Fire Protection Engineering Culminating Report

June 2015

Fire Protection Engineering Analysis

For Building 910 - Sandia National Labs/CA

Livermore, CA

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Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY

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Keywords:

ASET
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Prescriptive-Base Design
Performance-Based Design

Executive Summary

This Fire Protection Engineering analysis was performed on Building 910 in Sandia National Laboratories in Livermore, CA to examine the building's fire safety and fire protection criteria which originally adhered to the 1985 Uniform Building Code. The object of this analysis is to determine the degree of compliance with the prescriptive codes in place today as well compliance with performance based analysis.

For the prescriptive analysis consisted of evaluating the buildings occupancy classification, type of construction, egress design, fire detection and alarm systems, fire sprinkler system, Halon System, and structural fire protection are evaluated in terms of the life safety of the occupants. Each system was examined based on the requirements of the 2013 California Building Code and the 2013 California Fire Code, and the corresponding NFPA codes and standards. The sprinkler water demand was calculated and compared to the available supply to ensure adequacy of the water pressure and flow. The fire alarm system was analyzed for proper spacing of detection and adequate response of audio and visual notification appliances. The electrical demand of the alarm system was calculated to ensure the battery backup supply was sufficient for the required duration. The Halon system was evaluated to verify an adequate supply and concentration for total flooding as well as keeping in acceptable toxicity limits. The structural fire protection analysis confirmed proper materials and separation requirements existed in the building.

In the performance based design analysis computer models were used to simulate egress in fire conditions. These models produced outputs that could be compared to pre-selected acceptable tenability limits for the occupants to determine if the Available Safe Egress Time (ASET) was longer than the Required Safe Egress Time (RSET). This outcome would signify a successful performance.

In the first design fire scenario several scattered items located under a part of machinery related to a boiler ignites after being exposed to radiative heat from a nearby boiler. The fire is shielded from the high temperature ceiling sprinklers which are located at a height of 18 feet which never activate during the 10-minute fire model due to the combination of ceiling height, temperature ratings and the relatively small size of the fire. The boiler room doors were assumed to be left propped open enabling the passage of smoke into the exit corridor. The RSET was calculated to be 140 seconds while the ASET was 580 seconds. The tenability test was easily passed for the basement fire as the relatively few (50) basement occupants exit the building in less than half of the available time.

In the second design fire scenario a work station with an excessive fire load is ignited when a space heater is left on for several hours. The ensuing fire size is potentially 1.5 MW, however the sprinklers activate beginning at 70 seconds at the heat release rate (HRR) of 195 kW and the fire does not grow any larger. The required safe egress time (RSET) is calculated to be 253 seconds, while the conditions remain tenable for at least 260 seconds in both directions of egress.

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Project Overview:

This building is located at the Sandia National Laboratories branch in Livermore, CA (commonly referred to as SNL/CA). The SNL/CA site is a US Department of Energy site and the setting is similar to that of a college campus. This building was chosen because of its relative architectural complexity (3-stories and a basement) and with regards to occupancy classification (non-separated mixed use), as well as the many fire protection related components within it such as a Halon fire suppression system, two fire alarm systems including a voice alarm, and some of the security restrictions that make egress more challenging in some areas of the building.

Building 910 is a 3-story concrete structure with a basement. The building is fully sprinklered. The basement level houses computer server rooms as well as boiler rooms and other mechanical equipment. The first floor of the building houses office spaces and the second and third floors house laboratories. The type of construction of the building per the 2013 California Building Code (CBC) is Group B/L (non-separated mixed use). The type of construction for the building is IIB. The California Building Code (CBC) requires a 1-hour separation between laboratories and other spaces in the building. There are stairway enclosures at the East and West ends of the building which are each structurally independent from the remainder of the building.

The original code of record for the building is the 1985 Uniform Building Code (UBC).

Applicable Codes and Standards used in Prescriptive Analysis:

DOE Order 420.1.B utilizes the local Building and Fire Code regulations with some adjustments.

- 2013 California Building Code (CBC)
- 2012 NFPA 101 – Life Safety Code (LSC)
- 2013 NFPA 13 – Standard for installationof Sprinkler Systems
- 2015 NFPA 12A – Standard on Halon 1301 Fire Extinguisher Systems
- 2013 NFPA 14 – Standard for the Installation of Standpipe and Hose Systems
- 2014 NFPA 25 – Standard for the ITM of Water-Based Fire Protection Systems

Original Code of Record:

- 1985 Uniform Building Code (UBC) and related standards.

Applicable Codes and Standards used in Performance Analysis:

- SFPE Handbook of Fire Protection Engineering 4th Edition.
- 2012 NFPA 101 – Life Safety Code (LSC)

CBC Code Information for Building 910

Code Edition: 2013 California Building Code (CBC)

Occupancy: B/L (Non-separated Mixed use)

Type of Construction: IIB

Open perimeter around the entire building for at least 80 feet in all directions.

Fully Sprinklered

Number of stories: 3 with a basement

(The basement meets the CBC requirements for a basement classification – At least 50% of the perimeter 6 feet below grade level or any part 12 feet below grade level. The entire floor level is 12 feet below grade)

Base Allowable Area and height per story per Table 503:

Group B: 23,000 ft² / 3 stories
Group L: 17,500 ft² / 3 stories
The entire building must meet the height/area limitations for group L.

Actual area per story: 14,600 ft²

(The frontage increase is not needed. Note, Group L is not eligible for a sprinkler height/area increase)

Occupant Load Factor:

Office/Business areas: 100 (gross)
Laboratory areas (Non-educational): 100 (Net)

<u>Calculations still performed to illustrate the maximum possible height and area in case of future additions to the building:</u>

$A_a = \{ A_t + [A_t \times I_f] + [A_t \times I_s]\}$ (Equation 5-1, 2010 CBC)

Frontage Increase: $I_f = [F / P - 0.25]W / 30 = [(540\ ft/540\ ft) - 0.25]\ 30/30 = 0.75$ (Equation 5-2)

Per CBC Section 506.3, Exception 4, The sprinkler area increase does not apply to buildings with L occupancies.

Maximum possible Area: A_a = {23000 ft² + [23000 ft² x 0.75] + [23000 ft² x 0]} = 40,250 ft²

Per CBC Section 504.2, the sprinkler height increase and story increase does not apply to buildings with L occupancies.

Maximum possible Height: H = 55 feet, 3 stories

GROUP		TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
	HEIGHT (feet)	UL	160	65	55	65	55	65	50	40
	STORIES(S) AREA (A)									
A-1	S	UL	5	3	2	3	2	3	2	1
	A	UL	UL	15,500	8,500	14,000	8,500	15,000	11,500	5,500
A-2	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-3	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-4	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-5	S	UL	UL	UL	UL	UL	UL	UL	UL	UL
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	S	UL	11	5	3	5	3	5	3	2
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
E	S	UL	5	3	2	3	2	3	1	1
	A	UL	UL	26,500	14,500	23,500	14,500	25,500	18,500	9,500
F-1	S	UL	11	4	2	3	2	4	2	1
	A	UL	UL	25,000	15,500	19,000	12,000	33,500	14,000	8,500
F-2	S	UL	11	5	3	4	3	5	3	2
	A	UL	UL	37,500	23,000	28,500	18,000	50,500	21,000	13,000
H-1	S	1	1	1	1	1	1	1	1	NP
	A	21,000	16,500	11,000	7,000	9,500	7,000	10,500	7,500	NP
H-2[d]	S	*20*	3	2	1	2	1	2	1	1
	A	21,000	16,500	11,000	7,000	9,500	7,000	10,500	7,500	3,000
H-3[d]	S	*20*	6	4	2	4	2	4	2	1
	A	UL	60,000	26,500	14,000	17,500	13,000	25,500	10,000	5,000
H-4	S	*20*	7	5	3	5	3	5	3	2
	A	UL	UL	37,500	17,500	28,500	17,500	36,000	18,000	6,500
H-5	S	4	4	3	3	3	3	3	3	2
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
	S	UL	4	2	1	1	NP	1	1	NP

Alternative allowable construction types

It is already established that Building 910 with the occupancy group B/L is code compliant with the construction type IIB. Checking Table 503 of the CBC, the building is also compliant with any higher rated type of construction (Types IIA, IA, and IB) because the higher construction types have a higher base allowable tabular area and base height. The following illustrations indicate whether the building is also code compliant using lower rated types of construction:

Type IIIA

Limiting Allowable Base Area: 28,500 ft²; Limiting Allowable Height: 65 ft, 5 stories
Type IIIA is allowed without any adjustments to allowable base area.

Type IIIB

Limiting Allowable Base Area: 17,500 ft²; Limiting Allowable Height: 55 ft, 3 stories
Type IIIB is allowed without any adjustments to the allowable base area.

Type IV HT

Limiting Allowable Base Area: 36,000 ft²; Limiting Allowable Height: 65 ft, 5 stories
Type IV HT is allowed without any adjustments to the allowable base area.

Type VA

Limiting Allowable Base Area: 18,000 ft²; Limiting Allowable Height: 50 ft, 3 stories
Type VA is allowed without any adjustments to the allowable base area.

Type VB

Limiting Allowable Base Area: 6,500 ft²; Limiting Allowable Height: 40 ft, 2 stories
Type VB is NOT allowed without adjustments to the allowable base area. It is also NOT allowed with the height. No height adjustments are allowed for L occupancy buildings.
Using the open frontage increase: Allowable adjusted area = 11,375 ft², which is still not enough.
Therefore Type VB is not allowed for this building.

LSC Code Information for Building 910

Code Edition 2012 Life Safety Code (LSC)/NFPA 101

Open perimeter around the entire building for at least 80 feet in all directions. (see page 5)

Fully Sprinklered

Number of stories: 3 with a basement

Use: Business/Industrial (Per Table 7.3.1.2) Required separation is 1-hour

Occupant Load Factor:
Business Use: 100
Industrial Use: 100

Satelite Photo/Site Plan indicating open perimeter for Bldg. 910

Occupant Loads

The building is a 3-story with a basement. The basement level is mostly vacant and houses mechanical rooms, boiler rooms, and storage space as well as the communication center. The first floor consists of offices, and meeting rooms. The second and third floor are a combinationof office and laboratory spaces. While the calculated occupant load of the overall building is 584 people, the actual occupant load is closer to 200. The performance code analysis was performed with an occupant load of 50 for the basement (Actual occupant load is 20), and the full 146 for the third floor (actual occupant load is 60).

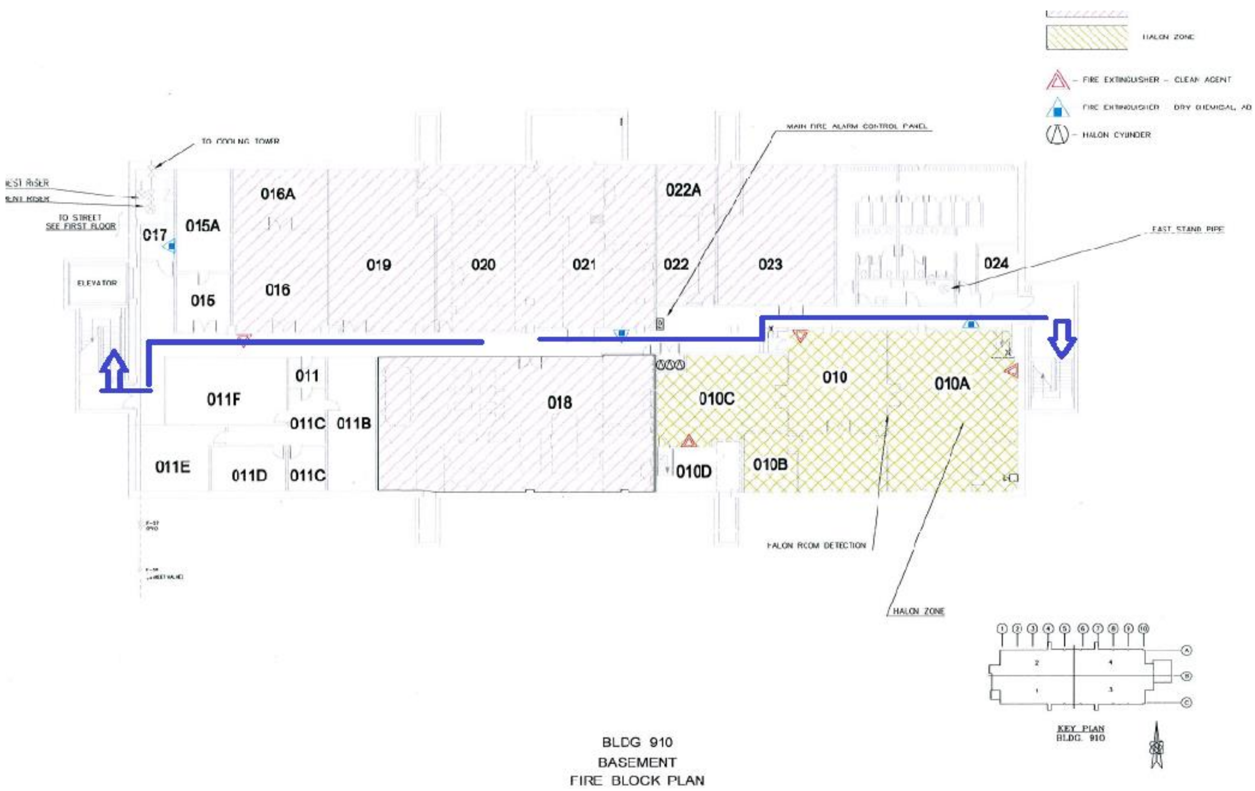
Floor	Area (ft^2)	Occupancy Classification	Occupant Load Factor	Occupant Load
Basement	14,600	B/S2	100	146
First Floor	14,600	B	100	146
Second Floor	14,600	B/L	100	146
Third Floor	14,600	B/L	100	146
			TOTAL	584

Exit Arrangement

Section 1021 of the 2013 CBC requires at least two exits per story when the occupant load is between 1 and 500 for the story. Each floor level in building 910 is equipped with two exits. The exits are located at the East and West ends of each story. The building is completely symmetrical and the exits are continuous fire rated stairway enclosures. The exits are arranged as remotely to each other as possible and meet the remoteness requirements of CBC Section 1015.2.1 as well as travel distance requirements of Section 1016, and common path of egress travel requirements of Section 1014.3.

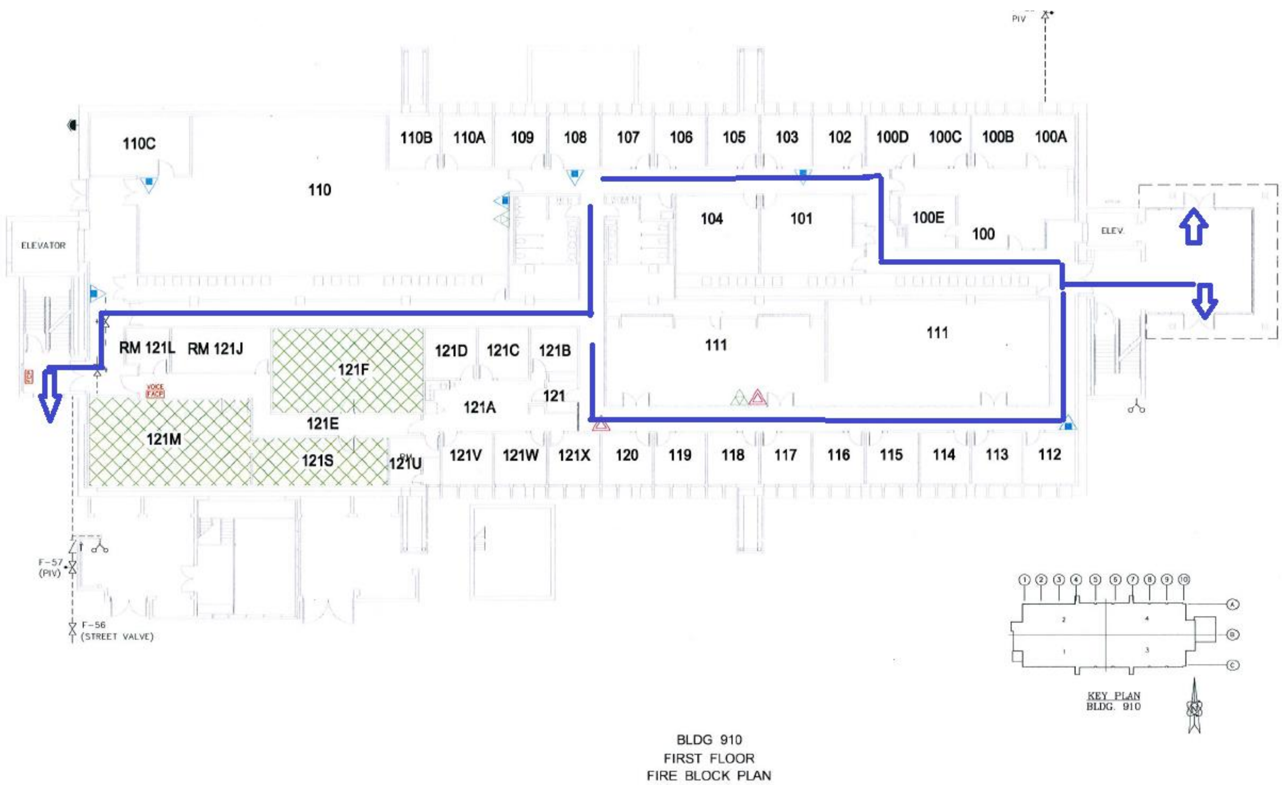
Basement Egress Plan:

There is one main corridor down the middle of the basement level leading to the East and West stairways. Occupants go one level up to get to the 1st floor exits. The basement level is mostly telecommunication hubs and boiler rooms. While this portion of the building is classified as group B occupancy, the actual occupant load is much less than that of an office environment. The door to each stairway is 36 inches wide, and each stairway is 60 inches wide. The estimated actual occupant load is 20 (10 per stairway). The maximum travel distance from the furthest point is approximately 130 feet. The maximum common path of egress as shown is 35 feet which is below the allowable 100 feet (increased from 75 feet due to the sprinkler system).



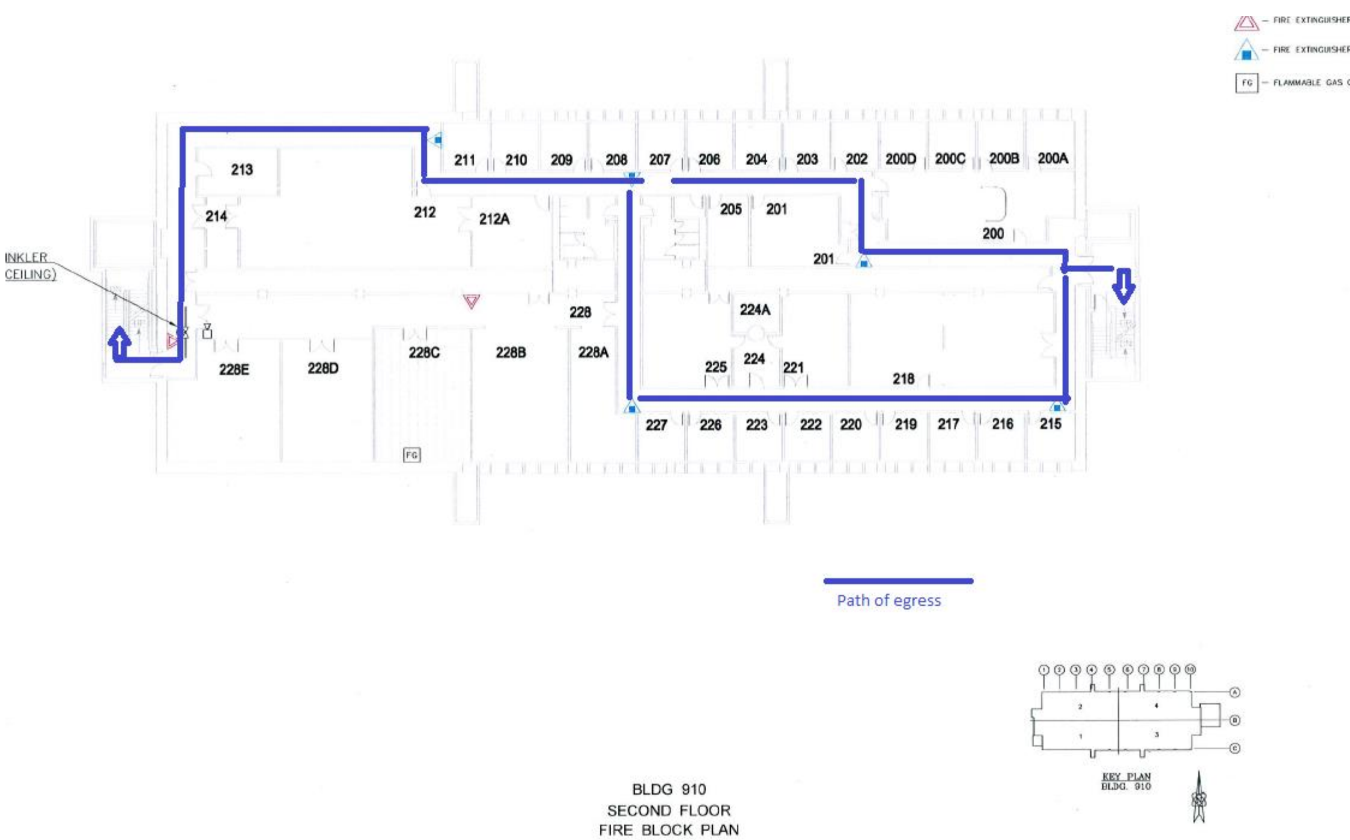
First Floor Egress Plan:

The Eastern side of the floor serving Suite 110 and Suite 121 has one linear corridor while the West side of the floor has a loop corridor because it serves the small offices along the exterior walls as well as laboratory suites in the interior. The corridor is 5 feet wide that lead to double leaf exit doors that are 6-feet wide (two sets in the East lobby and one set in the West enclosure). This is the Exit floor with the East end exiting through the stairway enclosure and the West end through a lobby area. There is a barrier gate at the top of the stairway leading to the basement so that occupants coming from the upper floors do not continue to go down to the basement in dark conditions. The occupant load of the floor is 146 with an assumed 73 being served by each side. The maximum travel distance from the furthest away point is 135 feet and the maximum common path of egress travel is approximately 40 feet which is less than the allowable 100 feet (increased from 75 feet due to the sprinkler system). Suite 121 is a high security area with classified weapons work. There is a standing policy in that suite of having one person stay back to shut down all systems in case of a fire alarm or other emergency which makes a full evacuation slightly more challenging.



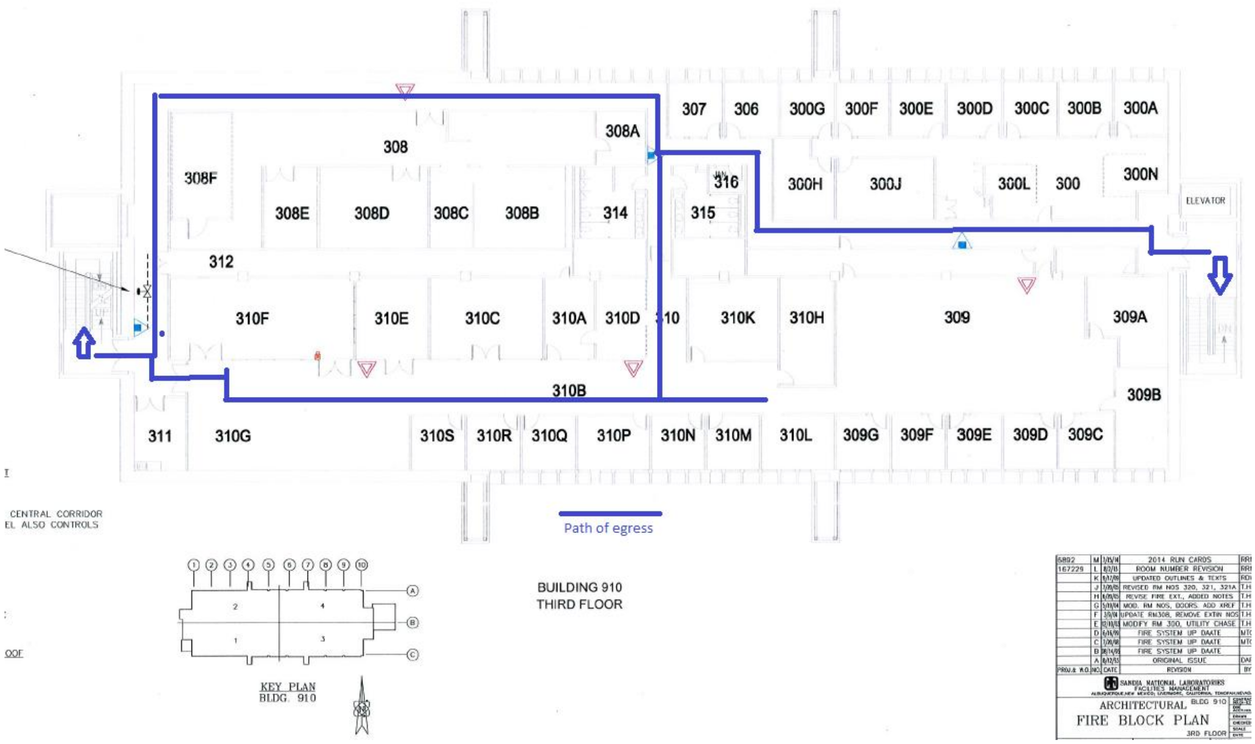
Second Floor Egress Plan:

The corridor layout on the second floor consists of two connecting 5 feet wide loops that lead to double leaf exit doors that are 6-feet wide going into the stairway enclosures on the East and the West end of the building. The occupants of the floor consist of those in offices and laboratories. The laboratory spaces are types working with electrical systems, so they contain very minimal flammable liquids and gases if any. The maximum travel distance from the furthest point is 140 feet, and the maximum common path of travel distance is approximately 25 feet which is lower than the allowable 75 feet. The occupant load for the floor is 146 with each stairway assumed to serve half of that number. The entire second floor is classified as a Sensitive Compartmented Information Facility (SCIF) which is a vault type room. This will make the entrance into the second floor restricted because once someone exits the second floor into a suite that will lead to the stairway enclosures, they cannot go back inside without the proper security clearance and the combination of the floor locks. The occupants are not willing to have the doors unlock automatically with the activation of the fire alarm system, therefore in order to achieve compliance, each lobby area leading to the stairway enclosures will have to install an exterior stairway. This will assure that all parts of the floor have access to two means of egress per CBC section 1021.1.



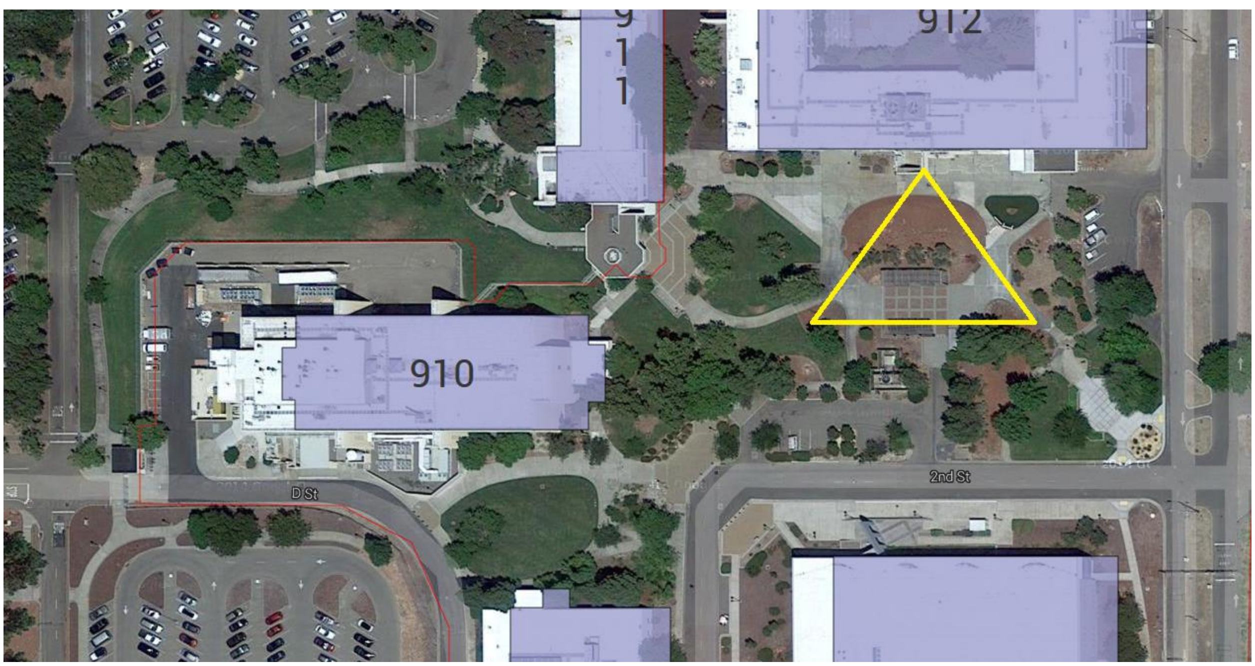
Third Floor Egress Plan:

The corridor layout on the second floor consists of two connecting 5 feet wide loops that lead to double leaf exit doors that are 6-feet wide going into the stairway enclosures on the East and the West end of the building. The occupants of the floor consist of those in offices and laboratories. The laboratory spaces are types working with electrical systems, so they contain very minimal flammable liquids and gases if any. The maximum travel distance from the furthest point is 140 feet, and the maximum common path of travel distance is approximately 25 feet which is lower than the allowable 75 feet. The occupant load for the floor is 146 with each stairway assumed to serve half of that number.



Emergency Evacuation Plan

The building is required to have an approved fire safety and evacuation plan per Section 404.2 of the 2013 California Fire Code (CFC) since the building is a group B occupancy with an occupant load of more than 100 above the lowest level of exit discharge. There are eight volunteer individuals known as the Building Evacuation Lead Team (BETL pronounced "*beatles")* who are tasked with assisting with building evacuations in emergencies. These individuals' work stations are spread through the building with strategic equipment placed at their desks such as radios, readily visible safety vests mega phones and building rosters. There is a designated area of assembly in an adjacent open space where all the members of the workforce (MOW) are trained to gather in case of the activation of the fire alarm. The BETL's then account for the presence all of the MOW at the designated assembly area. In some of the buildings where an occupant with a wheelchair or an elderly occupant may be stationed, there may be specific BETL's assigned to assist specific people where extra help might be needed. The BETL's also help direct traffic, look for people that may have been in an area where they may not have heard the alarm Managers are required to train the staff in the evacuation process including the egress routes, emergency reporting and the assembly area location. There is a fire drill conducted twice a year where the emergency evacuation process is timed and evaluated. The building and the designated assembly area (yellow triangle) are shown below:



Estimation of Evacuation Time:

Using the hydraulic model in assessing emergency movement from Chapter 13, section 3 of the 4th edition of the SFPE handbook we can calculate the t_e using the basic hydraulic model.

Assumptions (Per SFPE 4th edition Section 13-3 and Module 7, Slide 14):

- All persons will start to evacuate at the same instant.
- Occupant flow will not involve any interruptions caused by decisions of the individuals involved.
- All or most of the persons involved are free of disabilities that would significantly impede their ability to keep up with the movement of a group.

The prime controlling factor is the stairway door(s). Queuing will occur therefore the specific flow F_s will be the maximum specific flow F_{sm}. All occupants will start the egress flow at the same time. The population will use all facilities in the optimum balance. From SFPE Table 3-13.5, the maximum specific flow through the stairway doorways is 24 person /min/ft, and the maximum specific flow through the stairways is 18.5 person/min/ft.

Egress Component	Width (inches)	Effective Width (inches) [feet]	Max. Specific flow (person/min/ft)	Max. Flow (person/min)
East Stairway	60	48 [4.0]	18.5	74
West Stairway	60	48 [4.0]	18.5	74
East Stairway door	36	24 [2.0]	24	48
West Stairway door	36	24 [2.0]	24	48

From Chapter 13, section 3, Equation 10:

$$t_p = \frac{P}{F_c} = \frac{Population\ \ at\ pinch\ point}{Calculagted\ flow} = \frac{\frac{146}{2} persons}{48\ persons/minute} = 1.52\ minutes$$

This represents the time spent at the pinch point (stairway door). With all floors being evacuated simultaneously maximum specific flow is assumed We can use equation 5 from SFPE Chapter 13 to find the movement speed through the stairways (assume standard 7-11 thread/ riser types stairs) k= 212 per Table 3.13.2. and the D value for a stairway = 0.16 (figure 3.13.8 and 3.13.7)

$S = k - akD$ = 212 – [(2.86)(212)(0.16)] = 97 ft/min

From the example in module 7, assume 4 x 8 landings on each stairway and 12 ft. vertical height per landing. From SFPE Table 3.13.3 the conversion factor for 7-11 type stairs is 1.85.

Total distance per floor including the landing length and converted vertical distance:

Distance traveled per floor = 12(1.85) + 2(8) = 38.2 ft. Time per floor = distance/speed = $\frac{38.2\ feet.}{97\ feet\ /min}$ = 0.39 minutes per floor.

Overall occupant load for vertical travelers = 146 (4 floors) = 584 persons

Persons using each stairway = 584/2 = 292 persons.

Using the egress table, the F_{sm} for stairs is 74 persons/minute and the F_{sm} for doors is 48 persons/minute. → Evacuation time for stairway through doors = $\frac{292\ persons}{48\ persons/min}$ = 6.08 minutes

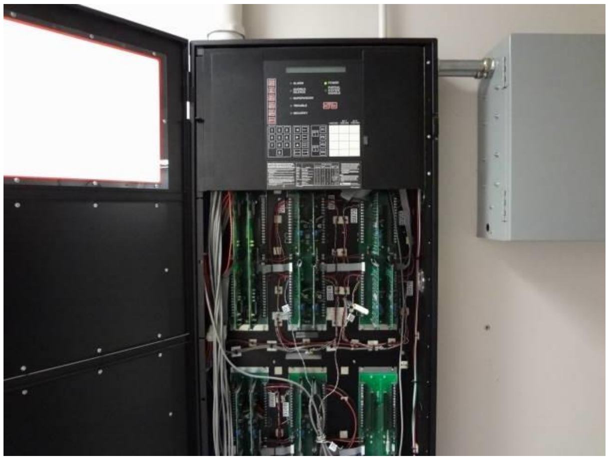
Adding the time for people of the last floor and the time for each floor to get to the stairway:

Total estimated evacuation time = 6.08 minutes + 1.52 minutes =**7.6 minutes**

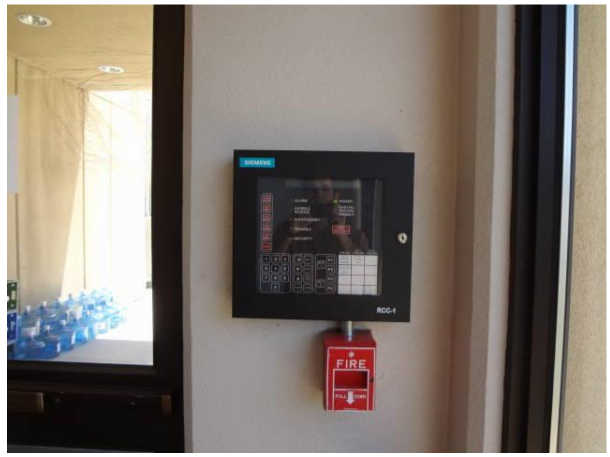
Fire Alarm System:

System Fundamentals

The Fire alarm system in building 910 is an addressable Siemen's MXL with a main FACP for the majority of the building and a pad 3 type supplemental panel for some of the annexed spaces and some of the outdoor chemical storage sheds associated with this building.   The voice-alarm system located in a suite on the first floor is a stand-alone system with its own MXL panel.



Main fire alarm panel located in the basement



Supplementary fire alarm panel on the first floor

The fire alarm panel for the voice alarm system in suite 121

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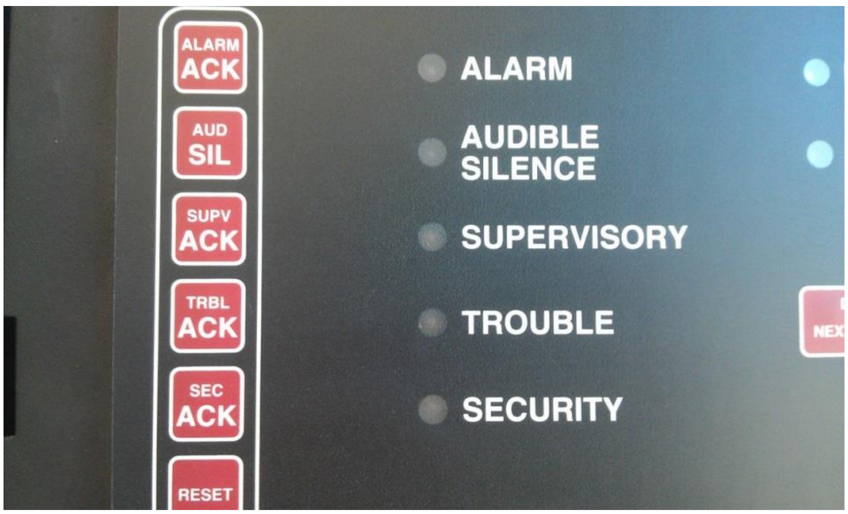
Fire Alarm System Types & Requirements

The fire alarm system in building 910 is a protected premises fire alarm system with automatic addressable components and multiple zones. All alarm, trouble and supervisory signals are received not only at the building panel, but also in building 964 which is the location of Sandia security forces and is attended 24 hours a day. This is a proprietary supervising station per 2013 NFPA 72 Section 3.3.283.2. Alarm signals are also relayed to the responding fire department which is located at the Lawrence Livermore National Laboratory across the street from Sandia. The response time to building 910 is generally less than 3 minutes. The application, installation and performance of the fire alarm system in building 910 complies with the requirements of Chapter 23 (23.1.1) of the 2013 NFPA 72.



Sub panel face located on the first floor of building 910 indicating the various types of signals.

Detection Devices

The building is equipped with ionization smoke detection devices in all of the lab and shop spaces. High velocity ionization smoke detectors are provided in all of the computer server rooms (both on the ceiling and under the floors). All HVAC systems are equipped with ionization duct detectors. The building is fully sprinklered, and of course the sprinklers act as heat detection devices. As previously mentioned there are other types of detectors that are connected to the fire alarm system such as flammable gas detectors and toxic gas detectors.

Ceiling Mounted smoke detector in a laser laboratory environment

Ceiling mounted ionization smoke detector in a laboratory

A flammable gas detector in building 910

Location and Placement of Detection Devices

The smoke detectors in this building are placed in laboratory rooms. Most of these rooms are not large enough to require more than one detector. Where multiple detectors are provided they are placed per manufacturer's listings or at every 30 feet in each direction. Flammable gas and toxic gas detectors are provided in the order of one per lab when dictated by the functionality of the lab. The duct detectors are placed in the return air ducts when the ventilation rate of the HVAC system exceeds 2,000 CFM which is all of the systems for this building. The placement of smoke detectors complies with section 17.7 of the 2013 NFPA 72. Other types of initiating devices located throughout building 910 include manual pull stations. The CBC requires manual pull stations placed at all exits and at every 200 feet. Building 910 complies with the placement requirements for all initiating devices.

Analysis of Fire Detector Response

There are two fire scenarios in the building that are most likely to occur. One is from a boiler fire in the basement, and another is a laboratory fire on the 2nd or 3rd floors. First we will examine the boiler fire scenario. A boiler fire can either be due to a situation where excessive combustibles receive radiative heat from the flame(s) of the boilers within the room. The maximum size of the fire is assumed to be approximately 1 MW and it would be classified with a fire growth rate of "slow". There are two smoke detectors placed in the boiler room along with 12 sprinklers. It is expected that the smoke detectors would activate in approximately 30 seconds and the sprinkler system would activate in approximately 60 seconds and prevent the fire from growing. If smoke gets out of the boiler room and reaches the telephone server room (also in the basement) then it is possible that the Halon fire suppression system may be activated in the telephone server room if the server room doors have also been left open.

The second fire scenario is that of a fire in an office or laboratory environment. Only small limited amounts of chemicals are permitted to be kept in each lab and even then they are kept in safety cabinets where they are stored with an additional level of safety. It is unclear whether such a fire would activate a smoke detector faster or a toxic gas (CO) detector. It would probably depend on the proximity of the fire to either of these detectors. I would again estimate that the detectors would activate in approximately 30 seconds and the sprinkler system would activate in approximately 60 seconds giving an opportunity for a maximum fire size of 1 MW with a "medium" fire growth classification. An office fire scenario is likely in cases where excessive fuel loads accumulate in office environments with a possible ignition source being a space heater that may have been left on.

Alarm Notification Appliances

The notification appliances in building 910 consist of only bells. There are no visual notification appliances with the exception of one suite on the first floor which has its own separate stand-alone voice alarm system. These are indoor bells only (no water flow bell on the outside of the building). The bells are spaced approximately 100 feet apart in the corridor areas. There are also bells placed in the shop areas. A few of the labs also have bells to make up for any possible sound deficiencies. The ambient noise in this building is far less than the typical office building. A great number of the labs and offices located in this building are usually engaged in classified work so great care is taken to be deliberately quiet. The shop areas in the basement as well as the server rooms have higher ambient noises than typical offices; therefore I suspect that the alarm sounds from the bells have the most opportunity for deficiency in the basement. Building 910 is not compliant with the visible notification requirements of 2013 NFPA 72 Section 18.5.

A wall mounted fire alarm bell in building 910.

Alarm Notification Appliances Analysis

The NACS in the suite with the voice alarm system consist of speakers and one ceiling strobe in the main lobby of this area. The work done in this area is highly classified and sensitive. Unfortunately the standard evacuation procedures in this suite during a fire alarm call for a designated person to stay behind and close down all of the computers in use and to put away any classified material while others evacuate. The speakers in this suite have a pre-recorded message directing occupants to evacuate. It is my conclusion that with only one strobe in the suite that contains many rooms, this area does not comply with the visual notification requirements of 2013 NFPA 72 Section 18.5.

A ceiling type strobe used in building 910 Suite 121

Emergency Communication Systems

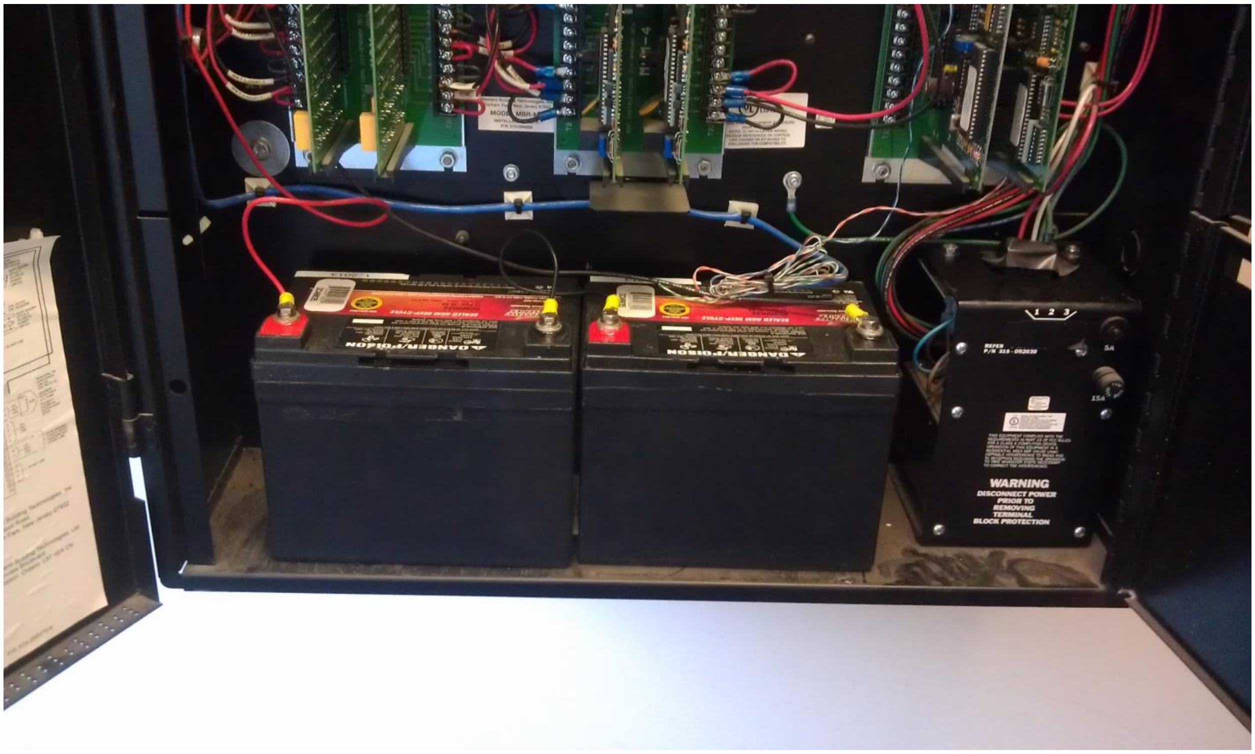
The entire Sandia National Laboratories site is served by a Tone Alert Radio (TAR) system which is operated and maintained by the site's security forces. This system can function even in the event of a power failure and is not connected to any buildings fire alarm system. There are pre-recorded messages that can be played on the TAR system as well as the capability for a live speaker if needed. TAR units are strategically placed all over every building (including building 910) for clear emergency instructions with a high degree of intelligibility. There are also loud speakers outdoors to alert the outside occupants to emergencies. Each TAR unit is plugged into a local power outlet which serves as the internal battery charger for that unit.

There is also another emergency communication system which is exclusive to building 910. One of the suites on the first floor is equipped with a voice alarm system instead of horns due to the sensitive classified nature of the work done in this area. The voice alarm system repeats the same pre-recorded message which directs the occupants to exit the building. There are six speakers placed within this suite and they provide a clear message with a high degree of intelligibility.

One of 30 Tone Alert Radio (TAR) units in building 910

Power Requirements for Fire Alarm & Communication Systems

Section 10.6.7 of the 2013 NFPA 72 requires secondary power supplies for fire alarm systems. The required capacity per Section 10.6.7.2 in an urban environment with reasonably quick fire department respondent access is enough battery power to sustain the fire alarm functions for a period of 24 hours of standby time and for 5 minutes of alarm time. There is also a requirement to add an additional capacity of 20% as a safety factor. The FACP in building 910 supports many smoke detectors (including several spaces with under-floor smoke detectors) as well as other initiation devices such as flammable gas sensors, toxic gas sensors and other of initiation devices such as pull stations. The notification devices are only bells (with the exception of one suite on the first floor), but the overall load on the system is substantial. There is a sub-panel on the first floor back lobby because there are too many devices in the building including fire alarm devices on some of the chemical storage sheds located outside of the building. The FACP houses the batteries for the system which consist of two 18-amp-hour batteries shown below for a total of 36 amp-hours.



System Commissioning and Inspection, Testing & Maintenance (ITM)

The fire alarm system in building 910 is over 20 years old, and there are no records of any commissioning being performed. Furthermore, since this building is on federal property, local codes and ordinances would not have had any bearing on the installation and acceptance of such systems. NFPA 72 does not specifically require commissioning, however there are requirements for acceptance testing that come close to those of official commissioning. Generally commissioning involves testing every piece of a system and verification of performance. This process can be quite lengthy and cumbersome. It is often performed by inspection firms that specifically offer this service at high prices. The acceptance test of a fire alarm system when done properly should take at least two days. One day should be taken to observe at least a good representative sample of all initiation and notification devices in action. This includes performing smoke tests, pull station tests and measurement of the notification devices using sound meters and light meters. Special care should also be taken to ensure that all visual notification devices are synchronized and reach all areas and spaces without obstruction. At the conclusion of testing on day one, the power supply should be disconnected and the system should automatically switch to battery power. The inspector should return approximately 24 hours later and perform all of the alarm tests again this time under battery power. The tests performed on the second should be run for a period of at least 5 minutes for all parts of the building. Section 14.2.2 of 2013 NFPA 72 lists the requirements for inspections of fire alarm systems. The inspections performed are the responsibility of the building owner.

Building 910 along with other buildings in Sandia is under contract to an inspection agency that performs annual inspections of the fire alarm system as a whole. All inspections are documented and kept permanently. In addition to these inspections, the entire building undergoes a thorough fire protection/prevention assessment every three years per Department of Energy regulations.

Fire Suppression

The hazard classification for the sprinkler system is Ordinary Hazard, Group 2. This is due to a Deparment of Energy requirement mandating OH-1 as the lowest allowable hazard classification within DOE facilities. The building was built in 1987, however this analysis is performed to the current codes and standards. The sprinkler system is equipped with seismic bracing and flexible hoses at some sprinkler head drops as well as flexible couples at wall penetrations per NFPA 13 Section 9.3.

Water Supply and Demand:

The water supply for the Sandia National Laboratories is provided by a private water main with very good pressure and flow. SNL/CA also has water tanks on top of a nearby hill that serve as an alternate supply.

Water supply available: 68 Psi Static, 63 Psi Residual, 2750 GPM flow.

System demand: 51 psi at 609 gpm

Hose Stream = 250 gpm

Smaller of the two risers, located in the West end of the building.

Sprinkler System:

Hazard Classification: Ordinary Hazard, Group 2

Design Density = 0.20 Area of Calculation = 1500 ft²

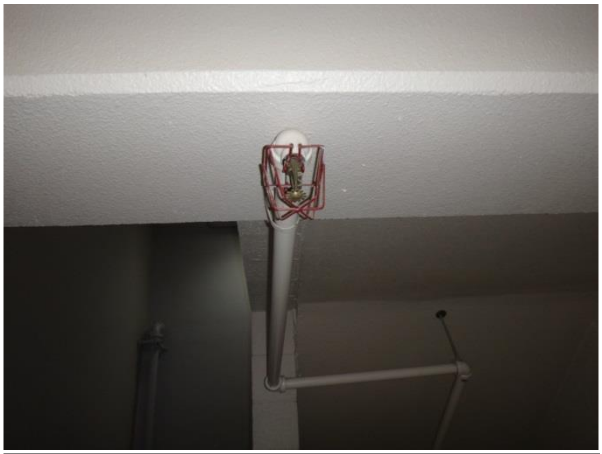
A_s= 100 ft² Number of sprinklers Calculated = $\frac{\text{Design Area}}{\text{Area per sprinkler}} = \frac{1500}{100} = 15$

No. of sprinklers on a branch line = $\frac{1.2\sqrt{A}}{S} = \frac{1.2\sqrt{1500}}{10}$ = 5 sprinklers.

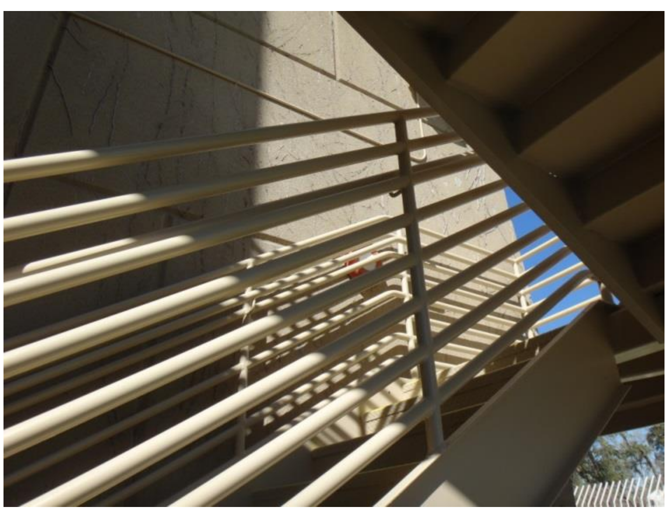
Sprinklers are ½ inch, RASCO brand with a K factor of 5.6

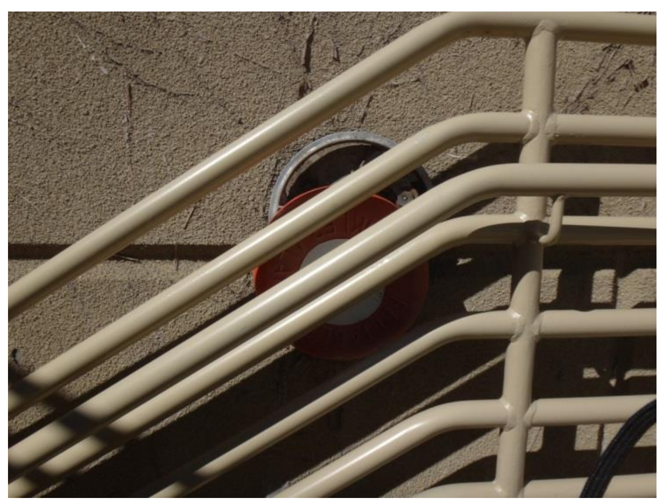
System Demand at riser: 51 psi at 609 gpm.

The sprinklers in the basement at located at only 6’ 8”. They are protected with a cover for both the sprinklers protection and occupants.

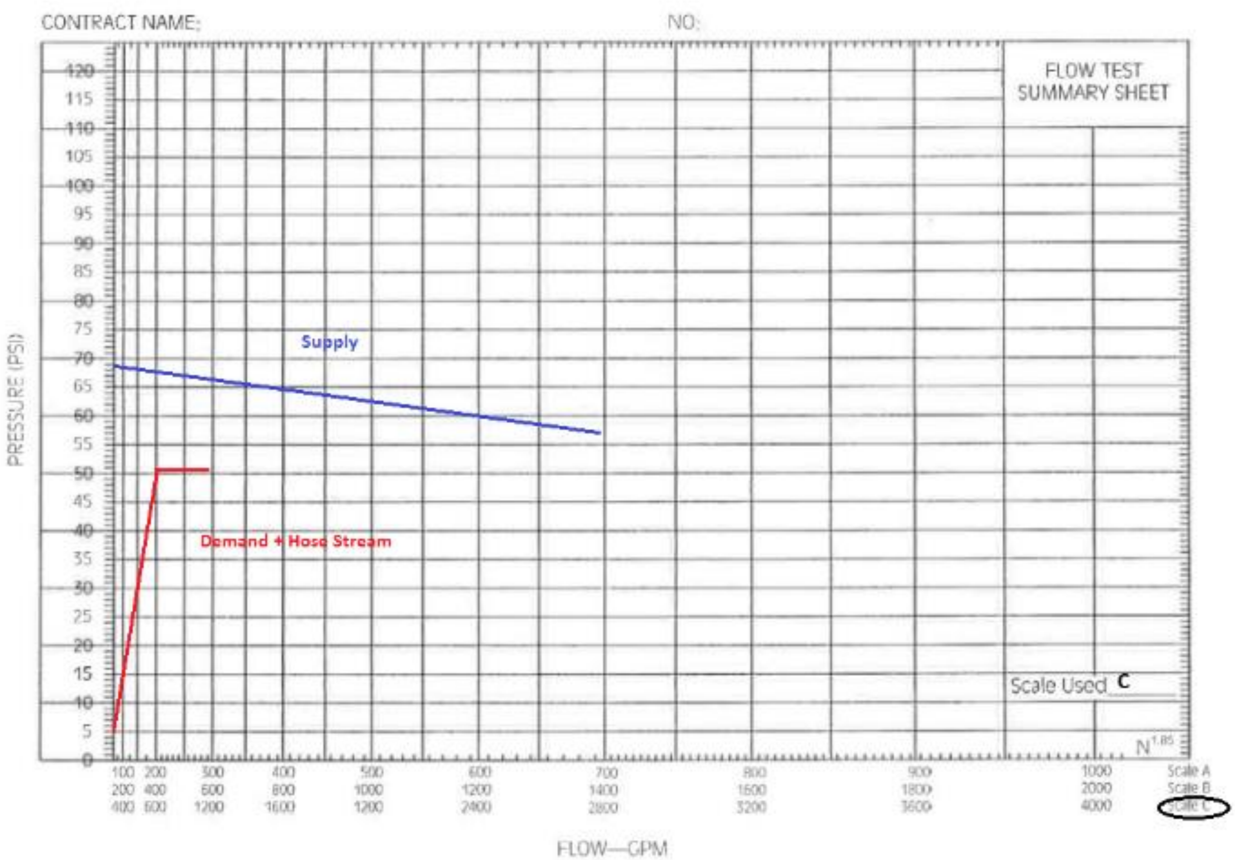


The waterflow alarm was recently disabled when the contractors installed a new exterior stairway right on top of it.





Hydraulic Graph



Standpipe System:

There are standpipe stations (no hoses) at each level of each stairway. The standpipes are class 1, with a class 2 adapter in each cabinet. This almost makes the standpipes function similarly to a class 3 standpipe.

Inspections, Testing & Maintenance Schedule per NFPA 25

Item	Inspection	Testing	Maintenance
Sprinklers	• Inspected from the floor level annually (5.2.1.1) • -Incorrect orientation check (5.2.1.1.3)0 • -Spare sprinkler supply and wrench for each type of sprinkler (5.2.1.4) • -Maintain minimum clearances to storage (5.2.1.2)	• Sample sprinklers submitted to testing agency (5.3.1.1) • Tested after 50 years and tests must be repeated every 10 years thereafter (5.3.1.1.1) • Fast-response sprinklers must be tested after 20 years and tests must be repeated every 10 years thereafter (5.3.1.1.1.3) • Testing should comprise of not less than 4 or 1% of the total number of sprinkler per sample (5.3.1.2)	• Sprinklers manufactured prior to 1920 must be replaced. (5.3.1.1.1.2) • Replacement sprinklers shall have the proper characteristics for the application intended (5.4.1.1) • A supply of spare sprinklers and a sprinkler wrench for them shall be maintained on the premises (5.4.1.4, 5)
Waterflow Alarm & Supervisory signal initiating devices	• Inspected quarterly to verify that they are free from physical damage (5.2.5)	• Tested quarterly (5.3.3.1) • Vane type and switch type waterflow alarm devices tested semiannually(5.3.3.2) • Testing alarm shall be accomplished by opening the inspectors test connection (5.3.3.3)	
Control Valve	• All valves inspected weekly(13.3.2.1) • Valves secured with a lock or supervised inspected monthly (13.3.2.1.1) • Inspection after any alterations or repairs(13.3.2.1.3) • Inspections shall ensure that the valves are in the normal open or closed position, properly sealed, locked or supervised, accessible, PIV's are provided with correct wrenches, free from external leaks, provided with appropriate wrenches and provided with appropriate identification (13.3.2.2)	• Tested annually by operating the control valve through its full range and returned to its normal position (13.3.3.1) • PIVs shall be tested by opening until spring or torsion is felt in the rod every time the valve is closed. (13.3.3.2) • A main drain test conducted whenever the valve is closed and reopened at the system riser (13.3.3.4)	• Operating stems of outside screw and yoke valves shall be lubricated annually(13.3.4.1) • The valve shall be completely closed and reopened to test its operation and distribute the • lubricant (13.3.4.2)
Gauges	• Inspected quarterly to ensure they are in good condition and normal water supply pressure is being maintained (5.2.4.1)	• Either replaced every 5 years or tested every 5 years by comparison with a calibrated gauge. Gauges not accurate within 3% of the full scale shall be recalibrated or replaced (5.3.2.1-2)	
Pipes & Fittings	• Inspected annually from the floor (5.2.2)		

Item	Inspection	Testing	Maintenance
Hydraulic Design Information Sign	• Inspected quarterly to verify that it is provided, attached securely to the sprinkler riser and is legible (5.2.6)		
Seismic Bracing	• Inspected annually from the floor (5.2.3)		
Alarm Valve	• Inspected externally monthly to verify the gauges indicate normal supply water pressure is being maintained, no physical damage, all valves are in appropriate open or closed position and retard chamber and alarm drains are not leaking. (13.4.1.1) • Inspected internally every 5 years unless tests indicate a greater frequency is needed (13.4.1.2)		• Internal components shall be cleaned/repaired as necessary in accordance with manufacturer's instructions. (13.4.1.3.1) • System shall be returned to service in accordance with manufacturer instructions (13.4.1.3.2)
Backflow Preventer	• Double check assembly (DCA) valves shall be inspected weekly or monthly if the valve is secured with a lock or electronic supervision to ensure the OS&Y isolation valves are in the normal open position (13.6.1.1, 13.6.1.1.1) • -Reduced pressure assembly (RPA) valves shall be inspected weekly or monthly if the valve is secured with a lock or electronic supervision to ensure the differential-sensing valve relief port is not continuously discharging (13.6.1.2, 13.6.1.2.1)	• Exercised annually by conducting a forward flow test at the minimum flow rate of the system demand	• Maintenance of the backflow prevention assemblies shall be conducted per the manufacturer's instructions in accordance with the policies of the AHJ. (13.6.3)
Fire Department Connections	• Inspected quarterly (13.7.1) • -Verify the FDC is visible and accessible, couplings or swivels are not damaged, plugs or caps are in place, identification sign is in place, check valve is not leaking, automatic drain valve is operating properly and the FDC clapper is in place and operating properly. (13.7.1)		• Components repaired or replaced as necessary in accordance with the manufacturer's instructions.(13.7.2) • Any obstructions present shall be removed (13.7.3)
Main Drain		Conducted annually for each water supply lead-in to the sprinkler system to determine whether there has been a change in the	•

		condition of the water supply. (13.2.5)	

Halon System and Calculations:

The basement houses office areas, a boiler room and the communications center. The 3,000 ft² communications center is protected with a Halon system in addition to the building's wet pipe sprinklers. The communications center is mostly switchgear but it also contains some work areas for the staff, so it is considered an occupied space. The communications center has its own smoke detection system which triggers the Halon discharge. There is also a manual discharge pull station. The system can be turned off temporarily for maintenance and other services.

Calculating the volume: Ceiling Height = 10 ft. Underfloor depth= 4 ft.

V=14 ft. x 3,000 ft^2 = 42,000 ft^3

Halon Quantity for total flooding: $W = \frac{V}{S}\left(\frac{C}{100-C}\right) = \frac{42000\,ft^3}{2.2062+0.005046\,(500)}\left(\frac{7}{100-7}\right)$ = 669 lbs.

Where W= Weight of halon
s=2.2062+0.005046t
t=minimum anticipated temperature of the protected volume (°F)
V = net volume of hazard ft³
C= Halon 1301 concentration, percent by volume = 7%

Add 20% minimum safety factor →
Total quantity required = 803 lbs.
Quantity Provided = 988 lbs.

The Halon control panel is very simple and it allows the deactivation of the system during maintenance periods.   There is a manual activation switch in addition to the automatic activation by smoke detection.

The nozzles are on the ceiling and spaced throughout the communications center and accessory areas.

Halon System Safety Analysis

Actual Concentration (based on available quantity) = 8.48%
Lowest Observed Adverse Effects Level (LOAEL) concerns Per 2015 NFPA 12A Section D.1 is due to exposure to decomposing Halon after contact with Fire or hot surfaces.

Maximum recommended exposure times based on concentration:

7% and below = 15 minutes

7 to 10 percent = 1 minute

10 to 15 percent = 30 seconds

Other Halon hazards in addition to toxicity include:
Noise – Often associated with loud discharges
Turbulence – High velocity discharge may cause injuries with direct contact
Cold Temperatures – Direct contact with vaporizing liquid can lead to frostbite burns

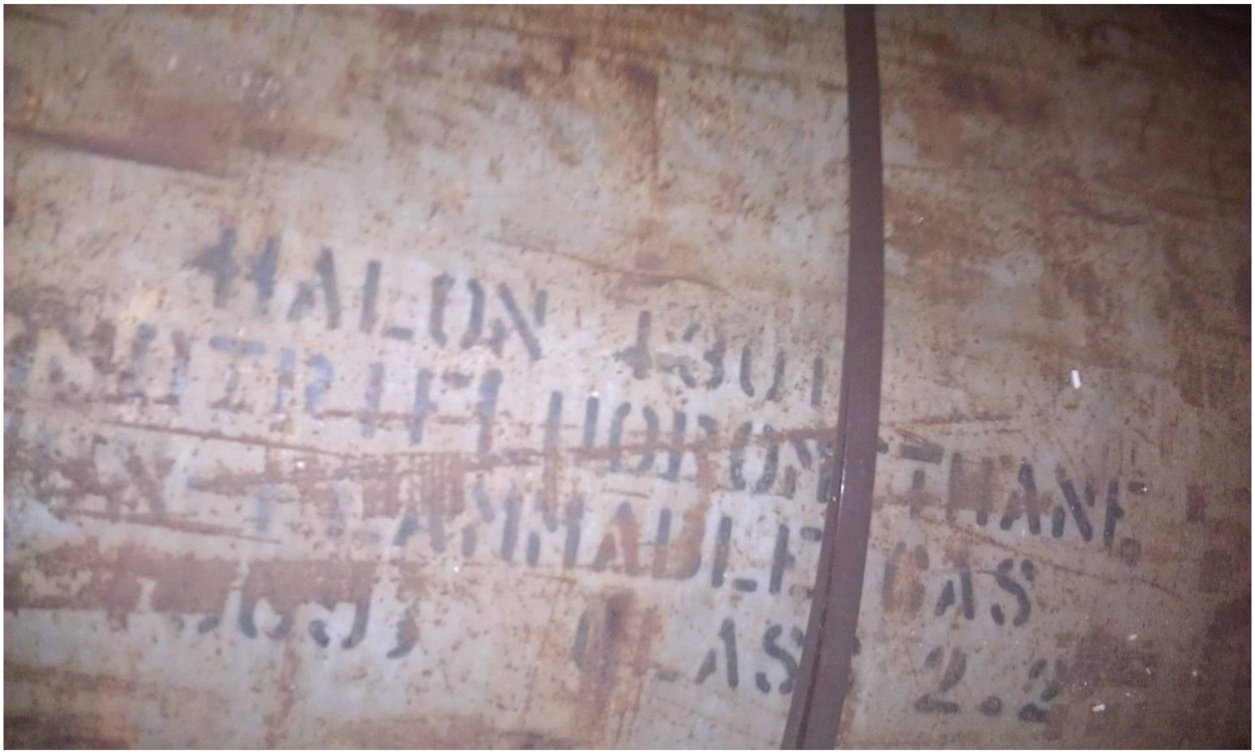
Signage and visual alarms on the entrance/exit doors warning people to stay out during a discharge.


CONTROL CENTER
010
CAUTION THIS ROOM PROTECTED BY A HALON 1301 SYSTEM. DO NOT ENTER DURING OR AFTER A DISCHARGE.
CAUTION
UNCLEARED PERSONNEL IN THE AREA


LIGHT INDICATES HALON DISCHARGE
EMERGENCY EXIT ONLY
CAUTION THIS ROOM PROTECTED BY A HALON 1301 SYSTEM, DO NOT ENTER DURING OR AFTER A DISCHARGE.
LIMITED AREA
Q
L

Reserve Supply Requirements

NFPA 12A Section 4.1.1.3 requires a reserve quantity of halon when uninterrupted service is needed. Halon is not readily available in most commercial applications; however federal government facilities are permitted to maintain their existing supplies. The estimated time to replenish a significant spent quantity to SNL/CA is approximately one week. For this reason there is a reserve supply kept in a nearby storage building. The reserve supply is roughly in equal quantity to the supply currently in use.



Structural Fire Protection

Fire resistance requirements of building elements including the structural frame are governed by Section 602.1 of the 2013 CBC. There are also other portions of the code that dictate certain fire resistance ratings. These other Sections are based on use, hazards, proximity to other structures, exiting requirements, and other factors.

Fire Resistance Requirements

TABLE 601 FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (hours)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A[d]	B	A[d]	B	HT	A[d]	B
Primary structural frame[g] (see Section 202)	3[a]	2[a]	1	0	1	0	HT	1	0
Bearing walls Exterior[f, g] Interior	3 3[a]	2 2[a]	1 1	0 0	2 1	2 0	2 1/HT	1 1	0 0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[e]	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and secondary members (see Section 202)	$1^1/_2$[b]	1[b, c]	1[b, c]	0[c]	1[b, c]	0	HT	1[b, c]	0

TABLE 508.4 REQUIRED SEPARATION OF OCCUPANCIES (HOURS)

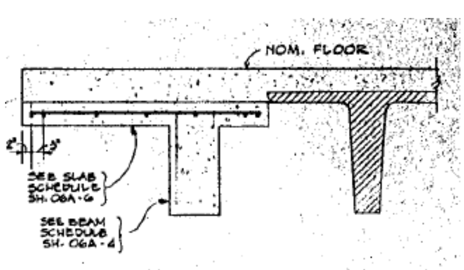
	A[d], E		I-4, R-2.1		I-2, I-2.1		I-3		R-1, R-2, R-3, R-3.1, R-4		F-2, S-2[b], U		B, F-1[g], M, S-1		L		H-1		H-2		H-3, H-4, H-5	
OCCUPANCY	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**	**S**	**NS**
A[d], E	N	N	2	2	2	NP	2	NP	1	2	N	1	1	2	2	NP	NP	NP	3	4	2	3[a]
I-4, R-2.1	-	-	1[e]	NP	2	NP	2	NP	1	NP	2	2	2[f]	2	2	NP	NP	NP	4	NP	4	NP
I-2, I-2.1	-	-	-	-	N	NP	2	NP	2	NP	2	NP	2[f]	NP	2	NP	NP	NP	4	NP	4	NP
I-3	-	-	-	-	-	-	N	NP	2	NP	2	2	2	2	2	NP	NP	NP	4	NP	4	NP
R-1, R-2, R-3, R-3.1, R-4									N	N	1[c]	2[c]	1	2	4	NP	NP	NP	3	NP	2	NP
F-2, S-2[b], U	-	-	-	-	-	-	-	-			N	N	1	2	1	NP	NP	NP	3	4	2	3[a]
B, F-1, M, S-1	-	-	-	-	-	-	-	-			-	-	N	N	1	NP	NP	NP	2	3	1	2[a]
L															1	NP	NP	NP	2	NP	1	NP
H-1	-	-	-	-	-	-	-	-			-	-	-	-			N	NP	NP	NP	NP	NP
H-2	-	-	-	-	-	-	-	-			-	-	-	-			-	-	N	NP	1	NP
H-3, H-4, H-5	-	-	-	-	-	-	-	-			-	-	-	-			-	-	-	-	1[e, f]	NP

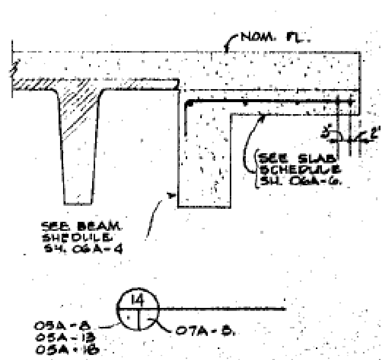
There are no fire resistance rating requirements for any of the building elements based on Type of construction (Table 601) or Fire separation distance (Table 602). The remaining fire resistance requirements for Building 910 are as follows:

- The stairway enclosures on East & West ends of the building require a 1-hour rating based on CBC Section 1022.1.
- The laboratory spaces on the 3rd floor are required to be separated vertically and horizontally from the remainder of the building by 1-hour construction per CBC Section 443.4.1.1., and Table 508.4.
- Electrical rooms housing transformers larger than 112.5 kva, 1 hour rating per NEC Section 450-21.B

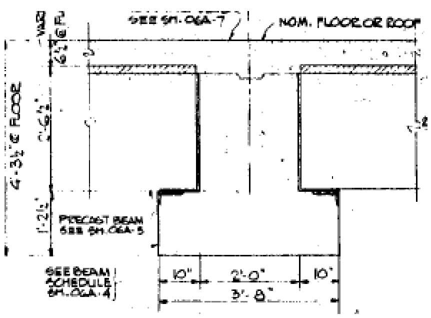
Calculating Fire Resistance

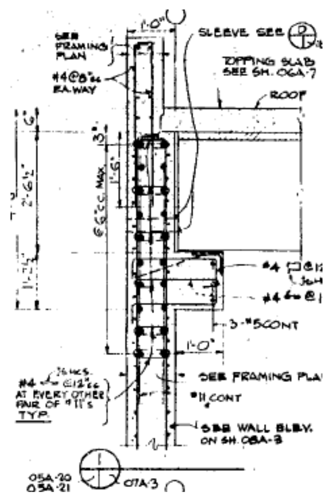
The following details are extracted from the plans for Building 910. See Appendix A.





Typical Floor Slabs for Bldg. 910





Typical Precast Beam

Typical Concrete Column/wall

FIGURE 721.2.2.1.2

DETERMINATION OF SLAB THICKNESS FOR SLOPING SOFFITS

721.2.2.1.3 Slabs with ribbed soffits. The thickness of slabs with ribbed or undulating soffits (see Figure 721.2.2.1.3) shall be determined by one of the following expressions, whichever is applicable:

For $s > 4t$, the thickness to be used shall be t

For $s \leq 2t$, the thickness to be used shall be t_e

For $4t > s > 2t$, the thickness to be used shall be

$$t + \left(\frac{4t}{s} - 1\right)\left(t_e - t\right)$$

(Equation 7-5)

where:

s = Spacing of ribs or undulations.

t = Minimum thickness.

t_e = Equivalent thickness of the slab calculated as the net area of the slab divided by the width, in which the maximum thickness used in the calculation shall not exceed $2t$.

Calculate the equivalent slab thickness per CBC Section 721.2.1.2

Thickness = $t + \left[\frac{4t}{s} - 1\right]\left[t_e - t\right]$ = 5.5inches + $\left[\frac{4\ (5.5\ inches)}{24\ inches}\right]\left[10 - 5.5\right]$ = 9.6 inches

721.2.2.1 Reinforced and prestressed floors and roofs. The minimum thicknesses of reinforced and prestressed concrete floor or roof slabs for *fire-resistance ratings* of 1 hour to 4 hours are shown in Table 721.2.2.1.

TABLE 721.2.2.1 MINIMUM SLAB THICKNESS (inches)

CONCRETE TYPE	FIRE-RESISTANCE RATING (hour)				
	1	$1^1/_2$	2	3	4
Siliceous	3.5	4.3	5.0	6.2	7.0
Carbonate	3.2	4.0	4.6	5.7	6.6
Sand-lightweight	2.7	3.3	3.8	4.6	5.4
Lightweight	2.5	3.1	3.6	4.4	5.1

Per Table 721.2.2.1, the equivalent fire resistance rating for the slab is 4-hours.

Evaluate the fire resistance of the walls per CBC Section 721.2.1.1

TABLE 721.2.1.1 MINIMUM EQUIVALENT THICKNESS OF CAST-IN-PLACE OR PRECAST CONCRETE WALLS, LOAD-BEARING OR NONLOAD-BEARING

CONCRETE TYPE	MINIMUM SLAB THICKNESS (inches) FOR FIRE-RESISTANCE RATING OF				
	1-hour	$1^1/_2$-hour	2-hour	3-hour	4-hour
Siliceous	3.5	4.3	5.0	6.2	7.0
Carbonate	3.2	4.0	4.6	5.7	6.6
Sand-Lightweight	2.7	3.3	3.8	4.6	5.4
Lightweight	2.5	3.1	3.6	4.4	5.1

With a precast wall thickness of 5.5 inches (assume siliceous concrete for a conservative estimate), the fire resistive rating of the walls is at least 2-hours.

Second floor ceiling photo showing the floor slab of 3rd floor

Performance Code Information

Codes Referenced:

2012 NFPA 101 Chapter 5

SFPE Handbook , 4th Edition

Models used:

Fire/Building Analysis: Pyrosim – 2014 Edition

Egress Analysis: Pathfinder- 2014 Edition

In the performance based design analysis computer models were used to simulate egress in fire conditions. These models produced outputs that could be compared to pre-selected acceptable tenability limits for the occupants to determine if the Available Safe Egress Time (ASET) was longer than the Required Safe Egress Time (RSET). This outcome would signify a successful performance. The tenability limits are based on various codes and standards including NFPA 101, California Building Code, and SFPE Handbook both 3rd and 4th editions. In the models presented several assumptions were made which may or may not be valid in real situations. These assumptions include that people do not go back inside to look for objects or other people. There is also an assumption that all occupants move at the same speed. Other assumptions include cooperation (or at least lack of conflict) among occupants, as well as no added mishaps to the fire at hand (such as structural collapse or falling objects) impeding the path of egress.

Another limitation of the fire models is that they accept only one type of fuel when setting up a fire scenario, whereas real life fire scenarios often involve a multitude of different fuels. With that in mind the models actually portray fire scenarios quite accurately as they are empirically designed based on years of fire tests.

Performance Criteria

There are three main conditions of tenability that should be maintained for safe egress during a fire event. These conditions are the ability to breathe, the ability to see and the ability to avoid excessive heat flux. The impediments to the ability to breathe are the toxic gases that are present in smoke. The most prevalent toxic gas in smoke is carbon monoxide. For this reason, carbon monoxide (CO) is often the only toxic gas evaluated in fire models. The fire models can measure and evaluate the three main tenability conditions which are visibility, carbon monoxide levels and heat exposure. The following are the accepted criteria for tenability.

- Maintain tenable conditions for the duration of the Required Safe Egress Time → ASET ≥ RSET per SFPE handbook 4th edition:
    1. Visibility > 13 m (Assume unfamiliar occupants for a conservative analysis)
    2. Carbon Monoxide concentration < 1000 ppm
    3. Smoke layer Height > 1.83 m (6 ft)
- Prevent Flashover → Maintain upper layer temp < 500 °C

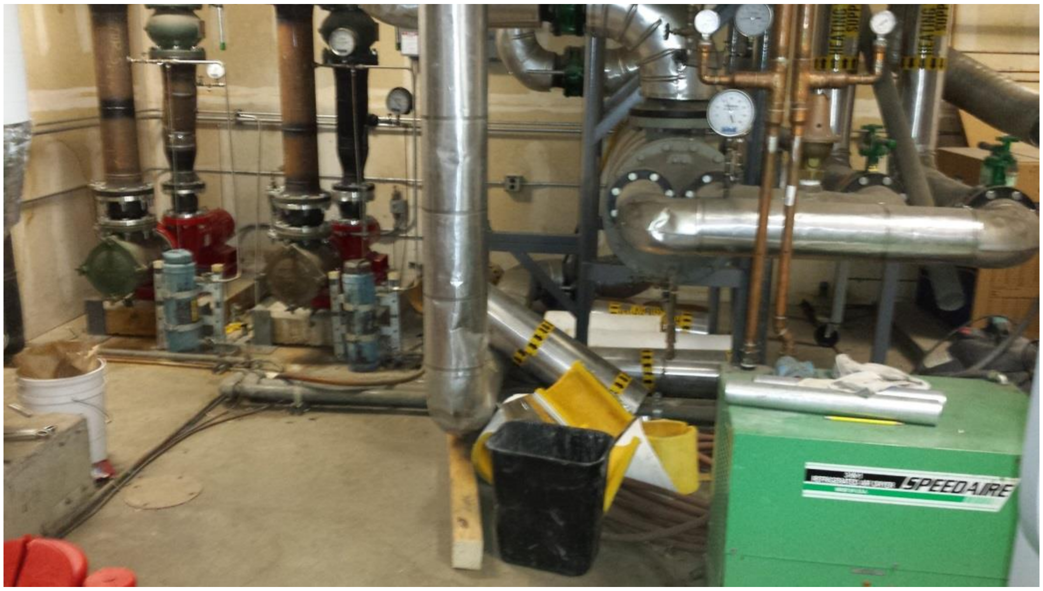
Design Fire Scenarios

The following fire scenarios are listed in Section 5.5.3 of the 2012 NFPA 101.

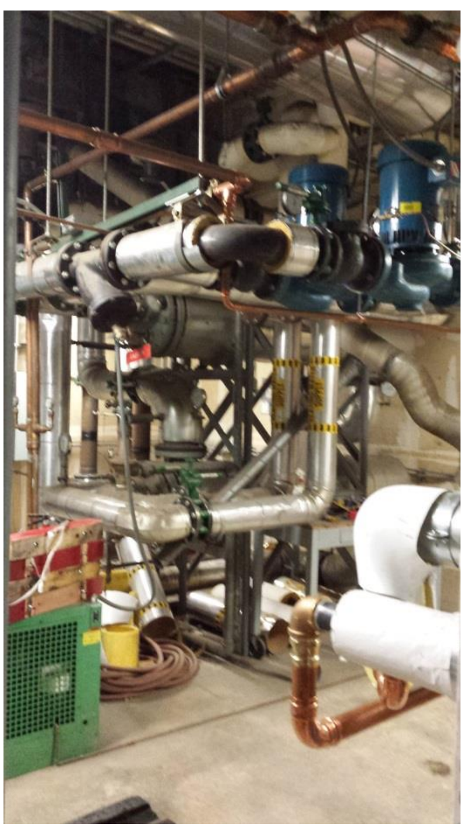
1. Occupancy Specific/activity related
2. Ultrafast-developing fire in primary means of egress
3. Normally unoccupied room
4. Concealed space next to large occupied room
5. Slowly developing fire, shielded from fire protection
6. Most Severe Fire/Largest Fuel Load
7. Outside Exposure Fire
8. Ordinary combustibles/Ineffective-unreliable fire protection

Fire Design Scenario 1:

Fire scenario 1 for building 910 takes place in the boiler room in the basement. The boiler room has 3 boilers along with other mechanical machinery such as condensers, regulators and other equipment. Some of the excessive combustible material left directly across from a boiler receives radiative heat from one of the boilers for a period of several days and ignites. The doors for the boiler room have been inadvertently left open and the fire from the smoke travels to the exit corridor.



The fuel for the fire shown above includes insulation for piping, a waste basket containing some trash, a piece of lumber, a 100-ft long rubber hose and other miscellaneous materials. The photo below is an indication of the height of the 286 °F sprinklers (approximately 16 feet), and an indication of how the fire is shielded from fire protection. Therefore the fire fits NFPA 101 scenarios 3 and 5 for unoccupied spaces and shielded fires.



The photo below shows that there is other fuel in the NE corner of the room that may sustain a fire for a longer period of time.

Egress Component data applicable to every floor

The following Table evaluates to the stairway doors which is applicable to every floor due to the building's symmetry.

Egress Component	Width (inches)	Effective Width (inches) [feet]	Max. Specific flow (person/min/ft)	Max. Flow (person/min)
East Stairway	60	48 [4.0]	18.5	74
West Stairway	60	48 [4.0]	18.5	74
East Stairway door	36	24 [2.0]	24	48
West Stairway door	36	24 [2.0]	24	48

Basement Egress Calculations (Determination of RSET)

Calculating RSET:

Pre-movement time = 30 Seconds

Adjusted basement occupant load = 50

Movement speed:
$S = k - akD$ = 212 – [(2.86)(212)(0.16)] = 97 ft/min

Maximum Horizontal distance traveled = (140/2)+(50/2) = 125 ft.
Time per floor = distance/speed = $\frac{125 feet.}{97\ feet\ /min}$ = 1.29 minutes

Time through the stairway doors:

$$t_p = \frac{P}{F_c} = \frac{Population\ at\ pinch\ point}{Calculated\ flow} = \frac{\frac{50}{2} persons}{48\ persons/minute} = 0.53\ minutes$$

Time needed to exit from basement area = 0.5 + 1.29 + 0.53 = 2.32 minutes = 140 seconds
Time comparison using Pathfinder was 111 seconds.

Determination of ASET for Basement Fire

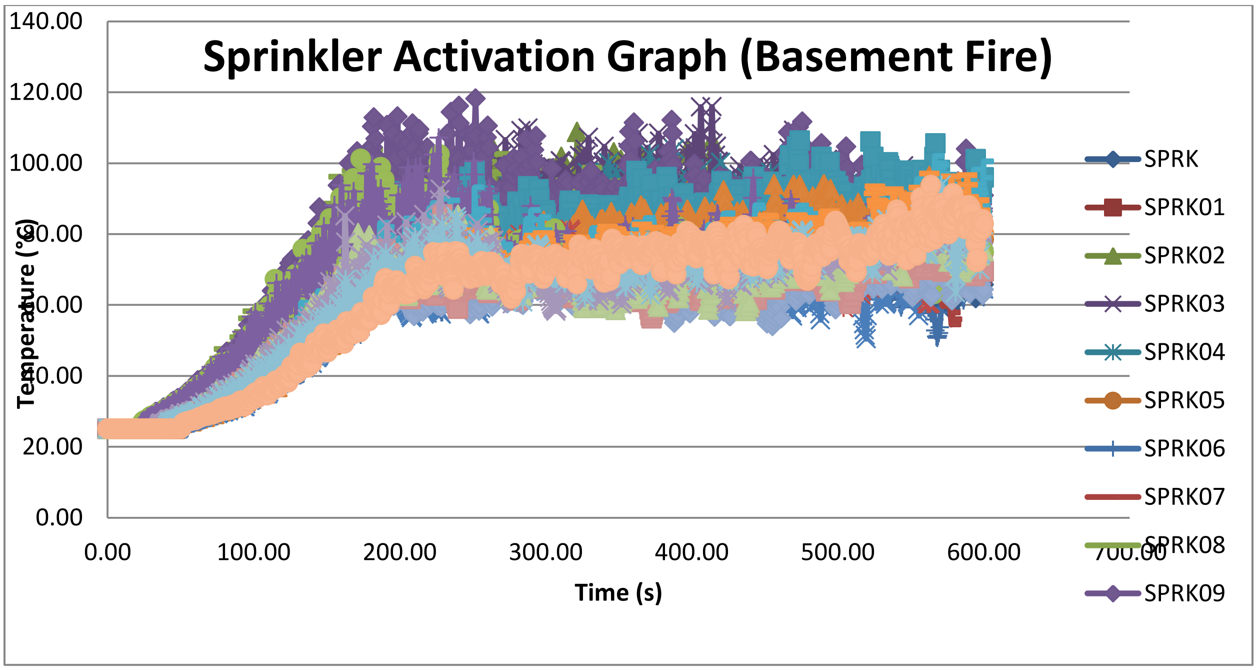
The following results are extracted from the output files of the Pyrosim model for the basement.

Visibility reduces to 13 meters at 180 seconds > 140 seconds

Heat exposure reaches 60℃ at 600 seconds > 140 seconds

Therefore the basement fire scenario passes the performance test.

The sprinklers do not activate because the fire is not large enough to provide enough heat to the high temperature, high ceiling sprinklers.



Fire Design Scenario 2

The second fire scenario takes place in an office space on the 3rd floor where excessive fire load in a work station is coupled with a space heater under the work station that is left on inadvertently for an entire shift. The fire has a potential to have a 1.5 MW output.

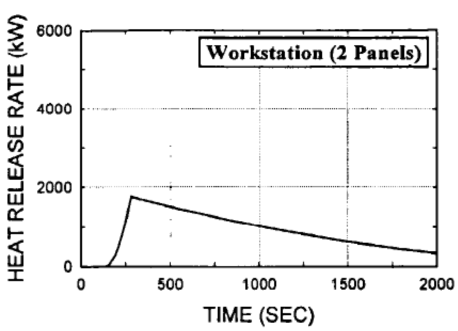


Fig. C9. Workstation (2 panels), Sponsored by GSA and performed at BFRL in 1991

The average workstation fire has a peak heat release rate of 1500 kW.

Determination of RSET for 3rd Floor Fire

3rd Floor Egress Calculations

Pre-movement time = 30 Seconds

Occupant load = 146

Movement speed: $S = k - akD$ = 212 – [(2.86)(212)(0.16)] = 97 ft/min

Maximum Horizontal distance traveled = (140)+(50/2) = 165 ft.

Time per floor = distance/speed = $\frac{165 feet.}{97\ feet\ /min}$ = 1.7 minutes

Time through the stairway doors:

$$t_p = \frac{P}{F_c} = \frac{Population\ at\ pinch\ point}{Calculated\ flow} = \frac{146/2\ persons}{48\ persons/minute} = 1.52\ minutes$$

Time needed to exit from 3rd floor area = 0.5 + 1.7 + 1.52 = 3.72 minutes = 223 seconds

Comparative time using Pathfinder was 4.22 minutes (253 seconds)

Determination of ASET for 3rd Floor Fire

Time needed to reach untenable limits for the 3rd floor fire based on the Pyrosim model:

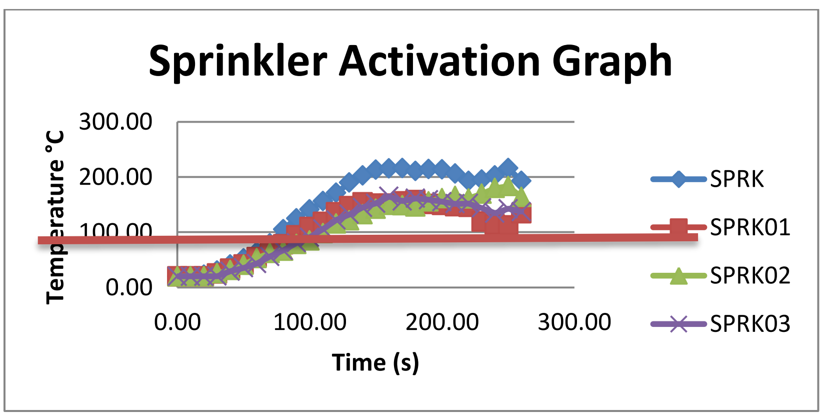
Visibility < 13 m at 260 seconds > 250 seconds

Carbon monoxide exposure at 1000 ppm at 300 seconds > 250 seconds

Heat exposure >60 °C at 800+ seconds > 250 seconds.

Therefore the 3rd floor fire scenario meets the performance test criteria.

The sprinklers activate at 70 seconds which corresponds to a heat release rate of 195 kW, and prevent the fire from growing larger than that value.



Conclusions

- **The building is compliant from a prescriptive standpoint.**

The building's size, height, type of construction, occupancy classifications, fire ratings, fire suppression, fire alarm systems, exiting arrangement, interior surfaces and architectural features meet all of the minimum code requirements for the code of record as well as the current codes. The occupants have adequate means of receiving notifications and have adequate means of egress in all parts of the building. The chances of survivability in a fire are very good and there is good redundancy of fire protection systems for life safety as well as property protection. There is a need however to install visual fire alarm notification devices (strobes).

- **The Basement fire scenario passes the performance test.**

The fire size in the basement is not large enough to activate the sprinklers. The calculated required safe egress time is far shorter than the time when tenability conditions fall below target levels. Even during a fire in the basement which is mostly vacant, the smoke and other fire by-products only affect the corridor and exiting system if a door leading to the corridor is assumed to be left open. The high temperature sprinklers in the boiler room and other mechanical areas of the basement are somewhat shielded due to the amount of machinery in these areas. If there is a small fire in these areas, it is likely that the sprinklers will not activate, however since these areas are equipped with smoke detection the fire would be quickly discovered.

- **The 3rd floor fire scenario passes the performance test.**

The 3rd floor space heater fire is close to the maximum credible expected fire. The first sprinkler is activated in 70 seconds and the fire is kept under control. The occupants have adequate time to exit with the tenability conditions all in place. Even if one of the exits on the 3rd floor is unavailable, there is adequate time to reach the other exit in good visibility and low enough carbon monoxide levels. The smoke detection within the HVAC system would activate before the sprinklers and provide the means for notification, as well as the pull stations located at the exits.

Perhaps the most telling conclusion is that the prescriptive codes work. By following the prescriptive codes we provide adequate occupant and property protection for the building with the given likely fire scenarios of a particular occupancy.

Recommendations

- **Good Housekeeping**

Both fire scenarios involved housekeeping issues. Section 304.1 of the 2013 CFC prohibits the accumulation of unnecessary combustible materials that may become fuel for a fire. This includes avoiding excessive accumulation of combustibles as well as keeping all paths of egress clear.

- **Preventative and corrective maintenance**

Perform all scheduled preventative maintenance for boilers and other mechanical equipment to keep them working in a safe and proper working condition. All exit signs, egress lighting and emergency lighting must be kept in working order.

- **Keep Fire doors closed**

Fire doors help prevent the passage of heat and smoke and they must be kept closed to function properly. In the basement fire scenario closed doors would have confined the fire to the boiler room and the occupants would not have been affected. Keeping stairway enclosure doors closed ensures that stairways serve as a safe haven from the fire hazards in the remainder of the building.

- **Fire Safety Education**

Train staff/occupants on acceptable types of space heaters with built-in safety features. Have education campaigns on importance of keeping exit aisle ways clear. Also re-inforce requirements for immediate exiting when fire alarms are activated in order to reduce the pre-movement time. Train staff on importance of immediate exiting from spaces where Halon is about to be discharged, and other aspects of Halon system operations including the use of the discharge delay switch. Fire drills must to be held at least annually.

Sources:

2013 California Building Code, Published by the International Codes Council.

2013 California Fire Code, Published by the International Codes Council

2012 NFPA 101 – Life Safety Code (LSC)

2013 NFPA 13 – Standard for installationof Sprinkler Systems

2015 NFPA 12A – Standard on Halon 1301 Fire Extinguisher Systems

2013 NFPA 14 – Standard for the Installation of Standpipe and Hose Systems

2014 NFPA 25 – Standard for the ITM of Water-Based Fire Protection Systems

SFPE Handbook of Fire Protection Engineering, 4th Edition

SFPE Handbook of Fire Protection Engineering, 3rd Edition

NFPA Fire Protection Handbook, 19th Edition

2012 DOE Standard 1066 – Standard for Fire Protection, US Department of Energy

2012 DOE order 420.1.B – Fire Protection Requirements, US Department of Energy

2011 SNL/CA Water pressure and flow tests records, Sandia National Laboratories

Building Plan Archives, Sandia National Laboratories, Livermore, CA

ELECTRICAL SHUTOFF: SUBSTATION 41,42,43,44

GAS SHUTOFF: OUT SIDE BOILER ROOM

SUPPRESSION: AUTOMATIC SPRINKLERS THROUGHOUT, AUTOMATIC HALON 1301 IN 010, IN MESHED AREA

DETECTION: IN CROSS HATCHED AREAS AND SUPPLY DUCTS

FIRE ALARM: MXL, MAIN PANEL IN BASEMENT CENTRAL CORRIDOR.
SATELLITE PANEL ON 1ST FLOOR WEST LOBBY.
PANEL ALSO CONTROLS REDWOOD CENTER (TRAILERS), AND CREDIT UNION
SUITE 121 HAS A VOICE EVACUATION FIRE ALARM SYSTEM FOR PARTIAL EVACUATION PURPOSES.
USE FUNCTION KEY F4 AT MAIN FACP OR SATELLITE FACP TO MANUALLY TRIGGER PRE-RECORDED VOICE EVACUATION MESSAGE TO SUITE 121 OCCUPANTS.

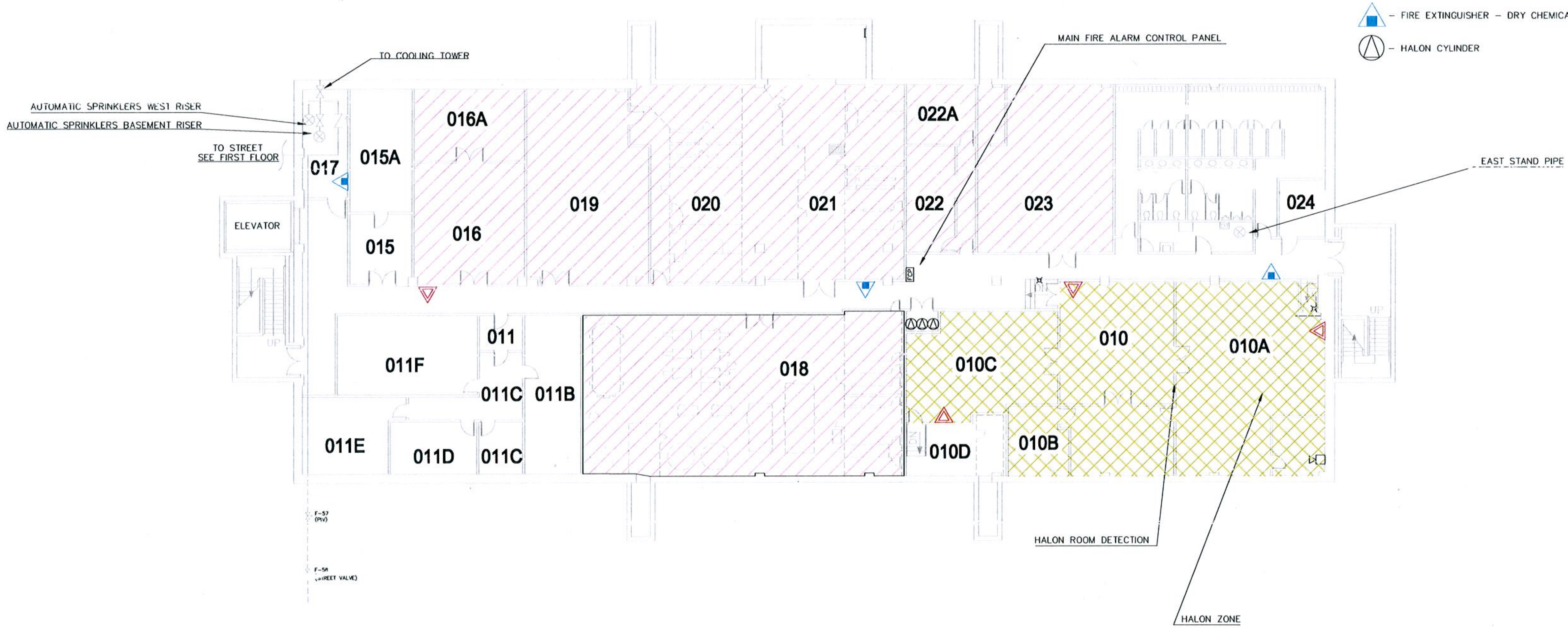
SMOKE DETECTORS

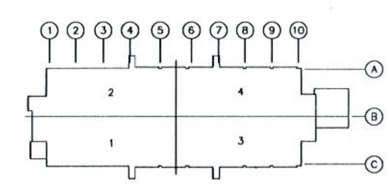
HALON ZONE

– FIRE EXTINGUISHER – CLEAN AGENT

– FIRE EXTINGUISHER – DRY CHEMICAL, ABC

– HALON CYLINDER





BLDG 910
BASEMENT
FIRE BLOCK PLAN

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
6892	P	7/15/14	2014 RUN CARDS	RRN	GDG	
167229	N	8/2/13	ROOM NUMBER REVISION	RRN	GDG	
E080403	M	03/28/08	UPDATED NOTES	CDM	SH	
	L	9/12/06	ADDED PIV, PIV NOS.	T.H.	MTG	
88432	K	03/31/06	OFFICE MOD. IN RM. 010A	DD	DD	
	J	7/20/05	REVISED RM NOS 011, 011A–F	T.H.	ARK	
	H	6/20/05	REVISE FIRE EXT., ADDED NOTES	T.H.	ARK	
	G	9/7/04	REVISED RM. 011	T.H.	MTG	
	F	5/27/04	ADDED ROOM NOS.	T.H.	MTG	
	E	3/9/04	REMOVE EXTINGUISHER NOS.	T.H.	CW	
	D	06/16/99	FIRE SYSTEM UPDATE	JBL	MTG	
	C	07/20/98	FIRE SYSTEM UPDATE	JBK	MTG	
	B	08/14/95	FIRE SYSTEM UPDATE	RYF		
	A	8/12/93	ORIGINAL ISSUE	DAP	CAC	

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ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

BUILDING 910 BLDG. 910
FIRE BLOCK PLAN
BASEMENT

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DA PETERS
CHECKED	CA CALDWELL
SCALE	NONE
DATE	AUG. 1993

SUBMITTED | RECOMMENDED | APPROVED

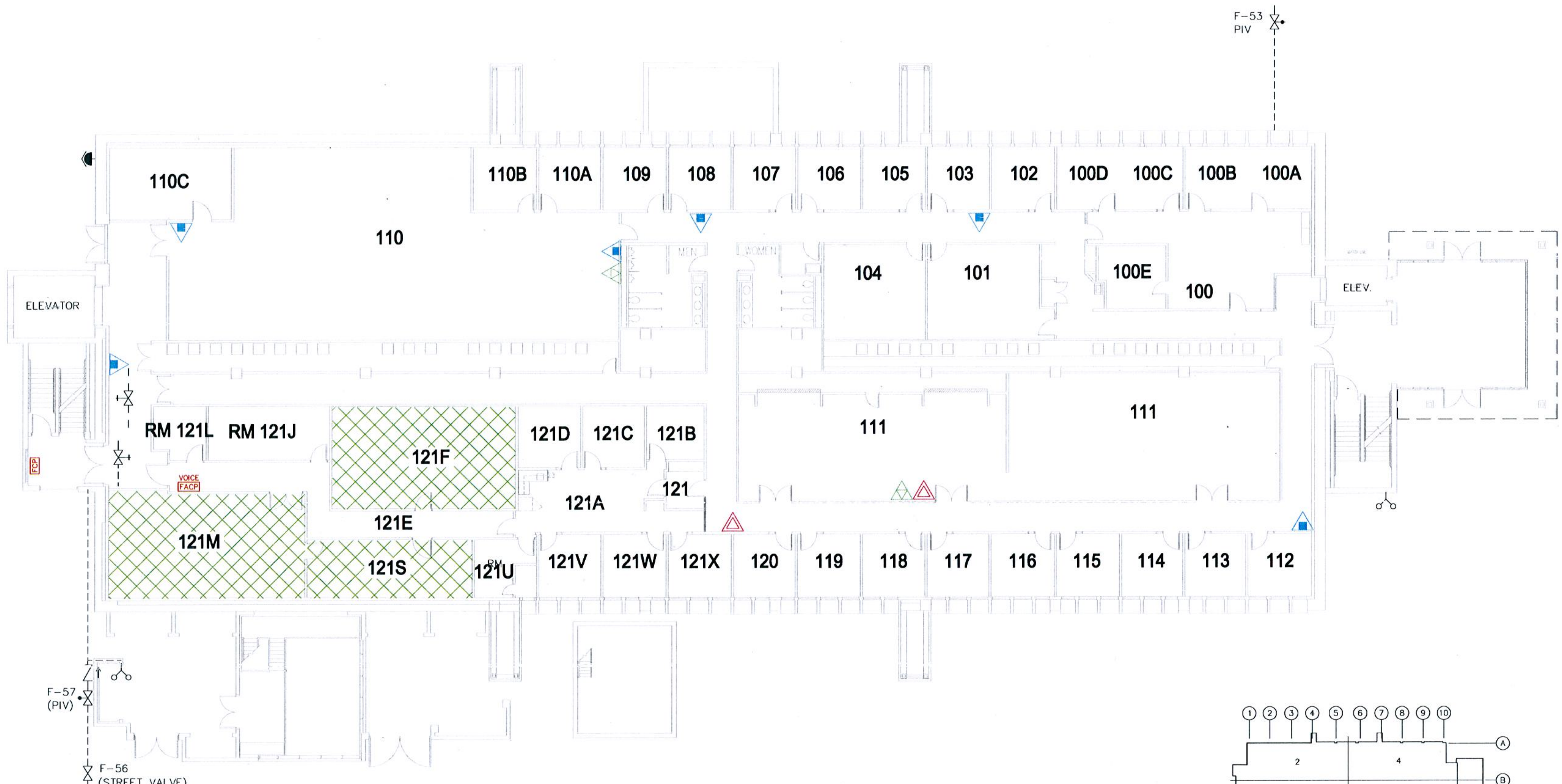
DWG.NO. 100050

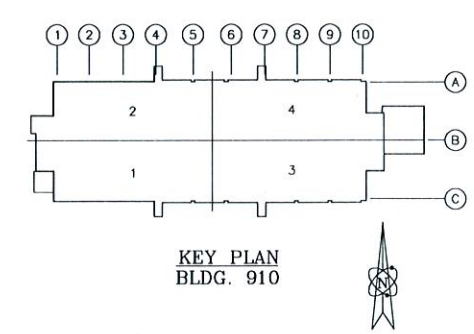
CADS DRAWING
FILE NAME: 100050P.dwg

PROJ. NO.
ORDER NO.

FM200 GASEOUS SUPPRESSION SYSTEM

SHEET 2





KEY PLAN
BLDG. 910

BLDG 910
FIRST FLOOR
FIRE BLOCK PLAN

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
6892	N	7/15/14	2014 RUN CARDS	RRN	GDG	
167229	M	8/2/13	ROOM NUMBER REVISION	RRN	GDG	

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BUILDING 910
BLDG.910
FIRE BLOCK PLAN
SHEET 2 OF 2
FIRST FLOOR

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	R. WHITNEY
CHECKED	
SCALE	NONE
DATE	SEPT 2009

SUBMITTED: | RECOMMENDED | APPROVED

DWG.NO. 101050

CADS DRAWING
FILE NAME: 101050N.dwg

PROJ. NO. E01025
ORDER NO.

SUPPRESSION: AUTOMATIC SPRINKLERS THROUGHOUT

DETECTION: DUCT DETECTORS

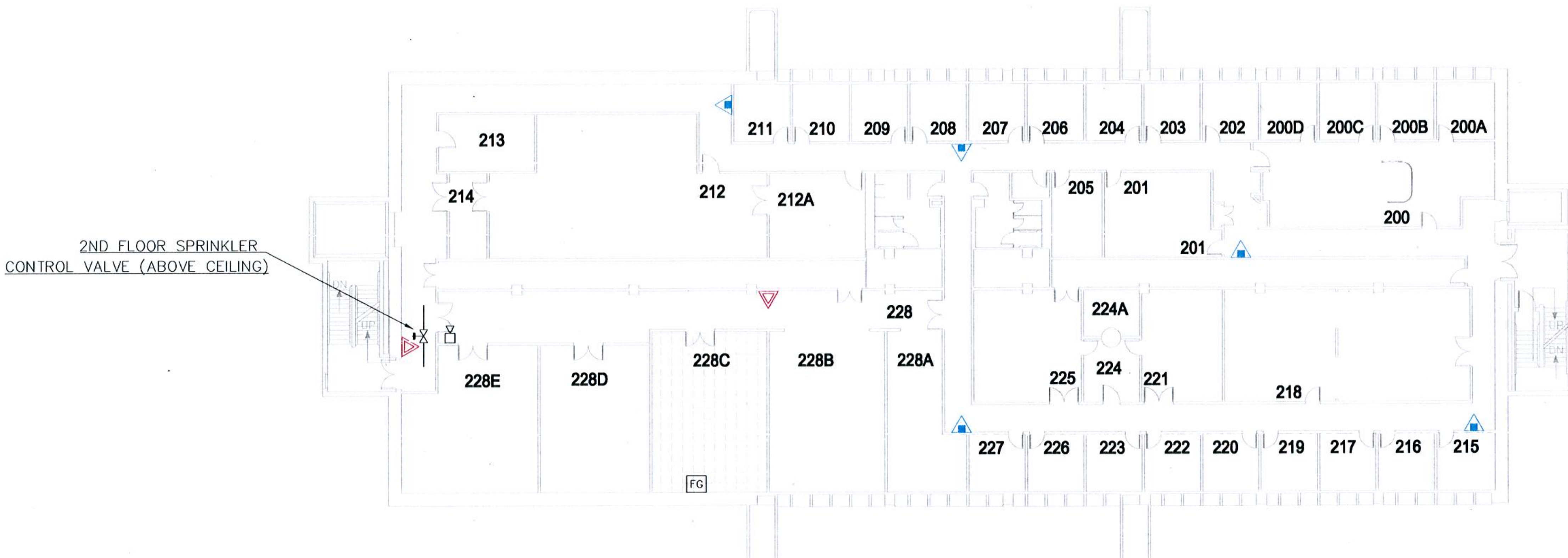
FIRE ALARM CONTROL PANEL: FOUND IN BASEMENT CENTRAL CORRIDOR SATELLITE PANEL ON 1ST FLOOR WEST LOBBY. PANEL ALSO CONTROLS REDWOOD CENTER (TRAILERS) AND CREDIT UNION

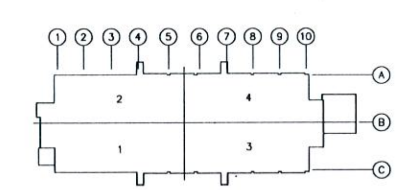
FLAMMABLE GAS DECTORS FOUND THIS AREA

– FIRE EXTINGUISHER – CLEAN AGENT

– FIRE EXTINGUISHER – DRY CHEMICAL, ABC

FG – FLAMMABLE GAS CONTROL PANEL





KEY PLAN
BLDG. 910

BLDG 910
SECOND FLOOR
FIRE BLOCK PLAN

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CADS DRAWING
FILE NAME: 102050L.dwg

PROJ. NO.
ORDER NO.

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
6892	L	7/15/14	2014 RUN CARDS	RRN	GDG	
167229	K	8/2/13	ROOM NUMBER REVISION	RRN	GDG	
E080403	J	03/28/08	UPDATED NOTES	CDM	SH	
	H	12/21/05	ADD FLAM. GAS CONTROL PANEL	T.H.	ARK	
	G	6/20/05	REVISE FIRE EXT., ADDED NOTES	T.H.	ARK	
	F	12/13/04	ADDED WALL, DOOR RM 228D	T.H.	MTG	
	E	3/9/04	REMOVE EXTINGUISHER NOS.	T.H.	CW	
	D	6/16/99	FIRE SYSTEM UPDAE	JBK	MTG	
	C	07/20/98	FIRE SYSTEM UPDAE	JBK	MTG	
	B	08/14/95	FIRE SYSTEM UPDAE	RYF		
	A	8/12/93	ORIGINAL ISSUE	DAP	CAC	

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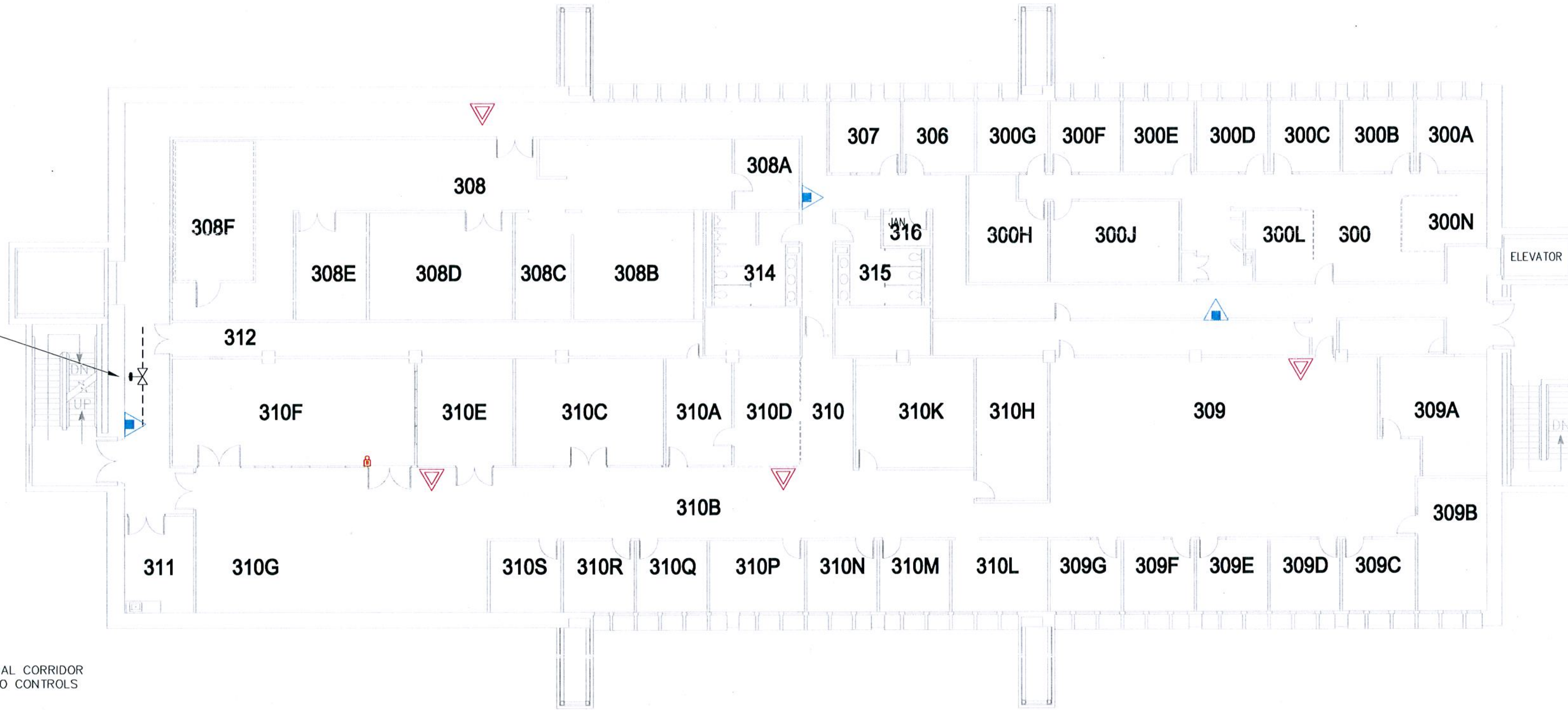
BUILDING 910 BLDG.910
FIRE BLOCK PLAN
SECOND FLOOR

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DA PYERS
CHECKED	CA CALDWELL
SCALE	NONE
DATE	AUG. 1993

SUBMITTED: RECOMMENDED: APPROVED:

DWG.NO. 102050

3RD FLOOR SPRINKLER ISOLATION VALVE
(ABOVE CEILING)



SUPPRESSION: AUTOMATIC SPRINKLERS THROUGHOUT

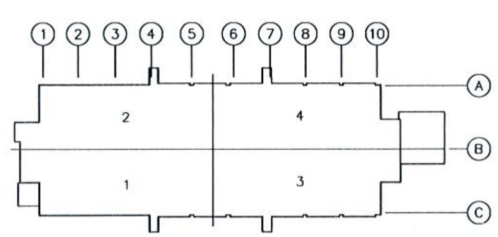
DETECTION: DUCT DETECTION

FIRE ALARM CONTROL PANEL: FOUND IN BASEMENT CENTRAL CORRIDOR SATELLITE PANEL ON 1ST FLOOR WEST LOBBY. PANEL ALSO CONTROLS REDWOOD CENTER (TRAILERS) AND CREDIT UNION

– FIRE EXTINGUISHER – CLEAN AGENT

– FIRE EXTINGUISHER – DRY CHEMICAL, ABC

NOTE: THERE ARE 3 FIRE EXTINGUSHERS ON THE ROOF EXTINGUSHERS 31,32,33



KEY PLAN
BLDG. 910

BUILDING 910
THIRD FLOOR

6892	M	7/15/14	2014 RUN CARDS	RRN	GDG	
167229	L	8/2/13	ROOM NUMBER REVISION	RRN	GDG	
	K	9/17/09	UPDATED OUTLINES & TEXTS	RDW	DTR	
	J	7/20/06	REVISED RM NOS 320, 321, 321A	T.H.	ARK	
	H	6/20/05	REVISE FIRE EXT., ADDED NOTES	T.H.	ARK	
	G	5/19/04	MOD. RM NOS, DOORS. ADD XREF	T.H.	MTG	
	F	3/9/04	UPDATE RM308, REMOVE EXTIN NOS	T.H.	MTG	
	E	12/10/03	MODIFY RM 300, UTILITY CHASE	T.H.	WCS	
	D	6/16/99	FIRE SYSTEM UP DAATE	MTG	JBK	
	C	7/20/98	FIRE SYSTEM UP DAATE	MTG	JBK	
	B	08/14/95	FIRE SYSTEM UP DAATE			
	A	8/12/93	ORIGINAL ISSUE	DAP	CAC	
PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.

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ARCHITECTURAL BLDG 910
FIRE BLOCK PLAN
3RD FLOOR

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DA PYERS
CHECKED	CA CALDWELL
SCALE	NONE
DATE	AUG. 1993

SUBMITTED | RECOMMENDED | APPROVED

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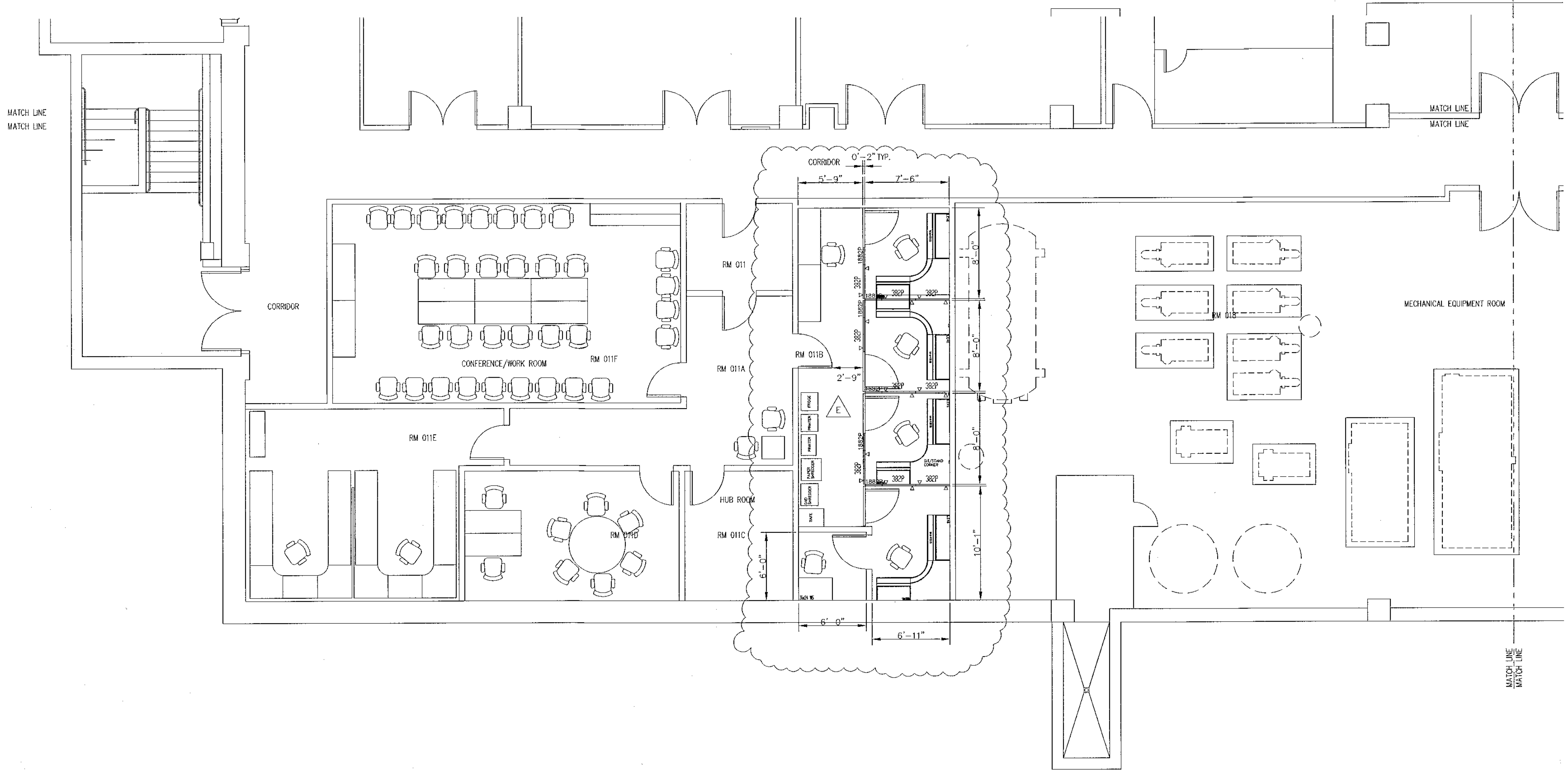
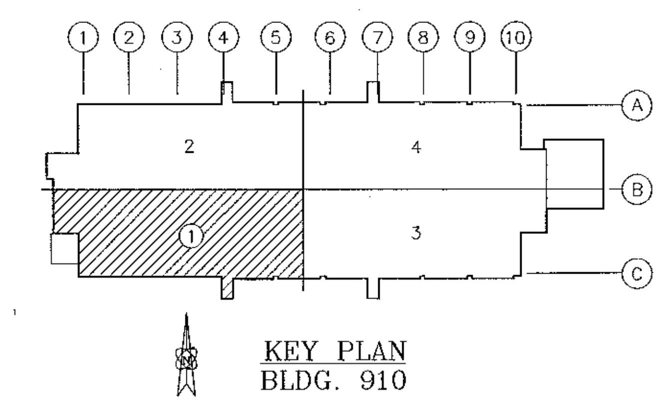
ORDER NO. ____



FIRST FLOOR PLAN – SOUTHWEST
SCALE: 1/4"=1'-0"



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
E011261	E	05/31/11	011B RE-CONFIGURE	KCD	GDG	
	D	11/05/07	XREF UPGRADE	CDM	GDG	
	C	08/22/05	ADDED CABINETS IN RM. 011F	S.J.	S.J.	
	B	7/20/05	REVISED RM NOS 011, 011A-F	T.H.	KCD	
	A	9/21/04	ORIGINAL ISSUE	T.H.	WCS	

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SECTOR 1 BLDG 910

LAYOUT
FLOOR PLAN
BASEMENT

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	T. HISAOKA
CHECKED	W. SCHOCK
SCALE	1/4"=1'-0"
DATE	9/21/04

SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 100140

CADS DRAWING
FILE NAME: 100140E.dwg

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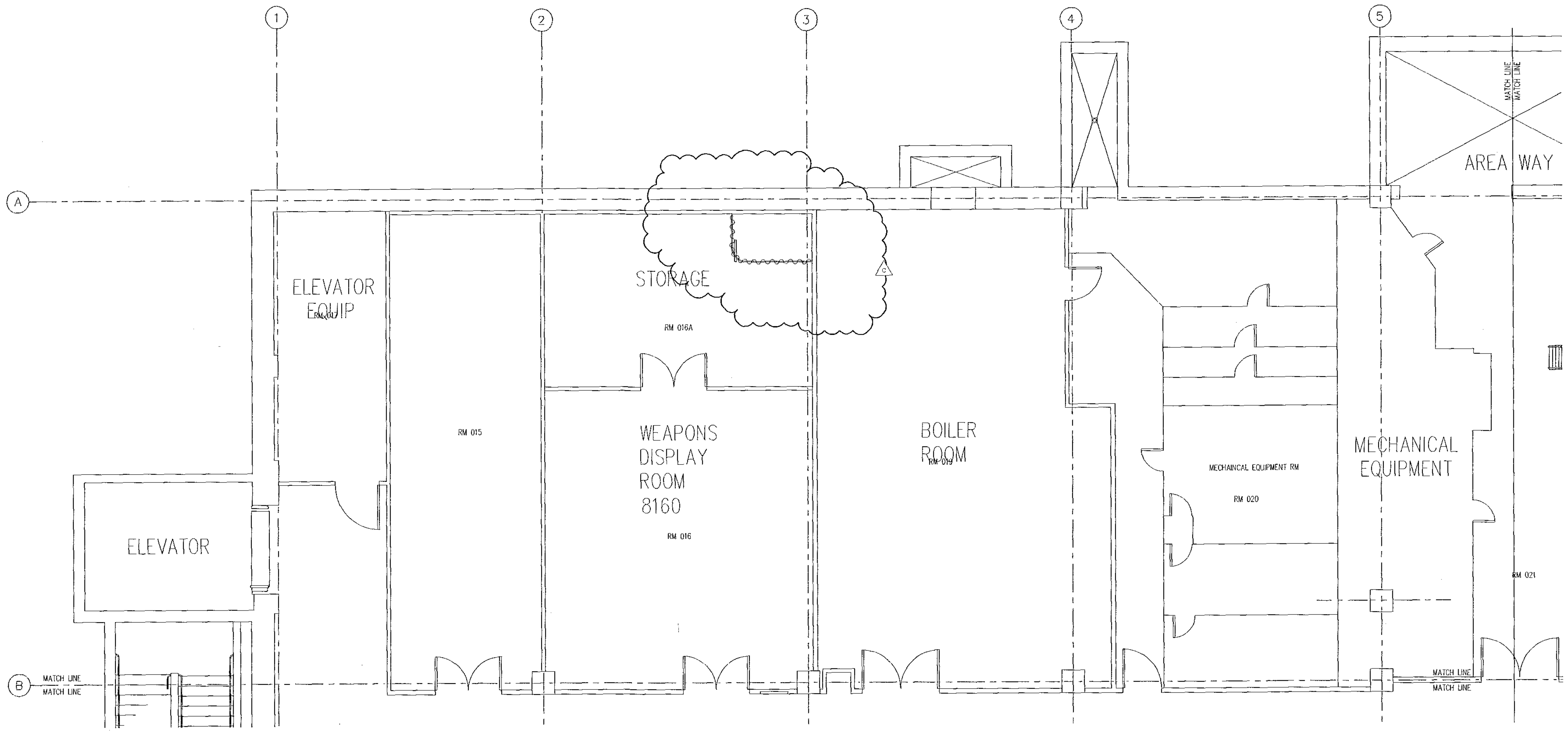
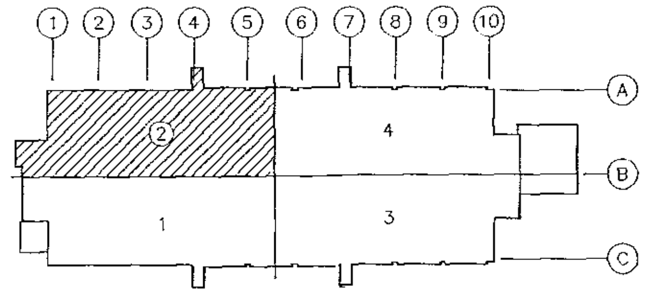
ORDER NO. 153863





KEY PLAN
BLDG. 910

CADS DRAWING
FILE NAME: 100241C.dwg

PROJ. NO. E010028
ORDER NO.

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	C	4/22/10	CURTAIN DIVIDER ADDED	KCD	GDG	
	B	11/05/07	XREF UPGRADE	CDM	GDG	
	A	4/23/98	REDRAWN ON CADS	T.H.	GDG	

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SECTOR 2 BLDG 910

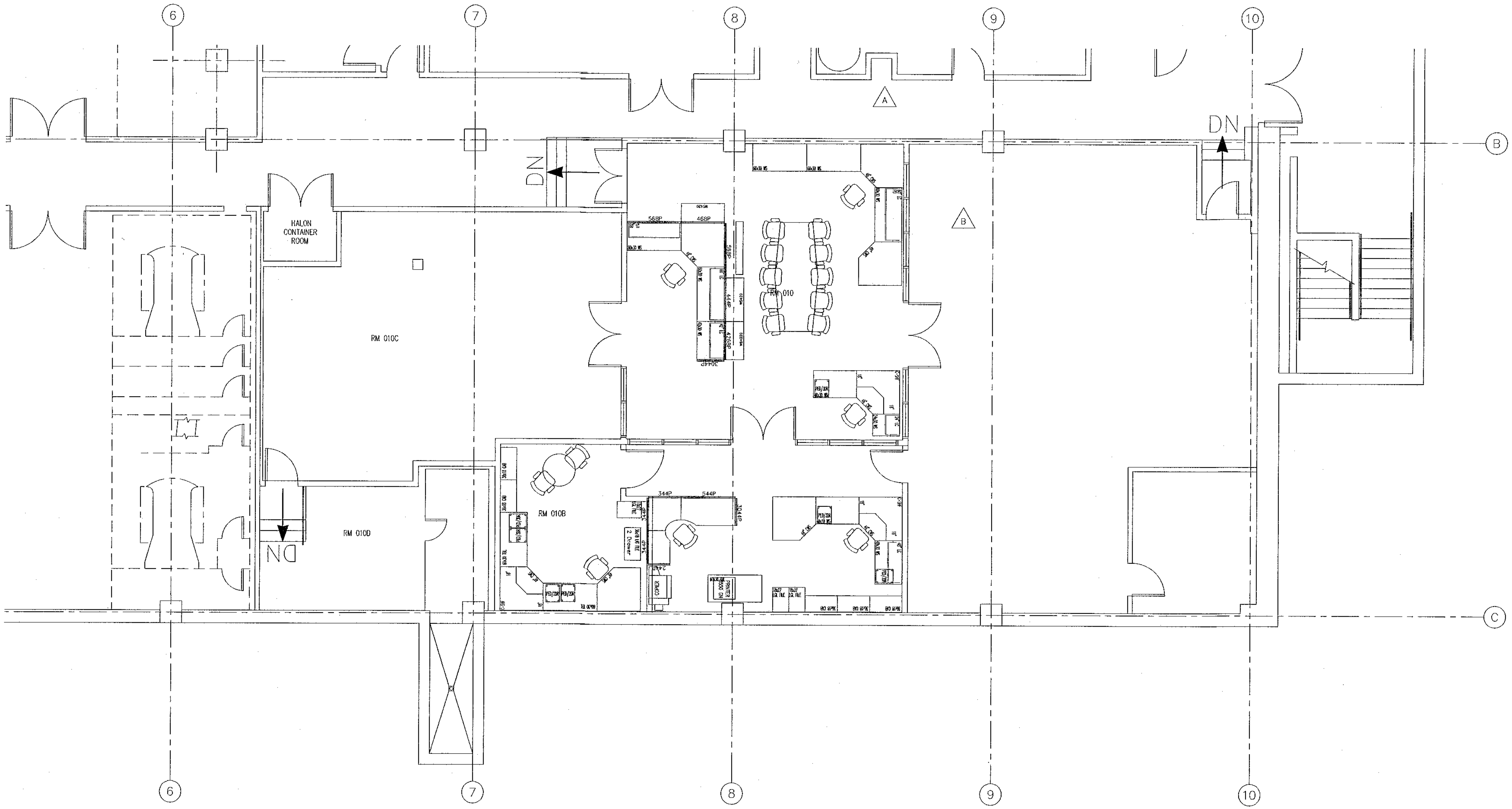
ARCHITECTURAL FLOOR PLAN

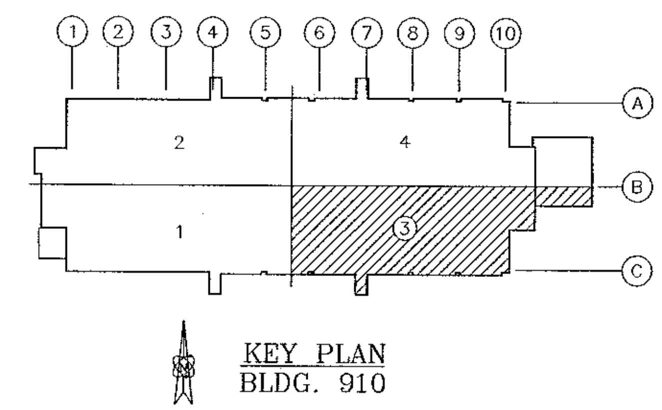
BASEMENT

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	T. HISAOKA
CHECKED	G. GUTIERREZ
SCALE	1/4"=1'-0"
DATE	4/8/98

SUBMITTED
RECOMMENDED
APPROVED

DWG.NO. 100241





KEY PLAN
BLDG. 910

	D	11/05/07	XREF UPGRADE	MAR	GDG	
88432	C	03/30/06	OFFICE MOD. IN RM. 010A	DD	DD	
NONE	B	6-14-04	AS-BUILT	HDH	DSS	
Q020127	A	11/20/02	ORGINAL CADS DRAWING	T.H.	DSS	
PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.

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ALBUQUERQUE, NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH, NEVADA

SECTOR 3
ARCHITECTURAL FLOOR PLAN
BLDG 910
BASEMENT

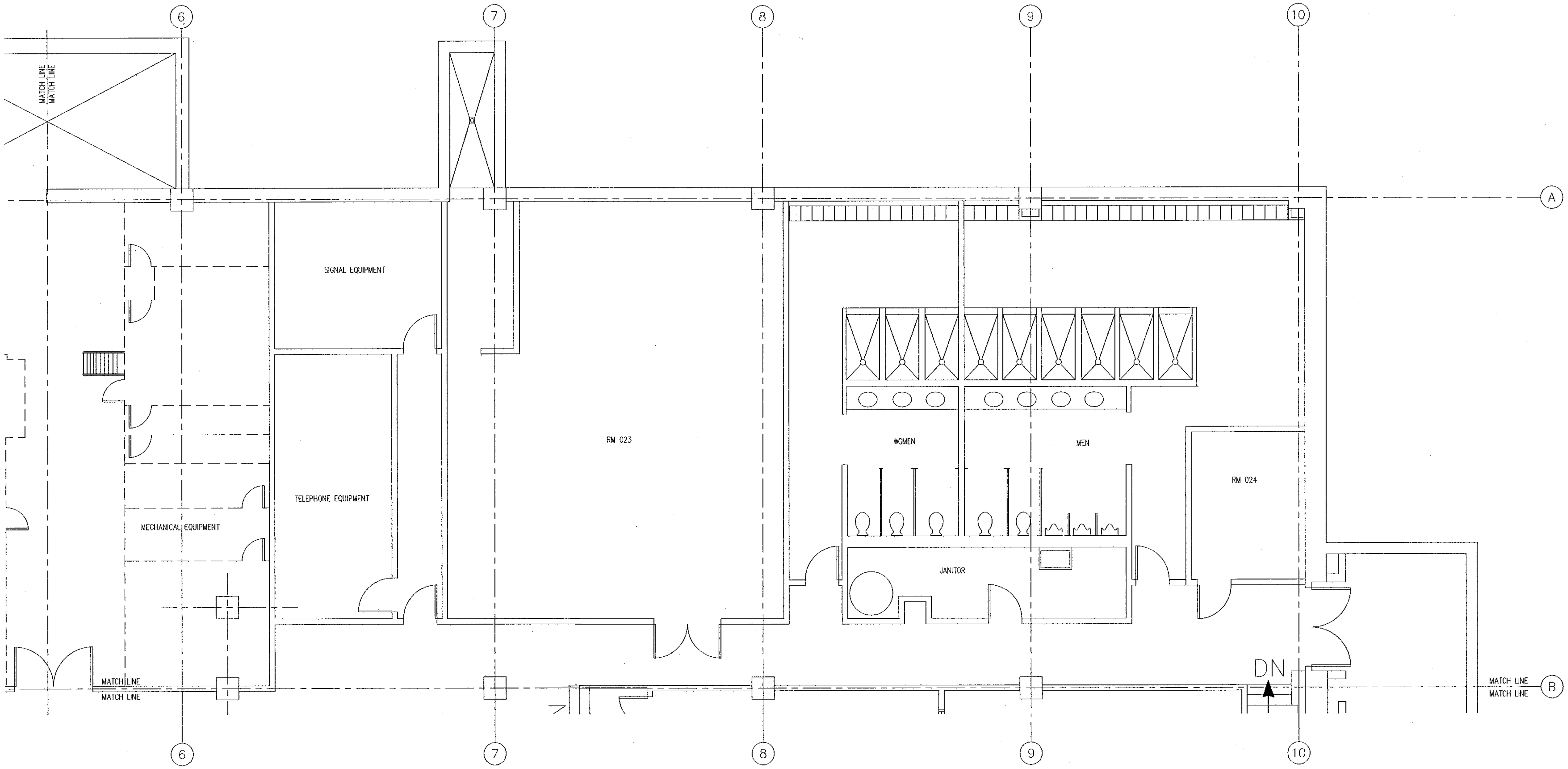
CONTRACT NO.(A-E)
DOE ACCT.NO.
DRAWN D. SHIMADA
CHECKED T.H.
SCALE 1/4"=1'-0"
DATE

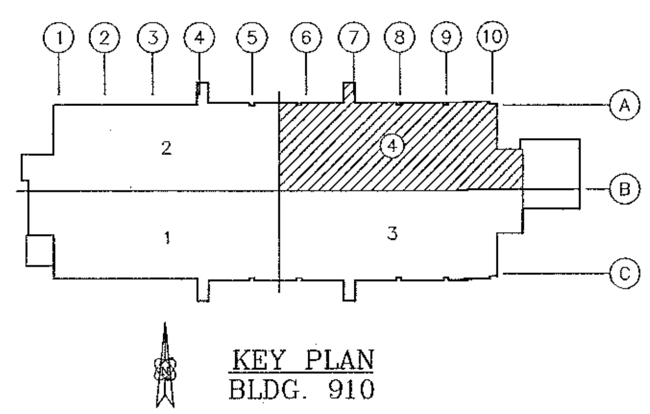
SUBMITTED
RECOMMENDED
APPROVED

DWG.NO. 100340

CADS DRAWING
FILE NAME: 100340D.dwg

PROJ. NO.
ORDER NO.





KEY PLAN
BLDG. 910

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CADS DRAWING
FILE NAME: 100441B.dwg

PROJ. NO. ____
ORDER NO. ____

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	B	11/05/07	XREF UPGRADE	CDM	GDG	
	A	4/23/98	REDRAWN ON CADS	T.H.	GDG	

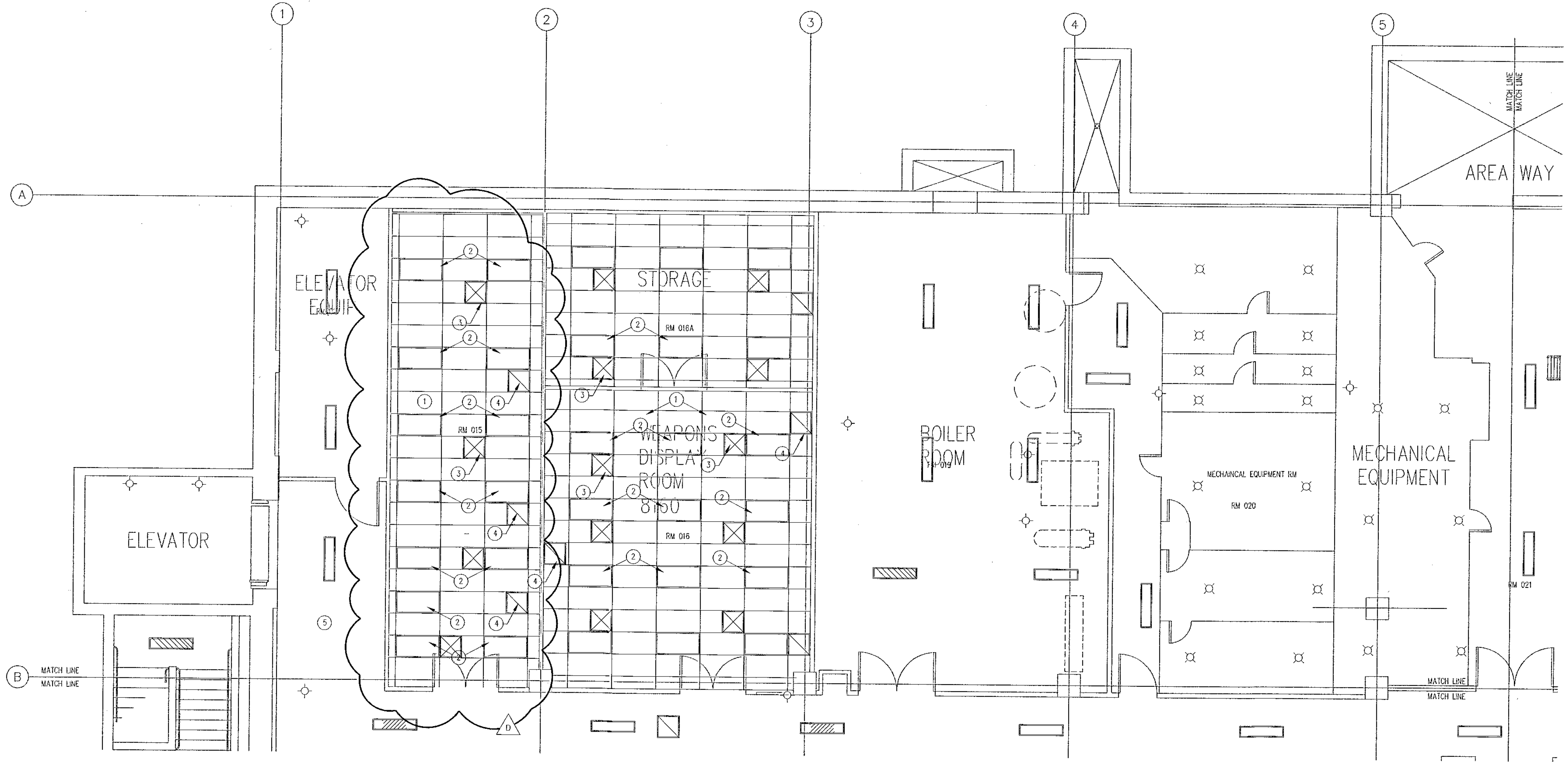
SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 4 ARCHITECTURAL FLOOR PLAN BLDG 910 BASEMENT

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	T. HISAOKA
CHECKED	G. GUTIERREZ
SCALE	1/4"=1'-0"
DATE	4/8/98

SUBMITTED | RECOMMENDED | APPROVED

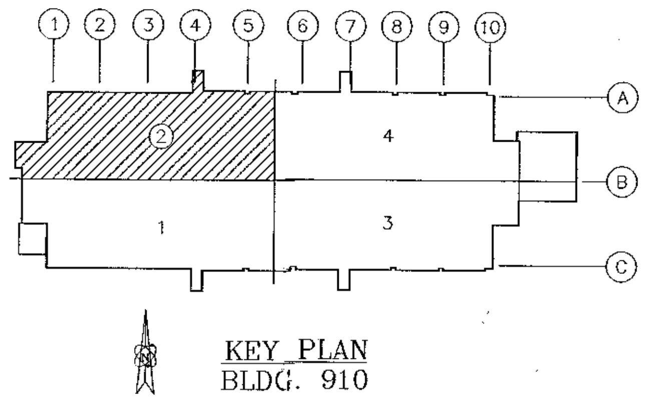
DWG.NO. 100441



ROOM 015 RENOVATION PLAN

NOTES:

1. 2'x4' ACOUSTICAL LAY-IN CEILING.
2. 2'x4' FLUOR. FIXTURE.
3. SUPPLY AIR DIFFUSER, SEE MECH. DRAWINGS.
4. RETURN AIR GRILLE, OR EXHAUST REGISTER, SEE MECH. DRAWINGS.
5. NEW 211R. CB. CEILING.



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
E010057	D	10/12/10	REMOVE RF ROOM	MRT	RDW	
	C	11/05/07	XREF UPGRADE	CDM	GDG	
	B	09/28/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 2 ARCHITECTURAL BLDG 910

GENERAL RENOVATION PLAN
BASMENT

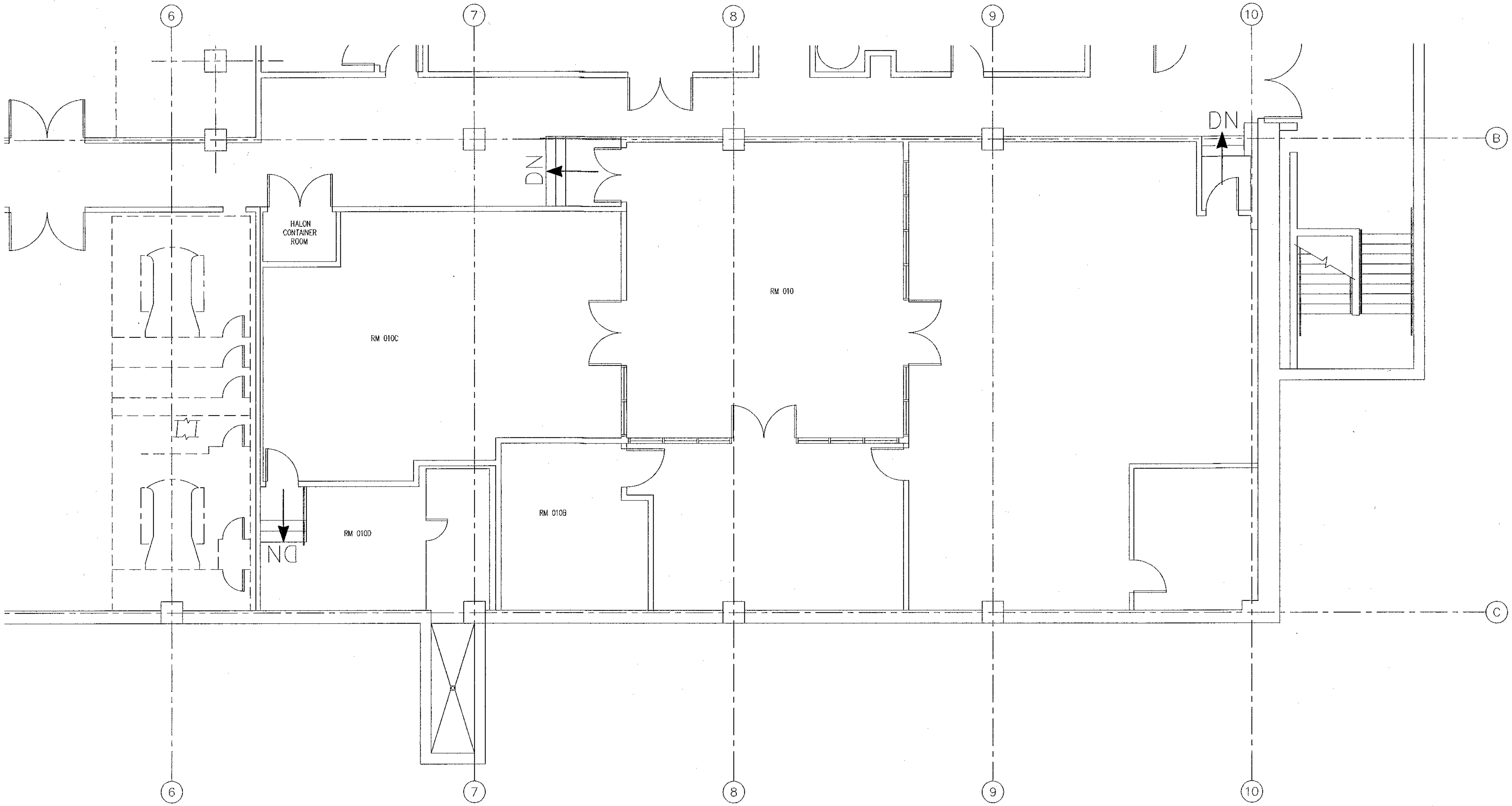
CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

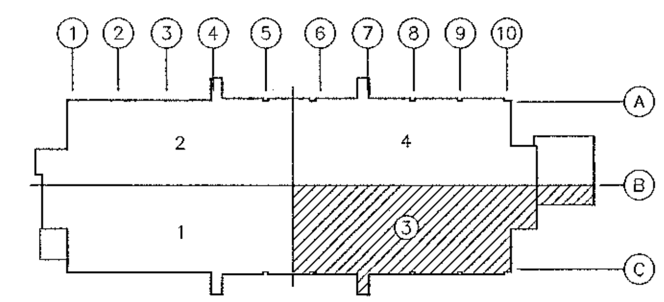
SUBMITTED RECOMMENDED APPROVED

CADS DRAWING
FILE NAME: 100242D.dwg

PROJ. NO.
ORDER NO.

DWG.NO. 100242





KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	C	11/05/07	XREF UPGRADE	MAR	GDG	
88432	B	03/30/06	OFFICE MOD. IN RM. 010A	DD	DD	
	A	4/10/95	REDRAWN ON CADS	GDG	WCS	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 3 BLDG 910

ARCHITECTURAL FLOOR PLAN

BASEMENT

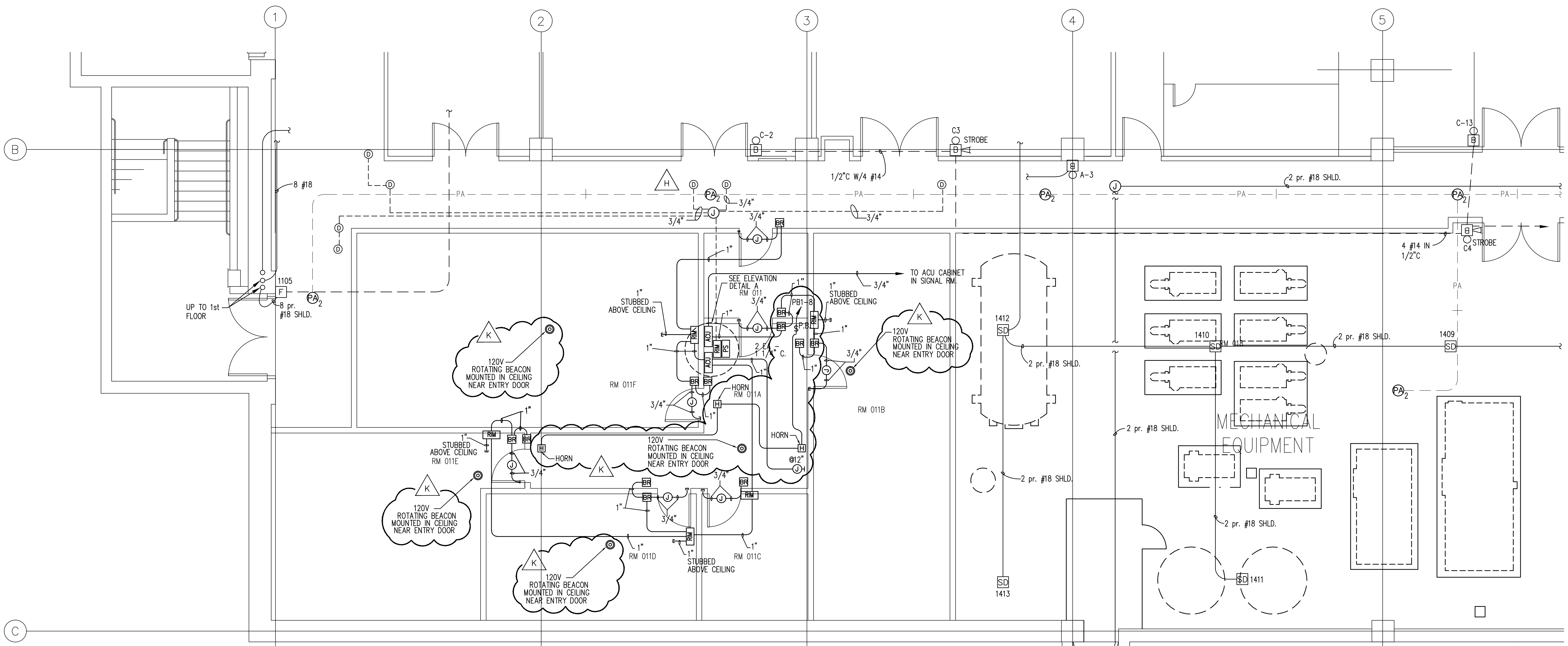
CONTRACT NO.(A-E)
DOE ACCT.NO.
DRAWN
CHECKED
SCALE 1/4"=1'-0"
DATE

SUBMITTED
RECOMMENDED
APPROVED

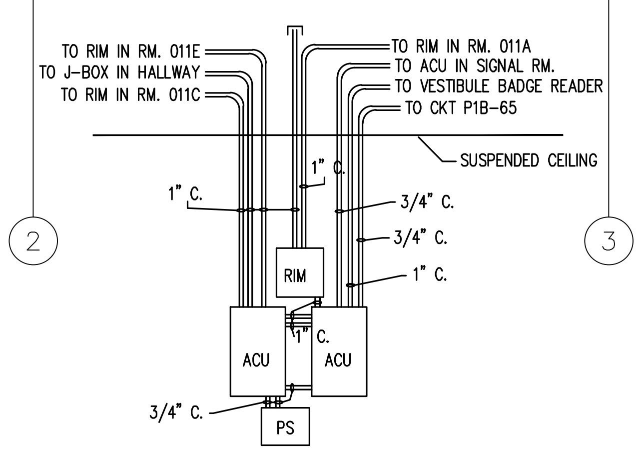
DWG.NO. 100341

CADS DRAWING
FILE NAME: 100341C.dwg

PROJ. NO.
ORDER NO.

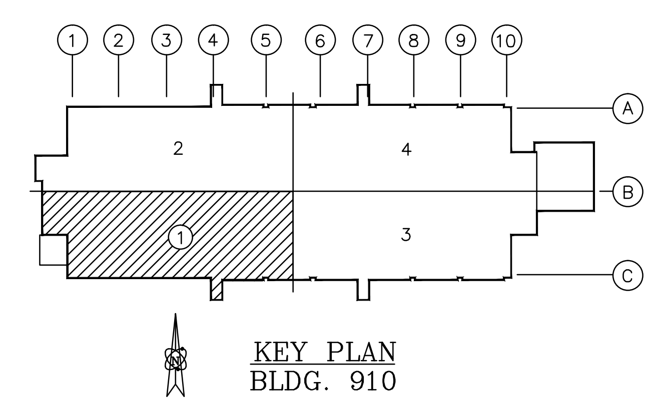


FIRST FLOOR PLAN – SOUTHWEST
SCALE: 1/4"=1'-0"



A
E3 E3

IA CABINETS
SCALE: NONE



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	L	11/05/07	XREF UPGRADE	CDM	GDG	
90840	K	7/26/06	ADDED HORNS AND STROBES IN RM. 011	MAR	CA	
	J	7/21/05	REVISED RM NOS 011, 011A-F	T.H.	KCD	
E05143	H	6/6/05	ADD MOTION SENSORS IN HALLWAY	DD	DD	
	G	9/22/04	UPDATE RM. 011	T.H.	WCS	
	F	09/23/93	REDRAWM ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 1 BLDG 910
ELECTRICAL
SPECIAL SYSTEMS
BASEMENT

CONTRACT NO.(A-E)
DOE ACCT.NO.
DRAWN DRAWNBY
CHECKED CHECKEDBY
SCALE 1/4"=1'
DATE DATE

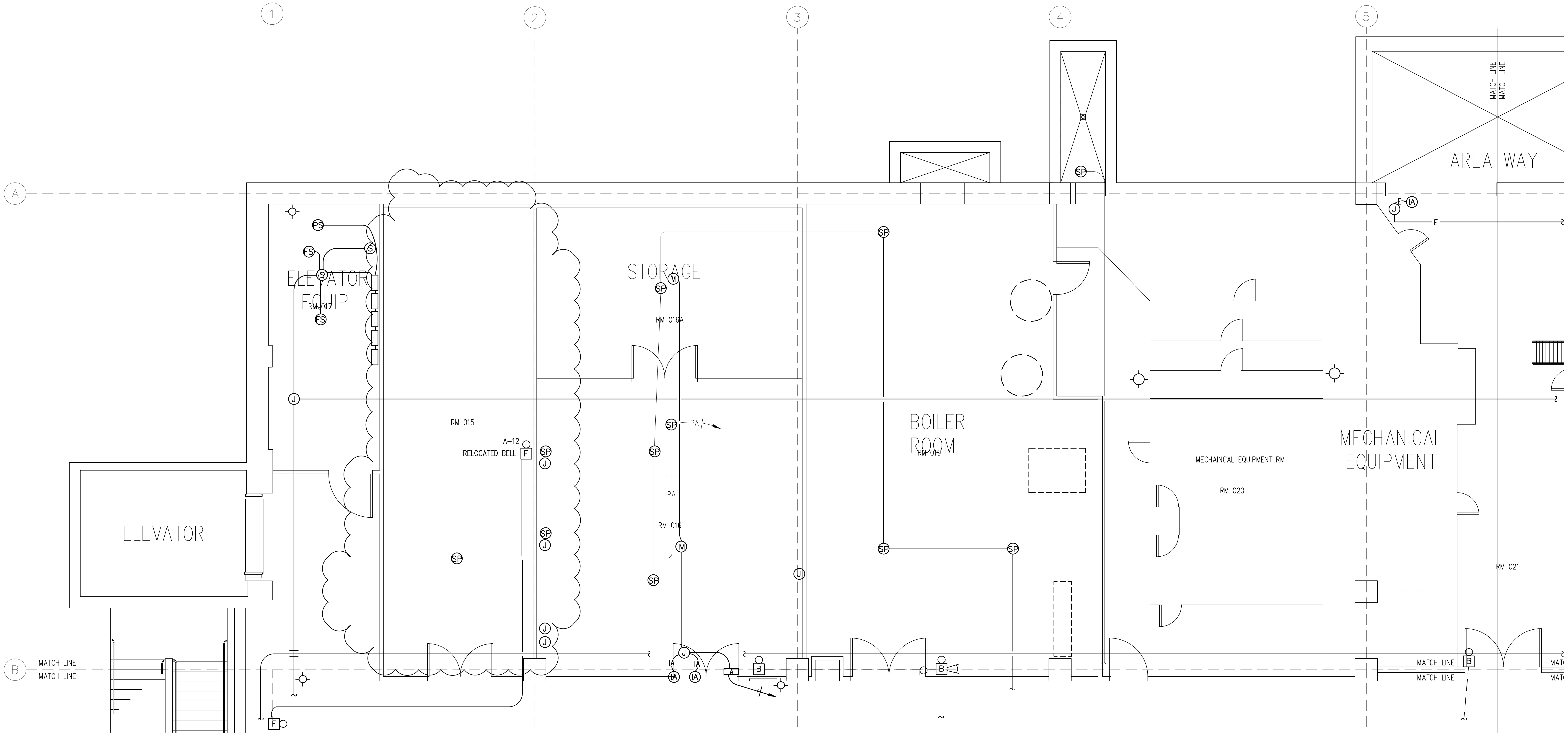
SUBMITTED RECOMMENDED APPROVED

DWG.NO. 100182

CADS DRAWING
FILE NAME: 100182L.dwg

PROJ. NO.
ORDER NO.

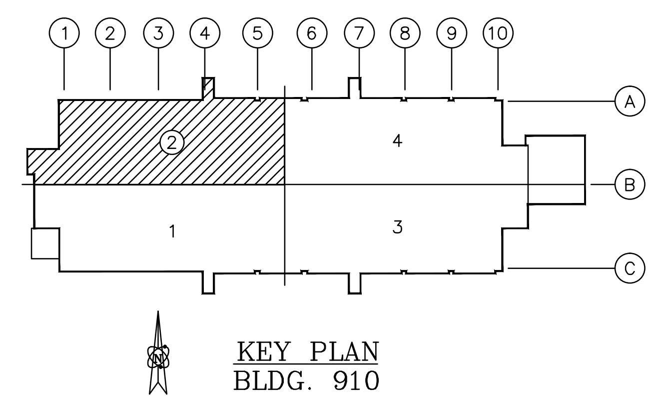
6/10/2013 4:22:18 PM, mtrimbl



ROOM 015 FIRE ALARM PLAN

GENERAL NOTES:

1. ALARM BELL REMOVED FROM SHIELDED ENCLOSURE TO BE REINSTALLED ON WALL OF ROOM AS SHOWN.



KEY PLAN
BLDG. 910

CADS DRAWING
FILE NAME: 100282K.dwg

PROJ. NO.
ORDER NO.

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
E010057	K	0929/10	REMODEL RM 015	MRT	---	
	J	11/05/07	XREF UPGRADE	CDM	GDG	
Q03123	H	08/30/03	IMS MODIFICATIONS IN RM. 016	DD	DD	
	G	09/25/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

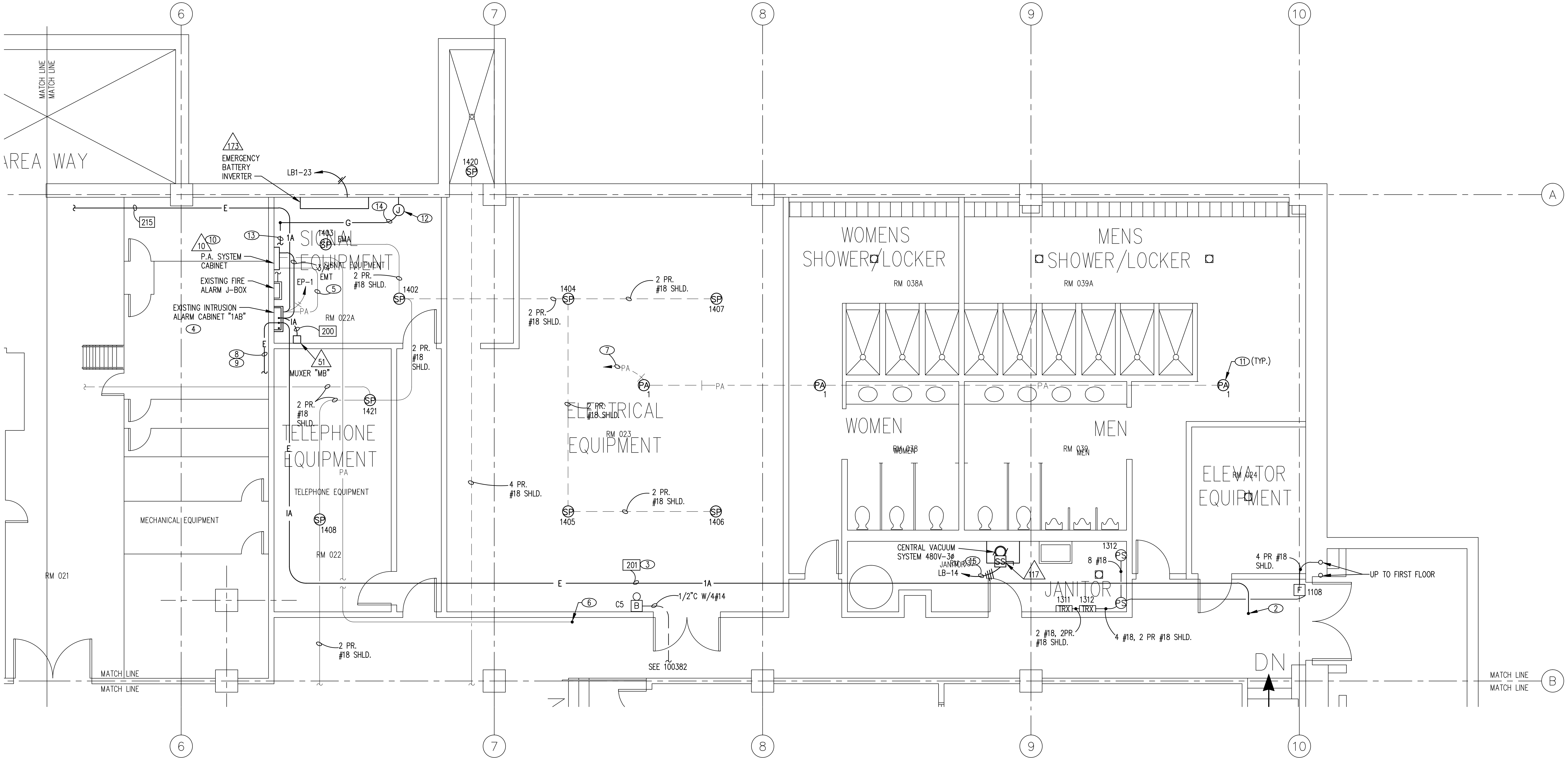
SECTOR 2
ELECTRICAL
FIRE ALARM
BLDG 910
BASEMENT

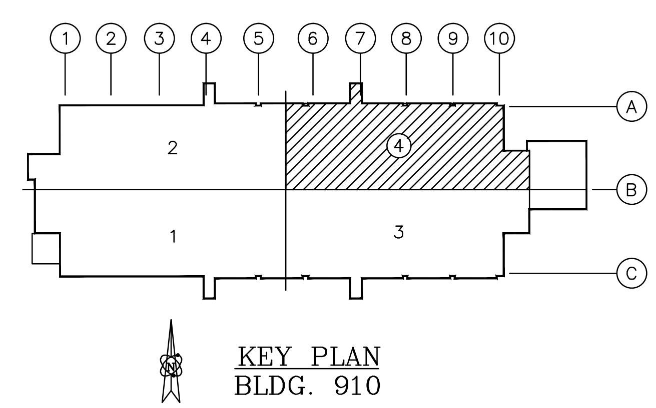
CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

SUBMITTED
RECOMMENDED
APPROVED

DWG.NO. 100282

6/10/2013 4:22:39 PM, mtrimbl





KEY PLAN
BLDG. 910

GENERAL NOTES:

1. SEE DWG. #86457/E1 FOR EQUIPMENT LIST.
2. SEE DWG. #86458/E1 FOR CONDUIT SCHEDULE.
3. SEE DWG. #86448/E1 FOR I.A. RISER DIAGRAM.
4. SEE DWG. #86449/E1 AND E2 FOR F.A., E.A. ELEMENTARY AND WIRING DIAGRAMS.
5. I.A. WIRING SHALL BE CONTINUOUS WITH NO SPLICES BETWEEN DEVICES AND TERMINAL CABINETS
6. NO MORE THAN 2 I.A. CONDUCTORS SHALL BE AT A TERMINAL POINT.
7. I.A. COLOR CODING TO BE AS SHOWN ON I.A. CABINET DETAILS, SEE DWG.
8. LABEL ALL WIRING AT ALL DEVICES WITH "BRADY" LABELS OR EQUAL AND COVER WITH "SCOTCHLITE" OR EQUAL HEAT REACTING TUBING.
9. SEE DWG. #86447/E1 FOR ISOLATED GROUNDING SYSTEM RISER DIAGRAMS.

KEYED NOTES:

1. SEE DWG. #86445/E2 FOR CONTINUATION.
2. UP TO I.A. CABINET "IA1", SEE DWG. #86448/E5.
3. REMOVE EXISTING CONDUCTORS AND PULL IN NEW AS INDICATED.
4. REVISE CONNECTIONS IN EXISTING CABINET SEE DWG. #86448/E2.
5. 3/4" CONDUIT WITH 1-#12 TWISTED, SHIELDED PAIR TO EXISTING I.A. CABINET AND OUT TO TELEPHONE MANHOLE IN EXISTING 4" CONDUIT.
6. UP TO P.A. SYSTEM J-BOX, FIRST FLOOR.
7. 3/4" CONDUIT TO P.A. TERMINAL CABINET SIGNAL ROOM.
8. 4" CONDUIT WITH 1 EXISTING 50 PAIR, CABLE TO TELEPHONE MANHOLE.
9. CONTRACTOR TO PULL IN 1-#12 TWISTED, SHIELDED PAIR AND 2-1" FIBEROPTIC INNER DUCTS IN PHILLIPS DRISCO PIPE WITH PULL ROPE IN EXISTING DUCTS (1 BLACK, 1 RED).
10. INSTALL 25 PAIR TERMINAL STRIPS INSIDE CABINET AND CONNECT CONDUITS TO TERMINAL STRIPS. JUMPER ALL SPEAKER ZONE WIRING TOGETHER AND CONNECT SYSTEM TO TWISTED PAIR.
11. FLUSH MOUNTED SPEAKER, NUMBER INDICATED ZONE, SEE DWG. #86447/E1 FOR P.A. SYSTEM RISER DIAGRAMS.
12. INSTALL 12"X12"X4" SCREW COVER J-BOX FOR GROUNDING SYSTEM. SEE DETAIL F 45/E1 59/E2
13. EXISTING GROUND CABLE TO COUNTER POISE SYSTEM. CONNECT NEW GROUND CABLE FOR J-BOX NOTE 12.
14. INSTALL #2/0 THW GROUND WIRING IN 3/4" CONDUIT.
15. 4 #10 THHN IN 3/4" CONDUIT.
16. SEE DWG. #86445/E4 FOR CONTINUATION.

	E	11/05/07	XREF UPGRADE	CDM	GDG	
	D	09/29/92	REDRAWN ON CADS	4WT	LRN	
PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 4 BLDG. 910

ELECTRICAL SPECIAL SYSTEMS

BASEMENT

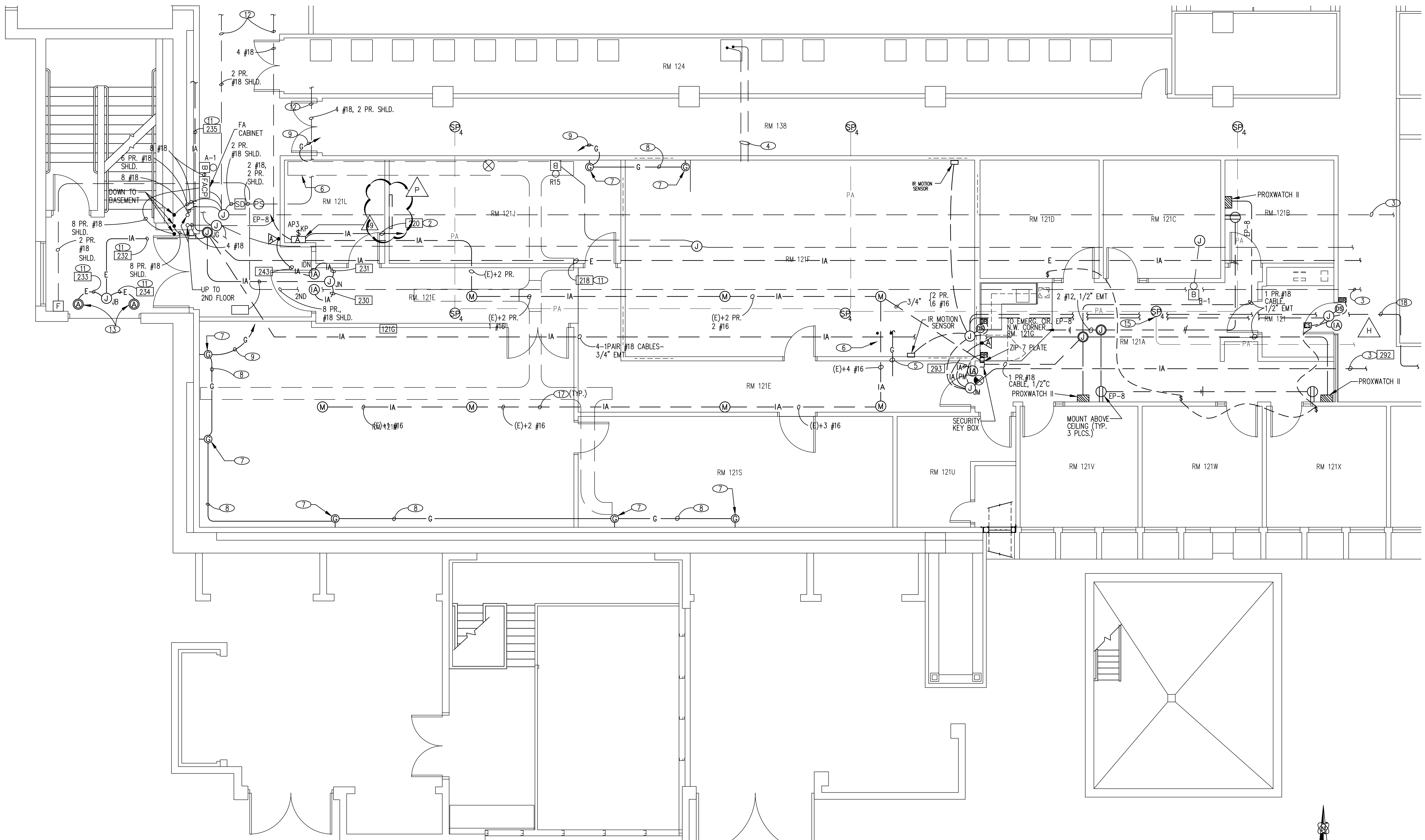
CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 100482

CADS DRAWING
FILE NAME: 100482E.dwg

PROJ. NO.
ORDER NO.



FIRST FLOOR PLAN – SOUTHWEST

0 5 10 25
SCALE IN FEET

GENERAL NOTES:

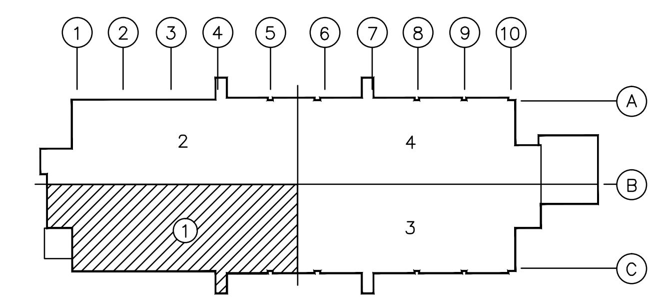
1. FOR GENERAL NOTES, SEE DWG #86445/E1

KEY NOTES:

1. IONIZATION TYPE SMOKE DETECTOR CEILING MOUNTED (TYPICAL).
2. EXTEND TO EXISTING I.A. CABINET "IA1", SEE DWG. #86445/E5 FOR LOCATION.
3. SEE DWG. #86445/E5 FOR CONTINUATION.
4. 2-1 1/2" CONDUITS TO ROOF FOR FUTURE ANTENNA CONNECTIONS. TERMINATE IN CABLE TRAY.
5. 00 SOLID Cu. SECURED TO CABLE TRAY EVERY 4'-0" WITH INSULATED STANDOFFS BRACKETS.
6. CABLE TRAY, REFER TO DWG. #86443/E7 FOR LAYOUT.
7. FLUSH J-BOX WITH GROUNDING LUG FOR FUTURE WORK STATION GROUNDING. SEE DETAIL.

F
45/E7 59/E2

8. 3/4" CONDUIT WITH 1 #2 TW GROUND WIRE.
9. 3/4" CONDUIT WITH 1 #2 TW GROUND WIRE, EXTEND TO ISOLATED GROUND J-BOX IN UTILITY CORRIDOR.
10. MOTION DETECTOR (TYPICAL) CEILING MOUNTED.
11. REMOVE EXISTING CONDUCTORS AND PULL IN NEW AS INDICATED.
12. SEE DWG. #86445/E8 FOR CONTINUATION.
13. RECONNECT EXISTING DOOR SWITCH.
14. DELETED.
15. FLUSH MOUNTED SPEAKER, NUMBER INDICATED ZONE. SEE DWG. #86447/E1 FOR P.A. SYSTEM RISER DIAGRAM.
16. INSTALL J-BOX WITH BLANK COVER ON WALL UP 48".
17. INSTALL BELDEN #8723 CABLE BETWEEN SENSORS IN 1/2" CONDUIT, SEE CONTROL DIAGRAMS ON DWG. #86448/E1.
18. INSTALL BELDEN #9506 CABLE BETWEEN BADGE READER AND ACP UNIT IN WEST CHASE IN 1" CONDUIT. USE EXISTING 1" EMT ABOVE RM.111 TO COMPLETE RUN BACK TO ACP UNIT IN WEST CHASE.



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
E010188	P	2/24/10	INSTALLED PLASMA SCREEN	MP	SK	
110480	N	02/04/10	RM 121 SUITE RENOVATION	RDW	DTR	
	M	07/06/07	XREF UPGRADE	MAR	GDG	
M. ORDER	L	12/20/01	AS BUILTS – RM 121G	DD	DD	
E01025	K	11/7/01	AS BUILTS – RM 121G	T.H.	WCS	
Q99066	J	9/99	Add Door Release to Rm.121	DD	DD	
Q98008	H	11/97	ADD BADGE RD.& SPACE ALARMS	DD	DD	
E6020-A	G	3/21/96	ADD BADGE RD.& SPACE ALARMS	LDM		
Q5032-A	Q	3/95	Add Badge Reader rm.121G	DD	DD	
	E	10/05/92	REDRAWN ON CADS	LRN	4WT	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 1 BLDG 910

ELECTRICAL SPECIAL SYSTEM

FIRST FLOOR

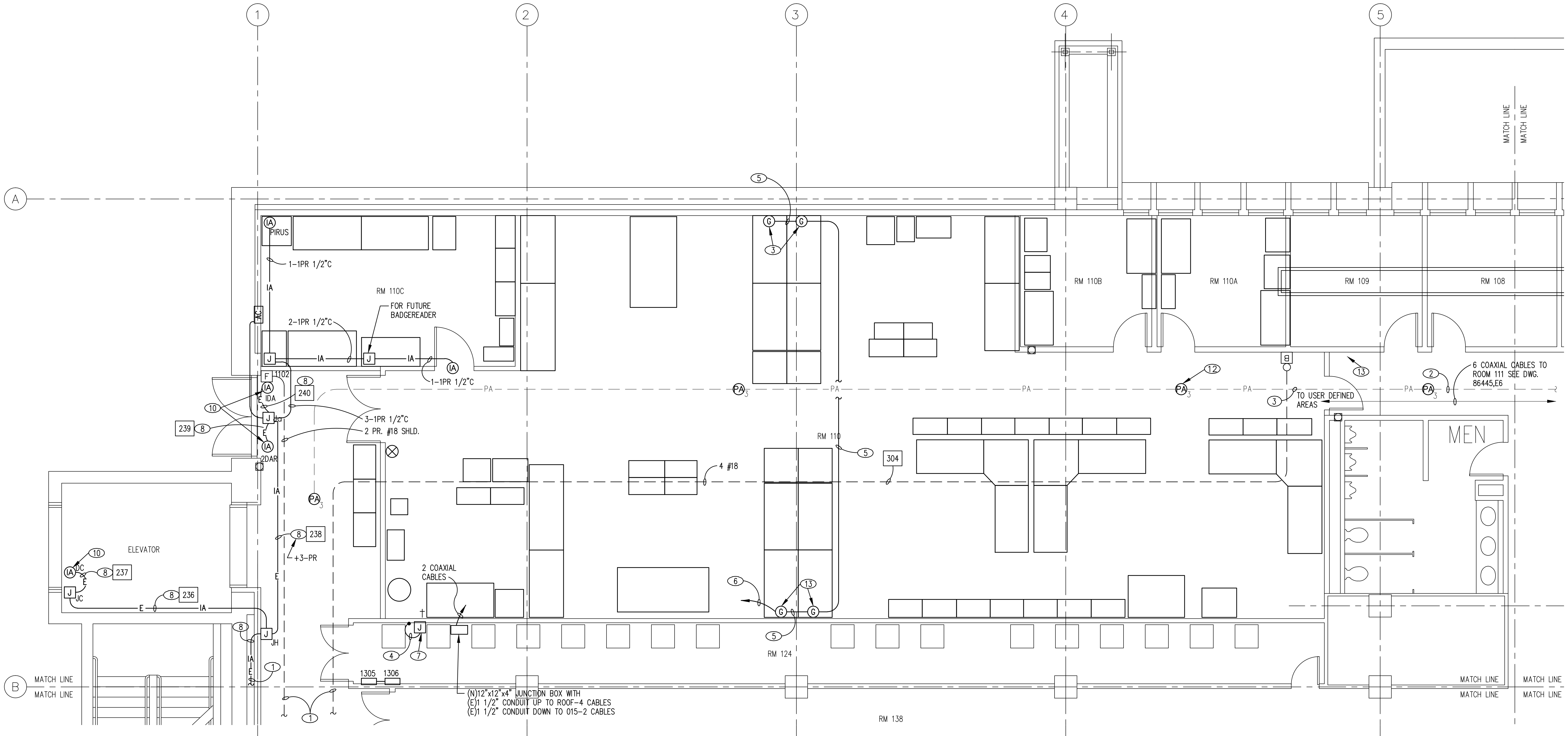
CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 101182

CADS DRAWING
FILE NAME: 101182P.dwg

PROJ. NO. 110480
ORDER NO.



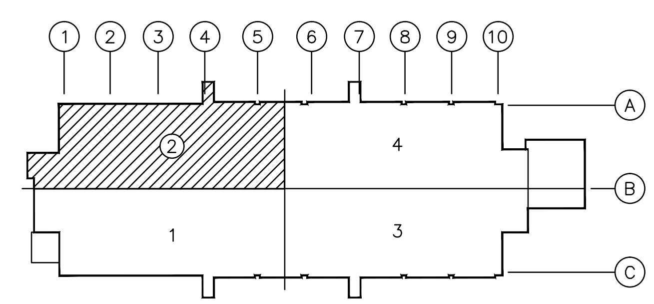
FIRST FLOOR PLAN - NORTHWEST

GENERAL NOTES:

1. FOR GENERAL NOTES, SEE DWG. #86445/E1.

KEYED NOTES:

1. SEE DWG. #88445/E7 FOR CONTINUATION.
2. SEE DWG. #86445/E5 FOR CONTINUATION.
3. FLUSH J-BOX WITH GROUNDING LUG FOR FUTURE WORK STATION GROUNDING. DEE DETAIL F 45/E8 59/E2
4. 3/4" CONDUIT WITH 1 #2/0TW GROUND DOWN TO J-BOX IN BASEMENT, SEE DRAWING #86445/E1 FOR LOCATION OF J-BOX.
5. 3/4" CONDUIT WITH 1 #2 TW GROUND WIRE
6. 3/4" CONDUIT WITH 1 #2 TW GROUND WIRE. EXTEND TO ISOLATED GROUND J-BOX IN UTILITY CORRIDOR.
7. INSTALL 12"x12"x24" SCREW COVER J-BOX, SEE DETAIL F 45/E8 59/E2
8. REMOVE EXISTING CONDUCTORS AND PULL IN NEW AS INDICATED.
9. DELETED.
10. RECONNECT EXISTING DOOR SWITCH.
11. DELETED
12. FLUSH MOUNTED SPEAKER, NUMBER INDICATES ZONE, SEE DRAWING #86447/E1 FOR PUBLIC ADDRESS SYSTEM RISER DIAGRAM.
13. INSTALL J-BOX WITH BLACK COVER ON WALL, UP 48", EXTEND 1/2" CONDUIT TO ABOVE CEILING FOR FUTURE I.A. SYSTEM.



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	F	07/06/07	XREF UPGRADE	MAR	GDG	
	E	5/3/98	REVISE RM NO. & MATCH LINE	T.H.	GDG	
	D	10/10/92	REDRAWN ONCADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 2 ELECTRICAL BLDG 910

SPECIAL SYSTEM

FIRST FLOOR

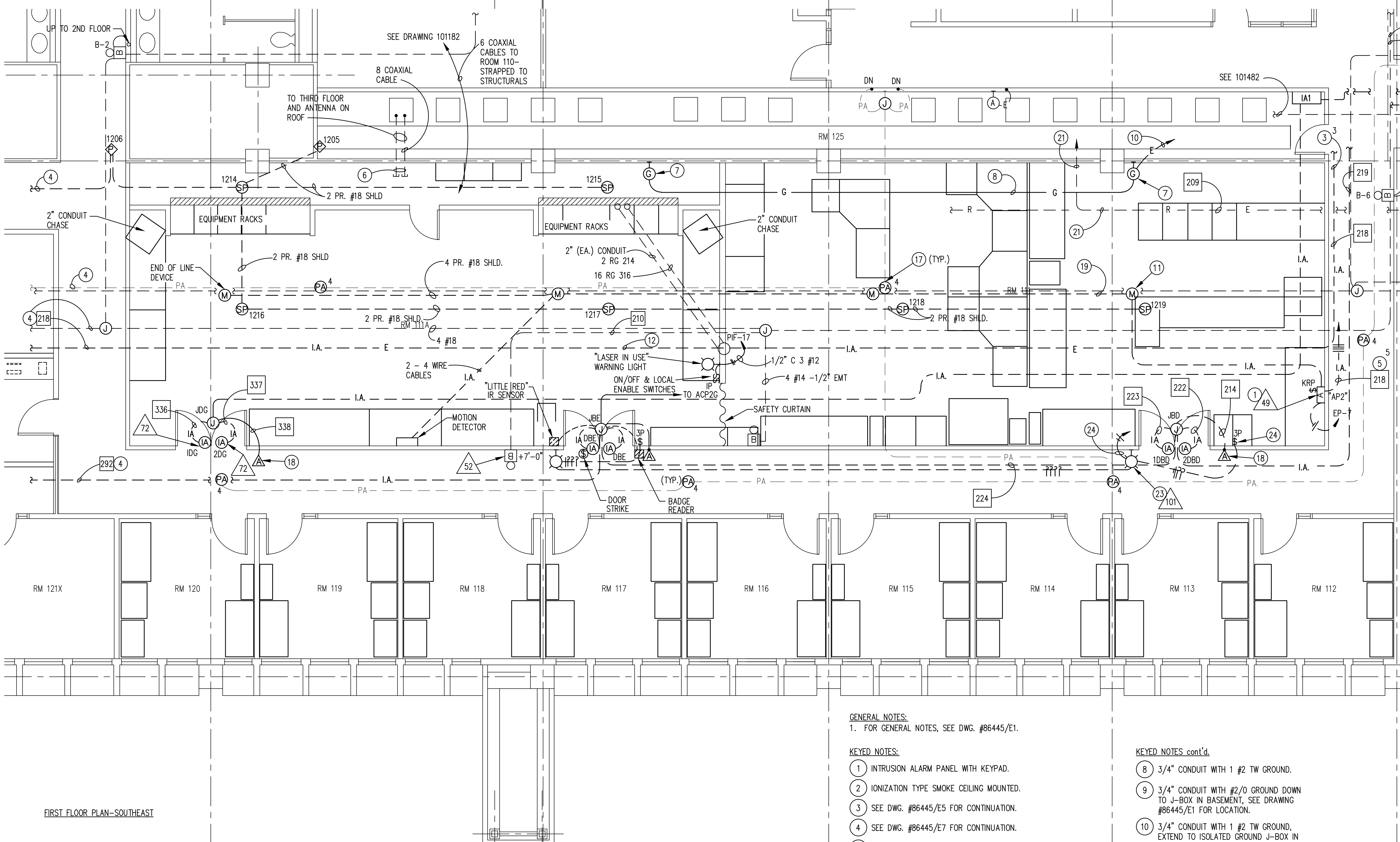
CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

SUBMITTED | RECOMMENDED | APPROVED

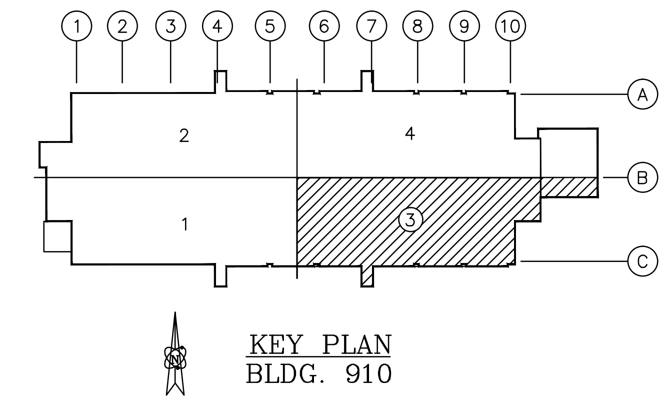
DWG.NO. 101282

CADS DRAWING
FILE NAME: 101282F.dwg

PROJ. NO.
ORDER NO.



FIRST FLOOR PLAN–SOUTHEAST



KEY PLAN
BLDG. 910

GENERAL NOTES:
1. FOR GENERAL NOTES, SEE DWG. #86445/E1.

KEYED NOTES:

1. INTRUSION ALARM PANEL WITH KEYPAD.
2. IONIZATION TYPE SMOKE CEILING MOUNTED.
3. SEE DWG. #86445/E5 FOR CONTINUATION.
4. SEE DWG. #86445/E7 FOR CONTINUATION.
5. EXTEND TO EXISTING I.A. CABINET "1A", SEE DWG. #86445/E4 FOR LOCATION.
6. 2–2" CONDUITS UP TO ROOF FOR FUTURE ANTENNA CONNECTIONS, TERMINATE IN CABLE TRAY.
7. SURFACE J–BOX WITH ISOLATED GROUND LUG FOR FUTURE WORK STATION GROUNDING, SEE DETAIL F. 45/E6 59/E2

KEYED NOTES cont'd.

8. 3/4" CONDUIT WITH 1 #2 TW GROUND.
9. 3/4" CONDUIT WITH #2/0 GROUND DOWN TO J–BOX IN BASEMENT, SEE DRAWING #86445/E1 FOR LOCATION.
10. 3/4" CONDUIT WITH 1 #2 TW GROUND, EXTEND TO ISOLATED GROUND J–BOX IN UTILITY CORRIDOR.
11. MOTION DETECTOR (TYPICAL), CEILING MOUNTED.
12. REMOVE EXISTING CONDUCTORS AND PULL IN NEW AS INDICATED.
13. RECONNECT EXISTING DOOR SWITCH.
14. REMOVE EXISTING TAMPER SWITCH.
15. DELETED.

KEYED NOTES cont'd.

16. INSTALL 12"x 12"x 24" SCREW COVER J–BOX, SEE DETAIL F 45/E6 59/E2 FOR GROUNDING SYSTEM.
17. FLUSH MOUNTED SPEAKER, NUMBER INDICATES ZONE, SEE DRAWING #86448/E1 FOR PUBLIC ADDRESS SYSTEM RISER DIAGRAM.
18. INSTALL J–BOX AND BLANK COVER ON WALL, UP 48".
19. INSTALL BELDEN #8773 CABLE BETWEEN SENSORS IN 1/2" CONDUIT, SEE CONTROL DIAGRAM ON DRAWING #86448/E1.
20. CONNECT NEW BELL TO EXISTING, SEE FIRE ALARM RISER DIAGRAM.
21. REWIRE EXISTING CONDUIT TO FIRE ALARM CONTROL PANEL IN BASEMENT.
22. INSTALL REMOTE FIRE ALARM SYSTEM ACTUATOR.
23. INSTALL "LASER IN USE" LIGHT ON WALL UP 6'–0".
24. FURNISH AND INSTALL 3–WAY SWITCH WITH PILOT LIGHT, LABEL SWITCH.
25. TO J–BOX FOR FUTURE REMOTE ANNUNCIATION.

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	L	07/06/07	XREF UPGRADE	MAR	GDG	
	K	5/6/98	REVISE RM NO. & MATCH LINE	T.H	GDG	
Q5045–A	J	2/95	Install Badge Reader Entree way	DD	DD	
E2242–A	G	5/93	INSTALL BADGE READER	DP	LM	
	F	10/09/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 3 BLDG 910
ELECTRICAL SPECIAL SYSTEM
FIRST FLOOR

CONTRACT NO.(A–E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	L.MARTINEZ
SCALE	1/4"=1'
DATE	DATE

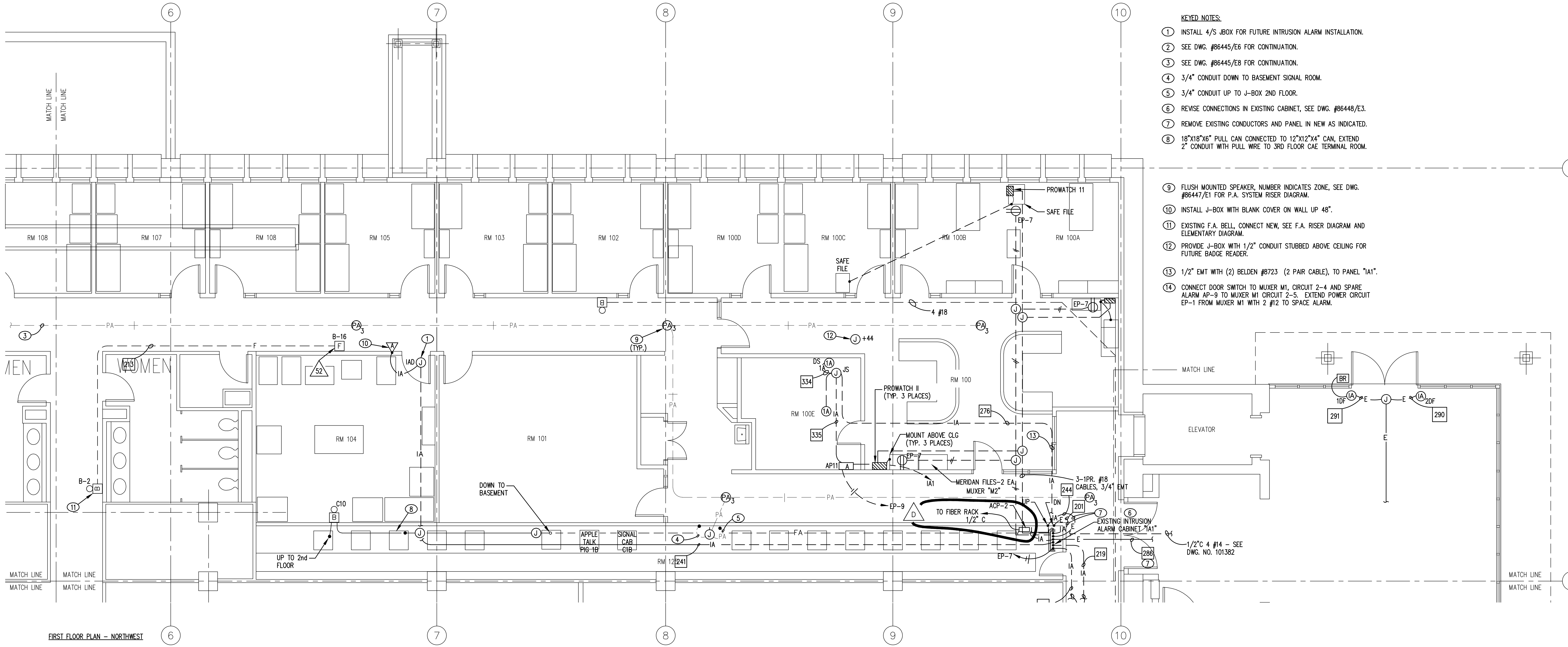
SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 101382

CADS DRAWING
FILE NAME: 101382L.dwg

PROJ. NO.
ORDER NO.

6/10/2013 4:15:36 PM, mtrimbl



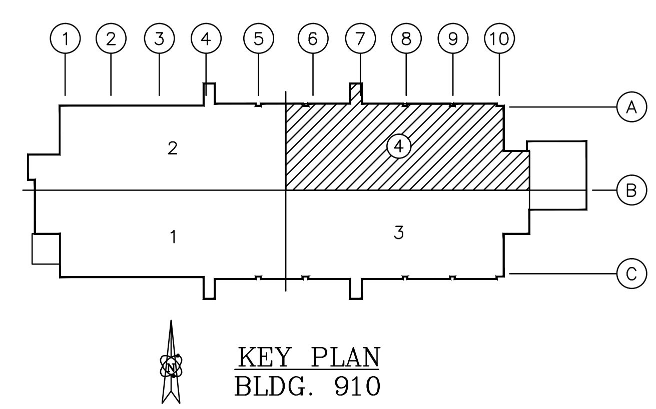
FIRST FLOOR PLAN – NORTHWEST

GENERAL NOTES:

1. FOR GENERAL NOTES, SEE DWG. #86445/E1.

KEYED NOTES:

1. INSTALL 4/S JBOX FOR FUTURE INTRUSION ALARM INSTALLATION.
2. SEE DWG. #86445/E6 FOR CONTINUATION.
3. SEE DWG. #86445/E8 FOR CONTINUATION.
4. 3/4" CONDUIT DOWN TO BASEMENT SIGNAL ROOM.
5. 3/4" CONDUIT UP TO J-BOX 2ND FLOOR.
6. REVISE CONNECTIONS IN EXISTING CABINET, SEE DWG. #86448/E3.
7. REMOVE EXISTING CONDUCTORS AND PANEL IN NEW AS INDICATED.
8. 18"X18"X6" PULL CAN CONNECTED TO 12"X12"X4" CAN, EXTEND 2" CONDUIT WITH PULL WIRE TO 3RD FLOOR CAE TERMINAL ROOM.
9. FLUSH MOUNTED SPEAKER, NUMBER INDICATES ZONE, SEE DWG. #86447/E1 FOR P.A. SYSTEM RISER DIAGRAM.
10. INSTALL J-BOX WITH BLANK COVER ON WALL UP 48".
11. EXISTING F.A. BELL, CONNECT NEW, SEE F.A. RISER DIAGRAM AND ELEMENTARY DIAGRAM.
12. PROVIDE J-BOX WITH 1/2" CONDUIT STUBBED ABOVE CEILING FOR FUTURE BADGE READER.
13. 1/2" EMT WITH (2) BELDEN #8723 (2 PAIR CABLE), TO PANEL "IA1".
14. CONNECT DOOR SWITCH TO MUXER M1, CIRCUIT 2-4 AND SPARE ALARM AP-9 TO MUXER M1 CIRCUIT 2-5. EXTEND POWER CIRCUIT EP-1 FROM MUXER M1 WITH 2 #12 TO SPACE ALARM.



KEY PLAN
BLDG. 910

CADS DRAWING
FILE NAME: 101482E.dwg

PROJ. NO. E6020-A
ORDER NO.

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	E	07/06/07	XREF UPGRADE	MAR	GDG	
E6020-A	D	2/20/96	IA MODS; REPLACE ACP W/ ACU	LDM		
	C	10/15/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

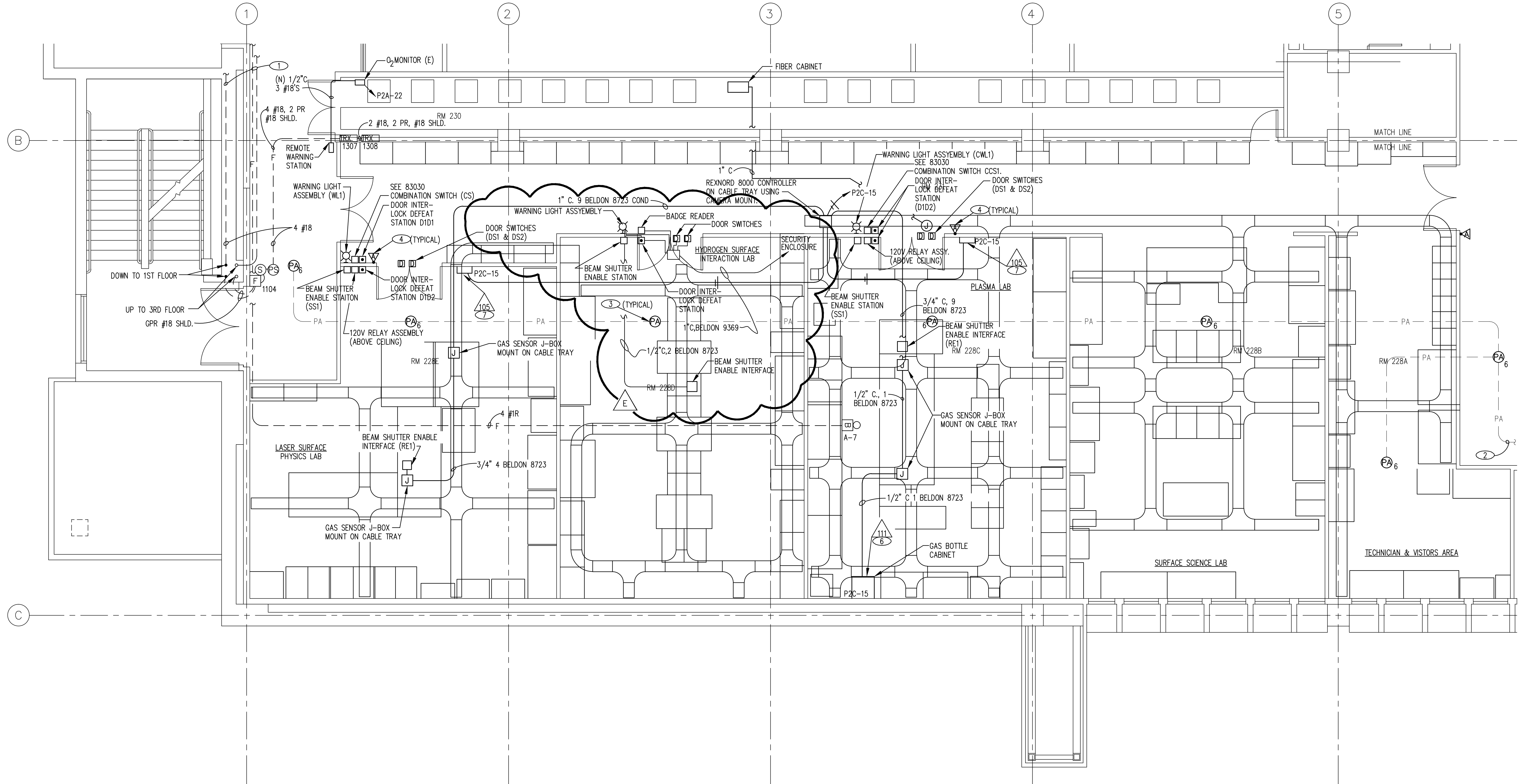
SECTOR 4 BLDG 910
ELECTRICAL
SPECIAL SYSTEMS
FIRST FLOOR

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 101482

6/10/2013 4:15:14 PM, mtrimbl



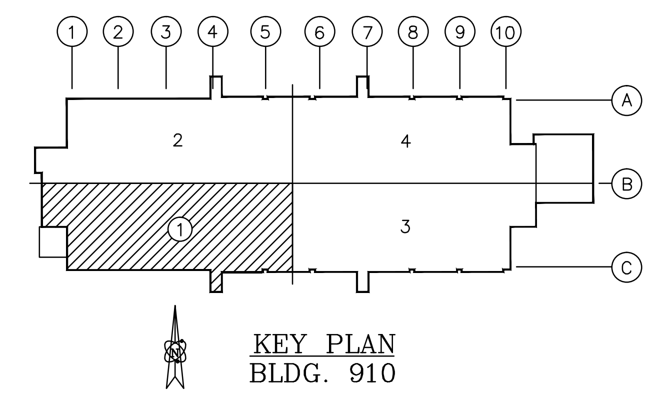
SECOND FLOOR PLAN – SOUTHWEST

GENERAL NOTES:

1. FOR GENERAL NOTES, SEE DWG. #86445/E1.

KEYED NOTES:

1. SEE DWG. #86445/E12 FOR CONTINUATION.
2. SEE DWG. #86445/E10 FOR CONTINUATION.
3. FLUSH SPEAKER, NUMBER INDICATES ZONE, SEE DWG. #86447/E1 FOR P.A. SYSTEM RISER DIAGRAM.
4. INSTALL J-BOX WITH COVER UP 48" FOR FUTURE I.A. SYSTEM. EXTEND 1/2" CONDUIT TO ABOVE CLG.
5. CONNECT NEW BELL TO EXISTING, SEE F.A. RISER DIAGRAM.
6. GAS DETECTOR SYSTEM. SENSOR HEADS TO BE CONNECTED BY COIL-END. HAZARDS CONTROL WILL DETERMINE LOCATION AND INSTALL THE SENSORS. MAKE REQUIRED CONNECTIONS PER SHOP DWGS. CONNECT SOLENOID VALVES ON GAS LINES, VERIFY EXACT LOCATIONS WITH MECHANICAL.
7. MAKE CONNECTIONS TO LASER INTERLOCK SYSTEM. SEE CONNECTION DIAGRAM DWG. #87038 & 87073. PROVIDE CONDUIT AND WIRING AS NECESSARY FOR COMPLETE INSTALLATION.



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	F	07/06/07	XREF UPGRADE	MAR	GDG	
Q020112	E	08/04/02	LAB. MOD. IN RM. 228D	DD	DD	
	D	10/20/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 1 BLDG 910

ELECTRICAL SPECIAL SYSTEMS

FIRST FLOOR

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 102182

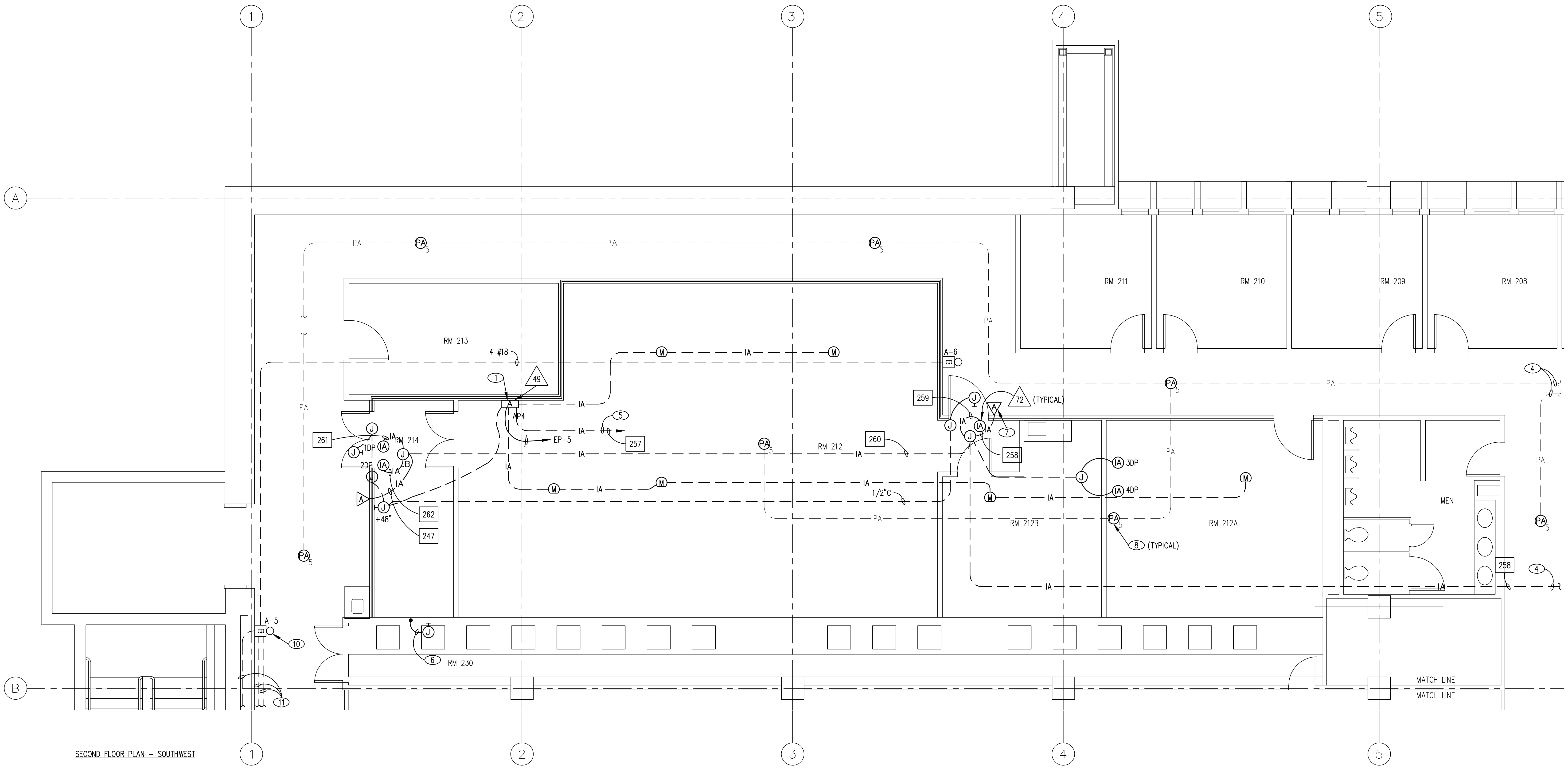
CADS DRAWING
FILE NAME: 102182F.dwg

PROJ. NO.
ORDER NO.

6/10/2013 4:18:14 PM, mtrimbl

GENERAL NOTES:

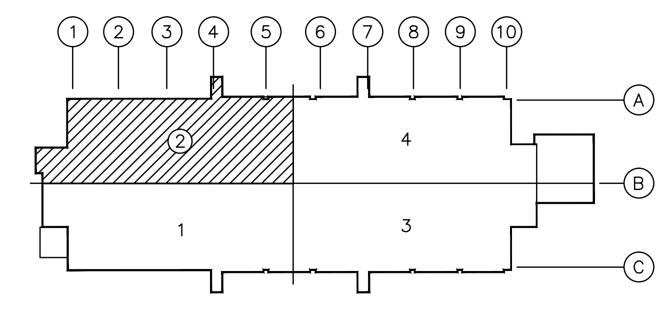
1. FOR GENERAL NOTES, SEE DWG. #86445/E1.



SECOND FLOOR PLAN – SOUTHWEST

KEYED NOTES:

1. INTRUSION ALARM PANEL WITH KEYPAD.
2. SEE DWG. #86445/E11 FOR CONTINUATION.
3. MOTION DETECTOR (TYPICAL), SURFACE WALL AT CEILING.
4. SEE DWG. #86445/E9 FOR CONTINUATION.
5. EXTEND TO NEW I.A. CABINET "IA2", SEE DWG. #86445/E9 FOR LOCATION.
6. 3/4" CONDUIT WITH 1 #2/0 THW GROUND DOWN TO BASEMENT GROUND SYSTEM J-BOX.
7. INSTALL J-BOX WITH COVER PLATE UP WALL 48" FOR FUTURE I.A. SYSTEM.
8. FLUSH SPEAKER, NUMBER INDICATES ZONE. SEE DWG. #86447/E1 FOR P.A. SYSTEM.
9. INSTALL BELDEN #8723 CABLE BETWEEN SENSOR IN 1/2" CONDUIT.
10. CONNECT NEW BELL TO EXISTING.
11. PROVIDE J-BOXES AND CONDUIT FOR FUTURE LASER INTERLOCK SYSTEM. PROVIDE FOR LIGHTS ABOVE DOORS, DOOR SWITCHES AND CONTROL PANEL.



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	D	07/06/07	XREF UPGRADE	MAR	GDG	
E1234–A	C	10/11/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 2 BLDG. 910

SPECIAL SYSTEMS
ELECTRICAL
SECOND FLOOR

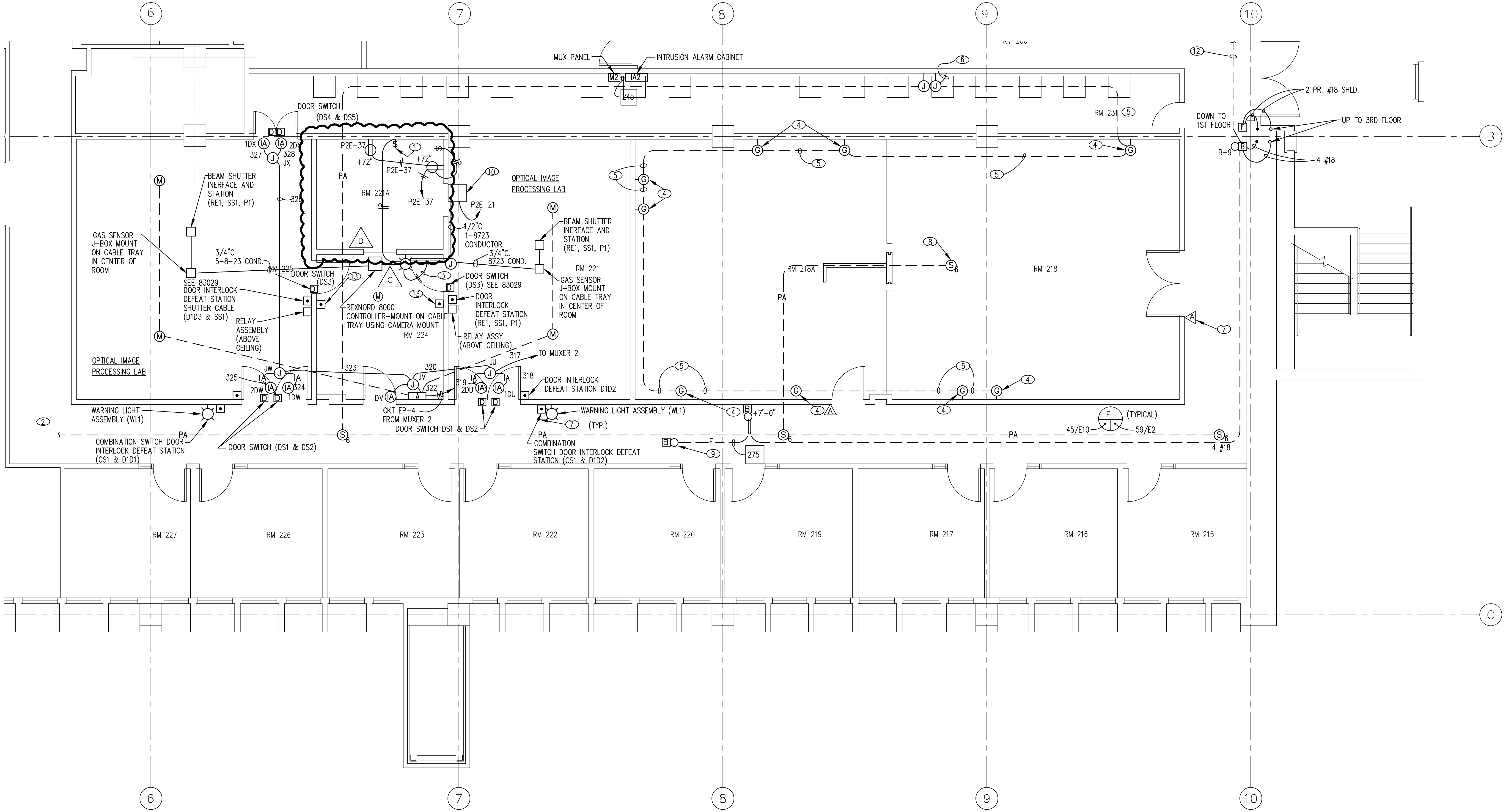
CONTRACT NO.(A–E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

SUBMITTED RECOMMENDED APPROVED

DWG.NO. 102282

CADS DRAWING
FILE NAME: 102282D.dwg

PROJ. NO. E1234
ORDER NO. XX–XXXX

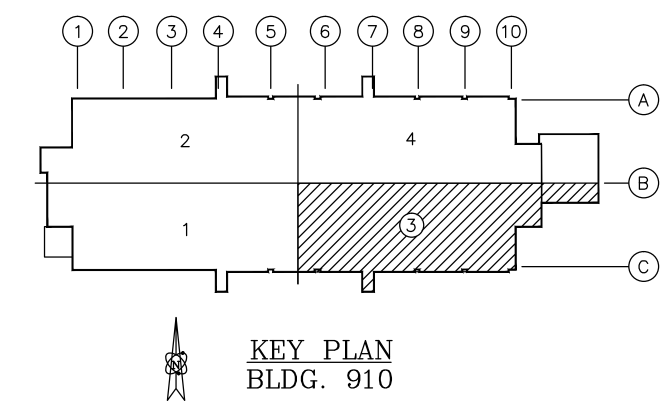


GENERAL NOTES:

1. FOR GENERAL NOTES, SEE DWG. #86445/E1.

KEYED NOTES:

1. LABEL SWITCH.
2. SEE DWG. #86445/E11 FOR CONTINUATION.
3. EXTEND 2 #12 IN 1/2" CONDUIT TO NEAREST 110V RECEPTACLE.
4. FLUSH J-BOX WITH INSULATED GROUNDING LUG FOR FUTURE WORK STATION GROUNDING.
5. 3/4" CONDUIT WITH 1 #2 TW GROUNDING WIRE.
6. 3/4" CONDUIT WITH #2/0 THW GROUND DOWN TO BASEMENT AND CONNECT TO J-BOX.
7. INSTALL J-BOX WITH COVER UP 48" ON WALL, EXTEND 1/2" CONDUIT TO ABOVE CEILING FOR FUTURE IA SYSTEM.
8. INSTALL FLUSH SPEAKER, NUMBER INDICATE ZONE. SEE DWG. #86447/E1 FOR PA SYSTEM RISER DIAGRAM.
9. RELOCATE EXISTING BELL, SEE F.A. RISER DIAGRAM.
10. GAS DETECTOR SYSTEM. SENSOR HEADS TO BE CONNECTED BY COIL-END. HAZARDS CONTROL WILL DETERMINE LOCATION AND INSTALL THE SENSORS. MAKE REQUIRED CONNECTIONS PER SHOP DRAWINGS. CONNECT SOLENOID VALVES ON GAS LINES, VERIFY EXACT LOCATION WITH MECHANICAL.
11. MAKE CONNECTIONS TO LASER INTERLOCK CABINET AND DOOR SWITCHES. SEE DWG. #87059 & 87072.
12. SEE DWG. #86445/E9 FOR CONTINUATION.
13. COMBINATION SWITCH, DOOR INTERLOCK DEFEAT STATION AND WARNING LIGHT ASSEMBLY (D1D4, CS2, WL2)



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	E	07/06/07	XREF UPGRADE	MAR	GDG	
E97072	D	12/3/98	UPDATED RM 221A	GDG	SCP	
Q5035	C	4/4/95	Create passageway Rm.228	JAO		
	B	10/06/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 3 BLDG 910
ELECTRICAL
SPECIAL SYSTEMS
SECOND FLOOR

SCALE 1/4"=1'

SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 102382

CADS DRAWING
FILE NAME: 102382E.dwg

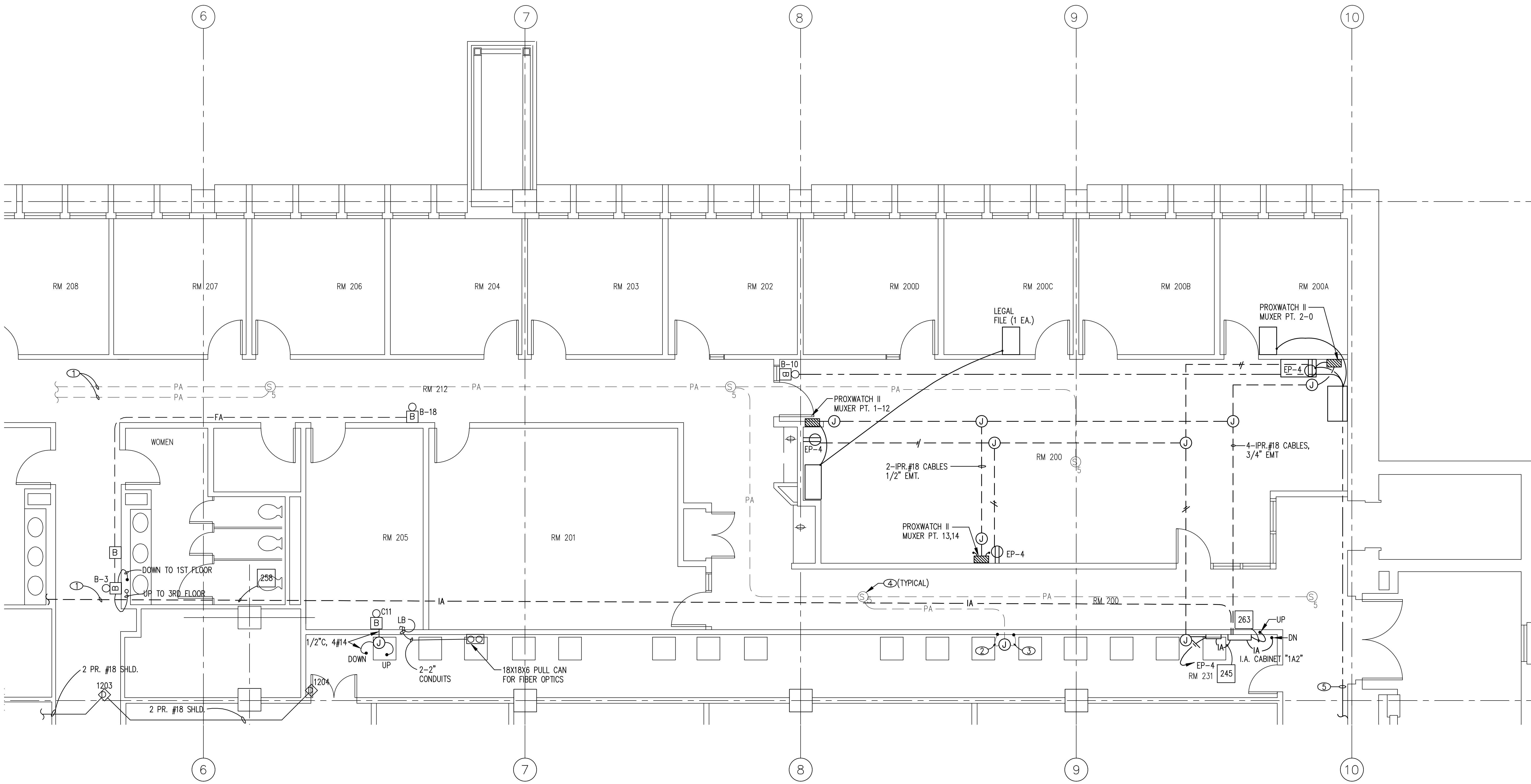
PROJ. NO. E97072
ORDER NO.

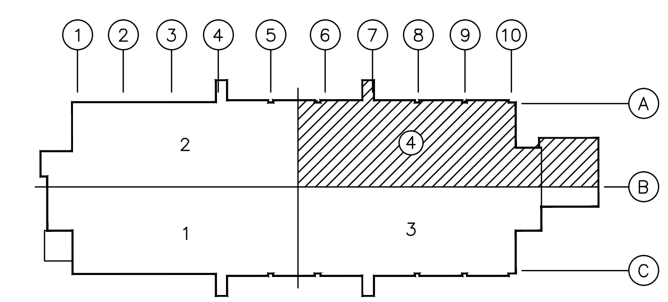
GENERAL NOTES:

1. FOR GENERAL NOTES, SEE DWG. #86445/E1.

KEYED NOTES:

1. SEE DWG. #86445/E12 FOR CONTINUATION.
2. 3/4" CONDUIT UP TO J-BOX 2ND FLOOR.
3. 3/4" CONDUIT DOWN TO J-BOX 3RD FLOOR.
4. FLUSH MOUNTING SPEAKER, NUMBER INDICATES ZONE. SEE DWG. #86447/E1 FOR P.A. SYSTEM RISER DIAGRAM.
5. SEE DWG. #86445/E10 FOR CONTINUATION.





KEY PLAN
BLDG. 910

	E	07/06/07	XREF UPGRADE	MAR	GDG	
	D	10/12/92	REDRAWN ON CADS	4WT	LRN	
PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 4 BLDG 910

ELECTRICAL
SPECIAL SYSTEMS
SECOND FLOOR

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

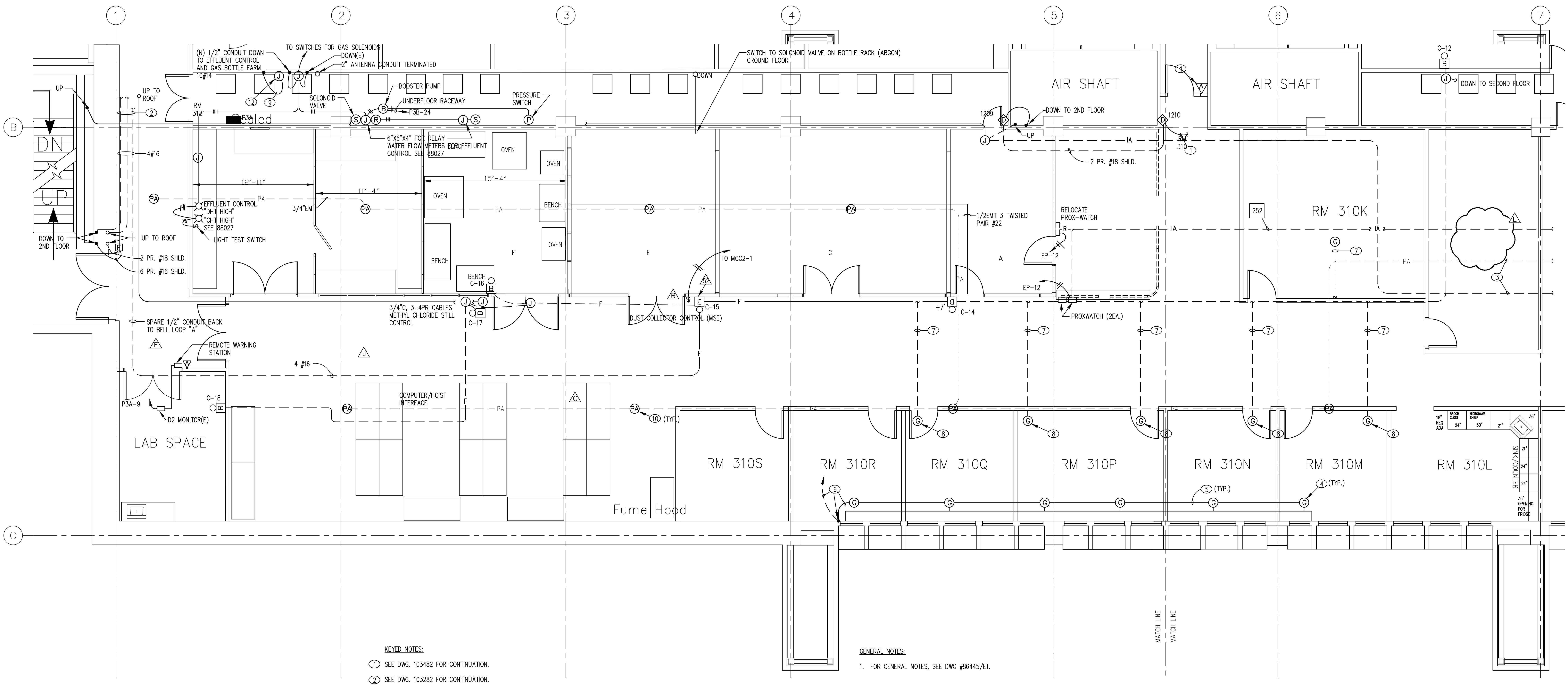
SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 102482

CADS DRAWING
FILE NAME: 102482E.dwg

PROJ. NO.
ORDER NO.

6/10/2013 4:17:23 PM, mtrimbl

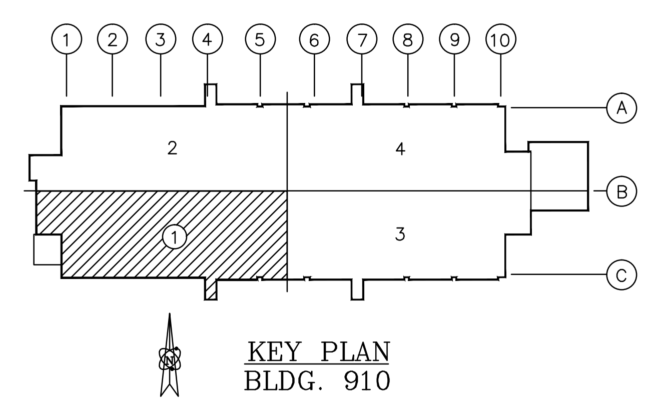


KEYED NOTES:

1. SEE DWG. 103482 FOR CONTINUATION.
2. SEE DWG. 103282 FOR CONTINUATION.
3. SEE DWG. 103382 FOR CONTINUATION.
4. J-BOX WITH INSULATED GROUNDING LUG SURFACE MOUNTED ON SIDE OF CABLE TRAY.
5. DELETED
6. 3/4" CONDUIT WITH 1 #2 TW GROUND WIRE UP TO CEILING SPACE AND ACROSS TO ISOLATED GROUND J-BOX IN UTILITY CORRIDOR.
7. 1-#2 TW GROUND RUN IN POWER UNDER FLOOR CELL TO HEADER DUCT AND EXTEND TO ISOLATED GROUND J-BOX IN UTILITY CORRIDOR.
8. MONUMENT TYPE POWER FLOOR OUTLET LEAVE GROUND WIRE PIGTAILED FOR FUTURE USE.
9. 3/4" CONDUIT WITH 1 #2/0 THW GROUND WIRE DOWN TO BASEMENT J-BOX, SEE ISOLATED GROUNDING SYSTEM RISER DIAGRAM.
10. ON DWG. #86447/E1.
11. J-BOX, 48" ABOVE FINISH FLOOR FOR FUTURE I.A. SYSTEM SWITCH, EXTEND 1/2" CONDUIT TO ABOVE FINISH CEILING.
12. J-BOX FOR ISOLATED GROUNDING SYSTEM, SEE DETAIL F 45/E15 57/E1

GENERAL NOTES:

1. FOR GENERAL NOTES, SEE DWG #86445/E1.



KEY PLAN
BLDG. 910

CADS DRAWING
FILE NAME: 103182L.dwg

PROJ. NO. E03031
ORDER NO.

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
E080418	L	07/24/08	VACATE SUITE 310	CDM	GDG	
	K	07/06/07	XREF UPGRADE	MAR	GDG	
E03031	J	12/03	PLATING LINE REPLACEMENT	DTR	DTR	
	H	10/15/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

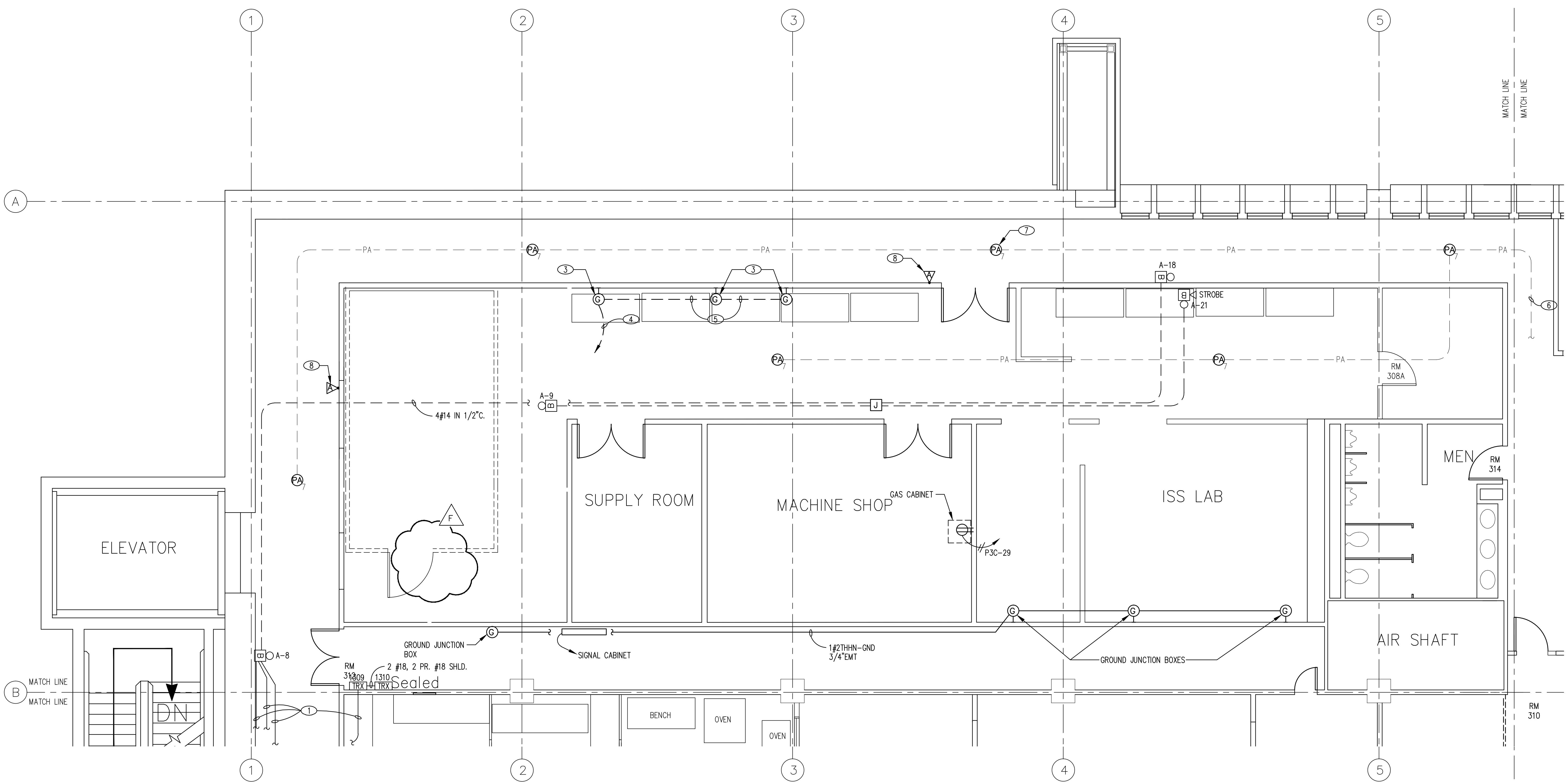
SECTOR 1 BLDG 910
ELECTRICAL
SPECIAL SYSTEMS
THIRD FLOOR

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 103182

6/10/2013 4:21:11 PM, mtrimbl

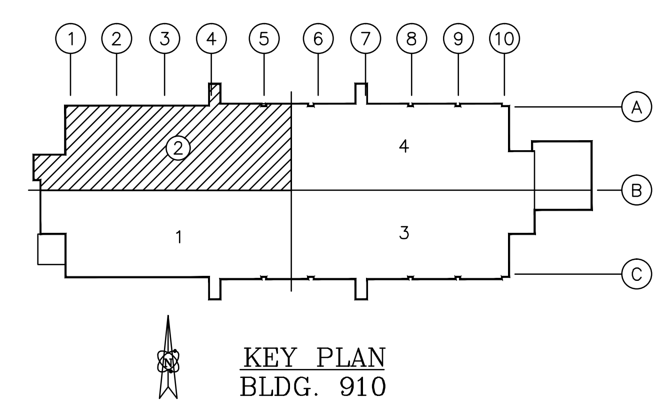


GENERAL NOTES:

1. FOR GENERAL NOTES, SEE DWG. #86445/E1.

KEYED NOTES:

1. SEE DWG. #86445/E13 FOR CONTINUATION.
2. DELETED
3. FLUSH J-BOX WITH GROUND LUG FOR FUTURE BENCH TOP GROUNDS.
4. 3/4" CONDUIT WITH 1 #2 TW GROUND WIRE. EXTEND TO ISOLATED GROUND J-BOX IN UTILITY CORRIDOR.
5. 3/4" CONDUIT WITH 1-#2 TW GROUND WIRE.
6. SEE DWG. #86445/E13 FOR CONTINUATION.
7. FLUSH SPEAKER, NUMBER INDICATES ZONE. SEE DWG. #86447/E1 FOR P.A. SYSTEM RISER DIAGRAM.
8. INSTALL J-BOX UP 48" WITH COVER PLATE. EXTEND 1/2" CONDUIT TO ABOVE CEILING FOR FUTURE I.A. SYSTEM.
9.
10. GAS DETECTOR SYSTEM. SENSOR HEADS TO BE CONNECTED BY COIL-END. HAZARDS CONTROL WILL DETERMINE LOCATION AND INSTALL THE SENSORS. MAKE REQUIRED CONNECTIONS PER SHOP DRAWINGS. CONNECT COLENOID VALVES ON GAS LINES, VERIFY EXACT LOCATIONS WITH MECHANICAL.



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
E080418	F	07/24/08	VACATE SUITE 310	CDM	GDG	
	E	07/06/07	XREF UPGRADE	MAR	GDG	
	D	7/26/05	REVISED RM NOS 320,321,321A, ADD XREF	T.H	KCD	
E1234-A	C	10/7/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 2 BLDG 910

ELECTRICAL
SPECIAL SYSTEM
THIRD FLOOR

CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWN BY
CHECKED	CHECKED BY
SCALE	1/4"=1'-0"
DATE	DATE

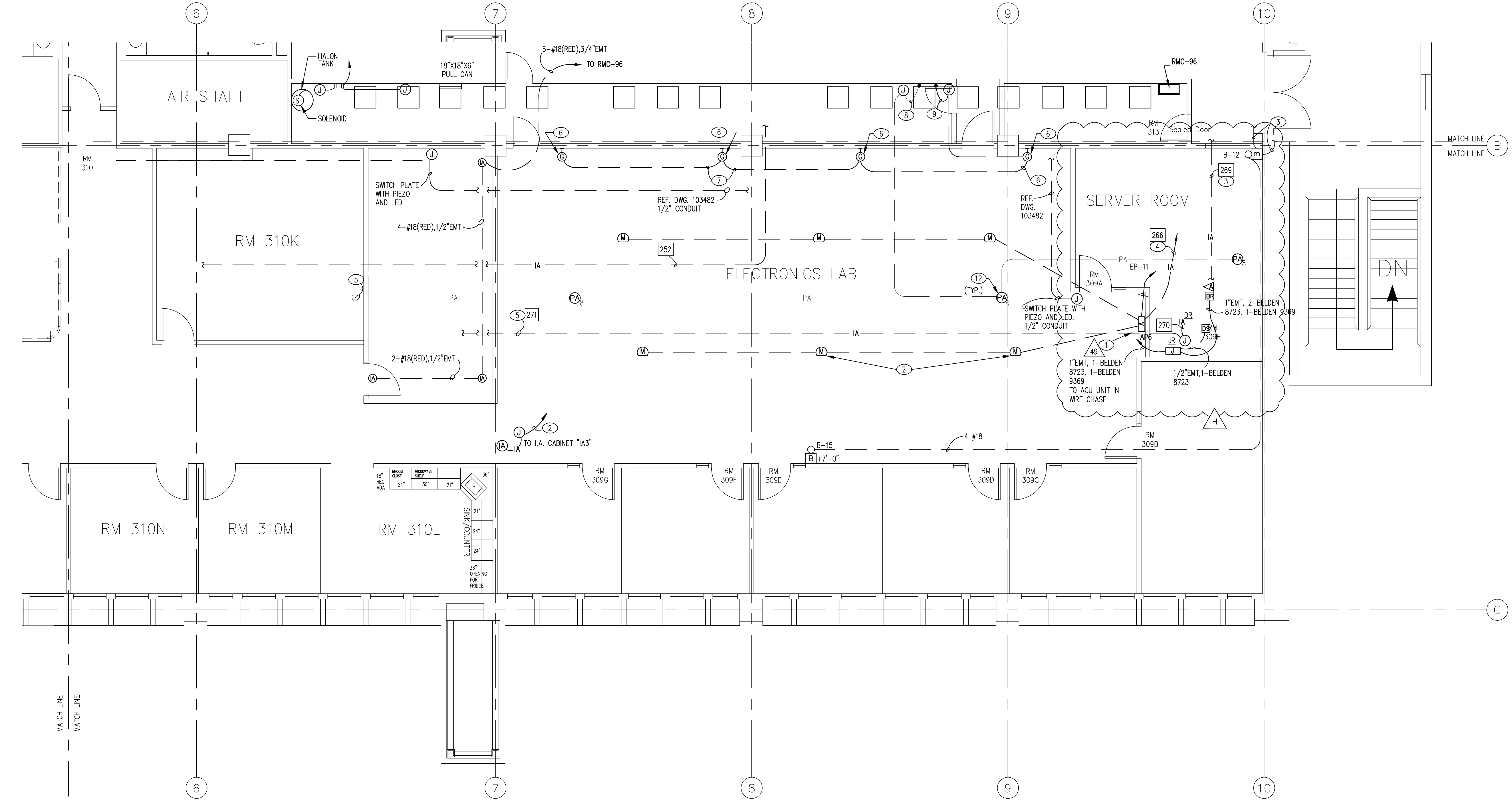
SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 103282

CADS DRAWING
FILE NAME: 103282F.dwg

PROJ. NO.
ORDER NO.

6/10/2013 4:20:30 PM, mtrimbl



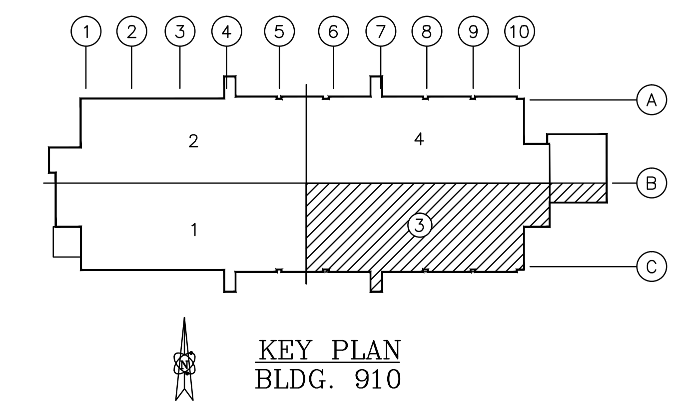
THIRD FLOOR PLAN – SOUTHEAST

GENERAL NOTES:

1. FOR GENERAL NOTES SEE DWG. #86445/E1.

KEYED NOTES:

1. ALARM PANEL WITH KEYPAD.
2. MOTION DETECTOR (TYPICAL), CEILING MOUNTED.
3. SEE DWG. #86445/E13 FOR CONTINUATION.
4. EXTEND TO I.A. CABINET "IA3" AND CONNECT. SEE DWG. #86445/E13 FOR LOCATION.
5. SEE DWG. #86445/E15 FOR CONTINUATION.
6. FLUSH J-BOX WITH INSULATED GROUNDING LUG FOR FUTURE WORK STATION GROUNDING.
7. 3/4" CONDUIT WITH 1-#2 TW GROUND WIRE.
8. 3/4" CONDUIT WITH 1-#2/0 THW GROUND WIRE DOWN TO BASEMENT J-BOX, SEE ISOLATED GROUNDING SYSTEM RISER DIAGRAM.
9. 3/4" CONDUIT DOWN TO J-BOX 2" FLOOR.
10. INSTALL BELDEN #8723 CABLE BETWEEN SENSORS.
11. FLUSH SPEAKER, NUMBER INDICATES ZONE, SEE DWG. #86447/E1 FOR P.A. SYSTEM RISER DIAGRAM.
12. INSTALL J-BOX ON WALL UP 48" FOR FUTURE I.A. SYSTEM SWITCH.
13. RELOCATE EXISTING F.A. BELL.



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
E010120	H	12/6/11	ELECTRICAL MODIFICATION	MP	GG	
E080418	G	07/24/08	VACATE SUITE 310	CDM	GDG	
	F	09/12/07	XREF UPGRADE	CDM	GDG	
Q97052	E	5/97	INSTALL BADGE READER	JRG	DD	
E3462–A	D	6/9/94	ALARM DOORS RM'S 3091 & H	GDG	GBF	
E2047–A	C	2/94	PUBLIC ADDRESS SIREN	GDG	HJR	
E1234–A	B	10/07/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 3 BLDG. 910

ELECTRICAL SPECIAL SYSTEMS

F.A. EVAC., I.A. & THIRD FLOOR

CONTRACT NO.(A–E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/4"=1'
DATE	DATE

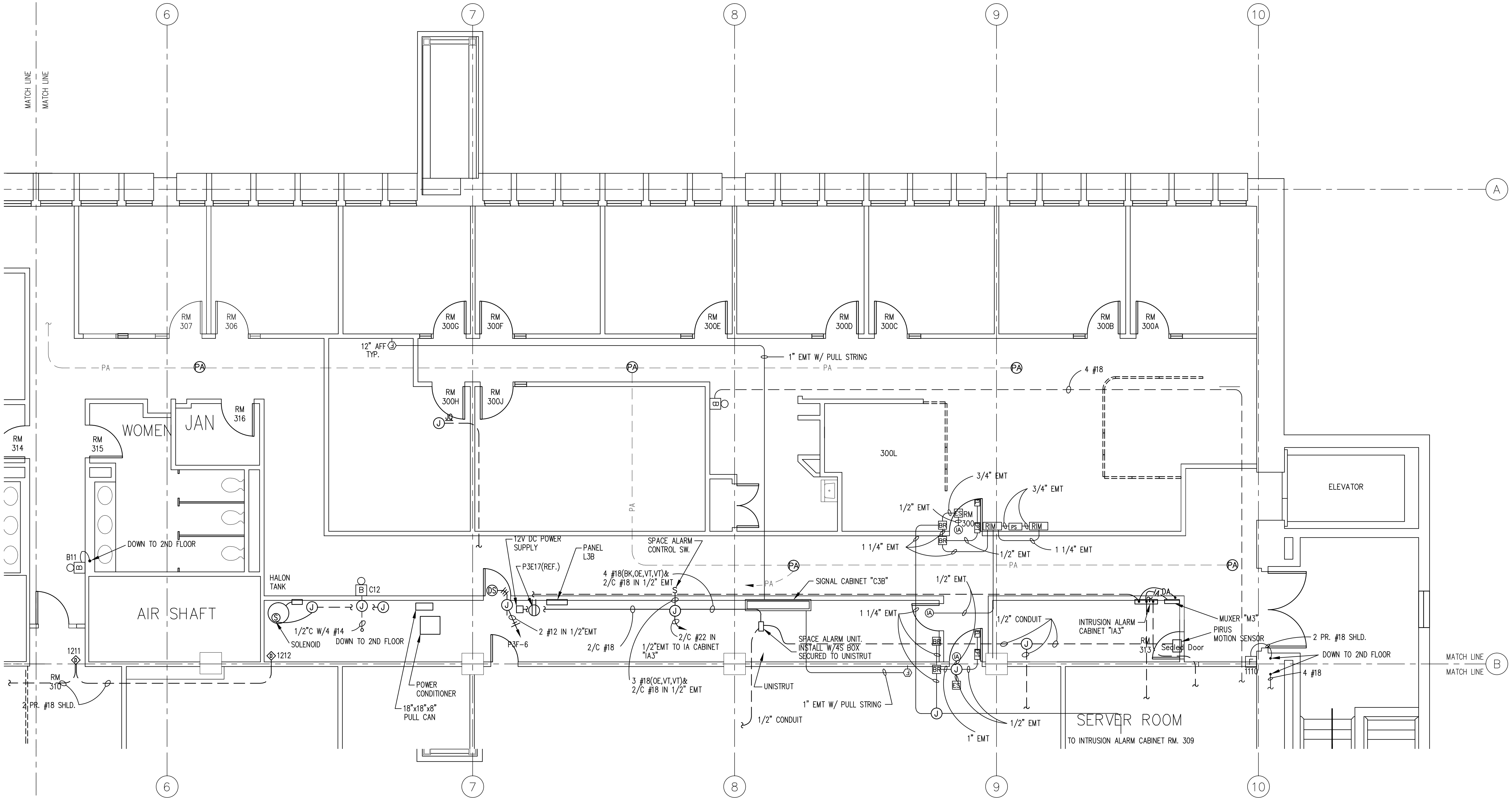
SUBMITTED | RECOMMENDED | APPROVED

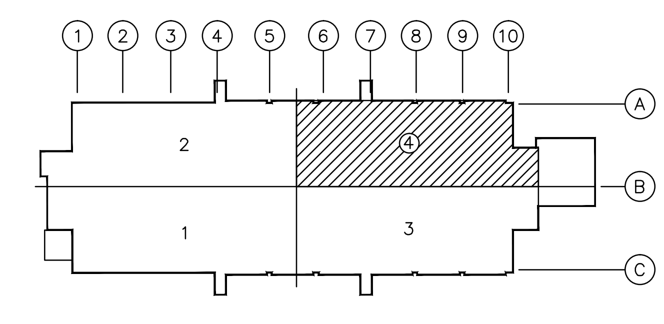
DWG.NO. 103382

CADS DRAWING
FILE NAME: 103382H.dwg

PROJ. NO. E1234
ORDER NO. XX–XXXX

6/10/2013 4:19:57 PM, mtrimbl





KEY PLAN
BLDG. 910

	NO.	DATE	REVISION	BY	CK.	DOE APP.
	J	09/12/07	XREF UPGRADE	CDM	GDG	
	H	3/24/04	MODIFY RM 300, UTILITY CHASE	T.H.	WCS	
E1234–A	G	10/12/92	REDRAWN ON CADS	4WT	LRN	
PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 4 BLDG 910

ELECTRICAL SPECIAL SYSTEM

THIRD FLOOR

CONTRACT NO.(A–E)
DOE ACCT.NO.
DRAWN DRAWNBY
CHECKED CHECKEDBY
SCALE 1/4"=1'
DATE DATE

SUBMITTED RECOMMENDED APPROVED

DWG.NO. 103482

CADS DRAWING
FILE NAME: 103482J.dwg

PROJ. NO.
ORDER NO.

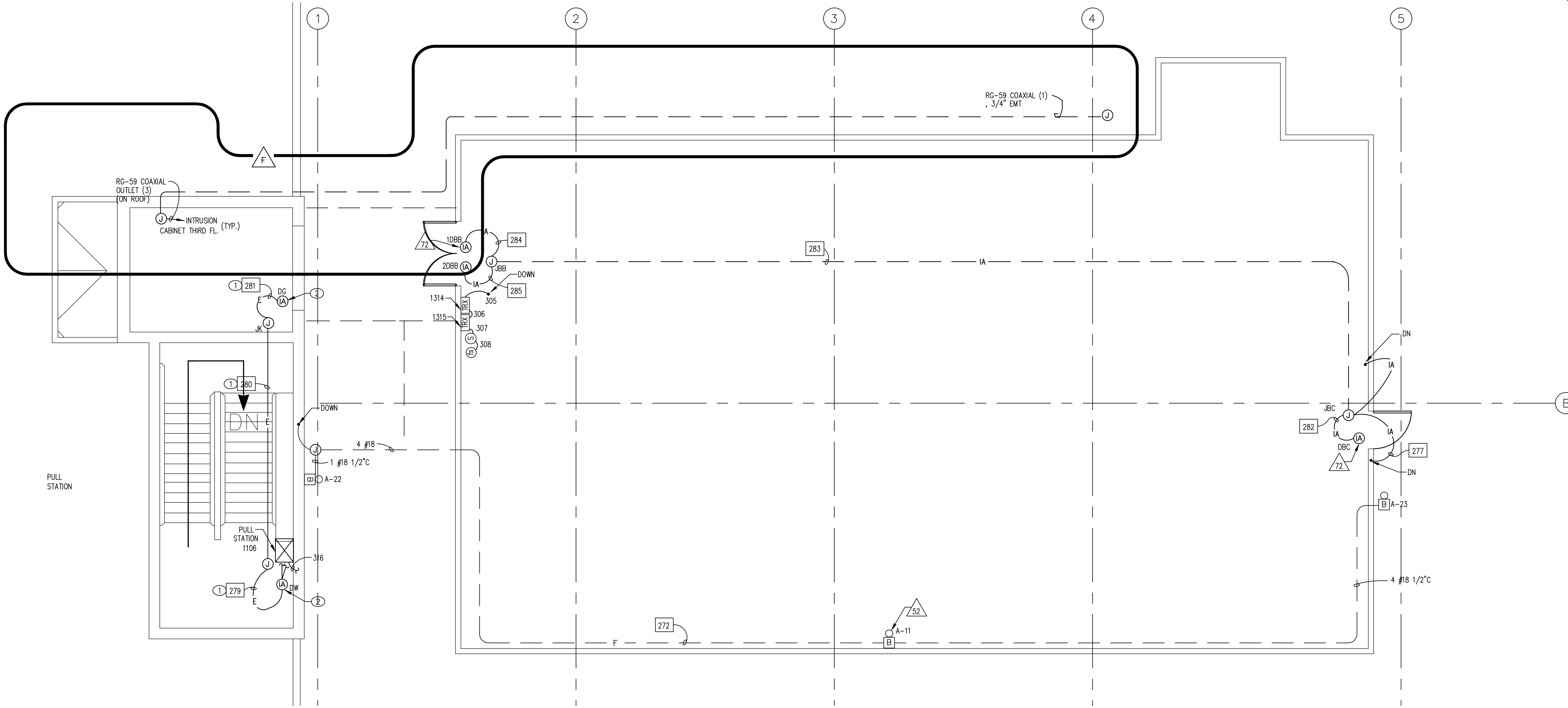
6/10/2013 4:19:31 PM, mtrimbl

GENERAL NOTES:

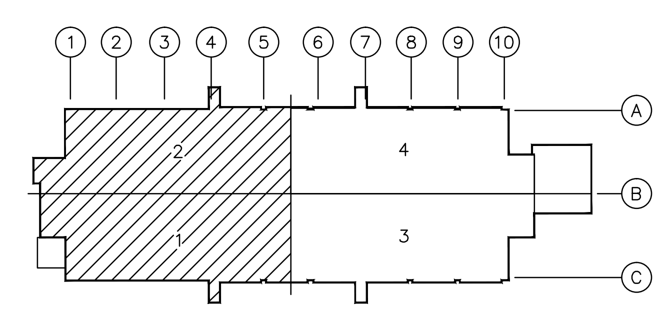
1. SEE SHEET #86445/E1 FOR GENERAL NOTES.

KEYED NOTES:

1. REMOVE EXISTING CONDUCTORS AND PULL IN NEW AS INDICATED.
2. RECONNECT EXISTING DOOR SWITCH.



MECHANICAL EQUIPMENT ENCLOSURE
SCALE: 1/4"=1'-0"



KEY PLAN
BLDG. 910

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
	G	09/12/07	XREF UPGRADE	CDM	GDG	
E4083B	F	7/95	Install (2) security cameras	DD	DD	
	E	10/14/92	REDRAWN ON CADS	4WT	LRN	

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

SECTOR 4 BLDG 910

ELECTRICAL
SPECIAL SYSTEMS
F.A., EVAC, I.A. & P.A.

CONTRACT NO.(A-E) | DOE ACCT.NO. | DRAWN DRAWNBY | CHECKED CHECKEDBY | SCALE 1/8"=1' | DATE DATE

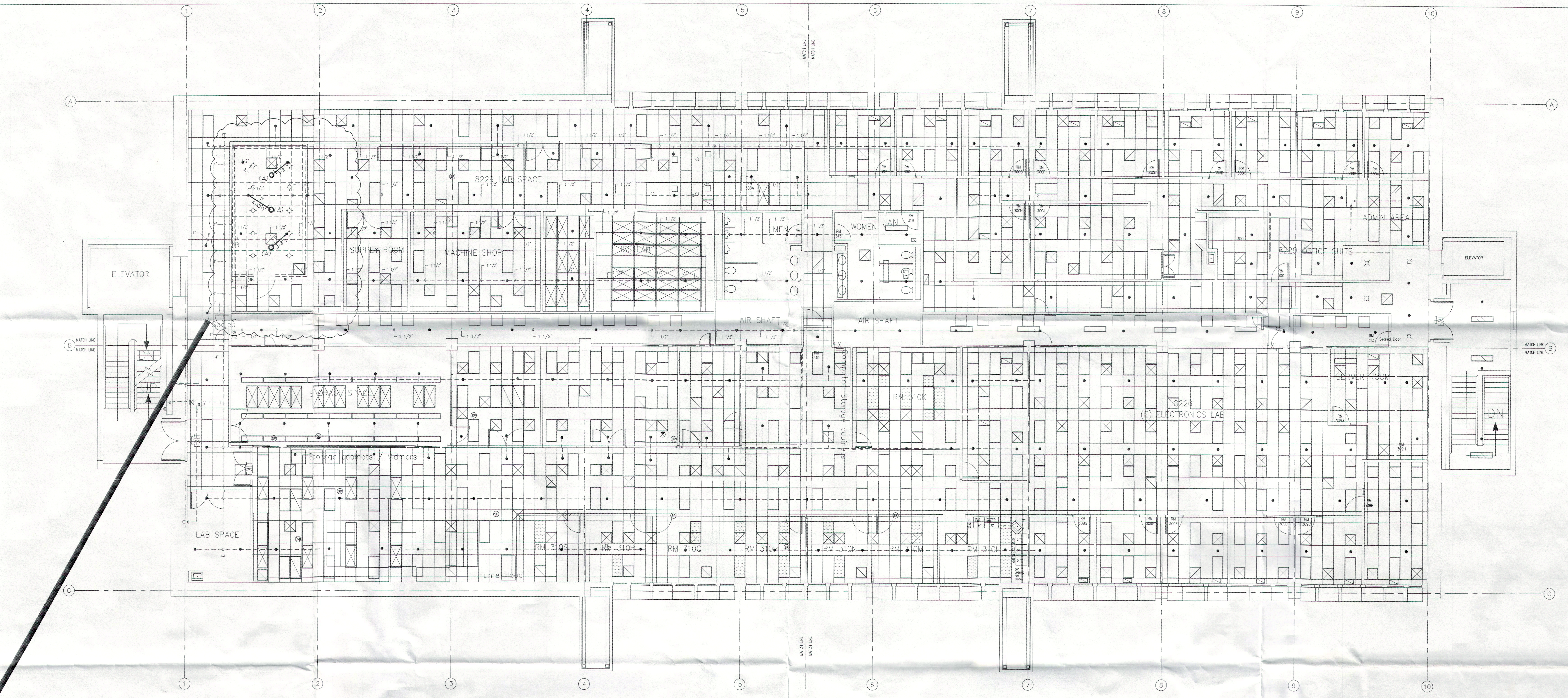
SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 104082

CADS DRAWING
FILE NAME: 104082G.dwg

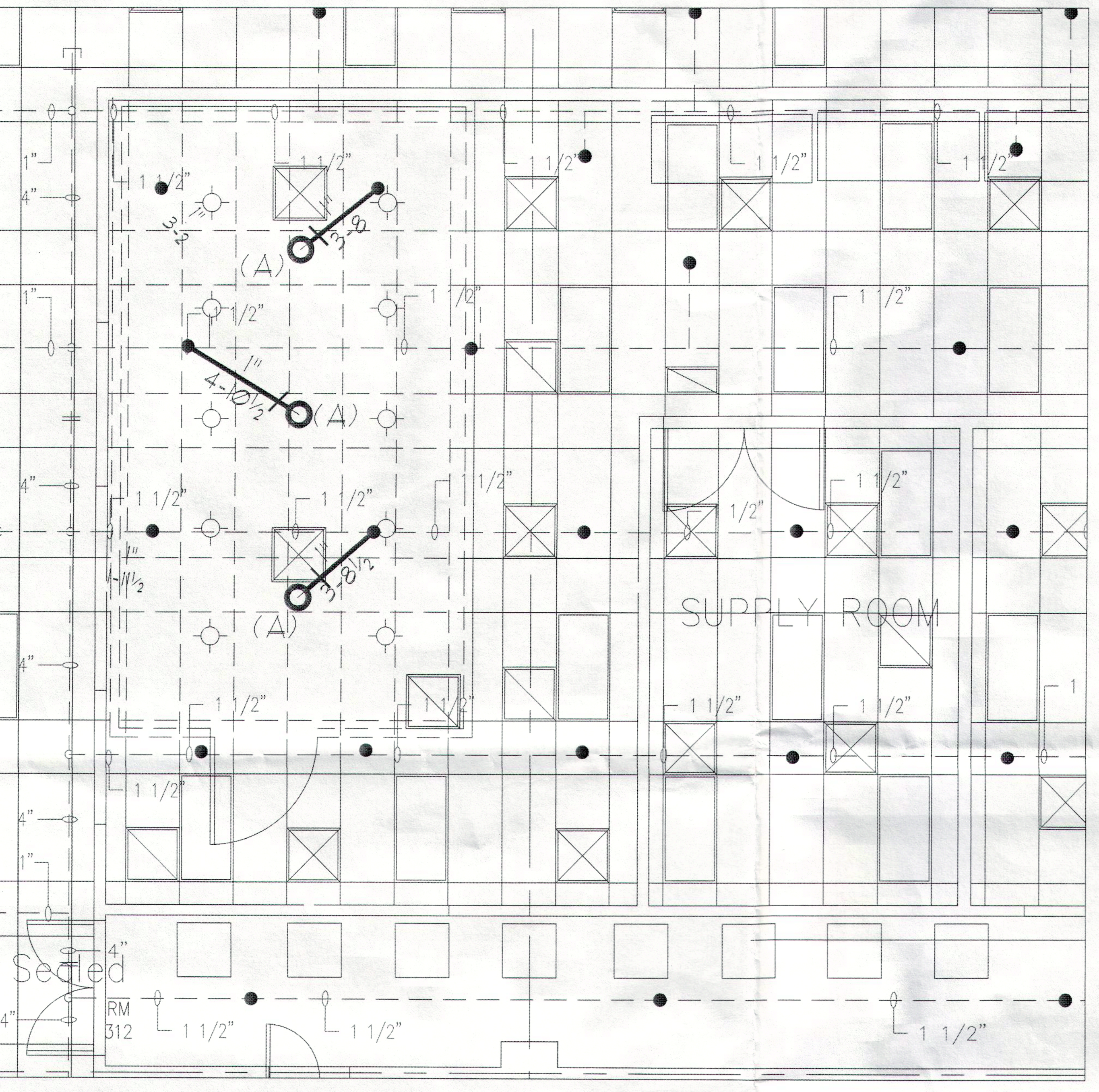
PROJ. NO.
ORDER NO.

6/10/2013 4:21:47 PM, mtrimbl



FLOOR PLAN

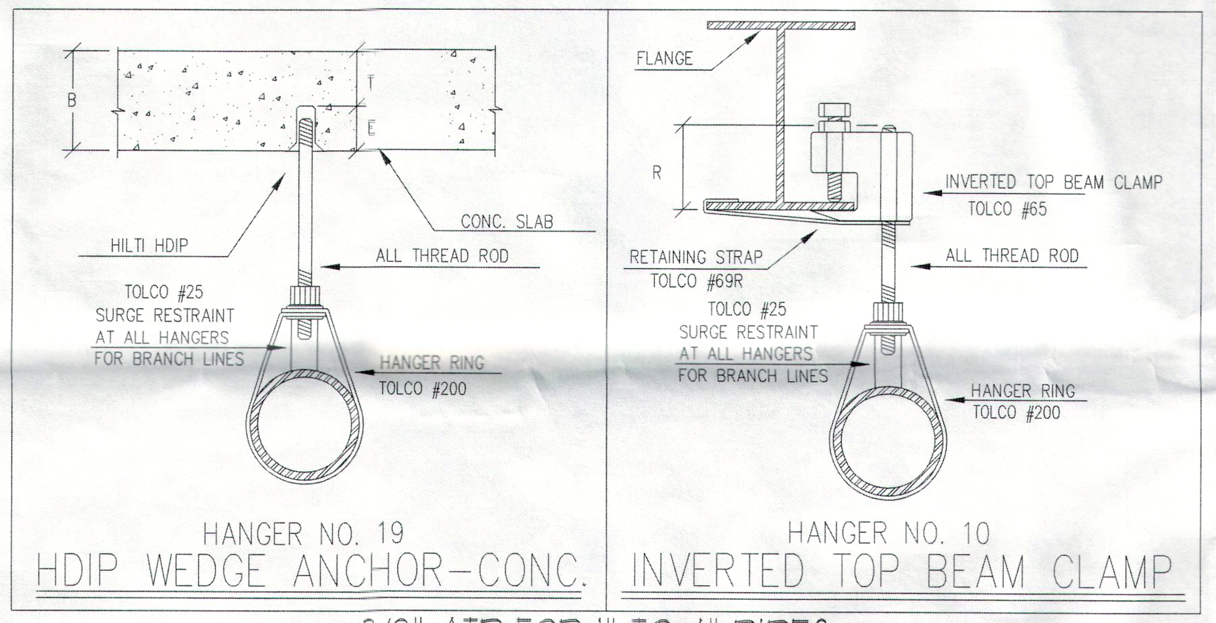
SCALE: 1/8"=1'-0



AREA OF WORK

SCALE: 1/4"=1'-0

HANGER DETAILS



3/8" ATR FOR 1" TO 4" PIPES

FIRE DEPARTMENT NOTES:

ALL METHODS OF HANGING, BRACING, AND INSTALLATION PER NFPA 13 AND THE CITY OF LIVERMORE

SCOPE OF WORK:

PROVIDE FIRE SPRINKLER COVERAGE TO ACCOMODATE THE NEW CEILING/WALL LAYOUT OF THE TENANT.

EXISTING PENDENTS TO REMAIN AS IS. ADDED (3) THREE PENDENTS FOR SHIELD ROOM.

LEGEND:

- - - - EXISTING PIPE
- NEW PIPE
- NEW HANGER. SEE DETAILS ON THIS SHEET
- • EXISTING PENDENT
- O (3) ADDED PENDENT

LICENSED FIRE PROTECTION CONTRACTOR, ALLIED FIRE PROTECTION, Classification C-16, LICENSE No. 251700, STATE OF CALIFORNIA

HYDRAULIC DESIGN DATA

D.		
GPM		
Q. FT.		
Q. FT.		
PSI		
M PSI	DATE: TIME:	TESTED BY:

OT PRESS.	STATIC PRESS.	RESID. PRESS.	FLOW	UNDERGROUND
PSI	PSI	PSI	GPM	DIAMETER
				LENGTH
				SAFETY
24'				

SPRINKLER SCHEDULE & LEGEND

SYMBOL(S)	SIN	SPRINKLER DESCRIPTION	STYLE	HAZARD	MAXIMUM SPACING	MINIMUM SPACING	MAX. OFF WALLS	RESPONSE	ORIFICE	K-FACTOR	TEMP.	FINISH	ESC.	FINISH	DATA PAGE/BULL.	QUANTITY
O	VK302	VIKING MICROFAST	PEN	ORD	130 SQ.FT.	6'-0"	7'-6"	QR	1/2"	5.6	155°	CHR	E-1	WHT	41AB	3

TOTAL COUNT THIS SHEET = 3

CONTRACTOR: C. OVERAA & CO
CONTRACTOR ADDRESS: 200 PARR BLVD., RICHMOND CA 94801
JOB SITE PHONE: 510-234-0926 FAX:

REVISION

NUMBER	DATE	DESCRIPTION	BY

LICENSED FIRE PROTECTION CONTRACTOR, ALLIED FIRE PROTECTION, Classification C-16, LICENSE No. 251700, STATE of CALIFORNIA

SANDIA NATIONAL LAB

7011 EAST AVE., LIVERMORE CA 94550

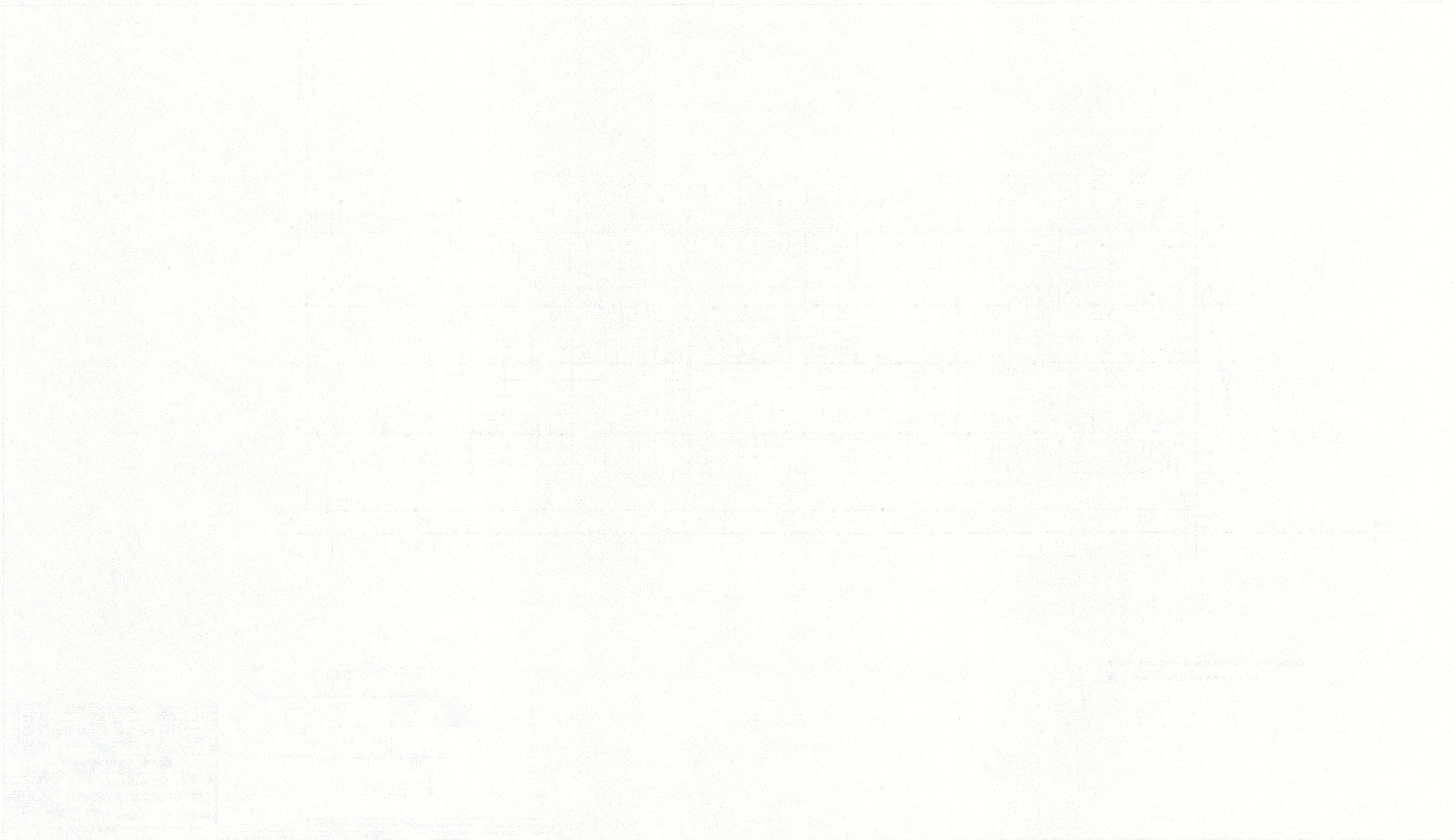
3RD FLOOR, ROOM 320 RENOVATION

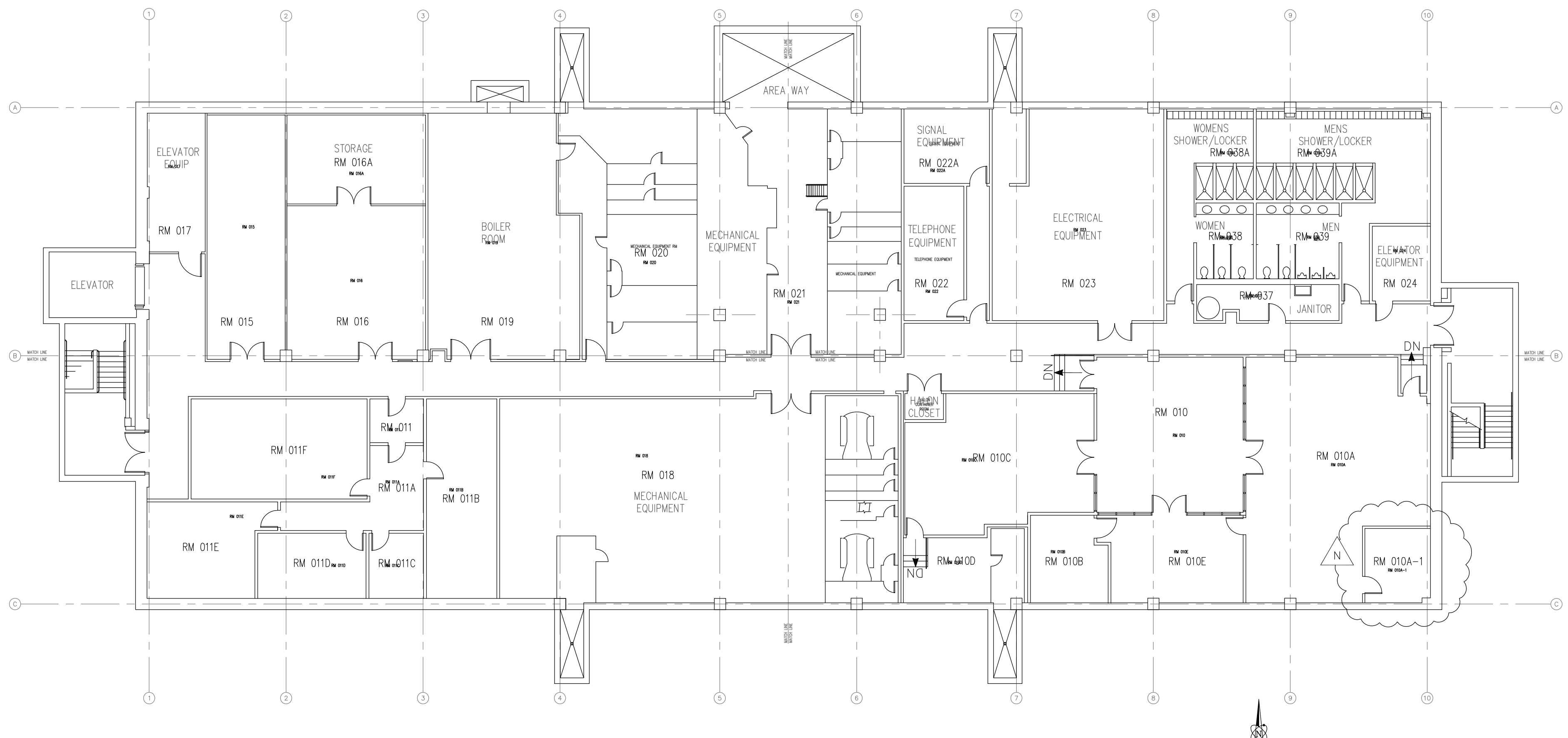
AFP ALLIED FIRE PROTECTION

CONTRACTORS * DESIGNERS * FABRICATION

555 HIGH STREET OAKLAND, CALIFORNIA 94601
PHONE (510) 533-5516 FAX (510) 533-0913

ISSUED:
FOR:
NORT
DESIGNER:
SCALE:
JOB NUMBER:
CHECKED BY:
FILE NAME:
ARCHIVE DATE:
SHEET NO.





BUILDING 910
BASEMENT

0 5 10 25 50
SCALE IN FEET

88432	N	03/30/06	OFFICE MOD. IN RM. 010A	DD	DD	
	M	7/20/05	REVISED RM NOS 011, 011A-F	T.H.	GDG	
	L	9/7/04	REVISED RM 011	T.H.	WCS	
	K	5/27/04	ADDED ROOM NUMBERS	T.H.	GDG	
	J	1/9/03	ISSUE (N) MASTER DWG NO.	T.H.	GDG	
	H	2MAR95	ISSUED NEW DETAIL NO.	TLC	AJD	
	G	1/5/93	POLYGON DEFINITION FOR FM SYSTEMS	DAP		
	F	10/23/92	REDRAWN ON CADS	4WT	LRN	
PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE, NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH, NEVADA

ARCHITECTURAL BLDG. 910
BLOCK PLAN
BASEMENT

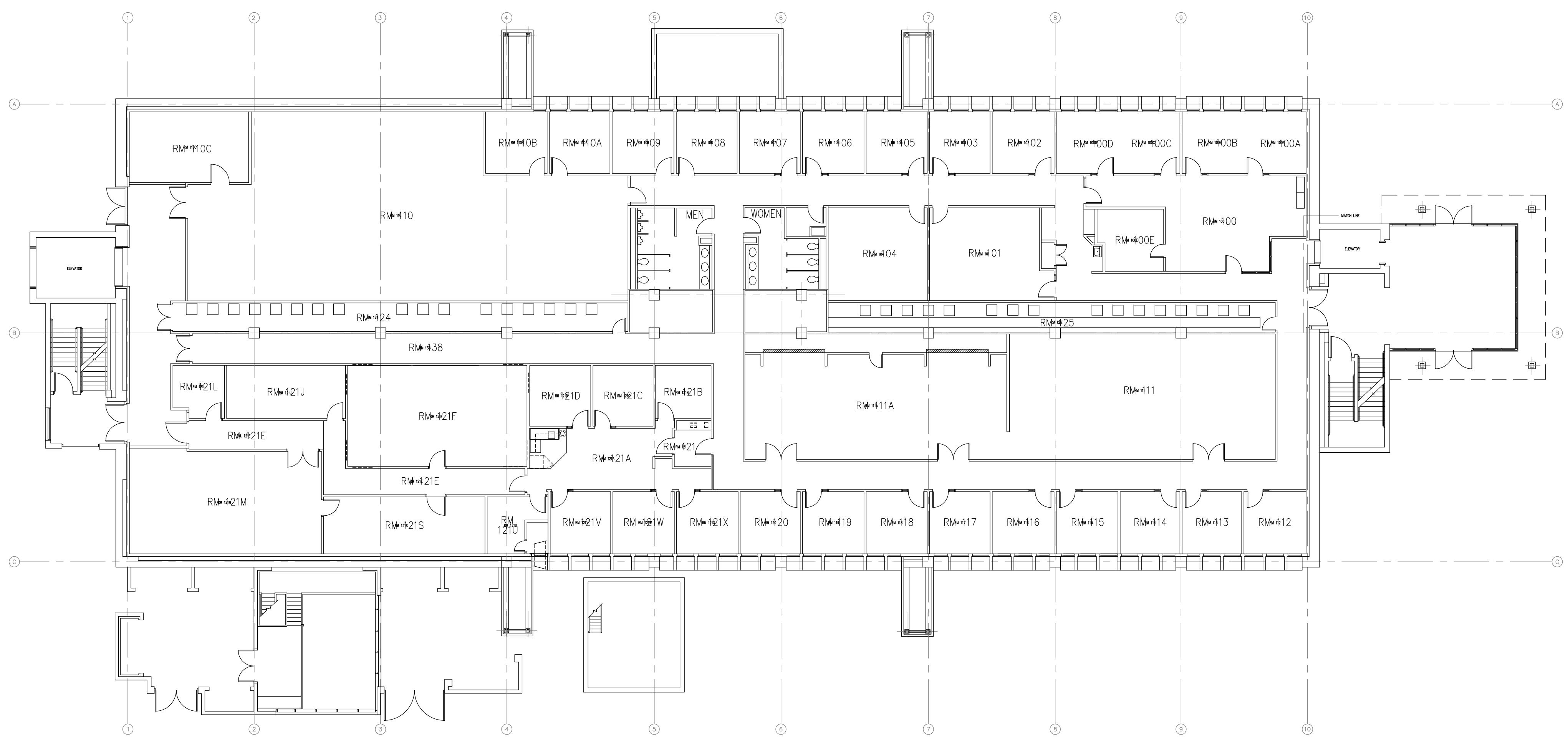
CONTRACT NO.(A-E)
DOE ACCT.NO.
DRAWN DA PYERS
CHECKED
SCALE 3/32"=1'
DATE 1/5/93

SUBMITTED | RECOMMENDED | APPROVED

DWG.NO. 100044

PROJ. NO.
ORDER NO.

CADS DRAWING
FILE NAME: 100044N.dwg



BUILDING 910
FIRST FLOOR

0 5 10 25 50
SCALE IN FEET

CADS DRAWING
FILE NAME: 101044K.dwg

PROJ. NO. E01025
ORDER NO.

PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
110480	L	1/28/10	RM 121 SUITE RENOVATION	RDW	DTR	
	K	2/17/03	AS-BUILT	RYF	GDG	
	J	1/9/03	ISSUE (N) MASTER DWG NO.	T.H.	GDG	
E01025	H	11/7/01	AS BUILTS – RM 121C	T.H.	WCS	
	H	2MAR95	ISSUED NEW DETAIL NO.	TLC	AJD	
	G	11/16/92	ADDED POLYGON DEFINITIONS FOR FM SYSTEMS	DAP		
	F	10/23/92	REDRAWN ON CADS	4WT	LRN	

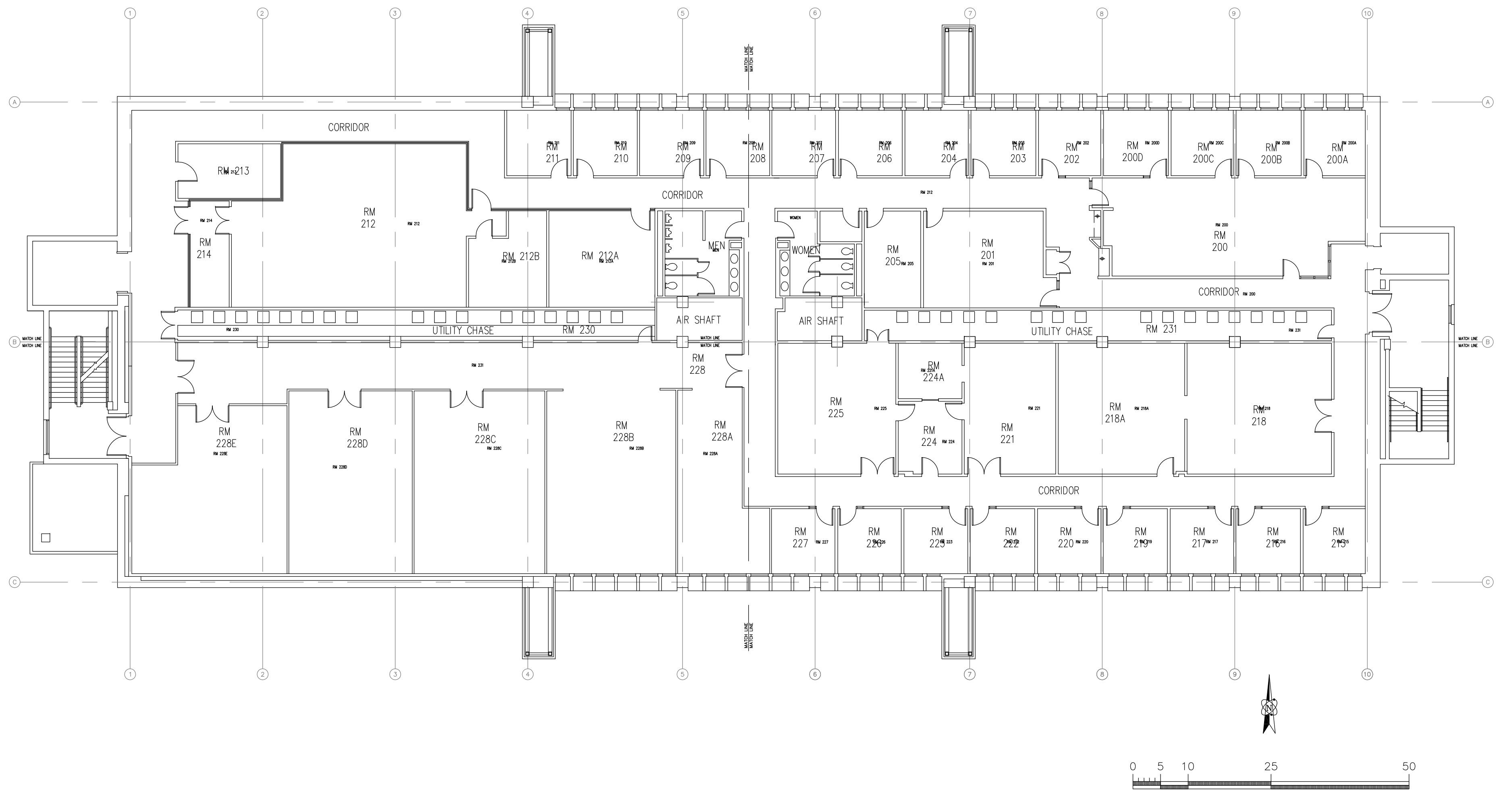
SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE, NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH, NEVADA

ARCHITECTURAL BLDG. 910
BLOCK PLAN
1ST FLOOR

CONTRACT NO.(A-E)
DOE ACCT.NO.
DRAWN D.A.PETERS
CHECKED
SCALE 3/32"=1'
DATE 1/8/93

SUBMITTED
RECOMMENDED
APPROVED

DWG.NO. 101044



BUILDING 910
SECOND FLOOR

CADS DRAWING
FILE NAME: 102044F.dwg

PROJ. NO.
ORDER NO.

F	12/13/04	ADDED WALL, DOOR RM 228D	t.h.	GDG	
E	2/17/03	AS BUILT	RYF	GDG	
D	1/8/03	ISSUE (N) MASTER DWG NO.	T.H.	GDG	
C	04/22/02	REMOVED RM TITLES	GDG	GDG	
B	03/02/95	ISSUED NEW DETAIL NO.	TLC	AJD	
A	11/20/92	POLYGON DEF. FOR FM SYSTEMS	DAP	DAP	
PROJ.& W.O. NO.	DATE	REVISION	BY	CK.	DOE APP.

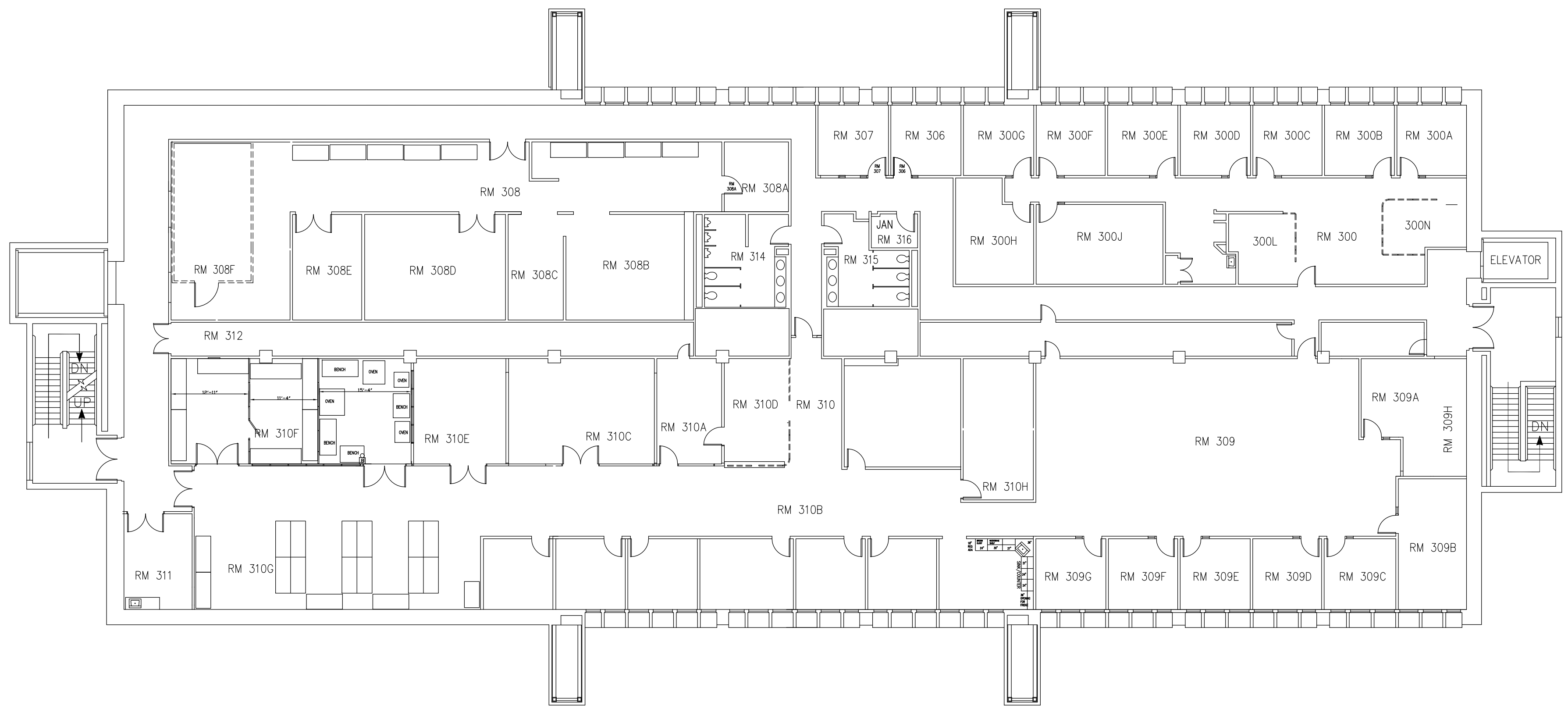
SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE, NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH, NEVADA

ARCHITECTURAL BLDG 910
BLOCK PLAN
2ND FLOOR

CONTRACT NO.(A-E)
DOE ACCT.NO.
DRAWN DAP
CHECKED
SCALE 1/4"=1'
DATE 11/20/92

SUBMITTED
RECOMMENDED
APPROVED

DWG.NO. 102044



BUILDING 910
THIRD FLOOR

0 5 10 25 50

SCALE IN FEET

	J	7/20/05	REVISED RM NOS 320. 321, 321A	T.H.	GDG
	H	5/19/04	MOD. RM NOS. DOORS. ADD XREF	T.H.	GDG
	G	3/9/04	MODIFY RMS 308, 310H, 310I	T.H.	GDG
	F	12/10/03	MODIFY RM300, UTILITY CHASE	T.H.	WCS
	E	2/17/03	AS-BUILT	RYF	GDG
	D	1/9/03	ISSUE (N) MASTER DWG NO.	T.H.	GDG
	C	03MAR95	ISSUED NEW DETAIL NO.	TLC	AJD
E3462-A	B	5/19/94	VAULT RM ADDN RM'S 3091 & H	GDG	WCS
	A	11/20/92	POLYGON DEF. FOR FM SYSTEMS	DAP	DAP
PROJ.& W.O.	NO.	DATE	REVISION	BY	CK.

SANDIA NATIONAL LABORATORIES
FACILITIES MANAGEMENT
ALBUQUERQUE,NEW MEXICO; LIVERMORE, CALIFORNIA; TONOPAH,NEVADA

ARCHITECTURAL BLDG. 910
BLOCK PLAN
3RD FLOOR

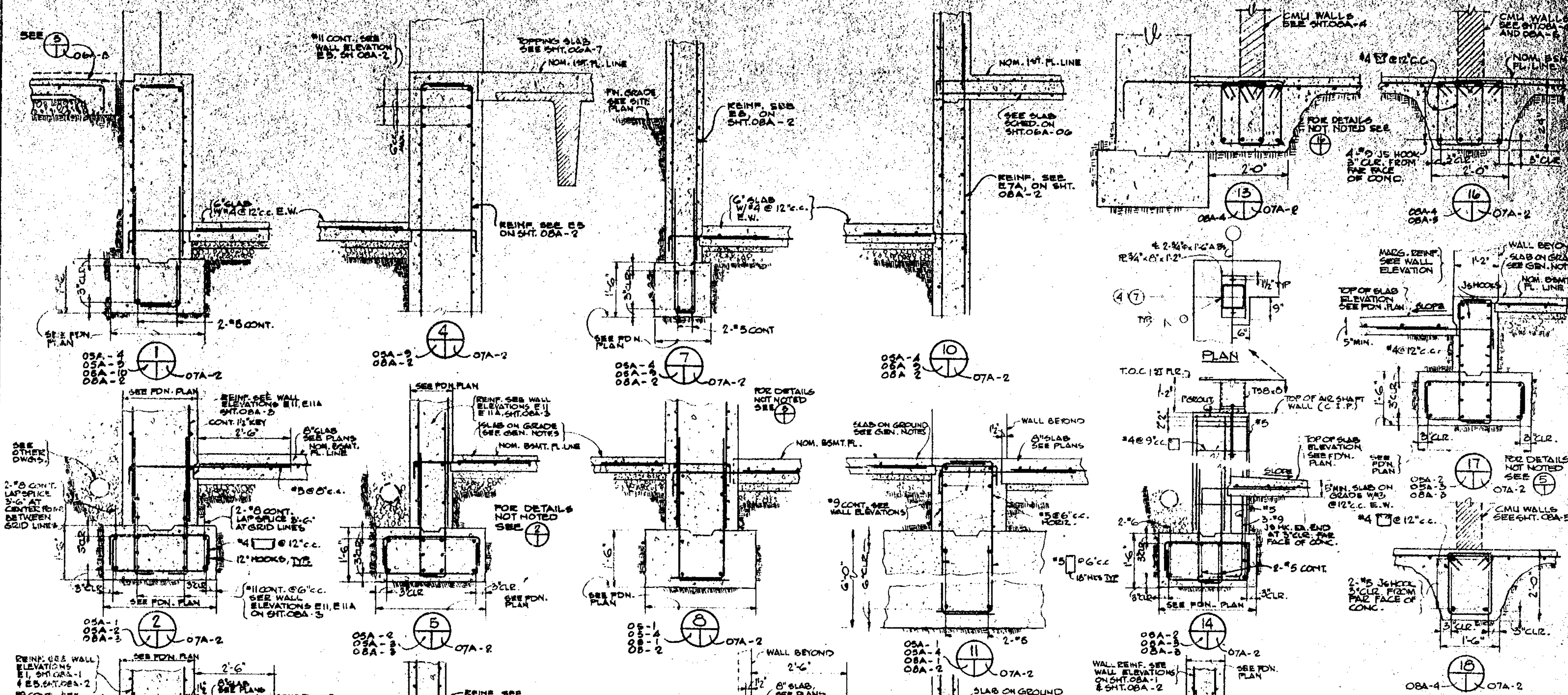
CONTRACT NO.(A-E)	
DOE ACCT.NO.	
DRAWN	DRAWNBY
CHECKED	CHECKEDBY
SCALE	1/8"=1'
DATE	11/20/92

SUBMITTED RECOMMENDED APPROVED

DWG.NO. 103044

CADS DRAWING
FILE NAME: 103044J.dwg

PROJ. NO.
ORDER NO.



NOTES

1. SEE GENERAL NOTES SH. S-06A-1
2. THE DETAILS ON THIS SHEET SHOW STRUCTURAL FEATURES ONLY. FOR DETAILS AND DIMENSIONS NOT SHOWN REFER TO DRAWINGS OTHER THAN STRUCTURAL.
3. FILL INDICATIONS ARE SYMBOLIC. ALL FILL SHALL MEET SPECIFICATIONS REQUIREMENTS.

PROJ. & W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
12108		1/81	AS BUILT DRAWING	JJ		

U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

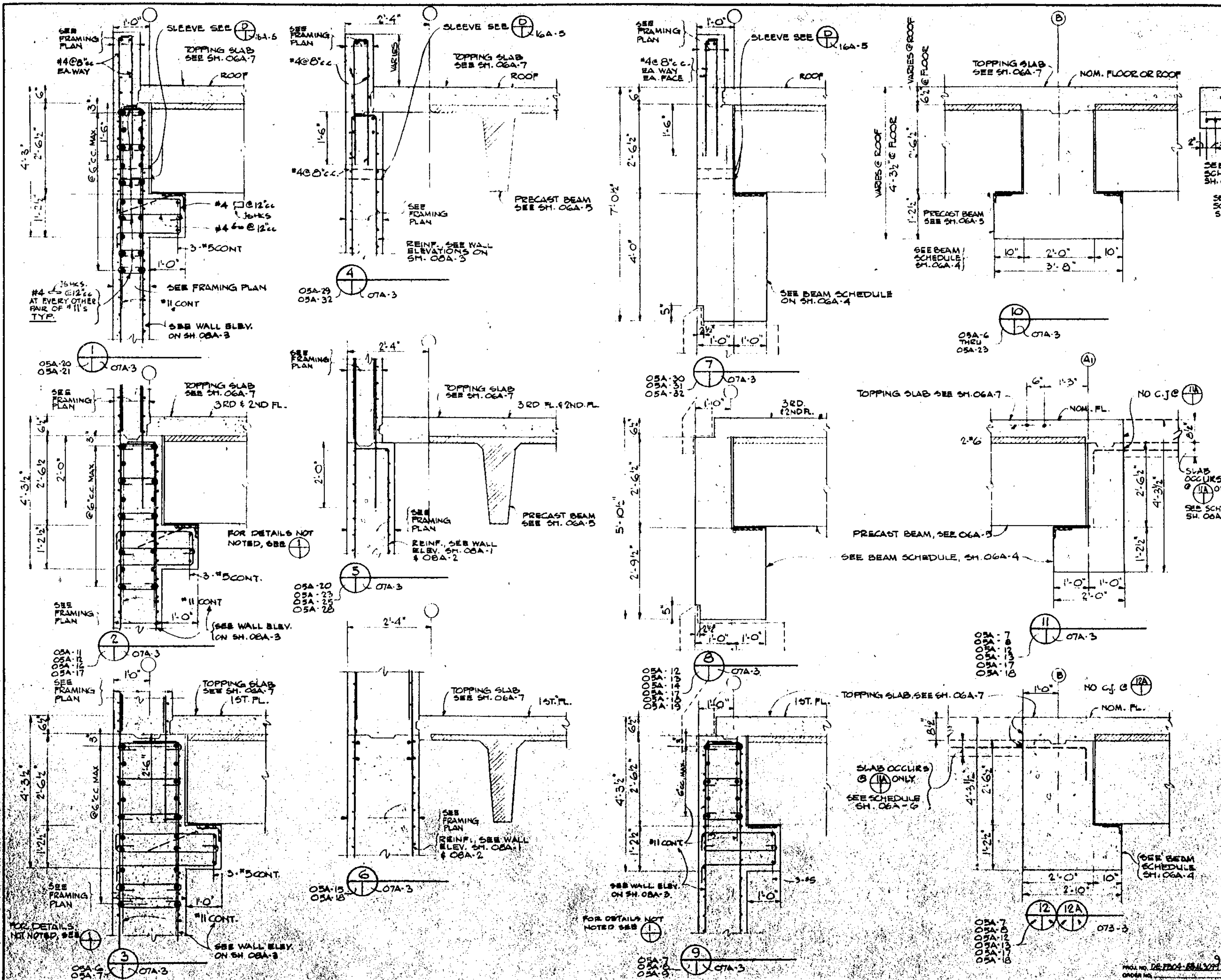
STRUCTURAL DETAILS

LABORATORY BUILDING 901

ARCHITECTURAL — BLDG. 901

DRAWN	OWP
CHECKED	EGY
SCALE	3/4" = 1'-0"
DATE	1-31-85

DWG. NO. 94807A-2 — SHEET 51 OF 307



12708		1/81	AS BUILT DRAWING	JT		
PROJ. & W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.

U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

STRUCTURAL DETAILS

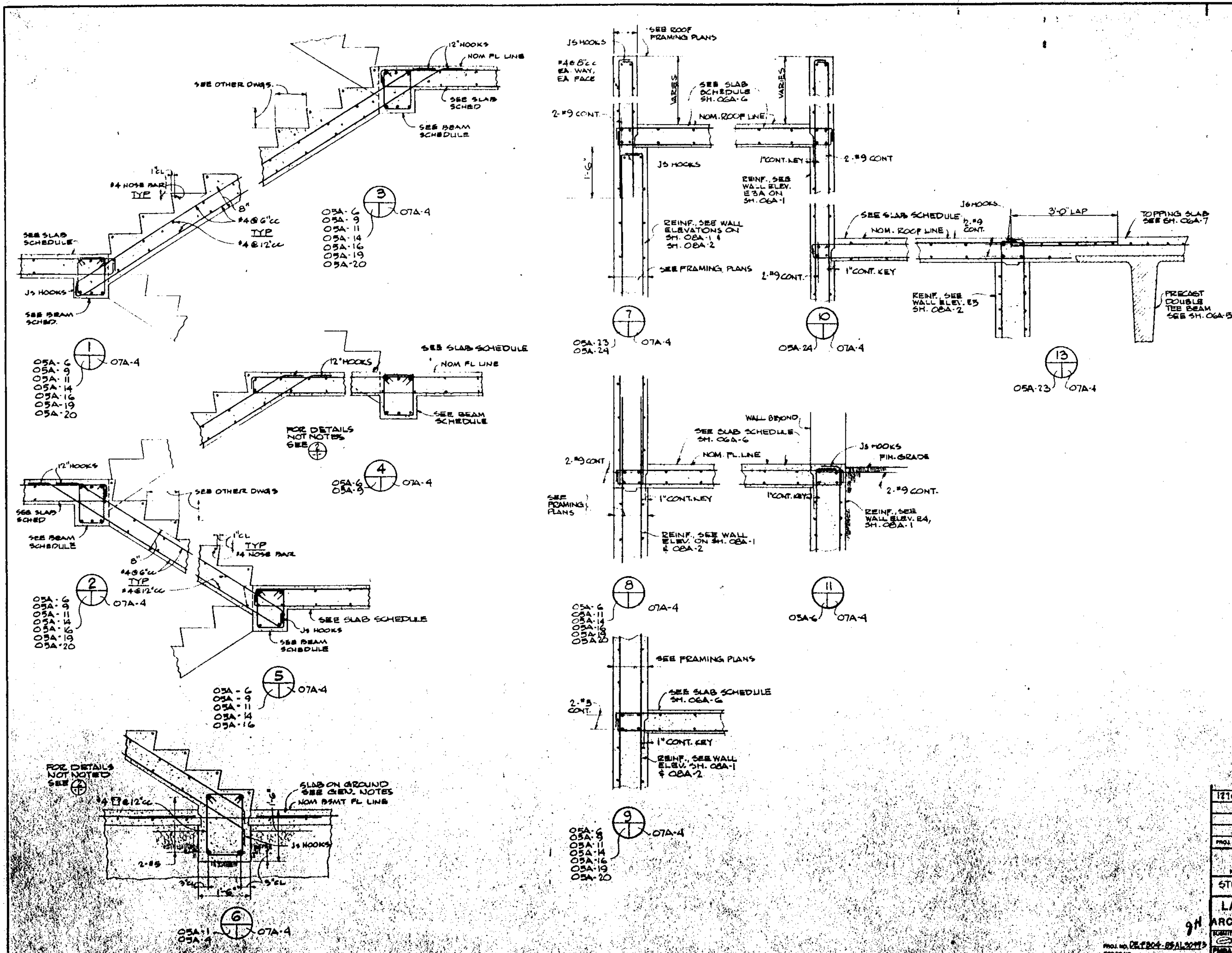
LABORATORY BUILDING 901
ARCHITECTURAL — BLDG. 901

DRAWN: OWP
SCALE: 3/4"=1'-0"
DATE: 1-9-82

PROJ. NO. DE-FB04-88AL30993

FMSA-AE ARCHITECTS-ENGINEERS albuquerque new mexico

DWG. NO. 94807A-3 SHEET 52 OF 809



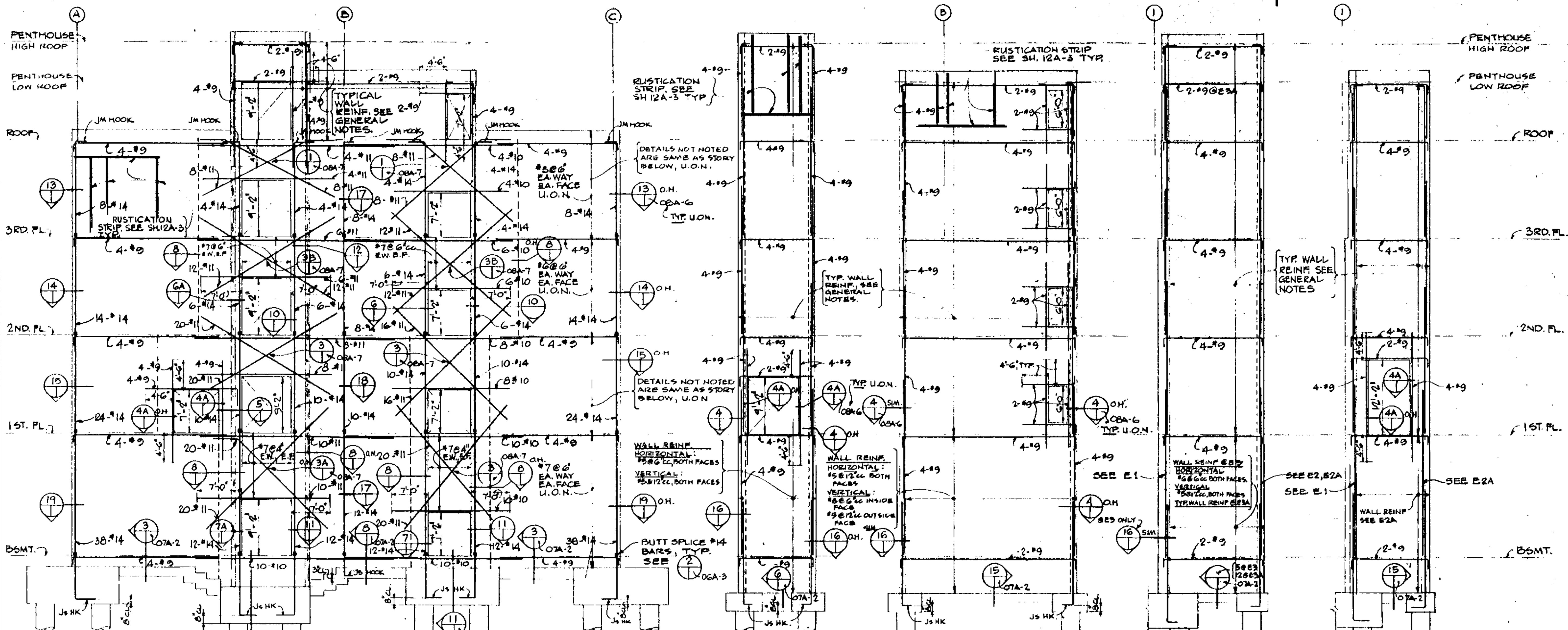
12108	1/83	AS BUILT DRAWING	JT
PROJ & W.O.	NO. DATE	REVISION	BY

U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

STRUCTURAL DETAILS

LABORATORY BUILDING 901

ARCHITECTURAL — BLDG. 901



ELEVATION E1

ELEVATION E2

ELEVATION E2A

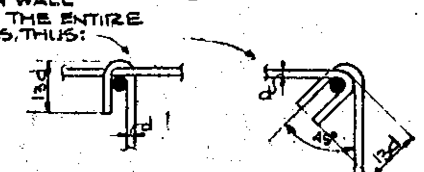
ELEVATION E3, E3A

ELEVATION E4

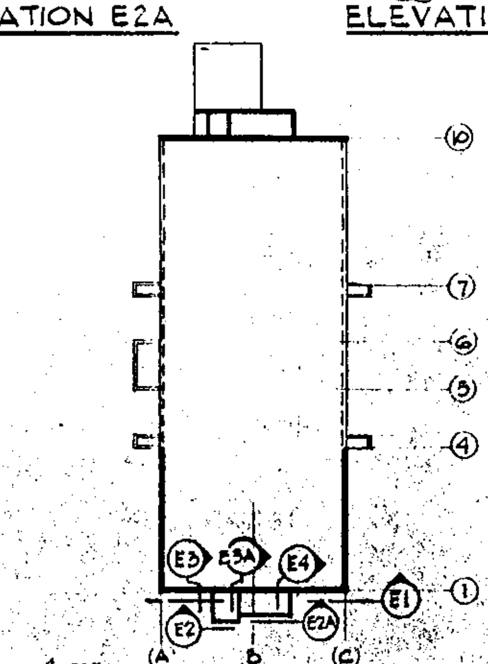
ALL DETAILS CUT ABOVE LOCATED ON SHEET 08A-6 U.O.N.

WALL ELEVATION NOTES

1. SEE GENERAL NOTES ON SHEET 06A-1.
2. HOLES AND OPENINGS THRU WALLS ARE NOT COMPLETE AS TO EXACT SIZE, NUMBER AND LOCATION. SEE DRAWINGS OTHER THAN STRUCTURAL.
3. ALL HORIZONTAL REINFORCEMENT SHALL BE CONTINUOUS UNLESS OTHERWISE SHOWN OR NOTED. IF SPLICES ARE REQUIRED STAGGER LAP SPLICES BETWEEN ADJACENT BARS WHERE POSSIBLE.
4. VERTICAL REINFORCEMENT SHALL BE LAP SPLICED ABOVE THE NOMINAL FLOOR LINES UNLESS OTHERWISE SHOWN OR NOTED.
5. REINFORCEMENT SPLICES SHALL BE AS PER LAP SPLICE SCHEDULE ON GENERAL NOTE SHEET. IF BARS BEING SPLICED ARE DIFFERENT SIZES, USE LAP SPLICE FOR BIGGER BAR.
6. ALL #14 BARS SHALL BE BUTT SPLICED. STAGGER SPLICES OF ADJACENT BARS, SEE 2 06A-3
7. TIE REINFORCEMENT WHICH ENCLOSE VERTICAL BARS AS SHOWN ON WALL ELEVATIONS OR AS DETAILED IN SECTIONS, SHALL EXTEND ALONG THE ENTIRE LENGTH OF VERTICAL BARS. PROVIDE HOOKS AT ENDS OF THE TIES, THUS:
8. ALL HORIZONTAL WALL SECTIONS ARE LOCATED ON SHEET 08A-6 UNLESS OTHERWISE NOTED.



CONSTRUCTION SEQUENCE
CAST-IN-PLACE CONSTRUCTION (WALLS & GIRDERS) SHALL BE LATERALLY SUPPORTED BY TEMPORARY SHORING PRIOR TO INSTALLATION OF PRECAST PRESTRESSED DOUBLE TEE UNITS. SHORING SHALL NOT BE REMOVED UNTIL TOPPING SLAB HAS BEEN PLACED.



KEY PLAN
NO SCALE

PROJ. NO. DE-FB04-85AL30193
ORDER NO.

PROJ. & W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
12706		1/87	AS BUILT DRAWING	JT		

U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

WALL ELEVATIONS

LABORATORY BUILDING 901

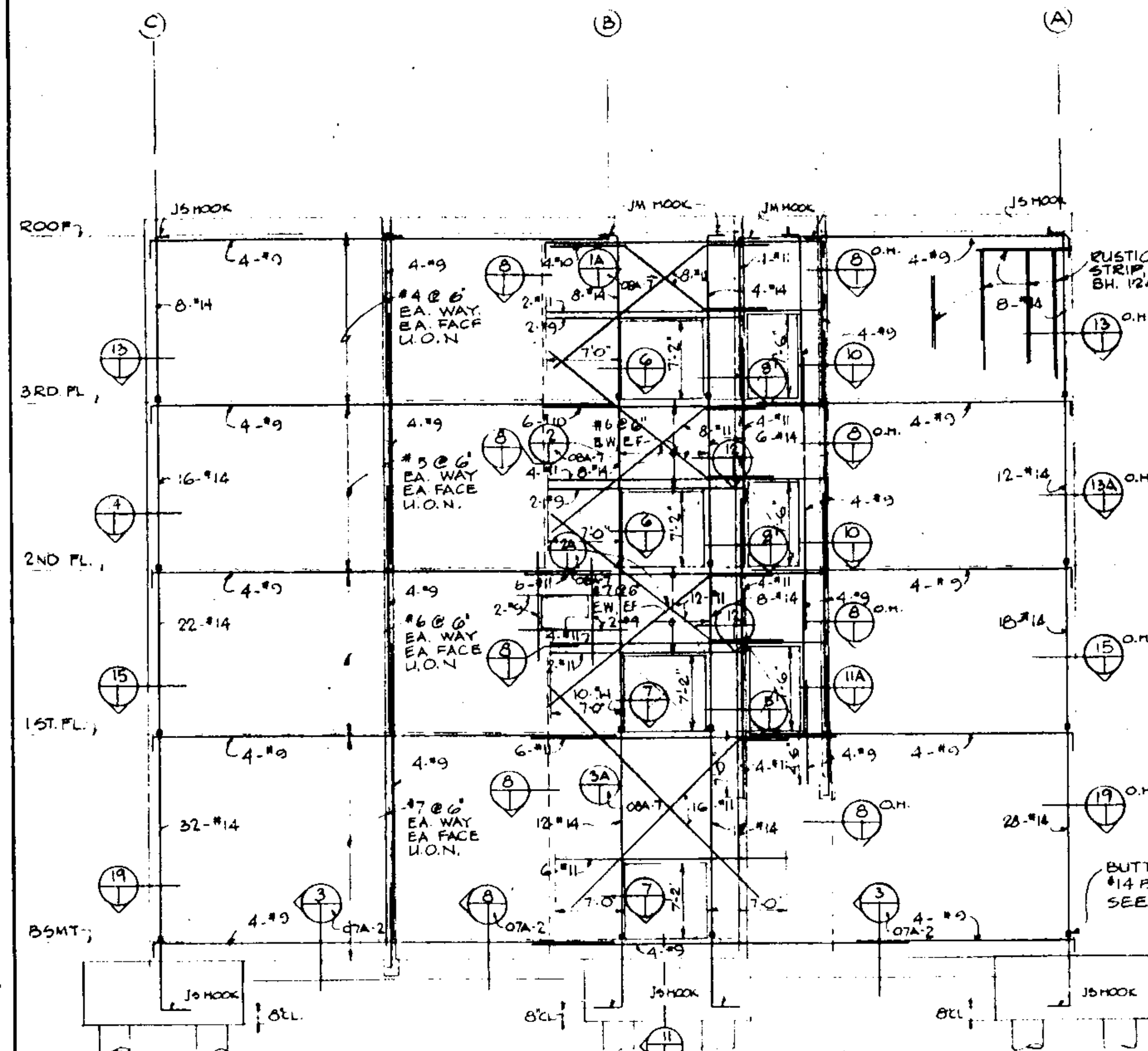
ARCHITECTURAL — BLDG. 901

CONTRACT NO. (A-E)	
CONTRACT NO. (CONST.)	
DRAWN	OWP
CHECKED	RGY
SCALE	1/8"=1'-0"
DATE	1-31-85

SUBMITTED: [signature] — RECOMMENDED — APPROVED: [signature]

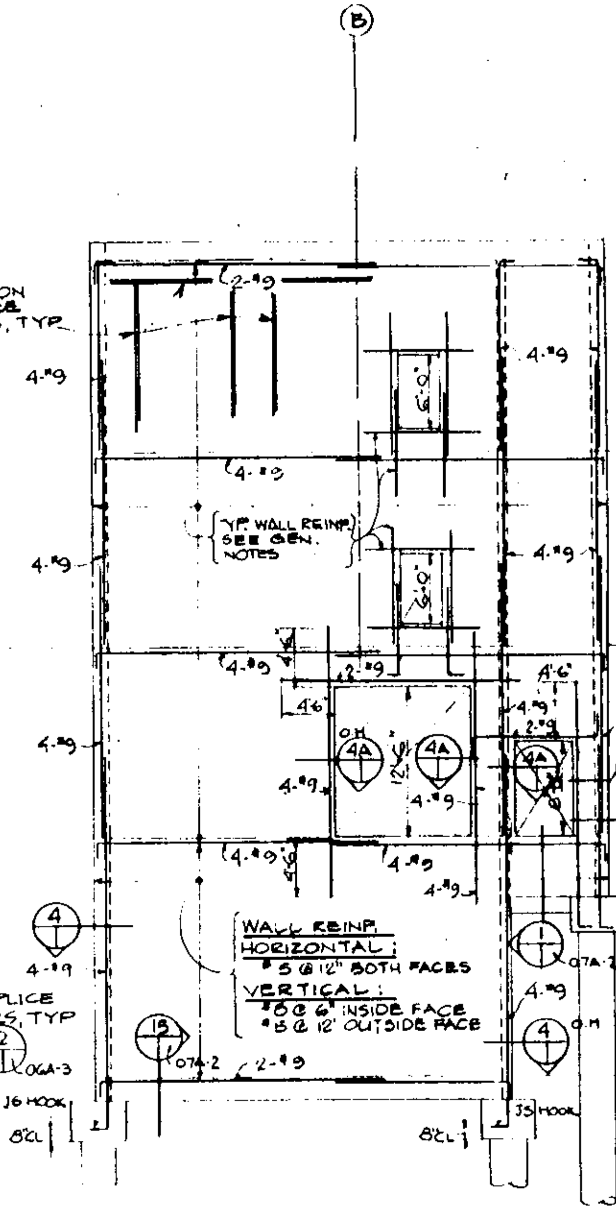
FMSM-AE ARCHITECTS-ENGINEERS, albuquerque, new mexico

DWG. NO. 94808A-1 — SHEET 54 OF 307

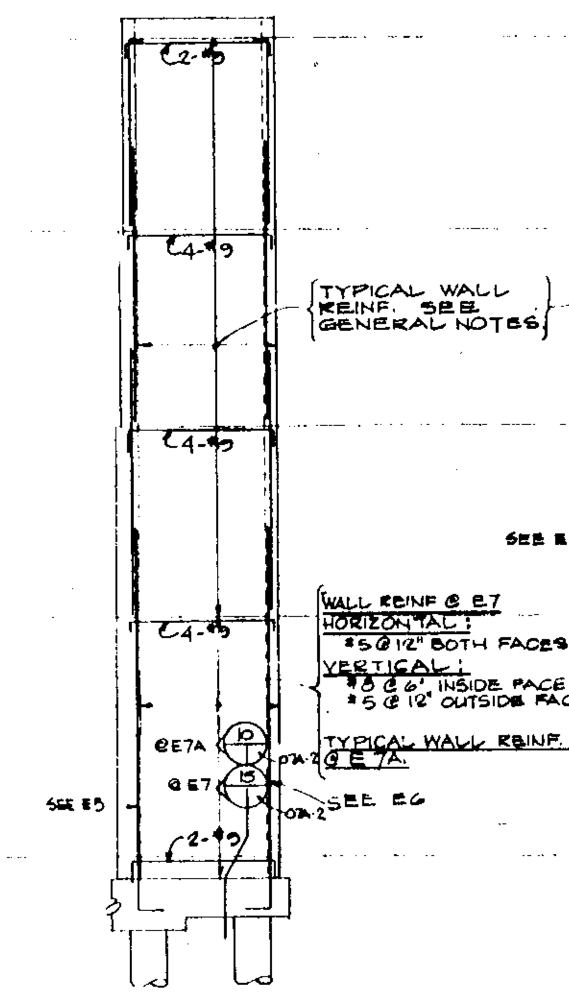


ELEVATION E5

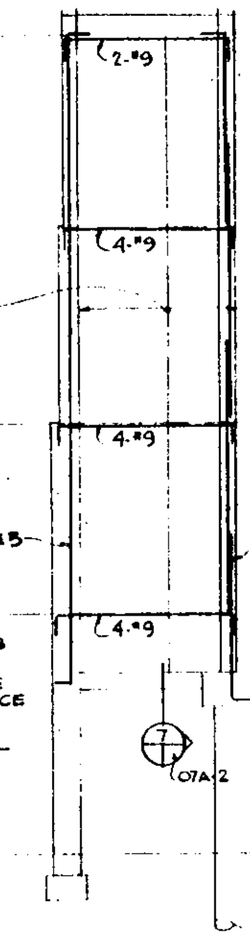
ALL DETAILS CUT ON THE WALL ELEVATIONS ARE LOCATED ON SHEET 08A-6 U.O.N



ELEVATION E6



ELEVATION E7, E7A.



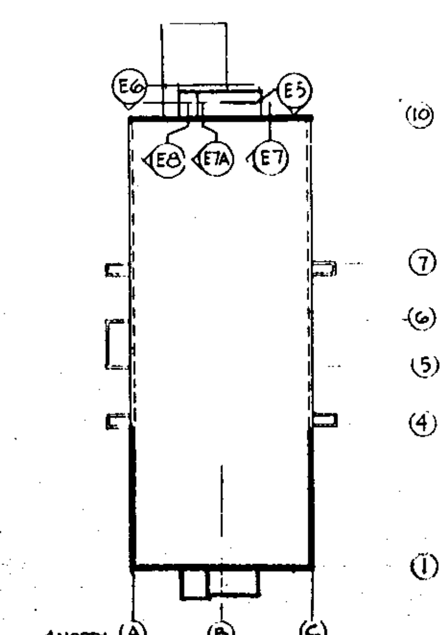
ELEVATION E8

WALL ELEVATION NOTES

1. SEE GENERAL NOTES ON SH. 06A-7
2. NOTES 2 THRU 8 ON SH. 08A-1 APPLY TO THIS SHEET.

CONSTRUCTION SEQUENCE

CAST-IN-PLACE CONSTRUCTION (WALLS & GIRDERS) SHALL BE LATERALLY SUPPORTED BY TEMPORARY SHORING PRIOR TO INSTALLATION OF PRECAST PRESTRESSED DOUBLE TEE UNITS. SHORING SHALL NOT BE REMOVED UNTIL TOPPING SLAB HAS BEEN PLACED.



KEY PLAN

PROJ. NO. DE-FB04-85AL30993
ORDER NO.

PROJ. & W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
12708		1/87	AS BUILT DRAWING	JY		

U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

WALL ELEVATIONS

LABORATORY BUILDING 901

ARCHITECTURAL — BLDG. 901

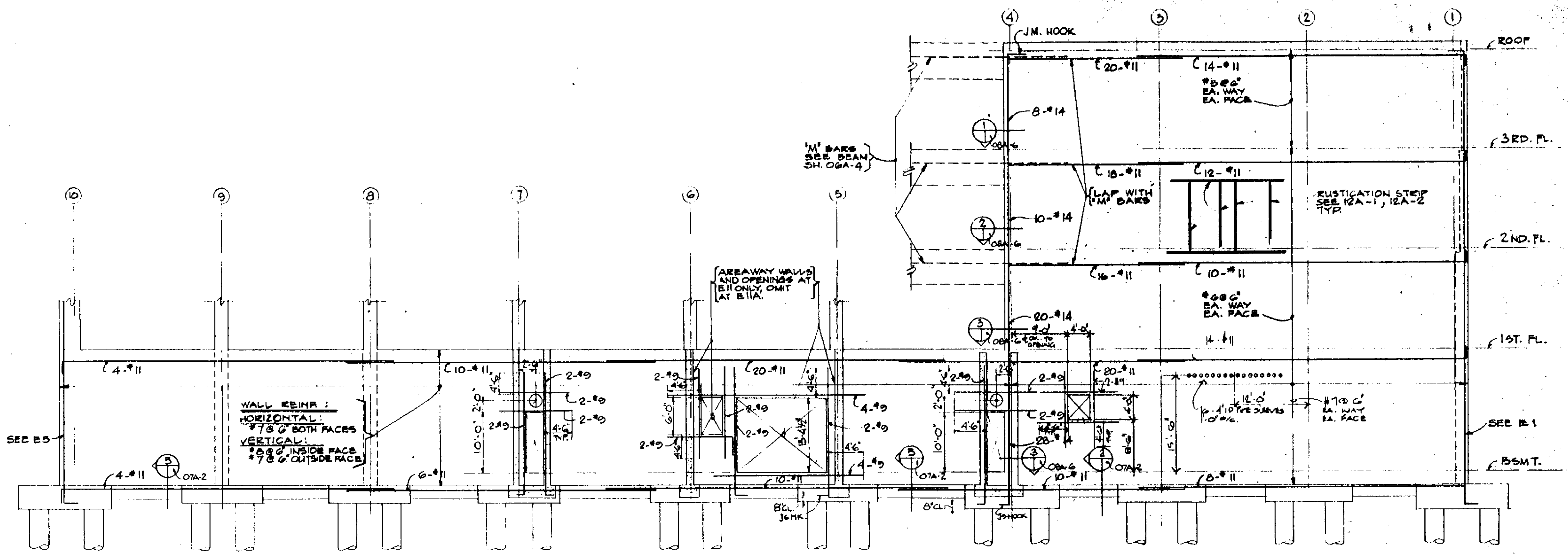
CONTRACT NO. (A-E)	
CONTRACT NO. (CONST.)	
DRAWN	OWP
CHECKED	RGY
SCALE	1/8" = 1'-0"
DATE	1-31-85

SUBMITTED — RECOMMENDED — APPROVED

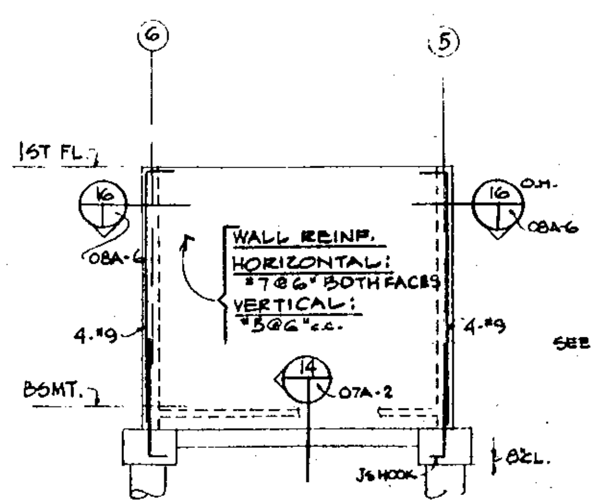
FMSA-AE ARCHITECTS-ENGINEERS albuquerque new mexico

DWG. NO. 94808A-2 — SHEET 55 — OF 307

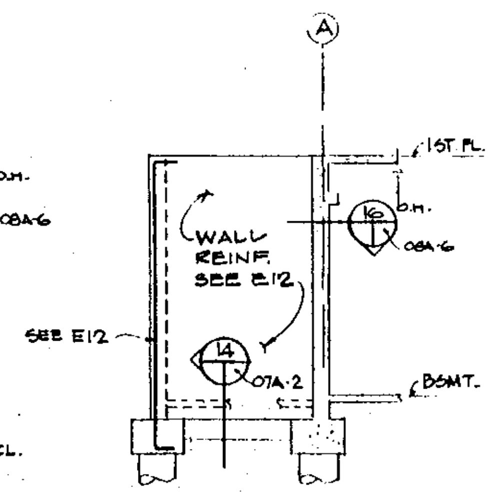
K & E HERCULENE 10-1300



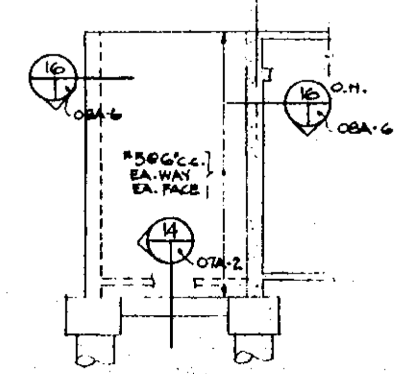
ELEVATION E11, E11A O.H.



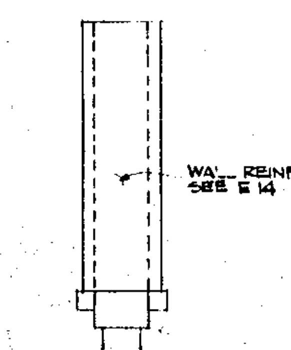
ELEVATION E12



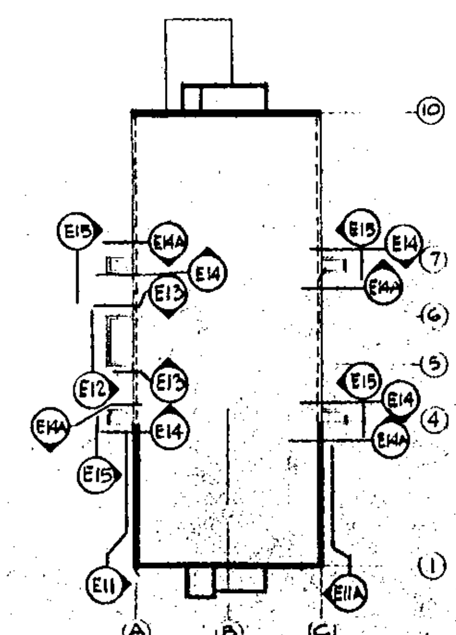
ELEVATION E13, E13A O.H.



ELEVATION E14, E14A O.H.



ELEVATION E15



KEY PLAN

CONSTRUCTION SEQUENCE:
CAST-IN-PLACE CONSTRUCTION (WALLS & GIRDERS) SHALL BE LATERALLY SUPPORTED BY TEMPORARY SHORING PRIOR TO INSTALLATION OF PRECAST PRESTRESSED DOUBLE TEE UNITS. SHORING SHALL NOT BE REMOVED UNTIL TOPPING SLAB HAS BEEN PLACED.

WALL ELEVATION NOTES

1. SEE GENERAL NOTES ON SH. 06A-1
2. NOTES 2 THRU 7 ON SH. 08A-1 APPLY TO THIS SHEET.

PROJ. & W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
12708		1/81	AS BUILT DRAWING	JT		
DOE MOD A004	1		AREAWAY	JT		
DOE MOD A005	2		16 PIPE SLEEVES	JT		

U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO

WALL ELEVATIONS

LABORATORY BUILDING 901

ARCHITECTURAL BLDG. 901

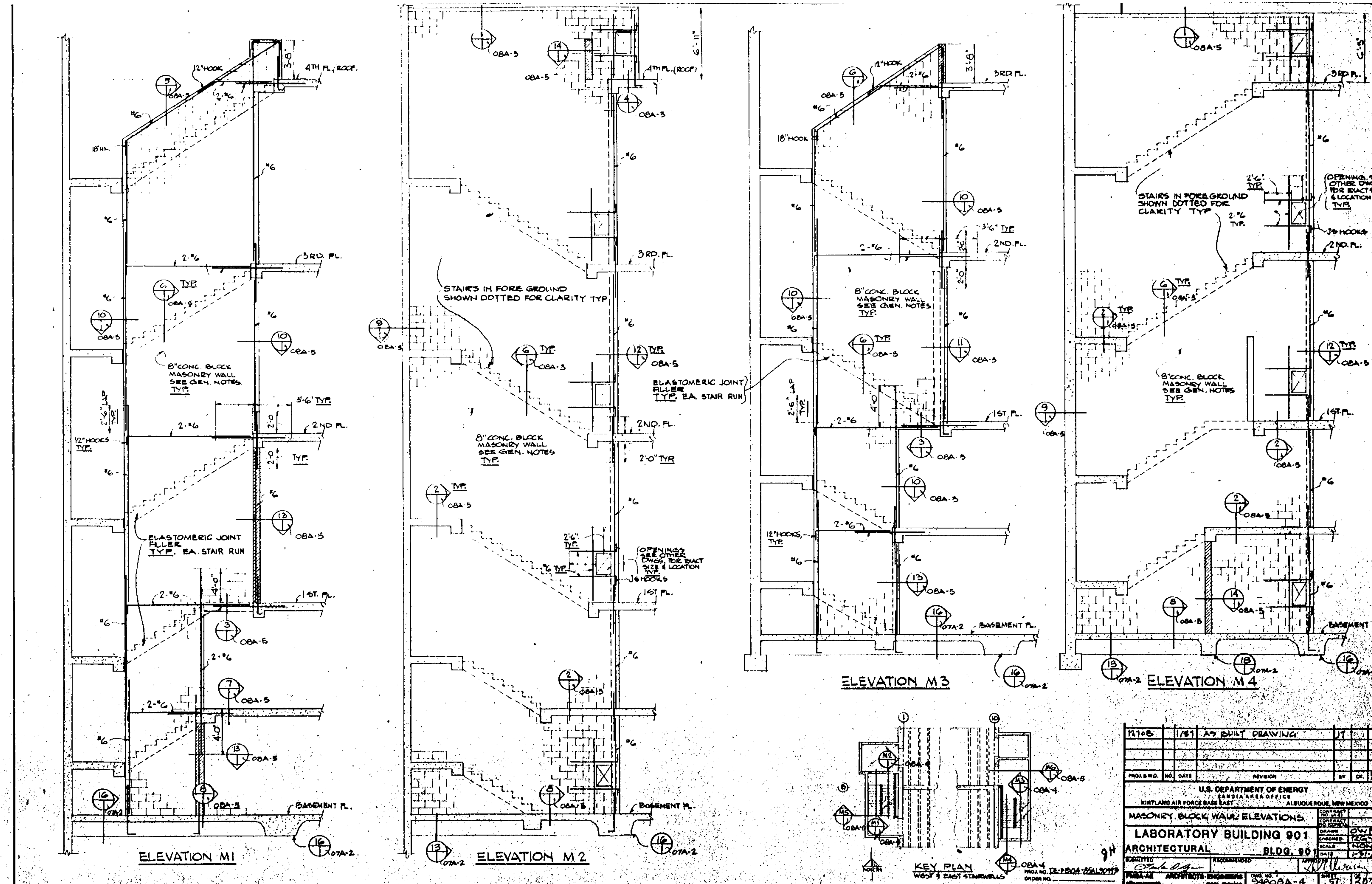
CONTRACT NO. (A-E)	
CONTRACT NO. (CONST.)	
DRAWN	AH
CHECKED	RGY
SCALE	1/8" = 1'-0"
DATE	1-31-85

SUBMITTED RECOMMENDED APPROVED

PROJ. NO. DE-FP04-85AL30993
ORDER NO.

FMSA-AE ARCHITECTS-ENGINEERS albuquerque new mexico

DWG. NO. 94800A-3 SHEET 56 307



PROJ. & W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
12108		1/81	AS BUILT DRAWING	JT		

U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

MASONRY BLOCK WALL ELEVATIONS

LABORATORY BUILDING 901

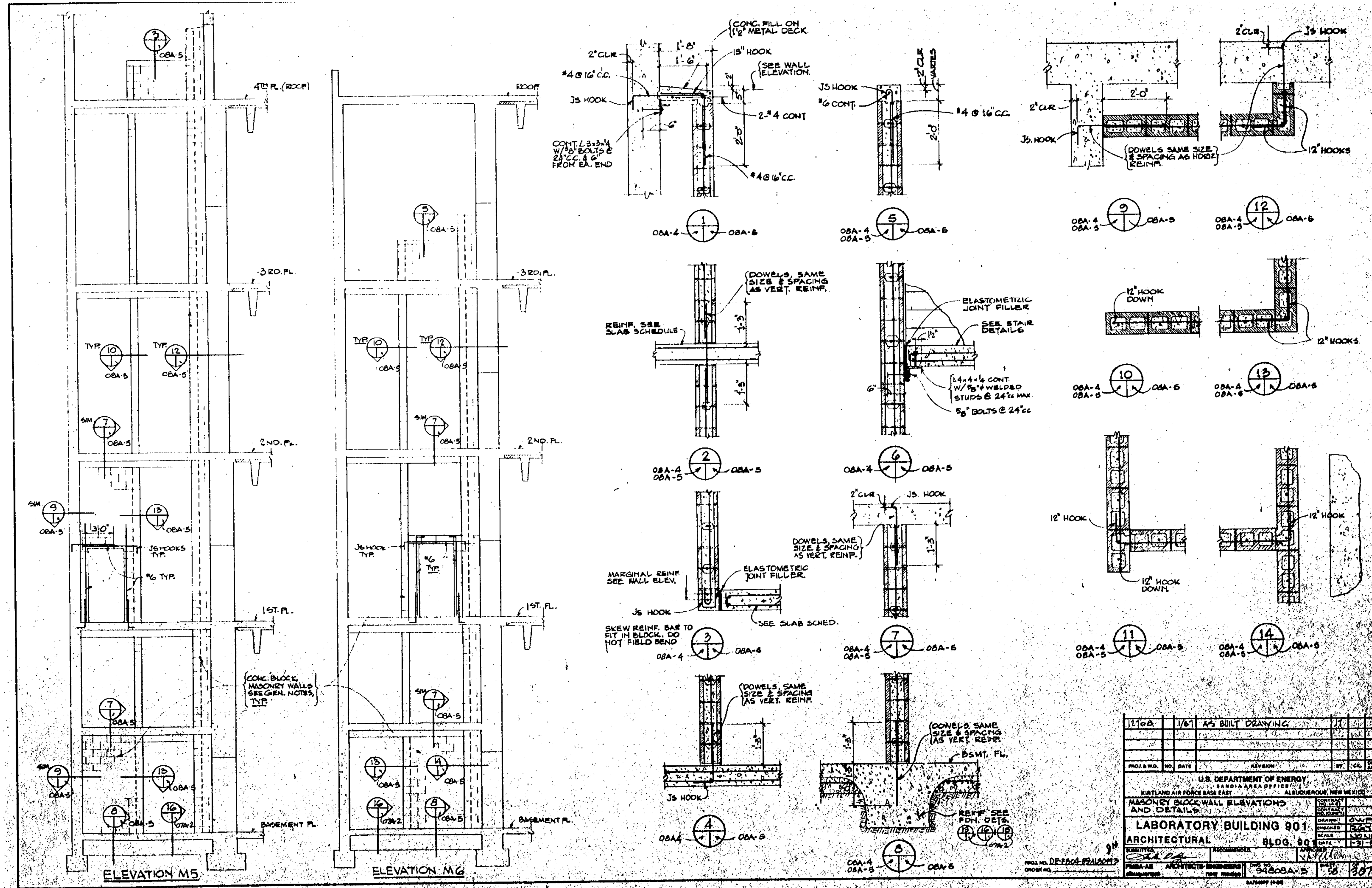
ARCHITECTURAL — BLDG. 901

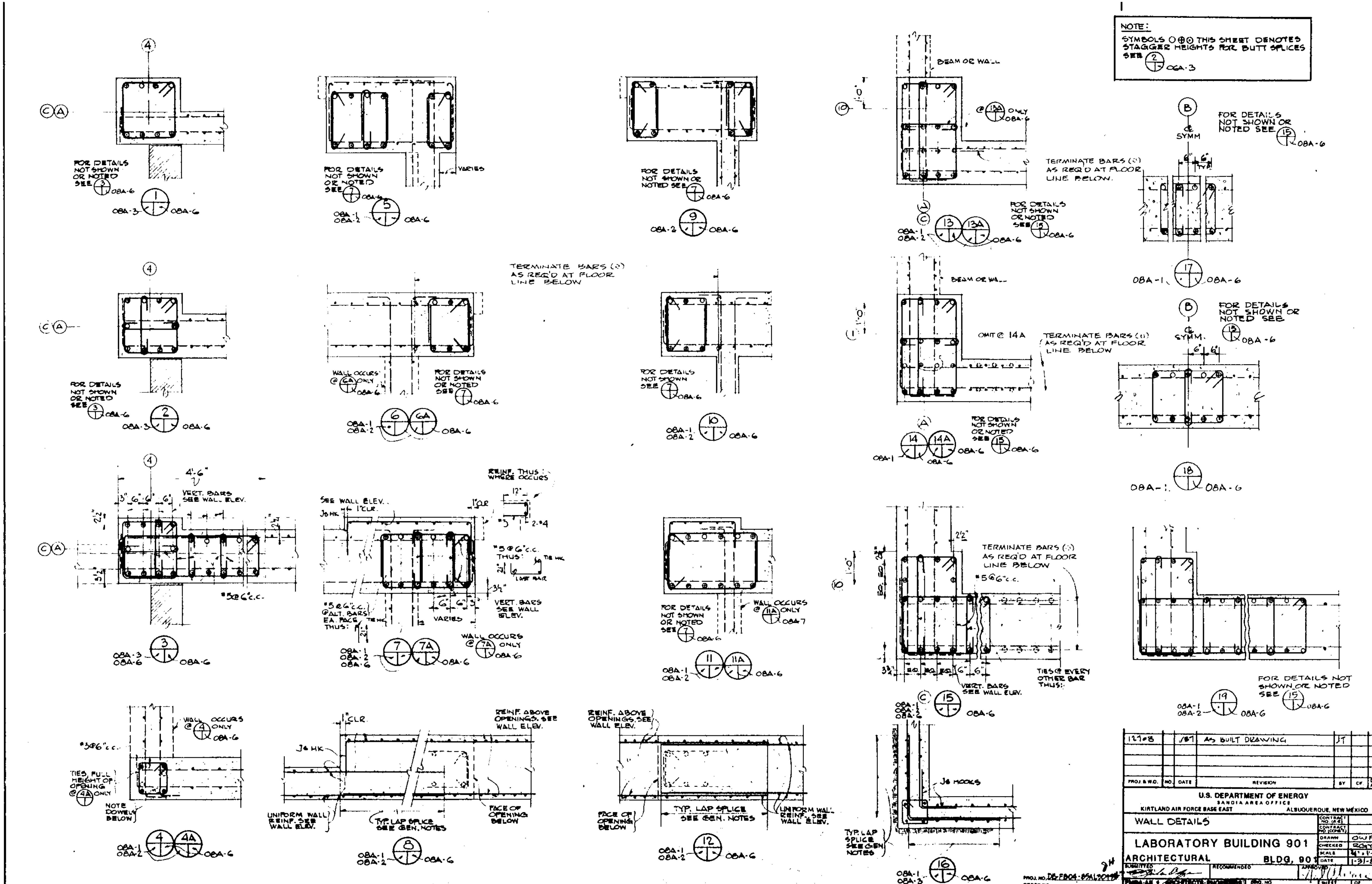
DRAWN	OW
CHECKED	RGY
SCALE	NONE
DATE	1-31-85

SUBMITTED — RECOMMENDED — APPROVED

FMSA-AE ARCHITECTS-ENGINEERS albuquerque new mexico

DWG. NO. 94808A-4 — SHEET 57 OF 307


ELEVATION M5
ELEVATION M6
4TH FL. (ROOF)
ROOF
3RD. FL.
2ND. FL.
1ST. FL.
BASEMENT FL.
CONC. BLOCK MASONRY WALLS SEE GEN. NOTES, TYP.
JS HOOKS TYP.
#6 TYP.
JS HOOK TYP.
CONC. FILL ON 1 1/2" METAL DECK
SEE WALL ELEVATION
2"CLR.
#4 @ 16" C.C.
JS HOOK
15" HOOK
2-#4 CONT
CONT. L 3x3x1/4 W/ 5/8" BOLTS @ 24" C.C. & 6" FROM EA. END
#6 CONT.
DOWELS, SAME SIZE & SPACING AS VERT. REINF.
REINF. SEE SLAB SCHEDULE
ELASTOMETRIC JOINT FILLER
SEE STAIR DETAILS
L4x4x1/4 CONT. W/ 5/8"φ WELDED STUDS @ 24" cc MAX.
5/8" BOLTS @ 24" cc
MARGINAL REINF. SEE WALL ELEV.
SEE SLAB SCHED.
SKEW REINF. BAR TO FIT IN BLOCK, DO NOT FIELD BEND
BSMT. FL.
REINF. SEE FDN. DETS.
DOWELS SAME SIZE & SPACING AS HORIZ. REINF.
12" HOOKS
12" HOOK DOWN
12" HOOK
12708 | 1/87 | AS BUILT DRAWING
U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO
MASONRY BLOCK WALL ELEVATIONS AND DETAILS
LABORATORY BUILDING 901
ARCHITECTURAL
BLDG. 901
PROJ. NO. DE-FB04-89AL30493
34808A-5
56
307



12/7/88	/87	AS BUILT DRAWING		JT		
PROJ & W.O.	NO.	DATE	REVISION	BY	CK	DOE APP.

U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

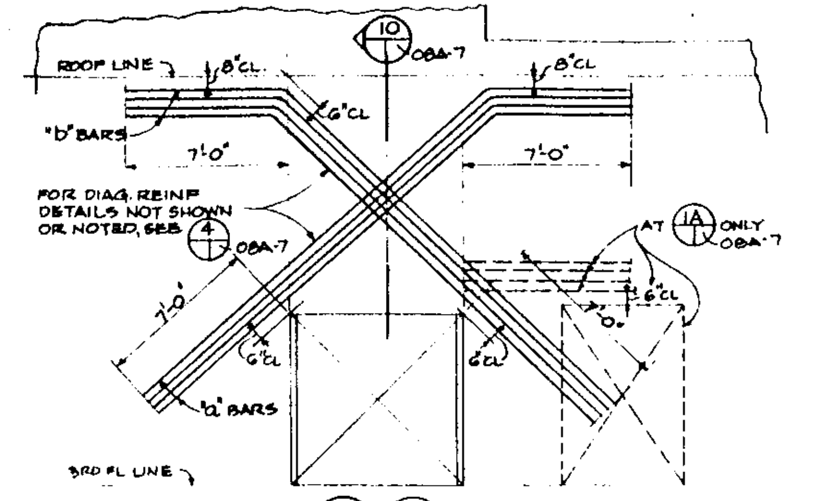
WALL DETAILS

LABORATORY BUILDING 901

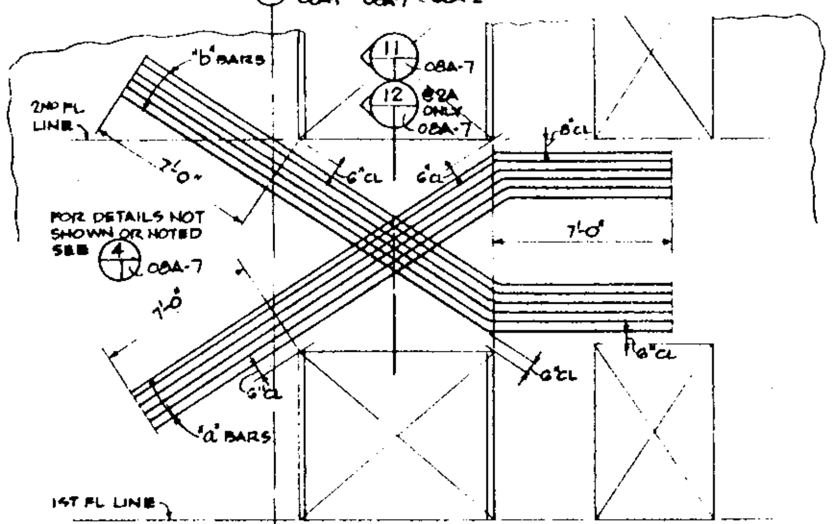
ARCHITECTURAL — BLDG. 901

DRAWN: OWP
CHECKED: RGSY
SCALE: 3/4"=1'-0"
DATE: 1-31-85

PROJ. NO. DE-FB04-85AL20148
DWG. NO. 94808A-6
SHEET 59 OF 307



1 / 08A-1 / 08A-7 — 1A / 08A-7 / 08A-2



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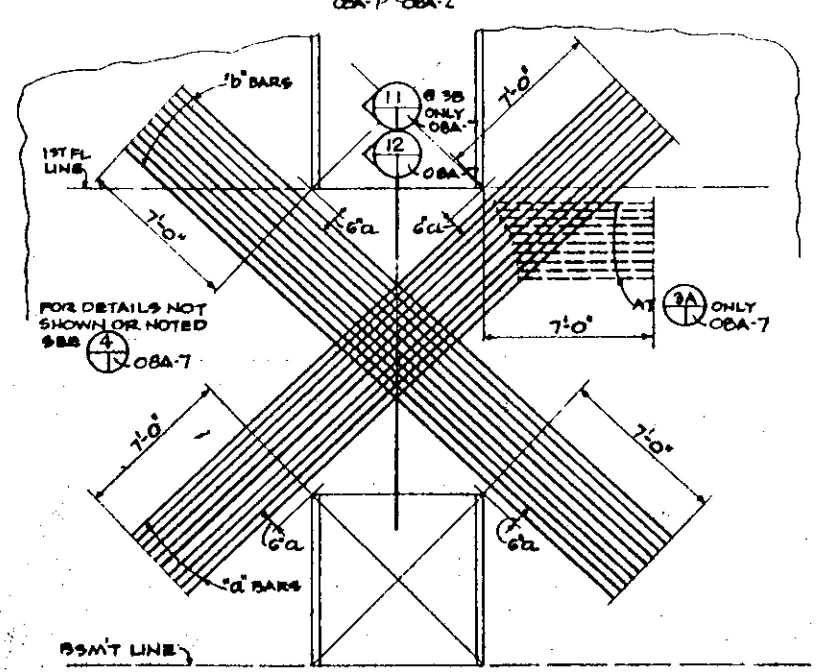

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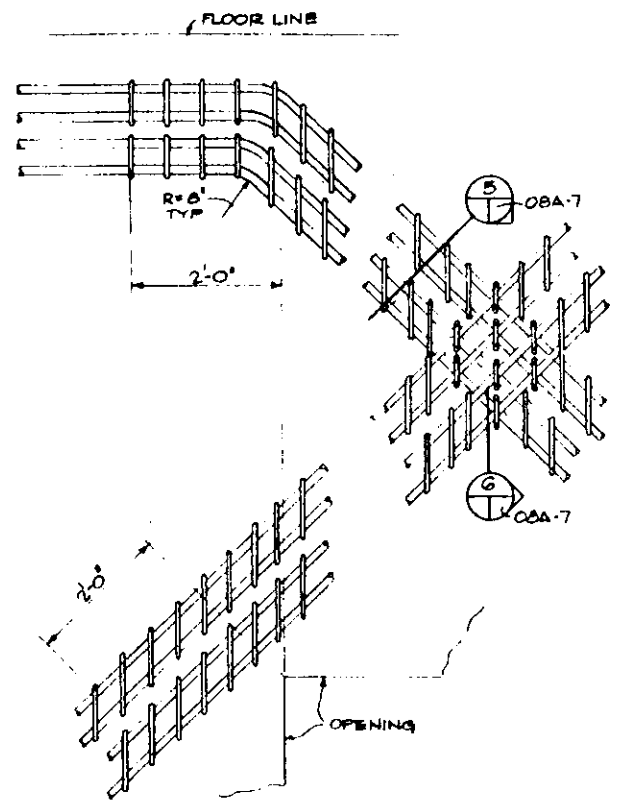

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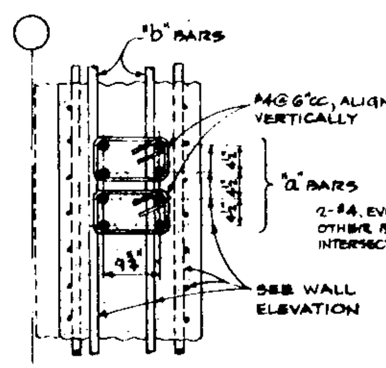
TYPICAL DIAGONAL REINFORCING



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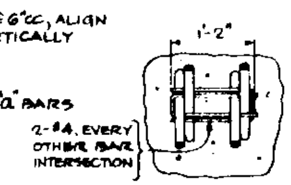

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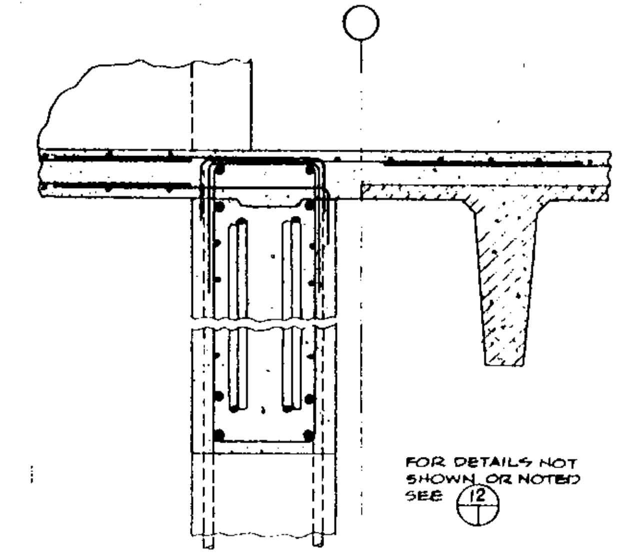

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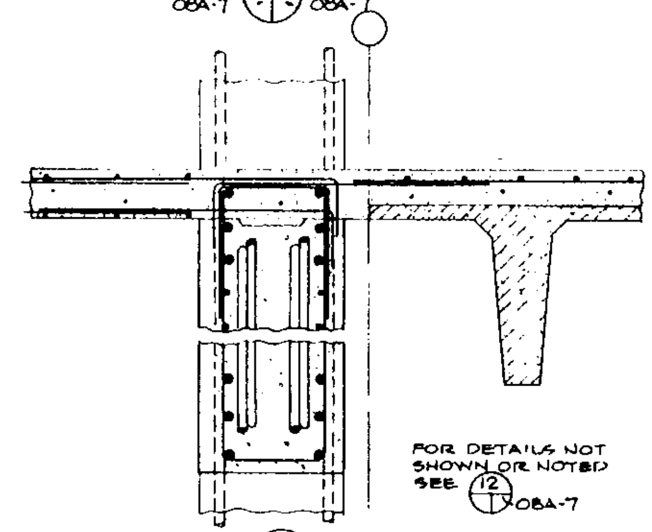

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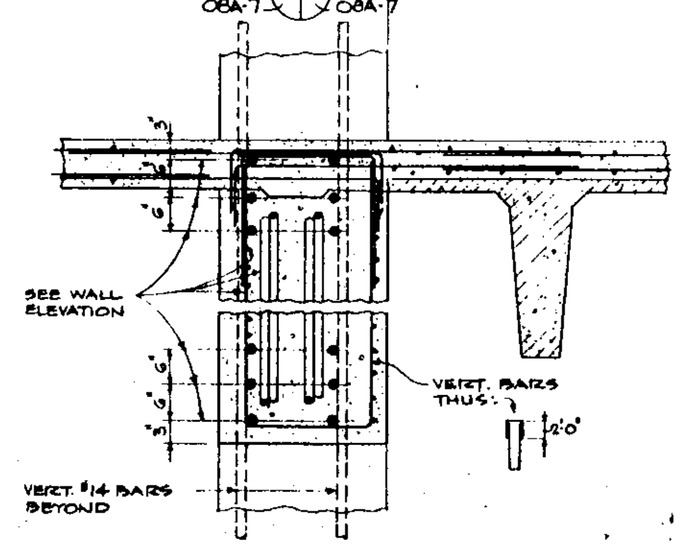


08A-7 12 08A-7

PROJ. & W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
12708		1/87	AS BUILT DRAWING	JT		

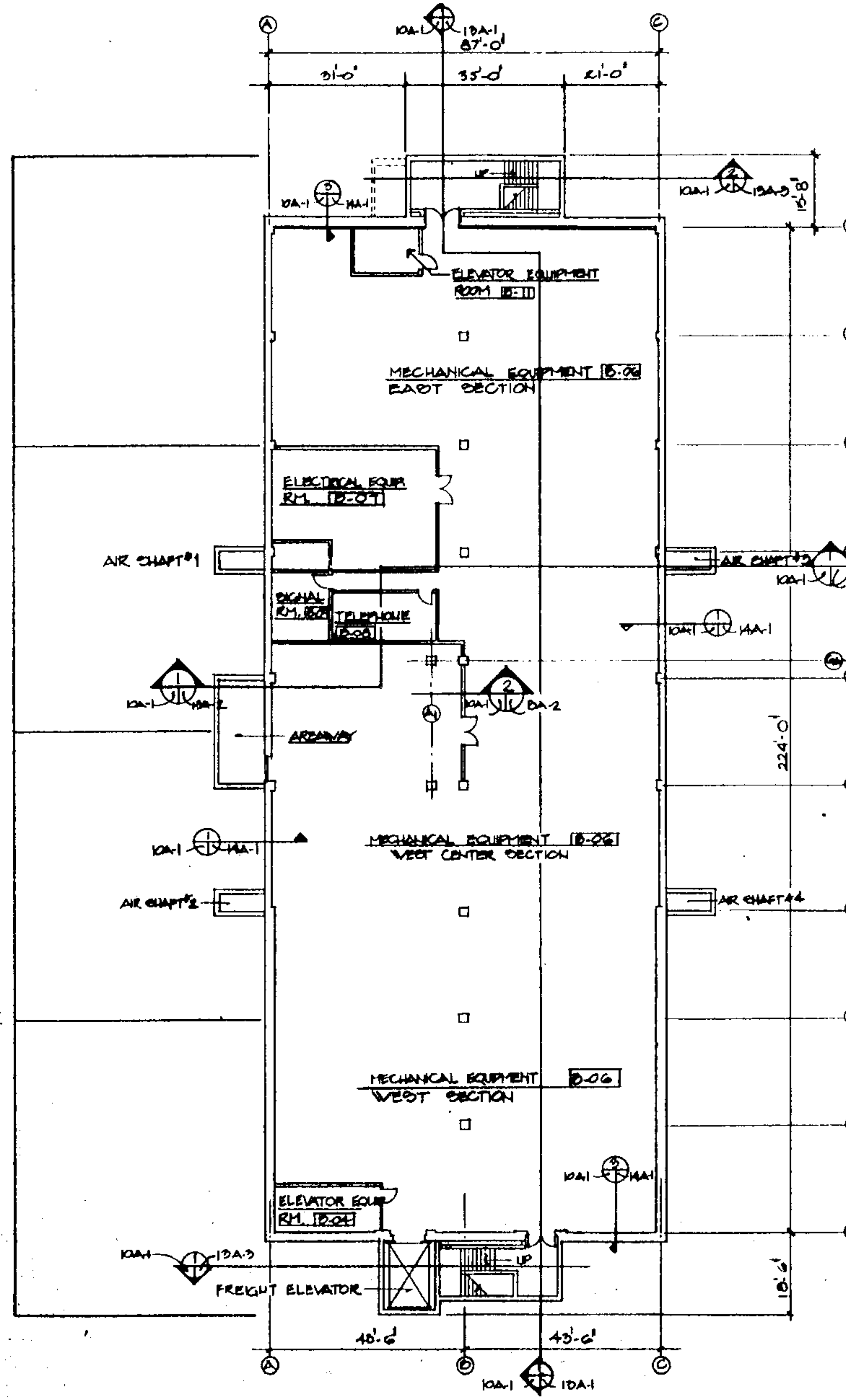
U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

WALL DETAILS

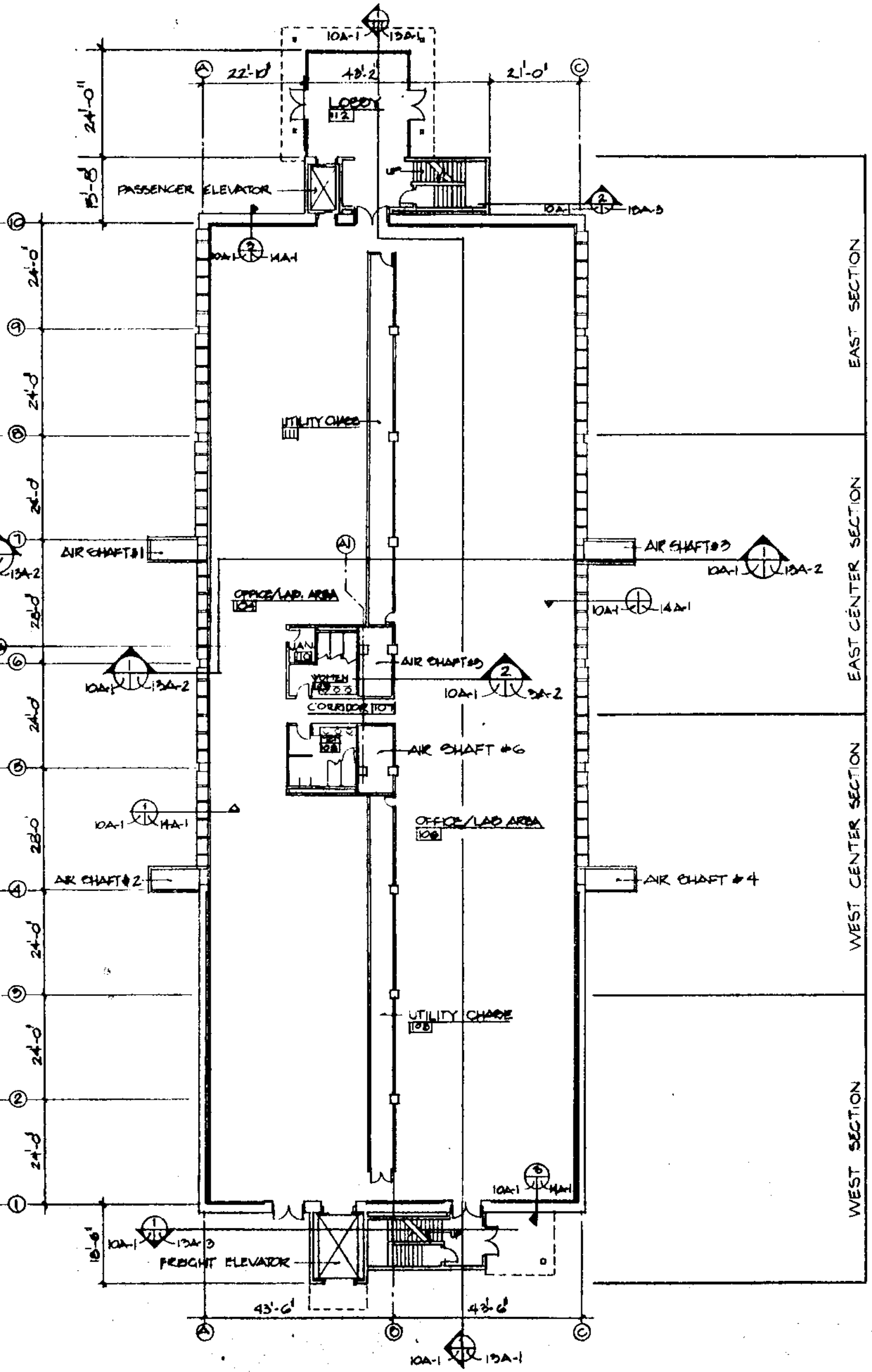
LABORATORY BUILDING 901
ARCHITECTURAL — BLDG. 901

DRAWN: AH
CHECKED: [illegible]
SCALE: NONE
DATE: 1-31-85

PROJ. NO. DE-FB04-85AL30993
ORDER NO.
DWG. NO. 94808A-7
SHEET 60 OF 307



BASEMENT FLOOR COMPOSITE PLAN
1/16" = 1'-0"



FIRST FLOOR COMPOSITE PLAN
1/16" = 1'-0"

GENERAL NOTES:

A. REFER TO DRAWING NUMBER 94800A-5 FOR MATERIALS LEGEND, SYMBOLS LEGEND, AND ABBREVIATIONS.

B. REFER TO DRAWING 94806A-1 FOR NOTES REGARDING CAST-IN-PLACE CONCRETE, REINFORCING STEEL, PRECAST CONCRETE, CONCRETE MASONRY UNITS, AND STRUCTURAL STEEL.

PROJ. & W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
12708		1/89	AS BUILT DRAWING	JT		

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KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

COMPOSITE PLANS
BASEMENT & FIRST FLOORS

LABORATORY BUILDING 901

ARCHITECTURAL — BLDG. 901

CONTRACT NO. (A-E): 12708
CONTRACT NO. (CONST.):
DRAWN: GH
CHECKED: OMS
SCALE: 1/16" = 1'-0"
DATE: 1-31-85

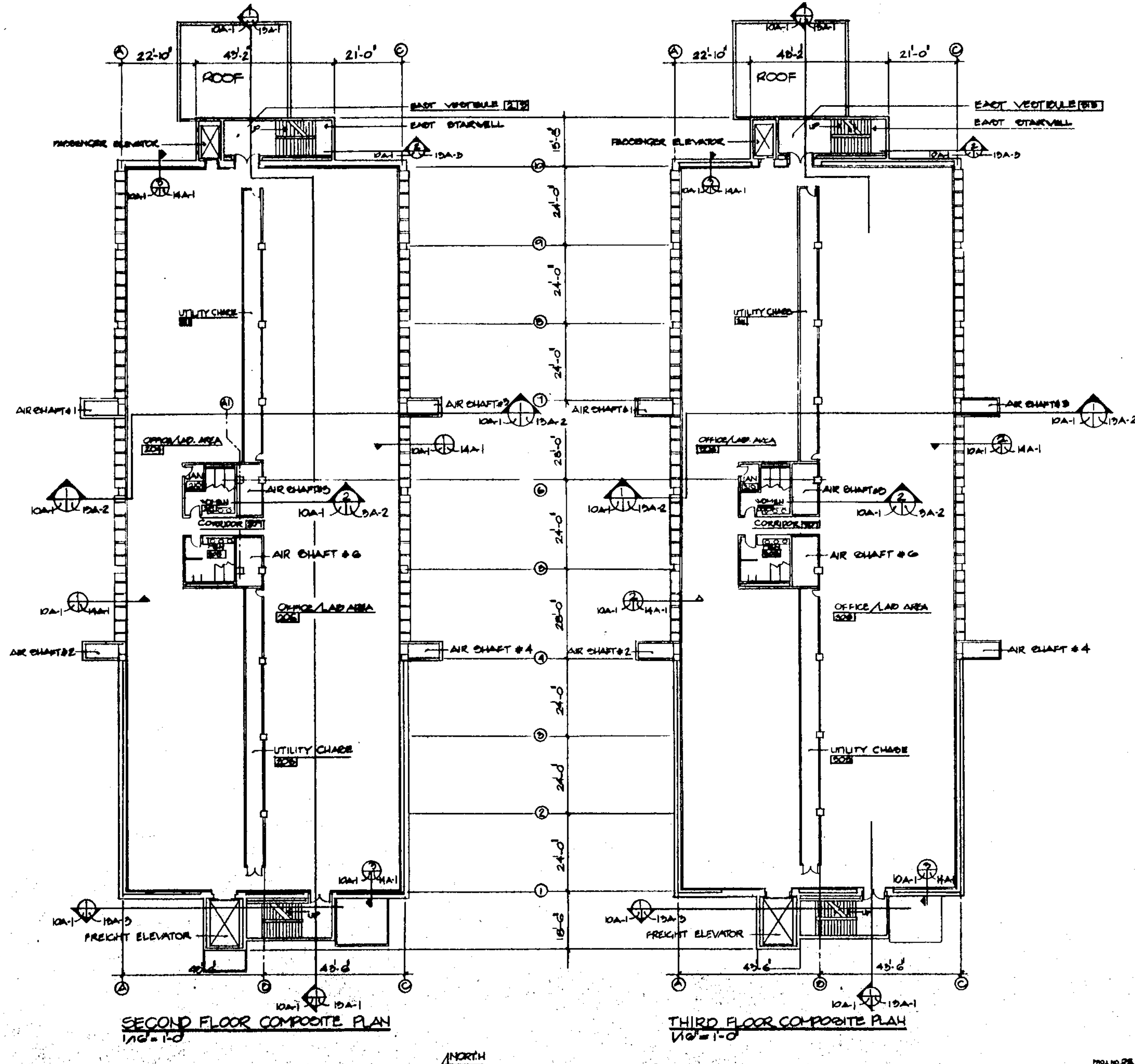
SUBMITTED / RECOMMENDED / APPROVED

FMSA-AE ARCHITECTS-ENGINEERS

DWG. NO. 94810A-1 — SHEET 61 OF 309

PROJ. NO. AE-FB04-85AL30955
ORDER NO.

9H



SECOND FLOOR COMPOSITE PLAN
1/16" = 1'-0"

THIRD FLOOR COMPOSITE PLAN
1/16" = 1'-0"

PROJ. & W.O.	NO.	DATE	REVISION	BY	CK.	DOE APP.
12708		1/87	AS BUILT DRAWING	JT		

U.S. DEPARTMENT OF ENERGY
SANDIA AREA OFFICE
KIRTLAND AIR FORCE BASE EAST — ALBUQUERQUE, NEW MEXICO

COMPOSITE PLANS
SECOND & THIRD FLOORS

LABORATORY BUILDING 901

9# ARCHITECTURAL — BLDG. 901

CONTRACT NO. (A-E)	12708
CONTRACT NO. (CONST.)	
DRAWN	CH
CHECKED	CKS
SCALE	1/16" = 1'-0"
DATE	1-31-58

SUBMITTED — RECOMMENDED — APPROVED

PROJ. NO. 26-FB04-B5ALB08
ORDER NO.

FMBA-AE ARCHITECTS-ENGINEERS Albuquerque — NEW MEXICO
DWG. NO. 94810 A-2
SHEET 62 OF 304