Shyh Wang Hall
LBNL Building 59

Computational Research and Theory Facility
Lawrence Berkeley National Laboratory
Berkeley, California

California Polytechnic University San Luis Obispo
FPE 596: Culminating Experience
Spring 2018
Mike Torkelson, P.E.
6/13/2018

Statement of Disclaimer

This project report is a result of a class assignment; it has been graded and accepted as fulfillment of the course requirements. Acceptance of this report in fulfillment of the course requirements does not imply technical accuracy or reliability. Any use of information in this report is done at the risk of the user. These risks may include, but may not be limited to, catastrophic failure of the device or infringement of patent or copyright laws. California Polytechnic State University at San Luis Obispo and its staff cannot be held liable for any use or misuse of the project.

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

Abstract
This report details the fire and life safety analysis of Shyh Wang Hall, a new building at the Lawrence Berkeley National Laboratory. Wang Hall houses offices, high performance computers, and associated mechanical space. The building is constructed as a Type IIB structure and includes four stories. Both prescriptive-based and performance-based design is considered.

The prescriptive analysis considers the fire and life safety features as required by applicable codes, including the Department of Energy requirements. The building is protected by fire detection and alarm system as well as automatic sprinklers. The prescriptive design meets the code requirements with the possible exception of the Central Stair. This stairway is not part of the means of egress and presents an unprotected four story shaft.

The building was evaluated following a performance-based design analysis. A design fire, modeled using Fire Dynamics Simulator (FDS), was placed adjacent to one exit, rendering that exit unusable. The maximum RSET for the building is 663 seconds, based on the simulated evacuation time using Pathfinder along with the detection and pre-movement time. The ASET for floors not associated with the fire is sufficient. On the fire floor, the south section becomes untenable at approximately 237 seconds. Depending on the actions of the occupants, the performance criteria may not be met.

Recommendations include: upgrading the construction of the Central Stair to meet two-hour fire-resistant construction; addition of smoke detectors on the office levels; enhancing the existing inspection, testing, and maintenance program to include all code and standard requirements; additional training for staff and BET members regarding actions in a fire emergency; and reevaluation of use of TB 117 furniture.

Table of Contents

Table of Figures

Table of Tables

Table of Equations

List of Abbreviations

AHJ	Authority Having Jurisdiction
ASET	Available Safe Egress Time
BET	Building Emergency Team
CBC	California Building Code
CMDA	Control Mode Density/Area
DSD	Duct Smoke Detector
DOE	US Department of Energy
EBMUD	East Bay Municipal Utility District
EPO	Emergency Power Off
EVACS	Emergency Voice/Alarm Communications System
FACP	Fire Alarm Control Panel
FACU	Fire Alarm Control Unit
FDC	Fire Department Connection
FDS	Fire Dynamics Simulator
HRR	Heat Release Rate
HSSD	High-Sensitivity Smoke Detection
ITM	Inspection, Testing & Maintenance
LBNL	Lawrence Berkeley National Laboratory
MNS	Mass Notification System
MPFL	Maximum Possible Fire Loss
NFPA	National Fire Protection Association
NICET	National Institute for Certification in Engineering Technologies
NIST	National Institute of Standards and Technology
OSFM	California Office of the State Fire Marshal
RSET	Required Safe Egress Time
RTI	Response Time Index
SFPE	Society of Fire Protection Engineers
UL	Underwriters Laboratories

Introduction

This report serves as the culmination of the Master of Science degree program in Fire Protection Engineering at California Polytechnic State University, San Luis Obispo. The culminating project requires the evaluation of the fire and life safety features of a specific building. This report details the evaluation of Shyh Wang Hall, located on the campus of Lawrence Berkeley National Laboratory (LBNL), as shown in Figure 1. Wang Hall, formerly known as the Computational Research and Theory Facility, is a new structure that was built to house the super computers used by the Computational Research Division at LBNL, the Department of Energy's National Energy Research Scientific Computing Center and the Scientific Networking Division, and the University of California Computational Science and Engineering program. Topics of study include: global climate change; clean, renewable energy; and energy efficiency.

Figure 1: LBNL Site Map

Objectives

The objective of this report is to evaluate this existing building with consideration to both prescriptive-based requirements and performance-based design. In a prescriptive-based design, a building is constructed following the specific requirements in the applicable building code. No consideration is given to changing the code-specified requirements. This method builds on decades of experience in constructing safe buildings. A design that meets the prescriptive-based requirements is considered to be a safe building, although the building likely meets only the minimum life safety requirements.

In a performance-based design, the fundamental life safety requirements of a prescriptive-based design are met. This is accomplished by applying the fundamentals in a way that does not meet the prescriptive requirements directly but through a demonstration that the design provides for the same level of protection, or perhaps an enhanced level of protection, through alternative means. Where a prescriptive-based design may specify a maximum value for a given aspect, this value may be exceeded provided the designer is able to demonstrate that the safety of the building occupants is not jeopardized.

Building Description

Wang Hall, LBNL Building 59, is four stories in height and constructed to meet Type II-B requirements of the California Building Code (CBC) and Type II(000) requirements of National Fire Protection Association (NFPA) 101, *Life Safety Code*. The building is classified as a Group B business occupancy with two Group A-3 assembly use rooms. The upper two floors (First Floor and Second Floor) house office space. The lower two floors house the high performance computers on the Computing Level and mechanical equipment on the Mechanical Level. The Roof Level does have accessible mechanical spaces but is not normally occupied. Architectural drawings for all floors are included in Appendix 3.

The building is protected throughout by an automatic sprinkler system. In addition, the building is protected by a fire detection and alarm system. The Computing Level, the second floor of the building, is constructed with a raised floor to allow for cables for the computers. The floor is protected by a pre-action sprinkler system and a VESDA-brand High Sensitivity Smoke Detection system. The building is equipped with two elevators and three interior stairs. Additional egress stairs are provided on the exterior of the building. As this building is situated on a hillside, exit discharge to the public way requires these additional exterior stairs.

The building is constructed on a hillside and is subject to a considerable wildland fire threat. This threat is mitigated through fuel modification including annual removal of grasses and other ground fuels. The building is also subject to potential damage in an earthquake. The Hayward earthquake fault is located just to the west of the building. The location of the building relative to adjacent buildings is shown in Figure 2. The following section details the codes and standards that are applicable to the building.

Figure 2: Aerial View of Wang Hall and Surroundings

Applicable Codes and Standards

The building was constructed by the University of California and was designed under the 2007 California Building Code, along with other applicable California codes. As the Lawrence Berkeley National Laboratory is operated under contract by the U.S. Department of Energy (DOE), this building is subject to compliance with both the California codes and NFPA standards once occupied. Under Department of Energy Order 420.1C, the most restrictive codes apply. As such, both the NFPA *Life Safety Code* and the California Building and Fire Code are considered herein. The current edition of each code is applied. One additional standard, NFPA 75, *Standard for the Fire Protection of Information Technology Equipment*, 2009 Edition, was determined to apply after the initial design period. The requirements of this standard were evaluated during construction of the building. Further application of the standard occurred during the buildout of the Computing Level.

Specific codes and standards that apply to this building include the following:

- 2007 California Building Code (Part 2, Title 24, CCR)
- 2007 California Electrical Code (Part 3, Title 24, CCR)
- 2007 California Mechanical Code (Part 4, Title 24, CCR)
- 2007 California Fire Code (Part 9, Title 24, CCR)
- 2007 NFPA 72, *National Fire Alarm Code*
- 2007 NFPA 13, *Standard for the Installation of Sprinkler Systems*
- 2009 NFPA 101, *Life Safety Code*

Prescriptive Code Analysis

Wang Hall was designed and built based on the codes and standards as discussed in the previous section. These requirements apply to the construction of the building, structural fire protection, life safety, fire alarm, fire suppression, and smoke control. Each of these topics is discussed in detail in the following sections. In a prescriptive-based design, there is no specified fire safety goal – the code provides the minimum requirements for a building to be considered safe for occupancy. In the second section of this report a performance-based design is considered. This analysis begins with a specific fire safety goal and then evaluates how well the building would perform under specified fire conditions.

Building Construction

Wang Hall is constructed as a Type II-B building as defined in California Building Code Section 602.2. This type of construction is required by DOE Order 420.1B. The building elements are noncombustible, primarily steel and concrete. As specified in Table 601 (CBC), no fire-resistance rating is required for any of the building elements. Additionally, given the separation distance of 30 feet or more, per Table 602 of the California Building Code no exterior wall fire-resistance rating is required.

The maximum allowable height and area of the building is based on the type of construction and the intended use. This is defined in California Building Code Section 503.1. Per Table 503, for a Type II-B building used as a business occupancy (Group B), the specified maximum height is 55 feet and the specified maximum number of stories is four. The maximum allowable area per floor is specified as 23,000 square feet. Wang Hall, as constructed, is approximately 71 feet tall and has four stories plus mechanical space on the Roof Level. Each floor has an area of approximately 35,000 square feet.

The California Building Code allows for increases in the maximum allowable height and area based on installation of automatic sprinklers and the width of street frontage. Section 504.2 (CBC) allows for an increase in height of 20 feet and an increase in number of stories by one for a building protected by automatic sprinklers. The allowable area can be increased by two factors as specified in Sections 506.1 using Equation 5-1 (CBC). This equation is shown below as Equation 1.

$$A_a = \left(A_t + \left(A_t \times I_f\right) + (A_t \times I_s)\right)$$

Equation 1: Allowable Area Increase

The tabular area per floor, A_t, is specified in Table 503 (CBC). For this building the tabular area is 23,000 square feet. The area increase for automatic sprinklers, A_f, is defined as 2 given the building has more than one story above grade (CBC Section 506.3). The area increase due to frontage, I_f, is calculated using CBC Equation 5-2, shown below as Equation 2.

$$I_f = \left[{}^{F}/_{P} - 0.25\right] \times {}^{W}/_{30}$$

Equation 2: Allowable Increase for Frontage

For Equation 2 the amount of perimeter of the building with a public way of at least 20 feet is considered. The number of feet of building perimeter that is adjacent to a public way with a width of at least 20 feet is defined as F. The total perimeter of the building is defined as P. The width of the public way is defined as W. For Wang Hall, the value of F is 799 feet, the value of P is 859 feet, and the value of W is 30 feet. The calculation provides for an increase in area of 0.68.

The calculated value from Equation 2 is substituted into Equation 1 using the values for A_t and I_s as previously specified. The calculation provides for an overall floor area, per floor, of 84,640 square feet. This is an increase of 61,640 square feet. If the allowable increase for frontage is excluded, given this building is constructed on a hill and does not have full access on all sides, the floor area increase would be 46,000 square feet. This increase for sprinkler protection only provides a total floor area per floor of 69,000 square feet.

Given the allowable number of floors of five, the gross allowable area for the entire building is 423,200 square feet if both sprinkler protection and frontage are considered. If the increase is based only on sprinkler protection, the gross allowable area is 345,000 square feet. The actual gross area of the building is 140,300 square feet. The building, as constructed, is well below the allowable area and meets the allowable height and number of stories. Based on the size and type of construction, the following section considers the required passive fire protection.

Structural Fire Protection

Wang Hall was constructed as a Type II-B building per the CBC. Type II construction is defined as construction that utilizes non-combustible materials for the structural elements. This includes the structural frame, bearing walls, partition walls, and floor and roof construction. As this is Type II-B construction, Table 601 of the CBC specifies that no fire resistance rating is required for any of the structural elements. Further, no fire resistance rating is required for the exterior walls as the separation distance is greater than 30 feet (CBC Table 602).

The building is considered a Group B occupancy, with two rooms designated as a Group A-3 occupancies. These do not require that the building be constructed as a separated mixed occupancy per Section 508.3.1.3 (CBC). The two assembly use rooms qualify as accessory occupancies. These two rooms have a total area of 1,101 square feet on a floor with a total area of 34,431 square feet. These two rooms occupy approximately 3.2% of the area. As this value is well below the maximum of 10%, the rooms are considered accessory. Section 508.3.2 (CBC) requires that the applicable code sections apply based on the individual occupancies. In this case the two assembly use rooms each require two exits, for example.

The floor/ceiling construction of the Computing, First, and Second floors may meet Underwriters Laboratory (UL) classification as 2-hour fire-resistance rated floor assemblies per UL Design No. D907. These are 3-1/4-inch thick slabs with lightweight concrete over 1-1/2-inch corrugated steel decking. The floor slab of the Computing Level is an 8-inch thick concrete slab over 3-inch corrugated steel decking. Floor-ceiling penetrations may be protected by appropriately rated UL Listed firestopping assemblies; some openings are not protected. As such, the floor/ceiling assemblies are not considered to have a fire resistance rating. No fire resistance rating is required.

The roof is of Class A rated construction, tested in accordance with UL 790, meeting the minimum requirement of a Class C rating for a Type II-B building per CBC (2007) Table 1505.1. In addition, the requirements of DOE-STD-1066-1999, Section 9.4.2, are met as the roof is a Factory Mutual (FM) Class I roof.

The Department of Energy, in the 1999 edition of Standard 1066, requires that a building with a Maximum Possible Fire Loss (MPFL) that exceeds $150 million be separated by a 3-hour fire barrier. At the time of construction Wang Hall had a total valuation of approximately $83 million. As such, no fire barriers were required.

The building meets the requirements of the DOE Order and Standard – the building was constructed to meet Type II requirements. The building is considered a Group B occupancy. No occupancy separation is required. The safety of the occupants of the building is considered in the next section.

Life Safety

Maintaining a safe building is the primary goal of any building code. As occupants will be present in this building continuously, providing an environment that is protected against fire is paramount. The *Life Safety Code* addresses the construction and egress elements necessary to “minimize danger to life from the effects of fire” and to provide for “prompt escape of occupants from buildings” in the event of a fire (Section 1.1.2, 1.1.3). The California Building Code has similar language in the purpose and scope sections.

The prescriptive code analysis in the following sections considers the design and construction of Wang Hall and compares it with the requirements of both NFPA 101 and the California Building Code. Some differences are apparent and are addressed. In general Wang Hall was designed and built in a manner that meets the prescriptive code requirements and therefore is assumed to be a safe building.

Building Occupancy Classifications

Wang Hall was designed as a Group B business occupancy. Within the building there are several different uses specified. These are based on what type of activity is expected in a given area. The total number of people that may be expected to occupy the various areas of the building is based on an occupant load factor. The occupant load factor is defined for the various uses.

The total number of people expected to occupancy the space within a building is determined by dividing the floor area by the occupant load factor. Occupant load factors consider the use of an area. In NFPA 101 the occupant load factors are listed in Table 7.3.1.2. A summary of the applicable occupant load factors for this building are listed in Table 1.

Table 1: Occupant Load Factors per NFPA 101

NFPA 101 Occupant Load Factor (Table 7.3.1.2)	
Assembly use: less concentrated use, without fixed seating	15 sq. ft./person net
Business use	100 sq. ft./person
Storage use, in other than storage and mercantile occupancies	500 sq. ft./person

The California Building Code lists a set of occupant load factors similar to NFPA 101 in Table 1004.1.2. The applicable occupant load factors for this building are listed here in Table 2.

Table 2: Occupant Load Factors per CBC

CBC Occupant Load Factor (Table 1004.1.2)	
Business areas	100 sq. ft./person gross
Accessory storage areas, mechanical equipment room	300 sq. ft./person gross
Assembly without fixed seating, unconcentrated	15 sq. ft./person net

The Computational Research Theory Facility was designed using the California Building Code. The occupant load factor used for the Computing Level is based on the use of the area as mechanical equipment. The area is expected to be occupied by only a small number of technicians responsible for the maintenance of the computers. NFPA 101 does not provide a similar occupant load factor for mechanical equipment space. The calculation of occupant load for the Computing Level assumes the space is business use. This may arbitrarily set the calculated occupant load much higher than is expected based on actual use. This topic is further discussed in the next section.

The use of each area is identified on the building floor plans shown in Figures 3-7. Each type of use is identified by a different color. These diagrams consider the California Building Code definitions of occupancy use. Mechanical spaces are highlighted in red. Storage spaces are highlighted in green. Yellow highlights business use areas and assembly use areas are highlighted in purple. Spaces that are not normally occupied are highlighted in cyan.

Occupant Load

The occupant load for each room or area of the building was calculated using the applicable occupant load factors from NFPA 101 and the California Building Code. The major difference between the two sets of calculations exists in the Computing Level occupant load. The use of 300 square feet per person from the California Building Code provides a much lower occupant load when compared to the 100 square feet per person occupant load factor from NFPA 101. The total occupant load per floor, using both NFPA 101 and the CBC, along with the original design drawings, is summarized in Table 3.

Table 3: Calculated Occupant Load per Floor and Building

Floor	Occupant Load Per Floor (NFPA)	Occupant Load Per Floor (CBC)	Occupant Load Per Floor (Design Drawings)
G	320	106	81
C	395	143	147
1	601	593	460
2	495	489	448
R	10	6	4
Total	1,821	1,337	1,140

The occupant load calculation does not include spaces that are not normally occupied. This includes restrooms, stairs, elevators, janitorial closets, and vertical shafts. An occupant load for the roof is also not calculated as the space is not normally occupied. Appendix 1 contains a table that details the occupant load calculations for each space in the building.

Exits Diagrams

The exits for each floor are identified in Figures 3-7. Each exit is marked with a green-colored arrow. There are two exits on the Mechanical Level, and First and Second Floors. The Computing Level has a total of four exits, two in the computing rooms and two in the electric rooms, and the Roof Level has only one exit.

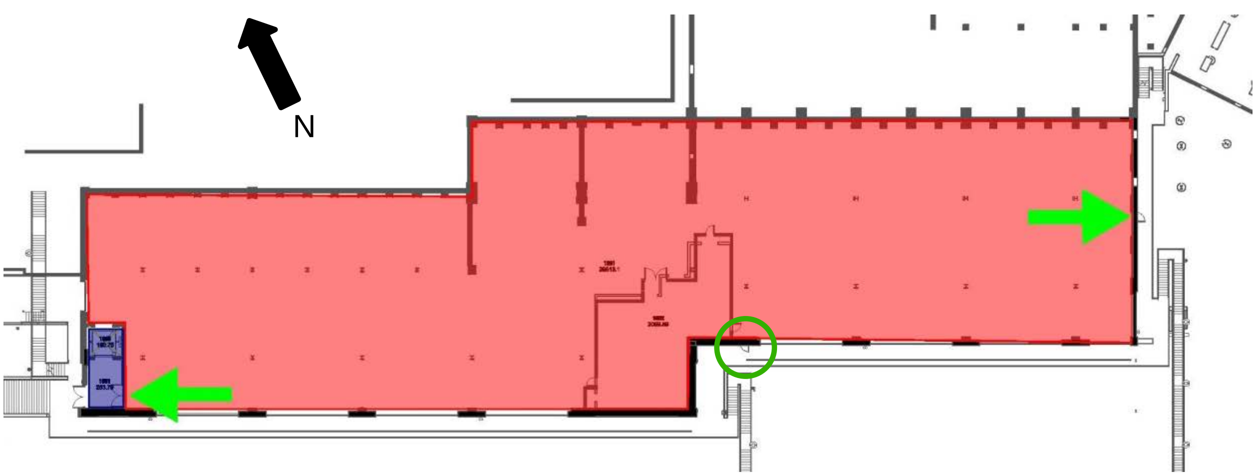


Figure 3: Mechanical Level Exits and Occupancy Use

On the west side of the Mechanical Level there is an exterior door located to the south of the electrical room. This is identified by a green circle in Figure 3. While this does allow for access to an exterior stair that does lead to the public way, this door is not considered an exit. It is provided for convenience purposes and for fire department ingress.

Figure 4: Computing Level Exits and Occupancy Use

A convenience door is provided on the Computing Level between the central control room area and the hallway that connects the north and south electric rooms. This is identified by a green circle in Figure 4. The door is not an exit access door. There is also a door in the central control room area that provides access to the Central Stair. This is not an exit or an exit access; the Central Stair provides for circulation only.

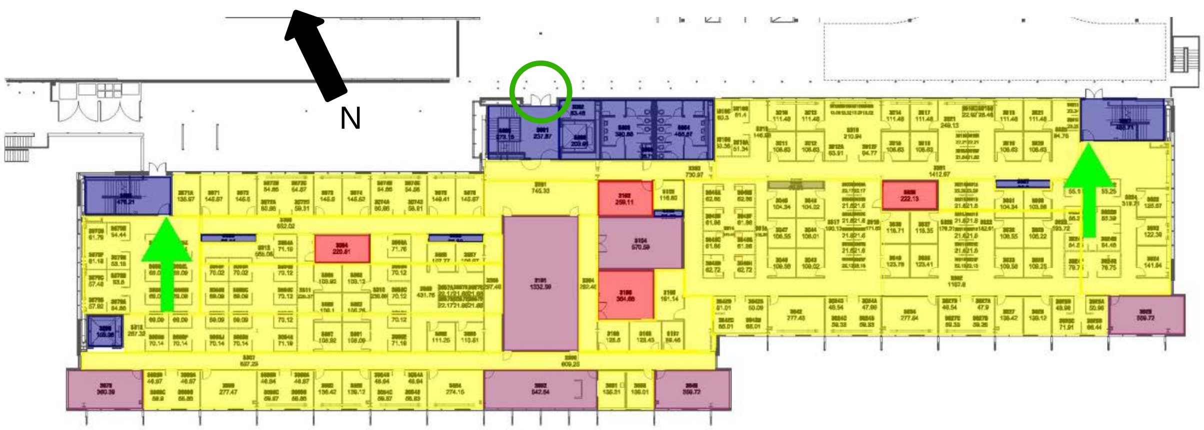


Figure 5: First Floor Exits and Occupancy Use

The main lobby on the First Floor is located along the east wall near the center of the building. This lobby provides access to the central elevator and the central stair. There is also an exterior door. This is identified by a green circle in Figure 5. The exterior door is not considered an exit. Likewise, the central stair provides for circulation only.

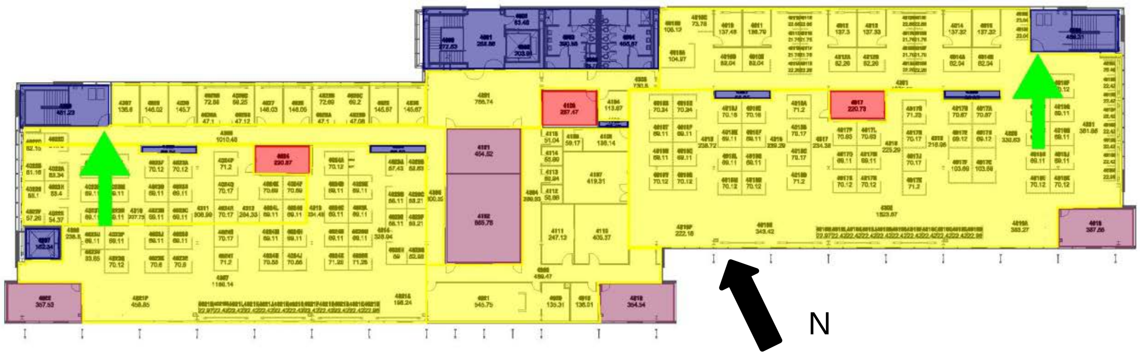


Figure 6: Second Floor Exits and Occupancy Use

Like the First Floor, the Second Floor has a central lobby located along the east wall, as shown in Figure 6. This provides access to the central elevator and the central stair. The central stair is used for circulation only. It is not an exit or exit access.

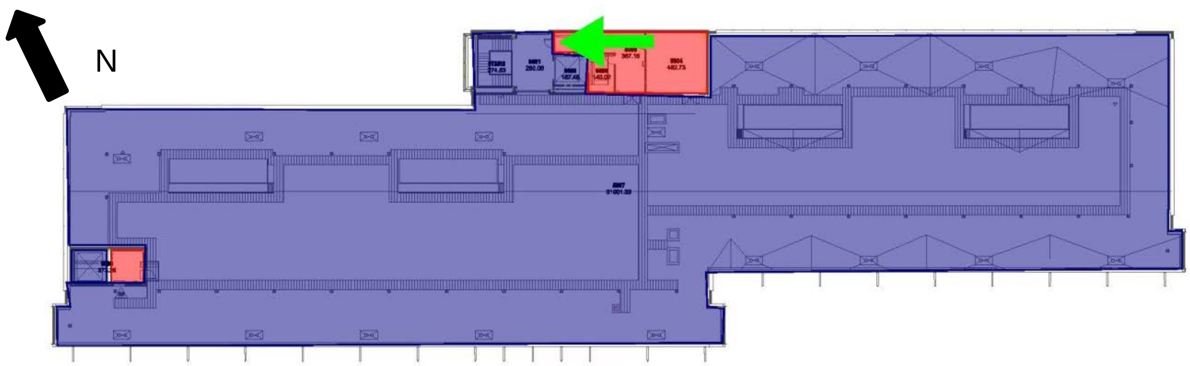


Figure 7: Roof Level Exits and Occupancy Use

The Roof Level has only one exit access, as shown in Figure 7. This door connects to the central lobby and central stair. While the central stair is not an exit, for the Roof Level it serves as exit access. An occupant must travel approximately one-half of the distance on the Second Floor to reach either the north or south exit stair.

Egress Capacity

The egress capacity for the individual rooms and the floors as a whole is calculated by dividing the width of the egress component by the capacity factor. These values are tabulated in Table 7.3.3.1 of NFPA 101. This building qualifies as “all other” for the area. In the California Building Code, the factor for stairs is found in Section 1005.3.1 and the factor for doors is found in Section 1005.3.2. The capacity factors for both NFPA 101 and CBC are shown in Table 4.

Table 4: Egress Component Capacity Factors

Egress Component	Capacity Factor (NFPA 101)	Capacity Factor (CBC)
Door	0.2 in./person	0.2 in./person
Stairway	0.3 in./person	0.3 in./person

The California Building Code allows for a reduction of the capacity factor for stairways in Section 1005.3.1 provided the building is equipped with an automatic sprinkler system and an emergency voice/alarm communication system. As both of these requirements are met, the capacity factor for the stairways will be calculated using 0.2 inchers per person.

The Mechanical Level contains one large open area and one separate room. The exit capacity, shown in Table 5, greatly exceeds the occupant load of 81 people, as defined by the original design drawings.

Table 5: Calculated Egress Capacities for Mechanical Level Exits

Egress Component	Effective Width	Capacity Factor	Calculated Capacity
North Exit Door	88 in.	0.2 in./person	440
South Exit Door	38 in.	0.2 in./person	190

The Computing Level has two areas that are largely separate: the computing space and the electrical rooms. The computing space is split into two sections. As such, the occupant load is split into these three general spaces. The exit capacity, shown in Table 6, greatly exceeds the occupant load of 147 people.

Table 6: Calculated Egress Capacities for Computing Level Exits

Egress Component	Effective Width	Capacity Factor	Calculated Capacity
North Exit Door	92 in.	0.2 in./person	460
Electrical North Exit Door	92 in.	0.2 in./person	460
South Exit Door	34 in.	0.2 in./person	170
Electrical South Exit Door	34 in.	0.2 in./person	170

The First Floor contains primarily office space and has two exit doors. These doors are accessed via travel through the north and south stairs, Stair 1 and Stair 3, respectively. The capacity of the two doors, arranged in series at each stair, does not meet the occupant load for the floor. The interior stair doors have a calculated capacity of 220 people each; however the occupant load that is expected to use each door is 230 people. The exterior exit doors meet the capacity, as these doors were made larger to accommodate the occupants that egress from the Second Floor. This is shown in Table 7. The central lobby door is considered the main building entrance however it is not considered a legal exit.

Table 7: Calculated Egress Capacities for First Floor Exits

Egress Component	Effective Width	Capacity Factor	Calculated Capacity
North Stair Door	44 in.	0.2 in./person	220
North Exit Door	68 in.	0.2 in./person	340
South Stair Door	44 in.	0.2 in./person	220
South Exit Door	68 in.	0.2 in./person	340

The Second Floor has two available stairs for egress. The north and south stairs are accessed via doors that connect the floor to the stair. The capacity of the doors is shown in Table 8. The stair door at the north and south stair is slightly undersized when compared to the occupant load for the floor, 448 people. The central stair is collocated with the elevator and is not considered a legal exit from the Second Floor.

Table 8: Calculated Egress Capacities for Second Floor Exits

Egress Component	Effective Width	Capacity Factor	Calculated Capacity
North Stair Door	44 in.	0.2 in./person	220
South Stair Door	44 in.	0.2 in./person	220

The Roof Level has only one exit, the central stair. While not considered here, the open roof area and the north elevator machine room must pass through the central mechanical spaces in order to reach the central stair. These areas are normally unoccupied. The stair serves as an exit access and occupants are expected to move across the Second Floor to either the north or south stair to exit. The capacity of the central stair for egress from the Roof Level greatly exceeds the occupant load. The capacity is shown in Table 9.

Table 9: Calculated Egress Capacities for Roof Level Exits

Egress Component	Effective Width	Capacity Factor	Calculated Capacity
Central Stair Door	34 in.	0.2 in./person	170

The north and south stairways connect the Second and First floors. The central stair connects the Roof Level to the Computing Level, although it is not considered an exit. The calculated capacity for the north and south stair using both the NFPA 101 and CBC factors indicate that the stair exceeds the occupant load for the Second Floor. This is shown in Table 10.

Table 10: Calculated Egress Capacities for Stairways

Egress Component	Effective Width	Capacity Factor (NFPA 101)	Calculated Capacity	Capacity Factor (CBC)	Calculated Capacity
North Stair	70 in.	0.3 in./person	233	0.2 in./person	350
South Stair	70 in.	0.3 in./person	233	0.2 in./person	350

NFPA 101 allows for an increase in the calculated capacity for stairways that exceed 44 inches in width. As all three stairways are greater than 44 inches wide, the increase in Section 7.3.3.2 applies. Equation 3 (NFPA 101 Equation 7.3.3.2) is shown below with the calculation for the 70 inch stairway.

$$C = 146.7 + \left(\frac{W_n - 44}{0.218}\right) = 146.7 + \left(\frac{70 - 44}{0.218}\right) = 265$$

Equation 3: Stair Capacity Modification

The north and south stairways have a calculated egress capacity of 265 people. The increased capacities remain considerably less than the calculated egress capacity following the California Building Code rules.

Number of Exits

The *Life Safety Code* and the California Building Code both require at least two exits from every space in Section 7.4.1.1 and Section 1015.1, respectively. Both codes allow for a single exit or exit access provided the space has a low number of occupants. For NFPA 101, the single exit exception applies if the occupancy chapter allows for a single exit. Given this building is a business occupancy, Chapter 39, Existing Business Occupancies, applies. In Section 39.2.4.2 a single exit access path is allowed provided the common path requirements of Section 39.2.5.3 are met. As this is a sprinklered building, the common path is 100 feet per Section 39.2.5.3.1. In the California Building Code, Section 1015.1, Exception 1 allows for a single exit provided the occupant load of a space is 49 people or less.

The office rooms, conference rooms with occupant load of 49 or less, and similar rooms meet the exceptions and are permitted to have only one exit. Following the same exception, the Roof Level is allowed only one exit as the calculated occupant load is five or six people, depending on the code used. In addition, the common path meets the limit of 100 feet. The rooms that require more than one exit are summarized in Table 11.

Table 11: Rooms Requiring More than One Exit

Floor	Room	Occupant Load (LSC)	Number of Exits
G	1201	296	2
C	2101	68	2
C	2102	199	2
1	3101	89	4
2	4102	58	2
2	4203	53	2
2	4206	53	2

Each floor is also required to have at least two exits per NFPA 101 Section 7.4.1.1 and California Building Code Section 1015.1. This minimum number of exits from the floor is allowed provided the total occupant load of the floor is 500 people or less. When the occupant load exceeds 500 people and is less than 1,000 people, a total of three exits are required per NFPA 101 Section 7.4.1.2(1) and California Building Code Section 1015.1.1. The total occupant load and number of exits per floor is summarized in Table 12.

Table 12: Calculated Occupant Load and Number of Exits per Floor

Floor	Occupant Load Per Floor (NFPA)	Occupant Load Per Floor (CBC)	Number of Exits
G	320	106	2
C	395	143	4
1	601	593	2
2	495	489	2
R	10	6	1

Despite the difference in calculated occupant load between use of the *Life Safety Code* and the California Building Code, all floors have a sufficient number of exits.

Egress Arrangement

Beginning with Section 7.5.1.3 of NFPA 101, the remoteness of means of egress is specified. Section 7.5.1.3.2 requires that means of egress be located at least one-half of the diagonal distance of the area served. This is reduced to one-third of the diagonal distance in buildings protected by automatic sprinklers in Section 7.5.1.3.3. This is further exempted for existing buildings in Section 7.5.1.3.5, provided the requirements of Section 7.5.1.3.1 are met. Section 7.5.1.3.1 requires that exits be located remotely to minimize the possibility that more than one exit is blocked in a fire event. The diagonal distance rule is considered in the Table 13. The existing exits on each floor meet the arrangement requirements of both NFPA 101 and the CBC.

Table 13: Diagonal Distances

Floor	Diagonal Distance	Exit Separation Distance
Mechanical	395 feet	388 feet
Computing	407 feet	381 feet
First	403 feet	323 feet
Second	404 feet	322 feet

For the spaces with an occupant load greater than 50 people, the doors must swing in the direction of egress per Section 7.2.1.4.2 of NFPA 101. For the seven rooms identified in Appendix 1 where the occupant load is greater than 50 people, the doors in these rooms swing in the direction of travel. All of the exit doors swing in the direction of travel. Smaller offices are equipped with doors that do not swing in the direction of travel.

The building does not have any dead-end corridors. Per NFPA 101 Section 39.2.5.2, the maximum dead-end travel distance for an existing business occupancy is 50 feet when the building is protected by sprinklers. The common path limit is 100 feet. With the exception of the roof, all areas meet the common path requirements. On the roof, there is only one exit. Two distinct means of egress do not become available until an occupant reaches the Second Floor via the Central Stair. The roof is not a normally occupied area.

The total travel distance limitation of 300 feet is met on all floors. The maximum measured travel distance on the Ground Floor is approximately 233 feet. On the Computing Level, the maximum travel distance is approximately 293 feet, measured from the west wall near the center of the computing area to the south exit. In the south electric room the maximum travel distance is approximately 290 feet if the north exit is selected. Travel distances on the First and Second Floors have a maximum of approximately 210 feet. On the Roof Level, the maximum travel distance is approximately 260 feet.

Fire Resistance Ratings

The interior stairways serve as exits for the Second Floor and the Roof Level. The north and south stair connect Second Floor to the First Floor and provide the two required exits. Per NFPA 101 Section 7.1.3.2.1(1), these stairs are required to have a 1-hour fire-resistance rating as the exit connects only two floors. The California Building Code, Section 1022.2, requires interior stairways that are used as exits have a 1-hour fire-resistance rating when connecting three or less stories and a 2-hour fire-resistance rating when connecting four or more stories. These stairways are treated as shafts and protected in accordance with Section 707.4.

Corridors do not have a fire-resistance rating for an existing business occupancy per Chapter 39 (LSC). An exit access corridor is required to meet Class A or Class B interior wall and ceiling finish for new business occupancies per Section 38.3.6.1 (LSC) unless the building is protected by an automatic sprinkler system. A 1-hour fire resistance rating is required by the California Building Code for a Group B occupancy unless the building is protected throughout by automatic sprinklers (Table 1017.1).

Central Stair

The Central Stair (Stair #2) connects four stories: Computing Level, First Floor, Second Floor, and Roof Level. It is not a part of the means of egress and is not enclosed at all locations by fire-resistance-rated fire barriers. In new construction, NFPA 101 and the CBC require this exit have a 2-hour fire-resistance rating. This may be reduced to 1-hour for an existing building protected throughout by a sprinkler system.

The Central Stair is constructed as follows. On the Computing Level the stairway is enclosed by a one-hour fire barrier on all sides. The door at the base of the stair has a 60 minute fire resistance rating. On the First Floor, the elevator lobby and adjacent open stair is separated from the floor by a smoke partition. The doors that separate the lobby from the floor are equipped with hold-open devices that are connected to the fire alarm system and provide smoke and draft control. Likewise the Second Floor elevator lobby is protected by a smoke partition. On the Roof Level the elevator lobby is isolated from the open stair by a one-hour fire barrier. On the First and Second Floors a draft curtain and closely spaced sprinklers protect the opening at the stair.

In the 2007 CBC, Section 707.2 Exception #2, a shaft enclosure is not required in a building equipped throughout with an automatic sprinkler system, where the floor opening between stories does not exceed twice the horizontal projected area of the stairway and closely space sprinklers are installed in accordance with NFPA 13 Section 8.15.4 (2010). The closely spaced sprinklers, as well as a draft curtain, are visible in Figure 8. The Central Stair meets both of these requirements. This is commonly known as the escalator exception.

Figure 8: First Floor Central Stair

NFPA 101 (2009), Section 38.3.1.1(1), permits unenclosed escalator openings in accordance with Section 8.6.8.2. However, Section 8.6.8.2 does not permit unenclosed stair openings that connect more than two adjacent stories. As a result, the architect formally requested that the 2012 edition of NFPA 101 be applied to this aspect of the project. In the 2012 edition of NFPA 101, Section 8.6.9.2 expands on the permissibility of unenclosed, non-egress stairway openings by permitting the use of the escalator exception, which has been in the California Building Code for many years. The key difference between the California Building Code and NFPA 101 is that the CBC allowed this exception for escalators and non-egress stairways, whereas NFPA 101 only allowed this exception for escalators. Under previous editions of NFPA 101, circulating or convenience stairs were not allowed to use the escalator exception. This change was permitted by the Department of Energy as they function as the Authority Having Jurisdiction.

Exit Signage and Illumination

Section 39.2.10 of NFPA 101 for existing business occupancies requires that exit signage meet Section 7.10. The applicable requirements from Section 7.10 include Sections 7.10.1.2.1, 7.10.1.5.1, 7.10.1.5.2, 7.10.2.1, and 7.10.5.1. Exits are required to be marked with an exit sign. Access to exits is required to be marked with an exit sign when the way to the exit is not readily apparent. The distance between signs is limited to 100 feet. Directional signs are required where the direction to the exit is not apparent. All signs are required to be illuminated. Similar language exists in CBC Section 1011.

On each floor an exit sign should be placed over the exterior exit doors and the exit access doors. In Figures 9-13 exit sign locations are identified via solid green circles.

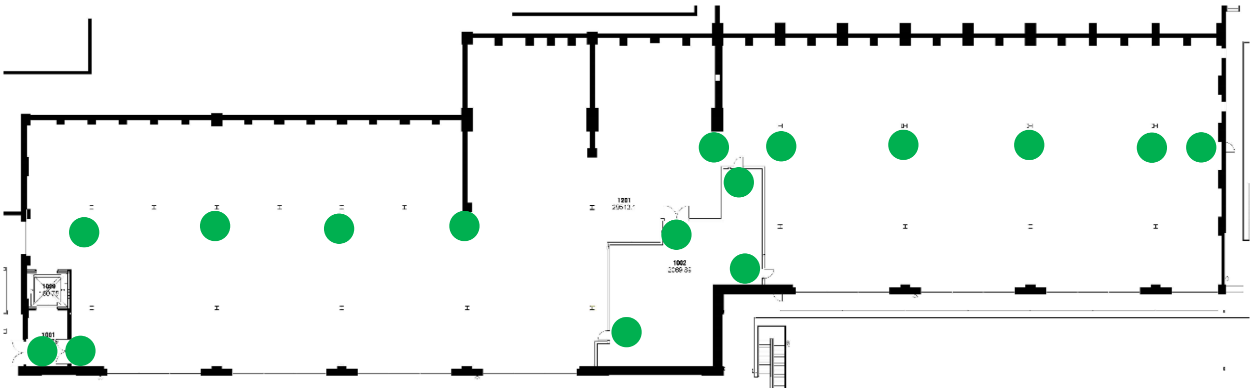


Figure 9: Mechanical Level Exit Sign Locations

On the Mechanical Level, Figure 9, the west exterior door is not considered an exit. As such, no exit sign is located at that door.

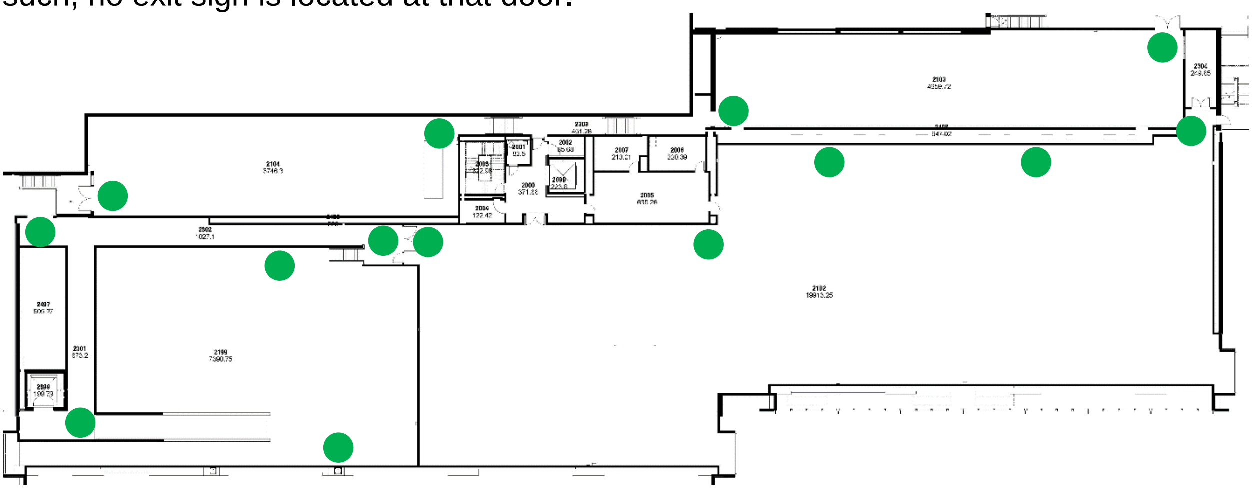


Figure 10: Computing Level Exit Sign Locations

The original design for the Computing Level, shown in Figure 10, did not consider the placement of the computer racks. After construction, during the fit-up phase, it was discovered that the computer racks created a situation wherein the path to an exit was not clear. Additional photo-luminescent exit signs have been installed on the Computing Level to indicate the path to an exit.

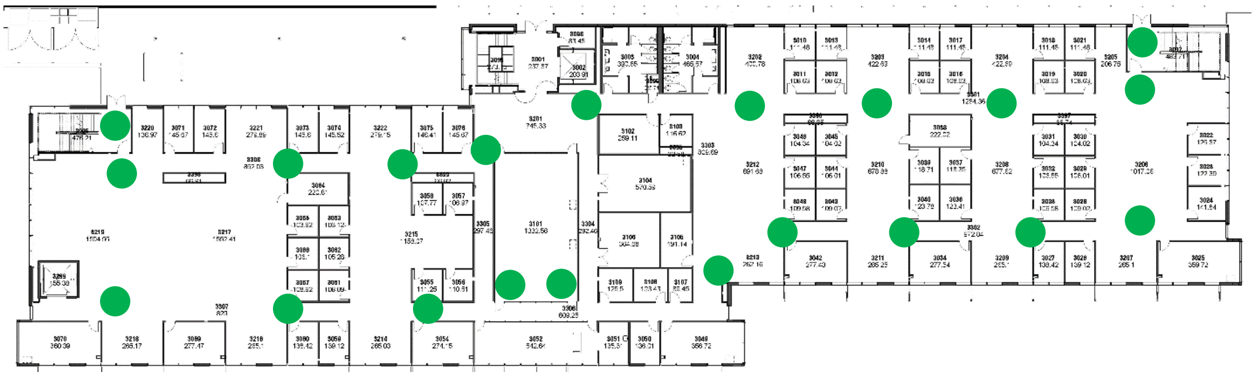


Figure 11: First Floor Exit Sign Locations

On the Computing Level, the First Floor, and the Second Floor, the Central Stair is not identified as an exit using an exit sign. This is shown on the First Floor in Figure 11. This stair serves as a circulation stair only and is not considered a legal exit.

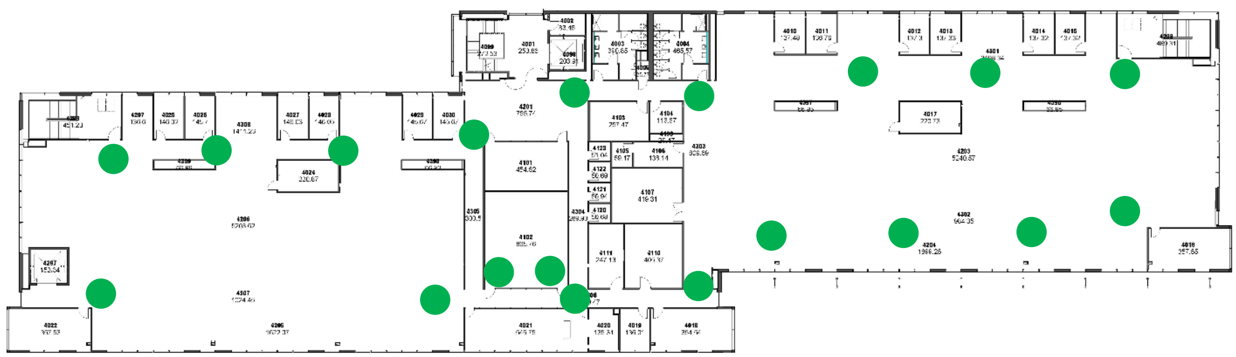


Figure 12: Second Floor Exit Sign Locations

Figure 13: Roof Level Exit Sign Locations

Illumination of the means of egress for existing business occupancies is required to meet Section 7.8 per Section 39.2.8 of NFPA 101. Similar language exists in the California Building Code, Section 1006. Emergency lighting is required per Section 39.2.9.1(1) as the building is three or more stories in height. Section 7.9 applies. The building is equipped with artificial lighting per Section 7.8.1.2.2. The lights are controlled by a motion sensor system and will return to full illumination upon activation of the fire alarm, per Section 7.8.1.2.2(5). The building is equipped with an uninterruptible power source (UPS) that powers emergency lighting throughout the building in accordance with Section 7.9.

Interior Finish

The interior wall and ceiling finish for an exit enclosure is required to meet Class A or Class B fire spread and smoke production requirements per Section 7.1.4.1 of NFPA 101. This is confirmed in Section 39.3.3.2.1 for existing business occupancies. The same requirements also apply for exit access corridors. The interior floor finish is required to be not less than Class II per Section 7.1.4.2 of NFPA 101. No interior floor finish requirements are listed for existing business occupancies in Chapter 39.

The interior finish requirements are summarized in Table 803.5 of the 2007 California Building Code. Two major categories exist for each group of occupancies: sprinklered and nonsprinklered. As this building is equipped with automatic sprinklers, the overall requirements are reduced. For a business occupancy, rooms and other enclosed spaces are required to meet Class C flame spread and smoke developed indexes. While this building is not constructed using the traditional corridor approach, corridors are required to meet Class C flame spread and smoke developed indexes. The stair enclosures are required to meet Class B flame spread and smoke developed indexes. Interior floor finish in required to be Class II for a business occupancy per Section 804.4.2 of the California Building Code.

Wall coverings are Class B tested in accordance with ASTM E 84, and comply with the NFPA 101(2009) requirements of a minimum Class B finish (Section 38.3.3.2). This also complies with the CBC (2007) requirement of a minimum Class B or C interior finish for A-3 & B occupancies in a sprinklered building (Table 803.5). NFPA 75 (2009), Section 5.3.1.1, requires Class B interior finish in fully sprinklered information technology equipment areas.

Window shades meet the testing requirements of NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films,* as required by CBC (2007) Section 806.1, and NFPA 101 (2009), Sections 38.3.3.1, 10.2.4.5 & 10.3. Bulletin boards are Class B tested in accordance with ASTM E 84 and comply with the area limitations of NFPA 101 (2009), Section 10.2.5.3.1.

The Computing Level, and First and Second Floors are built with raised floors. The raised floors include noncombustible floor tiles with a smooth finish. The tile covering is a traditional, smooth, resilient floor finish and is therefore exempt from the interior floor finish requirements of CBC (2007) Section 804.1. Some areas of the building contain carpet. All carpeting is classified as Class I. This satisfies the requirements of CBC (2007) Section 804, NFPA 101 (2009) Sections 10.2.7.4 and 38.3.3.3, and NFPA 75 (2009), Section 5.3.1.2.

Duct insulation on the Computing Level complies with the flame spread index of 25 or less and a smoke developed index of 50 or less, as required by NFPA 75 (2009), Section 10.1.3. Air filters are UL 900 Listed. This complies with the requirements of

NFPA 75 (2009), Section 10.1.4, and NFPA 90A (2009), Section 4.2.2.2. NFPA 75(2009) called for Class I filters. This classification was removed from the UL 900 Standard and NFPA 75 (2009) was updated accordingly. The air filters comply with NFPA 75 (2009).

Life Safety Conclusion

Wang Hall generally meets the prescriptive code requirements for egress life safety as specified in both the California Building Code and the *Life Safety Code*. The egress requirements are based on the occupancy type, Group B with two Group A rooms. The total occupant load is reported as 1,140 people, although it is expected that this number of people will occupy the building intermittently for brief periods of time. The Mechanical Level and Computing Level generally have a low number of occupants.

The capacity of the egress elements is acceptable, with the exception of the two stair entry doors located on the First Floor. Both are slightly undersized; however, it is not expected that this will present an impediment to egress of the occupants. Each floor, and the two assembly rooms, has a sufficient number of exits, and those exits are appropriately distributed. The Roof Level does not have direct access to an exit, only an exit access stair. The building was constructed with adequate emergency lighting and exit signs. Additional signs have been added on the Computing Level as the space has been built out. The interior finish for the building is acceptable.

The fire resistance rating for the two exit stairs meets the code requirements. The Central Stair, which is not an exit but serves only as a circulation stair, has been deemed acceptable as an unenclosed four-story shaft. The shaft is protected from smoke intrusion on all levels and this is expected to provide a safe exit access for anyone on the Roof Level. In the following section, additional information is provided on the control of smoke in the building.

Smoke Control

This building is provided with a smoke control system in the form of shutdown of the air handling units upon activation of the fire alarm system. No smoke exhaust system is provided; such a system was not required at the time of design. Typical smoke exhaust systems include mechanical smoke exhaust (manual or automatic) and natural smoke exhaust via vents. These types of systems are not available in the building.

The Computing Level is equipped with several large exhaust fans that are used to remove hot air from the space. While not considered during design, these fans could be used to exhaust smoke from the Computing Level. Operating these fans would require reprogramming the fire alarm and emergency power off devices, as the power to these fans is shut off by the fire alarm system during an alarm event. Provided power remained available, the fans could be used to exhaust the Computing Level. The following section includes a description and analysis of the fire alarm system, which operates the smoke control functions.

Fire Detection and Alarm

This building is required to be protected by a manual fire alarm system per the California Building Code, Section 907.2.2, for a Group B occupancy with a total occupant load of 500 or more people. The calculated occupant load for the building is 1,140 people. A fire alarm system is also required per DOE Order 420.1b and NFPA 101 Section 38.3.4.1. In order to comply with these requirements, the construction specification calls for “an intelligent, electrically supervised, manual and automatic, fire alarm and detection system.” The Siemens/ Cerberus Pyrotronics XLS fire alarm control unit was selected to serve as the fire alarm control unit. Design and installation follows the requirements of NFPA 72 and other applicable codes and standards.

The fire alarm system provides for manual and automatic detection of a fire, along with automatic notification of a change in status (supervisory) and trouble conditions. Initiating devices include manual fire alarm boxes, smoke detection, and heat detection. Notification appliances include speakers and strobes. Several auxiliary functions are also provided by the system. The primary fire alarm control unit is located on the First Floor in the fire alarm room, which is located adjacent to the main building entrance. A secondary (remote) fire alarm control panel is located in the electric room on the Mechanical Level. Drawings of the fire alarm system are included in Appendix 4.

Sequence of Operation

Given the variety of inputs and outputs for this system, the sequence of operation was changed numerous times during the design, installation, and commissioning phases. There are three groups of signals that are generated from the input devices: alarm, supervisory, and trouble. The output has 17 specific functions, with some of these having sub-functions. The final sequence of operation matrix is included in Appendix 5.

In the alarm category, there are several general output functions. This includes annunciating the alarm at the fire alarm control panel, the remote annunciator, and the LBNL receiver. The audible and visual notification appliances are activated and the building lighting returns to full bright. The door holders are released and the security doors are unlocked. Other functions, depending on the device that signals the alarm, include shutdown of air handling units, closure of fire smoke dampers, elevator recall, and release of the preaction sprinkler system solenoid. These functions are activated selectively depending on the input.

NFPA 72 defines a supervisory signal as “a signal that results from the detection of a supervisory condition” (Section 3.3.253.9). The supervisory category includes monitoring the status of the sprinkler valves, the status of the VESDA smoke detection systems, the status of the generator, the air pressure and status of the preaction sprinkler system, and the status of the emergency power off (EPO) switch on the Computing Level. A trouble signal is defined by NFPA 72 as “a signal that results from the detection of a trouble condition” (Section 3.3.253.10). The trouble category includes monitoring the integrity of the wiring and power supply, and any faults in the VESDA smoke detection systems.

Initiating Devices
A fire alarm system operates through monitoring the status of the initiating devices. Upon receiving an alarm signal from an initiating device, the fire alarm control unit activates notification appliances, transmits the alarm to the central station, and performs additional functions such as closing fire smoke dampers and releasing door hold-open magnets. In addition, this system will release the valve on the appropriate preaction sprinkler system when an alarm signal is received from devices on the Computing Level.

This system uses both manual and automatic fire detection devices. All of the devices are addressed; this means the activation of a particular device will be identified at the fire alarm control unit with a specific location. These locations are programmed into the fire alarm control unit based on the local conditions. Fire detection via initiating devices also includes the operation of a fire sprinkler through the use of a waterflow switch.

Additional initiating devices monitor the status of the emergency power off buttons, the status of the standby generator, and the status of the power extender panels. These inputs will generate a supervisory signal at the fire alarm control panel. The system is equipped with modules that will allow for monitoring of a gaseous fire suppression system for the Computing Level, provided such a system is installed in the future.

Manual Fire Alarm Boxes
A total of 18 manual fire alarm boxes are distributed throughout the building. These are located adjacent to exits from each of the floors. One example is pictured in Figure 14. Two waterproof models are mounted outside the building on the Computing Level South Platform. These are intelligent devices. Four additional manual fire alarm boxes are mounted on the Computing Level and serve to manually activate the pre-action fire sprinkler system. The typical mounting detail from the design drawings is shown in Figure 15. This detail complies with NFPA 72.

Figure 14: Manual Fire Alarm Box

The California Building Code allows for the omission of manual fire alarm boxes in buildings that are protected throughout by an automatic sprinkler system (§907.2.2). NFPA 101 allows for the same omission. DOE Standard 1066 recommends a manual means of fire alarm activation. Although manual fire alarm boxes are not required per minimum code, the LBNL Specification for this building does require these boxes be installed, in accordance with California Building Code and NFPA 72.

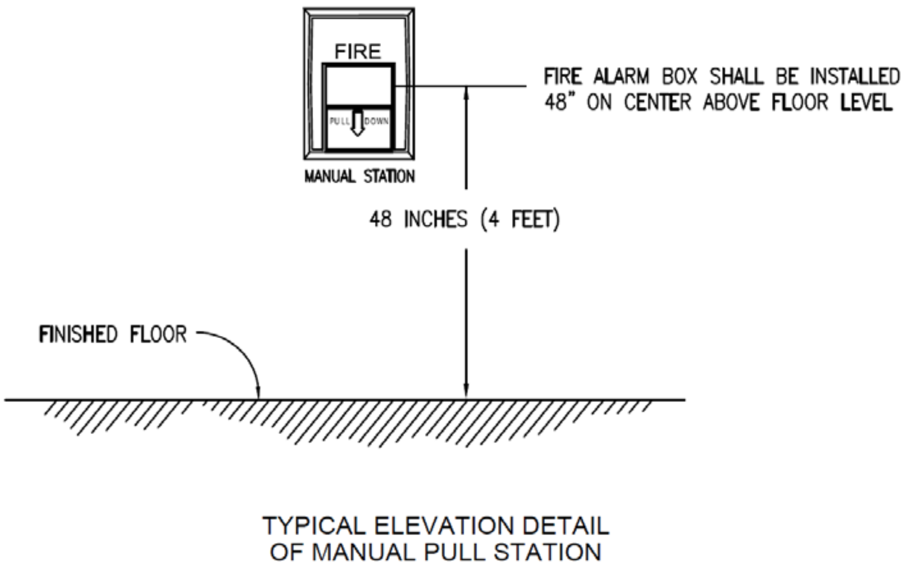
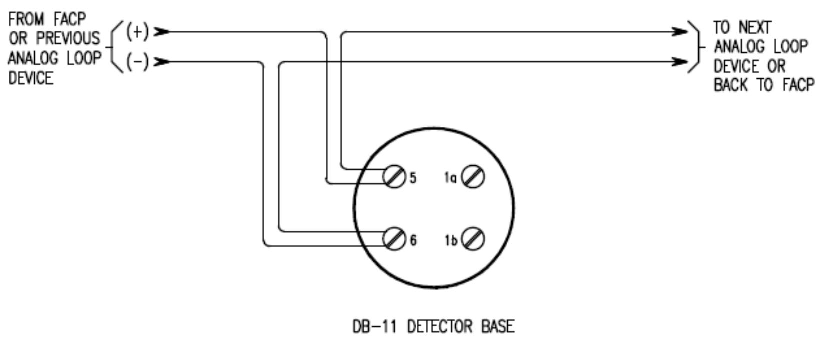


Figure 15: Typical Mounting of Manual Fire Alarm Boxes

Smoke Detectors

Spot smoke detection protects each elevator lobby, with two lobbies on the Mechanical Level, two lobbies on the Computing Level, two lobbies on the First Floor, two lobbies on the Second Floor, and one lobby on the Roof Level. Additional spot smoke detection is provided for a storage room on the Computing Level, the main lobby adjacent to the central elevator lobby on the First and Second Floors, and the elevator machine rooms on the Roof Level. One spot smoke detector is also provided on the Mechanical Level near the preaction sprinkler risers.

The fire control room, where the fire alarm control unit is located, is protected by a spot smoke detector per California Building Code Section 907.4.1. Two spot smoke detectors are located within the medium voltage switch gear enclosure. The north and south stairs on the First Floor and Second Floor are protected by spot smoke detectors. The wiring detail from the design drawings is shown in Figure 16.



HFP-11 INTELLIGENT PHOTOELECTRIC FIRE DETECTOR
with DB-11 DETECTOR BASE

Figure 16: Typical Wiring for Smoke Detector Devices

Spot-type smoke detectors are used in numerous locations for local detection at fire-smoke dampers. In many of the installations two smoke detectors are located in the air stream adjacent to a fire-smoke damper. These are used to protect dampers that are oriented both in the horizontal and vertical position. An example from the South Computing Level Electrical Room is shown in Figure 17.

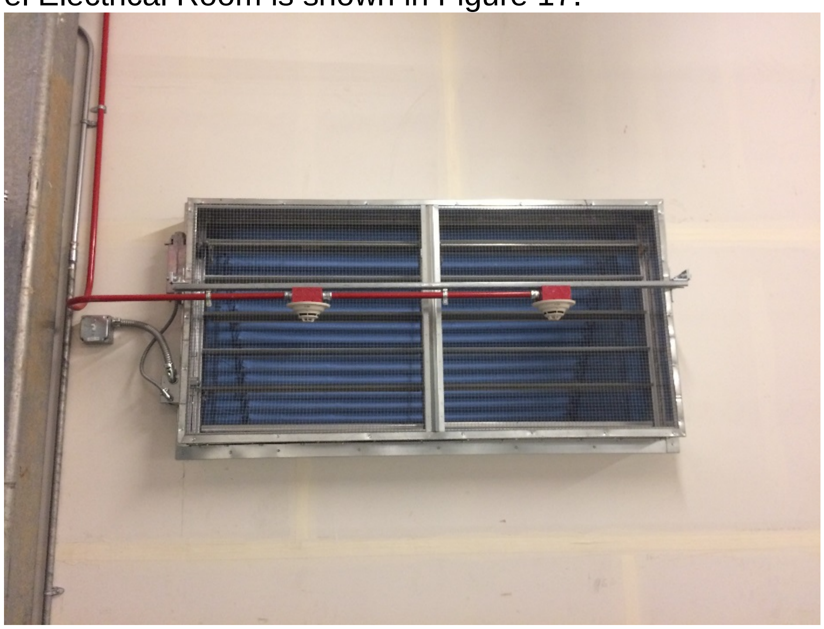


Figure 17: Electric Room Damper Smoke Detectors

Duct Smoke Detectors

A total of 39 duct smoke detectors (DSD) are installed in the building. Two are located on the Mechanical Level. Four are located on the Roof Level. The First Floor has 17 DSD and the Second Floor has 16 DSD. These detectors are required by the California Mechanical Code, Section 608.1, for systems that supply air in excess of 2,000 cubic feet per minute.

The duct detectors utilize a sampling tube that is mounted within the duct. As air passes around the tube, a small sample is allowed to enter the tube through small holes. Air in the tube flows back to the spot-type smoke detector. This system uses the Siemens AD2-XHR, ST50 model. It is designed for an air flow between 100 to 4,000 feet per minute. The sampling tube is designed for use in a duct that is between 3 inches and 5 feet wide. Typical wiring for duct detectors is shown in Figure 18.

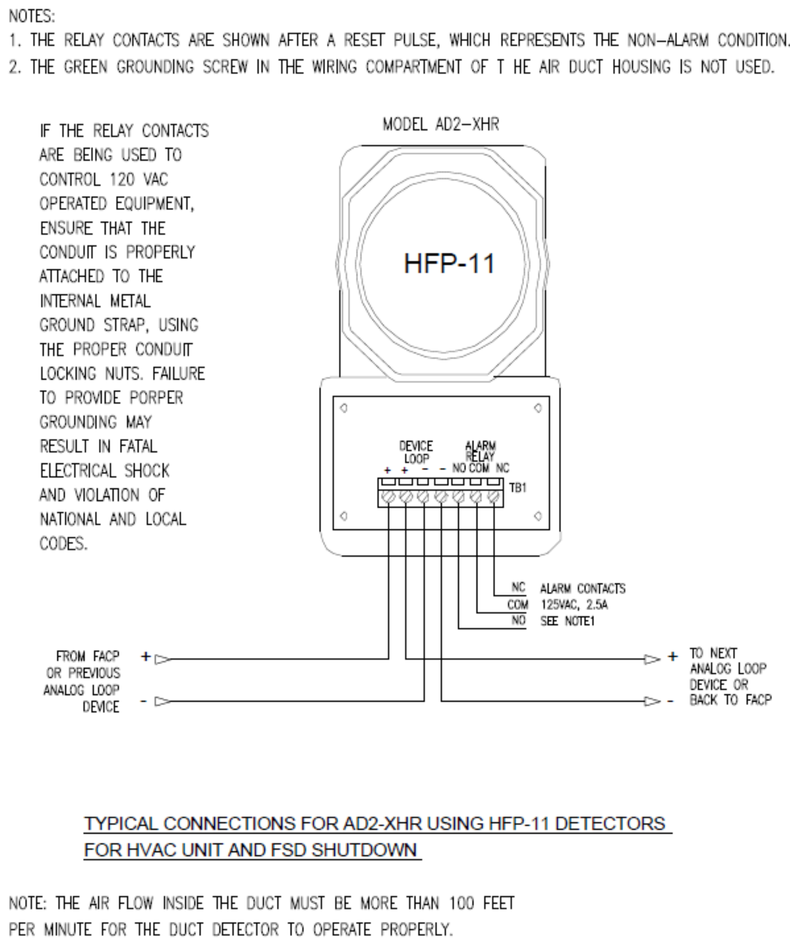


Figure 18: Typical Wiring for Duct Smoke Detectors

High-Sensitivity Smoke Detection

High-Sensitivity Smoke Detection (HSSD) is used on the Computing Level and Mechanical Level. The VEDSA brand system is installed, with Model VLC-500 Laser Compact detectors used for the Mechanical Level air handling units and Model VLP-012 Laser Plus detectors used on the Computing Level. The VLP unit is designed to monitor up to four individual inlet tubes while the VLC is designed to monitor only one inlet tube. The VLC units are programmed with a pre-alarm, and two alarm levels. The VLC unit is programmed with a pre-alarm and only one alarm level.

On the Computing Level each of the VESDA detectors protects one zone. There are four zones in the south computing room, five zones in the north computing room, and one zone in the Control Room. Each zone is designed with one VESDA unit for the ceiling and one for the underfloor. In the north computing room the raised floor has not been installed in three of the zones. As such, only the ceiling level VESDA has been installed. The wiring is in place for the underfloor VESDA, however it will not be installed until the room is built out. An example of the control units for one set of VESDA detectors is shown in Figure 19.

Figure 19: Computing Level VESDA Control Units

Beam Smoke Detection

On the Mechanical Level a standby power system is located in the electrical room. This system includes a stationary storage battery system. The total volume of electrolyte exceeds 50 gallons. As such, automatic smoke detection is required per CFC §907.2.23. A beam smoke detector is used to cover the space, as the ceiling is relatively tall in this room and there are numerous obstructions. The Fireray 3000 model beam detector is specified for this project. An example of the components of this type of detector are shown in Figure 20.

The system has two transmitters and two receivers. One beam is oriented above the remote fire alarm control panel and crosses the room in an east-to-west direction. The other beam crosses above the first beam in a northwest-to-southeast direction. The second beam spans the diagonal of the room while the first beam crosses the width of the room.

Figure 20: Fireray 3000 Beam Detector

Waterflow Switch

Fire sprinklers are essentially heat detectors, as the thermal element will fail when the operating temperature is reached. Water flowing through the sprinkler system following the activation of a sprinkler causes the waterflow switch to activate. This is turn generates an alarm signal that is received by the fire alarm control panel. A waterflow switch is installed on the sprinkler riser at each floor. An additional set of three waterflow switches are installed on each of the three preaction sprinkler systems that serve the Computing Level. The Potter VSR vane type water flow switch, Figure 21, is used.

Figure 21: First Floor Water Flow Switch

Valve Supervisory Switch

The position of each sprinkler system valve is monitored via tamper switch. Operating the valve causes a switch to operate within the device. This in turn generates a supervisory signal that is received by the fire alarm control panel. Each floor has a sprinkler isolation valve and each valve is equipped with a tamper switch. Additional tamper switches are installed to monitor the valves on the three preaction systems. The outside screw and yoke valves are monitored using a Potter OSYSU-2 double switch tamper switch. The butterfly valves, which are used as floor isolation valves, are monitored using a Potter PCVS-2 double switch tamper switch. Typical wiring for the HTRI module, which monitors the valve tamper switches, is shown in Figure 22.

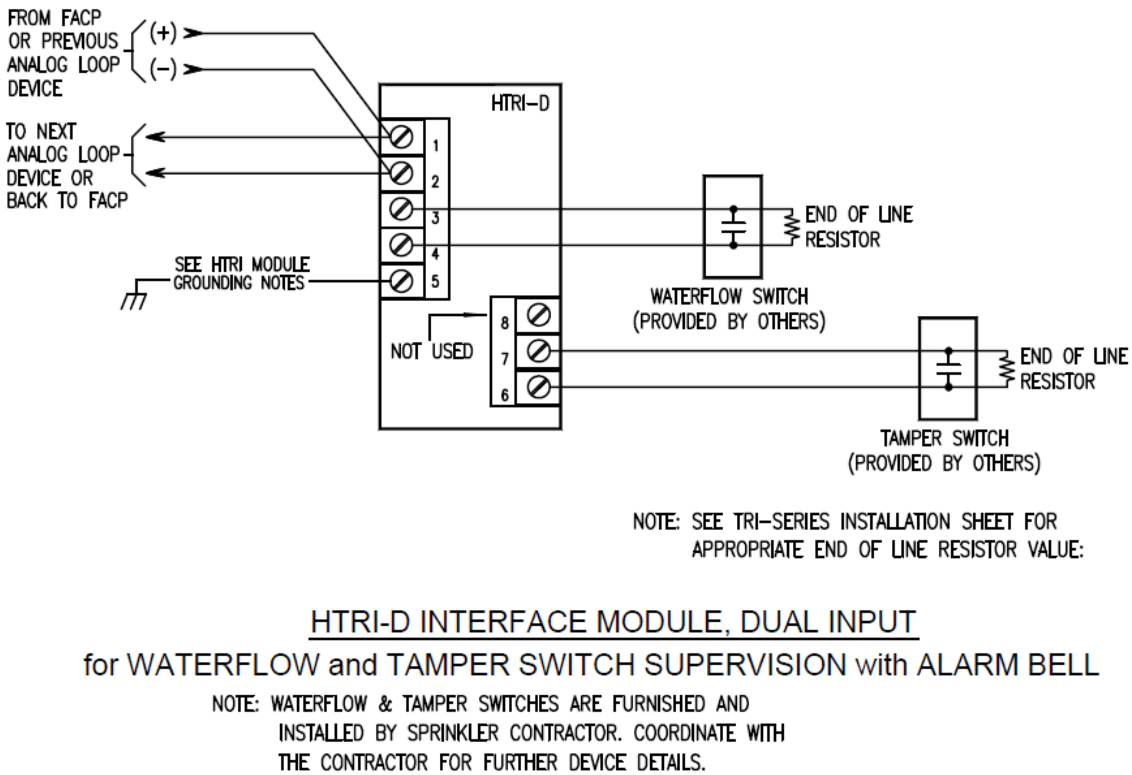


Figure 22: Typical Wiring for Waterflow and Tamper Switches

Preaction System Switch

In addition to a valve tamper switch, the fire alarm system monitors the air pressure within the dry-pipe section of the preaction sprinkler system. Should the air pressure drop below a set value, a supervisory signal is transmitted to the fire alarm control panel and on to the central station. The preaction systems are also equipped with a maintenance switch, which allows for authorized individuals to disable the preaction system. Operating the maintenance switch will generate a supervisory signal. If the system is not restored to normal operation, the supervisory signal should provide a reminder to the appropriate person that the system is offline. Figure 23 is a picture of these three modules located on one of the preaction cabinets.

Figure 23: Preaction Sprinkler Monitor Modules

Initiating Device Location, Spacing, and Placement

The manual fire alarm boxes that are located adjacent to the exits are not required per California Building Code and NFPA 101. Providing these devices is above the minimum code requirement. The installation follows the requirements of the California Building Code and NFPA 72. Smoke detection is required for operation of fire smoke dampers per NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilation Systems*, Section 6.3.1. All of the fire smoke dampers in the building are operated by spot-type smoke detectors located adjacent to the dampers.

Automatic detection systems are required for the Computing Level per Section 8.2.1 of NFPA 75, *Standard for the Fire Protection of Information Technology Equipment*. This detection is required throughout the space at the ceiling level and below the raised floor. This is accomplished through the use of VESDA-brand detection systems. Automatic detection through smoke or heat detectors is not required throughout the remainder of the building. Duct smoke detectors are provided as required per the California Mechanical Code. The installation, spacing, and placement of initiating devices meets the requirements of NFPA 72.

Notification Appliances

Upon receipt of an alarm condition, the fire alarm control unit initiates an array of output functions. Among these is the activation of the visual and audible notification appliances. This system uses public-mode notification via a temporal-coded audible signal followed by a voice message. Visual notification appliances are located per California Building Code in public spaces. An example speaker strobe is pictured in Figure 24.

Figure 24: Speaker Strobe

During an alarm condition, the fire alarm control unit transmits first a tone signal. The tone signal is a set of three temporal three tones. This is followed by a pre-recorded voice announcement:

> *May I have your attention please. May I have your attention please. An emergency has been reported. Please proceed to the nearest exit in a calm and orderly manner.*

Visual Notification
The use of visual notification is required California Building Code Section 907.5.2.3. These appliances are required only in public areas. As such, private areas such as individual offices are not equipped with a visual notification appliance.

Strobes
The fire alarm design includes both wall-mounted and ceiling-mounted strobes. The Siemens ZR-MC-R multi-candela wall-mounted strobe and the Siemens ZR-MC-CR and ZR-HMC-CR multi-candela ceiling-mounted strobes are specified. The use of a multi-candela strobe allows for one model of strobe to be installed throughout a project, with the specific candela rating selected at the time of installation based on the drawings. The design calls for 15, 30, 75, and 110 candela strobes, depending on the location where the strobes are placed. Similarly, the design calls for 15, 30, 75, 95, 115, and 177 candela ceiling-mounted strobes. The base of the strobe appliances is red in color and the word “FIRE” is spelled out on the appliance. The typical wiring detail from the design drawings is shown in Figure 25.

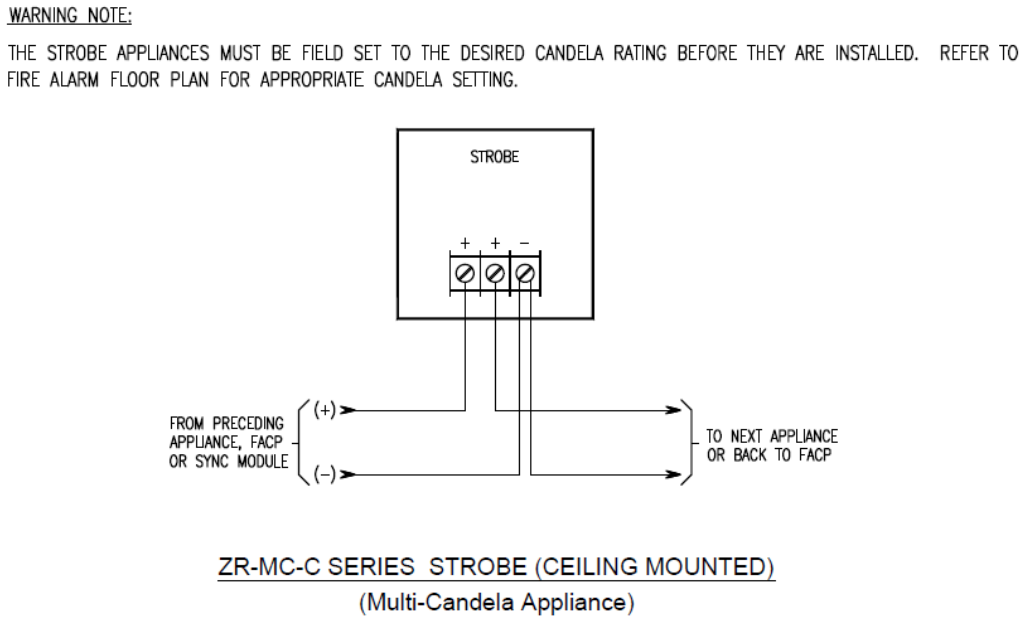


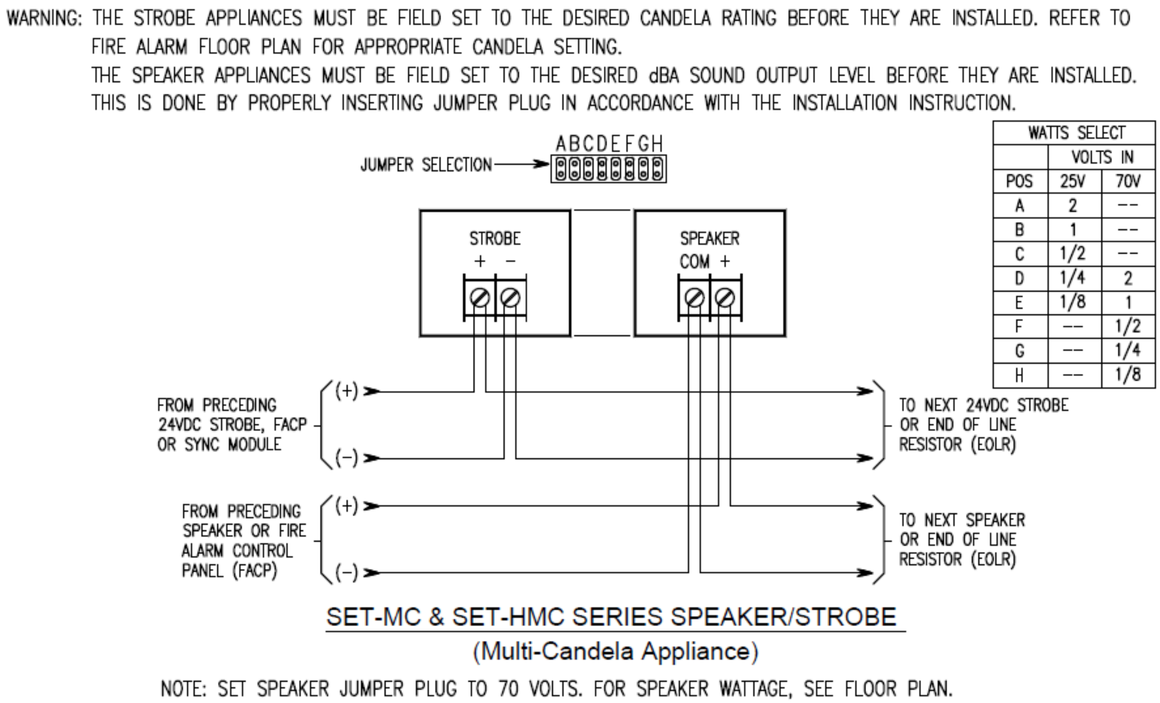
Figure 25: Typical Wiring for Ceiling-Mounted Strobe Appliance

Audible Notification

Audible notification is a requirement for a fire alarm system such as this per California Building Code Section 907.5. The sound pressure is required to be 15 decibels above the average ambient sound level or 5 decibels above the maximum sound level (CBC §907.5.2.1.1). The maximum sound pressure is 110 decibels (CBC §907.5.2.1.2).

Speakers

The fire alarm design includes ceiling-mounted combination speaker/strobe units. The Siemens SET-MC-R, SET-HMC-R, and SET-S17-R-WP combination speaker/strobe appliances are specified. These appliances combine a speaker with a multi-candela strobe. Like the standalone strobe appliances, the multi-candela rating allows for the specific candela rating to be set at the time of installation as specified in the drawing. Two weatherproof speaker/strobes appliances are used in an exterior location. All of the speaker/strobe appliances used inside the building have a white base. The word “FIRE” is written out above the strobe. The typical wiring detail for speaker strobes is shown in Figure 26.



WATTS SELECT		
	VOLTS IN	
POS	25V	70V
A	2	--
B	1	--
C	1/2	--
D	1/4	2
E	1/8	1
F	--	1/2
G	--	1/4
H	--	1/8

Figure 26: Typical Wiring for Speaker/Strobe Appliance

Notification Appliance Location, Spacing, and Placement

The strobe appliances are located in public areas in such a manner as to meet the requirements of NFPA 72 Table 18.5.5.4.1(a) for wall mounted appliances or Table 18.5.5.4.1(b) for ceiling mounted appliances. For example, on the Mechanical Level, wall mounted strobes are used. A series of 110 candela strobes are used to cover the majority of the open areas. The distance between the strobe and the opposite wall is just less than 54 feet for the appliances that are oriented facing west. This distance meets the requirements of NFPA 72.

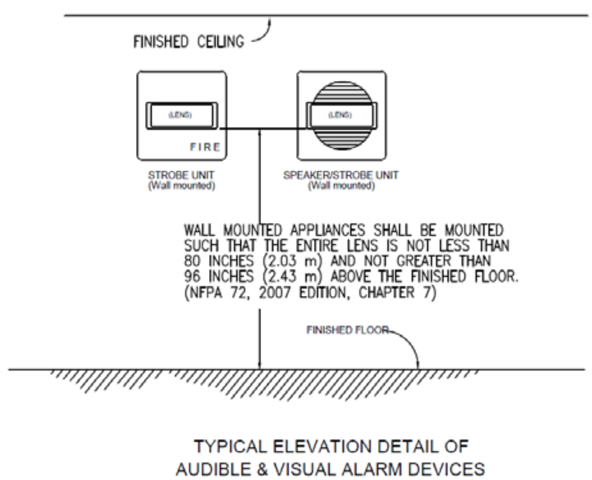


Figure 27: Typical Mounting of Notification Appliances

The locations where the appliances are mounted meet the requirements of NFPA 72, Chapter 18. This includes the mounting height of strobes, as shown in Figure 27, which meet the requirements of Section 18.5.5.1. The speakers meet the public mode audibility requirements of Section 18.4.3. The sound level of the tone is at least 15 dB above the ambient sound level, and does not exceed the maximum of 110 dB. It should be noted that the system is not designed to meet the intelligibility requirements of 18.4.10. Also, on the Computing Level, when all of the computers are operating it is possible for the ambient sound level to approach 110 dB. As such, the area is equipped with strobes.

On the Computing Level the placement of strobes and speaker-strobes was initially based on a shell space – that is the placement of computer racks was not included in the original design. During fit-up it was determined that the placement of notification appliances did not meet the code requirements. The Computing Level has a relatively high ambient sound level and the computer racks block the visual signaling devices. As a result, the existing fire alarm notification appliances were not sufficient to meet the volume and distribution requirements once racks were installed. As this space maintains a sound level that is near the maximum level allowed by NFPA 72, additional ceiling-mounted strobes have been installed to provide for adequate coverage. These strobes were mounted well below the ceiling as this space has a high ceiling. An example strobe is pictured in Figure 28. Also visible is a photoluminescent exit sign.

Figure 28: Computing Level Strobe

Emergency Control Function Interfaces

Two elevators are located in the building, the north elevator and the central elevator. The north elevator connects the Mechanical Level through to the Second Floor. The central elevator connects the Computing Level through to the Roof Level. Both elevators are subject to recall during an alarm, following the requirements of NFPA 72

Section 21.3. The north elevator uses the Mechanical Level as the primary recall floor and the Computing Level as the secondary recall floor. The central elevator uses the First Floor as the primary recall level and the Computing Level as the secondary recall level. The elevators are also equipped with a shunt trip function per NFPA 72 Section 21.4.

In several locations fire doors are held open using electromagnetic hold-open devices. These automatically release under alarm condition and allow the doors to close per NFPA 72 Section 21.8. Some electrically locked security doors are unlocked during a fire alarm per NFPA 72 Section 21.9. Upon activation of the alarm, one additional output from the fire alarm system restores the building lighting to full power.

The fire alarm system has an interface with the building information management system. During a fire alarm initiated by the HSSD on the Computing Level, the fire alarm has an output function that will shut off power to the computers. This operates in conjunction with the Emergency Power Off (EPO) switches. The EPO switches are located in the control room and allow for power to be isolated in the event of a fire involving the computer equipment.

The fire alarm system has an associated system that provides for emergency communications from two areas of refuge located in the stairways on the Second Floor, in accordance with NFPA 72, Section 24.10. Callboxes are provided in the north and south stairway, as shown in Figure 29. These are connected to a dedicated control panel in the fire alarm room. As this room is not a constantly attended location, the system has an automatic dialer that will connect the caller to the appropriate emergency dispatcher. The fire alarm control panel monitors the system for integrity.

Figure 29: Area of Refuge Emergency Communication Device

Power Supply

The primary source of power to operate the fire alarm system is commercial electricity that is provided to the site by Pacific Gas & Electric. This electricity is supplied to the building via the LBNL electrical distribution system. This type of primary power supply is identified by NFPA 72 Section 10.6.5.1.1(1) as one acceptable branch circuit. The system is required to have a secondary power supply that will automatically take over the load upon loss or failure of the primary power supply.

The secondary power supply is required to have sufficient capacity to operate the system under quiescent load for a period of 24 hours. At the end of this period, the secondary power supply is required to operate all notification appliances for a period of 5 minutes (NFPA 72 Section 106.7.2.1). As this system utilizes voice notification, the period of alarm following a quiescent period of 24 hours is 15 minutes (NFPA 72 Section 10.6.7.2.1.2).

Battery Calculations

The fire alarm system for this building is divided into two halves, one that serves the First, Second, and Roof Levels from the main FACU; and one that serves the Mechanical and Computing Levels from the remote fire alarm control panel (FACP). Battery calculations are required to include a minimum 20 percent safety margin per NFPA 72 Section 10.6.7.2.1.1. The calculations for this design include a safety factor of 25 percent. The summary of battery calculation for the main fire alarm control unit (FACU) is shown in Table 14 and the summary of calculation for the remote FACP is shown in Table 15.

Table 14: XLSV Battery Calculation Summary

Component	Current [Amps]	Condition	Capacity [Amp-Hr]
Total Supervisory Current	3.10	Supervisory (24 hours)	74.28
Total Module Alarm Current	1.10	Alarm (0.25 hours)	4.30
Total Alarm Current	16.12	Total	78.58
		Safety Factor (25%)	19.65
		Grand Total	98.23

The calculation provided by the contractor has a few errors but for both the FACU and the FACP, the battery that was provided to supply secondary power is adequate. The alarm current for the FACU does not include the module alarm current in the total. With this addition, the total amp-hour requirement is increased from 83.94 to 98.23. The battery provided for the FACU has a capacity of 100 amp-hours. For the FACP, the battery provided has a capacity of 100 amp-hours.

Table 15: XLSRV Battery Calculation Summary

Component	Current [Amps]	Condition	Capacity [Amp-Hr]
Total Supervisory Current	2.42	Supervisory (24 hours)	57.98
Total Module Alarm Current	1.04	Alarm (0.25 hours)	4.84
Total Alarm Current	18.31	Total	62.82
		Safety Factor (25%)	15.71
		Grand Total	78.53

System Wiring

The system is designed with Class A wiring. All wire is located within conduit. The outgoing and return conductors are physically separated to prevent physical damage from affecting both conductors. The initiating device circuit loops and the sprinkler system supervision circuits were wired as Class A, Style E loops. The notification appliance circuit loops were wired as Class A, Style Z loops.

Several different types of wire are used in this system. For the addressable loop devices and the speaker notification appliance circuits, two conductor, #16 AWG solid, twisted wire is used. This wire type is also used to power monitoring devices for waterflow, valve supervisory, manual pull stations, and the standby generator. For the strobe notification appliance circuits, two conductor, #14 AWG, solid, THHN wire is used. This type of wire is also used to power door hold-open devices, the remote annunciator, and the VESDA detectors. The area of refuge call stations use two conductor or four conductor, #22 AWG wire.

Voltage Drop Calculations

For the primary fire alarm control unit on the First Floor, the fire alarm designer provided voltage drop calculations. Circuits V1 through V17 are connected to the FACU located on the First Floor. These voltage drop for these circuits is summarized in Table 16. The worst case scenario is observed in Circuit V7, with a voltage drop of 3.24 volts. The remaining available voltage is 20.76 volts, which is well above the required 16 volts.

Table 16: FACU Circuits Voltage Drop Calculations

Circuit	Distance [ft]	Current Load [amps]	Voltage Drop	Available Voltage
V1	330	0.938	1.627	22.373
V2	380	0.992	1.981	22.019
V3	435	0.823	1.881	22.119
V4	670	3584	2.056	21.944
V5	600	0.750	2.364	21.635
V6	640	0.605	2.035	21.965
V7	660	0.934	3.24	20.760
V8	610	0.584	1.872	22.128
V9	540	0.894	2.537	21.483
V10	640	0.793	2.667	21.333
V11	590	0.612	1.898	22.102
V12	600	0.660	2.081	21.919
V13	670	0.733	2.581	21.419
V14	550	0.857	2.477	21.523
V15	640	0.864	2.906	21.094
V16	630	0.503	1.664	22.335
V17	170	0.265	0.237	23.763

Voltage drop calculations were also provided by the fire alarm designer for the remote fire alarm control panel on the Mechanical Level. Circuits V21 through V34 and R1 through R3 are connected to the remote FACP on the Mechanical Level. The voltage drop for these circuits is summarized in Table 17. The worst case scenario for the remote panel is Circuit V34, with a voltage drop of 3.079 volts. The remaining available voltage is 17.321, which is above the required 16 volts.

Table 17: FACP Circuits Voltage Drop Calculations

Circuit	Distance [ft]	Current Load [amps]	Voltage Drop	Available Voltage
V21	180	0.966	0.914	23.086
V22	500	0.852	2.239	21.761
V23	400	0.987	2.075	21.925
V24	385	0.987	1.997	22.003
V25	785	0.755	3.115	20.885
V26	640	1.045	3.515	20.485
V27	700	0.755	2.778	21.222
V28	780	0.917	3.759	20.241
V29	765	0.522	2.099	21.901
V30	820	0.755	3.254	20.746
V31	900	0.521	2.454	21.546
V32	800	0.945	3.973	20.027
V33	800	0.692	2.909	21.091
V34	620	0.945	3.079	17.321
R1	300	1.5	2.365	18.035
R2	300	1.5	2.365	18.035
R3	300	1.5	2.365	18.035

Transmission of Signals

The system is required to be monitored by an approved supervising station per California Building Code Section 907.6.5. Monitoring is accomplished by a hybrid central station and proprietary supervising station system. Signals from the fire alarm control unit transmit via telephone line and fiber optic network to receiving location on-site. These signals are immediately retransmitted via microwave link to an off-site monitoring station. This station is physically located within the Alameda County Regional Emergency Communications Center. The communications center is located on the Lawrence Livermore National Laboratory site and provides alarm monitoring for both Laboratories. When an alarm is received at the communications center, the information is passed to an emergency dispatcher, located in the same room, who transmits the information to the fire department.

Mass Notification System

At the time of design and construction, a mass notification system (MNS) was not required for this building by DOE requirements. Likewise, current California Building Code does not require an emergency voice/alarm communications system (EVACS) for this type of occupancy. There is a plan in place to upgrade all the fire alarm systems in all buildings at LBNL to be fully MNS/EVACS compliant. One building has been upgraded recently.

The fire alarm control unit that was installed in this building is equipped to handle MNS/EVACS. The unit has a handheld microphone and is capable of receiving live voice messages from a remote location, such as the LBNL Security Operations Center. The current installation of speakers may require supplemental appliances to meet the intelligibility requirements of NFPA 72. An existing site-wide public address system was installed in this building and connected to the existing network. While this system is not NFPA 72 compliant, it does provide for the same basic functionality until such time as the fire alarm system is upgraded.

Acceptance Testing and Commissioning

This full fire detection and alarm system was subject to commissioning following installation. The process includes acceptance testing, wherein the owner and the Authority Having Jurisdiction (AHJ) verify that the system was installed per the plans and specifications, and that the system functions correctly. At Berkeley Lab the AHJ is an employee and does, in small part, represent the owner. Commissioning and acceptance testing were completed by an outside vendor with the Berkeley Lab AHJ serving in an oversight capacity.

All devices were fully tested prior to the final acceptance test. This pre-test was part of the commissioning process. After all devices were tested and functionality was confirmed, additional testing was witnessed by the Berkeley Lab AHJ. Some problems were discovered and corrected during the pre-test.

Inspection, Testing, and Maintenance

The on-going upkeep of a system is discussed in NFPA 72, *National Fire Alarm and Signaling Code* (2016 Ed.) in Chapter 14. This chapter includes the requirement for initial acceptance testing, as discussed in the previous section, as well as ongoing periodic inspection, testing, and maintenance (ITM). This ongoing ITM is required by DOE and CFC and records are required to be maintained.

Visual inspection of system components is required on a daily, monthly, quarterly, semiannual, or annual basis, as specified in Table 14.3.1. Likewise, testing of components is required on a daily, monthly, semiannual, or annual basis, as specified in Table 14.4.3.2. The periodic frequency is determined based on the type of component. Not all components considered in the two tables will exist on a given system. Maintenance is required if any deficiencies are identified.

All ITM work is conducted by in-house Berkeley Lab employees. The fire alarm electricians are National Institute for Certification in Engineering Technologies (NICET), State of California, and manufacturer trained and certified. The ITM program for this building began once the building was complete. At present, all of the ITM records are completed and are maintained. In the future, older records will be destroyed in accordance with NFPA 72 and Department of Energy requirements.

Fire Alarm Conclusion

Overall the fire alarm system in Wang Hall complies with the applicable codes and standards. A fire detection and alarm system is required in this Group B building as the occupant load exceeds 500 people. Initiation of the system may occur via manual fire alarm boxes, smoke detection including HSSD, and water flow switches. The placement of the initiating devices is acceptable.

The system provides notification to building occupants via speaker/strobes and strobes. The speakers play a pre-recorded message during a fire event. Additional notification appliances, strobes, have been added on the Computing Level as the ambient sound level is high. The placement of notification appliances is acceptable. Mass notification features are provided but not currently enabled.

The fire alarm control unit provides for several emergency control functions in an alarm event, including release of door hold-open devices, recall of elevators, and emergency power off on the Computing Level. The wiring and power supply for the system meets the code requirements. Signals from the fire alarm control unit are transmitted to constantly attended locations both at LBNL and off-site.

The system has been tested during ITM and annual fire drills, and no issues have been identified. The emergency power off switches on the Computing Level have been functionally tested and were shown to operate as designed. The fire alarm has several interfaces with the fire suppression systems in Wang Hall. These fire suppression systems will be considered in the following section.

Fire Suppression

The building is protected by automatic sprinkler system throughout. This is required by DOE Order 420.1b. An automatic wet-pipe system is used on the Mechanical Level, the First and Second Floors, and the Roof Level. A small portion of the Computing Level is protected by the wet pipe system from the Mechanical Level. On the Computing Level, the system is a single interlock preaction system. This system is installed both at the ceiling level and also under the raised floor. A Class 1 combination automatic wet standpipe is also provided. Fire sprinkler drawings for the building are included in Appendix 6.

Fire Sprinklers

All sprinklers installed in this building have glass bulb operating elements with operating temperatures of 155^{O}F or 200^{O}F. The temperature rating varies depending on the location where the sprinkler is installed. All of the sprinklers are classified as quick response and therefore have a Response Time Index (RTI) that is less than or equal to 50 $(m\text{-}s)^{1/2}$. The RTI is a measure of the thermal sensitivity of the thermal element. The sprinklers specified for this installation are manufactured by Tyco and include Series RFII and Series TY-FRB.

Fire Sprinkler Description
The sprinkler system has a basis of design of Ordinary Hazard Group II per Department of Energy construction requirements. All systems are control mode density/area (CMDA) systems. The wet-pipe sprinkler system has a design density of 0.20 gpm/ft^2 over 3,000 ft^2. The preaction system has a design density of 0.20 gpm/ft^2 over 3,900 ft^2. This increased area of operation is required per NFPA 13 for a dry pipe system. One additional area protected by the wet-pipe system has a basis of design using Extra Hazard Group I. This protects a generator installed outside under an overhang and has a design density of 0.30 gpm/ft^2 over 1,350 ft^2. The area of operation is limited to the actual size of the protected area. The sprinkler design criteria are summarized in Table 18.

Table 18: Sprinkler Design Densities

Design Area	Design Density	Area of Operation
Wet-Pipe	0.20 gpm/ft^2	3,000 ft^2
Preaction	0.20 gpm/ft^2	3,900 ft^2
Generator Yard	0.30 gpm/ft^2	1,350 ft^2

On the two office floors, the upper two floors, sprinklers are not installed above the suspended ceiling or below the raised floor. At the time of construction, the preaction systems for the north portion of the Computing Level were not installed, as the space is currently vacant. Piping was stubbed out to allow for installation of the preaction systems at such time as the floor is built out.

Control valves are located at the backflow preventer, the riser, and at each floor. In addition, each preaction zone has an isolation control valve. A riser is installed in both the north and south stair. Standpipe hose connections are provided in these stairs. On the Computing Level there is a four foot tall subfloor that is protected by sprinklers. Several flexible couplings were added to meet seismic requirements, along with horizontal and perpendicular bracing.

Water Supply
Water is supplied to the site from the East Bay Municipal Utility District (EBMUD) distribution system. Two connections exist between LBNL and EBMUD; the Berkeley View Zone has a storage capacity of 1,000,000 gallons and the Shasta View Zone has a storage capacity of 2,000,000 gallons. Water flows by gravity from these two zones through water meters to LBNL. The distribution system at LBNL is isolated from the East Bay Municipal Utility District system and includes looped piping, three storage tanks, two pumps, and several pressure reducing valves. Supply to Wang Hall is tapped off of an 8-inch main on the northeast side of the building. Water passes through a Wilkins Model 350A double check valve and continues through 8-inch pipe into the building. Once inside the building the riser pipe size decreases to 6-inch.

The system design is based on a water supply of 1,400 gallons per minute from an existing nearby hydrant. A hydrant flow test was conducted on December 1, 2012. The static pressure was observed to be 90 psi and residual pressure was observed to be 79 psi. The flow at 20 psi residual is approximately 3,800 gallons per minute. This is depicted in Figure 30. The hydrant that was test is located at approximately the same elevation as the elevation of the water supply point for the building.

The sprinkler system may be supplemented through the use of a fire department connection (FDC). The FDC is located on Perlmutter Road to the west of the building, adjacent to the backflow preventer. Two 2 ½-inch connections and one 4 ½-inch connection is available. All of the sprinkler system and the standpipes may be supplied through this FDC. This connection is not provided with signage indicating the required fire department pumper pressure and flow to meet the demand at the most hydraulically remote point.

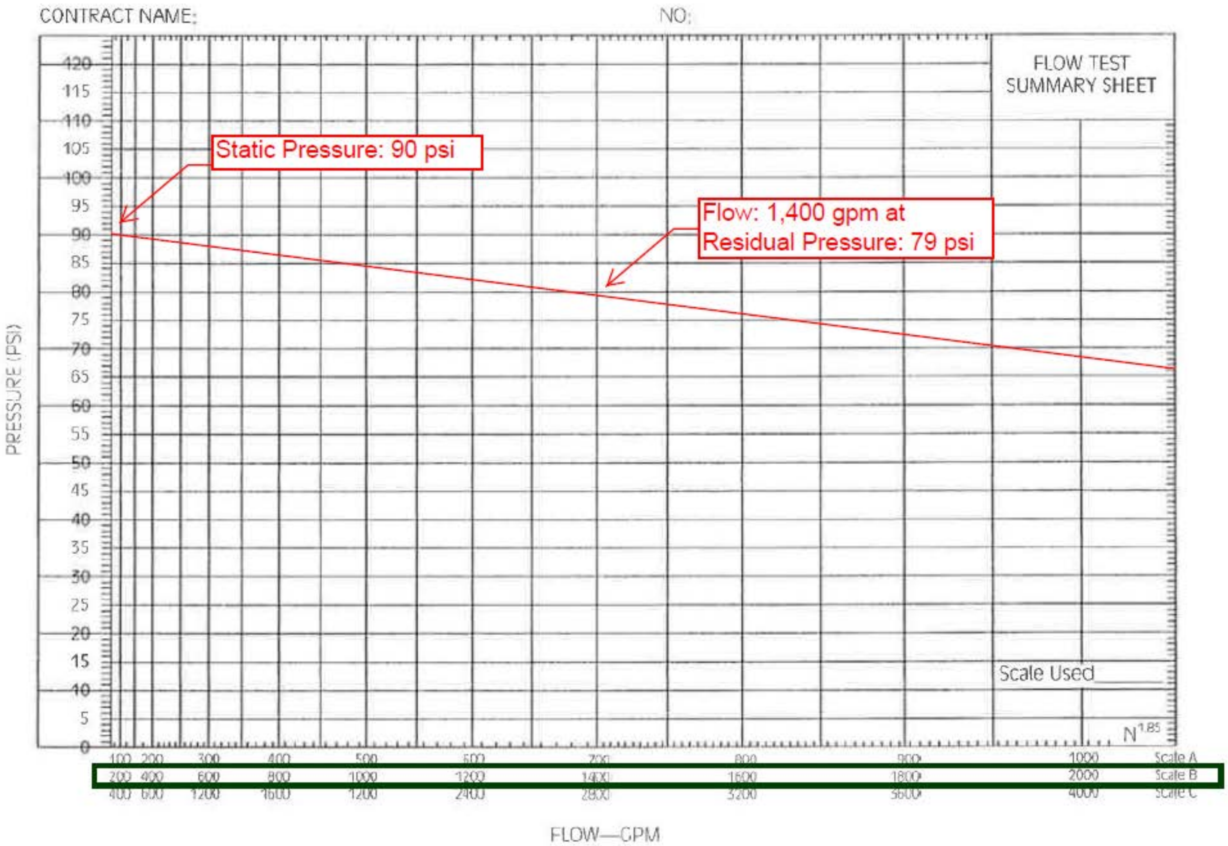


Figure 30: Available Water Supply

Wet-Pipe Sprinkler System

The Mechanical Level, First Floor, Second Floor, Penthouse (Roof Level), and a portion of the Computing Level are protected by a wet-pipe sprinkler system. The system is built using Schedule 40 black steel pipe. The individual sprinklers all have a k-factor of 5.6. In the office areas the sprinklers are quick response with a temperature rating of 155^{O}F. Sprinklers protecting the exhaust fan platform and electrical rooms have a temperature rating of 200^{O}F. In the generator yard the sprinklers have a temperature rating of 200^{O}F and are standard response.

Pre-Action Sprinkler System
On the Computing Level the actual area occupied by the super computers is protected by a single interlock preaction sprinkler system. This system protects the space both above the floor and below the floor. The space is divided into three different sections: North, Central, and South. Each section is protected by one preaction system, which protects both the above floor and the under floor spaces. Each system uses a Victaulic Totalpac preaction valve assembly. The building fire alarm panel controls releasing of the preaction valve. Upon activation of the smoke detection on the Computing Level, the preaction valve is released via a signal from the fire alarm output. One air compressor provides the supervisory air for the three systems.

Hydraulic Calculations
There are three remote areas that were calculated by the contractor during the design of the system. The preaction systems are located on the Computing Level. The remote area of operation is located on the south end of the Computing Level. The wet-pipe system protects multiple floors however only one remote area of operation was calculated. That area is on the Computing Level and is located in the South Electrical Room. The area of coverage for each sprinkler is 125 square feet. The final remote area of operation is located on the east side of the building and protects the generator, which is located a partially open yard. The area of coverage for each sprinkler is 70 square feet. The hydraulic calculations provided by the fire protection system designer are summarized in Table 19.

Table 19: Computer-Generated Hydraulic Demand

Area Served	Total Water Demand Including Hose Stream (gpm)	Hose Stream Allowance (gpm)	Base of Riser Demand Pressure (psi)
Generator Yard	1,076	500	85.8
Mechanical, First, Second, Penthouse, Computing (Wet)	933	250	71.2
Computing (Preaction)	1,130	250	60

Manual hydraulic calculations were completed for the Generator Yard. These are included in Appendix 7. A comparison of the calculations at the individual nodes is not possible as the computer-generated hydraulic calculations for this area are not available. The hydraulic data provided on the riser indicates that this area requires 1,076 gpm at a pressure of 85.8 psi. This includes a hose demand of 500 gpm. The manual calculation of the demand for this area provided a required flow of 1,261.5 gpm at 94.3 psi.

The result of the manual calculation is a higher demand in both flow and pressure. In both cases, it would appear that the water supply is not capable of meeting this demand, as is shown in Figure 31. A fire pump was not specified for this building as it is expected that the water supply can meet the demand. Water flows downhill from the EBMUD storage tanks, which are located in the hills above the LBNL site. Pressure reducing valves limit the pressure of the water as it flows downhill. Though unconfirmed, it is likely that the hydrant flow test did not cause the upstream pressure reducing valves to open. This limited the available pressure to that pressure which is developed via elevation within that hydraulic zone. In a fire event, the fire department is expected to use a sufficient quantity of water so as to cause the system pressure to drop enough to open the pressure reducing valves. This will provide water with more than enough pressure and volume flow. A fire pump is not required for this building.

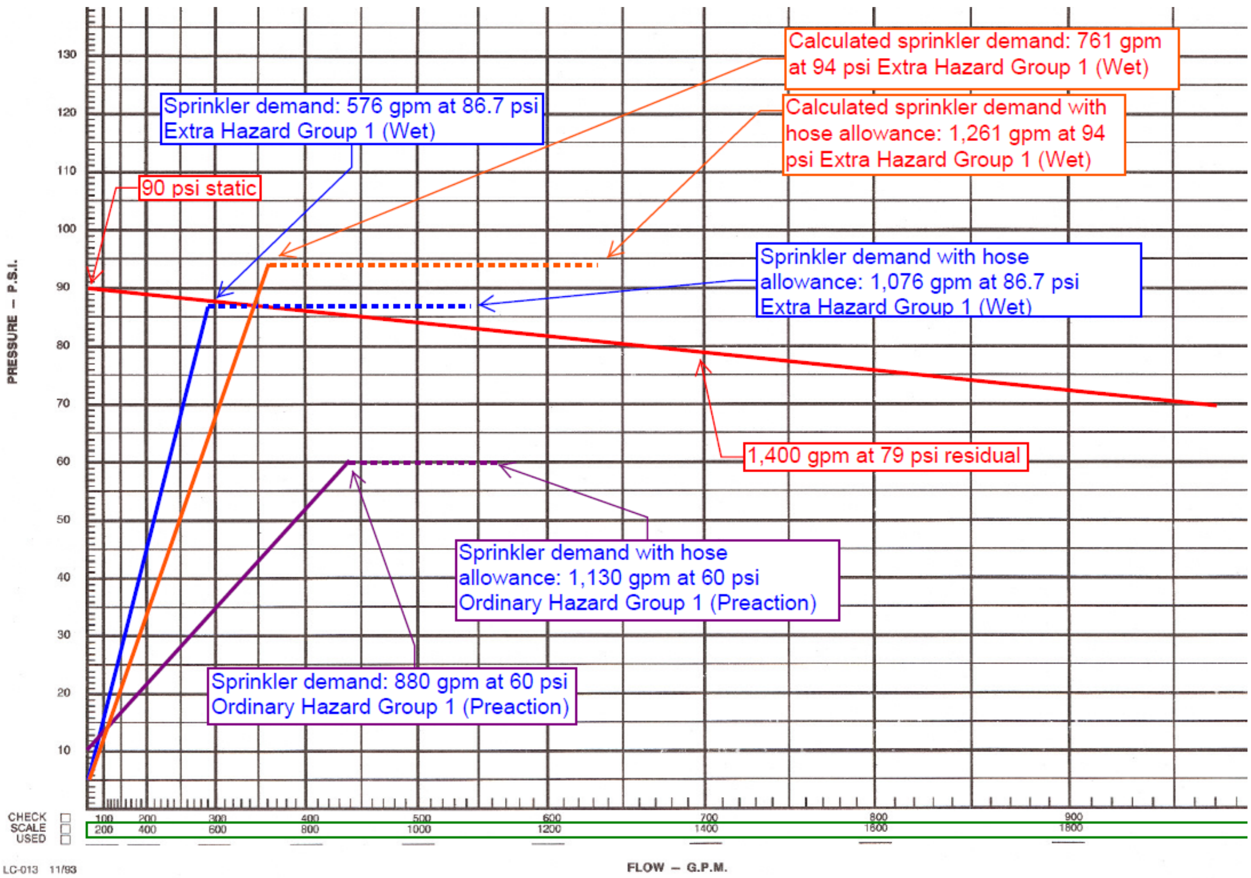


Figure 31: Water Supply and Hydraulic Demand

Standpipe System

A Class I automatic wet standpipe was designed as part of the automatic sprinkler system. This is a combination system, with a design of 750 gallons per minute flow at 100 psi at the most remote outlet. This outlet is located on the roof. The fire department is required to supply the flow at 131 psi at the fire department connection such that the minimum 100 psi is available at the most remote outlet. This information is included on a placard posted at the fire department connection.

Additional standpipe outlets (hose connections) were installed on the exterior of the building along the west side of the Mechanical Level. Access to this side of the building is limited due to the adjacent hillside. This is shown in Figure 32, looking from the north toward the south.

Figure 32: West Side Building Limited Access

A fire department access platform was added to this level and hose connections were added at four locations. An example of the exterior hose connections, along with the exterior walkway, is shown in Figure 33.


Figure 33: West Side Exterior Walkway and Hose Outlet

The piping for the standpipe system is mostly independent of the sprinkler system piping in the south end of the building; the supply for the standpipe system branches off of the main water supply at the riser. In the north end of the building, the standpipe system is plumbed directly off the sprinkler piping.

Inspection, Testing, and Maintenance

The requirements for Inspection, Testing, and Maintenance follow the same format as the design. The most restrictive components of the California and National versions of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, apply. In addition, at the time of commissioning several testing requirements from NFPA 13 were applied. This includes hydrostatic pressure testing of piping, flushing and flow testing the underground piping, and flow testing the standpipe.

On-going ITM is performed by LBNL employees who are qualified through National Institute for Certification in Engineering Technologies. The Fire Marshal, who serves as the Authority Having Jurisdiction both through DOE and California Office of the State Fire Marshal (OSFM) authority, oversees the ITM Program. Inspections, including testing and maintenance as appropriate, occur on a monthly basis. Three times per year the inspection includes the items required for a quarterly inspection and one time per year the inspection includes the items required for an annual inspection.

The monthly inspection includes checking that the control valve is locked in the open position, it is accessible, and it is free from damage and not leaking. The quarterly inspection includes checking the gauges, the fire department connection, and pressure-reducing valves. The annual inspection includes a visual inspection of the sprinklers, pipes, and fittings. At present the five year ITM is not performed. The main drain test is currently performed annually; the standard requires quarterly but drought concerns have limited our discharge or water.

Portable Fire Extinguishers

The building is equipped with UL Listed, multi-purpose portable fire extinguishers with typical ratings of 2A:10B:C and 3A:40B:C. Dry chemical and clean agent fire extinguishers are used. Clean agent fire extinguishers (HFC-236a) are located on the Computing Level and have been provided as required by NFPA 75 (2009), Section 8.3.1, to protect the electrical equipment. The diesel generator yard is equipped with a dedicated fire extinguisher. Travel distances are acceptable.

Special Hazard Extinguishing System

At the time of design, a special hazard extinguishing system was not specified for the computer racks on the Computing Level. Subsequent evaluation of the fire protection on the Computing Level has resulted in the consideration of adding a gaseous special hazard suppression system. Given the size of the space it is unclear if a total flooding gaseous system would be the best choice. A local application gaseous system that is designed and installed to protect each individual computer rack may be a better choice.

Fire Suppression Conclusion

The fire suppression system was designed and installed in compliance with the applicable codes and standards. Automatic sprinklers are required in this building per

Department of Energy Order. The sprinkler system design uses Ordinary Hazard Group II requirements. The Mechanical Level and both office floors are protected by a wet pipe system. The Computing Level is protected by a preaction system that is installed at the ceiling level and under the raised floor.

Three different areas were used in calculating the hydraulic demand for the system. While the hydraulic demand for the wet pipe sprinkler system that protects the generator enclosure appears to require more pressure than the water system can supply, it is expected that the actual flow can meet the demand provided the pressure reducing valves open. A fire pump is not necessary for this building.

Automatic, wet class I standpipes are installed at the north and south ends of the building, with additional hose outlets installed on the exterior of the Mechanical Level. Portable fire extinguishers, both dry chemical and clean agent, are provided throughout the building. At the time of design and construction, a special hazard fire suppression system was not considered for the Computing Level. While a special hazard system is not required, it would provide an additional level of protection.

Prescriptive Code Analysis Conclusion

Overall Wang Hall complies with the applicable codes and standards. The type of construction, height and area meet the limitations of the building code. Structural fire protection is provided where required. The building has a sufficient number of exits on each floor and those exits are appropriately located. The two stair doors on the First Floor are slightly undersized; however this is not expected to be an issue. Adequate exit signs and emergency lighting fixtures are provided.

The building does is equipped with a smoke control system that is initiated by an output from the fire alarm system. No smoke exhaust system is provided. The fire detection and alarm system is designed and installed in accordance with NFPA 72. The system has manual and automatic initiating devices and notification is accomplished via speaker/strobes. The system plays a pre-recorded message as well as alert tones. Through not set up, the system is capable of meeting mass notification requirements.

Fire suppression is provided throughout the building in the form of automatic sprinklers. Both wet-pipe and preaction systems are installed. The calculated demand for one design area exceeds the available water system supply based on the flow test. It is expected that in an actual fire event additional pressure would be available as pressure-reducing valves open. Standpipes for fire department use are provided on all floors. No special hazard suppression system is provided for the computing equipment on the Computing Level.

The single issue that presents perhaps the highest risk is the Central Stair. The Authority Having Jurisdiction agreed to allow for a newer edition of NFPA 101 to apply. This allowed for the existing conditions to meet the requirements of the escalator exception. Based on the history of actual fire incidents that comprise the California Building Code and the *Life Safety Code*, the design and construction of the building is assumed to provide a minimum level of fire and life safety. In the following sections the building will be analyzed based on the expected or modeled performance given the various fire and life safety features based on current design and installation.

Performance Based Analysis

Performance based design is a process that allows for the construction of a building that may not meet the letter of the applicable codes and standards but is shown to provide a level of protection that meets or exceeds the applicable codes and standards. First, the goals of the design are specified. Next the objectives and performance criteria are developed. Fire scenarios are constructed and tested. The results of these scenarios are compared to the performance criteria. If the criteria are met, the design is considered acceptable. This assumes that the goals and objectives are also met.

For the analysis of Wang Hall the primary goal is to allow sufficient time for building occupants to evacuate during a fire event in tenable conditions. Tenability is detailed in a later section. This goal of safe egress compares the required safe egress time (RSET) with the available safe egress time (ASET). The two times are calculated in the following sections using various models.

The RSET is described by Gwynne and Rosenbaum in the Society of Fire Protection Engineers (SFPE) Handbook as a combination of four time components. The first is the detection phase. The second is the notification phase. This third is the pre-evacuation phase. Finally the fourth is the evacuation phase. The combination of all four time components provides the amount of time that is required for all occupants of a building to exit.

The ASET is determined through performance based design. It is the total amount of time that is available for occupants to exit during which the environment of the building is considered safe. A safe environment is determined by considering a number of factors. This includes the ability of a given occupant to egress based on occupant characteristics, the actual time required to detect and notify the occupants, any pre-movement time, and finally the tenability of the space. The tenability may be broken into multiple factors, including visibility, temperature, radiant heat flux, and concentration of toxic gases. At some point during a fire event one or more of these factors will reach a level that will prevent an occupant from reaching an exit.

Occupant Characteristics

This building is used as a business occupancy. Two primary groups of occupants are expected. The first consists of people who work in the building on a regular basis. These people are expected to be familiar with the area where they normally work and also familiar with the LBNL Building Emergency Team (BET). The building is not set up to allow for sleeping; that said it is expected that employees will occupy the building at all hours of the day and night. The majority will be present during daytime hours. Those people in the building during the overnight hours are expected to be awake.

The second group consists of visitors. These people may be touring the building or may be present for a relatively short period of time while using the computing facilities. Some may be present for a few hours while others may be present during the day over the course of several weeks. These occupants are not expected to be familiar with the building and may require guidance during an emergency.

It is not expected that during normal use the building will host very young or very old people; these people may be present during tours or other special events as recently occurred during the building dedication. The building is expected to host people with physical disabilities. During normal operations, it is expected that very few people will occupy the Computing Level and the Mechanical Level. Most of the occupants will be located on the first and second floors. No regular occupancy of the roof is expected.

Proulx describes a total of six occupant characteristics in her chapter “Evacuation Time” in the SFPE Handbook. Three of these characteristics were not considered in the previous discussion. First is the responsibility of the occupant relative to the building. While the occupants are employees or users, the individual occupant is less likely to feel any level of responsibility. Second is the social affiliation characteristic. While most of the occupants will not be related by blood or marriage, the occupants do work together and share some level of social affiliation. Occupants may spend time looking for coworkers before beginning to evacuate. Finally, the third characteristic is commitment. The occupants will be engaged in their work and will not be quick to abandon it during an evacuation. All three factors will potentially add to the pre-movement time.

Pre-Movement & Movement Factors

As this building is a part of the Berkeley National Laboratory site, certain staff members will function as Building Emergency Team members. BET personnel are trained to provide for assistance during an emergency in evacuating all building occupants. Once outside, the BET personnel are responsible for conducting a head count and reporting any known personnel who are missing. Use of the BET allows for more timely evacuation and helps to limit the pre-movement time.

Occupants are expected to take time during the early stages of a building evacuation to secure their work and personal belongings. Work may be saved and computers shut down. Personal belongings may be gathered in anticipation that the evacuation may result in considerable time outside the building and the possibility that reentry may not be allowed for several hours or days. As such, work related materials may be gathered and moved out of the building during the evacuation. Provided the BET personnel are able to start motivating occupants to move toward the exit as soon as the alarm sounds, those occupants closest to the BET personnel will begin moving within one to two minutes. Those occupants located further away from where the BET personnel begin assisting with evacuation may not start moving for several minutes.

All LBNL employees receive basic fire safety and emergency training as a part of their initial training. Emergency guides are provided throughout all buildings. These guides outline the response to a variety of emergency situations. On-going public safety awareness if provided through outreach from the Fire Marshal's Office and the Emergency Management group. This includes annual fire evacuation drills.

Recently, during an actual fire event, the BET personnel began sweeping the affected building upon activation of the fire alarm. While the fire alarm may not be audible in all parts of the building, a total of four occupants were found in the building more than one hour after the fire started. All four remained in their offices and kept their doors locked. The BET personnel are not able to check rooms located behind locked doors. Personnel from the Fire Marshal's office were able to make access during a full search of the building. Given this experience it is possible that some people may choose to remain indefinitely in the building. No pre-movement time can be determined as there will not be any movement.

Evacuation Time: Hand Calculation

A first-order hand calculation is employed for this building following the information provided by Steven Gwynne and Eric Rosenbaum in the SFPE Handbook, Section 3 Chapter 13. The effective widths for the doors and stairs are summarized in Table 20. The boundary layer for both is six inches per side.

Table 20: Effective Width Calculations

Element	Clear Width [inches]	Boundary Layer [inches]	Effective Width [inches]
North, South Stair (#1,3)	70	12	58
Central Stair (#2)	49	12	37
Mechanical Level North Exit Door	45	12	33
Mechanical Level South Exit Door	38	12	26
Computing Level North Exit Door	46	12	34
Computing Level South Exit Door	34	12	22
Computing Level North Electrical Exit Door	46	12	34
Computing Level South Electrical Exit Door	44	12	32
First Floor North Stair Door	44	12	32
First Floor South Stair Door	44	12	32
First Floor North Exit Door	68	12	56
First Floor South Exit Door	68	12	56
Second Floor North Stair Door	44	12	32
Second Floor South Stair Door	44	12	32
Second Floor Lobby Door 4001	37	12	25
Roof Level Door 5003	32	12	20

The maximum specific flow through a door is 24 people per minute per foot of effective width. The maximum specific flow down a stair is 18.5 people per minute per foot of effective width for a 7/11 stair. The calculated flow considers the specific flow and the effective width. These calculated values are summarized in Table 21. It should be noted that the Central Stair serves as exit access for the Roof Level only.

Table 21: Calculated Specific Flow

Component	Specific Flow [people/min]	Effective Width [inches]	Calculated Flow [people/min]
North, South Stair (#1, 3)	18.6	58	89 each
Central Stair (#2)	18.6	37	57
Mechanical Level North Exit Door	24	33	66
Mechanical Level South Exit Door	24	26	52
Computing Level North Exit Door	24	34	68
Computing Level South Exit Door	24	22	44
Computing Level North Electrical Exit Door	24	34	68
Computing Level South Electrical Exit Door	24	32	64
First Floor North Stair Door	24	32	64
First Floor South Stair Door	24	32	64
First Floor North Exit Door	24	56	112
First Floor South Exit Door	24	56	112
Second Floor North Stair Door	24	32	64
Second Floor South Stair Door	24	32	64
Second Floor Lobby Door 4001	24	25	50
Roof Level Door 5003	24	20	40

The time to exit is the total population divided by the controlling element. It is assumed that: 1. All occupants are queued at the exit access door; 2. All occupants understand the fire alarm signal and will begin to move as soon as the signal is received; 3. The density is such that travel velocity is maximized; and 4. Occupants on a floor will split evenly between all available exits.

Egress from the Roof Level passes through Roof Level Door 5003, down the Central Stair, to the Second Floor lobby, through Second Floor Door 4001, across the Second Floor to the Second Floor North Stair Door, and out via the Second Floor North Exit Door. On the Second Floor occupants in the north area pass through the Second Floor North Stair Door, and travel down Stair 1 to exit through the First Floor North Exit Door. Occupants in the south area pass through the Second Floor South Stair Door, and travel down Stair 3 to exit through the South Stair Exit Door. Egress on the First Floor utilizes the North and South First Floor Stair Doors to exit through the North and South First Floor Exit Doors.

On the Computing Level occupants in the north area exit through the Computing Level North Exit Door or pass through to the south area and exit through the Computing Level South Exit Door. Likewise occupants in the south computing area exit through the Computing Level South Exit Door or pass through to the north area to exit through the

Computing Level North Exit Door. The north electrical room exits through the Computing Level North Electrical Exit Door or through both electrical rooms to exit through the Computing Level South Electrical Exit Door. The south electrical room has the same set up in reverse. The Mechanical Level exits through the Mechanical Level South Exit Door in the south half. In the north half the available exit is the Mechanical Level North Exit Door.

The time to exit is determined by the total population that uses the means of egress divided by the specific flow. For each path, the specific flow is regulated by the controlling element, either a door or stair. On the Mechanical level, only doors are used for the means of egress. On the other floors, doors and stairs are part of the means of egress.

On the Mechanical Level, the calculated occupant load is either 320 people or 106 people, depending on whether NFPA 101 or California Building Code is considered. Given two available exits, the population is assumed to split evenly between the doors. Each door will accommodate either 160 or 53 people. An example calculation is shown in the following equation, Equation 4. This is the calculated occupant load passing through the Mechanical Level North Exit Door, based on NFPA 101.

$$t = \frac{population}{F_C} = \frac{160}{66} = 2.4\ minutes$$

Equation 4: Time to Exit

The summary of calculated time to exit for the floors is shown in Table 22. The occupants on the Computing Level in the office area are assumed to exit through the ground level door rather than ascend Stair 2. In many cases the controlling element is the stair entry door. The calculated times do not reflect the time required to travel down the stair to the exit or the time required to travel across the stair lobby to the exit.

Table 22: Time to Exit

Floor	Controlling Element	Population (Original Design)	Time to Exit [min]
Mechanical Level	North Door	41	0.62
Mechanical Level	South Door	40	0.77
Computing North Electrical	North Electrical Door	15	0.22
Computing South Electrical	South Electrical Door	15	0.23
Computing North	North Computing Door	59	0.87
Computing South	South Computing Door	59	1.34
First North	North Stair Door	230	3.59
First South	South Stair Door	230	3.59
Second North	North Stair Door	224	3.50
Second South	South Stair Door	224	3.50
Roof	Mechanical Room Door	4	0.10

Evacuation Time: Computer Model

The Pathfinder© evacuation model was used to calculate the time to evacuate the building. The calculated occupant load using NFPA 101 factors was used as this represents a worst-case scenario. All available means of egress were utilized. The simulated occupants moved following the Pathfinder closest exit programming. No changes were made to the programming and no pre-movement time was used. All occupants are able-bodied. A representation of the building and occupants at the beginning of the evacuation as calculated by Pathfinder is depicted in Figure 34.

For this occupant load, the calculated time to exit is 5 minutes 32 seconds. This assumes that all exits are available. Further it assumes that all occupants begin to move as soon as the fire alarm sounds, thus reducing the pre-movement time to nearly zero. In reality the pre-movement time will vary. In addition, the amount of time required to activate the fire alarm system will vary depending on the type and location of a fire within the building. As such, a safety factor of 1.5 is used. This provides a time to exit of 8 minutes 13 seconds.

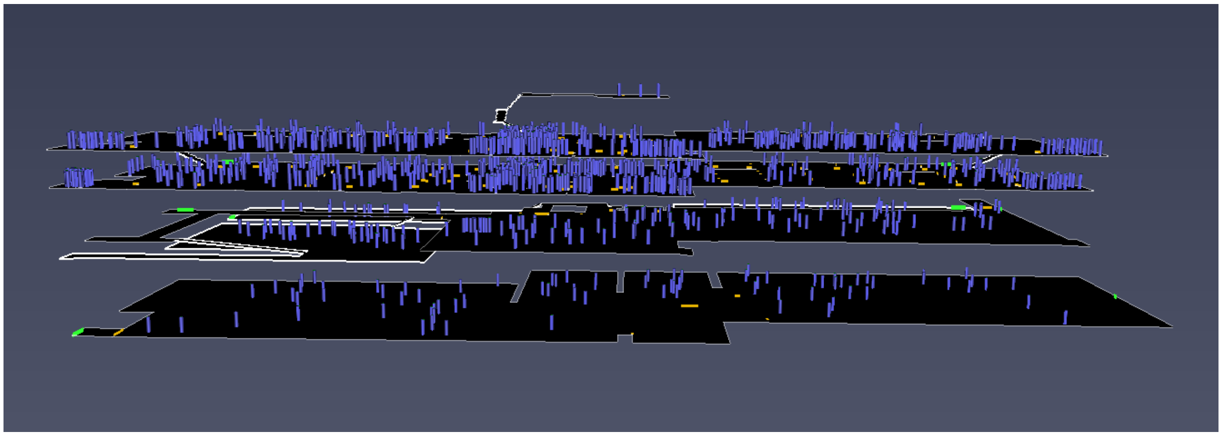


Figure 34: Pathfinder Model Screenshot

A second simulation in Pathfinder modeled egress in the building assuming that one of the two exits on the First Floor was blocked. This corresponds to the design fire. The egress time was calculated as 7 minutes 18 seconds. With a safety factor of 1.5, the total egress time is calculated as approximately 11 minutes. The south stairway and the stairway door on the First Floor have a fire resistance rating; it is assumed that the stairway remains available for occupant use. Occupants on the Second Floor are able to exit via this stair.

Tenability

A total of four criteria are considered for tenability in this building. The first is the level of carbon monoxide; the second is the visibility; the third is the temperature; and the fourth is the radiant heat flux. If the level of carbon monoxide is maintained below a set value, the amount of time available for egress prior to incapacitation remains greater. That coupled with a high level of visibility, that is a relatively low obscuration from smoke, will provide the greatest amount of time for egress during a fire event. In addition, maintaining the temperature and radiant heat flux below a certain value will allow for safe passage.

The carbon monoxide level should remain below 1,000 parts per million. If the occupants are assumed to have a level of activity equivalent to “light work”, the volume of air breathed each minute, V [l/min], will have a value of 25 and the exposure dose for incapacitation from carbon monoxide, D [% COHb], will have a value of 30. Incapacitation occurs when the fraction of CO reaches a value of 1. Equation 5 is used to calculate the fractional dose.

$$F_{I_{CO}} = \frac{3.317 \times 10^{-5} (CO)^{1.036} V t}{D}$$

Equation 5: Fractional Incapacitating Dose for CO

By rearranging this equation, as shown in Equation 6, and using the performance criteria of 1,000 ppm CO, the time to incapacitation is 28.2 minutes.

$$t = \frac{D \times F_{I_{CO}}}{3.317 \times 10^{-5}(CO)^{1.036}V} = \frac{30 \times 1}{3.317 \times 10^{-5}(1000)^{1.036} \times 25} = 28.2\ minutes$$

Equation 6: Reversed Fractional Incapacitating Dose for CO

If the allowable concentration of carbon monoxide is doubled, the available time decreases to slightly less than one-half of the time. If the allowable concentration is divided by one-half, the available time increases to slightly more than double. While most of the occupants will be mobile and able to self-rescue, there is a possibility that some occupants will require more time.

The visibility should be maintained at approximately 10 meters. Turn back behavior is reported to become more prevalent when visibility drops below 10 meters (SFPE Handbook Table 3-11.29). While exit signs may not be visible, a path will be visible. Other cues may provide assistance, such as other occupants moving as a crowd. By preventing turn back behavior, there is a higher probability that all occupants will make their way to the exit and leave the building before the conditions prevent escape.

The ambient temperature in the space below the upper layer should be maintained at or below 60^{O}C. This is a valid criteria provided the upper layer remains at or above 1.83 meters. If the upper layer descends below 1.83 meters, then the visibility criteria will be lost. Once the visibility is lost, the temperature becomes a lower priority as the occupants will be unlikely to move toward the exit.

The final tenability criteria are the radiant heat flux from the upper layer. This should be maintained at or below 2.5 kilowatts per square meter. If the heat flux exceeds this value the occupants will be subject to heat sufficient to cause burns. It is expected that a radiant heat flux greater than the criteria will be accompanied by a temperature that exceeds the criteria. In either case occupants will not be able to egress.

Performance Objectives: Life Safety Code

Section 5.2 of NFPA 101 requires that a design meet the objectives of Section 4.2. Section 4.2 requires that occupants who are not intimate with the initial fire development be protected for the time required to evacuate, relocate, or defend in place. The structural integrity must be maintained and the systems required for egress must remain operational for the time required for egress. Section 5.2.2 specifies that any occupant not intimate with the ignition, as previously stated in Section 4.2, will not be exposed to instantaneous or cumulative untenable conditions. During the time spent exiting the building an occupant should not encounter a part of the means of egress that is unusable due to fire or smoke. In addition, an occupant should not be subjected to conditions during evacuation that deteriorate to a point that the occupant may become incapacitated.

The Annex for Section 5.2.2 provides a total of four methods for evaluating the threat to occupants during evacuation. These are identified as Method 1, Method 2, Method 3, and Method 4. Each method requires the designer evaluate the level of hazard that an occupant will encounter during evacuation.

Method 1 references the *SFPE Engineering Guide to Performance-Based Fire Protection* and requires that detailed performance criteria be established for tenability. Method 2 considers the time to evacuate a room or area and requires that this time be less than the time for the smoke layer in this room or area to descend below 6 feet above the floor. Method 3 is a modified version of Method 2 and requires that the smoke layer not descend lower than 6 feet above the floor in any occupied room. Finally Method 4 requires that the fire effects will not reach any occupied room.

This building does not have a smoke control system. As such, it would be difficult to use Method 3 as the smoke will eventually fill the floor and perhaps the building during a fire event. Without a smoke control system, it is possible to show that the smoke layer will remain above 6 feet during the evacuation time. On the Computing Level the ceiling is approximately 20 feet above the floor. This is not the case on the first and second floors. It is assumed that the sprinkler system will contain the fire and may limit smoke production. Depending on the fire scenarios considered, this method may be acceptable, provided the calculated time for evacuation is solid.

Method 4 is not feasible as the building is not constructed with full compartmentation. A fire on any floor will produce smoke that will travel to other parts of the floor and perhaps to other floors. If a fire started in a normally unoccupied area such as an electrical room, then this method may work. For a fire that starts on the first or second floor, most of the areas are expected to be occupied.

The most likely method for use in a building like this is Method 1. Tenability criteria would need to be established through a survey of the combustibles contained in the building. By considering the possible fire scenarios, the amount of time available for egress is established. Provided these times are greater than the required egress time, the performance criteria would be met. This is perhaps the most difficult method as there are many variables and some of the variables do not have data available for examination. It is possible to combine aspects of Method 1 and Method 2 to show that the tenability criteria are met even though smoke is produced. By limiting exposure to the smoke, the occupants will be better able to exit while remaining within the established tenability criteria. Further, more time may be available as the area may begin to fill with the products of combustion but the environment will not be particularly unsafe.

DETACT Model

The Detector Activation (DETACT) Model developed by the National Institute of Standards and Technology (NIST) uses information about a specified fire and detector characteristics to estimate the time to activation of the detector. This program was used to estimate the time to activation for a sprinkler located on the First Floor that responds to a fire involving furniture; this is the first of two design fires described in the following section.

The sprinkler modeled is a quick response sprinkler with a RTI of 50 $(m\text{-}s)^{1/2}$ and an activation temperature of 68.3^{O}C. The height of the ceiling is 3.81 meters and the sprinkler has a maximum radial distance of 2.4 meters. The fire is modeled as a t-squared fire with a fast fire growth coefficient. The model provides the heat release rate (HRR) of the fire, the temperature of the ceiling jet over time and the temperature of the detector over time. In this case the detector is a sprinkler. The input and output values are shown in Appendix 8.

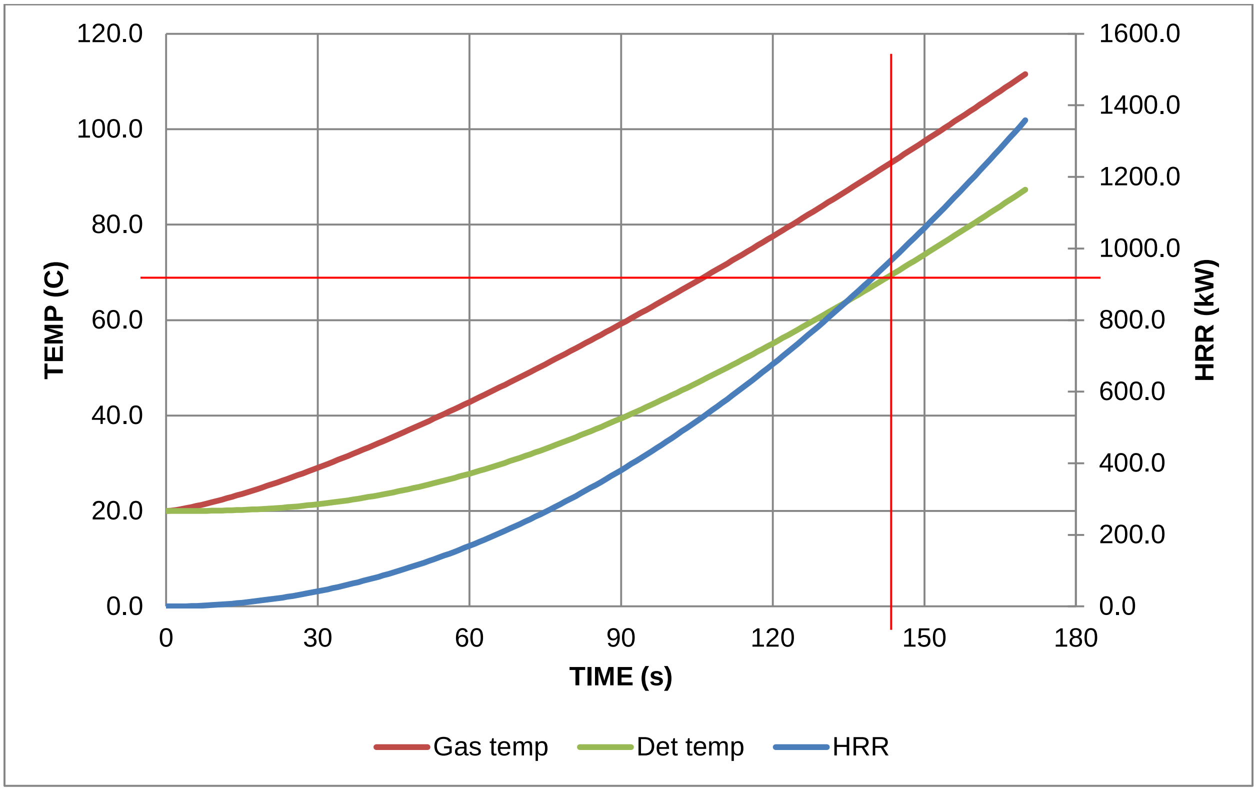


Figure 35: DETACT Office Level Sprinkler Activation

Based on the specified fire and the sprinkler characteristics, the sprinkler activates approximately 142 seconds after the fire starts, as shown in Figure 35. This corresponds to a sprinkler temperature of 68.5^{O}C. The heat release rate of the fire is approximately 950 kilowatts. The ceiling jet temperature is approximately 92^{O}C. A shorter time to activation would be expected if the sprinkler was located closer to the fire plume. Given that the furniture used in this fire scenario could be located up to the maximum radial distance from the sprinkler, this model is acceptable.

Design Fires

Chapter 5 of NFPA 101 details a total of eight design fires that must be considered when evaluating a building using a performance-based approach. A summary of each of the design fires in presented in Table 23.

Table 23: NFPA 101 Design Fire Scenarios

Design Fire	Characteristics of Design Fire
1	A typical fire for the occupancy
2	An ultra-fast developing fire in the primary means of egress
3	Fire starts in a normally unoccupied room
4	Fire starts in a concealed space
5	A slowly developing fire that is shielded from the fire protection system
6	Most severe fire burning the largest possible fuel load
7	Outside exposure fire
8	Fire in a room where the fire protection system is not operational

One specific design fire was selected for this evaluation. It most nearly addresses NFPA 101 Design Fire 2, although it is not an ultra-fast developing fire. A second simulation of this design fire scenario also addresses Design Fire 8, with the sprinkler system rendered inoperable. The other NFPA 101 design fires are not specifically addressed in this evaluation.

Modeled Design Fire

The design fire models a fire on the First Floor that blocks one of the two exits. The fire burns a chair located next to the south exit. The layout of the furniture in the area is shown in Figure 36. One chair located against the wall is burned in the model. The chair is simulated as polyurethane foam. The fabric covering is not considered in the model. The foam is expected to be the dominant combustible material.

Figure 36: First Floor South Furniture Layout

The specific sequence of ignition is not considered in the model. It is assumed that a fire begins on the chair. In the FDS model the chair has a seat, two sides and a back. The fire is modeled through the use of a burner placed on the seat. The chair is considered to be made using polyurethane foam. The fabric covering is ignored for the purpose of the model. The thermal properties of the polyurethane foam are summarized in Table 24. Values shown are from Drysdale.

Table 24: Polyurethane Foam Characteristics

Heat of Combustion	24.4 kJ/g
Heat Capacity (c_p)	1.4 kJ/kg-K
Density (ρ)	20 kg/m^3
Thermal Conductivity (k)	0.034 W/m-K
Heat of Reaction	1,960 KJ/kg
CO Yield	0.03 g/g
Soot Yield	0.23 g/g

The furniture located near the First Floor south exit meets the requirements of Technical Bulletin 117 from the California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation (2013 Edition). The actual identification tag is shown in Figure 37. As this chair does not meet the more restrictive TB 133, the heat release rate is not limited to 80 kilowatts.

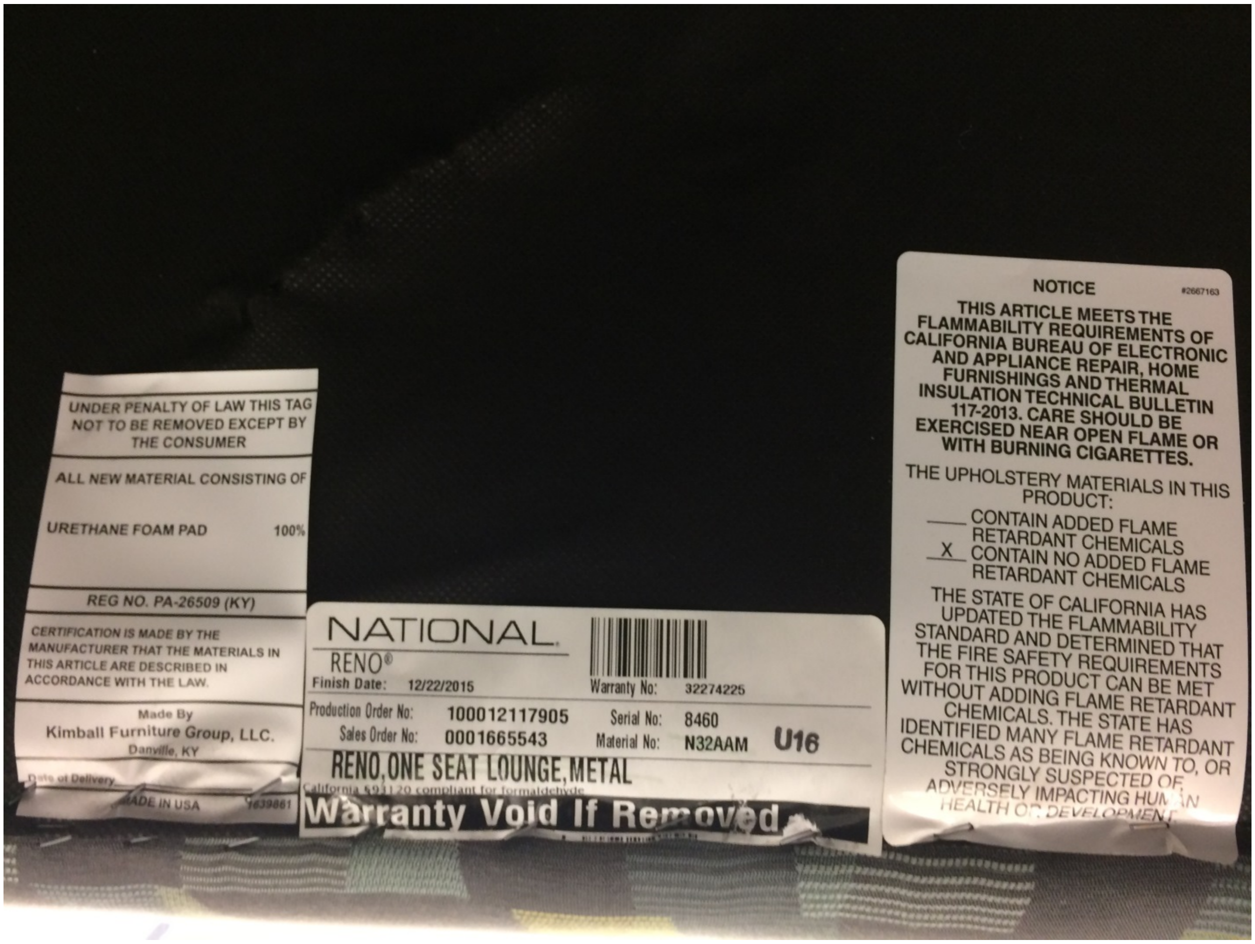


Figure 37: First Floor South Furniture Label

Fire Dynamics Simulator Model

The Fire Dynamics Simulator (FDS) is a computer modeling program developed by the National Institute of Standards and Technology. It is a computational fluid dynamics model. The input requires a description of the computation domain, a specified fire, and the specified output values. Both design fires are modeled using FDS. The input for both is discussed followed by an analysis of the output.

FDS Heat Release Rate Curve

For the design fire, the fire is modeled as a single chair using polyurethane foam as the fuel. The input file is included in Appendix 2. The heat release rate curve is modeled following information from the SFPE Handbook. Figure 38 shows the heat release rate curve as reported by Babrauskas. This curve was used to create the input curve in FDS. The maximum heat release rate is 2,000 kW.

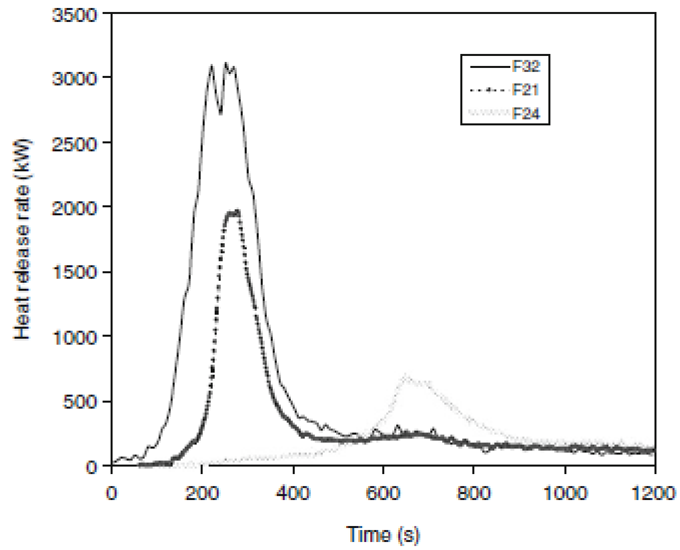


Figure 38: SFPE Heat Release Rate Curve for Upholstered Furniture

The actual heat release rate curve for the design fire is shown in Figure 39. This is based on the output from the FDS simulation. The simulation ran for a total of 700 seconds. The initial peak represents the time just before the sprinkler activated. It is not clear why there are two other significant peaks after sprinkler activation.

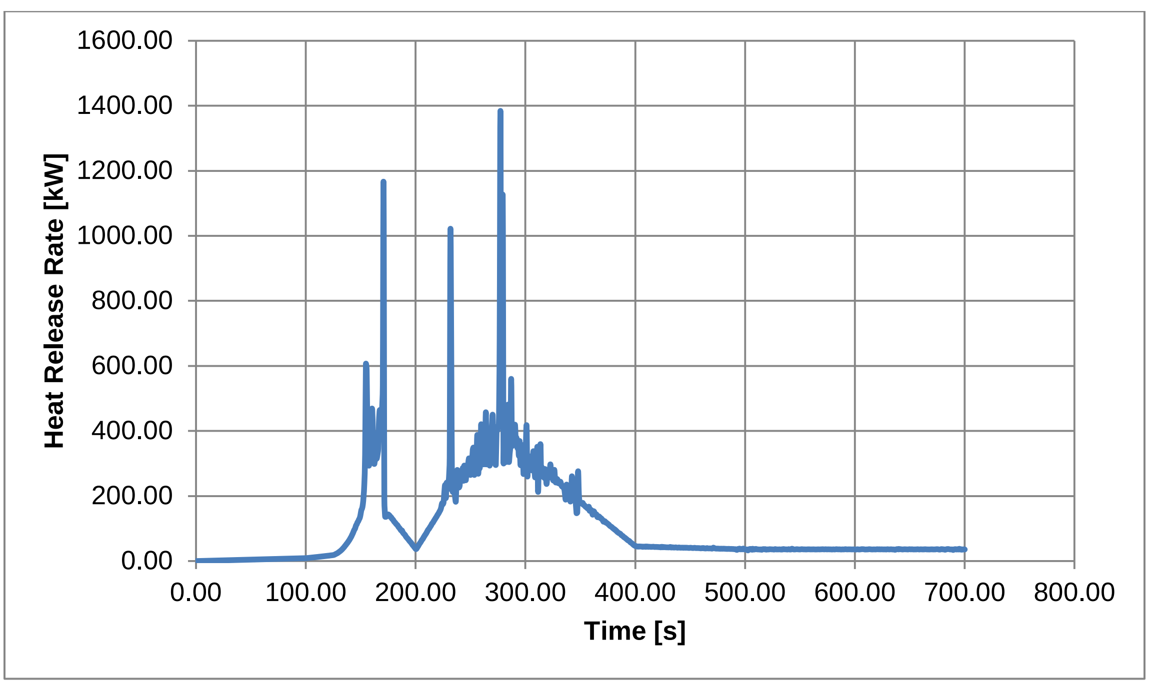


Figure 39: FDS Heat Release Rate Curve

A second chair is located direct adjacent to the chair that burns in the simulation. A device was added in FDS to measure the radiant heat flux on the adjacent chair throughout the simulation. The maximum heat flux measured on the adjacent chair is approximately 1.1 kW/m^2. Given a critical heat flux of approximately 18 kW/m^2, it is unlikely that the adjacent chair would ignite (Tewarson). The heat flux values are shown in Figure 40.

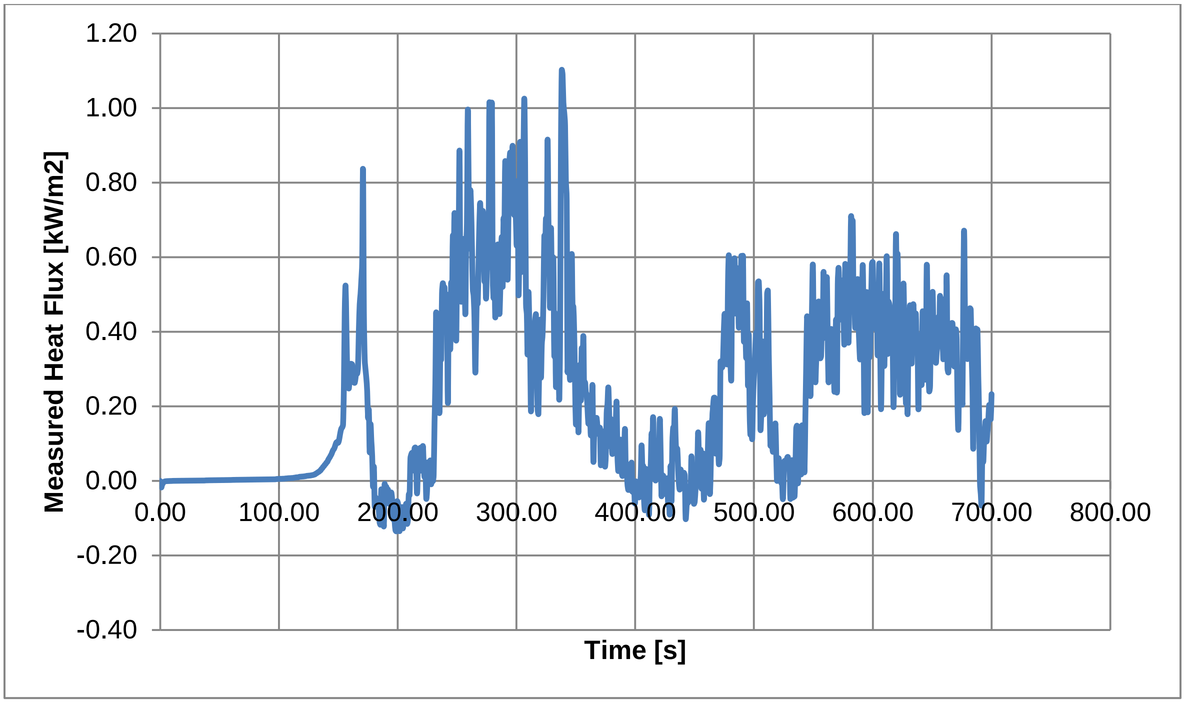


Figure 40: FDS Calculated Radiant Heat Flux on Adjacent Chair

FDS Mesh

Within the FDS model is a grid (also known as a mesh) that represents discrete three-dimensional cubes within the computational domain. The relationship between the size of the grid and the overall size of the computational domain will determine the relative level of accuracy of the output. This relationship can be calculated through the use of Equation 7. The characteristic fire diameter is identified as D*. The total heat release rate of the fire, $\dot{Q}$, is divided by the density of air, ρ, multiplied by the specific heat of air, c_p, the temperature of ambient air, T_∞, and the square root of gravity, g.

$$D^* = \left(\frac{\dot{Q}}{\rho_\infty c_p T_\infty \sqrt{g}}\right)^{\frac{2}{5}}$$

Equation 7: Characteristic Fire Diameter Calculation

The value of D* is divided by the size of the grid cell, dx. To be considered an acceptable grid size, the value of D* divided by dx should be between 4 and 16. For this design fire, the heat release rate is specified as 2,000 kW. The other values are considered constant. The calculation of D* is shown below in Equation 8.

$$D^* = \left(\frac{2{,}000kW}{1.2\frac{kg}{m^3} \times 1.005\frac{J}{kg \cdot K} \times 293K \times \sqrt{9.81\frac{m}{s^2}}} \right)^{\frac{2}{5}} = 1.267$$

Equation 8: Calculation of Characteristic Fire Diameter

A ratio of D*/dx with a value of four, for the given value of D*, would provide a grid size of 0.317 meters. For a ratio of D*/dx with a value of 16, the grid size would be 0.079 meters. For this design fire scenario, the grid size is 0.304 meters, which provides a value of D*/dx of 4.16. This value does fall within the acceptable range but the grid is very coarse. More accurate results would be expected with a smaller grid size.

FDS Geometry

The First Floor is modeled as a large rectangle, with an area that is outside the building on the northeast and southwest sides. The floor/ceiling assemblies are constructed using concrete. The floor is shown in gray. The exterior walls are constructed using gypsum boards over the framing members. Interior offices are modeled as obstructions and are shown in light green. These offices are effectively excluded from the model. The chair that is used to simulate the fire is located in the upper right, as shown in Figure 41, and is purple.

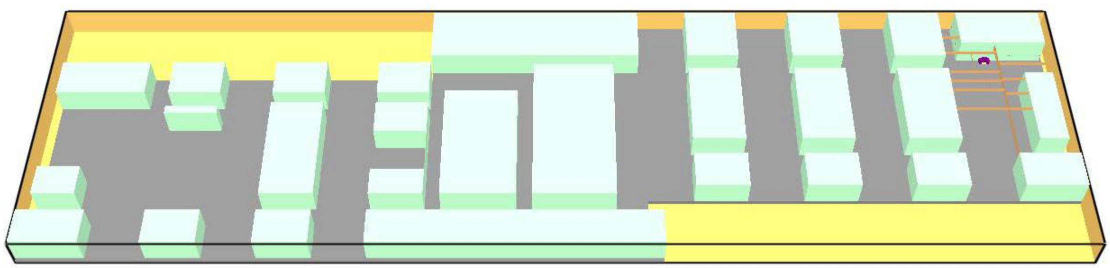


Figure 41: First Floor FDS Model Geometry

FDS Results & Analysis

The fire sprinkler used in the FDS simulation has an activation temperature of 68.3^{O}C. Output from the FDS simulation shows that the sprinkler activates at approximately 165 seconds. This is a slightly longer time than the DETACT model. At this time, the heat release rate is approximately 352 kilowatts. The heat release rate continues to increase to a maximum of 1,160 kilowatts at approximately 171 seconds. From this point on the heat release rate decreases considerably as the sprinkler is able to contain the fire.

A total of 17 individual sprinklers located on the First Floor near the design fire were included in the model. These are numbered from one to 17 and are shown in Figure 42. The design fire is located such that Sprinkler Number 7 is the only sprinkler that activates. Given the beam pockets created by the ceiling-level beams, it would be expected that a fire controlled by the sprinkler system would not generate sufficient heat to cause activation of sprinklers in other beam pockets.

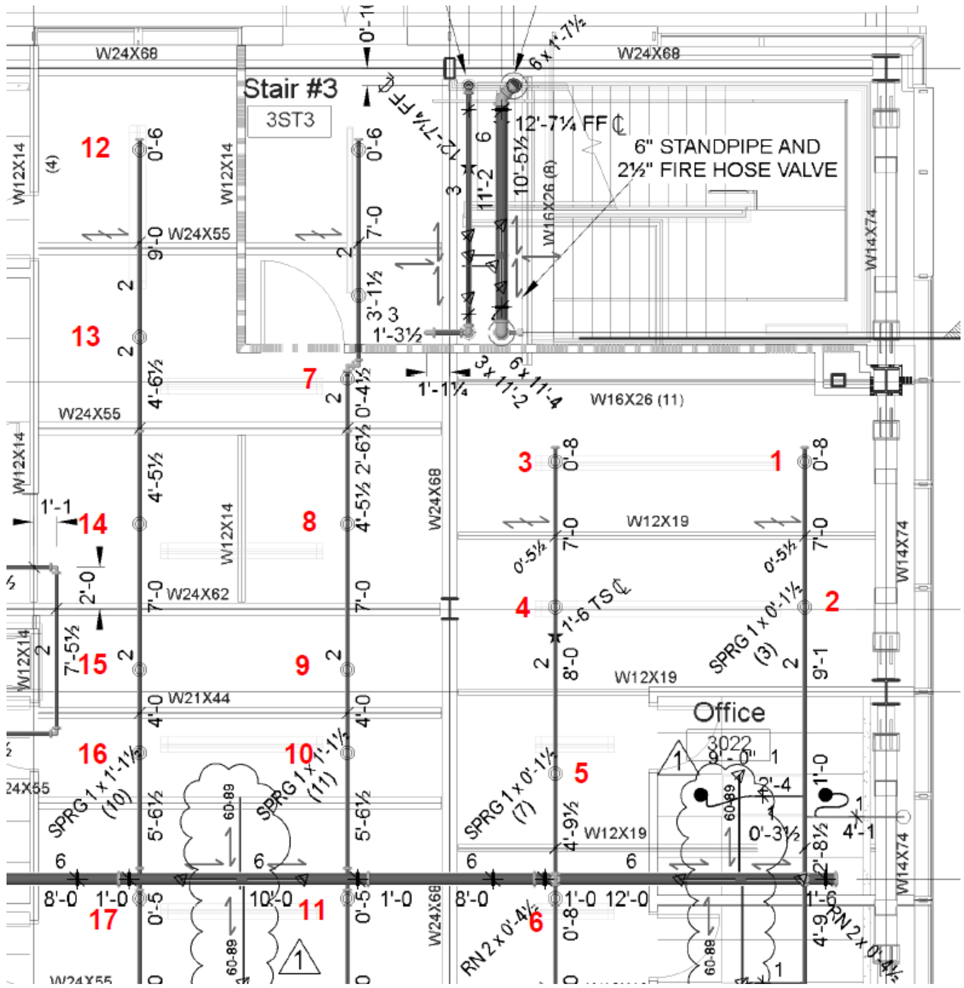


Figure 42: Design Fire Area Sprinklers

The ceiling-level temperature, as reported by the FDS output, is summarized in Figure 43 for each of the 17 sprinklers. As Sprinkler Number 13 is located within the same beam pocket as Sprinkler Number 7, the ceiling-level temperature does increase when compared to other sprinklers included in the model. In addition, Sprinklers Number 3 and 8 experience an increased ceiling-level temperature. For all three of these sprinklers the temperature is not sufficient to activate the sprinklers.

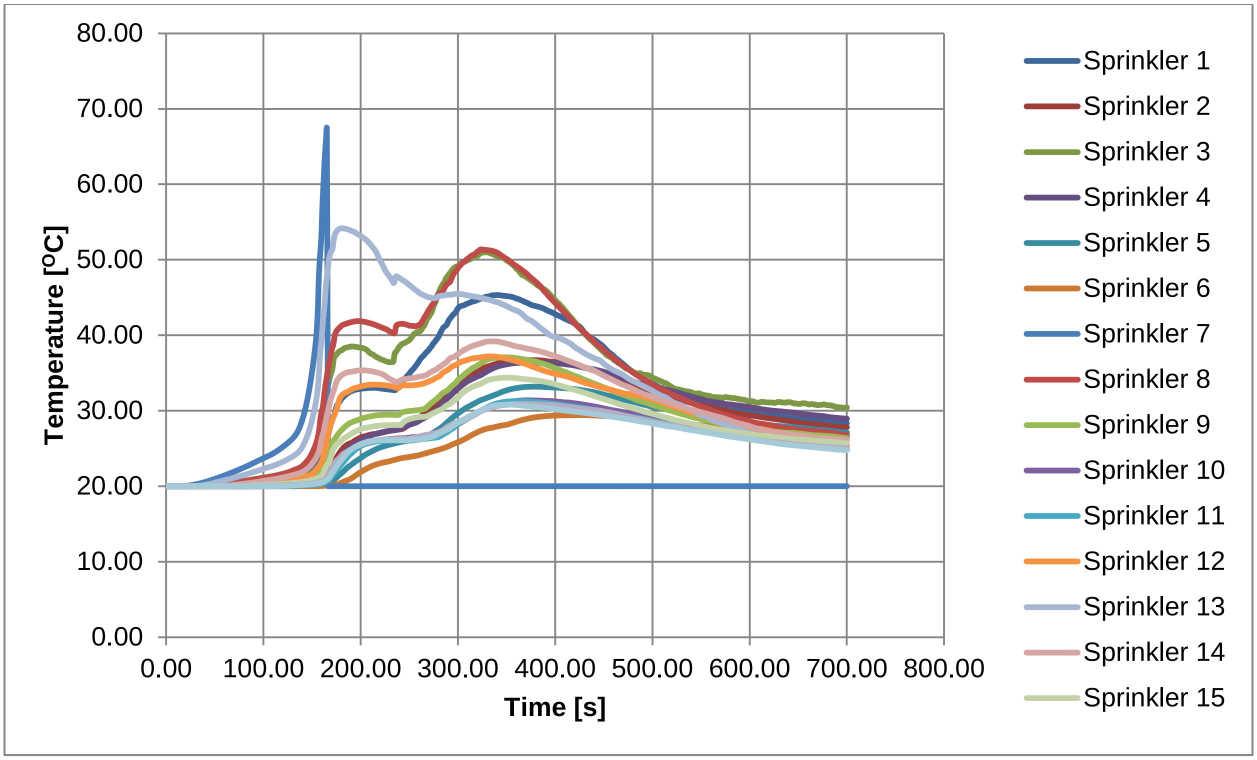


Figure 43: FDS Sprinkler Temperatures

The available safe egress time is expected to be nearly unlimited on the Mechanical Level and the Computing Level for a fire on the First Floor. Provided the fire doors and the smoke doors remain closed, it is expected that the occupants on the Second Floor and Roof Level will also have an available safe egress time that greatly exceeds the required safe egress time. If the door at the south stair on the First Floor is opened, it is possible that the south stair will become unusable. In this scenario, the Second Floor will remain tenable provided the stair door on the Second Floor remains closed. The occupants would need to exit via the north stair. The modeled evacuation time given the south stair is blocked on both the First and Second Floor is 10 minutes, 20 seconds.

It is important to note that the movement of the occupants will not begin until the fire alarm is activated, at least for areas of the building not in the immediate vicinity of the fire. Given a delay time of approximately 60 seconds for the sprinkler waterflow switch, it is possible that the pre-movement time will add approximately 225 seconds to the total evacuation time. For this design fire the movement time is approximately 438 seconds. The total evacuation time, assuming that most of the occupants do not begin movement until after the fire alarm activates, is approximately 663 seconds (given the south exit is blocked on the First Floor). This is the same amount of time identified as the RSET given the safety factor of 1.5.

Occupants in the immediate vicinity of the fire will begin to move shortly after the fire is identified. Staff at LBNL are trained to follow four basic steps when confronted with a fire. First, they are taught to leave the building. During the initial movement they are taught to alert others in their immediate vicinity to the presence of a fire. This is the second step. The third step is to activate the building fire alarm through the use of a manual fire alarm box. The final step is to dial 911 once they are outside the building.

Provided these steps are followed, the occupants of the building not in the immediate vicinity of the fire should be alerted much sooner when compared to fire alarm activation via the sprinkler waterflow switch. The BET members receive additional training in the event of a fire or other emergency and will confirm the fire alarm is activated as soon as possible, while they are assisting with the evacuation.

For comparison purposes, a second simulation in FDS modeled a fire without any fire suppression. The conditions at the First Floor North Stair Door remain tenable throughout the 700 second simulation. The same cannot be said for the remainder of the First Floor. At 700 seconds the visibility is well below 10 meters, as is shown in Figure 44.

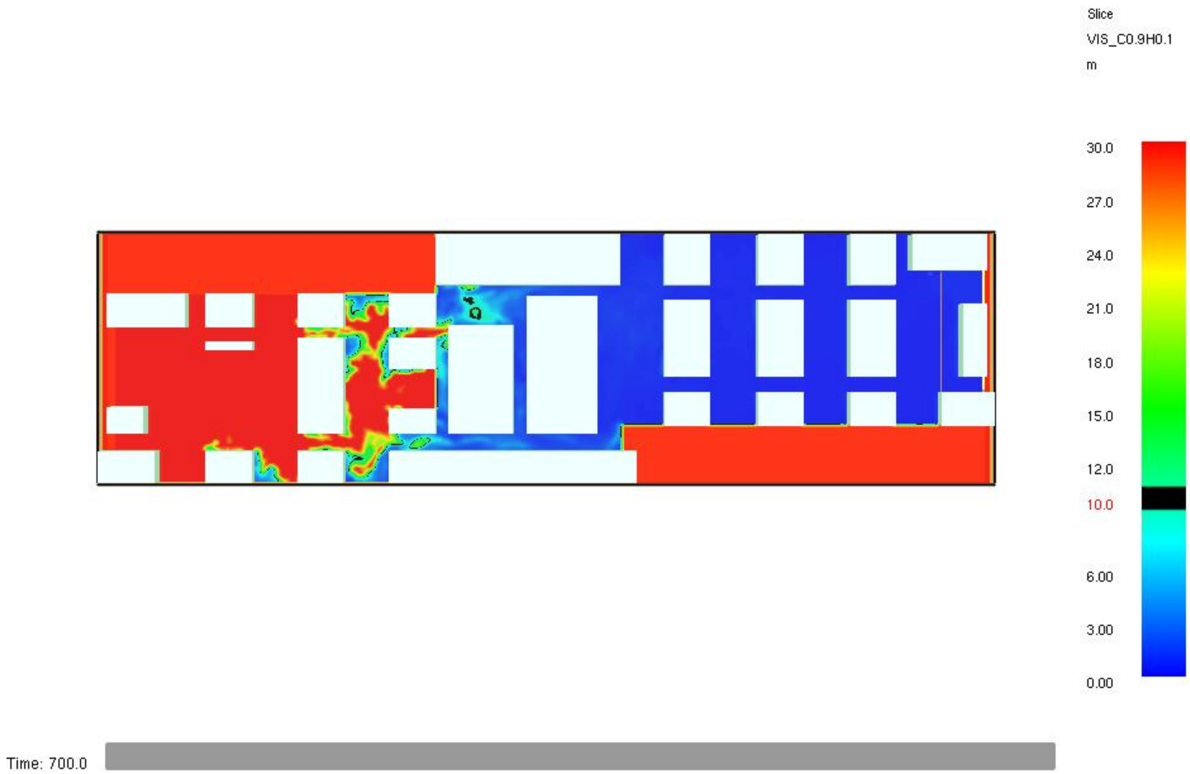


Figure 44: Visibility at 700 Seconds, Unsuppressed Fire

The visibility was calculated in the FDS model and specific values were output at three locations on the First Floor: near the south stair door, near the central lobby, and near the north stair door. The visibility, measured at 1.83 meters above the floor, remains at or above 30 meters throughout the simulation near the north stair door and the central lobby. Near the south stair door, the visibility drops below 10 meters for a brief period at approximately 160 seconds and then returns to 30 meters. The visibility drops below 10 meters, and remains below 10 meters, at approximately 237 seconds. This is shown in Figure 45.

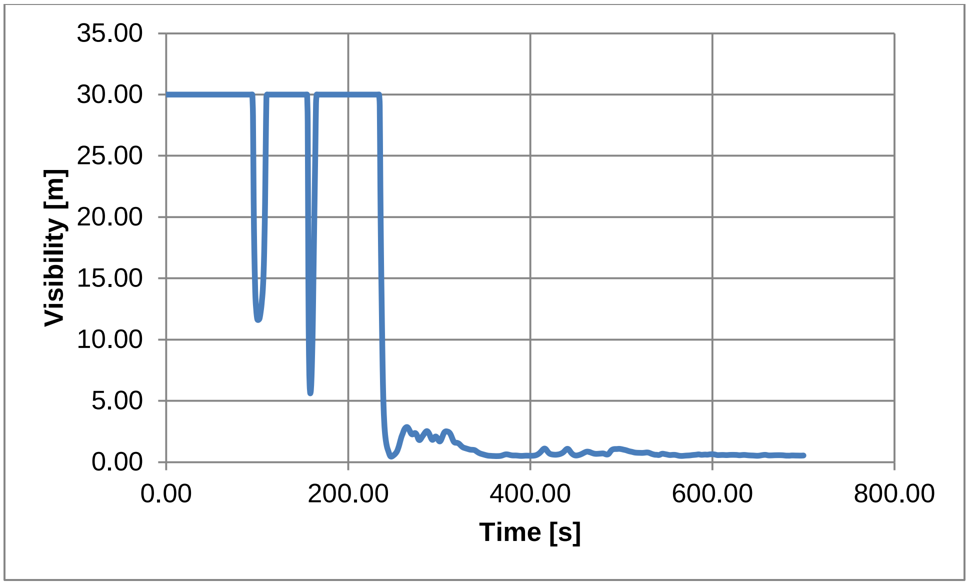


Figure 45: FDS Visibility Near the South First Floor Exit at 1.83 m

The temperature was calculated in the FDS model at the three locations previously mentioned. This temperature was calculated at five different heights above the floor: 0.5 meter, 1.0 meter, 1.5 meter, 2.0 meter, and 2.5 meter. For both the north stair door and the central lobby, the temperature at the highest location, 2.5 meters, increases to a maximum value of approximately 20.5^{O}C. Near the south stair door, the temperature reaches a maximum of approximately 40^{O}C at the 2.5 meter level. At lower elevations, the temperature remains below 30^{O}C, as shown in Figure 46.

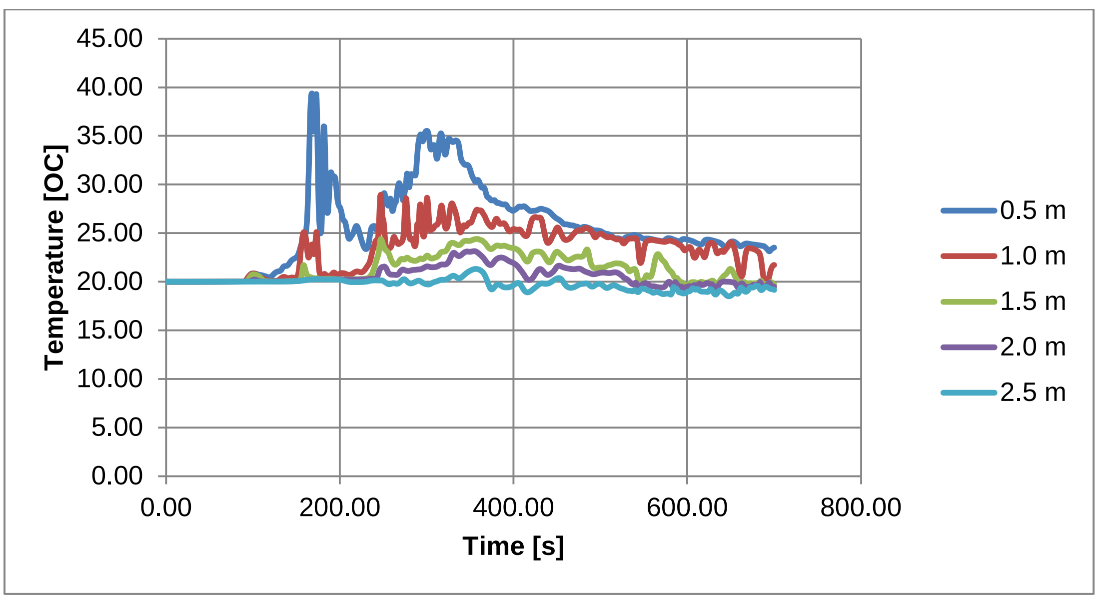


Figure 46: FDS Temperature Near South Stair Door

Based on the Pathfinder model, the occupants on the First Floor require approximately 60 seconds to move from the south half of the floor to the north half of the floor. While there is not a horizontal exit on the First Floor, the FDS model shows that the tenability criteria are met from the north half of the floor throughout the simulation. Provided occupants located in the south half of the floor begin moving as soon as the fire begins, the tenability criteria are met.

Given the possibility of movement that is dependent on the activation of the fire alarm, occupants in the south half of the First Floor may not being to move until approximately 225 seconds after the ignition of the fire. At this time, there will be some areas in the southern portion of the building where the visibility criteria are not met. This is pictured in Figure 47. It is possible that occupants in this area may not be able to safely exit the building given the conditions.

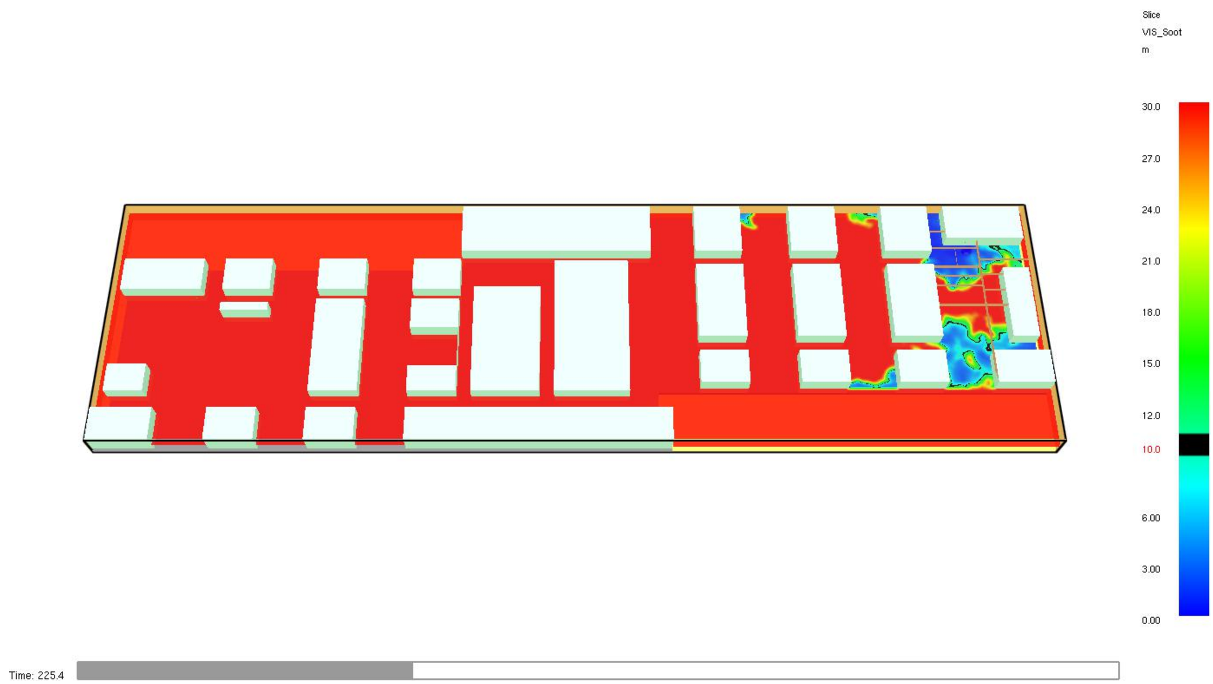


Figure 47: FDS Visibility at 225 Seconds

The fire that was modeled in the unsuppressed scenario was contained to the single chair. This is the same as the suppressed design fire. The radiant heat flux on the chair adjacent to the chair that burns was measured. The values are shown in Figure 48. Given a critical heat flux of approximately 18 kW/m^2, it is expected that the fire would spread to the adjacent chair. This would result in a higher heat release rate and generation of more products of combustion. In turn, this could cause the conditions to become untenable more quickly.

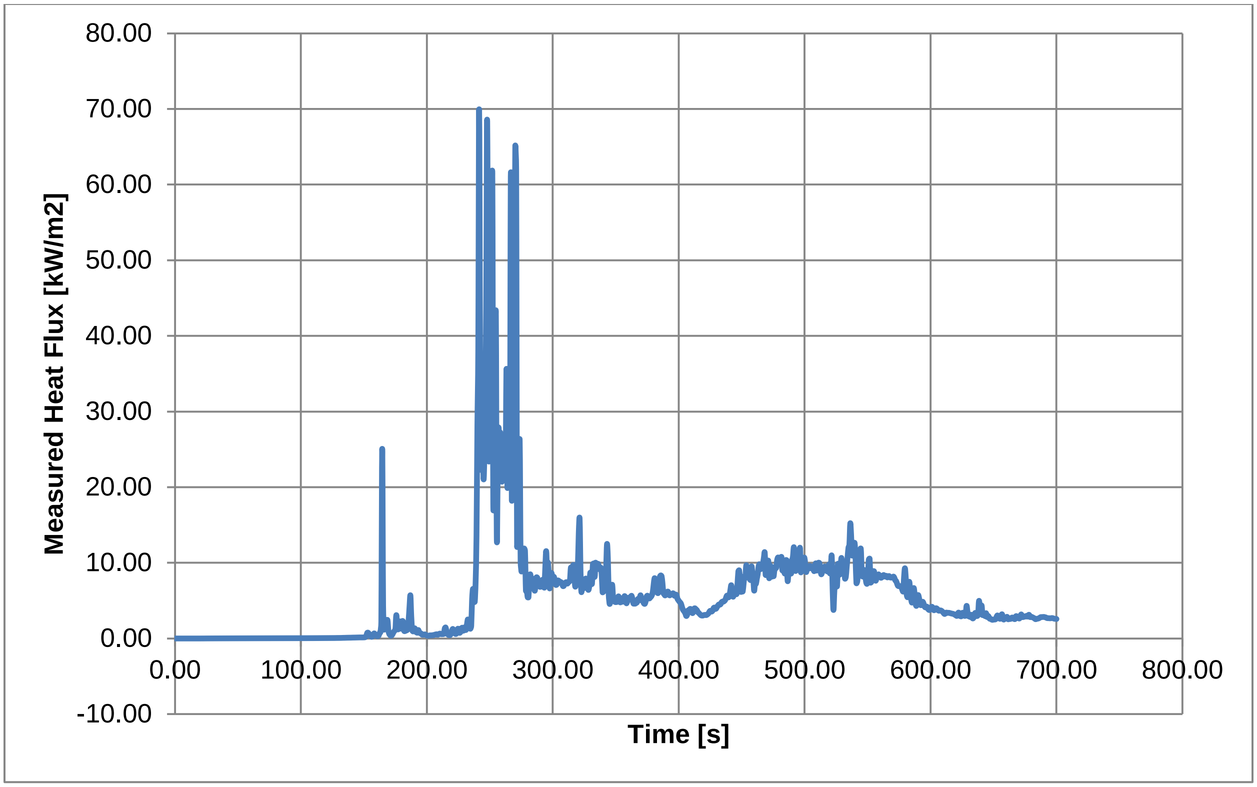


Figure 48: Unsuppressed Fire Radiant Heat Flux to Adjacent Chair

The level of carbon monoxide on the First Floor, as calculated by FDS, remains well below the tenability limit of 1,000 ppm for the duration of the fire model. No carbon monoxide was measured in the simulation near the north stair door or in the lobby area. Measureable amounts are identified in the immediate vicinity of the fire, and reach a peak well below 1,000 ppm just prior to operation of the sprinkler. This is shown in Figure 49.

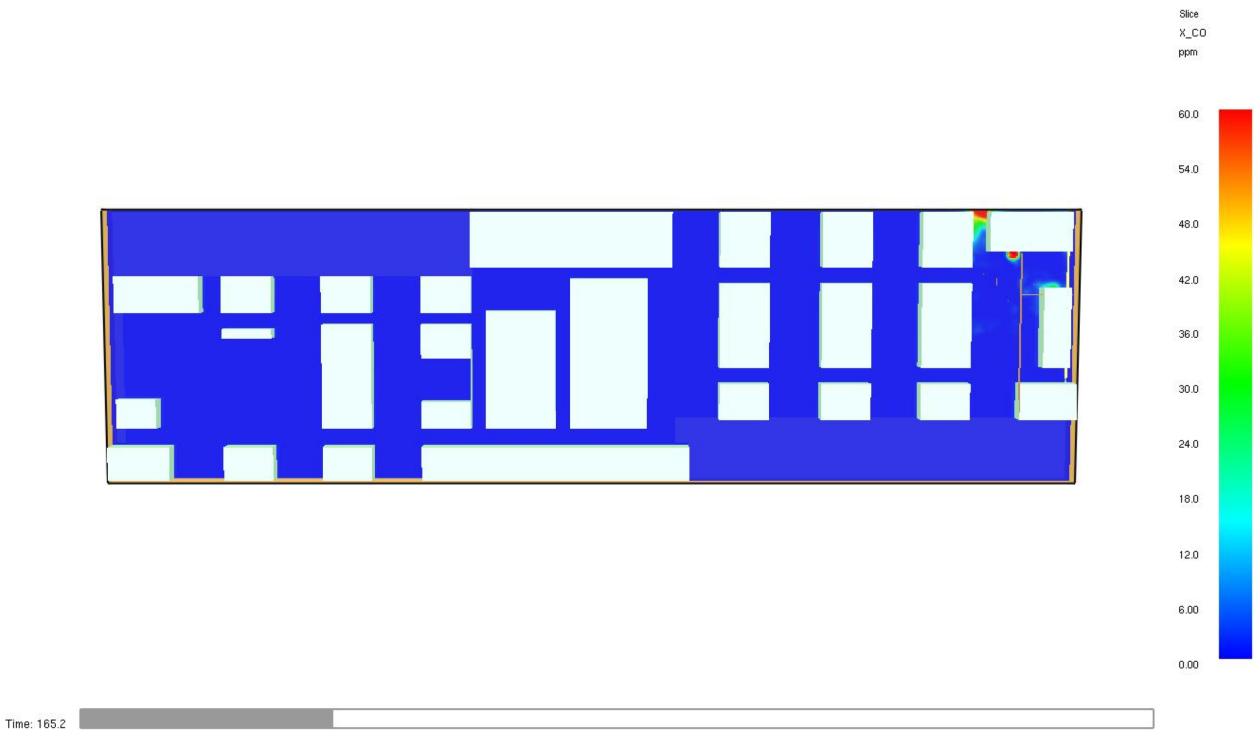


Figure 49: FDS Carbon Monoxide Level at 165 Seconds

The heat flux was measured near the modeled fire and the values are shown in Figure 50. Given a tenability limit of 2.5 kW/m^2, the values that were generated near the fire are well below the maximum. At other locations on the First Floor, the radiant heat flux is negligible.

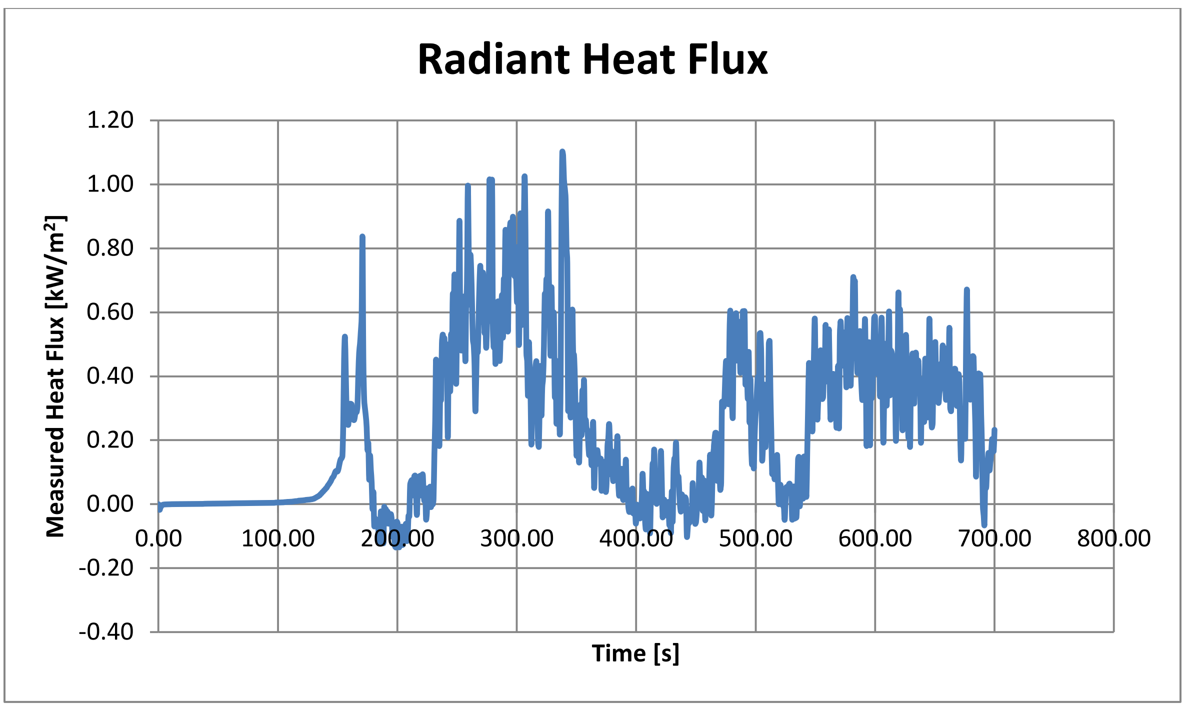


Figure 50: FDS Radiant Heat Flux Near Fire

Performance Based Analysis Conclusion

For a fire located on one of the office floors, the available safe egress time exceeds the required safe egress time, provided the fire is identified and the fire alarm is activated promptly. This assumes that occupants are able to move on the floor in a direction away from the fire. If occupant egress does not begin until after the fire alarm is activated via the sprinkler waterflow switch, there will be a delay that could present untenable conditions in the vicinity of the fire. It is expected that the fire will not spread from one floor to the next, provided the fire does not threaten any of the vertical openings.

The detection time for a fire on the First Floor near the south stair is approximately 165 seconds plus the waterflow switch delay of 60 seconds, for a total time of 225 seconds. Provided the area near the origin of the fire is occupied, the fire will likely be detected before the fire alarm is activated. The total evacuation time is 438 seconds. This provides a maximum RSET of 663 seconds, approximately 11 minutes. After 11 minutes of fire simulation, the area near the north stair exit remains within the performance criteria.

Given a loss of visibility in the south section of the First Floor at approximately 237 seconds, the ASET for the south section of the First Floor is less than 10 seconds. In reality, occupants in the south section are likely to begin movement as soon as the fire is discovered. Pre-movement time is limited through the use of the BET members. Furthermore, the fire alarm may be manually activated well before the sprinkler waterflow switch is activated. Occupants on the other floors of the building have sufficient ASET, as do occupants in the northern section of the First Floor.

It is important to note that occupants will exit through the lobby on the First Floor. This will potentially impact occupants on the second floor as smoke may travel up the open shaft when the lobby doors are opened. It is vital that the BET members encourage occupants on the Second Floor to exit via the north and south stairs. The egress time on the First Floor will be decreased through the use of the lobby. This will decrease the RSET for occupants on the First Floor.

It is apparent that the fire detection and suppression systems are vital for life safety. Without early warning and early fire control, the conditions in the building, on one floor if not more, will become unsafe. A fire that is not detected will likely spread to adjacent combustibles. This will accelerate the loss of tenability and present a significant life safety hazard.

Conclusion & Recommendations

Wang Hall was constructed based on the applicable DOE requirements, which include the California Building Code and NFPA 101. The building meets the construction type, size and height limitations. The means of egress is acceptable based on the code requirements. A sufficient number of exits are provided on each floor and those exits are arranged appropriately. Exit signs and emergency lighting is provided throughout.

The building is equipped with a fire detection and alarm system that was designed and installed in accordance with applicable codes and standard. The system provides for occupant notification after activation through manual or automatic means, including HSSD on the Computing Floor. Smoke control is provided through the shutdown of the air handling units upon activation of the fire alarm. No smoke exhaust is provided.

Automatic fire suppression is provided through the installation of automatic fire sprinklers, with both wet pipe and preaction systems being used. The calculated water supply requirement for one design area is not sufficient based on the available data. The expected actual available water supply does exceed the demand, however, as the water supply flows downhill through pressure reducing valves. These valves would open during a fire event thereby allowing higher pressure water to reach Wang Hall. Manual fire suppression is provided via standpipes and portable fire extinguishers. No gaseous fire suppression is provided for the computer equipment.

A fire was modeled using FDS on the First Floor near the south stair exit. The design fire considers the combustion of one chair and the fuel is modeled as polyurethane foam. One sprinkler activates in the FDS model and controls the fire. The fire does not spread beyond the initial fuel package. The grid size for the model is fairly coarse. More accurate output data would be achieved through the use of a finer mesh.

The egress time for the building was modeled using the Pathfinder model. The total egress time was calculated to be 332 seconds. A safety factor of 1.5 was applied, increasing the egress time to 493 seconds. The ASET for the floors removed from the fire is essentially unlimited, provided the fire does not spread beyond the First Floor. The RSET may be as high as 438 seconds, provided the occupants do not begin to move until the fire alarm system activates. The pre-movement time is expected to be very low as the BET members would begin encouraging occupants to leave as soon as the fire alarm activates.

Four tenability criteria were specified for the performance-based design. These are visibility, temperature, carbon monoxide level, and radiant heat flux. The visibility is the first criteria to be lost on the First Floor for the specified design fire. While the visibility is lost in parts of the south section of the floor at approximately 170 seconds, the visibility remains above 10 meters for most of the floor throughout the simulation. At 700 seconds, the visibility is below 10 meters for approximately one-half (southern half) of the First Floor. It is expected that all occupants will be out of this area well before this time.

Several recommendations are apparent following this performance-based design. The first would be to upgrade the construction of the Central Stair to meet the fire and smoke resistance requirements for a four story shaft. The Central Stair presents two issues. First, there is a potential for vertical fire spread. Second, while this is not considered an exit, the occupants of the building would be able to evacuate more quickly if the Central Stair was used as an exit. Likewise the main lobby doors provide for an increased egress rate for both the First and Second Floors. By protecting this stair through the use of two-hour fire-resistance-rated construction, the Central Stair would meet the requirements to be considered an exit.

It is recommended that the staff be trained on the appropriate egress routes in Wang Hall. In addition, the staff needs to be trained to properly report a fire as soon as it is discovered. Staff, especially the BET members, needs to be trained to assist any visitors or other occupants that are not familiar with the building and the means of egress.

The fire alarm, fire sprinkler, and fire barriers need to be inspected, tested, and maintained in accordance with the applicable codes and standards. An ITM program exists today, however not all of the requirements are met. It is recommended that the ITM program be bolstered so that all of the requirements are achieved. This will provide for a greater level of safety for the building occupants.

The occupants would be afforded a greater ASET if the fire alarm system was activated more quickly. A significant amount of time is lost while the fire grows to a sufficient size to activate the sprinkler system. It is recommended that the office levels be equipped with area smoke detection. While not required by the DOE or other applicable codes, installation of a smoke detection system would increase the amount of time available for safe egress. Further, it would cause the fire department to be summoned more quickly, which could provide for faster fire extinguishment and perhaps less fire damage.

Given the model results for fire involving furniture on the First Floor, it is recommended that the existing furniture be reevaluated. The use of TB 133 compliant furniture would greatly reduce the heat release rate. In turn this would reduce the production rate of the products of combustion. The lower heat release rate could delay fire detection and suppression, but through enhanced training building occupants would be able to manage the possible time difference. Further modeling with TB 133 compliant furniture is appropriate.

References

California Building Code. California Building Standards Commission, 2007.

California Building Code. California Building Standards Commission, 2016.

California Mechanical Code. California Building Standards Commission, 2007.

DOE O 420.1b, *Facility Safety*. Department of Energy, 2005.

DOE O 420.1c, *Facility Safety*. Department of Energy, 2012.

DOE STD-1066, *Fire Protection Design Criteria*. Department of Energy, 1999.

DOE-STD-1066, *Fire Protection Design Criteria*. Department of Energy, 2012.

Drysdale, Dougal. *An Introduction to Fire Dynamics*. 2nd Ed. Wiley: West Sussex. 1998.

Hurley, Morgan J., Ed. *SFPE Handbook of Fire Protection Engineering*, 5th Edition. Society of Fire Protection Engineers, 2016.

NFPA 13: Standard for the Installation of Sprinkler Systems. National Fire Protection Association, 2007.

NFPA 72: National Fire Alarm Code. National Fire Protection Association, 2007.

NFPA 75: Standard for the Protection of Information Technology Equipment. National Fire Protection Association, 2009.

NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems. National Fire Protection Association, 2009.

NFPA 101: Life Safety Code. National Fire Protection Association, 2006.

NFPA 101: Life Safety Code. National Fire Protection Association, 2018.

SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings. National Fire Protection Association, 2000.

Appendices

Appendix 1: Occupant Load Calculations

Floor	Room	Occupancy Type	Size [sq. ft.]	Occupant Load Factor [sq. ft./ person] (NFPA 101)	Calculated Occupant Load	Occupant Load Factor [sq. ft./ person] (CBC)	Calculated Occupant Load (CBC)
G	1002	UPS Room	2070	100	21	300	7
G	1201	Mechanical Space	29513	100	296	300	98
C	2101	Computing	6737	100	68	300	22
C	2102	Computing	19834	100	199	300	66
C	2103	Computing Electrical South	4617	100	47	300	16
C	2104	Computing Electrical North	3769	100	38	300	13
C	2002	Storage Room	70	500	1	300	1
C	2004	IDF Room	133	100	2	300	1
C	2005	Control Room	591	100	6	100	6
C	2006	Vendor Work Room	198	100	2	100	2
C	2007	Ops Room	188	100	2	100	2
C	2301	Hallway	1137	100	12	300	4
C	2302	Hallway	1061	100	11	300	4
C	2303	Corridor	144	100	2	300	1
C	2304	Storage	257	500	1	300	1
1	3010	Office	111	100	2	100	2
1	3011	Office	109	100	2	100	2
1	3012	Office	109	100	2	100	2
1	3013	Office	111	100	2	100	2
1	3014	Office	111	100	2	100	2
1	3015	Office	109	100	2	100	2
1	3016	Office	109	100	2	100	2
1	3017	Office	111	100	2	100	2

Floor	Room	Occupancy Type	Size [sq. ft.]	Occupant Load Factor [sq. ft./ person] (NFPA 101)	Calculated Occupant Load	Occupant Load Factor [sq. ft./ person] (CBC)	Calculated Occupant Load (CBC)
1	3018	Office	111	100	2	100	2
1	3019	Office	109	100	2	100	2
1	3020	Office	109	100	2	100	2
1	3021	Office	111	100	2	100	2
1	3022	Office	126	100	2	100	2
1	3023	Office	122	100	2	100	2
1	3024	Office	142	100	2	100	2
1	3025	Large Conference	360	15	24	15	24
1	3026	Office	139	100	2	100	2
1	3027	Office	138	100	2	100	2
1	3028	Office	109	100	2	100	2
1	3029	Office	106	100	2	100	2
1	3030	Office	104	100	2	100	2
1	3031	Office	104	100	2	100	2
1	3032	Office	106	100	2	100	2
1	3033	Office	109	100	2	100	2
1	3034	Office	277	100	3	100	2
1	3036	Office	123	100	2	100	3
1	3037	Office	118	100	2	100	2
1	3038	Electrical Room	222	100	3	300	1
1	3039	Office	119	100	2	100	2
1	3040	Office	124	100	2	100	2
1	3042	Office	277	100	3	100	3
1	3043	Office	109	100	2	100	2
1	3044	Office	106	100	2	100	2

Floor	Room	Occupancy Type	Size [sq. ft.]	Occupant Load Factor [sq. ft./ person] (NFPA 101)	Calculated Occupant Load	Occupant Load Factor [sq. ft./ person] (CBC)	Calculated Occupant Load (CBC)
1	3045	Office	104	100	2	100	2
1	3046	Office	104	100	2	100	2
1	3047	Office	106	100	2	100	2
1	3048	Office	109	100	2	100	2
1	3049	Conference	357	15	24	15	24
1	3050	Office	136	100	2	100	2
1	3051	Kitchen	135	100	2	100	2
1	3052	Break Room	543	15	36	15	36
1	3054	Conference	274	15	19	15	19
1	3055	Office	111	100	2	100	2
1	3056	Office	111	100	2	100	2
1	3057	Office	107	100	2	100	2
1	3058	Office	108	100	2	100	2
1	3059	Office	139	100	2	100	2
1	3060	Office	138	100	2	100	2
1	3061	Office	108	100	2	100	2
1	3062	Office	105	100	2	100	2
1	3063	Office	103	100	2	100	2
1	3064	Electrical Room	221	100	3	300	1
1	3065	Office	104	100	2	100	2
1	3066	Office	106	100	2	100	2
1	3067	Office	109	100	2	100	2
1	3069	Conference	277	15	19	15	19
1	3070	Large Conference	360	15	24	15	24
1	3071	Office	146	100	2	100	2

Floor	Room	Occupancy Type	Size [sq. ft.]	Occupant Load Factor [sq. ft./ person] (NFPA 101)	Calculated Occupant Load	Occupant Load Factor [sq. ft./ person] (CBC)	Calculated Occupant Load (CBC)
1	3072	Office	146	100	2	100	2
1	3073	Office	146	100	2	100	2
1	3074	Office	146	100	2	100	2
1	3075	Office	146	100	2	100	2
1	3076	Office	146	100	2	100	2
1	3101	Seminar	1333	15	89	15	89
1	3102	IDF	259	100	3	300	1
1	3103	Copy	117	100	2	100	2
1	3104	Vis Presentation	571	15	38	15	38
1	3105	Work Station Room	191	100	2	100	2
1	3106	CRD Workroom	365	100	4	300	2
1	3107	Phone Booth	89	100	1	100	1
1	3108	Office	123	100	2	100	2
1	3109	Office	126	100	2	100	2
1	3201	Lobby	745	100	8	100	8
1	3202	Open Office	401	100	5	100	5
1	3203	Office	423	100	5	100	5
1	3204	Open Office	423	100	5	100	5
1	3205	Open Office	207	100	3	100	3
1	3206	Open Office	1017	100	11	100	11
1	3207	Open Office	265	100	3	100	3
1	3208	Open Office	678	100	7	100	7
1	3209	Open Office	265	100	3	100	3
1	3210	Open Office	679	100	7	100	7
1	3211	Open Office	265	100	3	100	3

Floor	Room	Occupancy Type	Size [sq. ft.]	Occupant Load Factor [sq. ft./ person] (NFPA 101)	Calculated Occupant Load	Occupant Load Factor [sq. ft./ person] (CBC)	Calculated Occupant Load (CBC)
1	3212	Open Office	692	100	7	100	7
1	3213	Open Office	262	100	3	100	3
1	3214	Open Office	265	100	3	100	3
1	3215	Open Office	1158	100	12	100	12
1	3216	Open Office	265	100	3	100	3
1	3217	Open Office	1552	100	16	100	16
1	3218	Open Office	265	100	3	100	3
1	3219	Open Office	1505	100	16	100	16
1	3220	Open Office	137	100	2	100	2
1	3221	Open Office	280	100	3	100	3
1	3222	Open Office	279	100	3	100	3
1	3301	Hallway	1284	100	13	100	13
1	3302	Hallway	973	100	10	100	10
1	3303	Hallway	810	100	9	100	9
1	3304	Hallway	292	100	3	100	3
1	3305	Hallway	297	100	3	100	3
1	3306	Hallway	609	100	7	100	7
1	3307	Hallway	829	100	9	100	9
1	3308	Hallway	852	100	9	100	9
2	4002	Lactation Room	83	100	1	100	1
2	4010	Work Room	137	100	2	100	2
2	4011	Work Room	137	100	2	100	2
2	4012	Work Room	137	100	2	100	2
2	4013	Work Room	137	100	2	100	2
2	4014	Work Room	137	100	2	100	2

Floor	Room	Occupancy Type	Size [sq. ft.]	Occupant Load Factor [sq. ft./ person] (NFPA 101)	Calculated Occupant Load	Occupant Load Factor [sq. ft./ person] (CBC)	Calculated Occupant Load (CBC)
2	4015	Work Room	137	100	2	100	2
2	4016	Large Conference	358	15	24	15	24
2	4017	Electrical Room	221	100	3	300	1
2	4018	Large Conference	355	15	24	15	24
2	4019	Work Room	136	100	2	100	2
2	4020	Kitchen	135	100	2	100	2
2	4021	Break Room	546	15	36	15	36
2	4022	Large Conference	358	15	24	15	24
2	4024	Electrical Room	221	100	3	300	1
2	4025	Work Room	146	100	2	100	2
2	4026	Dir Work Room	146	100	2	100	2
2	4027	Work Room	146	100	2	100	2
2	4028	Dir Work Room	146	100	2	100	2
2	4029	Work Room	146	100	2	100	2
2	4030	Work Room	146	100	2	100	2
2	4101	Large Conference	455	15	30	15	30
2	4102	Large Conference	866	15	58	15	58
2	4103	IDF Room	257	100	3	300	1
2	4104	Copy	114	100	2	100	2
2	4105	Recycle	138	100	2	100	2
2	4106	Storage Closet	59	100	1	100	1
2	4107	ESNet Work Room	419	100	5	100	5
2	4110	Server Room	405	100	5	100	5
2	4111	Network Development	247	100	3	300	1
2	4112	Phone Booth	51	100	1	100	1

Floor	Room	Occupancy Type	Size [sq. ft.]	Occupant Load Factor [sq. ft./ person] (NFPA 101)	Calculated Occupant Load	Occupant Load Factor [sq. ft./ person] (CBC)	Calculated Occupant Load (CBC)
2	4113	Phone Booth	51	100	1	100	1
2	4114	Phone Booth	51	100	1	100	1
2	4115	Phone Booth	51	100	1	100	1
2	4201	Lobby	766	100	8	100	8
2	4203	Open Office	5241	100	53	100	53
2	4204	Open Office	1899	100	19	100	19
2	4205	Open Office	1622	100	17	100	17
2	4206	Open Office	5204	100	53	100	53
2	4207	Open Office	137	100	2	100	2
2	4301	Hallway	3198	100	32	100	32
2	4302	Hallway	984	100	10	100	10
2	4303	Hallway	810	100	9	100	9
2	4304	Hallway	290	100	3	100	3
2	4305	Hallway	301	100	4	100	4
2	4306	Hallway	489	100	5	100	5
2	4307	Hallway	1024	100	11	100	11
2	4308	Hallway	1411	100	15	100	15
R	5003	Storage Room	367	500	1	300	2
R	5004	Pump Room	483	100	5	300	2
R	5008	Elevator #1 Machine Room	123	100	2	300	1
R	5009	Elevator #2 Machine Room	140	100	2	300	1

Appendix 2: FDS Input File

```
&HEAD CHID='First_Floor_2', TITLE='First Floor-Sprinkler'/

&TIME T_END=700.0/

&MESH IJK=391,120,15, XB=0.00,119.00,0.00,33.53,0.00,3.81 /

&REAC FUEL='POLYURETHANE',
SOOT_YIELD=0.23,CO_YIELD=0.03,C=6.3,N=1.0,H=7.1,O=2.1 /

&MATL ID='FOAM', SPECIFIC_HEAT=0.034, CONDUCTIVITY=1.4, DENSITY=20,
N_REACTIONS= 1, NU_SPEC= 1., SPEC_ID='POLYURETHANE',
REFERENCE_TEMPERATURE=250, HEAT_OF_REACTION=1960,
HEAT_OF_COMBUSTION=24400/

&SURF ID= 'UPHOLSTERY', COLOR='PURPLE', BURN_AWAY=.TRUE.,
MATL_ID='FOAM', THICKNESS=0.1 /

&OBST XB=111.09,111.69,27.83,28.63,0.00,0.20/
&OBST XB=111.09,111.69,27.83,28.63,0.20,0.60, SURF_ID='UPHOLSTERY'/Cushion
&OBST XB=110.89,111.09,27.83,28.63,0.00,0.90, SURF_ID='UPHOLSTERY'/Right
Arm
&OBST XB=111.69,111.89,27.83,28.63,0.00,0.90, SURF_ID='UPHOLSTERY'/Left Arm
&OBST XB=111.09,111.69,28.33,28.63,0.60,1.20, SURF_ID='UPHOLSTERY'/Back

&VENT XB=111.09,111.69,27.83,28.43,0.60,0.60, SURF_ID='BURNER'/
&SURF ID='BURNER',HRRPUA=2000,RAMP_Q='fireramp'/
&RAMP ID='fireramp', T=0.0, F=0.00/
&RAMP ID='fireramp', T=100, F=0.025/
&RAMP ID='fireramp', T=125, F=0.05/
&RAMP ID='fireramp', T=150, F=0.15/
&RAMP ID='fireramp', T=175, F=0.40/
&RAMP ID='fireramp', T=200, F=0.1/
&RAMP ID='fireramp', T=250, F=0.85/
&RAMP ID='fireramp', T=275, F=1/
&RAMP ID='fireramp', T=300, F=0.875/
&RAMP ID='fireramp', T=400, F=0.125/
&RAMP ID='fireramp', T=500, F=0.1/
&RAMP ID='fireramp', T=600, F=0.1/
&RAMP ID='fireramp', T=700, F=0.1/
&RAMP ID='fireramp', T=800, F=0.0875/
&RAMP ID='fireramp', T=900, F=0.0875/
&RAMP ID='fireramp', T=1000, F=0.0875/
&RAMP ID='fireramp', T=1100, F=0.0875/
&RAMP ID='fireramp', T=1200, F=0.0875/
```

```
&MATL ID='CONCRETE', CONDUCTIVITY=1.75, DENSITY=2400,
SPECIFIC_HEAT=1, EMISSIVITY=0.9/
&MATL ID='GYPSUM', CONDUCTIVITY=0.14, DENSITY=770, SPECIFIC_HEAT=0.9,
EMISSIVITY=0.9/

&SURF ID='FLOOR', MATL_ID='CONCRETE', COLOR='GRAY', THICKNESS=0.46/
&SURF ID='WALL', MATL_ID='GYPSUM', COLOR='MINT', THICKNESS=0.15/
&SURF ID='EXTERIOR', MATL_ID='GYPSUM', COLOR='INVISIBLE',
THICKNESS=0.15/
&SURF ID='CEILING', MATL_ID='CONCRETE', COLOR='INVISIBLE',
THICKNESS=0.46/
&SURF ID='BEAM', MATL_ID='GYPSUM', COLOR='MELON', THICKNESS=0.01/

&OBST XB=0.00,1.32,0.00,4.55,0.00,0.46, SURF_ID='FLOOR'/Floor Area 1
&OBST XB=1.32,44.83,0.00,25.50,0.00,0.46, SURF_ID='FLOOR'/Floor Area 2
&OBST XB=44.83,70.05,0.00,33.53,0.00,0.46, SURF_ID='FLOOR'/Floor Area 3
&OBST XB=70.05,71.37,0.00,4.55,0.00,0.46, SURF_ID='FLOOR'/Floor Area 4
&OBST XB=70.05,118.29,7.92,33.53,0.00,0.46, SURF_ID='FLOOR'/Floor Area 5
&OBST XB=118.29,119.61,7.92,12.52,0.00,0.46, SURF_ID='FLOOR'/Floor Area 6

&OBST XB=0.00,1.32,0.00,4.55,3.81,4.27, SURF_ID='CEILING'/Ceiling Area 1
&OBST XB=1.32,44.83,0.00,25.50,3.81,4.27, SURF_ID='CEILING'/Ceiling Area 2
&OBST XB=44.83,70.05,0.00,33.53,3.81,4.27, SURF_ID='CEILING'/Ceiling Area 3
&OBST XB=70.05,71.37,0.00,4.55,3.81,4.27, SURF_ID='CEILING'/Ceiling Area 4
&OBST XB=70.05,118.29,7.92,33.53,3.81,4.27, SURF_ID='CEILING'/Ceiling Area 5
&OBST XB=118.29,119.61,7.92,12.52,3.81,4.27, SURF_ID='CEILING'/Ceiling Area 6

&OBST XB=0.00,71.37,0.00,0.15,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall 1
&OBST XB=71.22,71.37,0.00,4.55,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall 2
&OBST XB=69.80,71.37,4.40,4.55,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall 3
&OBST XB=69.65,69.80,4.55,7.92,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall 4
&OBST XB=69.80,119.61,7.77,7.92,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall 5
&OBST XB=119.46,119.61,7.92,12.47,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall
6
&OBST XB=118.29,119.61,12.16,12.31,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall
7
&OBST XB=118.14,118.29,12.31,33.42,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall
8
&OSBT XB=44.83,118.29,33.38,33.53,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall
9
&OBST XB=44.69,44.83,25.50,33.53,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall
10
&OBST XB=1.32,44.83,25.35,25.50,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall 11
&OBST XB=1.17,1.32,4.55,25.50,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall 12
&OBST XB=0.00,1.32,4.40,4.55,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall 13
&OBST XB=0.00,0.15,0.00,4.55,0.00,3.81, SURF_ID='EXTERIOR'/Exterior Wall 14
```

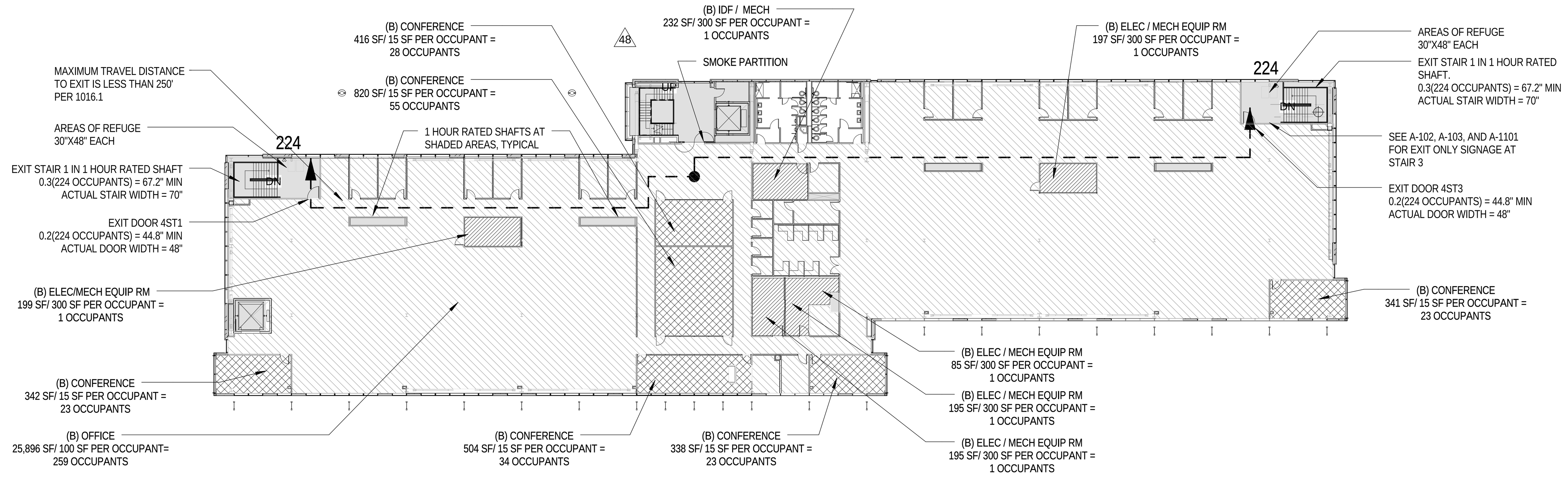
```
&OBST XB=0.15,7.67,0.15,4.55,0.46,3.81, SURF_ID='WALL'/Room 1
&OBST XB=14.35,20.40,0.15,4.55,0.46,3.81, SURF_ID='WALL'/Room 2
&OBST XB=26.54,32.64,0.15,4.55,0.46,3.81, SURF_ID='WALL'/Room 3
&OBST XB=38.73,71.37,0.15,4.55,0.46,3.81, SURF_ID='WALL'/Room 4
&OBST XB=1.32,6.20,6.71,10.34,0.46,3.81, SURF_ID='WALL'/ Room 5
&OBST XB=26.54,32.64,6.71,19.51,0.46,3.81, SURF_ID='WALL'/Room 6
&OBST XB=38.73,44.83,6.71,10.01,0.46,3.81, SURF_ID='WALL'/Room 7
&OBST XB=38.73,44.83,15.47,19.51,0.46,3.81, SURF_ID='WALL'/Room 8
&OBST XB=46.66,55.07,6.71,21.29,0.46,3.81, SURF_ID='WALL'/Room 9
&OBST XB=57.02,66.44,6.71,25.05,0.46,3.81, SURF_ID='WALL'/Room 10
&OBST XB=75.31,81.41,7.92,12.29,0.46,3.81, SURF_ID='WALL'/Room 11
&OBST XB=75.31,81.41,14.12,24.68,0.46,3.81, SURF_ID='WALL'/Room 12
&OBST XB=87.50,93.60,7.92,12.29,0.46,3.81, SURF_ID='WALL'/Room 13
&OBST XB=87.50,93.60,14.12,24.68,0.46,3.81, SURF_ID='WALL'/Room 14
&OBST XB=99.70,105.80,7.92,12.29,0.46,3.81, SURF_ID='WALL'/Room 15
&OBST XB=99.70,105.80,14.12,24.68,0.46,3.81, SURF_ID='WALL'/Room 16
&OBST XB=111.89,119.59,7.92,12.29,0.46,3.81, SURF_ID='WALL'/Room 17
&OBST XB=114.81,118.14,14.17,24.15,0.46,3.81, SURF_ID='WALL'/Room 18
&OBST XB=108.16,118.14,28.63,33.38,0.46,3.81, SURF_ID='WALL'/Room 19
&OBST XB=99.70,105.80,26.55,33.38,0.46,3.81, SURF_ID='WALL'/Room 20
&OBST XB=87.50,93.60,26.55,33.38,0.46,3.81, SURF_ID='WALL'/Room 21
&OBST XB=75.31,81.41,26.55,33.38,0.46,3.81, SURF_ID='WALL'/Room 22
&OBST XB=44.83,69.37,26.55,33.38,0.46,3.81, SURF_ID='WALL'/Room 23
&OBST XB=38.73,44.83,20.85,25.35,0.46,3.81, SURF_ID='WALL'/Room 24
&OBST XB=26.54,32.64,20.85,25.35,0.46,3.81, SURF_ID='WALL'/Room 25
&OBST XB=14.35,20.40,20.85,25.35,0.46,3.81, SURF_ID='WALL'/Room 26
&OBST XB=1.32,11.51,20.85,25.35,0.46,3.81, SURF_ID='WALL'/Room 27
&OBST XB=14.35,20.40,17.96,18.90,0.46,3.81, SURF_ID='WALL'/Room 28
&OBST XB=44.68,44.83,10.01,15.47,0.46,3.81, SURF_ID='WALL'/Wall 29

&OBST XB=111.88,111.89,7.92,28.22,3.00,3.81, SURF_ID='BEAM'/1
&OBST XB=111.89,118.29,25.54,25.55,3.33,3.81, SURF_ID='BEAM'/2
&OBST XB=111.89,118.29,23.25,23.26,3.33,3.81, SURF_ID='BEAM'/3
&OBST XB=111.89,118.29,20.96,20.97,3.33,3.81, SURF_ID='BEAM'/4
&OBST XB=111.89,118.29,18.70,18.71,3.33,3.81, SURF_ID='BEAM'/5
&OBST XB=105.79,111.89,18.70,18.71,3.33,3.81, SURF_ID='BEAM'/6
&OBST XB=105.79,111.89,21.54,21.55,3.33,3.81, SURF_ID='BEAM'/7
&OBST XB=105.79,111.89,22.86,22.87,3.33,3.81, SURF_ID='BEAM'/8
&OBST XB=105.79,111.89,24.38,24.39,3.33,3.81, SURF_ID='BEAM'/9
&OBST XB=105.79,111.89,27.02,27.03,3.33,3.81, SURF_ID='BEAM'/10
&OBST XB=105.79,111.89,29.66,29.67,3.33,3.81, SURF_ID='BEAM'/11
&OSBT XB=105.78,105.79,24.68,26.67,3.45,3.81, SURF_ID='BEAM'/12
&OBST XB=108.83,108.84,24.39,27.03,3.45,3.81, SURF_ID='BEAM'/13

&DEVC ID='S-1', PROP_ID='SPRINKLER', XYZ=117.10,26.62,3.66/ Sprinkler 1
```

```
&DEVC ID='S-2', PROP_ID='SPRINKLER', XYZ=117.10,24.49,3.66/ Sprinkler 2
&DEVC ID='S-3', PROP_ID='SPRINKLER', XYZ=113.44,26.62,3.66/ Sprinkler 3
&DEVC ID='S-4', PROP_ID='SPRINKLER', XYZ=113.44,24.49,3.66/ Sprinkler 4
&DEVC ID='S-5', PROP_ID='SPRINKLER', XYZ=113.44,22.05,3.66/ Sprinkler 5
&DEVC ID='S-6', PROP_ID='SPRINKLER', XYZ=113.44,20.25,3.66/ Sprinkler 6
&DEVC ID='S-7', PROP_ID='SPRINKLER', XYZ=110.39,27.84,3.66/ Sprinkler 7
&DEVC ID='S-8', PROP_ID='SPRINKLER', XYZ=110.39,25.73,3.66/ Sprinkler 8
&DEVC ID='S-9', PROP_ID='SPRINKLER', XYZ=110.39,23.60,3.66/ Sprinkler 9
&DEVC ID='S-10', PROP_ID='SPRINKLER', XYZ=110.39,22.38,3.66/ Sprinkler 10
&DEVC ID='S-11', PROP_ID='SPRINKLER', XYZ=110.39,20.25,3.66/ Sprinkler 11
&DEVC ID='S-12', PROP_ID='SPRINKLER', XYZ=107.34,31.19,3.66/ Sprinkler 12
&DEVC ID='S-13', PROP_ID='SPRINKLER', XYZ=107.34,28.45,3.66/ Sprinkler 13
&DEVC ID='S-14', PROP_ID='SPRINKLER', XYZ=107.34,25.73,3.66/ Sprinkler 14
&DEVC ID='S-15', PROP_ID='SPRINKLER', XYZ=107.34,23.60,3.66/ Sprinkler 15
&DEVC ID='S-16', PROP_ID='SPRINKLER', XYZ=107.34,22.38,3.66/ Sprinkler 16
&DEVC ID='S-17', PROP_ID='SPRINKLER', XYZ=107.34,20.25,3.66/ Sprinkler 17

&SPEC ID='WATER VAPOR'/

&PROP ID='SPRINKLER', QUANTITY='SPRINKLER LINK TEMPERATURE',
ACTIVATION_TEMPERATURE=68.3, RTI=50, PART_ID='Water',
FLOW_RATE=56.0, PARTICLE_VELOCITY=5.0, SPRAY_ANGLE=30.0,80.0/

&PART ID='Water',
SPEC_ID='WATER VAPOR',
DIAMETER=500.0,
MONODISPERSE=.TRUE.,
AGE=60.0,
SAMPLING_FACTOR=1/

&SLCF PBZ=1.83, QUANTITY='VOLUME FRACTION', SPEC_ID='CARBON
MONOXIDE' /
&SLCF PBZ=1.83, QUANTITY='TEMPERATURE'/
&SLCF PBZ=1.83, QUANTITY='VISIBILITY'/
&SLCF PBZ=1.83, QUANTITY='DENSITY', SPEC_ID='SOOT'/
&SLCF PBY=22.0, QUANTITY='VOLUME FRACTION', SPEC_ID='CARBON
MONOXIDE' /
&SLCF PBY=22.0, QUANTITY='VISIBILITY' /
&SLCF PBY=22.0, QUANTITY='TEMPERATURE'/

&DEVC ID='HF1', XYZ=112.00,28.23,0.70, IOR=-2, QUANTITY='GAUGE HEAT FLUX'/
&DEVC ID='NDT',   XYZ=11.0,20.0,1.83, QUANTITY='TEMPERATURE'/
&DEVC ID='LT',    XYZ=50.0,22.0,1.83, QUANTITY='TEMPERATURE'/
&DEVC ID='SDT',   XYZ=106.0,22.0,1.83, QUANTITY='TEMPERATURE'/
&DEVC ID='NDV',   XYZ=11.0,22.0,1.83, QUANTITY='VISIBILITY'/
&DEVC ID='LV',    XYZ=50.0,22.0,1.83, QUANTITY='VISIBILITY'/
```

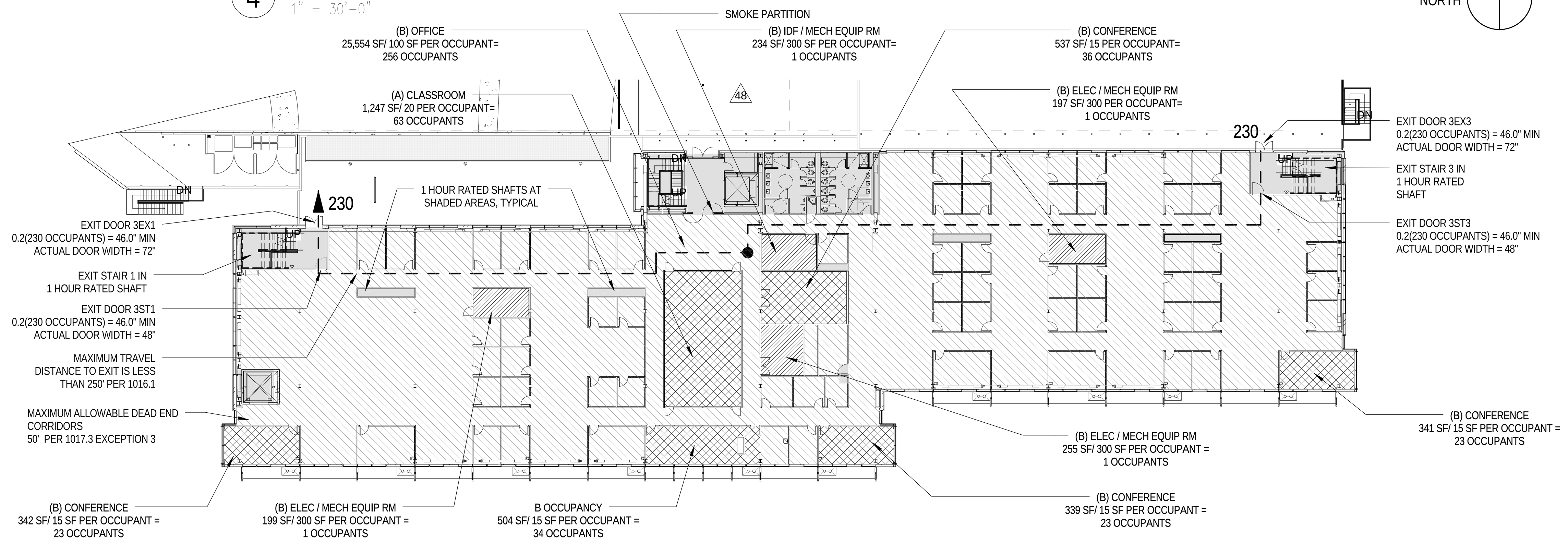
```
&DEVC ID='SDV',   XYZ=106.0,22.0,1.83, QUANTITY='VISIBILITY'/
&DEVC ID='NDLH',  XB=11.0,11.0,20.0,20.0,0.0,3.81, QUANTITY='LAYER HEIGHT',  /
&DEVC ID='LLH',   XB=50.0,50.0,22.0,22.0,0.0,3.81, QUANTITY='LAYER HEIGHT',  /
&DEVC ID='SDLH',  XB=106.0,106.0,22.0,22.0,0.0,3.81, QUANTITY='LAYER HEIGHT',
/
&DEVC ID='NDCO',  XYZ=11.00,20.0,1.83, QUANTITY='VOLUME FRACTION',
SPEC_ID='CARBON MONOXIDE'/
&DEVC ID='LCO',   XYZ=50.00,22.00,1.83, QUANTITY='VOLUME FRACTION',
SPEC_ID='CARBON MONOXIDE'/
&DEVC ID='SDCO',  XYZ=106.00,22.0,1.83, QUANTITY='VOLUME FRACTION',
SPEC_ID='CARBON MONOXIDE'/

&DEVC ID='ND3.0', XYZ=11.0,20.0,3.0, QUANTITY='TEMPERATURE' /
&DEVC ID='ND2.5', XYZ=11.0,20.0,2.5, QUANTITY='TEMPERATURE' /
&DEVC ID='ND2.0', XYZ=11.0,20.0,2.0, QUANTITY='TEMPERATURE' /
&DEVC ID='ND1.5', XYZ=11.0,20.0,1.5, QUANTITY='TEMPERATURE' /
&DEVC ID='ND1.0', XYZ=11.0,20.0,1.0, QUANTITY='TEMPERATURE' /
&DEVC ID='ND0.5', XYZ=11.0,20.0,0.5, QUANTITY='TEMPERATURE' /

&DEVC ID='L3.0', XYZ=50.0,22.0,3.0, QUANTITY='TEMPERATURE' /
&DEVC ID='L2.5', XYZ=50.0,22.0,2.5, QUANTITY='TEMPERATURE' /
&DEVC ID='L2.0', XYZ=50.0,22.0,2.0, QUANTITY='TEMPERATURE' /
&DEVC ID='L1.5', XYZ=50.0,22.0,1.5, QUANTITY='TEMPERATURE' /
&DEVC ID='L1.0', XYZ=50.0,22.0,1.0, QUANTITY='TEMPERATURE' /
&DEVC ID='L0.5', XYZ=50.0,22.0,0.5, QUANTITY='TEMPERATURE' /

&DEVC ID='SD3.0', XYZ=106.0,22.0,3.0, QUANTITY='TEMPERATURE' /
&DEVC ID='SD2.5', XYZ=106.0,22.0,2.5, QUANTITY='TEMPERATURE' /
&DEVC ID='SD2.0', XYZ=106.0,22.0,2.0, QUANTITY='TEMPERATURE' /
&DEVC ID='SD1.5', XYZ=106.0,22.0,1.5, QUANTITY='TEMPERATURE' /
&DEVC ID='SD1.0', XYZ=106.0,22.0,1.0, QUANTITY='TEMPERATURE' /
&DEVC ID='SD0.5', XYZ=106.0,22.0,0.5, QUANTITY='TEMPERATURE' /
&TAIL/
```

Appendix 3: Building Architectural Drawings

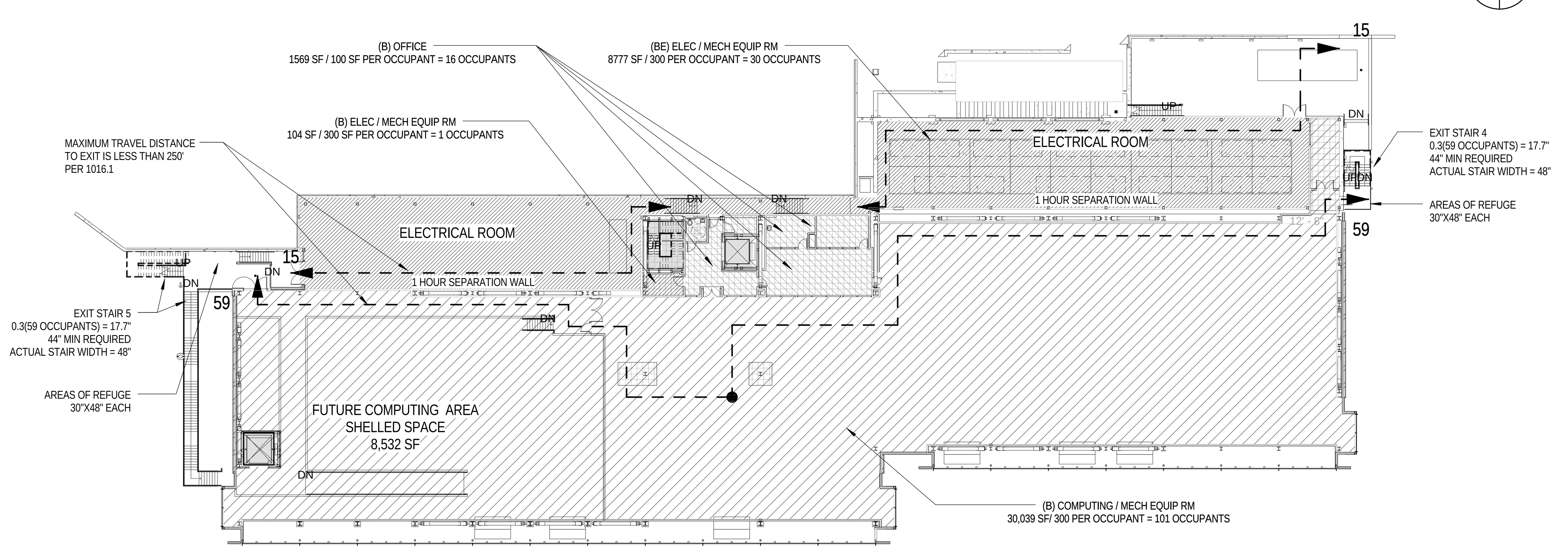
CODE ANAYLSIS



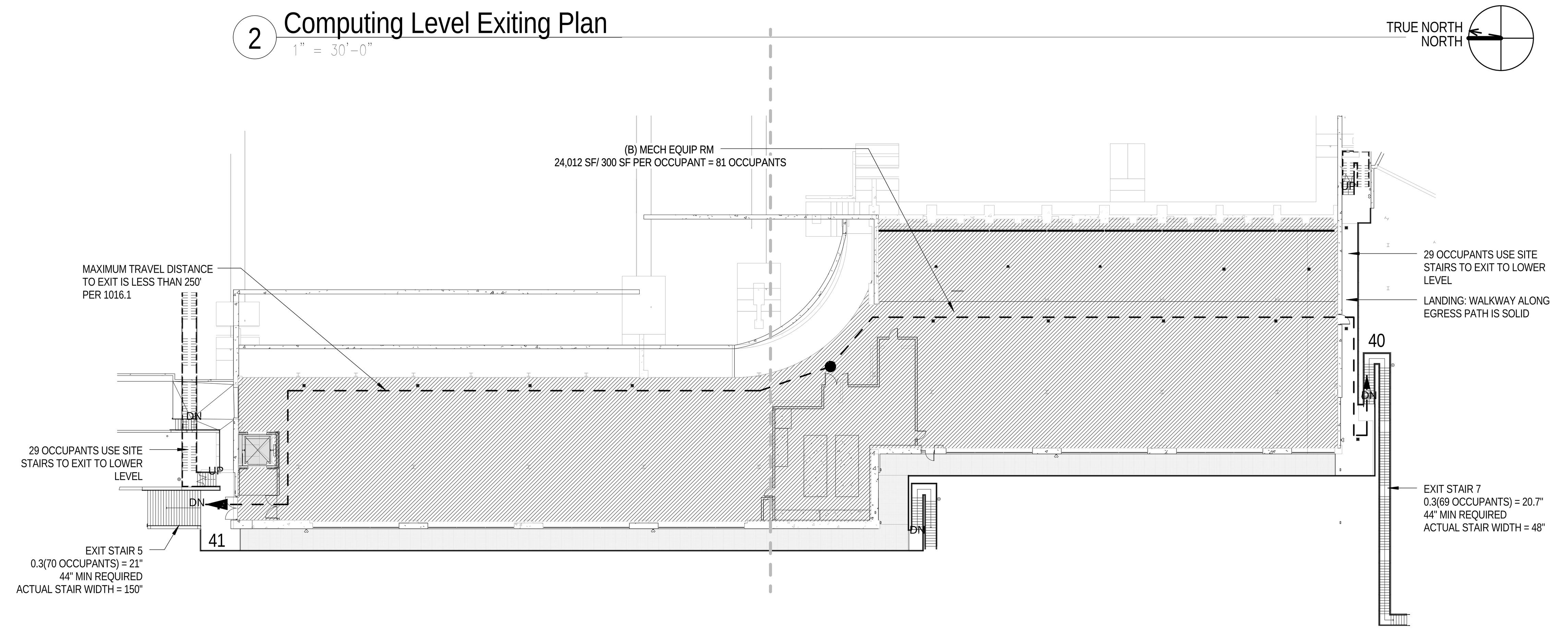
4 Second Level Office Floor Exiting Plan
1" = 30'-0"



3 Ground Level Office Floor Exiting Plan
1" = 30'-0"



2 Computing Level Exiting Plan
1" = 30'-0"



1 Mechanical Sub Level Exiting Plan
1" = 30'-0"

	PROJECT SUMMARY:	
	The Lawrence Berkeley Lab Computational Research Facility is a new 140,300 gsf	

	CODES FOR BASIS OF DESIGN	
	CALIFORNIA BUILDING STANDARDS CODE (TITLE 24)	
	CALIFORNIA BUILDING CODE	2007 CBC
	CALIFORNIA ELECTRICAL CODE	2007 CEC
	CALIFORNIA MECHANICAL CODE	2007 CMC
	CALIFORNIA PLUMBING CODE	2007 CPC
	CALIFORNIA FIRE CODE	2007 CFC
	CALIFORNIA ENERGY CODE	2007 CEC
	CALIFORNIA ELEVATOR SAFETY CONSTRUCTION CODE	2007 CESCC
	CALIFORNIA CODE OF REGULATIONS (TITLE 8)	2007 CCR
	CABO/ANSI 117.1-98	
	ADAAG	1991, amended through 2002
	NFPA 75 STANDARD FOR THE PROTECTION OF ELECTRONIC COMPUTER / DATA PROCESSING EQUIPMENT	2009
	NFPA 101 LIFE SAFETY CODE	2009
	NFPA 110 STANDARD FOR EMERGENCY AND STANDBY POWER SYSTEMS	2009

	CALIFORNIA BUILDING CODE		
3.0	**USE AND OCCUPANCY**		
	Occupancy Classification		
304.1	Offices - Occupancy	Type B	
304.1	Conference Rooms	Type B	
304.1	Computing Floor	Type B	
304.1	Mechanical Level	Type B Accessory Use	
304.1	Classroom/Seminar	Type A3	
4.0	**SPECIAL DETAILED REQUIREMENTS**		
	No Sections applicable		
5.0	**General Building Heights and Areas**		
	Height		
Table 503	Allowable Height	55 feet	B Occupancy, Type II B
504.2	Height Increase	20 feet	
	Total Height	55+20 = 75 feet	
	Designed Height	71.4 feet	
	Designed Height		
	Stories		
Table 503	Allowable Stories	4 stories	
504.2	Stories Increase	1	
	Total Stories	3 stories + 1 Basement	
	ALLOWABLE AREA AND MODIFICATIONS		
506.1	**Aa - Allowable area per story w/ increases**	84,643	Aa = (At + { At + If } + { At x Is})
	At - Tubular area per story	23,000	
506.2	**If - Area increase due to frontage (from below)**	0.68	If = F / P-0.25) W/30
	F- Bldg perimeter fronts public way w/ min. 20' (ft.)	799	
	P- Perimeter of entire building (ft.)	859	
	W- Width of public way	30	
506.3	**Is - Area increase due to sprinkler**	2	Sprinkler, > one story above grade
506.4	TOTAL AREA DETERMINATION	338,574	Area per floor x No. of stories
	MIXED USE AND OCCUPANCY		
508.3.1	**Accessory Occupancies**		
	A occupancy square footage	1101	
	Total Story square footage	34,431	
	Percentage	3.20%	Less than 10%
508.3.1.2	Allowable area/height calculated for main occupancy		
508.3.1.3	No Separation required for accessory occupancies		
6.0	**TYPE OF CONSTRUCTION**		Table 601
603.0	**Construction Classification**	**Type II B**	
Table 601	**Fire Resistance Ratings**	**Ratings**	
	Stuctural Frame	0	
	Bearing Walls	0	
	Exterior	0	
	Interior		
	Non Bearing Walls and partitions - Interior	0	
	Floor Construction	0	
	Roof Construction	0	
Table 602	Fire Resistance Ratings for Exterior Walls	0	

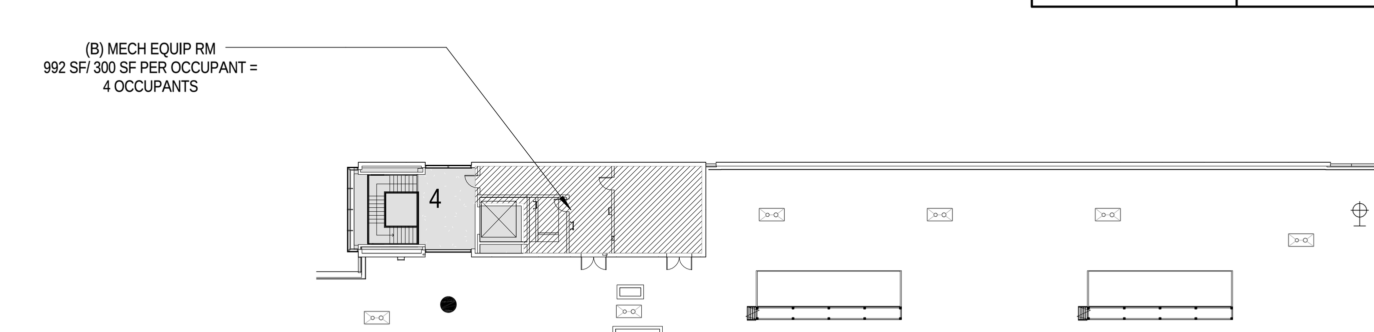
	CALIFORNIA BUILDING CODE (CONTINUED)		
7.0	**FIRE-RESISTANCE RATED CONSTRUCTION**		
	Exterior walls		
	Unexposed surface temperature		
704.7	Where protected openings not required ASTM E119 shall not apply		
Table 704.8	Buildings whose bearing, exterior non bearing wall exterior structural frame are not required to be fire		
Subnote i	resistance rated by Table 601 shall be permitted to have unlimited unprotected openings.		
	Parapets		
704.1	Parapets need not be provided when the wall is not required to be fire resistance rated per Table 602		
	Stairs		
707.2	Shaft Enclosure not required for stairs that are not a portion of the means of egress		Provide sprinklers or shutters per 707.2, 2.1 or 2,2
707.2.1	Convenience stair floor opening w/ full height scaled draft curtain and closely spaced sprinklers		Per 707.2.1 CBC
	Shafts		
707.4	Fire Resistance Rating Shafts (3 floors)	1 hour	
	Fire Resistance Rating Shafts (4 floors)	2 hour	
	Shaft Bottoms, either	Rated same as vertical shaft Smoke Dampers	
	Elevator Lobby		
707.14.1	Enclosed elevator lobby to match corridor rating	Non rated corridors	
Exception4	Sprinkler system installed throughout the building		
8.0	**INTERIOR FINISHES**		
	In addition to the requirements of the CBC/CFC, exposed interor wall or ceilings (including ceilings formed by the underside of roofs), and any factory installed facing material, shall have a UL-listed/FM-approved flame spread rating of 25 or less and a smoke developed rating of 50 or less per DOE-STD-1066-99.		
9.0	**FIRE PROTECTION SYSTEMS**		
	Sprinklers		Yes
	Sprinkler system not required under 18" high access floor per NFPA 13, 4-4.4.2(d) which occurs at Ground Level Office and Second Level Office		
	A wet-pipe sprinkler system will be provided under the 4'-0" high access floor which occurs at Computing Level		
	Standpipes		
	F] 905.3.1 Building height. Class III standpipe systems shall be installed throughout buildings where the floor level of the highest story is located more than 30 feet (9144 mm) above the lowest level of fire department vehicle access, or where the floor level of the lowest story is located more than 30 feet (9144 mm) below the highest level of fire department vehicle access.		
	Standpipes are provided in interior stairs 1 & 3, exterior stair 4 at Computing Level Landing, and along exterior fireman's walkay along the building west facade		
10.0	**MEANS OF EGRESS**		
1004.1	**Occupant Load**	**sq. footage / occupant load factor**	
	Second Floor - Conference Rooms	2,761 / 15 =	185
	Second Floor - Offices	25,896/ 100 =	259
	Second Floor - Elec / Mech Equip Room	1,097 / 300 =	4
	SECOND LEVEL OFFICE TOTAL OCCUPANCY		448
	Ground Floor - Conference Rooms	2,063/ 15	138
	Ground Floor - Offices	25,554 / 100 =	256
	Ground Floor - Classroom	1,247 / 20 =	63
	Ground Floor - Elec / Mech Equip Room	887 / 300 =	3
	GROUND LEVEL OFFICE TOTAL OCCUPANCY		460
	Computing Level - Elec / Mech Equip	30,039 / 300 =	101
	Computing Level - Computing / Mech Equip Room	8,887 / 300 =	30
	Computing Level - Offices	1,469 / 100	16
	COMPUTING LEVEL TOTAL OCCUPANCY		147
	Mechanical Sub Level	24,012 / 300 =	81
	Roof Level	992 / 300=	4
	Total Building Occupants		1,140
1005.1	**Minimum required egress width w/ sprinklers**	**stairways 44" clr min or 0.3**	**other egress components 32" clr min or 0.2**
	Second Level Office Floor Exiting Plan	0.3(449 total occ load/ 2 stairs) = 67.35"	0.2(449 occ/ 2 exits) = 44.9"
	Ground Level Office Floor Exiting Plan	NA	0.2(460 occ/ 2 exits) =46.0"
	Computing Level Exiting Plan	0.3(118total occ load/2 stairs) = 17.7"	0.2(118 occ/ 2 exits) = 11.8"
	Mechanical Sub Level Exiting Plan	NA	0.2(81 occ/ 2 exits) = 8.1"
	Roof Level	NA	0.2(4 occ/ 1 exits) = 0.8"
	Exit stairways - area of refuge required? L3/HPC?		
1007.3	48" clr width not req'd with sprinkler system		
1007.6	Size: (2) 30" x 48" wheelchairs	448 occupant load/4 spaces = 112	Min 1 per 200 people
	Width of stairways not less than 44"		
1009.1	Min headroom clearance of 80"	80"	
1009.2	Stair riser heights 4" min & 7" max		
1009.3	Stair tread depths shall be 11" min		
	Width of stairway landings shall	Maximum 12'	
1009.4	Vertical rise between landings	Not less than width of stairway	
1009.6	Spaces with one means of egress	A and B Occupancies - 49 or less	
1015.1	Exit Access Travel Distance	Two Means of egress when occupant load > 49	
1016.1	Corridor Resistance Rating	A Occupancy w/ Sprinklers	250 FEET
		B Occupancy w/ Sprinklers	300 FEET
1017.0		With sprinklers - non rated	
1017.3	Dead End Corridors (exception	50' Maximum Dead End Corridors	
1019.1	Min. number of Exits per story	1-500 - (2) exits required	
1025.3.1	Over 100 occupants requires 1 hour exiting		
11.0 B	**ACCESSIBILITY TO PUBLIC BUILDINGS, PUBLIC ACCOMMODATIONS, COMMERCIAL BUILDINGS, AND PUBLICLY FUNDED HOUSING**		
1103B.2	**Distance to Elevators**		
	Because it exceeds 200' to the nearest elevator, Stair 3 shall be used for emergency egress only.		

	CALIFORNIA FIRE CODE
D103.6.1	Roads 20 to 26 feet in width. Fire apparatus access roads 20 to 26 feet wide shall be posted on bothe sides as a fire lane.
D103.6.2	Roads more than 26 feet in width. Fire apparatus access roads more than 26 feet wide to 32 feet wide shall be posted on one side of the road as a fire lane.

	HAZARDOUS MATERIALS INVENTORY STATEMENT
	This is not a lab. Chemical inventory is limited to the following: typical office cleaning chemicals, UPS battery chemicals, diesel fuel (located outside), hydronic water treatment chemicals.
	NFPA 75
5.0	Construction Requirements
5.1.3	The information technology equipment area shall be separated from other occupancies within the building by fire-resistant-rated construction. The information technology equipment room shall be separated from other occupancies in the information technology equipment area by fire-resistant-rated construction. The fire resistance rating shall not be less than 1 hour.

CHEMICAL INVENTORY

CHEMICAL	PURPOSE	QUANTITY	LOCATION W/IN BUILDING	NOTES
DIESEL FUEL	GENERATOR FUEL	1300 GAL	BELLY TANK UNDER GENERATORS	
ALKEN	CHILLED WATER CORROSION INHIBITOR	10 GAL	MECHANICAL EQUIPMENT ROOMS	OTHER SIMILAR PRODUCTS MAY BE USED BY FACILITIES MAINTENANCE TEAM
TC-12150c BATTERY ELECTROLYTE	BATTERY ELECTROLYTE	281 GAL	SEALED IN BATTERIES IN UPS ROOM	NOTES
CLEANING CHEMICALS	GENERAL SANITATION	TBD	JANITOR'S CLOSETS	STAFF WILL DETERMINE TYPE AND QUANTITY



5 Roof Level Plan
1" = 30'-0"

DO NOT SCALE DRAWING. IF THIS DRAWING IS MODIFIED FROM THE ORIGINAL ARCH E (30.00 x 42.00 inches) IN SIZE THEN THE PRINT HAS BEEN REDUCED. SCALE NOTED ON DRAWING/DETAILS IS NO LONGER APPLICABLE.

PERKINS +WILL

185 Berry St., Lobby One
Suite 5100
San Francisco, California 94107
t 415.856.3000
f 415.856.3001
www.perkinswill.com

UC CRTF

UC Project No. 912314

Computational Research & Theory Facility

University of California
Berkeley, CA. 94720

Phase 2
Building Project

Revisions

NO	ISSUE	DATE
	90% Construction Documents	09/30/11
	Bid Documents	11/23/11
48	ASI-033	9/26/13

Sheet Information

Date	12/20/13
Job Number	497009
Drawn	P+W
Checked	P+W
Approved	P+W

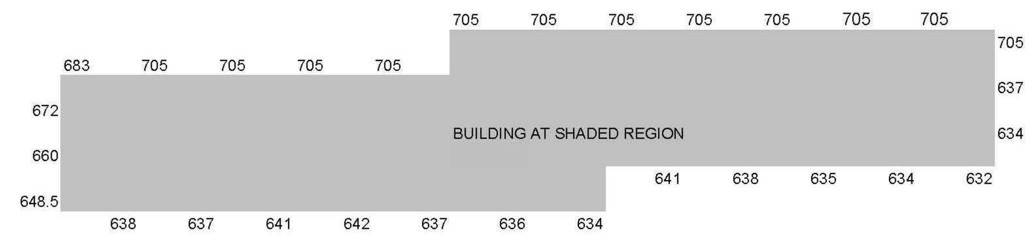
P2B Conformed Set
Bulletin #23

Code Compliance Data

Sheet
A-010

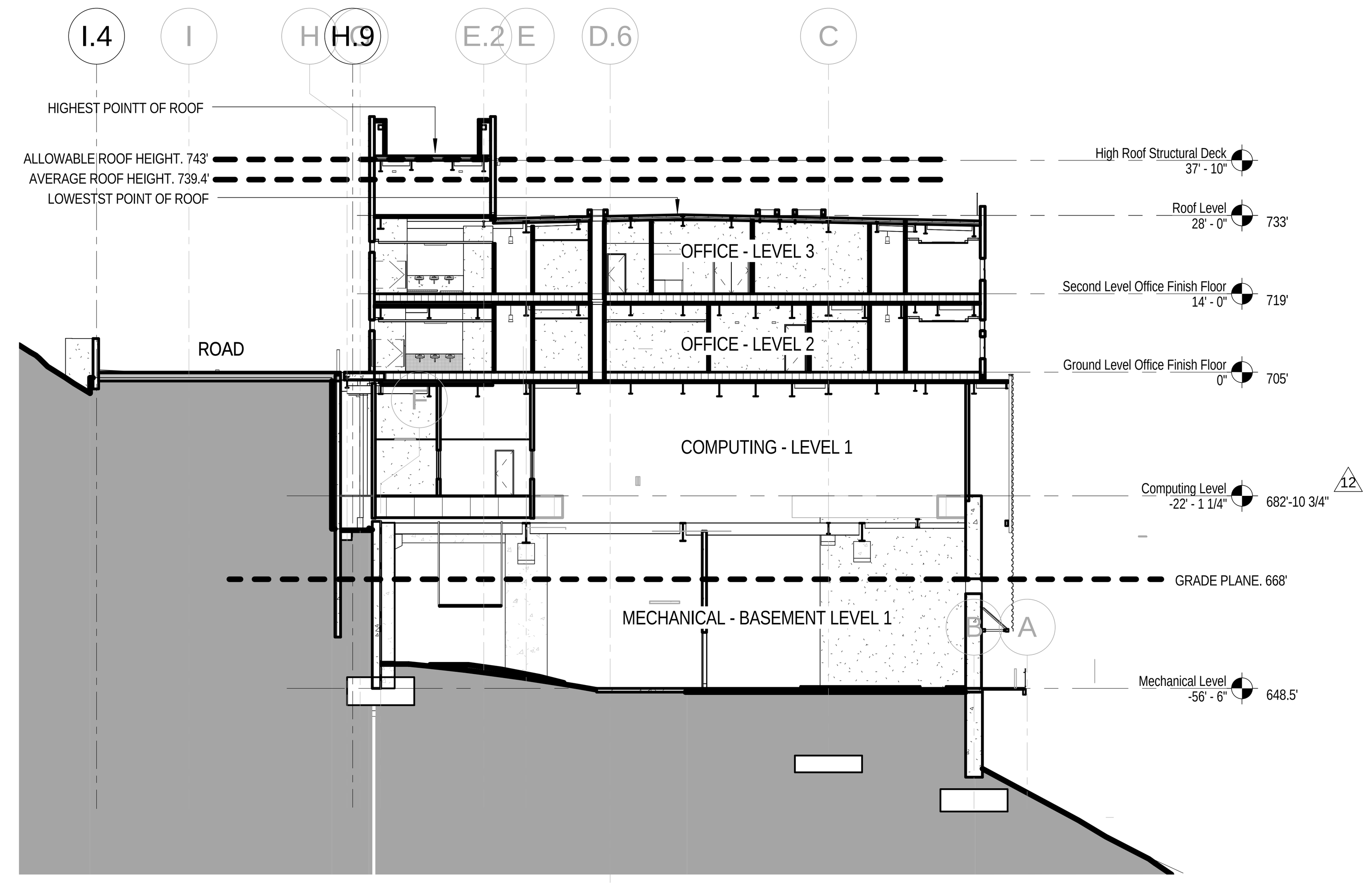
5N59A002

3/19/2014 12:17:18 PM
c:\temp\497009_CRTF_New_macostick.rvt



Allowable Maximum Height Calculation			
	Sum of all Points	20039.5	
	Number of Points	30	
	Average of Points	668	ESTABLISHED GRADE PLANE
	Allowable Height Type IIb	75	
	Allowable Height from Grade plane	743.0	ALLOWABLE HEIGHT BASED ON GRADE PLANE
Average Height of Roof			
	Lowest Point of Roof	733.75	
	Highest Point of Roof	745	
Allowable Maximum Height Calculation			
	Average Height of Building	739.4	HEIGHT OF BUILDING DESIGN
Average Height of Building		71.4	

4 Grade Plane and Height Calculation



3 Transverse Section
1" = 20'-0"

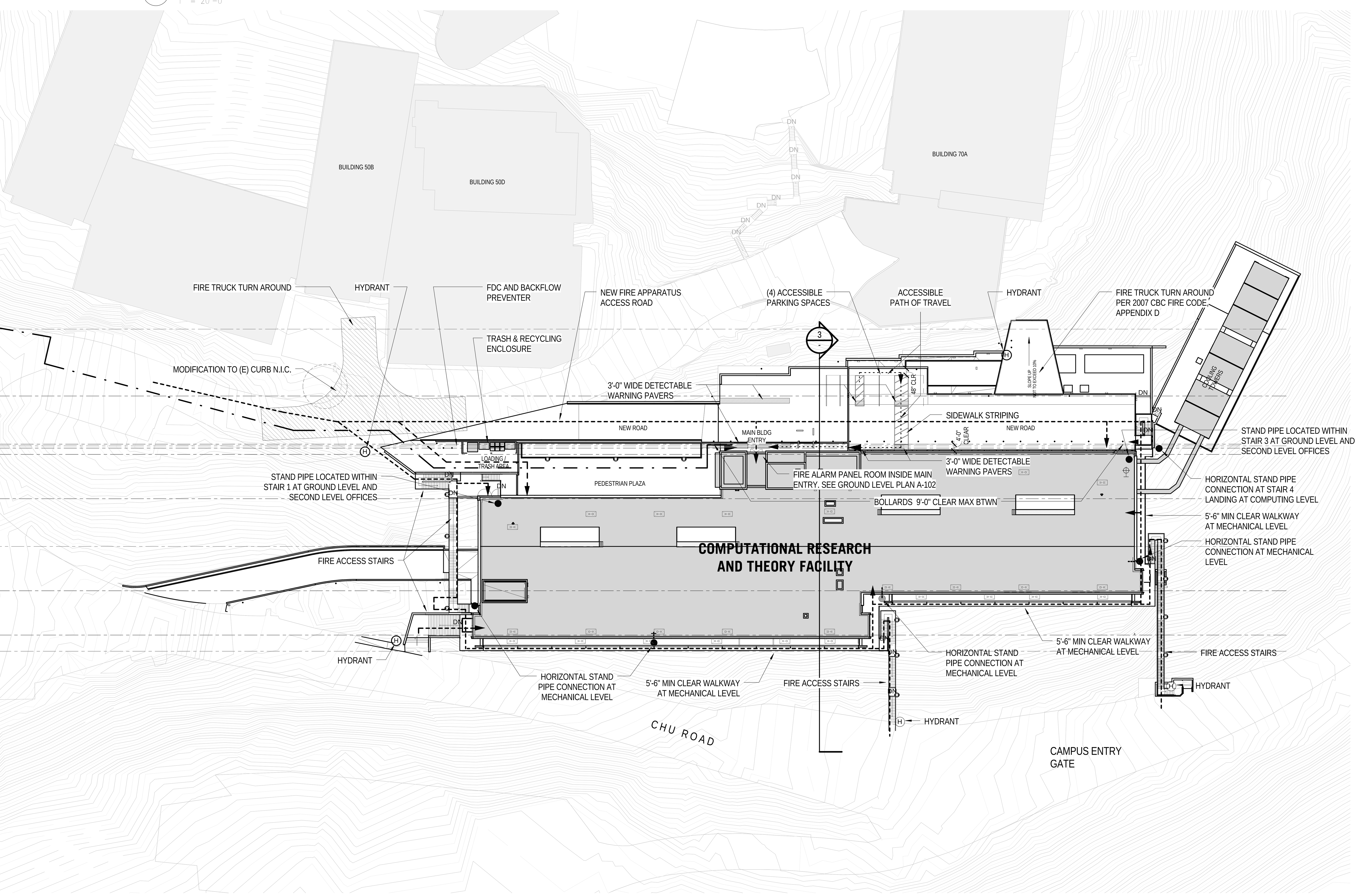
NOTES:
1) STANDPIPES ARE LOCATED WITHIN BUILDING INTERIOR STAIRS 1 & 3.

2) A CONCRETE WALL SHALL SEPARATE FDC/BFP FROM TRASH ENCLOSURE. SEE SHEET A-050A.

3) NO PARKING OR THROUGH TRAFFIC IS INTENDED BEYOND ACCESSIBLE PARKING SPACES.

4) SEE SHEET A-050 AND A-1101 FOR FIRE LANE AND ACCESSIBLE PARKING SIGNAGE

5) FOR ROADWAY GRADING, SEE CIVIL SHEET C2.1



SYMBOLS:

FIRE DEPT ACCESS ROUTE.

BUILDING ENTRY DOOR (ARROW)

ACCESSIBLE PATH OF TRAVEL

PATH OF TRAVEL TO/FROM PUBLIC TRANSPORTATION

STANDPIPE (DASHED) AND CONNECTION (DOT)

DETECTABLE WARNING PAVERS

FIRE HYDRANT. SEE CIVIL UTILITY DWG FOR NEW OR EXISTING

1 Site Life Safety and Accessibility Diagram
1" = 30'-0"

PERKINS + WILL

185 Berry St., Lobby One
Suite 5100
San Francisco, California 94107
t 415.856.3000
f 415.856.3001
www.perkinswill.com

UC CRTF

UC Project No. 912314

Computational Research & Theory Facility

University of California
Berkeley, CA. 94720

Phase 2
Building Project

LICENSED ARCHITECT MARC J. ARNOLD NO. C 21497 EXP. 8/31/15 STATE OF CALIFORNIA

Revisions

NO	ISSUE	DATE
	90% Construction Documents	09/30/11
	Bid Documents	11/23/11
12	P2B Bulletin 7	12/28/12

Sheet Information

Date	12/20/13
Job Number	497009
Drawn	P+W
Checked	P+W
Approved	P+W

P2B Conformed Set
Bulletin #23

Code Compliance Diagrams

Sheet
A-011

5N59A003

DO NOT SCALE DRAWING. IF THIS DRAWING IS MODIFIED FROM THE ORIGINAL ARCH E (30.00 x 42.00 inches) IN SIZE THEN THE PRINT HAS BEEN REDUCED. SCALE NOTED ON DRAWING/DETAILS IS NO LONGER APPLICABLE.

3/19/2014 12:18:04 PM
c:\temp\497009_CRTF_New_macosiok.rvt

PERKINS
+WILL

185 Berry St., Lobby One
Suite 5100
San Francisco, California 94107
t 415.856.3000
f 415.856.3001
www.perkinswill.com

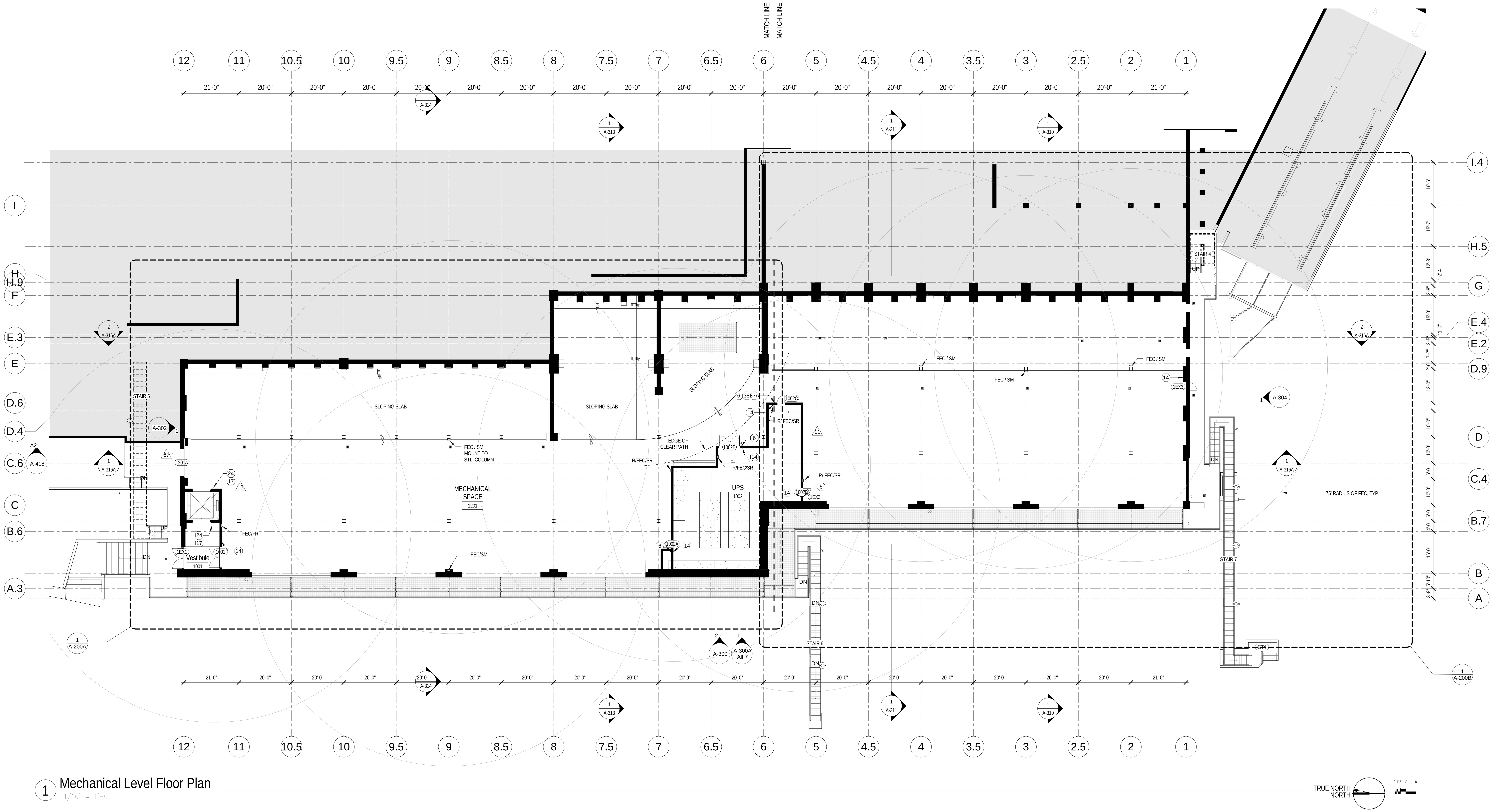
UC CRTF

UC Project No. 912314

Computational Research & Theory Facility

University of California
Berkeley, CA. 94720

Phase 2
Building Project



1 Mechanical Level Floor Plan
1/16" = 1'-0"

TRUE NORTH
NORTH

Revisions

NO	ISSUE	DATE
	90% Construction Documents	09/30/11
	Bid Documents	11/23/11
11	P2B Bulletin 5	12/12/12
12	P2B Bulletin 7	12/28/12
67	ASI-051	1/6/14

FLOOR PLAN SHEET NOTES

1. DIMENSIONS ARE TO FACE OF FINISH UNLESS OTHERWISE NOTED.

2. REFER TO A-810 FOR ALL SCHEDULED DOORS AND OPENINGS.

3. REFER TO A-801 FOR ALL SCHEDULED PARTITIONS.

4. REFER TO A-001 FOR TYPICAL SYMBOLS

5. REFER TO A-500A, A-500B AND A-811 FOR TYPICAL REQUIRED ACCESSIBLE CLEARANCES.

6. REFER TO A-500A AND A-500B FOR MOUNTING DETAILS

7. FOR EXTERIOR WALLS WITH FIRE RESISTIVE RATINGS, REFER TO EXTERIOR DETAILS

8. (1) REFER TO A-1100 SERIES FOR SIGNAGE LOCATIONS AND A-1100 AND A-1101 FOR SIGNAGE TYPES. PROVIDE SIGNS BY EACH PORTABLE FIRE EXTINQUISHER ON THE COMPUTING LEVEL PLAINLY INDICATING THE TYPE OF FIRE FOR WHICH IT IS INTENDED PER SECTION 8.3.3 OF NFPA 75

9. REFER TO SLB EDGE PLANS FOR FLOOR OPENINGS.

10. REFER TO SHEET A-840 FOR WOODWORK AND CASEWORK DETAILS.

11. REFER TO A-100 SERIES SHEETS FOR FIRE EXTINGUISHER LOCATIONS.

12. REFER TO DIS (DYNAMIC ISOLATION SYSTEMS, INC.) DRAWINGS FOR SEISMICALLY ISOLATED PLATFORM AND ACCESS FLOOR.

12. ACCESS FLOOR TYPE - 096900

AF-1 - TYPICAL AT OFFICE LEVELS UNLESS NOTED OTHERWISE.

AF-2 - OFFICE LEVELS IN ROOMS AS INDICATED IN THE SPECIFICATIONS. EXTENTS SHOWN WITH DIAGONAL HATCH ON A-202A AND A-203B.

AF-3 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. 300 PSF LOADING SEE FINISH SCHEDULE

AF-5 - COMPUTING LEVEL (ALT) AS SHOWN RECEIVES RF1 - TYP. 500 PSF LOADING SEE FINISH SCHEDULE

13. ACCESS FLOOR TYPE - 096900 (OVER SEISMICALLY ISOLATED PLATFORM - 096905)

AF-4 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. SEE FINISH SCHEDULE

14. REFER TO T AND SY SERIES SHEETS FOR TELECOM, AUDIO VISUAL AND SECURITY EQUIPMENT.

15. (X) REFER TO A-850 FOR EQUIPMENT SCHEDULE.

16. REFER TO A-807 FOR TYPICAL BACKING SUPPORT DETAILS.

17. FOR ACOUSTICAL AND FIRE RATED PARTITIONS SEE 2/A820 FOR TYP BOTTOM OF PARTITION DETAIL. FOR NON-RATED AND GENERAL ACOUSTIC PARTITIONS SEE 1/A820 FOR TYP BOTTOM OF PARTITION.

18. ALL EXPOSED STEEL TO RECEIVE HIGH PERFORMANCE COATING PER 099600.

19. SEE DETAILS ON A-805 FOR FEC DETAILS IN GYPSUM PARTIONS AND PLASTER WALLS SIDING. SURFACE MOUNT @ CONCRETE WALLS SIM.

20. ACCESS FLOOR PANELS ARE TO BE CUT AND TRIMED OUT AROUND EXPOSED BRACE FRAMES AND COLUMNS. CUT EDGE TO BE COVERED BY FLOOR BASE.

21. 1-HR RATED PARTITION

1-HR RATED PARTITION

22. 2-HR RATED PARTITION

2-HR RATED PARTITION

23. SMOKE PARTITION

SMOKE PARTITION

Sheet Information

Date	12/20/13
Job Number	497009
Drawn	P+W
Checked	P+W
Approved	P+W

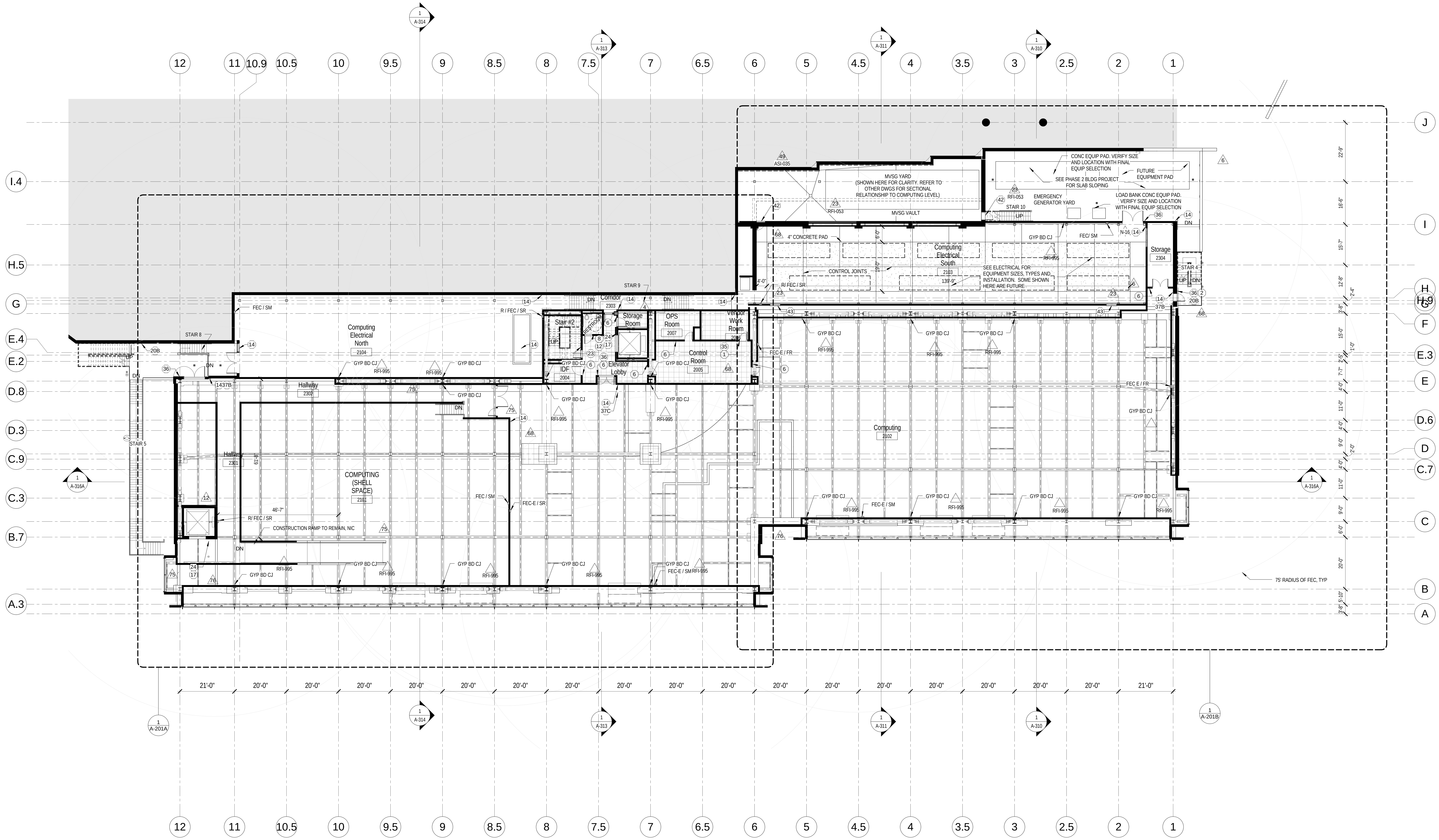
P2B Conformed Set
Bulletin #23

Mechanical Level Overall Plan

Sheet
A-100

5N59A010

DO NOT SCALE DRAWING. IF THIS DRAWING IS MODIFIED FROM THE ORIGINAL ARCH E (30.00 x 42.00 inches) IN SIZE THEN THE PRINT HAS BEEN REDUCED. SCALE NOTED ON DRAWING/DETAILS IS NO LONGER APPLICABLE.



1 Computing Level Overall Floor Plan
1/16" = 1'-0"

TRUE NORTH
NORTH

FLOOR PLAN SHEET NOTES

1. DIMENSIONS ARE TO FACE OF FINISH UNLESS OTHERWISE NOTED.

2. REFER TO A-810 FOR ALL SCHEDULED DOORS AND OPENINGS.

3. REFER TO A-801 FOR ALL SCHEDULED PARTITIONS.

4. REFER TO A-001 FOR TYPICAL SYMBOLS

5. REFER TO A-500A, A-500B AND A-811 FOR TYPICAL REQUIRED ACCESSIBLE CLEARANCES.

6. REFER TO A-500A AND A-500B FOR MOUNTING DETAILS

7. FOR EXTERIOR WALLS WITH FIRE RESISTIVE RATINGS, REFER TO EXTERIOR DETAILS

8. (1) REFER TO A-1100 SERIES FOR SIGNAGE LOCATIONS AND A-1100 AND A-1101 FOR SIGNAGE TYPES. PROVIDE SIGNS BY EACH PORTABLE FIRE EXTINQUISHER ON THE COMPUTING LEVEL PLAINLY INDICATING THE TYPE OF FIRE FOR WHICH IT IS INTENDED PER SECTION 8.3.3 OF NFPA 75

9. REFER TO SLB EDGE PLANS FOR FLOOR OPENINGS.

10. REFER TO SHEET A-840 FOR WOODWORK AND CASEWORK DETAILS.

11. REFER TO A-100 SERIES SHEETS FOR FIRE EXTINGUISHER LOCATIONS.

12. REFER TO DIS (DYNAMIC ISOLATION SYSTEMS, INC.) DRAWINGS FOR SEISMICALLY ISOLATED PLATFORM AND ACCESS FLOOR.

12. ACCESS FLOOR TYPE - 096900

AF-1 - TYPICAL AT OFFICE LEVELS UNLESS NOTED OTHERWISE.

AF-2 - OFFICE LEVELS IN ROOMS AS INDICATED IN THE SPECIFICATIONS. EXTENTS SHOWN WITH DIAGONAL HATCH ON A-202A AND A-203B.

AF-3 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. 300 PSF LOADING SEE FINISH SCHEDULE

AF-5 - COMPUTING LEVEL (ALT) AS SHOWN RECEIVES RF1 - TYP. 500 PSF LOADING SEE FINISH SCHEDULE

13. ACCESS FLOOR TYPE - 096900 (OVER SEISMICALLY ISOLATED PLATFORM - 096905)

AF-4 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. SEE FINISH SCHEDULE

14. REFER TO T AND SY SERIES SHEETS FOR TELECOM, AUDIO VISUAL AND SECURITY EQUIPMENT.

15. (X) REFER TO A-850 FOR EQUIPMENT SCHEDULE.

16. REFER TO A-807 FOR TYPICAL BACKING SUPPORT DETAILS.

17. FOR ACOUSTICAL AND FIRE RATED PARTITIONS SEE 2/A820 FOR TYP BOTTOM OF PARTITION DETAIL. FOR NON-RATED AND GENERAL ACOUSTIC PARTITIONS SEE 1/A820 FOR TYP BOTTOM OF PARTITION.

18. ALL EXPOSED STEEL TO RECEIVE HIGH PERFORMANCE COATING PER 099600.

19. SEE DETAILS ON A-805 FOR FEC DETAILS IN GYPSUM PARTIONS AND PLASTER WALLS SIDING. SURFACE MOUNT @ CONCRETE WALLS SIM.

20. ACCESS FLOOR PANELS ARE TO BE CUT AND TRIMED OUT AROUND EXPOSED BRACE FRAMES AND COLUMNS. CUT EDGE TO BE COVERED BY FLOOR BASE.

21. 1-HR RATED PARTITION
1-HR RATED PARTITION

22. 2-HR RATED PARTITION
2-HR RATED PARTITION

23. SMOKE PARTITION
SMOKE PARTITION

DO NOT SCALE DRAWING. IF THIS DRAWING IS MODIFIED FROM THE ORIGINAL ARCH E (30.00 x 42.00 inches) IN SIZE THEN THE PRINT HAS BEEN REDUCED. SCALE NOTED ON DRAWING/DETAILS IS NO LONGER APPLICABLE.

PERKINS +WILL
185 Berry St., Lobby One
Suite 5100
San Francisco, California 94107
t 415.856.3000
f 415.856.3001
www.perkinswill.com

UC CRTF

UC Project No. 912314

Computational Research & Theory Facility

University of California
Berkeley, CA. 94720

Phase 2 Building Project

Revisions

NO	ISSUE	DATE
	90% Construction Documents	09/30/11
	Bid Documents	11/23/11
4	Conformed Set	04/18/12
6	P2B Bulletin 2	07/27/12
12	P2B Bulletin 7	12/28/12
23	ASI-007	4/5/13
49	ASI-035	9/11/13
68	ASI-052	1/2/14
75	ASI-058	1/8/14
76	ASI-062	12/26/13
	RFI-995	12/12/13
80	ASI-065	1/8/14

N-16

Sheet Information

Date	12/20/13
Job Number	497009
Drawn	P+W
Checked	P+W
Approved	P+W

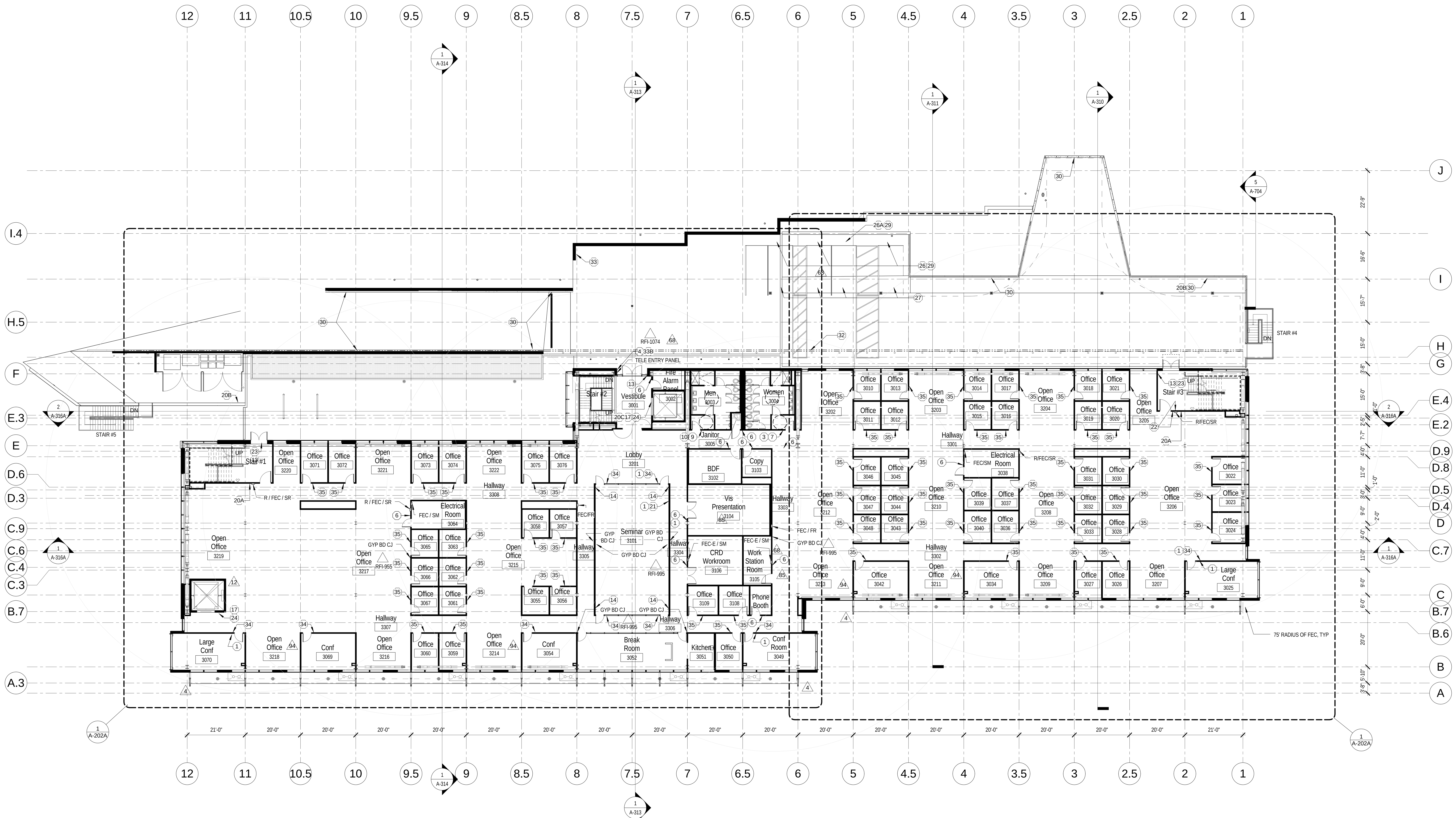
P2B Conformed Set
Bulletin #23

Computing Level Overall Floor Plan

Sheet
A-101

5N59A011

3/19/2014 12:21:30 PM



1 Ground Level Office Floor Plan
1/16" = 1'-0"

FLOOR PLAN SHEET NOTES

1. DIMENSIONS ARE TO FACE OF FINISH UNLESS OTHERWISE NOTED.

2. REFER TO A-810 FOR ALL SCHEDULED DOORS AND OPENINGS.

3. REFER TO A-801 FOR ALL SCHEDULED PARTITIONS.

4. REFER TO A-001 FOR TYPICAL SYMBOLS

5. REFER TO A-500A, A-500B AND A-811 FOR TYPICAL REQUIRED ACCESSIBLE CLEARANCES.

6. REFER TO A-500A AND A-500B FOR MOUNTING DETAILS

7. FOR EXTERIOR WALLS WITH FIRE RESISTIVE RATINGS, REFER TO EXTERIOR DETAILS

8. (1) REFER TO A-1100 SERIES FOR SIGNAGE LOCATIONS AND A-1100 AND A-1101 FOR SIGNAGE TYPES. PROVIDE SIGNS BY EACH PORTABLE FIRE EXTINQUISHER ON THE COMPUTING LEVEL PLAINLY INDICATING THE TYPE OF FIRE FOR WHICH IT IS INTENDED PER SECTION 8.3.3 OF NFPA 75

9. REFER TO SLB EDGE PLANS FOR FLOOR OPENINGS.

10. REFER TO SHEET A-840 FOR WOODWORK AND CASEWORK DETAILS.

11. REFER TO A-100 SERIES SHEETS FOR FIRE EXTINGUISHER LOCATIONS.

12. REFER TO DIS (DYNAMIC ISOLATION SYSTEMS, INC.) DRAWINGS FOR SEISMICALLY ISOLATED PLATFORM AND ACCESS FLOOR.

12. ACCESS FLOOR TYPE - 096900

AF-1 - TYPICAL AT OFFICE LEVELS UNLESS NOTED OTHERWISE.

AF-2 - OFFICE LEVELS IN ROOMS AS INDICATED IN THE SPECIFICATIONS. EXTENTS SHOWN WITH DIAGONAL HATCH ON A-202A AND A-203B.

AF-3 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. 300 PSF LOADING SEE FINISH SCHEDULE

AF-5 - COMPUTING LEVEL (ALT) AS SHOWN RECEIVES RF1 - TYP. 500 PSF LOADING SEE FINISH SCHEDULE

13. ACCESS FLOOR TYPE - 096900 (OVER SEISMICALLY ISOLATED PLATFORM - 096905)

AF-4 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. SEE FINISH SCHEDULE

14. REFER TO T AND SY SERIES SHEETS FOR TELECOM, AUDIO VISUAL AND SECURITY EQUIPMENT.

15. (X) REFER TO A-850 FOR EQUIPMENT SCHEDULE.

16. REFER TO A-807 FOR TYPICAL BACKING SUPPORT DETAILS.

17. FOR ACOUSTICAL AND FIRE RATED PARTITIONS SEE 2/A820 FOR TYP BOTTOM OF PARTITION DETAIL. FOR NON-RATED AND GENERAL ACOUSTIC PARTITIONS SEE 1/A820 FOR TYP BOTTOM OF PARTITION.

18. ALL EXPOSED STEEL TO RECEIVE HIGH PERFORMANCE COATING PER 099600.

19. SEE DETAILS ON A-805 FOR FEC DETAILS IN GYPSUM PARTIONS AND PLASTER WALLS SIDING. SURFACE MOUNT @ CONCRETE WALLS SIM.

20. ACCESS FLOOR PANELS ARE TO BE CUT AND TRIMED OUT AROUND EXPOSED BRACE FRAMES AND COLUMNS. CUT EDGE TO BE COVERED BY FLOOR BASE.

21. 1-HR RATED PARTITION

1-HR RATED PARTITION

22. 2-HR RATED PARTITION

2-HR RATED PARTITION

23. SMOKE PARTITION

SMOKE PARTITION

TRUE NORTH
NORTH

DO NOT SCALE DRAWING. IF THIS DRAWING IS MODIFIED FROM THE ORIGINAL ARCH E (30.00 x 42.00 inches) IN SIZE THEN THE PRINT HAS BEEN REDUCED. SCALE NOTED ON DRAWING/DETAILS IS NO LONGER APPLICABLE.

PERKINS
+WILL

185 Berry St., Lobby One
Suite 5100
San Francisco, California 94107
t 415.856.3000
f 415.856.3001
www.perkinswill.com

UC CRTF

UC Project No. 912314

Computational Research & Theory Facility

University of California
Berkeley, CA. 94720

Phase 2
Building Project

Revisions

NO	ISSUE	DATE
	90% Construction Documents	09/30/11
	Bid Documents	11/23/11
	P2B Addendum 1	12/20/11
	P2B Addendum 2	01/17/12
4	Conformed Set	04/18/12
12	P2B Bulletin 7	12/28/12
68	ASI-052	1/2/14
	RFI-995	12/12/13
	RFI-1074	1/6/14
85	Bltn-21	3/13/14
94	Bltn-22	3/18/14

Sheet Information

Date	12/20/13
Job Number	497009
Drawn	Author
Checked	Checker
Approved	Approver

**P2B Conformed Set
Bulletin #23**

Ground Level Office Overall Floor Plan

Sheet

A-102

5N59A012

3/19/2014 12:21:43 PM
c:\temp\497009_CRTF_New_macosiak.rvt

1 Second Level Office Floor Plan

1/16" = 1'-0"

FLOOR PLAN SHEET NOTES

1. DIMENSIONS ARE TO FACE OF FINISH UNLESS OTHERWISE NOTED.

2. REFER TO A-810 FOR ALL SCHEDULED DOORS AND OPENINGS.

3. REFER TO A-801 FOR ALL SCHEDULED PARTITIONS.

4. REFER TO A-001 FOR TYPICAL SYMBOLS

5. REFER TO A-500A, A-500B AND A-811 FOR TYPICAL REQUIRED ACCESSIBLE CLEARANCES.

6. REFER TO A-500A AND A-500B FOR MOUNTING DETAILS

7. FOR EXTERIOR WALLS WITH FIRE RESISTIVE RATINGS, REFER TO EXTERIOR DETAILS

8. (1) REFER TO A-1100 SERIES FOR SIGNAGE LOCATIONS AND A-1100 AND A-1101 FOR SIGNAGE TYPES. PROVIDE SIGNS BY EACH PORTABLE FIRE EXTINQUISHER ON THE COMPUTING LEVEL PLAINLY INDICATING THE TYPE OF FIRE FOR WHICH IT IS INTENDED PER SECTION 8.3.3 OF NFPA 75

9. REFER TO SLB EDGE PLANS FOR FLOOR OPENINGS.

10. REFER TO SHEET A-840 FOR WOODWORK AND CASEWORK DETAILS.

11. REFER TO A-100 SERIES SHEETS FOR FIRE EXTINGUISHER LOCATIONS.

12. REFER TO DIS (DYNAMIC ISOLATION SYSTEMS, INC.) DRAWINGS FOR SEISMICALLY ISOLATED PLATFORM AND ACCESS FLOOR.

12. ACCESS FLOOR TYPE - 096900

AF-1 - TYPICAL AT OFFICE LEVELS UNLESS NOTED OTHERWISE.

AF-2 - OFFICE LEVELS IN ROOMS AS INDICATED IN THE SPECIFICATIONS. EXTENTS SHOWN WITH DIAGONAL HATCH ON A-202A AND A-203B.

AF-3 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. 300 PSF LOADING SEE FINISH SCHEDULE

AF-5 - COMPUTING LEVEL (ALT) AS SHOWN RECEIVES RF1 - TYP. 500 PSF LOADING SEE FINISH SCHEDULE

13. ACCESS FLOOR TYPE - 096900 (OVER SEISMICALLY ISOLATED PLATFORM - 096905)

AF-4 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. SEE FINISH SCHEDULE

14. REFER TO T AND SY SERIES SHEETS FOR TELECOM, AUDIO VISUAL AND SECURITY EQUIPMENT.

15. (X) REFER TO A-850 FOR EQUIPMENT SCHEDULE.

16. REFER TO A-807 FOR TYPICAL BACKING SUPPORT DETAILS.

17. FOR ACOUSTICAL AND FIRE RATED PARTITIONS SEE 2/A820 FOR TYP BOTTOM OF PARTITION DETAIL. FOR NON-RATED AND GENERAL ACOUSTIC PARTITIONS SEE 1/A820 FOR TYP BOTTOM OF PARTITION.

18. ALL EXPOSED STEEL TO RECEIVE HIGH PERFORMANCE COATING PER 099600.

19. SEE DETAILS ON A-805 FOR FEC DETAILS IN GYPSUM PARTIONS AND PLASTER WALLS SIDING. SURFACE MOUNT @ CONCRETE WALLS SIM.

20. ACCESS FLOOR PANELS ARE TO BE CUT AND TRIMED OUT AROUND EXPOSED BRACE FRAMES AND COLUMNS. CUT EDGE TO BE COVERED BY FLOOR BASE.

21. 1-HR RATED PARTITION — 1-HR RATED PARTITION

22. 2-HR RATED PARTITION — 2-HR RATED PARTITION

23. SMOKE PARTITION — SMOKE PARTITION

TRUE NORTH
NORTH

DO NOT SCALE DRAWING. IF THIS DRAWING IS MODIFIED FROM THE ORIGINAL ARCH E (30.00 x 42.00 inches) IN SIZE THEN THE PRINT HAS BEEN REDUCED. SCALE NOTED ON DRAWING/DETAILS IS NO LONGER APPLICABLE.

PERKINS +WILL

185 Berry St., Lobby One
Suite 5100
San Francisco, California 94107
t 415.856.3000
f 415.856.3001
www.perkinswill.com

UC CRTF

UC Project No. 912314

Computational Research & Theory Facility

University of California
Berkeley, CA. 94720

Phase 2 Building Project

Revisions

NO	ISSUE	DATE
	90% Construction Documents	09/30/11
	Bid Documents	11/23/11
	P2B Addendum 1	12/20/11
	P2B Addendum 2	01/17/12
4	Conformed Set	04/18/12
12	P2B Bulletin 7	12/28/12
68	ASI-052	1/2/14
	RFI-995	12/12/13
85	Bltn-21	3/13/14

Sheet Information

Date	12/20/13
Job Number	497009
Drawn	Author
Checked	Checker
Approved	Approver

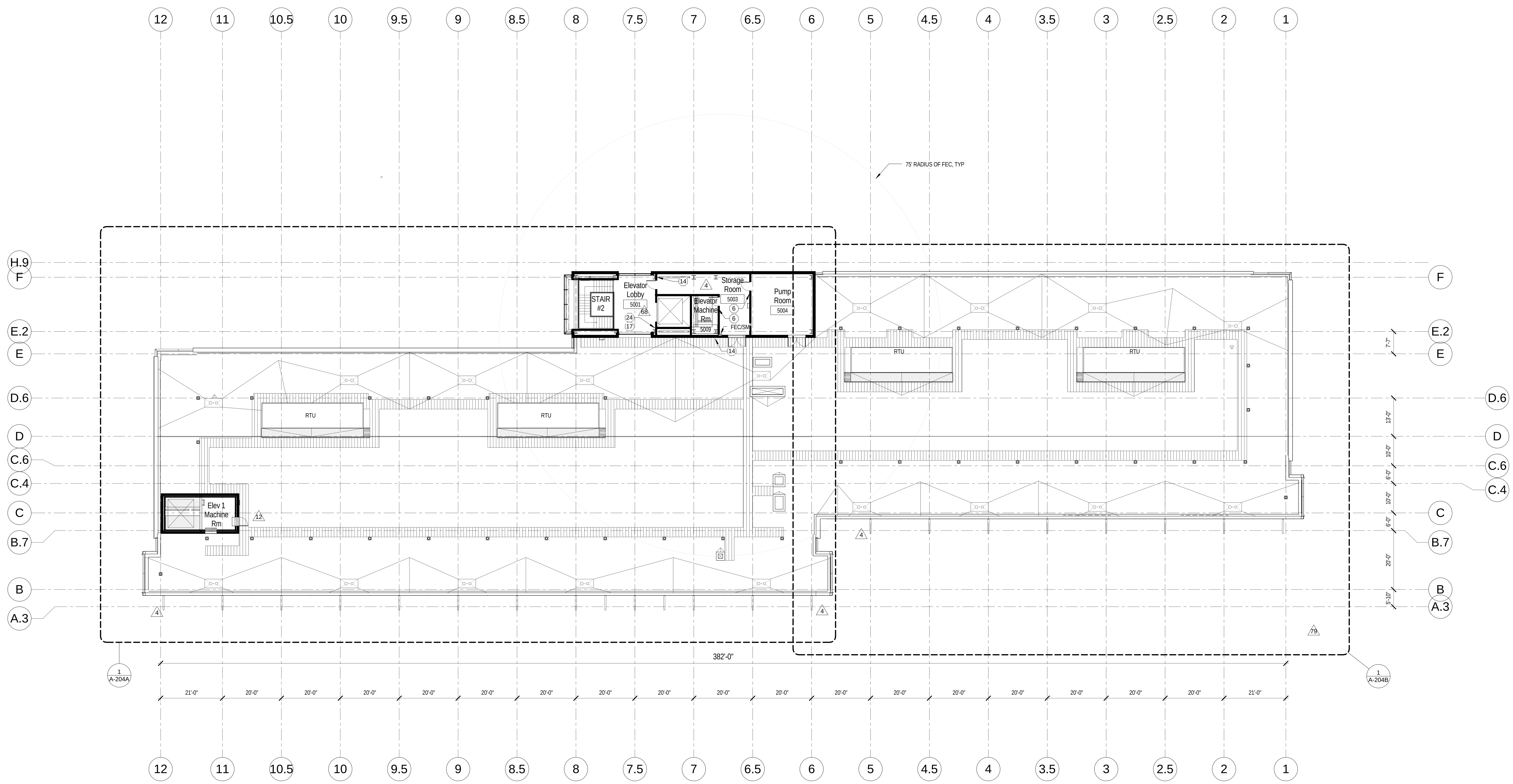
P2B Conformed Set
Bulletin #23

Second Level Office Overall Floor Plan

Sheet
A-103

5N59A013

3/19/2014 12:21:57 PM
c:\temp\497009_CRTF_New_macosko k.rvt



1 Roof Level Plan
1/16" = 1'-0"

FLOOR PLAN SHEET NOTES

1. DIMENSIONS ARE TO FACE OF FINISH UNLESS OTHERWISE NOTED.

2. REFER TO A-810 FOR ALL SCHEDULED DOORS AND OPENINGS.

3. REFER TO A-801 FOR ALL SCHEDULED PARTITIONS.

4. REFER TO A-001 FOR TYPICAL SYMBOLS

5. REFER TO A-500A, A-500B AND A-811 FOR TYPICAL REQUIRED ACCESSIBLE CLEARANCES.

6. REFER TO A-500A AND A-500B FOR MOUNTING DETAILS

7. FOR EXTERIOR WALLS WITH FIRE RESISTIVE RATINGS, REFER TO EXTERIOR DETAILS

8. (1) REFER TO A-1100 SERIES FOR SIGNAGE LOCATIONS AND A-1100 AND A-1101 FOR SIGNAGE TYPES. PROVIDE SIGNS BY EACH PORTABLE FIRE EXTINQUISHER ON THE COMPUTING LEVEL PLAINLY INDICATING THE TYPE OF FIRE FOR WHICH IT IS INTENDED PER SECTION 8.3.3 OF NFPA 75

9. REFER TO SLB EDGE PLANS FOR FLOOR OPENINGS.

10. REFER TO SHEET A-840 FOR WOODWORK AND CASEWORK DETAILS.

11. REFER TO A-100 SERIES SHEETS FOR FIRE EXTINGUISHER LOCATIONS.

12. REFER TO DIS (DYNAMIC ISOLATION SYSTEMS, INC.) DRAWINGS FOR SEISMICALLY ISOLATED PLATFORM AND ACCESS FLOOR.

12. ACCESS FLOOR TYPE - 096900
- AF-1 - TYPICAL AT OFFICE LEVELS UNLESS NOTED OTHERWISE.
- AF-2 - OFFICE LEVELS IN ROOMS AS INDICATED IN THE SPECIFICATIONS. EXTENTS SHOWN WITH DIAGONAL HATCH ON A-202A AND A-203B.
- AF-3 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. 300 PSF LOADING SEE FINISH SCHEDULE
- AF-5 - COMPUTING LEVEL (ALT) AS SHOWN RECEIVES RF1 - TYP. 500 PSF LOADING SEE FINISH SCHEDULE

13. ACCESS FLOOR TYPE - 096900 (OVER SEISMICALLY ISOLATED PLATFORM - 096905)
- AF-4 - COMPUTING LEVEL AS SHOWN RECEIVES RF1 - TYP. SEE FINISH SCHEDULE

14. REFER TO T AND SY SERIES SHEETS FOR TELECOM, AUDIO VISUAL AND SECURITY EQUIPMENT.

15. (X) REFER TO A-850 FOR EQUIPMENT SCHEDULE.

16. REFER TO A-807 FOR TYPICAL BACKING SUPPORT DETAILS.

17. FOR ACOUSTICAL AND FIRE RATED PARTITIONS SEE 2/A820 FOR TYP BOTTOM OF PARTITION DETAIL. FOR NON-RATED AND GENERAL ACOUSTIC PARTITIONS SEE 1/A820 FOR TYP BOTTOM OF PARTITION.

18. ALL EXPOSED STEEL TO RECEIVE HIGH PERFORMANCE COATING PER 099600.

19. SEE DETAILS ON A-805 FOR FEC DETAILS IN GYPSUM PARTIONS AND PLASTER WALLS SIDING. SURFACE MOUNT @ CONCRETE WALLS SIM.

20. ACCESS FLOOR PANELS ARE TO BE CUT AND TRIMED OUT AROUND EXPOSED BRACE FRAMES AND COLUMNS. CUT EDGE TO BE COVERED BY FLOOR BASE.

21. 1-HR RATED PARTITION
1-HR RATED PARTITION

22. 2-HR RATED PARTITION
2-HR RATED PARTITION

23. SMOKE PARTITION
SMOKE PARTITION

TRUE NORTH
NORTH

DO NOT SCALE DRAWING. IF THIS DRAWING IS MODIFIED FROM THE ORIGINAL ARCH E (30.00 x 42.00 inches) IN SIZE THEN THE PRINT HAS BEEN REDUCED. SCALE NOTED ON DRAWING/DETAILS IS NO LONGER APPLICABLE.

3/19/2014 12:22:08 PM
c:\temp\497009_CRTF_New_macostiok.rvt

PERKINS + WILL

185 Berry St., Lobby One
Suite 5100
San Francisco, California 94107
t 415.856.3000
f 415.856.3001
www.perkinswill.com

UC CRTF

UC Project No. 912314

Computational Research & Theory Facility

University of California
Berkeley, CA. 94720

Phase 2
Building Project

Revisions

NO	ISSUE	DATE
	90% Construction Documents	09/30/11
	Bid Documents	11/23/11
4	Conformed Set	04/18/12
12	P2B Bulletin 7	12/28/12
68	ASI-052	1/2/14
79	ASI-063	12/13/13

Sheet Information

Date	12/20/13
Job Number	497009
Drawn	Author
Checked	Checker
Approved	Approver

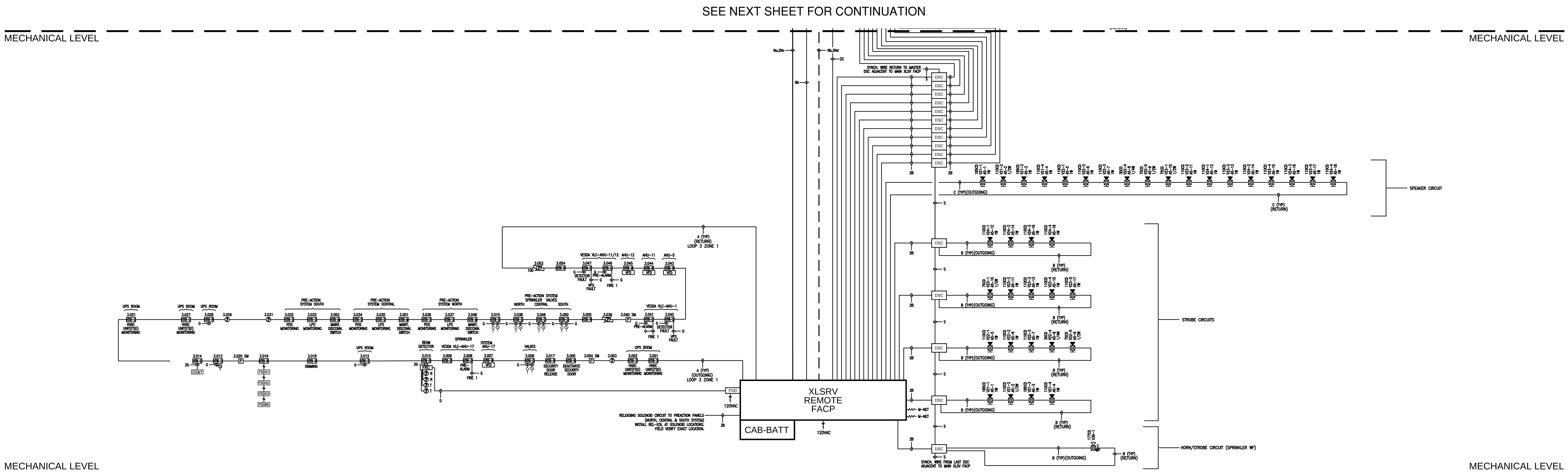
P2B Conformed Set
Bulletin #23

Roof Level Overall Plan

Sheet
A-104

5N59A014

Appendix 4: Building Fire Alarm Drawings



FIRE ALARM RISER DIAGRAM

SHEET NOTE:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR SIEMENS INDUSTRY LIC. NO. 758796 STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS):

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY
One Cyclotron Road, Berkeley, California 94720

SHEET CONTENTS:

FIRE ALARM RISER DIAGRAM MECHANICAL LEVEL

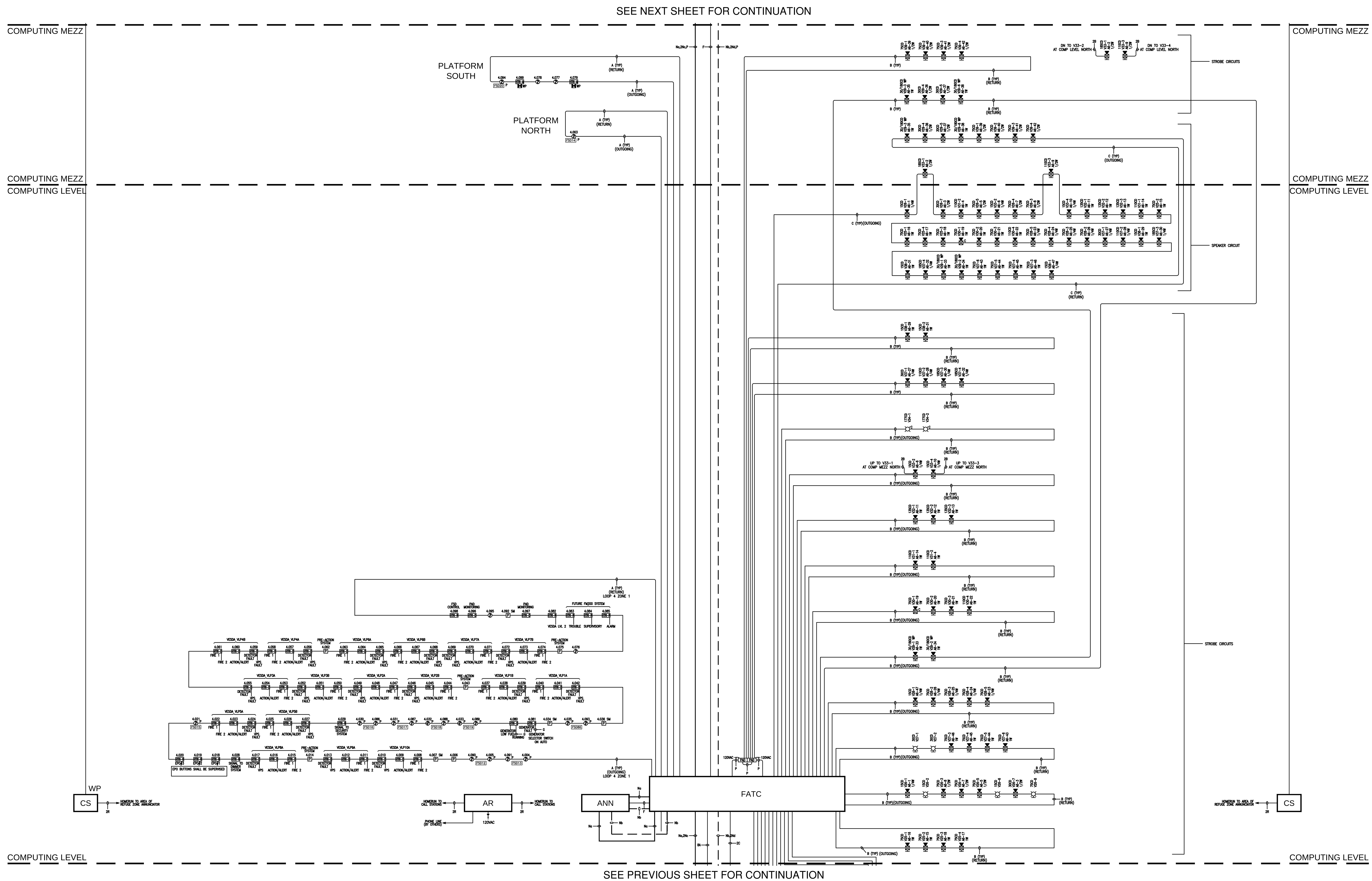
INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-11
SCALE:	Not Applicable
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA-11	JOB NUMBER: 44OP-116361

DRAWING NO.

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR
SIEMENS INDUSTRY
LIC. NO. 758796
STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com ©

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY
One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

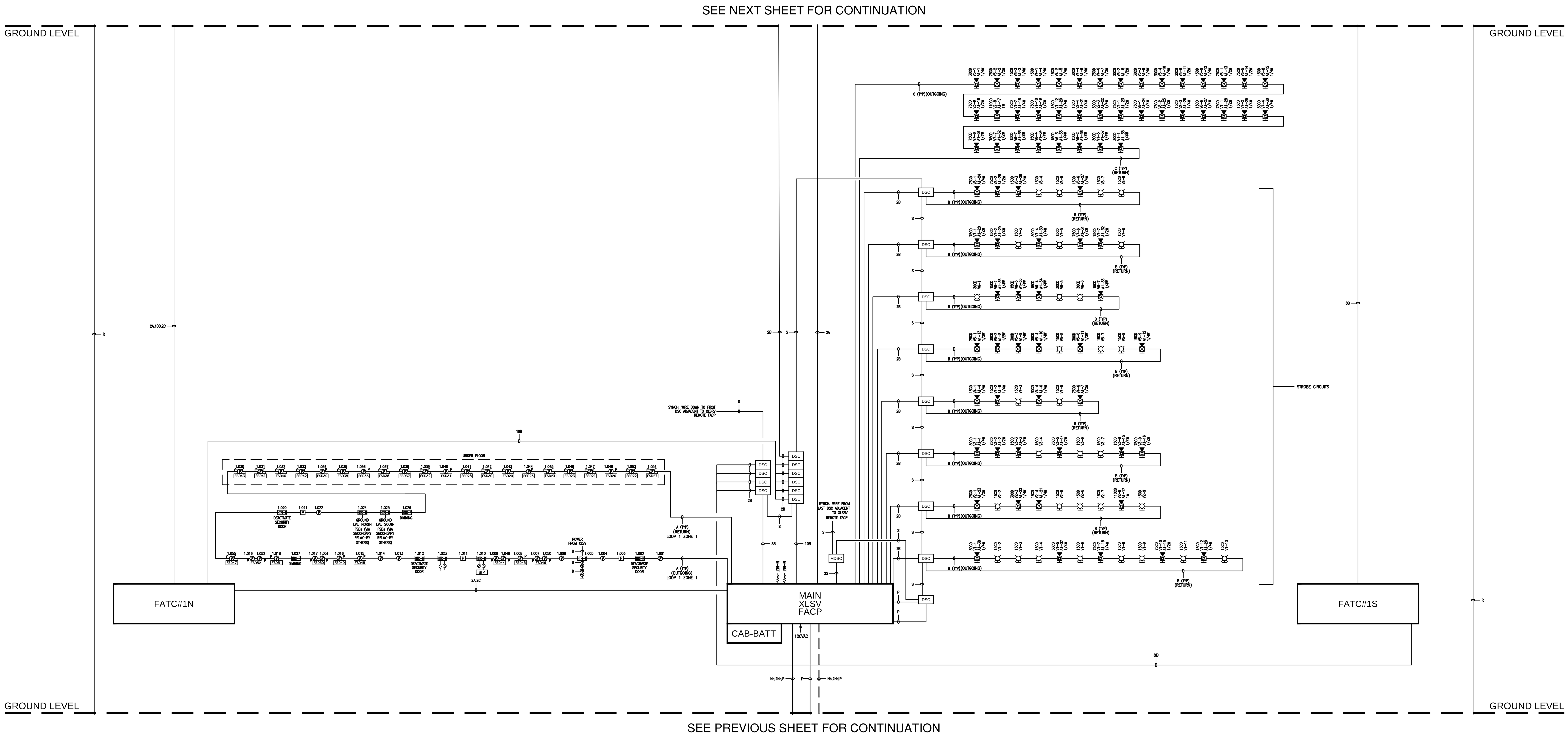
FIRE ALARM RISER DIAGRAM
COMPUTING LEVEL

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-11
SCALE:	Not Applicable
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA-12	JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR
SIEMENS INDUSTRY
LIC. NO. 758796
STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com ©

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY

One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

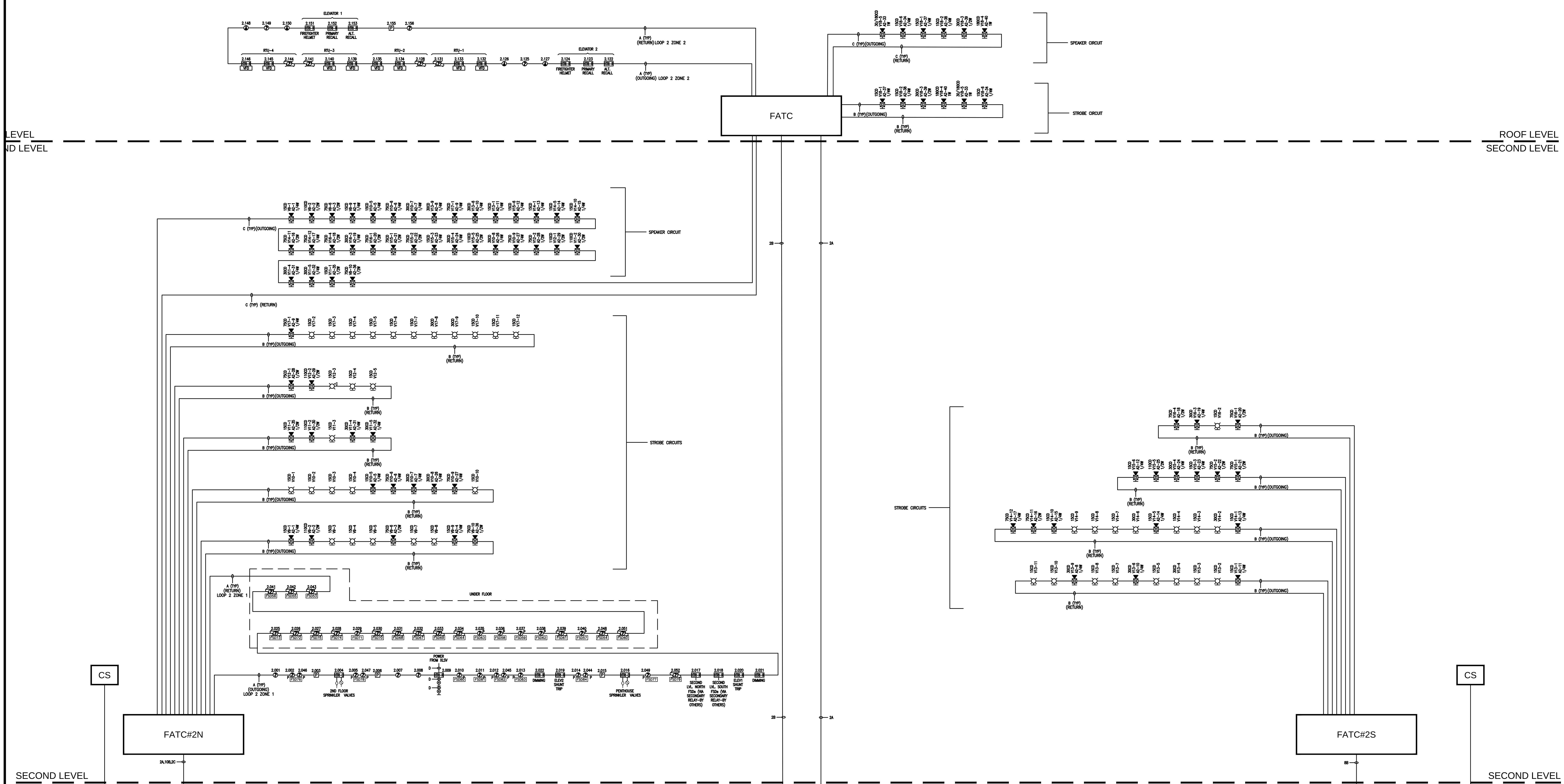
FIRE ALARM RISER DIAGRAM GROUND LEVEL

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.: Kevin Waxman
PROJECT MANAGER: Keith Posey
DRAWN BY: DH-EJ
CAD FILENAME: FA-11
SCALE: Not Applicable
DATE DRAWN: August 1, 2012
PLOT DATE: July 21, 2015
DRAWING NO.
SHEET: FA-12A
JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SEE PREVIOUS SHEET FOR CONTINUATION

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR SIEMENS INDUSTRY LIC. NO. 758796 STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com ©

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY

One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

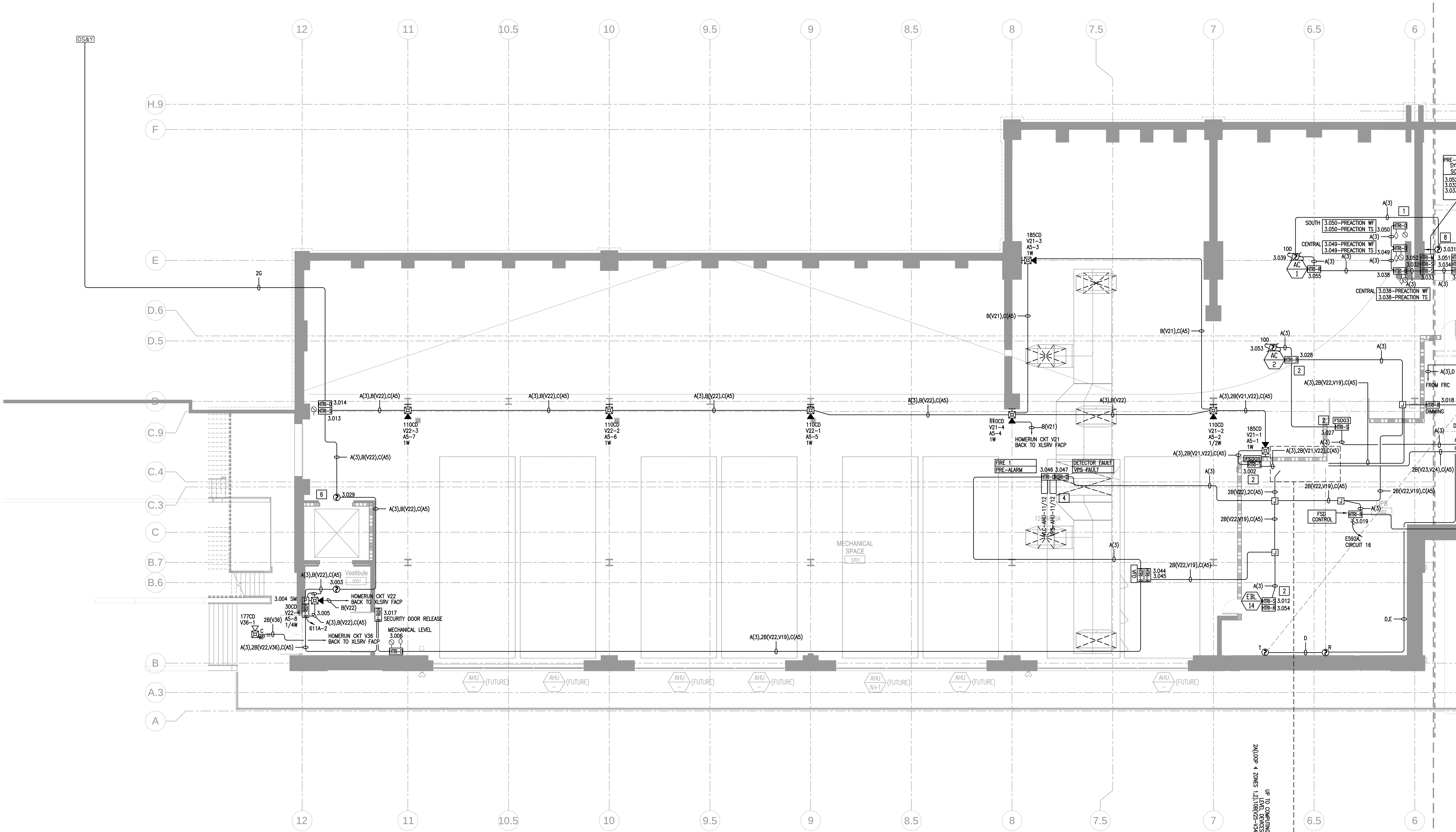
FIRE ALARM RISER DIAGRAM SECOND LEVEL - ROOF

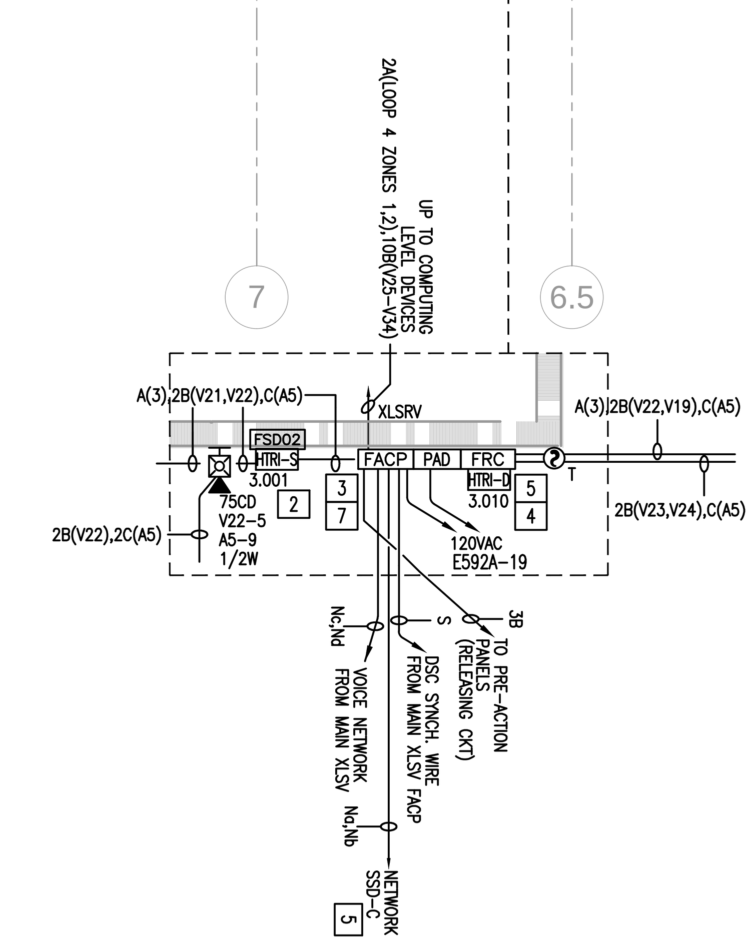
INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-11
SCALE:	Not Applicable
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA-12B	JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY





SHEET NOTES:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)
2 ALL FIRE/SMOKE DAMPERS ON THIS FLOOR ARE TO BE CIRCUITED TO PANEL E592A, CIRCUITS 16 AND 18. NO MORE THAN (15) FIRE/SMOKE DAMPERS MAY BE CONNECTED TO THE SAME CIRCUIT.
3. CEILING HEIGHT FOR UPS ROOM IS 28.5'. PLEASE REFER TO THE PLANS THIS SHEET FOR BEAM DIMENSION.
4. BEAM DEPTHS > (0.1xCEILING HEIGHT) + BEAM SPACING > (0.4H) = BEAM POCKET PER NFPA 72 2007 CH 5. SMOKE DETECTORS ARE LOCATED IN EACH BAY POCKET FORMED BY BEAMS.

KEYED NOTES:

1 DEACTIVATE SECURITY DOOR UPON ALARM.

2 ALL HVAC EQUIPMENT SERVING UPS ROOM SHALL BE MONITORED BY FACP.

3 REMOTE XLSRV FACP. REFER TO SHEET FA-11-12 FOR FIRE ALARM NETWORK DIAGRAM AND SHEET FA-05 FOR WIRING DETAILS.

4 VESDA LASER COMPACT(VLC) DETECTOR WITH VESDA POWER SUPPLY(VPS) & MONITOR MODULES. VESDA POWER SUPPY(VPS) MAY BE LOCATED BELOW THE VESDA DETECTOR. (TYPICAL)

5 ADDRESSABLE MODULE FOR FIRE RAY BEAM DETECTOR CONTROLLER ALARM AND TROUBLE MONITORING.

6 WALL MOUNT SMOKE DETECTOR ON WALL WITHIN 60" OF THE TOP OF ELEVATOR DOOR.

Fire Alarm Plan -
Mechanical Level North
1/8" = 1'-0"

TRUE NORTH
NORTH

R E V I S I O N S

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR
SIEMENS INDUSTRY
LIC. NO. 758796
STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com ©

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY
One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

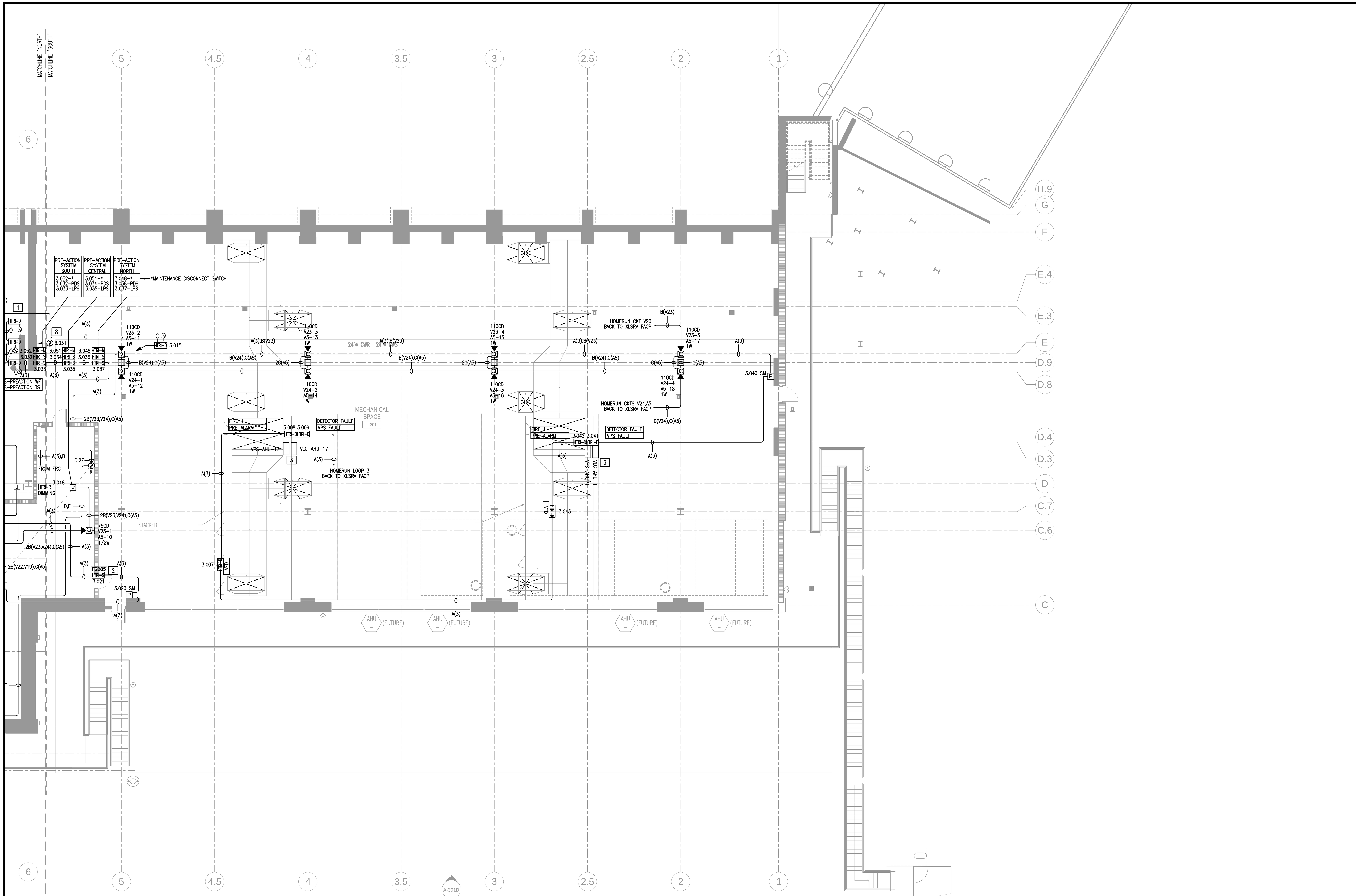
FIRE ALARM PLAN -
MECHANICAL LEVEL NORTH

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-13
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA-13	JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SHEET NOTES:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)
2. ALL FIRE/SMOKE DAMPERS ON THIS FLOOR ARE TO BE CIRCUITED TO PANEL E592A, CIRCUITS 16 AND 18. NO MORE THAN (15) FIRE/SMOKE DAMPERS MAY BE CONNECTED TO THE SAME CIRCUIT.
3. CEILING HEIGHT FOR UPS ROOM IS 30'. PLEASE REFER TO THE PLANS THIS SHEET FOR BEAM DIMENSION.
4. BEAM DEPTHS > (0.1xCEILING HEIGHT) = BEAM POCKET PER NFPA 72 2007 CH 5. SMOKE DETECTORS ARE LOCATED IN EACH BAY POCKETS FORMED BY BEAMS.

KEYED NOTES:

1. PRE-ACTION SYSTEM CONTROL PANELS(BY OTHERS).
2. ALL HVAC EQUIPMENT SERVING UPS ROOM SHALL BE MONITORED BY FACP.
3. VESDA LASER COMPACT(VLC) DETECTOR WITH VESDA POWER SUPPLY(VPS) & MONITOR MODULES. VESDA POWER SUPPY(VPS) MAY BE LOCATED BELOW THE VESDA DETECTOR. (TYPICAL)
4. RELEASING SOLENOID CIRCUIT TO PREACTION PANELS. INSTALL REL-EOL AT SOLENOID LOCATIONS. FIELD VERIFY EXACT LOCATIONS.
5. FOR CONNECTION TO REMOTE FIRE ALARM ANNUNCIATOR.
6. REMOTE XLSRV FACP SHALL HAVE DUAL SYNCHRONIZATION MODULES MOUNTED ADJACENT TO THE FIRE ALARM CONTROL PANEL.
7. REMOTE XLSRV FACP. REFER TO SHEET FA-11-12 FOR FIRE ALARM NETWORK DIAGRAM AND SHEET FA-05 FOR WIRING DETAILS.
8. WALL MOUNT SMOKE DETECTOR ON WALL WITHIN 60" OF THE TOP OF PRE-ACTION PANEL(S).

Fire Alarm Plan - Mechanical Level South
1/8" = 1'-0"

TRUE NORTH

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR · SIEMENS INDUSTRY · LIC. NO. 758796 · STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY
One Cyclotron Road, Berkeley, California 94720

SHEET CONTENTS:

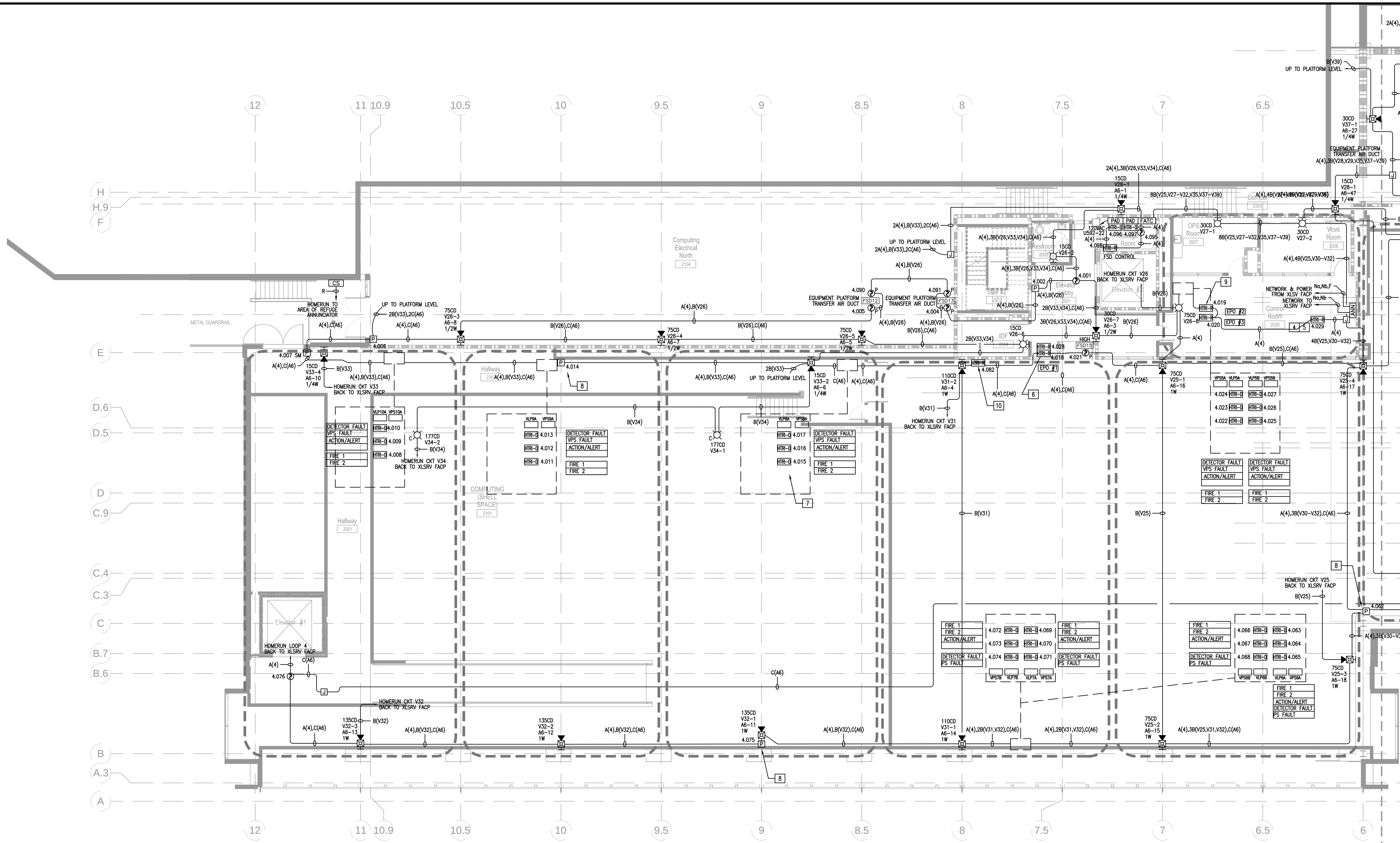
FIRE ALARM PLAN - MECHANICAL LEVEL SOUTH

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-14
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA-14	JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SHEET NOTES:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)
2. ALL FIRE/SMOKE DAMPERS ON THIS FLOOR ARE TO BE CIRCUITED TO PANEL E592A, CIRCUITS 20 AND 22. NO MORE THAN (15) FIRE/SMOKE DAMPERS MAY BE CONNECTED TO THE SAME CIRCUIT.

KEYED NOTES:

1 FIRE ALARM REMOTE ANNUNCIATOR PANEL. REFER TO SHEET FA-11-12 FOR FIRE ALARM NETWORK DIAGRAM AND SHEET FA-08 FOR WIRING DETAILS.

2 NOT USED

3 AREA OF REFUGE CALL STATIONS. HOMERUN WIRING TO AREA OF REFUGE ZONE ANNUNCIATOR. SEE SHEET FA-09 FOR WIRING DETAILS.

4 TRANSMIT A CONTACT CLOSURE SIGNAL TO THE SECURITY SYSTEM IN CASE OF ANY FIRE ALARM IN THE BUILDING.

5 TRANSMIT A CONTACT CLOSURE SIGNAL TO EACH DIMMER SYSTEM IN CASE OF ANY ALARM IN THE BUILDING.

6 EPO MONITORING. ELECTRICAL POWER TO EPO BUTTONS SHALL BE SUPERVISED PER NFPA 75, SECTION 8.2.2.

7 VESDA DETECTOR & POWER SUPPLY WITH MONITOR MODULES(TYPICAL)

8 PREACTION MANUAL PULL STATION AS PER NFPA 13 SECTION 7.4.2.3. SIGNAGE TO BE PROVIDED BY OTHERS.

KEYED NOTES CONT:

9 TWO (2) EMERGENCY POWER OFF SWITCHES SHOULD BE PLACED SIDE BY SIDE DIRECTLY BELOW THE EXISTING FIRE ALARM VISUAL DEVICE. IF THE METAL STUD FRAMING IS BUILT IN A WAY THAT WILL NOT ALLOW THIS CONDITION, THE DEVICES SHOULD BE LOCATED ON THE NORTH WALL CLOSE TO THE EXISTING FIRE ALARM DEVICE.

10 VESDA LEVEL 2 COUNTDOWN FOR NERSC MONITORING (MOUNTED 20" BELOW FINISHED FLOOR LEVEL).

Fire Alarm Plan - Computing Level North

1/8" = 1'-0"

TRUE NORTH

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR SIEMENS INDUSTRY LIC. NO. 758796 STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY
One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

FIRE ALARM PLAN - COMPUTING LEVEL NORTH

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.: Kevin Waxman

PROJECT MANAGER: Keith Posey

DRAWN BY: DH-EJ

CAD FILENAME: FA-15

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

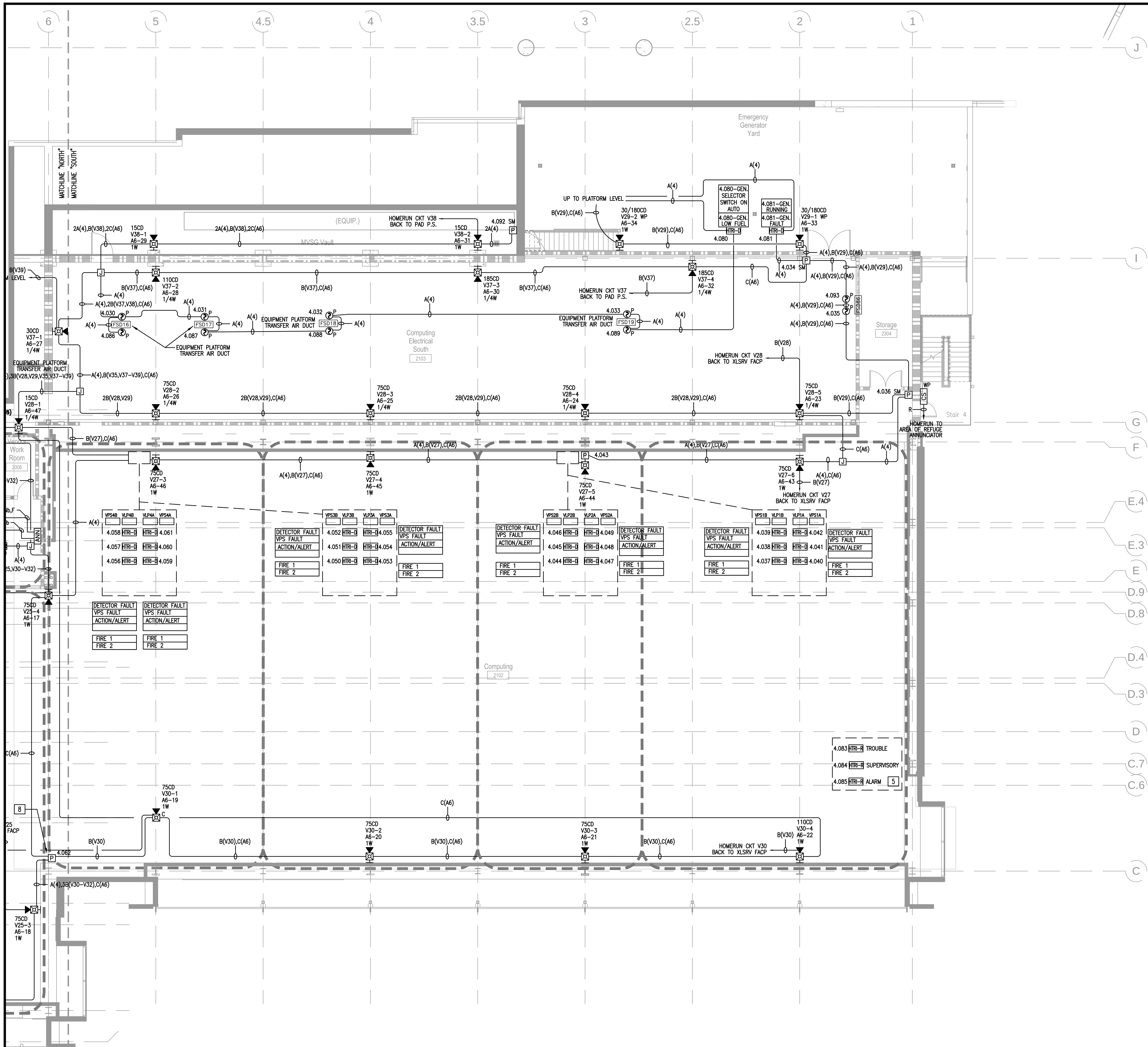
DATE DRAWN: August 1, 2012

PLOT DATE: July 21, 2015

SHEET: FA-15

JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SHEET NOTES:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)
2. ALL FIRE/SMOKE DAMPERS ON THIS FLOOR ARE TO BE CIRCUITED TO PANEL E592A, CIRCUITS 20 AND 22. NO MORE THAN (15) FIRE/SMOKE DAMPERS MAY BE CONNECTED TO THE SAME CIRCUIT.

KEYED NOTES:

1. AREA OF REFUGE CALL STATIONS. HOMERUN WIRING TO AREA OF REFUGE ZONE ANNUNCIATOR. SEE SHEET FA–09 FOR WIRING DETAILS.
2. VESDA DETECTOR AND POWER SUPPLY WITH MONITOR MODULES.
3. PREACTION MANUAL PULL STATION AS PER NFPA 13 SECTION 7.4.2.3. SIGNAGE TO BE PROVIDED BY OTHERS.
4. FIRE ALARM NOTIFICATION DEVICE SHALL BE LOCATED ABOVE MVSG VAULT.
5. THREE (3) HTRI–R MODULES FOR MONITORING FUTURE TROUBLE, SUPERVISORY, AND ALARM OF THE FUTURE FM200 SYSTEM THAT WILL BE PROVIDED FOR THE TAPE LIBRARY.

Fire Alarm Plan -
Computing Level South
1/8" = 1'–0"

TRUE NORTH
NORTH

0 1' 2' 4' 8'

R E V I S I O N S

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05–13–14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05–13–14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06–5–14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC–2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09–22–14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C–10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR · SIEMENS INDUSTRY · LIC. NO. 758796 · STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com ©

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY

One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

FIRE ALARM PLAN - COMPUTING LEVEL SOUTH

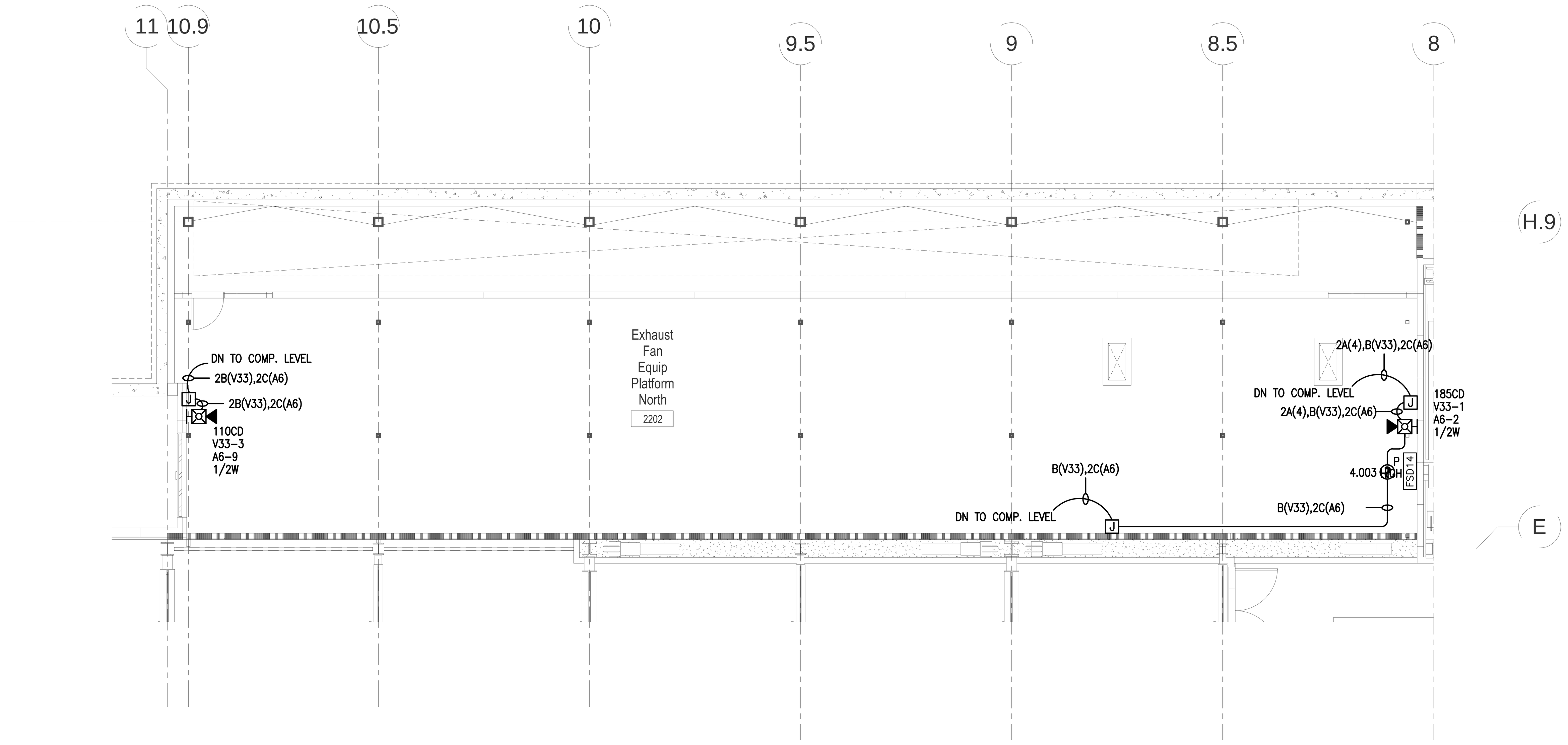
INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-16
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA–16	JOB NUMBER: 44OP-116361

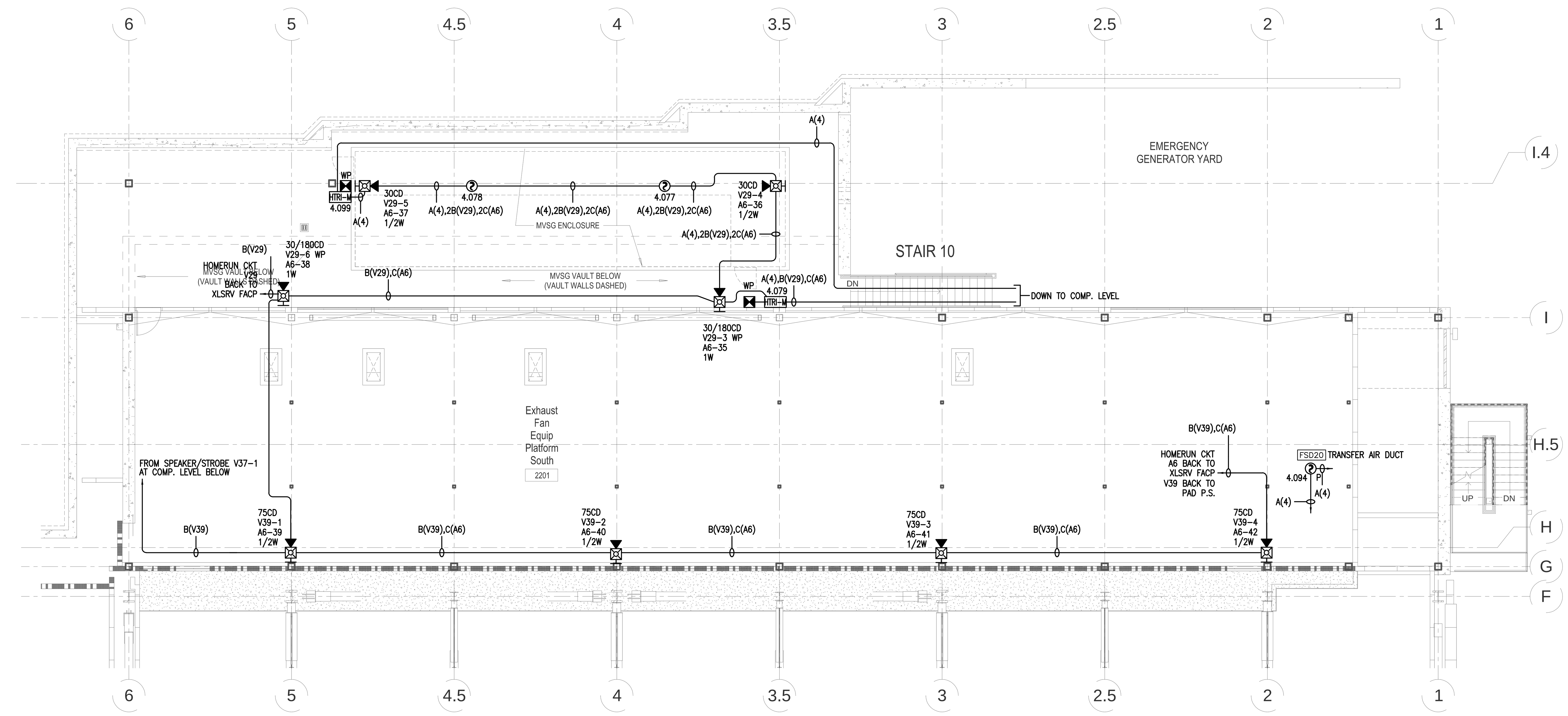
DRAWING NO.

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



Fire Alarm Plan -
Computing Level Platform North

1/8" = 1'-0"



Fire Alarm Plan -
Computing Level Platform South

1/8" = 1'-0"

TRUE NORTH

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR
SIEMENS INDUSTRY
LIC. NO. 758796
STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com ©

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY
One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

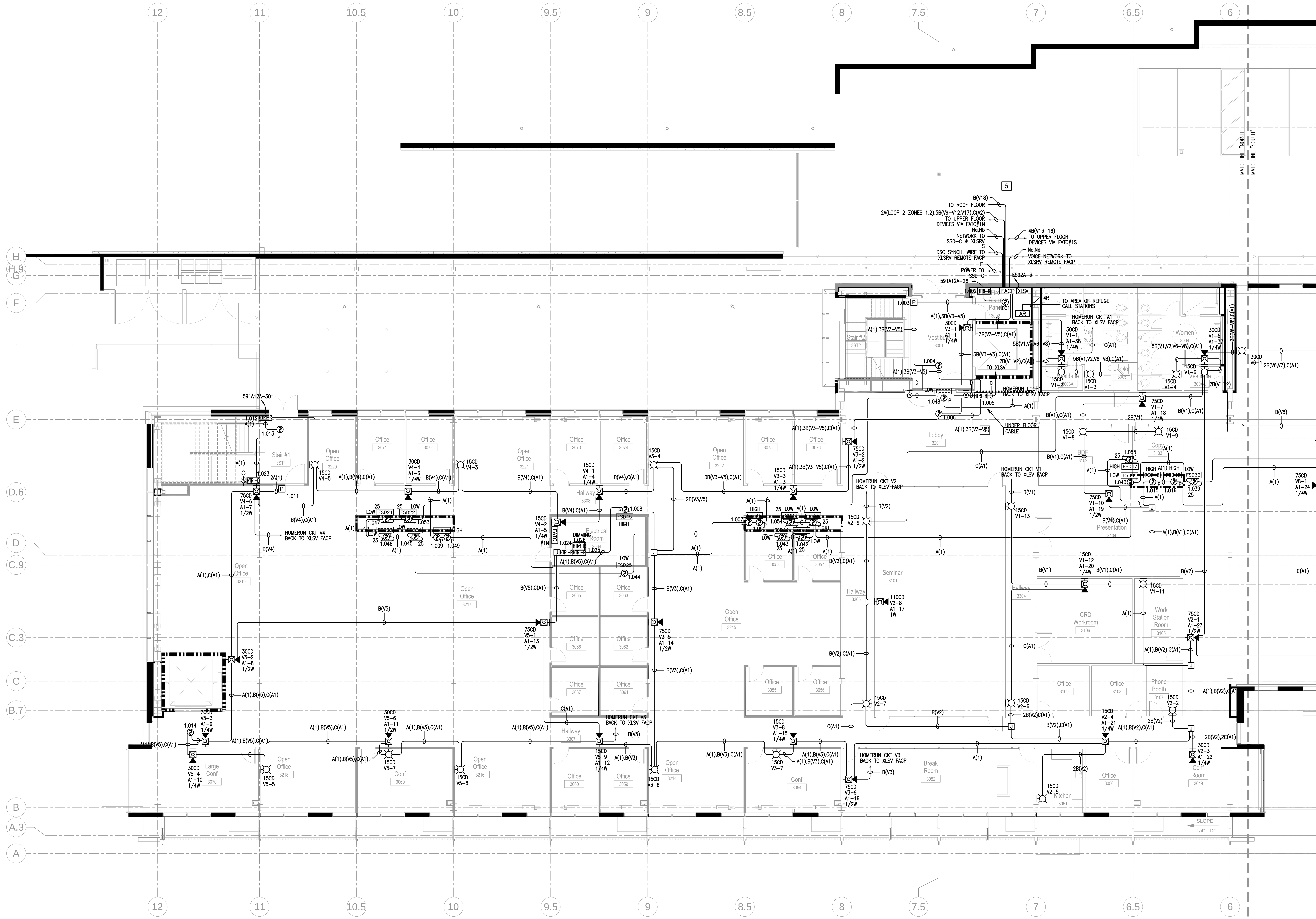
FIRE ALARM PLAN - COMPUTING LEVEL PLATFORMS

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-16A
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA-16A	JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SHEET NOTES:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)
2. ALL FIRE/SMOKE DAMPERS ON THIS FLOOR ARE TO BE CIRCUITED TO PANEL E592A, CIRCUITS 24 AND 26. NO MORE THAN (15) FIRE/SMOKE DAMPERS MAY BE CONNECTED TO THE SAME CIRCUIT.

KEYED NOTES:

1 DEACTIVATE SECURITY DOOR UPON ALARM.

2 BACKFLOW PREVENTER WITH TAMPER SWITCH.

3 FOR CONNECTION TO FIRE ALARM CONTROL PANEL.

4 MAIN XLSV FACP SHALL HAVE DUAL SYNCHRONIZATION MODULES MOUNTED ADJACENT TO THE FIRE ALARM CONTROL PANEL.

5 MAIN XLSV FACP. REFER TO SHEET FA–11–12 FOR FIRE ALARM NETWORK DIAGRAM AND SHEET FA–08 FOR WIRING DETAILS.

6 WIRING FOR UNDER FLOOR DUCT DETECTORS.

7 AREA OF REFUGE ZONE ANNUNCIATOR WITH BATTERY BACK–UP POWER SUPPLY AND TELEPHONE ACCESS KIT. SEE SHEET FA–09 FOR WIRING DETAILS.

8 ADDRESSABLE RELAY MODULE FOR THE CLOSURE OF MULTIPLE FIRE/SMOKE DAMPERS (15 MAX). USE A SECONDARY RELAY (BY OTHERS) TO CONNECT FSDs IF LOAD EXCEEDS THE RATING OF THE MODULE'S RELAY CONTACTS.

Fire Alarm Plan - Ground Level North

1/8" = 1'-0"

TRUE NORTH NORTH

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05–13–14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05–13–14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06–5–14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC–2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09–22–14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C–10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR SIEMENS INDUSTRY LIC. NO. 758796 STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA LAWRENCE BERKELEY NATIONAL LABORATORY FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY

One Cyclotron Road, Berkeley, California 94720

SHEET CONTENTS:

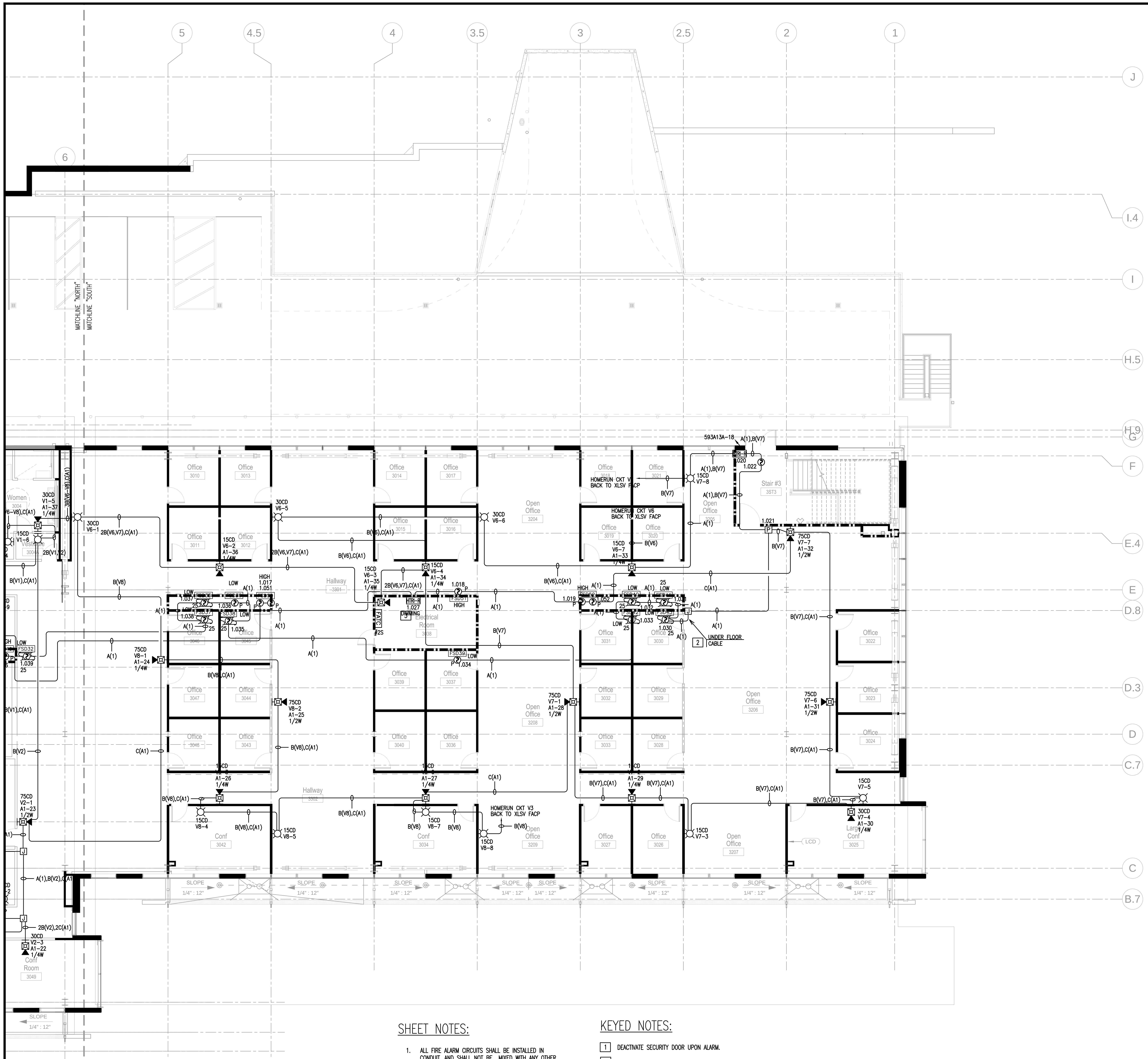
FIRE ALARM PLAN - GROUND LEVEL NORTH

INSTALLATION TYPE

☒ NEW INSTALLATION
☒ DESIGN/BUILD
☐ PER CONTRACT DOCUMENT
☐ EXISTING BASE JOB # N/A
☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-17
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET FA–17	JOB NUMBER 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SHEET NOTES:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)
2. ALL FIRE/SMOKE DAMPERS ON THIS FLOOR ARE TO BE CIRCUITED TO PANEL E592A, CIRCUITS 24 AND 26. NO MORE THAN (15) FIRE/SMOKE DAMPERS MAY BE CONNECTED TO THE SAME CIRCUIT.

KEYED NOTES:

[1] DEACTIVATE SECURITY DOOR UPON ALARM.

[2] WIRING FOR UNDER FLOOR DUCT DETECTORS.

[3] ADDRESSABLE RELAY MODULE FOR THE CLOSURE OF MULTIPLE FIRE/SMOKE DAMPERS (15 MAX). USE A SECONDARY RELAY (BY OTHERS) TO CONNECT FSDS IF LOAD EXCEEDS THE RATING OF THE MODULE'S RELAY CONTACTS.

Fire Alarm Plan - Ground Level South
1/8" = 1'-0"

TRUE NORTH

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR
SIEMENS INDUSTRY
LIC. NO. 758796
STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP

Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC

880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION

25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991

Tel (510) 783-6000 Fax (510) 293-2100

California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY

One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

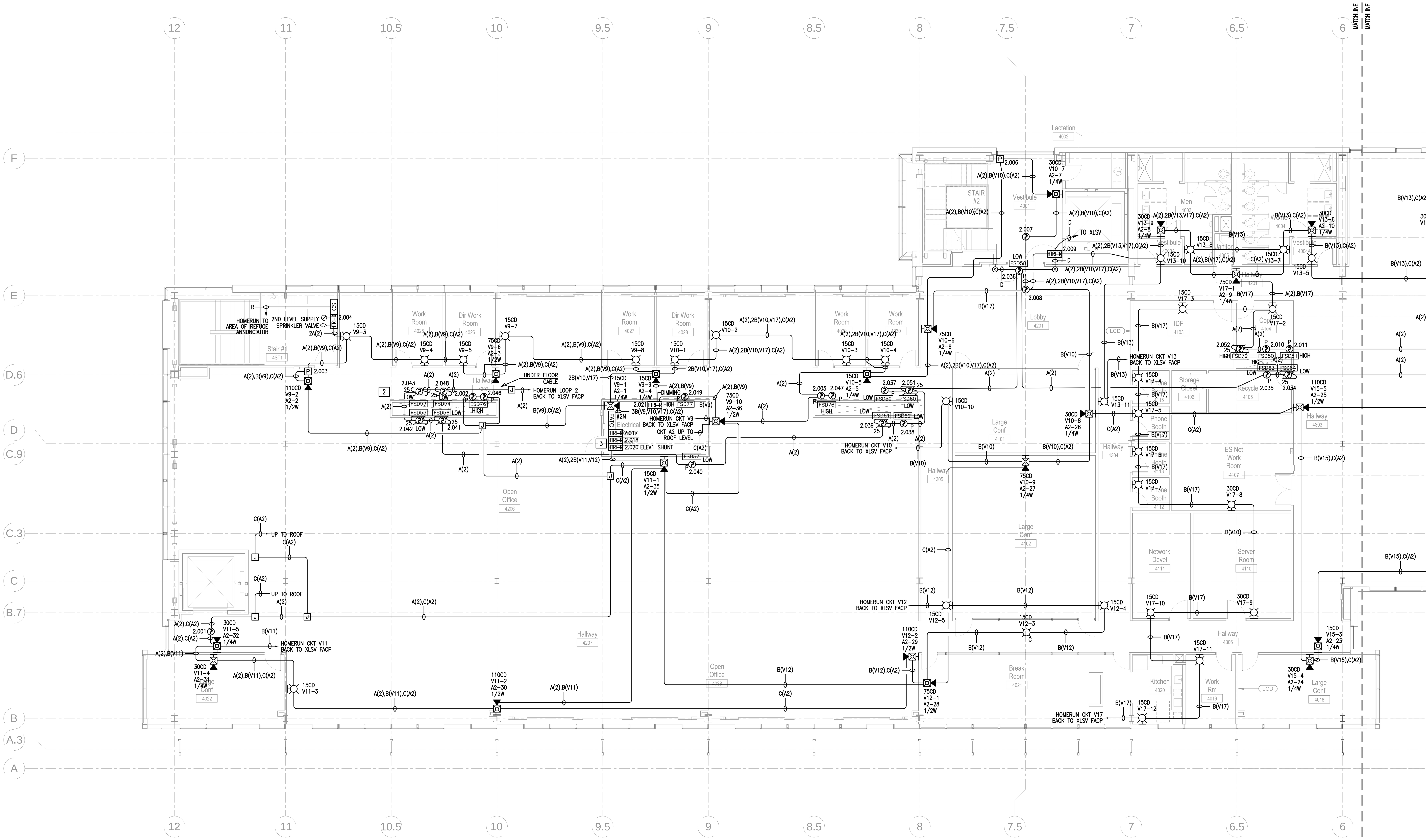
FIRE ALARM PLAN - GROUND LEVEL SOUTH

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-18
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET FA-18	JOB NUMBER 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SHEET NOTES:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)
2. ALL FIRE/SMOKE DAMPERS ON THIS FLOOR ARE TO BE CIRCUITED TO PANEL E592A13A, CIRCUITS 2 AND 4. NO MORE THAN (15) FIRE/SMOKE DAMPERS MAY BE CONNECTED TO THE SAME CIRCUIT.

KEYED NOTES:

[1] AREA OF REFUGE CALL STATIONS. HOMERUN WIRING TO AREA OF REFUGE ZONE ANNUNCIATOR. SEE SHEET FA–09 FOR WIRING DETAILS.

[2] WIRING FOR UNDER FLOOR DUCT DETECTORS.

[3] ADDRESSABLE RELAY MODULE FOR THE CLOSURE OF MULTIPLE FIRE/SMOKE DAMPERS (15 MAX). USE A SECONDARY RELAY (BY OTHERS) TO CONNECT FSDS IF LOAD EXCEEDS THE RATING OF THE MODULE'S RELAY CONTACTS.

Fire Alarm Plan - Second Level North

1/8" = 1'-0"

TRUE NORTH

NORTH

0 1' 2' 4' 8'

DRAWING NO.

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05–13–14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05–13–14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06–5–14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC–2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09–22–14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C–10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR — SIEMENS INDUSTRY — LIC. NO. 758796 — STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP

Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com ©

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC

880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY

One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

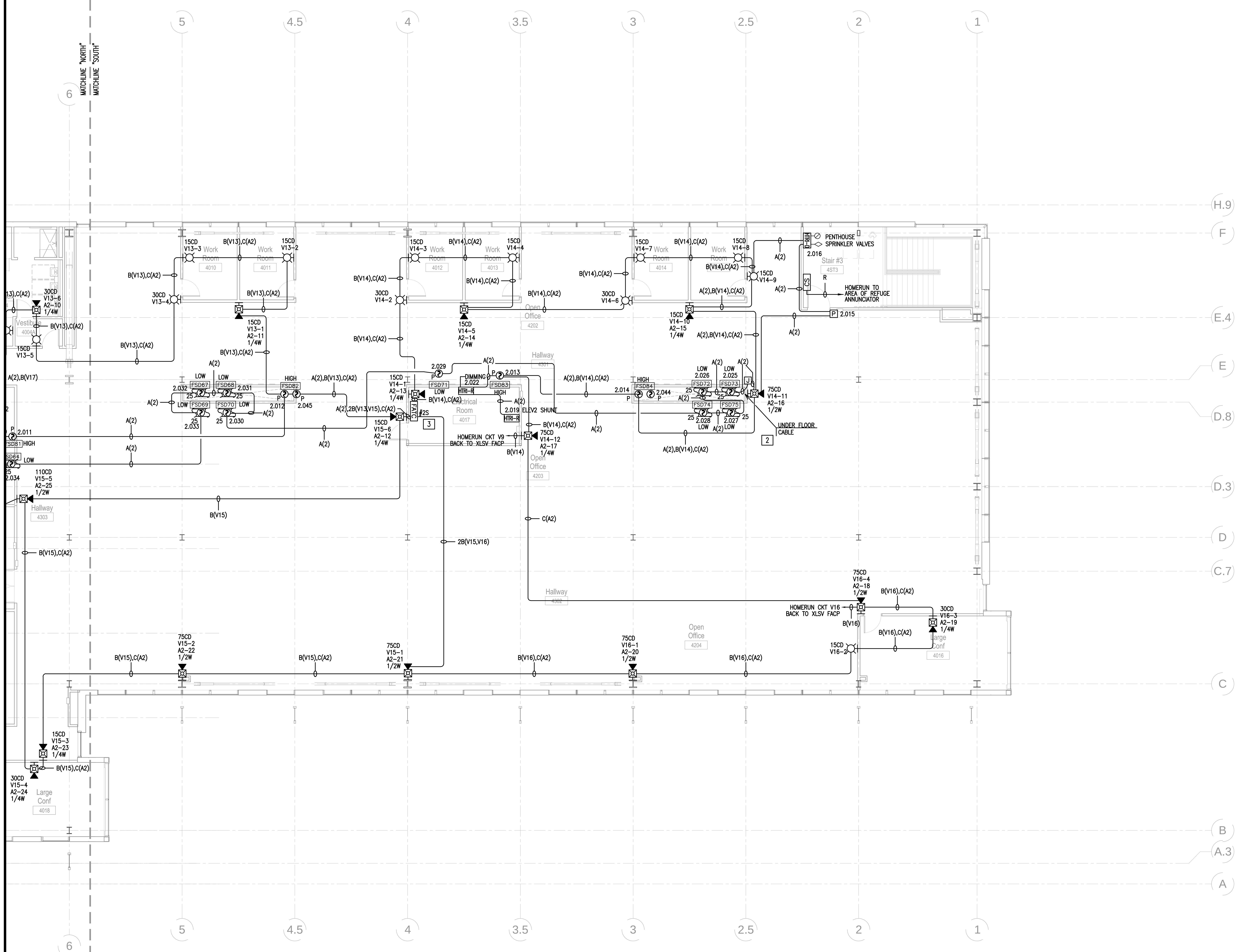
FIRE ALARM PLAN - SECOND LEVEL NORTH

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-19
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA–19	JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SHEET NOTES:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)
2. ALL FIRE/SMOKE DAMPERS ON THIS FLOOR ARE TO BE CIRCUITED TO PANEL E592A13A, CIRCUITS 2 AND 4. NO MORE THAN (15) FIRE/SMOKE DAMPERS MAY BE CONNECTED TO THE SAME CIRCUIT.

KEYED NOTES:

[1] AREA OF REFUGE CALL STATIONS. HOMERUN WIRING TO AREA OF REFUGE ZONE ANNUNCIATOR. SEE SHEET FA-09 FOR WIRING DETAILS.

[2] WIRING FOR UNDER FLOOR DUCT DETECTORS.

[3] ADDRESSABLE RELAY MODULE FOR THE CLOSURE OF MULTIPLE FIRE/SMOKE DAMPERS (15 MAX). USE A SECONDARY RELAY (BY OTHERS) TO CONNECT FSDS IF LOAD EXCEEDS THE RATING OF THE MODULE'S RELAY CONTACTS.

Fire Alarm Plan - Second Level South

1/8" = 1'-0"

TRUE NORTH

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05-13-14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05-13-14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06-5-14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC-2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09-22-14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C-10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR — SIEMENS INDUSTRY — LIC. NO. 758796 — STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY

One Cyclotron Road, Berkeley, California 94720

SHEET CONTENTS:

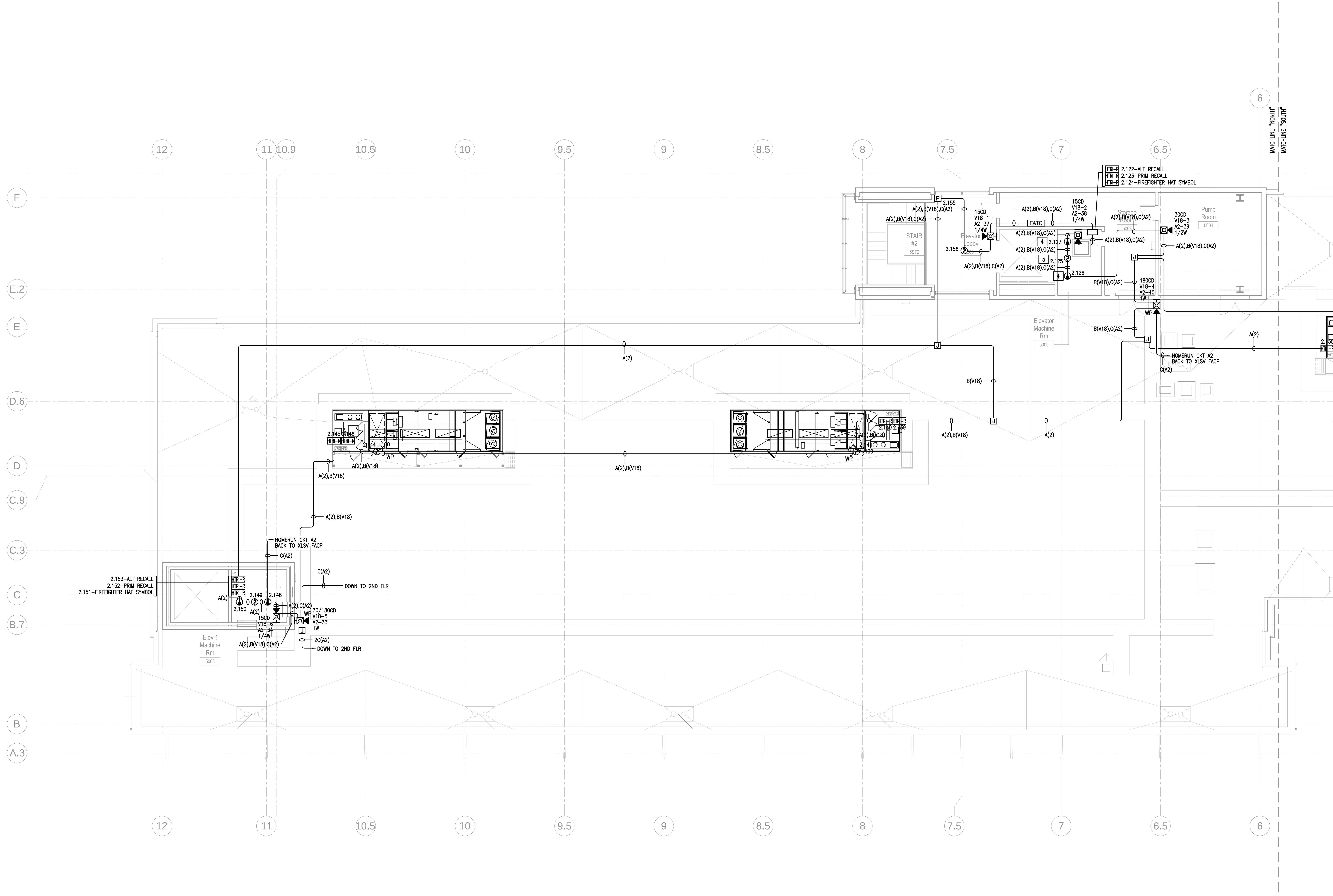
FIRE ALARM PLAN - SECOND LEVEL SOUTH

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-20
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA-20	JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SHEET NOTE:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)

- [1] FIRE ALARM INTERFACE TO ELEVATOR RECALL AND FIREMANS HAT LIGHT FUNCTIONS.
- [2] COORDINATE WITH MECHANICAL CONTRACTOR FOR DUCT SMOKE DETECTOR EXACT LOCATION.
- [3] RELAY MODULE INTERFACED WITH VFD FOR FAN SHUTDOWN.
- [4] MOUNT HEAT DETECTOR WITHIN 2 FEET OF SPRINKLER HEAD
- [5] SMOKE DETECTOR SHALL BE LISTED FOR USE IN DIRTY/HARSH ENVIRONMENTS.

Fire Alarm Plan - Roof Level North

1/8" = 1'-0"

TRUE NORTH
NORTH

REVISIONS

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05–13–14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05–13–14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06–5–14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC–2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09–22–14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C–10 STAMP:
REGISTERED C-10 LICENSED CONTRACTOR · SIEMENS INDUSTRY · STATE OF CALIFORNIA · LIC. NO. 758796

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

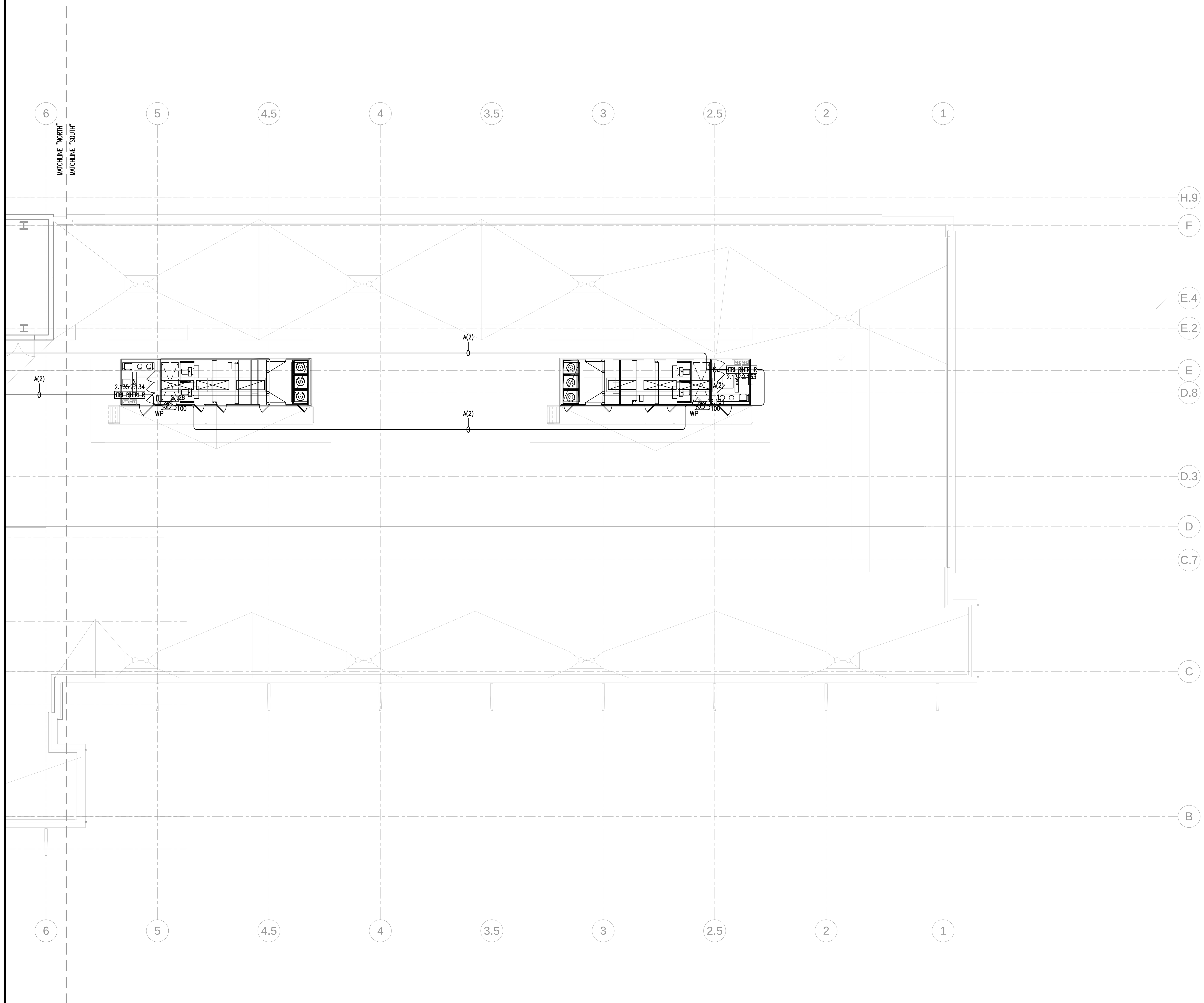
COMPUTATIONAL RESEARCH & THEORY FACILITY
One Cyclotron Road, Berkeley, California 94720

SHEET CONTENTS:
FIRE ALARM PLAN - ROOF LEVEL NORTH

INSTALLATION TYPE
- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-21
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA–21	JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY



SHEET NOTE:

1. ALL FIRE ALARM CIRCUITS SHALL BE INSTALLED IN CONDUIT, AND SHALL NOT BE MIXED WITH ANY OTHER CONDUIT SYSTEMS OF ANY CLASS WIRING. INITIATING AND NOTIFICATION DEVICES SHALL BE INSTALLED IN SEPARATE CONDUITS.(SPEC SECTION 28 31 10 – CHAPTER 3.1.C)

1

2

Fire Alarm Plan - Roof Level South

1/8" = 1'-0"

TRUE NORTH

R E V I S I O N S

No.	Revision	By	Date	Appr.
1	REVISED PER ARUP & FP2FIRE REVIEW COMMENTS 2/27/14	JPM MM	3/17/14	KW
94	REVISED PER BULLETIN 22	JPM	3/27/14	KW
2	REVISED PER LBNL COMMENTS & BACKCHECK FP2	DH EJ	5/02/14	KW
3	REVISED PER HUGHES ASSOCIATES COMMENTS (05–13–14)	DH EJ	5/16/14	KW
4	REVISED PER ARUP COMMENTS FIELD ORDER NO.185 (05–13–14)	DH EJ	5/16/14	KW
5	FIELD COORDINATION CHANGES	EJ	8/29/14	KW
6	RFI #1389 FSD CIRCUIT LIMIT CHANGE	EJ	8/29/14	KW
7	RFI # SPRINKLER HORN/STROBE	EJ	8/29/14	KW
8	CQ0897 COMP LVL ELEC RM CABLE TRAY	EJ	8/29/14	KW
9	MECHANICAL CHANGES PER INSTALLATION DWGS DATED 3/4/14	EJ	8/29/14	KW
10	RFI #165 DETECTION FOR UPS ROOM 1002	EJ	8/29/14	KW
11	LBNL FIRE MARSHAL COMMENTS (06–5–14)	EJ	8/29/14	KW
12	RFI #1439 OPERATIONAL MATRIX REVISIONS	EJ	8/29/14	KW
13	BULLETIN 5 AC–2 DUCT DETECTOR	EJ	8/29/14	KW
14	RFI #162 SPRINKLER VALVE ADDITIONS	EJ	8/29/14	KW
15	LBNL FIRE MARSHAL COMMENTS (09–22–14)	EJ	10/7/14	KW
16	RFI #1548.1 FSD LABELING	EJ	3/19/15	KW
17	FIELD ORDER #271 OPERATIONAL MATRIX REVISIONS	EJ	3/19/15	KW
	PRELIMINARY RECORD SET	EJ	5/14/15	KW
	RECORD SET	EJ	7/21/15	KW

C–10 STAMP:

REGISTERED C-10 LICENSED CONTRACTOR
SIEMENS INDUSTRY
LIC. NO. 758796
STATE OF CALIFORNIA

CONSULTANT'S NAME & ADDRESS:

ARUP
Arup North America Ltd.
560 Mission Street, Suite 700
San Francisco, CA 94105 USA
Tel (415) 957 9445 Fax (415) 957 9096
www.arup.com

CONTRACTOR'S NAME & ADDRESS:

ROSENDIN ELECTRIC
880 Mabury Road,
San Jose, CA 95133
Tel (408) 286-2800
C10 License #142881

PRODUCT MANUFACTURER:

SIEMENS INDUSTRY, INC.
FIRE SAFETY DIVISION
25821 Industrial Boulevard, Suite 300
Hayward, California 94545-2991
Tel (510) 783-6000 Fax (510) 293-2100
California State C10 License No. 758796
U.L. Certificate ID No. 324787-001

JOB NAME & LOCATION (STREET ADDRESS)

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY NATIONAL LABORATORY
FACILITIES DIVISION

COMPUTATIONAL RESEARCH & THEORY FACILITY
One Cyclotron Road,
Berkeley, California 94720

SHEET CONTENTS:

FIRE ALARM PLAN - ROOF LEVEL SOUTH

INSTALLATION TYPE

- ☒ NEW INSTALLATION
- ☒ DESIGN/BUILD
- ☐ PER CONTRACT DOCUMENT
- ☐ EXISTING BASE JOB # N/A
- ☐ OTHERS

SYSTEM SALES REP.:	Kevin Waxman
PROJECT MANAGER:	Keith Posey
DRAWN BY:	DH-EJ
CAD FILENAME:	FA-22
SCALE:	1/8" = 1'-0"
DATE DRAWN: August 1, 2012	PLOT DATE: July 21, 2015
SHEET: FA–22	JOB NUMBER: 44OP-116361

IF DRAWING IS SMALLER THAN 30" X 42" IT IS A REDUCED COPY

Appendix 5: Fire Alarm Sequence of Operations

	BERKELEY CRT - FIRE ALARM MATRIX (Siemens) updated 8/8/14, FM comments 4/1/15, updated 4/10/15. updated 6.17.15	ANNUNCIATE AT FACP	ANNUNCIATE AT REMOTE ANNUCNCIATOR	ANNUNCIATE AT LBNL RECEIVER	ACTIVATE AUDIBLE/VISUAL SIGNAL	OVERRIDE LIGHTING CONTROL - LIGHTS TO FULL BRIGHT	RELEASE DOOR HOLDERS	SHUTDOWN AIR HANDLERS	CLOSE FIRE/SMOKE DAMPERS IN ASSOCIATED AREA	ELEVATOR RECALL TO PRIMARY FLOOR (see notes 4 &5 below)	ELEVATOR RECALL TO ALTERNATE FLOOR (see notes 4 &5 below)	SHUNT TRIP ELEVATOR POWER	ELVATOR FIREFIGHTER'S HELMET SYMBOL	SEND SIGNAL TO PRE-ACTION SYSTEM TO RELEASE SOLENOID PRE-ACTION ZONE NORTH	SEND SIGNAL TO PRE-ACTION SYSTEM TO RELEASE SOLENOID PRE-ACTION ZONE CENTRAL	SEND SIGNAL TO PRE-ACTION SYSTEM TO RELEASE SOLENOID PRE-ACTION ZONE SOUTH	SHUNT-TRIP HPC FLOOR POWER	VESDA LEVEL 2 COUNTDOWN INITIATION
ALARM	MANUAL PULL STATION	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	LOBBY SMOKE DETECTOR, EXCEPT **PRIMARY** FLOOR *	YES	YES	YES	YES	YES	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	LOBBY SMOKE DETECTOR, AT **PRIMARY** FLOOR *	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO
ALARM	ELEVATOR #2 SMOKE DETECTOR AT COMPUTING LEVEL	YES	YES	YES	YES	YES	YES	YES (AC-1 ONLY)	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	SMOKE DETECTOR AT OPENING/DOOR (MAG-HOLD) @ ELEVATOR LOBBY	YES	YES	YES	YES		YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	SMOKE DETECTOR AT COMP LEVEL STORAGE ROOM/PAD-3 UNITS	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	**SMOKE BEAM DETECTOR (UPS AND GENERATOR SWITCHGEAR ROOM)**	YES	YES	YES	YES		YES	**YES (AC-2 AND EBL-14)**	YES (AC-2 AND EBL-14)	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	MSVG ENCLOSURE SMOKE DETECTOR (DEVICE 004-77 & 004-78)	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	SMOKE DETECTOR AT STAIR #3 (DEVICE 001-022)	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	VESDA (VLP) - FIRE 2 (VESDA ZONE 1 THRU 4)	YES	YES	YES	YES		N/A	**YES (NOTE 6, 7)**	YES	NO	NO	NO	NO	NO	NO	YES	YES	NO
ALARM	**VESDA (VLP) - FIRE 2 (VESDA ZONE 5 THRU 7)**	YES	YES	YES	YES	YES	N/A	**YES (NOTE 6, 7)**	YES	NO	NO	NO	NO	NO	YES	NO	YES	NO
ALARM	VESDA (VLP) - FIRE 2 (VESDA ZONE 8 THRU 10)	YES	YES	YES	YES	YES	N/A	**YES (NOTE 6, 7)**	YES	NO	NO	NO	NO	YES	NO	NO	YES	NO
ALARM	VESDA (VLP) - FIRE 1 (ANY ZONE) (EXCEPT ZONE 5A)	YES	YES	YES	YES	YES	N/A	**YES (NOTE 6, 7)**	YES	NO	NO	NO	NO	NO	NO	NO	NO	YES
ALARM	VESDA (VLP) - FIRE 1 (VESDA ZONE 5A)	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	SPRINKLER WATERFLOW SWITCH **(GROUND AND SECOND LEVEL)**	YES	YES	YES	YES	YES	YES	**YES (RTUs ONLY, NOTE 6)**	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	**SPRINKLER WATERFLOW SWITCH** (**HPC LEVEL & MECHANICAL LEVEL WET SYSTEMS)**	YES	YES	YES	YES	YES	YES	YES (AC-1 & 2 AND EBL-14)	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	ELEVATOR MACHINE ROOM SMOKE DETECTOR	YES	YES	YES	YES	YES	NO	NO	NO	YES	NO	NO	YES	NO	NO	NO	NO	NO
ALARM	ELEVATOR MACHINE ROOM HEAT DETECTOR	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO
ALARM	**DUCT SMOKE DETECTOR, AT FSDs OFFICE FLOORS**	YES	YES	YES	YES	YES	**YES**	YES (RTUs **ONLY, NOTE 6)**	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	**DUCT SMOKE DETECTORS AT FSDs ON COMPUTER OR MECHANICAL LEVEL**	YES	YES	YES	YES	YES	**NA**	**YES (NOTE 6)**	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	DUCT SMOKE DETECTOR AT ROOF TOP UNIT (RTU)	YES	YES	YES	YES	YES	**YES**	YES (RTUs **ONLY, NOTE 6)**	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	DUCT SMOKE DETECTOR AT AC-1	YES	YES	YES	YES	YES	NA	YES **(AC-1 ONLY)**	YES **(ONLY THOSE ASSOCIATED WITH COMP CORE AREA)**	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	DUCT SMOKE DETECTOR AT AC-2	YES	YES	YES	YES	YES	NO	YES **(AC-2 and EBL-14 ONLY)**	YES **(THOSE IN THE UPS ROOM ONLY)**	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	**VESDA (VLC) AT AIR HANDLING UNIT - FIRE 1**	YES	YES	YES	YES	YES	N/A	YES (only AHU(S) in alarm)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	PRE-ACTION SMOKE DETECTOR (DEVICE 003-031)	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
ALARM	PRE-ACTION WATER PRESSURE-SWITCH ACTIVATION	YES	YES	YES	YES		YES	**YES (NOTE 6, 7)**	YES	NO	NO	NO	NO	NA	NA	NA	YES	NO
SUPERVISORY	**VESDA (VLP) ACTION/ALERT (ANY ZONE)**	**YES**	**YES**	**YES**	**NO**	NO	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
SUPERVISORY	**VESDA (VLC) AT AIR HANDLING UNIT - PRE-ALARM**	**YES**	**YES**	**YES**	**NO**	NO	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
SUPERVISORY	SPRINKLER TAMPER SWITCH	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SUPERVISORY	POST INDICATOR VALVE	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SUPERVISORY	GENERATOR RUNNING	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SUPERVISORY	GENERATOR FAULT	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SUPERVISORY	GENERATOR **SELECTOR SWITCH NOT IN AUTO**	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SUPERVISORY	GENERATOR LOW FUEL	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SUPERVISORY	PRE-ACTION: LOSS OF AIR PRESSURE	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SUPERVISORY	PRE-ACTION: MAINTENANCE DISCONNECT SWTICH	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SUPERVISORY	EPO BUTTON (SEE NOTE 1)	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NO
SUPERVISORY	**ELEVATOR SHUNT TRIP MONITOR**	**YES**	**NO**	**NO**	**NO**	NO	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
TROUBLE	VESDA DETECTOR (VLP/VLC) "FAULT"	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
TROUBLE	VESDA AC/BATTERY (VLP/VLC) "FAULT"	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
TROUBLE	SYSTEM TROUBLE	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
TROUBLE	120V AC POWER FAILURE	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
TROUBLE	OPEN CIRCUIT	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
TROUBLE	GROUND FAULT	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

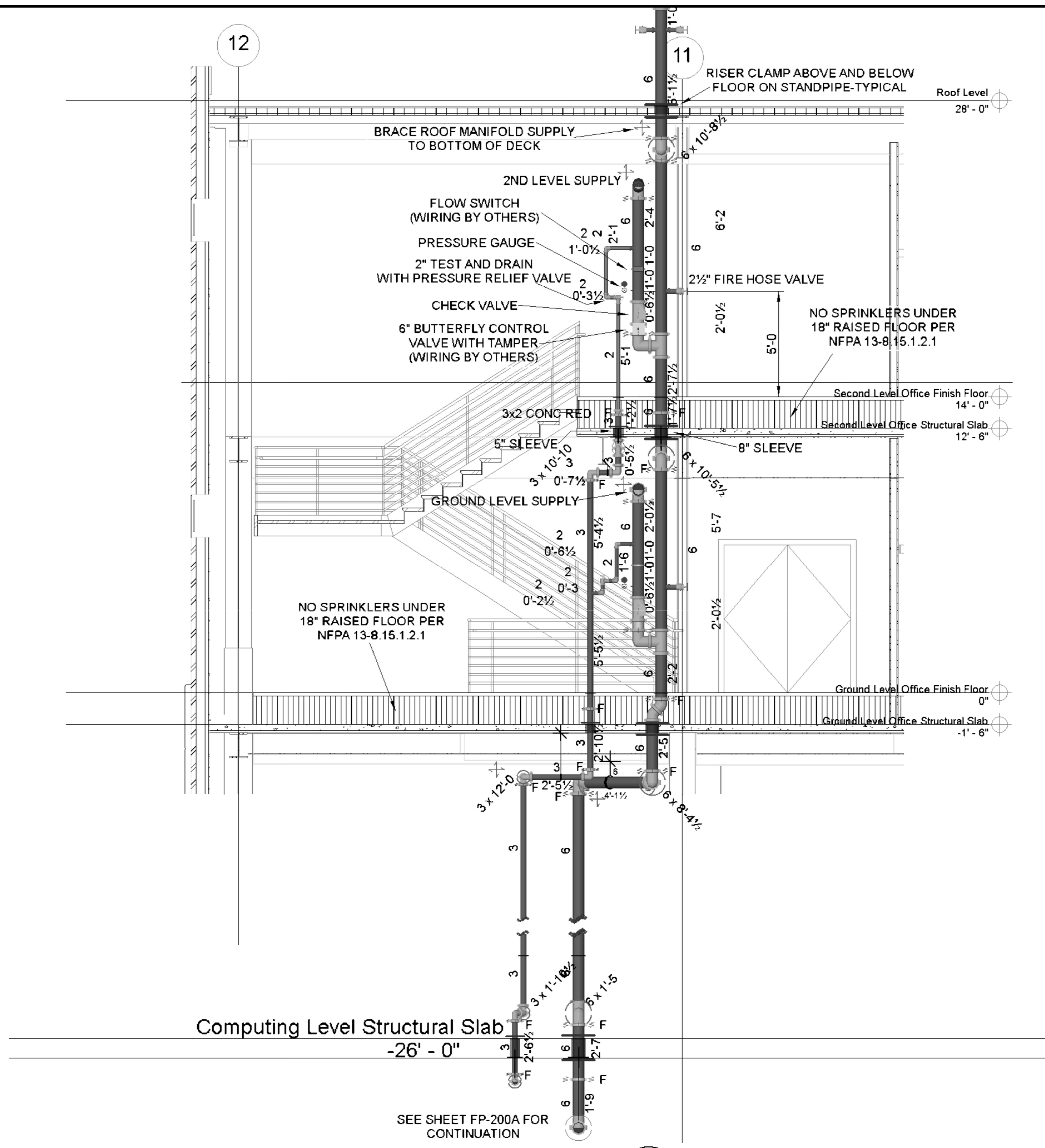
NOTES

1. ELECTRICAL POWER TO THE EPO BUTTON SHALL BE SUPERVISED PER NFPA 75, SECTION 8.2.2
2. ELECTRCIAL POWER TO THE ELEVATOR SHUTDOWN CONTROL CIRCUIT SHALL BE SUPERVISED PER NFPA 72, SECTION 6.16.4.4
3. ALARM SILENCE FUNCTION AT THE FACP SHALL SILENCE ALL AUDIBLE ALARM SIGNALLING DEVICES; VISUAL ALARM SHALL CONTINUE TO BE DIPLAYED AT THE FACP, AND NOTIFICATION TO LNBL'S MXL RECEIVING STATION (BUILDING-48) VIA THE MXL NETWORK (LOOP) SHALL BE MAINTAINED UNTIL ALARM RESET OCCURS, ACTUATION OF A SECOND INTITIATION DEVICE SHALL CAUSE THE ALARM TO RE-ACTIVATE IN ACCORDANCE WITH SPEC SECTION 283110 / 1.5 / L /10
4. **ELEVATOR 1 RECALL:** ELEVATOR 1 PRIMARY RECALL FLOOR SHALL BE THE MECHANICAL LEVEL (FLOOR 1). SECONDARY RECALL FLOOR IS THECOMPUTING LEVEL (FLOOR 2)
5. **ELVATOR 2 RECALL:** ELEVATOR 2 PRIMARY RECALL FLOOR SHALL BE THE GROUND LEVEL (FLOOR 3). SECONDARY RECALL FLOOR IS THE COMPUTING LEVEL (FLOOR 2).

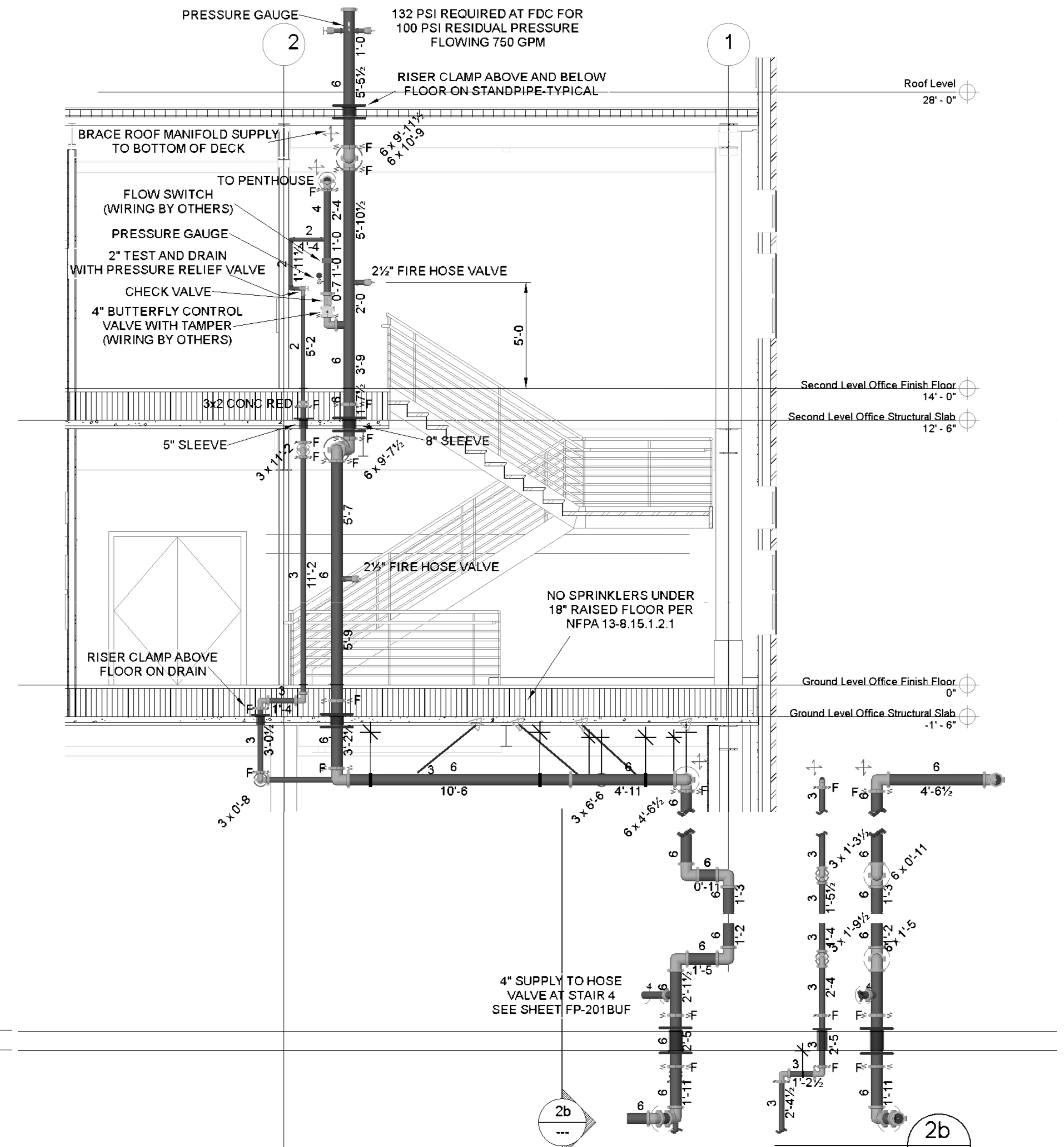
6. ASSOCIATED EXHAUST FAN S AND IN THE CASE OF RTU SHUTDOWN THE UFTs SHALL ALSO BE SHUT DOWN BY THE FMCS AS REQUIRED BY THE FMCS SEQUENCE OF OPERATIONS. NO ACTION BY THE FACP IS REQUIRED.

7. AHU-1, 11, 12, 17 AND AC-1

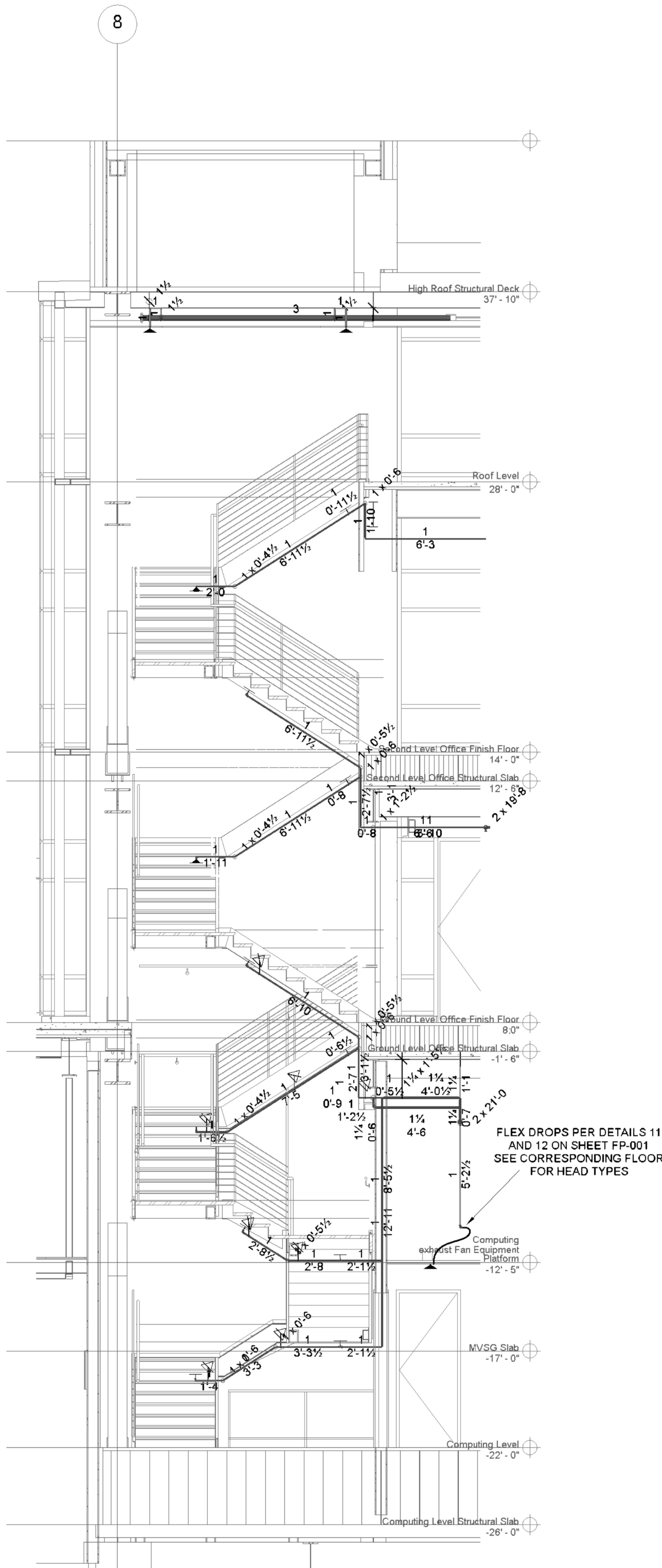
Appendix 6: Building Fire Sprinkler Drawings



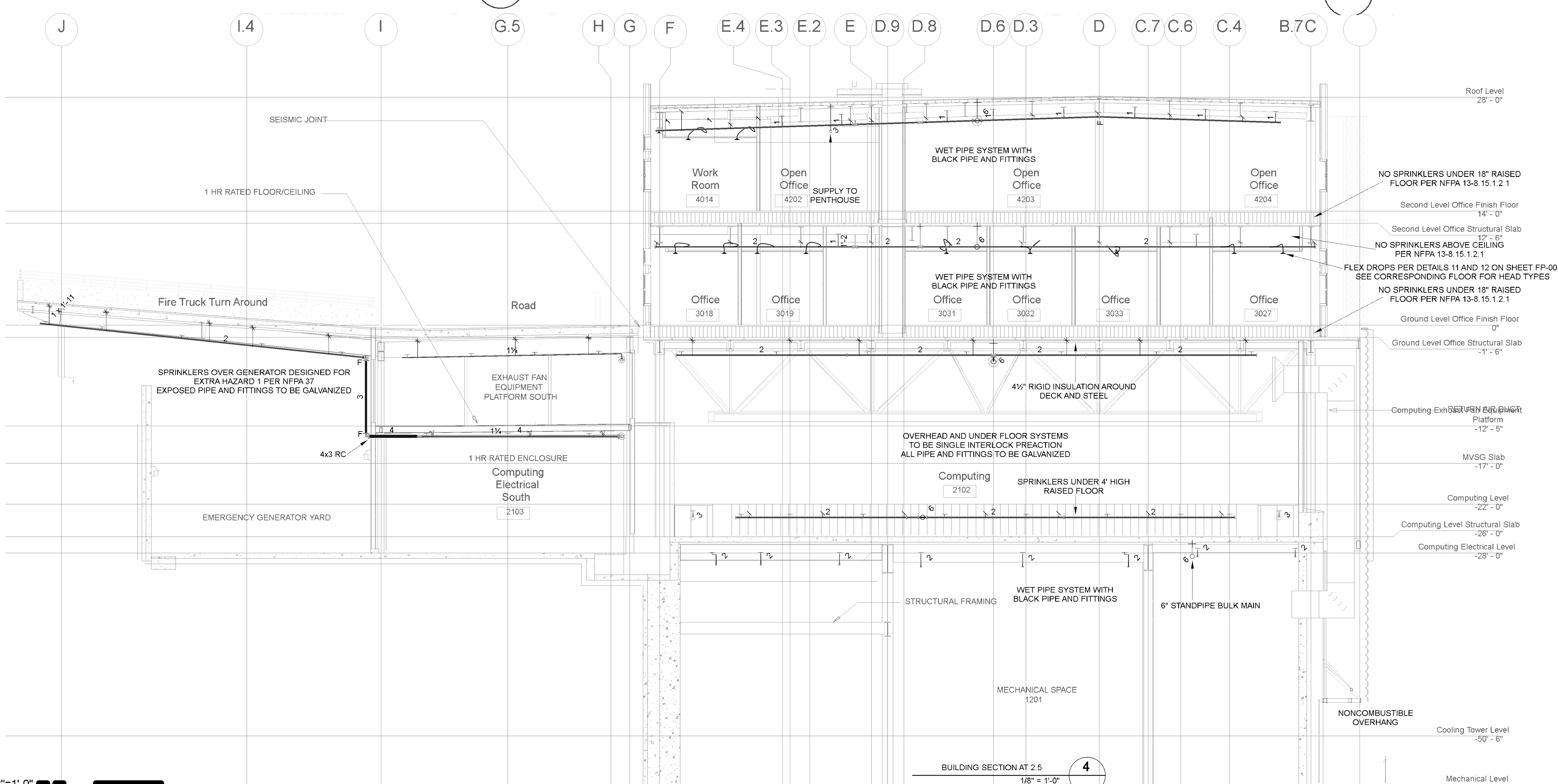
STAIR 1 RISER SECTION 3



STAIR 3 RISER SECTION 2



STAIR 2 SECTION DETAIL 1



BUILDING SECTION AT 2.5 4
1/8" = 1'-0"

1/8"=1'-0" 4' 0 4' 12'

DENOTES

DESIGN DATA

SYSTEM CLASSIFICATION
DENSITY ______ G.P.M./SQ.FT.
AREA OF APPLICATION ______ SQ. FT.
COVERAGE PER SPRINKLER ______ SQ. FT.
ORIFICE SIZE ______ K= ______
P.S.I. REQUIRED AT BASE OF RISER ______
P.S.I. REQUIRED AT P.O.C. ______
TOTAL WATER REQUIRED ______ G.P.M.
INSIDE HOSE (INCLUDED) ______ G.P.M.
HYDRANT HOSE (INCLUDED) ______ G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13
ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24
ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER:
FIRE DEPT: PHONE:

MK.	DATE	BY	REVISION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED ESTIMATED BY: JOHN HORNE
SCALE: 1/4" = 1'-0" DATE: 10/18/13 CONTRACT NO: 12-39028
CONTRACT WITH: DPR PHONE:
ADDRESS:

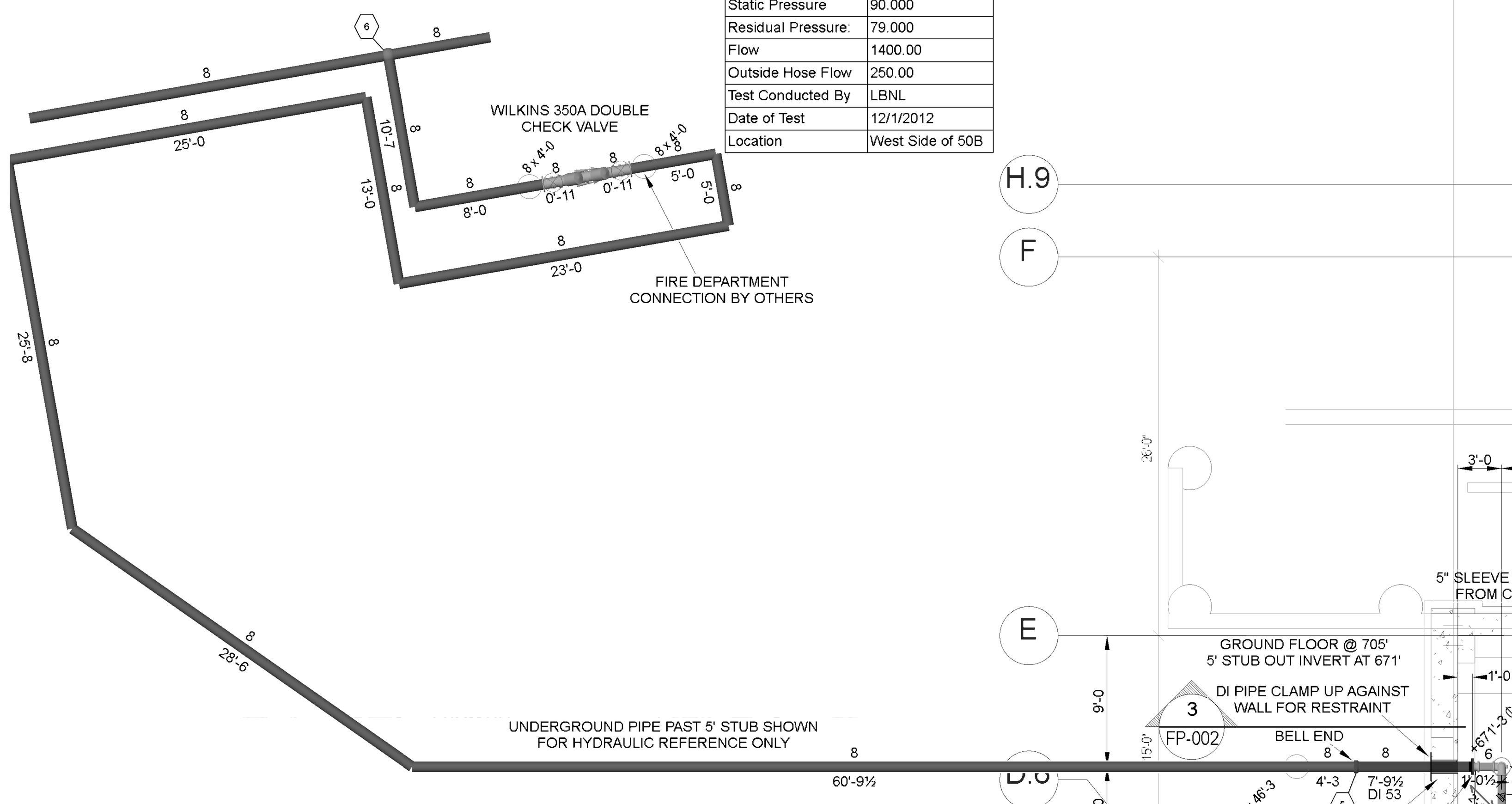
UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY
UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

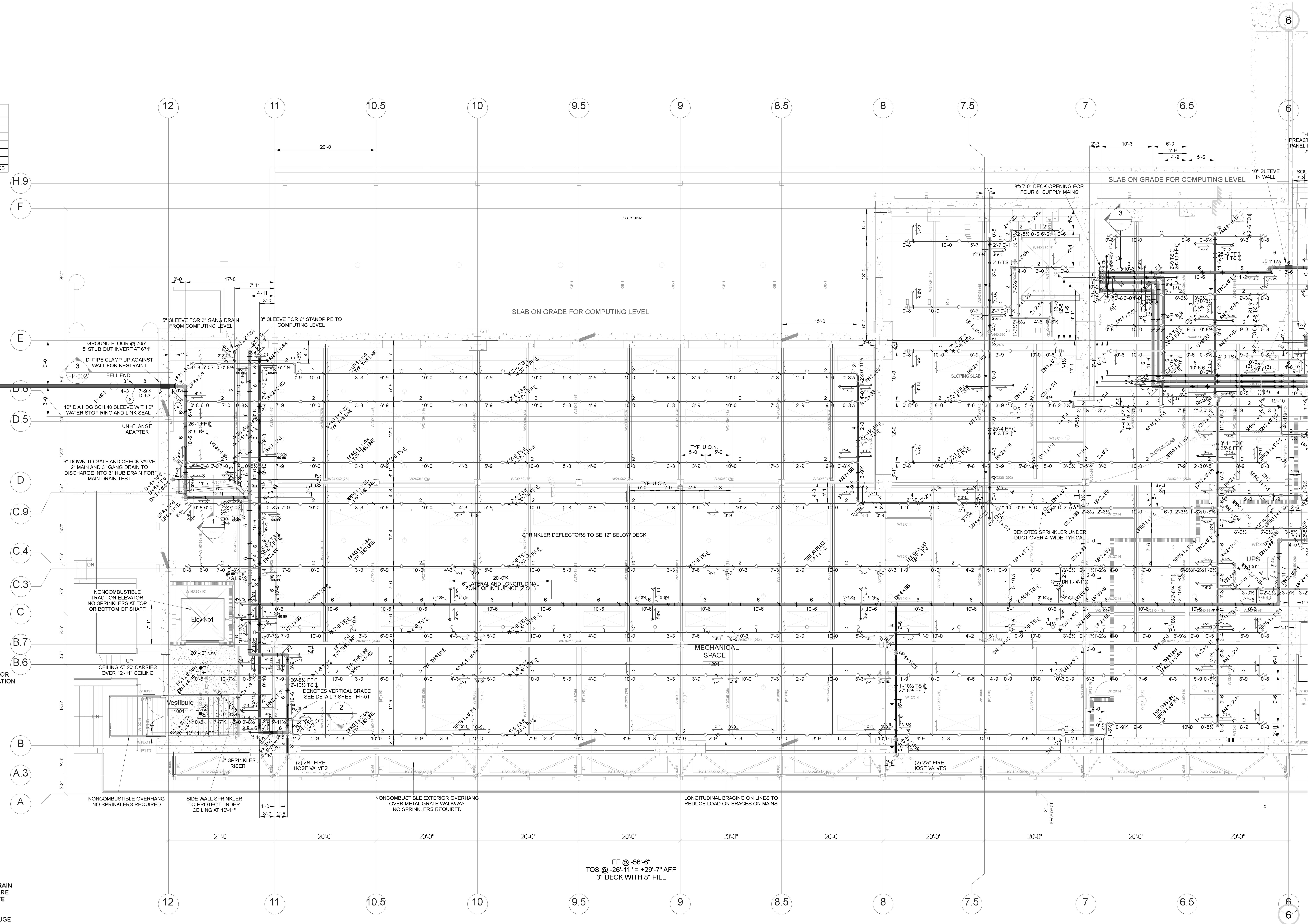
SECTION DETAILS

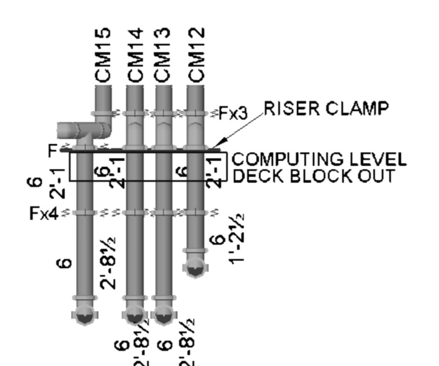
SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-002

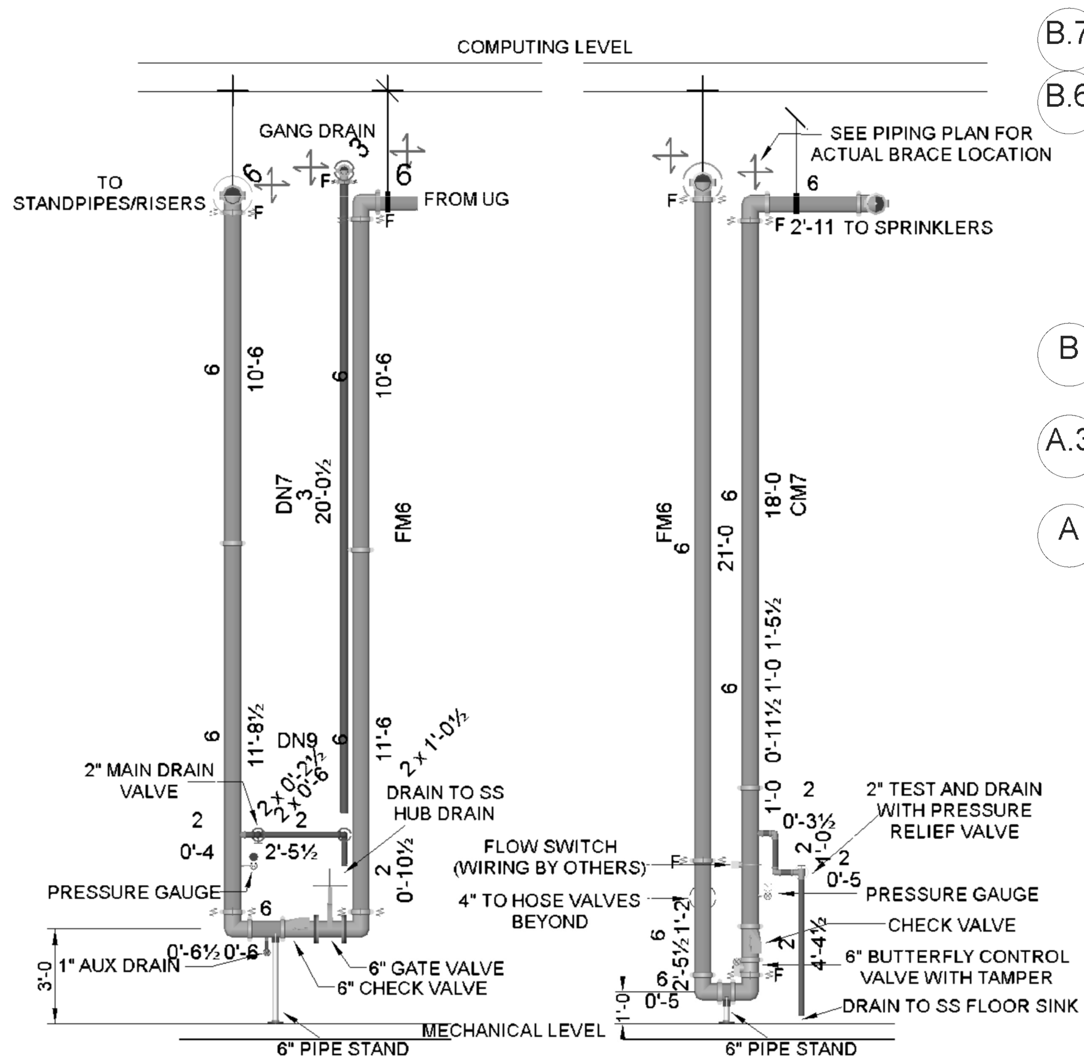
Supply Flow Test Data	
Static Pressure	90.000
Residual Pressure:	79.000
Flow	1400.00
Outside Hose Flow	250.00
Test Conducted By	LBNL
Date of Test	12/1/2012
Location	West Side of 50B







SUPPLY MAINS TO COMPUTING LEVEL (3)



BUILDING SUPPLY ELEVATION (1)   MECHANICAL LEVEL RISER ELEVATION (2)

1/8"=1'-0" 4' 0 4' 12'

	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
	"	
	"	
	"	
	"	
F	"	FLEXIBLE COUPLING
★0 TS℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
⊙	Tyco Inc.	TY3131	70	5.6	Upright	Quick	½"	Brass	155°F	
◎	Tyco Inc.	TY3131	273	5.6	Upright	Quick	½"	Brass	155°F	SPRIG
	Tyco Inc.	TY3131	35	5.6	Upright	Quick	½"	Brass	155°F	UNDER DUCT
	Tyco Inc.	TY3331	1	5.6	Sidewall	Quick	½"	White	155°F	
●	Tyco Inc.	TY3531	2	5.6	Pendent	Quick	½"	Brass	155°F	
			Total = 381							

DESIGN DATA

REMOTE AREA

SYSTEM CLASSIFICATION	ORDINARY 2	
DENSITY	.20	G.P.M./SQ.FT.
AREA OF APPLICATION	3,000	SQ. FT.
COVERAGE PER SPRINKLER	130	SQ. FT.
ORIFICE SIZE	1/2" K= 5.6	
P.S.I. REQUIRED AT BASE OF RISER		
P.S.I. REQUIRED AT P.O.C.		
TOTAL WATER REQUIRED		G.P.M.
INSIDE HOSE (INCLUDED)	0	G.P.M.
HYDRANT HOSE (INCLUDED)	250	G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: --

FIRE DEPT.: PHONE:

MK.	DATE	BY	REVISION
3			
2	6/24/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

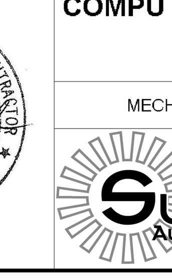
APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED   ESTIMATED BY: JOHN HORNE

SCALE: 1/8" = 1'-0"   DATE: 10/18/13   CONTRACT NO: 12-39028

CONTRACT WITH: DPR   PHONE:

ADDRESS:



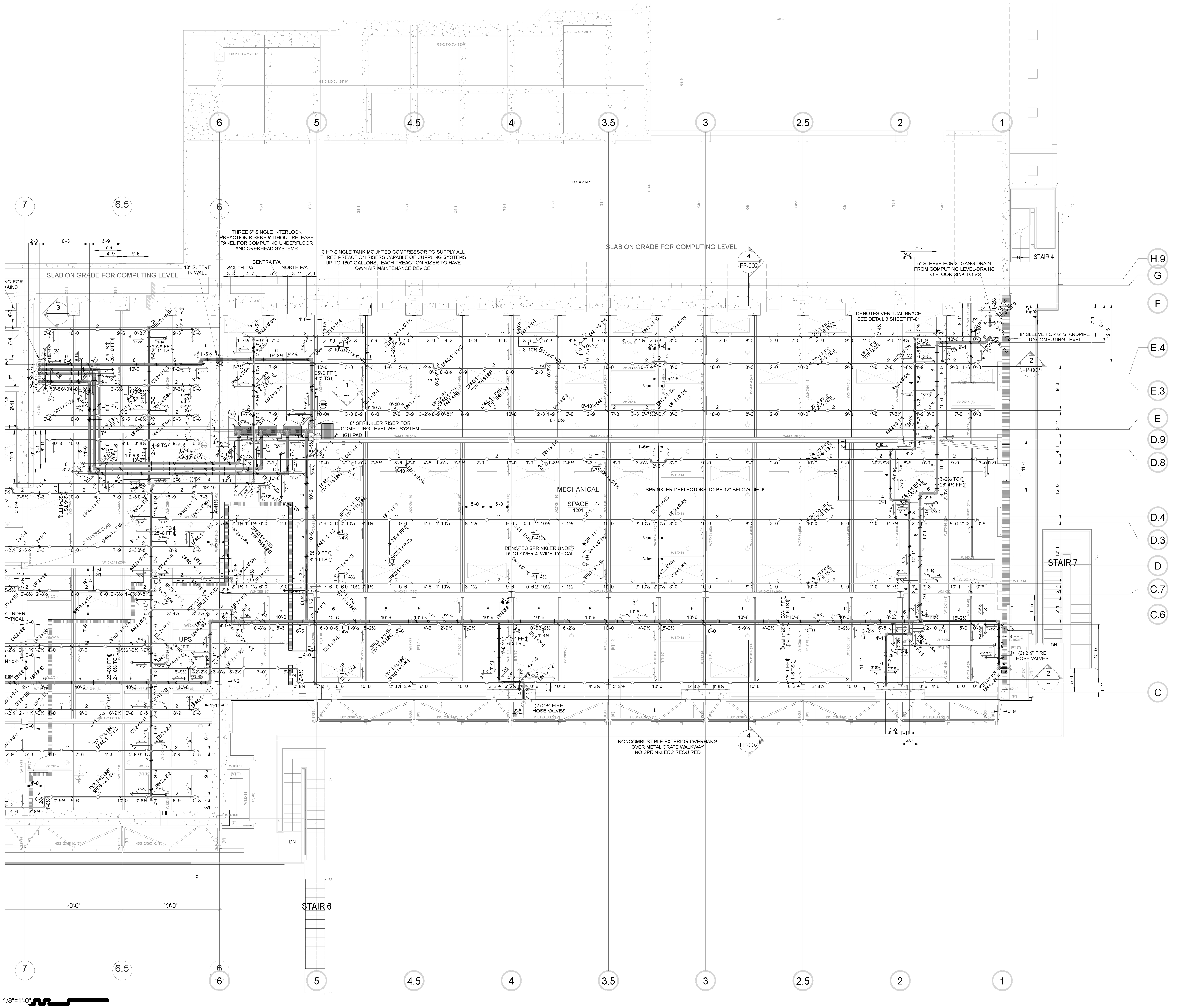
UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY

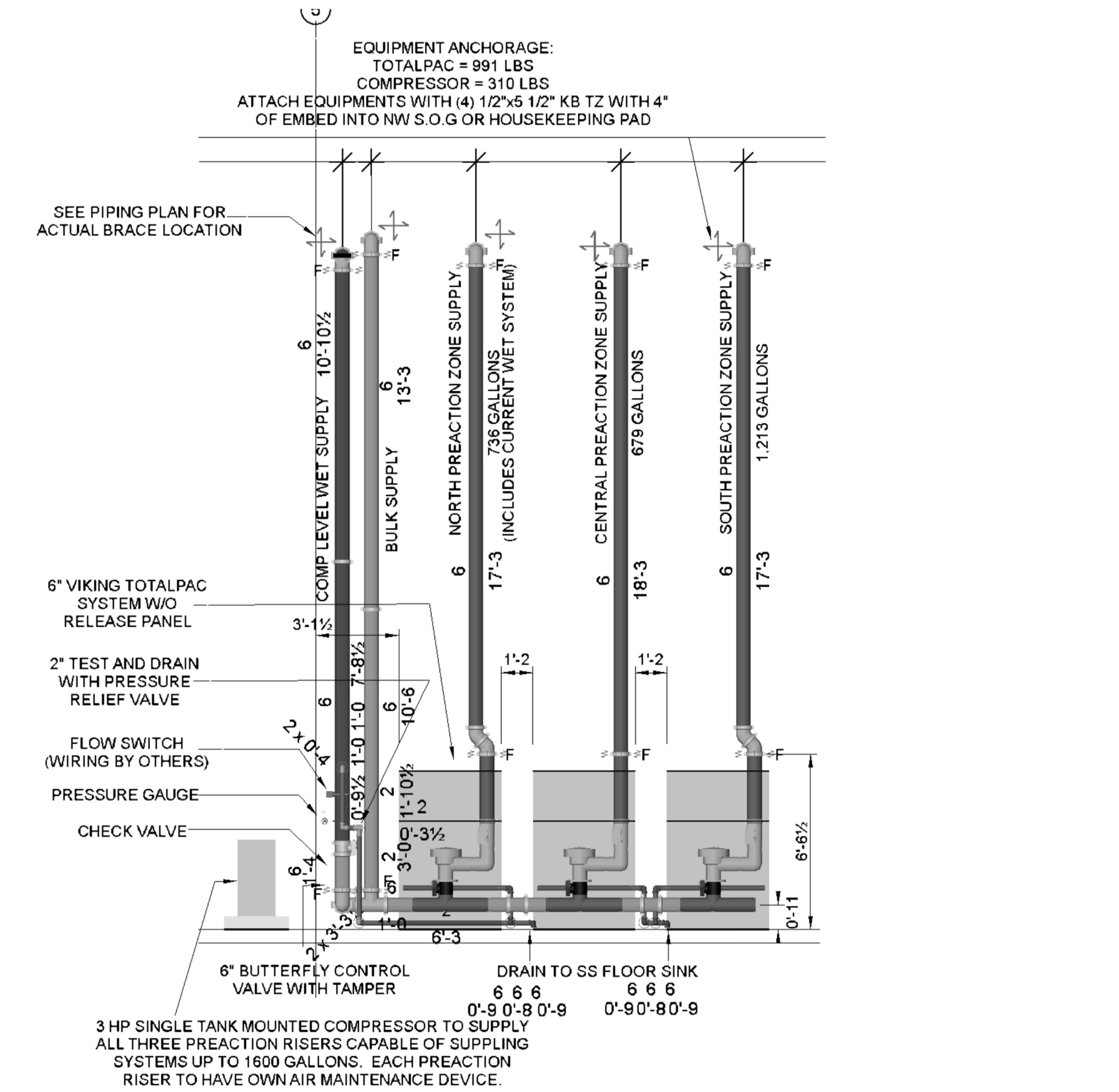
UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

MECHANICAL LEVEL NORTH PIPING/REFLECTED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-200A

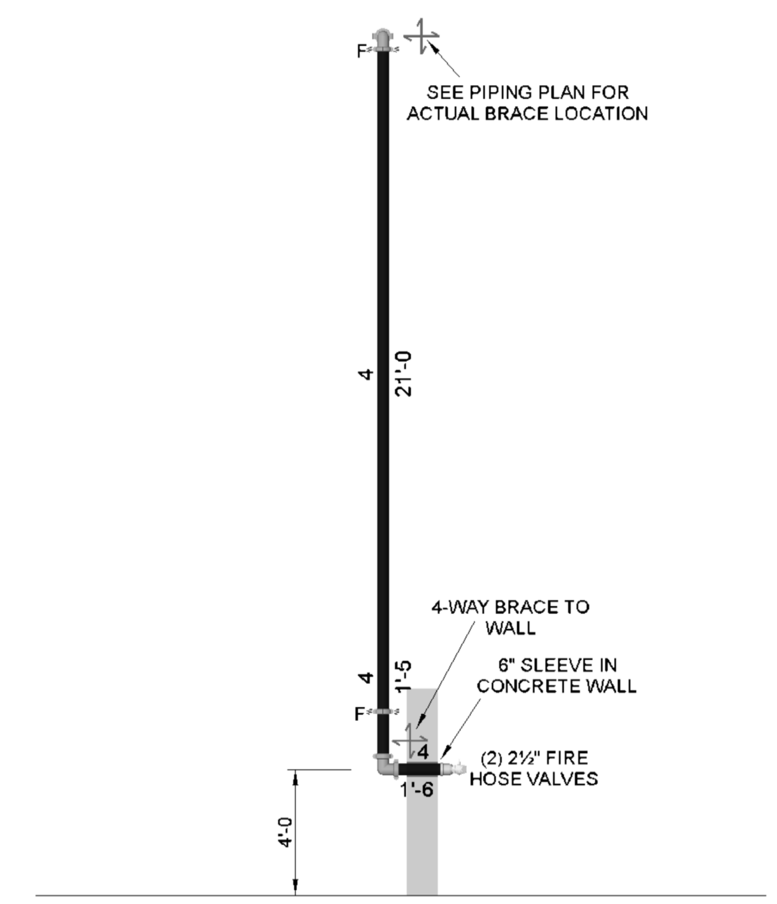




SINGLE INTERLOCK PREACTION RISER ELEVATION (1)

VIKING TOTALPAC SYSTEM W/O RELEASE PANEL

1/4" = 1'-0"



FIRE HOSE VALVE ELEVATION (2)

1/4" = 1'-0"

1/8"=1'-0" 4' 0 4' 12'

Symbol	DENOTES	
(beam clamp)	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
(cast in anchor)	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
(kwik bolt)	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
(kwik bolt)	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
	"	
	"	
	"	
	"	
F	"	FLEXIBLE COUPLING
★0 TS℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
⊙	Tyco Inc.	TY3131	70	5.6	Upright	Quick	½"	Brass	155°F	
◎	Tyco Inc.	TY3131	273	5.6	Upright	Quick	½"	Brass	155°F	SPRIG
◇	Tyco Inc.	TY3131	35	5.6	Upright	Quick	½"	Brass	155°F	UNDER DUCT
◀	Tyco Inc.	TY3331	1	5.6	Sidewall	Quick	½"	White	155°F	
●	Tyco Inc.	TY3531	2	5.6	Pendent	Quick	½"	Brass	155°F	
			Total = 381							

DESIGN DATA

REMOTE AREA

SYSTEM CLASSIFICATION	ORDINARY 2	
DENSITY	.20	G.P.M./SQ.FT.
AREA OF APPLICATION	3,000	SQ. FT.
COVERAGE PER SPRINKLER	130	SQ. FT.
ORIFICE SIZE	1/2" K= 5.6	
P.S.I. REQUIRED AT BASE OF RISER		
P.S.I. REQUIRED AT P.O.C.		
TOTAL WATER REQUIRED		G.P.M.
INSIDE HOSE (INCLUDED)	0	G.P.M.
HYDRANT HOSE (INCLUDED)	250	G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: ------------------------------------

FIRE DEPT.: PHONE:

MK.	DATE	BY	REVISION
3			
2			
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED — ESTIMATED BY: JOHN HORNE

SCALE: 1/8" = 1'-0" — DATE: 10/18/13 — CONTRACT NO: 12-39028

CONTRACT WITH: DPR — PHONE:

ADDRESS:

LICENSED FIRE PROTECTION CONTRACTOR — SUPERIOR AUTOMATIC SPRINKLER CORP. — Classification C-16 — License No. 287121 — STATE of CALIFORNIA

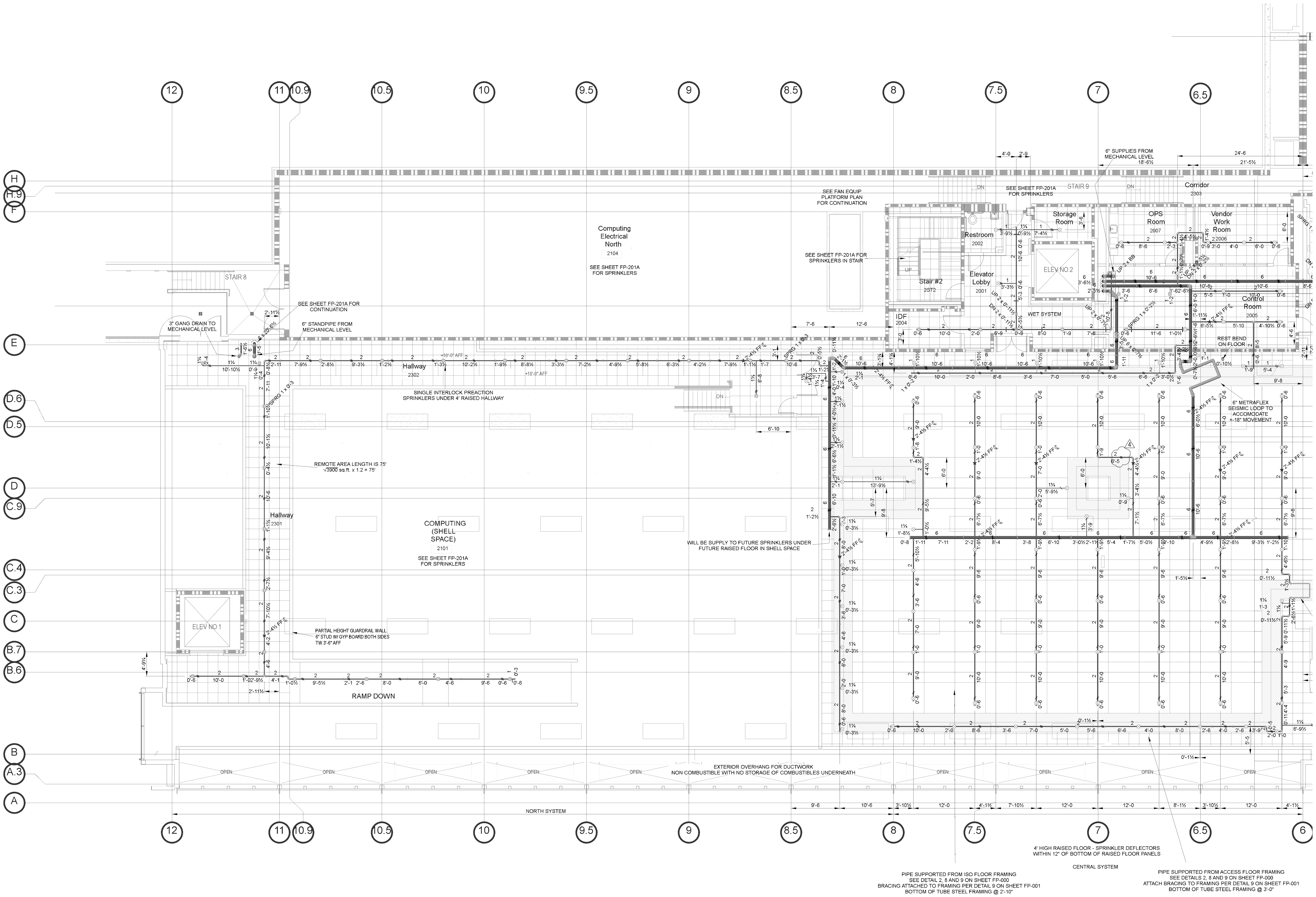
UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY

UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

MECHANICAL LEVEL SOUTH PIPING/REFLECTED PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-200B



1/8"=1'-0" 4' 0 4' 12'

	DENOTES	
	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
	"	SIDE BEAM BRACKET (DETAIL 2 SHEET FP-000)
F	"	FLEXIBLE COUPLING
★0 TS℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
⊗	Tyco Inc.	TY3131	72	5.6	Upright	Quick	½"	Brass	200°F	GUARD
⊗	Tyco Inc.	TY3131	196	5.6	Upright	Quick	½"	Brass	200°F	GUARD
			Total = 268							

DESIGN DATA

REMOTE AREA

SYSTEM CLASSIFICATION	ORDINARY 2	
DENSITY	.20	G.P.M./SQ.FT.
AREA OF APPLICATION	3,000	SQ. FT.
COVERAGE PER SPRINKLER	130	SQ. FT.
ORIFICE SIZE	1/2" K= 5.6	
P.S.I. REQUIRED AT BASE OF RISER		
P.S.I. REQUIRED AT P.O.C.		
TOTAL WATER REQUIRED		G.P.M.
INSIDE HOSE (INCLUDED)	0	G.P.M.
HYDRANT HOSE (INCLUDED)	250	G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER:

FIRE DEPT.: PHONE:

MK.	DATE	BY	REVISION
4	8/24/15	CR	AS BUILT
3	10/24/14	CR	REVISIONS FOR RFI 1522 AND 1540
2	7/18/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED ESTIMATED BY: JOHN HORNE

SCALE: 1/8" = 1'-0" DATE: 10/18/13 CONTRACT NO: 12-39028

CONTRACT WITH: DPR PHONE:

ADDRESS:

LICENSED FIRE PROTECTION CONTRACTOR · SUPERIOR AUTOMATIC SPRINKLER CORP. · Classification C-16 · License No. 287121 · STATE of CALIFORNIA

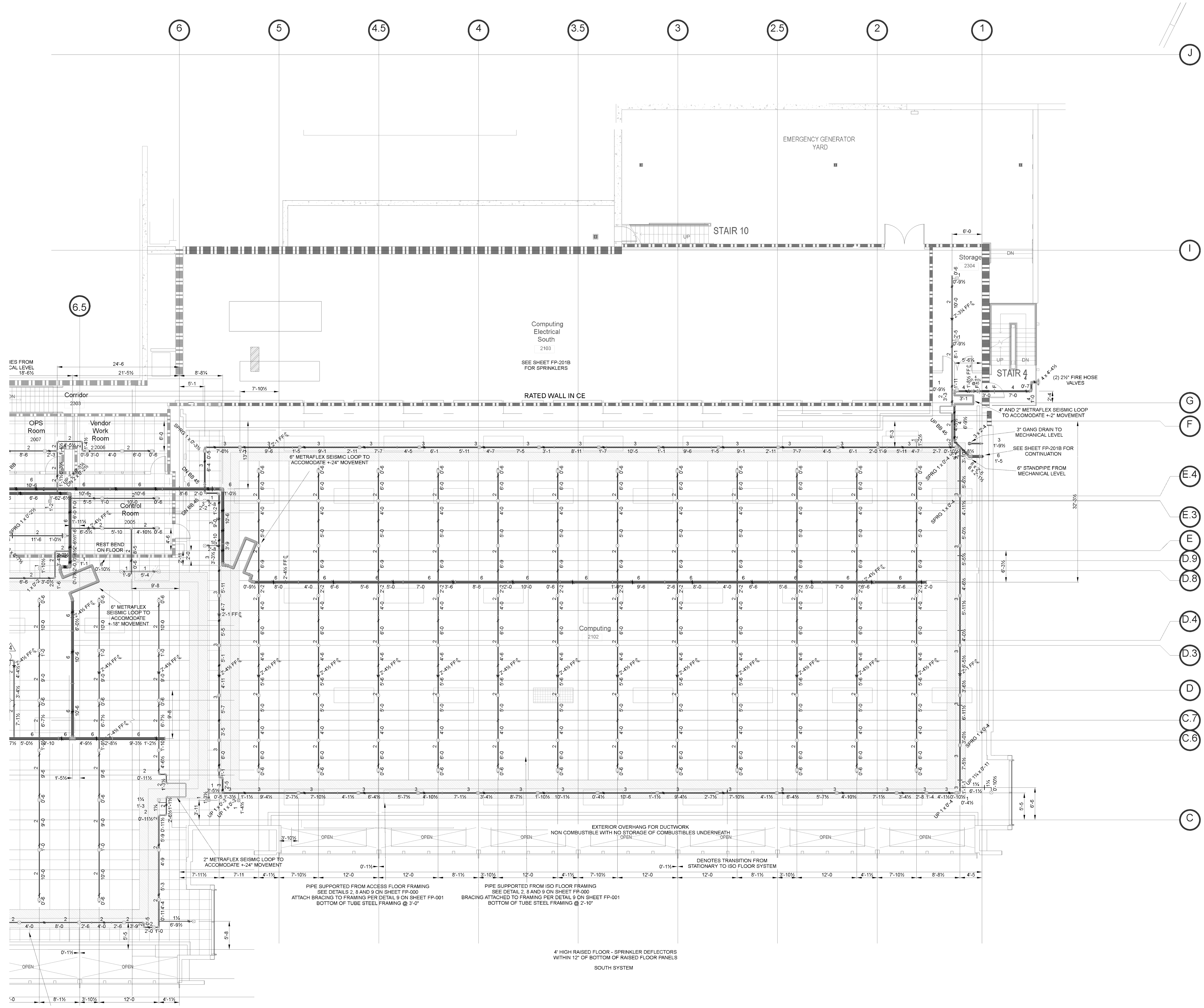
UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY

UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

COMPUTING LEVEL NORTH UNDERFLOOR PIPING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-201AUF



1/8"=1'-0" (scale: 4' 0 4' 12')

Symbol	DENOTES
	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
"	SIDE BEAM BRACKET (DETAIL 2 SHEET FP-000)
F "	FLEXIBLE COUPLING
★0 TS℄ "	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF℄ "	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
"	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
⊗	Tyco Inc.	TY3131	72	5.6	Upright	Quick	½"	Brass	200°F	GUARD
⊗	Tyco Inc.	TY3131	196	5.6	Upright	Quick	½"	Brass	200°F	GUARD
			Total = 268							

DESIGN DATA

REMOTE AREA

SYSTEM CLASSIFICATION ORDINARY 2
DENSITY .20 G.P.M./SQ.FT.
AREA OF APPLICATION 3,000 SQ. FT.
COVERAGE PER SPRINKLER 130 SQ. FT.
ORIFICE SIZE 1/2" K= 5.6
P.S.I. REQUIRED AT BASE OF RISER ______
P.S.I. REQUIRED AT P.O.C. ______
TOTAL WATER REQUIRED ______ G.P.M.
INSIDE HOSE (INCLUDED) 0 G.P.M.
HYDRANT HOSE (INCLUDED) 250 G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: ----------
FIRE DEPT.: ______ PHONE: ______

MK.	DATE	BY	REVISION
3	10/24/14	CR	REVISIONS FOR RFI 1522 AND 1540
2	7/18/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED | ESTIMATED BY: JOHN HORNE
SCALE: 1/8" = 1'-0" | DATE: 10/18/13 | CONTRACT NO: 12-39028
CONTRACT WITH: DPR | PHONE:
ADDRESS:

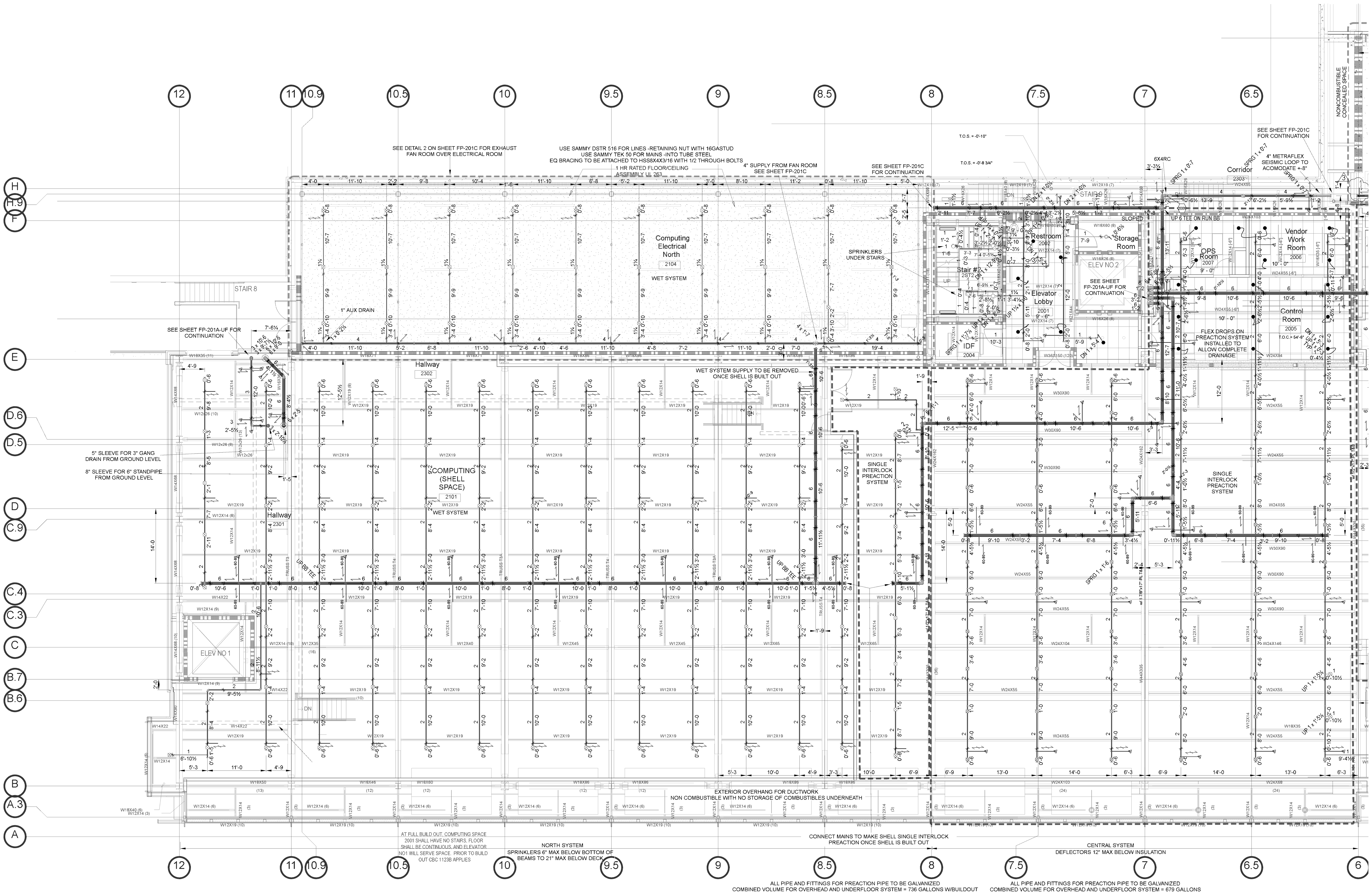
LICENSED FIRE PROTECTION CONTRACTOR — SUPERIOR AUTOMATIC SPRINKLER CORP. — Classification C-16 — License No. 287121 — STATE of CALIFORNIA

UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY
UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

COMPUTING LEVEL SOUTH UNDERFLOOR PIPING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-201BUF



1/8"=1'-0"
4' 0 4' 12'

	DENOTES
	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	" HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	" HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	" HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
	" SAMMY SCREW (DETAIL 8 SHEET FP-000)
F	" FLEXIBLE COUPLING
★0 TS ℄	" DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF ℄	" DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	" BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	" SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
	Tyco Inc.	TY3131	296	5.6	Upright	Quick	½"	Brass	200°F	GUARD
	Tyco Inc.	TY3531	26	5.6	Pendent	Quick	½"	Brass	155°F	
	Tyco Inc.	TY3131	65	5.6	Upright	Quick	½"	Brass	200°F	GUARD/SPRIG
	Tyco Inc.	TY3131	2	5.6	Upright	Quick	½"	Brass	155°F	
	Tyco Inc.	TY3131	15	5.6	Upright	Quick	½"	White	155°F	
	Tyco Inc.	TY3131	72	5.6	Upright	Quick	½"	White	200°F	
	Generic	TY3151	22	5.6	Upright	Standard	½"	White	200°F	
			Total = 498							

DESIGN DATA

SYSTEM CLASSIFICATION ORDINARY 2
DENSITY .20 G.P.M./SQ.FT.
AREA OF APPLICATION 3,000 SQ. FT.
COVERAGE PER SPRINKLER 130 SQ. FT.
ORIFICE SIZE 1/2" K= 5.6
P.S.I. REQUIRED AT BASE OF RISER ______
P.S.I. REQUIRED AT P.O.C. ______
TOTAL WATER REQUIRED ______ G.P.M.
INSIDE HOSE (INCLUDED) 0 G.P.M.
HYDRANT HOSE (INCLUDED) 250 G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: ------------------------------
FIRE DEPT.: ______ PHONE: ______

MK.	DATE	BY	REVISION
3	8/24/15	CR	AS BUILT
2	6/24/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED — ESTIMATED BY: JOHN HORNE
SCALE: 1/8" = 1'-0" — DATE: 10/18/13 — CONTRACT NO: 12-39028
CONTRACT WITH: DPR — PHONE:
ADDRESS:

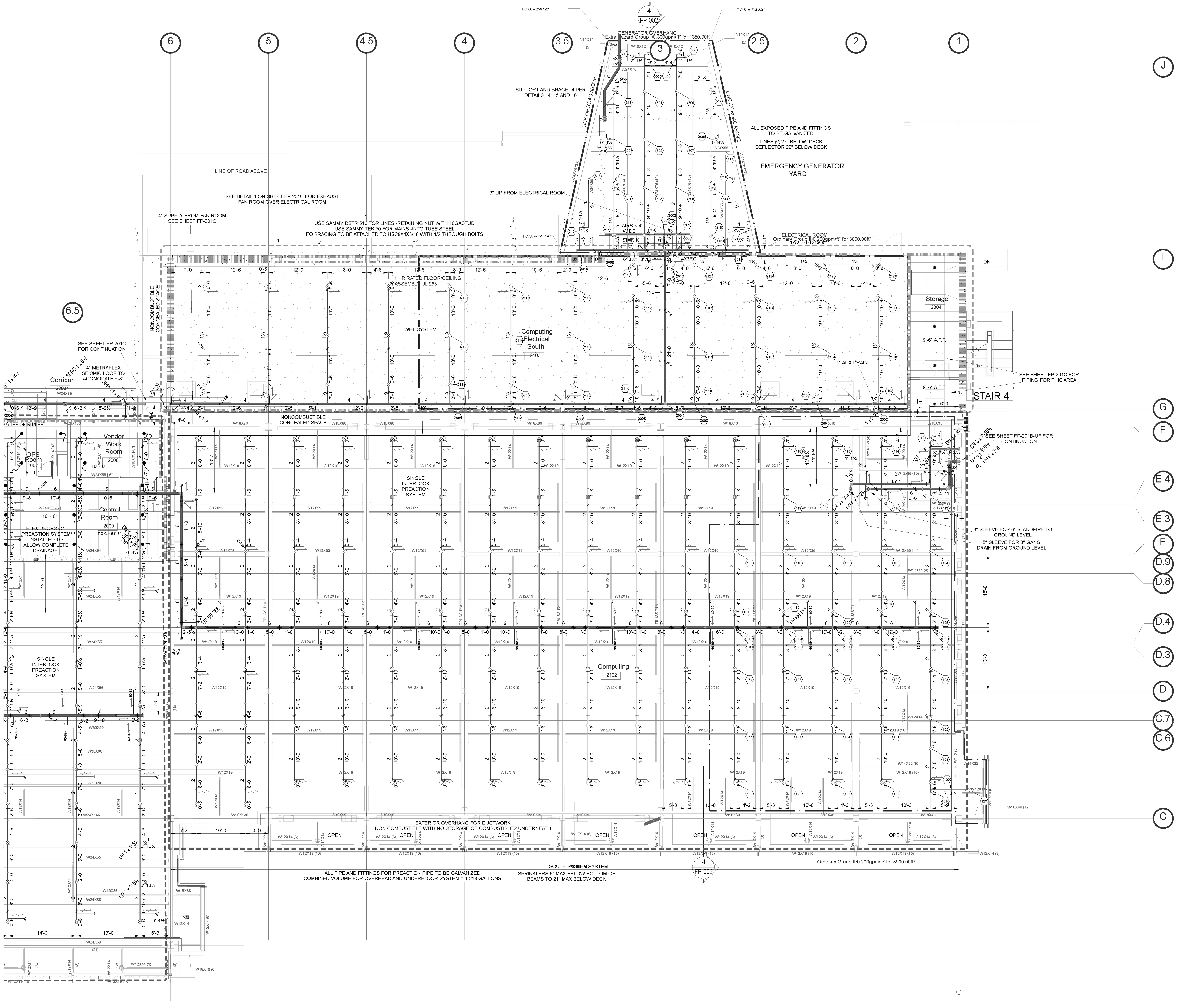
LICENSED FIRE PROTECTION CONTRACTOR — SUPERIOR AUTOMATIC SPRINKLER CORP. — Classification C-16 — License No. 287121 — STATE of CALIFORNIA

UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY
UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

COMPUTING LEVEL NORTH PIPING/REFLECTED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-201A



DESIGN DATA

GENERATOR OVERHANG

SYSTEM CLASSIFICATION **EXTRA HAZARD 1**
DENSITY .30 G.P.M./SQ.FT.
AREA OF APPLICATION 1,350 SQ. FT.
COVERAGE PER SPRINKLER 70 SQ. FT.
ORIFICE SIZE 1/2" K= 5.6
P.S.I. REQUIRED AT BASE OF RISER 85.8
P.S.I. REQUIRED AT P.O.C. 71.2
TOTAL WATER REQUIRED 1076 G.P.M.
P.S.I AVAILABLE AT P.O.C 83.2
HYDRANT HOSE (INCLUDED) 500 G.P.M.

DESIGN DATA

ELECTRICAL ROOM

SYSTEM CLASSIFICATION **ORDINARY 2**
DENSITY .20 G.P.M./SQ.FT.
AREA OF APPLICATION 3,000 SQ. FT.
COVERAGE PER SPRINKLER 125 SQ. FT.
ORIFICE SIZE 1/2" K= 5.6
P.S.I. REQUIRED AT BASE OF RISER 71.2
P.S.I. REQUIRED AT P.O.C. 79.0
TOTAL WATER REQUIRED 992.5 G.P.M.
P.S.I AVAILABLE AT P.O.C 84.2
HYDRANT HOSE (INCLUDED) 250 G.P.M.

	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
	"	SAMMY SCREW (DETAIL 8 SHEET FP-000)
	"	
	"	
	"	
F	"	FLEXIBLE COUPLING
★0 TS ℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF ℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
⊗	Tyco Inc.	TY3131	296	5.6	Upright	Quick	½"	Brass	200°F	GUARD
●	Tyco Inc.	TY3531	26	5.6	Pendent	Quick	½"	Brass	155°F	
⊗	Tyco Inc.	TY3131	65	5.6	Upright	Quick	½"	Brass	200°F	GUARD/SPRIG
⊙	Tyco Inc.	TY3131	2	5.6	Upright	Quick	½"	Brass	155°F	
⊙	Tyco Inc.	TY3131	15	5.6	Upright	Quick	½"	White	155°F	
◆	Tyco Inc.	TY3131	72	5.6	Upright	Quick	½"	White	200°F	
◁	Generic	TY3151	22	5.6	Upright	Standard	½"	White	200°F	
			Total = 498							

DESIGN DATA

COMPUTING LEVEL SOUTH P/A

SYSTEM CLASSIFICATION **ORDINARY 2**
DENSITY .20 G.P.M./SQ.FT.
AREA OF APPLICATION 3,900 SQ. FT.
COVERAGE PER SPRINKLER 130 SQ. FT.
ORIFICE SIZE 1/2" K= 5.6
P.S.I. REQUIRED AT BASE OF RISER 60.0
P.S.I. REQUIRED AT P.O.C. 58.3
TOTAL WATER REQUIRED 1130 G.P.M.
P.S.I AVAILABLE AT P.O.C 82.6
HYDRANT HOSE (INCLUDED) 250 G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: ----------
FIRE DEPT.: PHONE:

MK.	DATE	BY	REVISION
3	8/24/15	CR	AS BUILT
2	6/24/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED — ESTIMATED BY: JOHN HORNE
SCALE: 1/8" = 1'-0" — DATE: 10/18/13 — CONTRACT NO: 12-39028
CONTRACT WITH: DPR — PHONE:
ADDRESS:

LICENSED FIRE PROTECTION CONTRACTOR — SUPERIOR AUTOMATIC SPRINKLER CORP. — Classification C-16 — License No. 287121 — STATE of CALIFORNIA

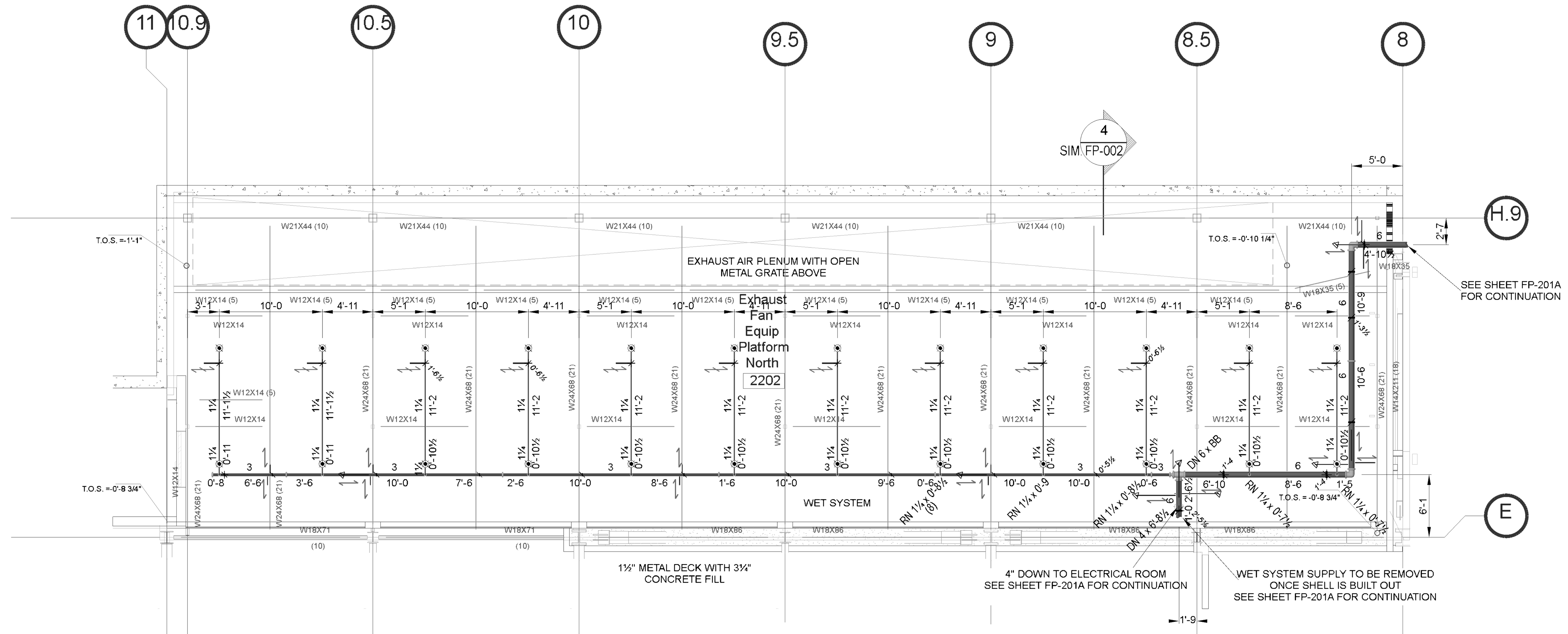
UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY

UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

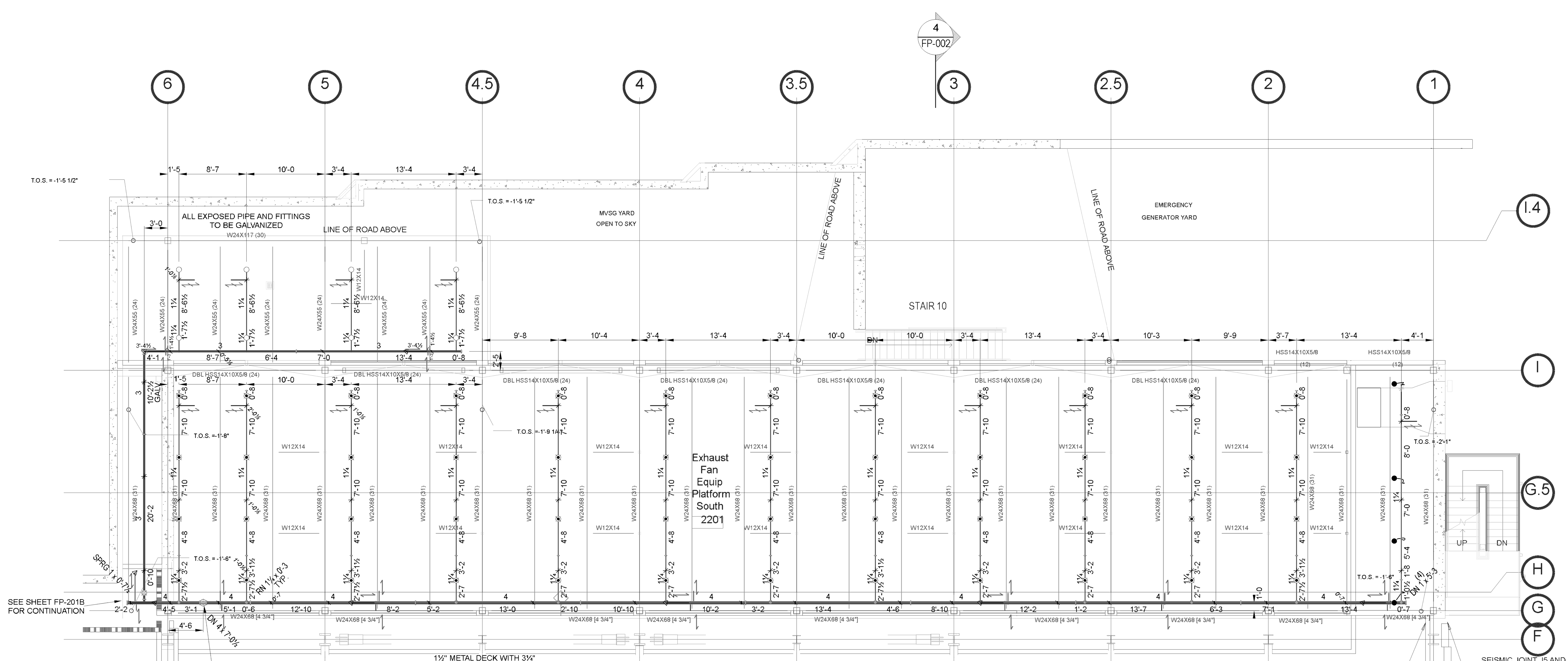
COMPUTING LEVEL SOUTH PIPING/REFLECED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-201B



NORTH EXHAUST FAN PLATFORM PIPING PLAN 2



SOUTH EXHAUST FAN PLATFORM PIPING PLAN 1

1/8"=1'-0" 4' 0 4' 12'

Symbol	Denotes
	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
F	FLEXIBLE COUPLING
★0 TS ℄	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF ℄	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend-Computing Level Overhead

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
⊗	Tyco Inc.	TY3131	296	5.6	Upright	Quick	½"	Brass	200°F	GUARD
●	Tyco Inc.	TY3531	26	5.6	Pendent	Quick	½"	Brass	155°F	
⊗	Tyco Inc.	TY3131	65	5.6	Upright	Quick	½"	Brass	200°F	GUARD/SPRIG
◎	Tyco Inc.	TY3131	2	5.6	Upright	Quick	½"	Brass	155°F	
⊙	Tyco Inc.	TY3131	15	5.6	Upright	Quick	½"	White	155°F	
◆	Tyco Inc.	TY3131	72	5.6	Upright	Quick	½"	White	200°F	
◁	Generic	TY3151	22	5.6	Upright	Standard	½"	White	200°F	
			Total = 498							

DESIGN DATA

REMOTE AREA

SYSTEM CLASSIFICATION ORDINARY 2
DENSITY .20 G.P.M./SQ.FT.
AREA OF APPLICATION 3,000 SQ. FT.
COVERAGE PER SPRINKLER 130 SQ. FT.
ORIFICE SIZE 1/2" K= 5.6
P.S.I. REQUIRED AT BASE OF RISER ______
P.S.I. REQUIRED AT P.O.C. ______
TOTAL WATER REQUIRED ______ G.P.M.
INSIDE HOSE (INCLUDED) 0 G.P.M.
HYDRANT HOSE (INCLUDED) 250 G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: ----------
FIRE DEPT.: ______ PHONE: ______

MK.	DATE	BY	REVISION
3			
2	6/24/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED — ESTIMATED BY: JOHN HORNE
SCALE: 1/8" = 1'-0" — DATE: 10/18/13 — CONTRACT NO: 12-39028
CONTRACT WITH: DPR — PHONE:
ADDRESS:

LICENSED FIRE PROTECTION CONTRACTOR — SUPERIOR AUTOMATIC SPRINKLER CORP. — Classification C-16 — License No. 287121 — STATE of CALIFORNIA

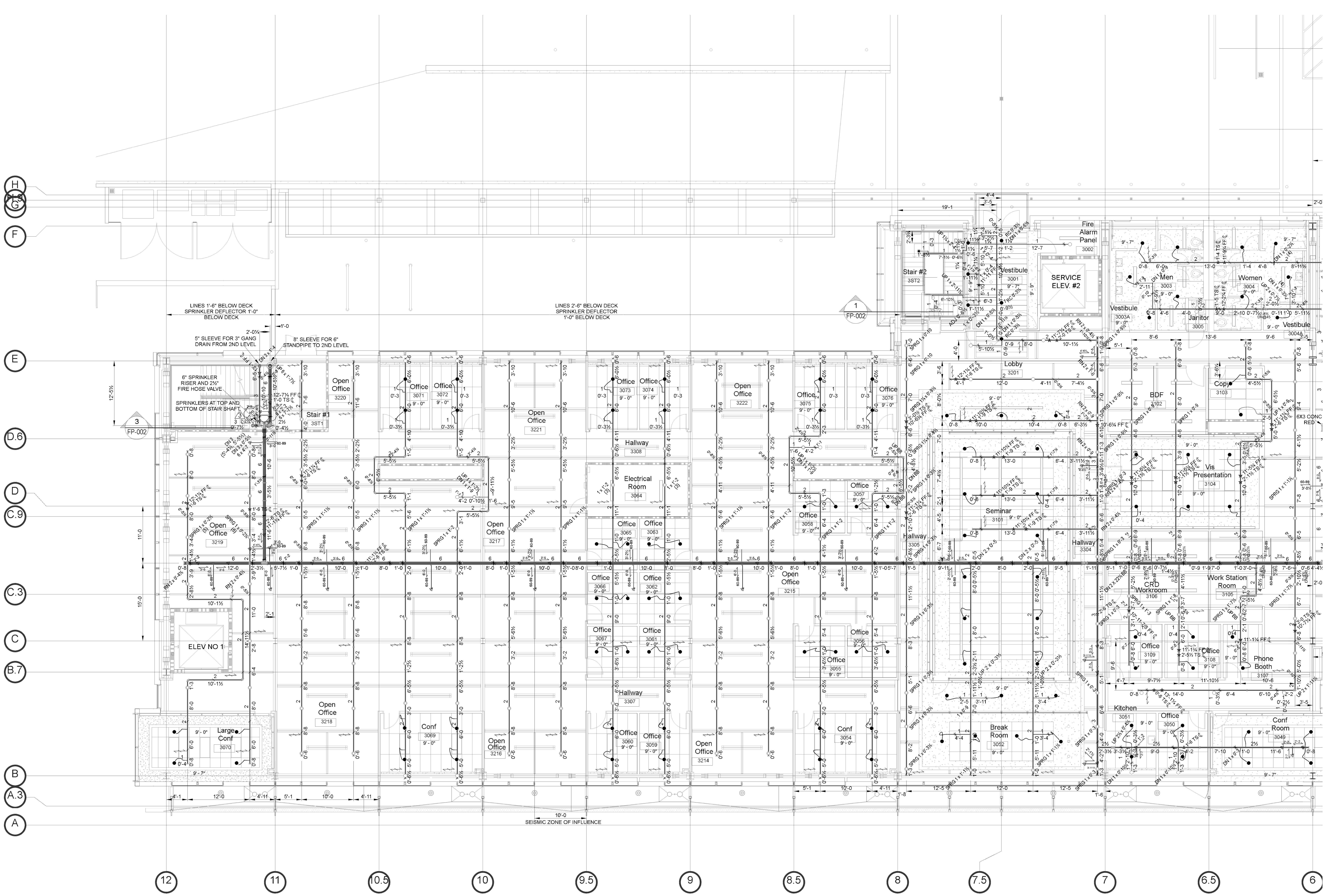
UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY

UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

EXHAUST FAN ROOMS PIPING/REFLECED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-201C



1/8"=1'-0"
4' 0 4' 12'

	DENOTES	
	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
F	"	FLEXIBLE COUPLING
★0 TS ℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF ℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
	Tyco Inc.	TY3131	45	5.6	Upright	Quick	½"	White	155°F	
	Tyco Inc.	TY3131	245	5.6	Upright	Quick	½"	White	155°F	SPRIG
	Tyco Inc.	TY3131	4	5.6	Upright	Quick	½"	White	155°F	DUCT
	Tyco Inc.	TY3531	186	5.6	Pendent	Quick	½"	Brass	155°F	
	Tyco Inc.	TY3231	1	5.6	Pendent	Quick	½"	White	155°F	
			Total = 481							

DESIGN DATA

REMOTE AREA

SYSTEM CLASSIFICATION **ORDINARY 2**
DENSITY **.20** G.P.M./SQ.FT.
AREA OF APPLICATION **3,000** SQ. FT.
COVERAGE PER SPRINKLER **130** SQ. FT.
ORIFICE SIZE **1/2"** K= **5.6**
P.S.I. REQUIRED AT BASE OF RISER
P.S.I. REQUIRED AT P.O.C.
TOTAL WATER REQUIRED G.P.M.
INSIDE HOSE (INCLUDED) **0** G.P.M.
HYDRANT HOSE (INCLUDED) **250** G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: --
FIRE DEPT.: PHONE:

MK.	DATE	BY	REVISION
3	8/24/15	CR	AS BUILT
2	6/24/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: *CARL REED* ESTIMATED BY: *JOHN HORNE*
SCALE: *1/8" = 1'-0"* DATE: *10/18/13* CONTRACT NO: **12-39028**
CONTRACT WITH: *DPR* PHONE:
ADDRESS:

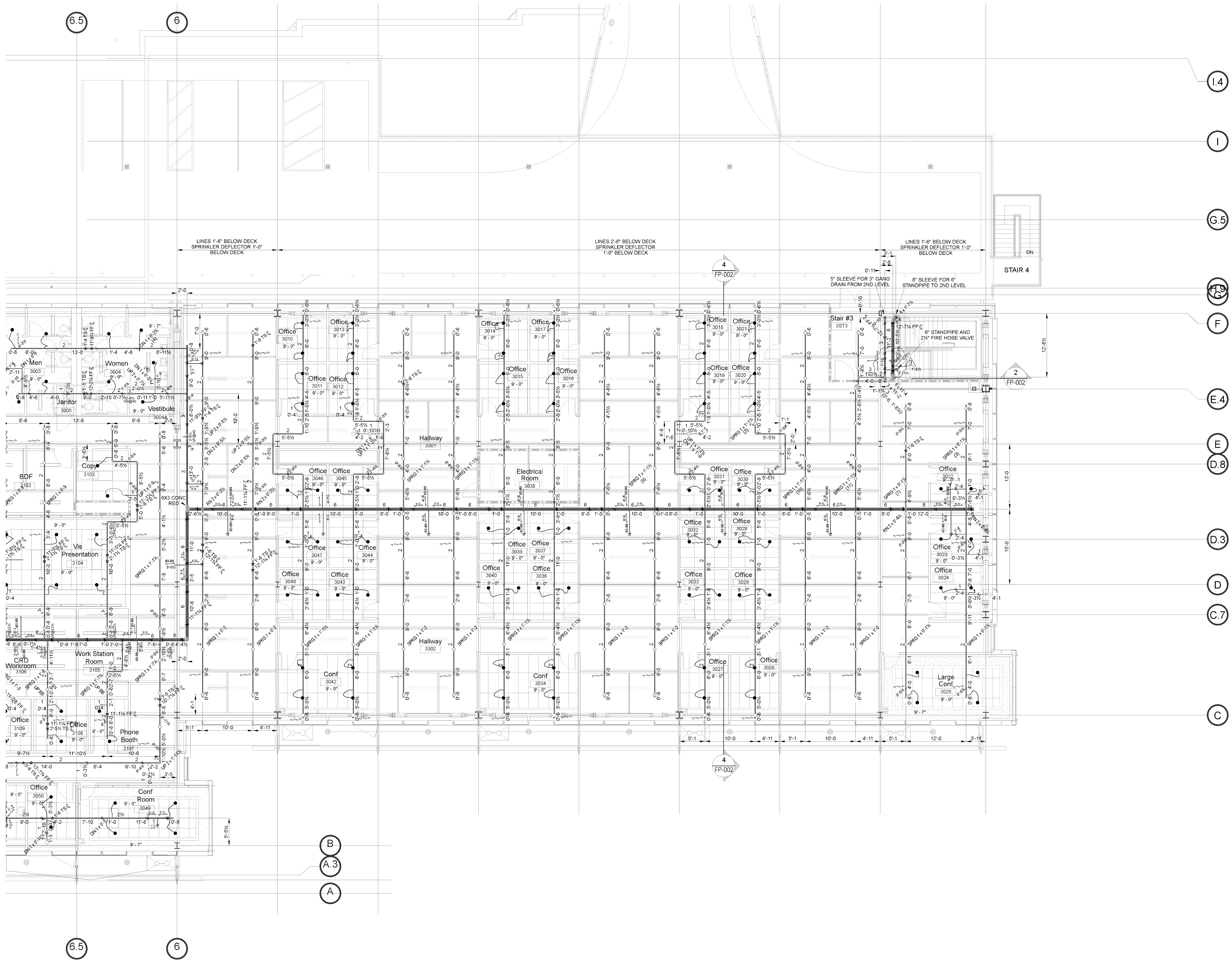
LICENSED FIRE PROTECTION CONTRACTOR
SUPERIOR AUTOMATIC SPRINKLER CORP.
Classification C-16
License No. 287121
STATE of CALIFORNIA

UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY
UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

GROUND LEVEL NORTH PIPING/REFLECTED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO.
FP-202A



1/8"=1'-0"
4' 0 4' 12'

	DENOTES	
	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
	"	
	"	
	"	
	"	
F	"	FLEXIBLE COUPLING
★0 TS ℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF ℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
⊙	Tyco Inc.	TY3131	45	5.6	Upright	Quick	½"	White	155°F	
◎	Tyco Inc.	TY3131	245	5.6	Upright	Quick	½"	White	155°F	SPRIG
◇	Tyco Inc.	TY3131	4	5.6	Upright	Quick	½"	White	155°F	DUCT
●	Tyco Inc.	TY3531	186	5.6	Pendent	Quick	½"	Brass	155°F	
◉	Tyco Inc.	TY3231	1	5.6	Pendent	Quick	½"	White	155°F	
			Total = 481							

DESIGN DATA

REMOTE AREA
SYSTEM CLASSIFICATION ORDINARY 2
DENSITY .20 G.P.M./SQ.FT.
AREA OF APPLICATION 3,000 SQ. FT.
COVERAGE PER SPRINKLER 130 SQ. FT.
ORIFICE SIZE 1/2" K= 5.6
P.S.I. REQUIRED AT BASE OF RISER ______
P.S.I. REQUIRED AT P.O.C. ______
TOTAL WATER REQUIRED ______ G.P.M.
INSIDE HOSE (INCLUDED) 0 G.P.M.
HYDRANT HOSE (INCLUDED) 250 G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: ----------
FIRE DEPT.: ______ PHONE: ______

MK.	DATE	BY	REVISION
3	8/24/15	CR	AS BUILT
2	6/24/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED — ESTIMATED BY: JOHN HORNE
SCALE: 1/8" = 1'-0" — DATE: 10/18/13 — CONTRACT NO: 12-39028
CONTRACT WITH: DPR — PHONE:
ADDRESS:

LICENSED FIRE PROTECTION CONTRACTOR — SUPERIOR AUTOMATIC SPRINKLER CORP. — Classification C-16 — License No. 287121 — STATE of CALIFORNIA

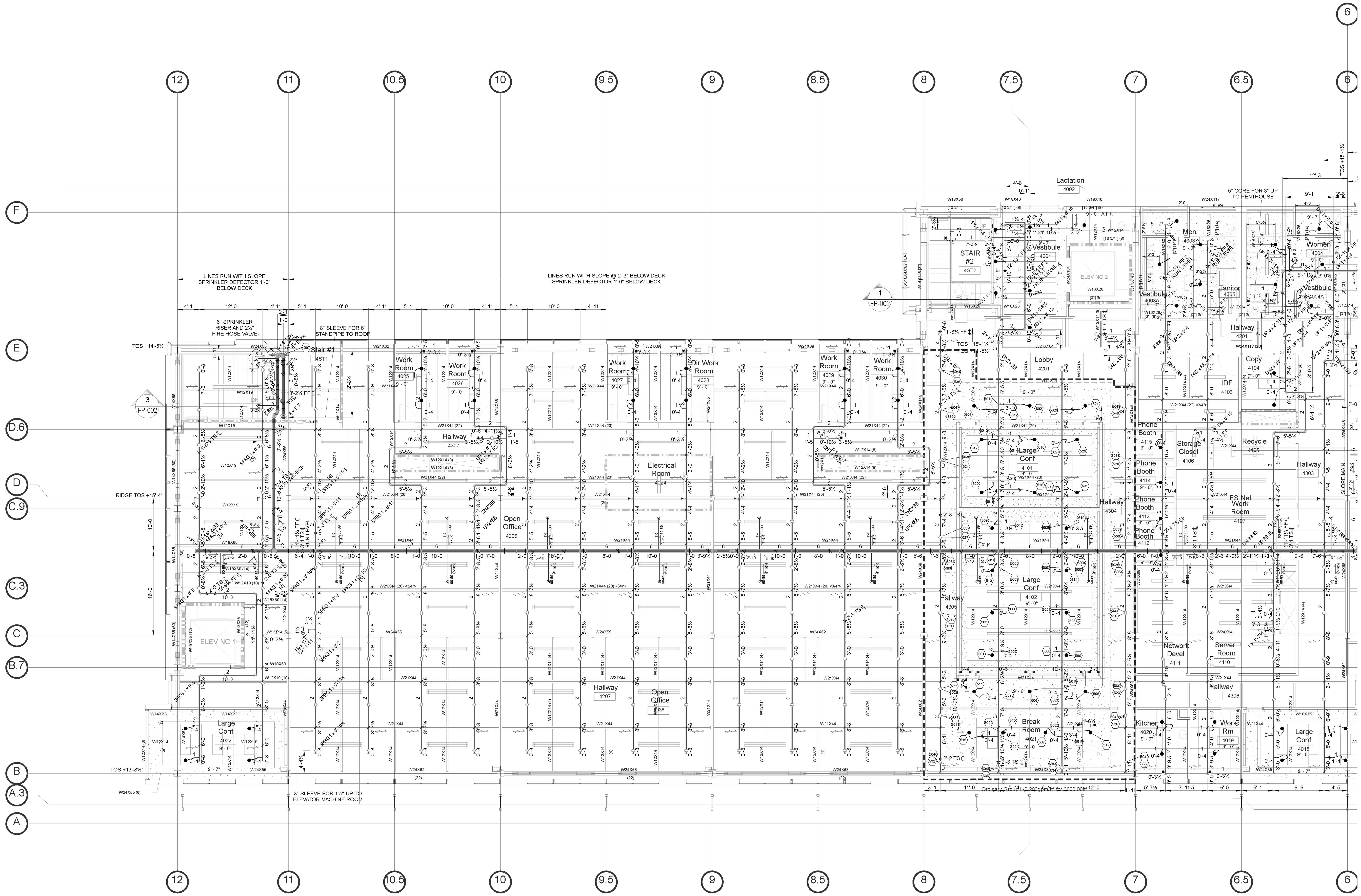
UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY

UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

GROUND LEVEL SOUTH PIPING/REFLECTED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO.
FP-202B



1/8"=1'-0"
4' 0 4' 12'

	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
	"	
	"	
	"	
	"	
F	"	FLEXIBLE COUPLING
★0 TS ℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF ℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
	Tyco Inc.	TY3131	13	5.6	Upright	Quick	½"	White	155°F	
	Tyco Inc.	TY3531	87	5.6	Pendent	Quick	½"	Brass	155°F	
	Tyco Inc.	TY3231	17	5.6	Pendent	Quick	½"	White	155°F	
	Tyco Inc.	TY3131	5	5.6	Upright	Quick	½"	White	155°F	DUCT
	Tyco Inc.	TY3131	314	5.6	Upright	Quick	½"	White	155°F	SPRIG
			Total = 436							

DESIGN DATA

REMOTE AREA - CONF

SYSTEM CLASSIFICATION ORDINARY 2

DENSITY .20 G.P.M./SQ.FT.

AREA OF APPLICATION 3,000 SQ. FT.

COVERAGE PER SPRINKLER 130 SQ. FT.

ORIFICE SIZE 1/2" K= 5.6

P.S.I. REQUIRED AT BASE OF RISER 46.3

P.S.I. REQUIRED AT P.O.C. 68.9

TOTAL WATER REQUIRED 1248 G.P.M.

P.S.I AVAILABLE AT P.O.C 81.1

HYDRANT HOSE (INCLUDED) 250 G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: ----------

FIRE DEPT.: PHONE:

MK.	DATE	BY	REVISION
3	8/24/15	CR	AS BUILT
2	6/24/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED ESTIMATED BY: JOHN HORNE

SCALE: 1/8" = 1'-0" DATE: 10/18/13 CONTRACT NO: 12-39028

CONTRACT WITH: DPR PHONE:

ADDRESS:

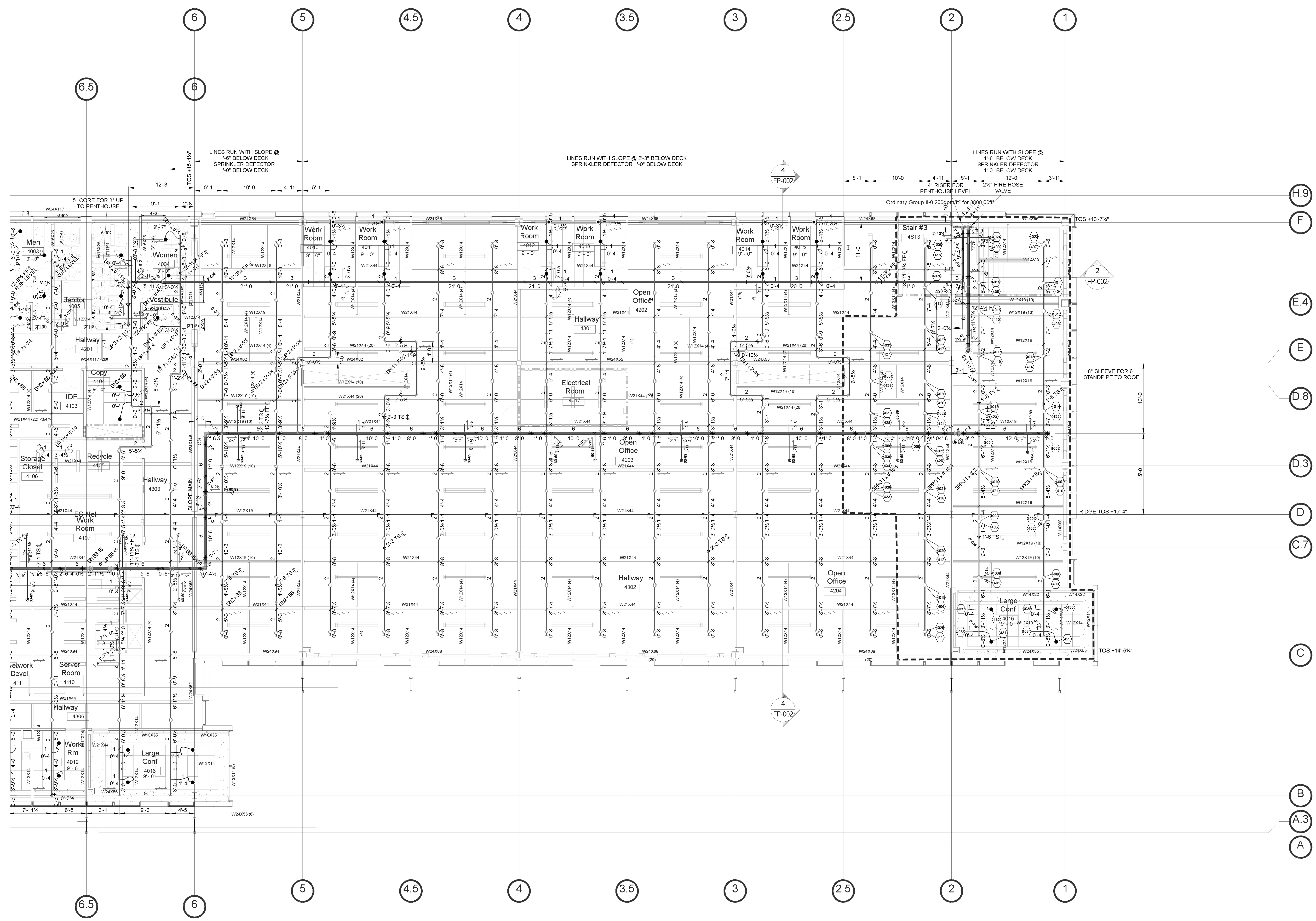
LICENSED FIRE PROTECTION CONTRACTOR · SUPERIOR AUTOMATIC SPRINKLER CORP. · Classification C-16 · License No. 287121 · STATE of CALIFORNIA

UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY
UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

SECOND LEVEL NORTH SPRINKLER PIPING/REFLECTED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-203A



1/8"=1'-0"

4' 0 4' 12'

	DENOTES	
	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
	"	
	"	
	"	
	"	
F	"	FLEXIBLE COUPLING
★0 TS ℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF ℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 1, 2, 3 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
⊙	Tyco Inc.	TY3131	13	5.6	Upright	Quick	½"	White	155°F	
●	Tyco Inc.	TY3531	87	5.6	Pendent	Quick	½"	Brass	155°F	
◉	Tyco Inc.	TY3231	17	5.6	Pendent	Quick	½"	White	155°F	
◈	Tyco Inc.	TY3131	5	5.6	Upright	Quick	½"	White	155°F	DUCT
◎	Tyco Inc.	TY3131	314	5.6	Upright	Quick	½"	White	155°F	SPRIG
			Total = 436							

DESIGN DATA

REMOTE AREA - SOUTH

SYSTEM CLASSIFICATION ORDINARY 2

DENSITY .20 G.P.M./SQ.FT.

AREA OF APPLICATION 3,000 SQ. FT.

COVERAGE PER SPRINKLER 130 SQ. FT.

ORIFICE SIZE 1/2" K= 5.6

P.S.I. REQUIRED AT BASE OF RISER 46.2

P.S.I. REQUIRED AT P.O.C. 65.0

TOTAL WATER REQUIRED 1126 G.P.M.

P.S.I AVAILABLE AT P.O.C 82.6

HYDRANT HOSE (INCLUDED) 250 G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: --

FIRE DEPT.: PHONE:

MK.	DATE	BY	REVISION
3			
2	6/24/14	CR	FOR CONSTRUCTION
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED — ESTIMATED BY: JOHN HORNE

SCALE: 1/8" = 1'-0" — DATE: 10/18/13 — CONTRACT NO: 12-39028

CONTRACT WITH: DPR — PHONE:

ADDRESS:

LICENSED FIRE PROTECTION CONTRACTOR — SUPERIOR AUTOMATIC SPRINKLER CORP. — Classification C-16 — License No. 287121 — STATE of CALIFORNIA

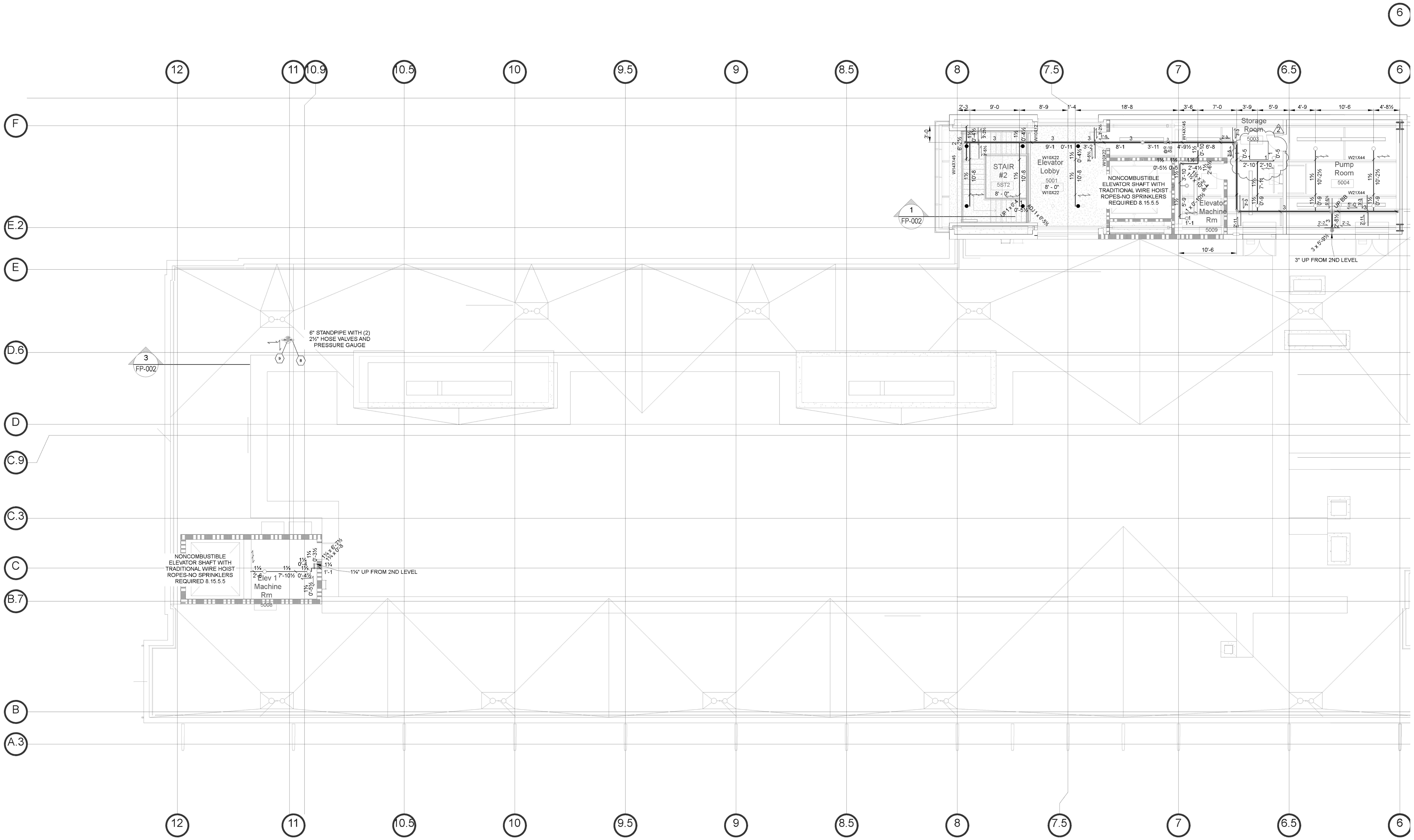
UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY

UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

SECOND LEVEL SOUTH PIPING/REFLECTED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-203B



1/8"=1'-0" 4' 0 4' 12'

	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
F	"	FLEXIBLE COUPLING
★0 TS℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 9, 10 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
●	Tyco Inc.	TY3531	6	5.6	Pendent	Quick	½"	Brass	155°F	
⊙	Tyco Inc.	TY3131	10	5.6	Upright	Quick	½"	Brass	155°F	
◎	Tyco Inc.	TY3131	3	5.6	Upright	Quick	½"	Brass	155°F	SPRIG
			Total = 19							

DESIGN DATA

REMOTE AREA

SYSTEM CLASSIFICATION ORDINARY 2

DENSITY .20 G.P.M./SQ.FT.

AREA OF APPLICATION 3,000 SQ. FT.

COVERAGE PER SPRINKLER 130 SQ. FT.

ORIFICE SIZE 1/2" K= 5.6

P.S.I. REQUIRED AT BASE OF RISER ______

P.S.I. REQUIRED AT P.O.C. ________

TOTAL WATER REQUIRED ______ G.P.M.

INSIDE HOSE (INCLUDED) 0 G.P.M.

HYDRANT HOSE (INCLUDED) 250 G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: ----------

FIRE DEPT.: ______ PHONE: ______

MK.	DATE	BY	REVISION
3			
2	8/24/15	CR	AS BUILT
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED ESTIMATED BY: JOHN HORNE

SCALE: 1/8" = 1'-0" DATE: 10/18/13 CONTRACT NO: 12-39028

CONTRACT WITH: DPR PHONE:

ADDRESS:

LICENSED FIRE PROTECTION CONTRACTOR SUPERIOR AUTOMATIC SPRINKLER CORP. Classification C-16 License No. 287121 STATE of CALIFORNIA

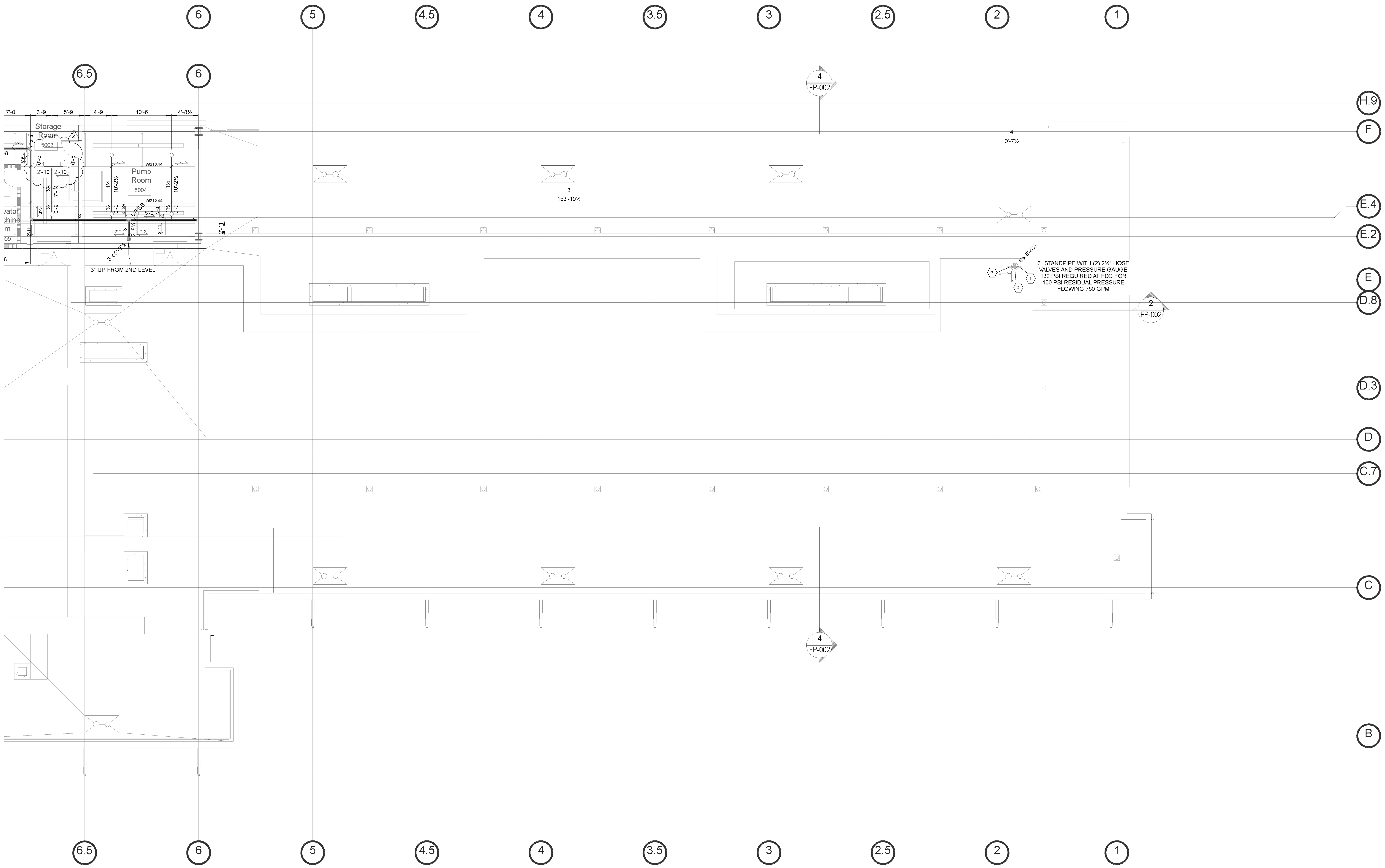
UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY

UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

ROOF LEVEL NORTH PIPING/REFLECTED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO. FP-204A



1/8"=1'-0"
4' 0 4' 12'

	DENOTES	
	DENOTES	TOLCO FIG 68 BEAM CLAMP (DETAILS 3A, 3B SHEET FP-000)
	"	HILTI HCE-MD CAST IN ANCHOR (DETAILS 6, 7 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 4, 5 SHEET FP-000)
	"	HILTI KWIK BOLT TZ (DETAILS 3, 4 SHEET FP-001)
	"	
	"	
	"	
	"	
F	"	FLEXIBLE COUPLING
★0 TS ℄	"	DISTANCE FROM PIPE CENTERLINE TO TOP OF STEEL
★0 FF ℄	"	DISTANCE FROM PIPE CENTERLINE ABOVE FINSHED FLOOR
	"	BRANCHLINE RESTRAINT (DETAILS 7, 8 SHEET FP-001)
	"	SEISMIC BRACE ASSEMBLY (DETAILS 9, 10 SHEET FP-001)

Sprinkler Legend

Symbol	Manufacturer	SIN/Model	Quantity	K-Factor	Type	Response	Orifice	Finish	Temperature	Note
●	Tyco Inc.	TY3531	6	5.6	Pendent	Quick	½"	Brass	155°F	
⊙	Tyco Inc.	TY3131	10	5.6	Upright	Quick	½"	Brass	155°F	
◎	Tyco Inc.	TY3131	3	5.6	Upright	Quick	½"	Brass	155°F	SPRIG
			Total = 19							

DESIGN DATA

REMOTE AREA

SYSTEM CLASSIFICATION ORDINARY 2
DENSITY .20 G.P.M./SQ.FT.
AREA OF APPLICATION 3,000 SQ. FT.
COVERAGE PER SPRINKLER 130 SQ. FT.
ORIFICE SIZE 1/2" K= 5.6
P.S.I. REQUIRED AT BASE OF RISER ______
P.S.I. REQUIRED AT P.O.C. ______
TOTAL WATER REQUIRED ______ G.P.M.
INSIDE HOSE (INCLUDED) 0 G.P.M.
HYDRANT HOSE (INCLUDED) 250 G.P.M.

ALL OVERHEAD PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 13

ALL UNDERGROUND PIPING CONFORMS WITH N.F.P.A. PAMPHLET NO. 24

ALL DIMENSIONS SHOWN ARE APPROX. AND ARE SHOWN AS A GUIDE FOR INSTALLATION ONLY. SPRINKLERS ARE NOT NECESSARILY IN THE CENTER OF CEILING TILES.

UNDERWRITER: ----------
FIRE DEPT.: ______ PHONE: ______

MK.	DATE	BY	REVISION
3			
2	8/24/15	CR	AS BUILT
1	2/18/14	CR	CHANGES PER PLAN CHECK COMMENTS

APPROVALS	OSHPD	OWNER	F.M.	I.S.O.	OTHER
		X			

DRAWN BY: CARL REED ESTIMATED BY: JOHN HORNE
SCALE: 1/8" = 1'-0" DATE: 10/18/13 CONTRACT NO: 12-39028
CONTRACT WITH: DPR PHONE:
ADDRESS:

LICENSED FIRE PROTECTION CONTRACTOR
SUPERIOR AUTOMATIC SPRINKLER CORP.
Classification C-16
License No 287121
STATE of CALIFORNIA

UC CRTF
COMPUTATIONAL RESEARCH & THEORY FACILITY
UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720

ROOF LEVEL SOUTH PIPING/REFLECTED CEILING PLAN

SUPERIOR Automatic Sprinkler
308 SANGO COURT
MILPITAS, CA 95035
(408) 946-7272 Office
(408) 263-5366 Fax

SHEET NO.
FP-204B

Appendix 7: Fire Sprinkler Hydraulic Calculations

Project name: CRT Generator Overhang Date: 21-Mar-17

Step No.	Nozzle Identification and Location	Flow in gpm		Pipe size	Pipe Fittings and Devices	Equivalent Pipe Length [ft]		Friction loss (psi/ft)		Pressure Summary		Normal Pressure		Notes	
	3003	q			Sch. 40	L	8.96	C=	120	Pt	28.7	Pt		k=	5.6
1				3"	Tee	F	15			Pe	3.9	Pv			q = k * (Pt)^1/2
		Q	761.5			T	23.96	pf	0.587	Pf	0.9	Pn		D=	3.1
	2004	q			Sch. 40	L	30.667	C=	120	Pt	33.5	Pt		k=	5.6
2				4"	Tee	F	20			Pe		Pv			
		Q	761.5			T	50.667	pf	0.156	Pf	7.9	Pn		D=	4.026
	Fan Platform	q			Sch. 40	L	95.667	C=	120	Pt	41.4	Pt		k=	
3				4"		F				Pe		Pv			
		Q	761.5			T	95.667	pf	0.156	Pf	15.0	Pn		D=	4.026
	Fan Platform	q			Sch. 40	L	8.62	C=	120	Pt	56.4	Pt		k=	
4				4"	Tee	F	20			Pe	3.7	Pv			
		Q	761.5			T	28.62	pf	0.156	Pf	4.5	Pn		D=	4.026
	Metraflex	q			Sch. 40	L	9.667	C=	120	Pt	64.6	Pt		k=	
5				4"	2 Tee	F	40			Pe		Pv			
		Q	761.5		Metraflex	T	49.667	pf	0.156	Pf	11.8	Pn		Pf	4.026
	2009	q			Sch. 40	L	27.29	C=	120	Pt	76.3	Pt		k=	
6	Corridor			4"	3 Tee	F	60			Pe		Pv			
		Q	761.5			T	87.29	pf	0.156	Pf	13.6	Pn		D=	4.026
	Bulk Main	q			Sch. 40	L	15.08	C=	120	Pt	90.0	Pt			
7				6"	Tee	F	44			Pe		Pv			
		Q	761.5		Elbow	T	59.08	pf	0.021	Pf	1.3	Pn		D=	6.065
	Corner	q			Sch. 40	L	1.167	C=	120	Pt	91.2	Pt			
8				6"	Elbow	F	14			Pe		Pv			
		Q	761.5			T	15.167	pf	0.021	Pf	0.3	Pn		D=	6.065
	Drop	q			Sch. 40	L	7	C=	120	Pt	91.6	Pt			
9				6"	Elbow	F	14			Pe	3.0	Pv			
		Q	761.5			T	21	pf	0.021	Pf	0.4	Pn		D=	6.065
	Mechanical	q			Sch. 40	L	32.167	C=	120	Pt	95.0	Pt			
10				6"	Elbow	F	14			Pe		Pv			
		Q	761.5			T	46.167	pf	0.021	Pf	1.0	Pn		D=	6.065
	Offset	q			Sch. 40	L	0.875	C=	120	Pt	96.0	Pt			
11				6"	2 Elbow	F	28			Pe		Pv			
		Q	761.5			T	28.875	pf	0.021	Pf	0.6	Pn		D=	6.065
	Mechanical	q			Sch. 40	L	23.29	C=	120	Pt	96.6	Pt			
12				6"		F				Pe		Pv			
		Q	761.5			T	23.29	pf	0.021	Pf	0.5	Pn		D=	6.065
	1068	q			Sch. 40	L	12.67	C=	120	Pt	97.1	Pt			
13				6"	Elbow	F	14			Pe		Pv			
		Q	761.5			T	26.67	pf	0.021	Pf	0.6	Pn		D=	6.065
	Drop	q			Sch. 40	L	10	C=	120	Pt	97.7	Pt			
14				6"	Elbow	F	14			Pe	4.3	Pv			
		Q	761.5			T	24	pf	0.021	Pf	0.5	Pn		D=	6.065
	Up	q			Sch. 40	L	10	C=	120	Pt	102.5	Pt			
15				6"	Elbow	F	14			Pe	4.3	Pv			
		Q	761.5			T	24	pf	0.021	Pf	0.5	Pn		D=	6.065
	Tee	q			Sch. 40	L	37.96	C=	120	Pt	98.7	Pt			
16				6"	Elbow	F	14			Pe		Pv			
		Q	761.5			T	51.96	pf	0.021	Pf	1.10	Pn		D=	6.065
	Cross Bulk	q			Sch. 40	L	10	C=	120	Pt	99.8	Pt			
17	Main			6"	Tee	F	30			Pe		Pv			
		Q	761.5			T	40	pf	0.021	Pf	0.8	Pn		D=	6.065
	Drop	q			Sch. 40	L	1.375	C=	120	Pt	100.7	Pt			
18				6"	Elbow	F	14			Pe	0.6	Pv			
		Q	761.5			T	15.375	pf	0.021	Pf	0.3	Pn		D=	6.065

Project name:	CRT Generator Overhang											Date:		21-Mar-17
Step No.	Nozzle Identification and Location	Flow in gpm		Pipe size	Pipe Fittings and Devices	Equivalent Pipe Length [ft]		Friction loss (psi/ft)		Pressure Summary		Normal Pressure		Notes
19	Bulk Main	q		6"	Sch. 40	L	47.5	C=	120	Pt	101.6	Pt		
					Elbow	F	14			Pe		Pv		
		Q	761.5			T	61.5	pf	0.021	Pf	1.3	Pn	D=	6.065
20	Bulk Main	q		6"	Sch. 40	L	154.67	C=	120	Pt	102.9	Pt		
						F				Pe		Pv		
		Q	761.5			T	154.67	pf	0.021	Pf	3.3	Pn	D=	6.065
21	Cross	q		6"	Sch. 40	L	19	C=	120	Pt	106.2	Pt		
	Bulk Main				Tee	F	30			Pe		Pv		
		Q	761.5			T	49	pf	0.021	Pf	1.0	Pn	D=	6.065
22	Bulk Main	q		6"	Sch. 40	L	12.75	C=	120	Pt	107.2	Pt		
					Tee	F	30			Pe		Pv		
		Q	761.5			T	42.75	pf	0.021	Pf	0.9	Pn	D=	6.065
23	Riser Drop	q		6"	Sch. 40	L	22.21	C=	120	Pt	108.1	Pt		
					Elbow	F	14			Pe	9.6	Pv		
		Q	761.5			T	36.21	pf	0.021	Pf	0.8	Pn	D=	6.065
24	Riser Cross	q		6"	Sch. 40	L	2.29	C=	120	Pt	118.5	Pt		
					Elbow	F	14			Pe		Pv		
		Q	761.5			T	16.29	pf	0.021	Pf	0.3	Pn	D=	6.065
25	Riser Up	q		6"	Sch. 40	L	22.21	C=	120	Pt	118.9	Pt		
					Elbow	F	64			Pe	-9.6	Pv		
		Q	761.5		GV, CV	T	86.21	pf	0.021	Pf	1.8	Pn	D=	6.065
26	Riser Cross	q		6"	Sch. 40	L	16.83	C=	120	Pt	111.1	Pt		
					Elbow	F	64			Pe		Pv		
		Q	761.5			T	80.83	pf	0.021	Pf	1.7	Pn	D=	6.065
37	Underground	q		6"	Sch. 40	L	3.29	C=	120	Pt	112.8	Pt		
	Connection				2 Elbow	F	28			Pe	1.0	Pv		
		Q	761.5			T	31.29	pf	0.021	Pf	0.7	Pn	D=	6.065
38	Underground	q		8"	DI C.52	L	243.25	C=	120	Pt	114.4	Pt		
					6 Elbow	F	90			Pe	21.7	Pv		
		Q	761.5			T	333.25	pf	0.004	Pf	1.5	Pn	D=	8.39
38	Hose Stream	q	500.0			L		C=		Pt	94.3	Pt		
						F				Pe		Pv		
		Q	1261.5			T		pf		Pf		Pn	D=	

Appendix 8: DETACT Model Input and Output

INPUT PARAMETERS			CALC. PARAMETERS	
Ceiling height (H)	3.81	m	R/H	0.625
Radial distance (R)	2.4	m	dT(cj)/dT(pl)	0.411
Ambient temperature (To)	20	C	u(cj)/u(pl)	0.296
Actuation temperature (Td)	68.3	C	Rep. t2 coeff.	k
Response time index (RTI)	50	(m-s)1/2	Slow	0.003
Fire growth power (n)	2	-	Medium	0.012
Fire growth coefficient (k)	0.047	kW/s^n	Fast	0.047
Time step (dt)	1	s	Ultrafast	0.400

Calculation time (s)	HRR	Gas temp	Gas velocity	Det temp	dT/dt
0	0.0	20.0	0.00	20.00	0.0000
1	0.0	20.1	0.07	20.00	0.0005
2	0.2	20.2	0.11	20.00	0.0016
3	0.4	20.4	0.14	20.00	0.0032
4	0.8	20.6	0.17	20.01	0.0051
5	1.2	20.8	0.20	20.01	0.0073
6	1.7	21.1	0.23	20.02	0.0099
7	2.3	21.3	0.25	20.03	0.0127
8	3.0	21.6	0.27	20.04	0.0159
9	3.8	21.8	0.30	20.06	0.0192
10	4.7	22.1	0.32	20.08	0.0228
11	5.7	22.4	0.34	20.10	0.0265
12	6.8	22.7	0.36	20.12	0.0305
13	7.9	23.0	0.38	20.16	0.0346
14	9.2	23.3	0.40	20.19	0.0390
15	10.6	23.6	0.42	20.23	0.0434
16	12.0	23.9	0.43	20.27	0.0481
17	13.6	24.2	0.45	20.32	0.0528
18	15.2	24.6	0.47	20.37	0.0578
19	17.0	24.9	0.49	20.43	0.0628
20	18.8	25.3	0.50	20.49	0.0679
21	20.7	25.6	0.52	20.56	0.0732
22	22.7	26.0	0.54	20.63	0.0785
23	24.9	26.4	0.55	20.71	0.0840
24	27.1	26.7	0.57	20.80	0.0895
25	29.4	27.1	0.58	20.89	0.0951
26	31.8	27.5	0.60	20.98	0.1008
27	34.3	27.9	0.62	21.08	0.1066
28	36.8	28.3	0.63	21.19	0.1124
29	39.5	28.7	0.65	21.30	0.1183
30	42.3	29.1	0.66	21.42	0.1242
31	45.2	29.5	0.67	21.54	0.1302

Calculation time (s)	HRR	Gas temp	Gas velocity	Det temp	dT/dt
32	48.1	29.9	0.69	21.67	0.1362
33	51.2	30.3	0.70	21.81	0.1423
34	54.3	30.7	0.72	21.95	0.1484
35	57.6	31.1	0.73	22.10	0.1545
36	60.9	31.6	0.75	22.26	0.1606
37	64.3	32.0	0.76	22.42	0.1668
38	67.9	32.4	0.77	22.58	0.1730
39	71.5	32.9	0.79	22.76	0.1792
40	75.2	33.3	0.80	22.94	0.1854
41	79.0	33.7	0.81	23.12	0.1916
42	82.9	34.2	0.83	23.31	0.1978
43	86.9	34.6	0.84	23.51	0.2041
44	91.0	35.1	0.85	23.71	0.2103
45	95.2	35.6	0.87	23.92	0.2165
46	99.5	36.0	0.88	24.14	0.2227
47	103.8	36.5	0.89	24.36	0.2289
48	108.3	37.0	0.90	24.59	0.2351
49	112.8	37.4	0.92	24.83	0.2413
50	117.5	37.9	0.93	25.07	0.2474
51	122.2	38.4	0.94	25.32	0.2535
52	127.1	38.9	0.95	25.57	0.2597
53	132.0	39.4	0.97	25.83	0.2657
54	137.1	39.8	0.98	26.10	0.2718
55	142.2	40.3	0.99	26.37	0.2778
56	147.4	40.8	1.00	26.65	0.2839
57	152.7	41.3	1.01	26.93	0.2898
58	158.1	41.8	1.02	27.22	0.2958
59	163.6	42.3	1.04	27.51	0.3017
60	169.2	42.8	1.05	27.82	0.3076
61	174.9	43.3	1.06	28.12	0.3134
62	180.7	43.9	1.07	28.44	0.3192
63	186.5	44.4	1.08	28.76	0.3250
64	192.5	44.9	1.09	29.08	0.3307
65	198.6	45.4	1.11	29.41	0.3364
66	204.7	45.9	1.12	29.75	0.3421
67	211.0	46.5	1.13	30.09	0.3477
68	217.3	47.0	1.14	30.44	0.3532
69	223.8	47.5	1.15	30.79	0.3588
70	230.3	48.0	1.16	31.15	0.3642
71	236.9	48.6	1.17	31.51	0.3697

Calculation time (s)	HRR	Gas temp	Gas velocity	Det temp	dT/dt
72	243.6	49.1	1.18	31.88	0.3751
73	250.5	49.7	1.19	32.26	0.3804
74	257.4	50.2	1.21	32.64	0.3857
75	264.4	50.8	1.22	33.03	0.3910
76	271.5	51.3	1.23	33.42	0.3962
77	278.7	51.8	1.24	33.81	0.4013
78	285.9	52.4	1.25	34.21	0.4065
79	293.3	53.0	1.26	34.62	0.4115
80	300.8	53.5	1.27	35.03	0.4165
81	308.4	54.1	1.28	35.45	0.4215
82	316.0	54.6	1.29	35.87	0.4264
83	323.8	55.2	1.30	36.30	0.4313
84	331.6	55.8	1.31	36.73	0.4361
85	339.6	56.3	1.32	37.16	0.4409
86	347.6	56.9	1.33	37.60	0.4456
87	355.7	57.5	1.34	38.05	0.4503
88	364.0	58.1	1.35	38.50	0.4549
89	372.3	58.6	1.36	38.96	0.4595
90	380.7	59.2	1.37	39.42	0.4641
91	389.2	59.8	1.38	39.88	0.4685
92	397.8	60.4	1.39	40.35	0.4730
93	406.5	61.0	1.40	40.82	0.4774
94	415.3	61.6	1.41	41.30	0.4817
95	424.2	62.1	1.42	41.78	0.4860
96	433.2	62.7	1.43	42.27	0.4903
97	442.2	63.3	1.44	42.76	0.4945
98	451.4	63.9	1.45	43.25	0.4986
99	460.6	64.5	1.46	43.75	0.5027
100	470.0	65.1	1.47	44.25	0.5068
101	479.4	65.7	1.48	44.76	0.5108
102	489.0	66.3	1.49	45.27	0.5148
103	498.6	66.9	1.50	45.78	0.5187
104	508.4	67.5	1.51	46.30	0.5226
105	518.2	68.2	1.52	46.83	0.5264
106	528.1	68.8	1.53	47.35	0.5302
107	538.1	69.4	1.54	47.88	0.5340
108	548.2	70.0	1.55	48.42	0.5377
109	558.4	70.6	1.56	48.95	0.5414
110	568.7	71.2	1.57	49.50	0.5450
111	579.1	71.9	1.58	50.04	0.5486

Calculation time (s)	HRR	Gas temp	Gas velocity	Det temp	dT/dt
112	589.6	72.5	1.59	50.59	0.5521
113	600.1	73.1	1.60	51.14	0.5556
114	610.8	73.7	1.61	51.70	0.5591
115	621.6	74.4	1.62	52.26	0.5625
116	632.4	75.0	1.63	52.82	0.5659
117	643.4	75.6	1.64	53.38	0.5692
118	654.4	76.3	1.65	53.95	0.5725
119	665.6	76.9	1.65	54.53	0.5758
120	676.8	77.5	1.66	55.10	0.5790
121	688.1	78.2	1.67	55.68	0.5822
122	699.5	78.8	1.68	56.26	0.5854
123	711.1	79.5	1.69	56.85	0.5885
124	722.7	80.1	1.70	57.44	0.5916
125	734.4	80.8	1.71	58.03	0.5946
126	746.2	81.4	1.72	58.62	0.5976
127	758.1	82.1	1.73	59.22	0.6006
128	770.0	82.7	1.74	59.82	0.6035
129	782.1	83.4	1.75	60.42	0.6064
130	794.3	84.0	1.76	61.03	0.6093
131	806.6	84.7	1.76	61.64	0.6121
132	818.9	85.3	1.77	62.25	0.6149
133	831.4	86.0	1.78	62.87	0.6177
134	843.9	86.7	1.79	63.49	0.6205
135	856.6	87.3	1.80	64.11	0.6232
136	869.3	88.0	1.81	64.73	0.6259
137	882.1	88.7	1.82	65.35	0.6285
138	895.1	89.3	1.83	65.98	0.6311
139	908.1	90.0	1.84	66.61	0.6337
140	921.2	90.7	1.84	67.25	0.6363
141	934.4	91.3	1.85	67.88	0.6388
142	947.7	92.0	1.86	68.52	0.6413
143	961.1	92.7	1.87	69.16	0.6438
144	974.6	93.4	1.88	69.81	0.6463
145	988.2	94.1	1.89	70.45	0.6487
146	1001.9	94.7	1.90	71.10	0.6511
147	1015.6	95.4	1.91	71.75	0.6535
148	1029.5	96.1	1.91	72.41	0.6558
149	1043.4	96.8	1.92	73.06	0.6581
150	1057.5	97.5	1.93	73.72	0.6604
151	1071.6	98.2	1.94	74.38	0.6627

Calculation time (s)	HRR	Gas temp	Gas velocity	Det temp	dT/dt
152	1085.9	98.9	1.95	75.04	0.6650
153	1100.2	99.6	1.96	75.71	0.6672
154	1114.7	100.3	1.97	76.38	0.6694
155	1129.2	100.9	1.97	77.05	0.6716
156	1143.8	101.6	1.98	77.72	0.6737
157	1158.5	102.3	1.99	78.39	0.6759
158	1173.3	103.0	2.00	79.07	0.6780
159	1188.2	103.7	2.01	79.75	0.6801
160	1203.2	104.4	2.02	80.43	0.6821
161	1218.3	105.2	2.02	81.11	0.6842
162	1233.5	105.9	2.03	81.79	0.6862
163	1248.7	106.6	2.04	82.48	0.6882
164	1264.1	107.3	2.05	83.17	0.6902
165	1279.6	108.0	2.06	83.86	0.6922
166	1295.1	108.7	2.07	84.55	0.6942
167	1310.8	109.4	2.07	85.24	0.6961
168	1326.5	110.1	2.08	85.94	0.6980
169	1342.4	110.8	2.09	86.64	0.6999
170	1358.3	111.6	2.10	87.34	0.7018