

60 Sutton

60 Sutton Place

New York, NY 10022

As-Built March 2020

Submitted to:

Frontier Energy
2695 Bingley Road
Cazanovia, NY 13035

Submitted by:

Tecogen, Inc.
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Waltham, MA 02451
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www.Tecogen.com

Measurement & Verification Plan for CHP System at 60 Sutton

Project Team:

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Measurement & Verification Plan for CHP System at 60 Sutton

1. Introduction

Tecogen, Inc. (Tecogen) designed and oversaw the installation of a combined heat and power (CHP) system at 60 Sutton. 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) Tecogen InVerde e+ 125kW engine generator units. The system is intended to produce a gross output of 250kW total output and recover engine jacket water and exhaust heat recovery for:

- i. DHW
- ii. Space Heating during winter and shoulder months

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 grid import, 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

Tecogen installed a CHPInsight panel with the cogen. 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.

Measurement & Verification Plan for CHP System at 60 Sutton

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	CHP Room
G _{IN}	GM-1	Net Generator Fuel Input	CF	Gas Pulse Meter	Pulse	Outer wall of Boiler Room
T _{OUT1}	BTU-TS1	Engine Heating Module Supply Temperature	°F	Onicon System-10	ModBus	Boiler Room
T _{RET1}	BTU-TS3	Engine Heating Module Return Temperature (Before HBR)	°F	Onicon System-10	ModBus	Boiler Room
F _{NET1}	F-CHP	Engine Heating Module System Flow	GPM	Onicon System-10	ModBus	Boiler Room
Q _{NET1}	BTU-1	CHP Engine Heat Supplied	BTUh	Onicon System-10	ModBus	Boiler 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:

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

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

Measurement & Verification Plan for CHP System at 60 Sutton

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

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: $C_p = \sim 500 \text{ Btu/h-gpm-}^\circ\text{F}$ 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

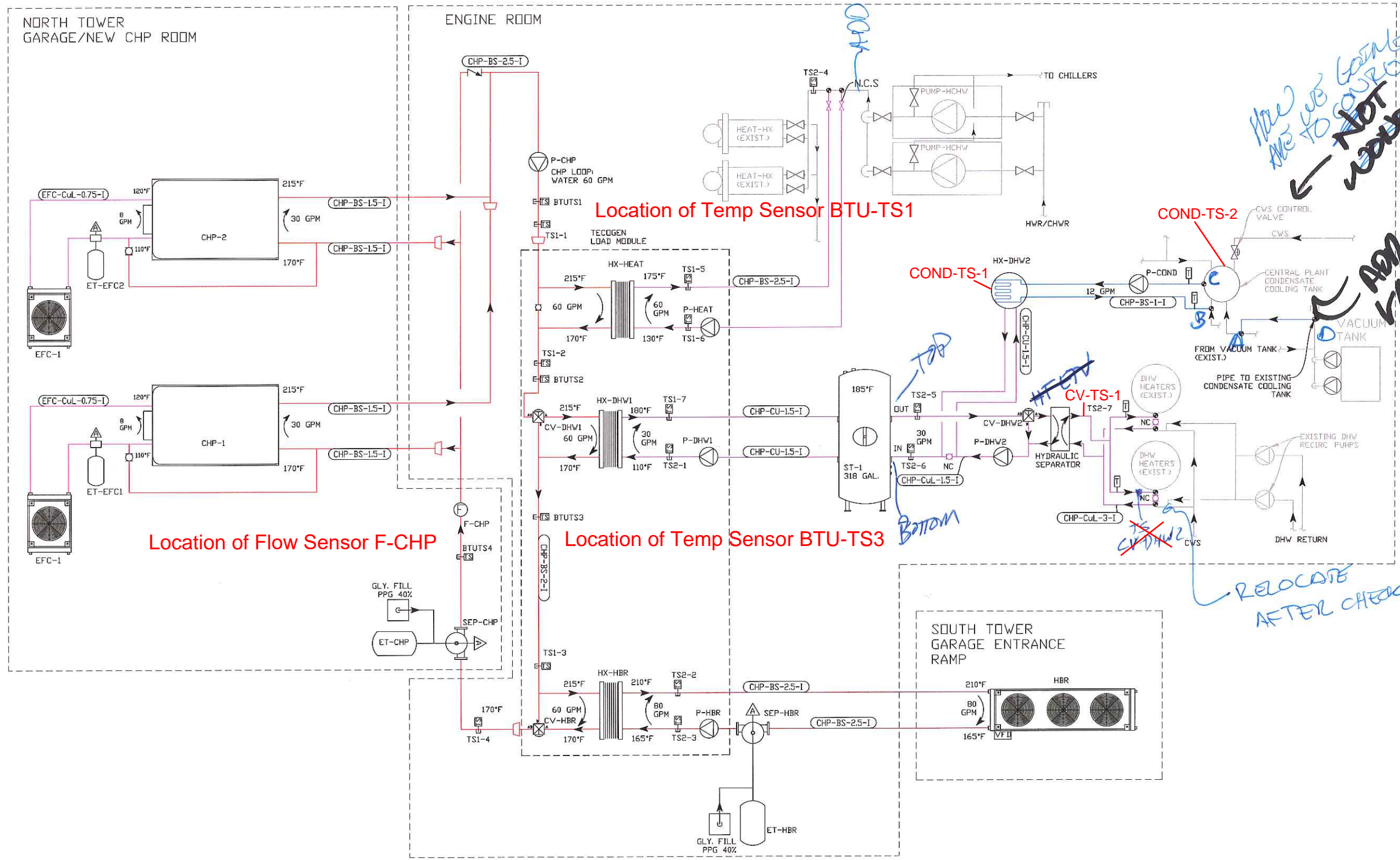
The fuel conversion efficiency (FCE) of the CHP system, based on the higher heating value of the fuel, will be defined as:

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

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 ($\sim 1020 \text{ Btu/CF}$)

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



Location of Flow Sensor F-CHP

Location of Temp Sensor BTU-TS1

Location of Temp Sensor BTU-TS3

- NOTES:
- 1. REFER TO DWG M-600 FOR TYPICAL DETAILS AND FITTINGS NOT SPECIFIED
 - 2. REFER TO DWG M-700 FOR PUMP CONTROL AND SEQUENCE OF OPERATION

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NO.	REVISION	DESCRIPTION	DATE
6			
5			
4			
3			
2	ISSUED FOR FILING		12/07/17
1	ISSUED FOR REVIEW		11/10/17
0	ISSUED FOR REVIEW		09/26/17

Professional Seal

MECHANICAL

DSMEA Low Carbon Engineering

1363-26 Veterans Hwy.
Hauppauge, NY 11788
(631) 360-1208
www.dsmea.com

Project Name and Address

MECHANICAL SCHEMATIC ONE-LINE SCHEMATIC

60 SUTTON PL
CHP PROJECT

60 SUTTON PLACE south
NEW YORK, NY, 10022

BLOCK: 01365 LOT: 0020

Project No.	Drawing Number:
Date: 08/21/2017	M-300.00
Scale: NTS	
Drawn by: SM	Approved by: JWA
Sheet #:	of

ROUTE REGULATOR VENTS
OVER EXISTING WINDOW
TO SIDE OF THE BUILDING

NEW 1" HIGH PRESSURE
GAS SERVICE FOR CHP
AND DOMESTIC LOADS

NEW CHP METER AND REGULATOR. REFER
TO CON ED SPEC G-414/EO-14166 AND
EO-16511 FOR FITTING AND
INSTALLATION DETAILS

OVERHANG AT 1ST
FLOOR AND UP

Approximate Location of Gas Pulse Meter GM-1

REFER TO CON ED SPEC.
G-414/EO-14166 FOR
FITTINGS AND
INSTALLATION DETAILS

NEW 2IN. GAS PIPE FOR
DOMESTIC LOADS. CONNECT TO
EXISTING DOMESTIC GAS
DISTRIBUTION PIPING OUTSIDE OF
EXISTING GAS METER ROOM

CWS CONTROL
VALVE

MAIN PLANT
CONDENSATE
COOLING TANK

DHW HEATER
(EXIST.)

DHW SUPPLY
TO BLDG.

DHW RECIRC.
PUMPS

DHW RETURN

CWS

DOMESTIC
WATER PUMPS

VACUUM
TANK

TECOGEN
LOAD MODULE

HEAT
EXCHANGER
ACCESSORY
PLATE

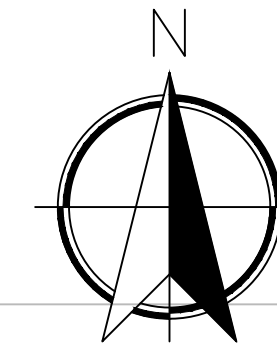
ST1 (318 GAL.)

XT-HBR
GLY. FILL
STATION

P-CHP

XT-CHP

54TH STREET



NOTES:

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THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER

6		
5		
4		
3		
2		
1		
0	GAS PIPING REVISION	12/13/17
NO.	REVISION DESCRIPTION	DATE

Professional Seal

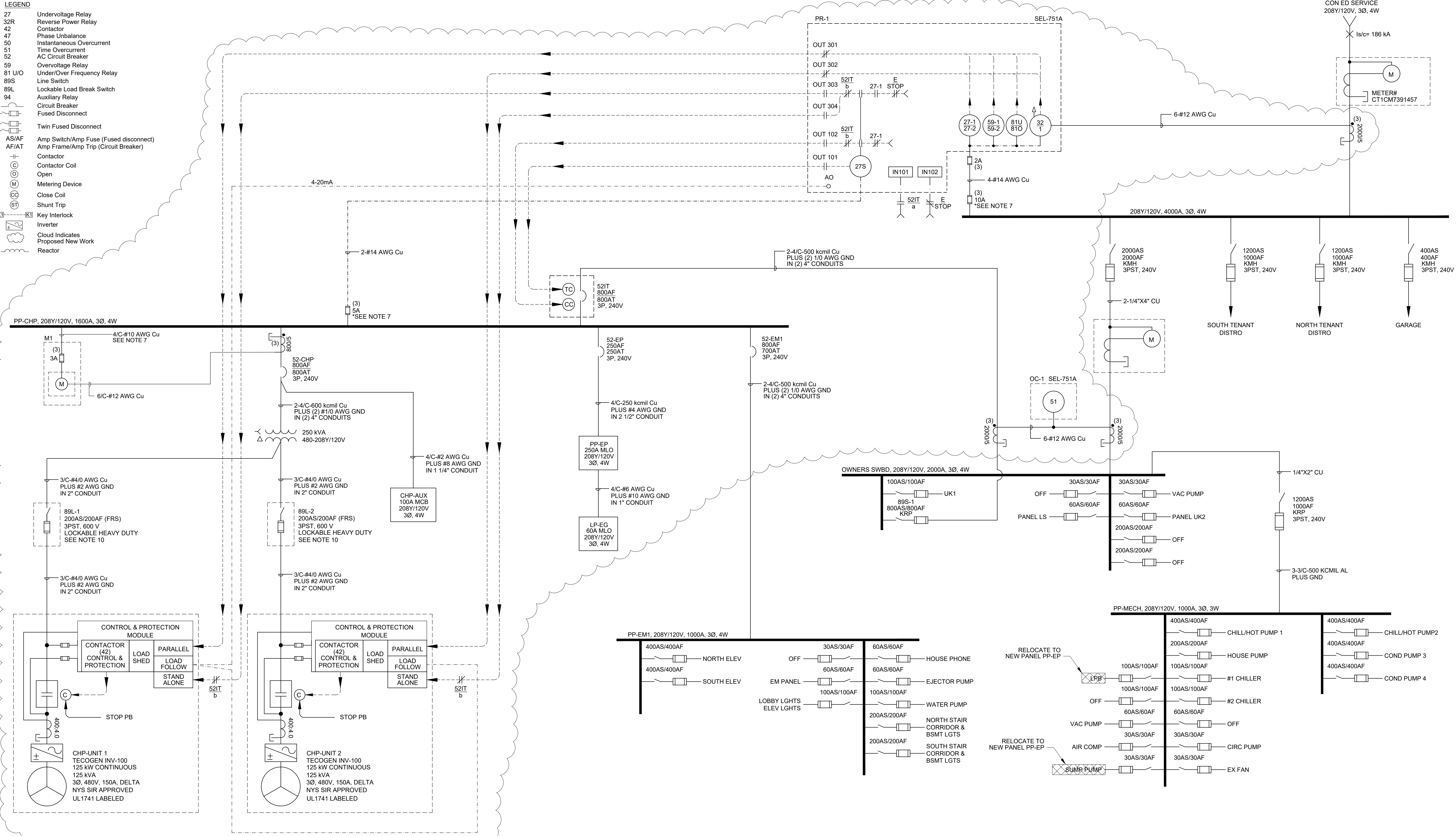
MECHANICAL
DSMEA
Low Carbon Engineering
1363-26 Veterans Hwy.
Hauppauge, NY 11788
(631) 360-1208
www.dsmea.com

Project Name and Address
**PLUMBING LAYOUT
GAS PIPING LAYOUT**
**60 SUTTON PL
CHP PROJECT**
**60 SUTTON PLACE SOUTH
NEW YORK, NY, 10022**
BLOCK: 01365 LOT: 0020

Project No.	Drawing Number:
Date: 12/12/2017	P-410.00
Scale: 3/8" = 1'0"	
Drawn by: SM	Approved by: JWA
Sheet #:	of

LEGEND

- 27 Undervoltage Relay
32R Reverse Power Relay
42 Contactor
47 Phase Unbalance
50 Instantaneous Overcurrent
51 Time Overcurrent
52 AC Circuit Breaker
59 Overvoltage Relay
81 U/O Under/Over Frequency Relay
89S Line Switch
89L Lockable Load Break Switch
94 Auxiliary Relay
Circuit Breaker
Fused Disconnect
Twin Fused Disconnect
AS/AF Amp Switch/Amp Fuse (Fused disconnect)
AF/AT Amp Frame/Amp Trip (Circuit Breaker)
Contactor
Contactor Coil
Open
Metering Device
Close Coil
Shunt Trip
Key Interlock
Inverter
Cloud Indicates Proposed New Work
Reactor



- NOTES:
- THIS PROJECT INSTALLS TWO NEW 100 kW CHP MODULES AND ALL NECESSARY EQUIPMENT TO PROVIDE PARALLEL OPERATION WITH CON EDISON AND ISOLATED OPERATION IN THE EVENT OF A UTILITY OUTAGE.
 - ALL FUSES INDICATED WILL PROVIDE SELECTIVE COORDINATION, AND HAVE 200 KAIC RATING.
 - THE GENERATORS TO BE INSTALLED IN ACCORDANCE WITH NEW YORK STATE STANDARD INTERCONNECTION REQUIREMENTS AND CON ED EO-2115. GENERATORS MAY RUN DURING UTILITY OUTAGE ONLY WHEN 52IT IS IN THE OPEN POSITION.
 - UNLESS NOTED, ALL EQUIPMENT IS EXISTING, AND WILL REMAIN IN USE AND IS PREVIOUSLY APPROVED.
 - ALL ELECTRICAL CONSTRUCTION TO BE IN COMPLIANCE WITH 2008 NEC, AS AMENDED BY THE NYC DOB.
 - BOND XO BUSHING TO SERVICE ENTRANCE THROUGH NEUTRAL CONDUCTOR. DO NOT GROUND AT TRANSFORMER.
 - CABLE TAPS AND FUSING TO BE IN ACCORDANCE WITH SECTION 240 NFPA 70 (NEC).
 - ELEVATOR CONTROL TO BE MODIFIED FOR EMERGENCY OPERATION, CONTRACTOR TO VERIFY ALL ELEVATOR POWER REQUIREMENTS ARE SUPPLIED.
 - ALL NEW CABLES IN TROUGH SHALL BE GROUPED A,B,C & N.
 - DISCONNECT SWITCH SHALL BE LOCKABLE WITH VISIBLE BREAK, LABELED AS "89L-X GENERATOR DISCONNECT SWITCH, MAY BE ENERGIZED FROM EITHER DIRECTION".

PR-1 SEL-751A INTERCONNECTION RELAY SETTINGS

PROTECTIVE ELEMENT	SETTING	TIME DELAY
27-1 UNDERVOLTAGE	80.0V	0.17 SEC
27-2 UNDERVOLTAGE	105.6V	2.00 SEC
32-1 (FORWARD POWER)	7.2 kW	2.00 SEC
59-1 OVERVOLTAGE	132.0V	1.00 SEC
59-2 OVERVOLTAGE	144.0V	0.17 SEC
81U UNDERFREQUENCY	57.0 Hz	0.17 SEC
81O OVERFREQUENCY	60.5 Hz	0.17 SEC

OC-1 SEL-751A RELAY SETTINGS

PROTECTIVE ELEMENT	SETTING	TIME DELAY
51 TIME OVERCURRENT	5A	TD= 1 (VI)

DSM Engineering Associates P.C.

1363-26 Veterans Memorial Highway
Hempstead, NY, 11788

Rev No.	Date	Description	By:
4	01/05/18	REVISE TRANSFORMER ARRANGEMENT	BTC
3	11/21/17	ADD AUXILIARY LOAD PANELS	BTC
2	09/29/17	REVISED PER CUSTOMER COMMENTS	AFC
1	08/29/17	ISSUE FOR REVIEW AND COMMENTS	AFC

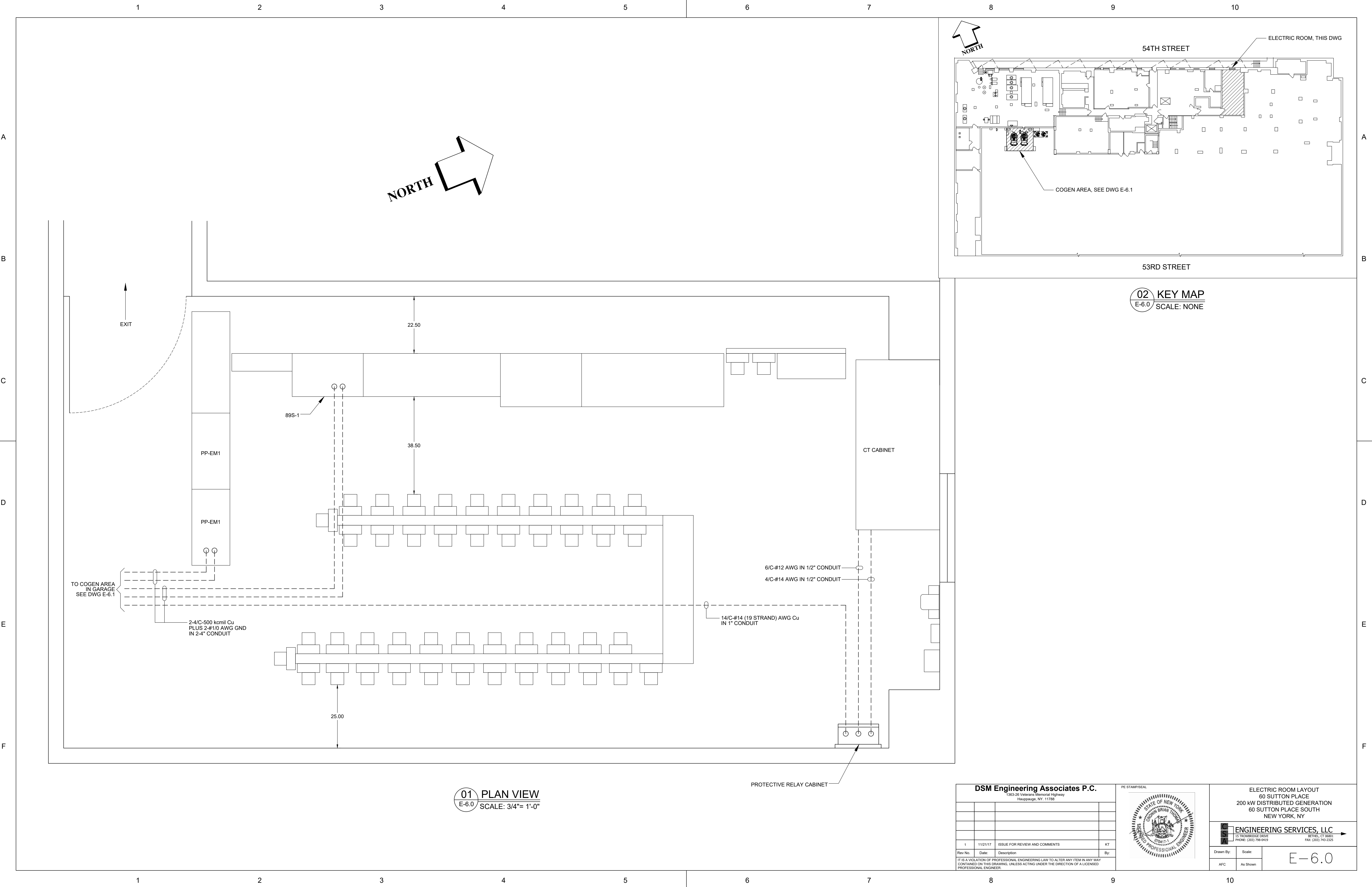
PE STAMP/SEAL



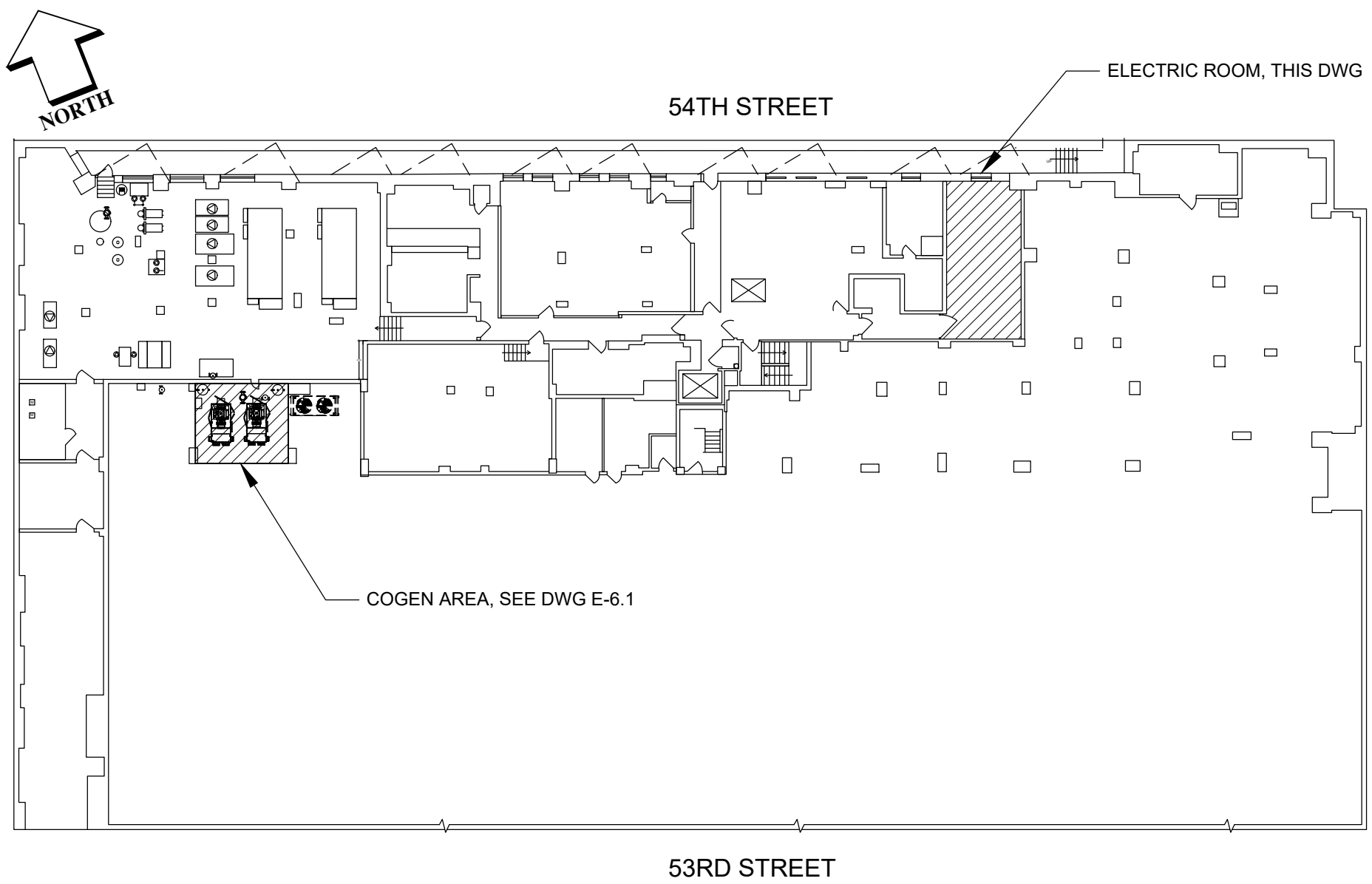
ONE-LINE DIAGRAM
200 kW DISTRIBUTED GENERATION
60 SUTTON PLACE SOUTH
NEW YORK, NY

ENGINEERING SERVICES, LLC
15 TROWBRIDGE DRIVE
PHONE: (203) 786-9419
FAX: (203) 782-2325

Drawn By:	Scale:	E-1.0
AFC	NONE	

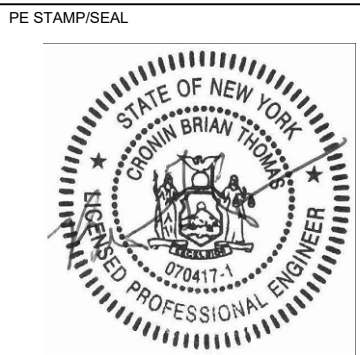


01 PLAN VIEW
E-6.0 SCALE: 3/4"= 1'-0"

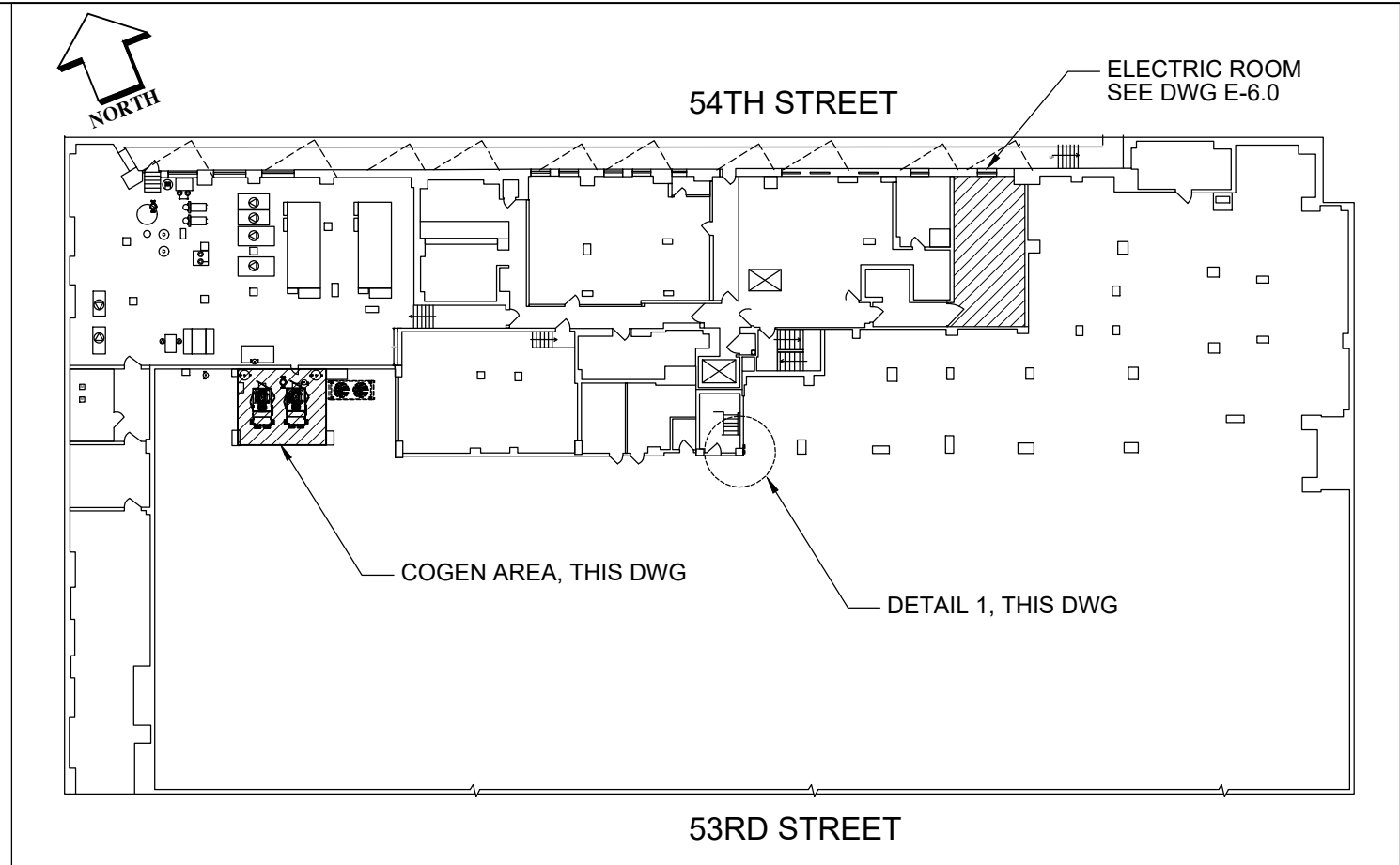
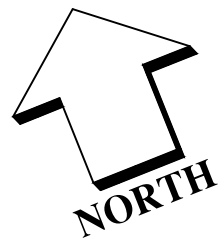


02 KEY MAP
E-6.0 SCALE: NONE

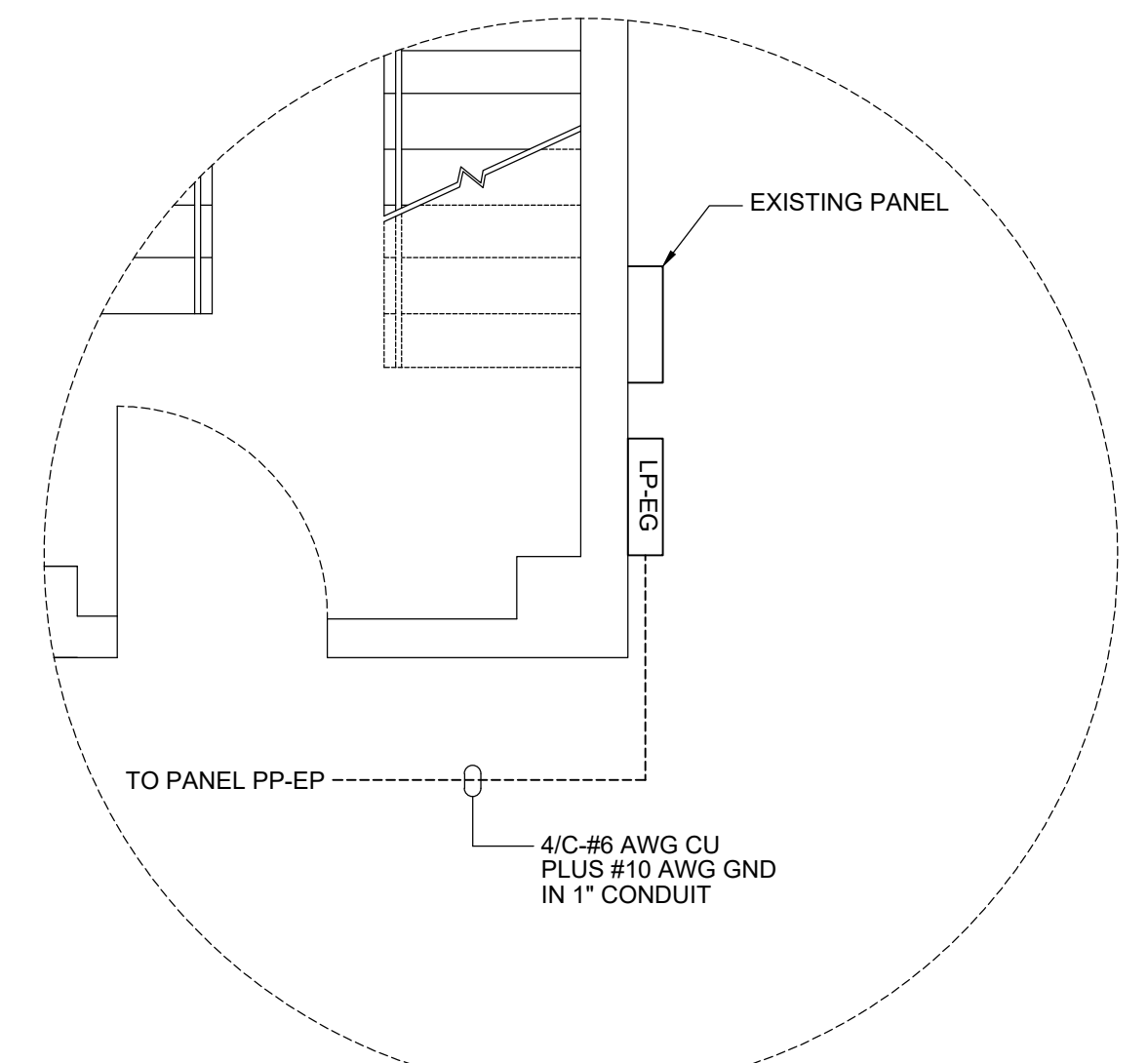
DSM Engineering Associates P.C.			
1363-26 Veterans Memorial Highway Hauppauge, NY 11788			
1	11/21/17	ISSUE FOR REVIEW AND COMMENTS	KT
Rev No.	Date:	Description	By:
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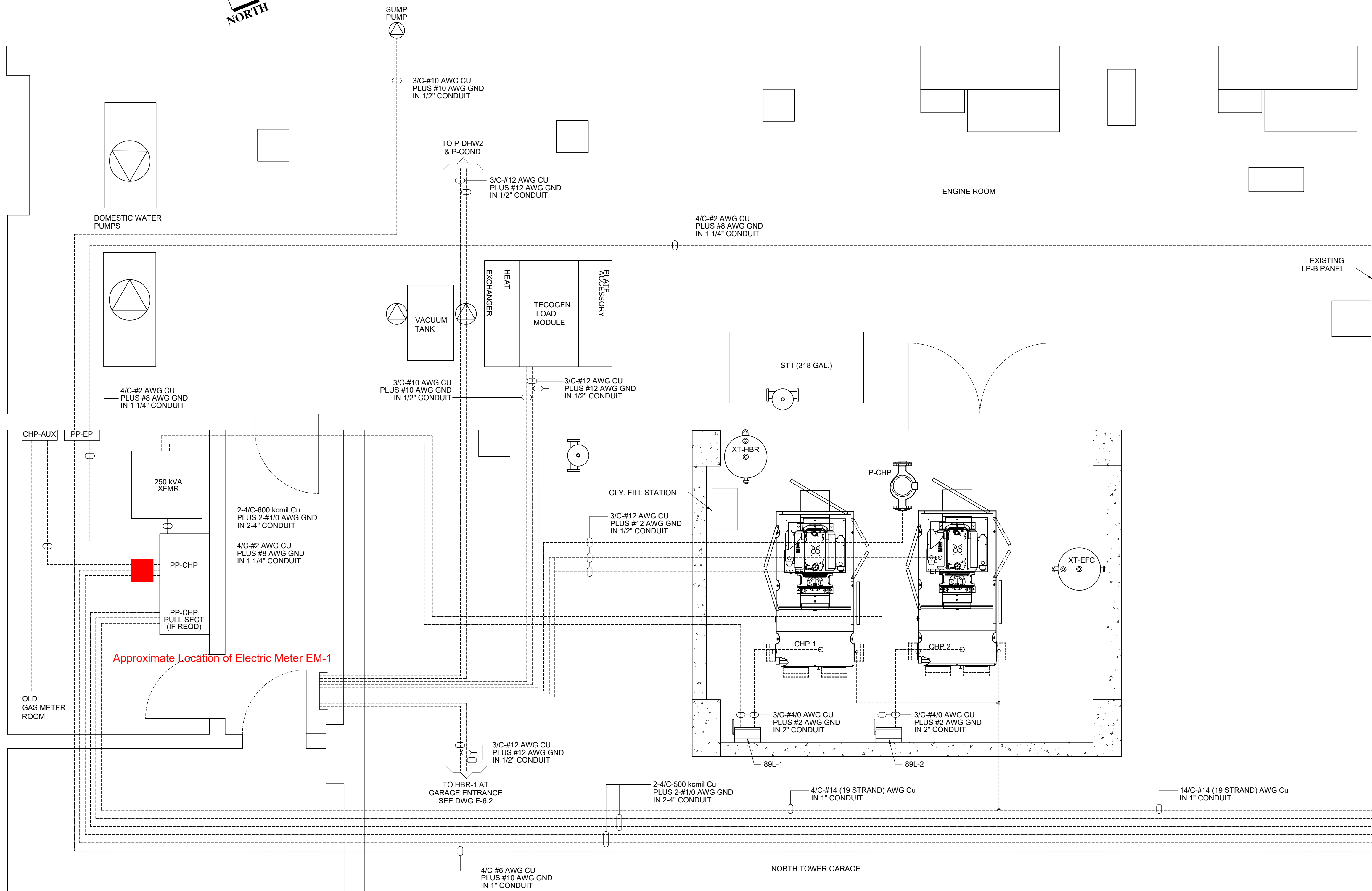
ELECTRIC ROOM LAYOUT			
60 SUTTON PLACE 200 kW DISTRIBUTED GENERATION 60 SUTTON PLACE SOUTH NEW YORK, NY			
ENGINEERING SERVICES, LLC 15 TROWBRIDGE DRIVE BETHEL, CT 06801 PHONE: (203) 796-9419 FAX: (203) 793-2325			
Drawn By:	Scale:	E-6.0	
AFC	As Shown		




02 KEY MAP
E-6.1 SCALE: NONE



02 DETAIL 1
E-6.1 SCALE: 3/8"= 1'-0"



01 PLAN VIEW
E-6.1 SCALE: 3/8"= 1'-0"

DSM Engineering Associates P.C. 1363-26 Veterans Memorial Highway Hauppauge, NY 11788				PE STAMP/SEAL 		ENGINEERING SERVICES, LLC 15 TROWBRIDGE DRIVE BETHEL, CT 06801 PHONE: (203) 786-9419 FAX: (203) 782-2325	
Rev No. Date Description By:				Drawn By: Scale: As Shown		PARTIAL BASEMENT PLAN 60 SUTTON PLACE 200 kW DISTRIBUTED GENERATION 60 SUTTON PLACE SOUTH NEW YORK, NY E-6.1	
2 01/05/18 REVISE TRANSFORMER ARRANGEMENT BTC							
1 11/21/17 ISSUE FOR REVIEW AND COMMENTS -							
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Appendix B

Cut Sheets for Key Sensors and Instruments



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 •



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 $\pm 0.15^\circ\text{F}$ 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 $\pm 0.2\%$ to $\pm 2.0\%$ 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

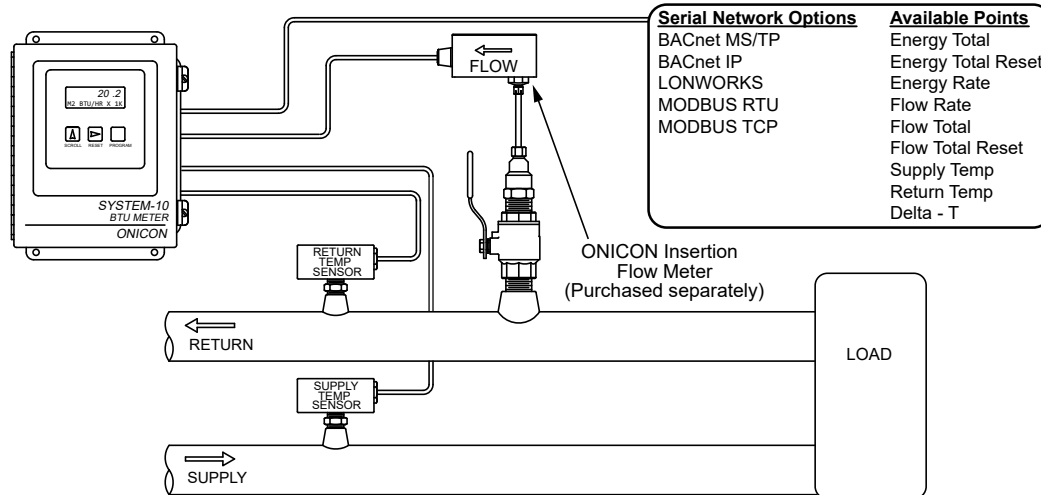
*National Institute of Standards and Technology

SPECIFICATIONS*

TEMPERATURE	Overall differential temperature measurement uncertainty of $\leq \pm 0.15^{\circ}\text{F}$ 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 $\pm 0.05\%$ 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



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

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)
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OUTPUTS

E50B1 & E5xCx	Real Energy Pulse: N.O. static**; Alarm contacts: N.C. static**
---------------	--

Revenue grade measurements

Meets ANSI C12.20 Class 0.2 standards

High reliability

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

Easy installation

DIN rail or screw mounting options

Multiple applications

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

Data logging

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

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

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
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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
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AGENCY APPROVALS

Agency Approvals	UL 508 (Open Type Device), IEC/EN 61010-1, California CSI Solar, ANSI C12.20, Cat III, Pollution Degree 2
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*10 kΩ Vac/dc to 4 to 10 Vdc.

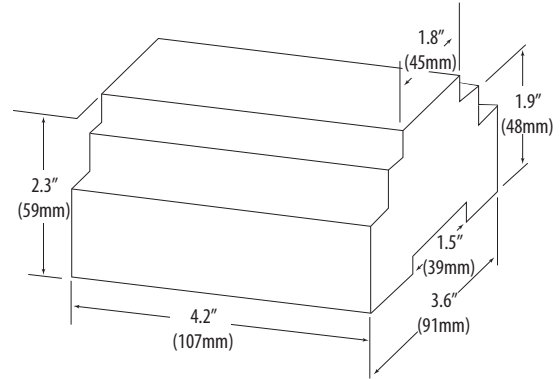
**30 Vac/dc, 100 mA max. (AC: 50/60Hz).



ORDERING INFORMATION

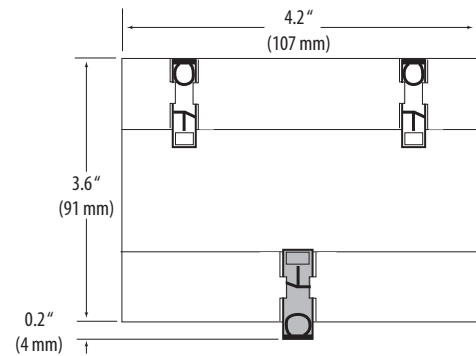
	E50B1	E50C2	E50C3	E50F2	E50F5	E50H2	E50H5	E51C2	E51C3	E51H2	E51H5
MEASUREMENT CAPABILITY - FULL DATA SET											
Bi-directional Energy Measurements											
Power (3-phase total and per phase): Real (kW) Reactive (kVAR), and Apparent (kVA)	•	•	•	•	•	•	•	•	•	•	•
Power Factor: 3-phase average & per 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

