Monitoring and Analysis Plan for Aegis AGEN-75 CHP System at the 800 6th Ave Manhattan, NY – Archstone Chelsea

This document describes the measurements, sensors, and data logging equipment proposed to quantify the performance of the Aegis AGEN-75 based CHP system installed at Archstone Chelsea (Figure 1). The CHP system consists of one Aegis AGEN-75 75-kW engine generators systems that produce electricity and hot water for domestic hot water.

Figure 1. 800 6th Ave – Archstone Chelsea

Description of CHP System

The one 75-kW engine generator is located in the sub-cellar level of the building. Also located in the sub-cellar adjacent to the CHP units are two heat exchangers (HX) coupling the heat recovery loop to the low pressure and high pressure domestic hot water systems, and a third HX connecting the heat recovery loop to a dump radiator.

AGEN 75-kW Engine Generator

HX-3 Dump Radiator

HX-1 and HX-2 Low and High Pressure HX

Figure 2. Archstone Chelsea CHP System

Description of Monitored Data Points

Table 1 lists the monitored points required to characterize the performance of the CHP system. Each point is accompanied by the respective sensor and engineering unit measured.

Table 1. Data Point List

No.	Data Point	Description	Units	Sensor	Output	Notes
1	WG1	Generator #1 Power/Energy	kW/kWh	Veris H8035-0800-3	Modbus	Provided and Installed by CDH Energy
2	FG	Generator Gas Use	CF	Utility pulse output	Pulse	1000 CF/pulse
3	FL	Heat Recovery Loop Flowrate	GPM	Onicon F1110	4-20 mA	Read from BPL Modicon PLC
4	TLS	Heat Recovery Loop Supply Temperature	deg F	BPL RTD TT173	n/a	Read from BPL Modicon PLC
5	TLR1	Heat Recovery Loop Return Temperature Leaving Load HXs	deg F	BPL RTD TT174	n/a	Read from BPL Modicon PLC
6	TLR2	Heat Recovery Loop Return Temperature Entering Dump HX	deg F	BPL RTD TT175	n/a	Read from BPL Modicon PLC
7	TLR3	Heat Recovery Loop Return Temperature Leaving Dump HX	deg F	BPL RTD TT176	n/a	Read from BPL Modicon PLC

Power Meters (WG1, WPAR)

A power transducer measuring the gross engine electrical output is installed inside the engine control compartment. The power transducer takes the place of the power monitoring from the Beckwith protection relay performed by the BPL Global PLC. The generator power meter (**WG1**) is a Veris H8035-300, which provides a Modbus data connection to the data logger for continuous reporting of system power (kW) and accumulated produced energy (kWh).

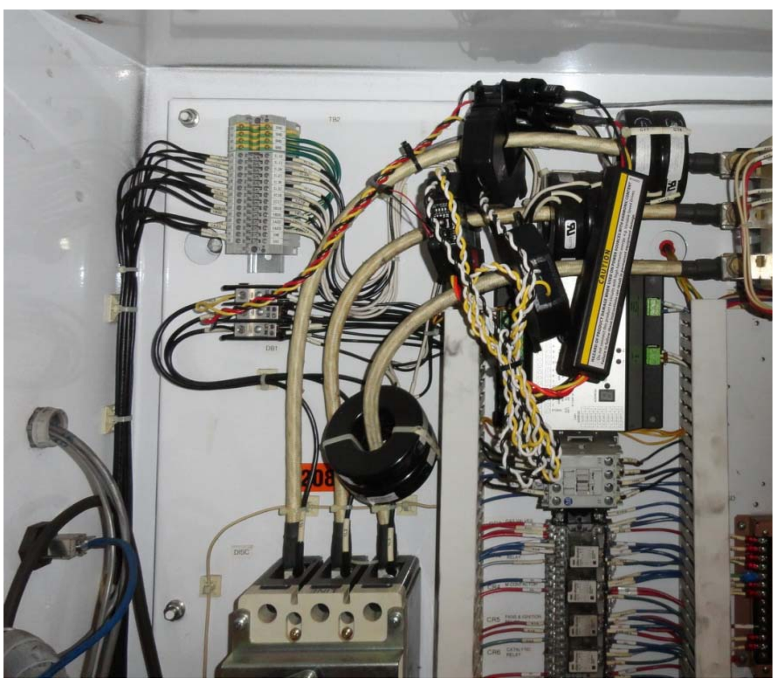


Figure 3. Veris H8035-300 Power Meter Installed on Disconnect in Engine Control Cabinet

No parasitic power (**WPAR**) power transducer is installed. One time readings of the parasitic loads were performed at the time of data system commissioning.

Natural Gas Flow (FG)

The natural gas meter for the CHP system is located in the sub-cellar level in a metering room. The CHP system gas consumption (**FG**) will be read using a utility supplied pulse interface that provides a dry-contact switch closure for a fixed volume of gas at 1,000 CF/pulse. The gas meter pulse output uses a dedicated twisted pair signal wire back to data logger.

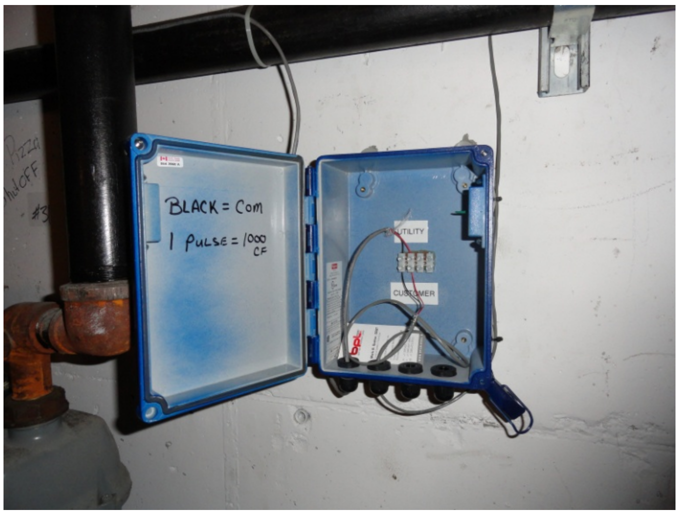


Figure 4. Utility Gas Pulse Output Demarcation

Heat Recovery Calculations (FL, TLS, TLR1, TLR2, TLR3)

The recovered heat from the CHP system is measured using a single flow meter (**FL**), and a series of cascading temperature differences, allowing for multiple heat transfer streams to be calculated.

The flow meter output and temperature readings are all read by the BPL Global Modicon PLC (Modicon), and transferred via Modbus/TCP to the data logger every second. The data logger then averages the 1-second scan data and records 1-minute averages for flow and temperature readings, to be used for calculation of heat transfer offline. The Modicon is connected to the data logger via a CAT5e cable, through the router. Flow and temperature sensors are wired directly to the Modicon.

Temperature sensors **TLS** and **TLR1** are insertion style probes inside thermowell fittings. Temperature sensors **TLR2** and **TLR3** are surface mount probes installed after construction.

Locations of the thermal metering equipment are shown on the piping diagram in Figure 5.

PUMP SCHEDULE

PUMP NO.	SERVICE	FLOW	HEAD	PUMP H.P.	PHASE	PUMP MODEL
P-1	COGEN LOOP	25 GPM	70 FT	3/4 HP	3 PH	BELL & GOSSETT SERIES 1535 353T
P-2,4	DOMESTIC HOT WATER	30 GPM	15 FT	1/6 HP	1 PH	BELL & GOSSETT SERIES PL-45B
P-3,5	DOMESTIC HOT WATER	40 GPM	7.5 FT	1/6 HP	1 PH	BELL & GOSSETT SERIES PL-45B
P-6	DUMP RADIATOR LOOP	30 GPM	33 FT	3/4 HP	3 PH	BELL & GOSSETT SERIES 60-13T

CONTROL VALVE SCHEDULE

VALVE NO.	SERVICE	FLOW TYPE	SIZE	VOLTAGE	VALVE MODEL	ACTUATOR
V-1,3	DHW	MIXING	1-1/2"	24 V	BARBER COLMAN VS2313-526-9-56	MS40-7043M MODULATING
V-2,4	DHW	MIXING	2"	24 V	BARBER COLMAN VS2313-526-9-63	MS40-7043M MODULATING

PLATE HEAT EXCHANGER H.X.- 1 AND 2

DESIGN MANUFACTURER	API HEAT TRANSFER	
MODEL	SBM7L-40	
TYPE	BRAZED PLATE	
MATERIAL	COPPER	
SIDE	HOT	COLD
FLUID TYPE	WATER	WATER
FLUID FLOW	20 GPM	30 GPM
TEMP IN	225	130
TEMP OUT	176	
PRESSURE DROP	.77 PSI	2.71 PSI
INLET SIZE	2" NPT	2" NPT

PLATE HEAT EXCHANGER H.X.-3

DESIGN MANUFACTURER	API HEAT TRANSFER	
MODEL	SBM7M-40	
TYPE	BRAZED PLATE	
MATERIAL	COPPER	
SERVICE	GLYCOL DUMP LOOP	
SIDE	HOT	COLD
FLUID TYPE	WATER	40% PROP. GLYCOL
FLUID FLOW	20 GPM	30 GPM
TEMP IN	225	160
TEMP OUT	176	193.6
PRESSURE DROP	0.77 PSI	1.73 PSI
INLET SIZE	2" NPT	2" NPT

TEMPERATURE SENSOR SCHEDULE

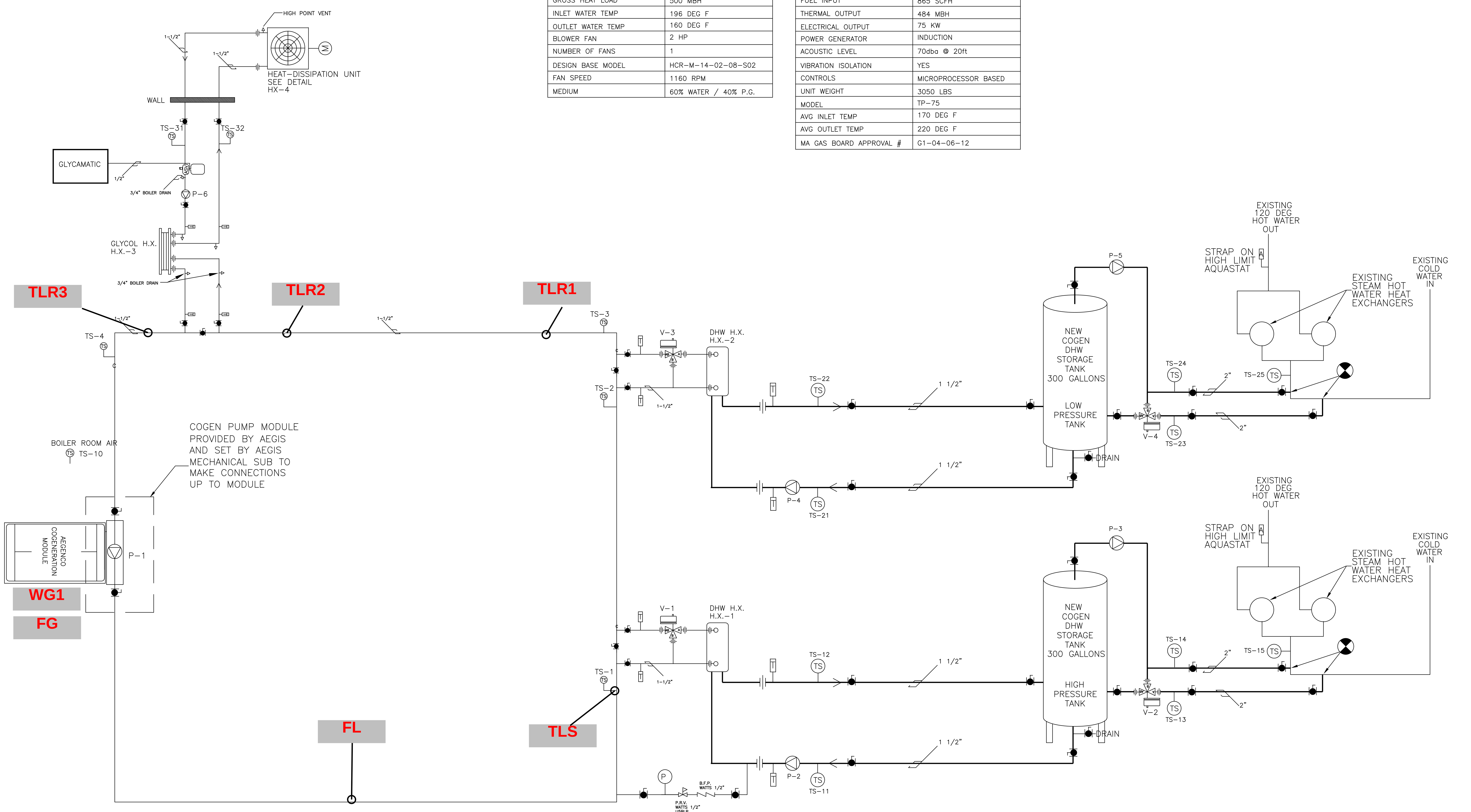
TS NO.	SERVICE	SENSOR MODEL NO.	WELL TYPE
TS-1	COGEN SUPPLY TO DHW PLATE H.X.-1	INVENSYS TS-8201-106	AT-225
TS-2	COGEN SUPPLY TO DHW PLATE H.X.-2	INVENSYS TS-8201-106	AT-225
TS-3	COGEN SUPPLY TO DUMP HX	INVENSYS TS-8201-106	AT-225
TS-4	COGEN RETURN	INVENSYS TS-8201-106	AT-225
TS-11	STORAGE TANK DHW TO HX-1	INVENSYS TS-8201-106	AT-225
TS-12	HX-1 TO STORAGE TANK DHW	INVENSYS TS-8201-106	AT-225
TS-13	DHW TO STORAGE TANK	INVENSYS TS-8201-106	AT-225
TS-14	STORAGE TANK TO DHW	INVENSYS TS-8201-106	AT-225
TS-21	STORAGE TANK DHW TO HX-1	INVENSYS TS-8201-106	AT-225
TS-22	HX-1 TO STORAGE TANK DHW	INVENSYS TS-8201-106	AT-225
TS-23	DHW TO STORAGE TANK	INVENSYS TS-8201-106	AT-225
TS-24	STORAGE TANK TO DHW	INVENSYS TS-8201-106	AT-225
TS-31	DUMP RADIATOR TO HX	INVENSYS TS-8201-106	AT-225
TS-32	HX TO DUMP RADIATOR	INVENSYS TS-8201-106	AT-225
TS-10	BOILER ROOM AIR	INVENSYS TS-8501	

AIR COOLED RADIATOR H.X.-4

DESIGN MANUFACTURER	IEA OR EQUAL
FLOW RATE	30 GPM
GROSS HEAT LOAD	500 MBH
INLET WATER TEMP	196 DEG F
OUTLET WATER TEMP	160 DEG F
BLOWER FAN	2 HP
NUMBER OF FANS	1
DESIGN BASE MODEL	HCR-M-14-02-08-S02
FAN SPEED	1160 RPM
MEDIUM	60% WATER / 40% P.G.

COGENERATION SCHEDULE

DESIGN MANUFACTURER	AEGENCO
FUEL	NATURAL GAS
FUEL INPUT	865 SCFH
THERMAL OUTPUT	484 MBH
ELECTRICAL OUTPUT	75 KW
POWER GENERATOR	INDUCTION
ACOUSTIC LEVEL	70dba @ 20ft
VIBRATION ISOLATION	YES
CONTROLS	MICROPROCESSOR BASED
UNIT WEIGHT	3050 LBS
MODEL	TP-75
AVG INLET TEMP	170 DEG F
AVG OUTLET TEMP	220 DEG F
MA GAS BOARD APPROVAL #	G1-04-06-12



COGENERATION FLOW DIAGRAM

NOT TO SCALE

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42-68 27TH STREET
LONG ISLAND CITY, NY 11101

ARCHSTONE CHELSEA
COGENERATION SYSTEM
800 6TH AVE
NEW YORK, NY 10001

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HOLYOKE, MA 01040
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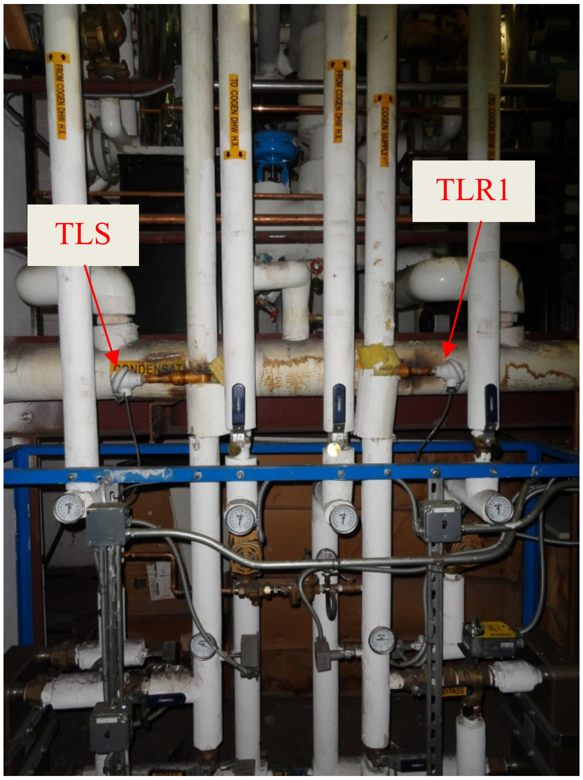
FAX:413-536-1104

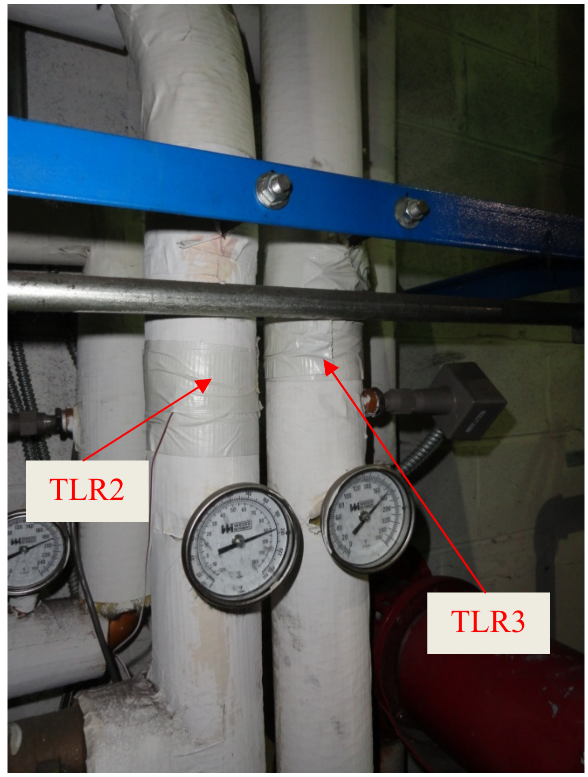
DATE: AUGUST 2007

TITLE: COGEN HEATING LOOP FLOW DIAGRAM

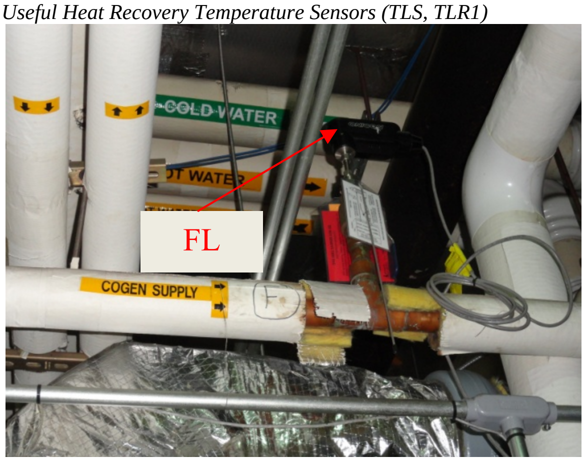
FIGURE M-1



Useful Heat Recovery Temperature Sensors (TLS, TLR1)



Dump HX Temperature Sensors (TLR2, TLR3)



Heat Recovery Loop Flow Meter (FL)

Figure 6. Heat Recovery Sensors

Data Logger Location and Communication

The data logger is an existing logger supplied by Constellation Energy, and has been repurposed for performance monitoring of the CHP system. The data logger communicates with the installed sensors via a mixture of Modbus RS-485, Modbus/TCP, and direct field point wiring.

To facilitate the use of the Modicon PLC using Modbus/TCP, a router was installed to create a local network that also could communicate with internet connection provided by Archstone. The Modbus communication loop was configured for the following Modbus slave address on each device.

Table 2. Modbus Communication Loop Device Numbers

Data Point	Sensor	Modbus Device Number
WG1	Veris H8035-0300-3	5 (Modbus RS-485)
FL	Onicon F-1110	3 (Modicon Modbus/TCP)
TLS	BPL RTD TT173	
TLR1	BPL RTD TT174	
TLR2	BPL RTD TT175	
TLR3	BPL RTD TT176	

Note: Modbus device 1 is Beckwith relay at engine (not used)

A diagram of the system communication configuration is shown in Figure 7.

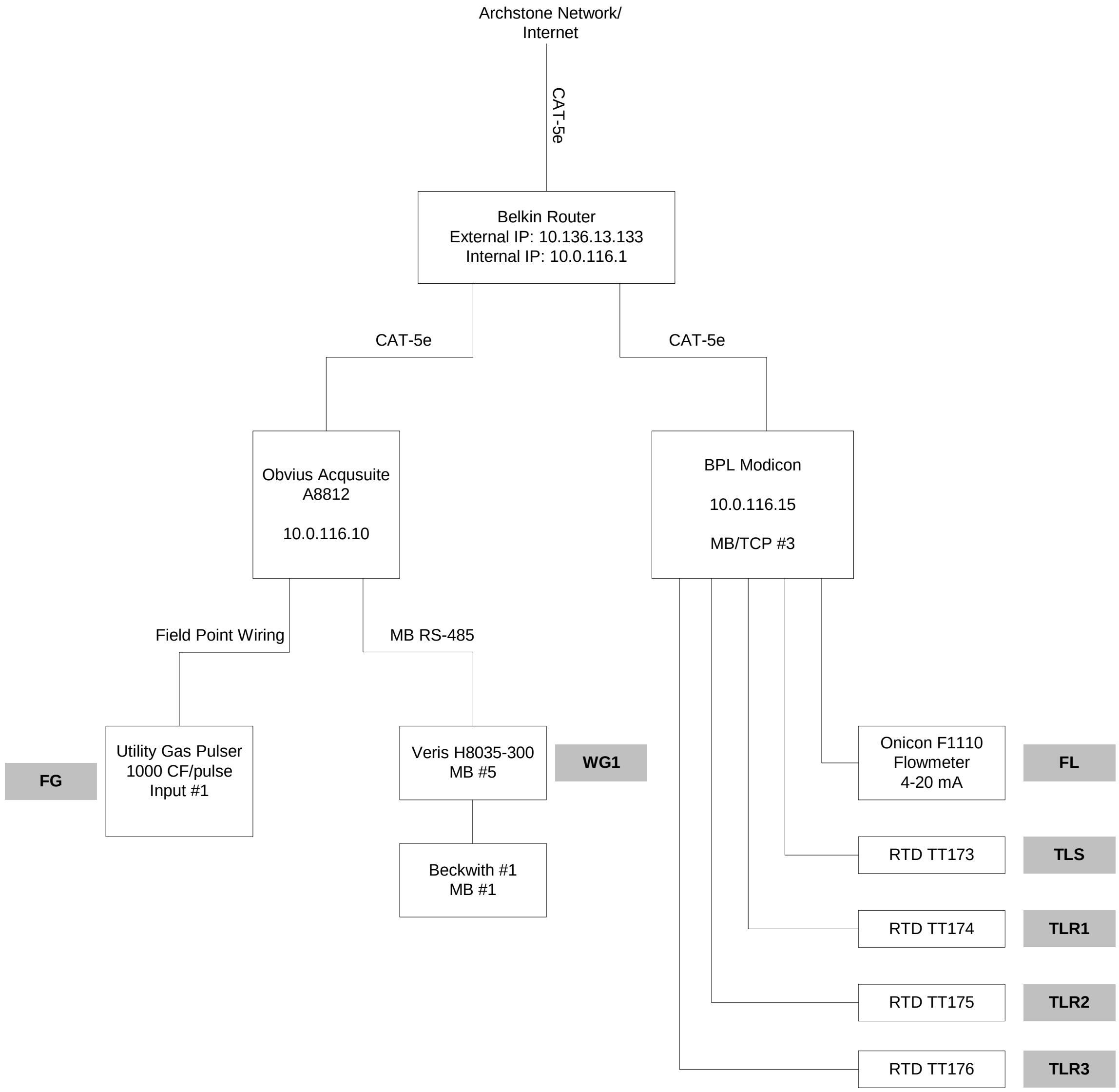


Figure 7. Datalogger Communication Configuration

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).

Peak Demand or Peak kW

The peak electric output or demand for each power reading will be taken as the average kW in a 1-minute interval, or

Gross Power (**WG1**) $kW = \frac{kWh}{\Delta t} = \frac{kWh\ per\ interval}{1/60\ h}$

Heat Recovery Rates

The heat recovery rates will be calculated based on the 1-minute data recorded by the data logger. The piping arrangement at this site requires uses a cascading temperature difference on a common loop flow for separate heat transfer rates to be determined with four temperature sensors and one flow reading:

Useful heat recovery (**QHU**) = $K \cdot \Sigma\ [FL \cdot (TLS-TLR1)]\ /\ n$

Dumped heat recovery (**QHD**) = $K \cdot \Sigma\ [FL \cdot (TLR2-TLR3)]\ /\ n$

The loop fluid is expected to be glycol water mixture, (K ~ 480 Btu/h-gpm-°F). 'n' is the number of scan intervals included in each recording interval (e.g., with 1-minute data, n=60).

Parasitic Loads

The parasitic electric loads on this system consists of six circulation pumps (four pumps are redundant) and one dump radiator fan. No parasitic power transducer is installed. Parasitic power for the system is based on the following relation, developed from one time handheld readings.

Parasitic Energy (**WPAR**) = 1.17 kW continuously + 1.785 W / MBtu/h dumped at HX

Calculated Quantities

The net power output from the CHP system will be defined as the power from the engine generators minus the parasitic power.

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

$$FCE = \frac{QHU \cdot \Delta t + 3.412 \cdot (WG - WPAR)}{LHV_{gas} \cdot FG}$$

where:

QHU	-	Useful heat recovery (Btu/h)
WG	-	Engine generator gross output (kWh)
WPAR	-	Parasitic energy (kWh)
FG	-	Generator gas consumption (Std CF)
Δt	-	1/60 for 1-minute data
LHV_{gas}	-	Lower heating value for natural gas (~920 Btu per CF).

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

$$FCE = \frac{\sum^{N} QHU \cdot \Delta t + 3.412 \cdot \sum^{N} (WG - WPAR)}{LHV_{gas} \cdot \sum^{N} FG}$$

Where N is equal to the number of intervals in the period of interest.

Data Logging Equipment

The data logging system will be based around the Obvius AquiSuite A8812 data logger. The logger has eight analog or digital inputs on the main board, and monitoring capabilities can be extended using expansion boards. The primary sensor connection configuration for the logger is a two-wire twisted pair network, that reduces the number of low voltage sensor wire runs. The logger has 32 MB of onboard RAM for data retention. The logger is equipped with both a 10/100 LAN port and an analog phone modem for remote data retrieval.

Obvius AcquiSuite

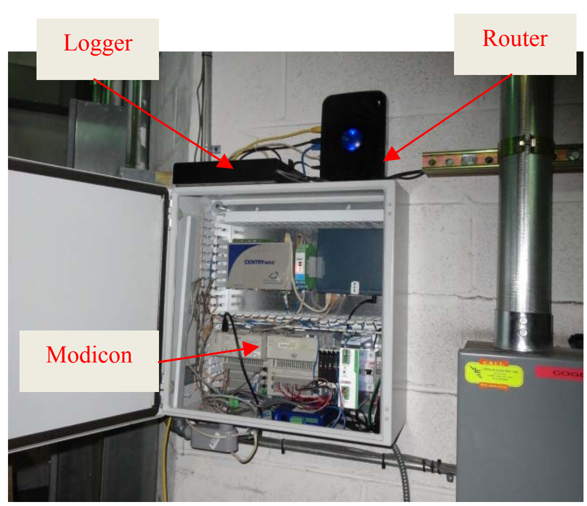


Figure 8. Obvious AcquiSuite Data Logger

The data logger is configured to supply data to the CDH Energy servers, as well as to the Constellation Energy C-Power servers, every 15-minutes. The internet connection provided by Archstone is not configured to allow inbound connections to the data logger from the internet at large. CDH Energy is not able to access the logger for remote configuration purposes.

Each night CDH Energy collects the data provided and data are automatically loaded into the database system here at CDH Energy, where a number of automated data verification routines will identify any suspect data. Verification routines will consist of range checks, where the data are compared to a preset range of value, and data exceeding these values will be flagged; and/or relational checks, where the data are compared to the operational state of the unit for validity, such as "Are the engines consuming gas while producing power?" Data that fails the verification routines will be checked manually by CDH personnel on a daily basis, and corrupt data will be removed from the database.

All data collected are converted to hourly data in a comma delimited CSV format consistent with the requirements for inclusion into the NYSERDA integrated data system website.

All sensors are scanned on the order of once per second, and these samples will be combined into 1-minute averages (for analog data) and totals (for digital data). The logger has sufficient memory to hold up to 30-days of data without overwriting the logger memory.

All data logging equipment is installed in or at the Connected Energy/BPL Global enclosure mounted inside the sub-cellar mechanical room, adjacent to the engine generator.

Other Monitoring Requirements and Issues

The data logger itself is provided by Constellation Energy. Any failure of the logger will be directed to NYSERDA and Constellation within 48-hours of detection.

The Modicon PLC is provided by BPL Global. If the Modicon fails, the flow meter can be wired directly on the data logger inputs, but the temperature sensors will need to be replaced with thermistors compatible with the Obvius datalogger. Existing wire pulls for the temperature sensors can be reused.

CDH Energy will not provide service on the data logger hardware itself, or any sensors or the Modicon PLC installed by BPL Global.

Sensor Selection

Cut sheets for the known data logging equipment and sensors are attached. No information is available on the RTDs used by BPL Global.

Sensor Verification

During the January 11, 2012 site visit, system temperatures were verified for location on the system piping as well as for accuracy against a Fluke Model 51II F handheld temperature probe. All temperature sensors were on the order of ±2° from the handheld probe, and with the location of the temperature sensors established via tracing wires, the readings from the Modicon were deemed accurate.

Table 3. Temperature Verification – Modicon Readout vs Handheld

Data Point	Modicon (F)	Fluke (F)	Difference (F)
TLS	217.0	216.8	0.2
TLR1	200.8	198.7	2.1
TLR2	186.1	187.3	-1.2
TLR3	166.5	168.9	-2.4

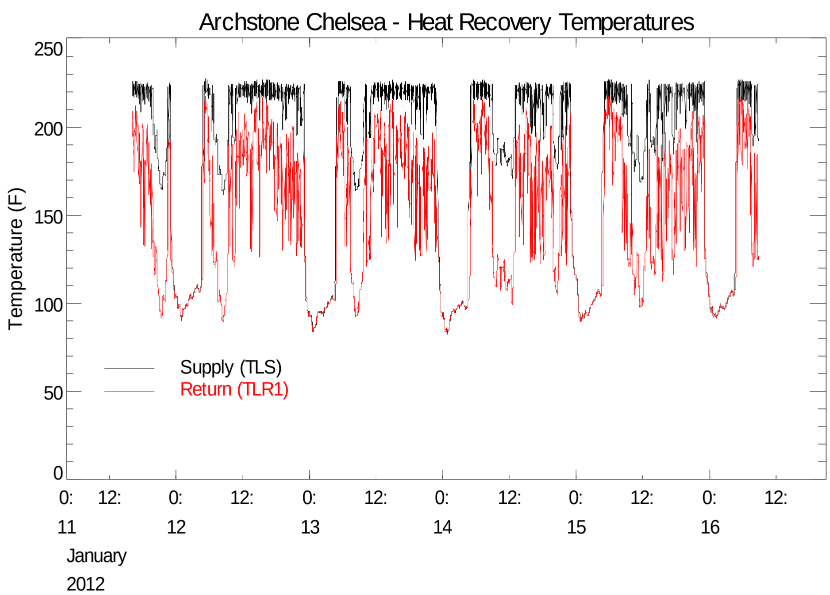


Figure 9. Heat Recovery Temperature Trend – Load HXs

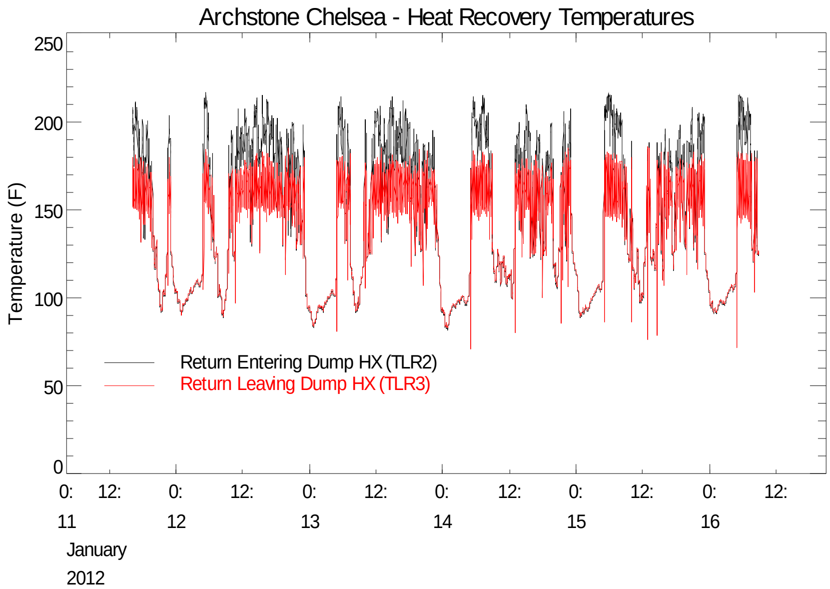


Figure 10. Heat Recovery Temperature Trend – Dump HX

Heat recovery flow rate was not verified, but the rate observed appeared reasonable based on the high heat recovery supply temperatures observed (approximately 230°F). Heat recovery flow is typically 14 GPM during engine operation, and the signal drops off to 10 GPM and below when the engine shuts down.

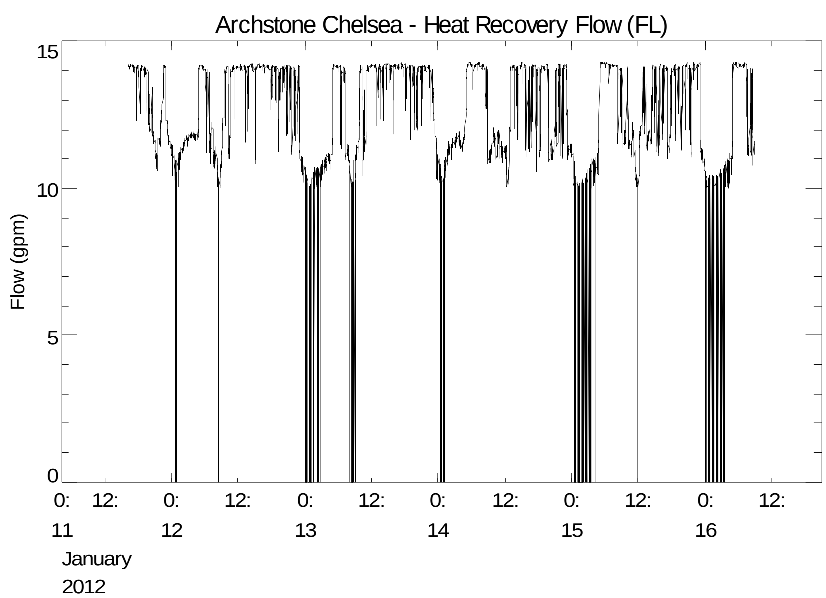


Figure 11. Heat Recovery Flow Trend

Gas use data from the utility pulse output appears reasonable given the coarse resolution of the data (1,000 CF/pulse). The typical rate when the engine is operating is 1,000 CFH, consistent with the approximately nominal rating of the engine (865 CFH).

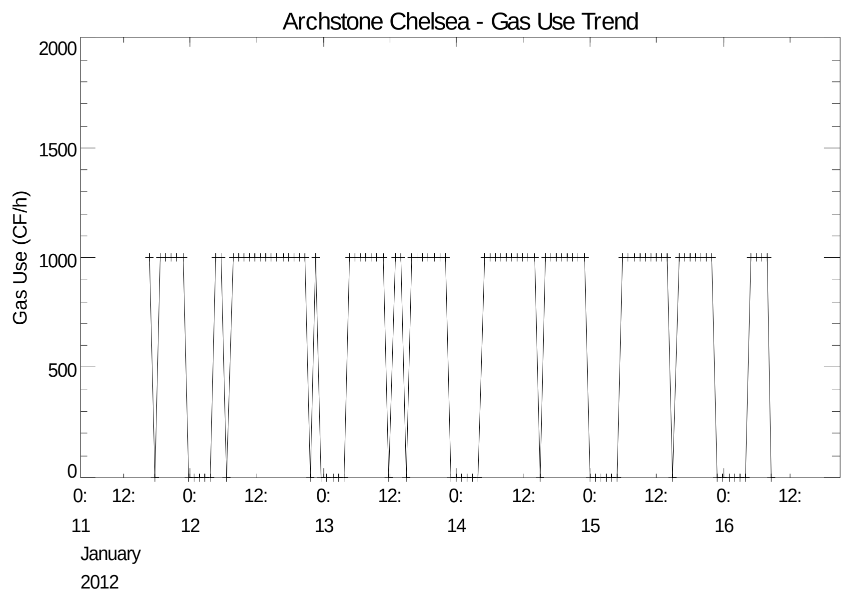


Figure 12. Engine Gas Use Trend

Parasitic power was measured for all pump and dump radiator fan loads on the Aegis Cogen Control Panel (CCP-1) main electrical service. Power was measured with, and without, the dump radiator running using an Extech 380940 power meter.

Figure 13. CCP-1 Containing All Parasitic Loads

Table 4. Parasitic Power Readings

CCP-1 Panel	Amps @ 208 VAC (A/B/C)	Power (kW)
Pumps ON, Dump HX Fan Off	3.6 / 3.7 / 3.6	1.17 kW
Pumps ON, Dump HX Fan @ 40%, 50°F temperature difference across dump HX	5.8 / 5.9 / 6.0	1.79 kW
Heat rejection at time of readings	0.480 x 14 GPM x 50°F = 336 MBtu/h dumped	
Estimated Fan Power	1.79 kW – 1.17 kW = 600 W / 336 MBtu/h = 1.785 W / MBtu/h dumped	

Engine power was verified using a Fluke 39 hand held probe, and the output from the Beckwith relay installed in the engine generator control compartment. The Beckwith relay can be accessed on the front serial port using the IPScom software.

Table 5. Engine Power Verification

Engine Power Reading	Amps @ 208 VAC (A/B/C)	Power (kW)
Fluke 39	225 / 224 / 221	48 + 22 = 70 kW (L → L) 23 + 23 + 23 = 69 kW (L → N)
Veris H8035	n/a	70.8 kW
Beckwith (Serial port reading using IPScom software)		71.3 kW

The power transducer was installed at 9:00 AM on January 23, 2012. The generator gross output was observed to vary from its set point of 70 kW down to 40 kW. The generator is scheduled to shut down at 11:00 PM and restart at 4:30 AM.

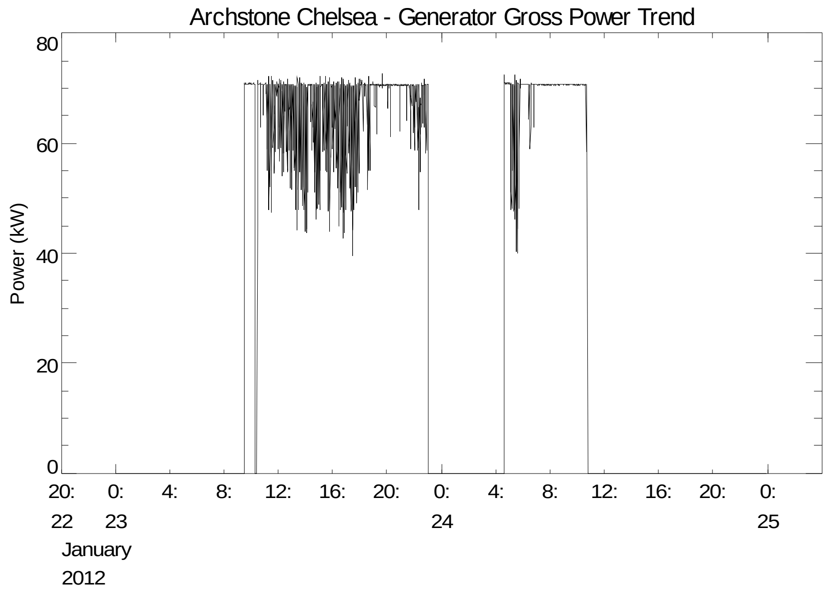


Figure 14. Generator Gross Power Trend

System Energy Flows

System energy and thermal flows documented in data analysis section.

Data Collection Status

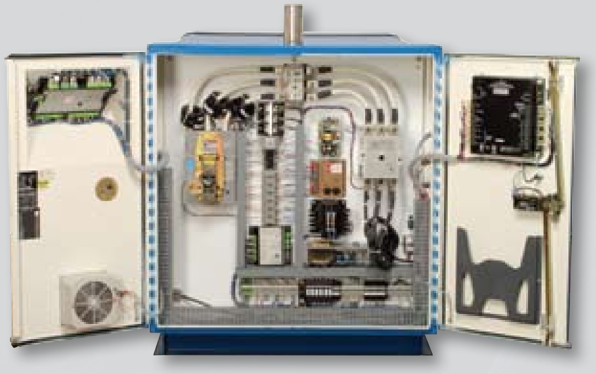
The data logger system was configured on January 11, 2012 and is providing data to CDH Energy. The power transducer for the engine generator was installed January 23, 2012.

AEGEN THERMO POWER™ TP-75

The AEGEN THERMO POWER 75 is a compact, modular combined heat and power (CHP) system producing 75 kW of power and 5.23 therms of heat per hour. A three-way non-selective catalyst reduction (NSCR) emissions control package includes a catalytic converter and temperature and oxygen controls designed to reduce emissions of nitrogen oxide, carbon monoxide, and hydrocarbons. The CHP module has a natural gas-fired reciprocating engine, an induction generator, heat recovery system, a sound attenuating enclosure, electrical switchgear, and solid-state controls for automatic and unattended operation. High efficiency heat recovery components consist of oil cooler, engine jacket for heat transfer, marine type exhaust gas manifolds and exhaust gas heat exchangers. The AEGEN THERMO POWER 75 operates in parallel with existing mechanical and electrical systems in the facility. The module includes an advanced utility-grade relay (U.L., C.S.A., and C.E. listed or certified) for electrical protection and redundancy as standard equipment.

Features

- Reliable, proven technology
- Highly efficient
- Environmentally sound with low emissions
- Quiet operation
- Modular – scaleable into larger systems
- Compact – easily fits in most buildings
- Indoor or outdoor installation
- Ease of installation – no business disruption
- U. L. listed
- Remote monitoring and control
- Digital display and user-friendly interface
- Infinite system life with maintenance program
- Electric and thermal load following
- Modbus compatible for networking with building automation systems



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Website: www.AegisEnergyServices.com • Email: Aegis@AegisEnergyServices.com

Characteristic	MODELS			
	Induction		Synchronous	
	TP-75	TP-75 LE	TPS-75	TPS-75 LE
Electrical Power Output	75 kW	75 kW	75 kW	75 kW
Thermal Output	484,000 Btus/hour	523,000 Btus/hour	484,000 Btus/hour	523,000 Btus/hour
Gas Input	865 standard cubic feet per hour (scfh)	930 standard cubic feet per hour (scfh)	865 standard cubic feet per hour (scfh)	930 standard cubic feet per hour (scfh)
Required Gas pressure	4 to 10 inches water column	10 to 14 inches water column	4 to 10 inches water column	10 to 14 inches water column
Efficiency	83.9%. at HHV of 1,020 Btus/scf	82.1%. at HHV of 1,020 Btus/scf	83.9%. at HHV of 1,020 Btus/scf	82.1%. at HHV of 1,020 Btus/scf
Max Output Water Temperature	230° F			
Weight	3,050 pounds			
Suspension	Vibration isolation mounts			
Dimension	46" width x 89' length x 49" height			
Acoustic Level (enclosed)	70 decibels (dba) from 20 feet away			
Output Voltage	208V or 460V nominal, 3 Phase, 3-wire			
Emissions	Each Aegen Thermo power model meets stringent air quality standards and requirments			

AEGENCO
AEGIS GENERATOR COMPANY

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APPENDIX A – Data Logger and Sensor Cut Sheets

A8812 AcquiSuite DR™ Data Acquisition Server

Description

Obvius, the leader in cost effective data acquisition and wireless metering solutions introduces the all-new A8812-x AcquiSuite DR™ data acquisition server, providing high performance and low cost for:

- Demand response programs
- Benchmarking building operations performance
- Verification of energy savings and utility costs
- Cost allocation to departments or tenants
- Internet based supervisory control outputs

The system combines the flexibility of choosing LAN, modem or cellular communication paths with the lowest total installed cost for logging building data such as:

- Electrical, gas and water usage and costs
- Indoor and outdoor temperatures
- Pressure, humidity, CO_2
- Industry standard pulse or analog inputs

AcquiSuite™ brings "plug and play" capability to the data acquisition market, dramatically reducing the time and training required to put a typical building on line. In most applications, the installation can be done by the building engineer or contractor in less than 2 hours. The system automatically detects and configures Modbus devices in just seconds reducing installation time and costs.

Applications

- Demand response program control and reporting
- Cost allocation to tenants and third parties
- Measurement & verification of energy savings
- Data center branch circuit monitoring
- Monitoring performance of building systems (e.g., chillers, boilers, fans)

Easy installation saves time and money

- Simple "plug and play" connectivity to standard Modbus meters minimizes installation time and costs
- "Flex" I/O inputs provide easy connections for analog, pulse and resistance sensors
- Integrated relay outputs allow supervisory control from any location for load shedding or local generation
- Integrated web server provides setup and configuration using any industry standard web browser (i.e., Netscape™ or Internet Explorer™)

AcquiSuite Framework lets users add Modbus devices

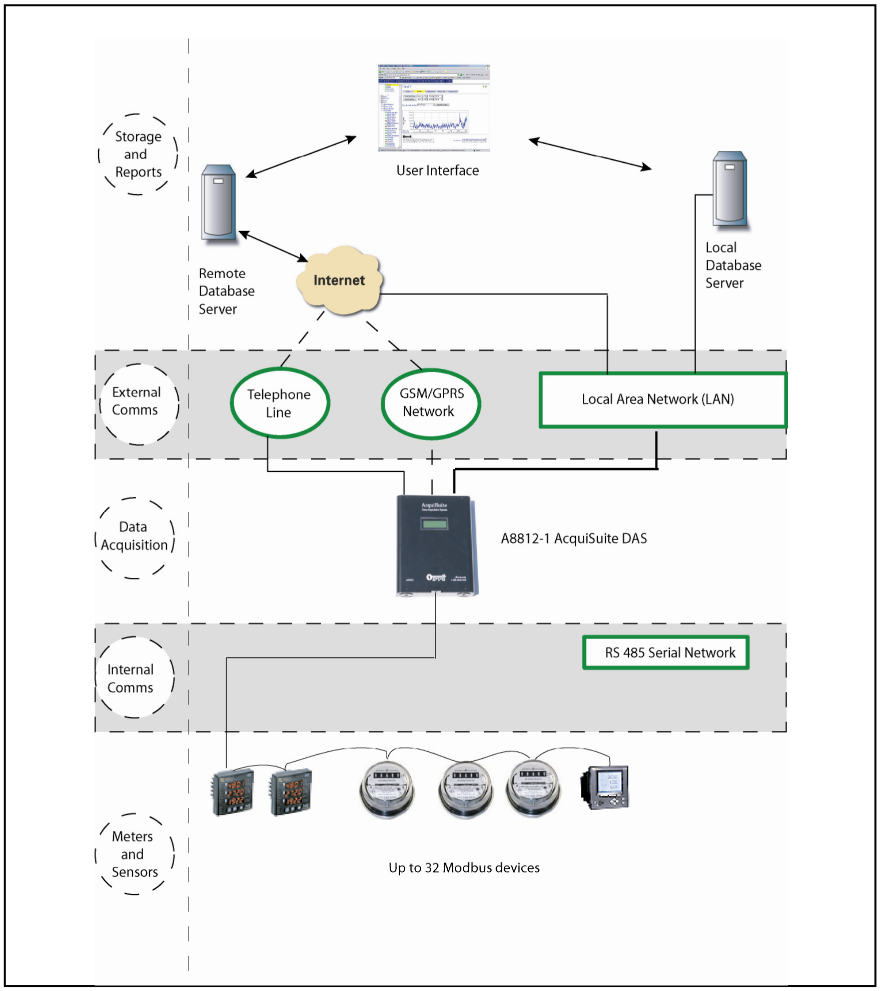
- Allows users a simple means to add Modbus devices not supported by AcquiSuite plug and play drivers
- Driver templates can be stored and shared with multiple AcquiSuites
- Simple web-based interface makes the process easy

Internet display of key building parameters

- Buildingmanageronline.com™ allows authorized users to see building performance data in an easy to use graphical format
- BMO site provides storage, display and downloads of historical data in a secure SQL database
- Users can be notified of alarm conditions in any or all monitored points
- Open protocols provide connectivity to any energy management or building automation software

Flexible communications and wireless connectivity

- All data is stored at the site in nonvolatile memory, insuring protection of valuable information in the event of power loss
- Optional on-board ModHopper (R9120-x) for wireless RS 485 communications (consult factory)
- A8812-1 provides two communication options: Local Area Network (LAN) or phone line
- A8812-GSM replaces the standard phone modem with a GSM/GPRS modem for cellular data transfer



SPECIFICATIONS

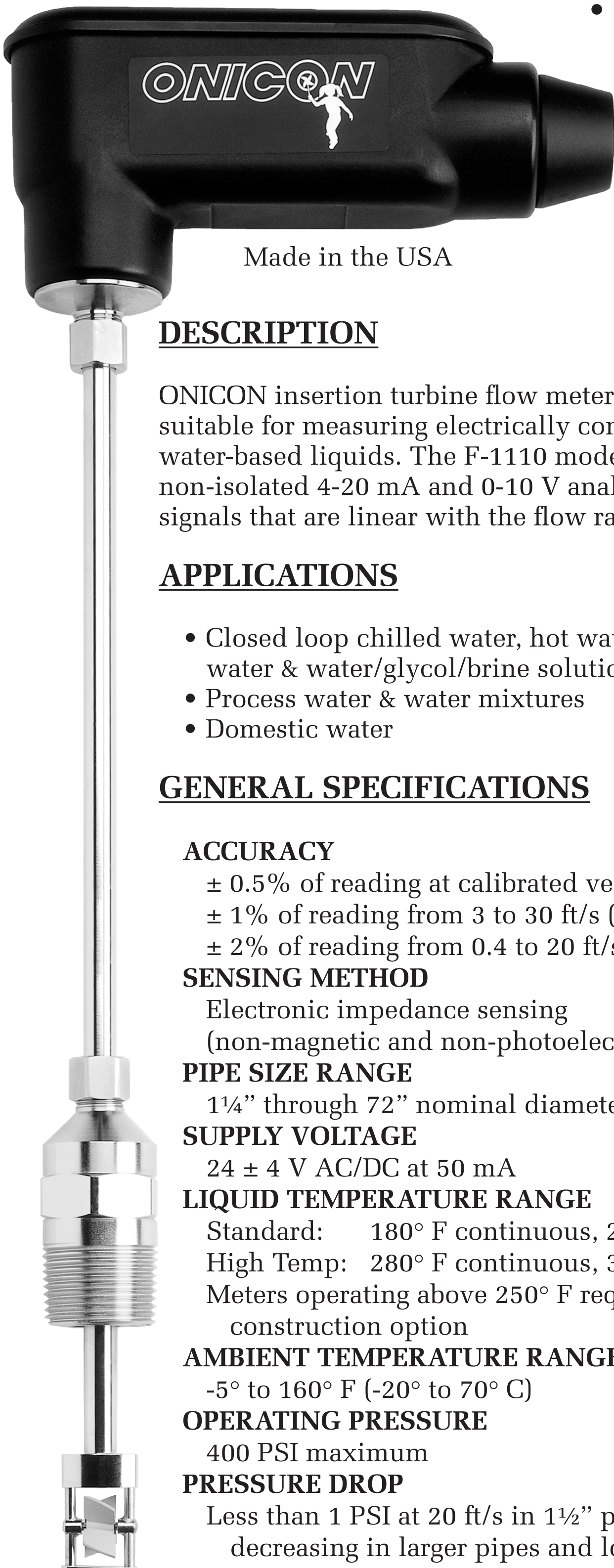
Processor	Main processor: ARM 9 ; I/O co-processor: ARM 7
Operating System	Linux 2.6
Flash ROM	16 MB NOR Flash (expandable with USB memory device)
Memory	32 MB RAM
LED	8x pulse input, 4 modem activity, Modbus TX/RX, power status
Console	2 x 16 LCD character, two buttons
LAN	10/100, Auto crossover detection
Modem (phone)	V.34 bis, 33,600 bps **(Part number A8812-1)**
Modem (cellular)	GSM/GPRS Class10, 85 kbps **(Part number A8812-GSM)**
Protocols	Modbus/RTU, Modbus/TCP, TCP/IP, PPP, HTTP/HTML, FTP,SNMP, SMTP, XML
Power Supply	24 VDC, included
Serial Port	RS-485 Modbus
Approvals	CE; FCC Part 15, Class A
USB port	USB memory expansion port
Power Requirement	110-120VAC
Interval recording	User selectable 1-60 minutes. Default 15 minute interval.
Outputs	2x, Dry contact 30 VDC, 150 mA max
Inputs	8x, user selectable:

- 0-10 V - Min/Max/Ave/Instantaneous
- 4-20 mA - Min/Max/Ave/Instantaneous
- Pulse- Consumption, Rate
- Resistance - Min/Max/Ave/Instantaneous
- Runtime - Runtime, Status

CE

• F-1110 SINGLE TURBINE •
INSERTION FLOW METER
ANALOG OUTPUT

ONICON INCORPORATED



Made in the USA

DESCRIPTION

ONICON insertion turbine flow meters are suitable for measuring electrically conductive water-based liquids. The F-1110 model provides non-isolated 4-20 mA and 0-10 V analog output signals that are linear with the flow rate.

APPLICATIONS

- Closed loop chilled water, hot water, condenser water & water/glycol/brine solutions for HVAC
- Process water & water mixtures
- Domestic water

GENERAL SPECIFICATIONS

ACCURACY
± 0.5% of reading at calibrated velocity
± 1% of reading from 3 to 30 ft/s (10:1 range)
± 2% of reading from 0.4 to 20 ft/s (50:1 range)

SENSING METHOD
Electronic impedance sensing
(non-magnetic and non-photoelectric)

PIPE SIZE RANGE
1¼" through 72" nominal diameter

SUPPLY VOLTAGE
24 ± 4 V AC/DC at 50 mA

LIQUID TEMPERATURE RANGE
Standard: 180° F continuous, 200° F peak
High Temp: 280° F continuous, 300° F peak
Meters operating above 250° F require 316 SS construction option

AMBIENT TEMPERATURE RANGE
-5° to 160° F (-20° to 70° C)

OPERATING PRESSURE
400 PSI maximum

PRESSURE DROP
Less than 1 PSI at 20 ft/s in 1½" pipe, decreasing in larger pipes and lower velocities

OUTPUT SIGNALS PROVIDED
Analog Outputs (non-isolated)
Voltage output: 0-10 V (0-5 V available)
Current output: 4-20 mA
Frequency Output
0 – 15 V peak pulse, typically less than 300 Hz

(continued on back)

CALIBRATION

Every ONICON flow meter is wet calibrated in a flow laboratory against primary volumetric standards that are directly traceable to N.I.S.T. A certificate of calibration accompanies every meter.

FEATURES

Unmatched Price vs. Performance - Custom calibrated, highly accurate instrumentation at very competitive prices.

Excellent Long-term Reliability - Patented electronic sensing is resistant to scale and particulate matter. Low mass turbines with engineered jewel bearing systems provide a mechanical system that virtually does not wear.

Industry Leading Two-year "No-fault" Warranty - Reduces start-up costs with extended coverage to include accidental installation damage (miswiring, etc.) Certain exclusions apply. See our complete warranty statement for details.

Simplified Hot Tap Insertion Design - Standard on every insertion flow meter. Allows for insertion and removal by hand without system shutdown.

OPERATING RANGE FOR COMMON PIPE SIZES
0.17 TO 20 ft/s

±2% accuracy begins at 0.4 ft/s

Pipe Size (Inches)	Flow Rate (GPM)
1 ¼	0.8 - 95
1 ½	1 - 130
2	2 - 210
2 ½	2.5 - 230
3	4 - 460
4	8 - 800
6	15 - 1,800
8	26 - 3,100
10	42 - 4,900
12	60 - 7,050
14	72 - 8,600
16	98 - 11,400
18	120 - 14,600
20	150 - 18,100
24	230 - 26,500
30	360 - 41,900
36	510 - 60,900

1500 North Belcher Road, Clearwater, FL 33765 • Tel (727) 447-6140 • Fax (727) 442-5699
www.onicon.com • sales@onicon.com

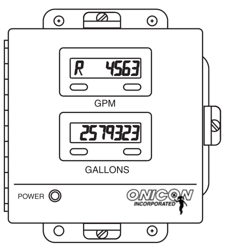
F-1110 SPECIFICATIONS cont.

MATERIAL
Wetted metal components:
Standard: Electroless nickel plated brass
Optional: 316 stainless steel

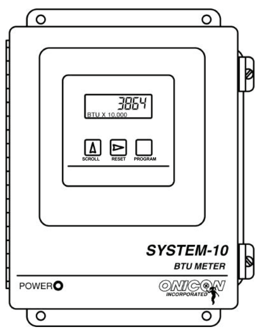
ELECTRONICS ENCLOSURE
Standard: Weathertight aluminum enclosure
Optional: Submersible enclosure

ELECTRICAL CONNECTIONS
3-wire for frequency output
Standard: 10’ of cable with ½” NPT conduit connection
Optional: Indoor DIN connector with 10’ of plenum rated cable

ALSO AVAILABLE



Display Modules



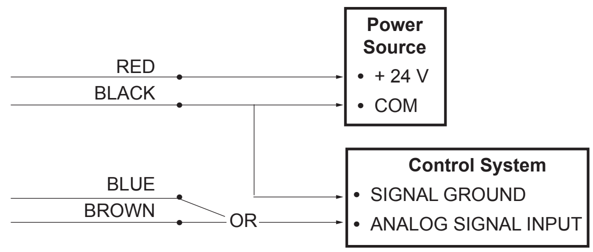
Btu Measurement Systems

F-1110 Wiring Information

WIRE COLOR	DESCRIPTION	NOTES
RED	(+) 24 V AC/DC supply voltage, 50 mA	Connect to power supply positive
BLACK	(-) Common ground (Common with pipe ground)	Connect to power supply negative & analog input ground
GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local display or Btu meter
BLUE	(+) Analog signal: 4-20 mA (non-isolated)	Both signals may be used independently.
BROWN	(+) Analog signal: 0-10 V (non-isolated)	

F-1110 Wiring Diagram

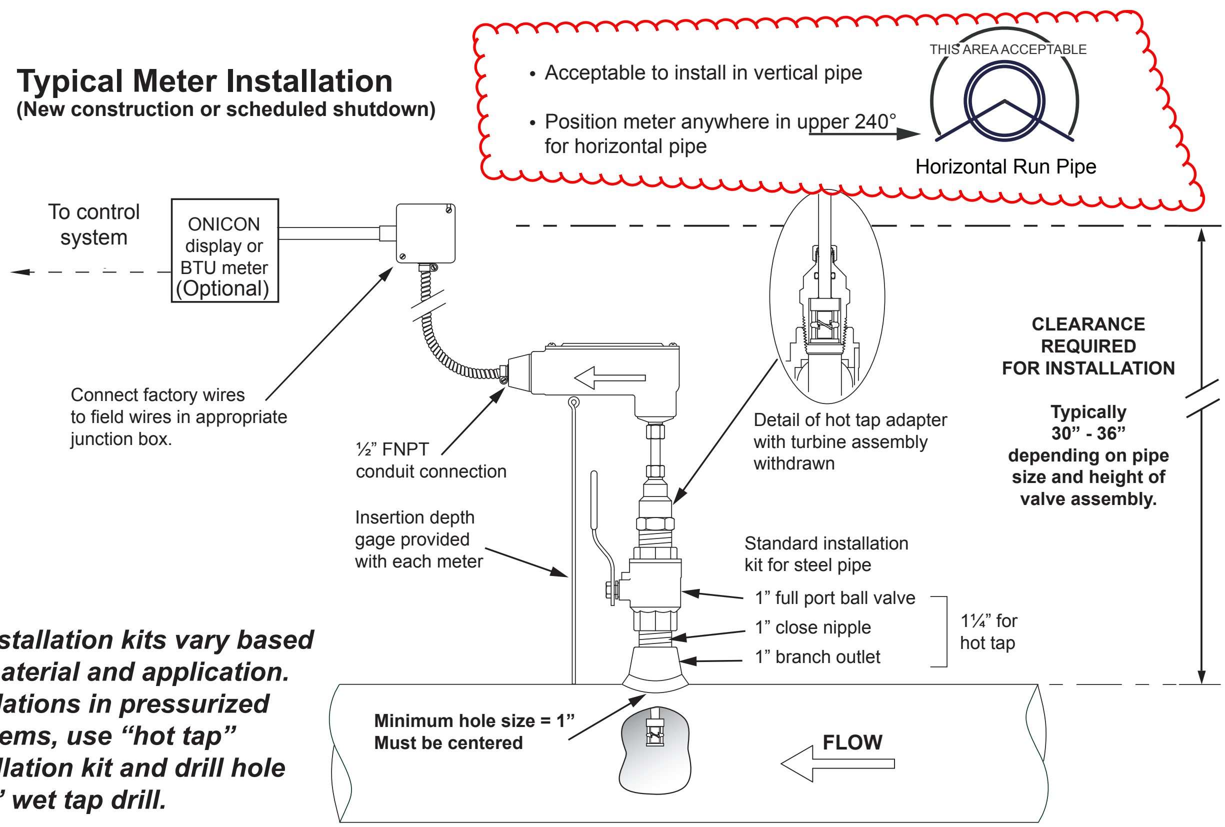
Flow meter into control system (no display or Btu meter)



NOTE: ***1. Black wire is common with the pipe ground (typically earth ground).***
2. Frequency output required for ONICON display module or Btu meter, refer to wiring diagram for peripheral device.

Typical Meter Installation

(New construction or scheduled shutdown)



NOTE: Installation kits vary based on pipe material and application. For installations in pressurized (live) systems, use “hot tap” 1¼” installation kit and drill hole using a 1” wet tap drill.

Enercept® Networked Power Transducers (Modbus® RTU)

Integral Monitoring Solution Eliminates The Need For Separate Enclosures

APPLICATIONS

- Energy managing & performance contracting
- Monitoring for commercial tenants
- Activity-based costing in commercial and industrial facilities
- Real-time power monitoring

FEATURES

The world's most cost-effective power transducer

- Monitor energy parameters (kW, kWh, kVAR, PF, Amps, Volts) at up to 63 locations on a single RS-485 network...greatly reduces wiring time and cost
- Fast split-core installation eliminates the need to remove conductors...saves time and labor
- Precision electronics and current transformers in a single package...reduces the number of installed components...huge labor savings
- Smart electronics eliminate CT orientation concerns...fast trouble-free installation

High accuracy

- ±1% total system accuracy, (10% to 100% of CT rating)

H8035

U.S. Patent No. 6,373,238

5 Year Warranty

DESCRIPTION

The **Enercept H8035/8036** are innovative three-phase networked (Modbus RTU) power transducers that combine measurement electronics and high accuracy industrial grade CTs in a single package. The need for external electrical enclosures is eliminated, greatly reducing installation time and cost.

There are two application-specific platforms to choose from. The Basic Enercept energy transducers (H8035) are ideal for applications where only kW and kWh are required. The Enercept Enhanced power transducers (H8036) output 26 variables including kW, kWh, volts, amps, and power factor, making them ideal for monitoring and diagnostics.

Color-coordination between voltage leads and CTs makes phase matching easy. Additionally, the Enercept automatically detects and compensates for phase reversal, eliminating the concern of CT load orientation. Up to 63 Enercepts can be daisy-chained on a single RS-485 network.

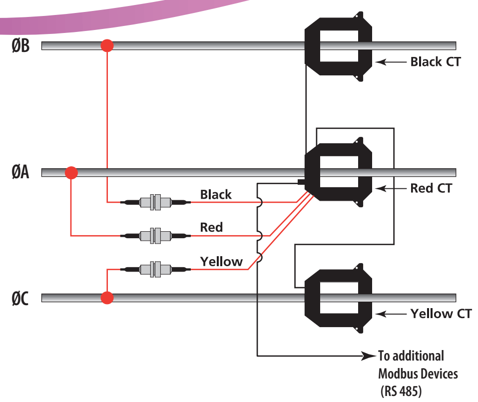
SPECIFICATIONS

Inputs:	
Voltage Input	208 to 480VAC, 50/60 Hz RMS †(††)
Current Input	Up to 2400A continuous per phase †
Accuracy:	
System Accuracy	±1% of reading from 10% to 100% of the rated current of the CTs, accomplished by matching the CTs with electronics and calibrating them as a system
Outputs:	
Type	Modbus RTU**(*)
Baud Rate	9600, 8N1 format
Connection	RS-485, 2-wire + shield
Environmental:	
Operating Temperature Range	0° to 60°C (32° F to 140°F), 50°C (122°F) for 2400A
Humidity Range	0 - 95% non-condensing

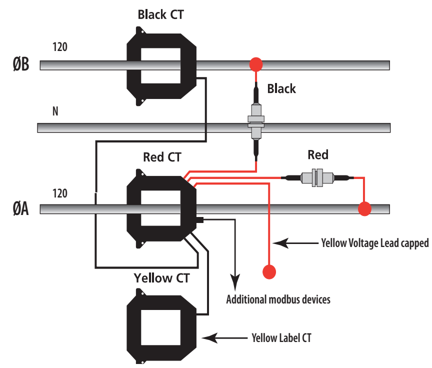
UL, approved for California CSI Solar applications (check the CSI Solar website for model numbers)
*** Detailed protocol specifications are available at: http://www.veris.com/modbus*
** Other protocols available. Please consult factory.*
† Contact factory to interface for voltages above 480VAC or current above 2400 Amps.
†† Do not apply 600V Class current transformers to circuits having a phase-to-phase voltage greater than 600V, unless adequate additional insulation is applied between the primary conductor and the current transformers. Veris assumes no responsibility for damage of equipment or personal injury caused by products operated on circuits above their published ratings.

APPLICATION/WIRING EXAMPLES

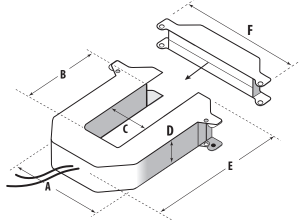
208 or 480VAC 3Ø, Installation



240VAC 1Ø, 3-Wire Installation

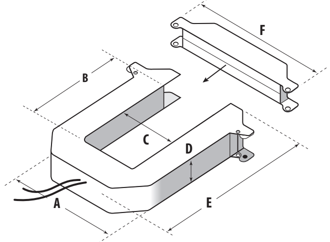


DIMENSIONAL DRAWINGS



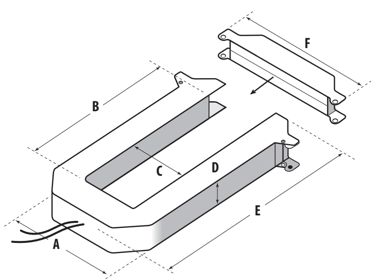
SMALL
100/300 Amp

A =	3.8"	(96 mm)
B =	1.2"	(30 mm)
C =	1.3"	(31 mm)
D =	1.2"	(30 mm)
E =	4.0"	(100 mm)
F =	4.8"	(121 mm)



MEDIUM
400/800 Amp

A =	4.9"	(125 mm)
B =	2.9"	(73 mm)
C =	2.5"	(62 mm)
D =	1.2"	(30 mm)
E =	5.2"	(132 mm)
F =	5.9"	(151 mm)



LARGE
800/1600/2400 Amp

A =	4.9"	(125 mm)
B =	5.5"	(139 mm)
C =	2.5"	(62 mm)
D =	1.2"	(30 mm)
E =	7.9"	(201 mm)
F =	6.0"	(151 mm)

DATA OUTPUTS

H8035

kWh
kW

H8036

kWh, Consumption
kW, Real Power
kVAR, Reactive Power
kVA, Apparent Power
Power Factor
Average Real Power
Minimum Real Power
Maximum Real Power
Voltage, L-L
Voltage, L-N*
Amps, Average Current
kW, Real Power ØA*
kW, Real Power ØB*
kW, Real Power ØC*

** Based on derived neutral voltage.*

POWER/ENERGY MONITORING

ORDERING INFORMATION

LISTED 44XJ UL 508 E212445

Modbus Basic Power Transducers*

MODEL	MAX. AMPS	CT SIZE
H8035-0100-2	100	SMALL
H8035-0300-2	300	SMALL
H8035-0400-3	400	MEDIUM
H8035-0800-3	800	MEDIUM
H8035-0800-4	800	LARGE
H8035-1600-4	1600	LARGE
H8035-2400-4	2400	LARGE

**H8035 models work with H8920-5 LON nodes*

Modbus Enhanced Data Stream Power Transducers*

MODEL	MAX. AMPS	CT SIZE
H8036-0100-2	100	SMALL
H8036-0300-2	300	SMALL
H8036-0400-3	400	MEDIUM
H8036-0800-3	800	MEDIUM
H8036-0800-4	800	LARGE
H8036-1600-4	1600	LARGE
H8036-2400-4	2400	LARGE

**H8036 models work with H8920-1 LON nodes*

ACCESSORIES

CT Mounting brackets (AH06)
H8920 Series LON nodes

APPENDIX B – Data Logger Wiring Diagrams and Modbus Register Maps

Instrumentation, Wiring Schematic, and Installation Details

Site Visits

January 11, 2012	Initial site visit, data logger commissioning
January 23, 2012	Engine generator power transducer installed

Description of Monitored Data Points and Schematics

Table B-1 lists the monitored points installed at the site.

Table B-1. Monitored Data Point List

No.	Data Point	Description	Units	Sensor	Output	Notes
1	WG1	Generator #1 Power/Energy	kW/kWh	Veris H8035-0800-3	Modbus	Provided and Installed by CDH Energy
2	FG	Generator Gas Use	CF	Utility pulse output	Pulse	1000 CF/pulse
3	FL	Heat Recovery Loop Flowrate	GPM	Onicon F1110	4-20 mA	Read from BPL Modicon PLC
4	TLS	Heat Recovery Loop Supply Temperature	deg F	BPL RTD TT173	n/a	Read from BPL Modicon PLC
5	TLR1	Heat Recovery Loop Return Temperature Leaving Load HXs	deg F	BPL RTD TT174	n/a	Read from BPL Modicon PLC
6	TLR2	Heat Recovery Loop Return Temperature Entering Dump HX	deg F	BPL RTD TT175	n/a	Read from BPL Modicon PLC
7	TLR3	Heat Recovery Loop Return Temperature Leaving Dump HX	deg F	BPL RTD TT176	n/a	Read from BPL Modicon PLC

Figure B-1 displays the data logger termination diagram.

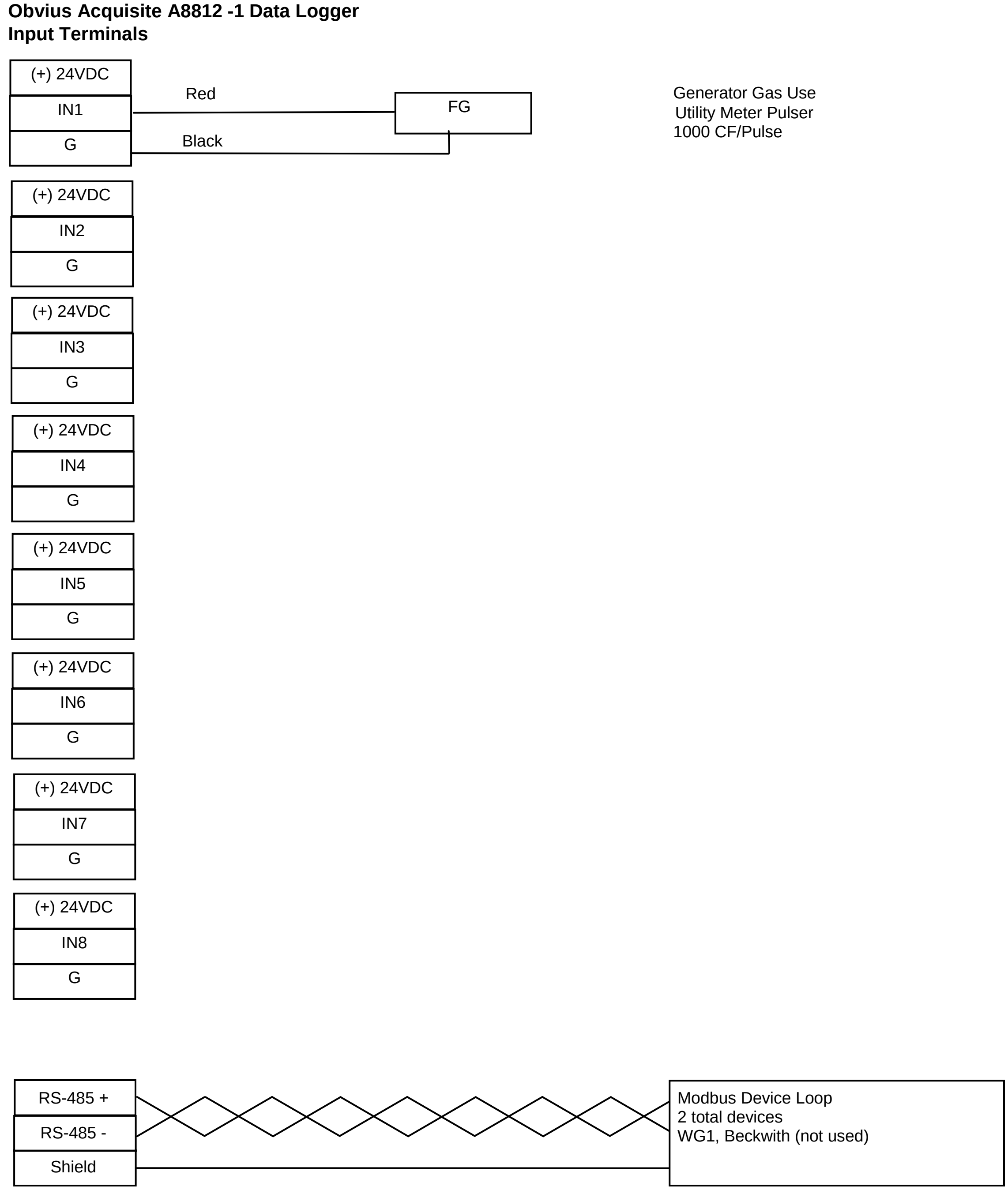


Figure B-1. Obvius Data Logger Wiring Schematic

Instrumentation, Wiring Schematic, and Installation Details

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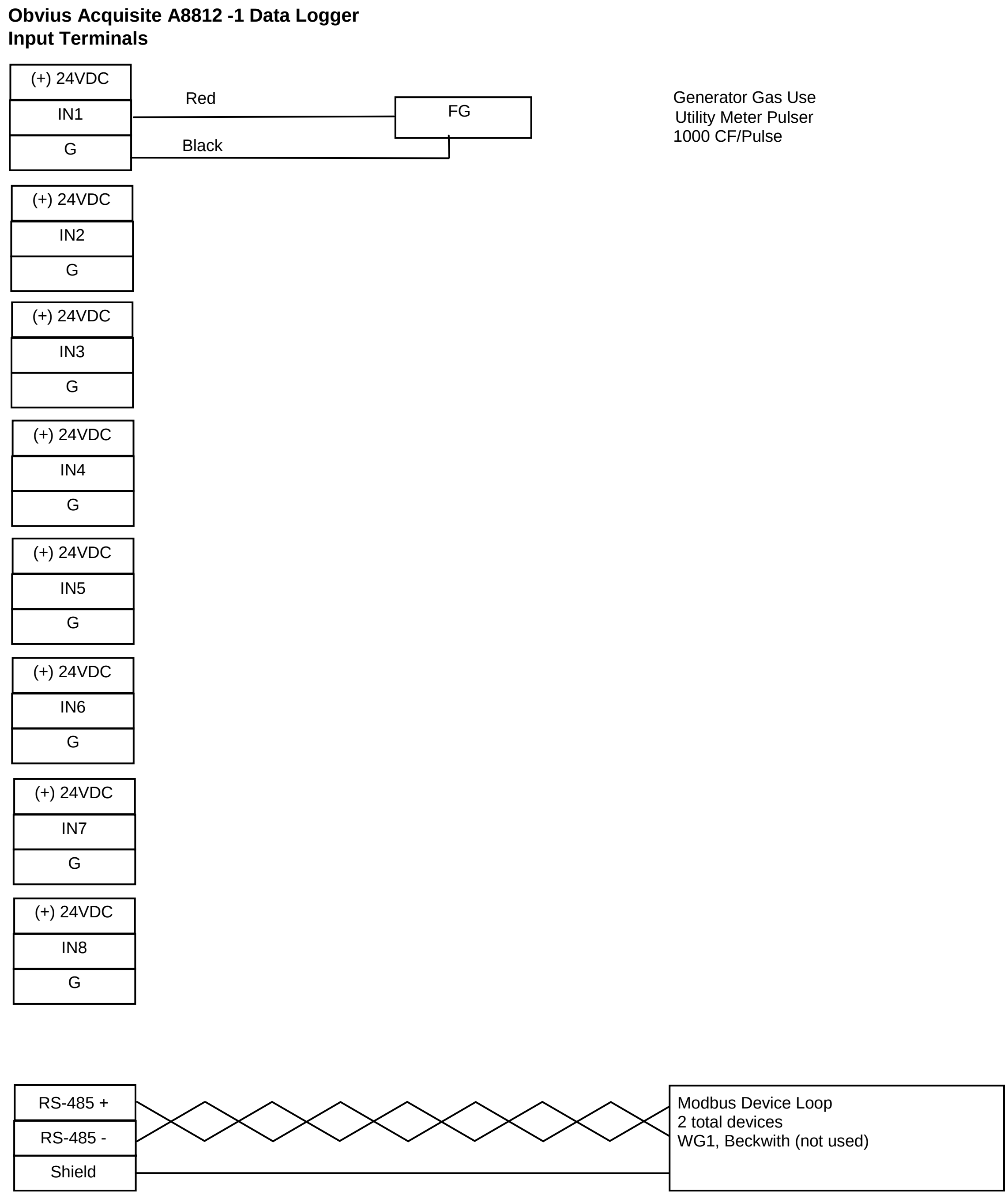

Figure B-1. Obvius Data Logger Wiring Schematic