

# **MEASUREMENT AND VERIFICATION PLAN**

**FOR**

**DG/CHP SYSTEM**

**AT**

**MILLENNIUM BROADWAY HOTEL**

*March 2015*

*Submitted to:*

**New York State Energy Research and Development Authority**  
17 Columbia Circle  
Albany, NY 12203-6399

*Submitted by:*

**CDH Energy Corp.**  
PO Box 641  
2695 Bingley Rd  
Cazenovia, NY 13035  
(315) 655-1063  
[www.cdhenergy.com](http://www.cdhenergy.com)

## Project Team:

### **NYSERDA Project Manager:**

Joanna Moore  
Energy Efficiency Services  
NYSERDA  
1-866-NYSERDA x. 3220  
Email: Joanna.Moore@nyserda.ny.gov

### **Project Team:**

#### **Developer/Applicant:**

Greenwood Energy  
134 East 40<sup>th</sup> Street  
New York, NY 10016

ENK Solutions  
21 Main Street  
East Brunswick, NJ 08816

CRC Engineering  
1261 Broadway  
7<sup>th</sup> Floor  
New York, NY 10001

SET Environmental, Inc.  
43 Houston Place  
Haworth, NJ 07641

Broadway Electric  
1261 Broadway  
6<sup>th</sup> Floor  
New York, NY 10001

#### **Site:**

Millennium Broadway Hotel  
145 West 44<sup>th</sup> Street, New York, NY 10036

#### **NYSERDA QC Contractor:**

John DeFrees, Modern Energy Technologies  
5533 State Route 80  
Tully, NY 13159  
315-238-7122 (office)  
John@modernenergyllc.com

#### **NYSERDA M&V Contractor:**

Adam Walburger, CDH Energy  
PO Box 641  
2695 Bingley Rd  
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## 1. Introduction

Greenwood Energy & CRC Engineering are in the process of installing a combined heat and power (CHP) system at the Millennium Broadway Hotel in Manhattan, NY.

The proposed CHP system based on three natural gas fueled reciprocating engine-generators having a combined gross output of 750 kW. Heat is recovered as hot glycol from the engine jacket and exhaust at a supply temperature of 190°F. The hot glycol loop will be used to drive a hot water absorption chiller, supplement facility space heating, and supplement domestic hot water production. Excess heat is rejected from the hot glycol loop to a dump radiator.

## 2. Instrumentation

In order to quantify the performance of the proposed CHP system, the CHP system fuel input, net electrical output, and useful thermal output must be measured. To capture these energy flows, an instrumentation plan was developed by the applicant, Greenwood Energy (based on information provided by CRC Engineering). The instrumentation plan covers the location and type of sensors necessary to provide the appropriate measurements of the energy flows of the system.

In accordance with the instrumentation plan, Greenwood Energy will supply the instrumentation listed in Table 1 below for use in meeting the NYSERDA CHP program monitoring requirements.

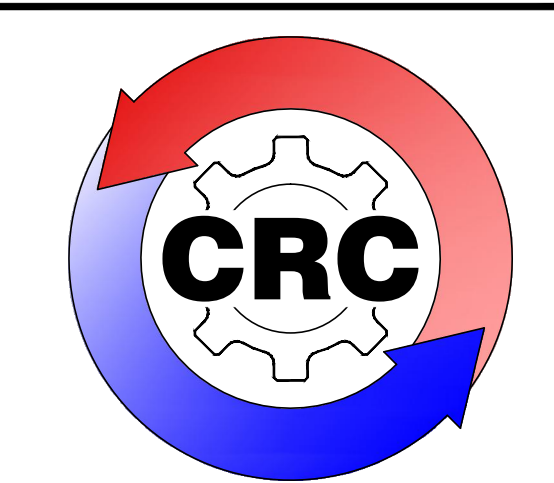
**Table 1. Instrumentation Supplied By Greenwood Energy**

Point	Instrument	Output Type	Sensor Location	Notes
Generator Power Output	Schneider Electric Power Logic Ion 6200	Modbus	CTs in BUS COG-1	· WG1, WG2, WG3
Parasitic Load Electrical Consumption	Schneider Electric Power Logic Ion 6200	Modbus	CTs in Panel CGH	· WPAR
Combined Generator Fuel Input	Fox Instruments FT2-061E-SS-ST-E1-DD-BO-G3	4 - 20 mA	Meter located at CHP skid	· FG
Hot Water Flow	SDI SDIOH1N110200 Paddlewheel	Pulse	Load Side HW Header	· FL
Hot Water Loop Temperature	BAPI 10k type 3 thermistor (Immersion Unit with Water Proof (WP) Enclosure)	Resistance	Load Side HW Header	· TLS, TLR1, TLR2, TLR3, TLR4
Heat Recovery	Btu calculated in DDC Controller		Calculated recovered heat based on main CHP loop readings (TLS, TLR3, FL)	· QU
Heat Rejection	Btu calculated in DDC Controller		Calculated recovered heat based on main CHP loop readings (TLR3, TLR4, FL)	· QD
Total Facility Energy / Power				· WT · From ConEd Bills
Ambient Temperature	BAPI BA/10K3/O/WP" 10k type 3 thermistor	Resistance		· TAO



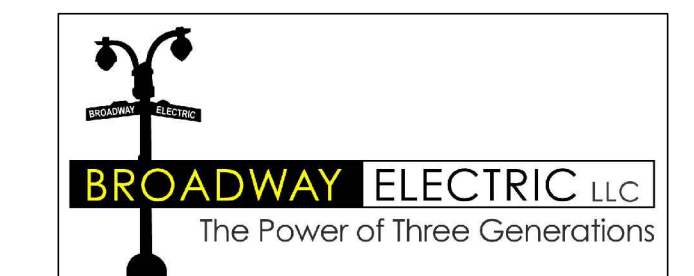
**MTE SOLUTIONS**  
Energy Independence Through Innovative Solutions

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**BROADWAY ELECTRIC LLC**  
The Power of Three Generations



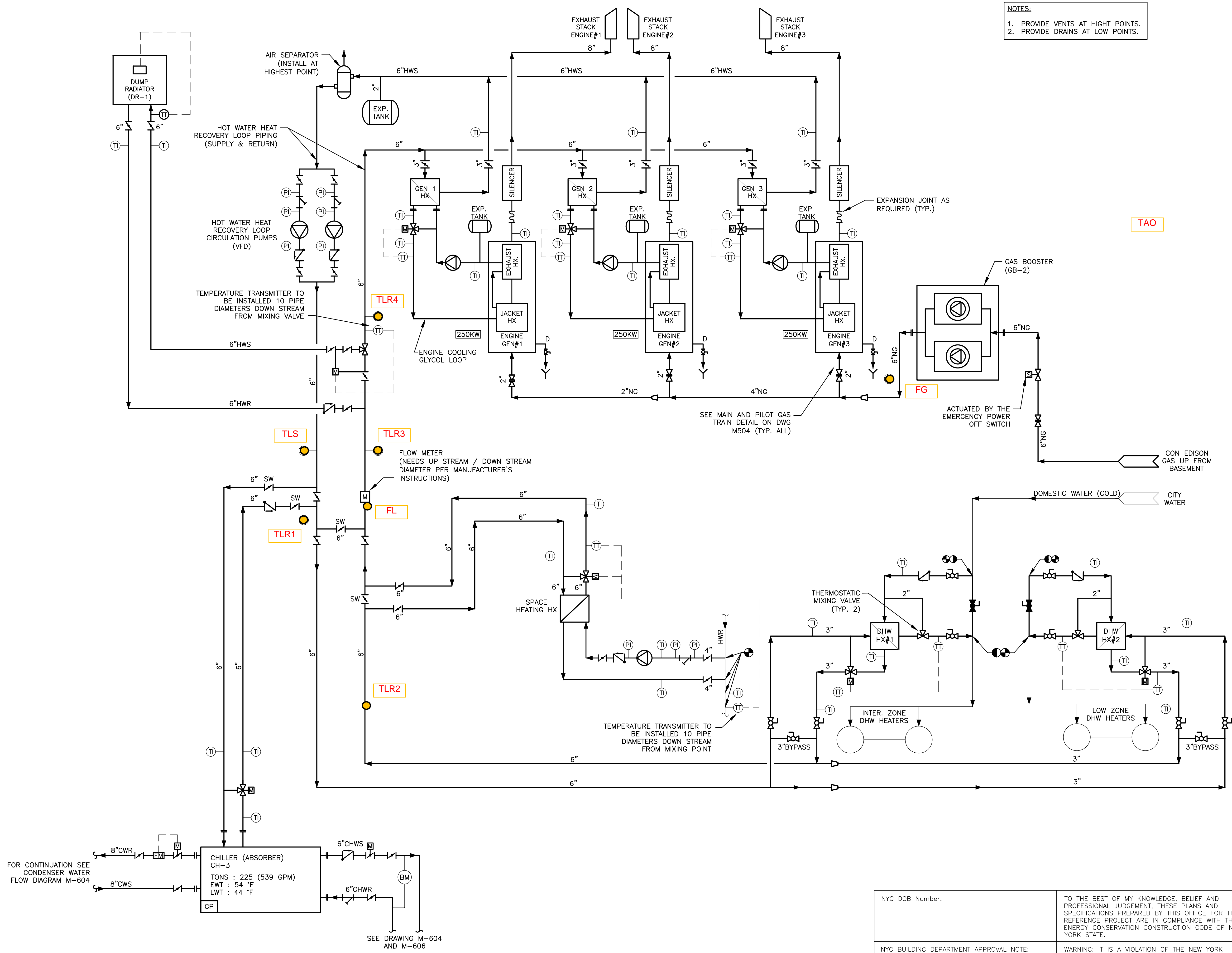
0 2-20-14 ISSUED FOR CONSTRUCTION  
PROJECT  
**INSTALLATION OF NATURAL GAS FUELED COGENERATION UNITS, LOW PRESSURE BOILERS AND REPLACEMENT OF CHILLERS ON NINTH FLOOR**

DRAWING TITLE  
**COGENERATION FLOW DIAGRAM INSTALLATION**

SCALE AS NOTED  
DRAWN BY ER  
CHECKED BY RB  
JOB No. / FILENAME MTE-12101  
DATE 01-31-14

SEAL & SIGNATURE  
DRAWING NUMBER  
**M-603.00**  
20 OF 45

- NOTES:**
1. PROVIDE VENTS AT HIGHT POINTS.
  2. PROVIDE DRAINS AT LOW POINTS.



NYC DOB Number: \_\_\_\_\_

TO THE BEST OF MY KNOWLEDGE, BELIEF AND PROFESSIONAL JUDGEMENT, THESE PLANS AND SPECIFICATIONS PREPARED BY THIS OFFICE FOR THE REFERENCE PROJECT ARE IN COMPLIANCE WITH THE ENERGY CONSERVATION CONSTRUCTION CODE OF NEW YORK STATE.

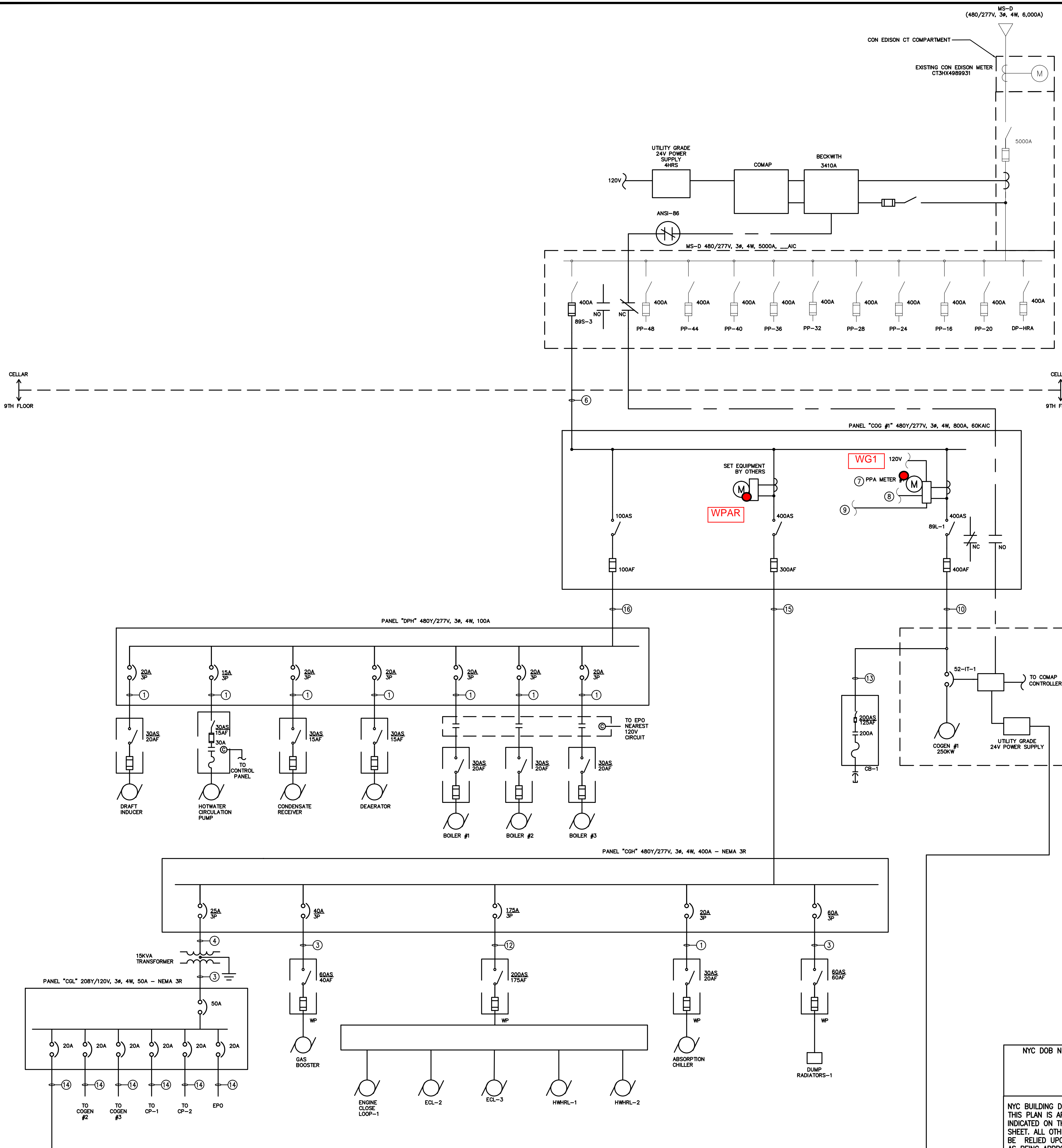
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FOR CONTINUATION SEE CONDENSER WATER FLOW DIAGRAM M-604

CHILLER (ABSORBER) CH-3  
TONS : 225 (539 GPM)  
EWT : 54 °F  
LWT : 44 °F

SEE DRAWING M-604 AND M-606



**KEYED NOTES**

- ① 4#12 & #12G - 3/4"
- ② 3#4 & #4G - 2"
- ③ 4#6 & #10G - 1"
- ④ 3#10 & #10G - 1"
- ⑤ 3#6 & #10G - 1"
- ⑥ (4) 600 KCML & #2G - 4"
- ⑦ SATEC PPA METER #PM174-N-60-5-ACDC-00-00-ETH NYSERDA APPROVED.
- ⑧ ETHERNET CAT 6 TO NEAREST DATA ROOM IDF RACK.
- ⑨ RS-485 TO SET EQUIPMENT.
- ⑩ (3) 600 KCML & #2G - 4"
- ⑪ EXISTING (3) SETS OF (3) 500 KCML IN 4" TO BE MEGGER OHM TESTED PRIOR TO CONNECTION
- ⑫ (3) 3/0 & 6G IN 2"
- ⑬ 3#1 & #6G - 2"
- ⑭ 2#12 & #12G - 3/4"
- ⑮ (4) 500 KCML & #2G - 4"
- ⑯ (4) #2 & #8C - 1-1/2"

**DRAWING NOTES**

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13. COORDINATE ALL RISER WORK WITH THE CONSTRUCTION MANAGER AND CONSOLIDATED EDISON.
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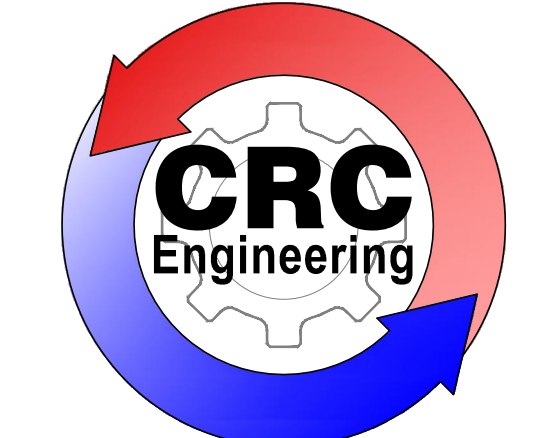
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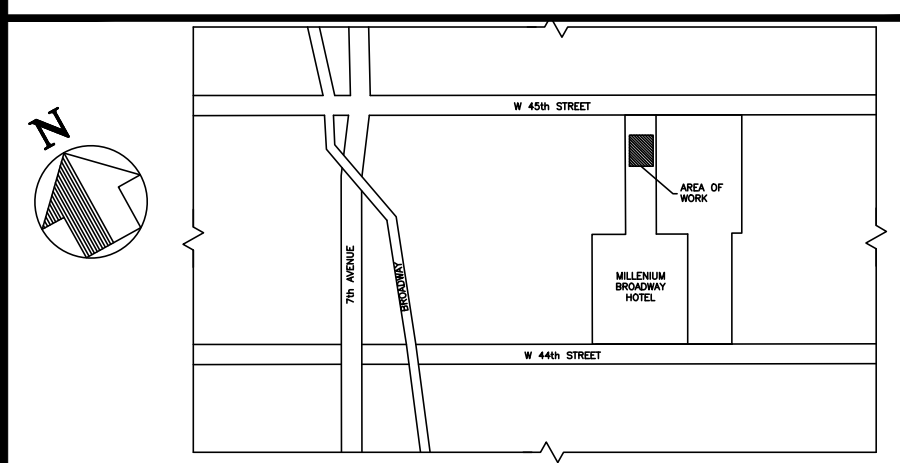
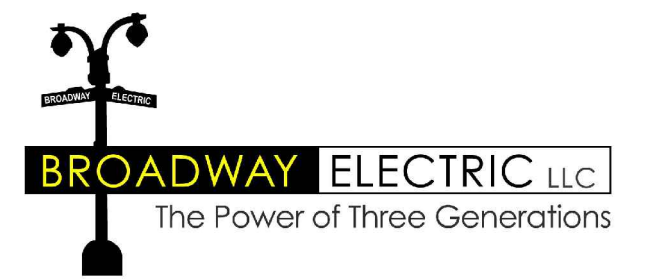
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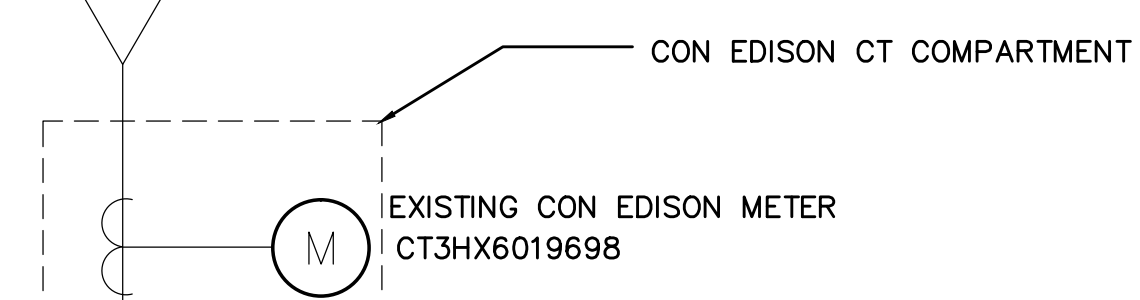
NO.	DATE	REVISION
1	02/08/13	ISSUED FOR FINAL REVIEW

PROJECT: **INSTALLATION OF 3-NEW NATURAL GAS FUELED COGENERATION UNITS ON NINTH FLOOR SETBACK ROOF**

**ELECTRICAL SINGLE LINE SERVICE "D"**

SEAL & SIGNATURE	DATE: 02-11-13
	PROJECT No.: MTE-0112/ENK2935
	DRAWING BY: ADM
	CHK BY: ENK
	DWG No.: E-202.00
CAD FILE No:	10 of 23
ENK2935E202.00	

MS-B  
(480/277V, 3Ø, 4W, 5,000A)



CON EDISON CT COMPARTMENT

EXISTING CON EDISON METER  
CT3HX6019698

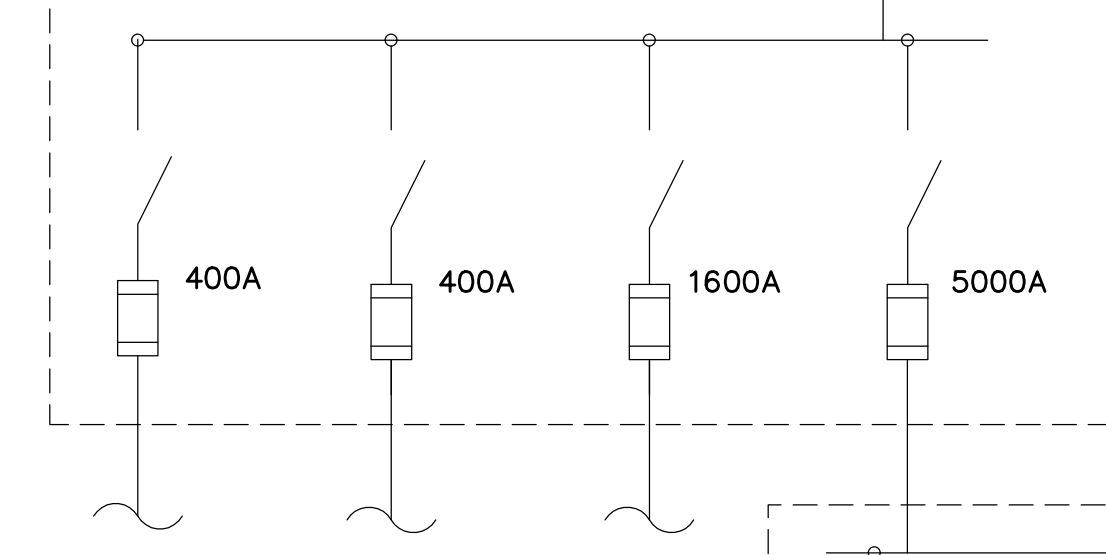
BECKWITH  
3410A

COMAP

UTILITY GRADE  
24V POWER  
SUPPLY

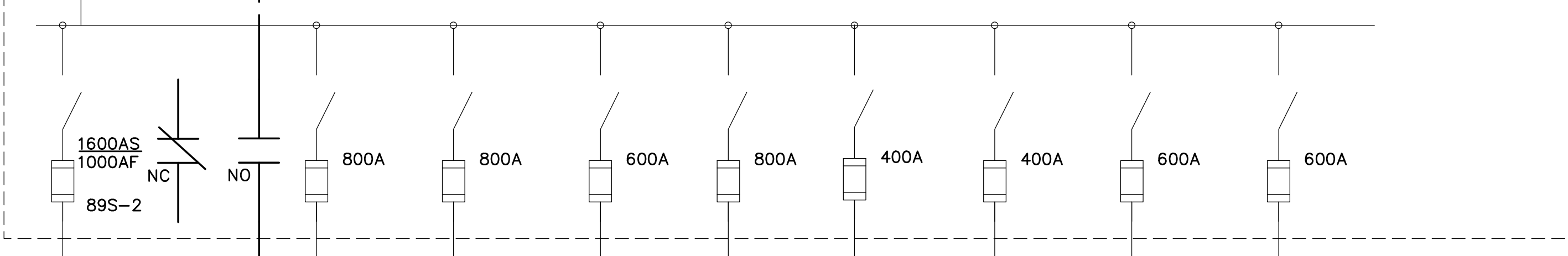
120V

MS-B 480/277V, 3Ø, 4W, 5000A, 200KAIC



ANSI-86

DP-B 480/277V, 3Ø, 4W, 5000A, 200K AIC

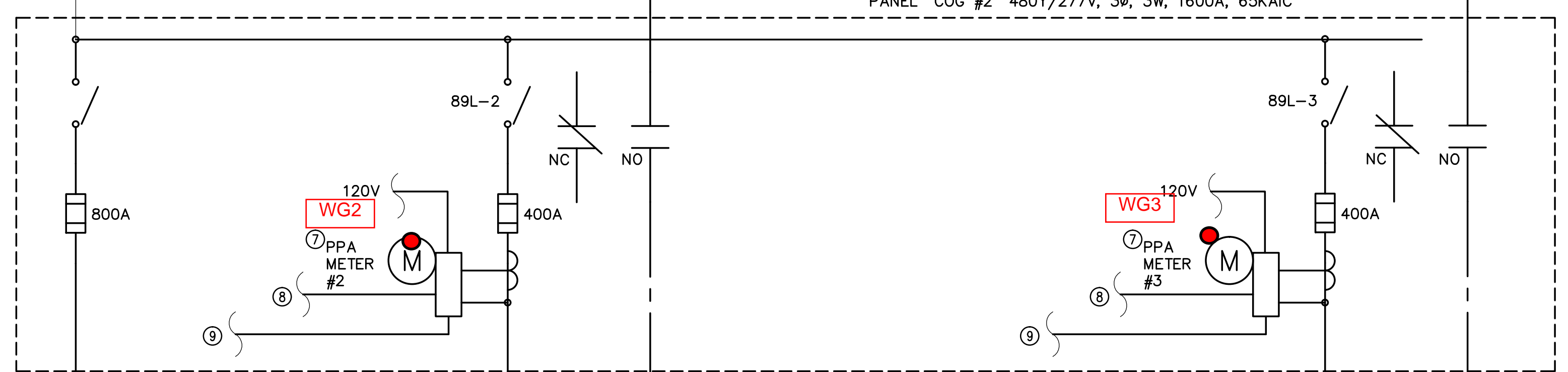


CELLAR  
↑  
9TH FLOOR

CELLAR  
↓  
9TH FLOOR

PANASONIC LED SIGN

PANEL "COG #2" 480Y/277V, 3Ø, 3W, 1600A, 65KAIC



800A

800A

CB-2

200AS  
125AF

200A

COGEN #2  
250KW

TO COMAP  
CONTROLLER

UTILITY GRADE  
24V POWER  
SUPPLY

120V

CHILLER #2  
(9TH FLR)

CAPACITOR BANK

CB-3

200AS  
125AF

200A

COGEN #3  
250KW

TO COMAP  
CONTROLLER

UTILITY GRADE  
24V POWER  
SUPPLY

120V

CAPACITOR BANK

**KEYED NOTES**

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- ⑭ FURNISH AND INSTALL CONDUIT GROUNDING HUBS ON EACH JUNCTION BOX ON THE CONDUIT RUN AND BOND EACH BOX, PANEL AND SWITCHGEAR IN ACCORDANCE WITH NYC EC 2011 ARTICLE 250.

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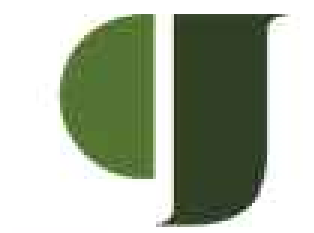
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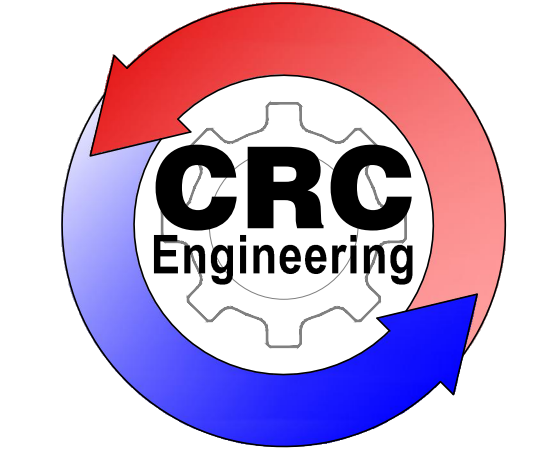
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**GREENWOOD ENERGY**

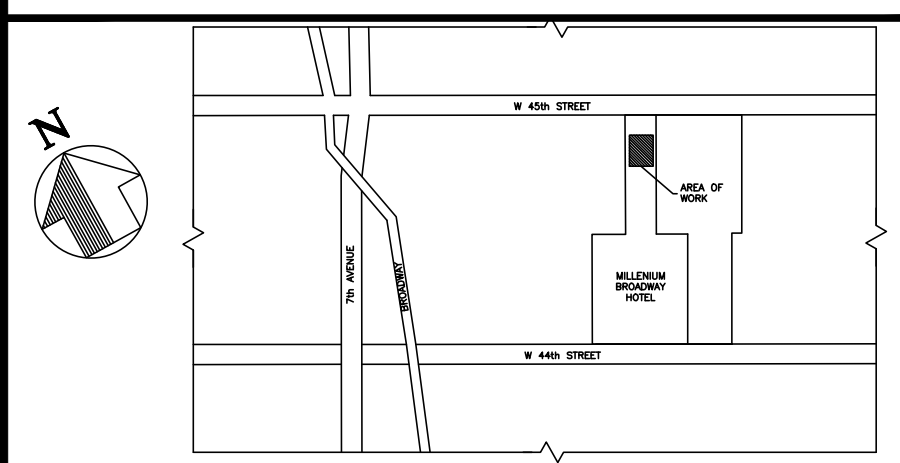
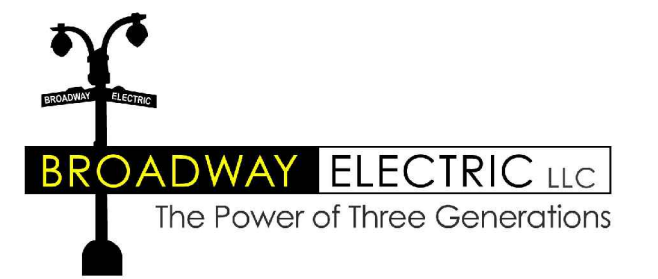
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NO.	DATE	REVISION
1	02/08/13	ISSUED FOR FINAL REVIEW

PROJECT: **INSTALLATION OF 3-NEW NATURAL GAS FUELED COGENERATION UNITS ON NINTH FLOOR SETBACK ROOF**

**ELECTRICAL SINGLE LINE SERVICE "MS-B"**

SEAL & SIGNATURE

DATE:	02-11-13
PROJECT No.:	MTE-0112/ENK2935
DRAWING BY:	ADM
CHK BY:	ENK
DWG No.:	E-201.00
CAD FILE No.:	ENK2935E201.00
	09 of 23

**Data Logger**

The Millennium Broadway Hotel CHP project is being provided with a server based BACnet DDC system. Individual data gathering panels will track, trend and archive usage at a web based server installed in a secure IT room in the hotel. System graphics and analytic software is also being provided to facilitate monitoring the performance of the new CHP plant. SET Environmental is providing the server, software, graphics, programming, sensors and meters as well as control valves. All field instrumentation and other devices for this project are being installed by the electrical and mechanical contractors.

The monitoring system samples specified sensors and calculated values approximately once per second and record total/average data every 15 minutes. The 15-minute readings of heat recovery temperatures and flows are 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 system has sufficient memory to store data continuously if remote communications with the logger are interrupted. Archived data storage capacity will be limited only to hard drive space on the server. The server provided with this system has a 350 GB drive, which could store data for many years.

The data are downloaded from the monitoring system once per day via FTP connection over the Owner's secured internet connection provided by the facility. An FTP script transfers calculated, formatted data to the NYSERDA verification server. The data are then loaded into a database, checked for validity, and posted on the NYSERDA web site.

**Onsite Installation**

Monitoring panels will be installed by the electrical contractor in owner approved locations. These panels are in general proximity to the systems they monitor. Sensors and meters are installed by the mechanical contractor. Electric meters, electronic sensors and current transducers are installed by the electrical contractor. All sensors and monitoring equipment will be provided as part of the CHP project.

**Communications**

The monitoring system will be connected to the Internet over an owner provided connection. A dedicated static IP address is being provided by the owner.



**On-Site Support**

The system being furnished by SET Environmental is web based and will be accessible to remote users through the owner's secured connection, with a static IP address and will be password protected with multiple levels of access available. SET's programmers, engineers and technicians will have access to multiple levels of the system for remote support.

The site will be responsible for providing access to all areas necessary for verification of sensors.

**3. Data Analysis**

The collected data will be used to determine the net power output of the system as well as the fuel conversion efficiency (FCE).

**Table 2. Summary of Monitored Data Points**

<b>Data Point</b>	<b>Description</b>	<b>Eng Units</b>
WG1	Gross Generator Output - Cogen Unit #1	kWh/kW
WG2	Gross Generator Output - Cogen Unit #2	kWh/kW
WG3	Gross Generator Output - Cogen Unit #3	kWh/kW
WPAR	Parasitic Loads	kWh/kW
FG	Natural Gas to Generators	CFM
FL	Glycol Loop Flow	gpm
TLS	Glycol Loop Supply Temperature	°F
TLR1	Glycol Loop Return Temperature - After Abs CH	°F
TLR2	Glycol Loop Return Temperature - After DHW HXs	°F
TLR3	Glycol Loop Return Temperature - After Space Heating HXs	°F
TLR4	Glycol Loop Return Temperature - After Dump Rad	°F
QU	Useful Heat Recovery	Mbtuh
QD	Dumped Heat Recovery	Mbtuh
TAO	Ambient Temperature	°F

**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:

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

The generator power meters will measure the individual gross output of the three engine generators. The net power delivered is determined by adding together the three individual generator power measurements and subtracting out the parasitic power measurements.

**Heat Recovery Rates**

The heat recovery rates will be calculated offline based on the 15 minute data collected. The piping arrangement of this CHP system uses individual circulation loops for each engine jacket water, with common secondary loop for the useful heat recovery and dumped heat. The recovered useful heat serves the absorption chiller, DHW and space heating systems.

The rate of useful hot water loop heat recovery in Btu/h will be defined as:

$$QU = K \times \frac{\sum [FL \times (TLS - TLR3)]}{n}$$

The rate of unused (rejected to atmosphere) hot water loop heat recovery in Btu/h will be defined as:

$$QD = K \times \frac{\sum [FL \times (TLR3 - TLR4)]}{n}$$

where: K = ~ 480 Btu/h-gpm-°F for water  
n = Number of scan intervals included in each recording interval (unitless) (e.g. with 1 sec scans and 15-minute data, n=4)

The loop fluid for both useful hot water heat recovery and rejected heat recovery is hot water. The factor K will be determined using temperature data.

**Calculated Quantities**

The net power output from the CHP system,  $WG_{net}$ , will be defined as the sum of gross powers for all engines,  $WG1$ ,  $WG2$ ,  $WG3$ , minus the parasitic power,  $WPAR$ .

$$WG_{net} = (WG1 + WG2 + WG3) - (WPAR)$$

The instantaneous fuel conversion efficiency of the CHP system, based on the lower heating value of the fuel, will be defined as:

$$FCE = \frac{QU + 3,412 \cdot (WG_{net})}{0.9 \cdot HHV_{gas} \cdot FG}$$

where:

QU	=	Useful heat recovery (Btu)
$WG_{net}$	=	Engine generator net output (kWh) ( $WG1 + WG2 + WG3$ ) - (WP)
FG	=	Generator gas consumption (Std CF)
$HHV_{gas}$	=	Higher heating value for natural gas (~1030 Btu/CF) Where 0.9 is the conversion factor between HHV and LHV

The average FCE can be calculated for any time interval. When converting to daily, monthly, or annual values, each value is summed and then the formula is applied:

$$FCE = \frac{\sum^N QU + 3,412 \cdot \sum^N (WG_{net})}{0.9 \cdot HHV_{gas} \cdot \sum^N FG}$$

where: N = The desired interval (e.g. day, month)

## **Appendix A**

### **System Schematic and Cut Sheets for Key Sensors and Instruments**

## **NYSERDA DEVICE INDEX**

1. Badger – Data Industrial SDI Insertion Flowmeter
2. BAPI Immersion Temperature Sensor
3. BAPI Outdoor Air Sensor
4. Fox FT2 Gas Flow Meter
5. Schneider Electric PowerLogic ION 6200 Meter

### FLOW SENSOR WITH INTEGRAL FLOW TRANSMITTER SDI SERIES

#### DESCRIPTION

The **SDI Series** flow sensor has an integral transmitter and is available in either brass or stainless steel. Hot tap stainless steel models include isolation valve and mounting hardware which enables flowmeter installation and removal while the piping system is pressurized; system shutdown is unnecessary. Hot tap stainless steel models are also available for bidirectional flow measurement. The impeller is rugged and non-fouling and requires no custom calibration. The **SDI Series** is available with a frequency output, analog output, and scaled-pulse output and the display is optional. Stainless steel models are available with a PEEK (polyetheretherketone) tip for high (up to 300 °F) fluid temperatures.

#### FEATURES

- Direct insertion or hot tap installation
- Fits pipe sizes 1.5" to 36"+ (3.8 to 91+ cm)
- Mounts in 1" NPT tap, weld-on or pipe saddle
- Low pressure drop
- Optional 8 character 3/8" (0.95 cm) LCD
- NEMA 4X enclosure standard
- Bidirectional models available
- Field programmable with optional software

#### SPECIFICATIONS

<b>Supply Voltage</b>	8-35 VDC
<b>Supply Current</b>	25 mA
<b>Maximum Output Impedance</b>	750Ω @ 24 VDC
<b>Output Signal</b>	Models with standard frequency pulse, two-wire 4-20 mA, scaled pulse, or bi-directional (hot-tap models only)
<b>Wiring Terminations</b>	Screw terminals
<b>Conduit Connection</b>	1/2" FNPT
<b>Configuration</b>	A-SDI Programming software kit, includes 20' cable
<b>Accuracy</b>	± 1% of flow rate
<b>Repeatability</b>	± 0.5%
<b>Display</b>	One line, eight character 3/8" (.95 cm) LCD, annunciators for rate, total, input, output
<b>Operating Temperature</b>	14° to 150°F (20° to 65°C)
<b>Velocity Range</b>	0.3 to 20 fps (.09 to 6.1 mps)
<b>Installation</b>	Install in straight pipe section with a minimum distance of 10 pipe diameters upstream and 5 pipe diameters downstream to any bend, obstruction or transition
<b>Mounting</b>	1" MNPT, mount in Thredolet® or pipe saddle
<b>Media Temperature Range</b>	Maximum 300°F (149°C) for PEEK tip; 180°F (82°C) for PPS tip
<b>Maximum Pressure</b>	1000 psig (6895 kPa) for stainless steel, 600 psig (4137 kPa) for brass
<b>Pressure Drop</b>	0.5 psid (3.5 kPa), or less, at 10 fps velocity
<b>Materials Of Construction</b>	Polypropylene enclosure with Viton® sealed acrylic cover, probe and sensor materials vary by model number (see ORDERING INFORMATION)
<b>Enclosure Rating</b>	NEMA 4X
<b>Warranty</b>	1 year



SDI Series



7

FLOW

#### ORDERING INFORMATION

MODEL	DESCRIPTION
<b>SDI</b>	Flow sensor with integral transmitter
<b>MATERIAL</b>	
0D1N	Stainless steel insertion with PPS tip for 1.5" to 10" pipes
0D2N	Stainless steel insertion with PPS tip for 12" to 36" pipes
0D3N	Stainless steel insertion with PPS tip for 36"+ pipes
1D1N	Brass insertion with PPS tip for 1.5" to 10" pipes
1D2N	Brass insertion with PPS tip for 12" to 36" pipes
1D3N	Brass insertion with PPS tip for 36"+ pipes
2D1N	Stainless steel insertion with PEEK tip for 1.5" to 10" pipes
2D2N	Stainless steel insertion with PEEK tip for 12" to 36" pipes
2D3N	Stainless steel insertion with PEEK tip for 36"+ pipes
0H1N	Stainless steel hot tap with PPS tip for 1.5" to 10" pipes
0H2N	Stainless steel hot tap with PPS tip for 12" to 36" pipes
0H3N	Stainless steel hot tap with PPS tip for 36"+ pipes
2H1N	Stainless steel hot tap with PEEK tip for 1.5" to 10" pipes
2H2N	Stainless steel hot tap with PEEK tip for 12" to 36" pipes
2H3N	Stainless steel hot tap with PEEK tip for 36"+ pipes
<b>OUTPUT</b>	
0	Standard frequency pulse
1	4-20 mA
2	Scaled pulse
5	Bidirectional, 4-20 mA + direction (hot tap, PPS tip only)
6	Bidirectional, scaled pulse (hot tap, PPS tip only)
<b>DISPLAY</b>	
0	No display
1	LCD option (not available with output option 0)
<b>CONSTRUCTION</b>	
0200	Viton O-ring, Carbide shaft, stainless steel impeller, Torlon bearing (std)
1200	EPDM O-ring, Carbide shaft, stainless steel impeller, Torlon bearing

SDI 2D1N 1 1 0200 Example: SDI2D1N1200 Flow sensor with integral transmitter, stainless steel insertion with PEEK tip, 4-20 mA output, display, standard construction.

#### ACCESSORIES

- 8132030** Replacement ball valve for hot tap install
- A-1027** Hot tap adapter nipple, required for hot tap
- A301-20** Flow/BTU transmitter programming kit, Includes cable

# Immersion Units

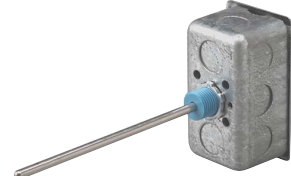


## Temperature Sensors

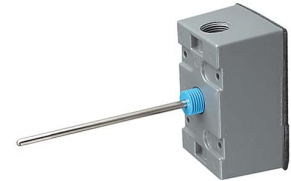
Rev. 05/28/08

### Features & Options

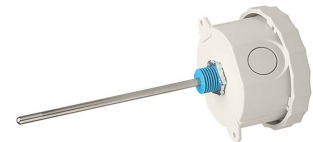
- Probe Lengths: 2", 4" and 8" (fit standard BAPI Thermowell lengths)
- Series 304 Stainless Steel Probes
- Four Enclosure Styles
- Limited Lifetime Warranty
- Double Encapsulated Sensors & Etched Teflon Leadwires
- Wide Selection of Temperature Sensing Elements



J-Box



Weatherproof (WP) Enclosure



Weather Tight (EU) Enclosure



BAPI-Box (BB) Enclosure

Immersion Units are available in 2", 4" and 8" probe lengths. The sensor is potted inside a 1/4" stainless steel probe with thermally conductive epoxy. All Immersion Units have etched Teflon leadwires and double encapsulated sensors to create a watertight package that can withstand high humidity and condensation.

### Enclosure Styles

Immersion Units come standard with a 2"x4" steel J-Box but are also available with three styles of enclosure: Weatherproof (WP), Weather Tight (EU) or BAPI-Box (BB). The metal WP enclosure carries a NEMA 3R rating, while the ABS polymer EU carries an IP66 rating and is available in a UV-resistant material (EUO). The BAPI-Box (BB) is made of UV-resistant polycarbonate and carries an IP66 rating. BAPI also offers optional liquid-tight fittings. For a comparison of the enclosure styles, please see the App. Notes section.

### BAPI Thermowells

Immersion Unit Probes are designed to be inserted into a Thermowell. BAPI Thermowells are available in machined stainless steel or brass, or welded stainless steel, in lengths to match our Immersion Unit Probe Lengths. For more info, see page A50.



**For detailed specs on the individual Sensors & Transmitters, turn to the "Sensors" section.**

\*Some items may not be CE compliant, call BAPI for additional information.

### Specifications

#### Encl. Material:

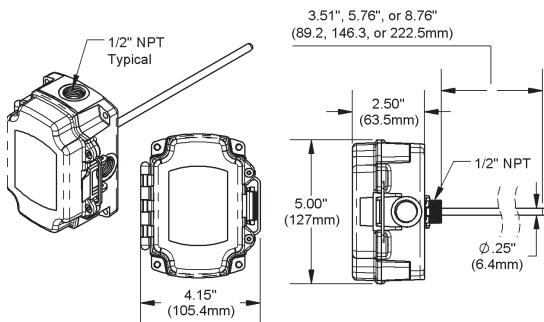
- J-Box Model: Galv. Steel
- WP Model: Cast Aluminum
- EU Model: ABS Plastic, UL94, V-0
- BB Model: UV-resistant polycarbonate, UL94, V-0

#### Environmental Operation Range:

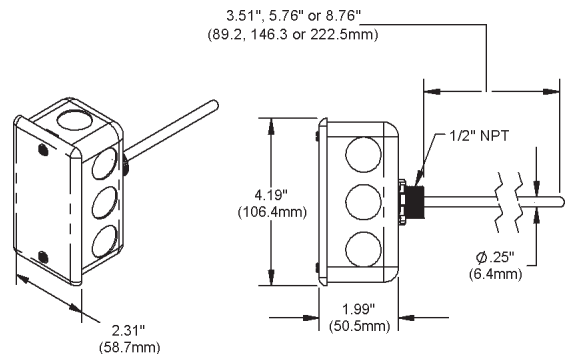
- Temperature:
  - EU & BB Enclosure: -40 °C to 85 °C
  - J-Box, WP Enclosure: -40 °C to 85 °C
- Humidity: 0 to 100%, non-condensing

#### Encl. Rating: WP Model: NEMA 3R

EU & BB Model: IP66



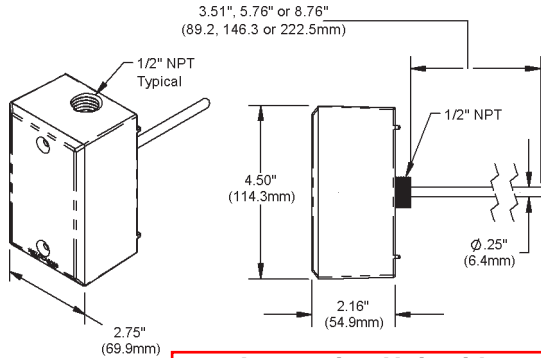
Immersion Unit with BAPI-Box (BB)



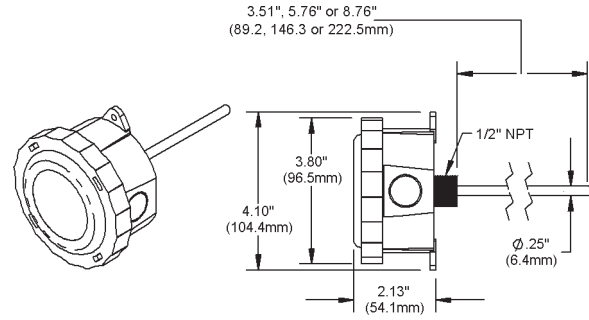
Immersion Unit with J-Box

Rev. 05/28/08

### Specifications



**Immersion Unit with Weather Proof (WP) Enclosure**



**Immersion Unit with Weathertight (EU) Enclosure**

Ordering Information		Immersion Units - Temperature																	
BA/																			
<b>Sensor Type</b>	Use the designator number (shown to the left in bold) to indicate the sensor																		
#	<p><b>THERMISTORS</b></p> <p>1.8K 1.8K <math>\Omega</math> @ 25 °C</p> <p>3K 3K <math>\Omega</math> @ 25 °C</p> <p>3.3K 3.3K <math>\Omega</math> @ 25 °C</p> <p>10K-2 10K <math>\Omega</math> @ 25 °C</p> <p><b>10K-3</b> 10K <math>\Omega</math> @ 25 °C</p> <p>10K-3[11K] 5,238 <math>\Omega</math> @ 25 °C</p> <p>20K 20K <math>\Omega</math> @ 25 °C</p> <p>50K 50K <math>\Omega</math> @ 25 °C</p> <p>100K 100K <math>\Omega</math> @ 25 °C</p>	<p><b>RTDs</b></p> <p>100 100 <math>\Omega</math> Platinum @ 0 °C, .385 <math>\Omega</math>/°C temp. coeff.</p> <p>100[3W] 3 Wire 100 <math>\Omega</math> Plat. @ 0 °C, .385 <math>\Omega</math>/°C temp. coeff.</p> <p>1K[375] 1K <math>\Omega</math> Platinum @ 0 °C, 3.75 <math>\Omega</math>/°C temp. coeff.</p> <p>1K[Ni] 1K <math>\Omega</math> Nickel @ 21°C, 5 <math>\Omega</math>/°C temp. coeff.</p> <p>1K 1K <math>\Omega</math> Platinum @ 0 °C, 3.85 <math>\Omega</math>/°C temp. coeff.</p> <p>2K 2K <math>\Omega</math> Silicon @ 20 °C, 8 <math>\Omega</math>/°C temp. coeff.</p>																	
	<p><b>SEMICONDUCTORS</b></p> <p>334 LM334 Semiconductor</p> <p>592 AD592 Semiconductor, 273 <math>\mu</math>A @ 0 °C</p> <p>592-10K AD592 Semicond. w/ 10 k<math>\Omega</math> shunt resistor, 2.73 V @ 0 °C</p>																		
	<p><b>TEMPERATURE TRANSMITTERS</b> <i>Must include a "range" figure</i></p> <p>T100[range] 100 Platinum RTD, 100 <math>\Omega</math> @ 0 °C with 4 to 20 mA Output</p> <p>T100M[range] 100 Platinum RTD, 100 <math>\Omega</math> @ 0 °C with MATCHED* 4 to 20 mA Output</p> <p>T1K[range] 1K Platinum RTD, 1,000 <math>\Omega</math> @ 0 °C with 4 to 20 mA Output</p> <p>T1KM[range] 1K Platinum RTD, 1,000 <math>\Omega</math> @ 0 °C with MATCHED* 4 to 20 mA Output</p> <p>T10K[range] 10K Thermistor, 10,000 <math>\Omega</math> @ 25 °C with 4 to 20 mA Output</p>																		
	<p><b>TEMPERATURE TRANSMITTER RANGES</b></p> <p>Custom temperature transmitter ranges are available. Common ranges are listed below</p> <table border="0"> <tr> <td>30 TO 81F</td> <td>-1 TO 27C</td> <td>32 TO 212F</td> <td>0 TO 100C</td> </tr> <tr> <td>0 TO 100F</td> <td>-18 TO 38C</td> <td>40 TO 240F</td> <td>4 TO 116C</td> </tr> <tr> <td>20 TO 120F</td> <td>-7 TO 48C</td> <td>50 TO 250F</td> <td>10 TO 121C</td> </tr> <tr> <td>32 TO 134F</td> <td>0 TO 57C</td> <td></td> <td></td> </tr> </table>	30 TO 81F	-1 TO 27C	32 TO 212F	0 TO 100C	0 TO 100F	-18 TO 38C	40 TO 240F	4 TO 116C	20 TO 120F	-7 TO 48C	50 TO 250F	10 TO 121C	32 TO 134F	0 TO 57C				
30 TO 81F	-1 TO 27C	32 TO 212F	0 TO 100C																
0 TO 100F	-18 TO 38C	40 TO 240F	4 TO 116C																
20 TO 120F	-7 TO 48C	50 TO 250F	10 TO 121C																
32 TO 134F	0 TO 57C																		
	<p><b>Configuration</b></p> <p><b>-I-2"</b> 2" length of 1/4" Diameter, Stainless Steel Probe</p> <p><b>-I-4"</b> 4" length of 1/4" Diameter, Stainless Steel Probe</p> <p><b>-I-8"</b> 8" length of 1/4" Diameter, Stainless Steel Probe</p> <p><b>-I-XX</b> Custom lengths of 1/4" Diameter, Stainless Steel Probe are available. Call for Details.</p>																		
	<p><b>Options</b> <i>2"x4" J-Box comes standard</i></p> <p><b>-BB</b> BAPI-Box Enclosure - IP66 rated, UV-resistant polycarbonate</p> <p><b>-EU</b> Weather Tight Enclosure - IP66 rated ABS polymer enclosure</p> <p><b>-EUO</b> Weather Tight Enclosure - IP66 rated UV-resistant enclosure</p> <p><b>-WP</b> Weatherproof Enclosure - NEMA 3R rated metal enclosure</p>																		
<b>EXAMPLE</b>																			
BA/	10K-2	-I-8"	-EU																
Part Number: BA/10K-2-I-8"-EU																			
<b>Your Part Number:</b>																			

Call BAPI if you have questions about the above ordering grid or the configuration of the product you are ordering.





BA/\*-O-EUO



## DESCRIPTION

The **BA Series OSA Sensors** are designed specifically for HVAC systems. The probes are available in a variety of easy-to-mount installation types, and they come in thermistor and RTD sensors. The BA probe sensors are compatible with every BAS system in use today.

## FEATURES

- $\pm 0.36^{\circ}\text{F}$  ( $\pm 0.2^{\circ}\text{C}$ ) thermistor accuracy
- $\pm 0.27^{\circ}\text{F}$  ( $\pm 0.15^{\circ}\text{C}$ ) or  $\pm 0.54^{\circ}\text{F}$  ( $\pm 0.3^{\circ}\text{C}$ ) RTD
- Lifetime limited sensor warranty
- Wide selection of mounting styles

SPECIFICATIONS		DIMENSIONS	
<b>Accuracy</b>			
Thermistor	$\pm 0.36^{\circ}\text{F}$ ( $0.2^{\circ}\text{C}$ )		
RTD (.385)	$\pm 0.27^{\circ}\text{F}$ ( $\pm 0.15^{\circ}\text{C}$ )		
RTD (.375)	$\pm 0.54^{\circ}\text{F}$ ( $\pm 0.30^{\circ}\text{C}$ )		
<b>Sensor types</b>			
Thermistor	10 k $\Omega$ ; Type 2, 10 k $\Omega$ ; Type 3		
RTD	100 $\Omega$ , 385 curve; 1000 $\Omega$ , 385 curve; 1000 $\Omega$ , 375 curve		
<b>Temperature range</b>	-40° to 185°F (-40° to 85°C)		
<b>Stability</b>			
Thermistor	<1.8°F (0.1°C) over five years		
RTD	< $\pm 0.1^{\circ}\text{C}$ drift		
<b>Heat dissipation</b>	Thermistor, 2.7 mW/°C (power needed to raise the temperature by 1°C)		
<b>Connections</b>	22 AWG wire-etched Teflon leads		
<b>Enclosure Materials</b>			
WP	NEMA 3R, cast aluminum		
BB	NEMA 4, UV resistant plastic, UL94V-0		
JB	Standard steel junction box		
<b>Agency approvals</b>	CE, RoHS		
<b>Warranty</b>	Lifetime (Sensor)		

TEMPERATURE

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## ORDERING INFORMATION

MODEL	DESCRIPTION
BA/	Probe temperature sensor
	<b>REQUIRED SENSOR TYPE</b>
10K2	10,000 $\Omega$ thermistor @ 77°F (25°C), Type 2
10K3	10,000 $\Omega$ thermistor @ 77°F (25°C), Type 3
100	100 $\Omega$ RTD @ 32°F (0°C), 385 curve
1K8	1000 $\Omega$ RTD @ 32°F (0°C), 385 curve
1K7	1000 $\Omega$ RTD @ 32°F (0°C), 375 curve
	<b>REQUIRED PROBE TYPE AND LENGTH</b>
O	OSA probe 5" long
	<b>REQUIRED MOUNTING ENCLOSURE (JB is standard)</b>
JB	2" x 4" handy box with 1/2" knockouts
EUO	Weathertight IP66 UV-rated enclosure
WP	NEMA 3R weatherproof enclosure
BB	NEMA 4 weatherproof, UV resistant plastic

Example: BA/10K3-O-BB BAPI 5" OSA 10,000 $\Omega$  thermistor sensor with NEMA 4 weatherproof enclosure

NOTE: Call Kele for additional temperature sensor options.



### THERMAL MASS FLOW METER FT2 SERIES

#### DESCRIPTION

The Fox **FT2 Series** Thermal Mass Flow Meters are perfect for measuring flow of natural gas, compressed air, propane, oxygen, and most common gases. The flow meters measure both flow rate and temperature with isolated 4-20 mA outputs for both variables. In addition, a separate pulse output can be used for logging total gas flow. The FT2 mass flow meters measure gas flow velocity as low as 50 sfpm (standard feet/minute) and as high as 50,000 sfpm, without the need for temperature or pressure compensation.

Each flow meter is calibrated at the factory using the same gas as per the application. As a result, the FT2 more than meets EPA accuracy requirements for monitoring both boiler intake gas -- and combustion emissions.

Standard models include a 2 x 16 character backlit display for viewing flow rate, flow total, elapsed time, process gas temperature and alarms, and an integral keypad for setting parameters such as signal spans, pulse frequency scaling, pipe area, zero cutoff, filtering, diagnostics and alarms.

The **FT2 Series** are available in two configurations, inline or insertion. The inline models (male NPT) include built-in flow conditioners which reduce the need for long straight runs of upstream and downstream pipe. The most common inline sizes are 1/2" to 2" and other inline sizes are available. The insertion models install in a 3/4" coupling (field provided) and are available in insertion lengths to fit pipes from 1-1/2" to 72". Both inline and insertion styles come standard with stainless steel wetted parts, an integral NEMA 4X enclosure rated for Class I, Div. 2, Groups B,C,D hazardous areas, and a NIST calibration certificate.

**NEW!**



#### APPLICATION

Natural gas, air, ammonia, biogas, butane, chlorine, compressed air, carbon monoxide, carbon dioxide, ethane, ethylene, helium, hydrogen, methane, nitrogen, oxygen, propane, and more

#### FEATURES

- Measures gas flow rate in SCFM, SCFH, NM3M, NM3H, KG/M, KG/H, and more, for complete choice in units
- Two 4-20 mA analog outputs, for both flow rate and temperature
- RS422/RS485-Modbus, Profibus-DP, DeviceNet and Ethernet models available for network communication
- Insertion or inline mounting styles for installation choices
- All welded 316SS sensor construction and no moving parts for durability and long life
- Field programmable for flexibility in configuration
- Standard NEMA 4X enclosure designed for Class I, Division 2, Groups B, C, and D
- NIST traceable calibration standard to assure accuracy

#### SPECIFICATIONS

<b>Supply Voltage</b>	24 VDC, ±10%, 85-250 VAC 50/60 Hz	<b>Operating Temperature</b>	1-1/2" to 6" pipes (standard insertion, other lengths available) 32° to 140°F (0° to 60°C)
<b>Supply Watts</b>	20 W (VDC powered models)	<b>Media Compatibility</b>	Standard configuration for natural gas; other gases such as air, biogas, butane, carbon monoxide, carbon dioxide, nitrogen, methane, oxygen, propane, etc. optional.
<b>Supply Current</b>	0.75A (VAC powered models)	<b>Media Temperature Range</b>	-40° to 250°F (-40° to 121°C)
<b>Output Signal</b>	2 isolated 4-20 mA outputs (one for flow and one for temperature); 1 isolated pulse output 0-100Hz, 10V p/p for flow (can be used for alarming)	<b>Maximum Pressure Rating</b>	300 psig (21 bar)
<b>Wiring</b>	Two 3/4" NPT conduit connections on sides of housing	<b>Materials of Construction</b>	316 stainless steel sensor and flow body
<b>Wiring Terminations</b>	Screw terminals	<b>Enclosure Rating</b>	NEMA 4X, designed for Class I, Division 2, Groups B, C & D hazardous areas
<b>Communication Interface</b>	RS232 for connection to computer, models available with RS422/RS485-Modbus, Profibus-DP, DeviceNet and Ethernet Modbus TCP	<b>Weight</b>	8.0 lb (3.6 kg) to 10.0 lb (4.5 kg) inline models, 6.0 lb (2.7 kg) 6" insertion model
<b>Accuracy</b>	Flow, ±1% of reading; Temperature ±1.8°F (±1.0°C)	<b>Approvals</b>	CE
<b>Repeatability</b>	±0.2% of full scale	<b>Warranty</b>	1 year
<b>Mounting</b>	1/2" MNPT pipe section to 2" MNPT pipe section (standard inline), 3/4" MNPT coupling, 6" length probe for		

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FLOW

**NEW!**



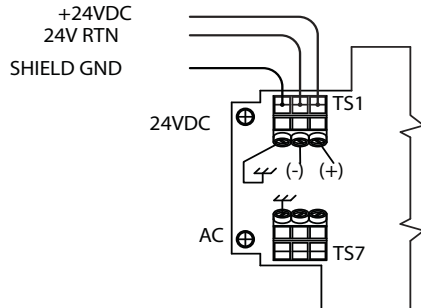
## THERMAL MASS FLOW METER FT2 SERIES

7

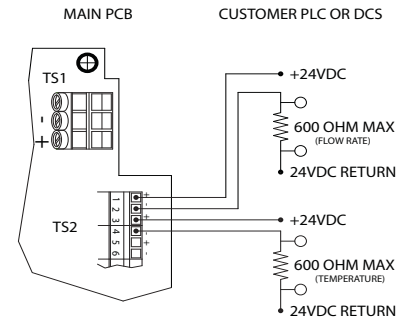
FLOW

### WIRING

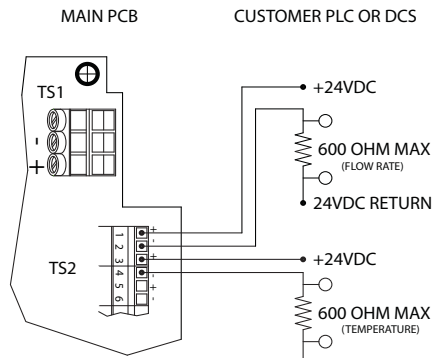
#### CONNECTIONS FOR EXTERNAL 24VDC POWER SUPPLY



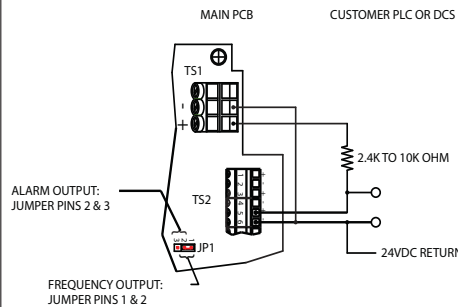
#### 4 TO 20mA ISOLATED CONNECTIONS (RECOMMENDED)



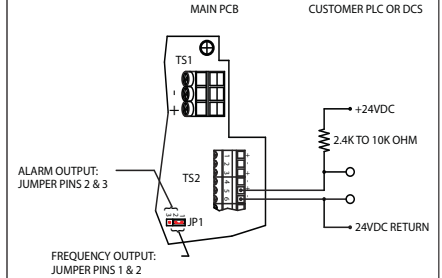
#### 4 TO 20mA ISOLATED CONNECTIONS (RECOMMENDED)



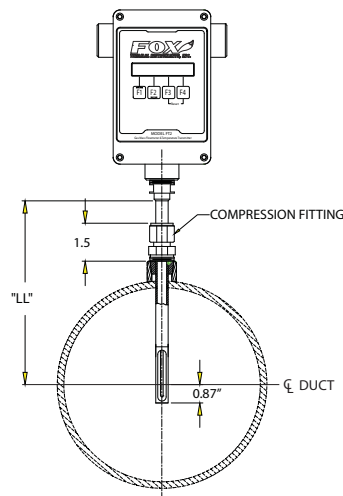
#### PULSE OUTPUT CONNECTIONS, NON-ISOLATED



#### PULSE OUTPUT CONNECTIONS, ISOLATED (RECOMMENDED)

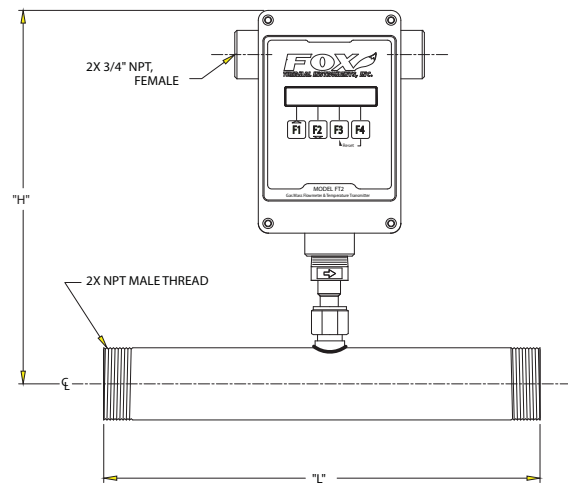


### DIMENSIONS



NOTE: DIMENSIONS IN PARENTHESIS ARE IN CENTIMETERS.

PROBE SIZE	DIMENSION LL ±.1"
4-inch	4.0 (10.2)
6-inch	6.0 (15.2)
9-inch	9.0 (22.9)
12-inch	12.0 (30.5)
15-inch	15.0 (38.1)
18-inch	18.0 (45.7)
24-inch	24.0 (61.0)
30-inch	30.0 (76.2)
36-inch	36.0 (91.4)



NOTE: DIMENSIONS IN PARENTHESIS ARE IN CENTIMETERS.

BODY SIZE	DIMENSION "L"	DIMENSION "H"
1/4-inch	5.80 (14.7)	12.5 (31.8)
1/2-inch	12.0 (30.5)	12.5 (31.8)
3/4-inch	12.0 (30.5)	12.5 (31.8)
1-inch	15.0 (38.1)	12.5 (31.8)
1 1/2-inch	12.0 (30.5)	12.5 (31.8)
2-inch	12.0 (30.5)	12.5 (31.8)
2 1/2-inch	18.0 (45.7)	12.6 (32.0)
3-inch	18.0 (45.7)	12.6 (32.0)
4-inch	18.0 (45.7)	13.1 (33.3)



## THERMAL MASS FLOW METER FT2 SERIES

7

FLOW

### ORDERING INFORMATION

MODEL	DESCRIPTION
<b>FT2</b>	Gas Mass Flowmeter
<b>PROBE/BODY</b>	
<b>05P</b>	1/2" MNPT Inline, flow range 0-48 scfm
<b>075P</b>	3/4" MNPT Inline, flow range 0-120 scfm
<b>10P</b>	1" MNPT Inline, flow range 0-192 scfm
<b>125P</b>	1 1/4" MNPT Inline, flow range 0-320 scfm
<b>15P</b>	1 1/2" MNPT Inline, flow range 0-450 scfm
<b>20P</b>	2" MNPT Inline, flow range 0-750 scfm
<b>06IE</b>	Insertion, 6" probe, flow range (see table)
<b>SENSOR MATERIAL</b>	
<b>SS</b>	316 Stainless steel sensor and flowbody
<b>SJ</b>	Hasteloy C-276 sensor, 316SS flowbody
<b>SENSOR TYPE</b>	
<b>ST</b>	Standard, -40-250°F (-40-121°C)
<b>HS</b>	High temperature 32-400°F (0-204°C)
<b>ENCLOSURE/POWER</b>	
<b>E1</b>	Local NEMA 4X, 24 VDC Power
<b>E2</b>	Local NEMA 4X, 85-250 VAC Power
<b>DISPLAY/KEYPAD</b>	
<b>DD</b>	Display and keypad
<b>BUS OPTIONS</b>	
<b>B0</b>	No communication bus
<b>MB</b>	Modbus
<b>BD</b>	DeviceNet
<b>BP</b>	Profibus-DP
<b>BE</b>	Ethernet Modbus TCP
<b>CALIBRATION</b>	
<b>G1</b>	Air, N <sub>2</sub> ; max flow less than 1200 SCFM (2040 NM <sup>3</sup> H)
<b>G2</b>	Air, N <sub>2</sub> ; max flow greater than 1200 SCFM (2040 NM <sup>3</sup> H)
<b>G3</b>	Ar, CO <sub>2</sub> , H <sub>2</sub> , CH <sub>4</sub> , Natural Gas, O <sub>2</sub> ; max flow less than 1000 SCFM (1700 NM <sup>3</sup> H)
<b>G4</b>	Ar, CO <sub>2</sub> , H <sub>2</sub> , CH <sub>4</sub> , Natural Gas, O <sub>2</sub> ; max flow greater than 1000 SCFM (1700 NM <sup>3</sup> H)
<b>G5</b>	CO, He, Ammonia, Propane, Digester gas; max flow less than 700 SCFM (1190 NM <sup>3</sup> H)
<b>G6</b>	CO, He, Ammonia, Propane, Digester gas; max flow greater than 700 SCFM (1190 NM <sup>3</sup> H)

Example: FT2-05P-SS-ST-E1-DD-B0-G3; 1/2" NPT inline, 316SS, standard temp., 24 VDC power, display/keypad, no communication, for natural gas <1000 SCFM.

**NOTE:** An FT2 Series Application Data form must be filled out and sent in with the purchase order. Details regarding application and media parameters are required for factory calibration. The form is located at [www.kele.com](http://www.kele.com) under Flow/FT2 Series/Related Products.

### ACCESSORIES

<b>101685</b>	RS232 Transition board for PC connection
<b>102299</b>	90° elbow mounting kit, makes housing upright in vertical pipe installations
<b>102878</b>	Teflon ferrule kit, for ease in removal of the insertion models

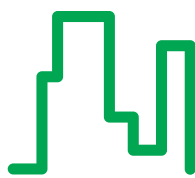
NEW!

# Low-cost, ultra compact meter with power, energy and demand measurements?

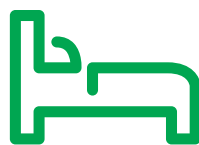
PowerLogic® ION6200 meters



Retail



Buildings



Medical Center



by Schneider Electric

# PowerLogic ION6200

## power and energy meter

The PowerLogic ION6200 meter offers outstanding quality, versatility and functionality in a low-cost, ultra-compact unit. The meter is simple to use and offers a big, bright LED display for superior readability in poor lighting conditions.

Complete with four-quadrant power, demand, energy, power factor and frequency measurements, the ION6200 meter is available in a variety of flexible configurations including ANSI and Measurement Canada certification for use as a revenue meter.

This versatile unit is easy to wire and mount. It offers an excellent upgrade path, allowing you to start with a low-cost base model and add enhanced functionality over the long term.

The ION6200 is the industry's first basic meter that lets you upgrade functionality in the field by activating the base unit. Rather than carry a large inventory of pre-configured meters, genset and electrical equipment manufacturers, panel shops, EMS manufacturers and energy service providers can each adapt meter functionality to specific applications, as required.

---

## Applications summary

- Revenue metering and sub-metering

The low cost and highly accurate ION6200 meter with optional revenue certification and simple retrofit installation provides economical power monitoring for commercial and residential tenants. The meter easily integrates with existing energy management systems and RTUs, and allows you to increase property values by eliminating previously uncontrolled expenses.

- Replace multiple analog meters

An ideal replacement for analog meters, the ION6200 meter can be used for stand-alone metering in custom panels, switchboards, switchgear, gensets, motor control centers and UPS systems.

- Basic metering

The ION6200 meter offers high-accuracy power, energy and demand measurements. These revenue-accurate values can be used for bill verification, monitoring backup power for critical systems and cost effective energy solutions.

- Cost allocation

Perfect for monitoring right down to the tool level, the ION6200 meter can help monitor cost centers, identify opportunities for demand control and check energy consumption patterns. Revenue certification is available if required.

- Substation monitoring

A megawatt and kilovolt readings option is available for high-voltage applications.

## Features

### > Modularity

- Simple retrofit
- Low initial investment that can still meet future needs
- Retrofittable upgrades add functionality as required

### > Ease of use

- Fast setup via display or software
- Free configuration software
- Bright, easy to read LED display

### > Revenue certification

- ANSI and Measurement Canada options
- Factory-sealed version available in Canada

### > Communications

- RS-485 port
- Modbus RTU for integration with energy management systems

### > Management systems

- ION<sup>®</sup> compatible protocol for use with PowerLogic ION Enterprise<sup>®</sup> software

### > Pulse outputs

- 2 outputs for kWh, kVARh or kVAh pulsing

### > Patented ION technology

A modular, flexible architecture that offers extensive user programmability.

- Uniquely addresses complex monitoring and control applications
- Adapts to changing needs, avoiding obsolescence

## Base unit

### > Physical configurations

- Integrated models have a built-in display and fit in an ANSI 10cm (4") and DIN 96 cutout
- Transducer (TRAN) models have no display and can be fastened to a flat surface with a 10cm (4") ANSI bolt pattern or mounted to a DIN rail. A remote display module (RMD) can be ordered for the TRAN and mounted through an ANSI 10cm (4") and DIN 96 cutout. A 4.3m (14ft) cable is standard with this option.

### > Front panel display

Bright LED display with twelve 19mm (3/4") high digits

- Displays all basic power parameters
- Easy setup for common configuration parameters
- Password protection on setup parameters
- Password protection for demand reset

### > Pulse outputs

- Optional kWh, kVARh and/or kVAh pulsing via two Form A outputs

### > Communications

- Optional RS-485 port with standard Modbus<sup>®</sup> RTU and ION compatible protocol
- Baud rates from 1,200bps to 19,200bps

### > Plug-in power supplies

- 100 to 240Vac (50 to 60Hz)/110 to 300Vdc
- Optional 20 to 60DC ( $\pm 10\%$ )
- Optional 480Vac (60Hz)

## Measurements

### > Metering

- 64 samples/cycle
- IEC 60687 class 0.5 accuracy
- ANSI C12.20 0.5 compliant
- Four-quadrant energy and demand
- 49 real-time, true RMS electrical parameters
- Per phase voltage, current, peak current demand, watts, VARs, kWh and more\*
- Neutral current, THD, frequency, power factor and more
- Megawatt option measures in MW and kV

## Specifications

### > Accuracy

- Voltage: L-N 0.3% reading, L-L 0.5% reading
- Frequency:  $\pm 0.1$ Hz
- Current:
  - ◆  $\geq 5\%$  of full scale: 0.3% reading
  - ◆  $< 5\%$  of full scale: 0.3% reading + 0.05% full scale
  - ◆ I4 derivation: 0.6% reading + 0.05% full scale
- Power factor: 1.0% reading
- Total harmonic distortion (THD):  $\pm 1.0\%$
- Power and energy measurements:
  - ◆ (kW, kVA, kVAR, kWh, kVAh, kVARh).Complies with IEC 60687 Class 0.5 and ANSI 12.20 Class 0.5 (0.5% reading)

### > Environmental conditions

- Operating temp:  $-20^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$  to  $158^{\circ}\text{F}$ )
- Storage:  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $185^{\circ}\text{F}$ )
- Humidity: 5% to 95% non-condensing

### > Installation and input ratings

- 64 samples/cycle true RMS
- Autoranging voltage inputs allow direct connection to 400/690Vac systems (the meter is calibrated for 60 to 400Vac L-N connections)
- Supports Direct 4-Wire Wye, 3-Wire Wye, 3-Wire Delta, Direct Delta and single-phase configurations
- 3-phase voltage and current inputs
- Impedance:  $2\text{M}\Omega/\text{phase}$
- Burden: 0.05VA (typical) @ 5A RMS
- 5A nominal/10A full scale/20% overrange full accuracy
- Current overload rating 120A for 1sec
- Standard terminal strip covers

### > Dimensions and shipping

- Basic unit installed depth: 106.7 x 106.7 x 40.6mm (4.2" x 4.2" x 1.6")
- Remote display: 106.7 x 106.7 x 22.9mm (4.2" x 4.2" x 0.9")
- Shipping weight: 0.68kg (1.5lb)

### > Software

- Download free ION Setup<sup>™</sup> configuration software from our web site
- Integrate the ION6200 into PowerLogic ION Enterprise, our monitoring, analysis and control software



\*Per phase energy values not available in Delta volts mode

# PowerLogic ION6200 meter standard and enhanced measurements

Standard and enhanced measurements		Standard	EP #1	EP #2
Voltage L-N	average	■	■	■
	per phase	■	■	■
Voltage L-L	average	■	■	■
	per phase	■	■	■
Frequency		-	■	■
Current	average	■	■	■
	per phase	■	■	■
I4		-	■	■
kW/MW	total	-	■	■
	per phase	-	-	■
kVAR/MVAR	total	-	-	■
	per phase	-	-	■
kVA/MVA	total	-	-	■
	per phase	-	-	■
kWh/MWh	total	-	■	■
Del/rec (imp/exp)	per phase	-	-	■
kVARh/MVARh	total	-	-	■
Del/rec (imp/exp)	per phase	-	-	■
kVAh/MVAh	total	-	-	■
	per phase	-	-	■
kW/MW	demand	-	-	■
	peak	-	■	■
kVAR/MVAR	demand	-	-	■
	peak	-	-	■
kVA/MVA	demand	-	-	■
	peak	-	-	■
Current demand	average	-	■	■
	per phase	-	■	■
Current peak demand	average	-	■	■
	per phase	-	■	■
Power factor	total	-	■	■
	per phase	-	-	■
Voltage THD	per phase	-	-	■
Current THD	per phase	-	-	■

## Software integration

- PowerLogic ION Enterprise software
- ION Setup software

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