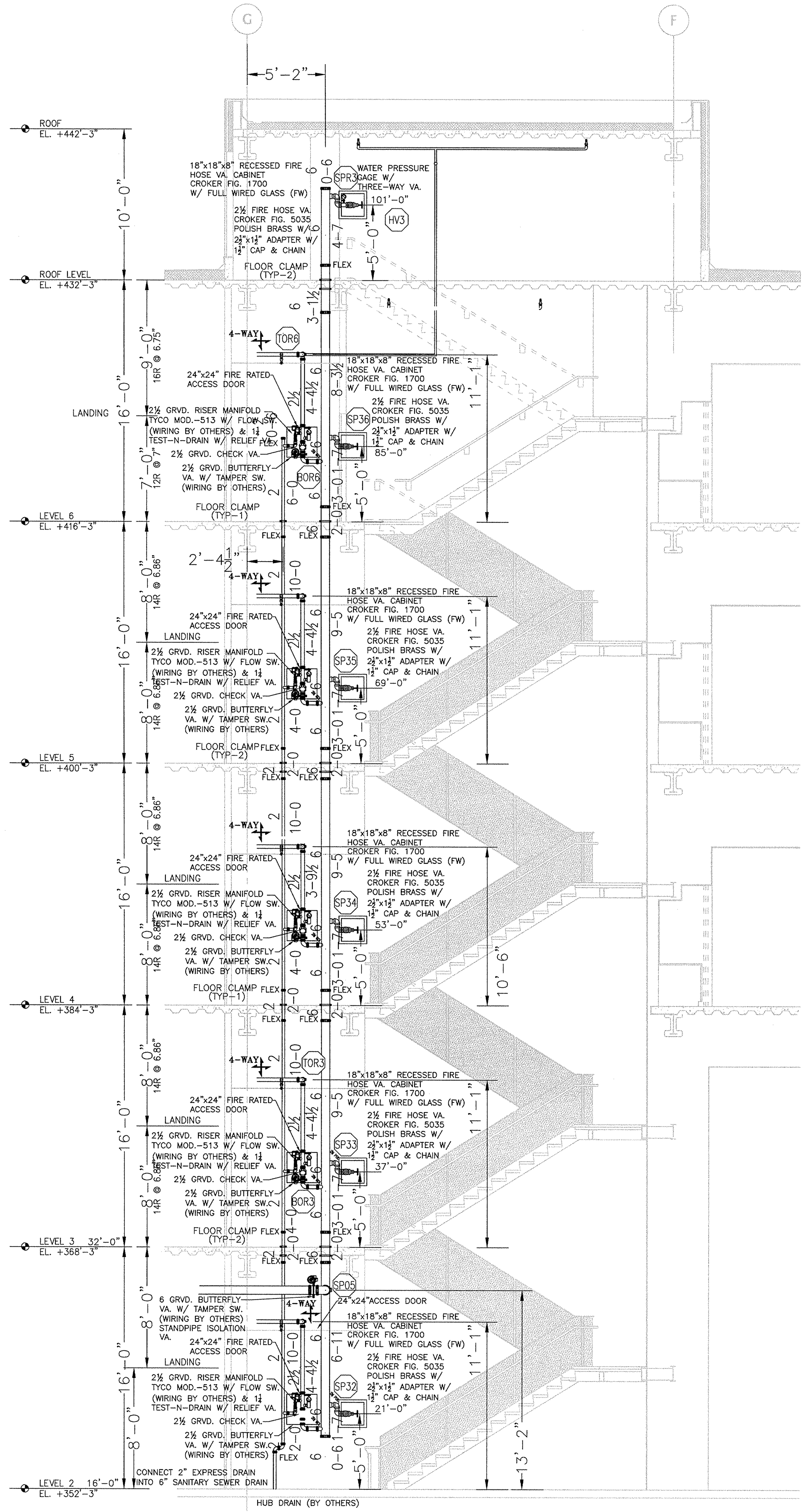
PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

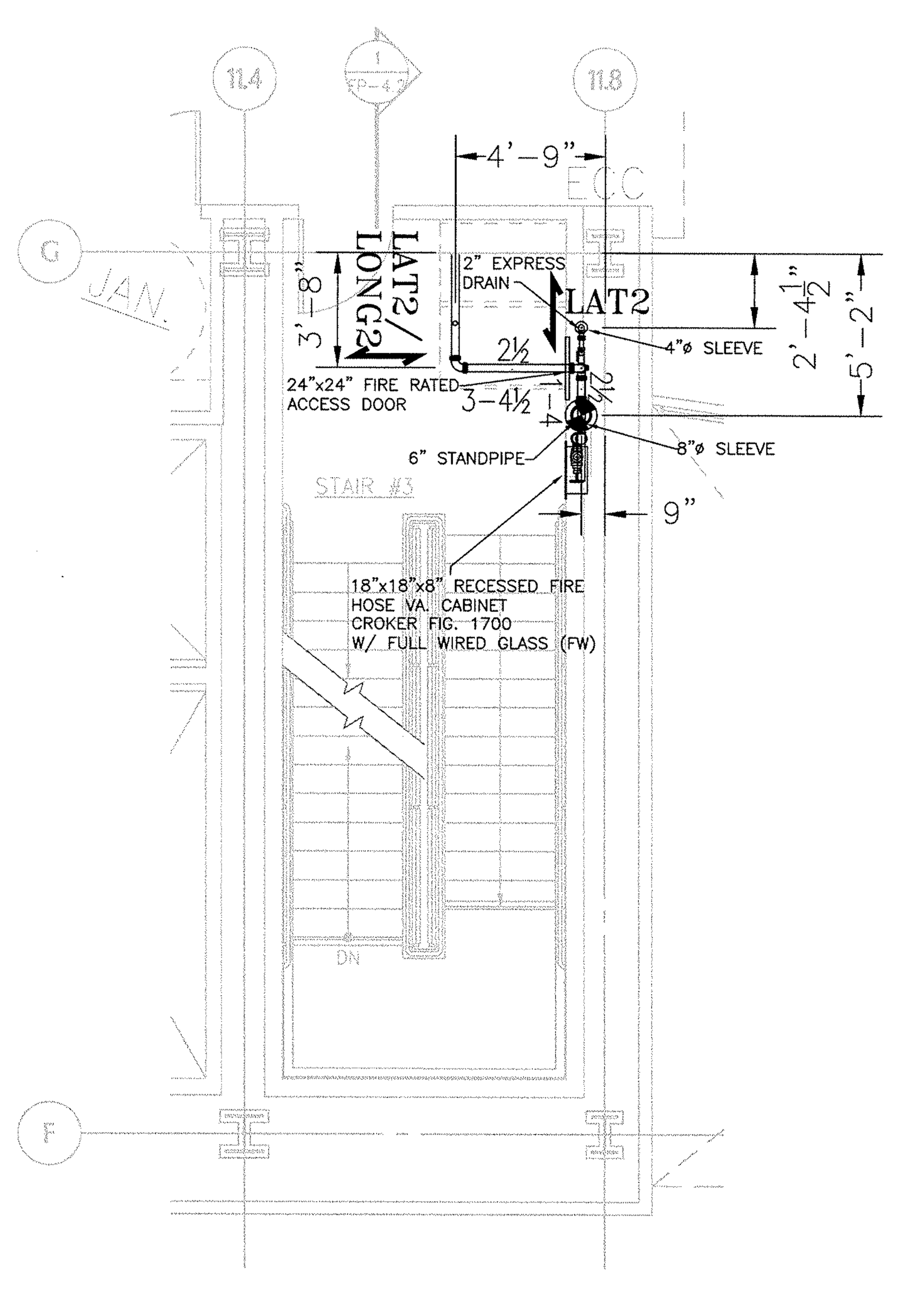
STANDPIPE # 1 DETAILS

DRAWN BY:	----
SCALE:	1/4"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-4.1

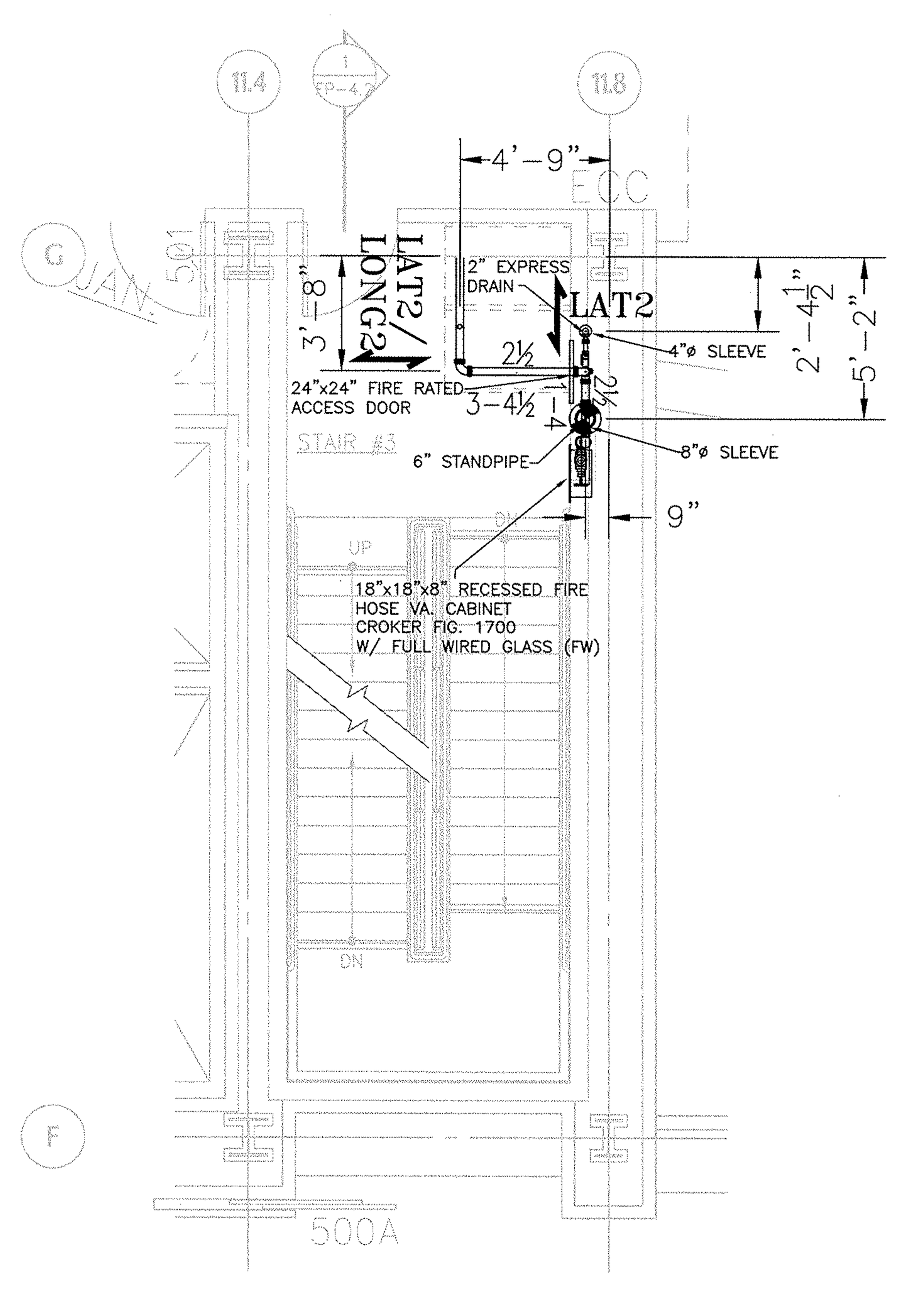
REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 exp 12-31-11 STATE OF ARIZONA 09/29/11



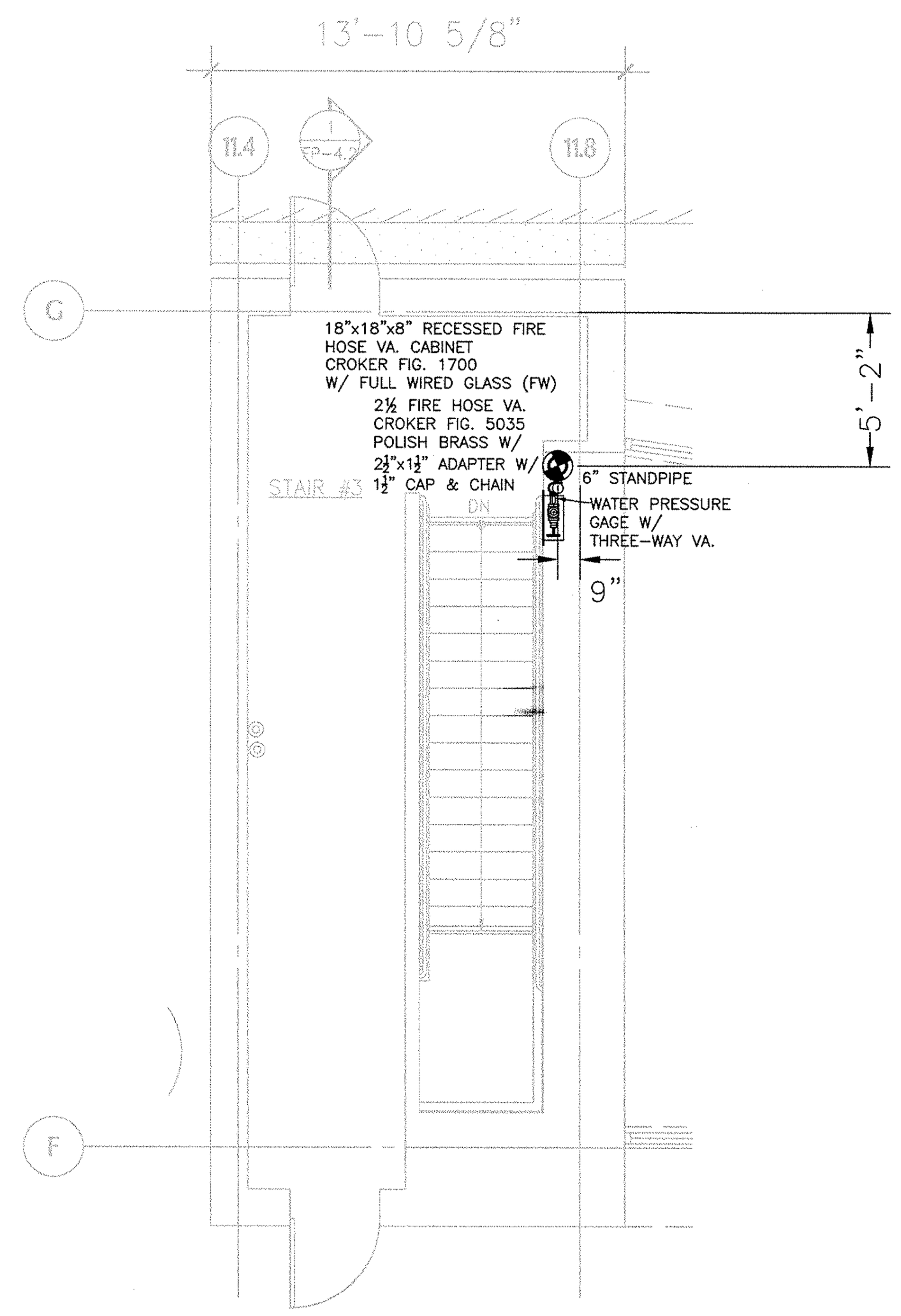
1 SECTION- STAIR #3 (FP-4.2) SCALE: 1/4" = 1'-0"



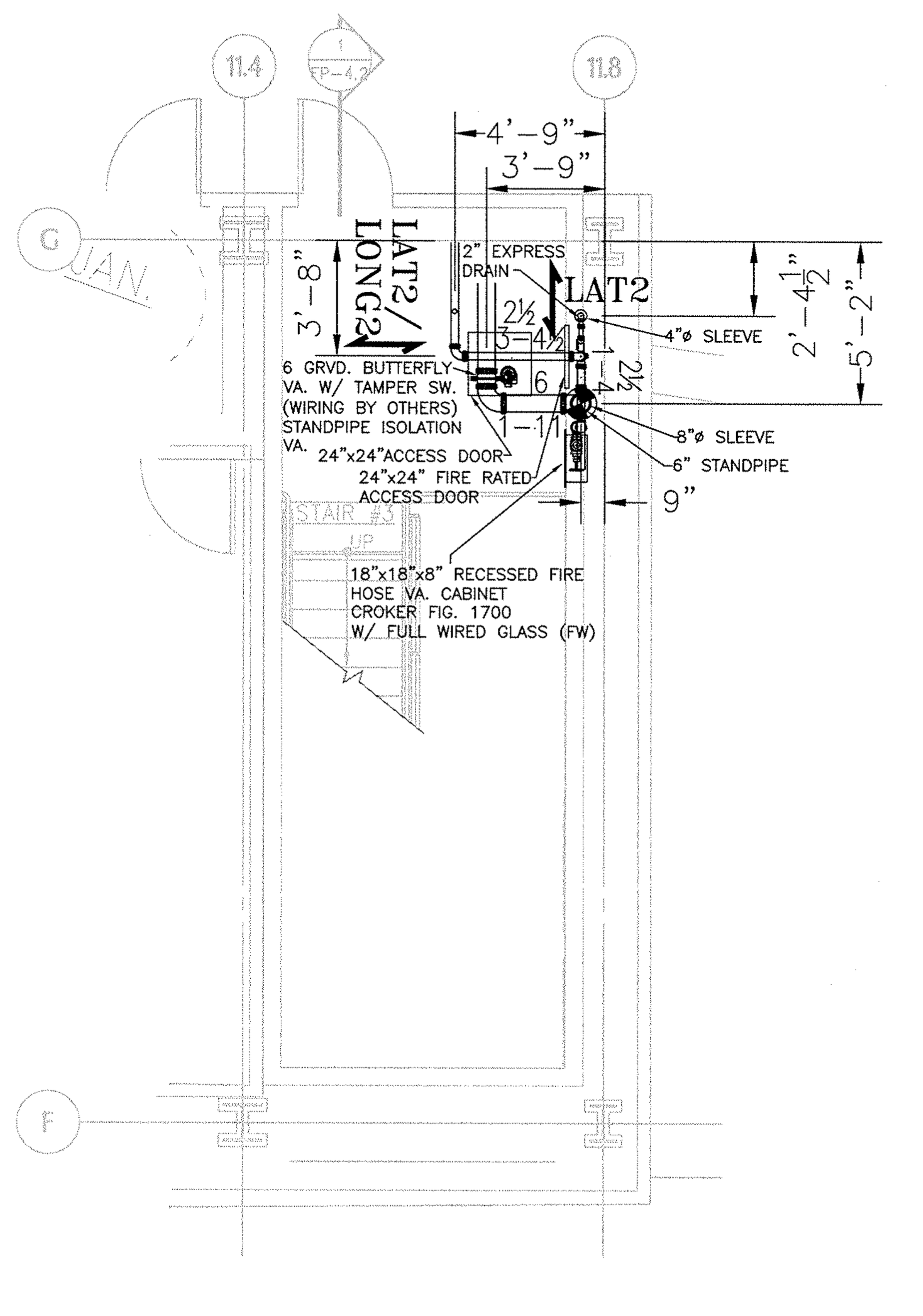
1B STAIR #3 - LEVEL 3 (FP-4.2) SCALE: 1/4" = 1'-0"



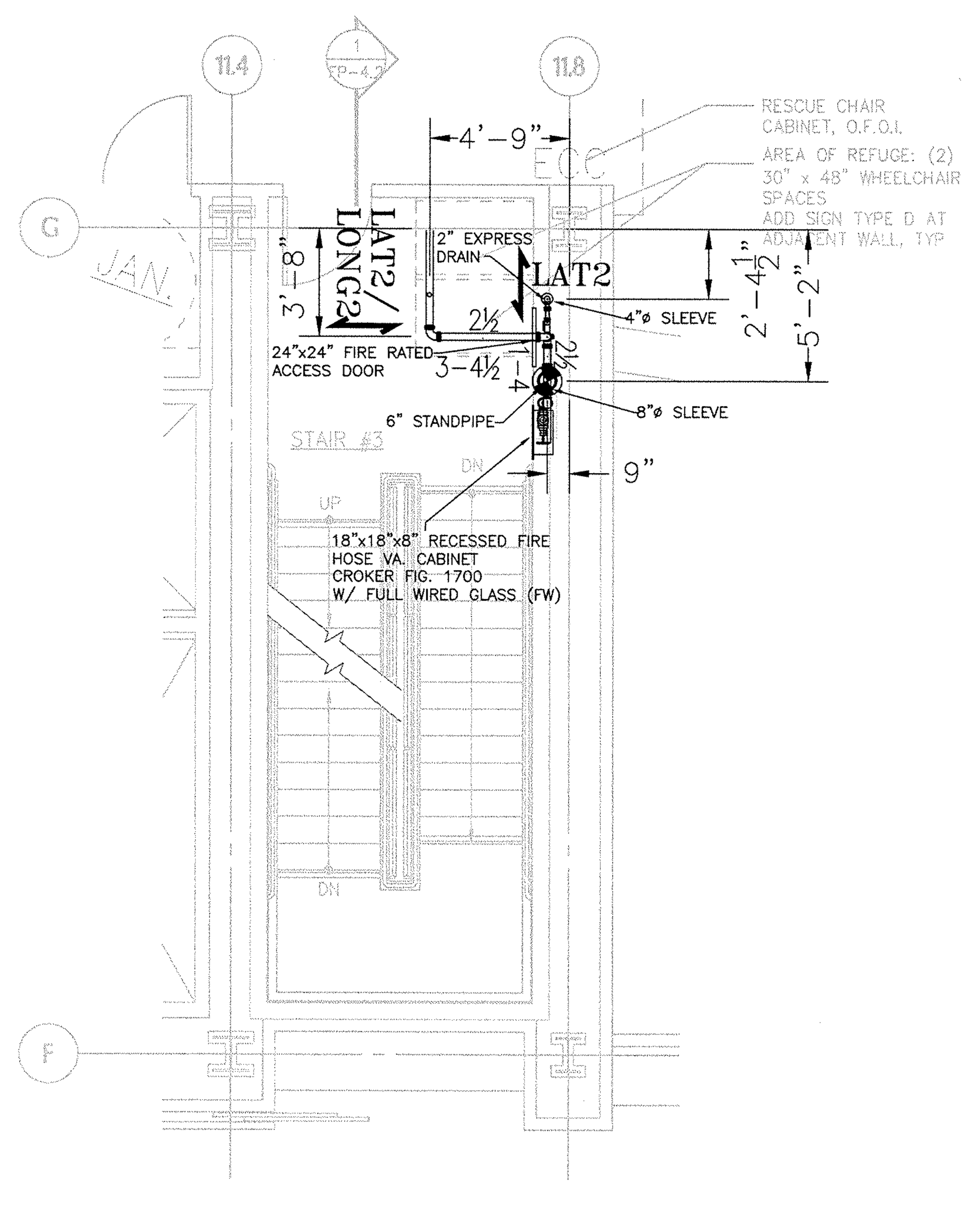
1D STAIR #3 - LEVEL 5 (FP-4.2) SCALE: 1/4" = 1'-0"



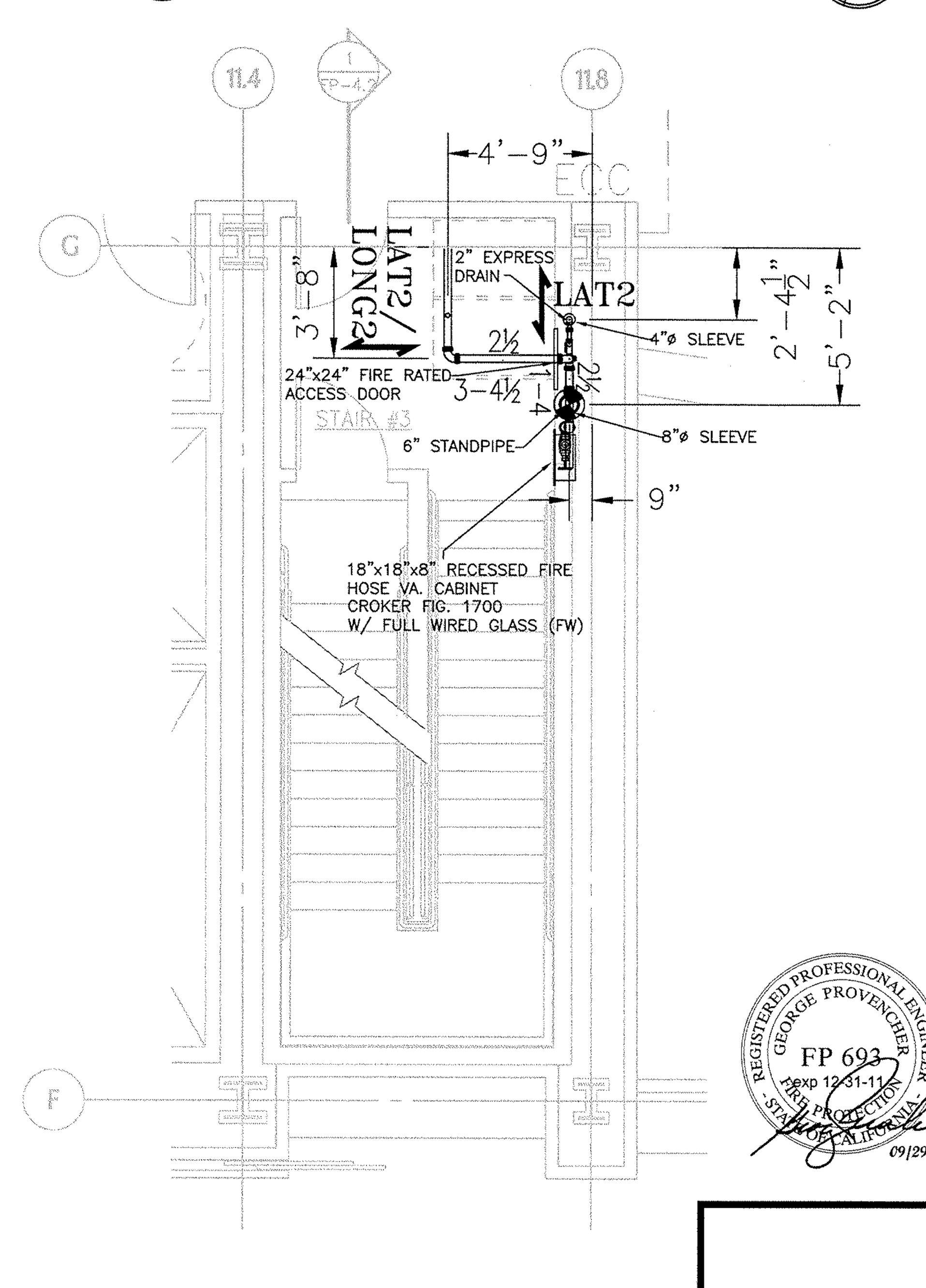
1F STAIR #3 - ROOF LEVEL (FP-4.2) SCALE: 1/4" = 1'-0"



1A STAIR #3 - LEVEL 2 (FP-4.2) SCALE: 1/4" = 1'-0"



1C STAIR #3 - LEVEL 4 (FP-4.2) SCALE: 1/4" = 1'-0"



1E STAIR #3 - LEVEL 6 (FP-4.2) SCALE: 1/4" = 1'-0"

REVISIONS: 1 — 9-28-2011 — NRL — SUBMITTAL TO GENERAL CONTRACTOR

SPRINKLER HEAD LEGEND — TOTAL SPRINKLERS THIS SHEET

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-9370-6690455-5501 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: STANDPIPE # 3 DETAILS

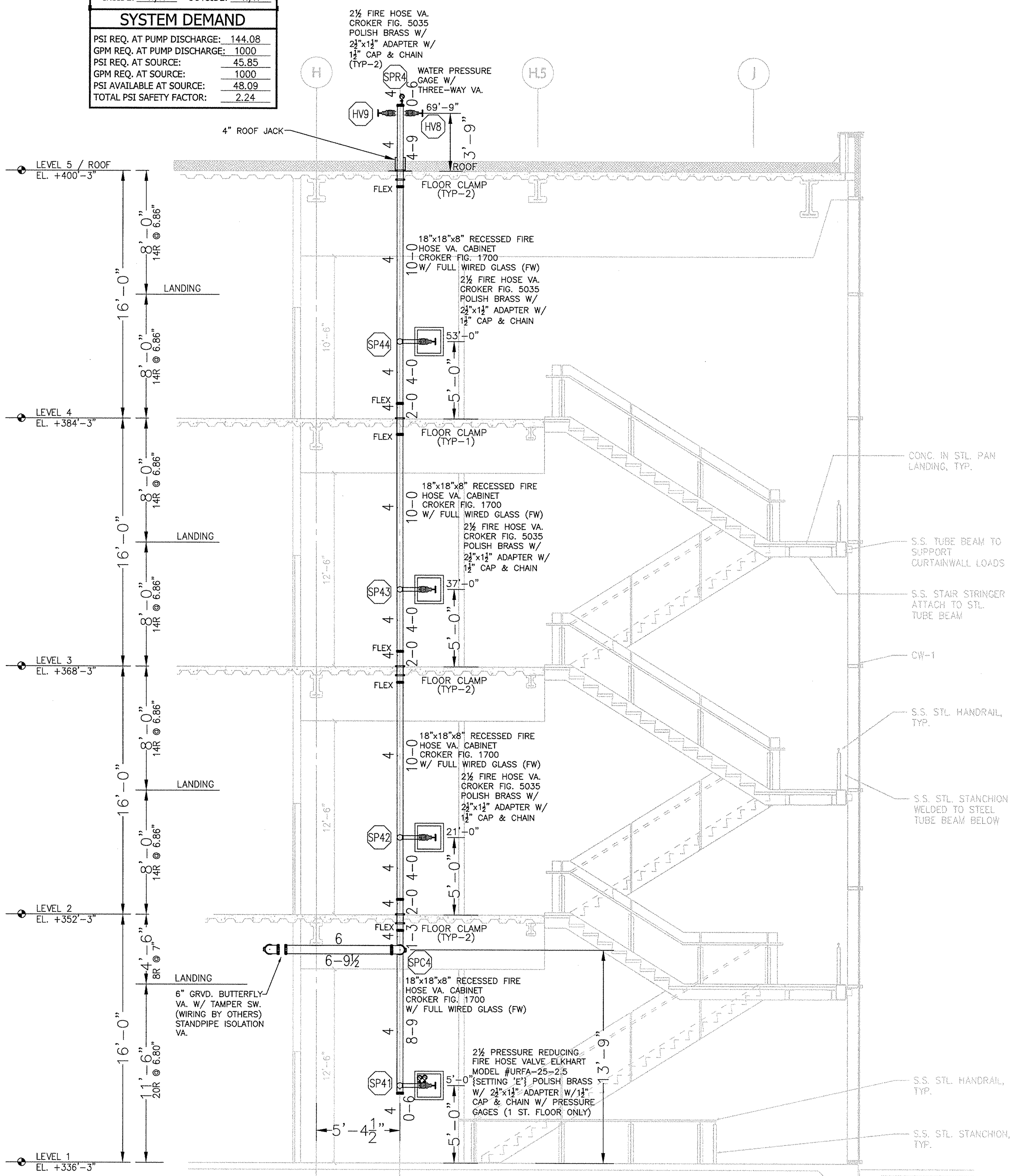
DRAWN BY:	----
SCALE:	1/4"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-4.2

CALCULATION DESIGN INFORMATION

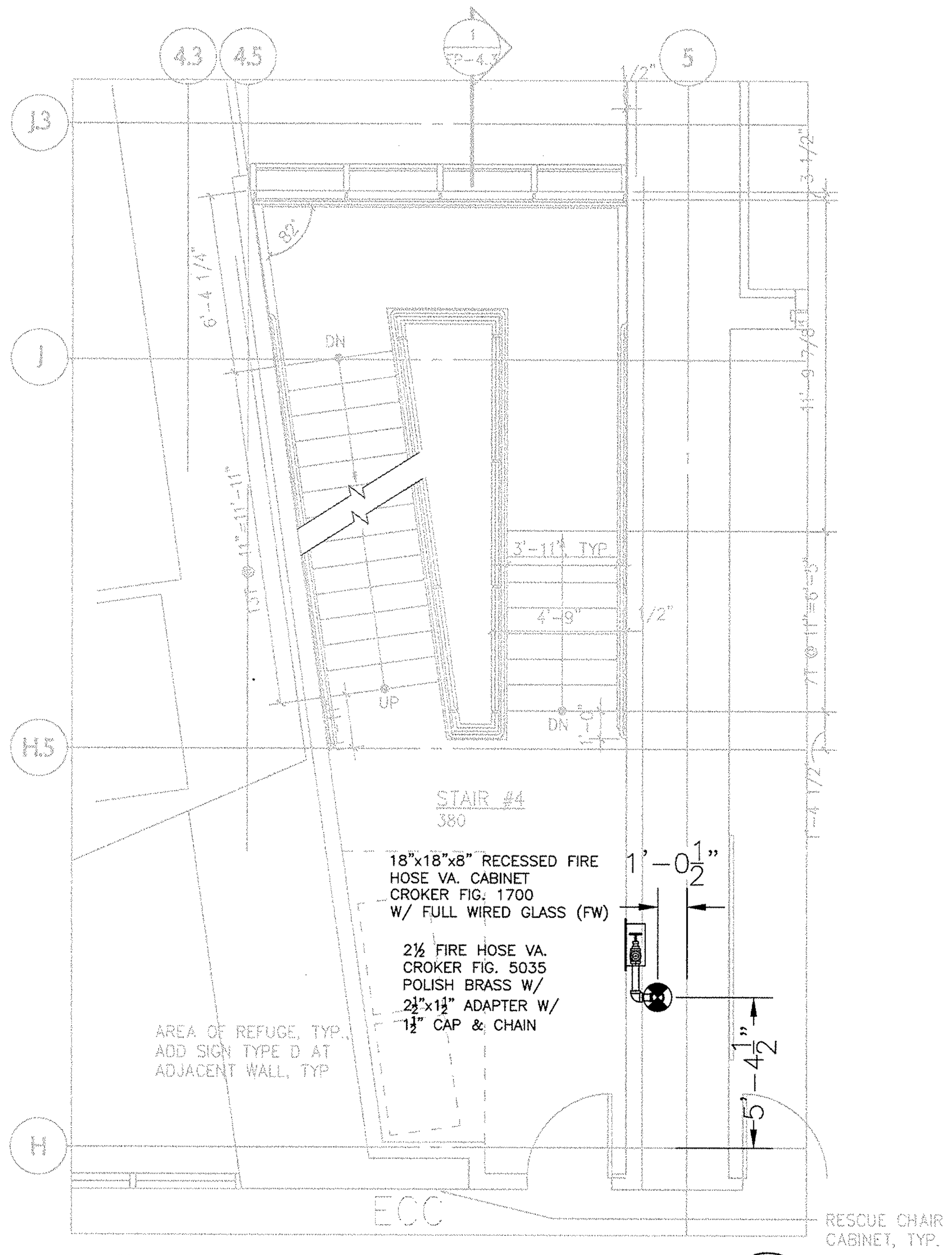
STANDPIPE NO.:	S/P # 4
OCCUPANCY:	LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET:	500 GPM
PRESS. @ TOP MOST OUTLET:	100 PSI
FLOW FOR ADDITIONAL S/P:	500 GPM
TOTAL STANDPIPE FLOW:	1000 GPM
HOSE STREAM ALLOWANCE: INSIDE:	N/A
OUTSIDE:	N/A

SYSTEM DEMAND

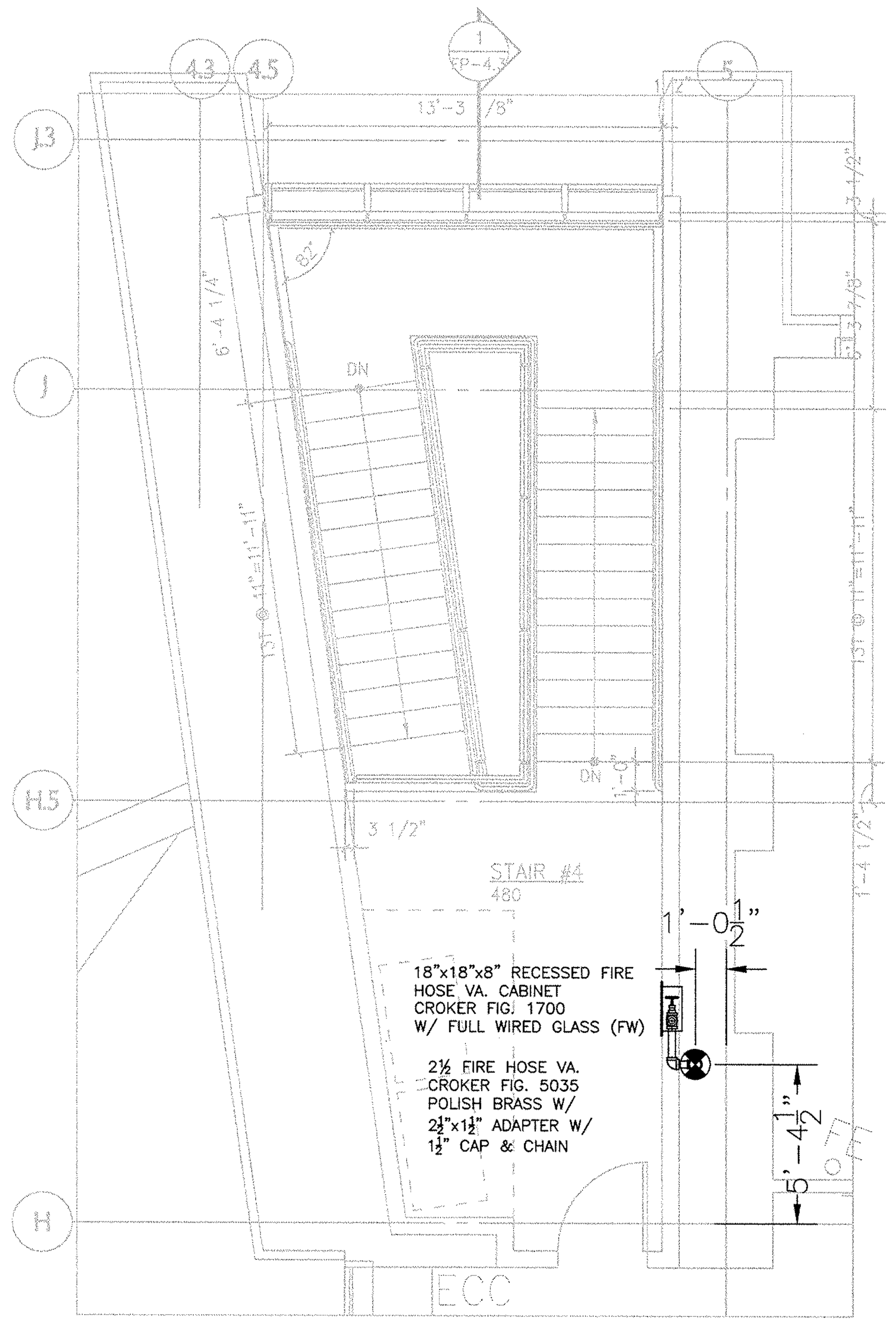
PSI REQ. AT PUMP DISCHARGE:	144.08
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	45.85
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.09
TOTAL PSI SAFETY FACTOR:	2.24



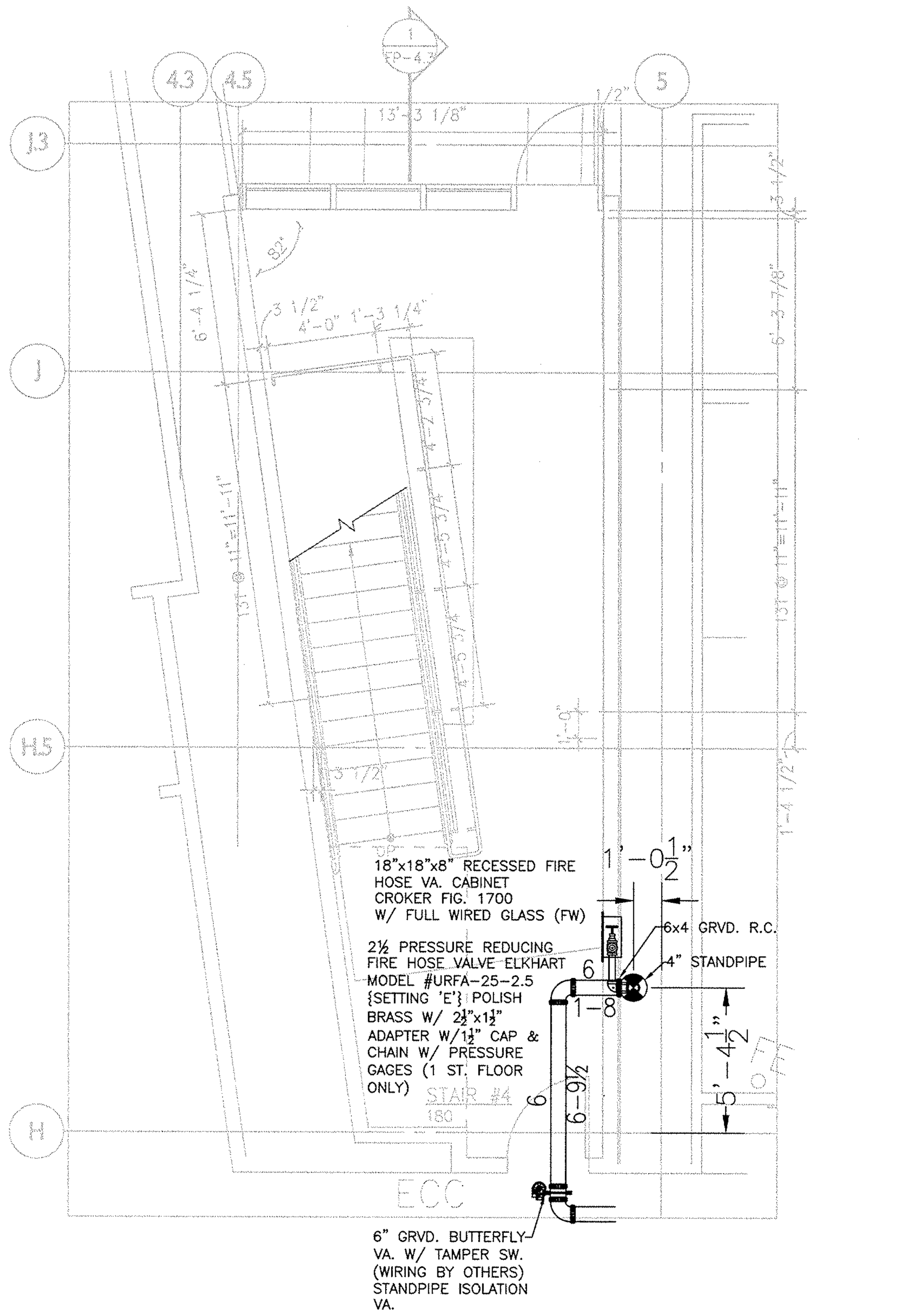
1 FP-4.3 **STAIR #4 - SECTION**
SCALE: 1/4" = 1'-0"



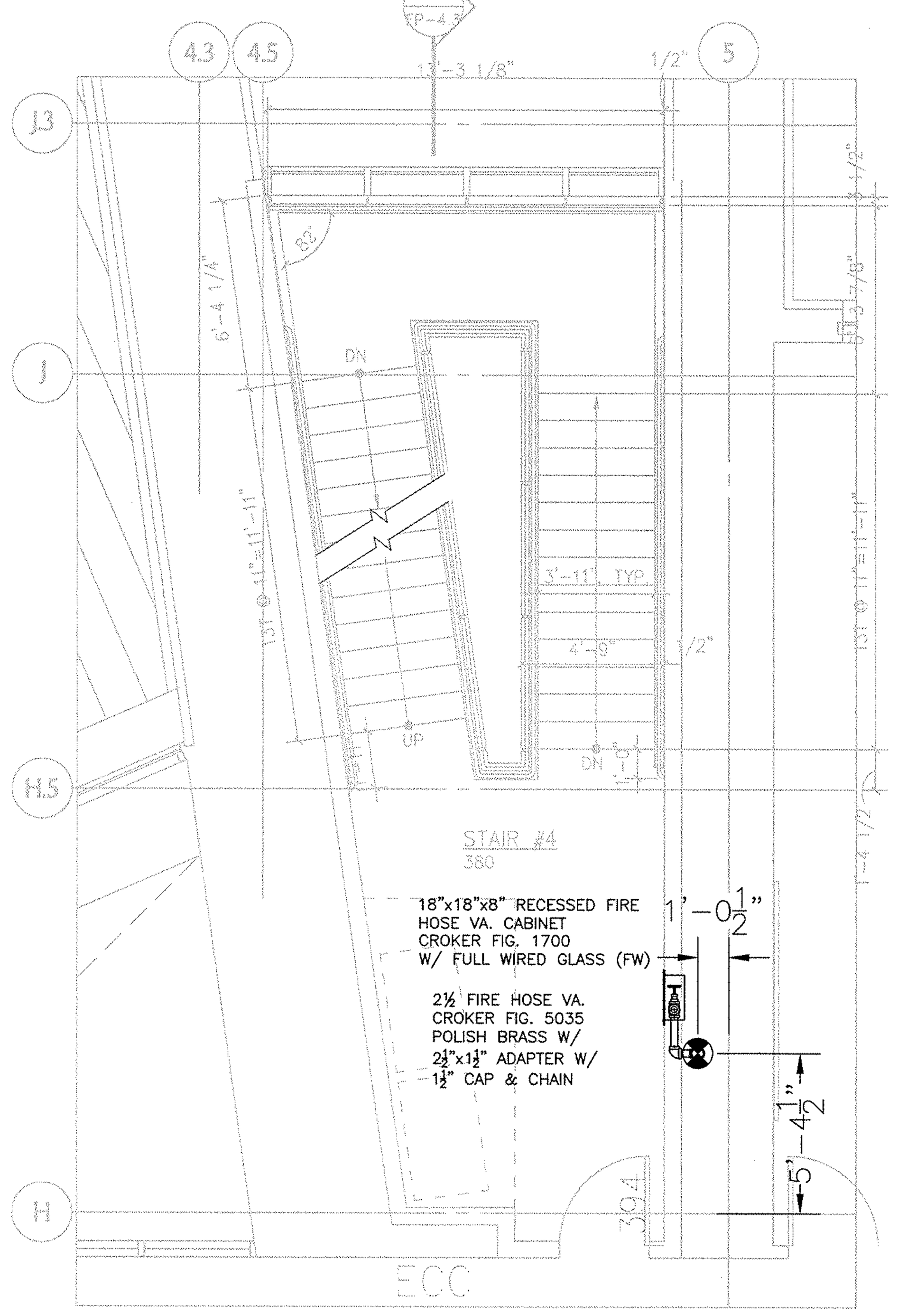
1B FP-4.3 **STAIR #4 - LEVEL 2**
SCALE: 1/4" = 1'-0"



1D FP-4.3 **STAIR #4 - LEVEL 4**
SCALE: 1/4" = 1'-0"



1A FP-4.3 **STAIR #4 - LEVEL 1**
SCALE: 1/4" = 1'-0"



1C FP-4.3 **STAIR #4 - LEVEL 3**
SCALE: 1/4" = 1'-0"

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.

SPRINKLER HEAD LEGEND — ESCUTCHEON — TOTAL SPRINKLERS THIS SHEET

REVISIONS

#	DATE	BY	DESCRIPTION
	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. Phoenix, Arizona 85024
623.580.7800 Fax 623.434.3154
AZ-L16-234798 AZ-C16-234797 UT-S370-6690455-5501
CA-C16-901529 NV-C41-69370 NM-MS 12-354807

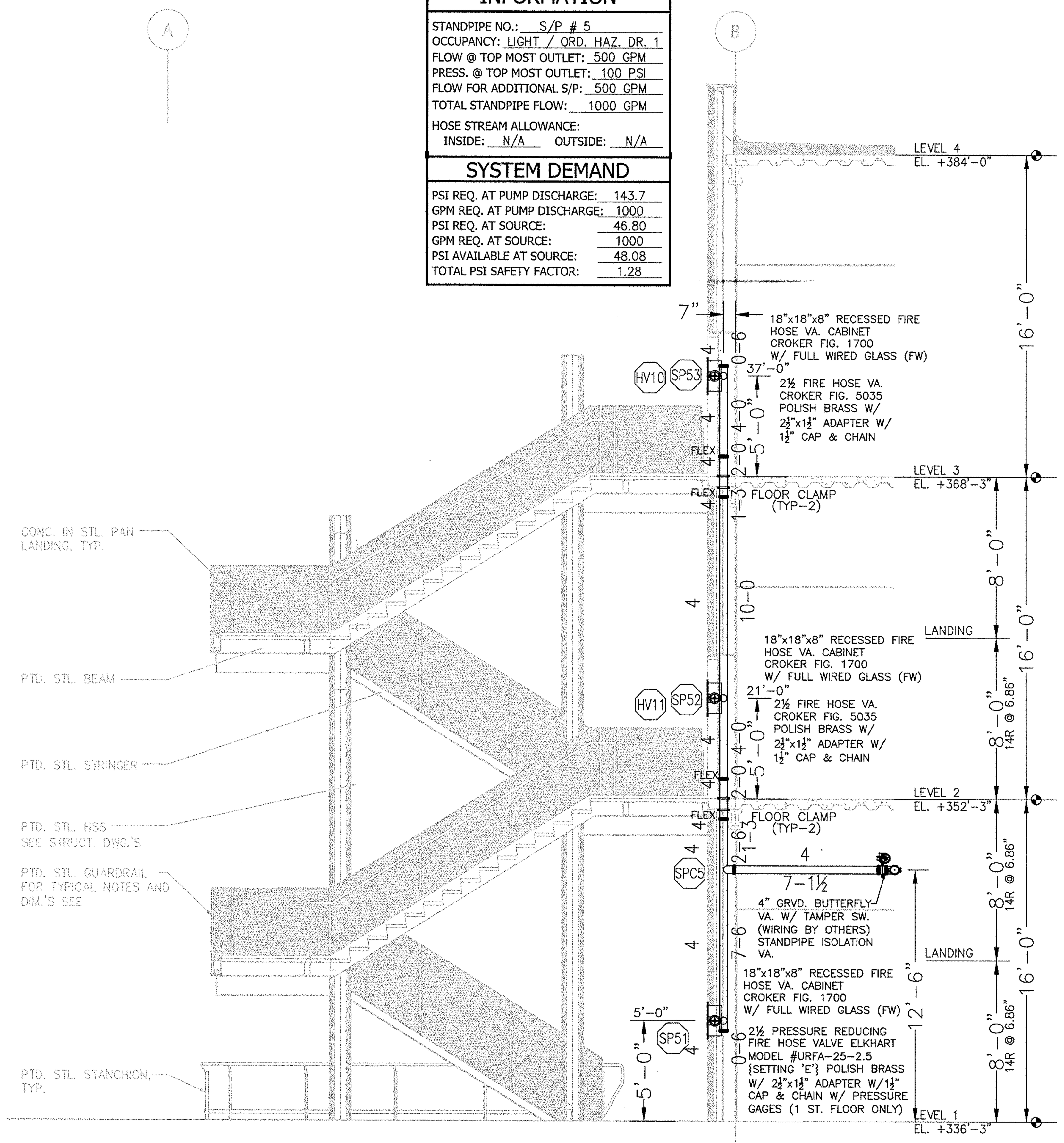
PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: STANDPIPE # 4 DETAILS

DRAWN BY:	----
SCALE:	1/4"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-4.3

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 Exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA 09/29/11



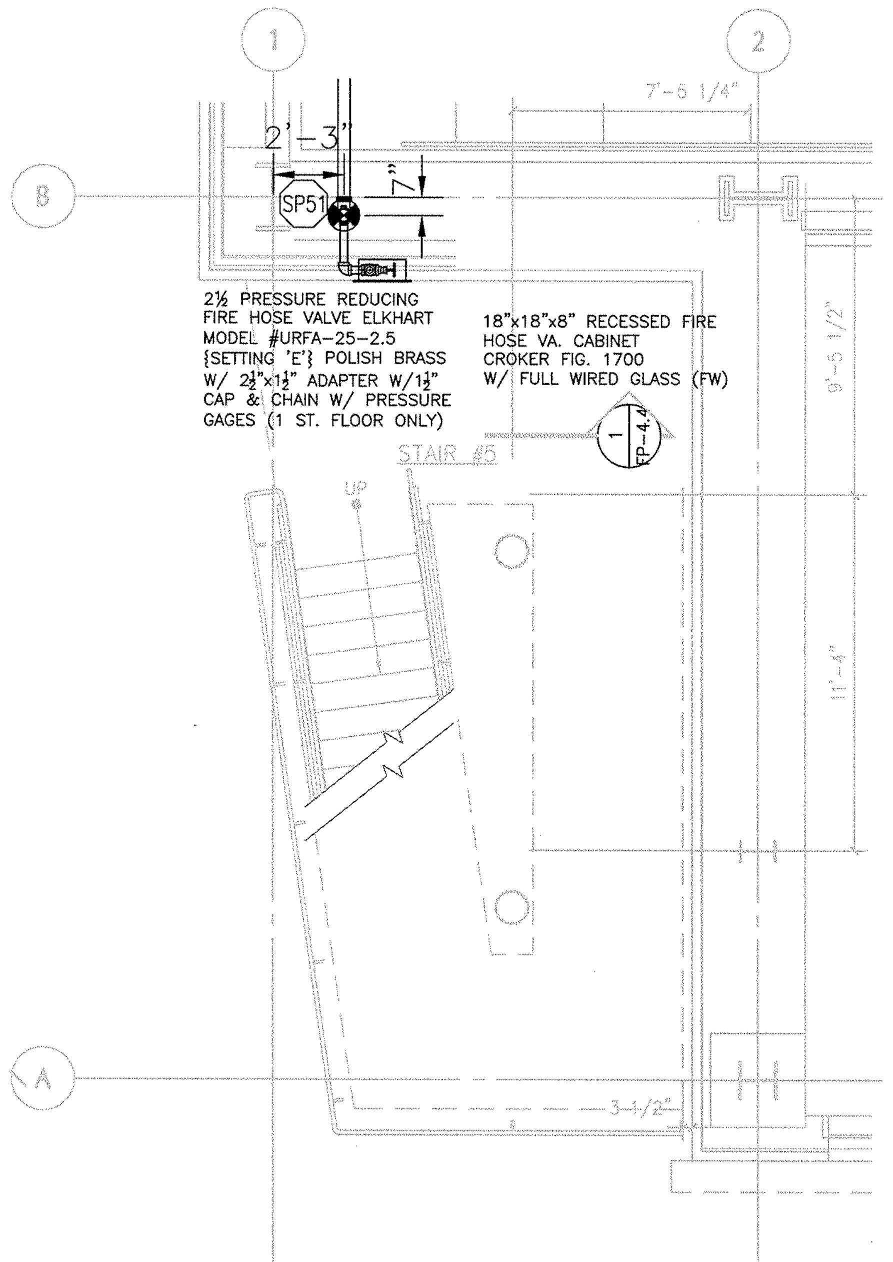
CALCULATION DESIGN INFORMATION

STANDPIPE NO.:	S/P # 5
OCCUPANCY:	LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET:	500 GPM
PRESS. @ TOP MOST OUTLET:	100 PSI
FLOW FOR ADDITIONAL S/P:	500 GPM
TOTAL STANDPIPE FLOW:	1000 GPM
HOSE STREAM ALLOWANCE: INSIDE:	N/A
OUTSIDE:	N/A

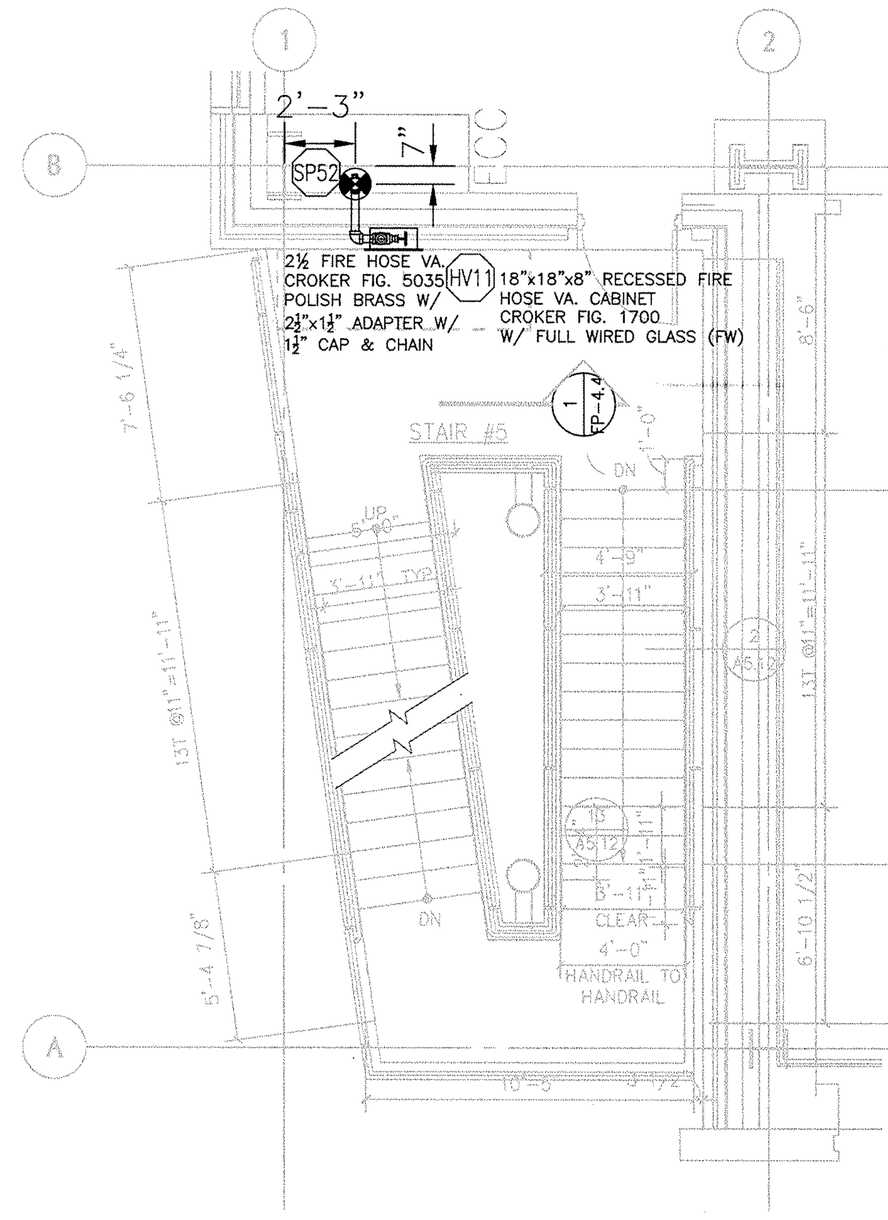
SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE:	143.7
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	46.80
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.08
TOTAL PSI SAFETY FACTOR:	1.28

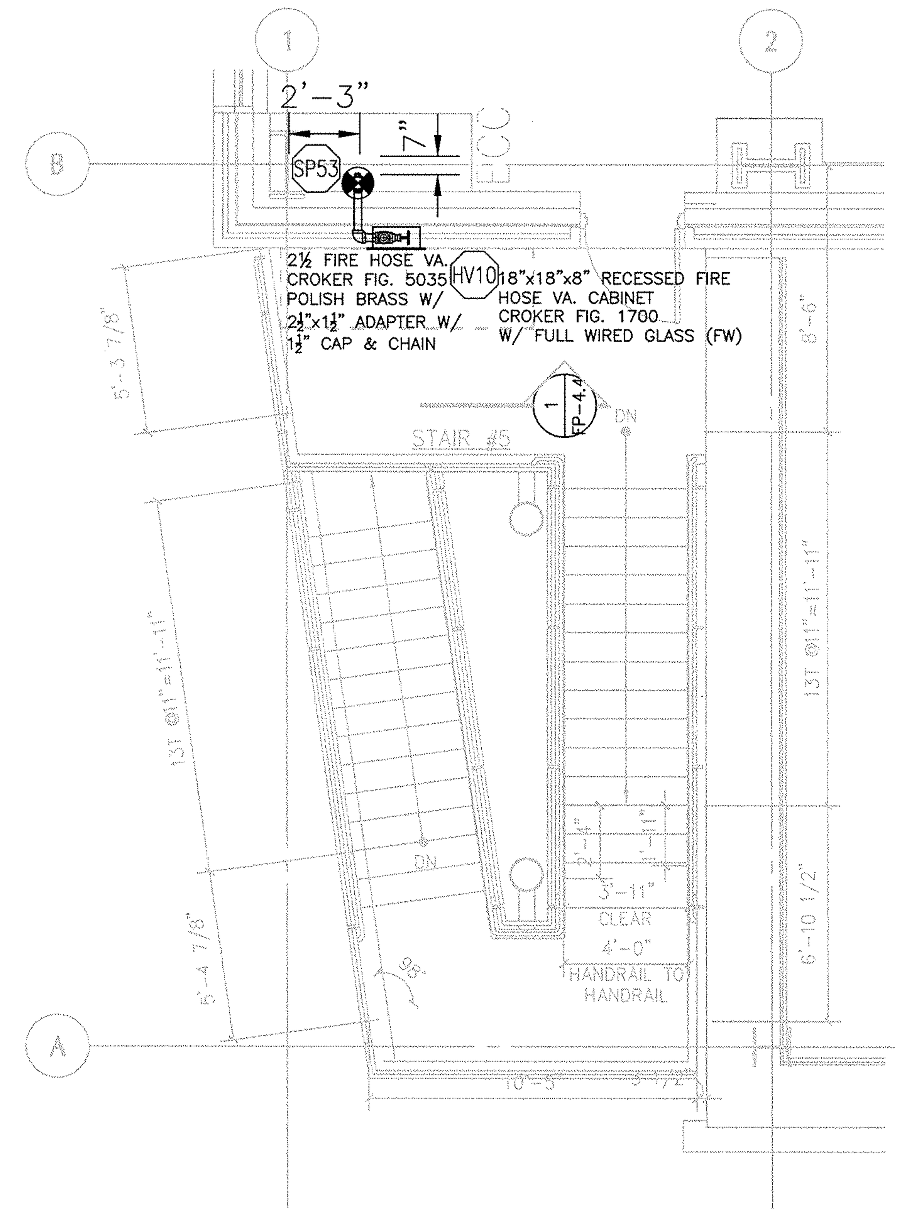
1 FP-4.4 **SECTION-STAIR #5**
SCALE: 1/4" = 1'-0"



1A FP-4.4 **STAIR #5 - LEVEL 1**
SCALE: 1/4" = 1'-0"



1B FP-4.4 **STAIR #5 - LEVEL 2**
SCALE: 1/4" = 1'-0"



1C FP-4.4 **STAIR #5 - LEVEL 3**
SCALE: 1/4" = 1'-0"

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP.	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	ESC. FINISH	ESC. TEMP.	QTY.

TOTAL SPRINKLERS THIS SHEET QTY

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. Phoenix, Arizona 85024
623.580.7800 Fax 623.434.3154
AZ-L16-234798 AZ-C16-234797 UT-8270-6890455-5501
CA-C16-905529 NV-C41-68070 NM-MS 12-354807

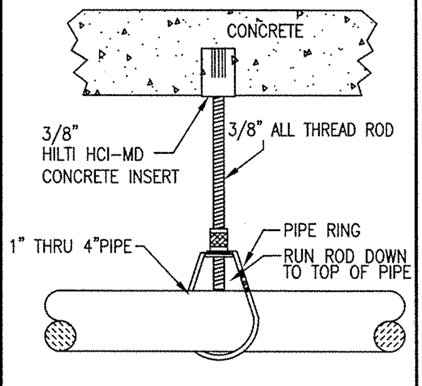
PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

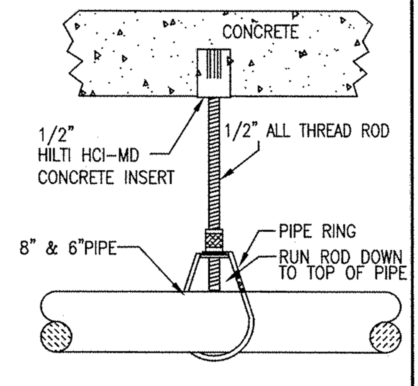
PLAN DESCRIPTION: STANDPIPE # 5 DETAILS

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 EXP. 12-31-11 STATE OF CALIFORNIA 09/29/11

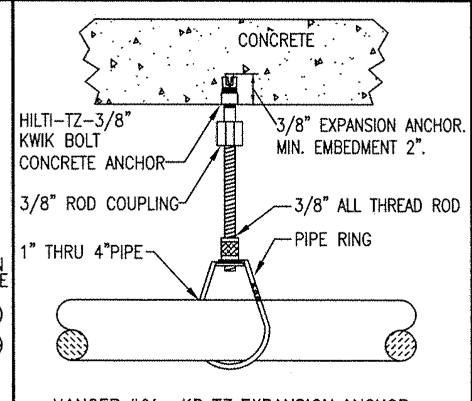
DRAWN BY:	----
SCALE:	1/4"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-4.4



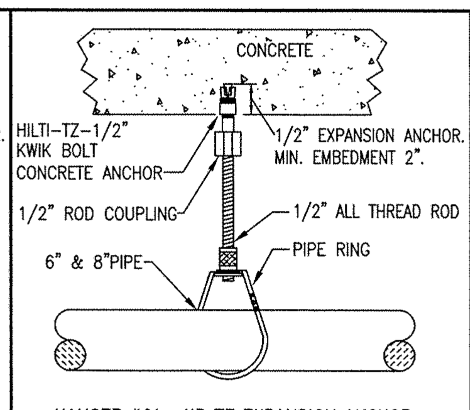
HANGER #05 - ROD & RING
HANGER DETAIL
NO SCALE



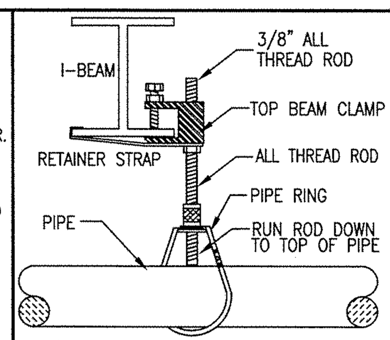
HANGER #05 - ROD & RING
HANGER DETAIL
NO SCALE



HANGER #04 - KB-TZ EXPANSION ANCHOR
HANGER DETAIL
NO SCALE

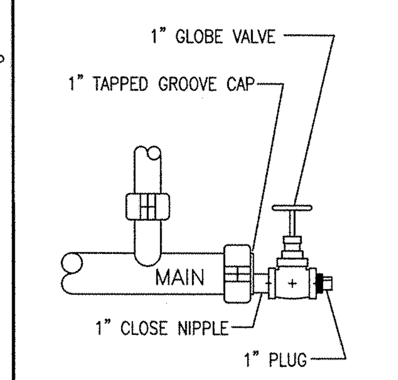


HANGER #04 - KB-TZ EXPANSION ANCHOR
HANGER DETAIL
NO SCALE

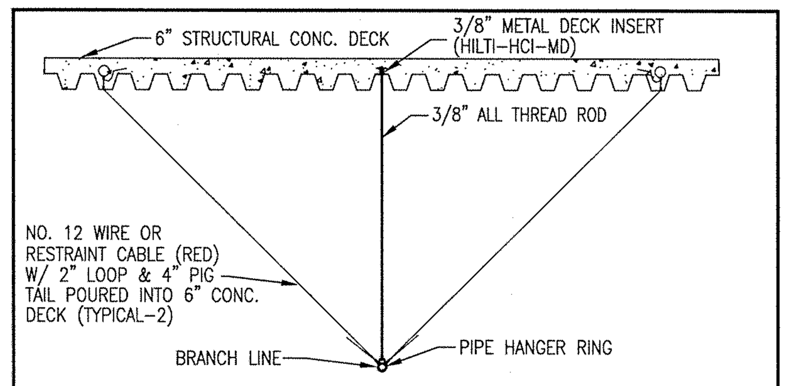


NOTE: HANGER ROD 6" OR LESS ACT AS LATERAL E.Q. BRACING AND BRANCH LINE RESTRAINT (BLR)

HANGER #01 - TOP BEAM CLAMP
HANGER DETAIL
NO SCALE



AUXILIARY DRAIN
NO SCALE



BRANCH LINE RESTRANT DETAIL (BLR)
NO SCALE

Tol-Brace Seismic Calculations

Project Address: Cal Poly Center for Science, California Polytechnic State University, San Luis Obispo, Ca.
Job # 10034

Aero Automatic Sprinkler C
21605 N. Central Ave.
Phoenix, Az. 85024
(623)580-7847
CA-C16-901529

TOLCO a brand of NIBCO

Calculations based on 2007 NFPA Pamphlet #13

Brace Information

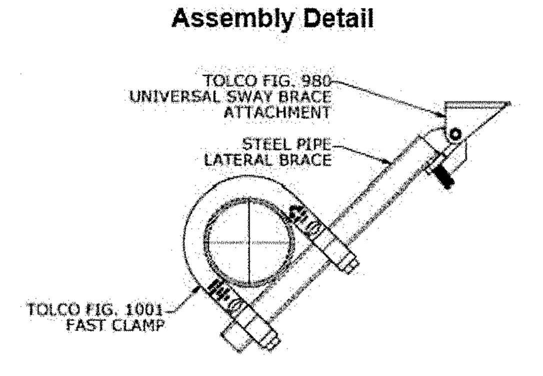
Maximum Spacing	40' 0" (12.19 m)
Maximum Brace Length	7' 0" (2.14 m)
Bracing Material	1" Sch.40
Angle from Vertical	30° Min.
Least Rad. of Gyration	0.421" (11 mm)
L/R Value	200
Max Horizontal Load	1227 lbs (557 kg)
Force Factor (Cp)	0.61

Tolco Brace Components

Tolco Component Fig. Number	Adjusted Load
Fig.1001 Clamp	1007 lbs (457 kg)
Fig.980 Universal Swivel	1382 lbs (627 kg)

*Calculation Based on CONCENTRIC Loading
*Please Note: These calculations are for Tolco components only. Use of any other components voids these calculations and the listing of the assembly.

Assembly Detail



Fastener Information

Fastener Orientation	NFPA Type A
Type	HILTI-TZ
Diameter	1/2
Length	3 3/4
Maximum Load	1412 lbs (640 kg)

Brace Identification on Plans: LAT 1
Orientation of Brace: Lateral

Braced Pipe: 6" Sch.40 Steel Pipe

Load Information

Size and Type of Pipe	Total Length	Total Calculated Load
6" Sch 40 Steel Pipe (152.4 mm)	40ft (12.2 m)	773 lbs (351 kg)
Percentage added for Fittings and Sprinklers	15%	116 lbs (52.62 kg)
Total Adjusted Load of all pipe within Zone of Influence		889 lbs (403 kg)

(Tol-Brace Version 7)

Tol-Brace Seismic Calculations

Project Address: Cal Poly Center for Science, California Polytechnic State University, San Luis Obispo, Ca.
Job # 10034

Aero Automatic Sprinkler C
21605 N. Central Ave.
Phoenix, Az. 85024
(623)580-7847
CA-C16-901529

TOLCO a brand of NIBCO

Calculations based on 2007 NFPA Pamphlet #13

Brace Information

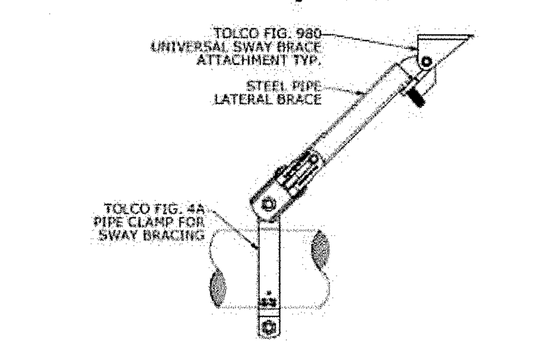
Maximum Spacing	45' 0" (13.72 m)
Maximum Brace Length	7' 0" (2.14 m)
Bracing Material	1" Sch.40
Angle from Vertical	30° Min.
Least Rad. of Gyration	0.421" (11 mm)
L/R Value	200
Max Horizontal Load	1227 lbs (557 kg)
Force Factor (Cp)	0.61

Tolco Brace Components

Tolco Component Fig. Number	Adjusted Load
Fig.4A Clamp	1007 lbs (457 kg)
Fig.980 Universal Swivel	1382 lbs (627 kg)

*Calculation Based on CONCENTRIC Loading
*Please Note: These calculations are for Tolco components only. Use of any other components voids these calculations and the listing of the assembly.

Assembly Detail



Fastener Information

Fastener Orientation	NFPA Type A
Type	HILTI-TZ
Diameter	1/2
Length	3 3/4
Maximum Load	1412 lbs (640 kg)

Brace Identification on Plans: LONG 1
Orientation of Brace: Longitudinal

Braced Pipe: 6" Sch.40 Steel Pipe

Load Information

Size and Type of Pipe	Total Length	Total Calculated Load
6" Sch 40 Steel Pipe (152.4 mm)	45ft (13.7 m)	870 lbs (395 kg)
Percentage added for Fittings and Sprinklers	15%	130 lbs (58.97 kg)
Total Adjusted Load of all pipe within Zone of Influence		1000 lbs (454 kg)

(Tol-Brace Version 7)

Tol-Brace Seismic Calculations

Project Address: Cal Poly Center for Science, California Polytechnic State University, San Luis Obispo, Ca.
Job # 10034

Aero Automatic Sprinkler C
21605 N. Central Ave.
Phoenix, Az. 85024
(623)580-7847
CA-C16-901529

TOLCO a brand of NIBCO

Calculations based on 2007 NFPA Pamphlet #13

Brace Information

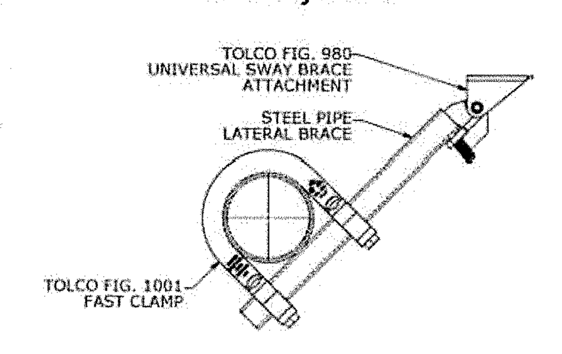
Maximum Spacing	35' 0" (10.67 m)
Maximum Brace Length	7' 0" (2.14 m)
Bracing Material	1" Sch.40
Angle from Vertical	30° Min.
Least Rad. of Gyration	0.421" (11 mm)
L/R Value	200
Max Horizontal Load	1227 lbs (557 kg)
Force Factor (Cp)	0.61

Tolco Brace Components

Tolco Component Fig. Number	Adjusted Load
Fig.1001 Clamp	1007 lbs (457 kg)
Fig.980 Universal Swivel	1382 lbs (627 kg)

*Calculation Based on CONCENTRIC Loading
*Please Note: These calculations are for Tolco components only. Use of any other components voids these calculations and the listing of the assembly.

Assembly Detail



Fastener Information

Fastener Orientation	NFPA Type A
Type	HILTI-TZ
Diameter	1/2
Length	3 3/4
Maximum Load	1412 lbs (640 kg)

Brace Identification on Plans: LAT 2
Orientation of Brace: Lateral

Braced Pipe: 3" Sch.10 Steel Pipe

Load Information

Size and Type of Pipe	Total Length	Total Calculated Load
3" Sch 10 Steel Pipe (76.2 mm)	35ft (10.7 m)	170 lbs (77 kg)
1.5" Sch 40 Steel Pipe (38.1 mm)	10ft (3 m)	22 lbs (10 kg)
1.25" Sch.40 Steel Pipe (31.75 mm)	31ft (9.4 m)	55 lbs (25 kg)
1" Sch 40 Steel Pipe (25.4 mm)	140ft (42.7 m)	175 lbs (79 kg)
Percentage added for Fittings and Sprinklers	15%	63 lbs (28.58 kg)
Total Adjusted Load of all pipe within Zone of Influence		485 lbs (220 kg)

(Tol-Brace Version 7)

Tol-Brace Seismic Calculations

Project Address: Cal Poly Center for Science, California Polytechnic State University, San Luis Obispo, Ca.
Job # 10034

Aero Automatic Sprinkler C
21605 N. Central Ave.
Phoenix, Az. 85024
(623)580-7847
CA-C16-901529

TOLCO a brand of NIBCO

Calculations based on 2007 NFPA Pamphlet #13

Brace Information

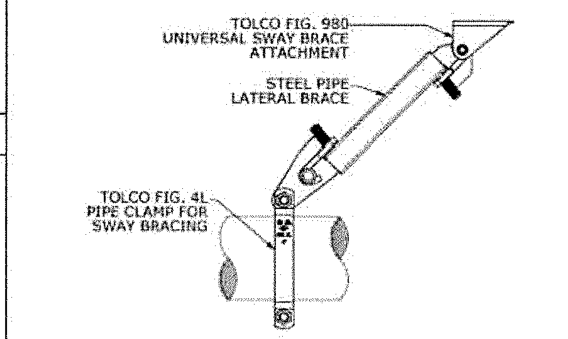
Maximum Spacing	80' 0" (24.38 m)
Maximum Brace Length	7' 0" (2.14 m)
Bracing Material	1" Sch.40
Angle from Vertical	30° Min.
Least Rad. of Gyration	0.421" (11 mm)
L/R Value	200
Max Horizontal Load	1227 lbs (557 kg)
Force Factor (Cp)	0.61

Tolco Brace Components

Tolco Component Fig. Number	Adjusted Load
Fig.4L Clamp	1007 lbs (457 kg)
Fig.980 Universal Swivel	1382 lbs (627 kg)

*Calculation Based on CONCENTRIC Loading
*Please Note: These calculations are for Tolco components only. Use of any other components voids these calculations and the listing of the assembly.

Assembly Detail



Fastener Information

Fastener Orientation	NFPA Type A
Type	HILTI-TZ
Diameter	1/2
Length	3 3/4
Maximum Load	1412 lbs (640 kg)

Brace Identification on Plans: LONG 2
Orientation of Brace: Longitudinal

Braced Pipe: 3" Sch.10 Steel Pipe

Load Information

Size and Type of Pipe	Total Length	Total Calculated Load
3" Sch 10 Steel Pipe (76.2 mm)	80ft (24.4 m)	387 lbs (176 kg)
Percentage added for Fittings and Sprinklers	15%	58 lbs (26.31 kg)
Total Adjusted Load of all pipe within Zone of Influence		446 lbs (202 kg)

(Tol-Brace Version 7)

SPRINKLER PIPE HANGER SPACING
N.F.P.A. 13, 2007 EDITION

TABLE 9.2.2.1 MAXIMUM DISTANCE BETWEEN HANGERS (FT-IN.)

NOMINAL PIPE SIZE	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"&4"	6"	8"
STEEL PIPE	N/A	12-0	12-0	15-0	15-0	15-0	15-0	15-0	15-0
THREADED LIGHTWALL	N/A	12-0	12-0	12-0	12-0			N/A	N/A
COPPER TUBE									
CPVC	5-6	6-0	6-6	7-0	8-0	9-0	N/A	N/A	N/A

FIGURE A-9.2.3.4 DISTANCE FROM SPRINKLER TO HANGER

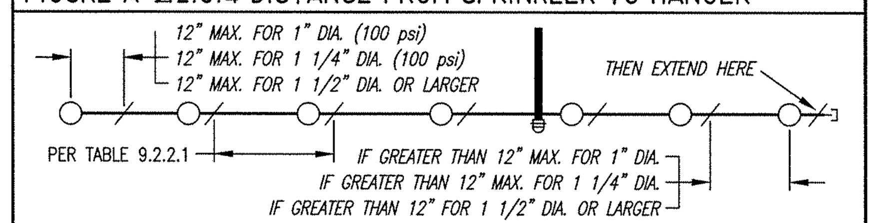
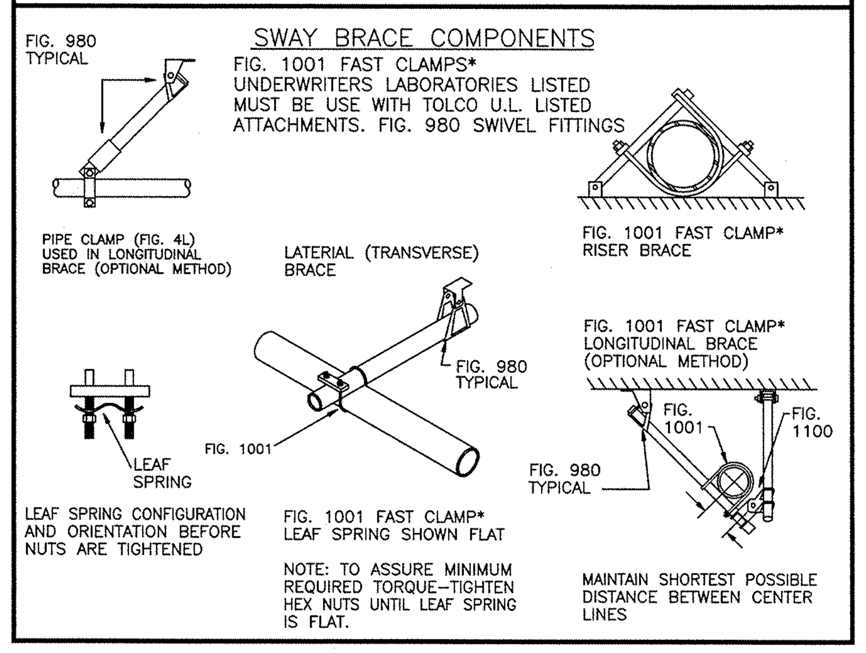


TABLE 9.1.2.1 HANGER ROD SIZE

PIPE SIZE	DIAMETER OF ROD	PIPE SIZE	DIAMETER OF ROD
UP TO AND INCLUDING 4"	3/8"	6" AND 8"	1/2"

THE CUMULATIVE HORIZONTAL LENGTH OF AN UNSUPPORTED ARMOVER TO A SPRINKLER, SPRINKLER DROP, OR SPRIG-UP SHALL NOT EXCEED 12 IN. FOR STEEL OR 6 IN. FOR COPPER TUBE. (PRESSURE EXCEEDS 100 psi)

SWAY BRACING



NOTES

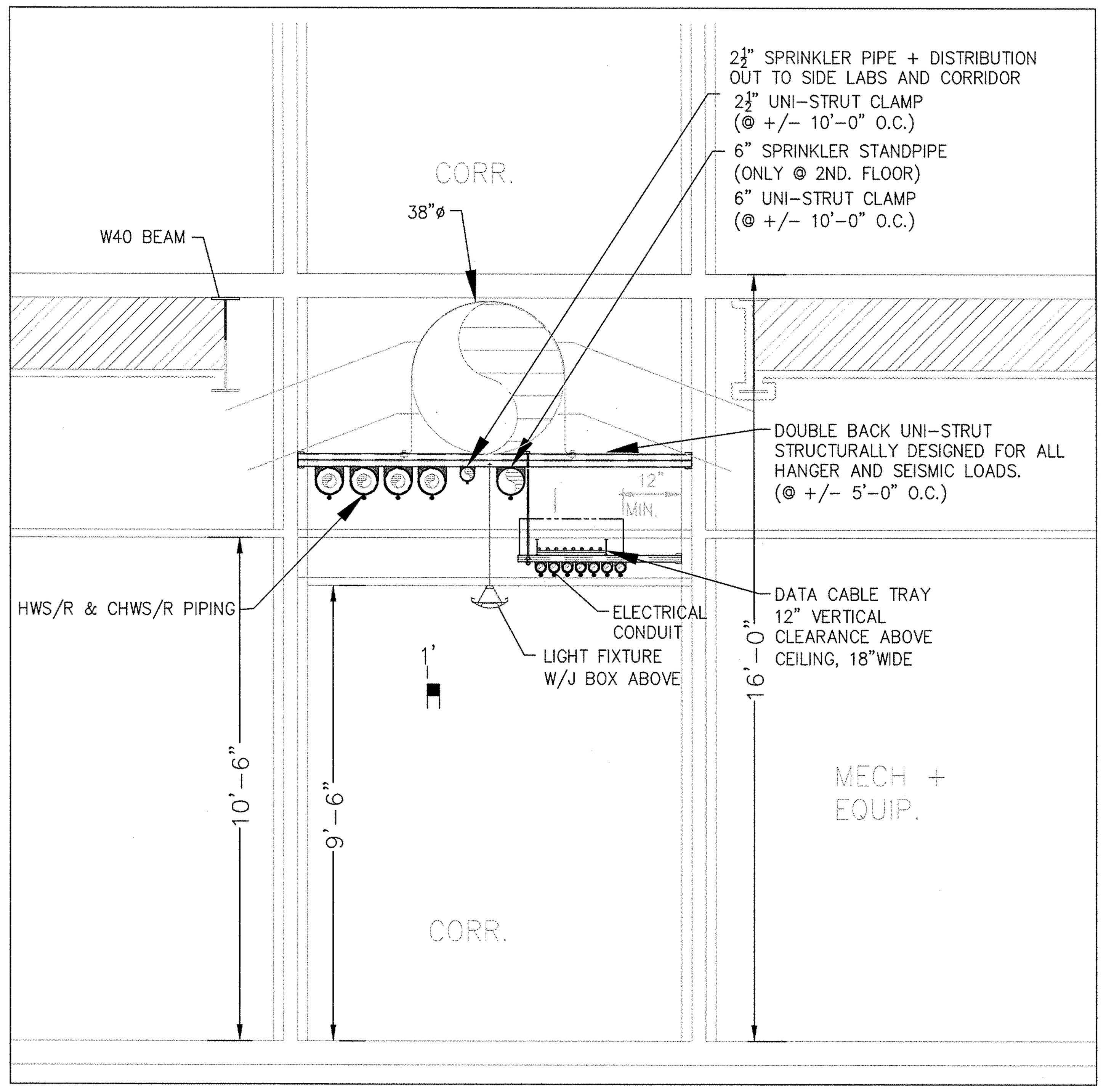
1. LAT 1 TO BE USED FOR LATERAL SWAY BRACING OF SPRINKLER SYSTEM 6" MAINS. MAX SPACING 40'-0".
2. LAT 2 TO BE USED FOR LATERAL SWAY BRACING OF SPRINKLER SYSTEM 3" OR 2 1/2" MAINS WITH BRANCH LINES. MAX SPACING 35'-0".
3. LONG 1 TO BE USED FOR LONGITUDINAL SWAY BRACING OF SPRINKLER SYSTEM 6" MAINS. MAX SPACING 45'-0".
4. LONG 2 TO BE USED FOR LONGITUDINAL SWAY BRACING OF SPRINKLER SYSTEM 3" OR 2 1/2" MAINS. MAX SPACING 80'-0".

SEISMIC CRITERIA

SEISMIC DESIGN CATEGORY D
SEISMIC IMP. FACTOR 1.0
SITE SOIL PROFILE TYPE B
SPECTRAL RESPONSE ACCELERATIONS:
Ss = 1.26*
S1 = 0.481*

SEISMIC COEFFICIENT:
Cp = 0.61**

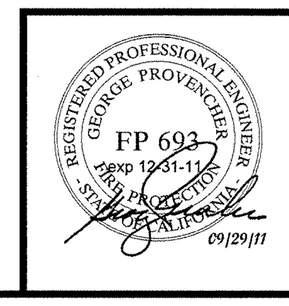
*Ss & S1 VALUES TAKEN FROM STRUCTURAL DRAWING S 1.01 - DATED 10-23-2009
** VALUE INTERPOLATED FROM TABLE 9.3.5.6.2 OF N.F.P.A.



HANGER DETAIL # 10
SCALE 1/2"=1'-0"

WEIGHT OF WATER FILLED PIPE [LB./FT.]		NOMINAL SIZE	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	6"	8"
THREADED OR GROOVED PIPE	SCHEDULE 40	I.D.	2.05	2.93	3.61	5.13	7.89	10.82	16.40	31.69	47.70
GROOVED PIPE	SCHEDULE 10	I.D.	NOT USED	NOT USED	NOT USED	4.22	5.89	7.94	11.78	23.03	40.08

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECH
OFFICE OF REGULATION SERVICES
APPL 01-110181



SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.

SPRINKLER HEAD LEGEND — ESCUTCHEON — TOTAL SPRINKLERS THIS SHEET

REVISIONS: 1 — 9-28-2011 — NRL — SUBMITTAL TO GENERAL CONTRACTOR (# DATE BY DESCRIPTION)

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: HANGER & E.Q. DETAILS

DRAWN BY:	NRL
SCALE:	AS NOTED
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-5.0

NOTE: ALL HANGER RODS 6" OR LESS ACT AS LATERAL E.Q. BRACING & BRANCH LINE RESTRAINT (BLR).

UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

CALCULATION DESIGN INFORMATION

AREA:	"1-2"
OCCUPANCY:	LECTURE
HAZARD:	LIGHT HAZARD
DENSITY:	0.10 GPM / SQ.FT.
AREA OF OPERATION:	1575 SQ. FT.
AREA PER HEAD:	163 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE: INSIDE:	100
OUTSIDE:	

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	162.2
GPM REQ. AT BASE OF RISER:	328.4
PSI REQ. AT SOURCE:	45.59
GPM REQ. AT SOURCE:	428.4
PSI AVAILABLE AT SOURCE:	52.76
TOTAL PSI SAFETY FACTOR:	7.17

CALCULATION DESIGN INFORMATION

AREA:	"1-1"
OCCUPANCY:	LECTURE
HAZARD:	LIGHT HAZARD
DENSITY:	0.10 GPM / SQ.FT.
AREA OF OPERATION:	1520 SQ. FT.
AREA PER HEAD:	168 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE: INSIDE:	100
OUTSIDE:	

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	126.6
GPM REQ. AT BASE OF RISER:	250.6
PSI REQ. AT SOURCE:	7.27
GPM REQ. AT SOURCE:	350.6
PSI AVAILABLE AT SOURCE:	53.15
TOTAL PSI SAFETY FACTOR:	45.88

PENDENT SPRINKLER HEAD
SCALE: N.T.S

FIRE SPRINKLER PLAN LEVEL I WEST

SCALE 1/8"=1'-0"

KEY PLAN

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	123
◎/○	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	-	-	-	66
△	TYCO	TY-FRB	TY3331	QR	HSW	BRASS	1/2"	1/2"	5.6	200	-	-	-	1

(ESC. TYPE, FINISH and TEMP. in the last columns are under ESCUTCHEON.)

TOTAL SPRINKLERS THIS SHEET 190

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER PLAN LEVEL I WEST

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-6.01W

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 Exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA 09/29/11

FIRE SPRINKLER PLAN LEVEL 2 WEST

SCALE 1/8"=1'-0"

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	186
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	2

(ESC. TYPE, FINISH and TEMP. under ESCUTCHEON)

TOTAL SPRINKLERS THIS SHEET 188

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. Phoenix, Arizona 85024
623.580.7800 Fax 623.434.3154
AZ-L16-234798
AZ-C16-234797
UT-S370-6690455-5501
CA-C16-901529
NV-C41-69370
NM-MS 12-354807

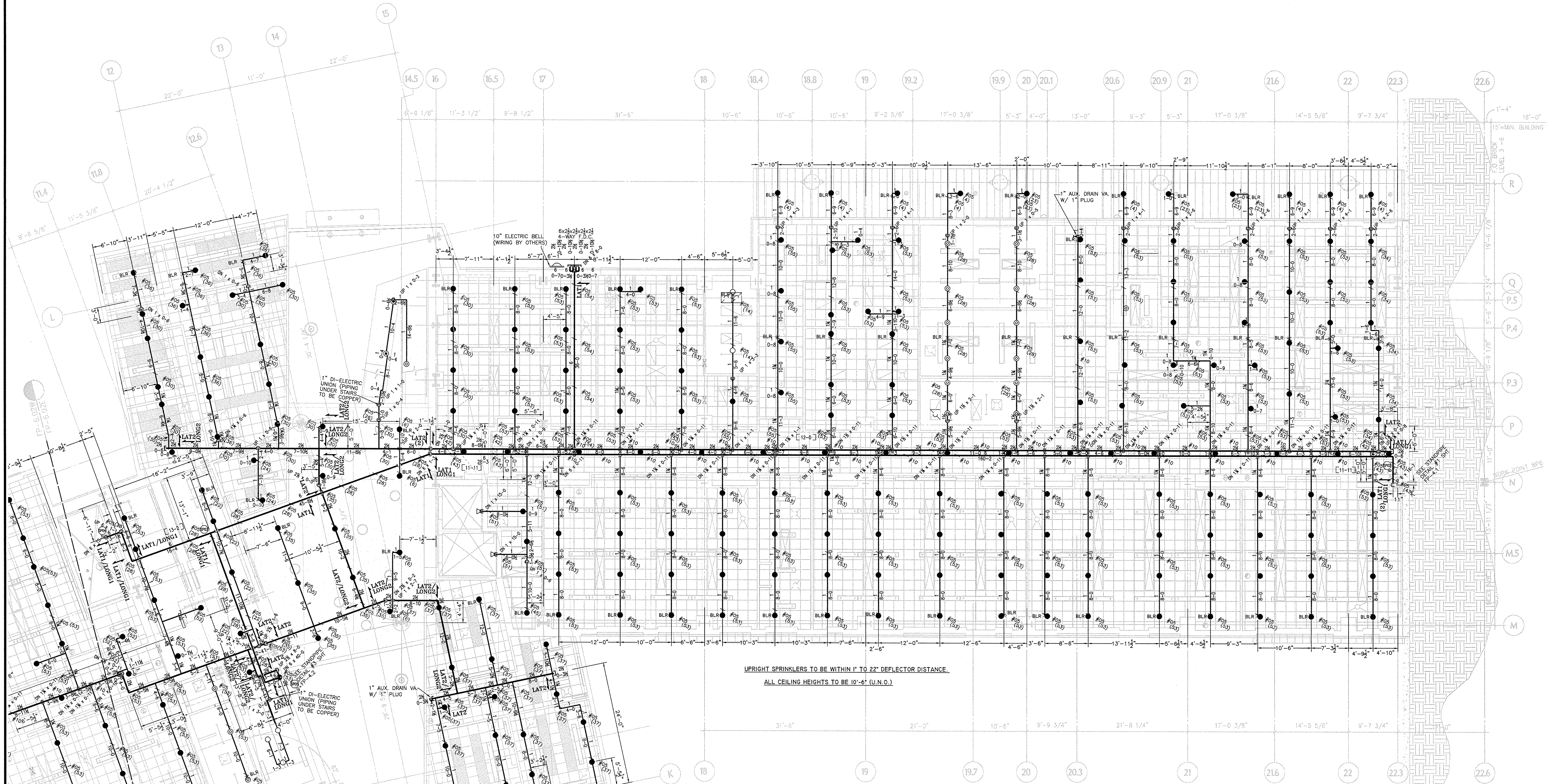
PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

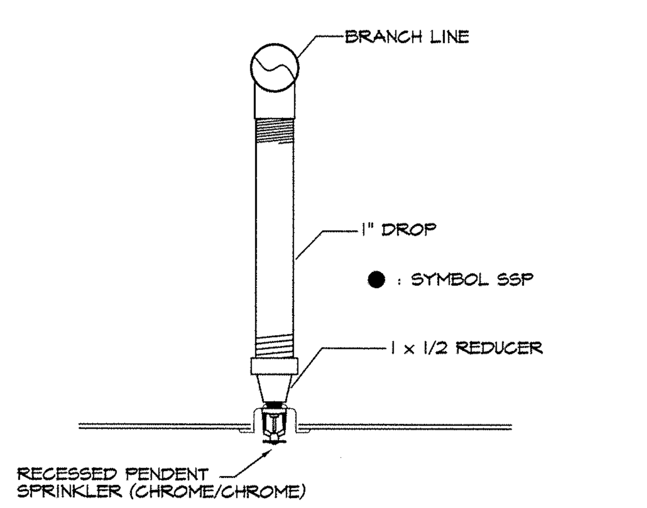
CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER PLAN LEVEL 2 WEST

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-6.02W

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 09/29/11





PENDENT SPRINKLER HEAD
SCALE: N.T.S

FIRE SPRINKLER PLAN LEVEL 2 EAST

SCALE 1/8"=1'-0"

SPRINKLER HEAD LEGEND / ESCUTCHEON

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	186
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	2

TOTAL SPRINKLERS THIS SHEET: 188

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave.
Phoenix, Arizona 85024
623.580.7800
Fax 623.434.3154
AZ-L16-234798
AZ-C16-234797
UT-S370-6690455-5501
CA-C16-901529
NV-C41-69370
NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER PLAN LEVEL 2 EAST

DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-6.02E

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 EXP 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA 09/29/11

UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

BRANCH LINE

1" DROP

● : SYMBOL SSP

1 x 1/2 REDUCER

RECESSED PENDENT SPRINKLER (CHROME/CHROME)

PENDENT SPRINKLER HEAD

SCALE: N.T.S

CALCULATION DESIGN INFORMATION

AREA: "3-1"
OCCUPANCY: LAB
HAZARD: ORDINARY HAZARD GR. 1
DENSITY: 0.15 GPM / SQ.FT.
AREA OF OPERATION: 967 SQ.FT.
AREA PER HEAD: 130 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: 150

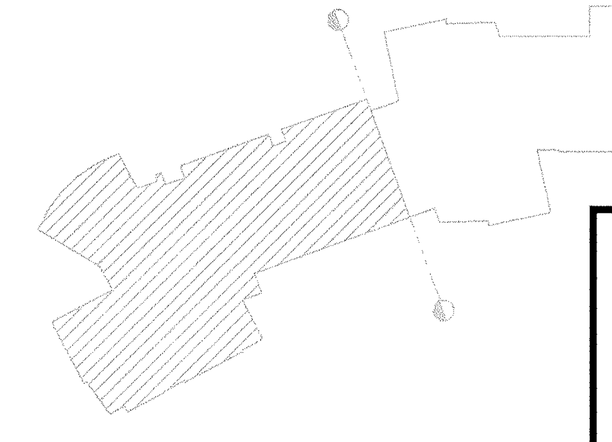
SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	102.61
GPM REQ. AT BASE OF RISER:	252.75
PSI REQ. AT SOURCE:	-0.88
GPM REQ. AT SOURCE:	502.75
PSI AVAILABLE AT SOURCE:	52.35
TOTAL PSI SAFETY FACTOR:	53.23

REMOTE AREA REDUCED BY 39.25% (CH=10'-6")
[912 SQ.FT. MIN.]

FIRE SPRINKLER PLAN LEVEL 3 WEST

SCALE 1/8"=1'-0"



KEY PLAN

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	204
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	–	–	–	4
TOTAL SPRINKLERS THIS SHEET														208

ESCUTCHEON columns: ESC. TYPE, FINISH, TEMP.

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

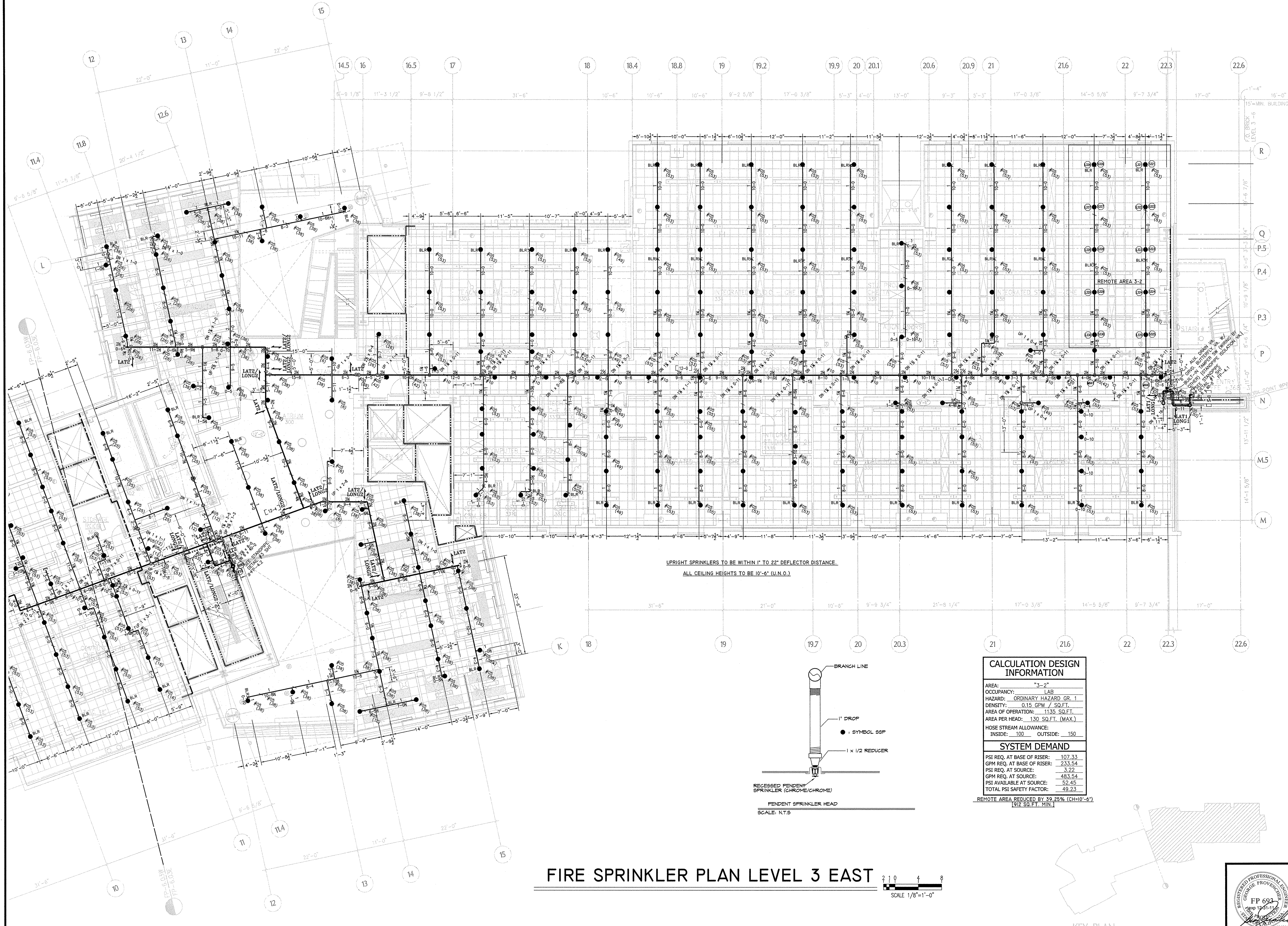
PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER PLAN LEVEL 3 WEST

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-6.03W

FP 693
09/29/11



PENDENT SPRINKLER HEAD

SCALE: N.T.S

CALCULATION DESIGN INFORMATION

AREA: "3-2"
OCCUPANCY: LAB
HAZARD: ORDINARY HAZARD GR. 1
DENSITY: 0.15 GPM / SQ.FT.
AREA OF OPERATION: 1135 SQ.FT.
AREA PER HEAD: 130 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: 150

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	107.33
GPM REQ. AT BASE OF RISER:	233.54
PSI REQ. AT SOURCE:	3.22
GPM REQ. AT SOURCE:	483.54
PSI AVAILABLE AT SOURCE:	52.45
TOTAL PSI SAFETY FACTOR:	49.23

REMOTE AREA REDUCED BY 39.25% (CH=10'-6")
[912 SQ.FT. MIN.]

KEY PLAN

FIRE SPRINKLER PLAN LEVEL 3 EAST

SCALE 1/8"=1'-0"

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	224
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	–	–	–	2

TOTAL SPRINKLERS THIS SHEET 226

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. Phoenix, Arizona 85024
623.580.7800 Fax 623.434.3154
AZ-L16-234798 AZ-C16-234797 UT-S370-6690455-5501
CA-C16-901529 NV-C41-69370 NM-MS 12-354807

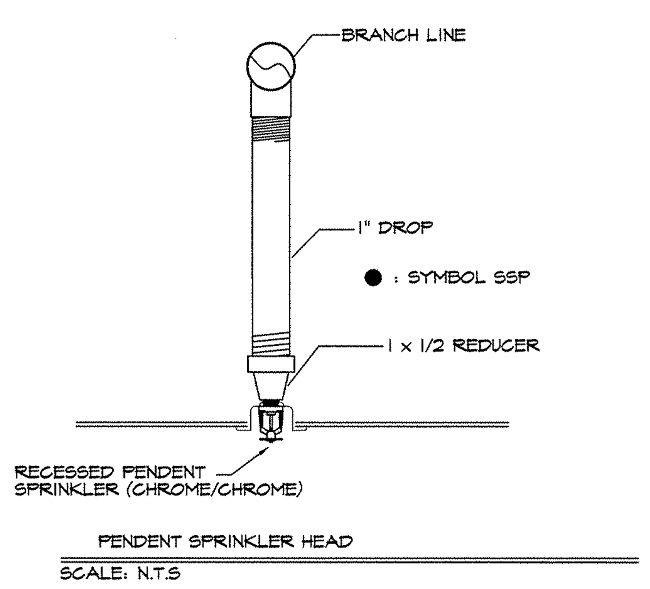
PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

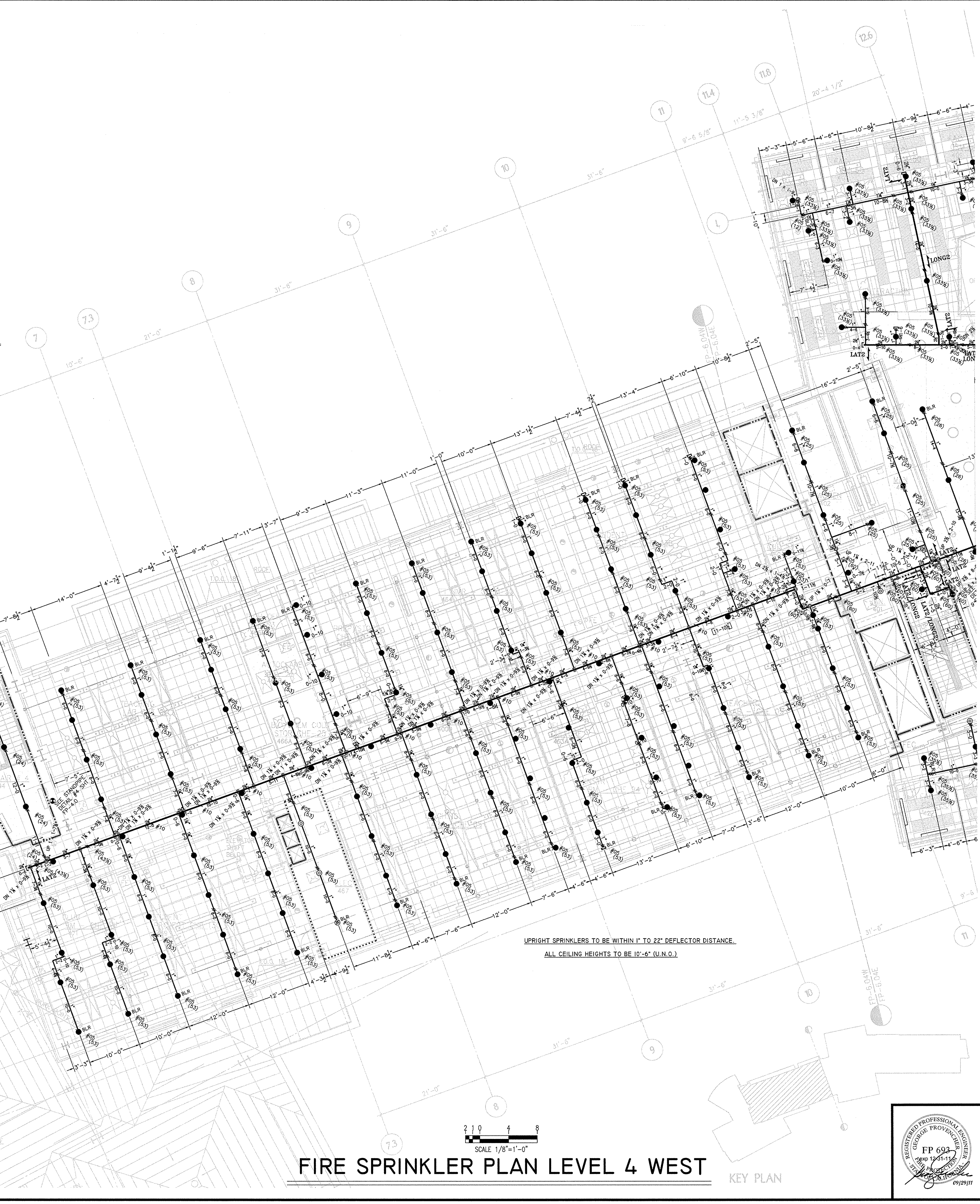
CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER PLAN LEVEL 3 EAST

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-6.03E

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 Exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA
09/29/11





FIRE SPRINKLER PLAN LEVEL 4 WEST

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

SPRINKLER HEAD LEGEND / ESCUTCHEON

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	118
◎	TYCO	TY-FRB	TY3131	QR	UPR	BRASS	1/2"	1/2"	5.6	200	–	–	–	3
TOTAL SPRINKLERS THIS SHEET														121

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

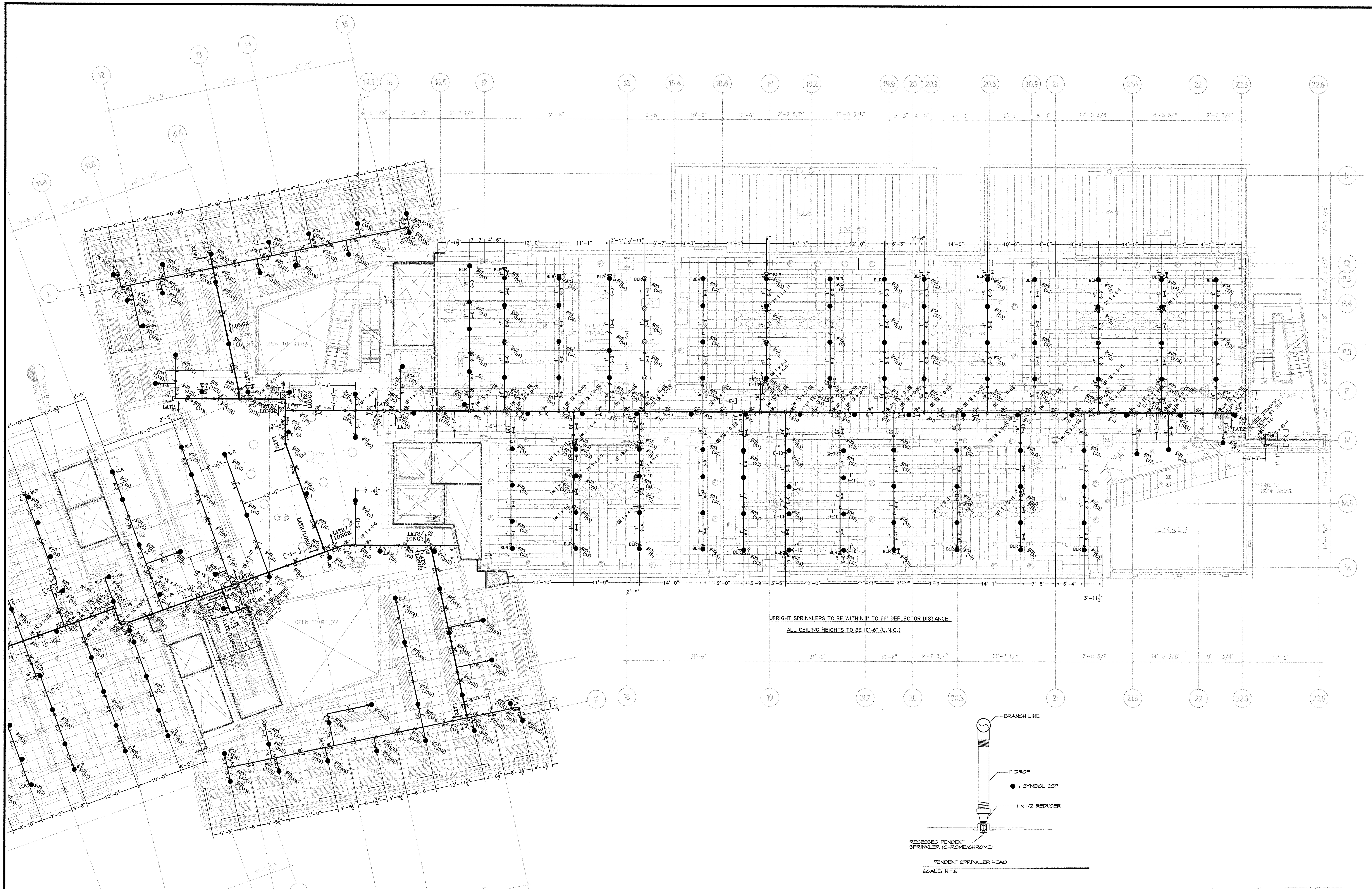
PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER PLAN LEVEL 4 WEST

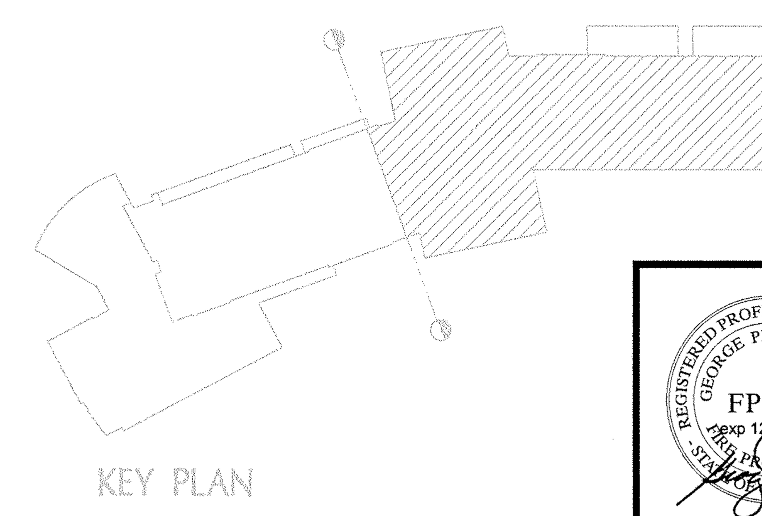
DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-6.04W

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA
09/29/11



FIRE SPRINKLER PLAN LEVEL 4 EAST

SCALE 1/8"=1'-0"



SPRINKLER HEAD LEGEND / ESCUTCHEON

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	189
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	5

TOTAL SPRINKLERS THIS SHEET 194

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. Phoenix, Arizona 85024
623.580.7800 Fax 623.434.3154
AZ-L16-234798 AZ-C16-234797 UT-S370-6690455-5501
CA-C16-901529 NV-C41-69370 NM-MS 12-354807

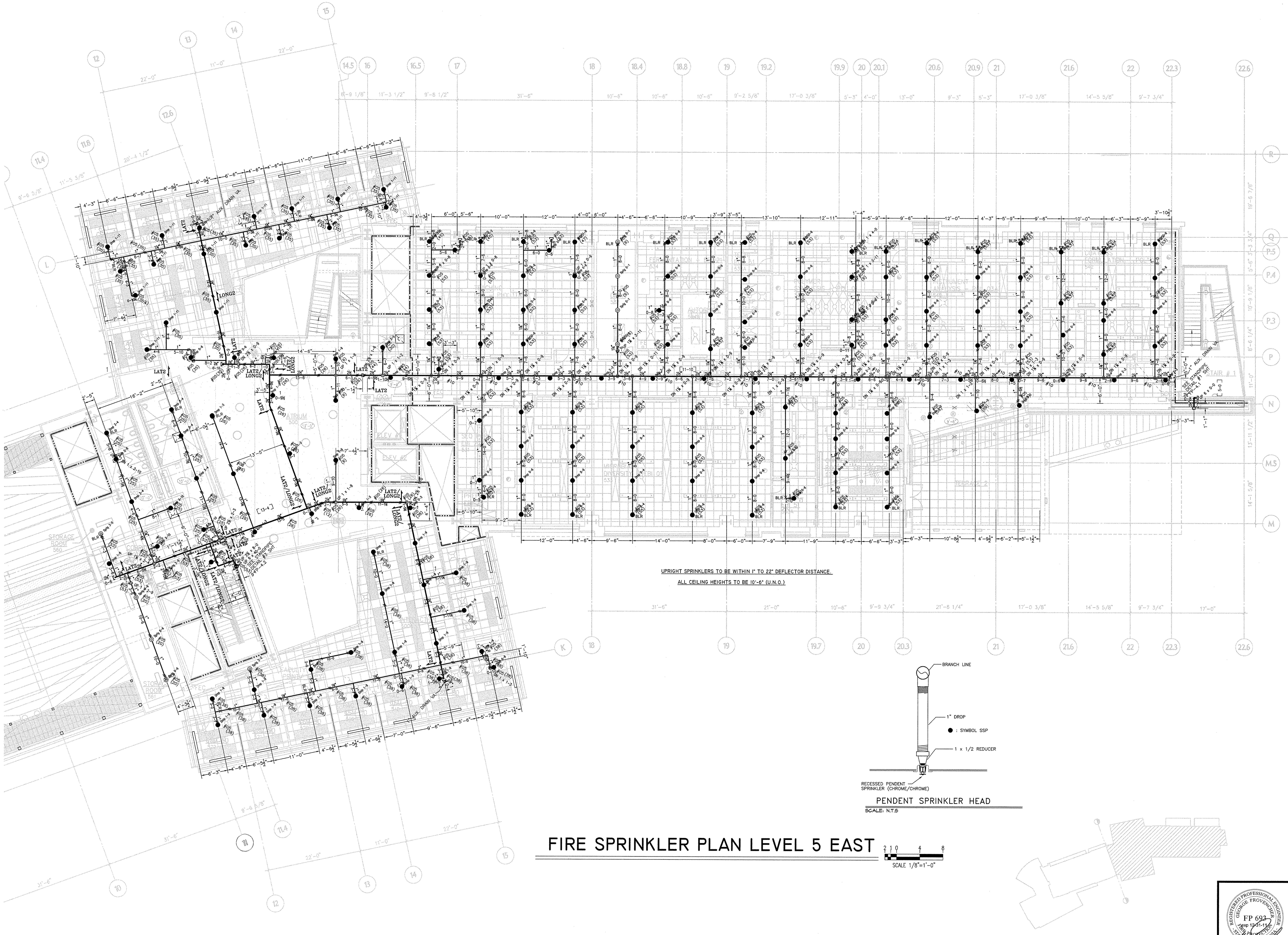
PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER PLAN LEVEL 4 EAST

DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-6.04E

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA
09/29/11



FIRE SPRINKLER PLAN LEVEL 5 EAST

SCALE 1/8"=1'-0"

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	184
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	10

(ESCUTCHEON: ESC. TYPE, FINISH, TEMP.)

TOTAL SPRINKLERS THIS SHEET 194

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-9370-6690455-5501 NM-MS 12-354807

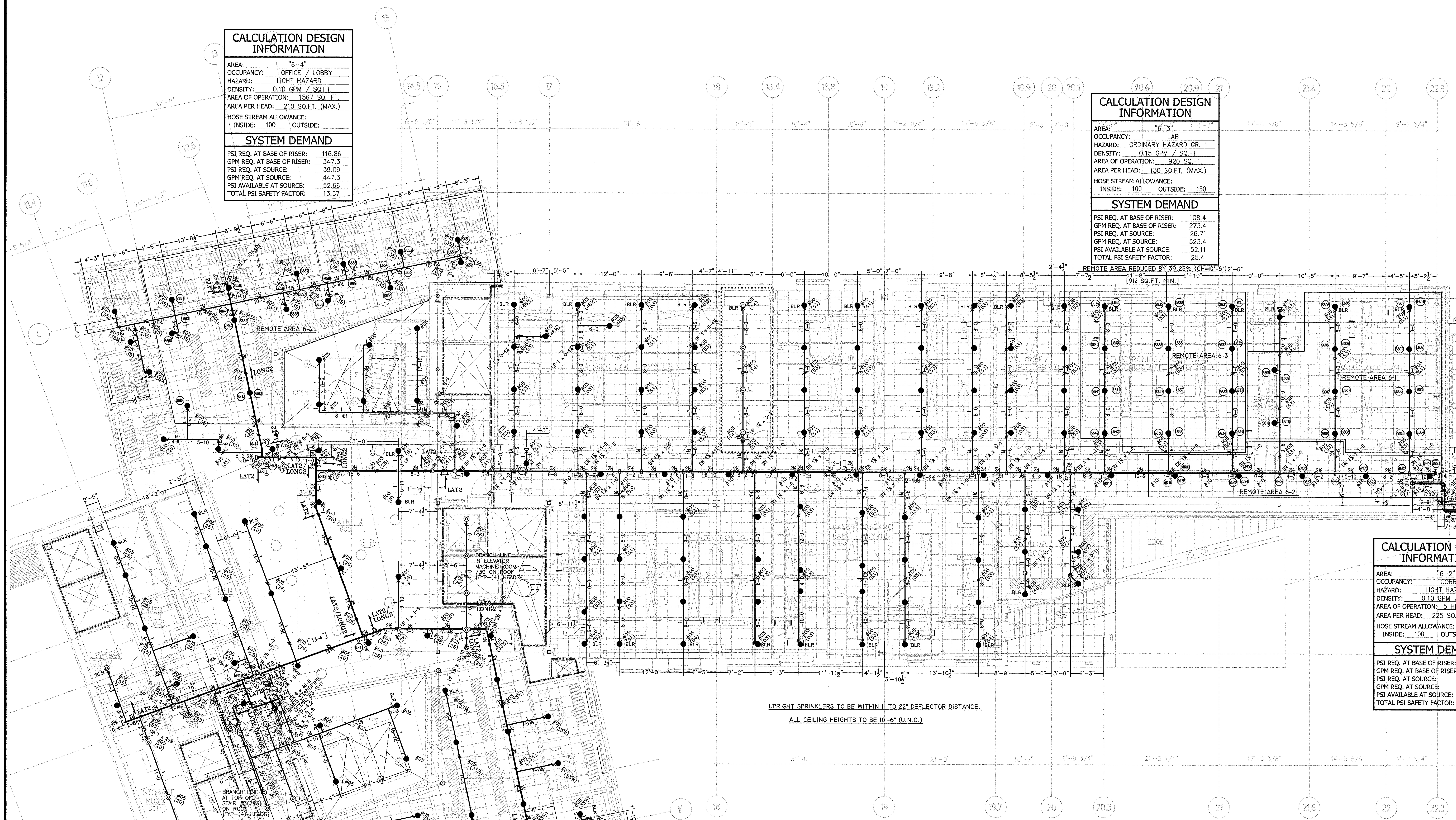
PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER PLAN LEVEL 5 EAST

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 EXP 12-31-11 STATE OF CALIFORNIA 09/29/11

DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-6.05E



CALCULATION DESIGN INFORMATION

AREA: "6-4"
OCCUPANCY: OFFICE / LOBBY
HAZARD: LIGHT HAZARD
DENSITY: 0.10 GPM / SQ.FT.
AREA OF OPERATION: 1567 SQ. FT.
AREA PER HEAD: 210 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE:

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	116.86
GPM REQ. AT BASE OF RISER:	347.3
PSI REQ. AT SOURCE:	39.09
GPM REQ. AT SOURCE:	447.3
PSI AVAILABLE AT SOURCE:	52.66
TOTAL PSI SAFETY FACTOR:	13.57

CALCULATION DESIGN INFORMATION

AREA: "6-3"
OCCUPANCY: LAB
HAZARD: ORDINARY HAZARD GR. 1
DENSITY: 0.15 GPM / SQ.FT.
AREA OF OPERATION: 920 SQ.FT.
AREA PER HEAD: 130 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: 150

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	108.4
GPM REQ. AT BASE OF RISER:	273.4
PSI REQ. AT SOURCE:	26.71
GPM REQ. AT SOURCE:	523.4
PSI AVAILABLE AT SOURCE:	52.11
TOTAL PSI SAFETY FACTOR:	25.4

CALCULATION DESIGN INFORMATION

AREA: "6-1"
OCCUPANCY: LAB
HAZARD: ORDINARY HAZARD GR. 1
DENSITY: 0.15 GPM / SQ.FT.
AREA OF OPERATION: 940 SQ.FT.
AREA PER HEAD: 130 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: 150

SYSTEM DEMAND

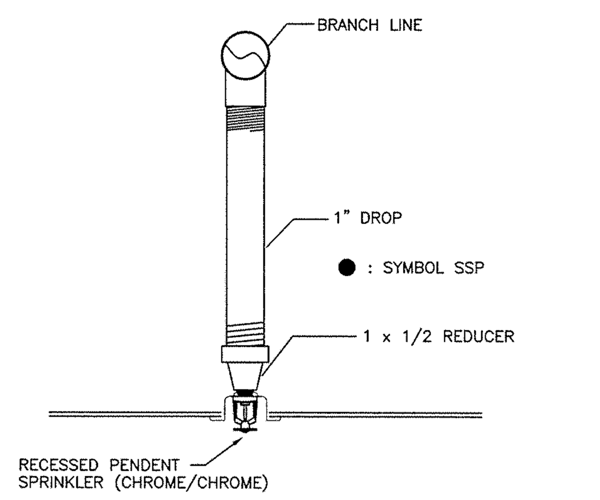
PSI REQ. AT BASE OF RISER:	95.47
GPM REQ. AT BASE OF RISER:	233.15
PSI REQ. AT SOURCE:	12.35
GPM REQ. AT SOURCE:	483.15
PSI AVAILABLE AT SOURCE:	53.35
TOTAL PSI SAFETY FACTOR:	40.1

CALCULATION DESIGN INFORMATION

AREA: "6-2"
OCCUPANCY: CORRIDOR
HAZARD: LIGHT HAZARD
DENSITY: 0.10 GPM / SQ.FT.
AREA OF OPERATION: 5 HEADS CORR.
AREA PER HEAD: 225 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE:

SYSTEM DEMAND

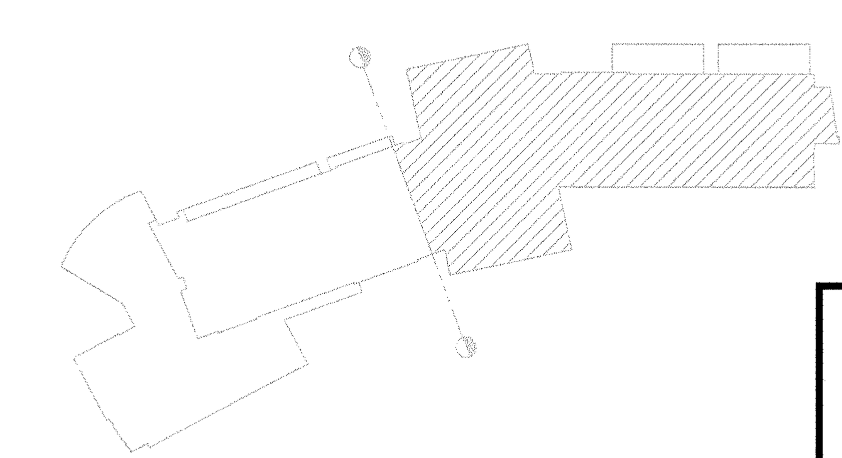
PSI REQ. AT BASE OF RISER:	34.5
GPM REQ. AT BASE OF RISER:	113.1
PSI REQ. AT SOURCE:	-51.52
GPM REQ. AT SOURCE:	213.09
PSI AVAILABLE AT SOURCE:	53.58
TOTAL PSI SAFETY FACTOR:	105.1



PENDENT SPRINKLER HEAD
SCALE: N.T.S

FIRE SPRINKLER PLAN LEVEL 6 EAST

SCALE 1/8"=1'-0"



KEY PLAN

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	193
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	N/A	N/A	N/A	20

(ESC. TYPE, FINISH, TEMP. under ESCUTCHEON)

TOTAL SPRINKLERS THIS SHEET 213

REVISIONS

#	DATE	BY	DESCRIPTION
△	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER PLAN LEVEL 6 EAST

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 EXP 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA
09/29/11

DRAWN BY:	----
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-6.06E

FIRE SPRINKLER RCP LEVEL 1 WEST

SCALE 1/8"=1'-0"

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	ESC. FINISH	ESC. TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	123
◎/○	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	–	–	–	66
△	TYCO	TY-FRB	TY3331	QR	HSW	BRASS	1/2"	1/2"	5.6	200	–	–	–	1

TOTAL SPRINKLERS THIS SHEET 190

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

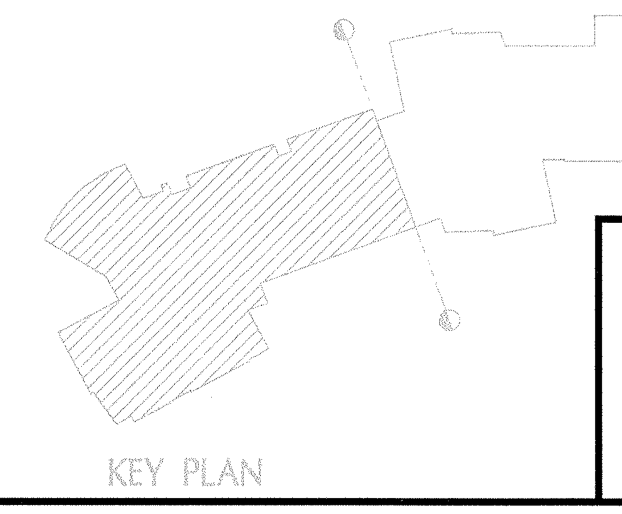
PLAN DESCRIPTION: FIRE SPRINKLER RCP LEVEL 1 WEST

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-7.01W

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 Exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA 09/29/11

FIRE SPRINKLER RCP LEVEL 2 WEST

SCALE 1/8"=1'-0"



SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE (ESCUTCHEON)	FINISH (ESCUTCHEON)	TEMP. (ESCUTCHEON)	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	186
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	2
TOTAL SPRINKLERS THIS SHEET														188

NORTH

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

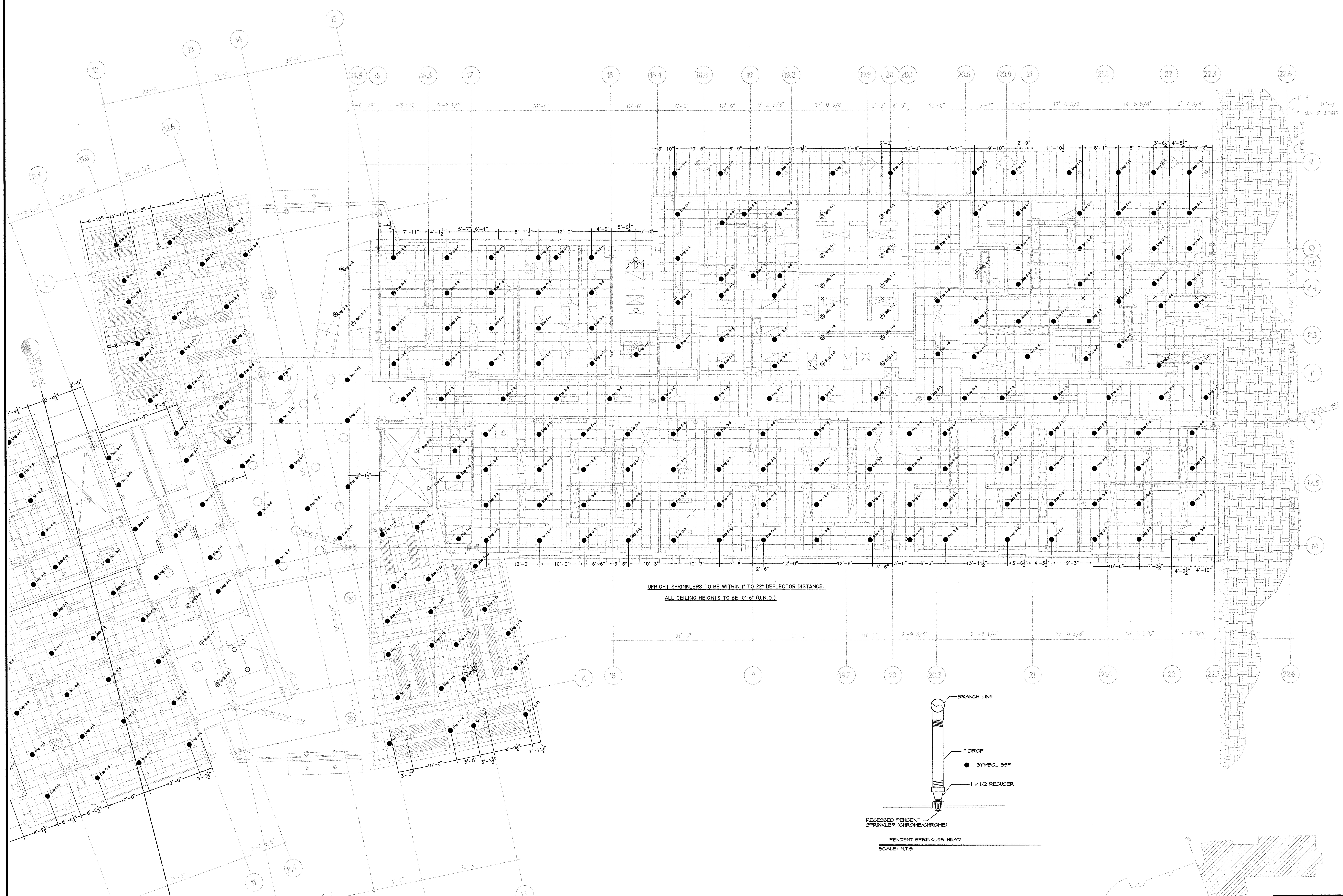
PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER RCP LEVEL 2 WEST

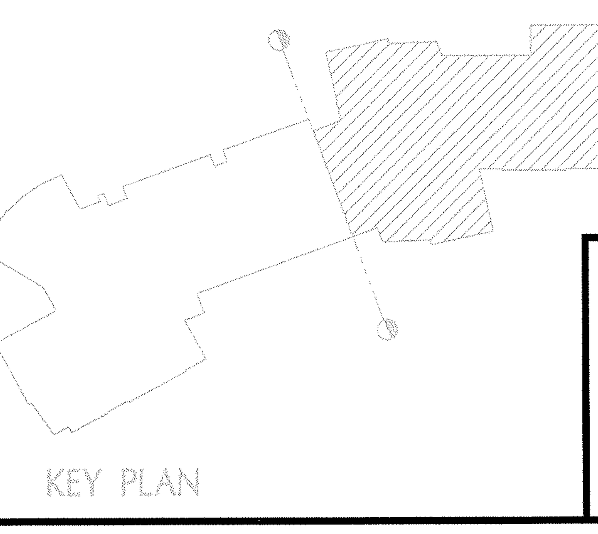
DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-7.02W

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA
09/29/11



FIRE SPRINKLER RCP LEVEL 2 EAST

SCALE 1/8"=1'-0"



SPRINKLER HEAD LEGEND											ESCUTCHEON			
SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	186
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	-	-	-	2
TOTAL SPRINKLERS THIS SHEET														188

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

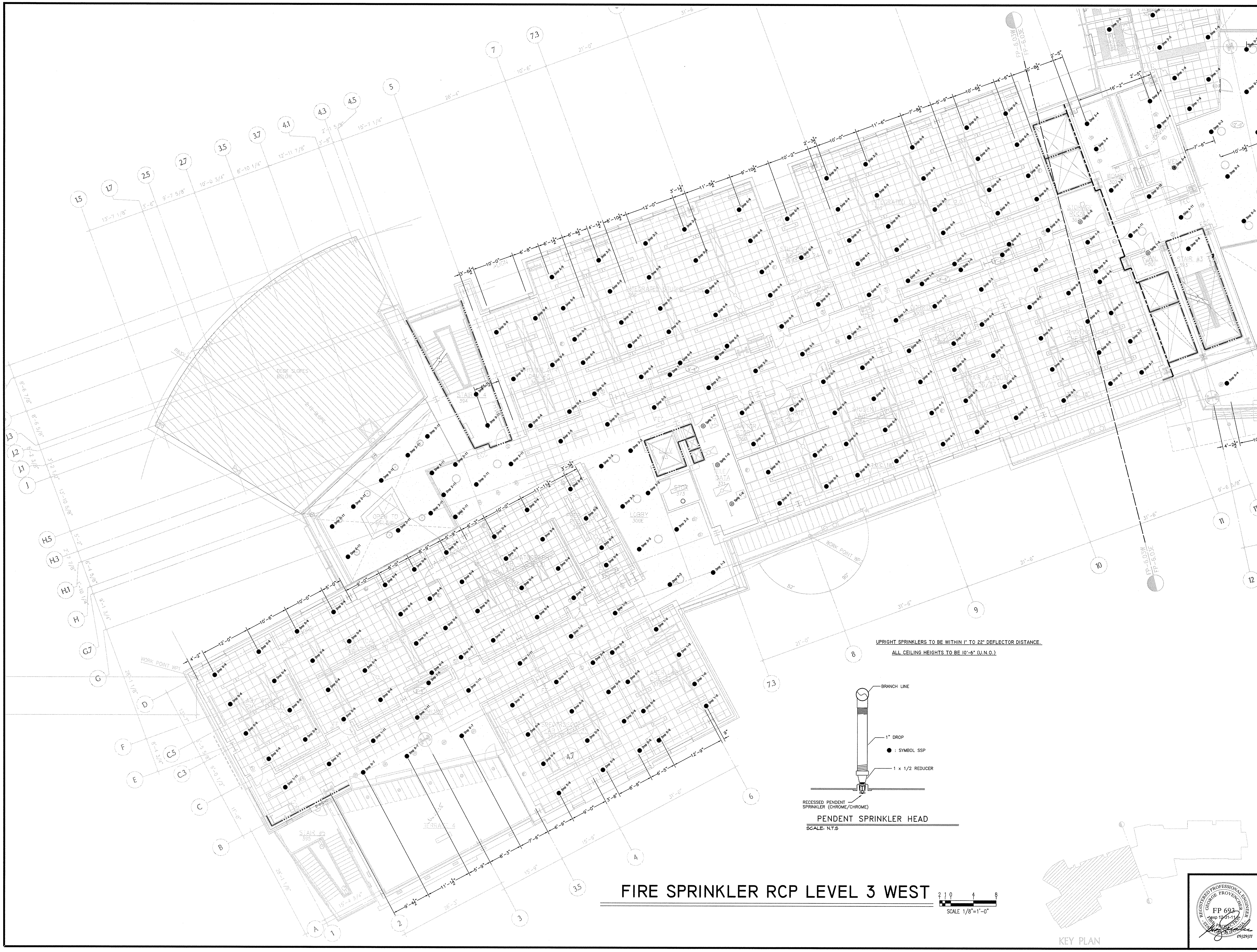
PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER RCP LEVEL 2 EAST

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-7.02E

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA 09/29/11



UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

BRANCH LINE

1" DROP

● : SYMBOL SSP

1 x 1/2 REDUCER

RECESSED PENDENT SPRINKLER (CHROME/CHROME)

PENDENT SPRINKLER HEAD

SCALE: N.T.S

FIRE SPRINKLER RCP LEVEL 3 WEST

SCALE 1/8"=1'-0"

SPRINKLER HEAD LEGEND / ESCUTCHEON

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	204
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	4
TOTAL SPRINKLERS THIS SHEET														208

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
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UT-S370-6690455-5501 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

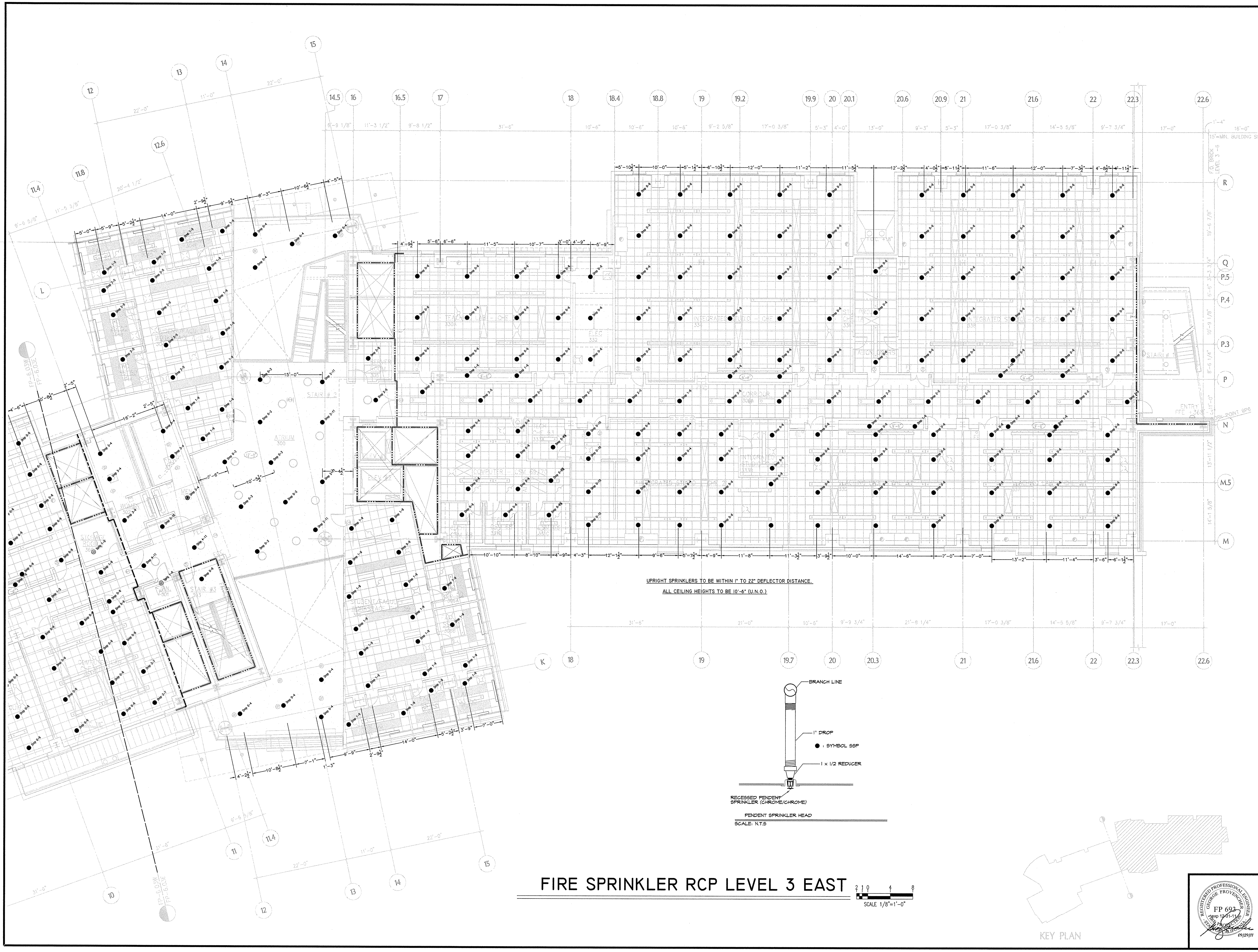
CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER RCP LEVEL 3 WEST

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-7.03W

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA 09/29/11

KEY PLAN



FIRE SPRINKLER RCP LEVEL 3 EAST

SCALE 1/8"=1'-0"

SPRINKLER HEAD LEGEND / ESCUTCHEON

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	224
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	–	–	–	2
											TOTAL SPRINKLERS THIS SHEET			226

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

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21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

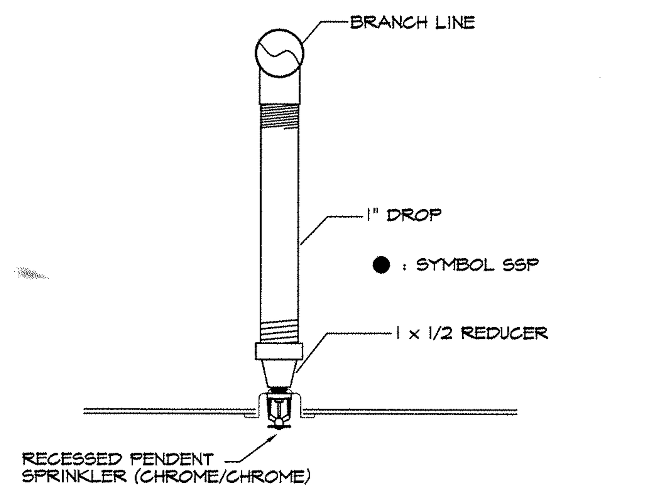
PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER RCP LEVEL 3 EAST

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-7.03E

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 Exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA
09/29/11



PENDENT SPRINKLER HEAD
SCALE: N.T.S

SCALE 1/8"=1'-0"

FIRE SPRINKLER RCP LEVEL 4 WEST

SPRINKLER HEAD LEGEND / ESCUTCHEON

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	118
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	–	–	–	3
TOTAL SPRINKLERS THIS SHEET														121

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

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UT-S370-6690455-5501 NM-MS 12-354807

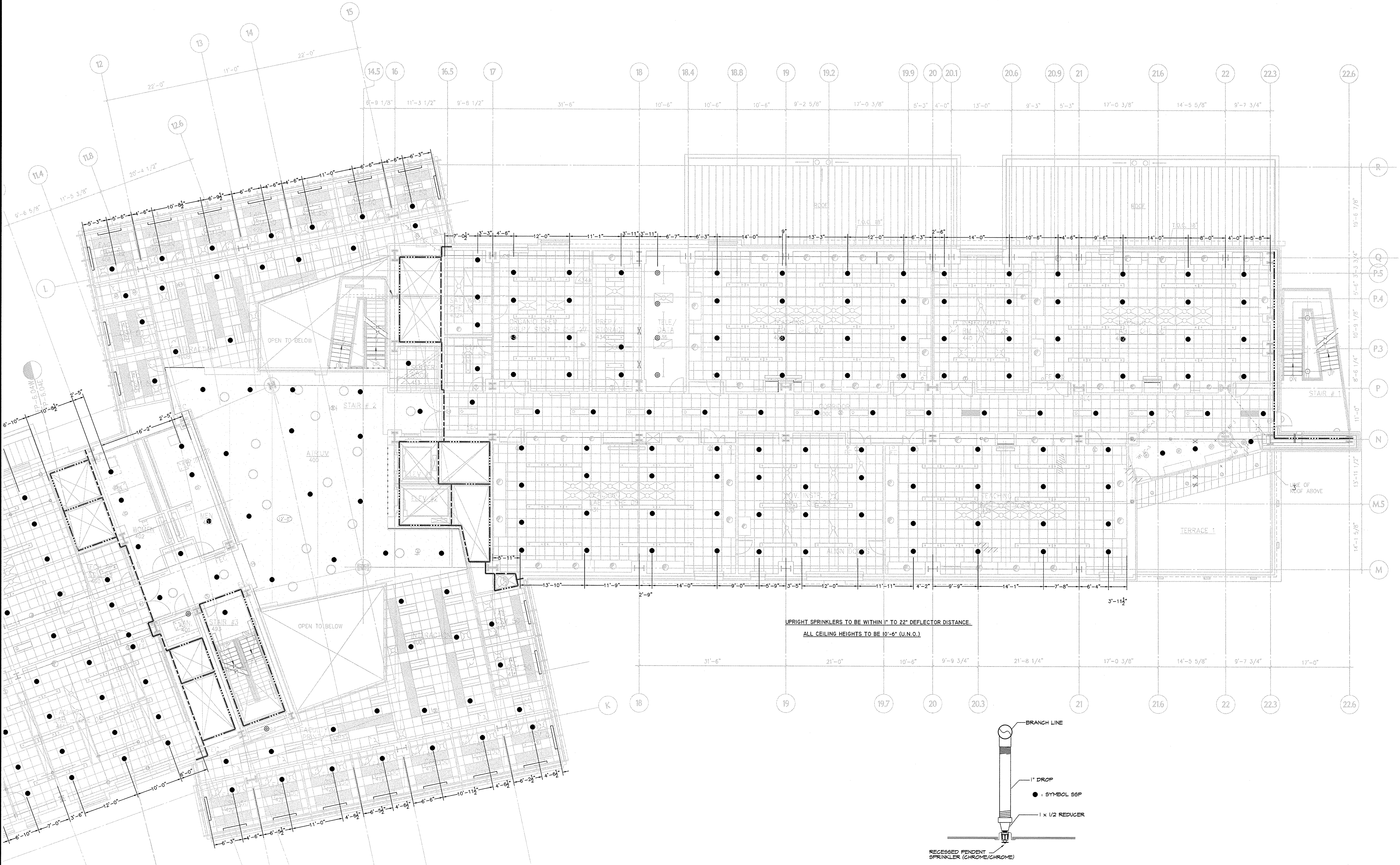
PROJECT: CAL POLY CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER RCP LEVEL 4 WEST

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 EXP 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA 09/29/11

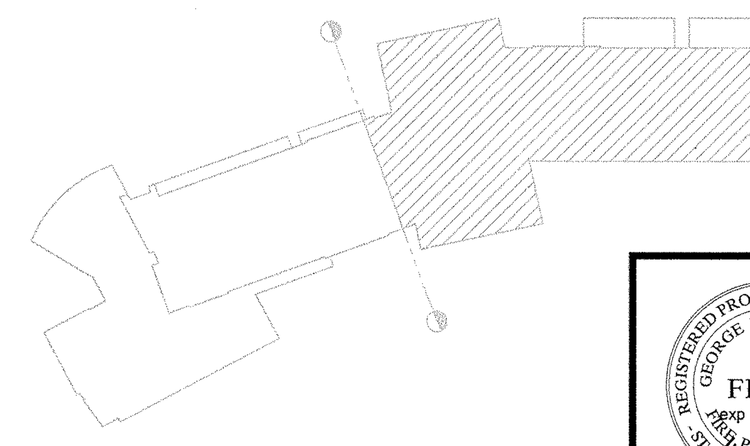
DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-7.04W



PENDENT SPRINKLER HEAD
SCALE: N.T.S

FIRE SPRINKLER RCP LEVEL 4 EAST

SCALE 1/8"=1'-0"



SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	189
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	5

(ESC. TYPE, FINISH, TEMP. under ESCUTCHEON)

TOTAL SPRINKLERS THIS SHEET 194

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

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PROJECT: CAL POLY CENTER FOR SCIENCE
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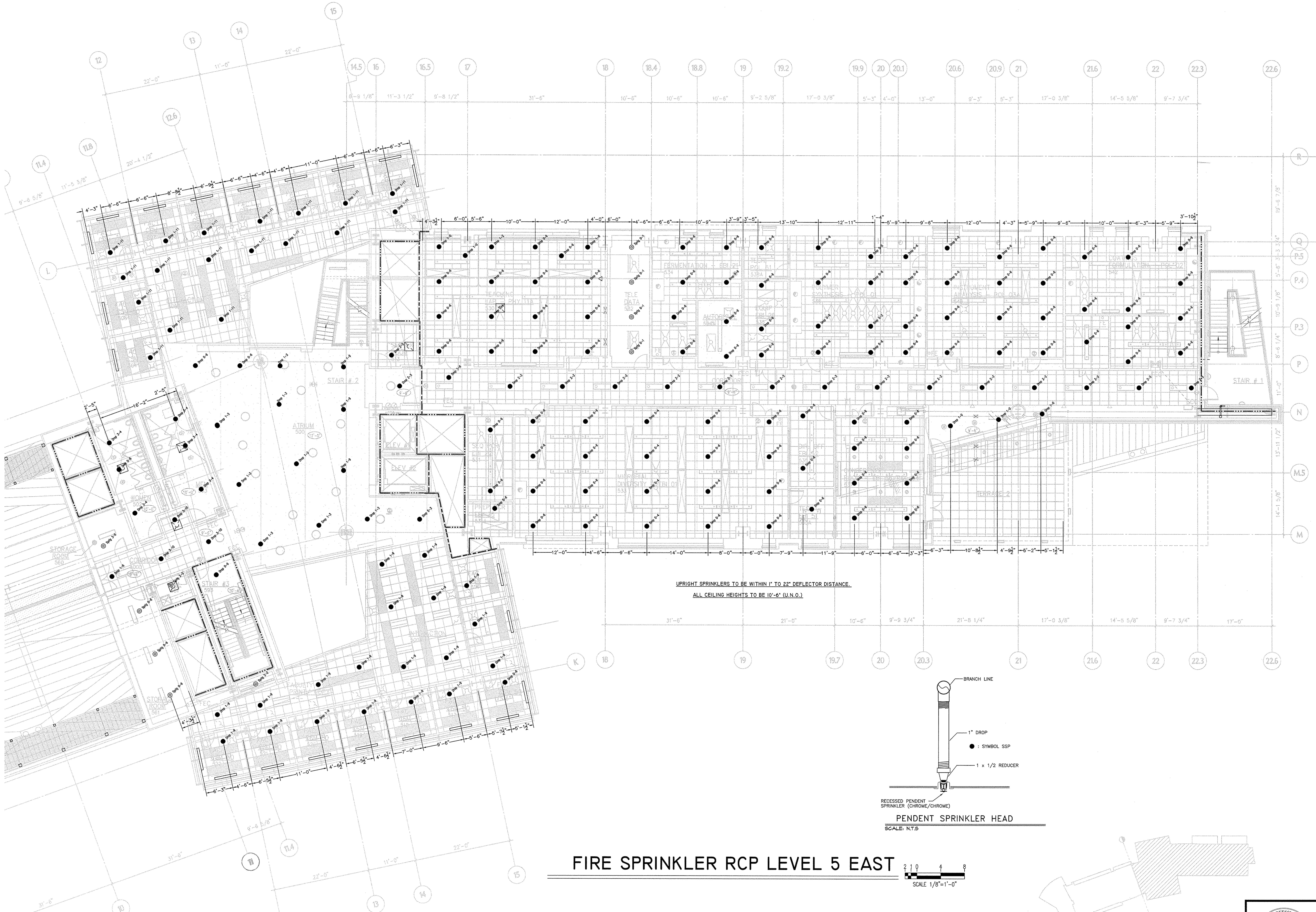
CONTRACT WITH: GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER RCP LEVEL 4 EAST

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-7.04E

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 Exp 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA
09/29/11



PENDENT SPRINKLER HEAD

SCALE: N.T.S

FIRE SPRINKLER RCP LEVEL 5 EAST

SCALE 1/8"=1'-0"

KEY PLAN

SPRINKLER HEAD LEGEND											ESCUTCHEON			
SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	184
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	10
TOTAL SPRINKLERS THIS SHEET														194

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

NORTH

AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154

AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

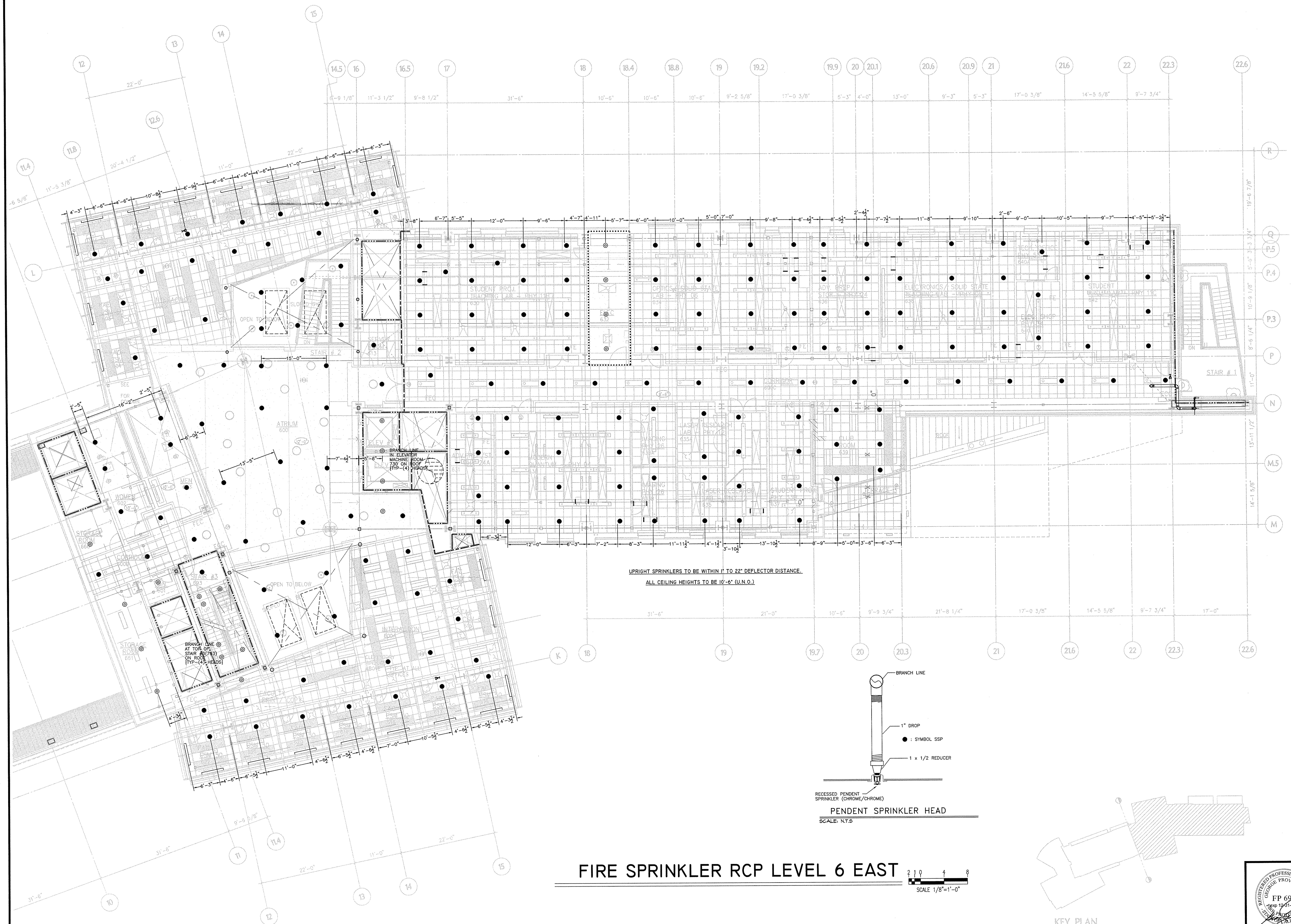
PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER RCP LEVEL 5 EAST

REGISTERED PROFESSIONAL ENGINEER GEORGE PROVENCHER FP 693 EXP 12-31-11 FIRE PROTECTION STATE OF CALIFORNIA 09/29/11

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-7.05E



UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

PENDENT SPRINKLER HEAD

SCALE: N.T.S

FIRE SPRINKLER RCP LEVEL 6 EAST

SCALE 1/8"=1'-0"

KEY PLAN

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	193
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	N/A	N/A	N/A	20

ESCUTCHEON

TOTAL SPRINKLERS THIS SHEET 213

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.

21605 North Central Ave. Phoenix, Arizona 85024 623.580.7800 Fax 623.434.3154

AZ-L16-234798 AZ-C16-234797 UT-5370-6690455-5501 CA-C16-901529 NV-C41-69370 NM-MS 12-354807

PROJECT: CAL POLY CENTER FOR SCIENCE, CALIFORNIA POLYTECHNIC STATE UNIVERSITY, SAN LUIS OBISPO, CA.

CONTRACT WITH: GILBANE CONSTRUCTION, 6265 GREENWICH DRIVE, SUITE 103, SAN DIEGO, CA. 92122

PLAN DESCRIPTION: FIRE SPRINKLER RCP LEVEL 6 EAST

DRAWN BY:	----
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-7.06E

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CALIFORNIA 93407
FIRE ALARM & EMERGENCY COMMUNICATION SYSTEM

GENERAL NOTES

1. NOTIFICATION DEVICES CANNOT BE T-TAPPED. ADDRESSABLE (IDC) DEVICES CAN BE T-TAPPED. ALL FIRE ALARM CABLING SHALL BE RUN FROM DEVICE TO DEVICE, WITH NO SPLICES. ANY REQUIRED TERMINATIONS MUST BE MADE IN APPROVED BOX.
2. ALL INTERIOR INITIATING DEVICES, NOTIFICATION DEVICES, AND MODULES REQUIRE 4"SQUARE SPECIAL DEEP BACK BOXES U.O.N.
3. PANEL BACK BOXES AND OTHER LISTED BACK BOXES SHALL BE PROVIDED TO THE EC BY DBI. ALL CONTROL PANELS, POWER SUPPLIES, AND BATTERY BOXES SHALL UTILIZE ONLY FACTORY KNOCKOUTS NEAR THE TOP OF THE CAN TO ALLOW PLACEMENT OF BATTERIES.
4. ALL FIRE ALARM CONDUIT TO BE $\frac{3}{4}$" EMT MINIMUM U.O.N. FIRE ALARM CONDUIT SHALL BE SEPARATE FROM CONDUIT SYSTEM FOR SECURITY ALARM CABLING AND OTHER SYSTEMS.
5. WALL MOUNT AUDIO/VISUAL DEVICES SHALL BE MOUNTED 80" AFF TO BOTTOM OF THE STROBE LENS.
6. MANUAL PULL STATIONS SHALL BE MOUNTED 48" AFF TO CENTERLINE OF BOX. MPS SHALL BE DOUBLE ACTION AND KEYED THE SAME AS THE FACP.
7. DEDICATED 120 VAC CIRCUIT WITH LOCKOUT @ BREAKER TO BE PROVIDED BY OTHERS AT LOCATION OF PANELS AND POWER SUPPLIES.
8. KNOX BOX, PIV, SUPERVISORY SWITCHES, FLOW SWITCHES, SOLENOIDS, AND SPRINKLER BELLS SHALL BE PROVIDED BY OTHERS.
9. SMOKE DETECTORS SHALL NOT BE PLACED WITHIN 3' OF ANY SUPPLY AIR REGISTER OR WHERE THE AIR MOVEMENT EXCEEDS THE MANUFACTURER'S LISTING.
10. FIRE FIGHTER TELEPHONE RISER IS CLASS A, STYLE Z
11. VOLTAGE DROP CALCULATIONS FOR NOTIFICATION DEVICES ARE BASED ON THE LAYOUT SHOWN. DEVIATION FROM THESE PLANS COULD RESULT IN ADDITIONAL CONDUIT WORK, REENGINEERING, UPSIZED CABLE AND/OR ADDITIONAL POWER REQUIREMENTS.
12. PAINT ALL FIRE ALARM JUNCTION BOXES AND COVERS RED IN UNFINISHED AREAS (IE ABOVE CEILINGS, MECHANICAL ROOMS ETC.) IN FINISHED AREAS CONDUIT AND JUNCTION BOXES CAN BE PAINTED TO MATCH THE ROOM FINISH, THE INSIDE COVER IF THE JUNCTION BOX MUST BE IDENTIFIED AS "FIRE ALARM" AND THE CONDUIT MUST HAVE PAINTED RED BANDS $\frac{3}{4}$" WIDE AT 10' CENTERS AND AT EACH SIDE OF A FLOOR, WALL, OR CEILING PENETRATION.
13. UPON COMPLETION OF INSTALLATION OF THE FIRE ALARM SYSTEM A SATISFACTORY TEST OF THE ENTIRE SYSTEM SHALL BE MADE IN THE PRESENCE OF THE AUTHORITY HAVING JURISDICTION (AHJ).
14. ALL NOTIFICATION DEVICES SHALL BE SYNCHRONIZED.
15. A STAMPED SET OF APPROVED FIRE ALARM PLANS SHALL BE AT THE JOBSITE AND USED FOR INSTALLATION.
16. SIGNALING LINE CIRCUIT IS CLASS B, STYLE 4
17. NOTIFICATION APPLIANCE CIRCUIT IS CLASS B, STYLE Y (5)
18. ALL SMOKE DETECTORS SHALL BE INSTALLED AT LEAST 1'-0" FROM FLUORESCENT LIGHT FIXTURES TO AVOID UNWANTED ALARMS AND SHALL BE INSTALLED IN AREAS THAT DO NOT EXCEED THE MANUFACTURE'S OPERATING TEMPERATURE RANGE BETWEEN 32°F AND 120°F.

CODE REGULATIONS

CALIFORNIA CODE REGULATIONS

APPLICABLE CODES

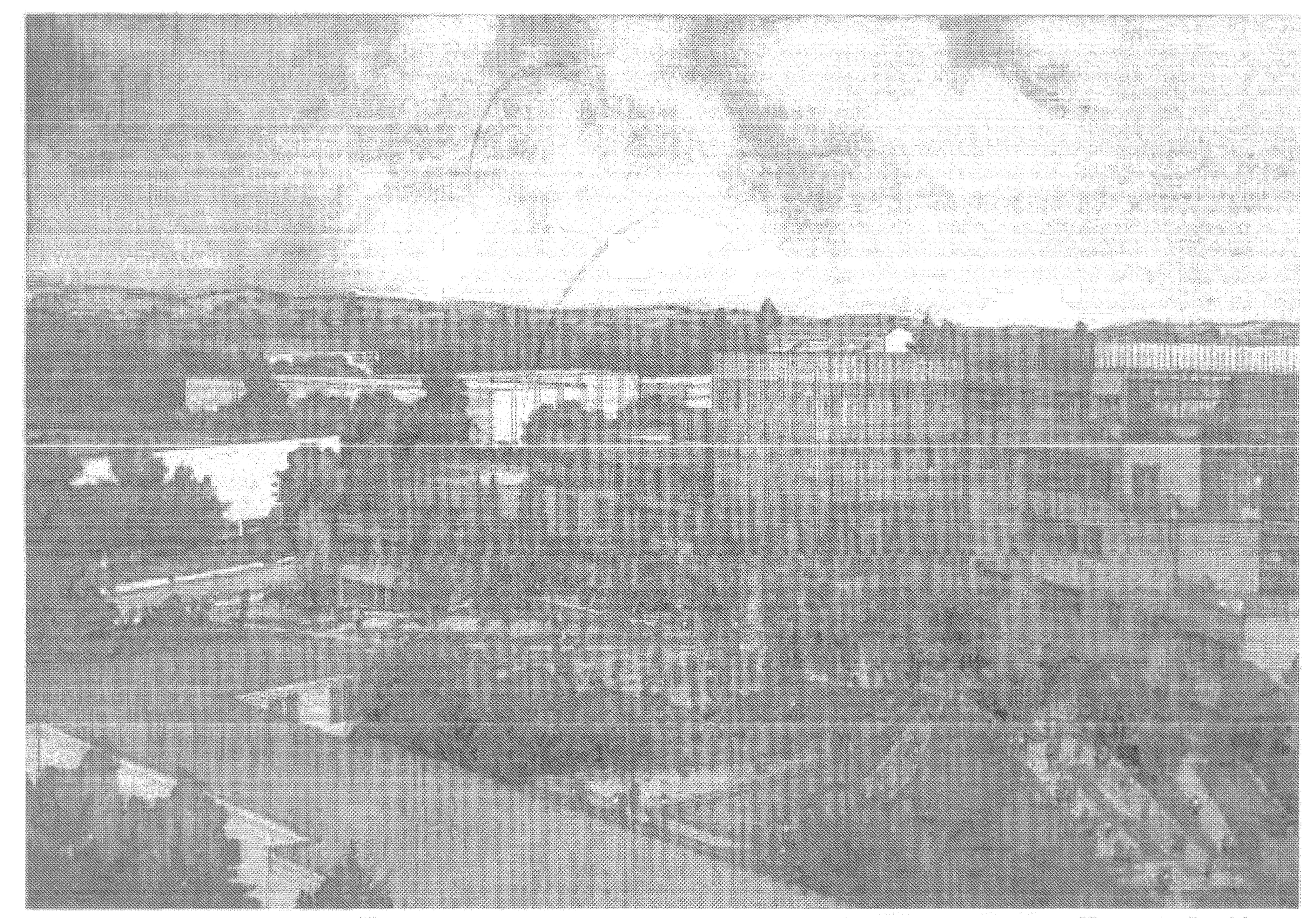
Year	Code	Reference
2007	BUILDING STANDARDS ADMINISTRATIVE CODE	TITLE 24 PART 1
2007	CALIFORNIA BUILDING CODE (CBC)	TITLE 24 PART 2
2007	CALIFORNIA ELECTRICAL CODE (CEC)	TITLE 24 PART 3
2007	CALIFORNIA MECHANICAL CODE (CMC)	TITLE 24 PART 4
2007	CALIFORNIA PLUMBING CODE (CPC)	TITLE 24 PART 5
2007	CALIFORNIA ENERGY CODE	TITLE 24 PART 6
2007	CALIFORNIA ELEVATOR SAFETY CONSTRUCTION CODE	TITLE 24 PART 7
2007	CALIFORNIA HISTORICAL BUILDING CODE	TITLE 24 PART 8
2007	CALIFORNIA FIRE CODE (CFC)	TITLE 24 PART 9
2007	CALIFORNIA REFERENCED STANDARDS CODE	TITLE 24 PART 12

APPLICABLE STANDARDS & GUIDELINES

Year	Standard	Reference
2007	AUTOMATIC SRINKLER SYSTEMS	NFPA 13
2007	STATIONARY PUMPS	NFPA 20
2007	NATIONAL FIRE ALARM CODES (CALIFORNIA AMENDED)	NFPA 72
2007	STANDARD FOR INSTALLATION OF AIR-CONDITIONING	NFPA90A
2007	STANDARD FOR INSTALLATION OF WARN AIR HEATING	NFPA 90B
2006	STANDARD FOR SMOKE-CONTROL SYSTEMS UTILIZING BARRIERS AND PRESSURE DIFFERENCES	NFPA 92A
2005	STANDARD FOR SMOKE MANAGEMENT SYSTEMS IN MALLS, ATRIA, AND LARGE SPACES	NFPA 92B

(4)

SITE PLAN



CENTER FOR SCIENCE

PROJECT DESCRIPTION

1. OCCUPANCY TYPE: A, B, AND H3
2. SYSTEM TYPE: CLASS B, ADDRESSABLE, MANUAL
3. METHOD OF COMMUNICATION: TELEPHONE
4. SCOPE OF WORK: FIRE ALARM & VOICE EVACUATION SYSTEMS

SEQUENCE OF OPERATIONS MATRIX

ACTION columns: (1) SUPERVISORY CONDITION AT FACU; (2) TROUBLE CONDITION AT FACU; (3) ALARM CONDITION AT FACU; (4) ACTIVATE FIRE ALARM AUDIO/VISUAL DEVICES AND VOICE ALARM COMMUNICATION; (5) DISPLAY TEXT ON LCD ANNUNCIATOR; (6) ACTIVATE SHUNT TRIP RELAY; (7) SHUTDOWN AIR HANDLER UNIT; (8) ACTIVATE ELEVATOR RECALL; (9) SHUTDOWN INDIVIDUAL ASSOCIATED DAMPERS; (10) DEACTIVATE MAGNETIC DOOR HOLDERS; (11) ACTIVATE SUPERVISORY SIGNAL TO RECEIVING STATION (CAMPUS POLICE); (12) ACTIVATE TROUBLE SIGNAL TO RECEIVING STATION (CAMPUS POLICE); (13) ACTIVATE ALARM DIALER SIGNAL TO RECEIVING STATION (CAMPUS POLICE); (14) BYPASS ALL ALARM OUTPUTS (NOTIFICATION, SHUNTS, RELAY OUTPUTS) FOR TESTING; (15) OPEN ATRUIM DOORS WITH MOTORIZED DOOR OPERATORS; (16) ACTIVATE ATRIUM PASSIVE SMOKE EVACUATION SYSTEM

EVENT — FIRE ALARM CONTROL UNIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PANEL SUPERVISORY CONDITION (TEST BYBASS) ON ACM-24 AT	X				X						X			X		
PANEL TROUBLE CONDITION (AC POWER FAIL, LOW BATTERY, OPEN CIRCUIT, GROUND FAULT, ETC.)		X			X							X				
PANEL ALARM CONDITION			X	X	X		X			X			X			
MANUAL PULL STATION ACTIVATION			X	X	X					X			X			
SPOT SMOKE DETECTOR ACTIVATION			X	X	X					X			X			
DUCT SMOKE DETECTOR ACTIVATION			X	X	X				X	X			X			
AIR HANDLING UNIT DUCT SMOKE DETECTOR ACTIVATION			X	X	X		X						X			
SPRINKLER TAMPER SWITCH	X				X						X		X			
SPRINKLER WATER FLOW ACTIVATION			X	X	X					X			X			
FIRE PUMP RUNNING			X	X	X					X			X			
FIRE PUMP LOSS OF PH ASE	X				X						X					
FIRE PUMP PHASE REVERSAL	X				X						X		X			
HEAT DETECTOR ACTIVATION (ELEVATOR EQUIPMENT)			X	X	X	X				X			X			
ELEVATOR LOBBY/ EMR SMOKE / ELEVATOR HOISTWAYS			X	X	X			X		X			X			
SHUNT TRIP POWER SUPERVISION	X				X						X					
GENERAL ALARM (ANYWHERE WITHIN THE BUILDING)			X	X	X		X			X			X			
ATRIUM SMOKE CONTORL SYSTEM ALARM			X	X	X					X			X		X	X
BEAM SMOKE DETECTION WITHIN ATRIUM			X	X	X					X			X		X	X
PULL STATION WITHIN ATRIUM			X	X	X					X			X		X	X
SPRINKLER WATER FLOW WITHIN ATRIUM			X	X	X					X			X		X	X

(2) (3) (4)

SYMBOL LEGEND

COUNT	FIRE ALARM SYMBOLS	DESCRIPTION	MODEL #	CSFM LISTING #
31	F	MANUAL PULL STATION	NBG-12LX	7150-0028:0199
73	F	STROBE ONLY	SW	7320-1653:201
165	F	SPEAKER/STROBE	SPWS	7320-1653:201
6	F	SPEAKER ONLY	SPW	7320-1653:201
7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
0	H	HEAT DETECTOR	FST-851	7270-0028:196
18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
32		END OF LINE RESISTOR	N/A	N/A
2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
12	RM	RELAY MODULE	FRM-1	7300-0028:219
16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
10	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
1	XP6-R	SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

DRAWING INDEX

AS-BUILT SET

Deep Blue Integration

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Service - Monitoring

Deep Blue Integration, Inc
3442 Empresa Drive Suite C
San Luis Obispo, CA 93401
C-10, C-16 #943465 ACO#6864
Toll Free: 888◆6000◆DBI FAX: 805◆791◆2037
www.deepblueintegration.com

Revisions

SYMBOL	DESCRIPTION	DATE	APPR.
1	REVIEW COMMENTS	6/14/2011	
2	CRB # 093.1 & FI 99	5/18/2012 4/11/2012	
3	SFM REVIEW COMMENTS	8/20/2012	
4	CRB 93.2	1/15/2013	
5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
6	AS-BUILT DRAWINGS	8/23/2013	

DESIGNED BY: Curtis Streeter

DRAWN BY: Derek Richardson

CHECKED BY: CURTIS STREETER, SET NICET IV #102672

PROJECT ENGINEER: Integral Design Associates INC.

DATE: 08/23/2013

SCALE:

DRAWING CODE: FA ALL DRAWINGS CPCFS

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA
CSFM #18-40-03-0001

SHEET ID: FA-0

COVER SHEET

SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS		MODEL #	CSFM LISTING #
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	73	F	STROBE ONLY	SW	7320-1653:201
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	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
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5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
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	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R	SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
4	1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

GENERAL NOTES:

1. The Notification Appliance Circuits vary between 14 AWG and 12 AWG, see ~~voltage drops for correct sizing.~~
2. All smoke detectors shall be placed at least 1'-0" from fluorescent light fixtures to avoid unwanted alarms and in areas that will not exceed manufacture's specified operating temperature 32°F to 120°F. (5)

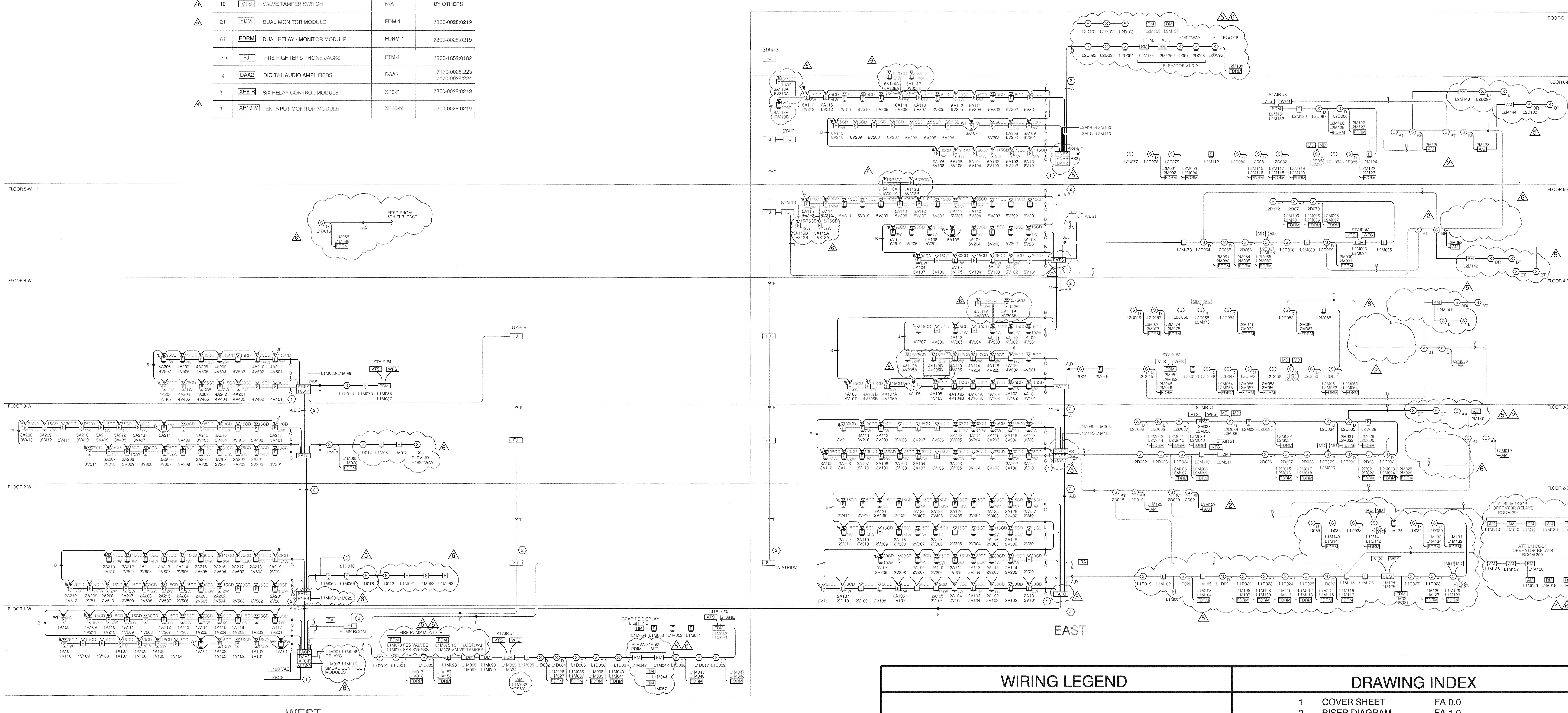
SHEET NOTES:

(1) The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

(2) The riser going between floors will be in 2" conduit or larger.

(3) 6.10.1.16* All circuits necessary for the operation of two-way telephone communication systems shall be installed using one of the following methods:
(1) A 2-hour fire rated circuit integrity (CI) cable
(2) A 2-hour fire rated cable system (electrical circuit protective system)
(3) A 2-hour fire rated enclosure
(4) Performance alternatives approved by the authority having jurisdiction
(5) Buildings fully protected by an automatic sprinkler system installed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, with the wiring or cables installed in metal raceways and in accordance with Article 760 of NFPA 70

A.6.10.1.16 One or more of the following means might be considered acceptable to provide a level of survivability consistent with the intent of this requirement:
(1) Routing two-way telephone circuits separately
(2) Using short-circuit fault tolerant circuits



FIRE ALARM RISER DIAGRAM
NTS

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

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DRAWN BY: Derek Richardson
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
PROJECT ENGINEER: Integral Design Associates INC.

DATE: 08/23/2013
SCALE:
DRAWING CODE: FA ALL DRAWINGS CPCFS

CENTER FOR SCIENCE AND MATHEMATICS
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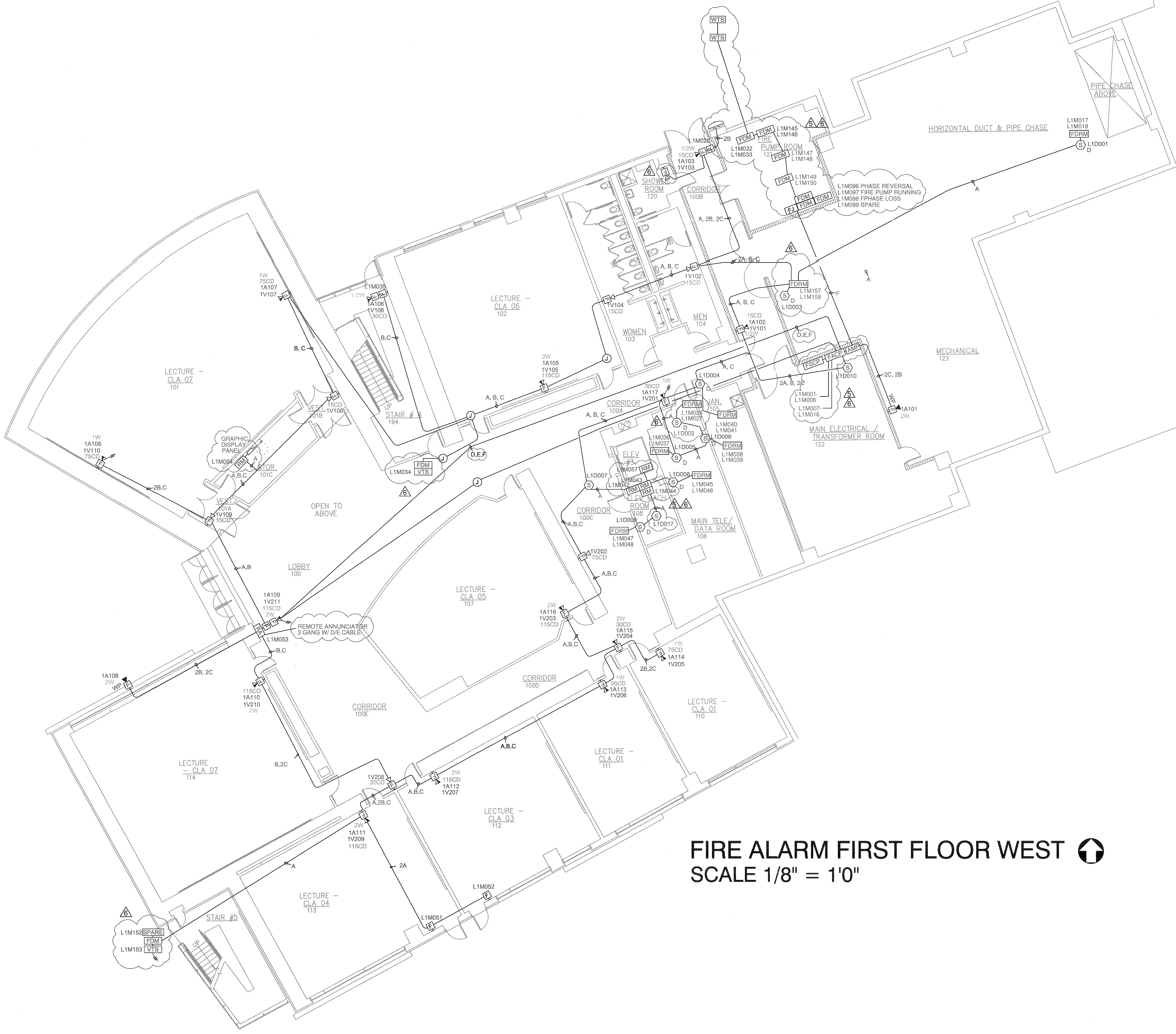
SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

SHEET ID
FA 1.0



FIRE ALARM FIRST FLOOR WEST

SCALE 1/8" = 1'0"

SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS	MODEL #	CSFM LISTING #
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	64	S D SMOKE DETECTOR - DUCT	DNR	3242-1653:209
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5, 2	15	S BR BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
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	4	DAA2 DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
4	1	XP10-M TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

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LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
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B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
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5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
6	AS-BUILT DRAWINGS	8/23/2013	

DESIGNED BY: Curtis Streeter
DRAWN BY: Derek Richardson
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
PROJECT ENGINEER: Integral Design Associates INC.

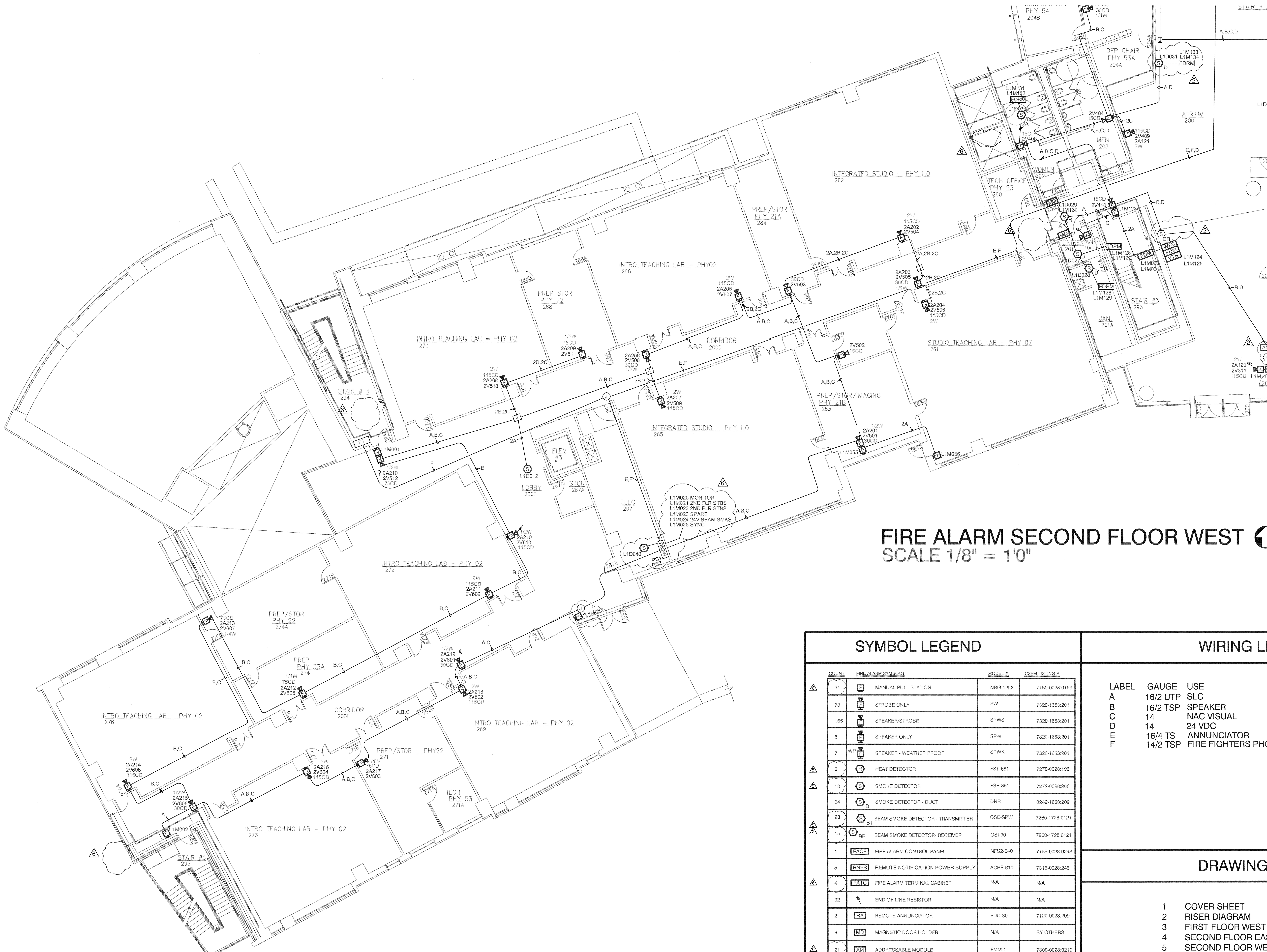
DATE: 08/23/2013
SCALE:
DRAWING CODE: FA ALL DRAWINGS CPCFS

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

SHEET ID

FA 3.01W



FIRE ALARM SECOND FLOOR WEST

SCALE 1/8" = 1'0"

SYMBOL LEGEND

REV.	COUNT	FIRE ALARM SYMBOLS	MODEL #	CSFM LISTING #
6	31	F MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	F STROBE ONLY	SW	7320-1653:201
	165	F SPEAKER/STROBE	SPWS	7320-1653:201
	6	F SPEAKER ONLY	SPW	7320-1653:201
	7	WP F SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H HEAT DETECTOR	FST-851	7270-0028:196
5	18	S SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	S BR BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC FIRE ALARM TERMINAL CABINET	N/A	N/A
	32	END OF LINE RESISTOR	N/A	N/A
	2	RA REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM RELAY MODULE	FRM-1	7300-0028:219
	16	WFS WATER FLOW SWITCH	N/A	BY OTHERS
6	10	VTS VALVE TAMPER SWITCH	N/A	BY OTHERS
5	21	FDM DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2 DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
4	1	XP10-M TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

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PROJECT ENGINEER: Integral Design Associates INC.

CENTER FOR SCIENCE AND MATHEMATICS CALIFORNIA STATE POLYTECHNIC UNIVERSITY

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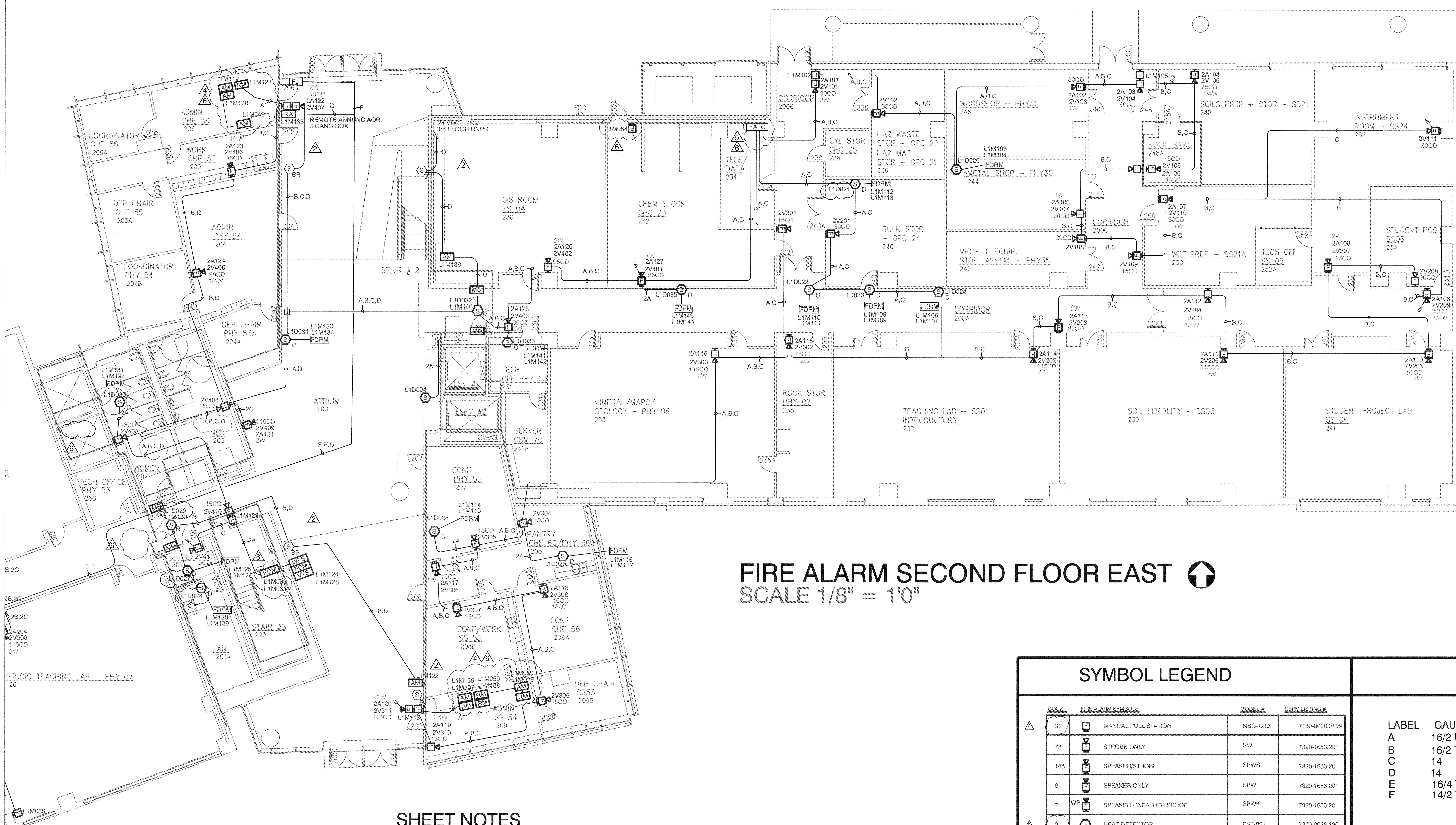

FIRE ALARM SECOND FLOOR EAST

SCALE 1/8" = 1'0"

SHEET NOTES

1. PROVIDE FIRE ALARM BEAM DETECTORS TRANSMITTER AND RECEIVER. INTERLOCK WITH SMOKE EVACUATION SYSTEM SUCH THAT WHEN BEAM DETECTOR IS ACTIVATED, SMOKE EVACUATION SYSTEM IS ACTIVATED. REFER TO DETAIL 4 & 5/FA5.0.
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SYMBOL LEGEND

Rev.	COUNT	FIRE ALARM SYMBOLS	MODEL #	CSFM LISTING #
6	31	MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	STROBE ONLY	SW	7320-1653:201
	165	SPEAKER/STROBE	SPWS	7320-1653:201
	6	SPEAKER ONLY	SPW	7320-1653:201
	7	WP SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	HEAT DETECTOR	FST-851	7270-0028:196
5	18	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC FIRE ALARM TERMINAL CABINET	N/A	N/A
	32	END OF LINE RESISTOR	N/A	N/A
	2	RA REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM RELAY MODULE	FRM-1	7300-0028:219
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6	10	VTS VALVE TAMPER SWITCH	N/A	BY OTHERS
5	21	FDM DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2 DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
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WIRING LEGEND

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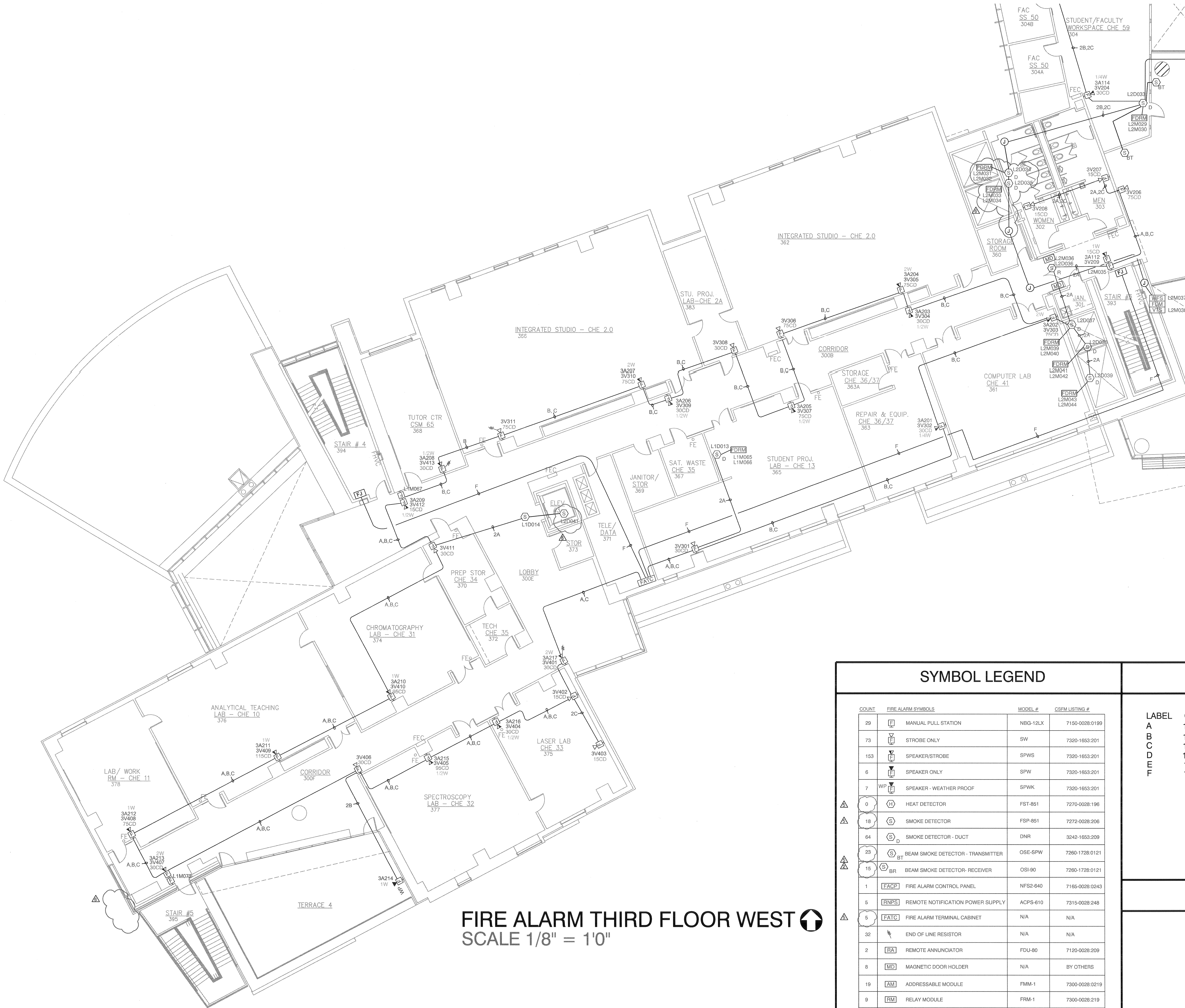
SHEET 5 OF 15



FIRE ALARM THIRD FLOOR WEST

SCALE 1/8" = 1'0"

SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS	MODEL #	CSFM LISTING #
	29	F MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	F STROBE ONLY	SW	7320-1653:201
	153	F SPEAKER/STROBE	SPWS	7320-1653:201
	6	F SPEAKER ONLY	SPW	7320-1653:201
	7	WP F SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H HEAT DETECTOR	FST-851	7270-0028:196
5	18	S SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	S BR BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
5	5	FATC FIRE ALARM TERMINAL CABINET	N/A	N/A
	32	END OF LINE RESISTOR	N/A	N/A
	2	RA REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD MAGNETIC DOOR HOLDER	N/A	BY OTHERS
	19	AM ADDRESSABLE MODULE	FMM-1	7300-0028:0219
	9	RM RELAY MODULE	FRM-1	7300-0028:219
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5	22	VTS VALVE TAMPER SWITCH	N/A	BY OTHERS
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	12	FJ FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2 DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
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WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
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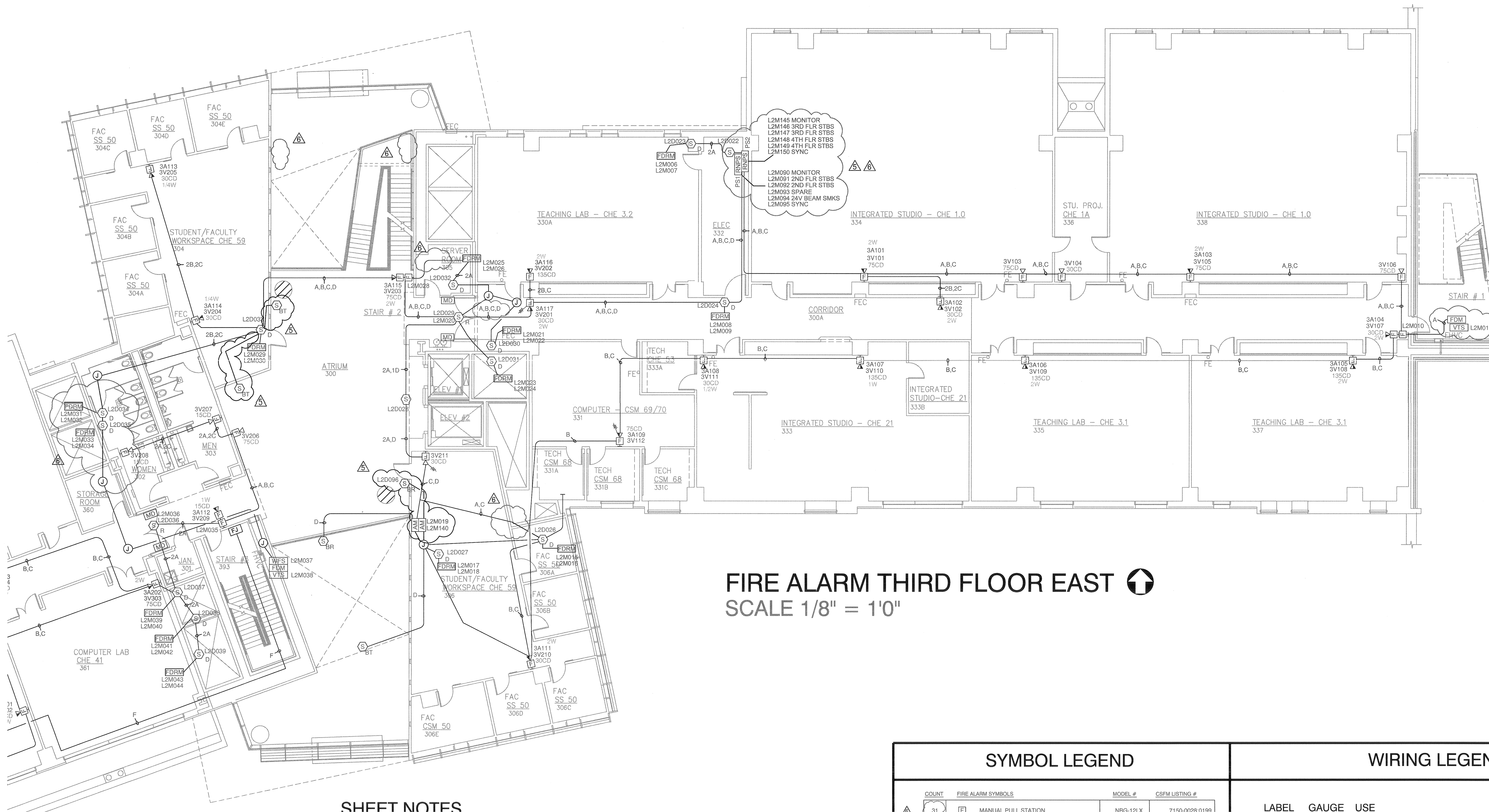

FIRE ALARM THIRD FLOOR EAST

SCALE 1/8" = 1'0"

SHEET NOTES

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	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
	23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
5 2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
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5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
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WIRING LEGEND

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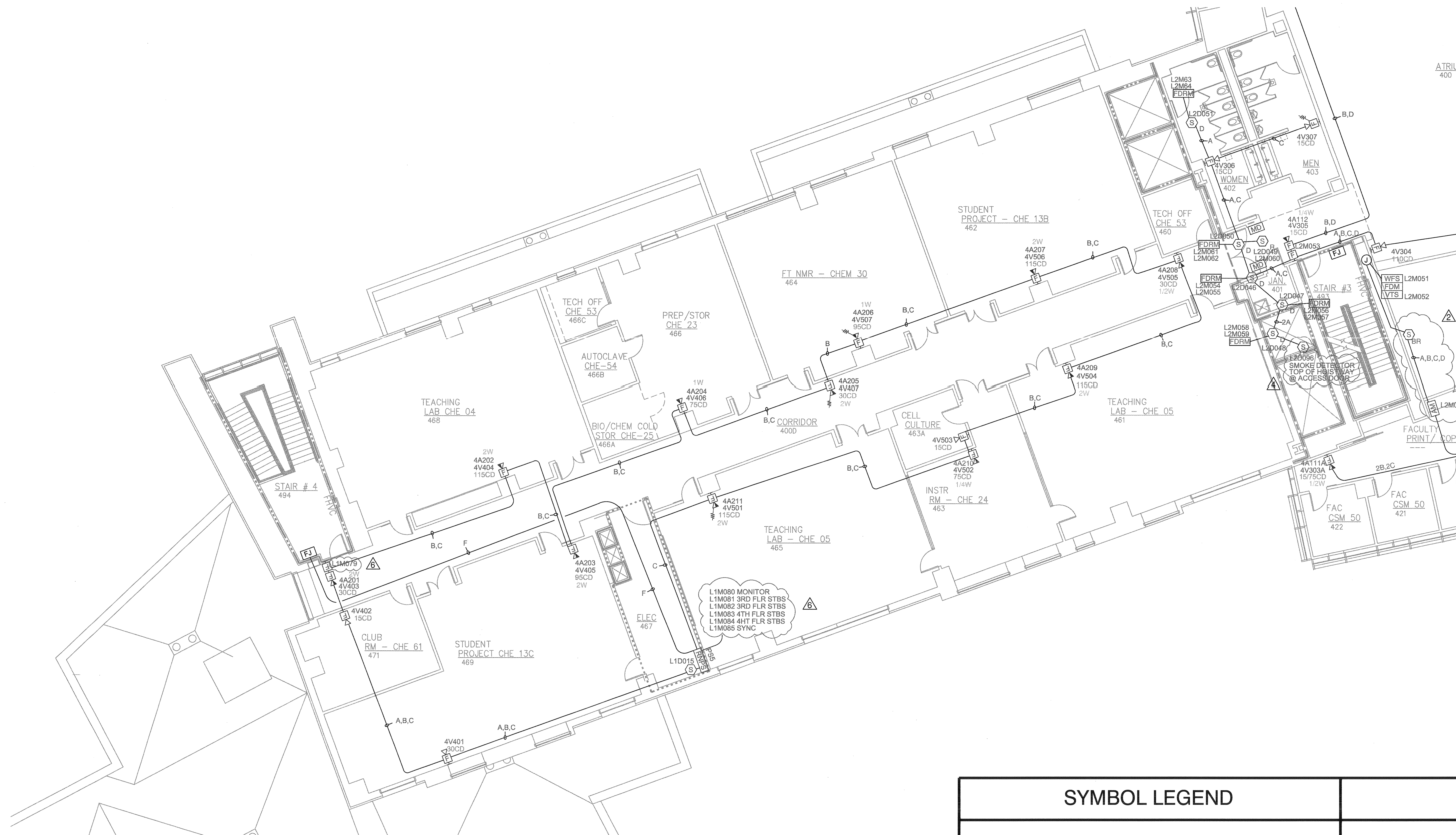

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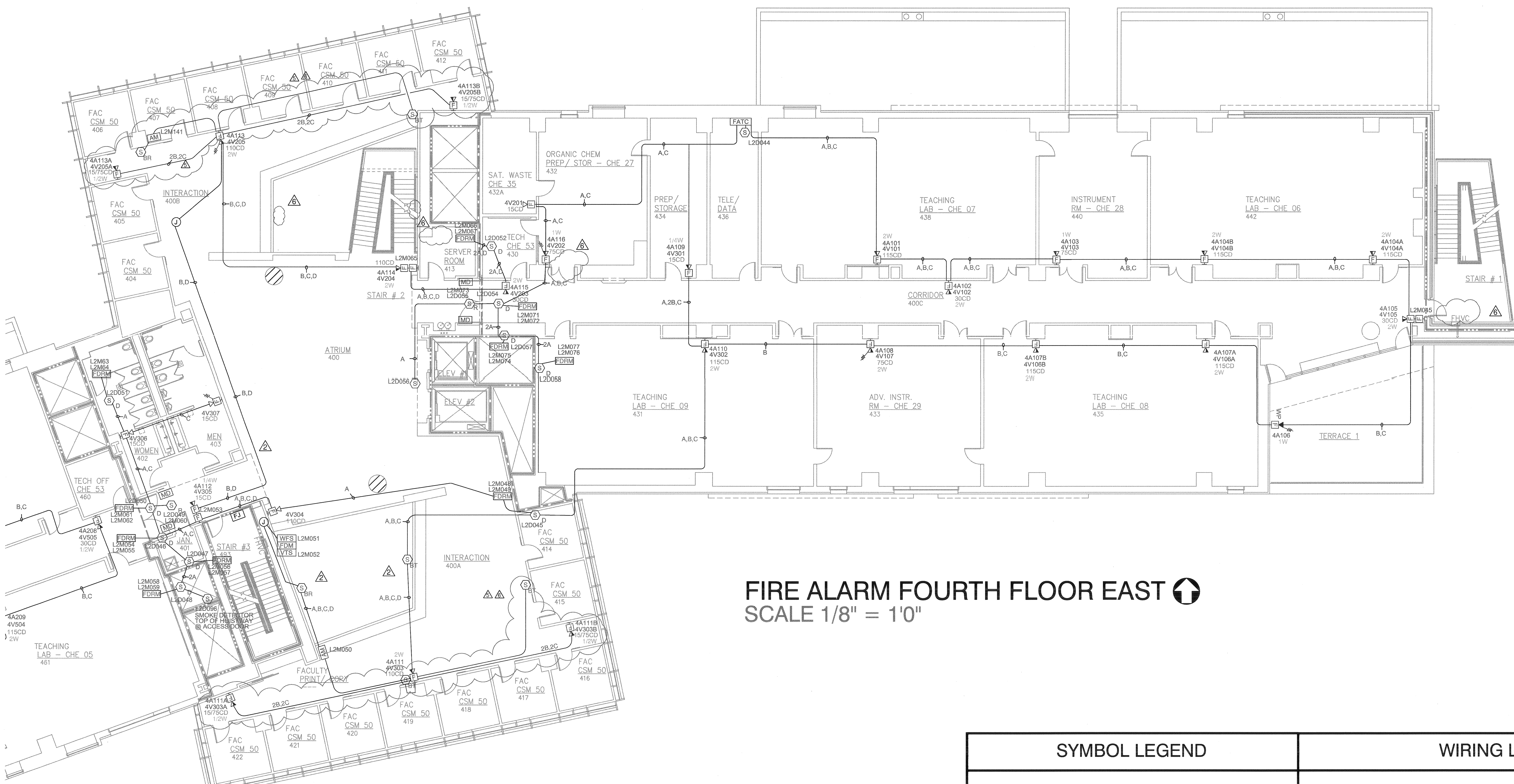

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	165	F	SPEAKER/STROBE	SPWS	7320-1653:201
	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
6	10	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R	SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
4	1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

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2	CRB # 093.1 & FI 99	5/18/2012 4/11/2012	
3	SFM REVIEW COMMENTS	8/20/2012	
4	CRB 93.2	1/15/2013	
5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
6	AS-BUILT DRAWINGS	8/23/2013	

DESIGNED BY: Curtis Streeter
DRAWN BY: Derek Richardson
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
PROJECT ENGINEER: Integral Design Associates INC.

DATE: 08/23/2013
SCALE:
DRAWING CODE: FA ALL DRAWINGS CPCFS

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA
CSFM #18-40-03-0001

SHEET ID
FA 3.04E

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CALIFORNIA 93407
FIRE ALARM & EMERGENCY COMMUNICATION SYSTEM

GENERAL NOTES

1. NOTIFICATION DEVICES CANNOT BE T-TAPPED. ADDRESSABLE (IDC) DEVICES CAN BE T-TAPPED. ALL FIRE ALARM CABLING SHALL BE RUN FROM DEVICE TO DEVICE, WITH NO SPLICES. ANY REQUIRED TERMINATIONS MUST BE MADE IN APPROVED BOX.
2. ALL INTERIOR INITIATING DEVICES, NOTIFICATION DEVICES, AND MODULES REQUIRE 4"SQUARE SPECIAL DEEP BACK BOXES U.O.N.
3. PANEL BACK BOXES AND OTHER LISTED BACK BOXES SHALL BE PROVIDED TO THE EC BY DBI. ALL CONTROL PANELS, POWER SUPPLIES, AND BATTERY BOXES SHALL UTILIZE ONLY FACTORY KNOCKOUTS NEAR THE TOP OF THE CAN TO ALLOW PLACEMENT OF BATTERIES.
4. ALL FIRE ALARM CONDUIT TO BE $\frac{3}{4}$" EMT MINIMUM U.O.N. FIRE ALARM CONDUIT SHALL BE SEPARATE FROM CONDUIT SYSTEM FOR SECURITY ALARM CABLING AND OTHER SYSTEMS.
5. WALL MOUNT AUDIO/VISUAL DEVICES SHALL BE MOUNTED 80" AFF TO BOTTOM OF THE STROBE LENS.
6. MANUAL PULL STATIONS SHALL BE MOUNTED 48" AFF TO CENTERLINE OF BOX. MPS SHALL BE DOUBLE ACTION AND KEYED THE SAME AS THE FACP.
7. DEDICATED 120 VAC CIRCUIT WITH LOCKOUT @ BREAKER TO BE PROVIDED BY OTHERS AT LOCATION OF PANELS AND POWER SUPPLIES.
8. KNOX BOX, PIV, SUPERVISORY SWITCHES, FLOW SWITCHES, SOLENOIDS, AND SPRINKLER BELLS SHALL BE PROVIDED BY OTHERS.
9. SMOKE DETECTORS SHALL NOT BE PLACED WITHIN 3' OF ANY SUPPLY AIR REGISTER OR WHERE THE AIR MOVEMENT EXCEEDS THE MANUFACTURER'S LISTING.
10. FIRE FIGHTER TELEPHONE RISER IS CLASS A, STYLE Z
11. VOLTAGE DROP CALCULATIONS FOR NOTIFICATION DEVICES ARE BASED ON THE LAYOUT SHOWN. DEVIATION FROM THESE PLANS COULD RESULT IN ADDITIONAL CONDUIT WORK, REENGINEERING, UPSIZED CABLE AND/OR ADDITIONAL POWER REQUIREMENTS.
12. PAINT ALL FIRE ALARM JUNCTION BOXES AND COVERS RED IN UNFINISHED AREAS (IE ABOVE CEILINGS, MECHANICAL ROOMS ETC.) IN FINISHED AREAS CONDUIT AND JUNCTION BOXES CAN BE PAINTED TO MATCH THE ROOM FINISH, THE INSIDE COVER IF THE JUNCTION BOX MUST BE IDENTIFIED AS "FIRE ALARM" AND THE CONDUIT MUST HAVE PAINTED RED BANDS $\frac{3}{4}$" WIDE AT 10' CENTERS AND AT EACH SIDE OF A FLOOR, WALL, OR CEILING PENETRATION.
13. UPON COMPLETION OF INSTALLATION OF THE FIRE ALARM SYSTEM A SATISFACTORY TEST OF THE ENTIRE SYSTEM SHALL BE MADE IN THE PRESENCE OF THE AUTHORITY HAVING JURISDICTION (AHJ).
14. ALL NOTIFICATION DEVICES SHALL BE SYNCHRONIZED.
15. A STAMPED SET OF APPROVED FIRE ALARM PLANS SHALL BE AT THE JOBSITE AND USED FOR INSTALLATION.
16. SIGNALING LINE CIRCUIT IS CLASS B, STYLE 4
17. NOTIFICATION APPLIANCE CIRCUIT IS CLASS B, STYLE Y (5)
18. ALL SMOKE DETECTORS SHALL BE INSTALLED AT LEAST 1'-0" FROM FLUORESCENT LIGHT FIXTURES TO AVOID UNWANTED ALARMS AND SHALL BE INSTALLED IN AREAS THAT DO NOT EXCEED THE MANUFACTURE'S OPERATING TEMPERATURE RANGE BETWEEN 32°F AND 120°F.

CODE REGULATIONS

CALIFORNIA CODE REGULATIONS

APPLICABLE CODES

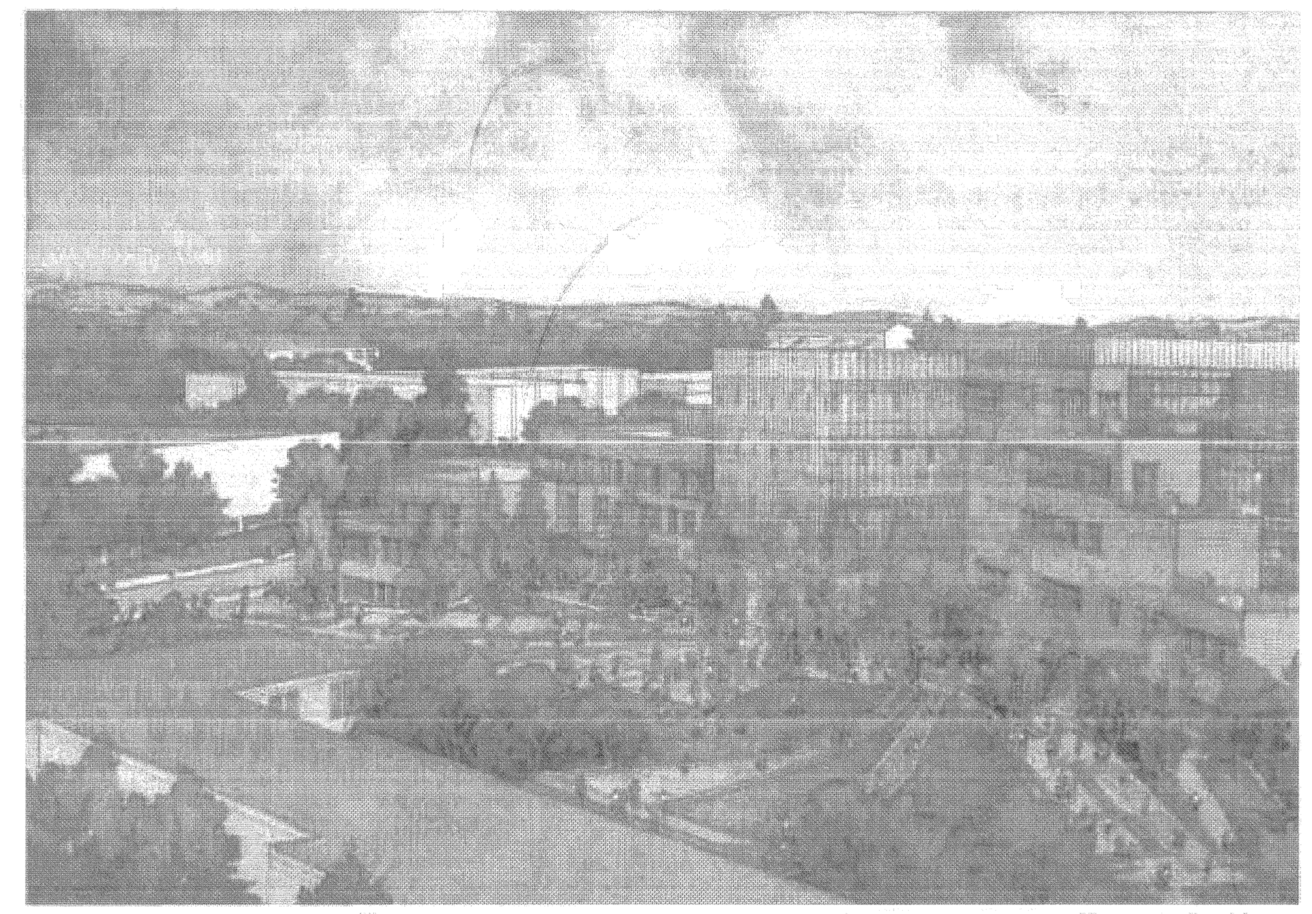
2007	BUILDING STANDARDS ADMINISTRATIVE CODE	TITLE 24 PART 1
2007	CALIFORNIA BUILDING CODE (CBC)	TITLE 24 PART 2
2007	CALIFORNIA ELECTRICAL CODE (CEC)	TITLE 24 PART 3
2007	CALIFORNIA MECHANICAL CODE (CMC)	TITLE 24 PART 4
2007	CALIFORNIA PLUMBING CODE (CPC)	TITLE 24 PART 5
2007	CALIFORNIA ENERGY CODE	TITLE 24 PART 6
2007	CALIFORNIA ELEVATOR SAFETY CONSTRUCTION CODE	TITLE 24 PART 7
2007	CALIFORNIA HISTORICAL BUILDING CODE	TITLE 24 PART 8
2007	CALIFORNIA FIRE CODE (CFC)	TITLE 24 PART 9
2007	CALIFORNIA REFERENCED STANDARDS CODE	TITLE 24 PART 12

APPLICABLE STANDARDS & GUIDELINES

2007	AUTOMATIC SRINKLER SYSTEMS	NFPA 13
2007	STATIONARY PUMPS	NFPA 20
2007	NATIONAL FIRE ALARM CODES (CALIFORNIA AMENDED)	NFPA 72
2007	STANDARD FOR INSTALLATION OF AIR-CONDITIONING	NFPA90A
2007	STANDARD FOR INSTALLATION OF WARN AIR HEATING	NFPA 90B
2006	STANDARD FOR SMOKE-CONTROL SYSTEMS UTILIZING BARRIERS AND PRESSURE DIFFERENCES	NFPA 92A
2005	STANDARD FOR SMOKE MANAGEMENT SYSTEMS IN MALLS, ATRIA, AND LARGE SPACES	NFPA 92B

(4)

SITE PLAN



CENTER FOR SCIENCE

PROJECT DESCRIPTION

1. OCCUPANCY TYPE: A, B, AND H3
2. SYSTEM TYPE: CLASS B, ADDRESSABLE, MANUAL
3. METHOD OF COMMUNICATION: TELEPHONE
4. SCOPE OF WORK: FIRE ALARM & VOICE EVACUATION SYSTEMS

SEQUENCE OF OPERATIONS MATRIX

ACTION columns:
1. SUPERVISORY CONDITION AT FACU
2. TROUBLE CONDITION AT FACU
3. ALARM CONDITION AT FACU
4. ACTIVATE FIRE ALARM AUDIO/VISUAL DEVICES AND VOICE ALARM COMMUNICATION
5. DISPLAY TEXT ON LCD ANNUNCIATOR
6. ACTIVATE SHUNT TRIP RELAY
7. SHUTDOWN AIR HANDLER UNIT
8. ACTIVATE ELEVATOR RECALL
9. SHUTDOWN INDIVIDUAL ASSOCIATED DAMPERS
10. DEACTIVATE MAGNETIC DOOR HOLDERS
11. ACTIVATE SUPERVISORY SIGNAL TO RECEIVING STATION (CAMPUS POLICE)
12. ACTIVATE TROUBLE SIGNAL TO RECEIVING STATION (CAMPUS POLICE)
13. ACTIVATE ALARM DIALER SIGNAL TO RECEIVING STATION (CAMPUS POLICE)
14. BYPASS ALL ALARM OUTPUTS (NOTIFICATION, SHUNTS, RELAY OUTPUTS) FOR TESTING
15. OPEN ATRUIM DOORS WITH MOTORIZED DOOR OPERATORS
16. ACTIVATE ATRIUM PASSIVE SMOKE EVACUATION SYSTEM

EVENT: FIRE ALARM CONTROL UNIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PANEL SUPERVISORY CONDITION (TEST BYBASS) ON ACM-24 AT	X				X						X			X		
PANEL TROUBLE CONDITION (AC POWER FAIL, LOW BATTERY, OPEN CIRCUIT, GROUND FAULT, ETC.)		X			X							X				
PANEL ALARM CONDITION			X	X	X		X			X			X			
MANUAL PULL STATION ACTIVATION			X	X	X					X			X			
SPOT SMOKE DETECTOR ACTIVATION			X	X	X					X			X			
DUCT SMOKE DETECTOR ACTIVATION			X	X	X				X	X			X			
AIR HANDLING UNIT DUCT SMOKE DETECTOR ACTIVATION			X	X	X		X						X			
SPRINKLER TAMPER SWITCH	X				X						X		X			
SPRINKLER WATER FLOW ACTIVATION			X	X	X					X			X			
FIRE PUMP RUNNING			X	X	X					X			X			
FIRE PUMP LOSS OF PH ASE	X				X						X					
FIRE PUMP PHASE REVERSAL	X				X						X		X			
HEAT DETECTOR ACTIVATION (ELEVATOR EQUIPMENT)			X	X	X	X				X			X			
ELEVATOR LOBBY/ EMR SMOKE / ELEVATOR HOISTWAYS			X	X	X			X		X			X			
SHUNT TRIP POWER SUPERVISION	X				X						X					
GENERAL ALARM (ANYWHERE WITHIN THE BUILDING)			X	X	X		X			X			X			
ATRIUM SMOKE CONTORL SYSTEM ALARM			X	X	X					X			X		X	X
BEAM SMOKE DETECTION WITHIN ATRIUM			X	X	X					X			X		X	X
PULL STATION WITHIN ATRIUM			X	X	X					X			X		X	X
SPRINKLER WATER FLOW WITHIN ATRIUM			X	X	X					X			X		X	X

(2) (3) (4)

SYMBOL LEGEND

COUNT	FIRE ALARM SYMBOLS		MODEL #	CSFM LISTING #
31 (6)	F	MANUAL PULL STATION	NBG-12LX	7150-0028:0199
73	F	STROBE ONLY	SW	7320-1653:201
165	F	SPEAKER/STROBE	SPWS	7320-1653:201
6	F	SPEAKER ONLY	SPW	7320-1653:201
7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
0 (5)	H	HEAT DETECTOR	FST-851	7270-0028:196
18 (5)	S	SMOKE DETECTOR	FSP-851	7272-0028:206
64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
23 (5)	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
15 (2)	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
4 (6)	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
32		END OF LINE RESISTOR	N/A	N/A
2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
21 (6)	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
12 (6)	RM	RELAY MODULE	FRM-1	7300-0028:219
16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
10 (6)	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
21 (5)	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
1 (4)	XP6-R	SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

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AS-BUILT SET

COVER SHEET

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3	SFM REVIEW COMMENTS	8/20/2012	
4	CRB 93.2	1/15/2013	
5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
6	AS-BUILT DRAWINGS	8/23/2013	

DATE: 08/23/2013
SCALE:
DRAWING CODE: FA ALL DRAWINGS CPCFS

DESIGNED BY: Curtis Streeter
DRAWN BY: Derek Richardson
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
PROJECT ENGINEER: Integral Design Associates INC.

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

SHEET ID: FA-0

SHEET 1 OF 15

SYMBOL LEGEND

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△2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
△6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
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△4	1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

GENERAL NOTES:

1. The Notification Appliance Circuits vary between 14 AWG and 12 AWG, see voltage drops for correct sizing.

△5 2. All smoke detectors shall be placed at least 1'-0" from fluorescent light fixtures to avoid unwanted alarms and in areas that will not exceed manufacture's specified operating temperature 32°F to 120°F.

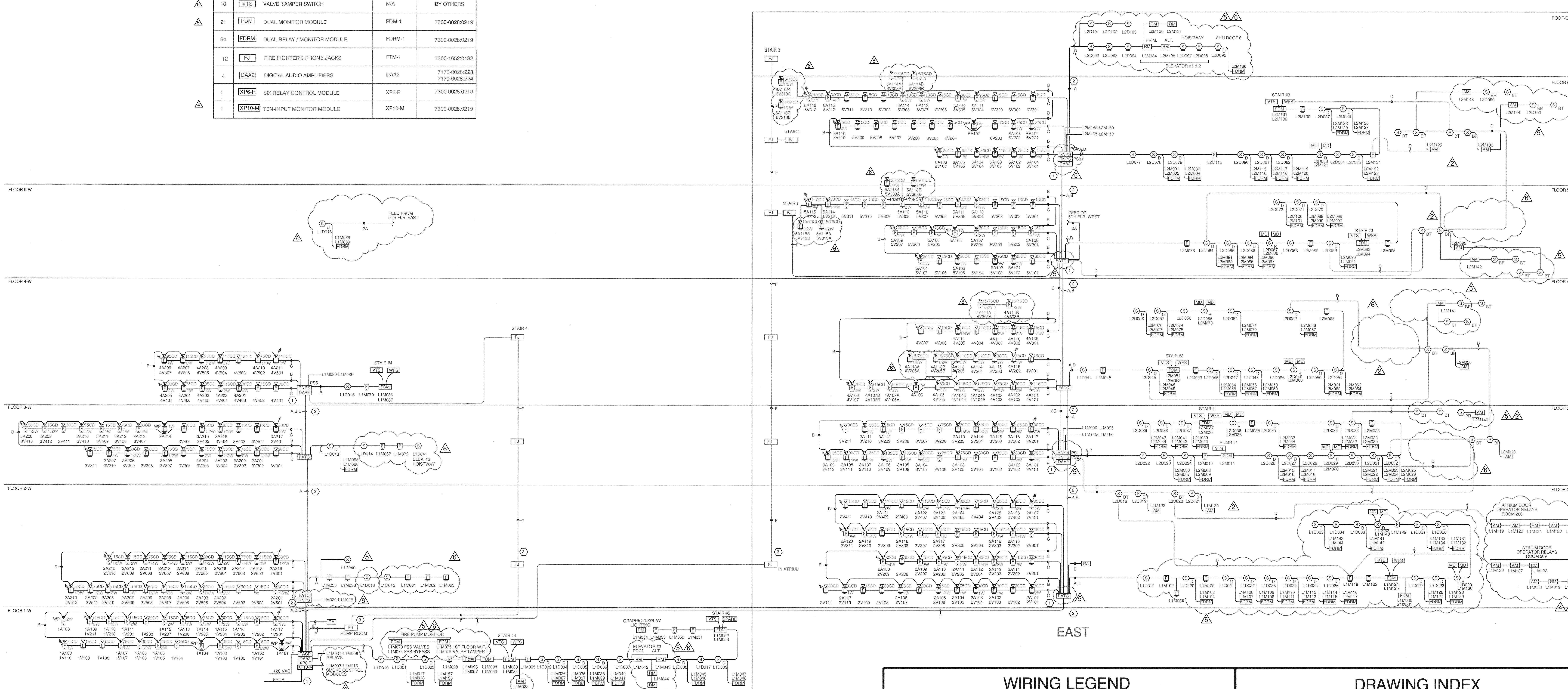
SHEET NOTES:

1. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2. The riser going between floors will be in 2" conduit or larger.

3. 6.10.1.16* All circuits necessary for the operation of two-way telephone communication systems shall be installed using one of the following methods:
   (1) A 2-hour fire rated circuit integrity (CI) cable
   (2) A 2-hour fire rated cable system (electrical circuit protective system)
   (3) A 2-hour fire rated enclosure
   (4) Performance alternatives approved by the authority having jurisdiction
   (5) Buildings fully protected by an automatic sprinkler system installed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, with the wiring or cables installed in metal raceways and in accordance with Article 760 of NFPA 70

   A.6.10.1.16 One or more of the following means might be considered acceptable to provide a level of survivability consistent with the intent of this requirement:
   (1) Routing two-way telephone circuits separately
   (2) Using short-circuit fault tolerant circuits



WEST

FIRE ALARM RISER DIAGRAM
NTS

WIRING LEGEND

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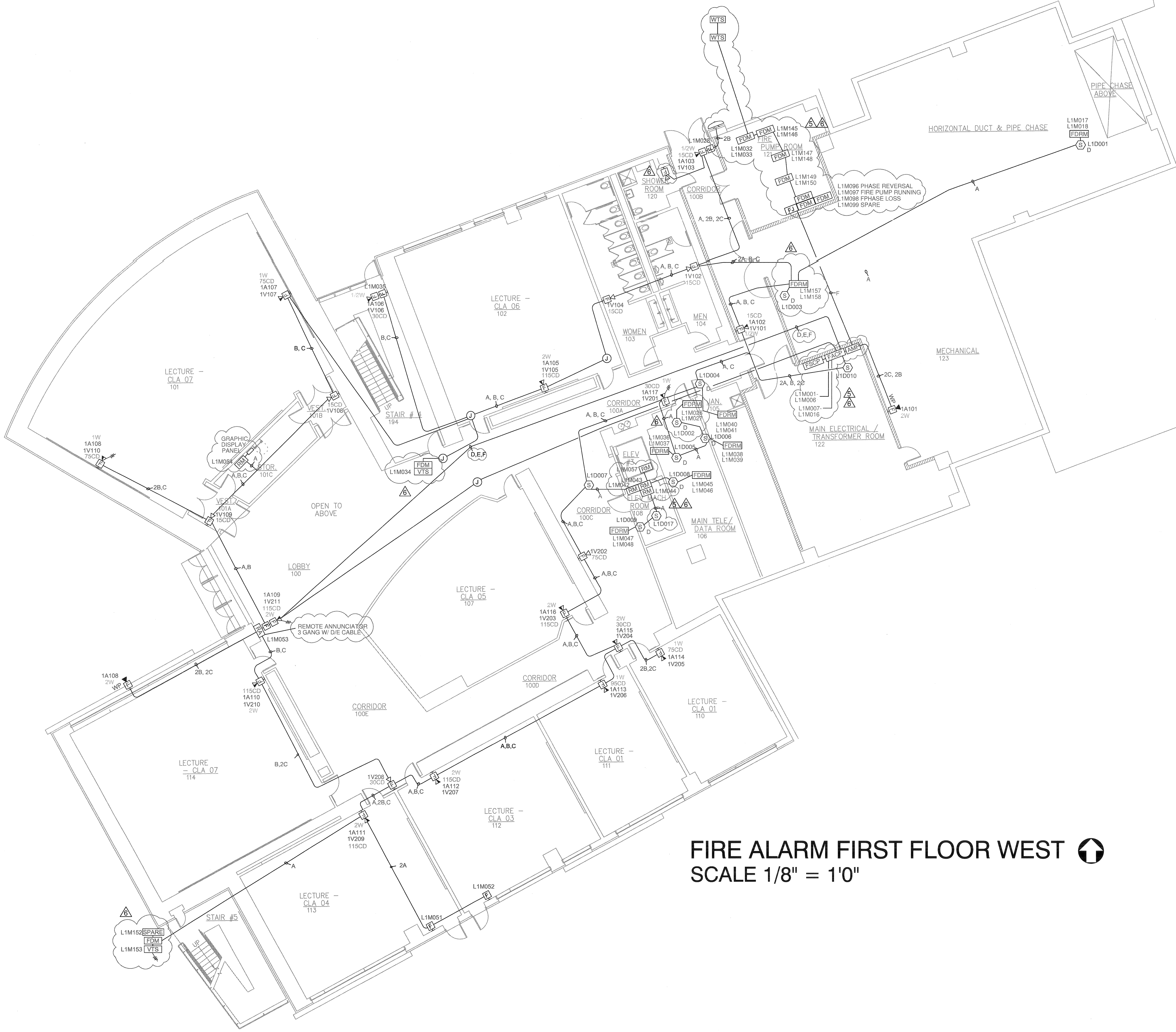

FIRE ALARM FIRST FLOOR WEST
SCALE 1/8" = 1'0"

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4	CRB 93.2	1/15/2013	
5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
6	AS-BUILT DRAWINGS	8/23/2013	

DESIGNED BY: Curtis Streeter
DRAWN BY: Derek Richardson
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
PROJECT ENGINEER: Integral Design Associates INC.

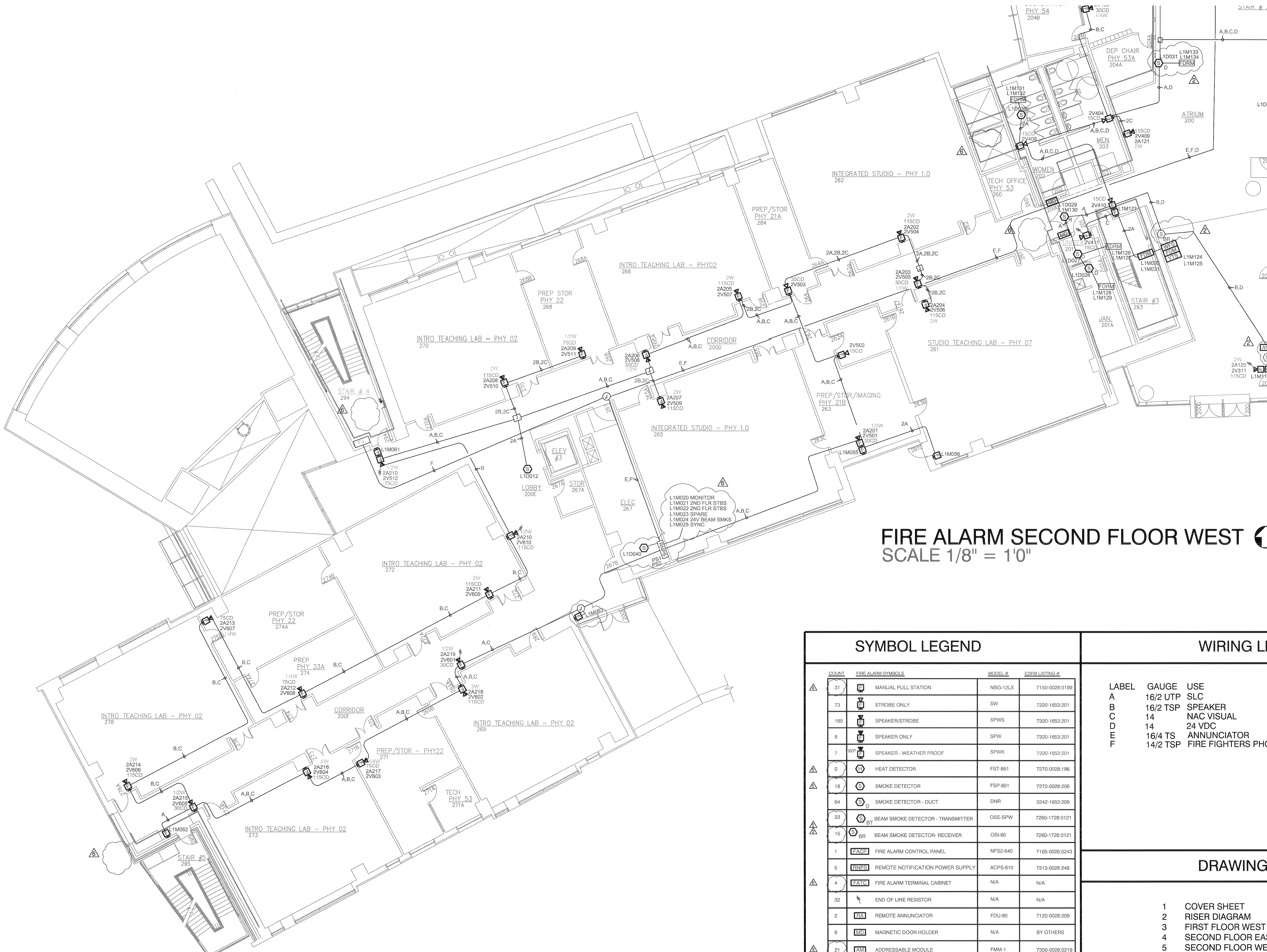
DATE: 08/23/2013
SCALE:
DRAWING CODE: FA ALL DRAWINGS CPCFS

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

SHEET ID

FA 3.01W



FIRE ALARM SECOND FLOOR WEST

SCALE 1/8" = 1'0"

SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS	MODEL #	CSFM LISTING #
6	31	F MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	STROBE ONLY	SW	7320-1653:201
	165	SPEAKER/STROBE	SPWS	7320-1653:201
	6	SPEAKER ONLY	SPW	7320-1653:201
	7	WP SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H HEAT DETECTOR	FST-851	7270-0028:196
5	18	S SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	S BR BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC FIRE ALARM TERMINAL CABINET	N/A	N/A
	32	END OF LINE RESISTOR	N/A	N/A
	2	RA REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM RELAY MODULE	FRM-1	7300-0028:219
	16	WFS WATER FLOW SWITCH	N/A	BY OTHERS
6	10	VTS VALVE TAMPER SWITCH	N/A	BY OTHERS
5	21	FDM DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2 DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
4	1	XP10-M TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

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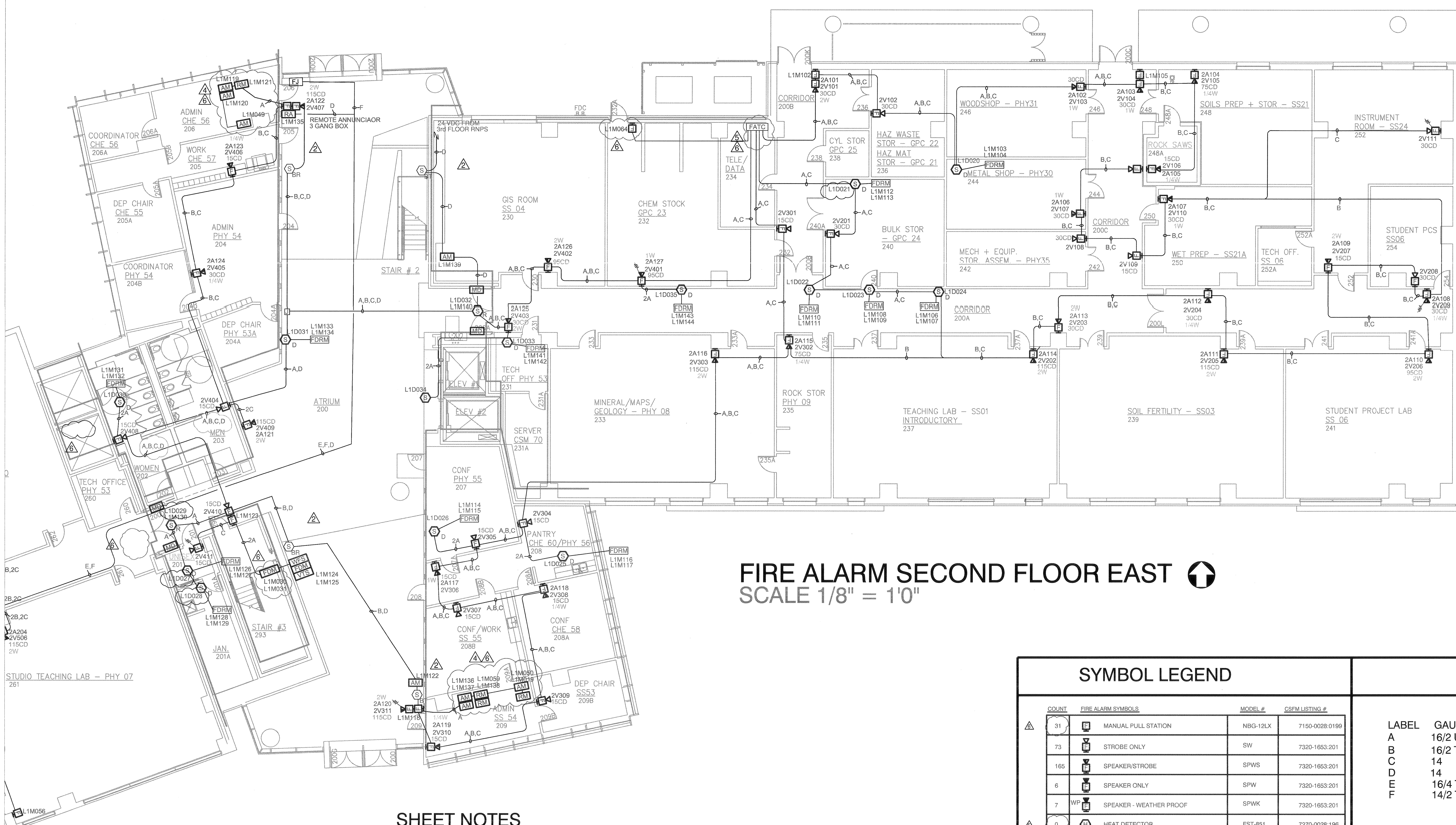

FIRE ALARM SECOND FLOOR EAST

SCALE 1/8" = 1'0"

SHEET NOTES

1. PROVIDE FIRE ALARM BEAM DETECTORS TRANSMITTER AND RECEIVER. INTERLOCK WITH SMOKE EVACUATION SYSTEM SUCH THAT WHEN BEAM DETECTOR IS ACTIVATED, SMOKE EVACUATION SYSTEM IS ACTIVATED. REFER TO DETAIL 4 & 5/FA5.0.
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SYMBOL LEGEND

REV.	COUNT	SYMBOL	FIRE ALARM SYMBOLS	MODEL #	CSFM LISTING #
6	31	F	MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	F	STROBE ONLY	SW	7320-1653:201
	165	F	SPEAKER/STROBE	SPWS	7320-1653:201
	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
6	10	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
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WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
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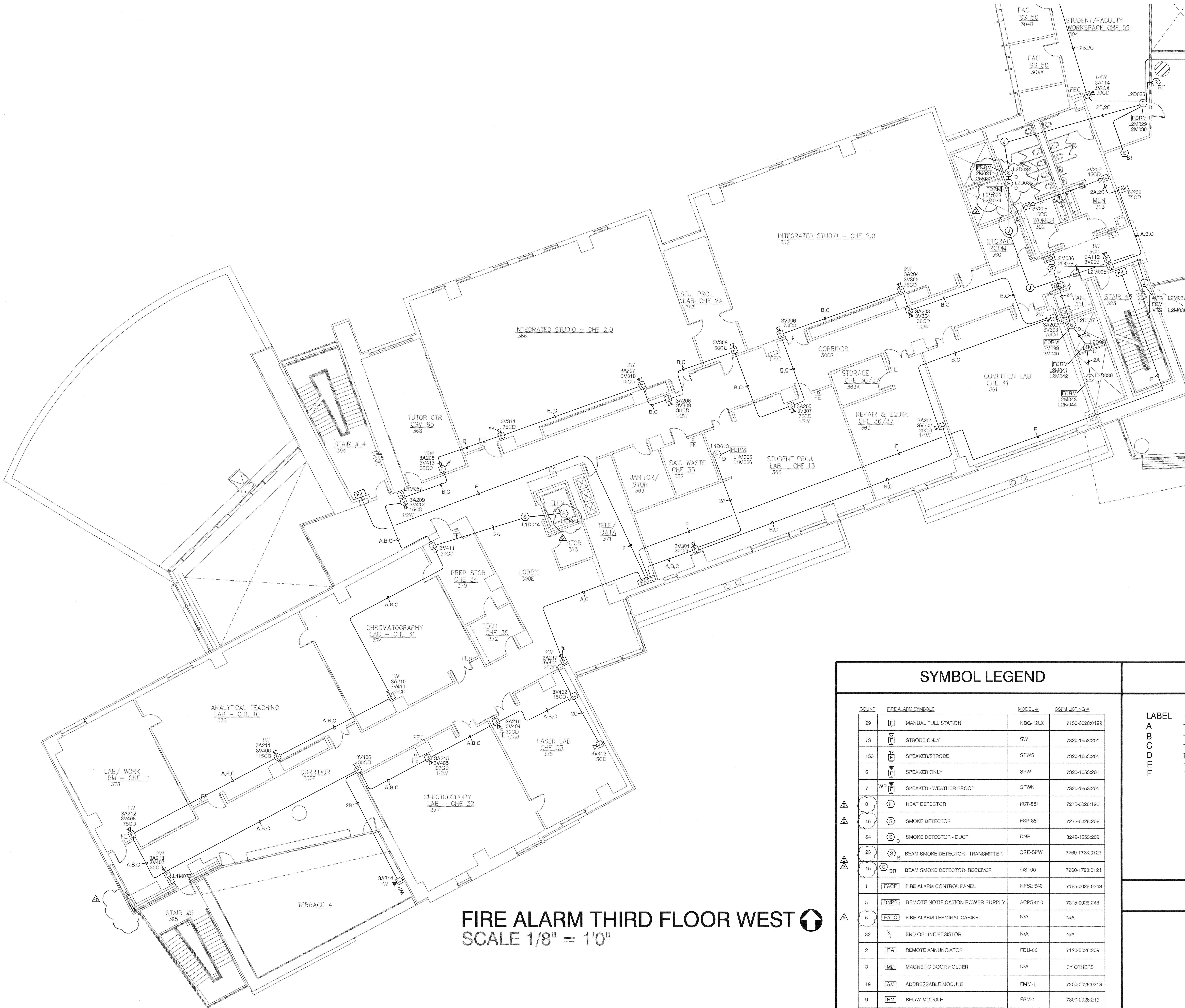

FIRE ALARM THIRD FLOOR WEST

SCALE 1/8" = 1'0"

SYMBOL LEGEND

REV.	COUNT	FIRE ALARM SYMBOLS	MODEL #	CSFM LISTING #
	29	F MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	F STROBE ONLY	SW	7320-1653:201
	153	F SPEAKER/STROBE	SPWS	7320-1653:201
	6	F SPEAKER ONLY	SPW	7320-1653:201
	7	WP F SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H HEAT DETECTOR	FST-851	7270-0028:196
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	64	S D SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
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	1	FACP FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
5	5	FATC FIRE ALARM TERMINAL CABINET	N/A	N/A
	32	END OF LINE RESISTOR	N/A	N/A
	2	RA REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD MAGNETIC DOOR HOLDER	N/A	BY OTHERS
	19	AM ADDRESSABLE MODULE	FMM-1	7300-0028:0219
	9	RM RELAY MODULE	FRM-1	7300-0028:219
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	64	FDRM DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
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	4	DAA2 DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
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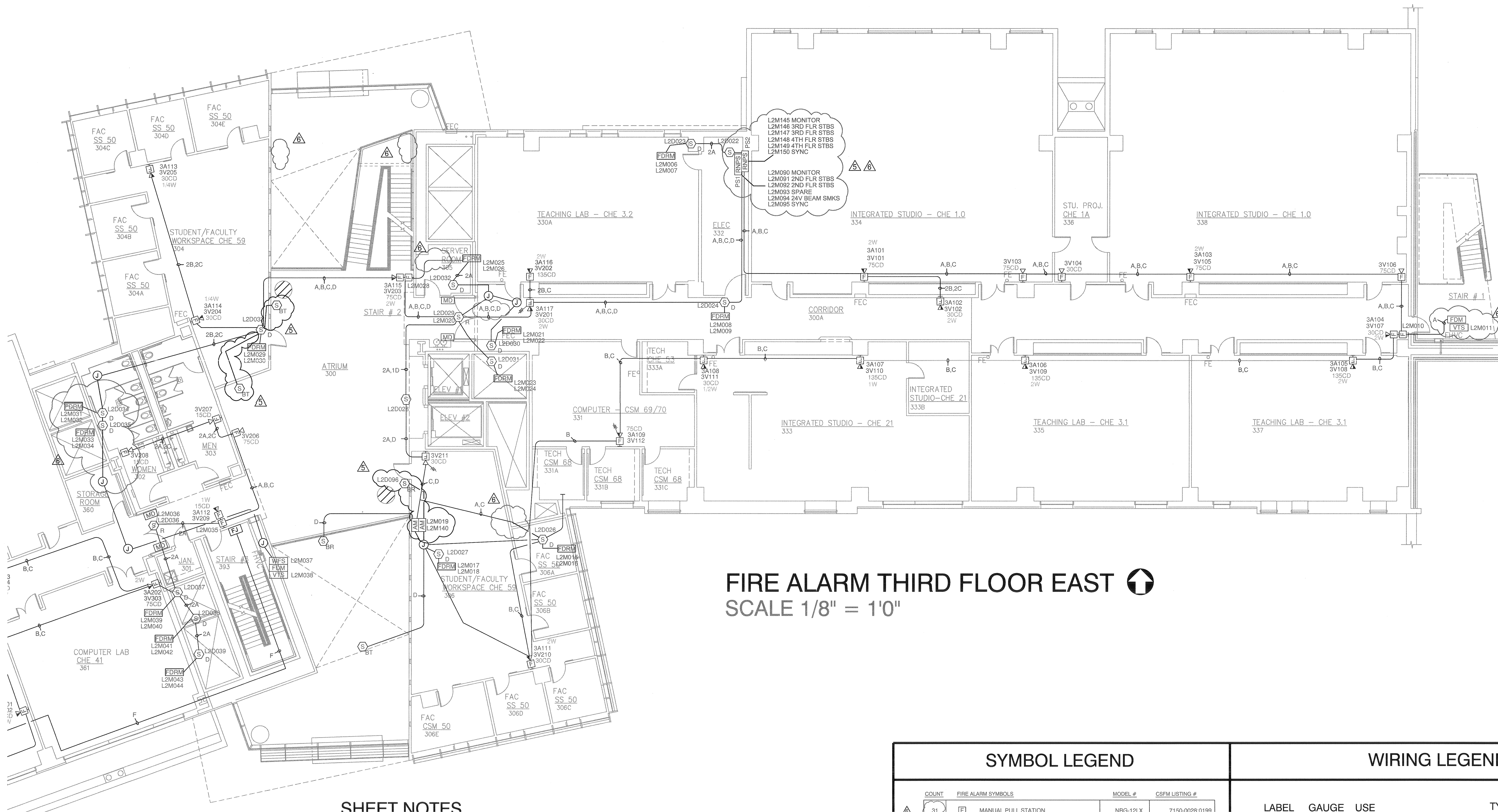

FIRE ALARM THIRD FLOOR EAST

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SHEET NOTES

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	6	SPEAKER ONLY	SPW	7320-1653:201
	7	WP SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
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	1	FACP FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
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6	4	FATC FIRE ALARM TERMINAL CABINET	N/A	N/A
	32	END OF LINE RESISTOR	N/A	N/A
	2	RA REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM ADDRESSABLE MODULE	FMM-1	7300-0028:0219
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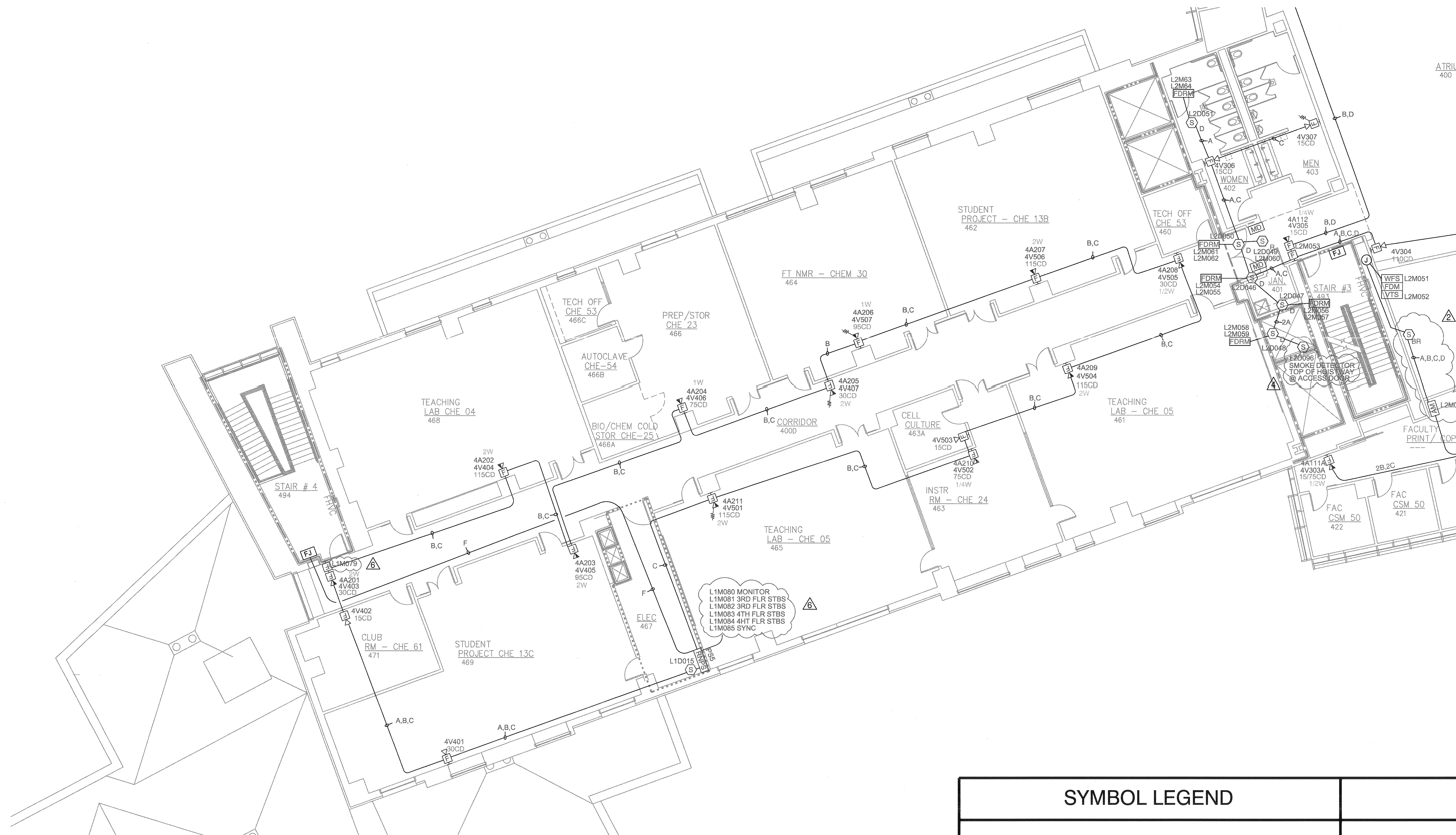

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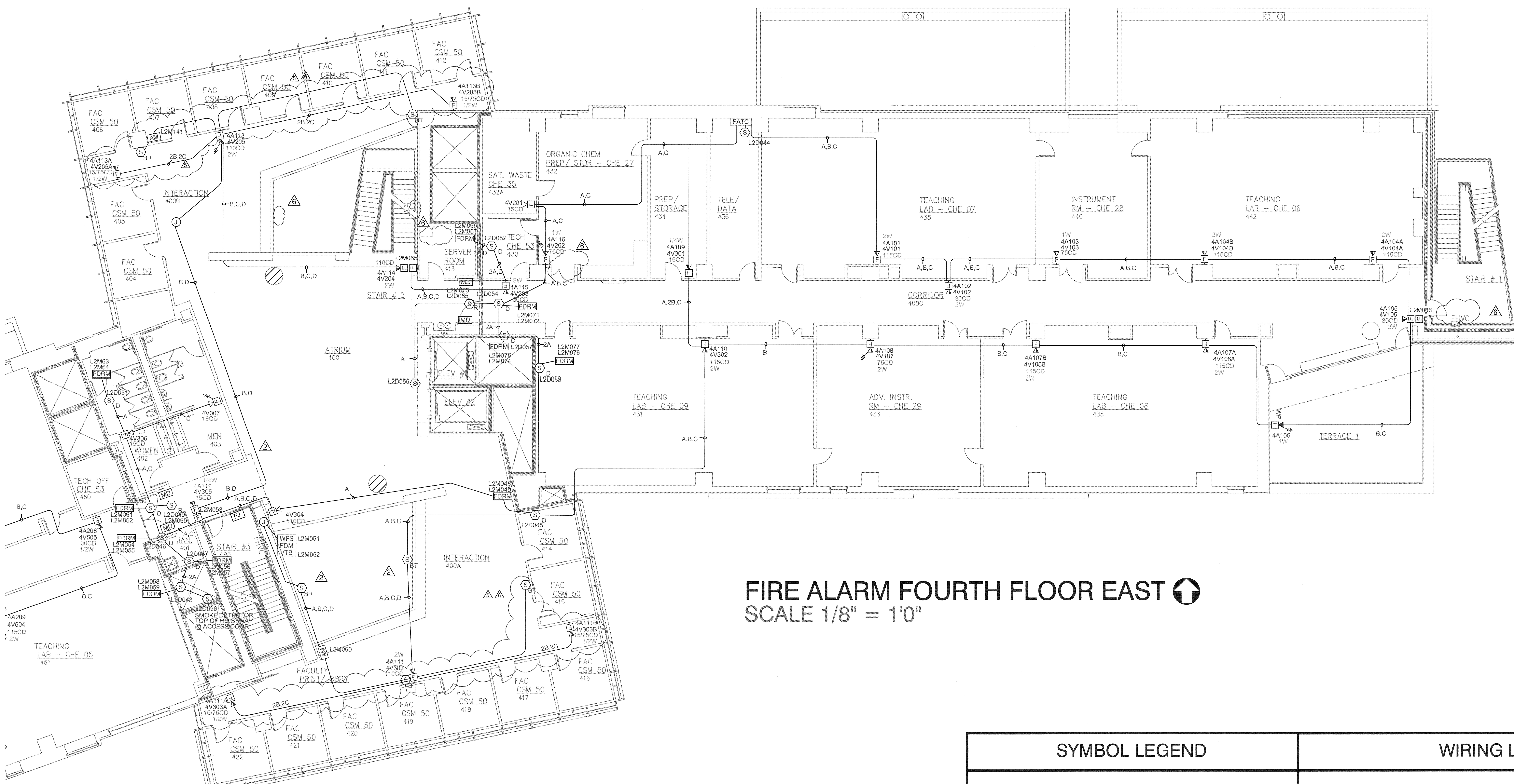

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	165	F	SPEAKER/STROBE	SPWS	7320-1653:201
	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
6	10	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R	SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
4	1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
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DESIGNED BY: Curtis Streeter
DRAWN BY: Derek Richardson
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
PROJECT ENGINEER: Integral Design Associates INC.

DATE: 08/23/2013
SCALE:
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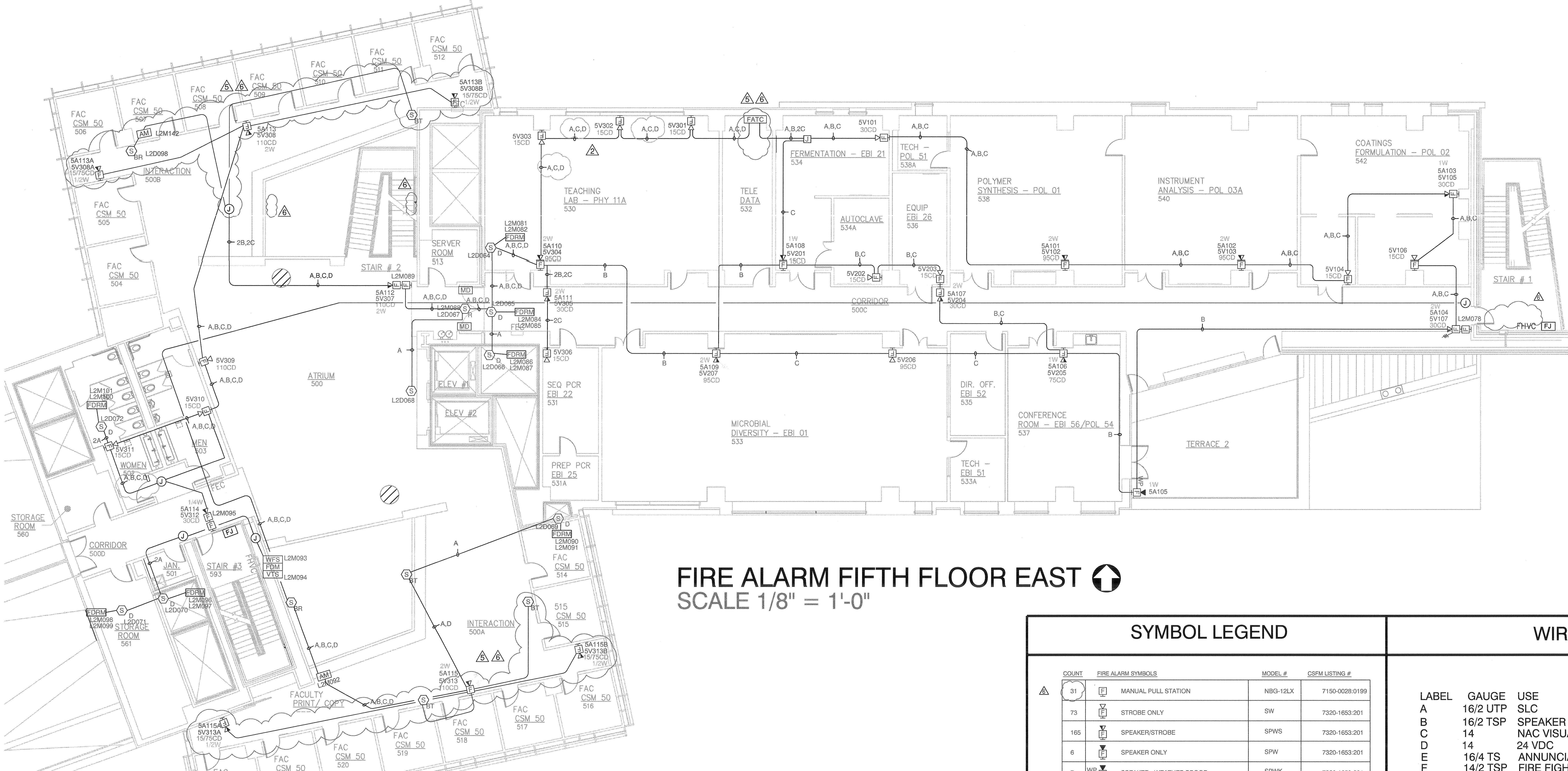

FIRE ALARM FIFTH FLOOR EAST

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SHEET NOTES

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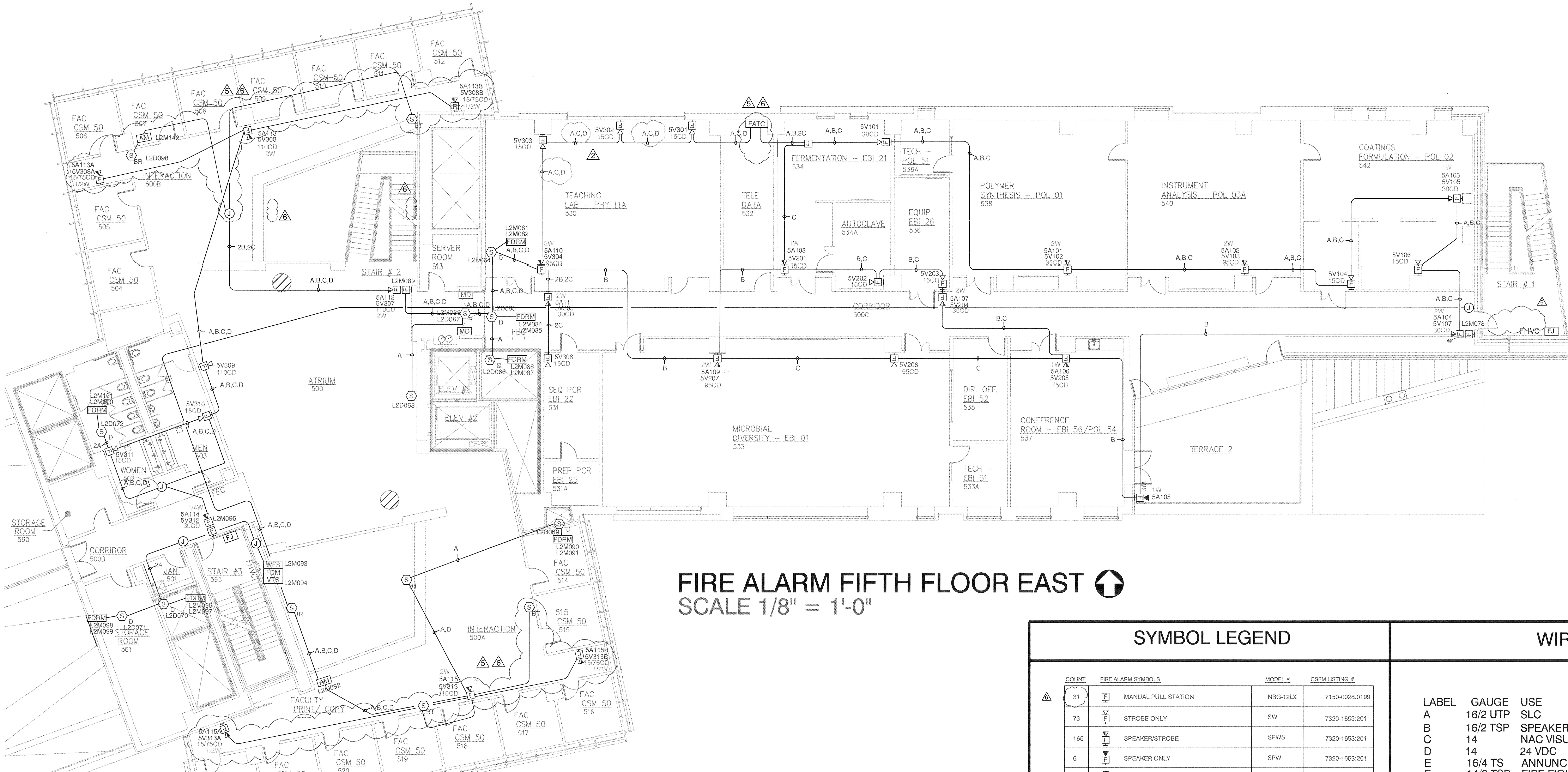

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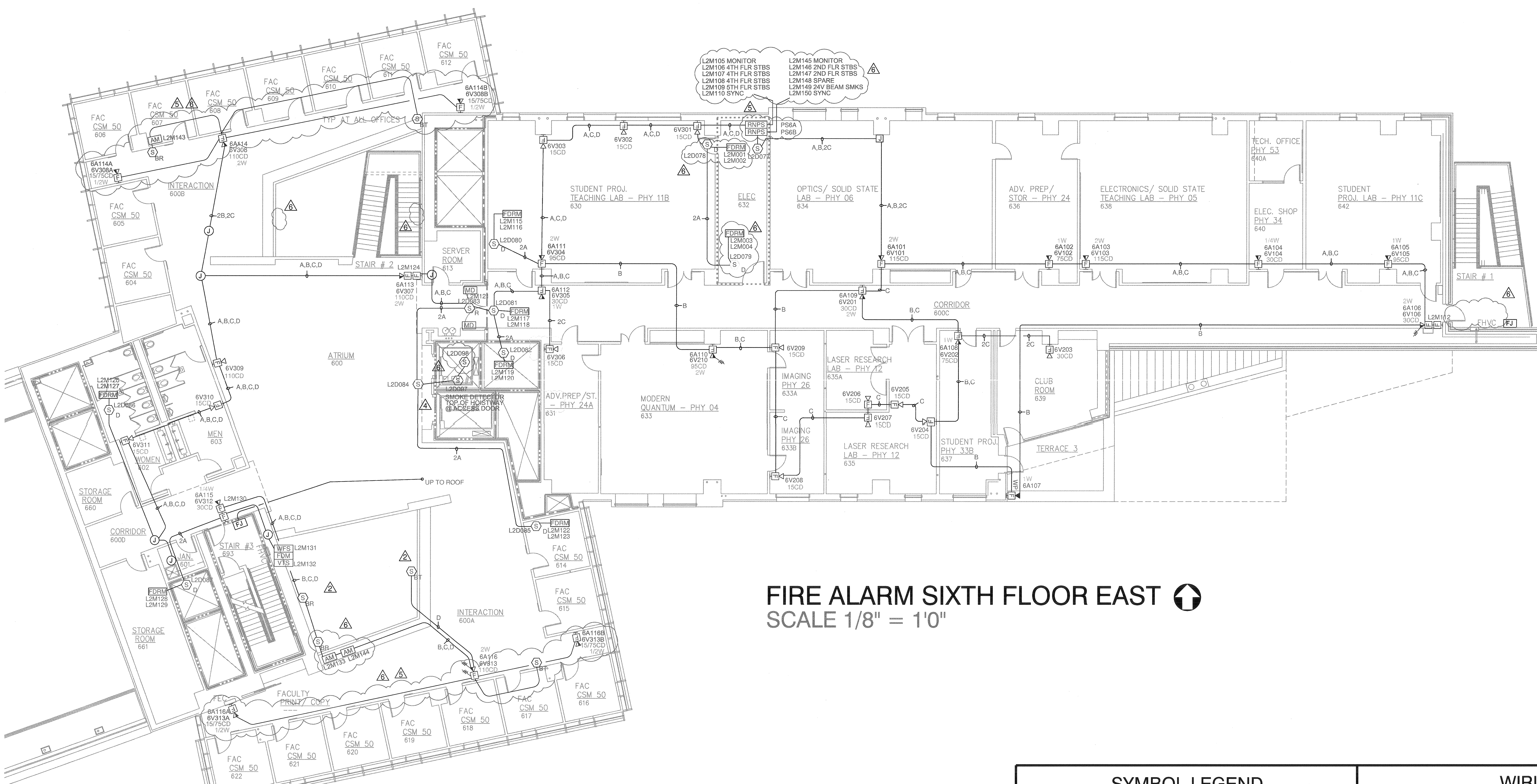

FIRE ALARM SIXTH FLOOR EAST

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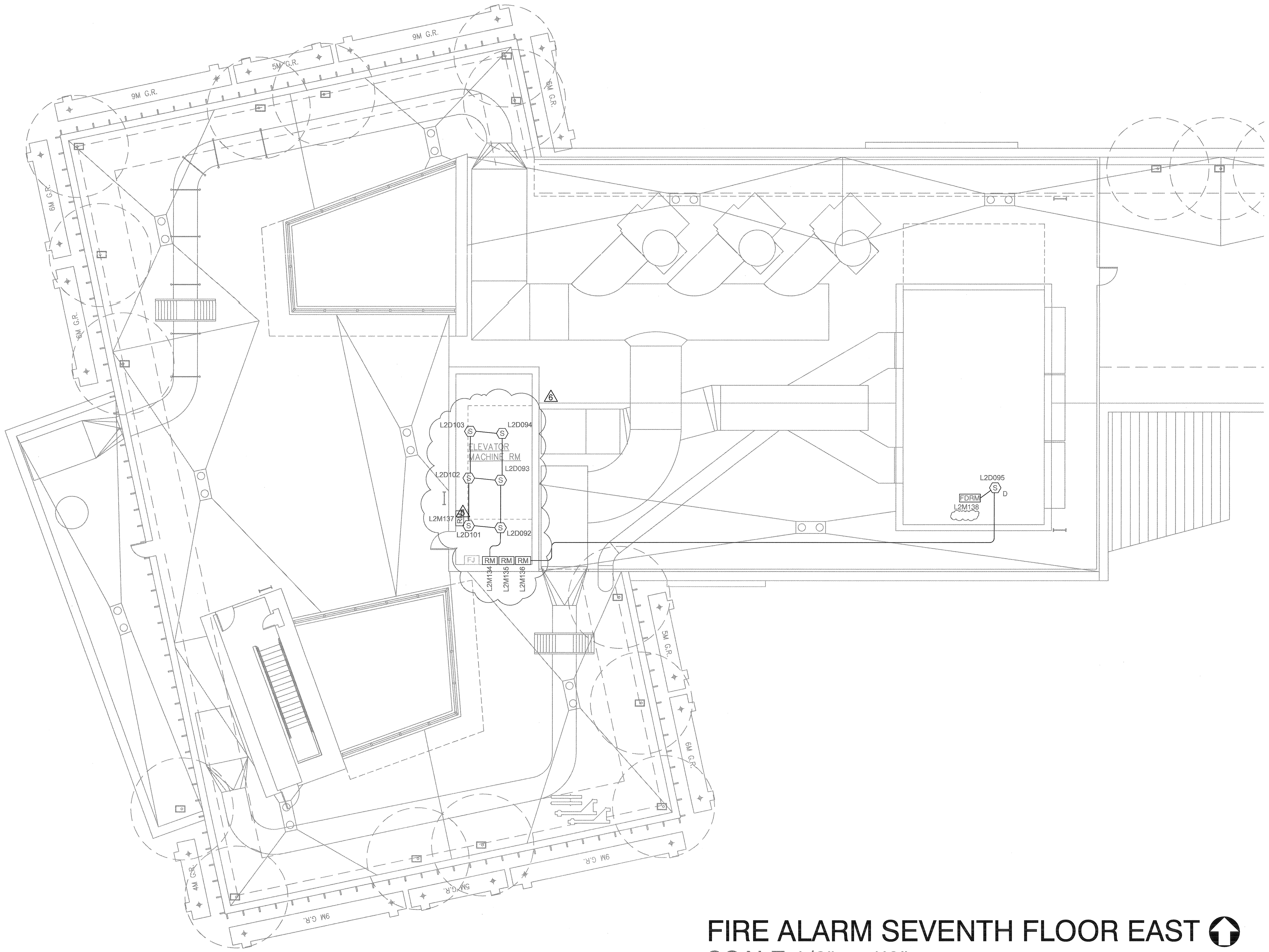

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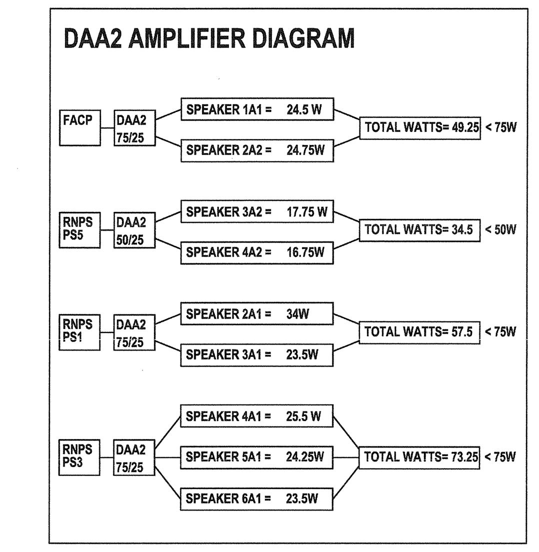
VOLTAGE DROP CALCULATIONS

WEST

EAST



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BATTERY CALCULATIONS

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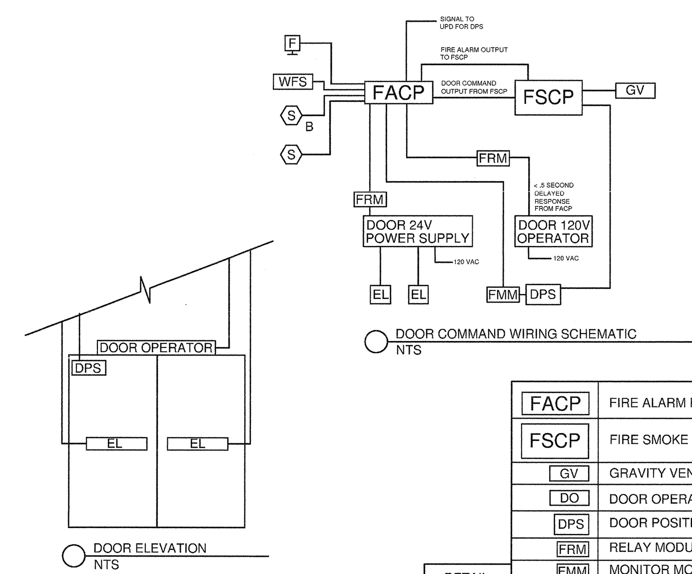
SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

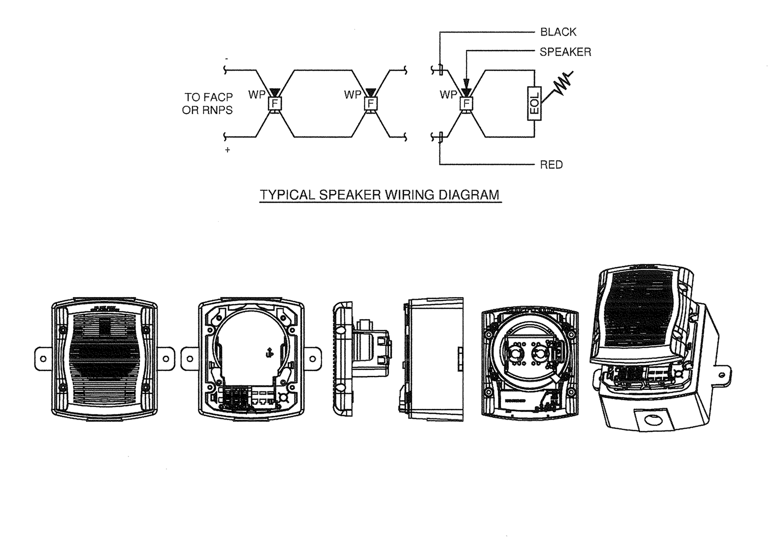
SHEET ID

FA 4.0

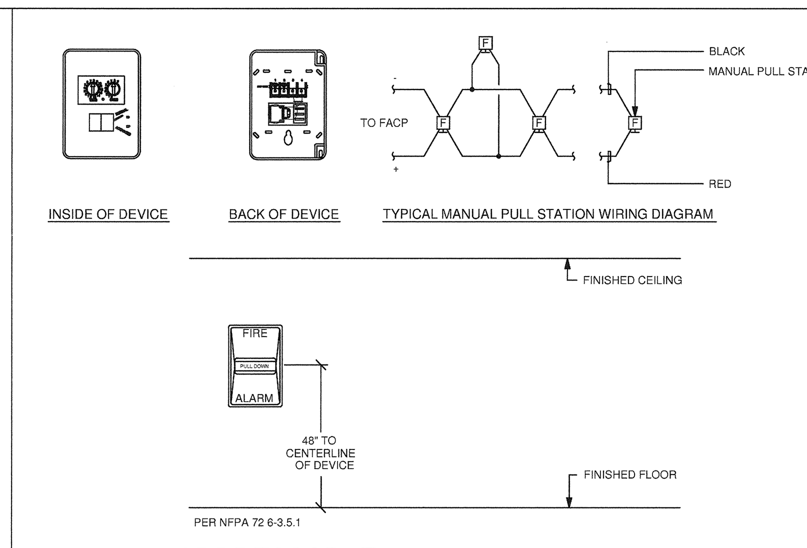


FACP	FIRE ALARM PANEL
FSCP	FIRE SMOKE CONTROL PANEL
GV	GRAVITY VENTILATOR
DO	DOOR OPERATOR
DPS	DOOR POSITION SWITCH
FRM	RELAY MODULE
FMM	MONITOR MODULE
EL	ELECTRIC LOCK

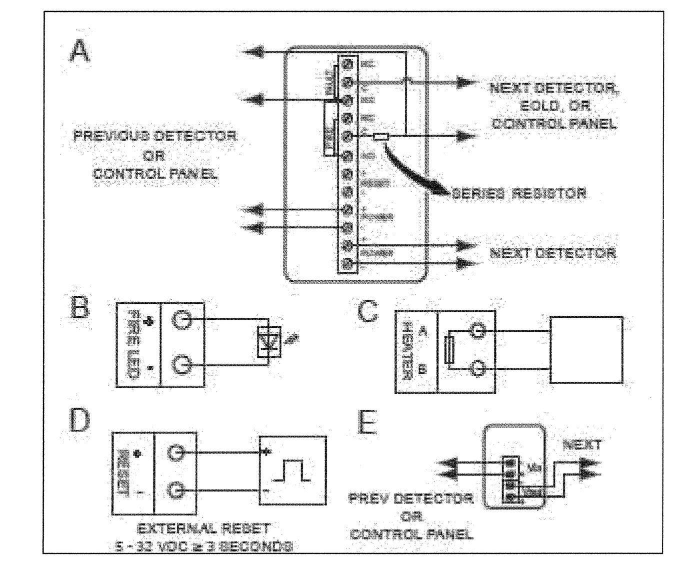
DETAIL 17 / FA-5



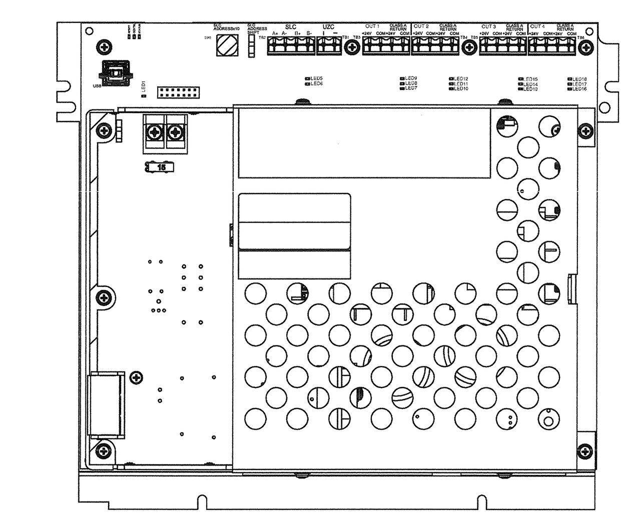
WP F (13) **WALL SPEAKER OUTDOOR**
SCALE 1:2



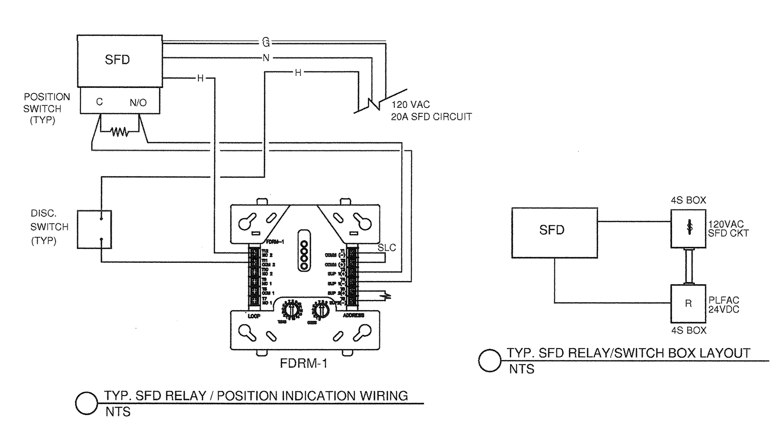
F (9) **ADDRESSABLE MANUAL PULL STATION INSTALLATION**
NOT TO SCALE



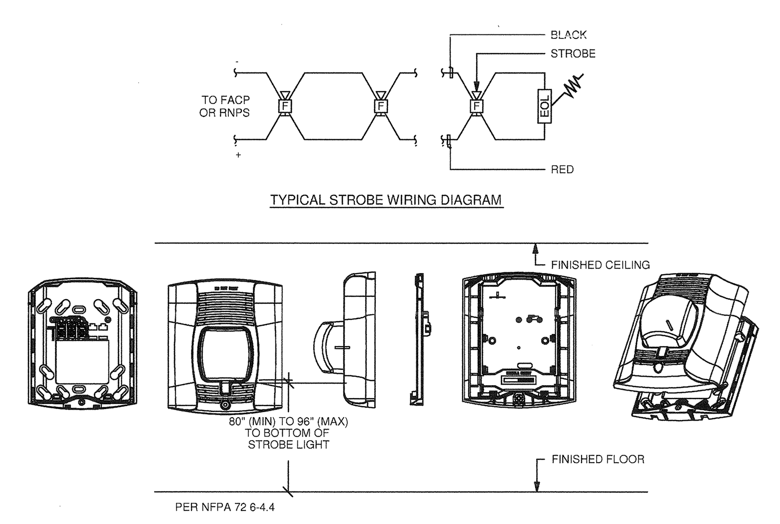
(5) **BEAM SMOKE DETECTOR WIRING**
NOT TO SCALE



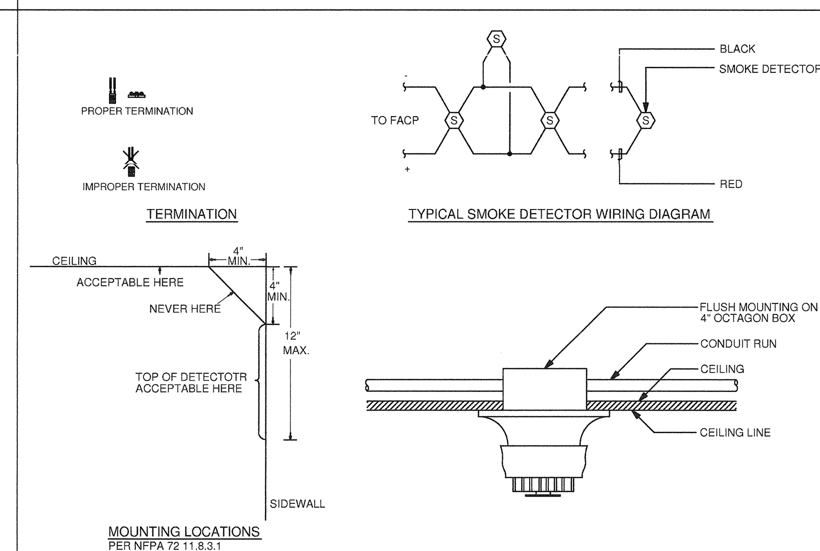
RNPS (0) **ACPS-610 POWER SUPPLY**
NOT TO SCALE



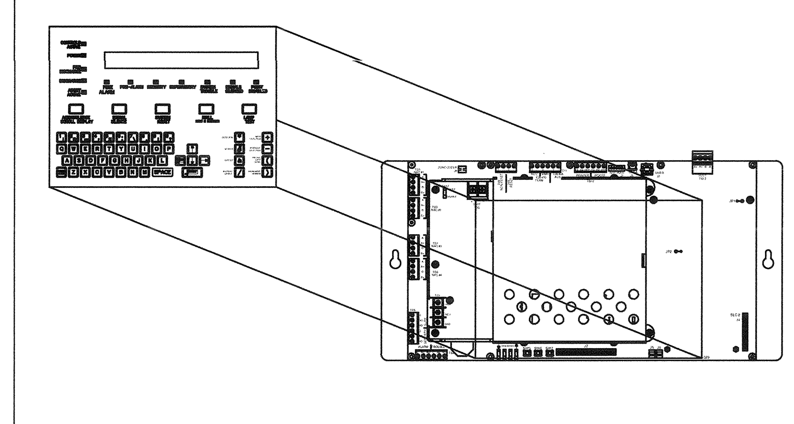
DETAIL 18 / FA-5 — CAL POLY CENTER FOR SCIENCE BLDG 52 — SMOKE FIRE DAMPER RELAY DETAIL



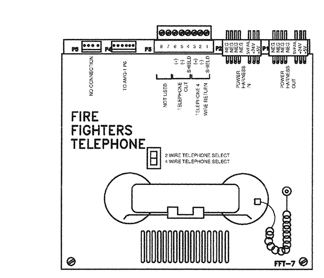
F (14) **WALL STROBE INSTALLATION**
NOT TO SCALE



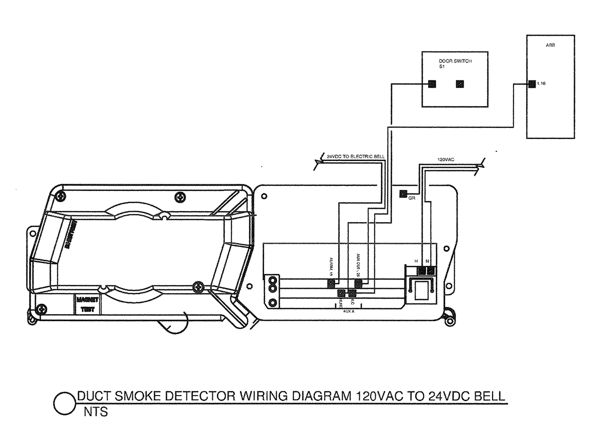
S (10) **ADDRESSABLE SMOKE DETECTOR INSTALLATION**
NOT TO SCALE



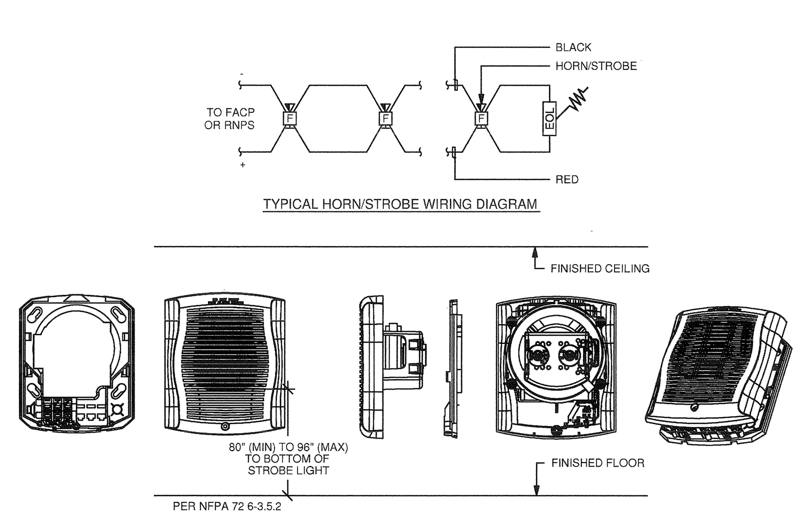
(6) **NFS2-640 PANEL**
NOT TO SCALE



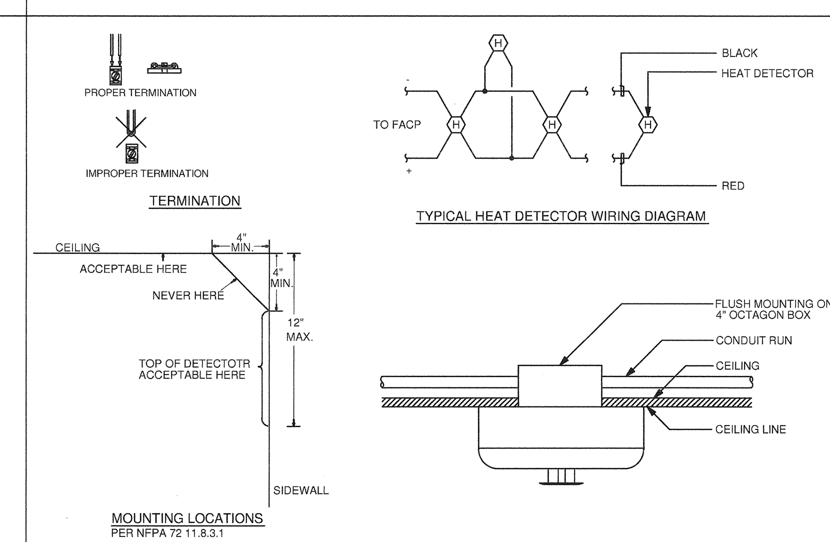
FJ (2) **FFT-7 FIRE FIGHTER TELEPHONE**
NOT TO SCALE



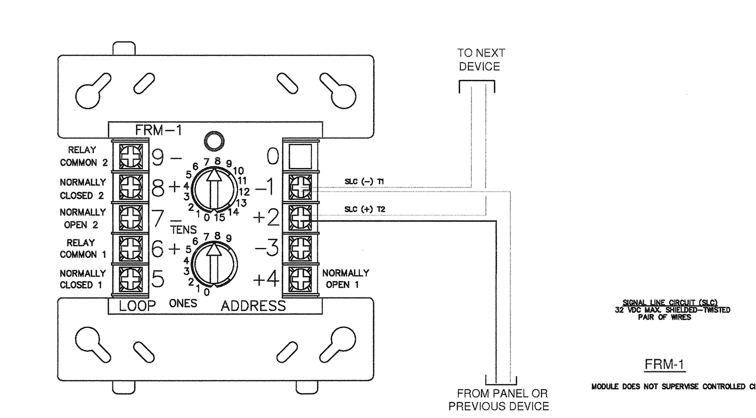
DETAIL 19 / FA-5 — REF. CWA 465 — CAL POLY CENTER FOR SCIENCE BLDG 52 — HVAC UNIT TEMP, DUCT DETECTOR SHUNT



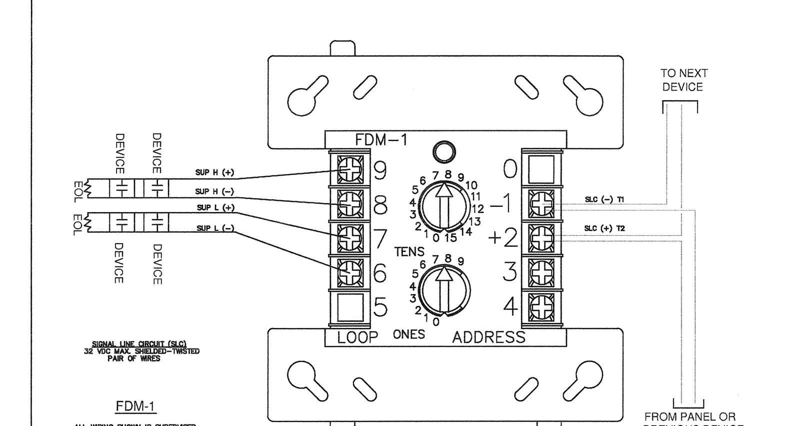
F (15) **WALL SPEAKER STROBE INSTALLATION**
SCALE 1:2



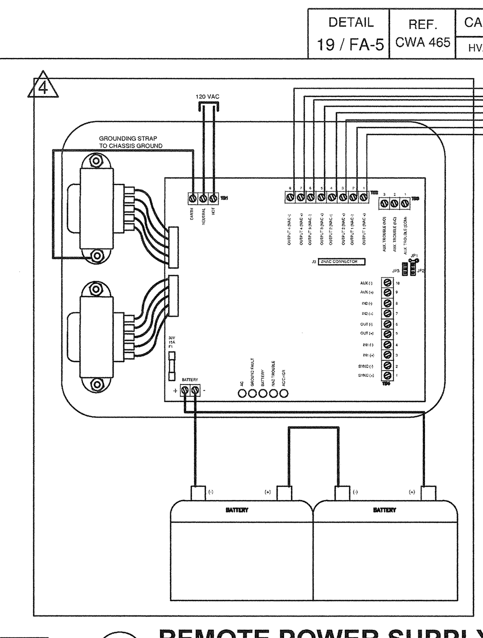
H (11) **ADDRESSABLE HEAT DETECTOR INSTALLATION**
NOT TO SCALE



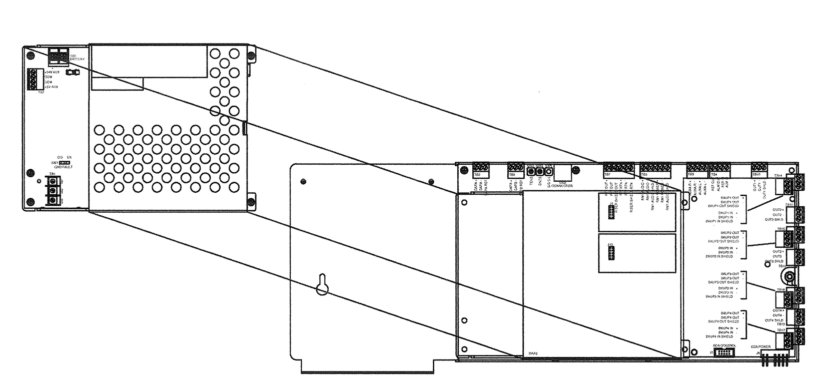
RM (7) **FRM-1 MODULE**
NOT TO SCALE



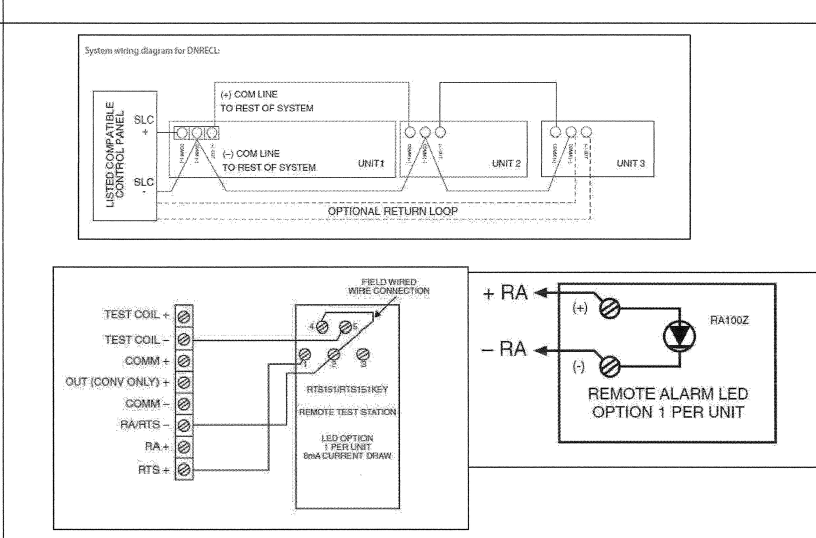
FDM (3) **FDM-1 MODULE**
NOT TO SCALE



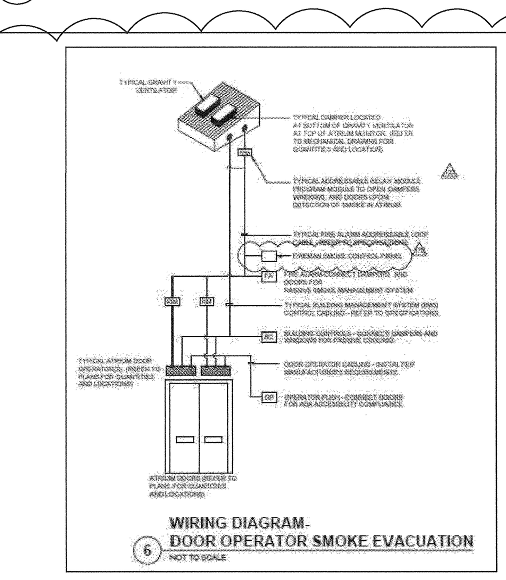
RNPS (20) **REMOTE POWER SUPPLY**
NOT TO SCALE



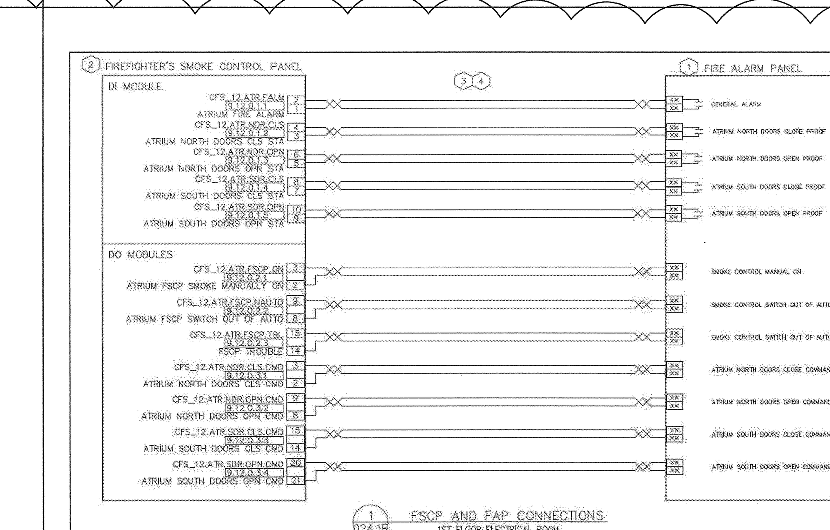
DAA2 (16) **DAA2 SERIES AUDIO AMPLIFIER**
NOT TO SCALE



S D (12) **DUCT DETECTOR WIRING**
NOT TO SCALE



(8) **PASSIVE SMOKE CONTROL SYSTEM DETAILS**
NOT TO SCALE



(4) **PASSIVE SMOKE CONTROL SYSTEM DETAILS**
NOT TO SCALE

DETAILS

Deep Blue Integration
Consulting - Design - Installation
Service - Monitoring
Deep Blue Integration, Inc
3442 Empresa Drive Suite C
San Luis Obispo, CA 93401
C-10, C-16 #943465 ACO#6864
Toll Free: 888◆6000◆DBI FAX: 805◆791◆2037
www.deepblueintegration.com

Revisions

SYMBOL	DESCRIPTION	DATE	APPR.
1	REVIEW COMMENTS	6/14/2011	
2	CRB # 093.1 & FI 99	5/18/2012 4/11/2012	
3	SFM REVIEW COMMENTS	8/20/2012	
4	CRB 93.2	1/15/2013	
5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
6	AS-BUILT DRAWINGS	8/23/2013	

DATE: 08/23/2013
SCALE:
DRAWING CODE: FA ALL DRAWINGS CPCFS

DESIGNED BY: Curtis Streeter
DRAWN BY: Derek Richardson
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
PROJECT ENGINEER: Integral Design Associates INC.

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SHEET ID
FA 5.0
SHEET 15 OF 15

Appendix F

Smoke extraction calculations

$Z = 27.5\ m$

$\dot{Q} = 1500\ kW$

Zukoski

$$T_p = 5 * \left(\frac{\sqrt{T_\infty}\,\dot{Q}}{\sqrt{g}\,c_p\,\rho_\infty}\right)^{2/3} z^{-5/3} + T_\infty = 305.1\ K$$

$$\rho_p = \frac{\rho_\infty T_\infty}{T_p} = 1.196\ \frac{kg}{m^3}$$

$$\dot{m}_p = 0.21\left(\frac{\rho_\infty^2 g}{c_p T_\infty}\right)^{1/3} \dot{Q}^{1/3} z^{5/3} = 220.6 \frac{kg}{s}$$

$$\dot{V}_p = \frac{\dot{m}_p}{\rho_p} = \frac{220.6}{1.196} = 184.4\ \frac{m^3}{s}$$

Heskestad

$$\dot{Q}_c = 0.7 * \dot{Q}$$

$$z_0 = 0.083\dot{Q}^{2/5} - 1.02D = 0.53\ m$$

$$T_p = 9.1 * \left(\frac{\sqrt{T_\infty}\,\dot{Q}_c}{\sqrt{g}\,c_p\,\rho_\infty}\right)^{2/3} (z - z_0)^{-5/3} + T_\infty = 308.5\ K$$

$$\rho_p = \frac{\rho_\infty T_\infty}{T_p} = 1.183\ \frac{kg}{m^3}$$

$$\dot{m}_p = 0.071\ \dot{Q}_c^{1/3} (z - z_0)^{5/3} + 0.00192\ \dot{Q}_c = 177.1 \frac{kg}{s}$$

$$\dot{V}_p = \frac{\dot{m}_p}{\rho_p} = \frac{177.1}{1.183} = 149.7\ \frac{m^3}{s}$$

McCaffrey

$$T_p = 22.3 * \left(\frac{\dot{Q}^{2/5}}{z}\right)^{5/3} + T_\infty = 309.9\ K$$

$$\rho_p = \frac{\rho_\infty T_\infty}{T_p} = 1.178\ \frac{kg}{m^3}$$

$$\dot{m}_p = 0.21\left(\frac{\rho_\infty^2 g}{c_p T_\infty}\right)^{1/3} \dot{Q}^{1/3} z^{5/3} = 220.6 \frac{kg}{s}$$

$$\dot{V}_p = \frac{\dot{m}_p}{\rho_p} = \frac{220.6}{1.178} = 187.3\ \frac{m^3}{s}$$