MEASUREMENT AND VERIFICATION PLAN

FOR

DG/CHP SYSTEM
AT
BREVOORT EAST

As-Built
April 2015

Submitted to:

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

Submitted by:

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Site:

Brevoort East
20 East 9th St.
New York, NY 10003

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CDH Energy
PO Box 641
2695 Bingley Rd
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1. Introduction

DSM Engineering Associates (DSMEA) designed and oversaw the installation of a combined heat and power (CHP) system at Brevoort East at 20 East 9th St. in New York. The site is receiving an incentive from NYSERDA under the CHP Demonstration program.

The proposed CHP system includes two (3) 100 kW Tecogen InVerde INV-100 engine generator units. Originally two (2) of the engine-generator units received an incentive from NYSERDA under the CHP Demonstration program. The inverter-based systems are intended to produce a gross output of 300 kW and recover jacket water engine heat for 1.) pre-heating the space heating hot water loop, 2.) an 80-ton hot-water absorption chiller, and 3.) DHW preheating. The CHP system will provide power in parallel with the existing utility service.

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, the Site (or its monitoring contractor) supplied the meters and instrumentation listed in Table 1 on page 2.

Data Logger

Readings for the installed instrumentation are recorded by an Obvius AcquiSuite datalogger provided and installed by CDH Energy. The datalogger samples all sensors approximately once per second and records one-minute totals (for pulse or digital sensors) or averages (for analog sensors). The one minute 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 (12), the logger will have sufficient memory to store 30-days of data if communications with the logger are interrupted. The data will be downloaded from the datalogger once per day via an Internet connection provided by the Site. The data will be loaded into a database, checked for validity, and posted on the NYSERDA web site.

Onsite Installation

CDH Energy installed a datalogger panel at a location in the cogeneration room agreeable to the site and developer. The monitoring system panel is approximately 2 ft x 2 ft x 1 ft. 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 datalogger has a connection to the Internet. A dedicated static IP address has been supplied. The logger uploads data every night to the CDH Energy servers.

On Site Support

The facility has assisted in providing a network connection for the datalogger. The site will be responsible for providing access to all areas necessary to complete the 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	Note
WGNet		Net Generator Output	kWh/ kW	Veris 8100 Series Energy Meter	Pulse	Cogen Distribution Panel	
WG1	CHP1	CHP Unit 1 Electrical Output	kW	Tecogen Inverde Sensor	MODBUS RTU	Tecogen generator MODBUS output	
WG2	CHP2	CHP Unit 2 Electrical Output	kW	Tecogen Inverde Sensor	MODBUS RTU	Tecogen generator MODBUS output	
WG3	CHP3	CHP Unit 3 Electrical Output	kW	Tecogen Inverde Sensor	MODBUS RTU	Tecogen generator MODBUS output	
WT		Building Imported Power (WT)	kW	Unknown Sensor	MODBUS RTU	Tecogen generator MODBUS output	MODBUS register TBD. Datapoint named Empty1 in CDH database.
FG		Combined Generator Fuel Input	CF	Utility Meter	Pulse	In gas meter room	Accumulator integrated to gas use. Pulse output not yet installed.
FL	F-CHPHW	Heat Recovery Loop Flow Rate (60 GPM through 3" S40 supply piping from Tecogen)	GPM	Onicon System-10 Flow Meter F3500 SN: 273369	MODBUS RTU	On main heat recovery loop downstream of generator, upstream of pumps	
TLS	BTUTS-1	Heat Recovery Loop Supply Temperature	deg F	Onicon System-10 Thermistor Calibrated 122 F - 300 F	MODBUS RTU	On main heat recovery loop downstream of generator	
TLR3	BTUTS-2	Heat Recovery Loop Return Temperature from HX-DHW	deg F	Onicon System-10 Thermistor Calibrated 122 F - 300 F	MODBUS RTU	On main heat recovery loop downstream of HX-DHW	
TLS_Alt	CHP1-TS3	Alt: Heat Recovery Loop Supply Temperature	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On main heat recovery loop downstream of generator	TLS_Alt equated to datapoint named G3T4 (TS3-3) in CDH database.
TLR2	CHP1-TS2	Diagnostic - Heat Recovery Loop Return Temperature from Abs Chiller	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On main heat recovery loop downstream of Abs Chiller	TLR2 equated to datapoint named G2T3 (TS2-2) in CDH database.
TLR3_Alt	CHP1-TS3	Alt: Heat Recovery Loop Return Temperature from HX-DHW	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On main heat recovery loop downstream of HX-DHW	TLR3_Alt equated to datapoint named G1T4 (TS1-3) in CDH database.
TLR4	CHP1-TS5	Diagnostic - Heat Recovery Loop Return Temperature from HX-CHPHBR	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On main heat recovery loop downstream of HX-CHPHBR	TLR4 equated to datapoint named G3T6 (TS3-5) in CDH database.
FL2	F-CHPABS	Diagnostic - Chiller Heat Recovery Sub-Loop Flow Rate	GPM	Onicon System-10 Flow Meter F350	MODBUS RTU	On chiller heat recovery loop upstream of pump	
THCHS	CHP1-TS1	Diagnostic - Chiller Heat Recovery Sub-Loop Supply Temperature to Absorption Chiller	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On chiller heat recovery loop upstream of chiller	TCH1 equated to datapoint named G1T2 (TS1-1) in CDH database.
THCHR	CHP1-TS4	Diagnostic - Chiller Heat Recovery Sub-Loop Return Temperature from Absorption Chiller	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On chiller heat recovery loop downstream from chiller	TCH2 equated to datapoint named G2T5 (TS2-4) in CDH database.
G1T2 - G3T8	CHP1-TS1 - CHP3-TS7	Generator Client Temperatures (7 per generator)	deg F	Unknown Thermistors	MODBUS RTU (Analog)		Datapoint names in database offset from Tecogen Labels based on MODBUS register.
TAO		Ambient Temperature (Data Integrator Value)	deg F	NWS Station		LGA	

3. Data Analysis

The collected data listed in Table 1 on page 2 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 on the cogeneration distribution panel directly measures net generator power output (WGNet). The generator meters will measure the individual gross output of the three engine generators as a check. The parasitic power (WPAR) can be determined by subtracting the net generator power output (WGNet) from the total of the three individual generator power measurements (WG1, WG2, WG3).

$$WPAR = (WG1 + WG2 + WG3) - WGNet$$

Heat Recovery Rates

The heat recovery rates will be calculated based on the one-minute data collected. The piping arrangement at this site allows for multiple heat rates to be determined with four (4) temperature sensors and one flow reading on the heat recovery loop:

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

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

The rate of rejected (unused) heat recovery in Btu/h is defined as:

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

where:

K	=	~ 500 Btu/h-gpm-°F for pure water; ~480 Btu/h-gpm-°F for 20% glycol
n	=	Number of 1-minute intervals included in period of interest

The heat recovery loop fluid is expected to be pure water. The factor K will be determined based on a periodic reading of the fluid properties with a refractometer to determine the glycol concentration as well as the operating temperature.

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

$$Q_{int} = \sum_{N} Q \cdot \Delta t$$

where: N = Number of intervals in in period of interest
Δt = interval duration (hrs.)

In addition to the useful heat recovery and the dumped heat, the heat recovered for the specific loads can also be calculated using the equations above with different temperatures:

Heating Load	**Temperature Difference**
Heat to either space heating (via HX-HTG) or hot-water absorption chiller	TLS – TLR2
Heat to DHW loop	TLR2 – TLR3

Calculated Quantities

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

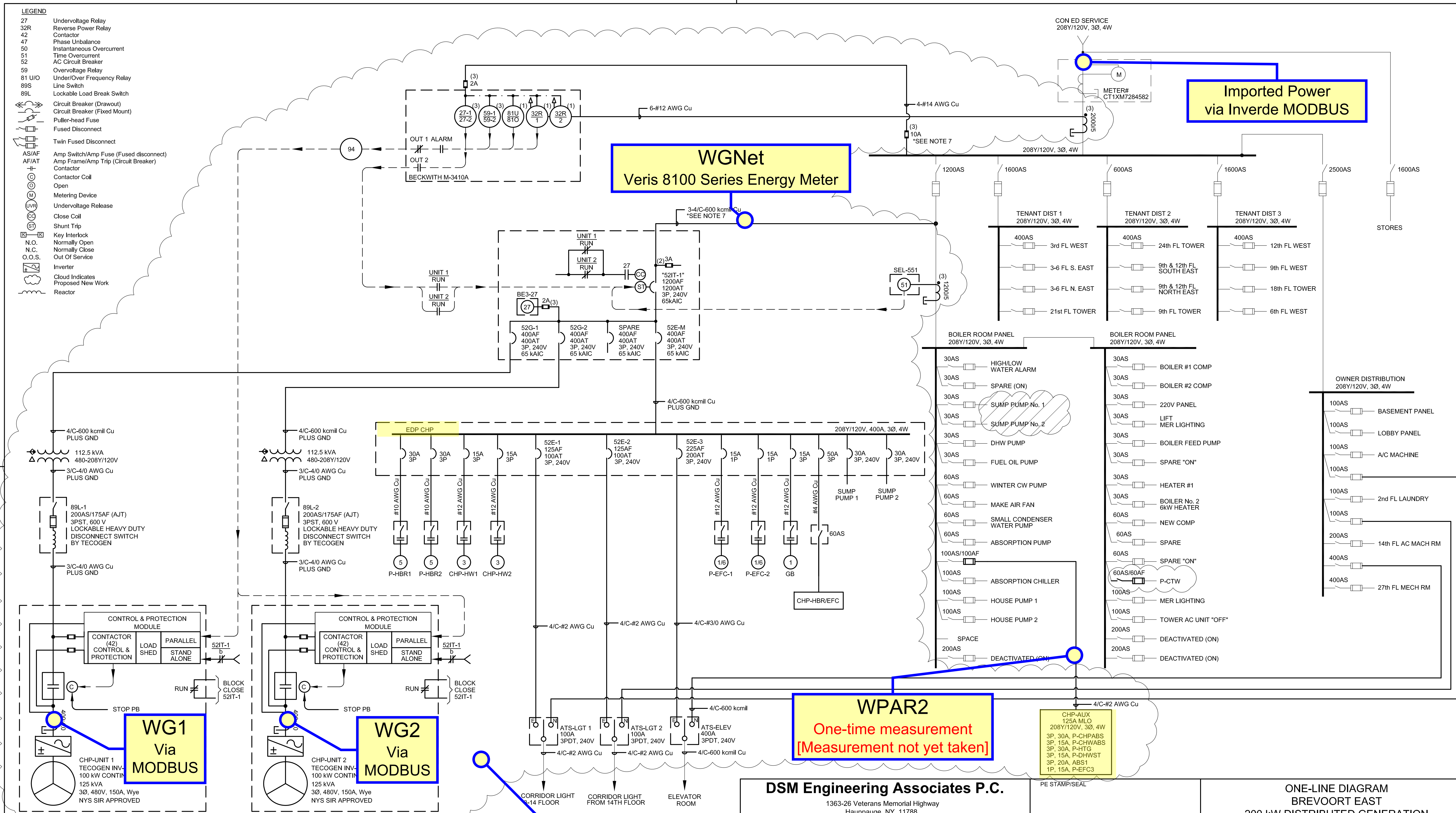
$$FCE = \frac{QU_{int} + 3413 \times (WGNet)}{0.9 \times HHV_{gas} \times FG}$$

where: QU_{int} = Useful heat recovery (Btu) (QU)
WG_{net} = Engine generator net output (kWh)
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 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 Schematic and Cut Sheets for Key Sensors and Instruments


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
Circuit Breaker (Drawout)
Circuit Breaker (Fixed Mount)
Puller-head Fuse
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
Undervoltage Release
Close Coil
Shunt Trip
Key Interlock
N.O. Normally Open
N.C. Normally Close
O.O.S. Out Of Service
Inverter
Cloud Indicates Proposed New Work
Reactor
CON ED SERVICE
208Y/120V, 3Ø, 4W
METER# CT1XM7284582
Imported Power
via Inverde MODBUS
WGNet
Veris 8100 Series Energy Meter
BECKWITH M-3410A
6-#12 AWG Cu
4-#14 AWG Cu
3-4/C-600 kcmil Cu
*SEE NOTE 7
208Y/120V, 3Ø, 4W
1200AS
1600AS
600AS
1600AS
2500AS
1600AS
TENANT DIST 1
208Y/120V, 3Ø, 4W
TENANT DIST 2
208Y/120V, 3Ø, 4W
TENANT DIST 3
208Y/120V, 3Ø, 4W
STORES
SEL-551
BE3-27
52G-1 400AF 400AT 3P, 240V 65 kAIC
52G-2 400AF 400AT 3P, 240V 65 kAIC
SPARE 400AF 400AT 3P, 240V 65 kAIC
52E-M 400AF 400AT 3P, 240V 65 kAIC
"52IT-1" 1200AF 1200AT 3P, 240V 65kAIC
BOILER ROOM PANEL
208Y/120V, 3Ø, 4W
OWNER DISTRIBUTION
208Y/120V, 3Ø, 4W
EDP CHP
208Y/120V, 400A, 3Ø, 4W
4/C-600 kcmil Cu PLUS GND
112.5 kVA
480-208Y/120V
3/C-4/0 AWG Cu PLUS GND
89L-1
200AS/175AF (AJT)
3PST, 600 V
LOCKABLE HEAVY DUTY
DISCONNECT SWITCH
BY TECOGEN
89L-2
200AS/175AF (AJT)
3PST, 600 V
LOCKABLE HEAVY DUTY
DISCONNECT SWITCH
BY TECOGEN
CONTROL & PROTECTION MODULE
CONTACTOR (42) CONTROL & PROTECTION
LOAD SHED
PARALLEL
STAND ALONE
BLOCK CLOSE 52IT-1
STOP PB
CHP-UNIT 1
TECOGEN INV-
100 kW CONTIN
125 kVA
3Ø, 480V, 150A, Wye
NYS SIR APPROVED
CHP-UNIT 2
TECOGEN INV-
100 kW CONTIN
125 kVA
3Ø, 480V, 150A, Wye
NYS SIR APPROVED
WG1
Via
MODBUS
WG2
Via
MODBUS
P-HBR1
P-HBR2
CHP-HW1
CHP-HW2
P-EFC-1
P-EFC-2
GB
CHP-HBR/EFC
SUMP PUMP 1
SUMP PUMP 2
ATS-LGT 1 100A 3PDT, 240V
ATS-LGT 2 100A 3PDT, 240V
ATS-ELEV 400A 3PDT, 240V
CORRIDOR LIGHT 3-14 FLOOR
CORRIDOR LIGHT FROM 14TH FLOOR
ELEVATOR ROOM
WPAR2
One-time measurement
[Measurement not yet taken]
CHP-AUX
125A MLO
208Y/120V, 3Ø, 4W
PE STAMP/SEAL

NOTES:
1. THIS PROJECT INSTALL 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 AND ALLOW FOR A THIRD FUTURE UNIT.
2. ALL FUSES INDICATED WILL PROVIDE SELECTIVE COORDINATION, AND HAVE 200 kAIC RATING.
3. THE GENERATORS ARE TO BE INSTALLED IN ACCORDANCE WITH NEW YORK STATE STANDARD INTERCONNECTION REQUIREMENTS AND CON ED EO-2115. GENERATOR MAY RUN DURING UTILITY OUTAGE ONLY AFTER 52IT-1 IS IN THE OPEN POSITION.
4. UNLESS NOTED, ALL EQUIPMENT IS EXISTING, AND WILL REMAIN IN USE AND IS PREVIOUSLY APPROVED.
5. ALL ELECTRICAL CONSTRUCTION TO BE IN COMPLIANCE WITH 2008 NEC, AS AMENDED BY THE NYC DOB.
6. BOND XO BUSHING TO SERVICE ENTRANCE THROUGH NEUTRAL CONDUCTOR, DO NOT GROUND AT TRANSFORMER.
7. CABLE TAPS AND FUSING TO BE IN ACCORDANCE WITH SECTION 240 NFPA 70 (NEC).
8. TRANSFER LOAD, AS REQUIRED BY OWNER, TO A NEWLY CREATED EMERGENCY DISTRIBUTION PANEL.
9. REFER TO DRAWING E-1.0E FOR OPERATION DURING CON EDISON OUTAGE.

WG3
From 3rd Generator
Via MODBUS

DSM Engineering Associates P.C.
1363-26 Veterans Memorial Highway
Hauppauge, NY. 11788

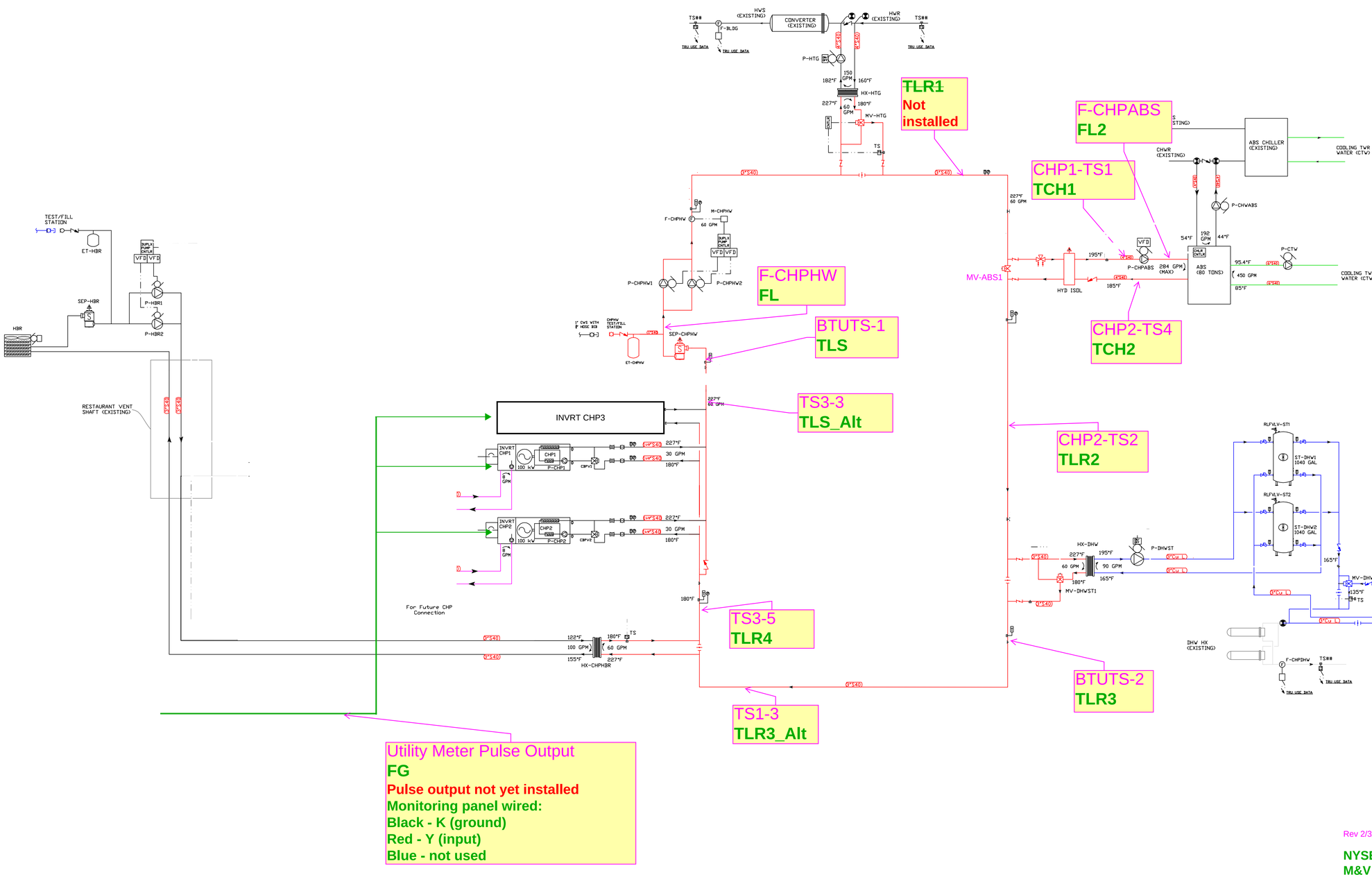
Rev No.	Date:	Description	By:
0	07/17/12	ISSUE FOR REVIEW AND COMMENTS	-

IT IS A VIOLATION OF PROFESSIONAL ENGINEERING LAW TO ALTER ANY ITEM IN ANY WAY CONTAINED ON THIS DRAWING, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER.

ONE-LINE DIAGRAM
BREVOORT EAST
200 kW DISTRIBUTED GENERATION
20 EAST 9TH STREET
NEW YORK, NY

CSA ENGINEERING SERVICES, LLC
15 TROWBRIDGE DRIVE, BETHEL, CT 06801
PHONE: (203) 798-0419 FAX: (203) 743-2325

Drawn By:	Scale:	
KT	NONE	E–1.0



Utility Meter Pulse Output
FG
Pulse output not yet installed
Monitoring panel wired:
Black - K (ground)
Red - Y (input)
Blue - not used

Rev 2/3/14

NYSERDA
M&V 4/3/2015

NOTES:

GENERAL NOTES:
1. DO NOT SCALE DRAWINGS
2. ALL DIMENSIONS AND LOCATIONS TO BE VERIFIED IN THE FIELD
3. DRAWINGS ARE PROVIDED FOR THE PURPOSE OF CONSTRUCTION. DRAWINGS ARE SUBJECT TO MODIFICATIONS AFTER FINAL FIELD MEASUREMENTS AS DIRECTED BY THE ENGINEER.

DRAWING NOTES:
1. DRAWING PROVIDES GENERAL SCHEMATIC SYSTEM INFORMATION. CHECK ALL PROJECT DRAWINGS AND PROJECT SPECIFICATIONS) FOR ADDITIONAL INSTALLATION DETAILS AND INFORMATION.
2. DETAILS FOR INSTALLATION OF COMPONENTS, PIPING, SYSTEM EQUIPMENT ARE NOT SHOWN IN THIS DRAWING.
3. DIMENSION AS SHOWN ARE APPROXIMATE ONLY AND TO BE VERIFIED IN FIELD BY CONTRACTOR
4. DRAWING DOES NOT SHOW ALL DEMOLITION WORK TO BE DONE
5. REFER TO STRUCTURAL CONSULTANTS DRAWINGS FOR ADDL DEMOLITION DETAILS AND ANY REQUIRED REINFORCEMENT

NO.	REVISION DESCRIPTION	DATE
6		
5		
4		
3		
2	ISSUE FOR BIDS	9/7/12
1	HYD SEP ON ABS CHILLER CHP HW SUPPLY	9/6/12

Professional Seal

DSM Engineering Associates PC
"Low Carbon" Engineering Specialists
1363-26 Veterans Memorial Highway
Hauppauge, New York 11788
631-360-1208
WWW.DSMEA.COM

Project Name and Address
MECHANICAL SCHEMATIC

BREVOORT EAST
CHCP DEMONSTRATION PROJECT
20 EAST 9TH STREET
NEW YORK, NY 10003
BLOCK: **00566** LOT: **0018**

Project No.	Drawing Number: **M-300.00**
Date: **7/17/12**	
Scale: **NTS**	
Drawn by: **SM**	Approved by: **JA**
Sheet #:	of

H81xx Series

H81xx

Sub-Tenant Meter with Calibrated CTs for Superior System Accuracy

FEATURES

- *Revenue Grade measurements*
- *High resolution backlit LCD display provides clear readings at a distance...reduces the risk of misinterpretation of the data. Backlighting can be disabled if desired*
- *H8163 provides a pulse output from 1/10 to 1 pulse per kWh for easy connection to existing control or data acquisition systems*
- *Provides a phase-loss alarm...protects equipment (H8163)*
- *With the optional communications board (H81xx-CB), the H81xx can easily be added to a Modbus, BACnet or N2 control system network to report multiple variables including kW, kWh, kVAR, PF, Amps and Volts, providing crucial power information at a reduced installation cost*

APPLICATIONS

- *Commercial tenant submetering*
- *Performance contracting*
- *Allocating costs*
- *Real-time power monitoring via local display or through control/data acquisition systems*

SPECIFICATIONS

5 Year Warranty

Agency Approvals	UL61010-1, Cat. III, pollution degree 2
INPUTS	
Voltage Input	
H8150	90-132VAC line-to-neutral
H8163	90-300VAC line-to-neutral
ACCURACY	
System Accuracy	±1% of reading from 2% to 100% of the rated current of the CTs, accomplished by matching the CTs with electronics and calibrating them as a system
Sample Rate	1280 Hz
OUTPUTS	
LCD Display *All Models*	1.2" x 3.8" (31 mm x 97 mm) viewing area, 160 segments, backlit with LCD
H8163 Only	
Pulse Output	Normally open, Opto-FET, 100mA@24VAC/DC
Pulse Rate	0.10[1], 0.25[2], 0.50, or 1.00kWh per pulse
Pulse Width	200 msec closed
Phase Loss Alarm	N.O. (opens on alarm), Opto-FET, 100 mA @ 24 VAC/DC; fixed threshold 25% below
ENVIRONMENTAL	
Protection Class	NEMA 1
Altitude of Operation	2000 m
Operating Temp Range	0° to 50°C (32° to 122°F)
Storage Temp Range	-40° to 70°C (-40° to 158°F)
Humidity Range	0-95% noncondensing; indoor use only

Approved for California CSI Solar applications (check the CSI website for model numbers).
1. not supported at >1600A
2. not supported at >2400A
Note: Meter and CTs serial numbers must match, except for 100A CTs. Neutral voltage connection is required.

DESCRIPTION

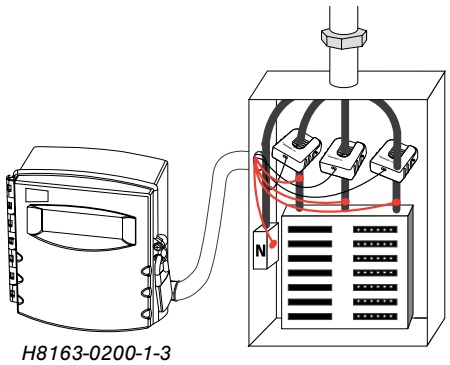
The **H81xx Series Energy Meters** are easy to install & provide exceptional system accuracy, making them ideal for all submetering applications.

Each meter is factory-matched with one to three split-core CTs. The meter/CT pairs are system-calibrated to provide excellent total system accuracies of 1% from 2% to 100% of the amperage rating of the CTs (e.g., 2-100 amps with 100 amp CTs).Matching serial numbers assure that the meter and CT were calibrated together (matching does not apply if using 100A CTs).

The H81xx is easy to install. The split-core CTs virtually eliminate the need to remove electrical conductors, reducing installation time. The meter is also capable of detecting and correcting phase reversal, eliminating the need for concern about CT load orientation. The convenient color coding of the CTs and voltage leads make correct connection simple.

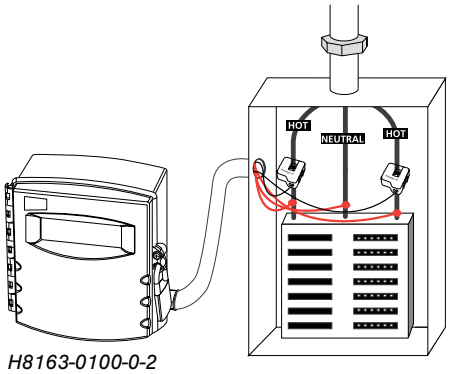
WIRING DIAGRAMS

208/120VAC, 4-wire, 3Ø, 200 Amp Service



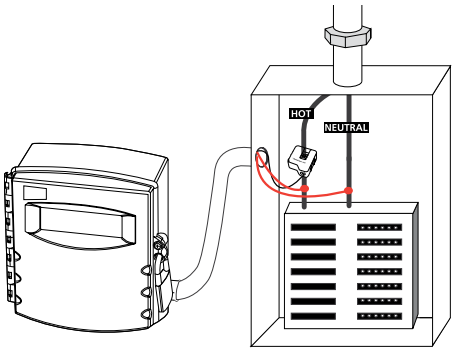
H8163-0200-1-3

240VAC, 3-wire, Single Phase, 100 Amp Service



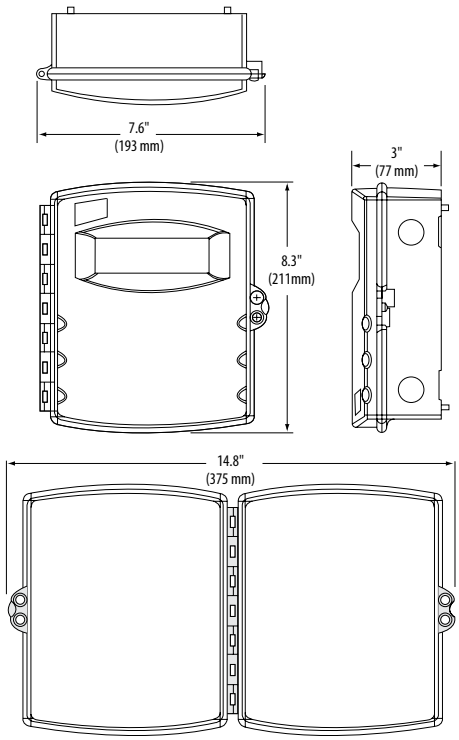
H8163-0100-0-2

120VAC, 2-wire, Single Phase, 100 Amp Service



H8163-0100-0-1

DIMENSIONAL DRAWINGS



DATA OUTPUTS

kWh, Consumption
kW, Real power
kVAR, Reactive power
kVA, Apparent power
Power factor
Voltage, line to line
Voltage, line to neutral
Amps, Average current
kW, Real Power ØA
kW, Real Power ØB
kW, Real Power ØC
Power factor ØA
Power factor ØB
Power factor ØC

Voltage, ØA to ØB
Voltage, ØB to ØC
Voltage, ØA to ØC
Voltage, ØA to Neutral
Voltage, ØB to Neutral
Voltage, ØC to Neutral
Amps, Current ØA
Amps, Current ØB
Amps, Current ØC
*Deman d kW and kVAR **
*Peak Demand **
*Time Stamp **
** with H8163-CB communications board installed*

ORDERING INFORMATION

c UL us LISTED

120VAC-240VAC (nom.)

Amps	One CT	Two CTs	Three CTs	Voltage	Output
100 Micro	H8150-0100 0-1	H8150-0100-0-2	H8150-0100-0-3	120VAC L-N	Display Only
200 Mini	H8150-0200-1-1	H8150-0200-1-2	H8150-0200-1-3		
300 Small	H8150-0300-2-1	H8150-0300-2-2	H8150-0300-2-3		
400 Med		H8150-0400-3-2	H8150-0400-3-3		
800 Med		H8150-0800-3-2	H8150-0800-3-3		
800 Lg			H8150-0800-4-3		
1600 Lg			H8150-01600-4-3		
2400 Lg			H8150-2400-4-3		

120VAC-480VAC (nom.) with Pulse and Phase Loss Outputs

Amps	One CT	Two CTs	Three CTs	Voltage	Output
100 Micro	H8163-0100-0-1	H8163-0100-0-2	H8163-0100-0-3	120-480VAC	Pulse & Phase Loss
200 Mini	H8163-0200-1-1	H8163-0200-1-2	H8163-0200-1-3		
300 Small	H8163-0300-2-1	H8163-0300-2-2	H8163-0300-2-3		
400 Med		H8163-0400-3-2	H8163-0400-3-3		
800 Med		H8163-0800-3-2	H8163-0800-3-3		
800 Lg			H8163-0800-4-3		
1600 Lg			H8163-01600-4-3		
2400 Lg			H8163-2400-4-3		

ACCESSORIES

Fuse and Fuseholders (AH02, AH03, AH04)
Comms board (H81xx-CB)
Modbus TCP Gateway (U013-0012)
BACnet IP Router (U013-0013)

AH04

H81xx-CB

U013-0012

U013-0013

U013-0015

• SYSTEM-10-MOD BTU METER •
MODBUS RTU RS485 or MODBUS TCP/IP COMPATIBLE

UL LISTED
PROCESS CONTROL EQUIPMENT
3GF5

FEATURES

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

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.

N.I.S.T. Traceable Calibration with Certification - Each Btu measurement system is individually calibrated using application specific flow and temperature data and is provided with calibration certificates.

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

Highly Accurate Flow Meters - ONICON offers a wide variety of insertion and inline type flow measurement technologies including turbine, electromagnetic and vortex 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.

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 (ordered separately). The System-10-MOD provides energy, flow and temperature data on a local alphanumeric display and to the network via the MODBUS RTU RS485 or MODBUS TCP/IP communications adapter. An optional auxiliary input is also available to totalize pulses from another device and communicate the total directly to the network.

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

ORDERING INFORMATION

The System-10 BTU Meter is sold complete with temperature sensors. Thermowell installation kits and flow meters are purchased separately.

ITEM #	DESCRIPTION
SYSTEM-10-MOD	System-10 BTU Meter, MODBUS Compatible
SYSTEM-10-OPT8	High temperature sensors (over 200°F)
SYSTEM-10-OPT9	Add one analog output
SYSTEM-10-OPT10	Add four analog outputs
Choose from the following commonly used thermowell installation kits:	
SYSTEM-10-OPT4	Upgrade to outdoor thermowells (pair)
BTU-ST-INSTL32	Brass kit for welded steel pipe (¾" - 5")
BTU-ST-INSTL52	Brass kit for threaded steel pipe (¾" - 2½")
BTU-ST-INSTL34	SS kit for welded steel pipe (¾" and up)
BTU-ST-INSTL36	Brass kit for copper tube (¾" - 2")
BTU-ST-INSTL37	Brass kit for copper tube (2½" - 3")
Choose from the following flow meters:	
F-1100/F-1200	Insertion Turbine Flow Meter (1¼" - 72")
F-1300	Inline Turbine Flow Meter (¾" - 1")
F-3000 Series	Inline Electromagnetic Flow Meter (¼" - 48")
F-3500	Insertion Electromagnetic Flow Meter (3"- 72")
F-4200	Clamp-on Ultrasonic Flow Meter (½" - 48")
F-2000 Series	Inline Vortex Flow Meter (½" - 12")
Refer to catalog for flow meter installation kits. Consult with ONICON for additional thermowell installation kit and flow meter options.	

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SYSTEM-10-MOD BTU METER SPECIFICATIONS

CALIBRATION
Flow meters and temperature sensors are individually calibrated followed by a complete system calibration.
Field commissioning is also available.

ACCURACY
Differential temperature accuracy ±0.15°F over calibrated range
Computing nonlinearity within ±0.05%

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 temp. and return temp.
Alpha: 16 character, 0.2" high; Numeric: 8 digit, 0.4" high

OUTPUT SIGNALS

Network Interface:
Protocol: MODBUS RTU
Connection: RS485: 2-wire (half duplex)
TCP/IP: 10 Base T, 10 Mbps, RJ45 Connection
Baud Rate for RS485: 9600, 19200, 38400, 57600 and 115200

Partial MODBUS Holding Register List:

NAME	Available Units
Total Energy	Btu, kW-hrs & ton-hrs
Energy Rate	Btu/hr, kW & tons
Total Flow	Gallons, liters & meters^3
Flow Rate	gpm, gph, mgd, l/s, l/m, l/hr & m^3/hr
Supply & Return Temperature	°F and °C
Operating Mode	Single, Dual or Bi-directional
Mode Status	Heating/Cooling or Forward/Reverse Flow
Auxiliary Input Total	Not Applicable
Energy Total Reset	Not Applicable
Flow Total Reset	Not Applicable
Auxiliary Total Reset	Not Applicable

Isolated solid state dry contact for energy total:
Contact rating: 100mA, 50V
Contact duration: 0.5, 1, 2, or 6 seconds

Optional 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.

LIQUID FLOW SIGNAL INPUT
0-15 V pulse output from any ONICON flow meter.

TEMPERATURE SENSORS
Solid state sensors are custom calibrated using N.I.S.T. traceable temperature standards.
Current based signal (mA) is unaffected by wire length.

TEMPERATURE RANGE
Standard liquid temperature range: 32° to 200°F
Optional extended temperature ranges available.
Ambient temperature range: -20° to 140°F

MECHANICAL

Electronics Enclosure:
Standard: Steel NEMA 13, wall mount, 8"x10"x4"
Optional: NEMA 4 (Not UL listed)
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*:
Standard: 24 VAC 50/60 Hz, 500 mA
Optional: 120 VAC 50/60 Hz, 200 mA
230 VAC, 50 Hz, 150 mA
*Based on Btu meters configured for network connection without the optional analog outputs

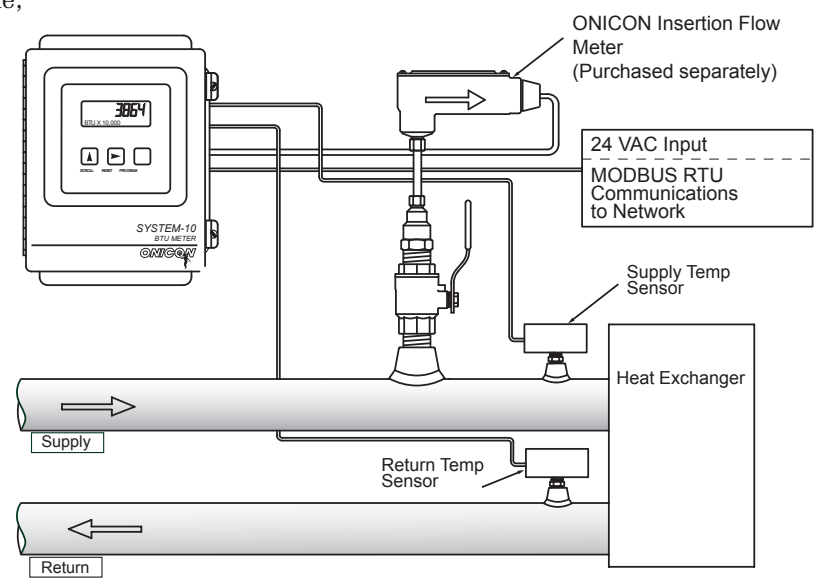
Internal Supply:
Provides 24 VDC at 200 mA to electronics and flow meter

Wiring:
Temperature signals: Use 18-22 ga twisted shielded pair
Flow signals: Use 18-22 ga shielded - see flow meter specification sheet for number of conductors

Note: Specifications are subject to change without notice.

TYPICAL INSTALLATION

Insertion turbine flow meter shown. Any ONICON flow meter may be used with the System-10 BTU Meter. Consult with ONICON for additional flow meter types.



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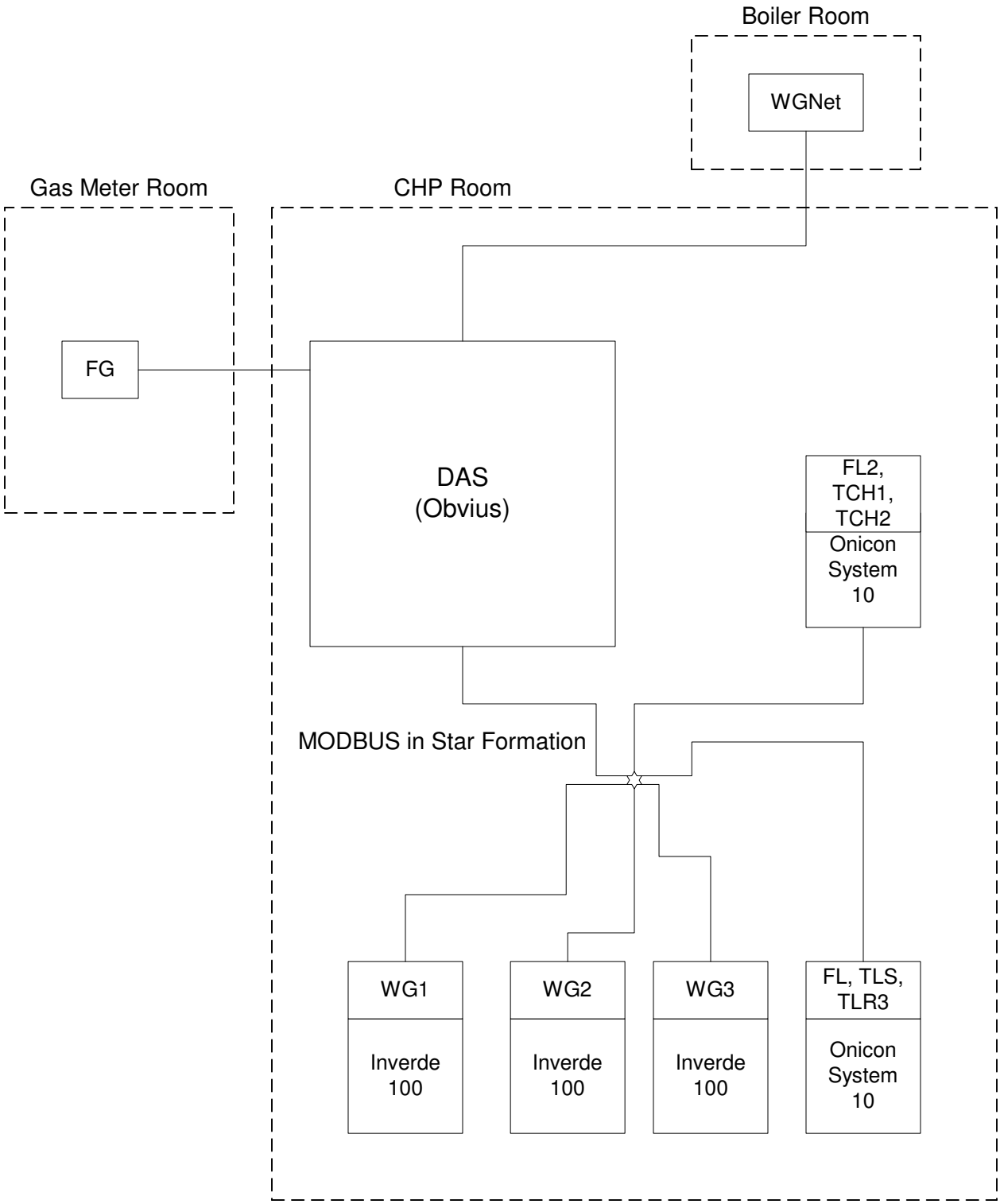
Appendix B

Logger Wiring Diagram and Details

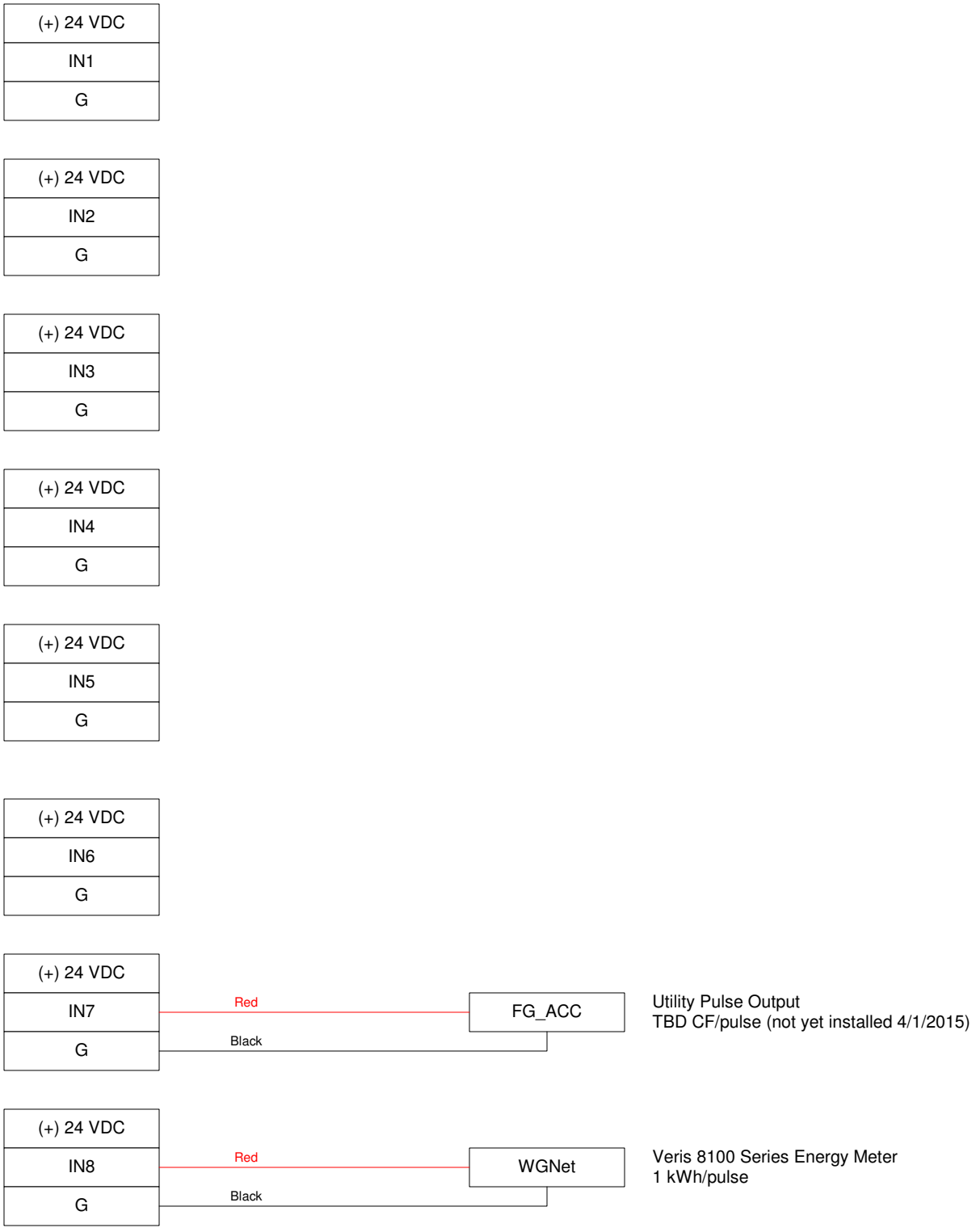
NYSERDA CHP Demonstration Project at Brevoort East
Obvius Acquisuite A8812 Data Logger
As Built Diagram



NYSERDA CHP Demonstration Project at Brevoort East

Obvius Acquisuite A8812 Data Logger

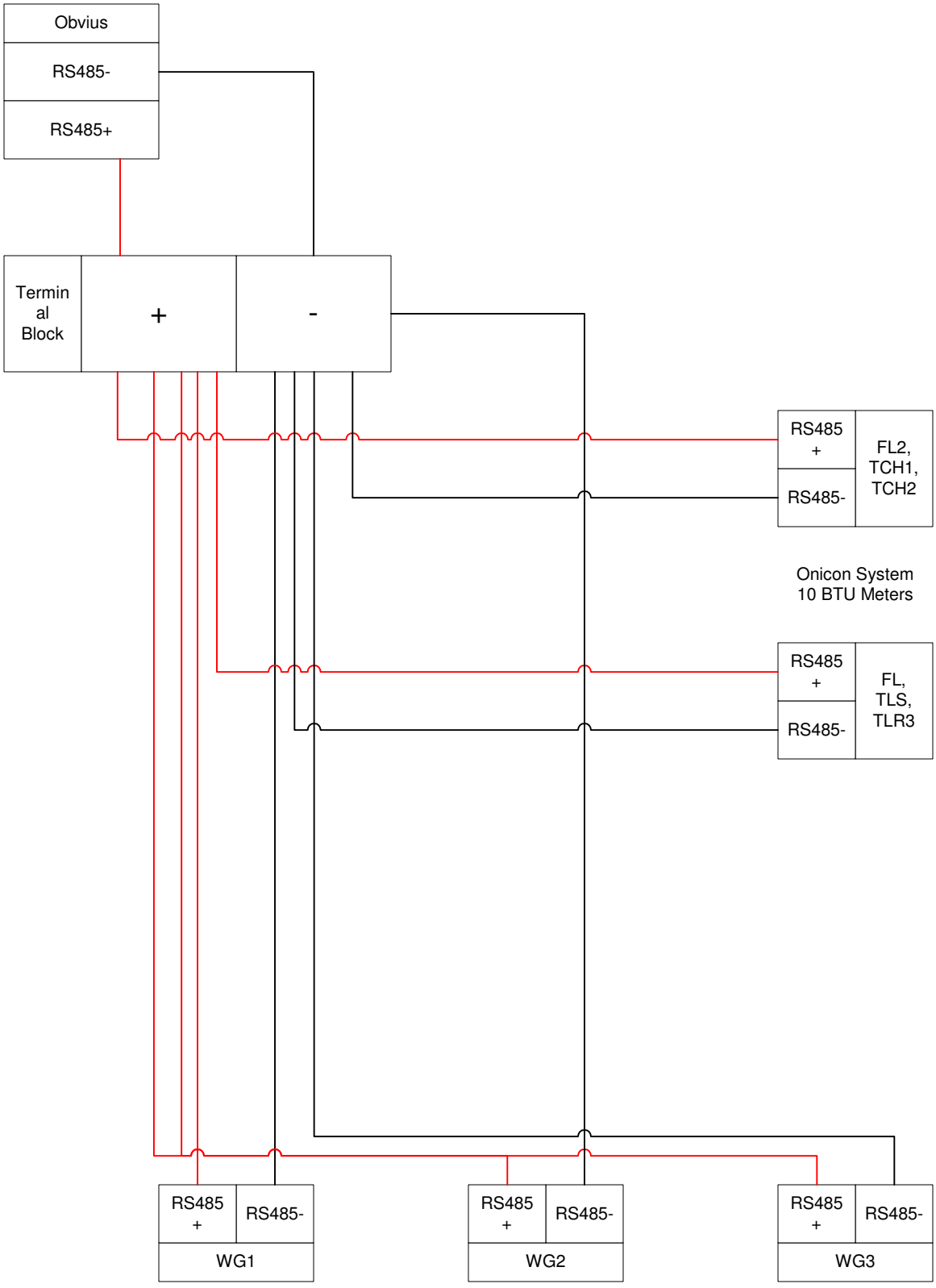
Main Board Input Terminals



NYSERDA CHP Demonstration Project at Brevoort East

Obvius Acquisuite A8812 Data Logger

MODBUS Map



Brevoort East

20 East 9th St.
New York, NY 10003

Site Contact

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- CDH was on site to install data logger and terminate sensors on August 14, 2014.
- The CHP system began running November 14, 2014.
- CDH was on site April 1, 2015 to finalize and verify metering.
- The gas meter pulse output was connected on July 8, 2015.

CDH To Do:

1. Determine the MODBUS registry of the Building Imported Power (WT)
2. Verify flow meter(s)

Summary

The site, developer, or Tecogen provided and installed the power and BTU meters and the temperature sensors. CDH provided the data logger. An electrician did the majority of the wire pulls while CDH terminated wiring and verified metering.

Monitored Data Points

No.	Data Point	Tecogen Label	Description	Units	Instrument / Sensor	Output Type	Location	Note
2	WGNet		Net Generator Output	kWh/ kW	Veris 8100 Series Energy Meter	Pulse	Cogen Distribution Panel	
4	WG1	CHP1	CHP Unit 1 Electrical Output	kW	Tecogen Inverde Sensor	MODBUS RTU	Tecogen generator MODBUS output	
5	WG2	CHP2	CHP Unit 2 Electrical Output	kW	Tecogen Inverde Sensor	MODBUS RTU	Tecogen generator MODBUS output	
6	WG3	CHP3	CHP Unit 3 Electrical Output	kW	Tecogen Inverde Sensor	MODBUS RTU	Tecogen generator MODBUS output	
50	WT		Building Imported Power (WT)	kW	Unknown Sensor	MODBUS RTU	Tecogen generator MODBUS output	MODBUS register TBD. Datapoint named Empty1 in CDH database.
3	FG		Combined Generator Fuel Input	CF	Utility Meter	Pulse	In gas meter room	Accumulator integrated to gas use.
7	FL	F-CHPHW	Heat Recovery Loop Flow Rate (60 GPM through 3" S40 supply piping from Tecogen)	GPM	Onicon System-10 Flow Meter F3500 SN: 273369	MODBUS RTU	On main heat recovery loop downstream of generator, upstream of pumps	
8	TLS	BTUTS-1	Heat Recovery Loop Supply Temperature	deg F	Onicon System-10 Thermistor Calibrated 122 F - 300 F	MODBUS RTU	On main heat recovery loop downstream of generator	
9	TLR3	BTUTS-2	Heat Recovery Loop Return Temperature from HX-DHW	deg F	Onicon System-10 Thermistor Calibrated 122 F - 300 F	MODBUS RTU	On main heat recovery loop downstream of HX-DHW	
22	TLS_Alt	CHP1-TS3	Alt: Heat Recovery Loop Supply Temperature	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On main heat recovery loop downstream of generator	TLS_Alt equated to datapoint named G3T4 (TS3-3) in CDH database.
21	TLR2	CHP1-TS2	Diagnostic - Heat Recovery Loop Return Temperature from Abs Chiller	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On main heat recovery loop downstream of Abs Chiller	TLR2 equated to datapoint named G2T3 (TS2-2) in CDH database.
15	TLR3_Alt	CHP1-TS3	Alt: Heat Recovery Loop Return Temperature from HX-DHW	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On main heat recovery loop downstream of HX-DHW	TLR3_Alt equated to datapoint named G1T4 (TS1-3) in CDH database.
31	TLR4	CHP1-TS5	Diagnostic - Heat Recovery Loop Return Temperature from HX-CHPHBR	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On main heat recovery loop downstream of HX-CHPHBR	TLR4 equated to datapoint named G3T6 (TS3-5) in CDH database.
10	FL2	F-CHPABS	Diagnostic - Chiller Heat Recovery Sub-Loop Flow Rate	GPM	Onicon System-10 Flow Meter F350	MODBUS RTU	On chiller heat recovery loop upstream of pump	
13	THCHS	CHP1-TS1	Diagnostic - Chiller Heat Recovery Sub-Loop Supply Temperature to Absorption Chiller	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On chiller heat recovery loop upstream of chiller	TCH1 equated to datapoint named G1T2 (TS1-1) in CDH database.
23	THCHR	CHP1-TS4	Diagnostic - Chiller Heat Recovery Sub-Loop Return Temperature from Absorption Chiller	deg F	Unknown Thermistor	MODBUS RTU (Analog)	On chiller heat recovery loop downstream from chiller	TCH2 equated to datapoint named G2T5 (TS2-4) in CDH database.
33	G1T2 - G3T8	CHP1-TS1 - CHP3-TS7	Generator Client Temperatures (7 per generator)	deg F	Unknown Thermistors	MODBUS RTU (Analog)		Datapoint names in database offset from Tecogen Labels based on MODBUS register.
49	TAO		Ambient Temperature (Data Integrator Value)	deg F	NWS Station		LGA	

IP Info

The Brevoort East Obvius datalogger is connected to the internet via DHCP. A static IP is not available for the datalogger at this site.

Procedure

- Net Power will be verified by comparing the Veris 8100 Series Energy Meter reading on the Obvius to the generator measured power as reported by the Inverde units.
- The one-time reading of parasitic power at Panel CHP-AUX and a verification of the net power will be read with a handheld Fluke-39.

- Temperatures will be measured using a Fluke 51-II and a surface probe.
    - All temperatures will be measured from the surface of the piping.
- Hot water loop flows were not able to be verified due to a failure of the ultrasonic flowmeter. The flow meter was set up as detailed below.

Verification Data – April 1, 2015

Generator Power:

TBD

Parasitic Loads:

TBD

Temperatures:

TBD

Flow Rate:

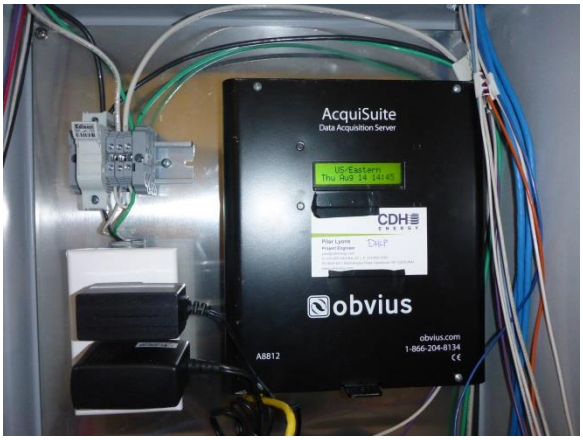
FL Flow Rate Veification April 1, 2015

Ultrasonic	Onicon	Difference
56.5	45.12	11.4
56.6	45.37	11.2
57.0	45.25	11.8
57.0	45.2	11.8
57.0	45.0	12.0
57.2	45.4	11.8
57.1	45.3	11.8
56.9	45.5	11.4
57.3	45.3	12.0
57.9	45.3	12.6

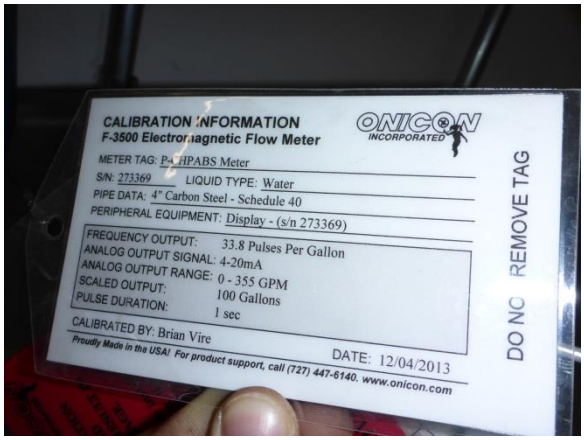
Spacing: 2.49 in
OD: 3.5 in
fluid: water
thickness: 0.216 in

A retry yielded 95 - 99 gpm while the Onicon read 45 gpm

Site Photos



CDH Enclosure and Obvius Datalogger



Onicon F-3500 Calibration Tag (FL)

Unknown Thermistor (TLR3_Alt) and Onicon System-10 Thermistor (TLR3)

Utility Gas Meter (FG)

Veris 8100 Series Energy Meter (WGNet)

Cogen Distribution Panel (WGNet) and Veris Meter