2019 CHAPTER/REGIONAL TECHNOLOGY AWARD APPLICATION

Johns Hopkins Bloomberg School of Public Health, Wolfe Street TR3 Laboratories

50

bkm

CHAPTER/REGIONAL TECHNOLOGY AWARD APPLICATION SHORT FORM

(Revision January 2016)

INTRODUCTION:

This Short Form has been developed to stimulate more participation in chapter and regional competition. ***This form is not intended to replace the full Society Technology Award Application form.*** *Regional winners using the short form will be required to complete the full Technology Award Application form before their applications can be forwarded for Society Competition. (This form does not require extensive narrative, plans or photographs.)*

INSTRUCTIONS:

A. The individual submitting the Technology Award Application must be a current member of ASHRAE who had a significant role in the design or development of the project.

B. Complete the "Short Form" and use it as the cover page.

C. Provide a system schematic/diagram not larger than 11" x 17" in size. In addition, attach a brief narrative (maximum of 2 pages). The narrative should include the gross and net building areas applicable to the project, a description of the major building areas (i.e.,operating rooms, laboratories, computer rooms, industrial processes, offices, warehouses) and a brief discussion regarding the following five criteria (if a criterion is not applicable, state accordingly):
   - Energy Efficiency
   - Indoor Air Quality
   - Innovation
   - Operation & Maintenance
   - Cost Effectiveness
   - Environmental Impact

D. Submit your schematic, brief narrative, and completed form to your Chapter Technology Transfer Committee Chapter (CTTC) Chair for judging at the chapter level in accordance with their instructions.

E. The ASHRAE Technology Award program is intended for built projects. First place winning projects should be eligible for submission to the Society level competition on September 1st of the following Society calendar year. Therefore, a project submitted to a Chapter or Regional competition shall be occupied prior to September 1st of the current Society year in order to satisfy the Society level competition requirement of one full year of occupancy.

   First place winners in each category from chapter competition will be submitted by the CTTC Chapter Chair to the CTTC Regional Vice Chair for judging in the Regional Technology Awards competition. At the discretion of the CTTC Regional Vice Chair, this may require completion of the full Society Technology Award Application form if the chapter submission was done on the Short Form Application.

   The CTTC Regional Vice Chair will invite first place winners in each category from regional competition to submit them for judging in the Society level Technology Awards competition. The regional winners will be given the opportunity to incorporate new information or otherwise improve their submittal before submitting it to the society level competition (e.g., by addressing comments from regional judges). At the discretion of the judging panels at the chapter and regional competitions, more than one first place winner may be awarded in each category.

   For the regional competition, submit the number of copies requested by the Regional CTTC Vice Chair. The CTTC Regional Vice Chair may require entries into the regional competition to be done on the full Society Technology Award Application form. In any case, all submissions to the Society level competition must be done on the full Society Technology Award Application form.

F. It is highly recommended that each entrant confirm by letter (and retain a copy for record) to the owner that the owner has granted permission to submit this project to competition.

NOTE: ASHRAE Technology Awards are the HVAC&R industry's most prestigious honor for efficient energy use in buildings and environmental system performance. While the awards do not certify responsible charge or professional license status, they do recognize outstanding design innovation and successful implementation.

CHAPTER/REGIONAL TECHNOLOGY AWARD - SHORT FORM

1. Category - Check one and indicate New, Existing, or Existing Building Commissioning (EBCx)

☐ Commercial Buildings	☐ New	☐ Existing or	☐ EBCx
Institutional Buildings:			
■ Educational Facilities	☐ New	■ Existing or	☐ EBCx
☐ Other Institutional	☐ New	☐ Existing or	☐ EBCx
☐ Health Care Facilities	☐ New	☐ Existing or	☐ EBCx
☐ Industrial Facilities or Processes	☐ New	☐ Existing or	☐ EBCx
☐ Public Assembly	☐ New	☐ Existing or	☐ EBCx
☐ Residential (Single and Multi-Family)			

2. Name of building or project: JHU Bloomberg School of Public Health TR3 Lab Energy Reduction

City/State: Baltimore, MD

3. Project Description: BKM provided MEP design services for conversion of supply air terminal units and exhaust air terminal units service fume hoods from constant volume to variable volume for 26 labs in the TR-3 Building, including an area of approximately 62,000 square feet. The TR-3 Building was built in 2001 as a research laboratory facility and integrated infill to the surrounding adjacent buildings.

Project Study/Design Period: 9/15/15 (Begin date (mm/yyyy)) to 11/17/2015 (End date (mm/yyyy))

Percent Occupancy at time of submission: 100%

4. Entrant (ASHRAE member with significant role in project):

a. Name: Collins, Jr., PE, William, J. (Last, First, Middle)

Membership Number: 2040382

Chapter: Baltimore

Region: III

b. Address (including country): 6300 Blair Hill Lane, Suite 400

Baltimore (City) | MD (State) | 21209 (Zip) | USA (Country)

c. Telephone: (O) 410-323-0600 d. Email: bcollins@bkma.com

e. Member's Role in Project: Principal-in-Charge

f. Member's Signature:

5. Engineer of Record: William J. Collins, Jr., PE

By affixing my signature above, I certify that the information contained in this application is accurate to the best of my knowledge. In addition, I certify that I have discussed this entry with the owner and have received permission from the owner to submit this project to the ASHRAE Technology Awards Competition.

Project Overview

BKM provided MEP design services for conversion of supply air terminal units and exhaust air terminal units service fume hoods from constant volume to variable volume for 26 labs in the TR-3 Building, including an area of approximately 62,000 square feet. The TR-3 Building was built in 2001 as a research laboratory facility and integrated infill to the surrounding adjacent buildings.

The building encompasses eight occupied floors and a penthouse, mostly consisting of laboratory space. The existing HVAC systems consist of a pair of custom air handling units located in the penthouse and laboratory exhaust fans located on the roof. The air handling units are 100% outside air with no energy recovery and served by district heating and cooling. The air handling units supply fans provide 49,000 CFM of conditioned air for each air handling unit using 75 HP fan motors, for a total supply fan output of 150 HP. The supply fan motors have variable speed drives but were operating at constant air volume. The existing exhaust fan (EF-5) that serves the project area, which consists of an array of four (40 HP) fans were also operating at constant speed and airflow.

In order to maximize energy savings, the supply and exhaust systems were converted from constant air volume to variable air volume systems. Several modifications were made to allow for the conversion; 1) existing constant volume terminal units were retrofitted to variable flow terminal units, 2) existing fume hood were fitted with occupancy sensors to allow the airflow to reduce to a minimum flow position when not in use, 3) space occupancy sensors were added to the labs to permit the total supply and exhaust air to reduce when the labs were unoccupied, whether during nights and weekends, or during normal business hours, and 4) control sensors and strategies were provided to vary the main air handling units and exhaust fan EF-5 as occupancies changed throughout business and non—business hours. The modified control system ensured proper lab pressurization.

A custom BGE incentive was prepared by BKM to offset construction costs, utilizing an energy model of the building with pre- and post-demolition airflow testing to verify the anticipated results.

M/E/P Systems Overview:

- Central System: Chilled water service for the TR3 Labs is delivered from the existing central chilled water plant, which also supplies most critical use buildings on the JHU campus. The existing chilled water plant uses a primary-secondary pumping system with variable frequency controls. Steam is also supplied from an existing central boiler plant to provide heat for the building.
- Air Distribution System: Two existing custom 100% outdoor air handling units (AHUs), located in the building penthouse, provide conditioned air to all occupied spaces. The units operate to maintain constant air pressurization, but have the capability through the building automation system (BAS) and variable frequency drives to decrease in airflow as total load reduces. From historic trending data, it was observed that prior to this project the units operated at 95-100% fan speed throughout all times of the year in order to maintain airflow differential pressures at the laboratories. Laboratory spaces are served by multiple supply and exhaust air terminal units, with dedicated control to each fume hood and bio-safety cabinet. Total airflow to laboratories spaces range from 12 – 15 air changes per hour prior to this project. At the completion of the project, laboratories are now capable of reducing airflow down to 6 air changes per hour in the unoccupied mode. Occupancy is determined by room level as well as hood level occupancy sensors. The supply and exhaust air systems communicate through the BAS to ensure the proper pressurization is achieved in each room, fume hood or biosafety cabinet.
- Lighting control has been provided in each room to shut off lights in response to occupancy. Occupancy is provided by room level and hood level occupancy sensors tied into the BAS system.
- Automatic Temperature Control Systems: Automatic temperature controls are direct digital control (DDC) type BAS with electric actuation. Each control function and associated control point of all mechanical equipment was incorporated into the building temperature control system.
- All temperature, relative humidity and pressurization control work interfaces with the existing dedicated BAS. The BAS is a web-based system with a BACnet communication platform. A dedicated workstation with color graphics to illustrate all HVAC systems, allows the Owner to view the operation of the systems and provides alarm reports should there be a condition where part of a system deviates

from its set point.

– All major mechanical equipment items (air handling units, pumps, heat exchangers, etc.), as well as all air terminals, sensors, and dampers are capable of being controlled and/or monitored locally at the building BAS and via web-based interface.

– Commissioning was provided during the design and construction.

Ventilation

All spaces served by the systems are 100% outside air once-through air handling units. Total ventilation far exceeds ASHRAE minimum values due to airflow rates being determined by minimum air change per hour values driven by university safety standards.

Energy Efficiency:

The project was primarily driven by energy savings, with a focus on reducing laboratory airflow through modification of existing controls and VAV air terminal controllers. Energy efficiency is gained by reduction of fan energy in supply airflow from variable frequency drive modulation, reduction of fan energy in exhaust airflow from staging of fan array on/off operation, and coincident reduction in chilled water consumption at the existing central chilled water plant.

Indoor Air Quality:

Due to nature of the work at TR3, which includes biological experimentation laboratories and 100% outdoor air, the quality of the indoor air is excellent. All rooms are the beneficiaries of a minimum of three filtration levels including 95% (MERV 14), with the select spaces adding a HEPA filter for a higher level of indoor air quality.

Innovation:

The project creatively stages main laboratory exhaust fans in a fan array to reduce overall airflow to the building while at the same time maintaining building safety. The existing exhaust fans have fixed discharge outlets, necessitating a staged operation of fans shutting down in response to decreased airflow demand, in order to maintain minimum.

Operation & Maintenance:

– Operation: Operations are largely unaffected as existing equipment and overall controls schemes are maintained.

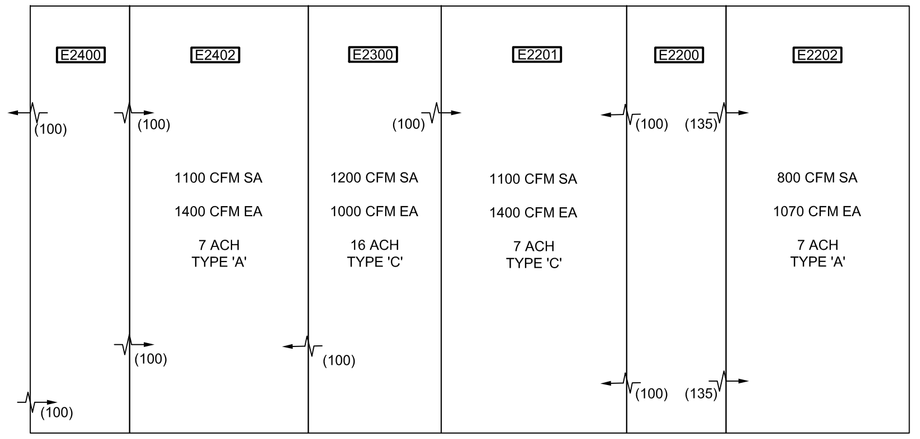
– Maintenance: Little impact to maintenance through the use of existing systems. Fan components and parts will see less replacement from a reduction in VFD speed.

Cost Effectiveness:

– The project was a very cost effective solution, relying on modifications to existing equipment, controls, and airflow balancing. The expected payment from actual cost of construction is estimated to be between 1-1/2 to 2 years.

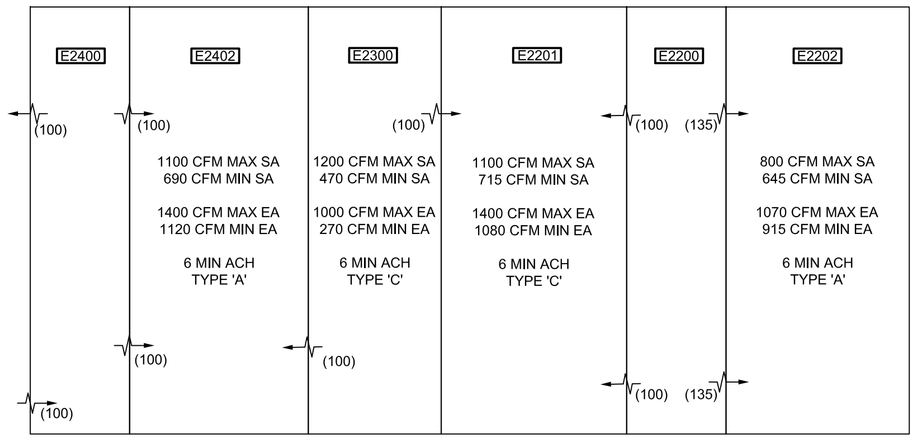
Environmental Impact:

– The reduction in fan energy at the building and cooling energy at the central plant level has a major environmental savings impact.



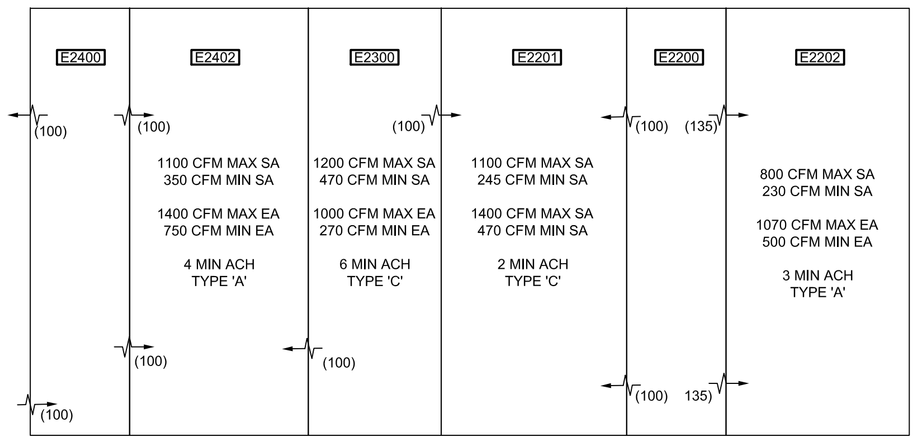
1 SECOND FLOOR PLAN - PRESSURIZATION - EXISTING

NO SCALE



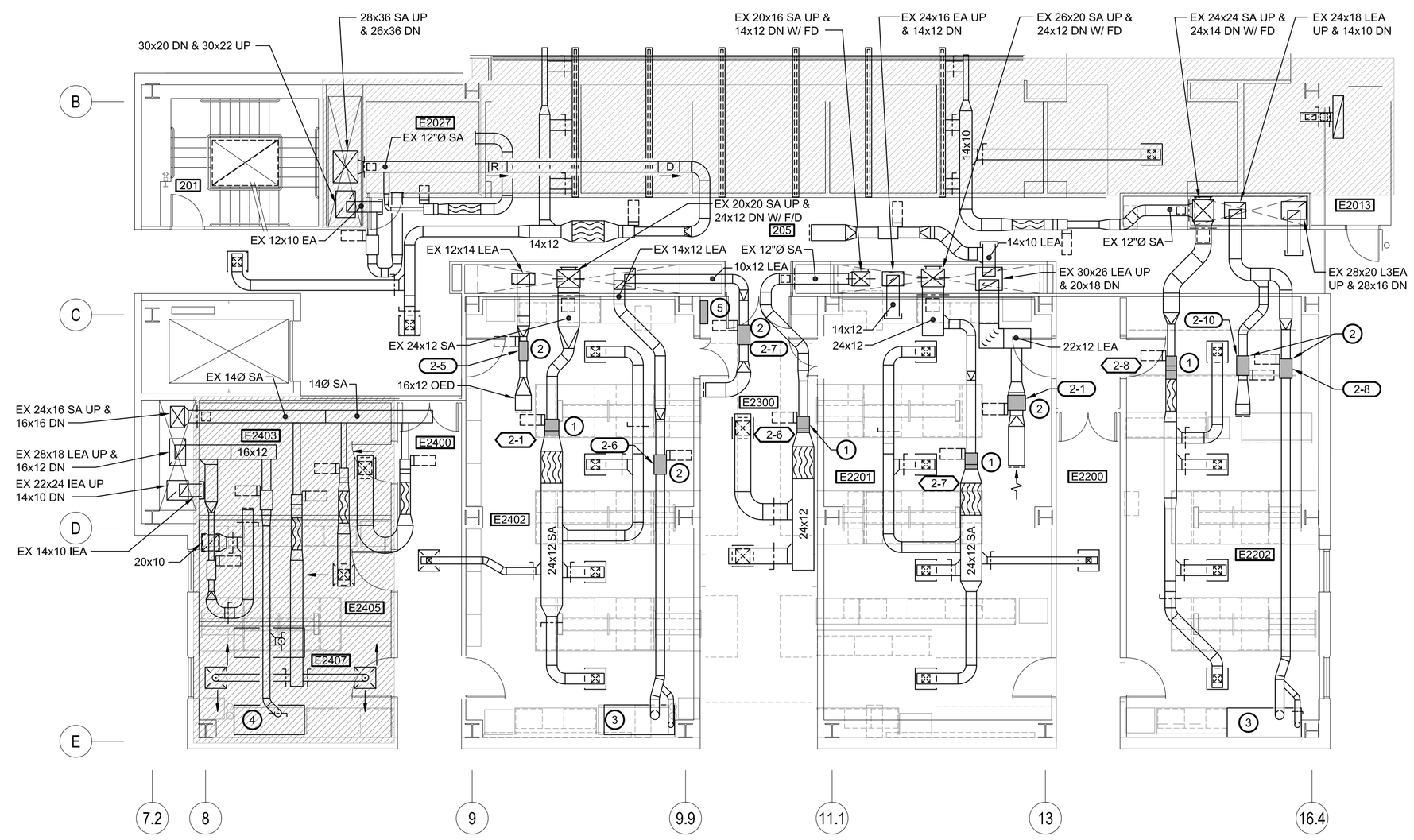
2 SECOND FLOOR PLAN - PRESSURIZATION - OCCUPIED

NO SCALE



3 SECOND FLOOR PLAN - PRESSURIZATION - UNOCCUPIED

NO SCALE



4 SECOND FLOOR PLAN - HVAC - NEW WORK

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

2ND FLOOR EXHAUST AIR VOLUME TERMINAL UNIT SCHEDULE

DESIG	MAX AIRFLOW (CFM)	MIN OCCUPIED AIRFLOW (CFM)	MIN UNOCCUPIED AIRFLOW (CFM)	EX INLET SIZE	SERVICE	CONTROLLER TYPE	REMARKS
2-1	1400	1080 (3)	470	12	E2201	NOTE 2	NOTE 1
2-5	750	300 (3)	250	8	E2402	NOTE 2	NOTE 1
2-6	820	820	500	10	E2402 FUME HOOD	NOTE 2	NOTE 1
2-7	1000	270 (3)	270 (4)	10	E2300	NOTE 2	NOTE 1
2-8	820	820	500	10	E2202 FUME HOOD	NOTE 2	NOTE 1
2-10	250	95 (3)	0	5	E2202	NOTE 2	NOTE 1

NOTES:
1. EXISTING TERMINAL TO BE RE-BALANCED.
2. PROVIDE NEW VARIABLE AIR VOLUME CONTROLLER.
3. CFM VALUE CALCULATED BASED ON 6 AIR CHANGES PER HOUR.
4. CFM VALUE BASED ON AIR TERMINAL UNIT MINIMUM.

2ND FLOOR SUPPLY AIR VOLUME TERMINAL WITH HOT WATER REHEAT SCHEDULE

DESIG	MAX AIRFLOW (CFM)	MIN OCCUPIED AIRFLOW (CFM)	MIN UNOCCUPIED AIRFLOW (CFM)	EX INLET SIZE (IN)	SERVICE	ASSOCIATED EXHAUST AIR TERMINAL UNITS	AIRFLOW DIFFERENTIAL (CFM)	REMARKS
2-1	1200	750	380 (3)	12	E2402	2-5, 2-6	370	NOTE 1
2-6	1200	470 (2)	470 (2)	10	E2300	2-7	200	NOTE 1
2-7	1200	780 (2)	270 (3)	10	E2201	2-1	200	NOTE 1
2-8	800	645 (2)	230	8	E2202	2-8, 2-10	270	NOTE 1

NOTES:
1. EXISTING TERMINAL TO BE RE-BALANCED.
2. CFM VALUE CALCULATED BASED ON 6 AIR CHANGES PER HOUR.
3. CFM VALUE CALCULATED BASED ON AIR TERMINAL UNIT MINIMUM.

GENERAL NOTES:

1. REFER TO M0.01 FOR MECHANICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.
2. REFER TO ELECTRICAL DIVISION FOR OCCUPANCY SENSORS LOCATION.
3. LAB TYPE REFERENCE:
   TYPE "A" - SUPPLY TERMINAL, FUME HOOD EXHAUST TERMINAL AND EXHAUST TERMINAL.
   TYPE "B" - SUPPLY TERMINAL, AND FUME HOOD EXHAUST TERMINAL.
   TYPE "C" - SUPPLY TERMINAL, AND EXHAUST TERMINAL.
4. ALL WORK SHALL BE LIMITED TO A MAXIMUM OF TWO (2) FLOORS CONCURRENT ACTIVE CONSTRUCTION AND A MAXIMUM OF ONE (1) ADDITIONAL FLOOR, FULLY COMMISSIONED, TO UNDERGO TESTING AND BALANCING. CONSTRUCTION SHALL PROCEED THROUGH BUILDING FLOORS SEQUENTIALLY, STARTING WITH ROOF AND COMPLETING ON SECOND FLOOR.

DRAWING NOTES:

1. BALANCE EXISTING SUPPLY TERMINAL UNIT TO OCCUPIED AND UNOCCUPIED AIR FLOW VALUES. PROVIDE EXISTING TERMINAL UNIT WITH NEW VARIABLE AIRFLOW CONTROLLER.
2. BALANCE EXISTING EXHAUST TERMINAL UNIT TO OCCUPIED AND UNOCCUPIED AIR FLOW VALUES. PROVIDE EXISTING TERMINAL UNIT WITH NEW VARIABLE AIRFLOW CONTROLLER.
3. EXISTING FUME HOOD, PROVIDE NEW TSI FUME HOOD VELOCITY SENSOR AND FUME HOOD MONITOR, MODEL FHM10.
4. EXISTING BIOSAFETY CABINET. EXISTING EXHAUST AIR TERMINAL SERVING BIOSAFETY CABINET SHALL NOT BE MODIFIED.
5. AUTOMATIC TEMPERATURE CONTROLS PANEL TO SERVE SECOND AND THIRD FLOORS.

ROOM NAME LIST

201	STAIRS
205	CORRIDOR
E2013	ELECTRIC/ PHONE
E2027	DATA
E2200	CORRIDOR
E2201	LAB - "NC"
E2202	LAB - "N"
E2300	EQUIPMENT CORRIDOR
E2400	CORRIDOR
E2402	LAB - "SC"
E2403	EQUIPMENT ROOF
E2405	PCR LAB
E2407	TISSUE CULTURE LAB
-	WARM ROOM

N

0 4' 8' 16' 24'

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

JOHNS HOPKINS
BLOOMBERG SCHOOL of PUBLIC HEALTH

TR3 LAB ENERGY REDUCTION

bkm
Burdette, Koehler, Murphy & Associates, Inc.
1416 Clarkview Road | Baltimore, Maryland 21209
P: 410.323.0600 | www.bkma.com

JOHNS HOPKINS SCHOOL OF PUBLIC HEALTH
FACILITIES MANAGEMENT
2007 East Monument Street
Baltimore, Maryland 21205
410-955-3451 410-955-0242 FAX

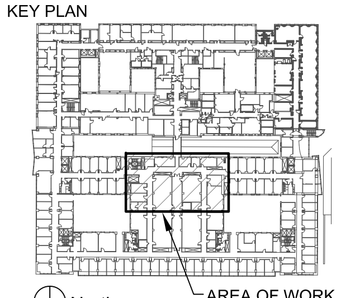
PROJECT LOCATION:
615 N. Wolfe St
Baltimore, MD 21205

Seal

PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND.
LICENSE NO. _____,
EXPIRATION DATE: _____.

Number	Date	Revision
	11/17/15	100% CD SUBMISSION

KEY PLAN

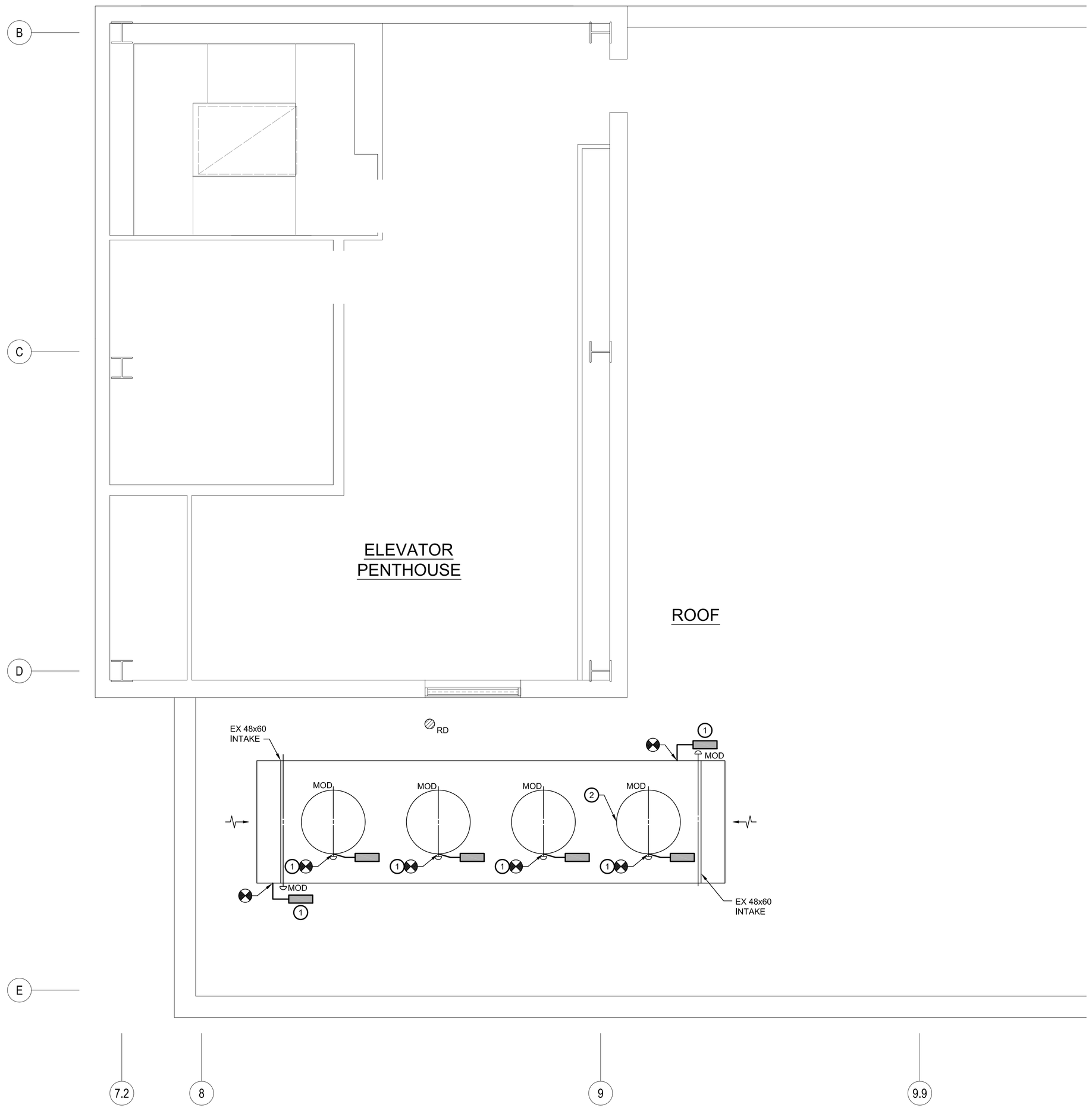


SECOND FLOOR PLANS
HVAC - NEW WORK

Drawn By	Scale	Date
CS	AS NOTED	11/17/15

Drawing No.
M1.01

BKM: 15107.01



GENERAL NOTES:

1. REFER TO M0.01 FOR MECHANICAL LEGEND, ABBREVIATIONS AND GENERAL NOTES.

○ DRAWING NOTES:

1. REPLACE EXISTING AUTOMATIC CONTROL DAMPER ACTUATOR AND CURRENT END SWITCH WITH NEW.
2. EXISTING LABORATORY EXHAUST FAN, TYPICAL OF 4.

1 ROOF PLAN - MECHANICAL - NEW WORK

SCALE: 1/4" = 1'-0"

N

0 2' 4' 8' 12'

SCALE: 1/4" = 1'-0"

JOHNS HOPKINS
BLOOMBERG SCHOOL
of PUBLIC HEALTH

TR3 LAB ENERGY REDUCTION

bkm

Burdette, Koehler, Murphy & Associates, Inc.

1416 Clarkview Road | Baltimore, Maryland 21209
P: 410.323.0600 | www.bkma.com

JOHNS HOPKINS SCHOOL OF PUBLIC HEALTH

FACILITIES MANAGEMENT

2007 East Monument Street
Baltimore, Maryland 21205
410-955-3451 410-955-0242 FAX

PROJECT LOCATION:
615 N. Wolfe St
Baltimore, MD 21205

Seal

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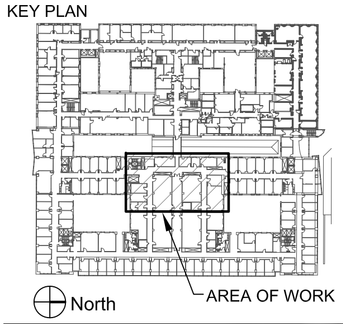
KEY PLAN



ROOF PLAN
MECHANICAL
NEW WORK

Drawn By	Scale	Date
CS	AS NOTED	11/17/15

Drawing No.

M1.08

BKM: 15107.01

ATC GENERAL NOTES

MC023

1. THE ATC WORK SHALL INCLUDE PROVISIONS FOR A COMPLETE AND OPERABLE CONTROL SYSTEM, INCLUDING ALL DEVICES REQUIRED TO ACHIEVE THE SEQUENCES AND FUNCTIONS INDICATED THROUGHOUT THE CONTRACT DOCUMENTS.
2. THE ATC CONTRACTOR SHALL FURNISH AND INSTALL ALL ELECTRICAL WIRING AND CONDUIT FROM POWER SOURCE, INCLUDING TERMINATION TO ALL REQUIRED ATC RELATED POWER CONNECTIONS INCLUDING, BUT NOT LIMITED TO, DDC CONTROLLERS (PROVIDE LOW VOLTAGE CONTROLLER FOR AIR TERMINAL UNITS INCLUDING TRANSFORMERS AND DISCONNECT SWITCHES AS REQUIRED), SENSORS, VALVE AND DAMPER ACTUATORS (INCLUDING SMOKE DAMPERS), AIR FLOW MONITORS, ATC PANELS, ETC. THE ATC CONTRACTOR SHALL OBTAIN A SEPARATE ELECTRICAL PERMIT AS REQUIRED BY THE LOCAL AUTHORITY. THE ATC CONTRACTOR SHALL BE WHOLLY RESPONSIBLE FOR ALL POWER REQUIREMENTS NECESSARY FOR A COMPLETE INSTALLATION FROM THE POWER SOURCE TO ALL ATC RELATED CONNECTIONS.
3. PROVIDE EQUIPMENT STATUS FOR ALL MECHANICAL EQUIPMENT. EQUIPMENT FAILURES SHALL BE ALARMED AT THE BAS.
4. ALL SAFETIES FOR THE AIR HANDLING EQUIPMENT (PRESSURE SWITCHES, ETC.) SHALL BE HARDWIRED TO THE FAN STARTER.
5. THE ATC CONTRACTOR SHALL PROVIDE ALL CONTROLLERS, DEVICES, POINTS, ETC. REQUIRED TO ACCOMPLISH THE CONTROL SEQUENCES AND FUNCTIONS INDICATED ON THE DRAWINGS AND IN THE SPECIFICATIONS. ALL POINTS SHALL BE TIED INTO THE BAS. IN ADDITION, THE ATC CONTRACTOR SHALL PROVIDE ALL CONTROLLERS, DEVICES, POINTS, ETC REQUIRED TO CONTROL, OPERATE AND MONITOR ALL EQUIPMENT (IE. AIR VOLUME TERMINALS, FANS, DAMPERS, FLOW MEASURING DEVICES, SENSORS, ETC.) INDICATED THROUGHOUT THE CONTRACT DOCUMENTS.
6. PROVIDE END SWITCHES FOR ALL MOTOR OPERATED DAMPERS. END SWITCHES SHALL BE INTERFACED WITH THE BAS.
7. PROVIDE CURRENT SENSING RELAYS FOR ALL MECHANICAL EQUIPMENT AS REQUIRED TO PROVIDE EQUIPMENT STATUS. EQUIPMENT STATUS SHALL BE INDICATED AS THE BAS.
8. PROVIDE OCCUPANCY SENSORS IN EACH LABORATORY AND OTHER SPACES AS INDICATED ON PLANS. OCCUPANCY SENSORS SHALL BE UTILIZED FOR CONTROL OF SUPPLY AND EXHAUST AIR TERMINAL UNITS.
9. ALL ATC DEMOLITION SHALL BE PERFORMED BY THE ATC CONTRACTOR ONLY.
10. ALL SETPOINTS INDICATED ON THE SEQUENCES SHALL BE ADJUSTABLE.
11. ALL ATC WIRING SHALL BE INSTALLED IN CONDUIT.
12. ATC CONTRACTOR SHALL SIZE VAC CONTROL TRANSFORMER TO ACCOMMODATE ALL VAV BOXES ON THE PROJECT. PROVIDE 120 VAC CIRCUIT FROM EXISTING POWER SYSTEM. 120 VAC TO ATC PANEL SHALL HAVE AN EARTH GROUNDING.
13. PROVIDE CABLING AND PANELS TO INTERFACE AND INTERCONNECT TO EXISTING HEAD-END SERVING THE BUILDING. COORDINATE PANEL LOCATION AND TIE-IN TO EXISTING SYSTEM WITH OWNER'S REPRESENTATIVE IN FIELD.
14. PROVIDE MINIMUM 15-MINUTE UPS BACKUP POWER FOR ALL NEW ATC PANELS, PROVIDED BY ATC CONTRACTOR.
15. ALL DATA INSTALLATION FOR ATC CONTROL PANELS SHALL BE PROVIDED BY JHU IT DEPARTMENT.

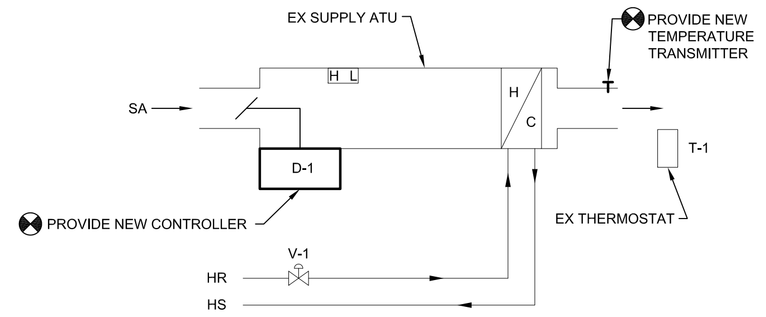
EXISTING AIR HANDLING SYSTEMS CONTROL

1. AIR HANDLING UNIT
   - 1.1. HIGH LIMIT STATIC PRESSURE SENSOR, SPS-3, SHALL DE-ENERGIZE AHU FANS WHEN STATIC PRESSURE REACHES 4.0" (ADJUSTABLE). ALARM AT THE BAS.
   - 1.2. AIR MEASURING DEVICE AFM-1 SHALL TRACK AND REPORT COMBINED SUPPLY AIRFLOW TO THE BAS.
2. EXHAUST AIR SYSTEM
   - 2.1. BAS SHALL MONITOR EXHAUST AIRFLOW AS SENSED BY AIRFLOW MEASURING DEVICE AFM-2.
   - 2.2. ON A WEEKLY BASIS, LEAD EXHAUST FAN ORDER SHALL BE CHANGED BY THE BAS TO EQUALIZE RUN TIME.
   - 2.3. DURING NORMAL OPERATION, EXISTING EXHAUST FANS EF-5A SHALL START AND RUN CONTINUOUSLY. ASSOCIATED FAN ISOLATION DAMPER SHALL FULLY OPEN. EXISTING EXHAUST BYPASS DAMPERS D-1A AND D-1B SHALL FULLY OPEN. EXISTING EXHAUST FANS EF-5B, EF-5C, AND EF-5D SHALL DE-ENERGIZE AND ASSOCIATED FAN ISOLATION DAMPERS SHALL FULLY CLOSE.
     - 2.3.A. UPON DETECTION OF EXHAUST SYSTEM STATIC PRESSURE BELOW MINIMUM PRESSURE SETPOINT (-1.0" W.G., ADJUSTABLE) BY STATIC PRESSURE SENSOR SPS-2, EXHAUST BYPASS DAMPERS D-1A AND D-1B SHALL SEQUENTIALLY MODULATE CLOSED TO MAINTAIN SETPOINT.
     - 2.3.B. UPON FURTHER DETECTION OF EXHAUST SYSTEM STATIC PRESSURE BELOW MINIMUM PRESSURE SETPOINT (-1.0" W.G., ADJUSTABLE) WITH BOTH EXHAUST BYPASS DAMPERS FULLY CLOSED, EXHAUST BYPASS DAMPERS SHALL MODULATE IN TANDEM FULLY OPEN, EXHAUST FAN EF-5B SHALL ENERGIZE, AND ASSOCIATED FAN ISOLATION DAMPER SHALL OPEN.
     - 2.3.C. UPON FURTHER DETECTION OF EXHAUST SYSTEM STATIC PRESSURE BELOW MINIMUM PRESSURE SETPOINT (-1.0" W.G., ADJUSTABLE), EXHAUST BYPASS DAMPERS, D-1A AND D-1B SHALL SEQUENTIALLY MODULATE CLOSED TO MAINTAIN SETPOINT.
     - 2.3.D. UPON FURTHER DETECTION OF EXHAUST SYSTEM STATIC PRESSURE BELOW MINIMUM PRESSURE SETPOINT (-1.0" W.G., ADJUSTABLE) WITH BOTH EXHAUST BYPASS DAMPERS FULLY CLOSED, EXHAUST BYPASS DAMPERS SHALL MODULATE IN TANDEM FULLY OPEN, EXHAUST FAN EF-5C SHALL ENERGIZE, AND ASSOCIATED FAN ISOLATION DAMPER SHALL OPEN.
     - 2.3.E. UPON DETECTION OF EXHAUST SYSTEM STATIC PRESSURE ABOVE MAXIMUM PRESSURE SETPOINT (-3.0" W.G., ADJUSTABLE) BY STATIC PRESSURE SENSOR SPS-2, THE REVERSE SHALL OCCUR.
     - 2.3.F. UPON FURTHER DETECTION OF EXHAUST SYSTEM STATIC PRESSURE ABOVE EMERGENCY PRESSURE SETPOINT (-4.0" W.G., ADJUSTABLE) BY STATIC PRESSURE SENSOR SPS-1, AN ALARM SHALL BE SENT THROUGH THE BAS.

INPUT / OUTPUT SCHEDULE

I/O LEGEND
X - REQUIRED POINT

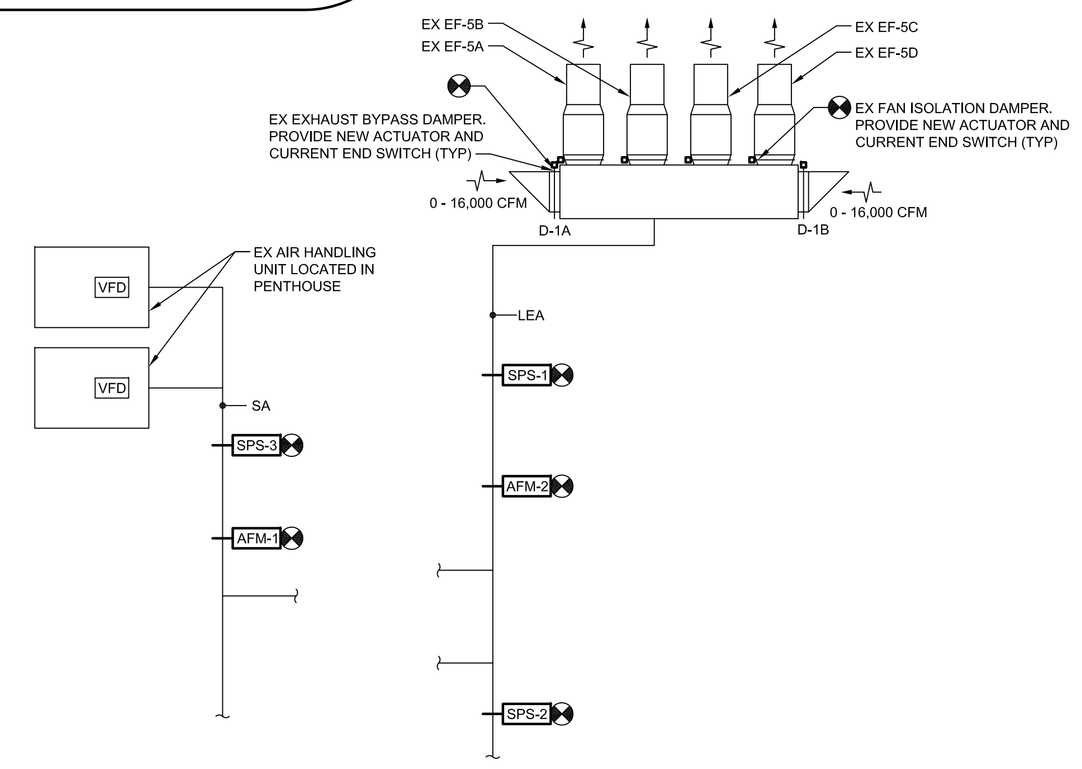
QUANTITY OF UNIT SYSTEM (ONE UON)		INPUTS: ANALOG MEASURED: TEMPERATURE	PRESSURE	RH	AIR FLOW/FLUID FLOW	ANALOG CALCULATED: KWH	ENTHALPY	RUN TIME	STATUS	BINARY: FILTER	SMOKE	FREEZE	AIR FLOW	METER	DP SWITCH	CURRENT SWITCH	END SWITCH	OUTPUTS: DIGITAL: OFF ON	OFF AUTO ON	OFF HIGH LOW	OPEN CLOSE	ANALOG: DAMPER POSITION	VALVE POSITION	SET POINT ADJ.	AOP	AOE	SYSTEM FEATURES: ALARMS: HIGH ANALOG	LOW ANALOG	HIGH BINARY	LOW BINARY	PROOF	SMOKE	APPLICATION PROGRAMS: TIME SCHEDULING	DEMAND LIMITING	PREVENTIVE MAINTENANCE	DUTY CYCLE	START STOP OPT	ENTHALPY ECON	SMOKE OPT	TREND	ALARM INSTRUMENT	DDC	MANUAL OVERRIDE	DRYBULB ECON	GENERAL: COLOR GRAPHICS
31	SUPPLY AIR TERMINAL UNITS	X			X																					X															X			X
35	EXHAUST AIR TERMINAL UNITS				X																					X															X			X
4	EXHAUST FANS (EF-5A, EF-5B, EF-5C, EF-5D)							X	X														X													X					X			X
3	STATIC PRESSURE SENSORS SPS-1, -2, -3		X																							X	X	X													X			X
2	AIRFLOW MEASURING DEVICE AFM-1, -2				X																					X															X			X



GENERAL AIR TERMINAL UNITS CONTROL SEQUENCE

NO SCALE

1. VARIABLE VOLUME ATU WITH HEATING COIL:
   SPACE THERMOSTAT SHALL MODULATE AIR TERMINAL UNIT DAMPER D-1 BETWEEN MAXIMUM AND MINIMUM SETTINGS TO MAINTAIN 75 DEGREES (ADJ). IF SPACE TEMPERATURE FALLS BELOW 73 DEGREES (ADJ), HEATING COIL VALVE SHALL MODULATE OPEN TO MAINTAIN 73 DEGREES (ADJ). MAXIMUM AND MINIMUM SETPOINT SHALL BE SET AT HEAD END.
2. UPON A CONTINUED DROP IN SPACE TEMPERATURE WITH AIR TERMINAL UNIT AT MINIMUM DAMPER POSITION, AND A DEADBAND OF 2° - 3° F, HEATING VALVE V-1 SHALL MODULATE OPEN TO MAINTAIN SPACE TEMPERATURE.
3. ON A RISE IN SPACE TEMPERATURE, THE OPPOSITE SEQUENCE SHALL OCCUR.
4. UPON ALL ROOM OCCUPANCY SENSORS SENSING THAT THE ROOM IS UNOCCUPIED FOR AT LEAST 10 MINUTES (ADJUSTABLE), THE SUPPLY AIR TERMINAL UNIT SERVING THE ROOM SHALL MODULATE TO ITS UNOCCUPIED MINIMUM SETTINGS UNTIL THE ROOM IS OCCUPIED AGAIN.
5. UPON ANY ROOM OCCUPANCY SENSOR SENSING THAT THE ROOM IS OCCUPIED, THE SUPPLY AIR TERMINAL UNIT SERVING THE ROOM SHALL MODULATE TO ITS OCCUPIED MINIMUM SETTINGS.
6. PROVIDE RELAYS CONNECTED TO ROOM OCCUPANCY CONTROLS.
7. SETPOINTS, INCLUDING MINIMUM AIR VOLUME TO THE AIR TERMINAL UNIT, SHALL BE FIELD ADJUSTABLE AT THE BAS.
8. THE UNOCCUPIED SETPOINTS SHALL BE 65°F AND 80°F, ADJUSTABLE.



1 EXISTING AIR HANDLING SYSTEMS - AIRFLOW CONTROL DIAGRAM

NO SCALE

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Seal

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LICENSE NO. _____,
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Number	Date	Revision
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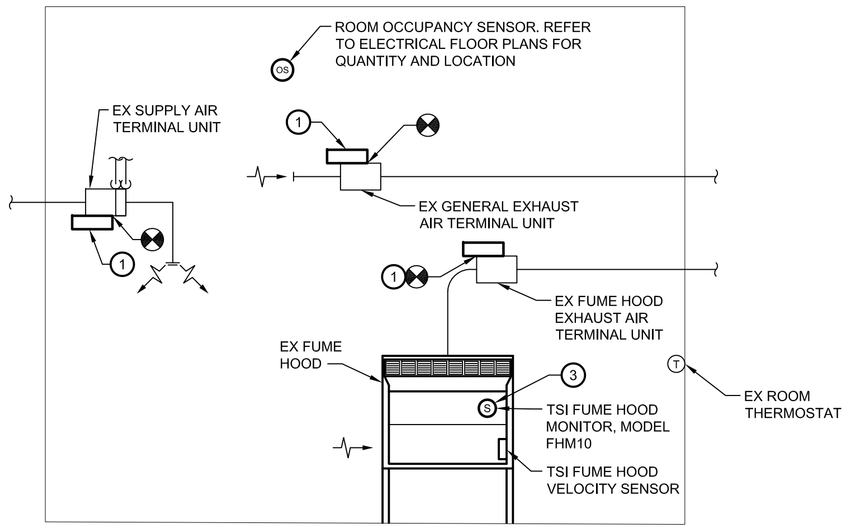
AUTOMATIC TEMPERATURE CONTROLS

Drawn By	Scale	Date
CS	AS NOTED	11/17/15

Drawing No.

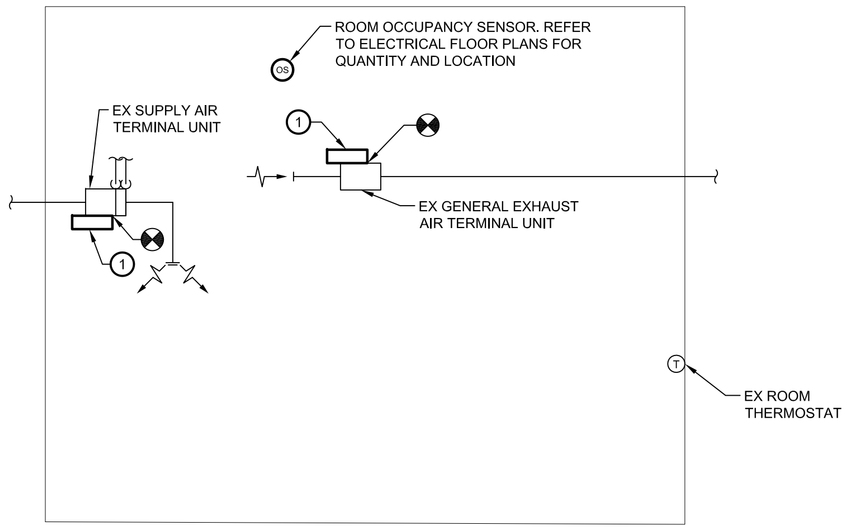
M2.01

BKM: 15107.01



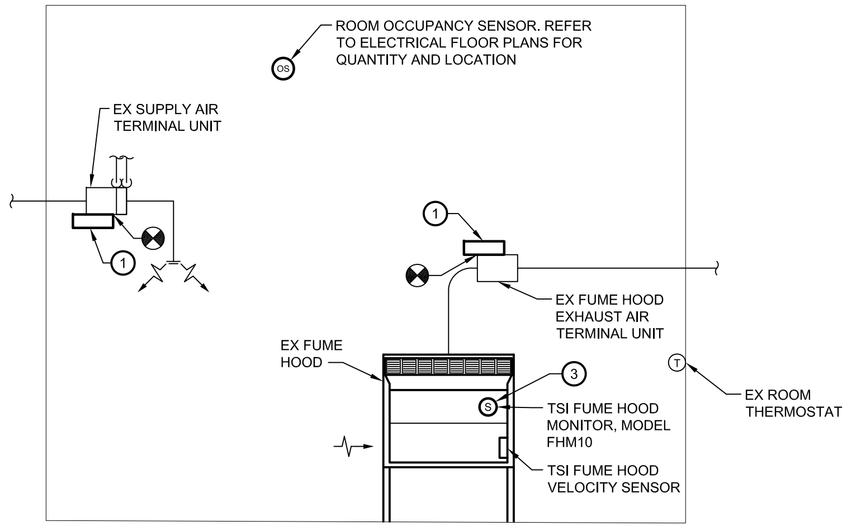
1 LABORATORY TYPE 'A' - AIRFLOW CONTROL DIAGRAM

NO SCALE



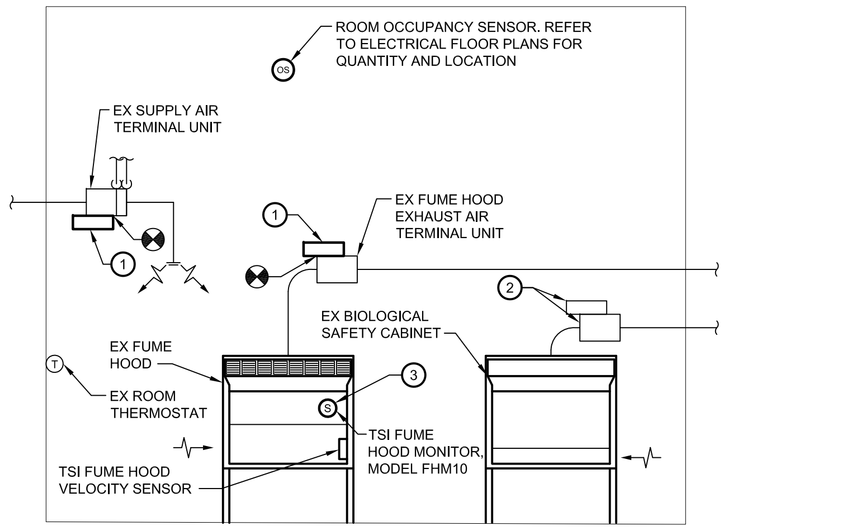
3 LABORATORY TYPE 'C' - AIRFLOW CONTROL DIAGRAM

NO SCALE



2 LABORATORY TYPE 'B' - AIRFLOW CONTROL DIAGRAM

NO SCALE



3 LABORATORY TYPE 'D' - AIRFLOW CONTROL DIAGRAM

NO SCALE

FUME HOOD MONITOR CONTROL

1. OCCUPIED AND UNOCCUPIED MODE SHALL BE DETERMINED BY ROOM OCCUPANCY SENSOR.
   - 1.1. OCCUPIED MODE
     - 1.1.1. FUME HOOD MONITOR SHALL MONITOR THE FUME HOOD FACE VELOCITY USING A NEW TSI FUME HOOD VELOCITY SENSOR. FUME HOOD MONITOR SHALL BE SET TO ALARM WHEN FUME HOOD VELOCITY DROPS BELOW 100 FPM (ADJ).
   - 1.2. UNOCCUPIED MODE
     - 1.2.1. FUME HOOD MONITOR SHALL MONITOR THE FUME HOOD FACE VELOCITY USING A NEW TSI FUME HOOD VELOCITY SENSOR. FUME HOOD MONITOR SHALL BE SET TO ALARM WHEN FUME HOOD VELOCITY DROPS BELOW 60 FPM (ADJ).

LABORATORY TYPE (A, B, C & D) - AIRFLOW CONTROL

1. OCCUPIED AND UNOCCUPIED MODE SHALL BE DETERMINED BY ROOM OCCUPANCY SENSOR AND FUME HOOD MONITOR. ONCE THE DEVICE SENSES THE ROOM IS OCCUPIED, THE ASSOCIATED AIR TERMINAL UNITS SHALL BE SET TO OCCUPIED MODE.
   - 1.1. DURING OCCUPIED AND UNOCCUPIED MODE, EXISTING ROOM SUPPLY AND EXHAUST AIR TERMINAL UNITS SHALL MODULATE TO MAINTAIN CONSTANT AIRFLOW DIFFERENTIAL AS INDICATED ON SCHEDULE.
   - 1.2. OCCUPIED MODE
     - 1.2.1. ON A FALL IN SPACE TEMPERATURE, EXISTING SPACE THERMOSTAT SHALL MODULATE SUPPLY AIR TERMINAL DAMPER TOWARD MINIMUM OCCUPIED SETTING.
     - 1.2.2. ON A CONTINUED FALL IN TEMPERATURE, EXISTING SPACE THERMOSTAT SHALL MODULATE EXISTING HEATING COIL VALVE TO MAINTAIN SETPOINT.
     - 1.2.3. ON A RISE IN SPACE TEMPERATURE, THE OPPOSITE SHALL OCCUR.
     - 1.2.4. EXISTING EXHAUST AIR TERMINAL UNIT SHALL, THROUGH THE BAS, MODULATE ITS DAMPER TO MAINTAIN CONSTANT DIFFERENTIAL AIRFLOW WITH ITS ASSOCIATED SUPPLY AIR TERMINAL UNIT. SEE SCHEDULES.
   - 1.3. UNOCCUPIED MODE
     - 1.3.1. ON A FALL IN SPACE TEMPERATURE, EXISTING SPACE THERMOSTAT SHALL MODULATE SUPPLY AIR TERMINAL DAMPER TOWARD MINIMUM UNOCCUPIED SETTING.
     - 1.3.2. ON A CONTINUED FALL IN TEMPERATURE, EXISTING SPACE THERMOSTAT SHALL MODULATE EXISTING HEATING COIL VALVE TO MAINTAIN SETPOINT.
     - 1.3.3. ON A RISE IN SPACE TEMPERATURE, THE OPPOSITE SHALL OCCUR.
     - 1.3.4. EXISTING EXHAUST AIR TERMINAL UNIT SHALL, THROUGH THE BAS, MODULATE ITS DAMPER TO MAINTAIN CONSTANT DIFFERENTIAL AIRFLOW WITH ITS ASSOCIATED SUPPLY AIR TERMINAL UNIT. SEE SCHEDULES. IN TYPE 'A' LABORATORIES GENERAL EXHAUST AIR TERMINAL UNIT WILL MODULATE DOWN TO ITS MINIMUM AIRFLOW SETPOINT BEFORE FUME HOOD EXHAUST AIR TERMINAL UNIT MODULATES AWAY FROM ITS MAXIMUM AIRFLOW SETPOINT.

DRAWING NOTES:

1. PROVIDE EXISTING AIR TERMINAL UNIT WITH NEW CONTROLLER. REFER TO SCHEDULES FOR ADDITIONAL REQUIREMENTS.
2. EXISTING BIOLOGICAL SAFETY CABINET EXHAUST AIR TERMINAL AND CONTROLLER. EXISTING TO REMAIN.
3. RETROFIT EXISTING KEWAUNEE FUME HOOD MONITOR WITH TSI FUME HOOD VELOCITY SENSOR AND FUME HOOD MONITOR, MODEL FHM10.

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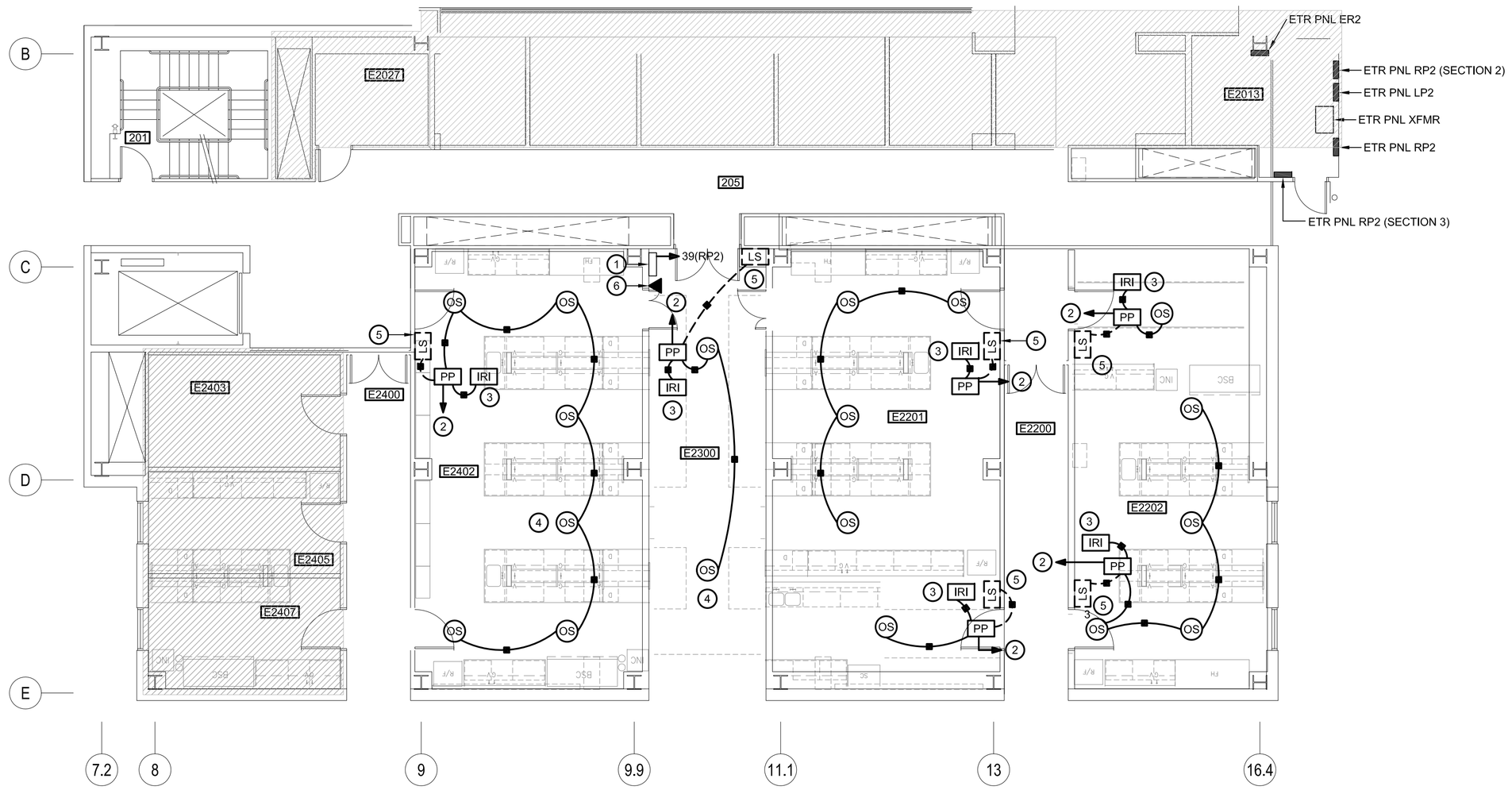
	11/17/15	100% CD SUBMISSION

AUTOMATIC TEMPERATURE CONTROLS

Drawn By	Scale	Date
SY	AS NOTED	11/17/15

Drawing No.
M2.02

BKM: 15107.01



1 SECOND FLOOR PLAN - ELECTRICAL - NEW WORK

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

1. ALL WORK UNLESS OTHERWISE NOTED MUST BE DONE DURING OFF HOURS (6PM - 6AM) AND/OR WEEKENDS. COORDINATE WITH OWNER, A MINIMUM OF 7 CALENDAR DAYS (5 WORKING DAYS) IN ADVANCE.
2. WORK THAT MAY BE DONE DURING NORMAL HOURS SHALL BE LIMITED TO:
   - AUTOMATIC CONTROLS
   - PROGRAMMING
   - TESTING AND BALANCING (AFTER COMPLETED COMMISSIONING)
   - ROOF WORK

LIGHTING CONTROL/HVAC SEQUENCE OF OPERATION:

1. AN AUXILIARY CONTACT IS PROVIDED AS PART OF THE LIGHTING CONTROL SYSTEM FOR USE BY THE HVAC SYSTEM THAT IS CONTROLLED AUTOMATICALLY BY LOCAL OCCUPANCY SENSOR AS REQUIRED FOR "OCCUPIED" AND "UNOCCUPIED" CONDITIONS. AUXILIARY CONTACT WILL AUTOMATICALLY CHANGE STATUS ("OCCUPIED") WHEN ROOM BECOMES OCCUPIED. CONTACT STATUS WILL REMAIN WHILE ROOM IS OCCUPIED AND FOR A FIELD SELECTABLE TIME PERIOD (INITIAL SETTING SHALL BE 10 MINUTES) AFTER THE LAST OCCUPANCY DETECTION. THEN THE CONTACT STATUS WILL AUTOMATICALLY CHANGE STATUS ("UNOCCUPIED").
2. LIGHTING CONTROL SYSTEM SHALL ALLOW FOR FUTURE CONNECTION (UNDER A SEPARATE PROJECT) OF DIGITAL LOW VOLTAGE DIMMING LIGHT WALL SWITCH AND FOR 0-10V CONTROL OF LIGHTS IN THE ROOM. ALLOW FOR FUTURE LIGHTING CONTROL SCHEME THAT WILL REQUIRE ROOM LIGHTS TO BE CONTROLLED BY LOW VOLTAGE DIMMING SWITCH (0-10V) AND OCCUPANCY SENSOR(S).

GENERAL NOTES:

1. REFER TO DRAWING E0.01 FOR ELECTRICAL LEGEND, ABBREVIATIONS, GENERAL NOTES AND SCHEDULES.
2. REMOVE, PROTECT AND REINSTALL EXISTING CEILING TILES IF REQUIRED FOR ELECTRICAL DEMOLITION AND NEW WORK. RETURN AREA TO EXISTING CONDITION. RETURN AREAS TO ORIGINAL CONDITION AT THE END OF EACH WORK DAY.
3. REFER TO DRAWINGS E2.01 AND E2.02 FOR SPECIFICATIONS.
4. UNLESS NOTED OTHERWISE, ELECTRICAL ITEMS SHOWN HEAVY DASHED (– – –) SHALL BE INSTALLED IN THE FUTURE, ELECTRICAL ITEMS SHOWN HEAVY SOLID (———) SHALL BE NEW AND ELECTRICAL ITEMS SHOWN LIGHT SOLID (———) SHALL BE EXISTING TO REMAIN.
5. ROUTE ALL HOMERUNS OUT INTO NEAREST CORRIDOR CEILING SPACE AND THEN TO SOURCE EQUIPMENT. DO NOT ROUTE HOMERUNS THROUGH ADJACENT ROOMS.
6. REFER TO DIVISION 1 SPECIFICATIONS FOR ADDITIONAL WORK RESTRICTIONS.
7. ALL WORK SHALL BE LIMITED TO A MAXIMUM OF TWO (2) FLOORS CONCURRENT ACTIVE CONSTRUCTION AND A MAXIMUM OF ONE (1) ADDITIONAL FLOOR, FULLY COMMISSIONED, TO UNDERGO TESTING AND BALANCING. CONSTRUCTION SHALL PROCEED THROUGH BUILDING FLOORS SEQUENTIALLY, STARTING WITH ROOF AND COMPLETING ON SECOND FLOOR.

○ DRAWING NOTES:

1. BAS CONTROL PANEL PROVIDED BY CONTROL SYSTEM PROVIDER/INSTALLER. PROVIDE 120V HOMERUN FROM AVAILABLE 20A, 1P 120V SPARE BREAKER INDICATED. PROVIDE RECEPTACLE OR HARDWIRED CONNECTION AS REQUIRED BY EQUIPMENT INSTALLED.
2. CONNECT TO EXISTING NORMAL 277V LIGHTING CIRCUIT SUPPLYING THIS AREA AHEAD OF ANY SWITCHING.
3. DEVICE CONTAINS AUXILIARY DRY CONTACT FOR INTEGRATION WITH THE HVAC SYSTEM.
4. PENDANT MOUNT OCCUPANCY SENSOR AT SAME HEIGHT AS EXISTING LIGHT FIXTURES IN THE ROOM. REFER TO LIGHTING CONTROLS SUPPORT DETAILS FOR ADDITIONAL INFORMATION. INSTALL DEVICE IN LOCATION SHOWN CENTERED IN THE MIDDLE OF SPACE. CORRIDOR OR AISLEWAY. ALL DEVICES SHALL BE ALIGNED WITHIN ANY ROOM OR SPACE. NOTIFY THE ENGINEER IF ANY CONFLICTS ARE ENCOUNTERED IN MEETING THIS DEVICE PLACEMENT CRITERIA PRIOR TO INSTALLATION OF DEVICE(S). TYPICAL UNLESS NOTED OTHERWISE.
5. LIGHTING CONTROL SYSTEM DIGITAL WALL SWITCH AND ASSOCIATED CONTROL CONNECTION PROVIDED IN FUTURE UNDER SEPARATE PROJECT.
6. PROVIDE DATA OUTLET FOR HVAC FOR NEW BAS PANEL. PROVIDE EMPTY 1900 BOX WITH SINGLE GANG EXTENSION. CABLE, JACKS, AND FACEPLATE PROVIDED BY OWNER. COORDINATE BOX HEIGHT AND INSTALLATION DETAILS WITH BAS CONTROL PANEL PROVIDER/INSTALLER.

ROOM NAME LIST

201	STAIRS
205	CORRIDOR
E2013	ELECTRIC/ PHONE
E2027	DATA
E2200	CORRIDOR
E2201	LAB - "NC"
E2202	LAB - "N"
E2300	EQUIPMENT CORRIDOR
E2400	CORRIDOR
E2402	LAB - "SC"
E2403	EQUIPMENT ROOF
E2405	PCR LAB
E2407	TISSUE CULTURE LAB
-	WARM ROOM

N

0 4' 8' 16' 24'

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

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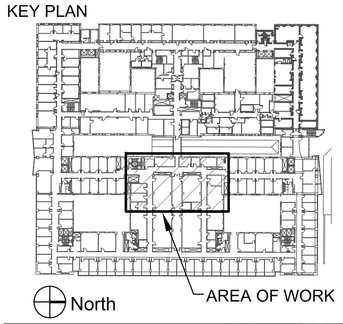
KEY PLAN



SECOND
FLOOR PLAN
ELECTRICAL - NEW WORK

Drawn By	Scale	Date
TMS	AS NOTED	11/17/15

Drawing No.

E1.01

BKM: 15107.01

50

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