The ARC Building (Taxi)

30-02 39 Avenue

Queens, NY 11101

As-Built April 2020

Submitted to:

Frontier Energy
2695 Bingley Road
Cazanovia, NY 13035

Submitted by:

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1. Introduction

Tecogen, Inc. (Tecogen) supported the installation of a combined heat and power (CHP) system at The ARC Building (known as Taxi throughout this application). The site is receiving an incentive from NYSERDA, of which the first two milestones have been paid out in full. The CHP system includes two (2) INV-e+ 100kW engine generator unit. The inverter-based system is intended to produce a gross output of 100 kW and recover engine jacket water and exhaust heat recovery for:

a) Pre-heating the hot water loop which in turn heats:
    i. DHW heating
    ii. Space Heating
    iii. Pool

The CHP system will provide power in parallel with the existing utility service, as well as the capabilities to operate in island-mode and provide backup power during an outage scenario.

2. Instrumentation

In order to quantify the performance of the CHP system, the CHP system fuel input, net electrical output, and useful thermal output will be measured. To capture that data Tecogen supplied the meters and instrumentation listed in **Table 1 on page 4.**

Data Logger

Readings for the installed instrumentation are recorded by a CHPInsight datalogger provided and installed by Tecogen. The computer samples all sensors approximately once per 30 seconds and records the information. The readings of heat recovery temperatures and flow rates will be used to provide an accurate calculation of heat transfer on the heat recovery loops, which are all continuous flow loops. Based on the number of monitored data points, the logger will have sufficient memory to store 3-days of data if communications with the logger are interrupted.

The data will be downloaded from CHPInsight once per day via an Internet connection provided by the Site. The data will be loaded into a Tecogen database for long term storage and checked for validity.

Onsite Installation

The contractor installed a CHPInsight panel in the boiler room near the CHP unit. The monitoring system panel is approximately 2 ft x 16 in x 10 in. The panel is supplied with 120 VAC power (it requires 1 amp or less). The panel is conveniently located relative to the sensors listed above as well as the communications line provided by the site.

Communications

The CHPInsight has a connection to the Internet. An IP address has been supplied. The logger uploads data every night to the Tecogen servers, is compiled into a csv file, and then distributed on an annual basis and provided to NYSERDA based on their monitoring requirements.

On Site Support

The facility has assisted in providing a network connection for the CHPInsight. Tecogen is responsible for providing a complete monitoring installation, as well as any access for return trips to verify sensors or service the monitoring system.

Table 1. Overview of CHP System Monitoring Instrumentation

Data Point	Tecogen Label	Description	Units	Instrument / Sensor	Output Type	Location
P_{NET}	EM-1	Generator NET Electrical Output	kW/ kWh	Veris E50C2	ModBus	Electric Room
P_{OUT}	INV	Generator Gross Electrical Output	kW/ kWh	InVerde	On-Board	Roof Mech Room
G_{IN}	GM-1	Net Generator Fuel Input	CF	Gas Meter Pulse	Pulse	Gas Meter Room
T_{OUT1}	BTU-TS-1	Engine Heating Module Supply Temperature	°F	Onicon System 10	ModBus	Roof Mech Room
T_{RET1}	BTU-TS-2	Engine Heating Module Usable HeatTemperature	°F	Onicon System 10	ModBus	Roof Mech Room
F_{NET1}	BTU-1	Engine Heating Module System Flow	GPM	Onicon System 10	ModBus	Roof Mech Room
Q_{NET1}	BTU-1	CHP Engine Heat Supplied	BTUh	Onicon System 10	ModBus	Roof Mech Room

3. Data Analysis

The collected data listed in Table 1 on page 4 will be used to determine the net power output of the system as well as the fuel conversion efficiency (FCE).

Peak Demand or Peak kW

The peak electric output or demand for each power reading will be taken as the average kW in a fixed 15-minute interval (0:00, 0:15, 0:30, etc.), defined as:

$$kW = \frac{\sum_{15\ min} kWh}{\Delta T} = \frac{kWh\ per\ interval}{0.25h}$$

Net Power Output

The power meter will measure the generator power output (P_{OUT}). The internal generator meter will measure the gross output of the engine generator as a check.

The parasitic power (P_{PAR}) is estimated to be 5 kW. The net power (P_{NET}) can be determined by subtracting parasitic power (P_{PAR}) from the power output (P_{OUT}).

$$kW_{NET} = P_{OUT} - P_{PAR}$$

Heat Recovery Rates

The heat recovery rates will be calculated based on the 30 second interval data collected. The piping arrangement at this site allows for the total recoverable heat rate to be determined at one location as there is no heat rejection unit included with the installation:

The rate of useful heat recovery in Btu/h is defined as:

$$Q_{NET} = C_P \times \sum (F_{NET} \times (T_{OUT} - T_{RET}) \times n)$$

where: C_p = ~ 500 Btu/h-gpm-°F for pure water;
n = Number of 1-minute intervals included in period of interest

The heat recovery loop fluid is expected to be pure water.

Any heat recovery measurement can be calculated for an interval sum (Btu) by the following:

Calculated Quantities

The fuel conversion efficiency (FCE) of the CHP system, based on the higher heating value of the fuel, will be defined as:

$$FCE = \frac{Q_{NET} + (3413 \times P_{NET})}{G_{IN} \times HHV_{Gas}}$$

where: Q_{Net} = Total Useful heat recovery (Btu) (QU)
P_{Net} = Engine generator net output (kWh)
G_{In} = Generator gas consumption (Std CF)
HHV_{gas} = Higher heating value for natural gas (~1020 Btu/CF)

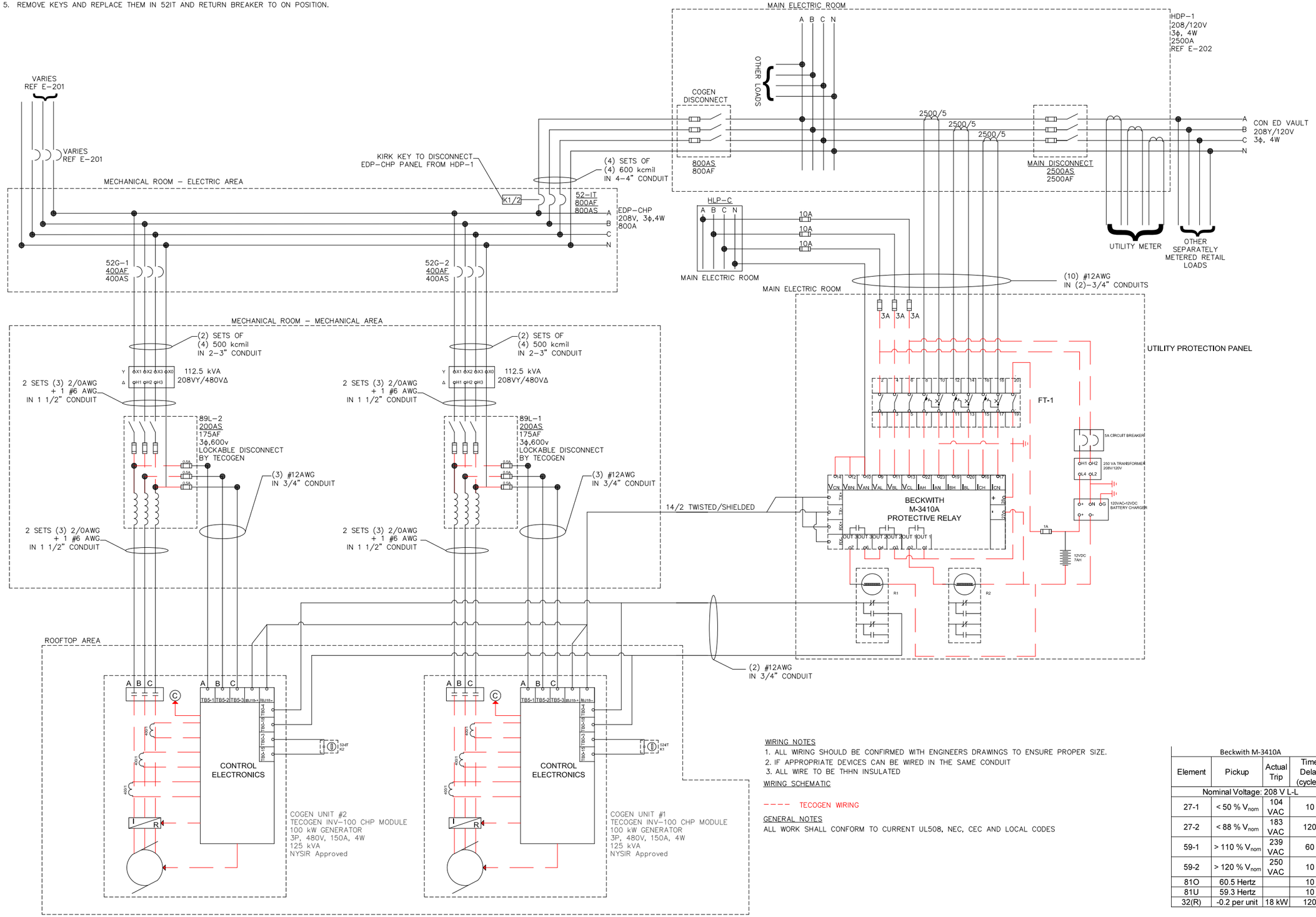
The FCE can be calculated for any time interval of interest (hourly, daily, monthly, etc.), depending on the resolution available for the gas meter reading.

Appendix A

System Schematics

SEQUENCE OF OPERATIONS FOR STAND ALONE (GRID-ISOLATED) MODE:

1. AFTER A POWER FAILURE CONDITION, VERIFY THE MACHINES HAVE RECEIVED A RELAY FAILURE ALARM.
2. TURN BREAKER 52IT TO OFF POSITION AND REMOVE KIRK KEYS
3. INSERT KIRK KEYS INTO MACHINES AND TURN, THEY WILL START AUTOMATICALLY
4. WHEN POWER IS RESTORED TO THE BUILDING, THE MACHINES WILL TURN OFF.
5. REMOVE KEYS AND REPLACE THEM IN 52IT AND RETURN BREAKER TO ON POSITION.



WIRING NOTES

1. ALL WIRING SHOULD BE CONFIRMED WITH ENGINEERS DRAWINGS TO ENSURE PROPER SIZE.
2. IF APPROPRIATE DEVICES CAN BE WIRED IN THE SAME CONDUIT
3. ALL WIRE TO BE THHN INSULATED

WIRING SCHEMATIC

---- TECOGEN WIRING

GENERAL NOTES

ALL WORK SHALL CONFORM TO CURRENT UL508, NEC, CEC AND LOCAL CODES

Beckwith M-3410A

Element	Pickup	Actual Trip	Time Delay (cycles)
Nominal Voltage: 208 V L-L			
27-1	< 50 % V_{nom}	104 VAC	10
27-2	< 88 % V_{nom}	183 VAC	120
59-1	> 110 % V_{nom}	239 VAC	60
59-2	> 120 % V_{nom}	250 VAC	10
81O	60.5 Hertz		10
81U	59.3 Hertz		10
32(R)	-0.2 per unit	18 kW	120

Tecogen

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(781) 466-6400
WWW.TECOGEN.COM

MECHANICAL ENGINEER

ELECTRICAL ENGINEER

PE STAMP/SEAL

DATE	REV	DESCRIPTION
5/27/16	1	REV TO MATCH E-501
6/11/19	2	AS BUILT

30-02 39th Ave.
Queens, NY 11101
CHP System

PROJECT

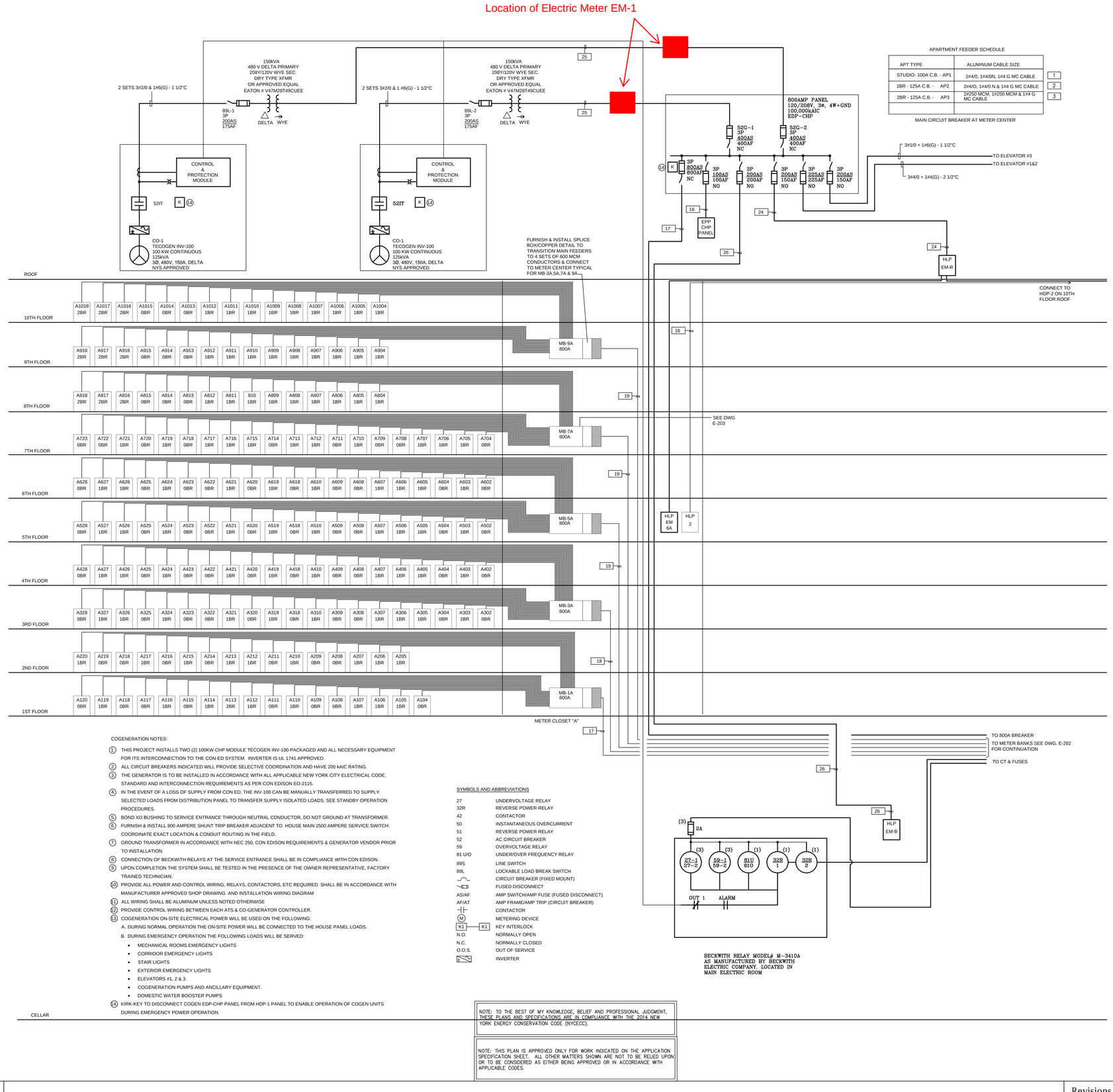
8/25/16	RJC
DATE	DRAWN BY

COGEN THREE LINE

DRAWING TITLE

E-1

DRAWING NUMBER



APARTMENT FEEDER SCHEDULE

APT TYPE	ALUMINUM CABLE SIZE	
STUDIO- 100A C.B. - AP1	2#4/0, 1#4/0N, 1#4 G MC CABLE	1
1BR - 125A C.B. - AP2	2#4/O, 1#4/0 N & 1#4 G MC CABLE	2
2BR - 125A C.B. - AP3	2#250 MCM, 1#250 MCM & 1#4 G MC CABLE	3

MAIN CIRCUIT BREAKER AT METER CENTER

NOTES:

1. PROVIDE DUAL ELEMENT TIME-DELAY FUSES FOR ELEVATORS.
2. PROVIDE SUB-FEED LUGS FOR ALL 2 SECTION PANELS. CONTRACTOR IS PERMITTED TO USE SINGLE SECTION 84 POLE PANEL IN LIEU OF 2 SECTION PANEL. REFER TO PANEL SCHEDULE FOR ADDITIONAL INFORMATION
3. ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR SHORT CIRCUIT COORDINATION STUDY, ADJUST SHORT CIRCUIT RATING TO PANELS WHERE REQUIRED. STUDY MUST BE PERFORM PRIOR TO FABRICATION OF SWITCHGEAR, METER CENTER AND PANELS. SUBMIT SHORT CIRCUIT REPORT ALONG WITH THE SWITCHGEAR & PANEL SHOP DRAWINGS.
4. FIRE ALARM POWER FEEDERS SHALL BE COPPER INSTALLED IN RIGID GALVANIZED STEEL.
5. G.C TO PROVIDE 4" HOUSE KEEPING PAD FOR ALL FLOOR MOUNTED ELECTRICAL EQUIPMENT
6. PROVIDE 8-4" CONDUIT SLEEVES AT THE FOUNDATION WALL TO SERVICE END BOX # 1 & 2 IN ACCORDANCE WITH CON EDISON REQUIREMENTS.
7. WHERE ALUMINUM OR COPPER-CALD ALUMINUM CABLE ARE USED ALL PANELBOARDS, DISTRIBUTION PANEL, SWITCHES, ETC SHALL BE PROVIDED WITH SUITABLE BUS RATING & LUGS TO ACCEPT THESE CABLES.
8. ALL COPPER OR COPPER-CLAD CABLES SHALL HAVE A MINIMUM RATING NOT LESS THAN 75DEG C
9. PROVIDE 2-2" EMPTY CONDUIT FROM EACH ELEVATOR PIT TO FRONT DESK FOR "EMS" & SECURITY SYSTEM.
10. WITHIN THE ELECTRICAL ROOM PROVIDE A MINIMUM OF 3 FEET CLEARANCE FROM ANY ELECTRICAL EQUIPMENT, RAILING, DOORS, ETC. PROVIDE FULLY COORDINATE ROOM LAYOUT FOR THE ENGINEER APPROVAL PRIOR TO COMMENCING ANY WORK.
11. CONTRACTOR IS REQUIRED TO PREPARE & FILE ELECTRICAL ONE LINE & SWITCHBOARD ROOM LAYOUT WITH NYC BUREAU OF ELECTRICAL CONTROLS FOR APPROVAL PRIOR TO FABRICATION & OR INSTALLATION OF ANY EQUIPMENT.
12. FIRE PUMP POWER CONDUITS TO BE INSTALLED IN THE CONCRETE SLAB OR PROVIDE 2 HOUR RATED ENCLOSURE.
13. CONTRACTOR MAY USE CIRCUIT BREAKERS IN LIEU OF SWITCH/FUSE IN THE MAIN SWITCHBOARD. CONTRACTOR TO PROVIDE CIRCUIT BREAKER(S) WITH ADEQUATE SHORT CIRCUIT RATING BASE ON SHORT CIRCUIT COORDINATION STUDY.
14. PROVIDE COPPER CABLES TO FIRE ALARM SYSTEM IN ACCORDANCE WITH 2011 NYC ELECTRICAL CODE.
15. CABLE SMALLER THAN # 10 WIRE SHALL BE SOLID & WIRES LARGER THAN # 8 SHALL BE STRANDED.
16. PROVIDE CONTROL WIRING TO CO-GENERATOR AS PER APPROVED TECO-GEN SHOP DRAWINGS. ALL CONTROL WIRING SHALL BE INSTALLED IN 3 /4"C MINIMUM.
17. COORDINATE CONTROL WIRING FROM ELEVATOR CONTROLLER TO SELECTOR SWITCH IN LOBBY WITH ELEVATOR VENDOR REQUIREMENTS. INSTALL CONTROL WIRING IN 2" CONDUIT MINIMUM UNLESS DIRECTED OTHERWISE BY VENDOR
18. FURNISH & INSTALL TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) AT THE MAIN SWITCHBOARD.
19. TAP JOCKEY PUMP FEED OUTSIDE THE FIRE PUMP CONTROLLER.
20. ALL PANEL LOCATED ON THE ROOF , WET OR DAMP LOCATION SHALL BE PROVIDED WITH NEMA 3R ENCLOSURE
21. WHERE ALUMINUM CABLE ARE USE & FEEDER IS NOT SUITABLE FOR LUGS IN PANEL OR SWITCHES, THE CONTRACTOR SHALL PROVIDE SUITABLE SPLICE BOX AND ASSOCIATED COPPER DETAIL & CONNECT THE EQUIPMENT WITH SUITABLE CABLE RATING TO MATCH AVAILABLE LUGS ON THE EQUIPMENT.
22. WHERE MC CABLE ARE USE PROVIDE A GROUNDING CONDUCTOR SIZES AS PER NEC 250.

COGENERATION NOTES:

1. THIS PROJECT INSTALLS TWO (2) 100KW CHP MODULE TECOGEN INV-100 PACKAGED AND ALL NECESSARY EQUIPMENT FOR ITS INTERCONNECTION TO THE CON-ED SYSTEM. INVERTER IS UL 1741 APPROVED.
2. ALL CIRCUIT BREAKERS INDICATED WILL PROVIDE SELECTIVE COORDINATION AND HAVE 200 kAIC RATING.
3. THE GENERATOR IS TO BE INSTALLED IN ACCORDANCE WITH ALL APPLICABLE NEW YORK CITY ELECTRICAL CODE, STANDARD AND INTERCONNECTION REQUIREMENTS AS PER CON EDISON EO-2115.
4. IN THE EVENT OF A LOSS OF SUPPLY FROM CON ED, THE INV-100 CAN BE MANUALLY TRANSFERRED TO SUPPLY SELECTED LOADS FROM DISTRIBUTION PANEL TO TRANSFER SUPPLY ISOLATED LOADS. SEE STANDBY OPERATION PROCEDURES.
5. BOND XO BUSHING TO SERVICE ENTRANCE THROUGH NEUTRAL CONDUCTOR, DO NOT GROUND AT TRANSFORMER.
6. FURNISH & INSTALL 800 AMPERE SHUNT TRIP BREAKER ADJACENT TO HOUSE MAIN 2500 AMPERE SERVICE SWITCH. COORDINATE EXACT LOCATION & CONDUIT ROUTING IN THE FIELD.
7. GROUND TRANSFORMER IN ACCORDANCE WITH NEC 250, CON EDISON REQUIREMENTS & GENERATOR VENDOR PRIOR TO INSTALLATION.
8. CONNECTION OF BECKWITH RELAYS AT THE SERVICE ENTRANCE SHALL BE IN COMPLIANCE WITH CON EDISON.
9. UPON COMPLETION THE SYSTEM SHALL BE TESTED IN THE PRESENCE OF THE OWNER REPRESENTATIVE, FACTORY TRAINED TECHNICIAN.
10. PROVIDE ALL POWER AND CONTROL WIRING, RELAYS, CONTACTORS, ETC REQUIRED SHALL BE IN ACCORDANCE WITH MANUFACTURER APPROVED SHOP DRAWING AND INSTALLATION WIRING DIAGRAM
11. ALL WIRING SHALL BE ALUMINUM UNLESS NOTED OTHERWISE
12. PROVIDE CONTROL WIRING BETWEEN EACH ATS & CO-GENERATOR CONTROLLER.
13. COGENERATION ON-SITE ELECTRICAL POWER WILL BE USED ON THE FOLLOWING:
    A. DURING NORMAL OPERATION THE ON-SITE POWER WILL BE CONNECTED TO THE HOUSE PANEL LOADS.
    B. DURING EMERGENCY OPERATION THE FOLLOWING LOADS WILL BE SERVED:
    - MECHANICAL ROOMS EMERGENCY LIGHTS
    - CORRIDOR EMERGENCY LIGHTS
    - STAIR LIGHTS
    - EXTERIOR EMERGENCY LIGHTS
    - ELEVATORS #1, 2 & 3.
    - COGENERATION PUMPS AND ANCILLARY EQUIPMENT.
    - DOMESTIC WATER BOOSTER PUMPS
14. KIRK-KEY TO DISCONNECT COGEN EDP-CHP PANEL FROM HDP-1 PANEL TO ENABLE OPERATION OF COGEN UNITS DURING EMERGENCY POWER OPERATION.

SYMBOLS AND ABBREVIATIONS

27	UNDERVOLTAGE RELAY
32R	REVERSE POWER RELAY
42	CONTACTOR
50	INSTANTANEOUS OVERCURRENT
51	REVERSE POWER RELAY
52	AC CIRCUIT BREAKER
59	OVERVOLTAGE RELAY
81 U/O	UNDEROVER FREQUENCY RELAY
89S	LINE SWITCH
89L	LOCKABLE LOAD BREAK SWITCH
	CIRCUIT BREAKER (FIXED MOUNT)
	FUSED DISCONNECT
AS/AF	AMP SWITCH/AMP FUSE (FUSED DISCONNECT)
AF/AT	AMP FRAME/AMP TRIP (CIRCUIT BREAKER)
	CONTACTOR
M	METERING DEVICE
K1 — K1	KEY INTERLOCK
N.O.	NORMALLY OPEN
N.C.	NORMALLY CLOSED
O.O.S.	OUT OF SERVICE
	INVERTER

BECKWITH RELAY MODEL# M-3410A AS MANUFACTURED BY BECKWITH ELECTRIC COMPANY. LOCATED IN MAIN ELECTRIC ROOM

NOTE: TO THE BEST OF MY KNOWLEDGE, BELIEF AND PROFESSIONAL JUDGMENT, THESE PLANS AND SPECIFICATIONS ARE IN COMPLIANCE WITH THE 2014 NEW YORK ENERGY CONSERVATION CODE (NYCECC).

NOTE: THIS PLAN IS APPROVED ONLY FOR WORK INDICATED ON THE APPLICATION SPECIFICATION SHEET. ALL OTHER MATTERS SHOWN ARE NOT TO BE RELIED UPON OR TO BE CONSIDERED AS EITHER BEING APPROVED OR IN ACCORDANCE WITH APPLICABLE CODES.

FEEDER SCHEDULE

DESIGNATION	DESCRIPTION	REMARKS
1	2#4/0, 1#4/0N, 1#4 G MC CABLE	COPPER CABLE
2	2#4/O, 1#4/0 N & 1#4 G MC CABLE	COPPER CABLE
3	2#250 MCM, 1#250 MCM & 1#4 G MC CABLE	COPPER CABLE
4	4#6 - 1"C	COPPER CABLE
5	2#8 & 1#8 G IN 1"C	COPPER CABLE
6	4#4 & 1#6 G IN 1 1/4"C	COPPER CABLE
7	10#14, 1 1/4"C	COPPER CABLE
8	2#10 & 1#10 G IN 3/4"C	COPPER CABLE
9	4#2/0 IN 2 1/2"C.	COPPER CABLE
10	4#4/0 - 2"C	COPPER CABLE
11	4#350 MCM- 3"C.	COPPER CABLE
12	3 SETS OF 4#250 MCM- (3) 2.5"C	COPPER CABLE
13	6 SETS OF 4#400 MCM IN (6) 3.5"C	COPPER CABLE
14	8-4" CONDUITS SLEEVES AS PER CON EDISON APPROVED LAYOUT.	COPPER CABLE
15	4 SETS 4#500 MCM IN 4-4"C	COPPER CABLE
16	4#1 IN 1 1/4 "C.	COPPER CABLE
17	4 SETS 4#600MCM IN 4-4"C	COPPER CABLE
18	5 SETS 4#600MCM IN 5-4"C	COPPER CABLE
19	6 SETS 4#600MCM IN 6-4"C	COPPER CABLE
20	7 SETS 4#600MCM IN 7-4"C	COPPER CABLE
21	4#500 MCM IN 3"C	COPPER CABLE
22	6 SETS OF 4#600 MCM IN 6-3.5"C	COPPER CABLE
23	4#600 MCM- 4"C.	COPPER CABLE
24	4#1/0 - 1 1/2"C	COPPER CABLE
25	2 SETS OF 500MCM IN 2-3"C	COPPER CABLE
26	4#3/0 - 2"C	COPPER CABLE
27	4#500 - 3 1/2"C	COPPER CABLE

PROVIDE 8-4" CONDUIT SLEEVES FROM EACH SERVICE END BOX TO 1'-0" PASS THE PROPERTY LINE IN ACCORDANCE WITH CON EDISON APPROVED SERVICE LAYOUT. SERVICE CONDUIT TO BE (RGS) RIGID GALVANIZED.

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Revisions

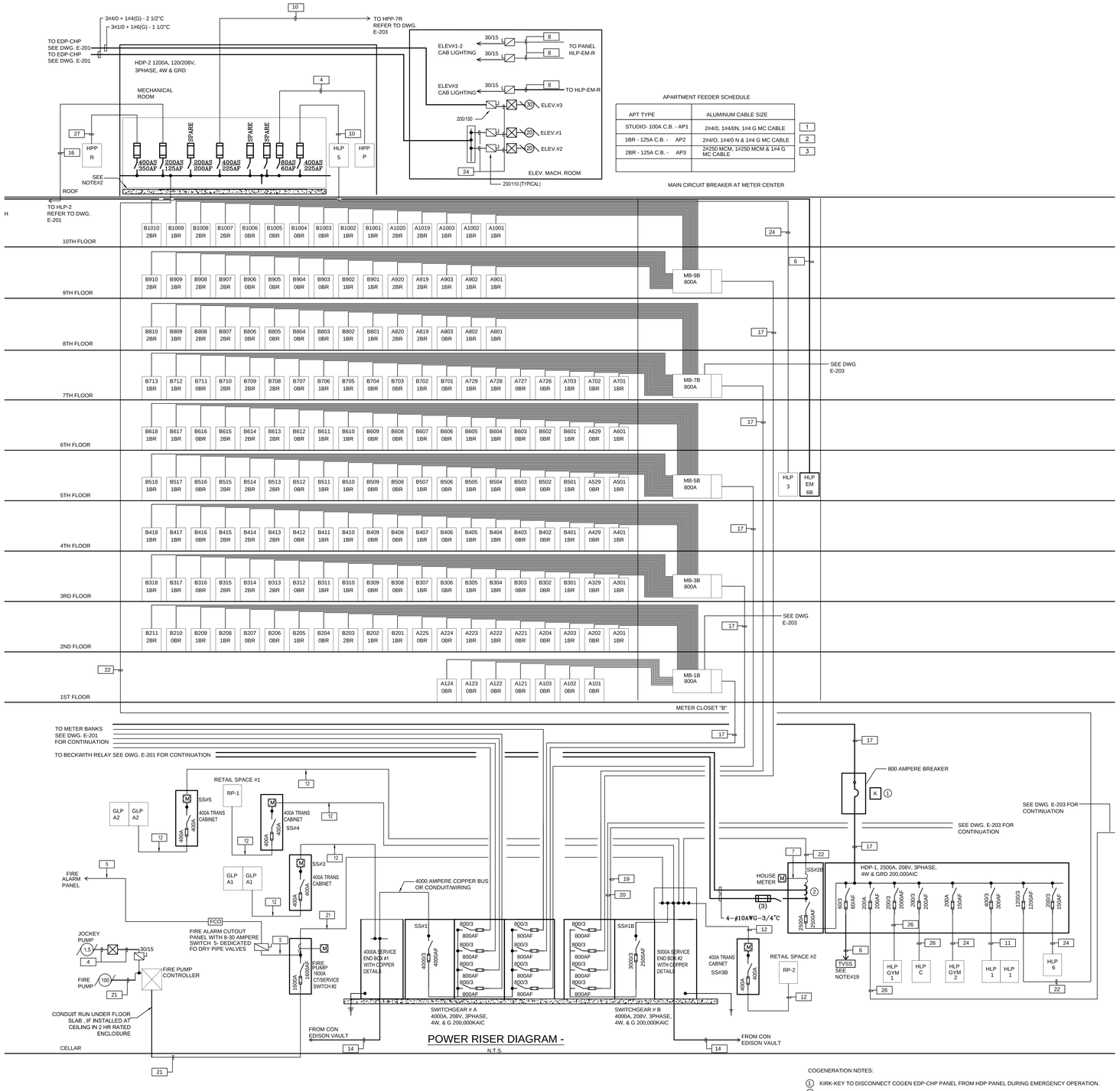
No.	Issue	Date
6.	ISSUED FOR 100% CD	07/27/15
5.	ISSUED FOR 80% CD	03/30/15
4.	ISSUED FOR 50% CD	02/06/15
3.	ISSUED FOR 25% CD	12/19/14
2.	ISSUE FOR DOB FILING	11/07/14
1.	ISSUED FOR 50% DD	10/14/14

ELECTRICAL POWER RISER DIAGRAM

E-201.00

Scale: NTS

Sheet No.: 42 OUT OF 50



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5	2#8 & 1#8 G IN 1"C	COPPER CABLE
6	4#4 & 1#6 G IN 1 1/4"C	COPPER CABLE
7	10#14, 1 1/4"C	COPPER CABLE
8	2#10 & 1#10 G IN 3/4"C	COPPER CABLE
9	4#2/0 IN 2 1/2"C.	COPPER CABLE
10	4#4/0 - 2"C	COPPER CABLE
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15	4 SETS 4#500 MCM IN 4-4"C	COPPER CABLE
16	4#1 IN 1 1/4 "C.	COPPER CABLE
17	4 SETS 4#600MCM IN 4-4"C	COPPER CABLE
18	5 SETS 4#600MCM IN 5-4"C	COPPER CABLE
19	6 SETS 4#600MCM IN 6-4"C	COPPER CABLE
20	7 SETS 4#600MCM IN 7-4"C	COPPER CABLE
21	4#500 MCM IN 3"C	COPPER CABLE
22	6 SETS OF 4#600 MCM IN 6-3.5"C	COPPER CABLE
23	4#600 MCM- 4"C.	COPPER CABLE
24	4#1/0 - 1 1/2"C	COPPER CABLE
25	2 SETS OF 500MCM IN 2-3"C	COPPER CABLE
26	4#3/0 - 2"C	COPPER CABLE
27	4#500 - 3 1/2"C	COPPER CABLE

PROVIDE 8-4" CONDUIT SLEEVES FROM EACH SERVICE END BOX TO 1'-0" PASS THE PROPERTY LINE IN ACCORDANCE WITH CON EDISON APPROVED SERVICE LAYOUT. SERVICE CONDUIT TO BE (RGS) RIGID GALVANIZED.

COGENERATION NOTES:

1. KIRK-KEY TO DISCONNECT COGEN EDP-CHP PANEL FROM HDP PANEL DURING EMERGENCY OPERATION.
2. ELECTRICAL CONTRACTOR SHALL PROVIDE CON-ED APPROVED 2500:5 CT'S AND CONNECT TO BECKWITH RELAY AS SHOWN. COORDINATE WIRING REQUIREMENTS WITH CHP EQUIPMENT VENDOR.

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Revisions

No.	Issue	Date
6.	ISSUED FOR 100% CD	07/27/15
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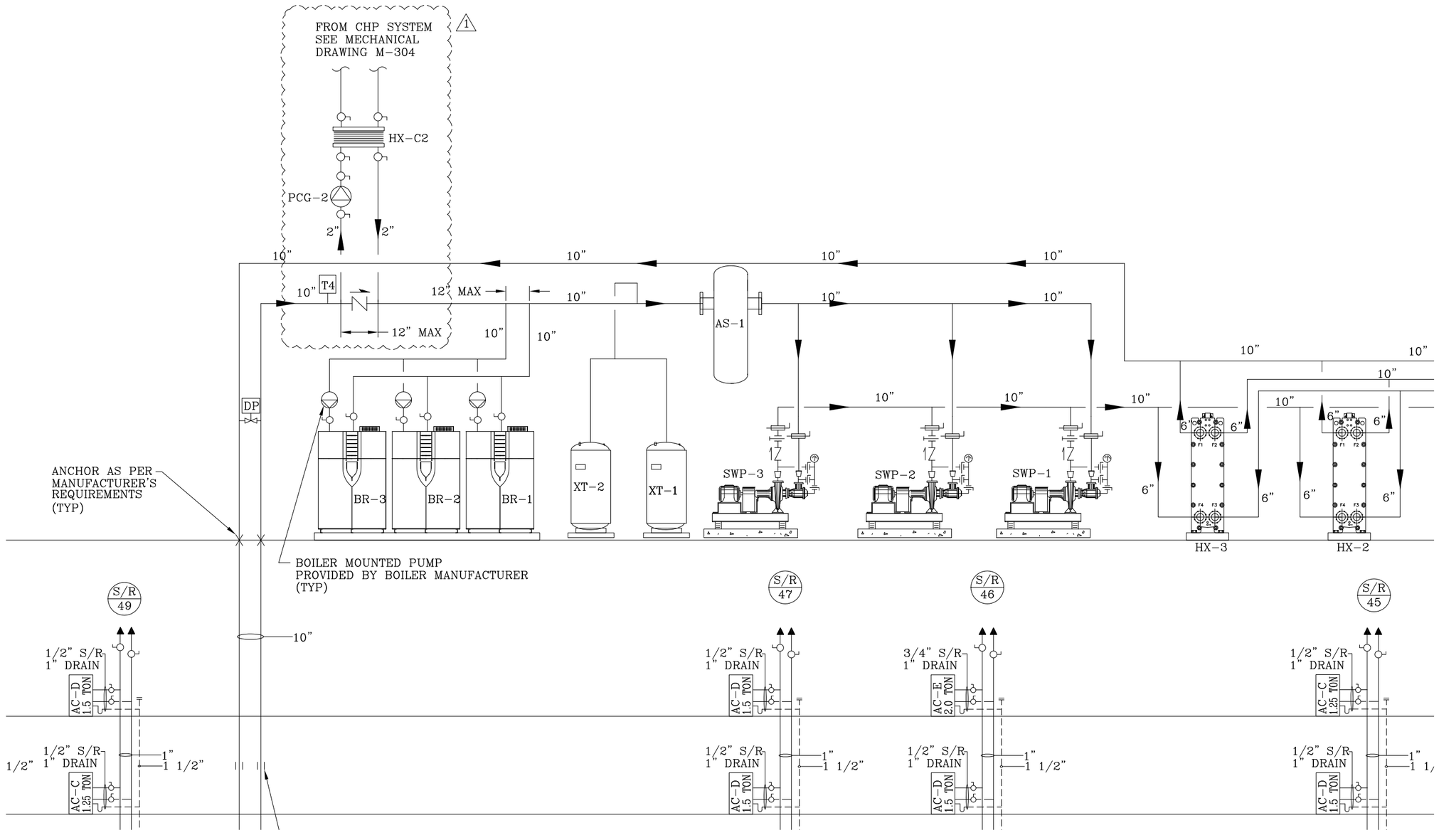
2.	ISSUE FOR DOB FILING	11/07/14
1.	ISSUED FOR 50% DD	10/14/14

ELECTRICAL POWER RISER DIAGRAM

E-202.00

Scale: NTS



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MSK-006

CO-GEN CLARIFICATION
WATER RISER DIAGRAM (M-206)

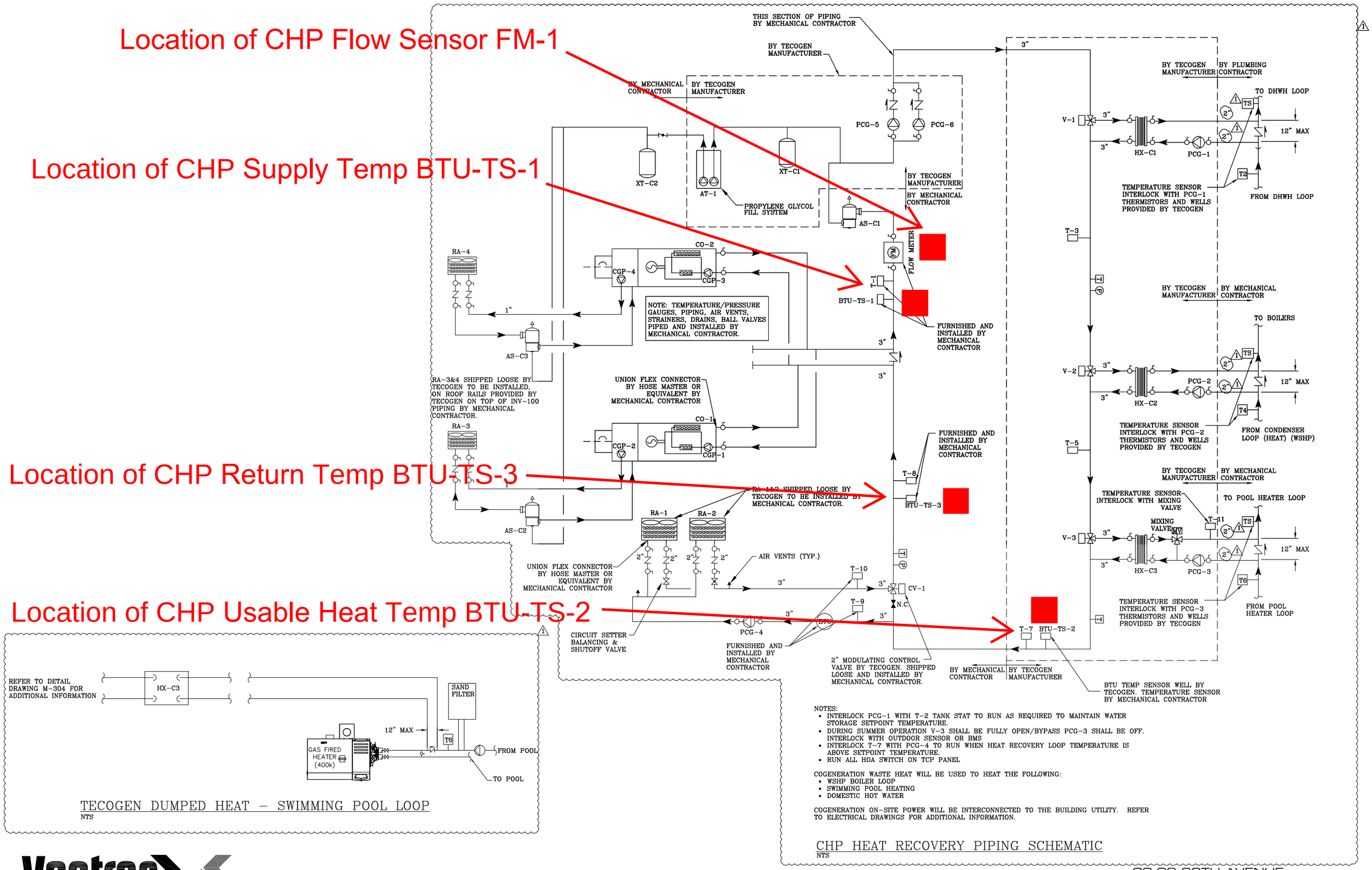
PROJECT NO : 2014-570
DATE 08-05-15
SCALE: NTS

Location of CHP Flow Sensor FM-1

Location of CHP Supply Temp BTU-TS-1

Location of CHP Return Temp BTU-TS-3

Location of CHP Usable Heat Temp BTU-TS-2



TECOGEN DUMPED HEAT – SWIMMING POOL LOOP
NTS

NOTES:
- INTERLOCK PCG-1 WITH T-2 TANK STAT TO RUN AS REQUIRED TO MAINTAIN WATER STORAGE SETPOINT TEMPERATURE.
- DURING SUMMER OPERATION V-3 SHALL BE FULLY OPEN/BYPASS PCG-3 SHALL BE OFF. INTERLOCK WITH OUTDOOR SENSOR OR BMS
- INTERLOCK T-7 WITH PCG-4 TO RUN WHEN HEAT RECOVERY LOOP TEMPERATURE IS ABOVE SETPOINT TEMPERATURE.
- RUN ALL HOA SWITCH ON TCP PANEL

COGENERATION WASTE HEAT WILL BE USED TO HEAT THE FOLLOWING:
- WSHP BOILER LOOP
- SWIMMING POOL HEATING
- DOMESTIC HOT WATER

COGENERATION ON-SITE POWER WILL BE INTERCONNECTED TO THE BUILDING UTILITY. REFER TO ELECTRICAL DRAWINGS FOR ADDITIONAL INFORMATION.

CHP HEAT RECOVERY PIPING SCHEMATIC
NTS

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MSK-005

CO-GEN CLARIFICATION
CO-GEN PIPING SCHEMATIC (M-304)

PROJECT NO: 2014-570
DATE: 08-05-15
SCALE: NTS

30th STREET

MANHOLE P-139
MANHOLE P-138

Location of CHP Gas Roof Connection

ROOF SLAB +130'-0"(+114'-0")

LAYER +130'-8"(+114'-8")

Synthetic Turf

Planting

Line of Surge Tank Below Deck

Surge Tank Access Panel

RAMP-UP

RAMP-UP

RAMP-UP

RAMP-UP

STEEL BASE

1926 SF

PE1

PE2

PE3

STAIR

SQUASH COURT

SEMI-PRIVATE SEATING

STAIR B BULKHEAD

ROOF HATCH

Gate to Mechanical Space

ELEVATOR LOBBY BULKHEAD

ELEVATOR BULKHEAD

MECHANICAL ROOM ROOF BULKHEAD

STAIR C BULKHEAD

31st STREET

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ROOF
PLUMBING PLAN

P-135.00

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

Sheet No.: 37 OUT OF 58

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NEW DRILL IN CONNECTION AT INV. ELEV. 16.64'

EXISTING CITY WATER MAIN

30TH STREET

NEW 6" DOMESTIC WATER SERVICE

NEW 6" FIRE SERVICE

Location of CHP
Gas Meter GM-1

NEW PRV& METER ASSEMBLY FOR COGENERATION UNITS (METER SHALL BE WITH PULSE HEAD) COORDINATE WITH CON EDISON FOR METERING REQUIREMENTS

NEW GAS SERVICE COORDINATE WITH CON EDISON

NEW PRV& METER ASSEMBLY FOR BOILER HEATING AND ROOFTOP UNITS COORDINATE WITH CON EDISON FOR METERING REQUIREMENTS

NEW PRV& METER ASSEMBLY FOR RESIDENTIAL COOKING COORDINATE WITH CON EDISON FOR METERING REQUIREMENTS

OUTLINE OF DETENTION TANK BELOW MECHANICAL ROOMS
DETENTION TANK 73'X20'X7.7'

10" COMBINED SANITARY AND STORM SEWER TO EXISTING CITY SEWER MAIN

INV. EL. : 17.89' AT PROPERTY LINE

CURB CUT
EL 28.3

EL 28.58
FIN. GRADE@DOOR

10" SANITARY HOUSE TRAP
INV. EL. : 18.10'

4" FAI UP

6" STORM HOUSE TRAP
INV. EL. : 18.10'

HOUSE TRAP PIT
HOUSE TRAP PIT

6" ST UG

4" UG

10" UG SAN

4" DN BELOW GARAGE FLOOR SLAB

DROP BELOW GAS ROOM FLOOR SLAB

SEE FP DRAWINGS FOR CONTINUATION

6" DCDA
WATTS 774DCDA-OSY

TRIPLEX BOOSTER PUMP

RUN BELOW FLOOR SLAB AND ABOVE DETENTION TANK SLAB

6" WATER METER

6" RPZ
WATTS 994

2 1/2" TANK FILL UP

6" CW UP

2" RPZ AND PRV

2" FOR IRRIGATION SYSTEM

BP-1

CODP

TIME WARNER /VERIZON SERVICE RM

FIRE PUMP RM

WATER RM

Outline of Detention Tank Below

VM-5

10" DOWN BELOW SLAB

CODP

STAIR A

SAN UP

STORM UP

GAS UP

6" SPRINKLER SUPPLY FROM TANK BY SPRINKLER CONTRACTOR

SEE FP DRAWINGS FOR CONTINUATION

ADA VAN

UP TO WH-3

MATCHLINE P-101
MATCHLINE P-104

MATCHLINE P-101
MATCHLINE P-102

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PARTIAL CELLAR FLOOR PLUMBING PLAN

P-101.00

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

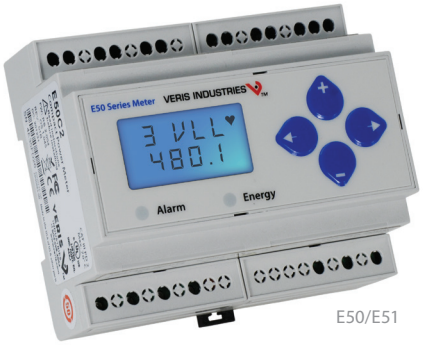
Sheet No.: 3 OUT OF 58

Appendix B

Cut Sheets for Key Sensors and Instruments

E5X SERIES

Versatile Energy Monitoring Solution



E50/E51

The E5x Series DIN Rail Meter combines exceptional performance and easy installation to deliver a cost-effective solution for power monitoring applications. The E5x can be installed on standard DIN rail or surface mounted as needed. The Modbus, LON, and BACnet output models offer added flexibility for system integration. The data logging capability (E5xC3 and E5xx5) protects data in the event of a communications or power failure elsewhere in the system. Combinations of serial communication, pulse output, and phase alarms are provided to suit a wide variety of applications. Additional pulse inputs on E5xHx and E50Fx provide an easy way to incorporate simple flow sensors to track gas, water, steam, or other energy forms using a BACnet or LON system.

The E51 models add a bi-directional monitoring feature designed expressly for renewable energy applications, allowing measurement of power imported from the utility grid as well as power exported from the renewable energy source (e.g. solar panels). In this way, a facility administrator can track all energy data, ensuring accuracy in billing and crediting. They are also useful for monitoring loads that use regenerative braking.

SPECIFICATIONS

INPUTS	
Control Power, AC	50/60 Hz; 5 VA max.; 90 V min.; UL Maximums: 600 V_{L-L} (347 V_{L-N}); CE Maximum: 300 V_{L-N}
Control Power, DC	3W max.; UL and CE: 125 to 300 Vdc (external DC current limiting required)
Voltage Input	UL: 90 V_{L-N} to 600 V_{L-L}; CE: 90 V_{L-N} to 300 V_{L-N}
CURRENT INPUT	
Scaling	5 A to 32,000 A
Input Range	0 to 0.333 V or 0 to 1 V (selectable) CTs must be rated for use with Class 1 voltage inputs
Pulse Inputs E5xHx & E50Fx only	Contact inputs to pulse accumulators (one set with E5xH2 and E50F2; two sets with E5xH5 and E51F5)*
ACCURACY	
Real Power & Energy	0.2% (ANSI C12.20, IEC 62053-22 Class 0.2S)
OUTPUTS	
E50B1 & E5xCx	Real Energy Pulse: N.O. static**; Alarm contacts: N.C. static**
E50Bx	Reactive energy pulse 30 Vac**
E5xCx	RS-485 2-wire Modbus RTU (1200 baud to 38.4 kbaud)
E5xHx	RS-485 2-wire BACnet MS/TP (9600 baud to 115.2 kbaud)
E50Fx	2-wire LON FT
MECHANICAL	
Mounting	DIN Rail or 3-point screw mount
ENVIRONMENTAL	
Altitude of Operation	3000 m
Operating Temp Range	-30 to 70 °C (-22 to 158 °F)
Storage Temp Range	-40 to 85 °C (-40 to 185 °F)
Humidity Range	<95% RH non-condensing
Mounting Location	Not suitable for wet locations. For indoor use only.
WARRANTY	
Limited Warranty	5 years
AGENCY APPROVALS	
Agency Approvals	UL 508 (Open Type Device), IEC/EN 61010-1, California CSI Solar, ANSI C12.20, Cat III, Pollution Degree 2

E51Cx only E5xH2 only

*10 kΩ Vac/dc to 4 to 10 Vdc.
**30 Vac/dc, 100 mA max. (AC: 50/60Hz).

Revenue grade measurements

Meets ANSI C12.20 Class 0.2 standards

Multiple applications

Real energy output and phase loss alarm output on E50Bx and E5xCx models…one device serves multiple applications

High reliability

ANSI C12.20 0.2% accuracy, IEC 62053-22 Class 0.2S on E5xxx

Data logging

Ensures long term data retrieval and safeguards during power failures (E5xC3 and E5xx5)

Easy installation

DIN rail or screw mounting options

Wide CT compatibility

Compatible with CTs from 5 A to 32000 A

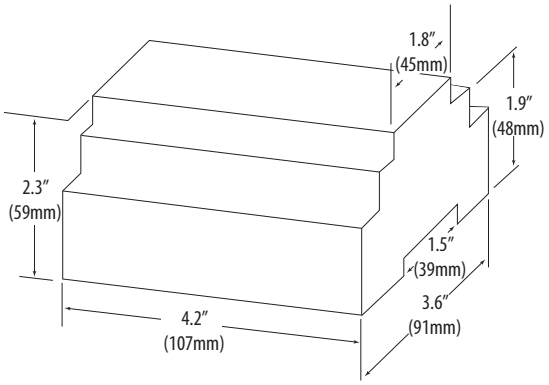
APPLICATIONS

- Energy monitoring in building automation systems
- Renewable energy
- Energy management
- Commercial sub-metering
- Industrial monitoring
- Cost allocation

ORDERING INFORMATION

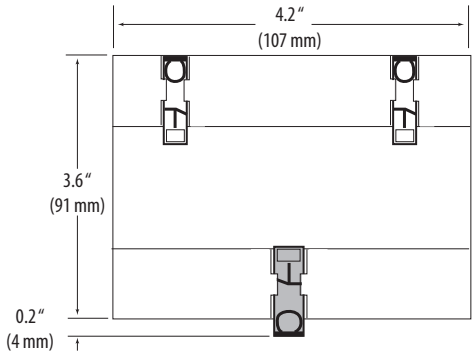
	E50B1	E50C2	E50C3	E50F2	E50F5	E50H2	E50H5	E51C2	E51C3	E51H2	E51H5
MEASUREMENT CAPABILITY - FULL DATA SET											
Bi-directional Energy Measurements									•	•	•
Power (3-phase total and per phase): Real (kW) Reactive (kVAR), and Apparent (kVA)	•	•	•	•	•	•	•	•	•	•	•
Power Factor: 3-phase average & per phase	•	•	•	•	•	•	•	•	•	•	•
Present Power Demand: Real (kW), Reactive (kVAR), and Apparent (kVA)	•	•	•	•	•	•	•	•	•	•	•
Import and Export totals of Present Power Demand: Real (kW), Reactive (kVAR), & Apparent (kVA)								•	•	•	•
Peak Power Demand: Real (kW), Reactive (kVAR), and Apparent (kVA)	•	•	•	•	•	•	•	•	•	•	•
Current (3-phase average and per phase)	•	•	•	•	•	•	•	•	•	•	•
Voltage: Line-Line and Line-Neutral (3-phase average and per phase)	•	•	•	•	•	•	•	•	•	•	•
Frequency	•	•	•	•	•	•	•	•	•	•	•
ANSI C12.20 0.2% accuracy, IEC 62053-22 Class 0.2S	•	•	•	•	•	•	•	•	•	•	•
Accumulated Net Energy: Real (kWh), Reactive (kVARh), and Apparent (kVAh)	•	•	•	•	•	•	•	•	•	•	•
Accumulated Real Energy by phase (kWh)	•	•	•	•	•	•	•	•	•	•	•
Import and Export Accumulators of Real and Apparent Energy								•	•	•	•
Reactive Energy Accumulators by Quadrant (3-phase total & per phase)								•	•	•	•
Demand Interval Configuration: Fixed or Rolling Block	•	•	•	•	•	•	•	•	•	•	•
Demand Interval Configuration: External Sync to Comms		•	•	•	•	•	•	•	•	•	•
DATA LOGGING											
Data Logging: 10 16-Bit Configurable (can include Date/Time) Data Buffers			•						•		
Data Logging: 3 Timestamped 32-Bit Configurable Data Buffers					•		•				•
Store up to 60 days of readings at 15-minute intervals			•		•		•		•		•
OUTPUTS											
Alarm Output (N.C.)	•	•	•	•		•		•	•	•	
1 Pulse Output (N.O.)		•	•					•	•		
2 Pulse Outputs (N.O.)	•										
RS-485 Serial (Modbus RTU Protocol)		•	•					•	•		
RS-485 Serial (BACnet MS/TP Protocol)						•	•			•	•
LON FT Serial (LonTalk Protocol)				•	•						
INPUTS											
2 Pulse Contact Accumulator Inputs					•		•				•
1 Pulse Contact Accumulator Input				•		•				•	

DIMENSIONAL DRAWING



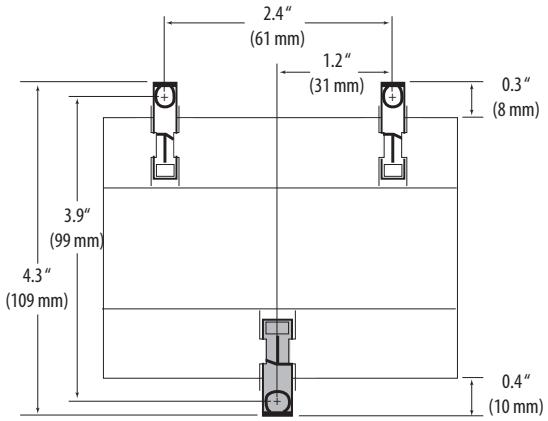
DIN MOUNT CONFIGURATION

Mounting Diagram



SCREW MOUNT CONFIGURATION

Mounting Diagram



System-10
BTU Meter

ONICON's SYSTEM-10 BTU METER is the premier platform for accurately measuring and reporting the thermal energy usage, flow and temperatures required by today's High Performance Buildings.

• Chilled Water • Hot Water • Condenser Water •

727.447.6140

DESCRIPTION

The System-10 BTU Meter provides highly accurate thermal energy measurement in chilled water, hot water and condenser water systems based on signal inputs from two matched temperature sensors (included) and any of ONICON's insertion or inline flow meters which are ordered separately. The basic model provides a local indication of energy, flow and temperature data through an alphanumeric display. An isolated solid state dry contact is provided for energy total. Optional analog outputs and network communications are also available.

Whether it's used for chiller plant optimization, CEP monitoring and control, or sub-metering the hydronic energy use across a campus, the System-10 has the versatility and functionality required to integrate seamlessly with your BMS/EMS.

APPLICATIONS

Chilled water, hot water and condenser water systems for:

- Commercial office tenant billing
- Central plant monitoring
- University campus monitoring
- Institutional energy cost allocation
- Performance/efficiency evaluations
- Performance contracting energy monitoring

CALIBRATION

Flow meters and temperature sensors are individually calibrated followed by a complete system calibration.

Field commissioning is also available.

FEATURES

Simple Installation and Commissioning - Factory programmed and ready for use upon delivery. All process data and programming functions are accessible via front panel display and keypad.

Single Source Responsibility - One manufacturer is responsible for every aspect of the energy measurement process ensuring component compatibility and overall system accuracy.

NIST* Traceable Calibration with Certification - Each BTU measurement system is individually calibrated using application specific flow and temperature data and is provided with a certificate of calibration.

Precision Solid State Temperature Sensors - Custom calibrated and matched to an accuracy better than ±0.15°F over the calibrated range.

Highly Accurate Flow Meters - ONICON offers a wide variety of insertion and inline type flow measurement technologies including turbine, electromagnetic and ultrasonic sensing. Each type offers unique advantages depending on the application. All ONICON flow meters are individually wet calibrated and designed to operate over a wide flow velocity range with accuracies ranging from ±0.2% to ±2.0% of rate depending on the model.

Complete Installation Package - All mechanical installation hardware, color coded interconnecting cabling and installation instructions are provided to ensure error-free installation and accurate system performance.

Serial Communications - Optional: Provides complete energy, flow and temperature data to the control system through a single network connection, reducing installation costs.

Smart button technology simplifies menu page navigation

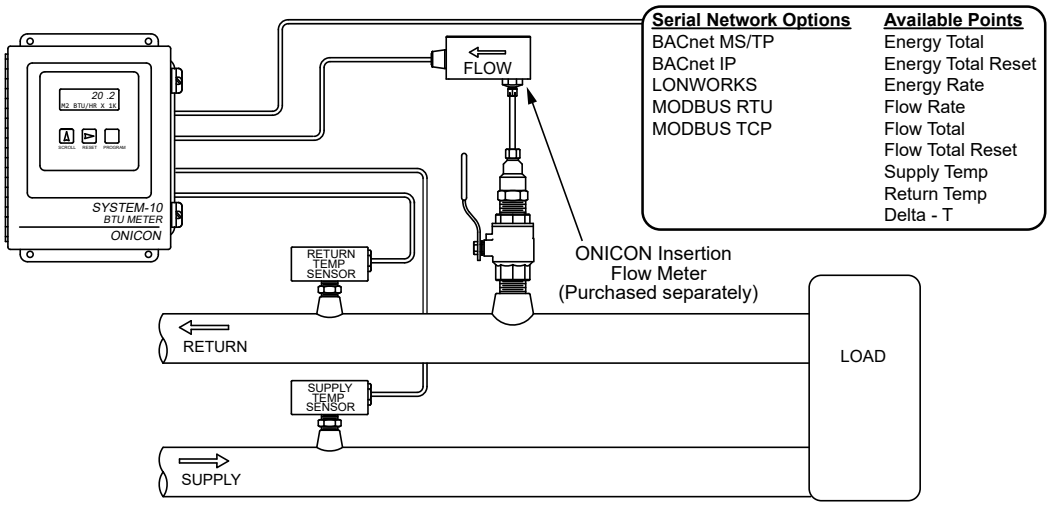
*National Institute of Standards and Technology

SPECIFICATIONS*

TEMPERATURE	Overall differential temperature measurement uncertainty of ≤ ±0.15°F over the stated range (Includes uncertainty associated with the sensors, transmitters, cabling and calculator input circuitry) Temperature sensors meet EN1434/CSA C900.1 accuracy requirements for 1K sensors for cooling applications, 32°F to 77°F. Temperature sensors meet EN1434/CSA C900.1 accuracy requirements for 2K sensors for heating applications, 140°F to 212°F.
CALCULATOR	Computing nonlinearity within ±0.05% Calculator meets EN1434 / CSA C900.1 class 1 accuracy requirements for 2K sensors for all applications.
PROGRAMMING	Factory programmed for specific application Field programmable via front panel interface
MEMORY	Non-volatile EEPROM memory retains all program parameters and totalized values in the event of power loss.
DISPLAY	Alphanumeric LCD displays total energy, total flow, energy rate, flow rate, supply temperature, return temperature, serial number and alarm status Alpha: 16 character, 0.2" high Numeric: 8 digit, 0.4" high Rate Display Range: 0 - 9,999,999 Total Display Range: 0 - 9,999,999
OUTPUT SIGNALS	Isolated solid state dry contact for energy total Contact rating: 100 mA, 50 V Contact duration: 0.5, 1, 2, or 6 sec Analog Output(s) (4-20 mA, 0-10 V or 0-5 V): One or four analog output(s) available for flow rate, energy rate, supply/return temps, or delta-T
SERIAL COMMUNICATIONS	BACnet® IP or MS/TP, MODBUS® RTU RS485 or TCP/IP, LONWORKS - TP/FT-10F, Siemens Apogee - P1, Johnson Controls Metasys - N2
TEMPERATURE SENSORS	Solid state sensors are custom calibrated using NIST traceable temperature standards. Current based signal (mA) is unaffected by wire length.
TEMPERATURE RANGE	Liquid temperature ranges based on application. See Meter Ordering Information on next page. Ambient temperature range: -20°F to 140°F
LIQUID FLOW SIGNAL INPUT	Pulse (frequency) or 4-20 mA input
MECHANICAL	**Available Electronics Enclosures:** Steel NEMA 13, wall mount, 8"x10"x4" NEMA 4 Approximate weight: 12 lbs **Temperature Sensor Thermowell Kits:** Thermowells and other kit components vary by fluid type, fluid temperature, pipe material and pipe size. Commonly used kits are listed on the previous page. Contact ONICON for additional thermowell kit options, including Hot Tap Installation Kits for retrofit installations.
ELECTRICAL	**Input Power:** Based on BTU meters configured for network connection without the analog outputs: 24 VAC, 50/60 Hz, 500 mA 120 VAC, 50/60 Hz, 200 mA 240 VAC, 50 Hz, 150 mA **Internal Supply:** Provides 24 VDC at 200 mA to electronics and select flow meters **Wiring:** Temperature signals: Use 18-22 ga twisted shielded pair Flow signals: Use 18-22 ga - see flow meter specification sheet for number of conductors.

* SPECIFICATIONS subject to change without notice.

TYPICAL INSERTION METER INSTALLATION



Serial Network Options	Available Points
BACnet MS/TP	Energy Total
BACnet IP	Energy Total Reset
LONWORKS	Energy Rate
MODBUS RTU	Flow Rate
MODBUS TCP	Flow Total
	Flow Total Reset
	Supply Temp
	Return Temp
	Delta - T

COMPATIBLE FLOW METERS

AVAILABLE OUTPUTS

METER ORDERING INFORMATION

Meter Model Number Coding = SYS-10-ABCD-EFGG

A = Electronics Enclosure

1 = NEMA 13 enclosure with LCD display

2 = NEMA 4 enclosure with LCD display

B = Input Power

1 = 24 VAC, 12 VA

2 = 120 VAC, 15 VA

3 = 240 VAC, 17.5 VA

C = Serial Communications

0 = No serial communications provided

1 = RS485, BACnet MS/TP

2 = RS485, MODBUS RTU

3 = BACnet IP

4 = MODBUS TCP/IP

5 = DualNet serial communications, IP and RS485

8 = LonWorks

D = Analog Output

0 = No analog output

1 = Single (1) isolated analog output

2 = Four (4) isolated analog outputs (Not available when C=5)

E = Auxiliary Pulse Inputs

0 = (1) Directional pulse input only

1 = (1) Directional pulse and auxiliary pulse input

F = Auxiliary Pulse Outputs

1 = Three (3) pulse outputs, dry contact

GG = Temperature Sensor

01 = Matched pair of current (mA) based sensors, CHW/CW range

02 = Matched pair of current (mA) based sensors, HHW range

S1 = Matched pair of current (mA) based sensors, 122°F to 302°F range

S4 = Matched pair of current (mA) based sensors, 80°F to 400°F range