Solar Energy Research Center
Lawrence Berkeley National Laboratory
1 Cyclotron Way Building 30

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Key words: Life Safety Code, RSET, ASET, Performance Based Design, Fire Dynamics Simulator (FDS)

Abstract

This report covers both a prescriptive and performance-based review of fire and life safety systems for the Solar Energy Research Center at the Lawrence Berkeley National Laboratory. The primary subjects covered are egress, fire alarm systems, and sprinkler systems. A unique feature and focal point for this report is the SERC east exit stair. This stair was originally designed as a glass atrium, but for various reasons cannot be utilized as an atrium. The east exit stair has a special VESDA detection system, is the most remote location for the sprinkler system, and is a primary exit for all three stories of the building. In addition, this exit exits to the exterior on the second floor. Due to the original design as an atrium, the second floor landing of the exit is a large open floor space that tenants could potentially try to utilize as storage or assembly space. The performance-based model consists of the east exit stair and evaluates how promptly the fire systems activate to notify occupants and contain the fire to the exit stair.

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1.0 Introduction

The Solar Energy Research Center (SERC) is located at 1 Cyclotron Way Building 30 at the Lawrence Berkeley National Laboratory (LBNL). This 39,000 square foot building will consist of office space and laboratories used to research the creation of biofuels. The researchers hope to manufacture fuels from carbon dioxide and water using the sun's rays, similar to photosynthesis. Potential fuels resulting from this research include hydrocarbons, ethanol, methanol, and hydrogen. This building is currently under construction and the expected completion is 2015.

1.1 Applicable Codes and Standards:

2010 California Building and Fire Codes

2009 NFPA 101: *Life Safety Code*

2010 NFPA 13: *Standard for the Installation of Sprinkler Systems* NFPA 70: *National Electrical Code*

2010 NFPA 72: *National Fire Alarm Code*

1.2 Design Criteria:

The SERC is classified as a business occupancy. Even though the building is a laboratory, it is not classified as a laboratory because it was built as a business laboratory. The California Building Code (CBC) has a laboratory classification. The intent of the laboratory classification is to increase the maximum allowable quantity of chemicals in a high-rise building by equipping the building with extra safety precautions such as rated walls. SERC is only three stories high and does not need an additional allowance for chemicals, so it was built as a business occupancy. Laboratories are also listed under business occupancy in the CBC table 304. This is the case with all of the laboratory buildings at the Lawrence Berkeley National Laboratory.

LBNL is owned and operated by the Department of Energy. The codes that apply to LBNL properties are both the codes and standards of the National Fire Protection Agency and the California Fire and Building Codes whichever is stricter.

1.3 Fire Resistance Rating Requirements:

The SERC is classified as Type II A construction (from specifications). The code of record for the SERC is the 2010 CBC. Footnote D of Table 601 allows the substitution of the 1-hour rated structural elements if the building is fully sprinklered. This substitution was utilized, and the roof deck of SERC is not rated. A stipulation of this substitution is that no other allowances for sprinklers may be utilized.

The fire resistance ratings according to the 2010 CBC table 601 for the structural elements are in Table 1:

Table 1: required fire resistance ratings for Structural Elements

Structural Element	Rating
Columns and beams	1 hour
Floor and roof assemblies	1 hour
Exterior and interior bearing walls	1 hour
Interior non-bearing walls and partitions	0 hour
Door openings	1 hour
Joints and Penetrations	Same as the wall, floor, or roof assembly where located

1.4 Building Description:

The SERC is a three-story building with the first story partially underground. The structure has three main exits including a first floor exit with an exterior staircase, a west stair and exit serving the second and third floors, and an east exit stair that serves all three floors. Figure 1 shows the south facing side of the exterior of the building. The only side of the first floor that is exposed to the exterior is the west side (left in the image). In addition to the first floor being underground, the first floor is considerably larger than the second and third floor. The first floor extends beyond the second and third floors in both the north and south directions. The floor plans for the SERC are located in Appendix A.

Figure 1: Exterior view of the south facing side of the SERC

1.4.1 Unique Feature, the East Exit Stair:

The SERC was originally designed to have a three-story glass atrium with a smoke control system on the east side of the building. Construction for the project started when the project was only partially funded. Due to budget issues, the smoke control system was value engineered out of the project. In addition, an external party reviewing the building for a fire protection assessment discovered that an atrium is not allowable by code because the designers of the building did not include a rated roof deck. This substitution is given in Table 601 Footnote D in the CBC where the code describes that the 1-hour rating of the structural elements may be substituted by a fully sprinklered building. When this substitution is taken, no other allowances can be utilized. Therefore, the glass atrium was never code compliant even with the smoke control system. Figures 2 and 3 are of this space that will be referred to from now on as the east exit stair.

Space at LBNL is expensive and valuable in the sense that there never seems to be enough of it. Due to the original design of the east exit as an atrium, the second floor of the space has a large open area. Also during construction of the SERC, LBNL had a change in the Authority Having Jurisdiction (Fire Marshal). Many proposals for use of the open space were debated including ideas such as concrete furniture. Ultimately, the authority having jurisdiction (AHJ) made the decision that the east exit stair may only be used as an exit stair. The only two objects in the space are a directory and a light box dedicated to the donors of the building.

Figure 2: East exit stair from the second floor large landing area (the main exit is behind the photographer)

Figure 3: large open landing on the second floor.

2.0 Life Safety Review

This section outlines the fire codes necessary for egress safety. First, I have evaluated the space to find the maximum occupancy for each room, each floor, and the building. Using the occupancy information, I have compiled the codes from the Life Safety Code handbook and

the California Building Code that pertain to the SERC building. Following each set of italicized codes is a brief explanation of the code and how it applies to the building.

2.1 Occupancies

This space is a three-story, mixed-use occupancy primarily consisting of office and laboratory space. The laboratory space is classified as business use because it is in a business occupancy (laboratory use is exclusively for laboratory occupancies). Table 2 identifies the area of each room, the occupancy classification for each room, and the occupant load for each room. In the floor plans located in Appendix A, the rooms are color coded according to occupancy classification.

Table 2: Occupancy by room for SERC as determined by CBC table 304.

Room #	Area (in sq. ft.)	Occupancy Classification	Sq. Ft. Per Person	Occupant Load
First Floor				134
105	1147	Business	100	12
106	480	Business	100	5
107	1079	Business	100	11
108	568	Business	100	6
109	1407	Business	100	15
112	194	Business	100	2
113	609	Business	100	7
114	176	Business	100	2
115	347	Business	100	4
117	100	Electrical	300	1
118A	24	Storage	500	1
118B	266	Storage	500	1
119	340	Business	100	4
120	318	Business	100	4
121	86	Business	100	1
122	411	Business	100	5
122A	98	Business	100	1
123	2143	Business	100	22
124	197	Business	100	2
125	78	Business	100	1
126	214	Business	100	3
127	213	Business	100	3
128	78	Business	100	1
129	203	Business	100	3
140	532	*Storage	500	2
141	80	*Storage	500	1

Table 2 (continued): Occupancy by room for SERC as determined by CBC table 304.

142	762	*Plumbing	300	3
143	1296	*Electrical	300	5
144	967	*Chilling	300	4
145	490	*Generator	300	2
Second Floor				123
202		Restroom		
203		Restroom		
205	566	Assembly	15	38
206	527	Assembly	15	36
207	60	Business	100	1
208	44	Business	100	1
209A	1791	Business	100	18
209B	1459	Business	100	15
212	167	Business	100	2
213	139	Business	100	2
214	133	Business	100	2
215	133	Business	100	2
216	134	Business	100	2
217	134	Business	100	2
218	189	Business	100	2
Third Floor				58
302		Restroom		
303		Restroom		
305	646	Business	100	7
306	1058	Business	100	11
307	1394	Business	100	14
308	260	Business	100	3
309	1026	Business	100	11
311	404	Business	100	5
312	404	Business	100	5
314	116	Elevator Control Room	300	1
317	105	Electrical	300	1

2.2 Exits

2.2.1 Number of Exits

Exits per room

LSC 7.4.1.2 The number of means of egress from any story or portion thereof shall be as follows:

(Typically) Occupant load < 50 requires 1 exit

(Typically) Occupant load between 50 and 500- not less than 2

(1) Occupant load more than 500 but not more than 1000—not less than 3

(2) Occupant load more than 1000 — not less than 4

All occupant loads for the rooms in this building are less than 50 people; therefore, each room needs one exit. In the areas where offices exit into larger rooms, the occupancy loads for these rooms combined are also less than 50 and requires one exit.

Exits per floor

LSC 7.4.1.1 The number of means of egress from any balcony, mezzanine, story, or portion thereof shall be not less than two for buildings with capacity under 500 persons.

Therefore two exits are needed for the first, second, and third floor. The first floor is located partially below grade. There are two exits. One discharges to an outside staircase that ascends to the second floor level on the Southwest corner of the building and the other is the east exit stair (100A), which leads to the second floor exterior exit on the Northeast corner of the building.

The second floor discharges at grade level and the two exits are located at the east and west exit stairs (200C). The third floor utilizes these stairs and exits also.

LSC 7.4.2.2 Over 600 Volts, Nominal. The minimum number of means of egress for working space about electrical equipment, other than existing electrical equipment, shall be in accordance with NFPA 70, National Electrical Code, Article 110.33(A).

NFPA 70, 110.26 For equipment rated 1200 amperes or more and over 1.8 m (6 ft) wide that contains overcurrent devices, switching devices, or control devices, there shall be one entrance to and egress from the required working space not less than 610 mm (24 in.) wide and 2.0 m (6 1/2 ft) high at each end of the working space.

The large electrical room on the first floor has a 12 kV disconnect. The room is equipped with an exit door on both ends of the room with the door swing in the direction of egress and panic hardware.

2.2.2 Arrangement of Exits

LSC 7.5.1.1 Exits shall be located, and exit access shall be arranged, so that exits are readily accessible at all times.

LSC 7.5.1.1.1 Where exits are not immediately accessible from an open floor area, continuous passageways, aisles, or corridors leading directly to every exit shall be maintained and shall be arranged to provide access for each occupant to not less than two exits by separate ways of travel.*

LSC 7.5.1.1.2 Exit access corridors shall provide access to not less than two approved exits.

LSC 7.5.1.2 Corridors shall provide exit access without passing through any intervening rooms other than corridors, lobbies, and other spaces permitted to be open to the corridor.

LSC 7.10.1.2.1 Exits, other than main exterior exit doors that obviously and clearly are identifiable as exits, shall be marked by an approved sign that is readily visible from any direction of exit access.*

LSC 7.1.3.2.1(8) Openings in exit enclosures shall be limited to door assemblies from normally occupied spaces and corridors and door assemblies for egress from the enclosure

First Floor

The rooms on the first floor almost all lead to exit corridors and these exit corridors lead to both exits. Room 107 exits through a shared office (Rm. 108) to the corridor.

The east staircase on the first floor has a janitors closet that opens into the exit corridor. This is not allowable per LSC 7.1.3.2.1(8). A recommended solution for the janitors closet is to relocate the door, so that the door leads to the room south of the stair and not into the exit stair.

Second and Third Floors

These floors have a single exit corridor leading to stairways 1 & 2. On the second floor, the corridor passes through open office space for 34 ft. before reaching the exit door. A sign with a directional arrow is located at the end of the corridor to direct occupants.

LSC 7.5.1.3.1 Where more than one exit, exit access, or exit discharge is required from a building or portion thereof, such exits, exit accesses, or exit discharges shall be remotely located from each other and be arranged to minimize the possibility that more than one has the potential to be blocked by any one fire or other emergency condition.

LSC 7.5.1.3.3 In buildings protected throughout by an approved, supervised automatic

sprinkler system in accordance with Section 9.7, the minimum separation distance between two exits, exit accesses, or exit discharges, measured in accordance with 7.5.1.3.2, shall be not less than one-third the length of the maximum overall diagonal dimension of the building or area to be served.

The SERC has a sprinkler system throughout; therefore the remoteness of the exits shall be 1/3 of the diagonal dimension of the building. The first floor has a diagonal dimension of 182 ft. The exits are 112 ft. apart on the first floor, which is greater than the 61 ft. required.

The second and third floors have a diagonal dimension of 161 ft. and a required separation of 54 ft. The exits are separated by 128 ft. and 120 ft. respectively, and meet the 54 ft. requirement.

2.2.3 Width of Exits & Exit Capacity

LSC 7.3.4.1 The width of any means of egress, unless otherwise provided in 7.3.4.1.1 through 7.3.4.1.3, shall be as follows:

(1) Not less than that required for a given egress component in this chapter or Chapters 11 through 43

(2) Not less than 36 in. (915 mm)

LSC 7.3.1.4 Exits Serving More than One Story. Where an exit serves more than one story, only the occupant load of each story considered individually shall be used in computing the required capacity of the exit at that story, provided that the required egress capacity of the exit is not decreased in the direction of egress travel.

All the rooms must have doors at least 32 inches wide. The exit capacity for doors is .2 inches per person. A 32-inch door has an exit capacity of 160 people. The west stair has a single 32-inch door serving the second and third floors (capacity 123 and 58 people respectively). Stair 1 has double doors, 64-inches, and connects all three floors, but exiting at the 2nd floor level.

The east staircase serves all three floors and is 60 inches wide and the west staircase serves the second and third floors and is 44 inches wide.

LSC 7.3.3.1 The capacity for stairs is .3 inches per person in a business occupancy with 44 inch wide stairs. The following equation is used to find the capacity for stairs over 44 inches, $C=146.7+((W-44)/.218)$ where W is the width.

LSC 7.3.1.5 Capacity from a Point of Convergence. Where means of egress from a story above and a story below converge at an intermediate story, the capacity of the means of egress from the point of convergence shall be not less than the sum of the capacity of the two means of egress.

The exit capacity for the 44-inch west staircase is 146 people and for the 60-inch east

staircase is 220 people. The first-floor exterior exit is limited by the 32-inch door at 160 people. The arrangement of the stairs is a bit complicated due to the partially underground first floor. Stair 1 must serve the capacity of the first floor and the third floor combined minus the capacity for the other exits on those floors. The capacity of the first and third floors combined is 172 people respectively, so the exterior exit and the west stair (capacity 147 and 238 respectively) adequately cover the exit capacities for those floors.

2.2.4 Exit Discharge

7.7.6 Discharge to Roofs. Where approved by the authority having jurisdiction, exits shall be permitted to discharge to roofs or other sections of the building or an adjoining building where the following criteria are met:

(1) The roof/ceiling assembly construction has a fire resistance rating not less than that required for the exit enclosure.

(2) A continuous and safe means of egress from the roof is available.

LSC 7.7.3.2 The exit discharge shall be arranged and marked to make clear the direction of egress travel from the exit discharge to a public way.

LSC 7.7.3.3 Stairs and ramps shall be arranged so as to make clear the direction of egress travel from the exit discharge to a public way.

LSC 7.1.6.4 Slip Resistance. Walking surfaces shall be slip resistant under foreseeable conditions. The walking surface of each element in the means of egress shall be uniformly slip resistant along the natural path of travel.*

Exit stairs 1 and 2 discharge on what I would classify as a roof because they are above the first floor. There are skylights on the exit path and they are slip resistant. The construction shall be 1-hour rated for the portion of the ceiling below the egress path on floor 1. This appears to be the case because the skylights are 1-hour rated.

2.2.5 Travel Distance Limits & Dead Ends

LSC 38.2.6.3 Travel distance shall not exceed 300 ft (91 m) in business occupancies protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 9.7.

LSC 38.2.5.2.1 In buildings protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1), dead-end corridors shall not exceed 50 ft (15 m).

2.3 Regulatory Requirements

2.3.1 Separation of Means of Egress

LSC 38.3.6.1 Where access to exits is provided by corridors, such corridors shall be separated from use areas by fire barriers in accordance with Section 8.3 having a minimum 1-hour fire resistance rating, unless one of the following conditions exists:*

*(1)*Where exits are available from an open floor area*

*(2)*Within a space occupied by a single tenant*

(3) Within buildings protected throughout by an approved, supervised automatic sprinkler system in accordance with 9.7.1.1(1)

*LSC 7.1.3.2.1 Where this Code requires an exit to be separated from other parts of the building, (1)*The separation shall have a minimum 1-hour fire resistance rating where the exit connects three or fewer stories.*

The corridors in the SERC are not protected by a 1-hour fire resistance rating because the building is served by an approved, supervised automatic sprinkler system. Stairs 1 and 2 are protected by a 1-hour fire resistance rating.

2.3.2 Stairs & Landings

Stairs

According to LSC table 7.2.2.2.1.1(b), Table 3 specifies the dimensions for the stairs required for this building.

Table 3: dimensions required for regular stairs.

Stair Feature	Dimension (inches or feet specified)
Minimum Width	44 in.
Maximum Height of Risers	7 in.
Minimum Height of Risers	4 in.
Minimum Tread Depth	11 in.
Minimum Head Room	6 ft. 8 in.
Minimum Height Between Landings	12 ft.

Landings

LSC 7.2.2.3.2.1 Stairs shall have landings at door openings.

LSC 7.2.2.3.2.3 In new buildings, every landing shall have a dimension, measured in the direction of travel, that is not less than the width of the stair.

The landings for stair 1 need to be 44-inches in depth from the stair to the wall and the landings for stair 2 must be at least 64-inches from the stair to the wall.

Tread

LSC 7.2.2.3.3.1 Stair treads and landings shall be solid, without perforations.

LSC 7.2.2.3.3.2 Stair treads and landings shall be free of projections or lips that could trip stair users.*

LSC 7.2.2.3.3.3 If not vertical, risers on other than existing stairs shall be permitted to slope under the tread at an angle not to exceed 30 degrees from vertical, provided that the projection of the nosing does not exceed 1.5 in.

Tread shall be solid and free of projections. The risers are allowed up to a 30 degree angle under the tread.

2.3.3 Guards and Handrails

LSC 7.2.2.4.1.1 Stairs and ramps shall have handrails on both sides.

LSC 7.2.2.4.1.2 In addition to the handrails required at the sides of stairs by 7.2.2.4.1.1, the following provisions shall apply:

(1) For new stairs, handrails shall be provided within 30 in. (760 mm) of all portions of the required egress width.

(2) For existing stairs, handrails shall meet the following criteria:

(a) They shall be provided within 44 in. (1120 mm) of all portions of the required egress width.

(b) Such stairs shall not have their egress capacity adjusted to a higher occupant load than permitted by the capacity factor in Table 7.3.3.1 if the stair's clear width between handrails exceeds 60 in. (1525 mm).

7.2.2.4.1.4 The required egress width shall be provided along the natural path of travel.*

LSC 7.2.2.4.2 Continuity. Required guards and handrails shall continue for the full length of each flight of stairs. At turns of new stairs, inside handrails shall be continuous between flights at landings.

LSC 7.2.2.4.4.1 New handrails on stairs shall be not less than 34 in. (865 mm), and not more than 38 in. (965 mm), above the surface of the tread, measured vertically to the top of the rail from the leading edge of the tread

The stairs are required to have handrails on both sides that are continuous down the flight of stairs and around the bend on landings. The handrail must be between 34 and 38 inches from the stair tread.

The exterior stair leading from the 1st floor widens as the stair ascends. The door is located on the far east side of the stair so that the natural path of travel is up the east side of the staircase.

2.3.4 Interior Finish

Wall/ Ceiling

LSC 10.2.3.4 Products required to be tested in accordance with ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials, or ANSI/UL 723, Standard for Test for Surface Burning Characteristics of Building Materials, shall be classified as follows in accordance with their flame spread index and smoke developed index, except as indicated in 10.2.3.4(4):*

(1) Class A interior wall and ceiling finish shall be characterized by the following:

(a) Flame spread index, 0–25

(b) Smoke developed index, 0–450

(2) Class B interior wall and ceiling finish shall be characterized by the following:

(a) Flame spread index, 26–75

(b) Smoke developed index, 0–450

(3) Class C interior wall and ceiling finish shall be characterized by the following:

(a) Flame spread index, 76–200

(b) Smoke developed index, 0–450

LSC table A.10.2.2 dictates that business occupancies use class A or B finishes for exit and exit access corridors. Class A, B, or C may be used everywhere else.

Floor Finish

LSC 10.2.7.4 Interior floor finishes shall be classified as follows in accordance with their critical radiant flux values:

(1) Class I interior floor finish shall be characterized by a critical radiant flux not less than 0.45 W/cm², as determined by the test described in 10.2.7.3.

(2) Class II interior floor finish shall be characterized by a critical radiant flux not less than 0.22 W/cm² but less than 0.45 W/cm², as determined by the test described in 10.2.7.3.

In accordance with LSC table A.10.2.2, Floor finishes may be class I or II for business occupancies.

2.3.5 Illumination of Exit Passage

LSC 7.8.1.1 Illumination of means of egress shall be provided in accordance with Section 7.8 for every building and structure where required in Chapters 11 through 43. For the purposes of this requirement, exit access shall include only designated stairs, aisles, corridors, ramps, escalators, and passageways leading to an exit. For the purposes of this requirement, exit discharge shall include only designated stairs, aisles, corridors, ramps, escalators, walkways, and exit passageways leading to a public way.*

LSC 7.8.1.3 The floors and other walking surfaces within an exit and within the portions of the exit access and exit discharge designated in 7.8.1.1 shall be illuminated as follows:*
(1) During conditions of stair use, the minimum illumination for new stairs shall be at least 10 ft-candle (108 lux), measured at the walking surfaces.
(2) The minimum illumination for floors and walking surfaces, other than new stairs during conditions of stair use, shall be to values of at least 1 ft-candle (10.8 lux), measured at the floor.

Therefore, the stairs need to be illuminated to 10 ft-candle measured at the floor, and the exit corridors must be illuminated to 1 ft-candle measured at the floor.

LSC 7.8.1.4 Required illumination shall be arranged so that the failure of any single lighting unit does not result in an illumination level of less than 0.2 ft-candle (2.2 lux) in any designated area.*

The failure of a light should not reduce illumination at floor level to below .2 ft-candle.

Sources of Illumination

LSC 7.8.2.1 Illumination of means of egress shall be from a source considered reliable by the authority having jurisdiction.*

LSC 7.8.2.2 Battery-operated electric lights and other types of portable lamps or lanterns shall not be used for primary illumination of means of egress. Battery-operated electric lights shall be permitted to be used as an emergency source to the extent permitted under Section 7.9

Primary lighting cannot be battery operated.

Emergency Illumination

LSC 38.2.9.1 Emergency lighting shall be provided in accordance with Section 7.9 in any building where any one of the following conditions exists:

- (1) The building is three or more stories in height.*
- (2) The occupancy is subject to 50 or more occupants above or below the level of exit discharge.*
- (3) The occupancy is subject to 300 or more total occupants.*

LSC 7.9.2.1 Emergency illumination shall be provided for a minimum of 1 1/2 hours in the event of failure of normal lighting. Emergency lighting facilities shall be arranged to provide initial illumination that is not less than an average of 1 ft-candle (10.8 lux) and, at any point, not less than 0.1 ft-candle (1.1 lux), measured along the path of egress at floor level. Illumination levels shall be permitted to decline to not less than an average of 0.6 ft-candle (6.5 lux) and, at any point, not less than 0.06 ft-candle (0.65 lux) at the end of 1 1/2 hours. A maximum-to minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.*

The SERC is three stories in height, so emergency lighting is required by LSC 38.2.9.1. Emergency lighting must provide at least 1 ft-candle of illumination measured at any point and last for at least 1.5 hours.

2.3.6 Exit Signs

LSC 7.10.1.2.1 Exits, other than main exterior exit doors that obviously and clearly are identifiable as exits, shall be marked by an approved sign that is readily visible from any direction of exit access.*

LSC 7.10.1.2.2 Horizontal components of the egress path within an exit enclosure shall be marked by approved exit or directional exit signs where the continuation of the egress path is not obvious.*

LSC 7.10.1.5.1 Access to exits shall be marked by approved, readily visible signs in all cases where the exit or way to reach the exit is not readily apparent to the occupants.

Recommended placement for exit signs:

First floor

1. At the exterior exit door and the two doors to the east stair.
2. In front of vestibule 120A, directing people to the east stair.
3. In front of shared office 108.
4. At the corridor junction in-between the two doors leading to room 109.

Second Floor

1. A sign with an arrow leading people to the path through the open office space before the elevator on the west end of the corridor.
2. The east end of the corridor.

Third Floor

1. Both ends of the corridor.

LSC 7.10.8.3.1 Any door, passage, or stairway that is neither an exit nor a way of exit access and that is located or arranged so that it is likely to be mistaken for an exit shall be identified by a sign that reads as follows:

NO
EXIT

LSC 7.10.8.3.2 The NO EXIT sign shall have the word NO in letters 2 in. (51 mm) high, with a stroke width of 3/8 in. (9.5 mm), and the word EXIT in letters 1 in. (25 mm) high, with the word EXIT below the word NO, unless such sign is an approved existing sign.

Recommended placement of a No Exit sign is outside of room 208 because this could be mistaken as an exit.

2.3.7 Fire Alarm Requirements

LSC 38.3.4.1 General. A fire alarm system in accordance with Section 9.6 shall be provided in all business occupancies where any one of the following conditions exists:

- (1) The building is three or more stories in height.*
- (2) The occupancy is subject to 50 or more occupants above or below the level of exit discharge.*
- (3) The occupancy is subject to 300 or more total occupants.*

LSC 9.6.1.3 A fire alarm system required for life safety shall be installed, tested, and maintained in accordance with the applicable requirements of NFPA 70, National Electrical Code, and NFPA 72, National Fire Alarm and Signaling Code, unless it is an approved existing installation, which shall be permitted to be continued in use.

LSC 9.6.1.5 To ensure operational integrity, the fire alarm system shall have an approved maintenance and testing program complying with the applicable requirements of NFPA 70, National Electrical Code, and NFPA 72, National Fire Alarm and Signaling Code.*

LSC 9.6.1.8.1 In areas that are not continuously occupied, and unless otherwise permitted by 9.6.1.8.1.1 or 9.6.1.8.1.2, automatic smoke detection shall be installed to provide notification of fire at the following locations:*

- (1) Each fire alarm control unit*
- (2) Notification appliance circuit power extenders*
- (3) Supervising station transmitting equipment*

The SERC is 3 stories in height, so the building requires an alarm system. The alarm system must be maintained regularly. The alarm system must have automatic smoke detection that transmits emergency information to the authorities.

3.0 Sprinkler System

The SERC is equipped with an automatic wet pipe sprinkler system throughout the building. The DOE requires all laboratory buildings to be sprinklered under an Ordinary Hazard II classification. The backflow preventer is located on the exterior west side of the building. The main riser/standpipe combination is located in the east staircase. The plans for the sprinkler system are located in Appendix B.

LBNL is located on the Hayward fault. The SERC sprinkler system is equipped with listed sway bracing, flexible hoses as drops to the sprinkler heads, and flexible couplings at wall and ceiling penetrations to avoid system failure during an earthquake as described in NFPA 13, Section 9.3.

3.1 Supply

The supply for the sprinkler system can be seen in chart 1. The supply has a static pressure of 9 psi and a flowing supply of 2050 gallons per minute (GPM) at 67 psi. Water for LBNL is supplied through a private main. LBNL also has a large water tank with a pump that provides the lab with a healthy pressure and flow.

3.2 Design Demand

The documents containing the design information about the sprinkler system state that the system was designed as an Ordinary Hazard I classification at a density of 0.17 GPM over an area of 3,000 sq. ft.. I believe that the documentation should have stated the design density is Ordinary Hazard II because this corresponds to the density utilized in the hydraulic calculations. According to the LBNL Fire Marshal, the laboratories at LBNL have been designed under an unofficial laboratory policy Ordinary Hazard II since the 1970's. The Fire Marshal is currently working with the facilities department to make an official LBNL policy regarding sprinkler design. The k-factor for the sprinkler heads is 5.6. The sprinkler layout is detailed in Appendix B, and the Autosprink hydraulic calculations are located in Appendix C.

The designers chose to utilize the density/ area method in chapter 11 of NFPA 13 to calculate the required demand. Using this method, the system demand was calculated for each floor utilizing 39, 37, and 31 sprinkler heads respectively on the first, second, and third floors. Each sprinkler covers 120 square ft. of floor space, so the designers only needed to calculate the demand for 25 sprinklers. In addition, a hose stream allowance of 250 GPM is added to the required demand (NFPA 13, Table 11.2.3.1.2).

The most demanding area hydraulically should have been the third floor. It ended up being the first floor because the designers included 14 extra sprinkler heads in the calculation. In addition, the required coverage area chosen could have been smaller, as small as 1,500 square ft. with a coverage of 0.2 GPM (13 sprinklers). I will discuss the calculations for the

third floor since I believe this to be the most hydraulically demanding section of the building. I have included all of the hydraulic calculations in Appendix C.

Figure 4 depicts the supply and demand for the third floor of the SERC. The supply is 90 pounds per square inch (psi) of static pressure and 2060 GPM at 67 psi. The demand of the 31 sprinklers on the third floor including the 250 GPM hose stream is 945 GPM at 76 psi. This leaves just over a 10% buffer for pressure fluctuations. The system supply adequately supplies the demand of the sprinklers.

Figure 4: third floor sprinkler supply and demand.

3.3 Alternate Design

The designers for the SERC sprinkler system utilized the density/area method for the hydraulic calculations. An alternate design that could have been utilized is the room design method described in NFPA 13, Section 11.2.3.3. Utilizing this method, the room that creates the most demand is the east exit stair. The stair is the most remote location in the building and the largest room. The east exit stair is protected with 1-hour rated walls with rated doors activated with automatic door closing devices as required in NFPA 13, Section 11.2.3.3.5. There are 14 sprinkler heads in this room including the 4 added to the skylights. The hydraulic calculations using the density/area method utilized 31 sprinkler heads compared to the 14 needed if utilizing the room design method.

The floor area for the room is below 1,500 sq. ft., therefore a design density of 0.2 GPM over the minimum 1,500 sq. ft. is required for an Ordinary Hazard II occupancy. The diagrams 1 and 2 below depict the difference in area and number of sprinkler needed for hydraulically calculating the system demand. The top portion of Figure 5 illustrates the floor plan of the third floor with the design/density method that the designers utilized with coverage outlined in red and the bottom of Figure 5 illustrates the third floor coverage utilizing the room design method also outlined in red.

It is also possible to utilize the density/area method over a smaller area. At 1,500 square ft. with each head covering 120 square feet, only 13 sprinkler heads would be needed for hydraulic calculations.

Figure 5: density/area design method (top) vs. room design method (bottom)

3.4 Inspection, Testing, and Maintenance

The ITM for the sprinkler system is detailed in NFPA 25 and the California Edition of NFPA 25. Because these two documents differ in some cases on the frequency of inspections, LBNL has created a testing schedule based on the shortest return times (the stricter of the two).

4.0 Detection and Alarm Systems

4.1 Types of Monitoring Devices

See Appendix D for photographs and details regarding the following devices.

4.1.2 Fire Suppression System:

The SERC is protected by a sprinkler system that also serves as a heat detection system. The sprinkler heads are heat activated and water flowing through the system will set off the alarms throughout the building. The waterflow switch is the activating device in this scenario.

The suppression system for SERC is a wet pipe sprinkler system. The occupancy classification is Ordinary Hazard II, and the maximum protection area per sprinkler is 130 square feet. The sprinklers are on a 10 foot by 13 foot spacing. The sprinkler heads are Reliable model F1FR quick response pendent sprinklers rated at 155 degrees Fahrenheit (about 68 degrees Celsius) in the office and laboratory spaces and 200 degree rated sprinklers in the utility areas.

4.1.2 Smoke Detectors:

The second types of detectors used in the SERC are smoke detectors. One type of smoke detector utilized in this building is photoelectric Siemens FP-11 Fireprint detectors. These detectors are ceiling mounted. They are programmable depending on the application to reduce nuisance alarms.

A second type of smoke detector is utilized in the east exit stair. This is a VESDA VFT-15 aspirating smoke detector. These detectors continuously measure ambient air through a pipe sampling network. The sampling network delivers the sampled air to a device that measures smoke with a laser. They are very sensitive to smoke, yet are able to distinguish between smoke and other particles virtually eliminating nuisance alarms.

Originally, the VESDA system was installed to support a smoke control system in what is now the east exit stair. In the original design of the building, the east exit stair was going to be an atrium; and the VESDA would activate the smoke control system. Due to budget constraints and the unrated roof deck, the stair is to be utilized as a stair only. The VESDA system was installed purely as an extra life safety precaution even though it was no longer needed to activate an exhaust system. The settings and layout of the VESDA system can be seen in Appendix F.

4.1.3 Duct Smoke Detectors:

The smoke detectors in the duct system in the SERC are the same as throughout the building, Siemens FP-11 Fireprint detectors, with a cover to protect the units from the dust

present in the heating, ventilation, and air-conditioning system (HVAC). The housing utilized with these particular smoke detectors is the Siemens AD-11P (Air Duct Housing). These work by covering the detector. They have a small hole that faces the oncoming air and a larger opening on the leeward side.

4.1.4 Fire Call Box (Manual Pull Station):

The manual pull stations in the SERC are Siemens MSM boxes. They may be utilized in fire or other emergency situations and are located near the stairways.

4.2 Type of Notification Devices:

All of the notification devices are Cooper notification, Exeder Series type. The 4 units utilized are wall-mounted strobes and horn/strobes and ceiling-mounted strobes and horn/strobes.

4.3 Fire Alarm Control Panel:

The control panel for the fire alarm devices is a Siemens MXL. It is designed to be connected to a 120 Volt power supply and will generate 24 VDC. The maximum number of devices per circuit is 60. The fire alarm control panel is located on the north end of the first level in the electrical room.

4.4 Spacing and Location of Fire Detection Devices

The maximum spacing for spot fire detection devices is 30 feet (NFPA 72, 17.7.3.2.3.1). The Siemens detectors are rated for a 30-foot spacing. The location of the detection devices can be seen in the fire alarm drawings in Appendix E. Spot smoke detectors are utilized almost exclusively in the hallways of the building and the air ducts. The other spaces that contain spot type smoke detector are the electrical room, the chiller, and the plumbing room on the first floor. The setting for these detectors is either duct for the duct detectors or office for the remaining detectors.

The east exit stair is equipped with a VESDA (Very Early Smoke Detection Apparatus). This system is an aspirating smoke detection system. The system consists of 6 sampling ports located on the ceiling. Above the finished ceiling, there is a network of pipes that continuously draw air through the sampling ports to a detection apparatus on the first floor. Smoke is detected by a laser in the detection unit on the first floor of the stair. The system is activated when the percent obscuration of the laser beam is over .2%.

4.5 Detact Model

For my fire model, I will be evaluating the response of the spot type smoke detectors and the sprinkler heads. Since the smoke detectors are located in the hallways and a few rooms on the first level, I chose to model a fire in the electrical room.

The scenario is that the electrical room is being utilized improperly for storage (not an uncommon occurrence at the lab). A pile of boxes 1 meter in height is located too close to electrical components and they catch fire. The fire is a fast growth rate t^2 fire with a growth coefficient of 0.047.

The input parameters for the sprinkler heads are as follows:

Table 4: Input Parameter for Sprinkler Activation

Input Parameters		
Ceiling Height (H)	2	m
Radial distance	2.3	m
Ambient temperature (T_o)	20	C
Actuation temperature (T_d)	93.3	C
Response time index (RTI)	50	$(m-s)^{1/2}$
Fire growth power (n)	2	-
Fire growth coefficient (k)	0.047	kW/s^n
Time step (dt)	5	s

These parameters were chosen on a worst-case scenario basis. Assuming the boxes are located the maximum distance from the sprinkler heads, 7.5 feet. I utilized an RTI of 50 which was identified from a cut sheet for this type of sprinkler.

Figure 6 depicts the model of the sprinkler response to the fire scenario. The activation time for the sprinkler head is 130 seconds. The size of the fire at this time is just under 800 kW. In this scenario, the sprinklers are activated in about 2 minutes 10 seconds and the fire is being controlled before the fire department can arrive.

Figure 6: Detact Model of Gas Temperature, Detector Temperature, and Heat Release Rate vs. Time for Sprinkler Head

For the second model, I will evaluate the response time of the smoke detector and the heat release rate at that time. I will assume the sprinklers are controlling the fire by the time the fire department arrives.

The following are the input parameter for the Detact model for the smoke detector:

Table 5: Input Parameters for Spot Smoke Detector Activation:

Input Parameters		
Ceiling Height (H)	2	m
Radial distance	4.6	m
Ambient temperature (To)	20	C
Actuation temperature (Td)	27.8	C
Response time index (RTI)	2	(m-s) ^{1/2}
Fire growth power (n)	2	-
Fire growth coefficient (k)	0.047	kW/s ⁿ
Time step (dt)	5	s

In the case of computing activation of the smoke detector, I am making the assumption that the detector activates at a temperature increase of 7.8 degrees Celsius. This assumption is made through a limited number of tests conducted on smoke detectors. The value of 7.8 is

the average temperature rise. Table B.4.7.5.3 of NFPA 72 has a list of materials and temperature of activation for smoke detectors.

I am assuming a distance of 15 feet radially from the fire and an RTI of 2. Smoke detectors are not RTI rated, so I chose a low value assuming almost immediate response.

Figure 7: Detact Model of Gas Temperature, Detector Temperature, and Heat Release Rate vs. Time for Spot-Type Smoke Detector

The response time for the smoke detector in this model is 30 seconds. The temperatures for both gas and detector in Figure 7 are similar due to the low response time index. I would expect the smoke detector to activate before the sprinklers. At the time of activation, the heat release rate is only about 50 kW.

If for some reason the sprinklers did not activate and the detectors activate at 30 seconds, we can use the model to estimate the size of the fire when the fire department arrives. We must assume that the fire continues to grow at the same rate. I'm going to estimate the response of the fire department at 5 minutes considering they are only one block from the SERC. This is a conservative estimate because the actual response times are about 3 minutes to other buildings at the lab. After 5 minutes, the fire would have grown to about 4,200 kW.

4.6 Types and Locations of Notification Appliances

The locations of the notification appliances can be found on the fire alarm plans in Appendix E. The NFPA requirements for placement of strobes is more restrictive than the placement of horns, therefore the SERC is equipped with horn/strobe combinations and strobes. These may be either ceiling mounted or wall mounted depending on the location.

The strobes are set to 15, 30, 75, and 110 candela. The area covered by a strobe is square in shape. The measurements for the candela level and the area covered by the strobe are in Table 6. Table 7 contains the area of allowable coverage for wall mounted strobes.

Table 6: Allowable coverage area for ceiling mounted strobes (NFPA 72, Table 18.5.5.4.1(b))

Candela	Area in feet
15	20 x 20
30	30 x 30
44	44 x 44
75	53 x 53

Table 7: Allowable coverage area for ceiling mounted strobes (NFPA 72, Table 18.5.5.4.1(b))

Candela	Area in feet
15	20 x 20
30	28 x 28
44	Not listed
75	45 x 45

Horns decrease in dBA by about 6 dBA every time the distance from the source doubles. The starting distance is usually 10 feet. Therefore, at the lowest decibel level of 90 for a horn/strobe, the horn is at 90 dBA at 10 feet. At 20 feet, the dBA is 84. At 40 feet the dBA is 78. At 80 feet, the dBA is 72. The minimum allowable dBA for a business occupancy is 70. This value is the required 15 dBA above the ambient dBA amount of 55 (NFPA 72, Table A.18.4.3 and 18.4.3.1). The maximum distance from the horn to a wall is 80 feet and from a horn to another horn is 160 feet.

The horns and strobes in the drawings appear to cover the building properly as long as they are set to the settings listed on the drawings.

4.6.1 Mass Notification System

This building is not equipped with a mass notification system.

4.7 Secondary Power Supply

The secondary power supply required for the SERC notification system is calculated by finding the amount of power needed to run the system on standby for 24 hours and run the system at full alarm notification mode for 5 minutes (NFPA 72, 10.6.7.2.1). In addition to the power required by the appliances for this duration, a 25% buffer is needed (from specifications for the building).

Table 8: Voltage Drop Calculations

NOTIFICATION APPLIANCE CIRCUIT POWER REQUIREMENTS & VOLTAGE DROP CALCULATIONS												
DESCRIPTION	CURRENT PER APPLIANCE	# OF APPLIANCES										
		CIRCUIT AV1	CIRCUIT AV2	CIRCUIT AV3	CIRCUIT AV4	CIRCUIT AV5	CIRCUIT AV6	CIRCUIT AV7	CIRCUIT AV8	CIRCUIT AV9	CIRCUIT AV10	CIRCUIT AV11
COOPER NOTIFICATION EXCEDER SERIES STROBE 15 cd	0.057	0	0.114	0	0.057	0.171	0	0.057	0	0	0	0
COOPER NOTIFICATION EXCEDER SERIES HORN/STROBE 15 cd	0.073	0.073	0.438	0.292	0.219	0.073	0	0.073	0	0	0.073	0.146
COOPER NOTIFICATION EXCEDER SERIES STROBE 30 cd	0.085	0.170	0	0.085	0.170	0	0.170	0	0	0.085	0	0
COOPER NOTIFICATION EXCEDER SERIES HORN/STROBE 30 cd	0.087	0	0.087	0.261	0	0.174	0.261	0.087	0.174	0	0.087	0.174
COOPER NOTIFICATION EXCEDER SERIES STROBE 75 cd	0.135	0.135	0.270	0.270	0.135	0.270	0.270	0.270	0.405	0.405	0.405	0
COOPER NOTIFICATION EXCEDER SERIES HORN/STROBE 75 cd	0.139	0.556	0.139	0.139	0.278	0.139	0.139	0.556	0.278	0.417	0.278	0.278
COOPER NOTIFICATION EXCEDER SERIES STROBE 110 cd	0.182	0	0	0	0	0	0	0	0	0	0	0
COOPER NOTIFICATION EXCEDER SERIES HORN/STROBE 110 cd	0.186	0.186	0	0	0.186	0.186	0	0	0	0	0	0
COOPER NOTIFICATION EXCEDER SERIES HORN	0.044	0	0	0	0	0	0	0	0	0	0	0.132
TOTAL CIRCUIT CURRENT		1.120	1.048	1.047	1.045	1.013	0.840	1.043	0.857	0.907	0.843	0.916

{(0) (D) (21.6)}/CM
WHERE: I = CIRCUIT POWER LOAD 21.6 = CONSTANT
D = CONDUCTOR ONE WAY DISTANCE CM = CROSS SECTION AREA OF WIRE (4110 FOR AWG#14)

NAC AV1: {(1.120 AMP)(575 FT)(21.6)}/4110 VOLTAGE DROP: 3.385 VOLTS AVAILABLE VOLTAGE: 20.615
NAC AV2: {(1.048 AMP)(575 FT)(21.6)}/4110 VOLTAGE DROP: 3.167 VOLTS AVAILABLE VOLTAGE: 20.833
NAC AV3: {(1.047 AMP)(575 FT)(21.6)}/4110 VOLTAGE DROP: 3.164 VOLTS AVAILABLE VOLTAGE: 20.836
NAC AV4: {(1.045 AMP)(575 FT)(21.6)}/4110 VOLTAGE DROP: 3.158 VOLTS AVAILABLE VOLTAGE: 20.842
NAC AV5: {(1.013 AMP)(575 FT)(21.6)}/4110 VOLTAGE DROP: 3.061 VOLTS AVAILABLE VOLTAGE: 20.939
NAC AV6: {(0.840 AMP)(625 FT)(21.6)}/4110 VOLTAGE DROP: 2.759 VOLTS AVAILABLE VOLTAGE: 21.241
NAC AV7: {(1.043 AMP)(625 FT)(21.6)}/4110 VOLTAGE DROP: 3.426 VOLTS AVAILABLE VOLTAGE: 20.574
NAC AV8: {(0.857 AMP)(675 FT)(21.6)}/4110 VOLTAGE DROP: 3.040 VOLTS AVAILABLE VOLTAGE: 20.960
NAC AV9: {(0.907 AMP)(675 FT)(21.6)}/4110 VOLTAGE DROP: 3.218 VOLTS AVAILABLE VOLTAGE: 20.782
NAC AV10: {(0.843 AMP)(675 FT)(21.6)}/4110 VOLTAGE DROP: 2.990 VOLTS AVAILABLE VOLTAGE: 21.010
NAC AV11: {(0.916 AMP)(675 FT)(21.6)}/4110 VOLTAGE DROP: 3.249 VOLTS AVAILABLE VOLTAGE: 20.751
NAC AV12: {(0.452 AMP)(775 FT)(21.6)}/4110 VOLTAGE DROP: 1.841 VOLTS AVAILABLE VOLTAGE: 22.159

THE CIRCUITS' AVAILABLE VOLTAGE IS ABOVE THE MINIMUM LISTED VOLTAGE FOR THE APPLIANCES.

NOTES:

1. COOPER NOTIFICATION, WHEELLOCK EXCEDER SERIES STROBES AND HORN/STROBES WERE USED IN THE DESIGN. THE USE OF OTHER APPLIANCES SHALL REQUIRE NEW VOLTAGE DROP CALCULATIONS TO DEMONSTRATE THE ADEQUACY OF DESIGN.
2. THE POWER DEMAND SHOWN (AND USED IN THE VOLTAGE DROP CALCULATIONS) FOR EACH AUDIBLE APPLIANCE IS FOR THE "MEDIUM" AUDIBLE SETTING.
3. THE CIRCUIT VOLTAGE DROP CALCULATIONS HAVE BEEN DETERMINED TO PROVIDE SPARE CAPACITY FOR FUTURE MODIFICATIONS IN ACCORDANCE WITH LBNL REQUIREMENTS.

A total of 12 notification alarm circuits are wired to the fire alarm control panel. The voltage drop for each circuit is calculated in Table 8 taken from the fire alarm drawings for the SERC. Table 9 contains the battery calculations for the notification system.

Table 9: Battery Calculations for the Notification System

Equipment	Supervisory Mode	Alarm Mode
FACP	.065	.145
NAC AV 1		3.385
NAC AV 2		3.167
NAC AV 3		3.164
NAC AV 4		3.158
NAC AV 5		3.061
NAC AV 6		2.759
NAC AV 7		3.426
NAC AV 8		3.040
NAC AV 9		3.218
NAC AV 10		2.990
NAC AV 11		3.249
NAC AV 12		1.841
Totals	.065	36.603
For 24 hrs and 5 min.	.065*24=1.56	3.038

Total Amp Hours: $1.56 + 3.038 = 4.598 \times 1.25$ (25% buffer) = **5.747 Amp Hours**

4.8 Inspection, Testing, and Maintenance (ITM)

A visual inspection and testing should be performed on the alarm system annually (NFPA 72, Table 14.3.1 and Table 14.4.3.2). Appropriate records should be kept as part of a regular ITM schedule. These records should include printouts from the fire alarm control panel.

Performance-Based Analysis

For the performance-based portion of this report, I will calculate the time for people to exit the building. Normally, I would compare the required safe egress time (RSET) to the actual safe egress time (ASET) and evaluate whether the occupants can egress the building before the actual safe egress time ($RSET < ASET$). Because the space I am modeling is an exit stair with 1-hour rated walls and automatic door closing devices, I will evaluate whether a fire in the stair will affect the occupants in the building. This evaluation does not utilize RSET because the fire effects are contained to the exit stair and the SERC has secondary exits for all 3 floors.

5.0 Pathfinder Model

In order to calculate the required safe egress time for occupants in the SERC, I created a model with Pathfinder. Pathfinder is a computer program that a user may create a three-dimensional floor plan of a building and place computer representations of people inside.

The user is able to choose different characteristics for the movement of the “people.” The model output is the time for the occupants of the model to exit the space. See figure 8 for a snapshot of a pathfinder output file.

The goal of calculating the required egress time for a building is to ensure that the time needed to egress the building is less than the time the building becomes unsafe.

I ran the Pathfinder model for the SERC under two scenarios. The first scenario was simply emptying the entire building. The second scenario was to empty the building while the east exit stair exterior door is blocked. The building occupants are assumed to be average adults because persons at LBNL consist primarily of employees and interns who are college age students.

In the model, the building is filled with the maximum number of occupants. Each room has the number of occupants as the occupancy tables in Life Safety Review, occupant section of this document. The time for the building to empty through the three main exits in the model is 105 seconds. When the east exit stair is blocked, the time for the building to empty increases to 172 seconds.

Figure 8: Pathfinder model filled to capacity with the east exit and the utility exit blocked.

6.0 FDS Model

The east exit stair is a critical area for life safety in the SERC because it accounts for 50% of the exit capacity for the building. The designers for the SERC originally designed the east exit stair to be utilized as an atrium, but due to cost constraints and conflicts with the life safety code, the space is now to be used as an exit only. Because construction had already begun when the details for the exit stair were still being discussed, the stair essentially has a very large landing on the second floor. The existence of the large open landing presents the potential problems of people wanting to utilize the space for storage, furniture, or

gatherings. In this model of the east exit, I will evaluate what would happen if a fire blocks the exterior exit. I will evaluate the time until the VESDA activates, the time that the sprinklers activate, and the tenability of the space.

6.1 The Model

In order to simplify the model, I have chosen to represent only the second and third floors of the space with the design fire on the large open space on the second floor blocking the exterior exit. I have included the skylights, VESDA, and sprinklers. Figures 9 and 10 on the following page compare a photograph of the space with the model. In the model, I also have included doors that may be opened or closed at specific times and thermocouples and slice files at door openings and through various parts of the room. The code for the model can be found in Appendix G.

Figure 9: the SERC east exit stair

Smokeyview 6.1.4 - Oct 24 2013

Figure 10: FDS east exit stair

mesh: 1

6.1.1 The Mesh

The mesh is the grid that FDS uses to complete the calculations in the model, the smaller the grid, the more accurate the model. For the east exit model, I have chosen a cell size of 0.2 meters squared. I initially ran the model with a 0.1 meter square mesh, and the results were similar, so I believe that the 0.2 meter square mesh is acceptable.

6.1.2 The Design Fire

The design fire scenario I chose was that a pallet of empty plastic bottles is delivered and left near the front door of the east exit stair. While combustibles are technically not allowed in exit stairs, it is not uncommon for deliveries of laboratory equipment to be found in hallways or anywhere where there is space. The design fire is addressing the loss of the main exit in the SERC as described by design fire scenario 2 in LSC 5.5.3.2, “(1) It is an ultrafast-developing fire, in the primary means of egress, with interior doors open at the start of the fire. (2) It addresses the concern regarding a reduction in the number of available means of egress.” The smoke detection system activates automatic door closing devices on the interior doors, so I will evaluate whether the smoke is contained in the exit stair. If the smoke layer descends to below the top of the third floor doors before the alarm is activated, the model does not pass method A in LSC annex A5.2.2 of, “no fire effects in occupied areas.”

In order to represent the pallet of plastic bottles, I fit a curve to the test data for a pallet of empty plastic fruit containers (Babrauskas, 2008). The model fire burns for 1100 seconds with a peak Heat Release Rate (HRR) of 4,000 kW. Figure 11 below is a comparison of the test data and the HRR curve fit to the test data.

Figure 11: Left, HRR test data for fruit containers; Right, HRR utilized in FDS

Most of the material that would be burning in the design scenario is PVC. As part of the model input parameters, I included the data for the release of soot and carbon monoxide. The data from chapter 4 of the SFPE Handbook, gives a soot yield of 0.172 g/g and 0.063 g/g of carbon monoxide.

FDS has the capability of modeling aspirating smoke detection systems. The input parameters for the detection system are the delay to the detector from each port in seconds, the mass of air sampled through the ports over time (kg/s), and the percent obscuration per meter that will activate the alarm. I have included the VESDA data in Appendix F.

6.2 Results

The VESDA system detects the smoke from the fire at 44 seconds. The smoke layer development can be seen in Figure 13. At this time the smoke layer has just begun to descend and is at a height of about 7.5 meters. The automatic door closers would activate and the model passes method 4 in the annex of no fire effects in occupied areas. The smoke layer rapidly descends after this causing the space to be untenable in a short amount of time. Figure 12 depicts the layer height from the second floor exit level to the ceiling over time. The top of the 3rd floor door is at 7 meters. The smoke layer would reach this height at about 85 seconds. At about 90 seconds the smoke layer descends to 6.6 meters, which is 6 ft. above the highest walking surface.

The first sprinkler activates at 165 seconds. At this time, the heat release rate is about 500 kW. Due to the high ceiling in this space, sprinklers may not be entirely effective at controlling the fire. The sprinkler will send an alarm to the fire department in the case where the VESDA system malfunctions.

Figure 12: Layer heights at the 3rd floor landing and above the large open space by the front door.

Smokeview 6.1.4 - Oct 24 2013

Frame: 40

Time: 44.0

mesh: 1

Figure 13: Smoke layer at 44 seconds when the smoke alarm activates and automatic doors are closed

The temperature at which the space becomes untenable is 60 degrees Celsius (Purser, 2008). The space becomes too hot for occupants at 245 seconds, see figure 15. This is after the space becomes untenable due to smoke at 88 seconds. The tenability criteria for smoke is 10 meters of visibility or less (Purser, 2008). I utilized the soot density slice file to evaluate visibility. I had to do a simple calculation from the FDS users guide to convert soot density to visibility. The soot density when visibility is 10 meters is 3.45×10^{-5} . Figure 14 illustrates the visibility of 10 meters at 6 ft. above the third floor landing (conservative head level).

Another criteria to evaluate the tenability of a space is the level of carbon monoxide in a room. An untenable condition is 1166 ppm or 0.1 fractional effective dose (Purser, 2008). The room never reaches these levels of carbon monoxide.

Smokeyview 6.1.4 - Oct 24 2013

Frame: 80

Time: 88.0

mesh: 1

Figure 14: Visibility 10 ft. 6 ft. above finished floor third level landing.

Flashover occurs at about 500-600 degrees Celsius (Walton and Thomas, 2008). The hottest temperature the room reaches is 220 degrees Celsius, see Figure 16. Therefore, the room never reaches flashover.

Due to the location of the fire (by the exterior exit door) and the smoke layer, the exit is lost in this scenario. The secondary exits would be available to the occupants, and the automatic door closing devices will keep the smoke out of the occupied space in the building. This conclusion is valid as long as the space remains an exit stair only.

Figure 16: Hot gas layer with 220 degrees outlined in black

7.0 Engineering Solution to Utilize the Second Floor “Landing” Area:

Due to the large “landing” in the east exit stair, the area will need constant policing to ensure that the area is free from combustibles and not used for gatherings. One solution that would allow occupant to utilize this large open area is to erect a 1-hour rated wall just south of the interior exit doors where the third floor landing ends. This would separate the exit stair from what would become an assembly space. An additional exterior exit door would be needed for the stair. This could be located on the east wall directly across from the interior exit door.

8.0 Conclusion

The sprinkler and detection systems in the SERC are both more than required by code for this building. The sprinkler system was designed as Ordinary Hazard II over 3,000 square feet. While sprinkler systems at the laboratory are designed as Ordinary Hazard II per an unwritten agreement, the 3,000 square feet of coverage could be reduced to 1,500 or the room method may have been utilized. Because laboratories contain many chemicals and scientists performing experiments, so an overdesigned sprinkler system is beneficial.

The smoke detection system is more than needed or required in the east exit stair. I don't know the cost of the specialized VESDA system, but I don't think that it's worth the extra cost for this

particular space. An evaluation of time to activation for a spot detector in the space would be interesting for comparison.

The east exit stair presents a problem because the space must be constantly monitored to be sure that it is free from combustibles and assemblies. I recommend adding a 1-hour rated wall separating the exit stair from the landing to create a usable space out of the landing.

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Appendix A

Floor Plans

↑
N

Key:
Blue-business
Green-utility
Red-corridor
Lt. blue-storage
Purple-restrooms
Yellow-assembly

Floor 2

Floor 3

Key:

- Blue-business
- Green-utility
- Red-corridor
- Lt. blue-storage
- Purple-restrooms
- Yellow-assembly

SHEET NOTES

TOTAL OCCUPANT LOAD = 124
(103 @ 100' + 21 @ 300')
EXIT WIDTH PER CBC 1003.1:
CORRIDOR MINIMUM 36" OCC X = 11.6"
USE 48" PER CBC 1007)

TOWELS FOR OFFICE OR PUBLIC BUILDING
FOR EACH TOILET USE:
10 TOILETS @ 100 MGS
REQUIRED 1 TOWEL WC / 1 MALE WC + 1
JURNAL (11.6V EACH)
PROVIDED 2 TOWELS WC / 1 MALE WC + 1
JURNAL (11.6V EACH)

LEGEND

Diagram 1: Laboratory Suite (Control Area)

- ONE HOUR WALL WITH 60 MINUTE RATED OPENING FIRE BARRIER
- ONE HOUR WALL WITH 60 MINUTE OPENING FIRE BARRIER
- ONE HOUR EXTERIOR WALL WITH 60 MINUTE UNPROTECTED OPENING
- DIAGONAL DISTANCE AND EXIT DISTANCE

Room Number	Room Area	Occupant Load per sq ft	Occupant Load at Exit
1	100	1.0	100
2	200	2.0	200
3	300	3.0	300

Labels on the right pointing to the table columns:

- ROOM NAME
- MOLECULAR SOLID INTERFACIAL CHARACTERIZATION
- ROOM NUMBER
- OCCUPANCY CLASSIFICATION
- OCCUPANT LOAD PER SQ FT
- ROOM AREA
- NUMBER OF OCCUPANTS
- REQUIRED NUMBER OF EXITS

Label on the left pointing to the table:

- OCCUPANT LOAD AT EXIT

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[illegible]

LIFE SAFETY FLOOR PLAN
- LEVEL 1

-LEVEL ↑

 $10^8 = 10^7$ UC BERKELEY PROJ. NO. 12501A
PROJECT NUMBER

DRAWING M.VEER
SG PROJECT NO. 38415.00

G2.1

SHEET NOTES

TOTAL OCCUPANT LOAD = 123
108 (30' x 18' x 8' @ 200)
15 (30' x 18' x 8' @ 200)
CORRIDOR MAIN AREA 29 OCC X 2 @ 11'F
USE OF 190A (CAL 1907)
FLOOR FINISH: POLISHED CONCRETE
FLOOR FINISH: POLISHED CONCRETE
OCCUPANT LOAD = 123
RECORDED 1 FEMALE WC 1 MALE WC = 1
PROVIDED 2 FEMALE WC 1 MALE WC = 1
UNLOCK 11 AM EACH
SMITH GROUP INC. 301 BATTERY STREET
SAN FRANCISCO, CA 94111
F 415.390.0882
WWW.SMITHGROUP.COM

LEGEND

B

OCCUPANCY CLASSIFICATION

1

LABORATORY SUITE (CONCRETE AREA)

ONE HOUR WALL WITH 45 MINUTE

ONE HOUR WALL WITH 45 MINUTE

ONE HOUR EXTERIOR WALL WITH 45

DIAGONAL DISTANCE AND EXIT

DISTANCE

DISTANCE

DISTANCE

DISTANCE

DISTANCE

DISTANCE

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SHEET NOTES

TOTALS FOR OFFICE OR PUBLIC BUILDING
 FOR EMPLOYEE USE:
 OCCUPANT LOAD = 20
 10 FEMALES, 10 MALES
 10 FEMALE WC, 1 MALE WC + 1
 URINAL, 11 V. AIR WC
 PROVIDED 2 STEAMER NO. 1 MALE WC + 1
 URINAL (2 V. AIR EACH)

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LEGEND

B	
1	OCCUPANCY CLASSIFICATION LABORATORY SUITE / CONTROL AREA ONE HOUR WALL WITH 45 MINUTE RATED OPENINGS (FIRE BARRIER) ONE HOUR WALL WITH 60 MINUTE OPENINGS (EXIT ENCLOSURE / SH-WF) ONE HOUR EXTERIOR WALL WITH 45% UNPROTECTED OPENINGS DIAGONAL DISTANCE AND EXIT DISTANCE

MOLECULAR SOLID INTERFACE CHARACTERIZATION

Room Number	Occupancy Classification	Occupant Load per sq ft	Room Area	Number of Occupants	Required Number of Exits
1	Assembly	1.0	100	100	2
 
54	Assembly	1.0	100	100	2
55	Assembly	1.0	100	100	2
56	Assembly	1.0	100	100	2
57	Assembly	1.0	100	100	2
58	Assembly	1.0	100	100	2
59	Assembly	1.0	100	100	2
60	Assembly	1.0	100	100	2
61	Assembly	1.0	100	100	2
62	Assembly	1.0	100	100	2
63	Assembly	1.0	100	100	2
64	Assembly	1.0	100	100	2
65	Assembly	1.0	100	100	2
66	Assembly	1.0	100	100	2
67	Assembly	1.0	100	100	2
68	Assembly	1.0	100	100	2
69	Assembly	1.0	100	100	2
70					

[illegible]

LIFE SAFETY FLOOR PLAN
- LEVEL 3

SCALE
1/8" = 1'-0"

UC BERKELEY PROJ. NO. 12501A
PROJECT NUMBER

DRAWING NUMBER

SG PROJECT NO. 38415.00

G2.3

SHEET NOTES

TOTAL OCCUPANT LOAD = 3
EXIT WIDTH PER IBC: 1005, 1 AND 307 = 48"

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BRUCE D. LANGRISH
ARCHITECT

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LEGEND

B

OCCUPANCY CLASSIFICATION

1

LABORATORY SUITE, CONTROL AREA

ONE HOUR WALL WITH 60 MINUTE

OPPENING EXIT ENCLOSURE (SHAFT)

ONE HOUR EXTERIOR WALL WITH 45%

OPPENING EXIT ENCLOSURE (SHAFT)

DISTANCE DISTANCE AND EXIT

INTERFERENCE

ROOM NAME

ROOM NUMBER

OCCUPANT CLASSIFICATION

OCCUPANT LOAD PER SQ FT

NUMBER OF OCCUPANTS

REQUIRED NUMBER OF EXITS

OCCUPANT LOAD AT EXIT

OCCUPANT LOAD AT EXIT

OCCUPANT LOAD AT EXIT

OCCUPANT LOAD AT EXIT

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OCCUPANT LOAD AT EXIT

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OCCUPANT LOAD AT EXIT

OCCUPANT LOAD AT EXIT

LIFE SAFETY FLOOR PLAN
- LEVEL 4 / ROOF

SCALE
1/8" = 1'-0"
DRAWN BY: J. M. L. NO. 12581A
CHECKED BY: J. M. L. NO. 12581A
DATE: 12/14/2012
SHEET NUMBER: 50 PROJECT NO. 10415-000

G2.4

Appendix B

Sprinkler System Layout

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FIRE SPRINKLER SYSTEM DETAILS

FS02

PROJECT NO. 2015-000

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HYT Corporation
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Fax: 916.481.1213

REVISION	DATE
1	10/20/2011
2	10/20/2011
3	10/20/2011
4	10/20/2011
5	10/20/2011
6	10/20/2011
7	10/20/2011
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40	10/20/2011
41	10/20/2011
42	10/20/2011
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44	10/20/2011
45	10/20/2011
46	10/20/2011
47	10/20/2011
48	10/20/2011
49	10/20/2011
50	10/20/2011

FIRE SPRINKLER SYSTEM
LEVEL 1

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

AS NOTED

5251A

FS2.1.1

50 PROJECT NO. 20415.000

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SEALS AND SIGNATURES

LEVEL 2

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

SG PROJECT NO. 38415.000

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[illegible]

FIRE SPRINKLER SYSTEM
LEVEL 4 - ROOF

AS NOTED	SCALE
UC BERKELEY PROJ. NO.	12501A
PROJECT NUMBER	
FS2.4.1	
DRAWING NUMBER	SG PROJECT NO. 38415.000

Appendix C

Hydraulic Calculations

Hydraulic Summary

Job Number: 1250
Report Description: Level 1

Job											
Job Number 1250				Design Engineer Randy Ralston							
Job Name: Solar Energy Research Center				State Certification/License Number C16 - 629778							
Address 1 Building 30, McMillan Road				AHJ State Fire Marshal							
Address 2 Berkeley, CA 94720				Job Site/Building Building 30							
Address 3				Drawing Name FP 01 - Submittal.cad							
System				Remote Area(s)							
Most Demanding Sprinkler Data 5.6 K-Factor 20.40 at 13.270				Occupancy Ordinary Group I				Job Suffix			
Hose Allowance At Source 250.00				Density 0.170gpm/ft²				Area of Application 3000.00ft² (Actual 3076.35ft²)			
Additional Hose Supplies <u>Node</u> <u>Flow(gpm)</u>				Number Of Sprinklers Calculated 39				Coverage Per Sprinkler 120.00ft²			
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area							
Total Hose Streams 250.00											
System Flow Demand 822.55		Total Water Required (Including Hose Allowance) 1072.55									
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 18.52 between nodes 7 and 322											
Maximum Velocity Under Ground 9.13 between nodes 2 and 4											
Volume capacity of Wet Pipes 3503.09gal		Volume capacity of Dry Pipes									
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1		250.00	90.000	67.000		2050.00	83.062		1072.55	61.316	21.745
Contractor											
Contractor Number 1250		Contact Name Randy Ralston					Contact Title PM				
Name of Contractor: Transbay Fire Protection, Inc.						Phone 800-870-7377			Extension 18		
Address 1 2182 Rheem Drive						FAX					
Address 2 Pleasanton, CA 94588						E-mail randy@transbayfire.com					
Address 3						Web-Site www.transbayfire.com

Supply at Node 1

Hydraulic Graph

Supply at Node 1

Static: Pressure

90.000

Residual: Pressure

67.000 @ 2050.00

Available Pressure at Time of Test

83.062 @ 1072.55

System Demand

61.316 @ 822.55

System Demand (Including Hose Allowance at Source)

61.316 @ 1072.55

Summary Of Outflowing Devices

Job Number: 1250
Report Description: Level 1

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
Sprinkler	101	20.92	20.40	5.6	13.955		
Sprinkler	102	20.99	20.40	5.6	14.052		
Sprinkler	103	21.44	20.40	5.6	14.658		
Sprinkler	104	20.74	20.40	5.6	13.721		
Sprinkler	105	20.78	20.40	5.6	13.769		
Sprinkler	106	21.82	20.40	5.6	15.185		
Sprinkler	107	20.66	20.40	5.6	13.611		
Sprinkler	108	20.73	20.40	5.6	13.700		
Sprinkler	109	20.93	20.40	5.6	13.972		
Sprinkler	110	21.14	20.40	5.6	14.257		
Sprinkler	111	20.65	20.40	5.6	13.603		
Sprinkler	112	21.25	20.40	5.6	14.405		
Sprinkler	113	21.45	20.40	5.6	14.666		
Sprinkler	114	20.74	20.40	5.6	13.722		
Sprinkler	115	21.10	20.40	5.6	14.202		
Sprinkler	116	21.03	20.40	5.6	14.100		
Sprinkler	117	20.67	20.40	5.6	13.628		
Sprinkler	118	20.95	20.40	5.6	13.994		
Sprinkler	119	20.76	20.40	5.6	13.748		
Sprinkler	120	20.71	20.40	5.6	13.675		
⇒ Sprinkler	121	20.40	20.40	5.6	13.270		
Sprinkler	122	21.14	20.40	5.6	14.257		
Sprinkler	123	20.49	20.40	5.6	13.385		
Sprinkler	124	22.44	20.40	5.6	16.058		
Sprinkler	125	20.49	20.40	5.6	13.390		
Sprinkler	126	20.42	20.40	5.6	13.293		
Sprinkler	127	20.88	20.40	5.6	13.900		
Sprinkler	128	20.82	20.40	5.6	13.825		
Sprinkler	129	21.24	20.40	5.6	14.387		
Sprinkler	130	21.04	20.40	5.6	14.113		
Sprinkler	131	20.53	20.40	5.6	13.440		
Sprinkler	132	20.84	20.40	5.6	13.853		
Sprinkler	133	20.89	20.40	5.6	13.913		
Sprinkler	134	20.78	20.40	5.6	13.773		
Sprinkler	135	21.23	20.40	5.6	14.371		
Sprinkler	136	23.02	20.40	5.6	16.899		
Sprinkler	137	21.15	20.40	5.6	14.267		
Sprinkler	138	22.45	20.40	5.6	16.073		
Sprinkler	139	22.81	20.40	5.6	16.587		

⇒ Most Demanding Sprinkler Data

Node Analysis

Job Number: 1250
Report Description: Level 1

Node	Elevation(Feet)	Fittings	Pressure(psi)	Discharge(gpm)	
1	-6'-0	S	61.316	822.55	
101	10'-0	Spr(-13.955), fd(22'-0)	13.955	20.92	
102	10'-0	Spr(-14.052), fd(22'-0)	14.052	20.99	
103	10'-0	Spr(-14.658), fd(22'-0)	14.658	21.44	
104	9'-0	Spr(-13.721), fd(22'-0)	13.721	20.74	
105	9'-0	Spr(-13.769), fd(22'-0)	13.769	20.78	
106	10'-0	Spr(-15.185), fd(22'-0)	15.185	21.82	
107	10'-0	Spr(-13.611), fd(22'-0)	13.611	20.66	
108	10'-0	Spr(-13.700), fd(22'-0)	13.700	20.73	
109	10'-0	Spr(-13.972), fd(22'-0)	13.972	20.93	
110	10'-0	Spr(-14.257), fd(22'-0)	14.257	21.14	
111	9'-0	Spr(-13.603), fd(22'-0)	13.603	20.65	
112	9'-0	Spr(-14.405), fd(22'-0)	14.405	21.25	
113	10'-0	Spr(-14.666), fd(22'-0)	14.666	21.45	
114	10'-0	Spr(-13.722), fd(22'-0)	13.722	20.74	
115	10'-0	Spr(-14.202), fd(22'-0)	14.202	21.10	
116	10'-0	Spr(-14.100), fd(22'-0)	14.100	21.03	
117	9'-0	Spr(-13.628), fd(22'-0)	13.628	20.67	
118	10'-0	Spr(-13.994), fd(22'-0)	13.994	20.95	
119	10'-0	Spr(-13.748), fd(22'-0)	13.748	20.76	
120	10'-0	Spr(-13.675), fd(22'-0)	13.675	20.71	
121	10'-0	Spr(-13.270), fd(22'-0)	13.270	20.40	
122	10'-0	Spr(-14.257), fd(22'-0)	14.257	21.14	
123	10'-0	Spr(-13.385), fd(22'-0)	13.385	20.49	
124	14'-9	Spr(-16.058)	16.058	22.44	
125	10'-0	Spr(-13.390), fd(22'-0)	13.390	20.49	
126	10'-0	Spr(-13.293), fd(22'-0)	13.293	20.42	
127	10'-0	Spr(-13.900), fd(22'-0)	13.900	20.88	
128	10'-0	Spr(-13.825), fd(22'-0)	13.825	20.82	
129	14'-9½	Spr(-14.387)	14.387	21.24	
130	10'-0	Spr(-14.113), fd(22'-0)	14.113	21.04	
131	10'-0	Spr(-13.440), fd(22'-0)	13.440	20.53	
132	10'-0	Spr(-13.853), fd(22'-0)	13.853	20.84	
133	10'-0	Spr(-13.913), fd(22'-0)	13.913	20.89	
134	10'-0	Spr(-13.773), fd(22'-0)	13.773	20.78	
135	8'-0	Spr(-14.371), fd(22'-0)	14.371	21.23	
136	5'-0	Spr(-16.899)	16.899	23.02	
137	14'-7½	Spr(-14.267)	14.267	21.15	
138	7'-0	Spr(-16.073)	16.073	22.45	
139	8'-10	Spr(-16.587)	16.587	22.81	
2	-6'-0	E(14'-0)	60.901		
4	6'-8		51.178		
7	13'-2	fE(8'-11½)	38.386		
301	13'-2	PO(12'-3½)	22.970		
302	13'-2	PO(12'-3½)	22.975		
303	13'-2	PO(12'-3½)	22.998		
304	13'-2	PO(12'-3½)	23.087		
305	13'-2	PO(12'-3½)	23.142		
306	13'-2	PO(12'-3½)	23.185		
307	13'-2	PO(12'-3½)	25.642		
308	13'-2	PO(12'-3½)	25.923		
309	13'-2	PO(12'-3½)	26.110		
310	13'-2	PO(12'-3½)	26.806		
311	14'-11	PO(5'-0)	17.050		
312	14'-11	PO(5'-0)	16.713		
313	14'-11	PO(5'-0)	18.020		
314	13'-2	PO(12'-3½)	27.688		
315	14'-11	PO(5'-0)	16.648		
316	14'-11	PO(5'-0)	16.518		
317	14'-11	PO(5'-0)	16.567		
318	14'-11	PO(5'-0)	17.059		
319	14'-11	PO(5'-0)	17.743

Node Analysis

Job Number: 1250
Report Description: Level 1

Node	Elevation(Feet)	Fittings	Pressure(psi)	Discharge(gpm)
320	14'-11"	PO(5'-0")	16.405	
321	13'-7½"	PO(12'-3½")	19.189	
322	13'-2"	PO(12'-3½")	28.666	
323	14'-11"	PO(5'-0")	16.452	
324	13'-7½"	PO(12'-3½")	19.183	
325	14'-11"	PO(5'-0")	16.652	
326	14'-11"	PO(5'-0")	16.440	
327	13'-7½"	PO(12'-3½")	19.155	
328	14'-11"	PO(5'-0")	17.075	
329	14'-3½"	T(5'-0")	16.393	
330	14'-11"	PO(5'-0")	17.090	
331	13'-7½"	PO(6'-0")	16.926	
332	13'-7½"	PO(12'-3½")	16.926	
333	14'-11"	PO(5'-0")	16.478	
334	13'-7½"	PO(12'-3½")	19.074	
335	14'-5½"	PO(5'-0")	16.639	
336	13'-7½"	PO(12'-3½")	16.926	
337	14'-11"	PO(5'-0")	16.342	
338	13'-7½"	PO(5'-0")	16.914	
339	13'-7½"	PO(12'-3½")	19.006	
340	14'-11"	PO(5'-0")	16.346	
341	13'-7½"	PO(12'-3½")	16.927	
342	13'-7½"	PO(12'-3½")	16.913	
343	15'-3"	PO(5'-0")	16.113	
344	13'-7½"	PO(12'-3½")	18.931	
345	14'-11"	PO(5'-0")	16.328	
346	14'-5½"	PO(5'-0")	16.681	
347	13'-7½"	PO(5'-0")	16.939	
348	13'-7½"	PO(12'-3½")	16.937	
349	14'-5½"	PO(5'-0")	16.457	
350	13'-7½"	PO(12'-3½")	17.792	
351	13'-7½"	PO(12'-3½")	16.907	
352	14'-9"	PO(5'-0")	16.034	
353	14'-5½"	PO(5'-0")	16.471	
354	14'-3½"	T(5'-0")	16.526	
355	13'-7½"	PO(6'-0")	17.061	
356	13'-7½"	PO(5'-0")	17.586	
357	13'-7½"	PO(12'-3½")	16.904	
358	13'-7½"	PO(12'-3½")	17.518	
359	14'-11"	PO(5'-0")	15.975	
360	14'-3½"	T(5'-0")	16.563	
361	13'-7½"	PO(12'-3½")	17.343	
362	13'-7½"	PO(6'-0")	17.098	
363	13'-7½"	PO(5'-0")	17.318	
364	14'-11"	PO(5'-0")	15.926	
365	14'-3½"	T(5'-0")	16.663	
366	13'-7½"	PO(6'-0")	17.206	
367	13'-7½"	PO(12'-3½")	17.196	
368	4'-11"	PO(5'-0")	17.889	
369	14'-3½"	PO(5'-0")	15.181	
370	6'-11½"	PO(5'-0")	17.090

Hydraulic Analysis

Job Number: 1250
Report Description: Level 1

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
DR	1.0490	20.40	7.57	120		0.134987	7'-6"	Pf 5.203
121	10'-0	20.40	5.6	13.270		Sprinkler	31'-0	Pe -2.132
337	14'-11			16.342		2E(2'-0), PO(5'-0), fd(22'-0)	38'-6"	Pv
BL	2.1570	32.24	2.83	120		0.009403	0'-6	Pf 0.005
337	14'-11	11.84		16.342		Flow (q) from Route 2	0'-6	Pe
340	14'-11			16.346			0'-6	Pv
BL	2.1570	53.27	4.68	120		0.023808	13'-4"	Pf 0.729
340	14'-11	21.03		16.346		Flow (q) from Route 24	17'-3	Pe
328	14'-11			17.075		4fE(4'-3 1/2)	30'-7"	Pv
BL	2.1570	74.71	6.56	120		0.044522	0'-4	Pf 0.015
328	14'-11	21.45		17.075		Flow (q) from Route 34	0'-4	Pe
330	14'-11			17.090			0'-4	Pv
BL	2.1570	95.42	8.38	120		0.070007	86'-2"	Pf 10.817
330	14'-11	20.71		17.090		Flow (q) from Route 9	68'-3"	Pe 0.759
322	13'-2			28.666		13fE(4'-3 1/2), PO(12'-3 1/2)	154'-6	Pv
CM	4.2600	822.55	18.52	120		0.136924	26'-3	Pf 9.724
322	13'-2			28.666			44'-9	Pe -0.004
7	13'-2			38.386		5fE(8'-11 1/2)	71'-0	Pv
FR	4.2600	822.55	18.52	120		0.136924	6'-11"	Pf 9.970
7	13'-2			38.386			65'-10	Pe 2.822
4	6'-8			51.178		f(-0.000), CV(28'-11 1/2), BV(15'-9 1/2), ft(21'-1)	72'-10	Pv
UG	6.0650	822.55	9.13	120		0.024509	12'-8	Pf 4.232
4	6'-8			51.178			39'-0	Pe 5.491
2	-6'-0			60.901		ft(25'-0), BFP(-2.966), E(14'-0)	51'-8	Pv
UG	6.3400	822.55	8.36	140		0.014848	23'-0	Pf 0.415
2	-6'-0			60.901			4'-11"	Pe
1	-6'-0			61.316		GV(4'-11 1/2), S	27'-11"	Pv
		250.00				Hose Allowance At Source		
1		1072.55						
Route 2								
DR	1.0490	20.42	7.58	120		0.135200	7'-2"	Pf 5.166
126	10'-0	20.42	5.6	13.293		Sprinkler	31'-0	Pe -2.132
345	14'-11			16.328		2E(2'-0), PO(5'-0), fd(22'-0)	38'-2"	Pv
BL	2.1570	11.84	1.04	120		0.001474	9'-7"	Pf 0.014
345	14'-11			16.328			9'-7"	Pe
337	14'-11			16.342			9'-7"	Pv
Route 3								
SP	1.0490	20.49	7.61	120		0.136062	4'-8	Pf 5.126
123	10'-0	20.49	5.6	13.385		Sprinkler	33'-0	Pe -1.572
347	13'-7 1/2			16.939		3E(2'-0), PO(5'-0), fd(22'-0)	37'-8	Pv
CM	4.2600	102.50	2.31	120		0.002906	6'-4"	Pf 0.123
347	13'-7 1/2	82.02		16.939		Flow (q) from Route 12	35'-10	Pe
355	13'-7 1/2			17.061		4fE(8'-11 1/2)	42'-2	Pv
CM	4.2600	123.32	2.78	120		0.004091	9'-0	Pf 0.037
355	13'-7 1/2	20.82		17.061		Flow (q) from Route 16	9'-0	Pe
362	13'-7 1/2			17.098			9'-0	Pv
CM	4.2600	144.17	3.25	120		0.005462	9'-0"	Pf 0.098
362	13'-7 1/2	20.84		17.098		Flow (q) from Route 17	8'-11"	Pe
367	13'-7 1/2			17.196		fE(8'-11 1/2)	18'-0	Pv
CM	4.2600	233.60	5.26	120		0.013338	0'-9	Pf 0.010
367	13'-7 1/2	89.43		17.196		Flow (q) from Route 29	0'-9	Pe
366	13'-7 1/2			17.206			0'-9	Pv
CM	4.2600	254.83	5.74	120		0.015667	7'-1"	Pf 0.112
366	13'-7 1/2	21.23		17.206		Flow (q) from Route 30	7'-1"	Pe
363	13'-7 1/2			17.318			7'-1"	Pv
CM	4.2600	275.72	6.21	120		0.018125	1'-4"	Pf 0.025
363	13'-7 1/2	20.89		17.318		Flow (q) from Route 19	1'-4"	Pe
361	13'-7 1/2			17.343			1'-4"	Pv
CM	4.2600	318.84	7.18	120		0.023716	7'-4	Pf 0.174
361	13'-7 1/2	43.13		17.343		Flow (q) from Route 4	7'-4	Pe
358	13'-7 1/2			17.518			7'-4	Pv
CM	4.2600	361.50	8.14	120		0.029918	2'-3	Pf 0.068
358	13'-7 1/2	42.66		17.518		Flow (q) from Route 8	2'-3	Pe
356	13'-7 1/2			17.586			2'-3	Pv
CM	4.2600	382.54	8.61	120		0.033219	6'-2"	Pf 0.206
356	13'-7 1/2	21.04		17.586		Flow (q) from Route 25	6'-2"	Pe
350	13'-7 1/2			17.792			6'-2"	Pv
CM	4.2600	320.73	7.22	120		0.023976	11'-8	Pf 1.139
350	13'-7 1/2			17.792			35'-10	Pe 0.000
344	13'-7 1/2			18.931		4fE(8'-11 1/2)	47'-6	Pv

Hydraulic Analysis

Job Number: 1250
Report Description: Level 1

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
CM	4.2600	266.36	6.00	120		0.017004	4'-5½"	Pf 0.076
344	13'-7½"			18.931				Pe
339	13'-7½"			19.006			4'-5½"	Pv
BL	2.1570	57.97	5.09	120		0.027839	103'-10½"	Pf 3.937
339	13'-7½"			19.006		PO(12'-3½")	37'-6½"	Pe 0.199
305	13'-2			23.142		3fE(4'-3½"), PO(12'-3½")	141'-5"	Pv
CM	4.2600	266.36	6.00	120		0.017004	2'-7"	Pf 0.044
305	13'-2	208.40		23.142		Flow (q) from Route 38		Pe
306	13'-2			23.185			2'-7"	Pv
CM	4.2600	320.73	7.22	120		0.023976	54'-6½"	Pf 2.456
306	13'-2	54.36		23.185		Flow (q) from Route 43	47'-11"	Pe
307	13'-2			25.642		fE(8'-11½"), 4fEE(4'-5½"), fT(21'-1")	102'-5½"	Pv
CM	4.2600	382.54	8.61	120		0.033219	8'-6"	Pf 0.282
307	13'-2	61.82		25.642		Flow (q) from Route 42		Pe
308	13'-2			25.923			8'-6"	Pv
CM	4.2600	465.13	10.47	120		0.047692	3'-11"	Pf 0.186
308	13'-2	82.59		25.923		Flow (q) from Route 6		Pe
309	13'-2			26.110			3'-11"	Pv
CM	4.2600	559.29	12.59	120		0.067074	10'-4½"	Pf 0.696
309	13'-2	94.16		26.110		Flow (q) from Route 7		Pe
310	13'-2			26.806			10'-4½"	Pv
CM	4.2600	639.73	14.40	120		0.086005	10'-3"	Pf 0.882
310	13'-2	80.44		26.806		Flow (q) from Route 10		Pe
314	13'-2			27.688			10'-3"	Pv
CM	4.2600	727.13	16.37	120		0.108996	8'-11½"	Pf 0.978
314	13'-2	87.40		27.688		Flow (q) from Route 5		Pe
322	13'-2			28.666			8'-11½"	Pv
Route 4								
DR	1.0490	20.49	7.61	120		0.136116	5'-9"	Pf 5.000
125	10'-0	20.49	5.6	13.390		Sprinkler	31'-0"	Pe -1.933
349	14'-5½"			16.457		2E(2'-0"), PO(5'-0"), fd(22'-0")	36'-9"	Pv
BL	2.1570	22.25	1.95	120		0.004736	2'-9"	Pf 0.013
349	14'-5½"	1.76		16.457		Flow (q) from Route 51		Pe
353	14'-5½"			16.471			2'-9"	Pv
BL	2.1570	43.13	3.79	120		0.016111	10'-10"	Pf 0.512
353	14'-5½"	20.88		16.471		Flow (q) from Route 18	20'-11"	Pe 0.361
361	13'-7½"			17.343		2fE(4'-3½"), PO(12'-3½")	31'-9"	Pv
Route 5								
AO	1.0490	20.53	7.62	120		0.136583	5'-2"	Pf 4.667
131	10'-0	20.53	5.6	13.440		Sprinkler	29'-0"	Pe -2.132
359	14'-11			15.975		E(2'-0"), PO(5'-0"), fd(22'-0")	34'-2"	Pv
BL	2.1570	41.31	3.63	120		0.014879	3'-10½"	Pf 0.369
359	14'-11	20.78		15.975		Flow (q) from Route 15	20'-11"	Pe 0.560
357	13'-7½"			16.904		2fE(4'-3½"), PO(12'-3½")	24'-9½"	Pv
CM	4.2600	41.31	0.93	120		0.000541	4'-7½"	Pf 0.003
357	13'-7½"			16.904				Pe
351	13'-7½"			16.907			4'-7½"	Pv
CM	4.2600	49.89	1.12	120		0.000767	8'-9½"	Pf 0.007
351	13'-7½"	8.58		16.907		Flow (q) from Route 53		Pe
342	13'-7½"			16.913			8'-9½"	Pv
BL	2.1570	23.54	2.07	120		0.005257	7'-0½"	Pf 0.124
342	13'-7½"			16.913		PO(12'-3½")	16'-7½"	Pe -0.560
333	14'-11			16.478		fE(4'-3½")	23'-7½"	Pv
BL	2.1570	44.65	3.92	120		0.017176	10'-1½"	Pf 0.174
333	14'-11	21.10		16.478		Flow (q) from Route 26		Pe
325	14'-11			16.652			10'-1½"	Pv
BL	2.1570	65.58	5.76	120		0.034980	13'-11½"	Pf 1.092
325	14'-11	20.93		16.652		Flow (q) from Route 21	17'-3"	Pe 0.000
319	14'-11			17.743		4fE(4'-3½")	31'-2½"	Pv
BL	2.1570	87.40	7.67	120		0.059513	86'-0¼"	Pf 9.186
319	14'-11	21.82		17.743		Flow (q) from Route 35	68'-3½"	Pe 0.759
314	13'-2			27.688		13fE(4'-3½"), PO(12'-3½")	154'-4"	Pv
Route 6								
DR	1.0490	20.65	7.67	120		0.138111	8'-1½"	Pf 5.402
111	9'-0	20.65	5.6	13.603		Sprinkler	31'-0"	Pe -2.565
326	14'-11			16.440		2E(2'-0"), PO(5'-0"), fd(22'-0")	39'-1½"	Pv
BL	2.1570	19.81	1.74	120		0.003820	3'-2½"	Pf 0.012
326	14'-11			16.440				Pe
323	14'-11			16.452			3'-2½"	Pv
BL	2.1570	41.07	3.61	120		0.014715	7'-9½"	Pf 0.115
323	14'-11	21.25		16.452		Flow (q) from Route 32		Pe
317	14'-11			16.567			7'-9½"	Pv

Hydraulic Analysis

Job Number: 1250
Report Description: Level 1

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.1570	61.81	5.43	120		0.031351	2'-7"	Pf 0.081
317	14'-11"	20.74		16.567		Flow (q) from Route 11	31'-0"	Pe -2.132
315	14'-11"			16.648			2'-7"	Pv
BL	2.1570	82.59	7.25	120		0.053593	107'-10"	Pf 8.517
315	14'-11"	20.78		16.648		Flow (q) from Route 14	51'-1"	Pe 0.759
308	13'-2"			25.923		9fE(4'-3½"), PO(12'-3½")	158'-11"	Pv
Route 7								
SP	1.0490	20.66	7.67	120		0.138187	5'-5½"	Pf 5.039
107	10'-0"	20.66	5.6	13.611		Sprinkler	31'-0"	Pe -2.132
316	14'-11"			16.518		2E(2'-0"), PO(5'-0"), fd(22'-0")	36'-5½"	Pv
BL	2.1570	52.24	4.59	120		0.022971	8'-6"	Pf 0.195
316	14'-11"	31.58		16.518		Flow (q) from Route 28	8'-6"	Pe
312	14'-11"			16.713				Pv
BL	2.1570	73.24	6.43	120		0.042909	7'-10"	Pf 0.337
312	14'-11"	20.99		16.713		Flow (q) from Route 23		Pe
311	14'-11"			17.050			7'-10"	Pv
BL	2.1570	94.16	8.27	120		0.068300	87'-8"	Pf 8.301
311	14'-11"	20.92		17.050		Flow (q) from Route 20	33'-10"	Pe 0.759
309	13'-2"			26.110		5fE(4'-3½"), PO(12'-3½")	121'-6½"	Pv
Route 8								
AO	1.0490	20.67	7.67	120		0.138348	7'-10½"	Pf 5.377
117	9'-0"	20.67	5.6	13.628		Sprinkler	31'-0"	Pe -2.366
335	14'-5½"			16.639		2E(2'-0"), PO(5'-0"), fd(22'-0")	38'-10½"	Pv
BL	2.1570	21.52	1.89	120		0.004450	9'-7½"	Pf 0.043
335	14'-5½"	0.84		16.639		Flow (q) from Route 47		Pe
346	14'-5½"			16.681			9'-7½"	Pv
BL	2.1570	42.66	3.75	120		0.015788	9'-2"	Pf 0.475
346	14'-5½"	21.14		16.681		Flow (q) from Route 27	20'-11"	Pe 0.361
358	13'-7½"			17.518		2fE(4'-3½"), PO(12'-3½")	30'-1"	Pv
Route 9								
DR	1.0490	20.71	7.69	120		0.138794	8'-11½"	Pf 5.546
120	10'-0"	20.71	5.6	13.675		Sprinkler	31'-0"	Pe -2.132
330	14'-11"			17.090		2E(2'-0"), PO(5'-0"), fd(22'-0")	39'-11½"	Pv
Route 10								
DR	1.0490	20.73	7.69	120		0.139023	6'-6"	Pf 5.491
108	10'-0"	20.73	5.6	13.700		Sprinkler	33'-0"	Pe -2.132
318	14'-11"			17.059		3E(2'-0"), PO(5'-0"), fd(22'-0")	39'-6"	Pv
BL	2.1570	59.00	5.18	120		0.028768	16'-2"	Pf 0.961
318	14'-11"	38.27		17.059		Flow (q) from Route 52	17'-3"	Pe
313	14'-11"			18.020		4fE(4'-3½")	33'-5"	Pv
BL	2.1570	80.44	7.06	120		0.051044	88'-11½"	Pf 8.027
313	14'-11"	21.44		18.020		Flow (q) from Route 33	68'-3½"	Pe 0.759
310	13'-2"			26.806		13fE(4'-3½"), PO(12'-3½")	157'-3"	Pv
Route 11								
AO	1.0490	20.74	7.70	120		0.139222	7'-10½"	Pf 5.411
104	9'-0"	20.74	5.6	13.721		Sprinkler	31'-0"	Pe -2.565
317	14'-11"			16.567		2E(2'-0"), PO(5'-0"), fd(22'-0")	38'-10½"	Pv
Route 12								
AO	1.0490	20.74	7.70	120		0.139229	3'-6½"	Pf 4.531
114	10'-0"	20.74	5.6	13.722		Sprinkler	29'-0"	Pe -1.861
329	14'-3½"			16.393		E(2'-0"), T(5'-0"), fd(22'-0")	32'-6½"	Pv
SP	1.3800	20.74	4.45	120		0.036618	0'-8"	Pf 0.244
329	14'-3½"			16.393			6'-0"	Pe 0.289
331	13'-7½"			16.926		PO(6'-0")	6'-8"	Pv
CM	4.2600	29.58	0.67	120		0.000292	1'-3"	Pf 0.000
331	13'-7½"	8.84		16.926		Flow (q) from Route 13		Pe
336	13'-7½"			16.926			1'-3"	Pv
CM	4.2600	19.14	0.43	120		0.000130	2'-11"	Pf 0.000
336	13'-7½"			16.926				Pe
341	13'-7½"			16.927			2'-11"	Pv
CM	4.2600	62.82	1.41	120		0.001175	8'-9"	Pf 0.010
341	13'-7½"	43.68		16.927		Flow (q) from Route 31		Pe
348	13'-7½"			16.937			8'-9"	Pv
CM	4.2600	82.02	1.85	120		0.001924	0'-11½"	Pf 0.002
348	13'-7½"	19.19		16.937		Flow (q) from Route 22		Pe
347	13'-7½"			16.939			0'-11½"	Pv
Route 13								
AO	1.0490	20.76	7.71	120		0.139471	4'-11½"	Pf 4.738
119	10'-0"	20.76	5.6	13.748		Sprinkler	29'-0"	Pe -1.572
338	13'-7½"			16.914		E(2'-0"), PO(5'-0"), fd(22'-0")	33'-11½"	Pv
CM	4.2600	47.11	1.06	120		0.000690	8'-6½"	Pf 0.012
338	13'-7½"	26.35		16.914		Flow (q) from Route 50	8'-11½"	Pe
332	13'-7½"			16.926		fE(8'-11½")	17'-6"	Pv

Hydraulic Analysis

Job Number: 1250
Report Description: Level 1

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
CM	4.2600	8.84	0.20	120		0.000031	0'-10"	Pf 0.000
332	13'-7½"			16.926			31'-0"	Pe -2.565
331	13'-7½"			16.926			0'-10"	Pv
Route 14								
DR	1.0490	20.78	7.71	120		0.139670	7'-11½"	Pf 5.444
105	9'-0"	20.78	5.6	13.769		Sprinkler	31'-0"	Pe -2.565
315	14'-11"			16.648		2E(2'-0), PO(5'-0), fd(22'-0)	38'-11½"	Pv
Route 15								
DR	1.0490	20.78	7.72	120		0.139713	3'-8"	Pf 4.285
134	10'-0"	20.78	5.6	13.773		Sprinkler	27'-0"	Pe -2.132
364	14'-11"			15.926		PO(5'-0), fd(22'-0)	30'-8"	Pv
BL	2.1570	20.78	1.82	120		0.004174	11'-8"	Pf 0.049
364	14'-11"			15.926				Pe
359	14'-11"			15.975			11'-8"	Pv
Route 16								
AO	1.0490	20.82	7.73	120		0.140201	3'-6½"	Pf 4.562
128	10'-0"	20.82	5.6	13.825		Sprinkler	29'-0"	Pe -1.861
354	14'-3½"			16.526		E(2'-0), T(5'-0), fd(22'-0)	32'-6½"	Pv
SP	1.3800	20.82	4.47	120		0.036874	0'-8"	Pf 0.246
354	14'-3½"			16.526			6'-0"	Pe 0.289
355	13'-7½"			17.061		PO(6'-0)	6'-8"	Pv
Route 17								
AO	1.0490	20.84	7.74	120		0.140462	3'-6½"	Pf 4.570
132	10'-0"	20.84	5.6	13.853		Sprinkler	29'-0"	Pe -1.861
360	14'-3½"			16.563		E(2'-0), T(5'-0), fd(22'-0)	32'-6½"	Pv
SP	1.3800	20.84	4.47	120		0.036942	0'-8"	Pf 0.246
360	14'-3½"			16.563			6'-0"	Pe 0.289
362	13'-7½"			17.098		PO(6'-0)	6'-8"	Pv
Route 18								
DR	1.0490	20.88	7.75	120		0.140904	2'-11½"	Pf 4.503
127	10'-0"	20.88	5.6	13.900		Sprinkler	29'-0"	Pe -1.933
353	14'-5½"			16.471		E(2'-0), PO(5'-0), fd(22'-0)	31'-11½"	Pv
Route 19								
SP	1.0490	20.89	7.75	120		0.141018	4'-3½"	Pf 4.977
133	10'-0"	20.89	5.6	13.913		Sprinkler	31'-0"	Pe -1.572
363	13'-7½"			17.318		2E(2'-0), PO(5'-0), fd(22'-0)	35'-3½"	Pv
Route 20								
SP	1.0490	20.92	7.77	120		0.141414	5'-11½"	Pf 5.227
101	10'-0"	20.92	5.6	13.955		Sprinkler	31'-0"	Pe -2.132
311	14'-11"			17.050		2E(2'-0), PO(5'-0), fd(22'-0)	36'-11½"	Pv
Route 21								
AO	1.0490	20.93	7.77	120		0.141576	5'-0"	Pf 4.811
109	10'-0"	20.93	5.6	13.972		Sprinkler	29'-0"	Pe -2.132
325	14'-11"			16.652		E(2'-0), PO(5'-0), fd(22'-0)	34'-0"	Pv
Route 22								
DR	1.0490	20.95	7.78	120		0.141780	4'-0"	Pf 4.395
118	10'-0"	20.95	5.6	13.994		Sprinkler	27'-0"	Pe -2.276
343	15'-3"			16.113		PO(5'-0), fd(22'-0)	31'-0"	Pv
BL	2.1570	19.19	1.68	120		0.003602	7'-11½"	Pf 0.119
343	15'-3"			16.113			25'-2½"	Pe 0.704
348	13'-7½"			16.937		3fE(4'-3½), PO(12'-3½)	33'-2"	Pv
Route 23								
DR	1.0490	20.99	7.79	120		0.142329	4'-8"	Pf 4.792
102	10'-0"	20.99	5.6	14.052		Sprinkler	29'-0"	Pe -2.132
312	14'-11"			16.713		E(2'-0), PO(5'-0), fd(22'-0)	33'-8"	Pv
Route 24								
DR	1.0490	21.03	7.81	120		0.142771	3'-8"	Pf 4.378
116	10'-0"	21.03	5.6	14.100		Sprinkler	27'-0"	Pe -2.132
340	14'-11"			16.346		PO(5'-0), fd(22'-0)	30'-8"	Pv
Route 25								
SP	1.0490	21.04	7.81	120		0.142900	4'-3½"	Pf 5.044
130	10'-0"	21.04	5.6	14.113		Sprinkler	31'-0"	Pe -1.572
356	13'-7½"			17.586		2E(2'-0), PO(5'-0), fd(22'-0)	35'-3½"	Pv
Route 26								
DR	1.0490	21.10	7.83	120		0.143727	3'-8"	Pf 4.408
115	10'-0"	21.10	5.6	14.202		Sprinkler	27'-0"	Pe -2.132
333	14'-11"			16.478		PO(5'-0), fd(22'-0)	30'-8"	Pv
Route 27								
DR	1.0490	21.14	7.85	120		0.144243	3'-2½"	Pf 4.357
122	10'-0"	21.14	5.6	14.257		Sprinkler	27'-0"	Pe -1.933
346	14'-5½"			16.681		PO(5'-0), fd(22'-0)	30'-2½"	Pv
Route 28

Hydraulic Analysis

Job Number: 1250
Report Description: Level 1

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
DR	1.0490	21.14	7.85	120		0.144248	2'-8"	Pf 4.279
110	10'-0"	21.14	5.6	14.257		Sprinkler	27'-0"	Pe -2.132
320	14'-11"			16.405		PO(5'-0), fd(22'-0)	29'-8"	Pv
BL	2.1570	31.58	2.77	120		0.009054	8'-2"	Pf 0.113
320	14'-11"	10.44		16.405		Flow (q) from Route 41	4'-3½"	Pe
316	14'-11"			16.518		fE(4'-3½)	12'-5½"	Pv
Route 29								
SP	1.0490	21.15	7.85	120		0.144339	0'-4"	Pf 0.770
137	14'-7½"	21.15	5.6	14.267		Sprinkler	5'-0"	Pe 0.145
369	14'-3½"			15.181		PO(5'-0)	5'-4"	Pv
BL	2.1570	89.43	7.85	120		0.062095	6'-10½"	Pf 1.726
369	14'-3½"	68.28		15.181		Flow (q) from Route 36	20'-11"	Pe 0.289
367	13'-7½"			17.196		2fE(4'-3½), PO(12'-3½)	27'-9½"	Pv
Route 30								
AO	1.0490	21.23	7.88	120		0.145311	5'-6½"	Pf 5.019
135	8'-0"	21.23	5.6	14.371		Sprinkler	29'-0"	Pe -2.728
365	14'-3½"			16.663		E(2'-0), T(5'-0), fd(22'-0)	34'-6½"	Pv
SP	1.3800	21.23	4.55	120		0.038218	0'-8"	Pf 0.255
365	14'-3½"			16.663			6'-0"	Pe 0.289
366	13'-7½"			17.206		PO(6'-0)	6'-8"	Pv
Route 31								
AO	1.0490	21.24	7.89	120		0.145463	4'-2"	Pf 1.624
129	14'-9½"	21.24	5.6	14.387		Sprinkler	7'-0"	Pe 0.023
352	14'-9"			16.034		E(2'-0), PO(5'-0)	11'-2"	Pv
BL	2.1570	21.24	1.86	120		0.004346	5'-6"	Pf 0.024
352	14'-9"			16.034				Pe
124	14'-9"			16.058			5'-6"	Pv
BL	2.1570	43.68	3.84	120		0.016495	6'-5½"	Pf 0.381
124	14'-9"	22.44	5.6	16.058		Sprinkler	16'-7½"	Pe 0.488
341	13'-7½"			16.927		fE(4'-3½), PO(12'-3½)	23'-1"	Pv
Route 32								
DR	1.0490	21.25	7.89	120		0.145633	4'-8"	Pf 4.612
112	9'-0"	21.25	5.6	14.405		Sprinkler	27'-0"	Pe -2.565
323	14'-11"			16.452		PO(5'-0), fd(22'-0)	31'-8"	Pv
Route 33								
DR	1.0490	21.44	7.96	120		0.147993	6'-1½"	Pf 5.494
103	10'-0"	21.44	5.6	14.658		Sprinkler	31'-0"	Pe -2.132
313	14'-11"			18.020		2E(2'-0), PO(5'-0), fd(22'-0)	37'-1½"	Pv
Route 34								
DR	1.0490	21.45	7.96	120		0.148069	3'-8"	Pf 4.541
113	10'-0"	21.45	5.6	14.666		Sprinkler	27'-0"	Pe -2.132
328	14'-11"			17.075		PO(5'-0), fd(22'-0)	30'-8"	Pv
Route 35								
DR	1.0490	21.82	8.10	120		0.152914	3'-8"	Pf 4.689
106	10'-0"	21.82	5.6	15.185		Sprinkler	27'-0"	Pe -2.132
319	14'-11"			17.743		PO(5'-0), fd(22'-0)	30'-8"	Pv
Route 36								
AO	1.0490	22.45	8.33	120		0.161165	1'-2½"	Pf 0.997
138	7'-0"	22.45	5.6	16.073		Sprinkler	5'-0"	Pe 0.019
370	6'-11½"			17.090		PO(5'-0)	6'-2½"	Pv
BL	2.1570	45.47	3.99	120		0.017767	8'-10"	Pf 0.310
370	6'-11½"			17.090			8'-7½"	Pe -0.813
139	8'-10"			16.587		2fE(4'-3½)	17'-5"	Pv
BL	2.1570	68.28	5.99	120		0.037690	12'-7"	Pf 0.961
139	8'-10"	22.81	5.6	16.587		Sprinkler	12'-11"	Pe -2.366
369	14'-3½"			15.181		3fE(4'-3½)	25'-6"	Pv
Route 37								
AO	1.0490	23.02	8.55	120		0.168805	0'-9"	Pf 0.967
136	5'-0"	23.02	5.6	16.899		Sprinkler	5'-0"	Pe 0.023
368	4'-11"			17.889		PO(5'-0)	5'-9"	Pv
BL	2.1570	23.02	2.02	120		0.005043	7'-2½"	Pf 0.080
368	4'-11"			17.889			8'-7½"	Pe -0.879
370	6'-11½"			17.090		2fE(4'-3½)	15'-10"	Pv
Route 38								
CM	4.2600	208.40	4.69	120		0.010799	5'-1"	Pf 0.055
304	13'-2"	160.88		23.087		Flow (q) from Route 39		Pe
305	13'-2"			23.142			5'-1"	Pv
Route 39								
CM	4.2600	108.41	2.44	120		0.003223	8'-8"	Pf 0.028
327	13'-7½"	160.88		19.155		Flow (q) from Route 44		Pe
324	13'-7½"			19.183			8'-8"	Pv

Hydraulic Analysis

Job Number: 1250
Report Description: Level 1

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.1570	54.32	4.77	120		0.024688	103'-8½"	Pf 3.593
324	13'-7½"			19.183		PO(12'-3½")	41'-10"	Pe 0.199
302	13'-2"			22.975		4fE(4'-3½"), PO(12'-3½")	145'-6½"	Pv
CM	4.2600	108.41	2.44	120		0.003223	6'-10"	Pf 0.022
302	13'-2"	54.09		22.975		Flow (q) from Route 46		Pe
303	13'-2"			22.998			6'-10"	Pv
CM	4.2600	160.88	3.62	120		0.006690	13'-4"	Pf 0.089
303	13'-2"	52.47		22.998		Flow (q) from Route 40		Pe
304	13'-2"			23.087			13'-4"	Pv
Route 40								
DY	2.1570	52.47	4.61	120		0.023152	102'-0"	Pf 3.643
327	13'-7½"	160.88		19.155		PO(12'-3½"), Flow (q) from Route 44	55'-4½"	Pe 0.199
303	13'-2"			22.998		2fEe2(2'-5½"), 6fE(4'-3½"), PO(12'-3½")	157'-4½"	Pv
Route 41								
BL	2.1570	10.44	0.92	120		0.001168	12'-3½"	Pf 0.039
336	13'-7½"			16.926		PO(12'-3½")	21'-0½"	Pe -0.560
320	14'-11"			16.405		fE(4'-3½"), 2fEE(2'-2½")	33'-4"	Pv
Route 42								
BL	2.1570	61.82	5.43	120		0.031357	146'-2"	Pf 7.651
350	13'-7½"			17.792		PO(12'-3½")	97'-10"	Pe 0.199
307	13'-2"			25.642		17fE(4'-3½"), PO(12'-3½")	244'-0"	Pv
Route 43								
BL	2.1570	54.36	4.77	120		0.024724	113'-7"	Pf 4.056
344	13'-7½"			18.931		PO(12'-3½")	50'-5½"	Pe 0.199
306	13'-2"			23.185		6fE(4'-3½"), PO(12'-3½")	164'-0½"	Pv
Route 44								
CM	4.2600	160.88	3.62	120		0.006690	12'-2½"	Pf 0.082
334	13'-7½"	208.40		19.074		Flow (q) from Route 49		Pe
327	13'-7½"			19.155			12'-2½"	Pv
Route 45								
BL	2.1570	47.52	4.17	120		0.019276	104'-3"	Pf 3.814
334	13'-7½"	208.40		19.074		PO(12'-3½"), Flow (q) from Route 49	93'-7½"	Pe 0.199
304	13'-2"			23.087		2fEE(2'-2½"), 15fE(4'-3½"), PO(12'-3½")	197'-10½"	Pv
Route 46								
CM	4.2600	54.09	1.22	120		0.000891	6'-1½"	Pf 0.005
301	13'-2"	54.09		22.970		Flow (q) from Route 48		Pe
302	13'-2"			22.975			6'-1½"	Pv
Route 47								
BL	2.1570	0.84	0.07	120		0.000011	6'-0"	Pf 0.000
326	14'-11"			16.440			8'-7½"	Pe 0.199
335	14'-5½"			16.639		2fE(4'-3½")	14'-7½"	Pv
Route 48								
CM	4.2600	54.09	1.22	120		0.000891	6'-9½"	Pf 0.006
324	13'-7½"			19.183				Pe
321	13'-7½"			19.189			6'-9½"	Pv
BL	2.1570	54.09	4.75	120		0.024496	104'-4½"	Pf 3.582
321	13'-7½"			19.189		PO(12'-3½")	41'-10"	Pe 0.199
301	13'-2"			22.970		4fE(4'-3½"), PO(12'-3½")	146'-2½"	Pv
Route 49								
CM	4.2600	208.40	4.69	120		0.010799	6'-2½"	Pf 0.067
339	13'-7½"			19.006				Pe
334	13'-7½"			19.074			6'-2½"	Pv
Route 50								
CM	4.2600	26.35	0.59	120		0.000235	1'-4"	Pf 0.000
342	13'-7½"			16.913				Pe
338	13'-7½"			16.914			1'-4"	Pv
Route 51								
BL	2.1570	1.76	0.15	120		0.000043	15'-8"	Pf 0.001
343	15'-3"			16.113			12'-11"	Pe 0.343
349	14'-5½"			16.457		3fE(4'-3½")	28'-7"	Pv
Route 52								
BL	2.1570	38.27	3.36	120		0.012918	19'-10"	Pf 0.693
332	13'-7½"			16.926		PO(12'-3½")	33'-10"	Pe -0.560
318	14'-11"			17.059		5fE(4'-3½")	53'-8"	Pv
Route 53								
BL	2.1570	8.58	0.75	120		0.000812	7'-0½"	Pf 0.019
345	14'-11"			16.328			16'-7½"	Pe 0.560
351	13'-7½"			16.907		fE(4'-3½"), PO(12'-3½")	23'-7½"	Pv

Hydraulic Analysis

Job Number: 1250
Report Description: Level 1

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure										
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary										
Upstream							Total Length											
Equivalent Pipe Lengths of Valves and Fittings (C=120 only)					C Value Multiplier													
$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$					<table border="1"> <tr> <td>Value Of C</td> <td>100</td> <td>130</td> <td>140</td> <td>150</td> </tr> <tr> <td>Multiplying Factor</td> <td>0.713</td> <td>1.16</td> <td>1.33</td> <td>1.51</td> </tr> </table>				Value Of C	100	130	140	150	Multiplying Factor	0.713	1.16	1.33	1.51
Value Of C	100	130	140	150														
Multiplying Factor	0.713	1.16	1.33	1.51														
Pipe Type Legend		Units Legend			Fittings Legend													
AO Arm-Over BL Branch Line CM Cross Main DN Drain DR Drop DY Dynamic FM Feed Main FR Feed Riser MS Miscellaneous OR Outrigger RN Riser Nipple SP Sprig ST Stand Pipe UG Underground		Diameter Inch Elevation Foot Flow gpm Discharge gpm Velocity fps Pressure psi Length Foot Friction Loss psi/Foot HWC Hazen-Williams Constant Pt Total pressure at a point in a pipe Pn Normal pressure at a point in a pipe Pf Pressure loss due to friction between points Pe Pressure due to elevation difference between indicated points Pv Velocity pressure at a point in a pipe			ALV Alarm Valve AngV Angle Valve b Bushing BalV Ball Valve BFP Backflow Preventer BV Butterfly Valve C Cross Flow Turn 90° cplg Coupling Cr Cross Run CV Check Valve DelV Deluge Valve DPV Dry Pipe Valve E 90° Elbow EE 45° Elbow Ee1 11¼° Elbow Ee2 22½° Elbow f Flow Device fd Flex Drop FDC Fire Department Connection fE 90° FireLock(TM) Elbow fEE 45° FireLock(TM) Elbow flg Flange FN Floating Node fT FireLock(TM) Tee g Gauge GloV Globe Valve GV Gate Valve Ho Hose Hose Hose HV Hose Valve Hyd Hydrant LtE Long Turn Elbow mecT Mechanical Tee Noz Nozzle P1 Pump In P2 Pump Out PIV Post Indicating Valve PO Pipe Outlet PRV Pressure Reducing Valve PrV Pressure Relief Valve red Reducer/Adapter S Supply sCV Swing Check Valve Spr Sprinkler St Strainer T Tee Flow Turn 90° Tr Tee Run U Union WirF Wirsbo WMV Water Meter Valve Z Cap

Hydraulic Summary

Job Number: 1250
Report Description: Level 2

Job											
Job Number 1250				Design Engineer Randy Ralston							
Job Name: Solar Energy Research Center				State Certification/License Number C16 - 629778							
Address 1 Building 30, McMillan Road				AHJ California State Fire Marshal							
Address 2 Berkeley, CA 94720				Job Site/Building SERC/Building 30							
Address 3				Drawing Name FP 02 - Submittal.cad							
System				Remote Area(s)							
Most Demanding Sprinkler Data 5.6 K-Factor 22.10 at 15.574				Occupancy Ordinary Group I				Job Suffix			
Hose Allowance At Source 250.00				Density 0.170gpm/ft²				Area of Application 3000.00ft² (Actual 3073.97ft²)			
Additional Hose Supplies <u>Node</u> <u>Flow(gpm)</u>				Number Of Sprinklers Calculated 37				Coverage Per Sprinkler 130.00ft²			
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area							
Total Hose Streams 250.00											
System Flow Demand 949.65		Total Water Required (Including Hose Allowance) 1199.65									
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 14.87 between nodes 318 and 321											
Maximum Velocity Under Ground 10.55 between nodes 2 and 8											
Volume capacity of Wet Pipes 3112.18gal		Volume capacity of Dry Pipes									
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1		250.00	90.000	67.000		2050.00	81.464		1199.65	62.412	19.052
Contractor											
Contractor Number 1250		Contact Name Andrew Murray					Contact Title				
Name of Contractor: McCarthy Construction						Phone 510-981-1810			Extension		
Address 1 343 Sansome Street, 14th Floor						FAX					
Address 2 San Francisco, CA 94104						E-mail AMurray@McCarthy.com					
Address 3						Web-Site

Supply at Node 1

Hydraulic Graph

Supply at Node 1

Static: Pressure
90.000

Residual: Pressure
67.000 @ 2050.00

Available Pressure at Time of Test
81.464 @ 1199.65

System Demand
62.412 @ 949.65

System Demand (Including Hose Allowance at Source)
62.412 @ 1199.65

Summary Of Outflowing Devices

Job Number: 1250
Report Description: Level 2

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
Sprinkler	101	27.59	22.10	5.6	24.279		
Sprinkler	102	27.51	22.10	5.6	24.136		
Sprinkler	103	27.46	22.10	5.6	24.053		
Sprinkler	104	27.87	22.10	5.6	24.776		
Sprinkler	105	27.32	22.10	5.6	23.799		
Sprinkler	106	25.21	22.10	5.6	20.265		
Sprinkler	107	27.85	22.10	5.6	24.733		
Sprinkler	108	27.28	22.10	5.6	23.738		
Sprinkler	109	25.77	22.10	5.6	21.176		
Sprinkler	110	26.70	22.10	5.6	22.728		
Sprinkler	111	25.70	22.10	5.6	21.055		
Sprinkler	112	27.66	22.10	5.6	24.403		
Sprinkler	113	26.61	22.10	5.6	22.573		
Sprinkler	114	25.66	22.10	5.6	20.990		
Sprinkler	115	24.93	22.10	5.6	19.820		
Sprinkler	116	25.49	22.10	5.6	20.724		
Sprinkler	117	26.21	22.10	5.6	21.902		
Sprinkler	118	27.64	22.10	5.6	24.361		
Sprinkler	119	24.87	22.10	5.6	19.729		
Sprinkler	120	25.03	22.10	5.6	19.974		
Sprinkler	121	24.96	22.10	5.6	19.867		
Sprinkler	122	24.90	22.10	5.6	19.775		
Sprinkler	123	25.57	22.10	5.6	20.846		
Sprinkler	124	22.95	22.10	5.6	16.798		
Sprinkler	125	25.48	22.10	5.6	20.699		
Sprinkler	126	24.85	22.10	5.6	19.691		
Sprinkler	127	25.37	22.10	5.6	20.520		
Sprinkler	128	25.42	22.10	5.6	20.604		
Sprinkler	129	24.63	22.10	5.6	19.345		
Sprinkler	130	24.88	22.10	5.6	19.737		
Sprinkler	131	24.59	22.10	5.6	19.277		
⇒ Sprinkler	132	22.10	22.10	5.6	15.574		
Sprinkler	133	24.70	22.10	5.6	19.458		
Sprinkler	134	25.39	22.10	5.6	20.564		
Sprinkler	135	24.41	22.10	5.6	19.001		
Sprinkler	136	24.59	22.10	5.6	19.284		
Sprinkler	137	24.49	22.10	5.6	19.123		

⇒ Most Demanding Sprinkler Data

Node Analysis

Job Number: 1250
Report Description: Level 2

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
1	-6'-3¾	S	62.412	949.65
101	27'-0	Spr(-24.279), fd(22'-0)	24.279	27.59
102	27'-0	Spr(-24.136), fd(22'-0)	24.136	27.51
103	27'-0	Spr(-24.053), fd(22'-0)	24.053	27.46
104	27'-0	Spr(-24.776), fd(22'-0)	24.776	27.87
105	27'-0	Spr(-23.799), fd(22'-0)	23.799	27.32
106	27'-0	Spr(-20.265), fd(22'-0)	20.265	25.21
107	27'-0	Spr(-24.733), fd(22'-0)	24.733	27.85
108	27'-0	Spr(-23.738), fd(22'-0)	23.738	27.28
109	27'-0	Spr(-21.176), fd(22'-0)	21.176	25.77
110	27'-0	Spr(-22.728), fd(22'-0)	22.728	26.70
111	27'-0	Spr(-21.055), fd(22'-0)	21.055	25.70
112	26'-0	Spr(-24.403), fd(22'-0)	24.403	27.66
113	27'-0	Spr(-22.573), fd(22'-0)	22.573	26.61
114	27'-0	Spr(-20.990), fd(22'-0)	20.990	25.66
115	27'-0	Spr(-19.820), fd(22'-0)	19.820	24.93
116	26'-0	Spr(-20.724), fd(22'-0)	20.724	25.49
117	27'-0	Spr(-21.902), fd(22'-0)	21.902	26.21
118	26'-0	Spr(-24.361), fd(22'-0)	24.361	27.64
119	27'-0	Spr(-19.729), fd(22'-0)	19.729	24.87
120	26'-0	Spr(-19.974), fd(22'-0)	19.974	25.03
121	27'-0	Spr(-19.867), fd(22'-0)	19.867	24.96
122	27'-0	Spr(-19.775), fd(22'-0)	19.775	24.90
123	26'-0	Spr(-20.846), fd(22'-0)	20.846	25.57
124	27'-0	Spr(-16.798), fd(22'-0)	16.798	22.95
125	27'-0	Spr(-20.699), fd(22'-0)	20.699	25.48
126	27'-0	Spr(-19.691), fd(22'-0)	19.691	24.85
127	26'-0	Spr(-20.520), fd(22'-0)	20.520	25.37
128	27'-0	Spr(-20.604), fd(22'-0)	20.604	25.42
129	27'-0	Spr(-19.345), fd(22'-0)	19.345	24.63
130	27'-0	Spr(-19.737), fd(22'-0)	19.737	24.88
131	30'-9¾	Spr(-19.277)	19.277	24.59
132	27'-0	Spr(-15.574), fd(22'-0)	15.574	22.10
133	30'-8	Spr(-19.458)	19.458	24.70
134	27'-0	Spr(-20.564), fd(22'-0)	20.564	25.39
135	27'-0	Spr(-19.001), fd(22'-0)	19.001	24.41
136	30'-2½	Spr(-19.284)	19.284	24.59
137	30'-2½	Spr(-19.123)	19.123	24.49
2	-6'-3¾	E(14'-0)	61.871	
8	7'-0½	BV(12'-7)	51.998	
9	12'-10¼	fE(12'-7)	49.021	
11	28'-4¼	fE(12'-7)	35.955	
301	28'-10½	PO(12'-3¾)	31.564	
302	28'-10½	PO(5'-0)	31.580	
303	28'-10½	PO(5'-0)	31.393	
304	28'-10½	PO(12'-3¾)	31.312	
305	28'-10½	PO(5'-0)	31.284	
306	30'-0	PO(5'-0)	30.361	
307	28'-10½	PO(5'-0)	31.183	
308	28'-10½	PO(12'-3¾)	31.193	
309	30'-0	PO(5'-0)	26.278	
310	30'-0	PO(5'-0)	26.220	
311	30'-0	PO(5'-0)	30.307	
312	30'-2½	PO(5'-0)	27.740	
313	28'-10½	PO(12'-3¾)	31.097	
314	28'-10½	PO(5'-0)	31.102	
315	30'-0	PO(5'-0)	25.677	
316	30'-0	PO(5'-0)	27.589	
317	28'-10½	PO(5'-0)	31.062	
318	28'-10½	PO(12'-3¾)	31.063	
319	30'-2½	PO(5'-0)	25.548	
320	30'-8	PO(5'-0)	23.961

Node Analysis

Job Number: 1250
Report Description: Level 2

Node	Elevation(Feet)	Fittings	Pressure(psi)	Discharge(gpm)
321	30'-3½"	PO(5'-0")	24.963	
322	30'-0"	PO(5'-0")	26.745	
323	28'-10½"	PO(12'-3¾")	31.007	
324	28'-10½"	PO(5'-0")	31.007	
325	30'-2½"	PO(5'-0")	24.130	
326	30'-3½"	PO(5'-0")	24.009	
327	30'-8"	PO(5'-0")	23.846	
328	30'-2½"	PO(5'-0")	24.014	
329	30'-3½"	PO(5'-0")	25.119	
330	30'-3"	PO(5'-0")	25.171	
331	30'-8"	PO(5'-0")	23.798	
332	30'-3½"	PO(5'-0")	24.704	
333	30'-8"	PO(5'-0")	20.126	
334	30'-3"	PO(5'-0")	25.051	
335	30'-2½"	PO(5'-0")	23.966	
336	30'-3½"	PO(5'-0")	23.451	
337	30'-8"	PO(5'-0")	19.392	
338	30'-3"	PO(5'-0")	25.001	
339	30'-3½"	PO(5'-0")	23.369	
340	30'-3½"	PO(5'-0")	23.367

Hydraulic Analysis

Job Number: 1250
Report Description: Level 2

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
DR	1.0490	22.10	8.20	120		0.156532	3'-6½"	Pf 5.407
132	27'-0"	22.10	5.6	15.574		Sprinkler	31'-0"	Pe -1.589
337	30'-8"			19.392		2E(2'-0"), PO(5'-0"), fd(22'-0")	34'-6½"	Pv
BL	2.1570	71.18	6.25	120		0.040707	1'-7½"	Pf 0.066
337	30'-8"			19.392				Pe
133	30'-8"			19.458			1'-7½"	Pv
BL	2.1570	95.88	8.42	120		0.070635	9'-5½"	Pf 0.668
133	30'-8"	24.70	5.6	19.458		Sprinkler		Pe
333	30'-8"			20.126			9'-5½"	Pv
BL	2.1570	118.83	10.43	120		0.105062	13'-10½"	Pf 3.721
333	30'-8"	22.95		20.126		Flow (q) from Route 2	21'-6½"	Pe 0.163
326	30'-3½"			24.009		5fE(4'-3½")	35'-5"	Pv
BL	2.1570	143.86	12.63	120		0.149625	6'-4½"	Pf 0.954
326	30'-3½"	25.03		24.009		Flow (q) from Route 13		Pe
321	30'-3½"			24.963			6'-4½"	Pv
BL	2.1570	169.36	14.87	120		0.202339	10'-6"	Pf 5.486
321	30'-3½"	25.49		24.963		Flow (q) from Route 19	16'-7½"	Pe 0.614
318	28'-10½"			31.063		fE(4'-3½"), PO(12'-3½")	27'-1½"	Pv
CM	6.3570	349.22	3.53	120		0.003995	8'-8"	Pf 0.035
318	28'-10½"	179.87		31.063		Flow (q) from Route 3		Pe -0.000
313	28'-10½"			31.097			8'-8"	Pv
CM	6.3570	478.33	4.84	120		0.007150	0'-8"	Pf 0.005
313	28'-10½"	129.11		31.097		Flow (q) from Route 16		Pe
314	28'-10½"			31.102			0'-8"	Pv
CM	6.3570	505.61	5.11	120		0.007923	10'-2¼"	Pf 0.081
314	28'-10½"	27.28		31.102		Flow (q) from Route 27		Pe
307	28'-10½"			31.183			10'-2¼"	Pv
CM	6.3570	532.93	5.39	120		0.008733	1'-1¼"	Pf 0.010
307	28'-10½"	27.32		31.183		Flow (q) from Route 28		Pe
308	28'-10½"			31.193			1'-1¼"	Pv
CM	6.3570	660.03	6.67	120		0.012972	7'-0"	Pf 0.091
308	28'-10½"	127.10		31.193		Flow (q) from Route 9		Pe
305	28'-10½"			31.284			7'-0"	Pv
CM	6.3570	687.49	6.95	120		0.013988	2'-0"	Pf 0.028
305	28'-10½"	27.46		31.284		Flow (q) from Route 29		Pe
304	28'-10½"			31.312			2'-0"	Pv
CM	6.3570	838.82	8.48	120		0.020212	4'-0"	Pf 0.081
304	28'-10½"	151.33		31.312		Flow (q) from Route 7		Pe
303	28'-10½"			31.393			4'-0"	Pv
CM	6.3570	866.33	8.76	120		0.021455	8'-0"	Pf 0.172
303	28'-10½"	27.51		31.393		Flow (q) from Route 30		Pe
301	28'-10½"			31.564			8'-0"	Pv
CM	6.3570	922.06	9.32	120		0.024078	0'-8"	Pf 0.016
301	28'-10½"	55.72		31.564		Flow (q) from Route 34		Pe
302	28'-10½"			31.580			0'-8"	Pv
CM	6.3570	949.65	9.60	120		0.025428	93'-10¼"	Pf 4.145
302	28'-10½"			31.580			69'-1¼"	Pe 0.230
11	28'-4¼"			35.955		5fE(12'-7"), fEE(6'-3½")	163'-0"	Pv
FR	6.3570	949.65	9.60	120		0.025428	64'-9¾"	Pf 6.348
11	28'-4¼"			35.955			184'-10"	Pe 6.719
9	12'-10¼"			49.021		f(-0.000), CV(40'-2¼"), BV(12'-7"), 6fE(12'-7"), fT(31'-5½"), 4fEE(6'-3½")	249'-7¾"	Pv
FR	6.3570	949.65	9.60	120		0.025428	5'-6¾"	Pf 0.461
9	12'-10¼"			49.021			12'-7"	Pe 2.515
8	7'-0½"			51.998		BV(12'-7")	18'-1¼"	Pv
UG	6.0650	949.65	10.55	120		0.031971	12'-8"	Pf 4.079
8	7'-0½"			51.998			14'-0"	Pe 5.794
2	-6'-3¾"			61.871		BFP(-3.227), E(14'-0")	26'-8"	Pv
UG	6.3400	949.65	9.65	140		0.019370	23'-0"	Pf 0.541
2	-6'-3¾"			61.871			4'-11½"	Pe
1	-6'-3¾"			62.412		GV(4'-11½"), S	27'-11¼"	Pv
		250.00				Hose Allowance At Source		
1		1199.65						
Route 2								
DR	1.0490	22.95	8.52	120		0.167873	2'-3¾"	Pf 4.917
124	27'-0"	22.95	5.6	16.798		Sprinkler	27'-0"	Pe -1.589
333	30'-8"			20.126		PO(5'-0"), fd(22'-0")	29'-3¾"	Pv
Route 3

Hydraulic Analysis

Job Number: 1250
Report Description: Level 2

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
DR	1.0490	24.41	9.06	120		0.188148	1'-9½"	Pf 5.793
135	27'-0"	24.41	5.6	19.001		Sprinkler	29'-0"	Pe -1.426
339	30'-3½"			23.369		E(2'-0"), PO(5'-0"), fd(22'-0")	30'-9½"	Pv
BL	2.1570	49.00	4.30	120		0.020400	4'-0½"	Pf 0.082
339	30'-3½"	24.59		23.369		Flow (q) from Route 5		Pe
336	30'-3½"			23.451			4'-0½"	Pv
BL	2.1570	73.63	6.46	120		0.043335	11'-8¼"	Pf 1.253
336	30'-3½"	24.63		23.451		Flow (q) from Route 6	17'-2¼"	Pe
332	30'-3½"			24.704		4fE(4'-3¾")	28'-11"	Pv
BL	2.1570	99.00	8.69	120		0.074936	5'-6½"	Pf 0.415
332	30'-3½"	25.37		24.704		Flow (q) from Route 15		Pe
329	30'-3½"			25.119			5'-6½"	Pv
BL	2.1570	124.56	10.94	120		0.114625	12'-2"	Pf 5.274
329	30'-3½"	25.57		25.119		Flow (q) from Route 20	33'-10"	Pe 0.614
323	28'-10½"			31.007		5fE(4'-3¾"), PO(12'-3¾")	46'-0¼"	Pv
CM	6.3570	124.56	1.26	120		0.000593	0'-6"	Pf 0.000
323	28'-10½"			31.007				Pe -0.000
324	28'-10½"			31.007			0'-6"	Pv
CM	6.3570	152.20	1.54	120		0.000860	13'-10¼"	Pf 0.055
324	28'-10½"	27.64		31.007		Flow (q) from Route 32	50'-3½"	Pe
317	28'-10½"			31.062		4fE(12'-7")	64'-1¼"	Pv
CM	6.3570	179.87	1.82	120		0.001171	0'-8"	Pf 0.001
317	28'-10½"	27.66		31.062		Flow (q) from Route 33		Pe 0.000
318	28'-10½"			31.063			0'-8"	Pv
Route 4								
BL	2.1570	24.49	2.15	120		0.005654	11'-3½"	Pf 0.161
137	30'-2¼"	24.49	5.6	19.123		Sprinkler	17'-2¼"	Pe -0.000
136	30'-2½"			19.284		4fE(4'-3¾")	28'-6¼"	Pv
BL	2.1570	49.08	4.31	120		0.020463	6'-4¼"	Pf 0.307
136	30'-2½"	24.59	5.6	19.284		Sprinkler	8'-7½"	Pe -0.199
337	30'-8"			19.392		2fE(4'-3¾")	15'-0"	Pv
Route 5								
SP	1.0490	24.59	9.13	120		0.190667	9'-4½"	Pf 3.883
131	30'-9¼"	24.59	5.6	19.277		Sprinkler	11'-0"	Pe 0.208
340	30'-3½"			23.367		3E(2'-0"), PO(5'-0")	20'-4½"	Pv
BL	2.1570	24.59	2.16	120		0.005696	0'-3"	Pf 0.001
340	30'-3½"			23.367				Pe
339	30'-3½"			23.369			0'-3"	Pv
Route 6								
DR	1.0490	24.63	9.14	120		0.191297	1'-11"	Pf 5.532
129	27'-0"	24.63	5.6	19.345		Sprinkler	27'-0"	Pe -1.426
336	30'-3½"			23.451		PO(5'-0"), fd(22'-0")	28'-11"	Pv
Route 7								
DR	1.0490	24.85	9.22	120		0.194456	2'-3½"	Pf 5.696
126	27'-0"	24.85	5.6	19.691		Sprinkler	27'-0"	Pe -1.589
331	30'-8"			23.798		PO(5'-0"), fd(22'-0")	29'-3½"	Pv
BL	2.1570	24.85	2.18	120		0.005810	8'-3¼"	Pf 0.048
331	30'-8"			23.798				Pe
327	30'-8"			23.846			8'-3¼"	Pv
BL	2.1570	49.72	4.37	120		0.020962	5'-6"	Pf 0.115
327	30'-8"	24.87		23.846		Flow (q) from Route 8		Pe
320	30'-8"			23.961			5'-6"	Pv
BL	2.1570	74.65	6.55	120		0.044458	14'-10¼"	Pf 1.426
320	30'-8"	24.93		23.961		Flow (q) from Route 11	17'-2¼"	Pe 0.289
315	30'-0"			25.677		4fE(4'-3¾")	32'-1"	Pv
BL	2.1570	100.35	8.81	120		0.076844	7'-0¼"	Pf 0.543
315	30'-0"	25.70		25.677		Flow (q) from Route 22		Pe
310	30'-0"			26.220			7'-0¼"	Pv
BL	2.1570	126.12	11.07	120		0.117287	0'-6"	Pf 0.059
310	30'-0"	25.77		26.220		Flow (q) from Route 23		Pe
309	30'-0"			26.278			0'-6"	Pv
BL	2.1570	151.33	13.29	120		0.164308	11'-0¼"	Pf 4.546
309	30'-0"	25.21		26.278		Flow (q) from Route 14	16'-7¼"	Pe 0.487
304	28'-10½"			31.312		fE(4'-3¾"), PO(12'-3¾")	27'-8"	Pv
Route 8								
DR	1.0490	24.87	9.23	120		0.194802	2'-3½"	Pf 5.706
119	27'-0"	24.87	5.6	19.729		Sprinkler	27'-0"	Pe -1.589
327	30'-8"			23.846		PO(5'-0"), fd(22'-0")	29'-3½"	Pv
Route 9								
DR	1.0490	24.88	9.24	120		0.194876	1'-10"	Pf 5.619
130	27'-0"	24.88	5.6	19.737		Sprinkler	27'-0"	Pe -1.390
335	30'-2½"			23.966		PO(5'-0"), fd(22'-0")	28'-10"	Pv

Hydraulic Analysis

Job Number: 1250
Report Description: Level 2

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.1570	24.88	2.18	120		0.005822	8'-3¼"	Pf 0.048
335	30'-2½"			23.966				Pe
328	30'-2½"			24.014			8'-3¼"	Pv
BL	2.1570	49.78	4.37	120		0.021008	5'-6"	Pf 0.116
328	30'-2½"	24.90		24.014		Flow (q) from Route 10		Pe
325	30'-2½"			24.130			5'-6"	Pv
BL	2.1570	74.74	6.56	120		0.044555	14'-7¼"	Pf 1.418
325	30'-2½"	24.96		24.130		Flow (q) from Route 12	17'-2¼"	Pe
319	30'-2½"			25.548		4fE(4'-3¼")	31'-10"	Pv
BL	2.1570	100.40	8.81	120		0.076912	11'-3¼"	Pf 2.192
319	30'-2½"	25.66		25.548		Flow (q) from Route 21	17'-2¼"	Pe
312	30'-2½"			27.740		4fE(4'-3¼")	28'-6"	Pv
BL	2.1570	127.10	11.16	120		0.118971	7'-6¼"	Pf 2.876
312	30'-2½"	26.70		27.740		Flow (q) from Route 26	16'-7¼"	Pe
308	28'-10½"			31.193		fE(4'-3¼"), PO(12'-3¼")	24'-2"	Pv
Route 10								
DR	1.0490	24.90	9.24	120		0.195224	1'-10"	Pf 5.629
122	27'-0"	24.90	5.6	19.775		Sprinkler	27'-0"	Pe -1.390
328	30'-2½"			24.014		PO(5'-0), fd(22'-0)	28'-10"	Pv
Route 11								
DR	1.0490	24.93	9.25	120		0.195633	2'-3¼"	Pf 5.730
115	27'-0"	24.93	5.6	19.820		Sprinkler	27'-0"	Pe -1.589
320	30'-8"			23.961		PO(5'-0), fd(22'-0)	29'-3¼"	Pv
Route 12								
DR	1.0490	24.96	9.27	120		0.196060	1'-10"	Pf 5.653
121	27'-0"	24.96	5.6	19.867		Sprinkler	27'-0"	Pe -1.390
325	30'-2½"			24.130		PO(5'-0), fd(22'-0)	28'-10"	Pv
Route 13								
DR	1.0490	25.03	9.29	120		0.197042	2'-11"	Pf 5.895
120	26'-0"	25.03	5.6	19.974		Sprinkler	27'-0"	Pe -1.860
326	30'-3½"			24.009		PO(5'-0), fd(22'-0)	29'-11"	Pv
Route 14								
DR	1.0490	25.21	9.36	120		0.199691	5'-7½"	Pf 7.313
106	27'-0"	25.21	5.6	20.265		Sprinkler	31'-0"	Pe -1.300
309	30'-0"			26.278		2E(2'-0), PO(5'-0), fd(22'-0)	36'-7½"	Pv
Route 15								
DR	1.0490	25.37	9.42	120		0.202017	2'-11"	Pf 6.044
127	26'-0"	25.37	5.6	20.520		Sprinkler	27'-0"	Pe -1.860
332	30'-3½"			24.704		PO(5'-0), fd(22'-0)	29'-11"	Pv
Route 16								
DR	1.0490	25.39	9.43	120		0.202418	1'-10½"	Pf 5.845
134	27'-0"	25.39	5.6	20.564		Sprinkler	27'-0"	Pe -1.408
338	30'-3"			25.001		PO(5'-0), fd(22'-0)	28'-10½"	Pv
BL	2.1570	25.39	2.23	120		0.006048	8'-3¼"	Pf 0.050
338	30'-3"			25.001				Pe
334	30'-3"			25.051			8'-3¼"	Pv
BL	2.1570	50.81	4.46	120		0.021821	5'-6"	Pf 0.120
334	30'-3"	25.42		25.051		Flow (q) from Route 17		Pe
330	30'-3"			25.171			5'-6"	Pv
BL	2.1570	76.29	6.70	120		0.046279	14'-5¼"	Pf 1.466
330	30'-3"	25.48		25.171		Flow (q) from Route 18	17'-2¼"	Pe 0.108
322	30'-0"			26.745		4fE(4'-3¼")	31'-8"	Pv
BL	2.1570	102.50	9.00	120		0.079917	10'-6¼"	Pf 0.844
322	30'-0"	26.21		26.745		Flow (q) from Route 24		Pe
316	30'-0"			27.589			10'-6¼"	Pv
BL	2.1570	129.11	11.34	120		0.122476	8'-0¼"	Pf 3.021
316	30'-0"	26.61		27.589		Flow (q) from Route 25	16'-7¼"	Pe 0.487
313	28'-10½"			31.097		fE(4'-3¼"), PO(12'-3¼")	24'-8"	Pv
Route 17								
DR	1.0490	25.42	9.44	120		0.202779	1'-10½"	Pf 5.855
128	27'-0"	25.42	5.6	20.604		Sprinkler	27'-0"	Pe -1.408
334	30'-3"			25.051		PO(5'-0), fd(22'-0)	28'-10½"	Pv
Route 18								
DR	1.0490	25.48	9.46	120		0.203644	1'-10½"	Pf 5.880
125	27'-0"	25.48	5.6	20.699		Sprinkler	27'-0"	Pe -1.408
330	30'-3"			25.171		PO(5'-0), fd(22'-0)	28'-10½"	Pv
Route 19								
DR	1.0490	25.49	9.46	120		0.203870	2'-11"	Pf 6.099
116	26'-0"	25.49	5.6	20.724		Sprinkler	27'-0"	Pe -1.860
321	30'-3½"			24.963		PO(5'-0), fd(22'-0)	29'-11"	Pv
Route 20

Hydraulic Analysis

Job Number: 1250
Report Description: Level 2

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
DR	1.0490	25.57	9.49	120		0.204987	2'-11"	Pf 6.133
123	26'-0"	25.57	5.6	20.846		Sprinkler	27'-0"	Pe -1.860
329	30'-3½"			25.119		PO(5'-0), fd(22'-0)	29'-11"	Pv
Route 21								
DR	1.0490	25.66	9.52	120		0.206293	1'-10"	Pf 5.948
114	27'-0"	25.66	5.6	20.990		Sprinkler	27'-0"	Pe -1.390
319	30'-2½"			25.548		PO(5'-0), fd(22'-0)	28'-10"	Pv
Route 22								
DR	1.0490	25.70	9.54	120		0.206881	1'-7½"	Pf 5.922
111	27'-0"	25.70	5.6	21.055		Sprinkler	27'-0"	Pe -1.300
315	30'-0"			25.677		PO(5'-0), fd(22'-0)	28'-7½"	Pv
Route 23								
DR	1.0490	25.77	9.57	120		0.207983	1'-6"	Pf 6.343
109	27'-0"	25.77	5.6	21.176		Sprinkler	29'-0"	Pe -1.300
310	30'-0"			26.220		E(2'-0), PO(5'-0), fd(22'-0)	30'-6"	Pv
Route 24								
DR	1.0490	26.21	9.73	120		0.214574	1'-7½"	Pf 6.142
117	27'-0"	26.21	5.6	21.902		Sprinkler	27'-0"	Pe -1.300
322	30'-0"			26.745		PO(5'-0), fd(22'-0)	28'-7½"	Pv
Route 25								
DR	1.0490	26.61	9.88	120		0.220642	1'-7½"	Pf 6.316
113	27'-0"	26.61	5.6	22.573		Sprinkler	27'-0"	Pe -1.300
316	30'-0"			27.589		PO(5'-0), fd(22'-0)	28'-7½"	Pv
Route 26								
DR	1.0490	26.70	9.91	120		0.222044	1'-10"	Pf 6.402
110	27'-0"	26.70	5.6	22.728		Sprinkler	27'-0"	Pe -1.390
312	30'-2½"			27.740		PO(5'-0), fd(22'-0)	28'-10"	Pv
Route 27								
SP	1.0490	27.28	10.13	120		0.231157	4'-4½"	Pf 8.177
108	27'-0"	27.28	5.6	23.738		Sprinkler	31'-0"	Pe -0.813
314	28'-10½"			31.102		2E(2'-0), PO(5'-0), fd(22'-0)	35'-4½"	Pv
Route 28								
SP	1.0490	27.32	10.14	120		0.231708	4'-4½"	Pf 8.197
105	27'-0"	27.32	5.6	23.799		Sprinkler	31'-0"	Pe -0.813
307	28'-10½"			31.183		2E(2'-0), PO(5'-0), fd(22'-0)	35'-4½"	Pv
Route 29								
SP	1.0490	27.46	10.20	120		0.233993	3'-4½"	Pf 8.044
103	27'-0"	27.46	5.6	24.053		Sprinkler	31'-0"	Pe -0.813
305	28'-10½"			31.284		2E(2'-0), PO(5'-0), fd(22'-0)	34'-4½"	Pv
Route 30								
SP	1.0490	27.51	10.21	120		0.234741	3'-4½"	Pf 8.069
102	27'-0"	27.51	5.6	24.136		Sprinkler	31'-0"	Pe -0.813
303	28'-10½"			31.393		2E(2'-0), PO(5'-0), fd(22'-0)	34'-4½"	Pv
Route 31								
SP	1.0490	27.59	10.24	120		0.236030	3'-4½"	Pf 8.114
101	27'-0"	27.59	5.6	24.279		Sprinkler	31'-0"	Pe -0.813
302	28'-10½"			31.580		2E(2'-0), PO(5'-0), fd(22'-0)	34'-4½"	Pv
Route 32								
SP	1.0490	27.64	10.26	120		0.236764	2'-4"	Pf 7.892
118	26'-0"	27.64	5.6	24.361		Sprinkler	31'-0"	Pe -1.246
324	28'-10½"			31.007		2E(2'-0), PO(5'-0), fd(22'-0)	33'-4"	Pv
Route 33								
SP	1.0490	27.66	10.27	120		0.237145	2'-4"	Pf 7.905
112	26'-0"	27.66	5.6	24.403		Sprinkler	31'-0"	Pe -1.246
317	28'-10½"			31.062		2E(2'-0), PO(5'-0), fd(22'-0)	33'-4"	Pv
Route 34								
DR	1.0490	27.85	10.34	120		0.240110	1'-7½"	Pf 6.873
107	27'-0"	27.85	5.6	24.733		Sprinkler	27'-0"	Pe -1.300
311	30'-0"			30.307		PO(5'-0), fd(22'-0)	28'-7½"	Pv
BL	2.1570	27.85	2.45	120		0.007174	7'-6¾"	Pf 0.054
311	30'-0"			30.307				Pe
306	30'-0"			30.361			7'-6¾"	Pv
BL	2.1570	55.72	4.89	120		0.025882	11'-0¾"	Pf 0.716
306	30'-0"	27.87		30.361		Flow (q) from Route 35	16'-7¾"	Pe 0.487
301	28'-10½"			31.564		fE(4'-3¾), PO(12'-3¾)	27'-8"	Pv
Route 35								
DR	1.0490	27.87	10.35	120		0.240497	1'-7½"	Pf 6.884
104	27'-0"	27.87	5.6	24.776		Sprinkler	27'-0"	Pe -1.300
306	30'-0"			30.361		PO(5'-0), fd(22'-0)	28'-7½"	Pv

Hydraulic Analysis

Job Number: 1250
Report Description: Level 2

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure										
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary										
Upstream							Total Length											
Equivalent Pipe Lengths of Valves and Fittings (C=120 only)					C Value Multiplier													
$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$					<table border="1"> <tr> <td>Value Of C</td> <td>100</td> <td>130</td> <td>140</td> <td>150</td> </tr> <tr> <td>Multiplying Factor</td> <td>0.713</td> <td>1.16</td> <td>1.33</td> <td>1.51</td> </tr> </table>				Value Of C	100	130	140	150	Multiplying Factor	0.713	1.16	1.33	1.51
Value Of C	100	130	140	150														
Multiplying Factor	0.713	1.16	1.33	1.51														
Pipe Type Legend		Units Legend			Fittings Legend													
AO Arm-Over BL Branch Line CM Cross Main DN Drain DR Drop DY Dynamic FM Feed Main FR Feed Riser MS Miscellaneous OR Outrigger RN Riser Nipple SP Sprig ST Stand Pipe UG Underground		Diameter Inch Elevation Foot Flow gpm Discharge gpm Velocity fps Pressure psi Length Foot Friction Loss psi/Foot HWC Hazen-Williams Constant Pt Total pressure at a point in a pipe Pn Normal pressure at a point in a pipe Pf Pressure loss due to friction between points Pe Pressure due to elevation difference between indicated points Pv Velocity pressure at a point in a pipe			ALV Alarm Valve AngV Angle Valve b Bushing BalV Ball Valve BFP Backflow Preventer BV Butterfly Valve C Cross Flow Turn 90° cplg Coupling Cr Cross Run CV Check Valve DelV Deluge Valve DPV Dry Pipe Valve E 90° Elbow EE 45° Elbow Ee1 11¼° Elbow Ee2 22½° Elbow f Flow Device fd Flex Drop FDC Fire Department Connection fE 90° FireLock(TM) Elbow fEE 45° FireLock(TM) Elbow flg Flange FN Floating Node fT FireLock(TM) Tee g Gauge GloV Globe Valve GV Gate Valve Ho Hose Hose Hose HV Hose Valve Hyd Hydrant LtE Long Turn Elbow mecT Mechanical Tee Noz Nozzle P1 Pump In P2 Pump Out PIV Post Indicating Valve PO Pipe Outlet PRV Pressure Reducing Valve PrV Pressure Relief Valve red Reducer/Adapter S Supply sCV Swing Check Valve Spr Sprinkler St Strainer T Tee Flow Turn 90° Tr Tee Run U Union WirF Wirsbo WMV Water Meter Valve Z Cap

Hydraulic Summary

Job Number: 1250
Report Description: Level 3

Job											
Job Number 1250				Design Engineer Randy Ralston							
Job Name: Solar Energy Research Center				State Certification/License Number C16 - 629778							
Address 1 Building 30, McMillan Road				AHJ California State Fire Marshal							
Address 2 Berkeley, CA 94720				Job Site/Building SERC/Building 30							
Address 3				Drawing Name FP 03 - Submittal.cad							
System				Remote Area(s)							
Most Demanding Sprinkler Data 5.6 K-Factor 21.42 at 14.631				Occupancy Ordinary Group I				Job Suffix			
Hose Allowance At Source 250.00				Density 0.170gpm/ft²				Area of Application 3000.00ft² (Actual 3062.61ft²)			
Additional Hose Supplies <u>Node</u> <u>Flow(gpm)</u>				Number Of Sprinklers Calculated 31				Coverage Per Sprinkler 126.00ft²			
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area							
Total Hose Streams 250.00											
System Flow Demand 694.86		Total Water Required (Including Hose Allowance) 944.86									
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 15.64 between nodes 13 and 110											
Maximum Velocity Under Ground 7.72 between nodes 2 and 8											
Volume capacity of Wet Pipes 3101.44gal		Volume capacity of Dry Pipes									
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1		250.00	90.000	67.000		2050.00	84.512		944.86	75.965	8.547
Contractor											
Contractor Number 1250		Contact Name Andrew Murray					Contact Title				
Name of Contractor: McCarthy Construction						Phone 510-981-1810			Extension		
Address 1 343 Sansome Street, 14th Floor						FAX					
Address 2 San Francisco, CA 94104						E-mail AMurray@McCarthy.com					
Address 3						Web-Site

Supply at Node 1

Hydraulic Graph

Supply at Node 1

Static: Pressure

90.000

Residual: Pressure

67.000 @ 2050.00

Available Pressure at Time of Test

84.512 @ 944.86

System Demand

75.965 @ 694.86

System Demand (Including Hose Allowance at Source)

75.965 @ 944.86

Summary Of Outflowing Devices

Job Number: 1250
Report Description: Level 3

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
⇒ Sprinkler	301	21.42	21.42	5.6	14.631		
Sprinkler	302	21.45	21.42	5.6	14.665		
Sprinkler	303	21.54	21.42	5.6	14.791		
Sprinkler	304	21.56	21.42	5.6	14.816		
Sprinkler	305	21.62	21.42	5.6	14.902		
Sprinkler	306	21.69	21.42	5.6	15.002		
Sprinkler	307	21.70	21.42	5.6	15.022		
Sprinkler	308	21.73	21.42	5.6	15.058		
Sprinkler	309	21.78	21.42	5.6	15.121		
Sprinkler	310	21.79	21.42	5.6	15.137		
Sprinkler	311	21.82	21.42	5.6	15.186		
Sprinkler	312	21.84	21.42	5.6	15.206		
Sprinkler	313	21.99	21.42	5.6	15.426		
Sprinkler	314	22.02	21.42	5.6	15.459		
Sprinkler	315	22.06	21.42	5.6	15.516		
Sprinkler	316	22.06	21.42	5.6	15.525		
Sprinkler	317	22.34	21.42	5.6	15.919		
Sprinkler	318	22.51	21.42	5.6	16.153		
Sprinkler	319	22.53	21.42	5.6	16.191		
Sprinkler	320	22.53	21.42	5.6	16.193		
Sprinkler	321	22.56	21.42	5.6	16.224		
Sprinkler	322	22.56	21.42	5.6	16.231		
Sprinkler	323	22.57	21.42	5.6	16.247		
Sprinkler	324	22.64	21.42	5.6	16.352		
Sprinkler	325	22.81	21.42	5.6	16.589		
Sprinkler	326	22.90	21.42	5.6	16.723		
Sprinkler	327	23.14	21.42	5.6	17.071		
Sprinkler	328	23.48	21.42	5.6	17.577		
Sprinkler	329	23.51	21.42	5.6	17.629		
Sprinkler	330	25.34	21.42	5.6	20.468		
Sprinkler	331	25.37	21.42	5.6	20.528		

⇒ Most Demanding Sprinkler Data

Node Analysis

Job Number: 1250
Report Description: Level 3

Node	Elevation(Feet)	Fittings	Pressure(psi)	Discharge(gpm)
106	45'-3½	PO(5'-0)	21.420	
107	45'-3½	PO(12'-3½)	21.721	
108	45'-3½	PO(12'-3½)	22.103	
109	45'-3½	PO(12'-3½)	22.181	
110	45'-3½	PO(12'-3½)	22.813	
111	46'-7½	PO(5'-0)	17.613	
112	46'-7½	PO(5'-0)	17.856	
113	46'-7½	PO(5'-0)	18.405	
114	46'-7½	PO(5'-0)	18.963	
115	46'-3½	PO(5'-0)	18.295	
116	46'-3½	PO(5'-0)	18.627	
117	45'-9½	PO(5'-0)	18.854	
118	45'-9½	PO(5'-0)	18.899	
119	45'-9½	PO(5'-0)	19.062	
120	45'-9½	PO(5'-0)	19.409	
121	45'-9½	PO(12'-3½)	20.593	
122	46'-3½	PO(5'-0)	18.104	
123	46'-3½	PO(5'-0)	18.124	
124	46'-3½	PO(5'-0)	18.283	
125	45'-9½	PO(5'-0)	20.289	
126	45'-9½	PO(5'-0)	20.337	
127	45'-9½	PO(5'-0)	20.339	
128	45'-9½	PO(5'-0)	20.388	
129	46'-3½	PO(5'-0)	19.532	
130	46'-3½	PO(5'-0)	19.562	
131	46'-3½	PO(5'-0)	19.698	
132	46'-3½	PO(5'-0)	20.004	
133	46'-3	PO(5'-0)	20.639	
1	-6'-0	S	75.965	694.86
301	44'-6	Spr(-14.631), fd(24'-0)	14.631	21.42
302	44'-6	Spr(-14.665), fd(24'-0)	14.665	21.45
303	44'-6	Spr(-14.791), fd(24'-0)	14.791	21.54
304	42'-0	Spr(-14.816), fd(24'-0)	14.816	21.56
305	42'-0	Spr(-14.902), fd(24'-0)	14.902	21.62
306	42'-0	Spr(-15.002), fd(24'-0)	15.002	21.69
307	44'-6	Spr(-15.022), fd(24'-0)	15.022	21.70
308	44'-6	Spr(-15.058), fd(24'-0)	15.058	21.73
309	42'-0	Spr(-15.121), fd(24'-0)	15.121	21.78
310	42'-0	Spr(-15.137), fd(24'-0)	15.137	21.79
311	44'-6	Spr(-15.186), fd(24'-0)	15.186	21.82
312	42'-0	Spr(-15.206), fd(24'-0)	15.206	21.84
313	42'-0	Spr(-15.426), fd(24'-0)	15.426	21.99
314	44'-6	Spr(-15.459), fd(24'-0)	15.459	22.02
315	44'-6	Spr(-15.516), fd(24'-0)	15.516	22.06
316	42'-0	Spr(-15.525), fd(24'-0)	15.525	22.06
317	46'-7½	Spr(-15.919)	15.919	22.34
318	44'-6	Spr(-16.153), fd(24'-0)	16.153	22.51
319	44'-6	Spr(-16.191), fd(24'-0)	16.191	22.53
320	44'-6	Spr(-16.193), fd(24'-0)	16.193	22.53
321	42'-0	Spr(-16.224), fd(24'-0)	16.224	22.56
322	44'-6	Spr(-16.231), fd(24'-0)	16.231	22.56
323	42'-0	Spr(-16.247), fd(24'-0)	16.247	22.57
324	42'-0	Spr(-16.352), fd(24'-0)	16.352	22.64
325	42'-0	Spr(-16.589), fd(24'-0)	16.589	22.81
326	42'-0	Spr(-16.723), fd(24'-0)	16.723	22.90
327	42'-0	Spr(-17.071), fd(24'-0)	17.071	23.14
328	45'-4	Spr(-17.577)	17.577	23.48
329	45'-4	Spr(-17.629)	17.629	23.51
330	46'-3	Spr(-20.468)	20.468	25.34
331	46'-3	Spr(-20.528)	20.528	25.37
2	-6'-0	E(14'-0)	75.662	
8	7'-4½	BV(12'-7)	66.578

Node Analysis

Job Number: 1250
Report Description: Level 3

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
9	13'-2	fE(12'-7)	63.804		
12	34'-6½	PO(26'-4)	51.880		
13	45'-1	E(13'-2)	38.346		
101	45'-9½	PO(5'-0)	18.356		
102	45'-9½	PO(5'-0)	18.400		
103	45'-9½	PO(5'-0)	18.559		
104	45'-9½	PO(5'-0)	19.480		
105	45'-9½	PO(12'-3½)	20.644

Hydraulic Analysis

Job Number: 1250
Report Description: Level 3

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
DY	1.0490	21.42	7.95	120		0.147738	0'-0"	Pf 4.284
301	44'-6"	21.42	5.6	14.631		Sprinkler	29'-0"	Pe -0.559
101	45'-9½"			18.356		PO(5'-0), fd(24'-0)	29'-0"	Pv
BL	2.1570	21.42	1.88	120		0.004414	10'-0"	Pf 0.044
101	45'-9½"			18.356			10'-0"	Pe
102	45'-9½"			18.400			10'-0"	Pv
BL	2.1570	42.87	3.76	120		0.015929	10'-0"	Pf 0.159
102	45'-9½"	21.45		18.400		Flow (q) from Route 2	10'-0"	Pe
103	45'-9½"			18.559			10'-0"	Pv
BL	2.1570	64.40	5.65	120		0.033828	10'-0"	Pf 0.921
103	45'-9½"	21.54		18.559		Flow (q) from Route 3	17'-3"	Pe -0.000
104	45'-9½"			19.480		4fE(4'-3½)	27'-3"	Pv
BL	2.1570	86.46	7.59	120		0.058334	7'-8"	Pf 1.164
104	45'-9½"	22.06		19.480		Flow (q) from Route 15	12'-3½"	Pe
105	45'-9½"			20.644		PO(12'-3½)	19'-11½"	Pv
CM	4.2600	263.87	5.94	120		0.016711	13'-11½"	Pf 0.559
105	45'-9½"	132.32		20.644		Flow (q) from Route 7	19'-6"	Pe 0.217
106	45'-3½"			21.420		2Ee2(5'-3), fE(8'-11½)	33'-5½"	Pv
CM	4.2600	286.77	6.46	120		0.019493	6'-6"	Pf 0.301
106	45'-3½"	22.90		21.420		Flow (q) from Route 26	8'-11½"	Pe
107	45'-3½"			21.721		fE(8'-11½)	15'-5½"	Pv
CM	4.2600	396.36	8.92	120		0.035473	10'-9½"	Pf 0.382
107	45'-3½"	109.59		21.721		Flow (q) from Route 5	10'-9½"	Pe
108	45'-3½"			22.103			10'-9½"	Pv
CM	4.2600	470.21	10.58	120		0.048659	1'-7"	Pf 0.078
108	45'-3½"	73.85		22.103		Flow (q) from Route 27	1'-7"	Pe
109	45'-3½"			22.181			1'-7"	Pv
CM	4.2600	560.79	12.62	120		0.067408	9'-4½"	Pf 0.632
109	45'-3½"	90.58		22.181		Flow (q) from Route 21	9'-4½"	Pe
110	45'-3½"			22.813			9'-4½"	Pv
CM	4.2600	694.86	15.64	120		0.100216	108'-9½"	Pf 15.441
110	45'-3½"			22.813			45'-3½"	Pe 0.092
13	45'-1"			38.346		2fEE(4'-5½), Ee2(5'-3), 2fE(8'-11½), E(13'-2)	154'-1"	Pv
FR	4.2600	694.86	15.64	120		0.100216	9'-5"	Pf 8.966
13	45'-1"			38.346			80'-0½"	Pe 4.568
12	34'-6½"			51.880		f(-0.000), CV(28'-11½), BV(15'-9½), fE(8'-11½), PO(26'-4)	89'-5½"	Pv
ST	6.3570	694.86	7.02	120		0.014267	73'-1½"	Pf 2.658
12	34'-6½"			51.880			113'-2"	Pe 9.267
9	13'-2"			63.804		7fE(12'-7), f(-0.000), 4fEE(6'-3½)	186'-3½"	Pv
FR	6.3570	694.86	7.02	120		0.014267	5'-7"	Pf 0.259
9	13'-2"			63.804			12'-7"	Pe 2.515
8	7'-4½"			66.578		BV(12'-7)	18'-1½"	Pv
UG	6.0650	694.86	7.72	120		0.017938	12'-8"	Pf 3.289
8	7'-4½"			66.578			14'-0"	Pe 5.794
2	-6'-0"			75.662		BFP(-2.811), E(14'-0)	26'-8"	Pv
UG	6.3400	694.86	7.06	140		0.010868	23'-0"	Pf 0.304
2	-6'-0"			75.662			4'-11½"	Pe
1	-6'-0"			75.965		GV(4'-11½), S	27'-11½"	Pv
		250.00				Hose Allowance At Source		
1		944.86						
Route 2								
DY	1.0490	21.45	7.96	120		0.148062	0'-0"	Pf 4.294
302	44'-6"	21.45	5.6	14.665		Sprinkler	29'-0"	Pe -0.559
102	45'-9½"			18.400		PO(5'-0), fd(24'-0)	29'-0"	Pv
Route 3								
DY	1.0490	21.54	8.00	120		0.149233	0'-0"	Pf 4.328
303	44'-6"	21.54	5.6	14.791		Sprinkler	29'-0"	Pe -0.559
103	45'-9½"			18.559		PO(5'-0), fd(24'-0)	29'-0"	Pv
Route 4								
DR	1.0490	21.56	8.00	120		0.149465	3'-1½"	Pf 4.801
304	42'-0"	21.56	5.6	14.816		Sprinkler	29'-0"	Pe -2.004
111	46'-7½"			17.613		PO(5'-0), fd(24'-0)	32'-1½"	Pv
BL	2.1570	68.54	6.02	120		0.037963	6'-5"	Pf 0.243
111	46'-7½"	46.99		17.613		Flow (q) from Route 28	6'-5"	Pe
112	46'-7½"			17.856			6'-5"	Pv
BL	2.1570	90.24	7.92	120		0.063132	8'-8½"	Pf 0.550
112	46'-7½"	21.69		17.856		Flow (q) from Route 6	8'-8½"	Pe
113	46'-7½"			18.405			8'-8½"	Pv

Hydraulic Analysis

Job Number: 1250
Report Description: Level 3

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.1570	112.23	9.85	120		0.094515	5'-11"	Pf 0.557
113	46'-7½"	21.99		18.405		Flow (q) from Route 13	31'-0"	Pe -1.860
114	46'-7½"			18.963			5'-11"	Pv
BL	2.1570	134.07	11.77	120		0.131326	4'-0"	Pf 3.273
114	46'-7½"	21.84		18.963		Flow (q) from Route 12	20'-11"	Pe 0.578
110	45'-3½"			22.813		2fE(4'-3½"), PO(12'-3½")	24'-11"	Pv
Route 5								
AO	1.0490	21.62	8.03	120		0.150270	3'-11½"	Pf 5.253
305	42'-0"	21.62	5.6	14.902		Sprinkler	31'-0"	Pe -1.860
115	46'-3½"			18.295		E(2'-0"), PO(5'-0"), fd(24'-0")	34'-11½"	Pv
BL	2.1570	87.52	7.68	120		0.059669	5'-6"	Pf 0.332
115	46'-3½"	65.91		18.295		Flow (q) from Route 9	5'-6"	Pe
116	46'-3½"			18.627			5'-6"	Pv
BL	2.1570	109.59	9.62	120		0.090444	8'-6"	Pf 2.661
116	46'-3½"	22.06		18.627		Flow (q) from Route 16	20'-11"	Pe 0.434
107	45'-3½"			21.721		2fE(4'-3½"), PO(12'-3½")	29'-5"	Pv
Route 6								
DR	1.0490	21.69	8.05	120		0.151208	3'-1½"	Pf 4.857
306	42'-0"	21.69	5.6	15.002		Sprinkler	29'-0"	Pe -2.004
112	46'-7½"			17.856		PO(5'-0"), fd(24'-0")	32'-1½"	Pv
Route 7								
DY	1.0490	21.70	8.06	120		0.151394	0'-0"	Pf 4.390
307	44'-6"	21.70	5.6	15.022		Sprinkler	29'-0"	Pe -0.559
117	45'-9½"			18.854		PO(5'-0"), fd(24'-0")	29'-0"	Pv
BL	2.1570	21.70	1.91	120		0.004523	10'-0"	Pf 0.045
117	45'-9½"			18.854			10'-0"	Pe
118	45'-9½"			18.899			10'-0"	Pv
BL	2.1570	43.44	3.81	120		0.016324	10'-0"	Pf 0.163
118	45'-9½"	21.73		18.899		Flow (q) from Route 8	10'-0"	Pe
119	45'-9½"			19.062			10'-0"	Pv
BL	2.1570	65.26	5.73	120		0.034664	10'-0"	Pf 0.347
119	45'-9½"	21.82		19.062		Flow (q) from Route 11	10'-0"	Pe
120	45'-9½"			19.409			10'-0"	Pv
BL	2.1570	87.28	7.66	120		0.059356	7'-8"	Pf 1.184
120	45'-9½"	22.02		19.409		Flow (q) from Route 14	12'-3½"	Pe
121	45'-9½"			20.593		PO(12'-3½")	19'-11½"	Pv
CM	4.2600	132.32	2.98	120		0.004660	11'-0"	Pf 0.051
121	45'-9½"	45.04		20.593		Flow (q) from Route 18	11'-0"	Pe
105	45'-9½"			20.644			11'-0"	Pv
Route 8								
DY	1.0490	21.73	8.07	120		0.151725	0'-0"	Pf 4.400
308	44'-6"	21.73	5.6	15.058		Sprinkler	29'-0"	Pe -0.559
118	45'-9½"			18.899		PO(5'-0"), fd(24'-0")	29'-0"	Pv
Route 9								
DR	1.0490	21.78	8.08	120		0.152317	2'-9½"	Pf 4.842
309	42'-0"	21.78	5.6	15.121		Sprinkler	29'-0"	Pe -1.860
122	46'-3½"			18.104		PO(5'-0"), fd(24'-0")	31'-9½"	Pv
BL	2.1570	21.78	1.91	120		0.004551	4'-5½"	Pf 0.020
122	46'-3½"			18.104			4'-5½"	Pe
123	46'-3½"			18.124			4'-5½"	Pv
BL	2.1570	43.56	3.82	120		0.016413	9'-8½"	Pf 0.159
123	46'-3½"	21.79		18.124		Flow (q) from Route 10	9'-8½"	Pe
124	46'-3½"			18.283			9'-8½"	Pv
BL	2.1570	65.91	5.79	120		0.035304	0'-4"	Pf 0.012
124	46'-3½"	22.34		18.283		Flow (q) from Route 17	0'-4"	Pe
115	46'-3½"			18.295			0'-4"	Pv
Route 10								
DR	1.0490	21.79	8.09	120		0.152463	2'-9½"	Pf 4.847
310	42'-0"	21.79	5.6	15.137		Sprinkler	29'-0"	Pe -1.860
123	46'-3½"			18.124		PO(5'-0"), fd(24'-0")	31'-9½"	Pv
Route 11								
DY	1.0490	21.82	8.10	120		0.152923	0'-0"	Pf 4.435
311	44'-6"	21.82	5.6	15.186		Sprinkler	29'-0"	Pe -0.559
119	45'-9½"			19.062		PO(5'-0"), fd(24'-0")	29'-0"	Pv
Route 12								
DR	1.0490	21.84	8.11	120		0.153108	4'-7½"	Pf 5.760
312	42'-0"	21.84	5.6	15.206		Sprinkler	33'-0"	Pe -2.004
114	46'-7½"			18.963		2E(2'-0"), PO(5'-0"), fd(24'-0")	37'-7½"	Pv
Route 13								
DR	1.0490	21.99	8.16	120		0.155149	3'-1½"	Pf 4.984
313	42'-0"	21.99	5.6	15.426		Sprinkler	29'-0"	Pe -2.004
113	46'-7½"			18.405		PO(5'-0"), fd(24'-0")	32'-1½"	Pv
Route 14

Hydraulic Analysis

Job Number: 1250
Report Description: Level 3

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
DY	1.0490	22.02	8.17	120		0.155464	0'-0	Pf 4.508
314	44'-6	22.02	5.6	15.459		Sprinkler	29'-0	Pe -0.559
120	45'-9½			19.409		PO(5'-0), fd(24'-0)	29'-0	Pv
Route 15								
DY	1.0490	22.06	8.19	120		0.155989	0'-0	Pf 4.524
315	44'-6	22.06	5.6	15.516		Sprinkler	29'-0	Pe -0.559
104	45'-9½			19.480		PO(5'-0), fd(24'-0)	29'-0	Pv
Route 16								
DR	1.0490	22.06	8.19	120		0.156072	2'-9½	Pf 4.961
316	42'-0	22.06	5.6	15.525		Sprinkler	29'-0	Pe -1.860
116	46'-3½			18.627		PO(5'-0), fd(24'-0)	31'-9½	Pv
Route 17								
SP	1.0490	22.34	8.29	120		0.159735	4'-11	Pf 2.220
317	46'-7½	22.34	5.6	15.919		Sprinkler	9'-0	Pe 0.145
124	46'-3½			18.283		2E(2'-0), PO(5'-0)	13'-11	Pv
Route 18								
DY	1.0490	22.51	8.36	120		0.161902	0'-0	Pf 4.695
318	44'-6	22.51	5.6	16.153		Sprinkler	29'-0	Pe -0.559
125	45'-9½			20.289		PO(5'-0), fd(24'-0)	29'-0	Pv
BL	2.1570	22.51	1.98	120		0.004837	10'-0	Pf 0.048
125	45'-9½			20.289			10'-0	Pe
126	45'-9½			20.337			10'-0	Pv
BL	2.1570	45.04	3.95	120		0.017457	2'-4	Pf 0.256
126	45'-9½	22.53		20.337		Flow (q) from Route 19	12'-3½	Pe
121	45'-9½			20.593		PO(12'-3½)	14'-8	Pv
Route 19								
DY	1.0490	22.53	8.36	120		0.162256	0'-0	Pf 4.705
319	44'-6	22.53	5.6	16.191		Sprinkler	29'-0	Pe -0.559
126	45'-9½			20.337		PO(5'-0), fd(24'-0)	29'-0	Pv
Route 20								
DY	1.0490	22.53	8.37	120		0.162272	0'-0	Pf 4.706
320	44'-6	22.53	5.6	16.193		Sprinkler	29'-0	Pe -0.559
127	45'-9½			20.339		PO(5'-0), fd(24'-0)	29'-0	Pv
BL	2.1570	22.53	1.98	120		0.004848	10'-0	Pf 0.048
127	45'-9½			20.339			10'-0	Pe
128	45'-9½			20.388			10'-0	Pv
BL	2.1570	45.10	3.96	120		0.017496	2'-4	Pf 0.256
128	45'-9½	22.56		20.388		Flow (q) from Route 22	12'-3½	Pe
105	45'-9½			20.644		PO(12'-3½)	14'-8	Pv
Route 21								
DR	1.0490	22.56	8.37	120		0.162564	2'-9½	Pf 5.168
321	42'-0	22.56	5.6	16.224		Sprinkler	29'-0	Pe -1.860
129	46'-3½			19.532		PO(5'-0), fd(24'-0)	31'-9½	Pv
BL	2.1570	22.56	1.98	120		0.004857	6'-0½	Pf 0.029
129	46'-3½			19.532			6'-0½	Pe
130	46'-3½			19.562			6'-0½	Pv
BL	2.1570	45.13	3.96	120		0.017520	7'-9	Pf 0.136
130	46'-3½	22.57		19.562		Flow (q) from Route 23	7'-9	Pe
131	46'-3½			19.698			7'-9	Pv
BL	2.1570	67.77	5.95	120		0.037176	8'-3	Pf 0.307
131	46'-3½	22.64		19.698		Flow (q) from Route 24	8'-3	Pe
132	46'-3½			20.004			8'-3	Pv
BL	2.1570	90.58	7.95	120		0.063581	6'-6	Pf 1.744
132	46'-3½	22.81		20.004		Flow (q) from Route 25	20'-11	Pe 0.434
109	45'-3½			22.181		2fE(4'-3½), PO(12'-3½)	27'-5	Pv
Route 22								
DY	1.0490	22.56	8.38	120		0.162626	0'-0	Pf 4.716
322	44'-6	22.56	5.6	16.231		Sprinkler	29'-0	Pe -0.559
128	45'-9½			20.388		PO(5'-0), fd(24'-0)	29'-0	Pv
Route 23								
DR	1.0490	22.57	8.38	120		0.162775	2'-9½	Pf 5.175
323	42'-0	22.57	5.6	16.247		Sprinkler	29'-0	Pe -1.860
130	46'-3½			19.562		PO(5'-0), fd(24'-0)	31'-9½	Pv
Route 24								
DR	1.0490	22.64	8.41	120		0.163747	2'-9½	Pf 5.205
324	42'-0	22.64	5.6	16.352		Sprinkler	29'-0	Pe -1.860
131	46'-3½			19.698		PO(5'-0), fd(24'-0)	31'-9½	Pv
Route 25								
DR	1.0490	22.81	8.47	120		0.165941	2'-9½	Pf 5.275
325	42'-0	22.81	5.6	16.589		Sprinkler	29'-0	Pe -1.860
132	46'-3½			20.004		PO(5'-0), fd(24'-0)	31'-9½	Pv
Route 26

Hydraulic Analysis

Job Number: 1250
Report Description: Level 3

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
SP	1.0490	22.90	8.50	120		0.167185	3'-7½"	Pf 6.123
326	42'-0"	22.90	5.6	16.723		Sprinkler	33'-0"	Pe -1.426
106	45'-3½"			21.420		2E(2'-0"), PO(5'-0"), fd(24'-0")	36'-7½"	Pv
• • • • • Route 27 • • • • •								
DR	1.0490	23.14	8.59	120		0.170398	2'-9"	Pf 5.410
327	42'-0"	23.14	5.6	17.071		Sprinkler	29'-0"	Pe -1.842
133	46'-3"			20.639		PO(5'-0"), fd(24'-0")	31'-9"	Pv
BL	2.1570	73.85	6.48	120		0.043571	3'-1½"	Pf 1.049
133	46'-3"	50.71		20.639		Flow (q) from Route 29	20'-11"	Pe 0.415
108	45'-3½"			22.103		2fE(4'-3½"), PO(12'-3½")	24'-1"	Pv
• • • • • Route 28 • • • • •								
BL	2.1570	23.48	2.06	120		0.005230	9'-11½"	Pf 0.052
328	45'-4"	23.48	5.6	17.577		Sprinkler		Pe
329	45'-4"			17.629			9'-11½"	Pv
BL	2.1570	46.99	4.13	120		0.018880	12'-10"	Pf 0.544
329	45'-4"	23.51	5.6	17.629		Sprinkler	16'-0"	Pe -0.560
111	46'-7½"			17.613		f(-0.000), BV(7'-4½"), 2fE(4'-3½")	28'-10"	Pv
• • • • • Route 29 • • • • •								
BL	2.1570	25.34	2.22	120		0.006021	10'-0"	Pf 0.060
330	46'-3"	25.34	5.6	20.468		Sprinkler		Pe
331	46'-3"			20.528			10'-0"	Pv
BL	2.1570	50.71	4.45	120		0.021737	5'-1½"	Pf 0.111
331	46'-3"	25.37	5.6	20.528		Sprinkler		Pe
133	46'-3"			20.639			5'-1½"	Pv

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

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

C Value Multiplier

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

Hydraulic Analysis

Job Number: 1250
Report Description: Level 3

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream					Fittings	Total Length	
Pipe Type Legend	Units Legend		Fittings Legend				
AO Arm-Over	Diameter	Inch	ALV	Alarm Valve			
BL Branch Line	Elevation	Foot	AngV	Angle Valve			
CM Cross Main	Flow	gpm	b	Bushing			
DN Drain	Discharge	gpm	BaIV	Ball Valve			
DR Drop	Velocity	fps	BFP	Backflow Preventer			
DY Dynamic	Pressure	psi	BV	Butterfly Valve			
FM Feed Main	Length	Foot	C	Cross Flow Turn 90°			
FR Feed Riser	Friction Loss	psi/Foot	cplg	Coupling			
MS Miscellaneous	HWC	Hazen-Williams Constant	Cr	Cross Run			
OR Outrigger	Pt	Total pressure at a point in a pipe	CV	Check Valve			
RN Riser Nipple	Pn	Normal pressure at a point in a pipe	DeIV	Deluge Valve			
SP Sprig	Pf	Pressure loss due to friction between points	DPV	Dry Pipe Valve			
ST Stand Pipe	Pe	Pressure due to elevation difference between indicated points	E	90° Elbow			
UG Underground	Pv	Velocity pressure at a point in a pipe	EE	45° Elbow			
			Ee1	11¼° Elbow			
			Ee2	22½° Elbow			
			f	Flow Device			
			fd	Flex Drop			
			FDC	Fire Department Connection			
			fE	90° FireLock(TM) Elbow			
			fEE	45° FireLock(TM) Elbow			
			flg	Flange			
			FN	Floating Node			
			ft	FireLock(TM) Tee			
			g	Gauge			
			GloV	Globe Valve			
			GV	Gate Valve			
			Ho	Hose			
			Hose	Hose			
			HV	Hose Valve			
			Hyd	Hydrant			
			LtE	Long Turn Elbow			
			mecT	Mechanical Tee			
			Noz	Nozzle			
			P1	Pump In			
			P2	Pump Out			
			PIV	Post Indicating Valve			
			PO	Pipe Outlet			
			PRV	Pressure Reducing Valve			
			PrV	Pressure Relief Valve			
			red	Reducer/Adapter			
			S	Supply			
			sCV	Swing Check Valve			
			Spr	Sprinkler			
			St	Strainer			
			T	Tee Flow Turn 90°			
			Tr	Tee Run			
			U	Union			
			WirF	Wirsbo			
			WMV	Water Meter Valve			
			Z	Cap

Hydraulic Summary

Job Number: 1250
Report Description: Standpipe

Job																	
Job Number 1250				Design Engineer Randy Ralston													
Job Name: Solar Energy Research Center				State Certification/License Number C16 - 629778													
Address 1 Building 30, McMillan Road				AHJ California State Fire Marshal													
Address 2 Berkeley, CA 94720				Job Site/Building SERC/Building 30													
Address 3				Drawing Name FP 00U - Standpipe Calcs.cad													
System				Remote Area(s)													
Most Demanding Sprinkler Data K-Factor at				Occupancy NA			Job Suffix Manually Flowing										
Hose Allowance At Source 0.00				Density NA			Area of Application NA										
Additional Hose Supplies <table><tr><td>Node</td><td>Flow(gpm)</td></tr><tr><td>Hose At Node 24</td><td>250.00</td></tr><tr><td>Hose At Node 20</td><td>250.00</td></tr><tr><td>Hose At Node 22</td><td>250.00</td></tr></table>				Node	Flow(gpm)	Hose At Node 24	250.00	Hose At Node 20	250.00	Hose At Node 22	250.00	Number Of Sprinklers Calculated 0			Coverage Per Sprinkler NA		
Node	Flow(gpm)																
Hose At Node 24	250.00																
Hose At Node 20	250.00																
Hose At Node 22	250.00																
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area													
Total Hose Streams 750.00																	
System Flow Demand 750.00		Total Water Required (Including Hose Allowance) 750.00															
Maximum Pressure Unbalance In Loops 0.000																	
Maximum Velocity Above Ground 18.90 between nodes 14 and 15																	
Maximum Velocity Under Ground 18.90 between nodes 16 and 17																	
Volume capacity of Wet Pipes 2093.14gal		Volume capacity of Dry Pipes															
Supplies																	
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)						
14	Water Supply		160.000	160.000		750.00	160.000		750.00	153.229	6.771						
Contractor																	
Contractor Number 1250		Contact Name Andrew Murray				Contact Title											
Name of Contractor: McCarthy Construction				Phone 510-981-1810				Extension									
Address 1 343 Sansome Street, 14th Floor				FAX													
Address 2 San Francisco, CA 94104				E-mail AMurray@McCarthy.com													
Address 3				Web-Site

Water Supply at Node 14

Hydraulic Graph

Water Supply at Node 14

Static: Pressure

160.000

Residual: Pressure

160.000 @ 750.00

Available Pressure at Time of Test

160.000 @ 750.00

System Demand

153.229 @ 750.00

System Demand (Including Hose Allowance at Source)

153.229 @ 750.00

Summary Of Outflowing Devices

Job Number: 1250
Report Description: Standpipe

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
Hose	20	250.00	250.00	25	100.698		
Hose	22	250.00	250.00	25	100.263		
Hose	24	250.00	250.00	25	100.000		

⇒ Most Demanding Sprinkler Data

Node Analysis

Job Number: 1250
Report Description: Standpipe

Node	Elevation(Feet)	Fittings	Pressure(psi)	Discharge(gpm)	
14	3'-6	S	153.229	750.00	
20	52'-1¾	Hose(-100.000)	100.698	250.00	
22	53'-1¾	Hose(-100.000)	100.263	250.00	
24	35'-6	Hose(-100.000)	100.000	250.00	
4	6'-8		125.511		
5	6'-8	fT(21'-0¾)	126.659		
8	7'-4½	BV(12'-7)	124.964		
9	13'-2	fE(12'-7)	122.308		
15	3'-6	E(17'-11)	145.180		
16	-6'-0	E(13'-3½)	137.415		
17	0'-8		132.243		
18	13'-2	fE(8'-11¼)	122.875		
19	52'-1¾	PO(12'-0)	103.465		
21	53'-1¾	PO(12'-0)	103.030		
23	35'-6	PO(12'-0)	105.937

Hydraulic Analysis

Job Number: 1250
Report Description: Standpipe

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
OR	2.4690	250.00	16.75	120		0.215409	3'-6"	Pf 5.937
24	35'-6"	250.00		100.000		Hose(-100.000)	24'-0"	Pe
23	35'-6"			105.937		2E(6'-0), PO(12'-0)	27'-6"	Pv
ST	4.2600	250.00	5.63	120		0.015122	205'-11"	Pf 7.255
23	35'-6"			105.937			273'-10"	Pe 9.682
18	13'-2"			122.875		28fE(8'-11½), Ee2(5'-3¼), 2fEE(4'-5¼), fE(8'-11½)	479'-9½"	Pv
FR	4.2600	250.00	5.63	120		0.015122	5'-11"	Pf 0.966
18	13'-2"			122.875			57'-11"	Pe 2.818
5	6'-8"			126.659		BV(15'-9½), 2fT(21'-0¼)	63'-11"	Pv
FM	4.2600	750.00	16.88	120		0.115423	7'-11"	Pf 2.983
5	6'-8"			126.659			17'-10½"	Pe 2.601
17	0'-8"			132.243		2fE(8'-11¼)	25'-10"	Pv
UG	4.0260	750.00	18.90	140		0.114269	6'-8"	Pf 2.282
17	0'-8"			132.243			13'-3½"	Pe 2.890
16	-6'-0"			137.415		E(13'-3½)	19'-11½"	Pv
UG	4.2800	750.00	16.72	140		0.084827	89'-11"	Pf 11.884
16	-6'-0"			137.415			50'-2"	Pe -4.119
15	3'-6"			145.180		3LtE(10'-9), E(17'-11)	140'-1"	Pv
FR	4.0260	750.00	18.90	120		0.151978	4'-11½"	Pf 8.049
15	3'-6"			145.180			48'-0"	Pe
14	3'-6"			153.229		T(20'-0), LtE(6'-0), CV(22'-0), S	52'-11½"	Pv
		0.00				Hose Allowance At Source		
14		750.00						
Route 2								
AO	2.4690	250.00	16.75	120		0.215409	0'-10¼"	Pf 2.767
22	53'-1¼"	250.00		100.263		Hose(-100.000)	12'-0"	Pe
21	53'-1¼"			103.030		PO(12'-0)	12'-10¼"	Pv
ST	6.3570	250.00	2.53	120		0.002153	1'-0"	Pf 0.002
21	53'-1¼"			103.030				Pe 0.434
19	52'-1¼"			103.465			1'-0"	Pv
ST	6.3570	500.00	5.05	120		0.007761	112'-2"	Pf 1.944
19	52'-1¼"			103.465			138'-3¾"	Pe 16.899
9	13'-2"			122.308		9fE(12'-7), 2f(-0.000), 4fEE(6'-3½)	250'-6"	Pv
FR	6.3570	500.00	5.05	120		0.007761	5'-6"	Pf 0.141
9	13'-2"			122.308			12'-7"	Pe 2.515
8	7'-4½"			124.964		BV(12'-7)	18'-1¼"	Pv
DY	6.0650	500.00	5.55	120		0.009758	0'-0"	Pf 0.244
8	7'-4½"			124.964			25'-0"	Pe 0.303
4	6'-8"			125.511		fT(25'-0)	25'-0"	Pv
DY	4.2600	500.00	11.25	120		0.054516	0'-0"	Pf 1.149
4	6'-8"			125.511			21'-0¼"	Pe -0.000
5	6'-8"			126.659		fT(21'-0¼)	21'-0¼"	Pv
Route 3								
AO	2.4690	250.00	16.75	120		0.215409	0'-10¼"	Pf 2.767
20	52'-1¼"	250.00		100.698		Hose(-100.000)	12'-0"	Pe
19	52'-1¼"			103.465		PO(12'-0)	12'-10¼"	Pv
Equivalent Pipe Lengths of Valves and Fittings (C=120 only)								
$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$								
C Value Multiplier								
Value Of C	100	130	140	150				
Multiplying Factor	0.713	1.16	1.33	1.51

Hydraulic Analysis

Job Number: 1250
Report Description: Standpipe

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
Pipe Type Legend		Units Legend				Fittings Legend		
AO	Arm-Over	Diameter	Inch			ALV	Alarm Valve	
BL	Branch Line	Elevation	Foot			AngV	Angle Valve	
CM	Cross Main	Flow	gpm			b	Bushing	
DN	Drain	Discharge	gpm			BaIV	Ball Valve	
DR	Drop	Velocity	fps			BFP	Backflow Preventer	
DY	Dynamic	Pressure	psi			BV	Butterfly Valve	
FM	Feed Main	Length	Foot			C	Cross Flow Turn 90°	
FR	Feed Riser	Friction Loss	psi/Foot			cpIlg	Coupling	
MS	Miscellaneous	HWC	Hazen-Williams Constant			Cr	Cross Run	
OR	Outrigger	Pt	Total pressure at a point in a pipe			CV	Check Valve	
RN	Riser Nipple	Pn	Normal pressure at a point in a pipe			DeIV	Deluge Valve	
SP	Sprig	Pf	Pressure loss due to friction between points			DPV	Dry Pipe Valve	
ST	Stand Pipe	Pe	Pressure due to elevation difference between indicated points			E	90° Elbow	
UG	Underground	Pv	Velocity pressure at a point in a pipe			EE	45° Elbow	
						Ee1	11¼° Elbow	
						Ee2	22½° Elbow	
						f	Flow Device	
						fd	Flex Drop	
						FDC	Fire Department Connection	
						fE	90° FireLock(TM) Elbow	
						fEE	45° FireLock(TM) Elbow	
						flg	Flange	
						FN	Floating Node	
						ft	FireLock(TM) Tee	
						g	Gauge	
						GloV	Globe Valve	
						GV	Gate Valve	
						Ho	Hose	
						Hose	Hose	
						HV	Hose Valve	
						Hyd	Hydrant	
						LtE	Long Turn Elbow	
						mecT	Mechanical Tee	
						Noz	Nozzle	
						P1	Pump In	
						P2	Pump Out	
						PIV	Post Indicating Valve	
						PO	Pipe Outlet	
						PRV	Pressure Reducing Valve	
						PrV	Pressure Relief Valve	
						red	Reducer/Adapter	
						S	Supply	
						sCV	Swing Check Valve	
						Spr	Sprinkler	
						St	Strainer	
						T	Tee Flow Turn 90°	
						Tr	Tee Run	
						U	Union	
						WirF	Wirsbo	
						WMV	Water Meter Valve	
						Z	Cap

Hydraulic Analysis

Job Number: 1250
Report Description: Standpipe

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
Pipe Type Legend		Units Legend				Fittings Legend		
AO	Arm-Over	Diameter	Inch			ALV	Alarm Valve	
BL	Branch Line	Elevation	Foot			AngV	Angle Valve	
CM	Cross Main	Flow	gpm			b	Bushing	
DN	Drain	Discharge	gpm			BaIV	Ball Valve	
DR	Drop	Velocity	fps			BFP	Backflow Preventer	
DY	Dynamic	Pressure	psi			BV	Butterfly Valve	
FM	Feed Main	Length	Foot			C	Cross Flow Turn 90°	
FR	Feed Riser	Friction Loss	psi/Foot			cpIlg	Coupling	
MS	Miscellaneous	HWC	Hazen-Williams Constant			Cr	Cross Run	
OR	Outrigger	Pt	Total pressure at a point in a pipe			CV	Check Valve	
RN	Riser Nipple	Pn	Normal pressure at a point in a pipe			DeIV	Deluge Valve	
SP	Sprig	Pf	Pressure loss due to friction between points			DPV	Dry Pipe Valve	
ST	Stand Pipe	Pe	Pressure due to elevation difference between indicated points			E	90° Elbow	
UG	Underground	Pv	Velocity pressure at a point in a pipe			EE	45° Elbow	
						Ee1	11¼° Elbow	
						Ee2	22½° Elbow	
						f	Flow Device	
						fd	Flex Drop	
						FDC	Fire Department Connection	
						fE	90° FireLock(TM) Elbow	
						fEE	45° FireLock(TM) Elbow	
						flg	Flange	
						FN	Floating Node	
						ft	FireLock(TM) Tee	
						g	Gauge	
						GloV	Globe Valve	
						GV	Gate Valve	
						Ho	Hose	
						Hose	Hose	
						HV	Hose Valve	
						Hyd	Hydrant	
						LtE	Long Turn Elbow	
						mecT	Mechanical Tee	
						Noz	Nozzle	
						P1	Pump In	
						P2	Pump Out	
						PIV	Post Indicating Valve	
						PO	Pipe Outlet	
						PRV	Pressure Reducing Valve	
						PrV	Pressure Relief Valve	
						red	Reducer/Adapter	
						S	Supply	
						sCV	Swing Check Valve	
						Spr	Sprinkler	
						St	Strainer	
						T	Tee Flow Turn 90°	
						Tr	Tee Run	
						U	Union	
						WirF	Wirsbo	
						WMV	Water Meter Valve	
						Z	Cap

Appendix D

Smoke Detection and Notification Appliances

MXL, MXL-IQ and MXLV Panels

Intelligent *FirePrint™* Detector Model FP-11

ARCHITECT AND ENGINEER SPECIFICATIONS

- Most Sophisticated "Detector Intelligence" available in the Fire / Life Safety market
- Multi-criteria fire detection for the price of a photoelectric detector
- *FirePrint™* technology to distinguish between deceptive phenomena and an actual fire
- Easily programmed to match specific hazard profiles from the fire-alarm control panel (FACP)
- *Pre-Alarm* reporting based upon fire profile selected
- Remote-sensitivity-measurement capability
- System-logic activation based upon any of three (3) inputs from the detector (smoke, heat or neural network)
- Field-cleanable chamber with replaceable chamber parts
- Compatible with field programmer / tester (Model DPU) or FPI-32 Upgrade Kit
- Supports software-based, automatic environmental compensation (EnviroLINK)
- Backward compatible with older MXL systems (Rev. 2 and above)
- Optional fully programmable relay base, audible base and duct housing

- Multi-color, detector-status LED
- (2) Two-wire operation
- ©UL and ©ULC Listed;
FM, CSFM & NYMEA Approved

Product Overview

The Intelligent Fire Detector (Model FP-11) provides the most highly evolved detection system – including the most sophisticated level of protection; as well as nuisance-alarm immunity – currently available in the Fire / Life Safety market.

Model FP-11 utilizes advanced detection technology that allows the detector to distinguish non-threatening deceptive phenomena (i.e. - cigarette smoke) from actual fire hazards, while optimizing detection for the area of its intended zone. Model FP-11 uses state-of-the-art microprocessor circuitry with error check, detector self-diagnostics and supervision programs.

Model FP-11 is compatible with the Siemens Industry, Inc. – Fire Safety division's FPI-32 upgrade kit or Siemens' field-programmer / tester (Model DPU), which is a compact, portable and menu-driven accessory for efficiently programming and testing detectors electronically. Model DPU or FPI-32 upgrade kit eliminates the need for cumbersome, unreliable mechanical programming

methods and reduces installation and service costs by electronically programming and testing the detector prior to installation.

Specifications

Model FP-11 is a plug-in, two-wire, multi-sensor detector with photoelectric and thermal inputs that is compatible with the MXL family of FACP's. Each detector consists of a dust-resistant, field-cleanable photo chamber; a solid-state, non-mechanical thermal sensor, and microprocessor-based electronics with a low-profile plastic cover and base.

Model FP-11 utilizes state-of-the-art ASIC and surface-mount technology for maximum reliability. Every Model FP-11 fire detector is shipped with a protective dust cover. Model FP-11 fire detector utilizes an infrared light-emitting diode (IRLED), and light sensing photodiode. Under normal conditions, light transmitted by the LED is directed away from the photodiode and scattered through the smoke chamber in a controlled pattern.

Intelligent *FirePrint™* Detector **6175**

Specifications — (continued)

The smoke chamber is designed to manage light dissipation and extraneous reflections from dust particles or other non-smoke airborne contaminants in such a way as to maintain stable, consistent detector operation. When smoke enters the detector chamber, light emitted from the IRLED is scattered by the smoke particles, and is received by the photodiode.

Model FP-11 also utilizes a modern, accurate and shock-resistant thermistor to sense temperature changes. The 'on-board' *FirePrint* technology allows the detector to gather smoke and thermal data, analyzing this data in the detector's 'neural network.' By comparing data received with the common characteristics of fires, or fire fingerprints, Model FP-11 can compare these 'fire prints' to those of deceptive phenomena that cause other detectors to alarm. The advanced *FirePrint* technology allows the Model FP-11 to accurately determine a true fire hazard from non-threatening, deceptive phenomena — without the need to use alarm delaying verification and confirmation techniques, which can increase the probability of losses due to fire.

Model FP-11 provides the highest level of detector intelligence available today with a detector / control-panel link that allows the user to program the detector for the specific hazard profile.

Detectors are optimized by selecting one (1) of the following applications:

- Office / Retail
- Lobby
- Computer room
- Dormitory
- Healthcare facility
- Parking garage
- Utility / transformer room
- Hostile environment
- Precious storage
- Air duct
- Warehouse / light manufacturing

Once programmed, the software does the rest — no guessing on detector sensitivities or alarm verification — the FACP programs Model FP-11 for the protected area without any confirmation delays. Once optimized for the hazards in the protected area, Model FP-11 provides the utmost means in detection. Should the operator or installer forget to program the detector, Model FP-11 will revert to a default setting that, in turn, allows operation as a standard photoelectric or photothermal detector.

The FP-11's *FirePrint* technology for Model FP-11 monitors input from the photo chamber and the thermal sensor, evaluating this information with

sophisticated mathematical formulas or algorithms — comparing this input to characteristics of both threatening fires and deceptive phenomena that would deceive any ordinary detector. This technology was developed over years of research and reviewing the results of over 20 years of fire-test data in one of the world's most advanced fire research centers. The results of this research are the mathematical models that form the algorithms used in *FirePrint*. No other fire detector has this level of intelligence or this amount of research and development supporting its design.

The software of the microprocessor can identify and disregard false input caused by radio frequency (RFI) and electromagnetic (EMI) interference, and validates all *trouble* conditions before annunciating or reporting to the control panel. The microprocessor for Model FP-11 uses an integral EEPROM to store the detector's address and other critical operating parameters, which include the assigned program values for *alarm* and *trouble* thresholds.

Communications within the detector; between Model FP-11 and the FACP; or with the field programmer / tester (Model DPU), are supervised and safeguarded against disruption by reliable, microprocessor-based error checking routines. Additionally, the microprocessor supervises all EEPROM memory locations and provides a high degree of EEPROM failure fault tolerance.

In MXL / (V) applications, Model FP-11 determines its operating status to be in *normal*, *alarm*, or *trouble* mode, depending on the difference between the alarm threshold values stored in the detector's memory and the detector's latest analog measurement. The detector then communicates changes in its status to the FACP.

In addition, the MXL / (V) FACP will sample the value of the analog signal for Model FP-11 over a period of time, in order to determine if those values indicate excessive buildup in the photo chamber. In the event of excessive buildup, the MXL / (V) FACP will accurately indicate which detector shall require maintenance.

Model FP-11 is listed as a self-testing device. The LED for Model FP-11 flashes GREEN every four (4) seconds, indicating communication with the FACP, and that it has passed its self-test. Should the detector sense a fault or failure within its systems, the LED will flash AMBER, and the detector will transmit that data to the FACP. A quick visual inspection is sufficient to indicate the condition of the detector at any time. If more detailed information is required, a printed report can be provided from the MXL panel, indicating the status and settings assigned to each individual detector.

When Model FP-11 moves to the *alarm* mode, it will flash AMBER, and will transmit that data to the FACP. When the MXL / (V) confirms the condition of the detector, the FACP will instruct Model FP-11 to flash

Specifications — (continued)

RED – and to continue flashing RED, until the system is reset manually at the FACP. At that same time, any user-defined system alarm functions programmed into the system are activated. Each Model FP-11 detector can operate one (1) remote alarm indicator; one (1) auxiliary relay, or one (1) audible base.

Detector sensitivity, calibration and identification are dynamically supervised by the FACP. Detector sensitivity and *pre-alarm* levels are a function of the application chosen at the FACP, and are controlled by the panel. If an alternate, non-*FirePrint* mode is selected, then the sensitivity can be changed from the FACP.

The Program / Test unit (Model DPU) or FPI-32 upgrade kit is used to program and verify the detector's address. The technician selects the accessory's program mode to enter the desired address. In turn, Model DPU or FPI-32 automatically sets / verifies the address, and tests the detector. Model DPU also allows the user to change the device ID from that of a Model FP-11 detector to an older detector ID (such as: ILP-1, ILPT-1, ILP-2, ID-60P or ID-60PT) to allow for easy replacement of older detectors without the need of reprogramming the FACP.

The FPI-32 upgrade kit operates on AC power or rechargeable batteries, providing flexibility and convenience in programming and testing equipment from almost any location. When in test mode, Model DPU or FPI-32 upgrade kit will perform a series of diagnostic tests without altering the address or other stored data, allowing technicians to determine if the detector is operating properly.

Model FP-11 may be installed on the same initiating circuit with IL or ID series detectors (Photoelectric, thermal, or ionization), MSI-series manual stations, TRI-series interfaces, ICP output control devices, or CZM series of addressable, conventional-zone modules.

All Model FP-11 detectors can be cleaned in the field – when required – by simply removing the detector cover and unsnapping the photo chamber. There is also the option of cleaning the interior of the detector with a clean, soft cloth or brush, or replacing the labyrinth and bug screen included in the detector maintenance kit, Model DMK-11.

Model FP-11 uses the low-profile, surface-mounting base, Model DB-11. This base mounts on a 4-inch octagon, square, or a single-gang electrical box. The base utilizes screw-clamp contacts for electrical connections and self-wiping contacts for increased reliability. The base can be used with the optional Model LK-11 detector locking kit, which contains 50

detector locks, as well as an installation tool, preventing unauthorized removal of the detector head. Model DB-11 has integral, decorative plugs to cover the outer mounting screw holes.

Model FP-11 is electrically compatible with existing MXL-detector accessories, including relays, remote lamps, duct housings and audible bases. With duct housings, a base adapter and new detector housing cover are required (order AD-11UK upgrade kit). To use existing Model DB-3S base or audible base, Model FP-11 requires a base adapter (Model DB-ADPT).

All Model FP-11 detectors are approved for operation within the UL-specified temperature range of 32°F (0°C) to 100°F (38°C).

Application Data

Installation of the Model FP-11 series of fire detectors requires a (2) two-wire circuit of 18 AWG (minimum) thermoplastic fixture wire enclosed in conduit, or 18 AWG (American Wire Gauge) limited energy, shielded cable without conduit, if permitted by local codes. Field wiring should conform to local and national electric codes and the control panel wiring specifications.

"T-tapping" is permitted only for Style 4 (Class B) wiring.

Model FP-11 fire detectors can be applied within the maximum 30-foot center spacing (900 sq. ft. areas), as referenced in NFPA 72. This applications guideline is based upon ideal conditions – specifically – smooth ceiling surfaces, minimal air movement, and no physical obstructions between potential fire sources and the detector. Do not mount detectors in close proximity to ventilation or heating and air-conditioning outlets.

Exposed joints or beamed ceilings may also affect safe spacing limitations for detectors. Should questions arise regarding detector placement, observe National Fire Protection Association (NFPA) 72 guidelines.

Dimensions

Technical Data

Environmental

Temperature: 32°F (0°C) to 100°F (38°C)
 Humidity: Up to 93% RH, non-condensing
 Air Pressure: No effect
 Alarm Temperature: 135°F (57°C)

Electrical

Voltage: 16-27 VDC
 Ripple: 3V peak-to-peak
 Supervisory Current: 110µA max
 Alarm Current: 33-50 mA

Details for Ordering

Model Number	Part Number	Description
FP-11	500-095112	Addressable <i>FirePrint™</i> Detector
DB-11	500-094151	Detector Mounting Base For Series 11 Intelligent Detectors
DB-11E	500-094151E	Detector Base (Small)
AD2-P	500-649706	Air-Duct Housing (for use with Models FP-11, HFP-11, HFPO-11 and PE-11 Detectors)
AD2-XHR	500-649708	Air-Duct Housing (for use with Models FP-11, HFP-11, HFPO-11 Detectors with Relay)
ADBX-11	500-096181	Audible Base
DB-X11RS	500-096125	Relay Base for Series 11 Intelligent Detectors
RLI-1	500-390673	Remote Alarm Indicator: 4" Octagon Box Mount, Red
RLI-2	500-390674	Remote Alarm Indicator: Single-Gang Mount, Red
DMK-11	500-695338	Series 11 Maintenance Kit (replacement labyrinth and bug screen)
DB-ADPT	500-094187	Base Adapter to Model DB-3S Base
LK-11	500-695350	Base Locking Kit for Series 11 Detectors

In Canada, please order:

Model Number	Part Number	Description
FP-11C	500-095112C	135°F Fixed Temperature, Plug-In Detector Addressable <i>FirePrint™</i> Detector [ULC Listed]
DB-11C	500-095687	Detector Mounting Base For Series 11 Intelligent Detectors [ULC Listed]
AD-11PC	500-095984	Air-Duct Housing [ULC Listed]
DB-X11RSC	500-093125C	Relay Base for Series 11 Intelligent Detectors [ULC Listed]
ADBX-11C	500-096181C	Audible Base for Series 11 Intelligent Detectors [ULC Listed]

Notice: This marketing catalog sheet is not intended to be used for system design or installation purposes.
 For the most up-to-date information, refer to each product's installation instructions.

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 Printed in U.S.A.

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August 2010
 Supersedes sheet dated 5/06
 (Rev.1)

VESDA VFT

VFT-15

VESDA VFT-15 detectors are multi-channel microbore air-sampling systems with an alarm sensitivity range from 0.001% to 20% obscuration/m (0.0003% to 6.10% obscuration/ft). These detectors are classified as Very Early Warning Smoke Detectors and can reliably detect fire at an early stage, and low to high concentrations of smoke. As a multi-channel system, the VFT detector is able to divide a protected space into sampling sectors, enabling the localization of a fire for faster incident response.

The detectors are configurable for a variety of environments, providing ideal fire detection solutions for cabinets, Electronic Data Processing (EDP) rooms, prisons, historic houses, custody suites, museums and art galleries.

How it works

The VFT detector draws a combined air sample from a network of microbore flexible tubing from all sectors in the protected area, then filters and analyzes the sample in a laser detection chamber. When smoke particles are detected and the smoke level reaches a TRACE alarm threshold, the system will sequentially scan the sectors via the rotary valve to identify the sector, or sectors, with the smoke condition. Alarm states (Alert, Action, Fire 1 and Fire 2) are shown on the display and communicated to a host fire alarm control panel.

Product Features

Programming and Configuration

Four independent alarm levels are available for each channel. The smoke thresholds for each of these alarms can be individually programmed per sector. VFT detectors provide a comprehensive display that includes an LED array to show the measured smoke level for the currently selected microbore tube, and an on-board programmer for local configuration.

RS232, RS485 and TCP/IP communication interfaces are provided as standard to connect to Xtralis Configuration and Fire System Management software packages: Xtralis VSC and Xtralis VSM4. RS485 interfaces also allow connections to programming devices and remote displays, and the TCP/IP Ethernet interface can provide access to an email messaging service.

Inputs and Outputs

VFT detectors support a number of additional modules. These provide the detector with programmable output relay interfaces and 4 to 20 mA analog outputs. A Remote Display panel can also be connected at a distance of up to 1 km away from the main VFT detector.

Features

- 15 tube addressable air sampling
- 0.001% to 20% obscuration/m (0.0003% to 6.10% obscuration/ft)
- 4 Alarms - Alert, Action, Fire 1, Fire 2
- 15 x 50 m (15 x 164 ft) microbore sampling tube
- Reliable linear pump technology
- Ethernet TCP/IP
- RS232 and RS485 Modbus
- 5 relay outputs and expandable
- Optional relay module and 4 to 20 mA analog output modules
- Area coverage of up to 1500 m² (16 150 ft²)
- Event Log

Listings/Approvals

- UL
- ULC
- FM
- VdS
- CE - EMC, LVD and CPD
- EN54-20
 - Class A: 0.1% obs/m (0.03% obs/ft)
 - Class B: 0.1% obs/m (0.03% obs/ft)
 - Class C: 1.0% obs/m (0.3% obs/ft)

VFT-15 detectors have one sampling hole per microbore tube.

Regional approvals listings and regulatory compliance vary between VESDA models.

VESDA[®]
by **xtralis**[™]

VESDA VFT

Aspiration and Flow Sensing

The aspirator is a linear vacuum pump, which provides superior detection times over long tube lengths and reliable detection in high air flow environments. Airflow in each tube is monitored by a differential pressure sensor, with airflow faults indicated on the display and to monitoring equipment.

Dimensions

Ordering Information

24 VDC, Display/Programmer, TCP/IP, 15 inlets, Class A/B/C,
0.001 to 20% obs/m (0.0003 to 6.1% obs/ft)

VFT-15

24 VDC, Display/Programmer, TCP/IP, 15 inlets, Class C,
1 to 20% obs/m (0.3 to 6.1% obs/ft)¹

VFT-15-C

4-Channel Relay Module²

01-E606-01

8-Channel 4-20 mA Re-Transmission Module²

01-E624-00

VFT-15 Remote Display²

01-V921-15

Notes:

1. The VFT-15-C is not available in all regions. Please consult your nearest Xtralis office before placing an order.
2. Please contact your nearest Xtralis office for approvals status.

VFT-15

Specifications

Supply Voltage:

Nominal 24 VDC

Supply Current at 24 VDC:

	Quiescent	Scanning
Power	31.2 W	32.0 W
Current	1.30 A	1.33 A

Aspirator:

Linear vacuum pump

Dimensions (WHD):

490 mm x 355 mm x 200 mm
(19.3 in. x 14.0 in. x 7.9 in.)

Operating Conditions: *

Tested to:

-10 to 55 °C (14 to 131 °F)

Recommended Detector Ambient:

0 to 39 °C (32 to 103 °F)

Sampled Air:

-20 to 60 °C (4 to 140 °F)

Humidity:

10 to 95% RH (non-condensing)

Please consult your Xtralis office for operation outside these parameters or where sampled air is continually above 0.05% obs/m (0.015% obs/ft) under normal operating conditions.

Microbore Tube Size:

Outer Diameter: 6 mm (0.24 in.)

Inner Diameter: 4 mm (0.16 in.)

Microbore Tube Length:

15 x 50m (15 x 164 ft)

Pipe Length: 50 m (164 ft)

Alarm Sensitivity Range:

0.001 to 20 % obs/m

(0.0003 to 6.10 % obs/ft)

Alarm Settings:

Alarm levels: Alert, Action, Fire 1 and Fire 2

Individually programmable for each level

IP Rating:

IP30

Cable Access:

7 x 25mm (1") cable entries

Cable Termination:

Screw Terminal blocks 0.2–2.5 mm² (30–12 AWG)

Filtration:

Field exchangeable dual stage filter

Flow Monitoring:

Differential pressure sensor

Relay Outputs:

4 alarm relays, 1 fault relay

Rated 2 A @ 30 VDC NO/NC Contacts

Communication:

Modbus over RS232, RS485 and

TCP/IP

Event Log:

Up to 20,000 events stored

* Product UL listed for use from
0 °C to 38 °C (32 °F to 100 °F)

www.xtralis.com

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UK and Europe +44 1442 242 330 Middle East +962 6 588 5622

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Doc. no. 16317_10

Part no. 29323

VESDA
by **xtralis**

Air Duct Housings-Series 11

ENGINEER AND ARCHITECT SPECIFICATIONS

- For Series 11 Detectors
- Relay Models Available
- Self contained Model available with "On - Board" Power Supply
- Alarm LED Visible from Front
- Clear Housing Cover for Quick Identification of Detector Type
- Listed, ULC Listed
CSFM, FM, NYMEA Approved

Introduction

The Siemens Building Technologies, Fire Safety Division air duct detector housings are designed to be used with the PE-11 and FP-11 detectors. Designed for installation directly to heating, ventilating and air conditioning duct systems, they comply with National Fire Protection Association Standard No. 90A. When equipped with photoelectric detectors, these units will signal the presence of hazardous quantities of products of combustion or smoke being carried through the duct system. Air duct detectors are not intended to be substituted for open area detection.

Air duct housings can be equipped with optional relays. These relays are utilized to operate any supplementary equipment when smoke or particles of combustion are detected.

Note: Most control equipment guarantee only one detector per zone when the detector operated relay function is critical. The connection of a remote lamp and a remote relay per detector is allowed with PXL or System 3™ only, other conventional systems may use either a remote lamp or a relay.

With the MXL series of control panels, up to 60 detectors per circuit having relays may be used. The connection of a remote lamp or a remote relay is allowed for each detector but not both.

Air duct housings (see Ordering Information) are Underwriters Laboratories, Inc. listed.

Description

The Fire Safety air duct housing is uniquely designed to use the photoelectric detector.

Sensitivity of PE-11 detectors can be checked by viewing the LED or an RSAW-11 or RSAC-11 multicolor remote lamp. A green flash indicates the detector has passed its self test. Amber indicates a trouble condition, and red indicates an alarm state.

FP-11 sensitivity may be viewed from the multicolor LED on the detector or preferably may be printed by command on an optional printer from the MXL control panel.

The detector unit employs a cross-sectional sampling principle of operation. Inlet sampling tubes are available in four lengths (see table on reverse side). Outlet sampling tubes are one common length. A continuous cross-sectional sample of air moving through the duct is taken. This averages the effects of laminar flow, stratification or skin effect phenomena occurring in the duct that could prevent combustion product or smoke (especially in large ducts) from reaching a spot type detector.

In addition, the unique design of the sampling chamber insures uniform sensitivity in air velocities, ranging from a low of 300 feet per minute to as high as 4000 feet per minute.

CATALOG NUMBER **6178**

Replaces Catalog Sheet Number 6177

The inlet sampling tube length is determined by the width of the air duct being protected. The inlet tube nearest to but greater than the duct width should be used (see table). The inlet tube can then be trimmed at the job site to the exact width of the duct. The outlet sampling tube for all ducts, irrespective of width, has a fixed length of approximately 3 inches (7.5 cm) and is supplied with the duct housing.

Duct Width	Sampling Tube Model No.
9" to 1'9" (21 cm to 51 cm)	STA-2
1'9" to 3'3" (51 cm to 97.5 cm)	STA-3
3'3" to 6'3" (95.5 cm to 187.5 cm)	STA-6
6'3" to 9'9" (187.5 cm to 292.5 cm)	STA-10
Greater than 9'9" (292.5 cm)	Consult Siemens Fire Safety

When the use of a remote relay is required, order model AD-11PR for conventional systems; AD-11XPR for MXL systems. When required the EAD-3 weatherproof enclosure for Duct Housing is available.

Sampling Tube Selection Table

Maintenance of the detector is easily accomplished by the removal of the Series 11 duct housing sampling chamber cover. The detector, which plugs into the housing, is easily removed for cleaning by a trained technician.

All that is necessary for the installation of the air duct detector is the cutting of three small holes for the sampling tube installation (template included) and the drilling of four holes for mounting the air duct housing. The unit is then easily mounted in place and connection made to the existing wires or terminals if optional accessories are utilized.

When using the PE-11 or FP-11 detector in an AD-3I or AD-3ILP duct detector housing you must use the AD-11UK upgrade kit consisting of a detector base adapter and a new duct housing cover. Any Series 3 accessories such as remote lamps or relays will also have to be updated to PE-11 accessories. The FP-11 is

electrically compatible with Series 3 MXL accessories.

Model	Description	Shipping Weight Lb. Kg.	
AD-11P	Series 11 air duct housing with cover for the PE-11 and FP-11 detectors	5	2.25
AD-11PR	Series 11 air duct housing with cover for the PE-11 photoelectric detector and equipped with remote relay	5	2.25
AD-11XPR	Series 11 air duct housing with civer for the FP-11 detector equipped with remote relay	5	2.25
SA-11P	Series 11 air duct housing with power supply for self-contained unit operation for Pe-11 photoelectric detector	7	3.15
AD-11UK	Upgrade kit for using PE-11 or FP-11 detector in a series 3 duct housing	1	.45
STA-2	Sampling Tube, for ducts 9" to 1'9"	1	.45
STA-3	Sampling Tube, for ducts 1'9" to 3'3"	2	.9
STA-6	Sampling Tube, for ducts 3'3" to 6'3"	4	1.8
STA-10	Sampling Tube, for ducts 6'3" to 9'9". Sampling Tubes greater than 9'9", consult Siemens Fire Safety	6	3.7
RLC-11	Remote Alarm Lamp, ceiling mounted for PE-11	.5	.22
RLW-11	Remote Alarm Lamp, wall mounted for PE-11	.5	.22
RSAC-11	Remote Tri-color LED, ceiling mounted for PE-11	.5	.22
RSAW-11	Remote Tri-color LED, wall mounted for PE-11	.5	.22
PE-11	Conventional Photoelectric Detector	1	.45
FP-11	Intelligent FirePrint™ Detector	1	.45
EAD-3	Weatherproof enclosure for Duct Housing	5.5	2.5

Model	Description	Part Number
RLI-1	Remote (red) alarm indicator - 4" octagon box mount	500-390673
RLI-2	Remote (red) alarm indicator - single gang box mount	500-390674

Note: Minimum hardware required is one Air Duct Housing Assembly, one Sampling Tube and one Detector.

NOTICE: The use of other than Fire Safety detectors and bases with Fire Safety equipment will be considered a misapplication of Fire Safety equipment and as such voids all warranties either expressed or implied in regard to loss, damage, liabilities and/or service problems

Siemens Building Technologies
Fire Safety

Fire Safety
8 Fernwood Road
Florham Park, NJ 07932
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FAX: (973) 593-6670
Website: www.sbt.siemens.com/fis

5/03
5M
SFS-IG
Printed in U.S.A.

Fire Safety
2 Kenview Boulevard
Brampton, Ontario
Canada L6T 5E4
Tel: (905) 799-9937
FAX: (905) 799-9858

May 2003
Supersedes sheet dated 4/02

SIEMENS MSM SERIES

Fire Safety

Metal Manual Fire Alarm Box

ENGINEER AND ARCHITECT SPECIFICATIONS

- Rugged Die-Cast Metal Housing
- Reset Key Matches Control Panel
- Optional Break Glass Operation
- Single-Gang Semi-Flush Mount
- Optional Surface Mount Backbox
- Double-Action Institutional, Weather-Proof and Explosion-Proof Models Available
- UL Listed, ULC Listed, CSFM, FM and NYMEA Approved

**Standard Model
Or Weatherproof**

Institutional Model

Description

The MSM Series manual stations feature a rugged die-cast metal housing that satisfies both architectural and code requirements for manual fire alarm box initiation devices. The MSM-Series box features keyed reset using the same key as the control panels.

The MSM Series models are low-profile with all surfaces either painted or plated to inhibit corrosion. These boxes have raised lettering and are shipped with two reset keys and a break glass rod (use of rod is optional.) Options include: double action, institutional, weatherproof, and explosion-proof.

These stations are equipped with a S.P. S.T. switch rated at 10amps @ 120 VAC and all connections are made to a terminal block. The explosion-proof model has a D.P. D.T. switch. **Both the weatherproof and explosion-proof models are shipped complete with backbox.** (Backbox is optional with other models, or you can mount to standard single-gang box.)

These models are intended for use with all Siemens Building Technologies, Fire Safety Division conventional zones, but can also be used with addressable zones when used in conjunction with a TRI-Series addressable module.

CATALOG NUMBER **6184**

Dimensions

Station

Width 3.20 in.
Height 4.75 in.
Depth 1.20 in. (2.30 in. overall, including back of switch)

Station w/Double Action

Width 3.33 in.
Height 4.57 in.
Depth 1.50 in. (2.60 in. overall, including back of switch)

Weatherproof Model

Width 3.20 in.
Height 4.75 in.
Depth 2.75 in.

Explosion-proof Model

Width 3.20 in.
Height 4.75 in. (6.00 in. overall, including mounting ears)
Depth 3.50 in.

Ordering Information

Model Number	Description	Part Number
MSM-K	Manual Station, Metal w/Key	500-698215
MSM-KD	Manual Station, Metal w/Key, Double Action	500-698216
MSM-K-WP	Manual Station, Metal w/Key, Weatherproof	500-698217
MSM-KD-WP	Manual Station, Metal w/Key, Weatherproof, Double Action	500-698218
MSM-EXP	Manual Station, Metal w/Key, Explosion-proof	500-698219
MSM-INST	Manual Station, Metal w/Key, Institutional	500-698220
MSM-BOX	Surface Backbox for MSM-series Manual Stations	500-698221

Double Action Model

Explosion-proof Model

Siemens Building Technologies
Fire Safety

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Florham Park, NJ 07932
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April 2007
Supersedes sheet dated 6/03

Strobe, Horn Strobe, and Horn Notification Appliances

Description:

The Wheelock® Exceder™ Series of notification appliances feature a sleek modern design that will please building owners with reduced total cost of ownership. Installers will benefit from its comprehensive feature list, including the most candela options in one appliance, low current draw, no tools needed for setting changes, voltage test points, 12/24 VDC operation, universal mounting base and multiple mounting options for both new and retrofit construction.

The Wheelock® Exceder™ Series incorporates high reliability and high efficiency optics to minimize current draw allowing for a greater number of appliances on the notification appliance circuit. All strobe models feature an industry first of 8 candela settings on a single appliance. Models with an audible feature 3 sound settings (90, 95, 99 dB). All switches to change settings, can be set without the use of a tool and are located behind the appliance to prevent tampering. Wall models feature voltage test points to take readings with a voltage meter for troubleshooting and AHJ inspection.

The Wheelock® Exceder™ Series of wall and ceiling notification appliances feature a Universal Mounting Base (UMB) designed to simplify the installation and testing of horns, strobes, and combination horn strobes. The separate universal mounting base can be pre-wired to allow full testing of circuit wiring before the appliance is installed and the surface is finished. It comes complete with a Contact Cover for protection against dirt, dust, paint and damage to the contacts. The Contact Cover also acts as a shunting device to allow pre-wire testing for common wiring issues. The Contact Cover is polarized to prevent it from being installed incorrectly and prevents the appliance from being installed while it is on the UMB. When the Contact Cover is removed the circuit will show an open until the appliance is installed. The UMB allows for consistent installation and easy replacement of appliances if required. Wall models provide an optional locking screw for extra secure installation, while the ceiling models provide a captivated screw to prevent the screw from falling during installation.

Compliance

- UL 1971, UL 464, ULC, CSFM, FM
- ADA/NFPA/ANSI/OSHA
- RoHS

Compatibility and Requirements

- Synchronize using the Wheelock® Sync Modules or panels with built-in Wheelock® Patented Sync Protocol
- Compatible with UL "Regulated Voltage" using filtered VDC or unfiltered VRMS input voltage
- Strobes produce 1 flash per second over the "Regulated Voltage" range

* Compared to competitive models

*** Patented

** Compared to previous models

- Save up to **48%** in current draw*
- Up to **9** models now in **1** appliance
- Save up to **14%** cost of installation**

Sleek Modern Aesthetics

Finger Slide Switches

Voltage Test Points

Multiple Voltages

3 Audible Settings
90, 95, 99 dB

8 Candela Settings ***
Wall - 15/1575/30/75/95/110/135/185
Ceiling - 15/30/60/75/95/115/150/177

Universal Mounting Base ***
Ceiling and Wall
Mounts to 5 Backbox Types

Environmentally Friendly
Low Current Draw

NOTE: All CAUTIONS and WARNINGS are identified by the symbol ⚠. All warnings are printed in bold capital letters.

⚠ WARNING: PLEASE READ THESE SPECIFICATIONS AND ASSOCIATED INSTALLATION INSTRUCTIONS CAREFULLY BEFORE USING, SPECIFYING OR APPLYING THIS PRODUCT. VISIT WWW.COOPERNOTIFICATION.COM OR CONTACT COOPER NOTIFICATION FOR THE CURRENT INSTALLATION INSTRUCTIONS. FAILURE TO COMPLY WITH ANY OF THESE INSTRUCTIONS, CAUTIONS OR WARNINGS COULD RESULT IN IMPROPER APPLICATION, INSTALLATION AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE, AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

General Notes:

General Notes:

- Strobes are designed to flash at 1 flash per second minimum over their "Regulated Voltage Range".
- All candela ratings represent minimum effective strobe intensity based on UL Standard 1971.
- Series Exceder Strobe products are Listed under UL Standards 1971 and 464 for indoor use with a temperature range of 32°F to 120°F (0°C to 49°C) and maximum humidity of 93% (± 2%) UL 464 (85% UL 1971).
- Series Exceder horns are under UL Standard 464 for audible signal appliances (Indoor use only).

Low Current Draw = Fewer Power Supplies

Strobe Ratings per UL Standard 1971

		UL Max Current*													
		24 VDC / 24 FWR												12 VDC	
Model	Regulated Voltage Range VDC	15	15/75	30	60	75	95	110	115	135	150	177	185	15	15/75
ST	8.0-33.0	0.057	0.070	0.085		0.135	0.163	0.182		0.205			0.253	0.110	0.140
STC	8.0-33.0	0.061		0.085	0.103	0.135	0.163		0.182		0.205	0.253		0.110	

Horn Strobe Ratings per UL 1971 & Anechoic at 24 VDC

		UL Max Current* at Anechoic 99 dBA													
		24 VDC												12 VDC	
Model	Regulated Voltage Range VDC	15	15/75	30	60	75	95	110	115	135	150	177	185	15	15/75
HS	8.0-33.0	0.082	0.095	0.102		0.148	0.176	0.197		0.242			0.282	0.125	0.159
HSC	8.0-33.0	0.082		0.102	0.141	0.148	0.176		0.197		0.242	0.282		0.125	
		UL Max Current* at Anechoic 95 dBA													
		24 VDC												12 VDC	
Model	Regulated Voltage Range VDC	15	15/75	30	60	75	95	110	115	135	150	177	185	15	15/75
HS	8.0-33.0	0.073	0.083	0.087		0.139	0.163	0.186		0.230			0.272	0.122	0.153
HSC	8.0-33.0	0.073		0.087	0.128	0.139	0.163		0.186		0.230	0.272		0.122	
		UL Max Current* at Anechoic 90 dBA													
		24 VDC												12 VDC	
Model	Regulated Voltage Range VDC	15	15/75	30	60	75	95	110	115	135	150	177	185	15	15/75
HS	8.0-33.0	0.065	0.075	0.084		0.136	0.157	0.184		0.226			0.267	0.120	0.148
HSC	8.0-33.0	0.065		0.084	0.120	0.136	0.157		0.184		0.226	0.267		0.120	

Horn Ratings per UL Anechoic

Model	Regulated Voltage Range VDC	99 dB	95 dB	90 dB
HN	16-33.0	0.064	0.044	0.022
HNC	16-33.0	0.084	0.044	0.022
HN	8.0-17.5	0.047	0.026	0.017
HNC	8.0-17.5	0.047	0.026	0.017

* UL max current rating is the maximum RMS current within the listed voltage range (16-33 VDC for 24 VDC units). For strobes the UL max current is usually at the minimum listed voltage (16 VDC for 24 VDC units). For audibles the max current is usually at the maximum listed voltage (33 VDC for 24 VDC units). For unfiltered ratings, see installation instructions.

Specification & Ordering Information

Easy to remember model codes	Model	Strobe Candela	Sync w/ DSM or Wheelock Power Supplies	12/24 VDC*	1 gang, 2 gang, 4" sq, 3.5" octal & 4" octal boxes	Mounting Options
	Horn Strobes					
	HSR	15/1575/30/75/95/110/135/185	X	X		UMB**
	HSW	15/1575/30/75/95/110/135/185	X	X		UMB**
	HSRC	15/30/60/75/95/115/150/177	X	X		UMB**
	HSWC	15/30/60/75/95/115/150/177	X	X		UMB**
	Strobes					
	STR	15/1575/30/75/95/110/135/185	X	X		UMB**
	STW	15/1575/30/75/95/110/135/185	X	X		UMB**
	STRC	15/30/60/75/95/115/150/177	X	X		UMB**
	STWC	15/30/60/75/95/115/150/177	X	X		UMB**
	Horn					
	HNR		X	X		UMB**
	HNW		X	X		UMB**
	HNRC		X	X		UMB**
	HNWC		X	X		UMB**

*12 VDC models feature 15 & 15/75 settings

**UMB = Universal Mounting Base

Model Legend

HN = Horn
 ST = Strobe
 HS = Horn Strobe
 C = Ceiling Mount
 W = White
 R = Red
 A = Agent Lettering (Strobes only)
 AL = Alert Lettering (Strobes only)
 N = No Lettering (Strobes only)

Example 1: STRC = Strobe, Red, Ceiling Mount

Example 2: HSR = Horn Strobe, Red, Wall Mount

Example 3: HSW = Horn Strobe, White, Wall Mount

Example 4: STW-AL = Strobe, White, Wall Mount, Alert Lettering

Example: HSR

Example: HSWC

Voltage test points for quick troubleshooting and easy spot checking (wall models only)

8 candela settings

*UMB

Common base for wall and ceiling with 5 mounting options

Contact Cover

NOTE: Due to continuous development of our products, specifications and offerings are subject to change without notice in accordance with Cooper Wheelock Inc., dba Cooper Notification standard terms and conditions.

Architects and Engineers Specifications

The notification appliances shall be Wheelock® Exceder™ Series HS Audible Strobe appliances, Series ST Visual Strobe appliances and Series HN Audible appliances or approved equals. The Series HS and ST Strobes shall be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service. The Series HS and HN Audibles shall be UL Listed under Standard 464 (Fire Protective Signaling). All Series shall meet the requirements of FCC Part 15 Class B. All inputs shall be compatible with standard reverse polarity supervision of circuit wiring by a Fire Alarm Control Panel (FACP) with the ability to operate from 8 to 33 VDC. Indoor wall models shall incorporate voltage test points for easy voltage inspection.

The Series HS Audible Strobe and ST Strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range and shall incorporate a Xenon flashtube enclosed in a rugged Lexan® lens. The Series shall be of low current design. Where Multi-Candela appliances are specified, the strobe intensity shall have 8 field selectable settings at 15, 15/75, 30, 75, 95, 110, 135, 185 candela for wall mount and 15, 30, 60, 75, 95, 115, 150, 177 candela for ceiling mount. The selector switch for selecting the candela shall be tamper resistant. The 15/75 candela strobe shall be specified when 15 candela UL Standard 1971 Listing with 75 candela on-axis is required (e.g. ADA compliance). Appliances with candela settings shall show the candela selection in a visible location at all times when installed.

The audible shall have a minimum of three (3) field selectable settings for dBA levels and shall have a choice of continuous or temporal (Code 3) audible outputs.

The Series HS Audible Strobe, ST Strobe and Series HN Audible shall incorporate a patented Universal Mounting Base that shall allow mounting to a single-gang, double-gang, 4-inch square, 3.5-inch octal, 4-inch octal or 100mm European type back boxes. Two wire appliance wiring shall be capable of directly connecting to the mounting base. Continuity checking of the entire NAC circuit prior to attaching any notification appliances shall be allowed. Product shall come with Contact Cover to protect contact springs. Removal of an appliance shall result in a supervision fault condition by the Fire Alarm Control Panel (FACP). The mounting base shall be the same base among all horn, strobe, horn strobe, wall and ceiling models. All notification appliances shall be backwards compatible.

The Series HS and ST wall models shall have a low profile measuring 5.24" H x 4.58" W x 2.19" D. Series HN wall shall measure 5.24" H x 4.58" W x 1.6" D. The Series HSC and STC shall be round and have a low profile with a diameter of 6.68" x 2.63" D. Series HNC ceiling shall have a diameter of 6.68" x 1.50" D.

When synchronization is required, the appliance shall be compatible with Wheelock®'s DSM Sync Modules, Wheelock® Power Supplies or other manufacturer's panels with built-in Wheelock® Patented Sync Protocol. The strobes shall not drift out of synchronization at any time during operation. If the sync protocol fails to operate, the strobe shall revert to a non-synchronized flash-rate and still maintain (1) flash per second over its Regulated Voltage Range. The appliance shall also be designed so that the audible signal may be silenced while maintaining strobe activation when used with Wheelock® synchronization protocol.

Wall Appliances – UL Standard 1971, UL Standard 464, California State Fire Marshal (CSFM), ULC, FM, RoHS

Ceiling Appliances – UL Standard 1971, UL Standard 464, California State Fire Marshal (CSFM), ULC, FM, RoHS

WE ENCOURAGE AND SUPPORT NICET CERTIFICATION
3 YEAR WARRANTY

Exceder - Spec Sheet 5/13

NJ Location
273 Branchport Ave.
Long Branch, NJ 07740
P: 800-631-2148
F: 732-222-8707
www.coopernotification.com

Cooper Notification is Wheelock®
COOPERNotification

INSTALLATION INSTRUCTIONS **WHEELLOCK EXCEDER SERIES 2-WIRE FIELD** **SELECTABLE HORN STROBE, AND HORN/STROBE** **APPLIANCES (CEILING MOUNT)**

Use this product according to this instruction manual. Please keep this instruction manual for future reference.

GENERAL

The Cooper Wheellock Exceder Series HN-C Horn, ST-C Strobe, and HS-C Horn/Strobe Appliances are designed for easy installation. All models are for 12V or 24V operation. The appliance comes in two main parts. The universal mounting back plate allows the the ceiling appliance to be mounted to a single gang, double gang, 4-inch square, 4-inch octagon, or a 3 1/2-inch octagon backbox. Two-wire appliance wiring is then connected to the mounting back plate. This allows a continuity check of the entire NAC circuit before any appliances are attached. It also allows the appliances to be installed after all finish work has been completed. The installer can snap or install the appliances when all other work is complete.

WARNING: Please read these instructions carefully before using this product. Failure to comply with any of the following instructions, cautions and warnings could result in improper application, candlea setting, installation and/or operation of these products in an emergency situation, which could result in property damage and serious injury or death to you and/or others.

Table 1: Models and Settings

Model	Regulated Voltage	Voltage Range Limit per UL/ULC	Strobe (cd)	Horn	Current Draw	Mounting
ST-C	12 (NDC)	8.0-17.5	15	-----	3	Ceiling
	24 (NDC/V _{max})	16.0-33.0	15/30/60/75/95/115/150/177			
HS-C	12 (VDC)	8.0-17.5	15	X	4	Ceiling
	24 (NDC/V _{max})	16.0-33.0	15/30/60/75/95/115/150/177			
HN-C	12 (NDC/V _{max})	8.0-17.5	-----	X	5	Wall/Ceiling
	24 (NDC/V _{max})	16.0-33.0				

STROBE AND HORN STROBE APPLIANCES

Cooper Notification's Exceder Multi-Candlea Strobes can provide a non-synchronized strobe appliance when connected directly to a Fire Alarm Control Panel (FACP), or provide a synchronized strobe appliance when used in conjunction with an FACP that incorporates the Wheellock sync protocol, a Wheellock Sync Module, or the Wheellock Power Supply. The Strobe Appliances are UL Listed under Standard 1971 Signaling Devices for the Hearing Impaired for Indoor Fire Protection Service. They are listed for **indoor use only**. Cooper Notification's Exceder Horn Appliances provide a selectable Continuous or Code 3 Horn tone when connected directly to the Fire Alarm Control Panel (FACP). They can also provide a synchronized Code 3 Horn tone when used in conjunction with an FACP that incorporates the Wheellock sync protocol, a Wheellock Sync Module, or the Wheellock Power Supply. The Horn Appliances can be field set for High (H), Medium (ME), or Low (LO) dBA sound output. The Horn Appliances are UL Listed under Standard 464 for Audible Signal Appliances. They are listed for **indoor use only**. All models are designed for use with either filtered DC (VDC) or unfiltered Full-Wave Rectified (V_{max}) input voltage. All inputs are polarized for compatibility with standard reverse polarity supervision of circuit wiring by an FACP. The ST-C Strobe, HS-C Horn/Strobe, and the HN-C Horn are for 12V or 24V operation. Strobe devices for 12V are only approved by UL to be set at 15cd and only to be powered by DC not FWR.

NOTE: The HN-C may be used on both wall and ceiling applications.

NOTE: The Code 3 temporal pattern (1/2 second on, 1/2 second off, 1/2 second off, 1/2 second on, 1-1/2 off and repeat) is specified by ANSI and NFPA 72 for standard emergency evacuation signaling. **The Code 3 Horn should be used only for fire evacuation signaling and not for any other purpose.**

Table 2A: HN-C and HS-C dBA Sound Output

Reverberant dBA Per UL 464		HN-C and HS-C at 12V						HN-C and HS-C at 24V					
Description	Volume	8.0V	12.0V	17.5V	16.0V	24.0V	33.0V						
Continuous Horn	High	83	88	91	91	93	96						
	Medium	79	82	86	86	89	92						
	Low	72	76	79	78	82	85						
Code 3 Horn	High	80	84	86	86	89	91						
	Medium	74	78	81	81	85	84						
	Low	67	71	74	74	78	80						

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Table 2B: HN-C and HS-C dBA Sound Output

Anechoic Per CANULC-S825-07		HN-C and HS-C at 12V						HN-C and HS-C at 24V					
Description	Volume	8.0V	12.0V	17.5V	16.0V	24.0V	33.0V						
Continuous Horn	High	89	93	96	96	99	101						
	Medium	85	89	92	92	91	95						
	Low	79	84	87	86	88	90	92					
Code 3 Horn	High	87	93	96	96	95	99	101					
	Medium	85	89	92	92	91	95	97					
	Low	79	84	87	86	90	92						

Table 2C: ULC Directional Characteristics

Axis	dBA	Angle
Horizontal	-3dBA	80° left and right
	-6dBA	85° left and right
Vertical	-3dBA	45° up and down
	-6dBA	60° up and down

Table 3: ST-C Strobe Current Draw (Amps)

Strobe Candlea Settings (cd)		8.0-17.5 Volts					
16.0-33.0 Volts		15	30	60	75	95	115
Current	15	0.082	0.102	0.141	0.148	0.176	0.197
DC	0.061	0.085	0.103	0.135	0.163	0.182	0.205
FWR	0.083	0.105	0.166	0.185	0.223	0.256	0.328
							0.372
							FWR
							~

Table 4: HS-C Horn/Strobe Current Draw (Amps)

Strobe Candlea Settings (cd)		16.0-33.0 Volts						8.0-17.5 Volts	
Horn		15	30	60	75	95	115	150	177
Settings	High*	0.082	0.102	0.141	0.148	0.176	0.197	0.242	0.282
	Medium*	0.073	0.097	0.128	0.139	0.163	0.186	0.230	0.272
	Low*	0.065	0.084	0.120	0.136	0.167	0.184	0.226	0.267
	High*	0.131	0.138	0.220	0.216	0.258	0.289	0.357	0.384
	Medium*	0.112	0.126	0.202	0.201	0.247	0.272	0.340	0.378
	Low*	0.106	0.120	0.186	0.196	0.235	0.265	0.331	0.375
									~

* Current Draw is the same for the Continuous Horn and Code 3 Horn Settings.

Table 5: HN-C Horn Current Draw (Amps)

Horn Settings		8.0-17.5 Volts		16.0-33.0 Volts	
Current	High*		0.047		0.084
	Medium*		0.026		0.044
	Low*		0.017		0.022
FWR	High*		0.073		0.092
	Medium*		0.048		0.079
	Low*		0.036		0.054

* Current Draw is the same for the Continuous

Hom and Code 3 Hom Settings.

NOTE: Candela setting, hom setting and voltage will determine the current draw of the product.

When calculating the total currents use Tables 5-9 to determine the highest value of RMS current for an individual appliance, then multiply these values by the total number of appliances. Be sure to add the currents for any other appliances, including audible signaling appliances powered by the same source, and to include any required safety factors.

NOTE: The maximum number of strobes on a single notification appliance circuit shall not exceed 50.

NOTE: These notification appliances are UL Listed as "Regulated". They are intended to be used with FACP's whose notification circuits are UL Listed as "Regulated". These appliances shall not be used on UL Listed "Special Application" notification circuits unless the appliances are identified to be compatible in the installation instructions of the FACP or unless the FACP is identified to be compatible in this instruction manual.

NOTE: These notification appliances are UL Listed as "Regulated". They are intended to be used with FACP's whose notification circuits are UL Listed as "Regulated". These appliances shall not be used on UL Listed "Special Application" notification circuits unless the appliances are identified to be compatible in the installation instructions of the FACP or unless the FACP is identified to be compatible in this instruction manual.

NOTE: These appliances were tested to the regulated voltage limits of 160-33.0 Volts for 24 volt models and 8.0-17.5 Volts for 12 volt models using filtered dc for the 12 volt range and either filtered dc or unfiltered dc for the 24 volt range voltage. Do not apply voltage outside of this range.

NOTE: Check the minimum and maximum output of the power supply and standby battery and subtract the voltage drop from the circuit wiring resistance to determine the applied voltage to the strobes. The maximum wire impedance between strobes shall not exceed 35 ohms.

NOTE: Strobes are not designed to be used on coded systems in which the applied voltage is cycled on and off.

NOTE: Make sure that the total RMS current required by all appliances that are connected to the system's primary and secondary power sources, notification appliance circuits, DSW sync modules, or Cooper Wheelock's power supplies does not exceed the power sources rated capacity or the current ratings of any uses on the circuits to which these appliances are wired. Overloading power sources or exceeding these ratings could result in loss of power and failure to alert occupants during an emergency, which could result in property damage and serious injury or death to you and/or others.

Figure 1: Expected Light Output

WIRING AND MOUNTING BASE:

1. All strobe appliances have in-out wiring terminals that accept two #12 to #18 American Wire Gauge (AWG) wires at each screw terminal. Strip leads 3/8 inches and connect to screw terminals.
2. Break all in-out wire runs on supervised circuits to ensure integrity of circuit supervision as shown in Figure 2. The polarity shown in the wiring diagrams is for the operation of the appliances. The polarity is reversed by the FACP during supervision.

Figure 2 and Figure 3

NOTE: Wiring method shall be in accordance with CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, Section 32.

WIRING AND MOUNTING SETTINGS

NOTE: The HS-C and ST-C are factory set for the most common application of 15sdc. The HS-C and HN-C are factory set for the most common application of Medium dB and Code 3.

Figure 4: Selector Switch

NOTE: Candela factory settings are shown in above illustrations.

CAUTION: Check that the installed product will have sufficient clearance and wiring room prior to installing backboxes and conduit, especially if shielded multi-conductor cable or 3/4" conduit fittings are used.

Although the limits shown for each mounting option comply with the National Electrical Code (NEC), Cooper Notification recommends use of the largest backbox option shown and the use of approved stranded field wires, whenever possible, to provide additional wiring room for easy installation and minimum stress on the product from wiring.

WARNING: Do not over tighten mounting screws. Excessive torque can distort the base and may affect operation.

MOUNTING OPTION:

1. Install mounting plate as shown in Figure 5 to a single-gang, double-gang, 4" square or octagon backbox with the provided part head screws.
2. Connect field wiring per Figures 2 and 3.
3. Dress wires back into backbox.
4. While performing wiring continuity check, leave terminal cover in place.
5. Remove terminal cover before snugging or installing the appliance into the mounting plate per Figure 5.
6. **Important:** Device only has one mounting orientation. Match the top of the base to the top of the device.
7. Secure screw at the top of the device. (This is required.)
8. To remove the appliance, disengage screw, slide appliance up and then pull appliance away from mounting plate.

Figure 5: Installation

WARNING: THESE APPLIANCES ARE A "FIRE ALARM DEVICE - DO NOT PAINT."

WARNING: When installing strobes in an open office or other areas containing partitions or other viewing obstructions, special attention should be given to the location of the strobes so that their operating effect can be seen by all intended viewers, with the intensity, number, and type of strobes being sufficient to ensure the intended viewer is alerted by proper illumination, regardless of the viewer's orientation.

WARNING: A small possibility exists that the use of multiple strobes within a person's field of view, under certain circumstances, might induce a photo-sensitive response in persons with epilepsy. Strobe reflections in a glass or mirrored surface might also induce such a response. To minimize this possible hazard, Cooper Notification strongly recommends that the strobes installed should not present a composite flash rate in the field of view which exceeds five (5) hz at the operating voltage of the strobes. Cooper Notification also strongly recommends that the intensity and composite flash rate of installed strobes comply with levels established by applicable laws, standards, regulations, codes and guidelines.

NOTE: NFPA 72/ANSI 117.1 conform to ADMAQ Equivalent Facility Guidelines in using fewer, higher intensity strobes within the same protected area.

NOTE: Final acceptance is subject to Authorities Having Jurisdiction.

CAUTION: Check the installation instructions of the manufacturers of other equipment used in the system for any guidelines or restrictions on wiring and/or locating Notification Appliance Circuits (NAC) and notification appliances. Some system communication circuits and/or audio circuits, for example, may require special precautions to assure immunity from electrical noise (e.g., audio crosstalk).

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: 1) Reorient or relocate the receiving antenna, 2) increase the separation between the equipment and receiver, 3) Connect the equipment into an outlet on a circuit different from that to which the receiver is connected, and 4) Consult the dealer or an experienced radio/TV technician for help.

COMPATIBLE WHEELLOCK DEVICE: DSM-11224

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MXL Panel

Advanced Fire Protection System

ARCHITECT AND ENGINEER SPECIFICATIONS

- *FirePrint™* application-specific detection
- More than 2,000 intelligent input-device capacity
- Dynamic supervision of intelligent devices
- Multiple command stations
- Security-device monitoring
- Sprinkler supervision
- Detector-sensitivity readout / printout, per NFPA 72 Chapter 7
- Intelligent / analog detection circuits:
 - Style 6 (Class A) or Style 4 (Class B)
- Conventional initiating circuits:
 - Style D (Class A) or Style B (Class B)
- Notification appliance circuits [NACs]:
 - Style Z (Class A) or Style Y (Class B)
- Degrade-mode operation
- Distributed processing
- 80-character backlit, alphanumeric display
- 32-character custom messages
- Thermal-strip printer
- Supervised remote printer
- Compare system software
- Fully field programmable, via laptop PC
- Menu-driven operator commands
- Central & distributed architecture
- Up to 800-event history log with online and offline reports
- User help screens
- Holiday schedule

- Logic-controlled output functions
- Multiple levels of password protection
- Automatic environmental compensation for smoke detectors
- One-person 'walk test' via 'loop,' 'zone' or 'system'
- *Alarm* verification by 'device' or 'zone'
- Time-base controlled output functions
- City Tie / Lease Line
- Coded outputs
- Supervised serial annunciator driver / input Interface
- 16-gauge steel enclosure
- Multi-language display
- Intelligent interface to building / process-management systems
- Operates as an interactive peer with other MXL, MXL-IQs or MXLV systems in a *LifeLINK* Network
- *Pre-alarm* operation
- NCC graphics
- NEC 760 power-limited circuits (©UL 864 9th Edition compliant)
- Sinorix™ NFPA Approval (2001)
- UUKL Listed for Smoke Control
- ©UL 864 9th Edition Listed, ©ULC Listed; CSFM, NYC Fire Department and City of Chicago Approved

System Overview

The MXL fire panel is a microprocessor-based advanced protection system. The use of the MXL system's unique multiprocessor 'network' design; as well as its ability to utilize analog and conventional detection devices, makes the MXL panel a highly flexible and reliable fire-control system.

The MXL panel is ideally suited for commercial, industrial and institutional fire-detection and notification applications. The MXL system complies with the requirements of NFPA Standard 72, and is listed by ©Underwriters Laboratories (UL), via its ©UL 864 9th Edition. ©Underwriter's Laboratories of Canada (ULC) also lists the MXL panel for fire applications.

The MXL system is approved by CSFM, NYMEA and the City of Chicago for use in those specific locales.

In addition to the standard fire applications, MXL is ©UL Listed, under the category 'UUKL for Smoke Control.' The MXL panel can be used as a listed fireman's smoke-control station in high-rise office buildings, malls and other multi-level or vast structures. The MXL system also complies with Uniform Building Code Section 905 requirements for smoke control.

The MXL panel is ©UL Listed for releasing Sinorix™ Engineered Fire Suppression System. MXL follows the releasing requirements specified in the NFPA 2001.

MXL Panel 5000

MXL Components

The basic MXL control unit consists of the following sub-assemblies: MMB-3 Main Control Board; MPS-6 / MPS-12 Power Supply; MKB-2 Annunciator and Keyboard; MME-3, or MLE-6 Enclosures. Optional modules — which can be installed with the MXL System — include: MOM-2/4 Expansion Card Cage; ALD-2I Analog Loop Driver; CRM-4 Controllable Relay Module; NIM-1W Network/Foreign Systems Interface Module; REP-1 Network Repeater Module; CSM-4 Controllable Signal Module; CZM-4 Conventional Zone Module; PIM-1 Peripheral Interface Driver; CMI-300 NCC-WAN Modem Interface Module; PSR-1 Remote Power Supply; NET-4 Style 4 Network Interface, and NET-7 Style 7 Network Interface.

Additionally, the MXL system includes option modules MOI-7 System Interface, MOD-16 Output Driven and MID-16 Point Input Module. These option modules can be used to drive graphic annunciators and fireman's smoke control stations, or to monitor foreign systems.

The MXL is compatible with a full line of intelligent initiating devices highlighted by the *FirePrint™* application-specific detectors: Models FP-11 and FPT-11. The MXL panel is also compatible with FireFinder, the NCC series of text and graphic command centers.

MXL Enhanced Main Board (MMB-3)

MMB-3

The function control of the MXL is contained on the MMB-3 Main Control Board. Model MMB-3 offers a fast, integral microprocessor and installation conveniences such as diagnostic LEDs and removable terminal blocks for field wiring. Model MMB-3 acts as the central controller for the system, and includes two (2) ALD circuits and two (2) notification appliance circuits. Model MMB-3 mounts in the MXL enclosure back box.

Display / Keyboard (MKB-2)

MKB-2

The Model MKB-2 display keyboard, which mounts on the inner door of any MXL enclosure, provides:

- [2] two-line, 80-character LCD display
- indicator LEDs
- display-control keys
- numeric keypad
- 12 programmable function keys
- all other keys necessary for operator control

These keys include but are not limited to: *Acknowledge; Silence and Reset*. Model MKB-2 also includes spaces for mounting the Model MMM-1 microphone module and the Model TMM-1 telephone. Model MKB-2 is supplied with two (2) blank plates for use when either the microphone or telephone is omitted.

Display / Keyboard (MKB-5)

MKB-5

The MKB-5 display keyboard, which mounts on the inner door of any MXL enclosure, provides:

- 6-1/4" VGA backlit, 80-character LCD display
- indicator LEDs
- 12 programmable function keys
- numeric keypad
- user-programmable function keys
- all other keys necessary for operator control

These keys include but are not limited to: *Acknowledge; Silence and Reset*. Multiple Model MKB-5 modules can be used; each providing full control of the MXL system. Up to four (4) Model MKB-5 can operate in a fully supervised mode; each with independent, built-in printer / driver capability.

Power Supply (MPS-6)

MPS-6

Model MPS-6 is a fully supervised power supply that provides the MXL system with primary DC power. Model MPS-6 is rated at 6.5 Amps, and is unfiltered and unregulated. Model MPS-6 supplies power to the MXL Control Unit, and supplies its expansion modules with power required for normal operation. Model MPS-6 incorporates a circuit breaker on the primary input, and includes a built-in AC-line filter for surge and noise suppression. Model MPS-6 mounts in the MXL enclosure back box.

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MXL Components — (continued)

Power Supply (MPS-12)

MPS-12

Model MPS-12 is a fully supervised power supply that provides the system with preliminary DC power. Model MPS-12 is rated at 12 Amps, and is unfiltered and unregulated. Model MPS-12 supplies power to Models PSR-1, MMB-3 and their expansion modules with power required for normal operation. Model MPS-12 incorporates a resettable circuit breaker on the primary input, and includes a built-in AC-line filter for surge and noise suppression. Model MPS-12 mounts in the MXL enclosure back box.

Network Optional Module Card Cage (MOM-4)

MOM-4

The Model MOM-4 Card Cage provides the MXL main unit or remote units with card slots for option modules. Each Model MOM-4 supplies connection space for either two (2) full-width option modules: (Models ALD-2I, CZM-4, NIM-1R) or four (4) half-width option modules: (Models CSM-4, CRM-4, CMI-300, NET-7, REP-1) or a combination of one (1) full and two (2) half-width modules.

Network Optional Module Card Cage (MOM-2)

MOM-2

Model MOM-2 provides the MXL main unit, remote units. Each Model MOM-2 provides space for one (1) full-width module (Models: ALD-2I, CZM-4, and NIM-1R) or two (2) half-width optional modules (Models: CSM-4, CRM-4, CMI-300, NET-7, REP-1).

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Analog Loop Driver (ALD-2I)

ALD-2I

Model ALD-2I is a MXL network-option module that supplies two (2) intelligent analog circuits utilizing Fire Safety "I", "IL", and FP series intelligent devices. Model ALD-2I occupies two (2) addresses on the MXL Network and through the use of unique communication-protocol devices connected to the circuits of Model ALD-2I. The circuits are dynamically supervised by the MXL control panel. Up to 60 programmable input and output devices may be connected to each of its two (2) circuits. Each circuit may be wired as Class B (Style 4) or Class A (Style 6).

Controllable Signal Module (CSM-4)

CSM-4

Model CSM-4 provides two (2) fully supervised, programmable notification-appliance circuits. Model CSM-4 supplies two (2) Class B (Style Y) or Class A (Style Z)-type output circuits for the supervision and control of listed audible or visual notification appliances such as: horns, bells, strobes, etc.

Each circuit can provide up to 1.5 amps (24 VDC) of current to power notification appliances. Model CSM-4 is also used for Sinorix. Leased line and municipal-tie connections are also possible with Model CSM-4.

Controllable Relay Module (CRM-4)

CRM-4

Model CRM-4 is designed to provide auxiliary control of building functions such as: door-holder release, elevator capture, smoke control, lock release, etc. Model CRM-4 provides four (4) fully programmable relays. Each relay contains one (1) set of SPDT contacts rated at 2 amps 30 VDC / 120 VAC resistive.

MXL Components — (continued)

Communication Module (NET-4)

NET-4

Model NET-4 is a plug-in-type module used to provide communication between the Fire Safety MXL panel and various other MXL remote modules. Model NET-4 is designed to plug into an edge-connector-type slot on the Model PSR-1 Network Supply. Model NET-4 provides NFPA Style 4-type communication: fully digital; RS-485 operating at 19.2K Baud rate.

Style 7 Network Interface Card (NET-7)

NET-7

Model NET-7 is a microprocessor-controlled MXL network-interface module that allows the wiring of the MXL RS-485 network in a NFPA Style 7 configuration. Model NET-7 plugs into a half slot of the Models MOM-2/4 card cage at the MXL command center (MMB-2) and at the Model PSR-1 or Model MOM-4 slot at the MXL remote units (MXLR, MXLRV).

Model NET-7 provides two (2) independent and fully supervised communication paths, allowing system operation through an open and short circuit. Model NET-7 also isolates the power supplies at each remote unit, providing the ability to localize ground-fault conditions. The communication for Model NET-7 operates at 19.2K Baud rate and is fully digital.

Network Repeater Module (REP-1)

REP-1

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Model REP-1 provides the ability to configure the local or global networks of the MXL panel in a 'star' or 'daisy-chain' configuration. Model REP-1 provides two (2) Style 4 or one (1) Style 7 RS-485 network circuits. Through the use of Model REP-1, the MXL's local network (MXL-MXLR) can be expanded up to 64 nodes.

Remote Power Supply (PSR-1)

PSR-1

Model PSR-1 is a microprocessor-controlled remote power supply and battery charger for use with the MXL panel. Model PSR-1 operates in conjunction with either a Model MPS-6 or MPS-12, providing 6 or 12 Amps of power for use with various MXL modules. When used with a Model NET-4 or Model NET-7 plug-in communication module, Model PSR-1 becomes a part of the MXL panel's internal network. Model PSR-1 acts as an interface between remote-option modules and the MXL.

Peripheral Interface Driver (PIM-1)

PIM-1

Model PIM-1 is a MXL option module that provides a bidirectional, isolated RS-232 port for connection to peripheral devices, such as: printers, CRTs, VDTs, color graphics, alphanumeric pagers and remote diagnostics hardware. Model PIM-1 mounts in the MXL enclosure, and connects to Model MMB-3, providing a screw-terminal block for connection of RS-232. A number of supervised and non-supervised formats are available for Model PIM-1.

Output / Input Module (MOI-7)

MOI-7

MXL Components — (continued)

Model MOI-7 is a MXL RS-485 network module that provides a fully programmable serial interface to Model MOD-16 output drivers and MID-16 input drivers. When used with Model MOD-16 drivers, Model MOI-7 provides a serial-annunciator output or relay driver. When used with Model MID-16, Model MOI-7 provides programmable inputs.

Each Model MOI-7 can operate up to eight (8) Model MOD-16 drivers and eight (8) Model MID-16 drivers simultaneously. Each Model MOD-16 output and Model MID-16 input is independently programmable, via the MXL custom software.

Output Driver (MOD-16)

MOD-16

Model MOD-16 is an output-driver module used in conjunction with Model MOI-7, as a part of the Fire Safety MXL System. Up to eight (8) Model MOD-16s can be connected to a Model MOI-7 interface module. Each Model MOD-16 provides 16 open-collector, current-sinking outputs, which are rated at 24 VDC, 50mA. Model MOD-16 outputs are programmable, via the MXL custom software.

Programmable Input Driver (MID-16)

MID-16

Model MID-16 is an input module used in conjunction with Model MOI-7, as a part of the Fire Safety MXL System. Up to eight (8) Model MID-16s can be connected to a single Model MOI-7, along with eight (8) Model MOD-16 output-driver modules. Each Model MID-16 provides a non-supervised input, which can monitor normally open contact devices.

Each Model MID-16 input can be separately used as a part of the MXL custom programming logic.

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These inputs can be individually set for: *Alarm, Supervisory, Trouble, Security or Status* usage. Further, the Model MID-16 inputs can also be configured to provide supervision for lamps driven by Model MOD-16 outputs. Screw terminals and connectors are provided on the Model MID-16 modules for interface to monitored devices.

MXL / (V) Standard Size Enclosure (MME-3)

MME-3

The Model MME-3 enclosure set consists of a sheet-metal back box and door with key-lock. Model MME-3 can be used for the MXL System, MXLV Voice Command Console, MXLR Transponder, MXLRV Voice Transponder or Amplifier Equipment (via the Model MSR-1 Rail Kit). To mount MXL / MXLV modules in Model MME-3, the Model MBR-MP removable-module mounting plate is required.

Using the Model MBR-MP mounting plate — one (1) Model MMB, or one (1) Model PSR-1, and up to three (3) expansion card cages (Model MOM or Model OMM) can be mounted in the Model MME-3 enclosure. When used to mount MXL amplifiers (Model EL-410), the Model MBR-MP module is not required. Instead, up to three (3) Model EL-410 amplifiers may be installed in Model MME-3, via three (3) Model MSR-1 Rail Kits. When amplifiers are mounted in any enclosure, always install Model MDG-1 grills in the door for proper ventilation.

Model MME-3 is designed for surface or semi-flush mounting, and includes various knockouts for wire and conduit entry. The door in the Model MME-3 set has two (2) cutouts for clear lenses, blank plates or grills — depending on the application — and contains a key-lock.

MXL MME-3 and MLE-6 Modules Mounting Plates (MBR-MP)

MBR-MP

The MXL /V Module Mounting Plate (Model MBR-MP) is required for use in both Models MME-3 and MLE-6 enclosures in order to mount all MXL and MXLV equipment.

MXL Components — (continued)

Model MBR-MP is not necessary if Models MME-3 and MLE-6 enclosures are used only for mounting of amplifiers (Model EL-410D).

Model MBR-MP is a removable MXL /V module mounting plate that allows the Model MME-3 or Model MLE-6 enclosure to be shipped to the job site for wiring and conduit installation, while the system hardware (electronics) is mounted to the studs on Model MBR-MP — pre-wired, programmed and tested — prior to delivery and installation at the job site. This process allows for faster, more efficient system start-ups with less chance of the sensitive electronics being damaged while field wiring and conduit are connected to the system enclosure.

The Model MBR-MP mounting plate bolts to the Model MME-3 or Model MLE-6 enclosures for easy installation on the job site. Model MBR-MP also has handles to allow easy transport and mounting. Model The MBR-MP contains mounting studs for one (1) Model MMB or Model PSR-1; one (1) Model PIM-1; one (1) Model TBM-2, and up to three (3) Model MOM or Model OMM card cages or two (2) card cages and one (1) TSP-40 Printer (same mounting studs as the Model MBR-2 enclosures).

Model MBR-MP is ordered and shipped separately from the Models MME-3 and MLE-6 enclosures.

MXL / (V) Large Size Enclosure (MLE-6)

MLE-6

The Model MLE-6 enclosure set consists of a sheet-metal back box and door with two (2) key-locks. Model MLE-6 can be used for the MXL system, MXLV Voice Command Console, MXLR Transponder, MXLRV Voice Transponder or Amplifier Equipment (via the Model MSR-1 Rail Kit.)

To mount MXL/V modules in Model MLE-6, the Model MBR-MP removable module mounting plate is required with the Model MBR-3MP option available for use.

Using the Model MBR-MP mounting plate, one (1) Model MMB or Model PSR-1 and up to three (3) expansion card cages (Model MOM or Model OMM) can be mounted in Model MLE-6. If additional card cages are required, the Model MBR-3MP optional card cage mounting plate can also be installed in Model MLE-6, below Model MBR-MP.

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Model MBR-3MP allows mounting of an additional three (3) Model MOM or Model OMM module expansion card cages.

Various combinations of hardware can be installed in Model MLE-6. If only amplifiers are to be installed in Model MLE-6, no Model MBR-MP or Model MBR-3MP plates are required. Instead, up to five (5) Model EL-410D amplifiers can be installed by using five (5) Model MSR-1 rail kits.

Model MLE-6 can also be used to mount up to three (3) MXL card cages and two (2) amplifiers. This configuration would be typical of a remote, voice transponder cabinet. In this configuration, one (1) Model MBR-MP would be used in the upper half of Model MLE-6 to mount the MXL modules, while the lower half would use two (2) Model MSR-1 rail kits to mount up to two (2) Model EL-410D amplifiers.

Model MLE-6 is designed for surface or semi-flush Mounting, and includes various knockouts for wire and conduit entry. The door supplied with the Model MLE-6 set has three (3) cutouts for either clear lenses, blank plates or grills — depending on the application. The door also contains two (2) key-locks, which are keyed the same.

Various combinations of dead-front mounting plates are possible with the Model MLE-6 enclosure. A typical MXLV installation would have one (1) Model MKB-2 at the top, and two (2) Model MHD-3 dead-front plates in the middle [for 14 VSM / VLM / VFM modules per plate] and one (1) or two (2) Model MHD-2 lower dead-front plates.

MLE-6 Optional Card cage Mounting Plate (MBR-3MP)

MBR-3MP

Model MBR-3MP is an optional MXL / MXLV card cage mounting plate for use exclusively in the Model MLE-6 enclosure. When installed in the Model MLE-6 back box, Model MBR-3MP adds the option of mounting up to an additional three (3) Model MOM or Model OMM expansion card cages.

Clear Lens (MDL-1)

MDL-1

MXL Components — (continued)

Model MDL-1 is a clear Plexiglas® lens that fits in one (1) of the two (2) openings in the Model MME-3 enclosure door, or in one (1) of the three (3) openings in the Model MLE-6 enclosure door.

One (1) lens is included in the Model MDL-1 package.

Sheet Metal Blank Plate (MDB-1)

MDB-1

Model MDB-1 is a sheet-metal blank plate that fits in one (1) of the two (2) openings in the Model MME-3 enclosure door, or in one (1) of the three (3) openings in the Model MLE-6 enclosure door. One (1) blank plate is in the Model MDB-1 package.

Upper or Middle Dead-Front Panel (MHD-1)

MHD-1

Model MHD-1 is a hinged sheet-metal panel that attaches to the Model MME-3 or the MLE-6 enclosure back box, and fits in the upper or the middle section of the Model MME-3 back box, or the upper or either of the two (2) middle sections of the Model MLE-6 back box.

Model MHD-1 has an opening with a cover plate for the Model TSP-40 printer (when used), and attaches to the backboxes with screw fasteners. Once in place, Model MHD-1 covers and protects modules and wiring; providing dead-front construction to that area.

Lower Dead-Front Panel (MHD-2)

MHD-2

Model MHD-2 is a hinged sheet-metal panel that attaches to the Model MME-3 or the MLE-6 enclosure back box, and fits in the lower section of the Model MME-3, and on the lower two (2) sections of the Model MLE-6 back box.

Model MHD-2 has no openings and attaches to the backboxes with screw fasteners. Once in place, Model MHD-2 covers and protects modules and wiring; providing dead-front construction to that area.

Middle Dead-Front Plate for Mounting Switch and LED / Fan-Control Modules (MHD-3)

MHD-3

Model MHD-3 is a hinged sheet-metal panel that attaches to the Model MME-3 or MLE-6 enclosure back box, and fits in either the middle of the upper sections of the Model MME-3 or MLE-6 enclosures. Model MHD-3 has openings for two (2) rows of Model VSM-1 Switch Modules; Model VLM-1 LED Annunciator Modules; Model VFM-1 Fan Control Modules, or Model VSB-1 Blank Plates.

Model MHD-3 has openings for two (2) rows of Model VSM-1 Switch Modules; Model VLM-1 LED Annunciator Modules; Model VFM-1 Fan Control Modules, or Model VSB-1 Blank Plates. Each row can mount up to seven (7) modules, totaling 14 modules for each Model MHD-3. Model MHD-3 attaches to the backboxes with screw fasteners, and is hinged for easy access to the rear of the modules inside the enclosure.

Middle Dead Front Plate for the Switch/LED/ Fan-Control Modules with Printer Cutout (MHD-4)

MHD-4

Model MHD-4 is a hinged sheet-metal panel that attaches to the Model MME-3 or the MLE-6 enclosure back box, and fits in the middle section of both enclosures.

Model MHD-4 has openings for two (2) rows of Model VSM-1 Switch Modules; Model VLM-1 LED Annunciator Modules; Model VFM-1 Fan Control Modules, or Model VSB-1 Blank Plates. Each row has space to mount four (4) modules, totaling eight (8) modules for each Model MHD-4.

Model MHD-4 also has a cutout to display the Model TSP-40 Internal Thermal Strip Printer. Model MHD-4 mounts to the backboxes with screw fasteners, and is hinged for easy access to the rear of the modules and inside of the enclosure. When in place, Model MHD-4 covers and protects modules and wiring, providing dead-front construction to that area.

Rail Kit (MSR-1)

MSR-1

MXL Components — (continued)

Model MSR-1 is a System 3™-type rail kit that fits into either the Model MME-3 or MLE-6 enclosure back box. Model MSR-1, which comes with a U-bracket and a Z-bracket, allows the following modules — or any other System 3-type module — to be mounted in a Model MME-3 or Model MLE-6 enclosure:

- Model EL-410D amplifier
- Model PS-35 power supply
- Model BC-35 battery charger
- Model MOI-7 I / O interface
- Model MID-16 input driver
- Model MOD-16 output driver
- Model PS-5A power supply
- Model SYS3-MPFO
[for mounting the D2300CP fiber-optic interface modules]

When used in the Model MME-3 enclosure three (3) Model MSR-1 Rail Kits can be installed to mount up to three (3) rows for up to three (3) EL-410D amplifiers. When used in the Model MLE-6, up to five (5) MSR-1 Rail Kit rows can be installed to allow mounting for up to five (5) EL-410D amplifiers.

When the Model MLE-6 enclosure is used with the Model MBR-MP mounting plate for installation of MXL or MXLV equipment, up to two (2) Model MSR-1 Rail Kit rows can also be installed in Model MLE-6 for mounting of either two (2) Model EL-410 amplifiers or some complement of System 3-type mount modules. MPS-12 transformer / supply, can accept NET-4 or NET-7 network interfaces, and includes diagnostic LEDs and two (2) system relays. Model PSR-1 mounts in the upper section of the MXL enclosure back box.

Thermal Strip Printer (TSP-40A)

TSP-40A

Model TSP-40A is a thermal strip printer, designed as an event-logging device for the MXL panel, providing a permanent-history report of all system activity. Model TSP-40A mounts in the MXL enclosure, and its printout is visible through a window in the locked-door enclosure. Printouts are automatically spooled on a take-up reel for easy records storage.

Remote Command Console (RCC-1)

RCC-1

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Model RCC-1 is a remotely located MXL annunciator display module. Model RCC-1 contains an 80-character LCD display and control keypad (MKB), as well as a PS-5N7 network interface.

Model RCC-1 modules can be located anywhere that annunciation or control is required. Model RCC-1 can be programmed for display only, or can provide display and system control. Remote printers, VDT, or graphics computers can be located throughout a facility — provided Model PIM-1 is added to Model RCC-1.

©UL Listed Parallel Printer (PAL-1)

PAL-1

Model PAL-1 is a ©UL Listed, supervised parallel-system printer for the MXL panel. Model PAL-1 connects to Model MKB-5 to provide the MXL panel with a ©UL Listed, supervised parallel-system printer.

B6 Intelligent Control Point (ICP-B6)

ICP -B6

Model ICP-B6 is a field-mounted output module that is capable of being programmed to either a remote bell or horn — or to a speaker or telephone zone. Model ICP-B6 communicates with the MXL fire panel, via ALD loop.

Line-Isolator Module (LIM-1)

LIM-1

Model LIM-1 is a short-circuit isolator module for use on the analog loops of the MXL panel. Model LIM-1 is capable of providing Style 4 or Style 6 wiring of the ALD loop. Multiple short-circuit isolators can be used on a single ALD loop to prevent loss of protection in the event of a short circuit.

MXL Components — (continued)

5-Volt Power Supply / Network Interface (PS-5N7)

PS-5N7

Model PS-5N7 is a 5V power supply and MXL local-network interface module. Model PS-5N7 is an integral part of Model RCC-1. Model PS-5N7 can be used to provide a Style 4 or Style 7 network interface for either a remote transponder for the MXLV panel (with either Model TBM-2, ACM-1 and VSM-1 / VLM-1 / VFM-1), or to drive Model OMM-1 and associated MXLV cards.

5-Volt Power Supply (PS-5A)

Model PS-5A provides 5 Volts for powering Model MOI-7. Model PS-5A obtains its power from the 24-Volt power supply in the MXL system. Models MOI-7 and PS-5A both mount on System 3 rails, and can also be mounted externally to the MXL system.

Models MOI-7 and PS-5A typically drive remote-graphics annunciators or monitor foreign systems and devices.

Network Interface Module (NIM-1W)

NIM-1W

Model NIM-1W allows for the interconnection or networking of up to 63 MXL panels. Model NIM-1W provides a RS-485 communications path in either Style 4 or Style 7 wiring configurations. Model NIM-1W allows MXL panels to have inter-panel logic, as well as communicate in a peer-to-peer manner. Model NIM-1W can be programmed via CSGM logic as a foreign system interface to communicate with external-building management systems.

Details for Ordering

Model Number	Part Number	Description
ALD-2I	500-891618	[2] Two-Loop Analog Driver
CRM-4	500-890401	Programmable Relay [94] Modules
CSM-4	500-890402	Notification Appliance Circuits [2] Module
ICP-B6	500-895303	Intelligent Control Output [B6 chip]
LIM-1	500-892361	Short-circuit Line Isolator (ALD)
MBR-MP	500-694210	Module Mounting Plate [MME-3, MLE-6]
MBR-3MP	500-694532	Module Mounting Plate [MLE-6 use only]
MDB-1	500-692070	Blank Metal-Door Inserts
MDL-1	500-692069	Plexiglas® Door Insert
MHD-1	305-092071	Middle / Dead Front / no openings
MHD-2	305-092072	Bottom / Dead Front / no openings
MHD-3	305-092073	Middle / Dead Front [w/ switch openings]
MHD-4	305-092074	Middle / Dead Front [w/ switch, printer openings]
MID-16	500-891747	16-Input Driver Module
MKB-2	500-892077	Hinged Display /Control Keyboard
MKB-5	500-648727	Multi-Line Display / Control Keyboard
MLE-6	500-694530	Large Enclosure [holds up to six (6) Model OMM / MOM modules]
MMB-3	500-648860	MXL Main Board, Fast Processor
MME-3	500-694209	Medium Enclosure [holds up to 6 OMMs/ MOMs]
MOD-16	500-890828	Programmable Output Driver
MOI-7	500-892800	Network I / O Interface [Style 4 or 7]
MOM-2	500-892766	Expansion Card Cage [2 slots]
MOM-4	500-890269	Expansion Card Cage [4slots]
MPS-6	500-490357	MXL 6-Amp Power Supply
MPS-12	500-492209	MXL 12-Amp Power Supply
MSR-1	545-092415	Single-Row Rail Kit for Model MBR-2
NET-4	500-891181	Style 4 Communication Module
NET-7	500-091914	Style 7Communication Module
NIM-1W	500-699103	Local and Wide-Area Network Interface Module
PAL-1	500-692407	®UL Listed, Field-Mounted Parallel Printer
PIM-1	500-691324	Peripheral Interface Module
PS-5N7	500-892728	Local Network Interface [Style 4 or 7]
PSR-1	500-891182	Remote Power Supply / Controller
RCC-1	500-692533	Remote Command Display Console
REP-1	500-892954	RS-485 Network Repeater
TSP-40A	500-634933	Thermal Strip Printer

Related Documentation

Product	Data Sheet Number
MXLV	5035

Appendix E

Smoke Detection Layout

FIRE ALARM SYSTEM		FIRE ALARM CHIRP	
NOTE: ELEVATOR FLIGHT OR ELEVATOR WITH FIRE SERVICE SIGNAL			
SYSTOL EVENT	RESPONSE		
ARMED (ELEVATOR)	ANNOUNCE AT FANCI		
FIRE SIGNALING SYSTEMS	FIRE SIGNAL TO RECEIVER		
TRouble SIGNAL TO LHM, RECEIVER			
SUPERVISORY TO LHM.			
OPERATE NOTIFICATION APPLIANCES			
RECALL ELEVATOR PRIMARY FLOOR			
RECALL ELEVATOR SECONDARY FLOOR			
OPERATE ELEVATOR POWER SHUNT			
CLOSE ELEVATOR DOOR			
SHUT DOWN HVAC FAN UNIT			
CLOSE DOOR			
CLOSE FIRE/SMOKE DAMPER			
OPERATE LIGHTING CONTACTS			
UNLOCK SECURITY DOORS			

- ## Ⓐ GENERAL NOTES

- [illegible]

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BUILDING 39

UNIVERSITY OF CALIFORNIA

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 Concord, California 94519
 Phone: (925) 883-2731

[illegible]

PROJECT NO.	52	PROJECT NO. 34-13-000
DATE	12/29/12	DATE
BY	AS NOTED	BY
FOR	12/29/12	FOR
PROJECT NO.	52	PROJECT NO. 34-13-000
DATE	12/29/12	DATE
BY	AS NOTED	BY
FOR	12/29/12	FOR

 

SECTION OF WORK TO BE DONE		APPROX.	
NO.	DESCRIPTION	DATE	TIME
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3	REPAIR TO ROOF	10/10/10	10:00
4	REPAIR TO ROOF	10/10/10	10:00
5	REPAIR TO ROOF	10/10/10	10:00
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2022	2022	1	1
2023	2023	1	1
 
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2328	2328	1	1
2329	2329	1	1
2330	2330	1	1
2331	2331	1	1
2332</			

NOTIFICATION APPLIANCE CIRCUIT POWER REQUIREMENTS & VOLTAGE DROP CALCULATIONS												
SECTION 1												
DESCRIPTION	UNIT	AMPS	VA	W	VA	W	VA	W	VA	W	VA	W
GENERAL LIGHTING (20' x 20' x 8' CEILING)	100	10.0	2000	1000	10.0	2000	1000	10.0	2000	1000	10.0	2000
RECEIVER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
TELEVISION (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
STOVE (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WASHER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
DRYER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
REF. (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER PUMP (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0	200	100	1.0	200	100	1.0	200
WATER HEATER (10' x 10' x 8' CEILING)	10	1.0	200	100	1.0							

[illegible]

 

SOLAR ENERGY RESEARCH CENTER
(BUILDING 30)

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F 415.808.0862
www.smithgroup.com

Fire Protection Engineers
3496 Clayton Road - Suite 101
Concord, California 94519
Phone: (925) 681-2731

[illegible]

WIND TITLE
FIRE ALARM SYSTEM
LEVEL 1

BERKELEY PROJ. NO. 122
 OCT 1982
FA2.1
 NO. 1035
 SG PROJECT NO. 38415.0

SERC
SEAN NICHOLS ENGINEERING CENTER
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ANN ARBOR, MI 48106-1500
734.227.0000
www.hyt.com

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED BY: _____
CHECKED BY: _____
DATE: _____
SCALE: _____
SHEET NO.: _____

HYT CORPORATION
ANN ARBOR, MI 48106-1500
734.227.0000
www.hyt.com

FIRE ALARM SYSTEM
LEVEL 2

DATE: 08/01/00
DRAWN BY: JENNA
CHECKED BY: JENNA
PROJECT NO. 200-1000
SHEET NO. 200-1000

SERC

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UNIVERSITY OF CALIFORNIA
RIVERSIDE

UNIVERSITY OF CALIFORNIA

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FAX: 408.271.0000
www.smithgroup.com

HYT Corporation
10000 N. 10TH AVE.
DENVER, CO 80231
TEL: 303.440.7220

REVISIONS

DATE

HYT

HYT
FA.2.3.1

FA.2.3.1
HYT

SOLAR ENERGY RESEARCH CENTER
BUILDING 30

architecture engineering interiors planning

www.dnainfiguring.com

CONTACT: CHRISTINA WAGNER
Phone: (925) 881-2731

REALS AND ROMANS CAN STAY

LEVEL 4 - ROOF

ISSUE NUMBER	SG PROJECT NO.
--------------	----------------

0 6 16 20
SCALE: 1/8"=1'-0"

0 6 16 20
SCALE: 1/8"=1'-0"

Appendix F

VESDA Details

THE SHAWNO AND DESSON HEIR, SHALL NOT BE OBLIGATED, USED OR DERIVED TO OBTAIN FOR ACQUISITION OR OTHER PURPOSES (EXCEPT AS OTHERWISE AUTHORIZED BY CONTRACT) ANY OF THE INFORMATION OF THE SHAWNO POLICE, INC. FIRE SAFETY DIVISION, ALL OTHER INFORMATION.

SHALL BEAR THE COST.

REVISIONS

1	SENSED FOR HT & LBL SEVEN COMMENTS	W	6/7/73	RM
---	---------------------------------------	---	--------	----

--	--

HYT Corporation
Fire Protection Engineers and Consultants
5404 Canyon Blvd • Suite 100 • Greenwood Village, CO 80111
Phone: (303) 691-2711 FAX: (303) 691-2723

INSTALLATION CONTRACTORS NAME & ADDRESS

DEL MONTE
ELECTRIC, INC.
6006 Stearns Court
Dallas, TX 75248
Tel (972) 829-4000 Fax (972) 829-4003
CA License No. 187995

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION

25621 Industrial Boulevard, Suite 300
Hayward, California 94545-2891
Tel (510) 784-6000 Fax (510) 253-2100
California State C/O Licenses No. 7567396
U.L. Certificate ID No. 324762-401

DO NOT WRITE IN SPACES BETWEEN LINES

UNIVERSITY OF CALIFORNIA
FACILITIES DIVISION

SOLAR ENERGY
RESEARCH CENTER
BUILDING 30
FIRE ALARM

One Cyclotron Road,
Berkeley, California 94720

		ASPIRE CALCULATIONS	
STUDY NO.		☐ NEW INSTALLATION ☒ REINSTALLATION ☐ PERMITS DOCUMENT ☐ EXISTING BASE JOB # NA	
OTHERS		☐ OTHERS _____ _____	
DATE OF TEST	TESTER NAME	Kevin Weisman Margaret Chaves MM & JIM PA-15	
DATE INSTALLED	CALC	Not Applicable	
February 04, 2013	7/27/2013	June 26, 2013	

CONTRACT NO.	2011	001 NUMBER
-	FA-15	44OP-126034

ASPIRE2 Insulation Data Pack[illegible]

ASPHRE2 Insulation Data Pack

[illegible]AS191R12 Insulation Data Pack[illegible]Page 4 of 6Page 5 of 6Page 6 of 10

Pipe/Pipe 3	
Total Pipe Length	200' 6"
Asbestos Presence	0%
Soil Contamination	179%
Water Contamination	179%
Pipe Materials	14.0000

[illegible]

Pipe/Pipe 1	
Total Pipe Length	487' 8"
Average Pressure	107.4
Inside Friction	10.7
Outside Friction	10.7
Water Friction	10.7
Pipe Friction	48.1 (10.7)

Section 1

[illegible]

Section 1

Fig. 2. Results of the Experiment

No.	Dimensions of Specimen		Initial Length, mm	Time, min		New Force, N	New Quantity, %	Initial Quantity, %	Increase of Quantity, %
	a, mm	b, mm		t ₁	t ₂				
1	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
2	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
3	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
4	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
5	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
6	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
7	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
8	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
9	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
10	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
11	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
12	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
13	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
14	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
15	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
16	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
17	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
18	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
19	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
20	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
21	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
22	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
23	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
24	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
25	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
26	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
27	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
28	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
29	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
30	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
31	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
32	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
33	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
34	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
35	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
36	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
37	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
38	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
 
89	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
90	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
91	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
92	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
93	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
94	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
95	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
96	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
97	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
98	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
99	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11
100	120.0	12.0	5200	10	10	1.0	0.13	0.02	0.11

Characteristic	Number of patients (n)	Percentage (%)
Gender		
Male	10	100
Female	0	0
Age (years)		
18-25	2	20
26-35	3	30
36-45	2	20
46-55	2	20
56-65	1	10
66-75	0	0
76-85	0	0
86-95	0	0
Education level		
High school or below	2	20
College	3	30
University	5	50
Marital status		
Married	10	100
Divorced	0	0
Widowed	0	0
Single	0	0
Occupation		
Student	2	20
Employee	3	30
Self-employed	2	20
Retired	3	30

Detector : VL-C-Roof	
Type	VERTICAL V-T ROOF/ROOF
Working Usage	Creates a Balanced Design
Applications	Cooling
Temperature	68.0 F
Absorption Pressure	1.013 inch
System Pressure	46.4 inch
Refrigerant Pressure	0.73
Total Pipe Length	68.0'

file://C:\Documents and Settings\All Users\Application Data\Xerials\Xplore2\MDP.html	3/6/2013
--	----------

File: C:\Documents and Settings\All Users\Application Data\Xerials\aspire2\ASP2.html
3/6/2013file:\C:\Documents and Settings\All Users\Application Data\Xerial\Aspire2\IDP.html 3/6/2011

WEEDS DESIGNATION | LEGEND

YES/NO(,VLC)

1. NISDA DETECTOR TO BE MOUNTED SUCH THAT ITS DISPLAY IS 5'-0" AFF.
2. SAMPLE PORTS SHALL BE LOCATED AS REQUIRED BY NFPA 72 AND AS SHOWN IN THE DRAWINGS.
3. SAMPLE PIPING SHALL BE CPVC.

[illegible]

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REVISIONS

SHEET NOTE:
1. REFER TO SHEET FA-16 FOR VESDA PIPE ISOMETRIC DETAILS AND SAMPLING POINT INFORMATION.

VESDA DESIGNATION LEGEND

- VESDA PIPING AND CAPILLARY SAMPLE PORT (CEILING SYSTEM)
- VESDA PIPING AND SAMPLE PORT
- VESDA PIPING WITH ELBOW RISE/DOWN
- VESDA DETECTOR (VAP MODEL)
- VESDA (VPS)
- VESDA DETECTOR (VLC MODEL)
- VESDA (VCL)

VESDA Piping Layout - 1st Floor
1/4" = 1'-0"

VESDA Piping Layout - 2nd Floor
1/4" = 1'-0"

FA-17 440P-126034

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CA License No. 191865

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SHEETS: 10000 E. 15th

SIEMENS INDUSTRY, INC.

PIRE SAFETY DIVISION

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Denver, CO 80231

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ALL Dimensions to be 3000/2000

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PIRE SAFETY DIVISION

- SHEET NOTES:**
1. REFER TO SHEET FA-16 FOR VESDA PIPE ISOMETRIC DETAILS AND SAMPLING POINT REGULATIONS.
 2. VESDA PIPING AT THIRD FLOOR (LEFT) SHALL NOT BE ROUTED THROUGH HANGING SPACES AND SHALL MAINTAIN CONTACT WITH CEILING. VESDA PIPING AT THIRD FLOOR (RIGHT) SHALL BE ROUTED THROUGH HANGING SPACES WITH PROTECTED SAMPLING PORTS AT CEILING. VESDA PIPING AT CEILING SHALL MAINTAIN OTHER PROTECTED SAMPLING PORTS AT CEILING SHALL MAINTAIN OTHER PROTECTED SAMPLING PORTS AT CEILING.
- VESDA DESIGNATION LEGEND**
- VESDA PIPING AND CEILING SAMPLE PORT (CEILING SYSTEM)
 - VESDA PIPING AND SAMPLE PORT
 - VESDA PIPING WITH ELBOW RIS/DOWN
 - VESDA DETECTOR (VLP MODEL)
 - VESDA DETECTOR (VLC MODEL)
 - VESDA DETECTOR (VLC MODEL)

FA-18	440P-126034
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Appendix G

FDS Input File

East Exit fire SERC.

&HEAD CHID='e_exit_fire', TITLE='SERC E Exit Fire' /

&MESH IJK=36,90,60, XB=0.0,7.2,0.0,18,0.0,12.0 /

&TIME TWFIN=1100.0 /

&REAC
ID = 'PVC'
FYI = 'CH 4 SFPE HANDBOOK'
C = 2.
H = 3.
CO_YIELD = 0.063
SOOT_YIELD = 0.172 /

&SURF ID='pallet', HRRPUA=4000., RAMP_Q='fire', COLOR='RED' /

&RAMP ID='fire',T= 0.0,F=0.0 /

&RAMP ID='fire',T= 300.0,F=0.25 /

&RAMP ID='fire',T=400.0,F=1.0 /

&RAMP ID='fire',T=600.0,F=1.0 /

&RAMP ID='fire',T=700.0,F=0.5 /

&RAMP ID='fire',T=900.0,F=.125 /

&RAMP ID='fire',T=1100.0,F=0.0 /

&MISC TMPA=20., SURF_DEFAULT='WALL' /

&MATL ID = 'GYPSUM PLASTER'
FYI = 'Quintiere, Fire Behavior'
CONDUCTIVITY = 0.48
SPECIFIC_HEAT = 0.84

DENSITY = 1440. /

&MATL ID = 'GLASS1'
FYI = 'ENGINEERING TOOLBOX'
CONDUCTIVITY = 0.96
SPECIFIC_HEAT = 0.84
DENSITY = 2500. /

&SURF ID = 'WALL'
DEFAULT = .TRUE.
RGB = 200,200,200
MATL_ID = 'GYPSUM PLASTER'
THICKNESS = 0.012 /

&SURF ID = 'GLASS'
DEFAULT = .FALSE.
COLOR = 'BLUE'
MATL_ID = 'GLASS1'
THICKNESS = 0.012 /

&VENT XB=0.0, 7.2, 0.0, 0.0, 0.0, 4.6, SURF_ID='GLASS' / GLASS SOUTH WALL
&VENT XB=7.2, 7.2, 0.0, 18.0, 0.0, 4.6, SURF_ID='GLASS' / GLASS EAST WALL
&VENT XB=0.0, 7.2, 18.0, 18.0, 0.0, 4.6, SURF_ID='GLASS' / GLASS NORTH WALL

&VENT XB= 0.0, 0.0, 10.1, 11.9, 4.6, 7.0, SURF_ID='OPEN' / 3rd floor door
&VENT XB=0.0, 0.0, 10.1, 11.9, 0.0, 2.4, SURF_ID='OPEN' / 1ST FLOOR DOOR

OBST XB=0.0, .02, 10.1, 11.9, 4.6, 7.0, COLOR='BROWN', DEVC_ID='DOOR 1'
OBST XB=0.0, .02, 10.1, 11.9, 0.0, 2.4, COLOR='BROWN', DEVC_ID='DOOR 2'

DEVC XYZ=1.0,2.0,3.0 , ID='DOOR 1', SETPOINT=43.0, QUANTITY='TIME',
INITIAL_STATE=.FALSE.
DEVC XYZ=1.0,3.0,3.0 , ID='DOOR 2', SETPOINT=43.0, QUANTITY='TIME',
INITIAL_STATE=.FALSE.

&OBST XB=6.2, 7.2, 2.0, 3.0, 0.0, 1.0 , SURF_IDS='pallet', 'WALL', 'WALL' / burner

&OBST XB=0.0, 7.3, 0.0, 18.0, 9.5, 12.0, SURF_ID='WALL' / CEILING SPACE
&HOLE XB=0.3, 0.9, 1.8, 4.2, 9.5, 10.8/ SKYLIGHT 1
&HOLE XB=0.3, 0.9, 5.4, 7.8, 9.5, 10.8/ SKYLIGHT 2
&HOLE XB=0.3, 0.9, 9.6, 12.0, 9.5, 10.8/ SKYLIGHT 3
&HOLE XB=0.3, 0.9, 13.2, 15.6, 9.5, 10.8/ SKYLIGHT 4

&OBST XB=0.0,6.2, 9.1, 12.3, 4.0, 4.6/ 3RD FLOOR LANDING
&OBST XB=4.5, 6.2, 16.4, 18.0, 2.5, 3.1, SURF_ID='WALL' / LANDING 2

&OBST XB=0.0,1.8, 16.4, 18.0, 1.0, 1.6, SURF_ID='WALL' / LANDING 3
 &OBST XB=4.6, 6.2, 12.3, 16.5, 3.2, 3.8, SURF_ID='WALL' / STAIR 1
 &OBST XB=1.8, 4.5, 16.4, 18.0 , 1.7, 2.3, SURF_ID='WALL' /STAIR 2
 &OBST XB=0.0, 1.6, 16.4, 12.0, 0.3, 0.9, SURF_ID='WALL' /STAIR 3
 &OBST XB=0.0, 6.2, 9.1, 9.112, 4.6, 5.6, SURF_ID='GLASS' / GLASS RAILING

&DEVC ID='HD_1',PROP_ID='SPRINKLER', XYZ=6.0, 1.0, 9.49/
 &DEVC ID='HD_2', PROP_ID='SPRINKLER', XYZ=6.0, 5.0, 9.49/
 &DEVC ID='HD_3', PROP_ID='SPRINKLER', XYZ=6.0, 9.0, 9.49/
 &DEVC ID='HD_4', PROP_ID='SPRINKLER', XYZ=6.0, 13.0, 9.49/
 &DEVC ID='HD_5', PROP_ID='SPRINKLER', XYZ=6.0, 17.0, 9.49/
 &DEVC ID='HD_6', PROP_ID='SPRINKLER', XYZ=3.6, 1.0, 9.49/
 &DEVC ID='HD_7', PROP_ID='SPRINKLER', XYZ=3.6, 5.0, 9.49/
 &DEVC ID='HD_8', PROP_ID='SPRINKLER', XYZ=3.6, 9.0, 9.49/
 &DEVC ID='HD_9', PROP_ID='SPRINKLER', XYZ=3.6, 13.0, 9.49/
 &DEVC ID='HD_10', PROP_ID='SPRINKLER', XYZ=3.6, 17.0, 9.49/
 &DEVC ID='HD_11', PROP_ID='SPRINKLER', XYZ=0.6, 1.8, 10.79/
 &DEVC ID='HD_12', PROP_ID='SPRINKLER', XYZ=0.6, 5.4, 10.79/
 &DEVC ID='HD_13', PROP_ID='SPRINKLER', XYZ=0.6, 9.6, 10.79/
 &DEVC ID='HD_14', PROP_ID='SPRINKLER', XYZ=0.6, 13.2, 10.79/

&CTRL ID='HD1', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_1' /
 &CTRL ID='HD2', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_2' /
 &CTRL ID='HD3', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_3' /
 &CTRL ID='HD4', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_4' /
 &CTRL ID='HD5', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_5' /
 &CTRL ID='HD6', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_6' /
 &CTRL ID='HD7', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_7' /
 &CTRL ID='HD8', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_8' /
 &CTRL ID='HD9', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_9' /
 &CTRL ID='HD10', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_10' /
 &CTRL ID='HD11', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_11' /
 &CTRL ID='HD12', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_12' /
 &CTRL ID='HD13', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_13' /
 &CTRL ID='HD14', FUNCTION_TYPE= 'ANY', INPUT_ID='HD_14' /

&PROP ID='SPRINKLER', QUANTITY='LINK TEMPERATURE', RTI=50,
 ACTIVATION_TEMPERATURE=68.3/

&DEVC XYZ=6.0, .6, 9.49, QUANTITY='DENSITY', SPEC_ID='SOOT', ID='SOOT1',
 DEVC_ID='ASP1', FLOWRATE=.0467, DELAY=42 /
 &DEVC XYZ=6.0, 4.6, 9.49, QUANTITY='DENSITY', SPEC_ID='SOOT', ID='SOOT2',
 DEVC_ID='ASP1', FLOWRATE=.0467, DELAY=32 /
 &DEVC XYZ=6.0, 8.6, 9.49, QUANTITY='DENSITY', SPEC_ID='SOOT', ID='SOOT3',
 DEVC_ID='ASP1', FLOWRATE=.0467, DELAY=25 /

&DEVC XYZ=6.0, 12.6, 9.49, QUANTITY='DENSITY', SPEC_ID='SOOT', ID='SOOT4',
 DEVC_ID='ASP1', FLOWRATE=.0467, DELAY=20 /
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 DEVC_ID='ASP1', FLOWRATE=.0467, DELAY=16 /
 &DEVC XYZ=3.6, .6, 9.49, QUANTITY='DENSITY', SPEC_ID='SOOT', ID='SOOT6',
 DEVC_ID='ASP1', FLOWRATE=.0467, DELAY=45 /
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 &DEVC XYZ=3.6, 8.6, 9.49, QUANTITY='DENSITY', SPEC_ID='SOOT', ID='SOOT8',
 DEVC_ID='ASP1', FLOWRATE=.0467, DELAY=28 /
 &DEVC XYZ=3.6, 12.6, 9.49, QUANTITY='DENSITY', SPEC_ID='SOOT', ID='SOOT9',
 DEVC_ID='ASP1', FLOWRATE=.0467, DELAY=23 /
 &DEVC XYZ=3.6, 17.3, 9.49, QUANTITY='DENSITY', SPEC_ID='SOOT', ID='SOOT10',
 DEVC_ID='ASP1', FLOWRATE=.0467, DELAY=18 /

&DEVC XYZ=3.6, 10.7, 0.0, QUANTITY='ASPIRATION', ID='ASP1',
 BYPASS_FLOWRATE=0.114, SETPOINT=0.2 /

&SLCF PBX=11.0, QUANTITY='TEMPERATURE', VECTOR=.TRUE. /

&SLCF PBX=6.7, QUANTITY='TEMPERATURE', VECTOR=.TRUE. /

&SLCF PBX=2.9, QUANTITY='TEMPERATURE', VECTOR=.TRUE. /

&SLCF PBX=9.0, QUANTITY='TEMPERATURE', VECTOR=.TRUE. /

&SLCF PBX=11.0, QUANTITY='DENSITY', SPEC_ID='SOOT' /
 &SLCF PBZ=6.4, QUANTITY='DENSITY', SPEC_ID='SOOT' /

&DEVC XB=0.2, 0.2, 11.0, 11.0, 0.0, 9.5, QUANTITY='LAYER HEIGHT', ID='LAYER HEIGHT' /
 &DEVC XB=3.6, 3.6, 11.0, 11.0, 0.0, 9.5, QUANTITY='LAYER HEIGHT', ID='LH LANDING' /
 &DEVC XB=3.6, 3.6, 5.0, 5.0, 0.0, 9.5, QUANTITY='LAYER HEIGHT', ID='LH FRONT D' /

&DEVC ID='D2 6 FT', XYZ=0.02, 11.0, 6.4, QUANTITY='TEMPERATURE' /
 &DEVC ID='D2 7 FT', XYZ=0.02, 11.0, 6.7, QUANTITY='TEMPERATURE' /
 &DEVC ID='D2 5 FT', XYZ=0.02, 11.0, 6.1, QUANTITY='TEMPERATURE' /
 &DEVC ID='D1 6 FT', XYZ=0.02, 11.0, 1.8, QUANTITY='TEMPERATURE' /
 &DEVC ID='D1 7 FT', XYZ=0.02, 11.0, 2.2, QUANTITY='TEMPERATURE' /
 &DEVC ID='D1 5 FT', XYZ=0.02, 11.0, 1.5, QUANTITY='TEMPERATURE' /

&DEVC ID='VIS DR2', XYZ=0.02, 11.0, 6.4, QUANTITY='VISIBILITY' /
 &DEVC ID='VIS DR1', XYZ=0.02, 11.0, 1.8, QUANTITY='VISIBILITY' /
 &DEVC ID='VIS LANDING', XYZ=3.6, 11.0, 6.4, QUANTITY='VISIBILITY' /
 &DEVC ID='VIS FD', XYZ=2.9, 0.0, 1.8, QUANTITY='VISIBILITY' /

&DEVC ID='CO DR2', XYZ=0.02, 11.0, 6.4, QUANTITY='VOLUME FRACTION',
SPEC_ID='CARBON MONOXIDE'/
&DEVC ID='CO DR1', XYZ=0.02, 11.0, 1.8, QUANTITY='VOLUME FRACTION',
SPEC_ID='CARBON MONOXIDE'/
&DEVC ID='CO Landing', XYZ=3.6, 11.0, 6.4, QUANTITY='VOLUME FRACTION',
SPEC_ID='CARBON MONOXIDE'/
&DEVC ID='CO FD', XYZ=2.9, 0.0, 1.8, QUANTITY='VOLUME FRACTION', SPEC_ID='CARBON
MONOXIDE'/

&DEVC ID='FD 1FT', XYZ=2.9, 0.0, .3, QUANTITY='TEMPERATURE'/
&DEVC ID='FD 2FT', XYZ=2.9, 0.0, .6, QUANTITY='TEMPERATURE'/
&DEVC ID='FD 3FT', XYZ=2.9, 0.0, .9, QUANTITY='TEMPERATURE'/
&DEVC ID='FD 4FT', XYZ=2.9, 0.0, 1.2, QUANTITY='TEMPERATURE'/
&DEVC ID='FD 5FT', XYZ=2.9, 0.0, 1.5, QUANTITY='TEMPERATURE'/
&DEVC ID='FD 6FT', XYZ=2.9, 0.0, 1.8, QUANTITY='TEMPERATURE'/
&DEVC ID='FD 7FT', XYZ=2.9, 0.0, 2.1, QUANTITY='TEMPERATURE'/
&DEVC ID='FD 8FT', XYZ=2.9, 0.0, 2.4, QUANTITY='TEMPERATURE'/

&TAIL /