MEASUREMENT AND VERIFICATION PLAN

FOR

DG/CHP SYSTEM
AT
PARKER JEWISH HOSPITAL – ALL SYSTEMS COGEN

Revised
July 19, 2012

Submitted to:

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

Submitted by:

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1. Introduction

All Systems Cogen has installed a combined heat and power (CHP) system at the Parker Jewish Hospital facility in New Hide Park, NY. The CHP system based on four natural gas fueled reciprocating engine-generators having a combined electrical rating of 300 kW. The site's electric demand is sufficient to keep the system operating at or near its rated capacity on a continuous basis. Heat would be recovered as hot water from the engine jacket at a supply temperature of 205°F. A heat exchanger will separate the engine coolant from the DHW load side equipment. Additionally, exhaust heat exchangers are used at each engine to provide additional heating to boiler jacket water. Boiler water is pulled from the lower boiler jacket, mixed with makeup water, and circulated through the four engine exhaust HX and re-injected at a higher point in the boiler jacket. Excess heat is rejected from the DHW hot water loop to a dump radiator.

Peak operation of the CHP system will result in the following performance:

Gross electrical output:	300 kW
Parasitic electrical input (estimated):	-15 kW
Jacket water at 195°F:	1.34 MMBtu/h
Exhaust boiler water at 205°F:	0.70 MMBtu/h
Fuel input:	3.34 MMBtu/h LHV

Annually the system is anticipated to displace 2,250,266 kWh and displace 150,362 therms of gas through heat recovery. Annual fuel consumption is 283,833 therms.

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 CDH Energy and presented to the applicant, All Systems Cogen. 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 to the instrumentation plan, All Systems Cogen will supply the instrumentation listed Table 1 below for use in meeting the NYSERDA CHP program monitoring requirements.

Table 1. Instrumentation Supplied By All Systems Cogen

Point	Instrument	Output Type	Sensor Location	Data Point	Notes
Facility Power	None	Monthly utility billing	n/a	WT	
Generator Power Output	WattNode WNB-3Y-208-P 1200 A Cts	Pulse output 25 Wh/pulse	CTs in Panel DP-CHP on collector bus	WG	Meter location is net power output
System Parasitic (Combined)	WattNode WNB-3Y-208-P 200 A Cts	Pulse output 5 Wh/pulse	CTs in disconnect for parasitic load panel	WPAR	
Generator Gas Input	Utility pulse meter	Pulse output Pulse constant TBD by utility	At gas service entrance	FG	Meter and rate selection subject to National Grid discretion
DHW heat recovery loop flow rate	Onicon F-1110 insertion turbine meter	4-20 mA output 0 – 150 GPM	On DHW heat recovery loop piping, downstream of dump radiator (lowest temperature point on system piping)	FL1	
DHW heat recovery loop temperatures	Veris TIGB1-D0 10K Type II Thermistor	Resistance	In thermowells installed on heat recovery loop piping	TLS1, TLR1, TLR2	TLR2 surface mount sensor
Boiler water heat recovery loop flow rate	Nice Instruments Titan Insertion Shedding Vortex Meter Titan IV – 1.5-2 L R10 24 LT TX	4-20 mA output 8 - 190.4 GPM	On boiler heat recovery loop piping, upstream of boiler	FL2	
Boiler water heat recovery loop temperatures	Veris TIGB1-D0 10K Type II Thermistor	Resistance	In thermowells installed on heat recovery loop piping	TLS2, TLR3	

Data Logger

Readings for the installed instrumentation are recorded by an Obvius AcquiSuite data logger provided and installed by CDH Energy. The data logger samples all sensors approximately once per second and record one-minute totals (of pulse or digital sensors) or averages (of analog sensors). The one minute readings of heat recovery temperatures and flows 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 (10), 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 data loggeronce per day via a cellular modem provided by CDH Energy. 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 mounted near a 120 VAC power receptacle (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

Parker Jewish has provided an network connection for the logger. The logger is located on a VLAN at the hospital with the following parameters:

- Network – 192.168.16.0
- Subnet – 255.255.255.0
- Default Gateway – 192.168.16.254
- DNS servers – 172.16.3.41 and 172.16.3.42

The data logger IP address is 192.168.16.10, and when accessing the data logger on site, the PC address must be set to 192.168.16.11. Outside access to the internet from the PC is possible using the following proxy server:

- 172.16.3.46, port 8080

However, the connection will not allow transmission out to the public internet. CDH Energy has provided a cellular modem for the data logger. The data logger uploads data nightly to the CDH Energy servers (data.cdhenergy.com).

On Site Support

The site will be responsible for providing access to all areas necessary to complete the monitoring installation, as well as any return trips for verification of sensors or service to the monitoring system.

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

No.	Data Point	Description	Engineering Unit
1	WG	Generator Electrical Output (Combined)	kW/kWh
2	WPAR	Parasitic Load Electrical Consumption	kW/kWh
3	FG	Combined Generator Fuel Input	CF
4	FL1	Glycol DHW Loop Flow Rate	GPM
5	TLS1	Glycol DHW Loop Supply Temperature	deg F
6	TLR1	Glycol DHW Loop Return Temperature from HX loads, upstream of dump radiator	deg F
7	TLR2	Glycol DHW Loop Return Temperature downstream of dump radiator	deg F
8	FL2	Boiler Water Loop Total Flow Rate	GPM
9	TLS2	Boiler Water Loop Supply Temperature	deg F
10	TLR3	Boiler Water Loop Return Temperature from Boilers, downstream of makeup water connection	deg 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), or

$$\text{kW} \quad = \quad \sum\nolimits_{15min} \frac{\text{kWh}}{\Delta t} \quad = \quad \sum\nolimits_{15min} = \frac{\text{kWh per interval}}{0.25\,\text{h}}$$

Heat Recovery Rates

The heat recovery rates will be calculated offline based on the 1-minute data collected. The piping arrangement at this site allows for multiple heat rates to be determined with 3 temperature sensors and one flow reading on the DHW heat recovery loop:

Useful DHW heat recovery (**QUD**) $\quad = \quad$ K·Σ [FL1·(TLS1-TLR1)] / n

Rejected (unused) heat recovery (**QR**) $\quad = \quad$ K ·Σ [FL1·(TLR1-TLR2)] / n

The loop fluid is expected to be a glycol-water mixture. The factor K will be determined based on a periodic reading of the fluid properties with a refractometer to determine the glycol concentration. (K ~ 500 Btu/h-gpm-°F for pure water; ~480 for 20% glycol). 'n' is the number of scan intervals included in each recording interval (e.g., with 1 sec scans and 1-minute data, n=60)

For the boiler heat recovery loop, the temperature rise of the boiler jacket water and corresponding flow rate are used to calculate the heat recovery:

Useful boiler loop heat recovery (**QUB**) $\quad = \quad$ K·Σ [FL2·(TLS2-TLR3)] / n

The factor K for the boiler water is expected to be 500 Btu/h-gpm-°F (pure water). Note that the possibility of mixed phase (liquid/gas) flow in the boiler water loop is high. The boiler water (which is at saturation) has the potential to flash to vapor in the circulating pump suction leg. Measuring the heat transfer that occurs in the boiler water loop based solely on temperature change and flow, may not fully account for the entirety of heat transfer that occurs, especially with regard to the potential in phase change. Also, accurate measurement of mixed phase flow is difficult due to the constantly changing density of the fluid. Due to these issues, and other unforeseen complications, a full accounting of the heat transfer on the boiler loop may not be possible, and the final FCE determined by the measurements may be understated.

Calculated Quantities

The net power output from the CHP system will be defined as the gross power from the engines minus the parasitic power. Note that for this particular site, WG represents the <u>net</u> power output from the engines, and therefore can be directly used directly to calculate the fuel conversion efficiency (FCE), without involving the parasitic energy in the computation.

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

$$FCE = \frac{QU + 3{,}413 \cdot (WG)}{0.9 \cdot HHV_{gas} \cdot FG}$$

Where: QU =   Useful heat recovery (Btu) (QUD+QUB)
          WG =   Engine generator net output (kWh)
          FG =   Generator gas consumption (Std CF)
          HHV_{gas}=   Higher heating value for natural gas (~1030 Btu per CF).
                       Where 0.9 is the conversion factor between HHV and LHV

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

$$FCE = \frac{\sum^{N} QU + 3{,}413 \cdot \sum^{N} (WG)}{0.9 \cdot HHV_{gas} \cdot \sum^{N} FG}$$

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

The parasitic power for the entire CHP system is measured at WPAR. The parasitic power is being recorded for consistency with other NYSERDA CHP monitored sites, but will not used directly in determining compliance with either the kWspc, kWp, or annual FCE of the project.

Appendix A

System Schematic and Cut Sheets for Key Sensors and Instruments

Parker Jewish CHP M&V instrumentation Plan - As Built 2012May02

No.	Data Point	Description	Units	Sensor	Signal Type	Multiplier/Pulse Rate?	Note	Est Price	Supplied by
1	WG	Generator Electrical Output (Combined)	kW/kWh	WattNode WNB-3Y-208-P 1200 A Cts	Pulse	0.025 kWh/pulse	CTs face generator(s), measures net generator power		Applicant
2	WPAR	Parasitic Load Electrical Consumption	kW/kWh	WattNode WNB-3Y-208-P 200 A Cts	Pulse	0.005 kWh/pulse	CTs face utility		Applicant
3	FG	Combined Generator Fuel Input	CF	Utility Pulser	Pulse	1000 CF/pulse (typ)	To be installed as of 2012May02		Applicant
4	FL1	Glycol DHW Loop Flow Rate	GPM	Onicon F-1110	4-20 mA	0-150 GPM	1-inch full port ball valve assembly used.		Applicant
5	TLS1	Glycol DHW Loop Supply Temperature	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	CDH Energy supplied thermowell, 4-inch well/probe		CDH Energy
6	TLR1	Glycol DHW Loop Return Temperature from HX loads, upstream of dump radiator	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	CDH Energy supplied thermowell, 4-inch well/probe		CDH Energy
7	TLR2	Glycol DHW Loop Return Temperature down stream of dump radiator	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	CDH Energy supplied strap on sensor, mounted below insulation.		CDH Energy
8	FL2	Boiler Water Loop Total Flow Rate	GPM	Shedding Vortex HW meter	4-20 mA	8.375 - 190.4 GPM	Shedding vortex meter recommended due to possibility of mixed phase flow. 1-inch full port ball valve assembly used.		Applicant
9	TLS2	Boiler Water Loop Supply Temperature	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	CDH Energy supplied thermowell, 4-inch well/probe		CDH Energy
10	TLR3	Boiler Water Loop Return Temperature from Boilers, down stream of makeup water connection	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	CDH Energy supplied thermowell, 4-inch well/probe		CDH Energy
11	WT	Total Facility Energy / Power	kW/kWh	n/a	n/a	n/a	Can be obtained on a monthly basis from ConEd Bills		Applicant
12	TAO	Ambient Temperature	deg F	n/a	n/a	n/a	Can be obtained from Internet NCDC website		Applicant / NCDC

Note:

Burkert flow meters shown in drawings used for balancing, not used in monitoring. All HX Flow/Temperature difference sensors removed.

CHP Efficiency Calculations:

Net Power $WG_{net} = WG$

Useful Heat $QHU = 480 \times FL1 \times (TLS1 - TLR1) + 500 \times FL2 \times (TLS2 - TLR3)$
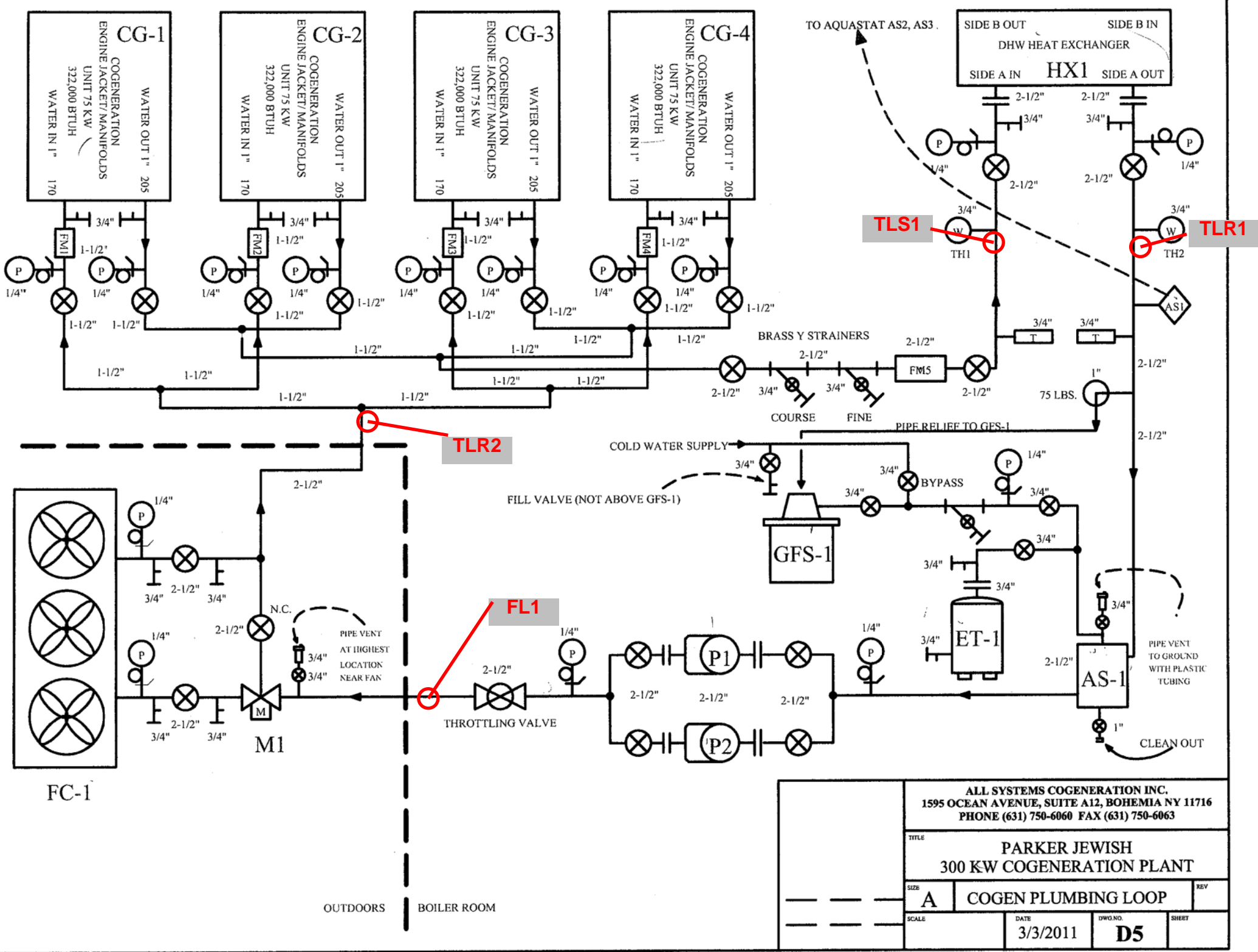
Dumped Heat $QHD = 480 \times FL1 \times (TLR1 - TLR2)$

Fuel Conversion
$$FCE = \frac{QHU \cdot \Delta t + 3.412 \cdot (WGnet)}{LHV_{gas} \cdot FG}$$

EQUIPMENT SCHEDULE FOR PARKER JEWISH

ITEM	ORDERED/DELIVERED	DESCRIPTION	MANUFACT.	PART NO.	FUNCTION	BY
CG1,CG2,CG3,CG4	YES/NO	COGEN	ASC	75 KW	COGENERATION MODULE	ASC
FC-1	YES/NO	FAN	COLMAC	AFV-45162-11	COOLING RADIATOR	ASC
P1, P2	YES/YES	PUMP	TACO	KV1509-5HP	COGEN MAIN AND SPARE PUMP	ASC
P3, P4	YES/YES	PUMP	TACO	1641 B-3HP	DHW MAIN AND SPARE PUMP	ASC
P5, P6	YES/YES	PUMP	TACO	KV1509-3HP	EXHAUST MAIN AND SPARE PUMP	ASC
HX1	YES/YES	HEAT EXCHANGER	FLATEPLATE	LC110-80DW	DOM. HOT WATER EXCHANGER	ASC
FM1,2,3,4	YES/YES	FLOW METER (1-1/2")	BURKERT	423990	FLOW METER (1-1/2")	ASC
FM5	YES/YES	FLOW METER (2-1/2")	BURKERT	8025	FLOW METER (2-1/2")	ASC
FM6	YES/YES	FLOW METER (2")	BURKERT	423991	FLOW METER (2")	ASC
FM7,8,9,10	YES/NO	FLOW METER (1")	BURKERT	449735	FLOW METER (1") HI TEMP	ASC
FM11	YES/YES	FLOW METER (1-1/2")	BURKERT	449737	FLOW METER (1-1/2") HI TEMP	ASC
GFS-1	YES/NO	FILL STATION	AXIOM	SF 100HP	GLYCOL FILL STATION	ASC
E1, E2	NO/NO	3 WAY VALVES	GRAINGER	1AWB8	110/140 DHW CONTROL	ASC
M1	YES/NO	THERMOSTATIC VALVE	AMOT	1-1/2BOCT17001	FAN MIXING VALVE	ASC
TANK 1&2	YES/YES	STORAGE TANKS	AO SMITH	750 GAL.	DOMESTIC HOT WATER STORAGE	ASC
W1-W6	NO/NO	THERMISTOR WELLS	TECOGEN	72075	TEMPERATURE SENSOR	ASC
AS-1	N/A	AIR SEPERATOR	TACO	AC3	AIR SEPERATOR	MECH. CONTRACTOR
ET-1	N/A	EXP. TANK	TACO	PAX-170	EXPANSION TANK	MECH. CONTRACTOR
AS1,AS2,AS3,AS4	N/A	AQUASTAT	HONEYWELL	L6006A	PUMP CONTROL	MECH. CONTRACTOR
P	N/A	PRESSURE GAUGE	MCMASTER	4053K15	PRESSURE GAUGE	MECH. CONTRACTOR
	N/A	1/4" COUPLING	MCMASTER	4429K111	PIPE COUPLING	MECH. CONTRACTOR
	N/A	SIPHON TUBE	MCMASTER	4031K65	SIPHON TUBE	MECH. CONTRACTOR
	N/A	1/4' PETCOCK	MCMASTER	4912K72	SHUT OFF VALVE	MECH. CONTRACTOR
T	N/A	TEMPERATURE GAUGE	MCMASTER	3946K14	TEMPERATURE GAUGE	MECH. CONTRACTOR
	N/A	TEMP. GAUGE WELL	MCMASTER	3957K64	TEMP. GAUGE WELL	MECH. CONTRACTOR

TITLE
PARKER JEWISH
300 KW COGENERATION PLANT

SIZE A
EQUIPMENT SCHEDULE
REV

SCALE | DATE 3/21/2011 | DWG.NO. D1 | SHEET

CG-1 — COGENERATION ENGINE JACKET/MANIFOLDS UNIT 75 KW 322,000 BTUH — WATER IN 1" 170 — WATER OUT 1" 205

CG-2 — COGENERATION ENGINE JACKET/MANIFOLDS UNIT 75 KW 322,000 BTUH — WATER IN 1" 170 — WATER OUT 1" 205

CG-3 — COGENERATION ENGINE JACKET/MANIFOLDS UNIT 75 KW 322,000 BTUH — WATER IN 1" 170 — WATER OUT 1" 205

CG-4 — COGENERATION ENGINE JACKET/MANIFOLDS UNIT 75 KW 322,000 BTUH — WATER IN 1" 170 — WATER OUT 1" 205

TO AQUASTAT AS2, AS3

DHW HEAT EXCHANGER HX1 — SIDE B OUT — SIDE B IN — SIDE A IN — SIDE A OUT

TLS1 — TH1
TLR1 — TH2
TLR2
FL1

AS1
AS-1

FM1 FM2 FM3 FM4 FM5

BRASS Y STRAINERS
COURSE — FINE

PIPE RELIEF TO GFS-1
COLD WATER SUPPLY
FILL VALVE (NOT ABOVE GFS-1)
GFS-1
BYPASS
75 LBS.
ET-1

FC-1
PIPE VENT AT HIGHEST LOCATION NEAR FAN
N.C.
M1
THROTTLING VALVE
P1
P2

PIPE VENT TO GROUND WITH PLASTIC TUBING
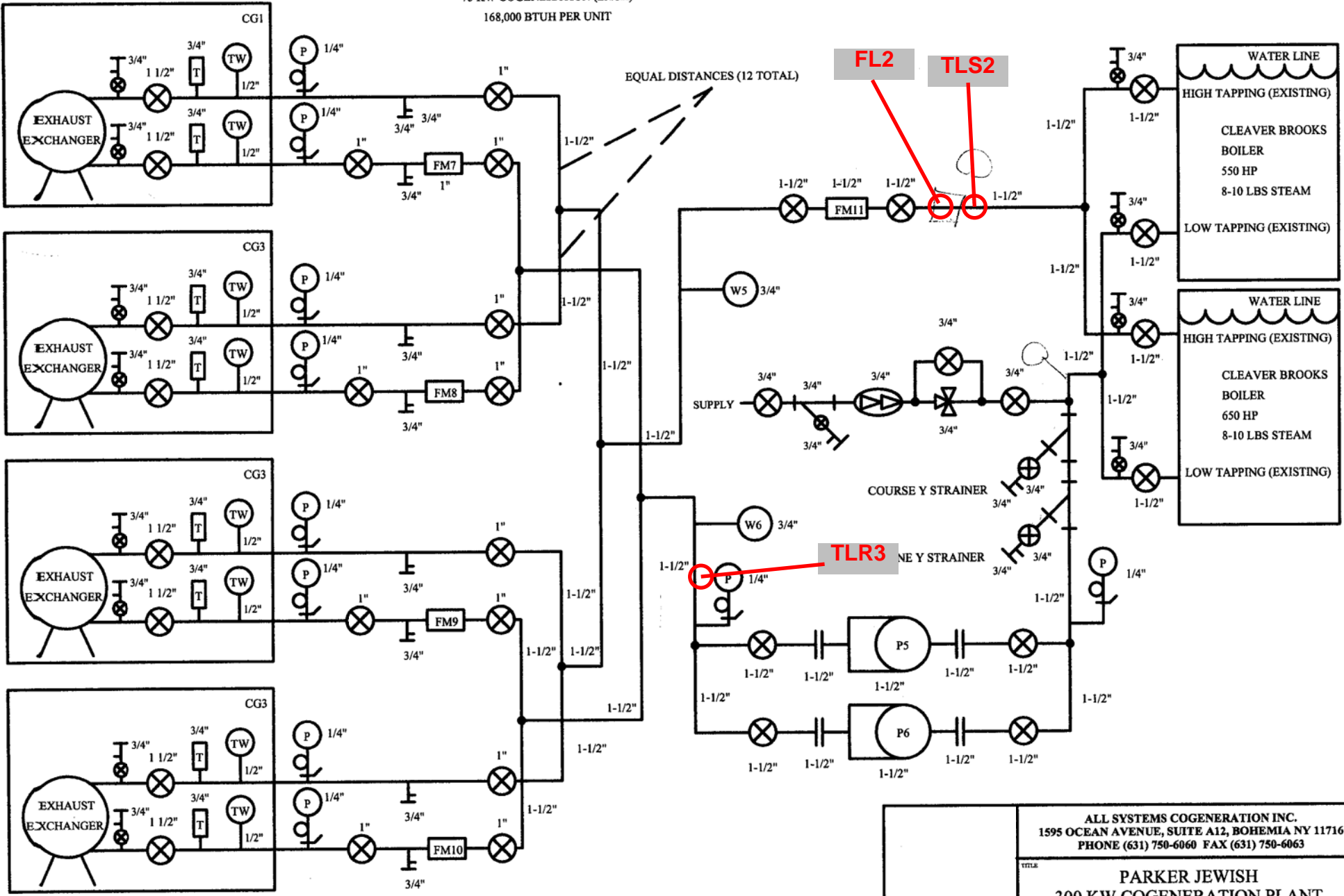CLEAN OUT

OUTDOORS — BOILER ROOM

ALL SYSTEMS COGENERATION INC.
1595 OCEAN AVENUE, SUITE A12, BOHEMIA NY 11716
PHONE (631) 750-6060 FAX (631) 750-6063

TITLE: PARKER JEWISH 300 KW COGENERATION PLANT
COGEN PLUMBING LOOP
SIZE A
REV
SCALE
DATE 3/3/2011
DWG.NO. D5
SHEET

EXHAUST RECOVERY
75 KW COGENERATION (EACH)
168,000 BTUH PER UNIT

CG1

EXHAUST EXCHANGER

EQUAL DISTANCES (12 TOTAL)

FL2   TLS2

WATER LINE
HIGH TAPPING (EXISTING)

CLEAVER BROOKS
BOILER
550 HP
8-10 LBS STEAM

LOW TAPPING (EXISTING)

FM7

FM11

CG3

EXHAUST EXCHANGER

FM8

W5

WATER LINE
HIGH TAPPING (EXISTING)

CLEAVER BROOKS
BOILER
650 HP
8-10 LBS STEAM

LOW TAPPING (EXISTING)

SUPPLY

CG3

EXHAUST EXCHANGER

FM9

W6

TLR3

COURSE Y STRAINER

FINE Y STRAINER

P5

CG3

EXHAUST EXCHANGER

FM10

P6
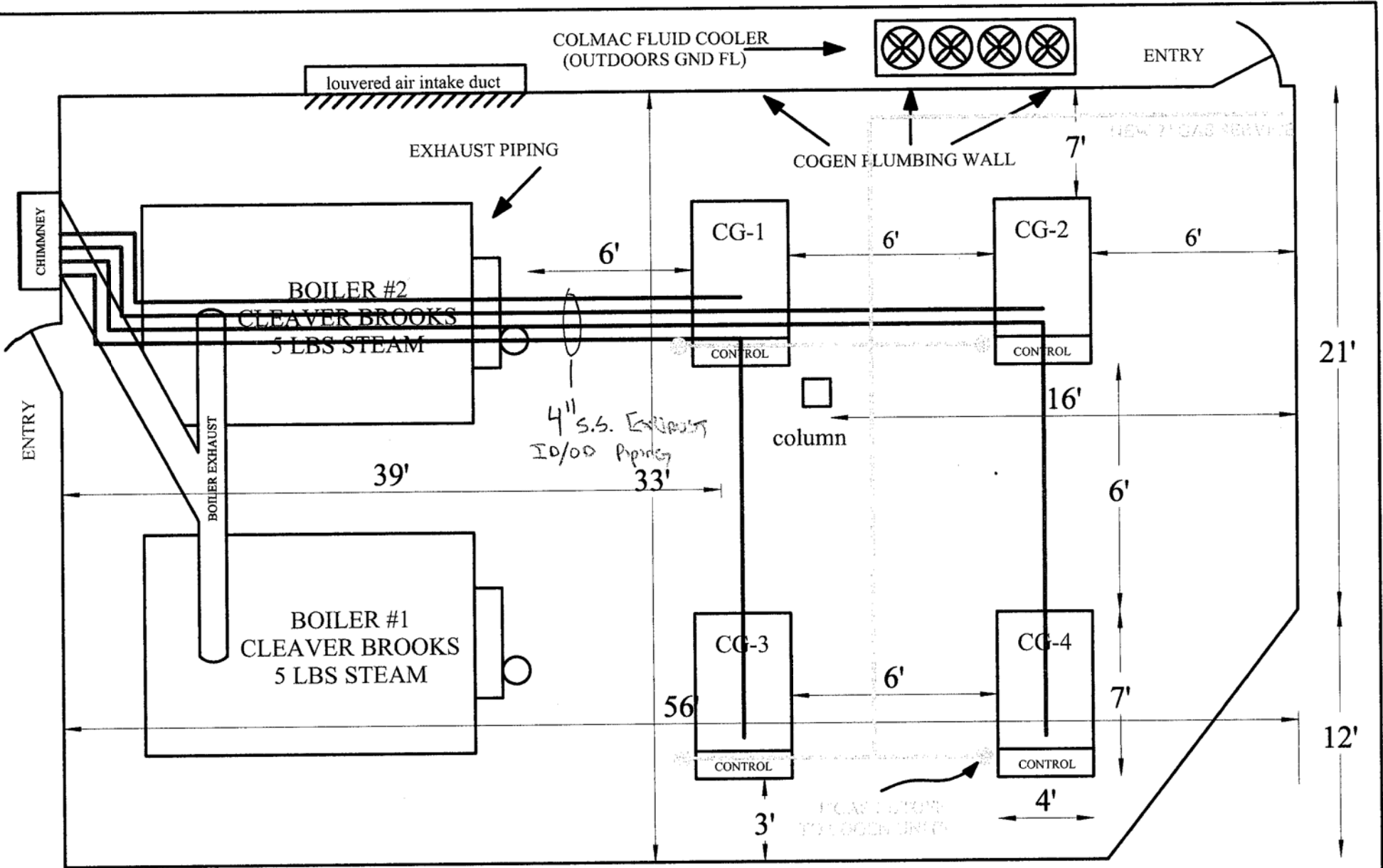
NOTES:
-MOUNT BOTH PUMPS AS CLOSE TO BOILER AND FLOOR AS POSSIBLE

ALL SYSTEMS COGENERATION INC.
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PHONE (631) 750-6060 FAX (631) 750-6063

TITLE
PARKER JEWISH
300 KW COGENERATION PLANT

SIZE
A

BOILER LOOP

REV

SCALE

DATE
3/21/2011

DWG.NO.
D7

SHEET

COLMAC FLUID COOLER
(OUTDOORS GND FL)

ENTRY

louvered air intake duct

EXHAUST PIPING

COGEN PLUMBING WALL

7'

CHIMMNEY

CG-1

6'

6'

CG-2

6'

BOILER #2
CLEAVER BROOKS
5 LBS STEAM

CONTROL

CONTROL

21'

ENTRY

16'

BOILER EXHAUST

4" S.S. Exhaust
I0/00 Piping

column

6'

39'

33'

CG-3

6'

CG-4

7'

BOILER #1
CLEAVER BROOKS
5 LBS STEAM

56'

CONTROL

CONTROL

12'

3'

4'

BOILER ROOM LAYOUT

70x2   5000
60x2   1000

ALL SYSTEMS COGENERATION INC.
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PHONE (631) 750-6060 FAX (631) 750-6063

TITLE
PARKER JEWISH INSTITUTE

SIZE
A

COGENERATION LAYOUT

REV

SCALE
NONE

DATE
1/19/2011

DWG NO.
D8

SHEET

LEGEND

27	Undervoltage Relay
32R	Reverse Power Relay
42	Contactor
47	Phase Unbalance
50	Instantaneous Overcurrent
51	Time Overcurrent
52IT	AC Circuit Breaker
59	Overvoltage Relay
81 U/O	Under/Over Frequency Relay
87	Differential Relay
89S	Line Switch
89L	Lockable Load Break Switch
	Circuit Breaker (Fixed Mount)
	Fused Disconnect
	Twin Fused Disconnect
	Disconnect Switch
	Contactor
	Shunt Trip Device
C	Contactor Coil
O	Open
M	Metering Device
CC	Close Coil
	Key Interlock
N.O.	Normally Open
N.C.	Normally Close
O.O.S.	Out Of Service
AS/AF	Amp Switch/Amp Fuse (Fused disconnect)
AF/AT	Amp Frame/Amp Trip (Circuit Breaker)
	Cloud Indicates Proposed New Work

UTILITY SERVICE A

UTILITY SERVICE B

5-4/C-500 kcmil CU

5-4/C-500 kcmil CU

METER# ACTICX809536

METER# ACTICX8095361

4-#12 AWG Cu

*SEE NOTE 6

6-#12 AWG Cu

BECKWITH M-3410A

208Y/120V, 3∅, 4W

208Y/120V, 3∅, 4W

2000AS 1600AF KRP

2000AS 1600AF KRP

600AS 500AF LEN

600AS 500AF LEN

600AS 500AF LEN

600AS 500AF LEN

2000AS 1600AF KRP

2000AS 1000AF KRP

600AS 500AF LEN

600AS 500AF LEN

600AS 500AF LEN

600AS 500AF LEN

DP-2 SERVICE ROOM

LP3F-8F

LP-3A, LP-4A RP-3B, RP-4B

LP-5A, LP-6A RP-5B, RP-6B

LP-7A, LP-8A RP-7B, RP-8B

MECH ROOM EMERGENCY

KPP KITCHEN

LP-3C, LP-4C RP-3D, RP-4D

LP3E-8E

LP-5C, LP-6C RP-5D, RP-6D

LP-7C, LP-8C RP-7D, RP-8D

CONTINUE ON DRAWING E-1.02

TRIP UNIT 1 & UNIT 2 — AA

TRIP UNIT 3 & UNIT 4 — BB

4-4/C-500 kcmil CU

4-4/C-350 kcmil CU

BASLER BE3-51

WG

89S-1 1200AS 1200AF (KRP) 3PST, 240V 200 kAIC

3-4/C-600 kcmil CU

4/C-#3/0 AWG CU

DP-1 208Y/120V, 3∅, 4W

DP-CHP 208Y/120V, 1200A, 3∅, 4W

"89L-1" 400AS 350AF (LPN) 3PST, 240V 200 kAIC

"89L-2" 400AS 350AF (LPN) 3PST, 240V 200 kAIC

"89L-3" 400AS 350AF (LPN) 3PST, 240V 200 kAIC

"89L-4" 400AS 350AF (LPN) 3PST, 240V 200 kAIC

200AS 200AF (FRN) 3PST, 240V 200 kAIC

3/C-400 kcmil CU THHN & #2 AWG GND

WPAR

CC — TO UNIT 1

DD — TO UNIT 2

EE — TO UNIT 3

FF — TO UNIT 4

CONTINUE ON DRAWING E-1.02

30AS/30AF — AIR HANDLER

30AS/30AF — AIR COMP

400AS/400AF — TOW DRIVE MOTOR

400AS/300AF — P-1, P-2

400AS/300AF — TRASH CONVEY

30AS/30AF — DUPLEX PUMP

30AS/30AF — R-3

400AS/250AF — R-1

400AS/200AF — R-2

600AS/500AF — P6

60AS/60AF — ABSORPTION CHILLER #3

60AS/60AF — SPARE

100AS/100AF — ABSORPTION CHILLER #1 & #2

100AS/100AF — AC-4

200AS/200AF — DUPLEX VACUUM PUMP

600AS/400AF — AC-2

600AS/600AF — ELEVATORS

All Systems Cogeneration

1595 Ocean Ave., Suite A12
Bohemia, NY 11716

Phone: (631) 750-6060
Fax: (631) 750-6063

MAIN ONE-LINE DIAGRAM (1 OF 2)
PARKER JEWISH INSTITUTE
300 kW DISTRIBUTED GENERATION
271-11 76th AVENUE
NEW HYDE PARK, NY 11040

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

Rev No.	Date	Description
1	03/22/11	ISSUE FOR REVIEW AND COMMENTS

Drawn By: KT   Scale: NONE

E-1.01

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.

STATE OF NEW YORK
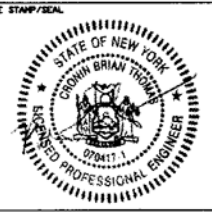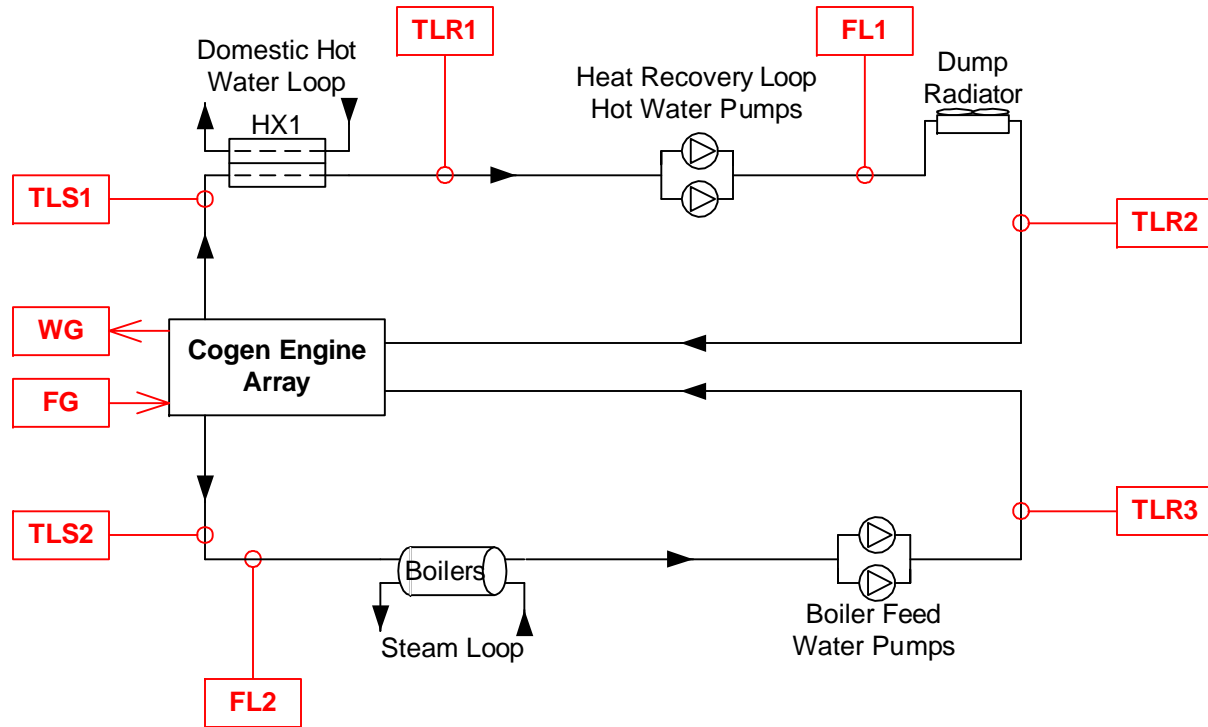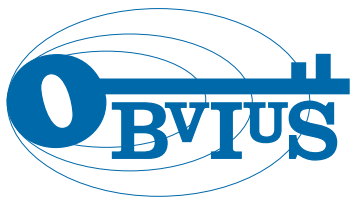CRONIN BRIAN THOMAS
070417.1
LICENSED PROFESSIONAL ENGINEER

NOTES:
1. THIS PROJECT INSTALLS FOUR COGENERATION MODULES, EACH HAVING A 75 kW INDUCTION GENERATOR, AND ALL EQUIPMENT NECESSARY FOR ITS INTERCONNECTION TO THE CON ED ELECTRIC SYSTEM. THESE MODULES ARE NYS SIR APPROVED.
2. ALL FUSES INDICATED WILL PROVIDE SELECTIVE COORDINATION, AND HAVE 200 kAIC RATING.
3. THE GENERATOR FRAME SHALL BE GROUNDED TO THE MAIN SWITCHBOARD THROUGH EQUIPMENT GROUNDING CONDUCTOR.
4. GENERATOR TO BE INSTALLED IN ACCORDANCE WITH NEW YORK STATE STANDARD INTERCONNECTION REQUIREMENTS AND CON ED EO-2115, RUNNING ONLY WHEN CON ED IS AVAILABLE. GENERATOR SUPPLY BASE LOAD ONLY.
5. ALL ELECTRICAL CONSTRUCTION TO BE IN COMPLIANCE WITH THE 2005 NEC, AS AMENDED BY THE NYC DOB.
6. CABLE TAPS AND FUSING TO BE IN ACCORDANCE WITH SECTION 240 NFPA 70 (NEC).

AcquiSuite
Data Acquisition Server

ACQUISUITE A8812-1 AND A8812-GSM

Obvius' AcquiSuite is an intelligent, flexible data acquisition server allowing users to collect energy data from meters and environmental sensors. Designed to connect to IP-based applications such as enterprise energy management, demand response and smart grid programs, the AcquiSuite server lets you connect thousands of energy points, benchmark energy usage and reduce energy costs.

DATA COLLECTION

The AcquiSuite collects and logs data from connected (wired or wireless) devices based on user selected intervals. Data from downstream devices are time stamped and stored in non-volatile memory. This interval data is stored locally until the next scheduled upload or manual download. Using an integrated modem or Ethernet (LAN) connection you can push or pull data via HTTP, XML, FTP or any custom protocol utilizing our AcquiSuite Module to build your own application, including integrated cellular communication options.

INSTALLATION & FEATURES

No software is required. Easily access information through ANY web browser. The AcquiSuite has eight integrated flex I/O inputs. Each field selectable input can measure resistive, analog (4/20mA / 0-10V) and standard pulse / KYZ pulse output devices. This simplifies installation for basic projects monitoring electric, gas or water meters. There are several additional features including alarming, SNMP Traps, network configuration, wireless diagnostics, security provisions, alarm relays and backlit LCD. Our integrated meter driver library is designed to speed up installation and lower integration costs through "plug-and-play" connectivity. Ask about our free commissioning software, Obvius Configuration Console (OCC).

COMPATIBILITY

The AcquiSuite is compatible with nearly any front-end software platform allowing customers to use a variety of reporting tools; whether it's a local server or an enterprise wide reporting suite. Obvius offers a free utility for automated .CSV file downloads or an affordable hosted solution for $195.00 annually (unlimited data storage).

PARTNERS

Obvius' outstanding integration and software partners supplement our products and services to ensure you receive the very best energy monitoring solution.

APPLICATIONS

- Utility submetering (electricity, gas, water, etc.)
- Measurement and verification (M&V)
- Reduce energy costs
- Access energy information from local or remote sites
- Benchmark building energy usage
- View "real time" performance data
- Track energy use and peak demand for Demand Response programs

- Monitor performance of critical systems (lighting, HVAC, PDUs, inverters, etc.)
- Alarm notification for data points above or below target levels (including SNMP Traps)
- Monitor renewable energy performance and production
- Create load profiles for energy purchases
- Push or pull meter data to energy dashboards, kiosks and software applications
- LEED / Energy Star certification

ABOUT OBVIUS

Obvius manufactures data acquisition and wireless connectivity products specifically for energy management. We deliver cost-effective, reliable hardware designed to speed up installation. Our products are based on an open architecture allowing our customers to collect and log energy information from virtually any meter or sensor. The ability to support multiple communication options provides remote access to all your energy information. Founded in 2003, Obvius is located in Hillsboro, Oregon. We serve a global clientele and continue to drive innovation by simplifying data collection.

SOLUTIONS

- Data Acquisition
- Wireless Communication
- Meters & Sensors
- Custom Packaged Solutions
- Integration & Software Partners

HEADQUARTERS
Hillsboro, Oregon

CONTACT US
sales@obvius.com

AcquiSuite A8812

Obvius helps customers collect and distribute energy information. Users can begin with one best-of-breed solution that solves a specific pain point, or incorporate several products and services that help reduce energy costs.

Specifications

Processor	ARM9 embedded CPU, ARM7 IO co-processor
Operating System	Linux 2.6
Memory	32 MB RAM
Flash ROM	16 MB NOR Flash (expandable with USB memory device)
Interval Recording	1 to 60 minutes, user selectable
LEDs	8x input, 4 modem activity, Modbus TX/RX, power, system, IO status
Console	2 x 16 LCD character, two push buttons

Power

North America	110-120VAC, 60Hz, primary
CE/Europe	100-240VAC, 50-60Hz, primary (interchangeable plug adapters optional)
Power Supply	24VDC, 1A, class 2 wall brick transformer included

Communication

Protocols	Modbus/RTU, Modbus/TCP, TCP/IP, PPP, HTTP/HTML, FTP, NTP, XML, SNMP-Trap
LAN	RJ45 10/100 Ethernet, full half duplex, auto polarity
Modem	V.34 bis, 33,600 bps (A8812-1 only)
Cellular	GSM/GPRS Cellular (A8812-GSM only)
USB	USB expansion port

Inputs

Serial Port	RS-485 Modbus, supports up to 32 external devices (expandable)
I/O	8x Flex IO inputs with user selectable modes: voltage, current, resistance, pulse and status

Outputs

Relays	2x, dry contact 30 VDC, 150 mA max

Physical

Weight	5lbs (2.3kg)
Size	8" x 9.25" x 2.5" (203mm x 235mm x 64mm)

Environment

North America	0 to 50C, 0-90% RH, non-condensing
CE/Europe	5 to 40C, 0-90% RH, non-condensing

Codes and Standards

FCC CFR 47 Part 15, Class A, EN 61000, EN 61326, CE

Additional Notes

NEMA enclosures available upon request

Manufactured in the USA

CE

Flex I/O Module
Analog/Digital to Modbus Converter

FLEX I/O A8332-8F2D

Our Flex I/O is a cost-effective way to collect data from meters or sensors and bring that information into a Modbus network or energy monitoring system. As a stand-alone or bundled package, the Obvius Flex I/O can be incorporated with data acquisition and wireless metering devices to provide a cost-effective energy monitoring solution.

WHY USE THE OBVIUS FLEX I/O

- Designed specifically for metering applications
- Easily add meters and sensor to a Modbus network
- 8x user selectable inputs
- 2x output relays
- 2x pulse replicator
- Non-volatile memory
- Industrial temperature range -30 to 70C
- LEDs for visual verification / status
- Din or wall mount for easy installation
- Field upgradable firmware

COMPATIBILITY

The Flex I/O is compatible with virtually any Modbus master, allowing customers the flexibility to use it in existing Modbus networks. Use with the Obvius AcquiSuite and take advantage of plug-and-play communication or us with the Obvius ModHopper for wireless communication.

PARTNERS

Obvius' outstanding integration and software partners supplement our products and services to ensure you receive the very best energy monitoring solution.

APPLICATIONS

- Converting analog, resistive and pulse inputs to Modbus
- Utility submetering (electric, gas, water, etc.)
- Cost Allocation
- Measurement and Verification
- Benchmark building energy usage
- Relay outputs for demand control
- Environmental monitoring
- Track energy use and peak demand for Demand Response
- DC current monitoring for Renewable Energy

ABOUT OBVIUS

Obvius manufactures data acquisition and wireless connectivity products specifically for energy management. We deliver cost-effective, reliable hardware designed to speed up installation. Our products are based on an open architecture allowing our customers to collect and log energy information from virtually any meter or sensor. The ability to support multiple communication options provides remote access to all your energy information. Founded in 2003, Obvius is located in Hillsboro, Oregon. We serve a global clientele and continue to drive innovation by simplifying data collection.

SOLUTIONS

- Data Acquisition
- Wireless Communication
- Meters & Sensors
- Custom Packaged Solutions
- Integration & Software Partners

HEADQUARTERS

Hillsboro, Oregon

CONTACT US

sales@obvius.com

Flex IO – A8332-8F2D

Obvius helps customers collect and distribute energy information. Users can begin with one best-of-breed solution that solves a specific pain point, or incorporate several products and services that help reduce energy costs.

Specifications	
Processor	ARM7, field upgradeable firmware
LEDs	8x input status LEDs (red), 2x Modbus TX/RX (yellow), 1 power/alive status (green)
Memory	Pulse count and runtime values are stored in non-volatile memory

Power	
Power Supply	24VDC, 200mA but not to exceed 8A, Required (not included)

Communication	
Protocols	Modbus/RTU

Inputs	
Voltage Mode	0-10VDC (min/max/average/instantaneous data) Accuracy: +/- 0.25% of full scale at 20C
Current Mode	4/20mA (min/max/average/instantaneous data) Accuracy +/- 0.25% of full scale at 20C
Resistance Mode	100 ohms to 100k (see installation for accuracy specification)
Pulse Mode	• Intended for use with dry contact outputs (consumption/rate/runtime/status) • Standard and KYZ modes for form A and C relay outputs • Input terminals supplies 5V at 5mA sense voltage to detect contact closures • Maximum rate: 10Hz, minimum pulse width 50ms • Adjustable contact closure threshold: 100Ω to 5kΩ, broken wire sense above 10kΩ optional
Serial Port	RS-485 two wire, 19200 or 9600 baud, 8N1
I/O	8 Flex IO inputs with user selectable modes: voltage, current, resistance, pulse and status
Isolation	Pulse outputs and RS485 port are isolated to 1500VDC; Power input, RS232 and analog/pulse inputs are non-isolated

Outputs	
Relays	2x, dry contact (opto-fet) 30 VDC, 150 mA max

Physical	
Weight	3.7oz (105g)
Size	4.13" x 3.39" x 1.18" (105mm x 86mm x 30mm)

Environment	
North America	−30 to 70C, 0-95% RH, non-condensing
Altitude	2000M max
Pollution	Degree 2

Codes and Standards	
Emissions	FCC CFR 47 Part 15, Class A, EN 61000, EN 61326
Safety	UL61010 Recognized, EN61010

Additional Notes
NEMA enclosures available upon request.
For use with any Modbus RTU device / server

c**UL**us CE

277/480 *VAC* **120/240**

THE WATTNODE is a true RMS AC watt-hour transducer with pulse output (solid state relay closure) proportional to kWH consumed. The WATTNODE provides accurate measurement at low cost to meet your needs for sub-metering, energy management and performance contract applications.

Easy Installation saves you time and money. The WATTNODE is small enough to fit entirely within a standard electrical panel and the screw terminals unplug for easy wiring.

The Advanced Output includes separate pulse channels for positive and negative power, for net metering and PV metering. Optional models are available with one pulse output channel per measurement phase, which can be used to monitor each phase independently or to monitor three separate single-phase circuits with one WattNode.

Our Diagnostic LEDs provide a per-phase indication of power (green flashing), negative power (red flashing), and advanced diagnostics (yellow flashing) to help troubleshoot connection problems, like swapped CTs, or excessive line voltage. See the User's Guide for a full description.

The Pulse Series family measures 1, 2, or 3 phases in 2, 3 or 4 wire configurations. With voltage ratings from 120 to 600 VAC and current transformer (CT) rating from 5 to 4000 amps, there is a WATTNODE combination to meet your AC power measurement requirements.

ACCURACY of the WATTNODE is is 0.5% of reading over a wide range of power factors and harmonic content. You get true kWH measurements even with switching power supplies and variable speed drives.

Our Safe CTs, with internal burden resistors produce a voltage proportional to the load current. At rated current voltage is only 0.333 VAC. Split-core CTs quickly install on existing wiring and solid-core CTs cost less for new wiring.

C **UL** US LISTED

(888) 928-8663

Continental Control Systems LLC
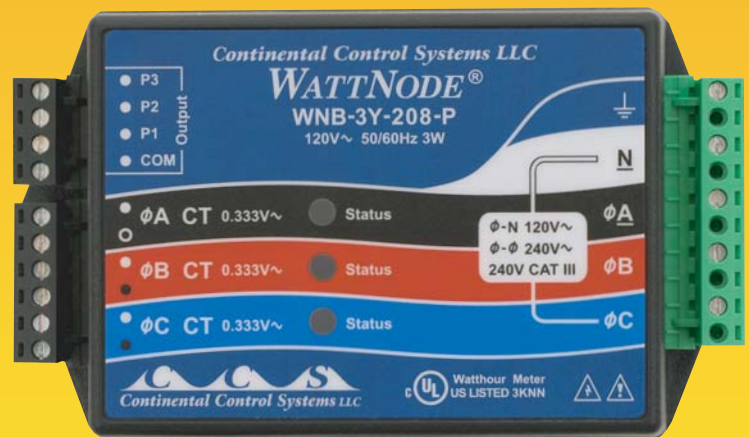
3131 Indian Road, Suite A
Boulder, CO 80301 USA
(888) 928-8663   Fax (303) 444-2903
sales@ccontrolsys.com

www.ccontrolsys.com

- **Advanced Pulse Output**
  Separate pulse channels for positive and negative power. Optional models are available with one pulse output channel per measurement phase.
- **Small Size**
  Can be installed in existing service panels or junction boxes.
- **Uses Safe CTs**
  Output limited to one volt.

- **Line Powered**
  No external power supply required.
- **Digital Signal Processing**
  Accurate kWH measurement over a wide harmonic range.
- **Detachable Terminal Blocks**
  Easy to install and remove.

Measurement Configurations

Single phase: 2-wire or 3-wire
Three phase: 3-wire or 4-wire

Electrical

Line Powered
Operating Voltage Range: +15%, -20% of nominal
Power Line Frequency: 50/60 Hz
CT Input: 0.333 VAC

Pulse Output

Optoisolated, solid state relay closures handle up to maximum 60 VDC & to 5mA
Standard: 4.00 Hz Bidirectional Output
Optional: 0.01 Hz to 600 Hz Bidirectional Output Models
Optional: Per-Phase Output Models 0.01 Hz to 150 Hz available

Accuracy

Normal Operation: Line voltage: 80% - 115% of nominal
Power factor: 1.0
Frequency: 50- 60 Hz
Ambient Temperature: 25°C
Current: 5% - 100% of rated current
Accuracy: ±0.5% of reading

Environmental

Operating Temperature: -30°C to +55°C (-22°F to 131°F)
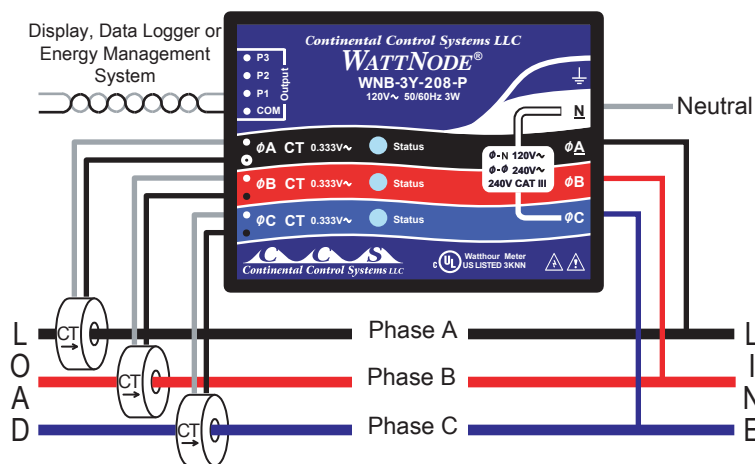Operating Humidity: 5 to 90% (RH)

Mechanical

Enclosure: High impact, UL rated, ABS plastic
Size: 3.3″ x 5.6″ x 1.5″
Connectors: UL, CSA recognized, detachable, screw terminals (14AWG), 600V

Optional LCD Display

Display: Eight digits, each 0.43" high
Reset: Wired remote and configurable front panel button
Enclosure: Panel mount box, 2.95" x 1.52"
Battery: Lithium 2/3A, replace every four years

MADE IN THE USA

(888) 928-8663

Continental Control Systems

3131 Indian Road, Suite A
Boulder, CO 80301
(888) 928-8663   Fax (303) 444-2903
sales@ccontrolsys.com

www.ccontrolsys.com

WATTNODE

Model	VAC Line To Neutral	VAC Line To Line	Phases	Wires
WNB-3Y-208-P	120	208-240	3	4
WNB-3Y-400-P	230	400	3	4
WNB-3Y-480-P	277	480	3	4
WNB-3Y-600-P	347	600	3	4
WNB-3D-240-P	120	208-240	3	3
WNB-3D-400-P	230	400	3	3
WNB-3D-480-P	277	480	3	3

LCD Displays

Model	Displays	Units
LCDA-E	Energy	WH, kWH, or MWH
LCDA-P	Power	W or kW
LCDA-EP	Energy & Power	WH, kWH, or MWH & W or kW

OPENING CURRENT TRANSFORMERS (SPLIT-CORE)

Model	Inside Diameter	Rated Amps
CTS-0750	0.75"	5, 15, 30, 50, 70, 100, 150
CTS-1250	1.25"	70, 100, 150, 200, 250, 300, 400, 600
CTS-2000	2.00"	600, 800, 1000, 1200, 1500
CTB	Bus Bar	600, 800, 1200, 2000, 3000 (custom)

TOROIDAL CURRENT TRANSFORMERS (SOLID-CORE)

Model	Inside Diameter	Rated Amps
CTT-0300	0.30"	5, 15, 30
CTT-0500	0.50"	15, 30, 50, 60
CTT-0750	0.75"	30, 50, 70, 100
CTT-1000	1.00"	50, 70, 100, 150, 200
CTT-1250	1.25"	70, 100, 150, 200, 250, 300, 400

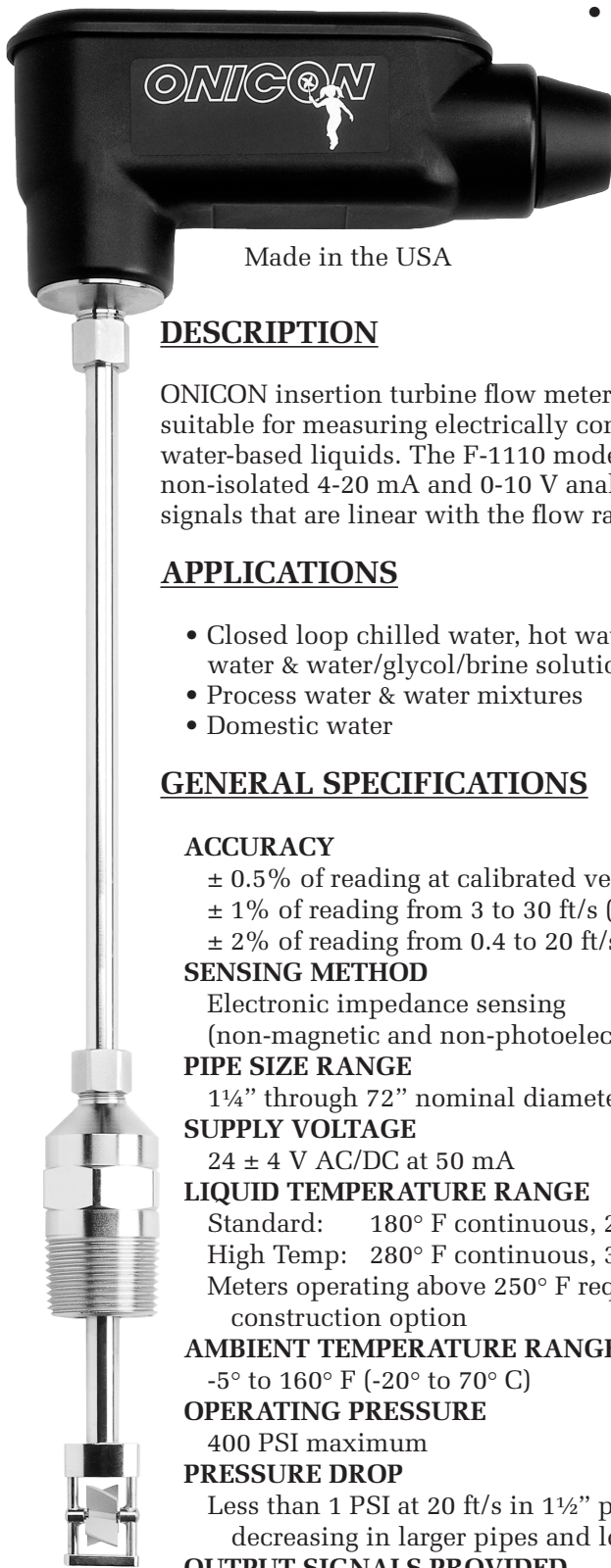Current Transformer Output Voltage: 0 - 0.333 VAC @ rated current

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

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

0213-1

09-09

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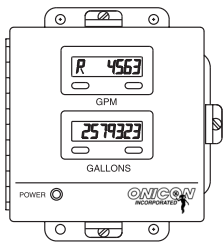
ELECTRICAL CONNECTIONS
3-wire for frequency output
Standard: 10' of cable with ½" NPT
                conduit connection
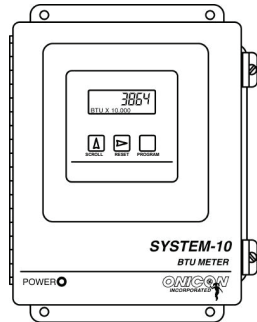Optional: Indoor DIN connector with 10'
                of plenum rated cable

ALSO AVAILABLE

Display Modules

Btu Measurement Systems

F-1110 Wiring Information

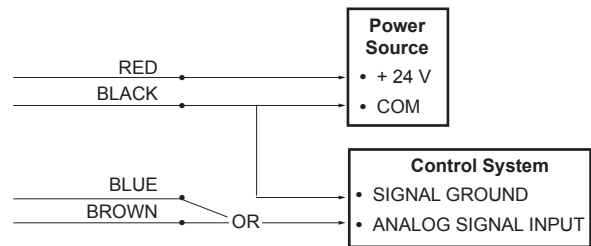| WIRE COLOR	DESCRIPTION	NOTES
RED	(+) 24 V AC/DC supply voltage, 50 mA	Connect to power supply positive
BLACK	(-) Common ground (Common with pipe ground)	Connect to power supply negative & analog input ground
GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local 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)

Power Source
- + 24 V
- COM

RED
BLACK

Control System
- SIGNAL GROUND
- ANALOG SIGNAL INPUT

BLUE
BROWN   OR

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.
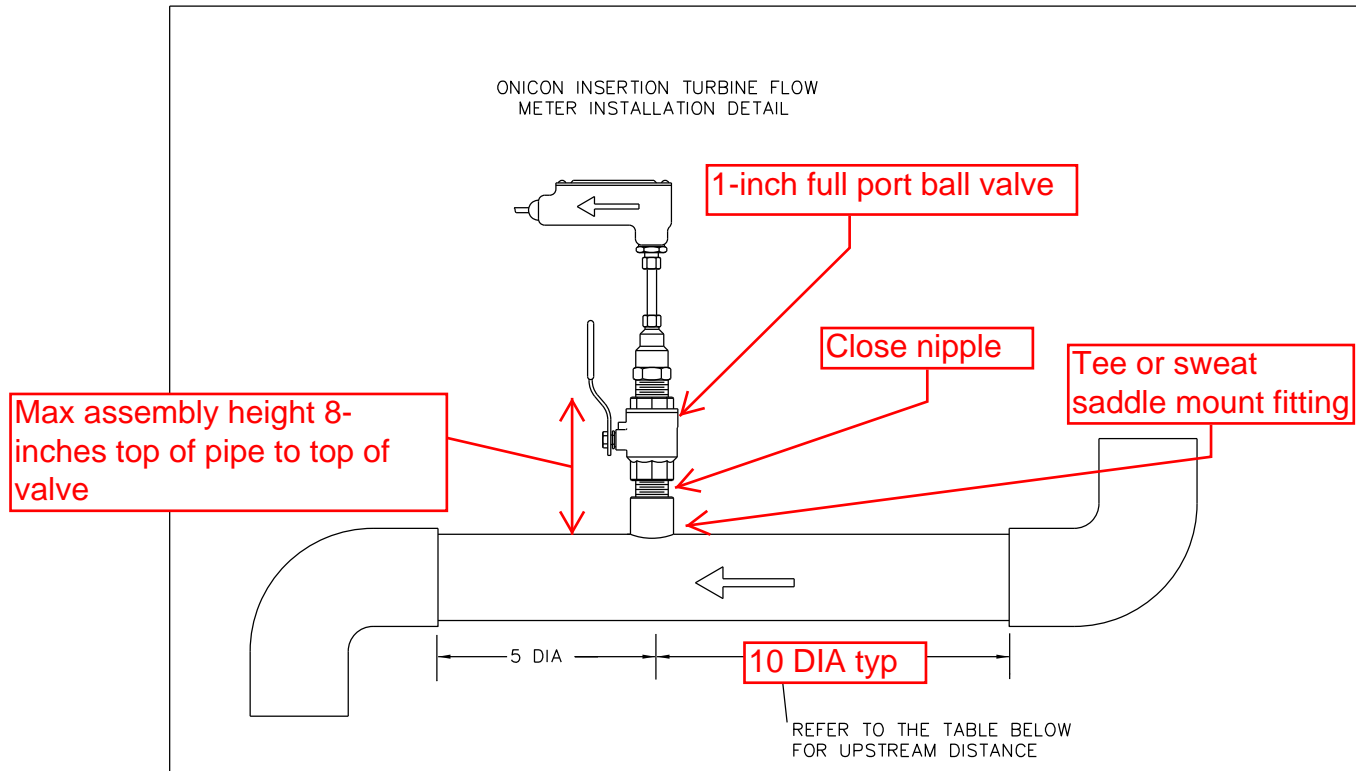
Typical Meter Installation
(New construction or scheduled shutdown)

- Acceptable to install in vertical pipe
- Position meter anywhere in upper 240° for horizontal pipe

THIS AREA ACCEPTABLE

Horizontal Run Pipe

To control system

ONICON display or BTU meter (Optional)

Connect factory wires to field wires in appropriate junction box.

½" FNPT conduit connection

Insertion depth gage provided with each meter

Detail of hot tap adapter with turbine assembly withdrawn

CLEARANCE REQUIRED FOR INSTALLATION

Typically 30" - 36" depending on pipe size and height of valve assembly.

Standard installation kit for steel pipe

1" full port ball valve
1" close nipple
1" branch outlet

1¼" for hot tap

Minimum hole size = 1"
Must be centered

FLOW

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.

1500 North Belcher Road, Clearwater, FL 33765 • Tel (727) 447-6140 • Fax (727) 442-5699
www.onicon.com • sales@onicon.com
0213-1   09-09

ONICON INSERTION TURBINE FLOW
METER INSTALLATION DETAIL

1-inch full port ball valve

Close nipple

Tee or sweat
saddle mount fitting

Max assembly height 8-
inches top of pipe to top of
valve

5 DIA

10 DIA typ

REFER TO THE TABLE BELOW
FOR UPSTREAM DISTANCE

ONICON, INC
1500 N. BELCHER ROAD, CLEARWATER FLORIDA

DATE:	DRAWN BY:	SCALE:	DRAWING #:
01-07-09	DBJ	N.T.S.	090107DBJ-2

MINIMUM UPSTREAM STRAIGHT RUN REQUIRED	
FLOW METER MODEL	UPSTREAM
F-1100 SERIES SINGLE TURBINE FLOW METER	20 DIA
F-1200 SERIES DUAL TURBINE FLOW METER	10 DIA

TITAN BTU Insertion Vortex

Product Features

- Complete BTU, water, gas or steam measurement solutions.

- Standardize on an insertion bar that can measure line sizes 1.5" – 36"

- Heavy Duty & Maintenance Free Design

- All parts are welded stainless steel construction

- No moving parts, No holes to clog

- Life-time repeatability

- 1" NPT Connection

- Dual Piezo Sensors never contact fluid

- Dual Thermistor Sensors ± .1 Deg °C accuracy

- No pins or screws to corrode and rust

- Can handle process pressure over 500 psig

- Can handle process temperature up to 450 °F

- Simultaneous 4-20 mA, programmable Pulse output..

Model TITAN BTU General Specification

BTU One-Piece Technology

LIQUID   GAS

Accuracy • Reliability • Standardization • Installation

The **TITAN** vortex sensing element is CNC machined out of one piece of solid stainless steel. The ceramic ISO Piezo electric sensors are bonded inside the vortex element which is press fit to the stainless steel insertion bar and completely welded together. There are NO internal o-rings or seals of any kind and absolutely NO leak paths into the sensors or electronics. Our sensors NEVER touch the process fluid giving them an almost unlimited life span. Our elements are ONE-PIECE technology and geometry will NEVER change.

With over 100 years of combined CNC machining experience our solid stainless steel **TITAN** vortex element has no pins, screws or gaskets of any kind. The bluff body and tail piece are CNC machined from the body of the element. Since there are no holes to clog and no moving parts, there are no mechanical limitations due to frequency or velocities. Our machined elements will never wear or move out of place, giving the same steady frequency from the first day to year thirty.

Each **TITAN** comes with its own seal assembly that rides along the shaft of the insertion bar. This stainless steel seal assembly has a 1" NPT connection for easy connect and disconnect with any valve, thread-o-let or any ANSI class flange. The **TITAN** can be installed or removed during flow with a 1" fully ported ball valve during higher pressure applications.

The unique design of the **TITAN** can be used in BTU measurement calculations for LIQUID lines. The same **TITAN** design can measure water as low as slow as 1feet per second to excess of 30 feet per second.

The **TITAN** has no moving or wearing parts making certain that the K Factor, pulses per foot – per second, will not change over time and long term accuracy is always constant. This allows all of our insertion instruments to achieve an accuracy of ± 1% of reading with ± .25% repeatability.

The **TITAN** has dual Thermistors for temperature measurement with accuracies of ± .1 °C. All Thermistors are epoxy coated, precision matched to 5 standardized resistance curves. Maximum working temperature is 150ºC.

Where Flow Measurement Meets Innovation…

NICE Instrumentation, Inc.

Model # TITAN-XX-X(XX)-XX-XX

Category	Description	Suffix Codes				
TITAN IV TITAN IV/BTU	Insertion Vortex Flow Meter Insertion Vortex Flow Meter with BTU calculation.	TITAN	—	—	—	—
Line Sizes	Standard line sizes 1.5" to 36"	— —	1.5 36	— —	— —	— —
Microtel Transmitter Display	Volumetric Flow Only Total BTU calculations (1 external Temperature sensor)	— —	— —	V BTU	— —	— —
Power Supply	Standard 24 V dc input	— — —	— — —	— — —	24 — —	— — —
-250 to 450 °F -	Standard Temperature -250 to 450 °F	— —	— —	— —	— — —	LT — —

Notes:

1. Your registered representative will use Nice Instrumentation Vortex Sizing Application to determine precise scaling factor for your application.
2. The Standard remote option comes with 30 feet of cable and available up to 300 feet from meter.
3. Unit has 4-20mA output
4. OPTIONAL Enclosure for remote display is NEMA 4X watertight and explosion proof requirements.
   - FM Approved
   - UL Classified
   - CSA Approved
   - ATEX for use in;
   - Class I, Groups B,C & D,
   - Class II, Groups E,F & G and
   - Class III hazardous locations as defined by the National Electrical Codes and Canadian Electrical Code.

Nice Vortex Sizing Program
for precise application sizing

Please specify the following information with your order:
- Fluid Type
- Min – Max operating flow rate
- Operating Temperature
- Operating Pressure

Where Flow Measurement Meets Innovation…

NICE Instrumentation, Inc.

Project Information

CDH Energy
Project: Hot Water Measurement
Serial Number: TITAN/IV-1.5-L

Fluid
Liquid

MeterType
TITAN

Line Size
1.5 in.

Temp.

Schedule
40

Pressure

Customer Min & Max Flow

Min: 8.375 GAL/MIN

Max: 100.0 GAL/MIN

Vortex Meter

K-FACTOR: 13.60 PLS/LIN. FT.

DENSITY: 63.00 LB/FT³

AREA: 0.0141 FT²

PIPE ID: 1.610 IN.

METER MIN: 8.375 GAL/MIN

METER MAX: 190.4 GAL/MIN

METER TURNDOWN: 22.73 TO 1

Customer Application

CUSTOMER TURNDOWN: 11.94 TO 1

FREQUENCY MIN: 17.95 PLS/SEC

FREQUENCY MAX: 214.3 PLS/SEC

SCALING FACTOR: 128.6 PULSES/GAL

CUSTOMER V-MIN: 1.320 FT/SEC. MIN

CUSTOMER V-MAX: 15.76 FT/SEC. MAX

ACFM MIN: 1.120

ACFM MAX: 13.37

MICROTEL SF: 128896

Straight Run Piping Requirements	Upstream	Downstream
One 90° elbow before the meter	10 D	5 D
Two 90° elbows before the meter	15 D	5 D
Two 90° elbows out of plane before the meter	30 D	5 D
Reduction before the meter	10 D	5 D
Regulator or Valve partially closed before the meter	30 D	5 D

D=Pipe Diameter

Where Flow Measurement Meets Innovation

February 1, 2012

Immersion Temperature Sensors

TIW

TID

Corrosion Resistant Stainless Steel Probe

TIH

TIG
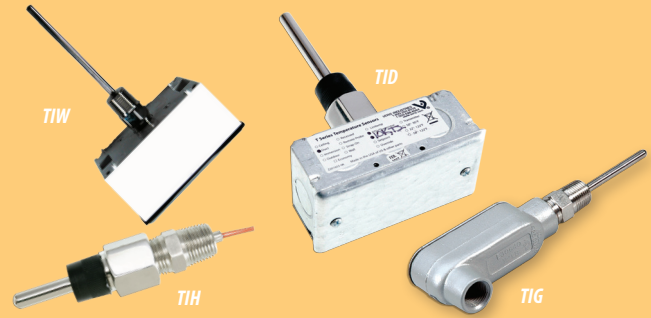
DESCRIPTION

These immersion probe type temperature sensors are both highly accurate and cost effective. Installation could not be easier. The sensor is encased in a corrosion-resistant stainless steel probe for durability, with a choice of service entry body, indoor junction box, or threaded enclosures. A variety of RTD or thermistor sensor options and probe lengths are available for maximum application versatility.

FEATURES

- Cost-effective high accuracy thermistors/RTDs
- Corrosion resistant stainless steel probe design...durable
- 1/2" NPT threads standard...ease of selection
- Variety of enclosures include duct mount, service entry body, threaded, and water resistant to fit your application
- Thermowells available...enables easy servicing

APPLICATIONS

- Tanks
- Pipes
- Chillers

TEMPERATURE

Class	Pt RTD		THERMISTOR										10k High Accuracy	
Type	100 Ohm	1000 Ohm	2.2k	3k	10k Type 2	10k Type 3	10k Dale	10k 3A221	10k "G" US	20k	20k "D"	100k	10k Type 2	10k Type 3
Accuracy	±0.3°C	±0.3°C	±0.2°C 0/70°C	±0.2°C 0/70°C	±1.0°C -50/150°C	±0.2°C 0/70°C	±0.2°C -20/70°C	±1.1°C 0/70°C	±0.2°C 0/70°C	Consult Factory	Consult Factory	Consult Factory	±0.1°C 20/70°C ±0.2°C 0/20°C	±0.1°C 0/70°C
Temp. Response*	0.0385 curve PTC	0.0385 curve PTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC	NTC

*PTC: Positive Temperature Coefficient
*NTC: Negative Temperature Coefficient

STANDARD RTD AND THERMISTOR VALUES (Ohms Ω)

°C	°F	100 Ohm	1000 Ohm	2.2k	3k	10k Type 2	10k Type 3	10k Dale	10k 3A221	10k "G" US	20k	20k "D"	100k	10k Type 2	10k Type 3
-50	-58	80.306	803.06	154,464	205,800	692,700	454,910	672,300	-	441,200	1,267,600	-	-	692,700	454,910
-40	-40	84.271	842.71	77,081	102,690	344,700	245,089	337,200	333,562	239,700	643,800	803,200	3,366,000	344,700	245,089
-30	-22	88.222	882.22	40,330	53,730	180,100	137,307	177,200	176,081	135,300	342,000	412,800	1,770,000	180,100	137,307
-20	-4	92.160	921.60	22,032	29,346	98,320	79,729	97,130	96,807	78,910	189,080		971,200	98,320	79,729
-10	14	96.086	960.86	12,519	16,674	55,790	47,843	55,340	55,252	47,540	108,380	122,400	553,400	55,790	47,843
0	32	100.000	1000.00	7,373	9,822	32,770	29,588	32,660	32,639	29,490	64,160	70,200	326,600	32,770	29,588
10	50	103.903	1039.03	4,487	5,976	19,930	18,813	19,900	19,901	18,780	39,440	41,600	199,000	19,930	18,813
20	68	107.794	1077.94	2,814	3,750	12,500	12,272	12,490	12,493	12,260	24,920	25,340	124,900	12,500	12,272
25	77	109.735	1097.35	2,252	3,000	10,000	10,000	10,000	10,000	10,000	20,000	20,000	100,000	10,000	10,000
30	86	111.673	1116.73	1,814	2,417	8,055	8,195	8,056	8,055	8,194	16,144	15,884	80,580	8,055	8,195
40	104	115.541	1155.41	1,199	1,598	5,323	5,593	5,326	5,324	5,592	10,696	10,210	53,260	5,323	5,593
50	122	119.397	1193.97	811.5	1,081	3,599	3,894	3,602	3,600	3,893	7,234	6,718	36,020	3,599	3,894
60	140	123.242	1232.42	561.0	747	2,486	2,763	2,489	2,486	2,760	4,992	4,518	24,880	2,486	2,763
70	158	127.075	1270.75	395.5	527	1,753	1,994	1,753	1,751	1,990	3,512	3,100	17,510	1,753	1,994
80	176	130.897	1308.97	284.0	378	1,258	1,462	1,258	1,255	1,458	2,516	2,168	12,560	1,258	1,462
90	194	134.707	1347.07	207.4	-	919	1,088	917	915	1,084	1,833	1,542	9,164	919	1,088
100	212	138.506	1385.06	153.8	-	682	821	679	678	816.8	1,356	1,134	6,792	682	821
110	230	142.293	1422.93	115.8	-	513	628	511	509	623.6	1,016	816	5,108	513	628
120	248	146.068	1460.68	88.3	-	392	486	389	388	481.8	770	606	3,894	392	486
130	266	149.832	1498.32	68.3	-	303	380	301	299	376.4	591	456	3,006	303	380
Sensor Codes		B	C	E	F	D	H	J	S	R	M	U	T	W	Y

To compute Linitemp Temperature:

2-Wire version (1µA/°C)
µA reading - 273.15 = Temperature in °C
3-Wire version (10mV/°C)
mV reading/10 - 273.15 = Temperature in °C

SPECIFICATIONS

5 Year Warranty

Wiring	22 AWG; 2-wire: RTD Thermistor, 4-20mA; 3-wire: Voltage output models
Probe	Stainless Steel
Test Pressure	200 psi
Linitemp:	
Input Power	5 to 30VDC
Output	1µA/°C or 10mV/°C
Operating Temperature	-25° to 105°C (-13° to 221°F)
Resistive:	
RTD/Thermistor	See table, above
Accuracy:	
Calibration Error	1.5°C (2.7°F) typical; 2.5°C (4.5°F) max. at 25°C (77°F)*
Error over Temperature	1.8°C (3.24°F) typical; 3.0°C (5.4°F) max. over 0° to 70°C (32° to 158°F) range; 2.0°C (3.6°F) typical, 3.5°C (6.3°F) max. over -25° to 105°C (-13° to 221°F) range

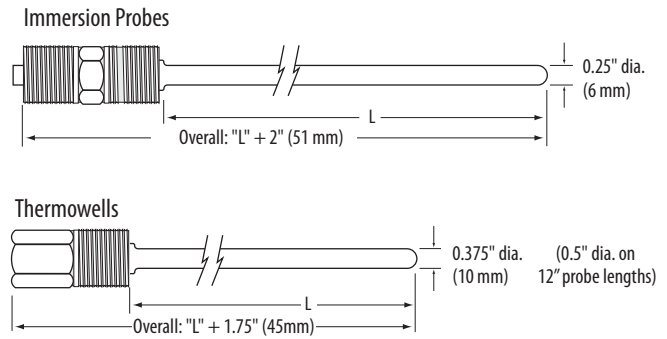*Room temperature error documented on each unit.*
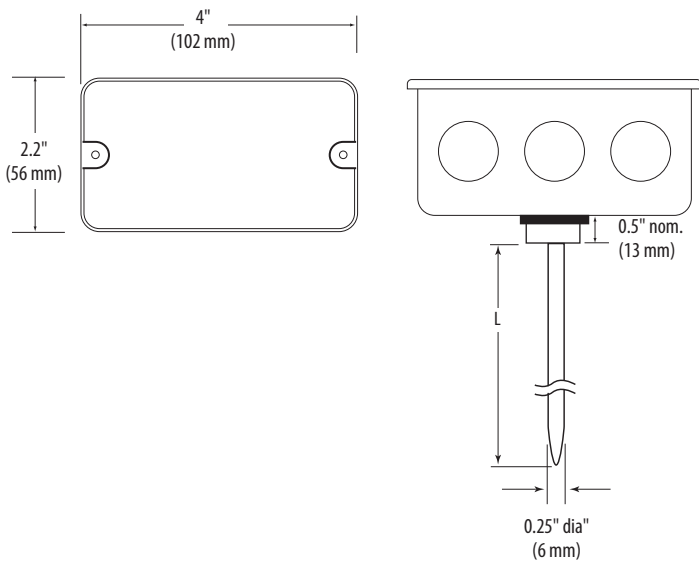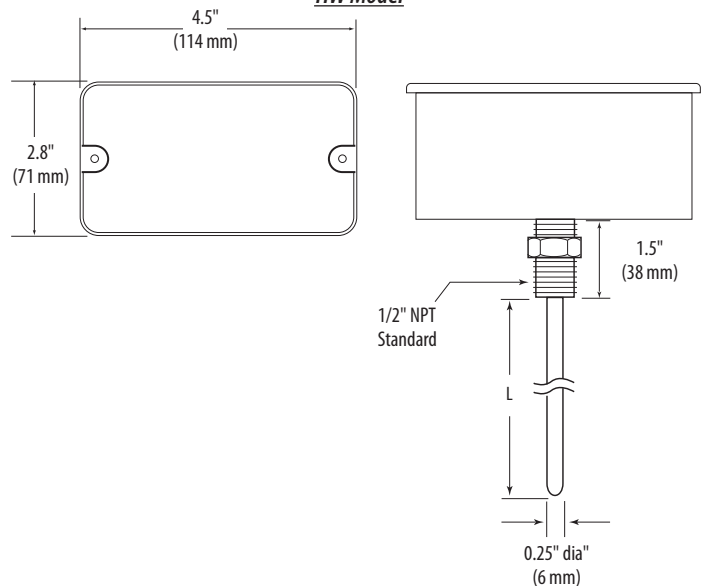
VERIS INDUSTRIES

DIMENSIONAL DRAWINGS

TIG Model

TIH Model

Immersion Probes

0.25" dia.
(6 mm)

Overall: "L" + 2" (51 mm)

Thermowells

0.375" dia.   (0.5" dia. on
(10 mm)   12" probe lengths)

Overall: "L" + 1.75" (45mm)

1.5"
(38 mm)

1/2" NPT
Standard

0.25"Dia.
(6 mm)

TID Model

TIW Model

4"
(102 mm)

4.5"
(114 mm)

2.2"
(56 mm)

2.8"
(71 mm)

0.5" nom.
(13 mm)

0.25" dia"
(6 mm)

1/2" NPT
Standard

1.5"
(38 mm)

0.25" dia"
(6 mm)

TEMPERATURE
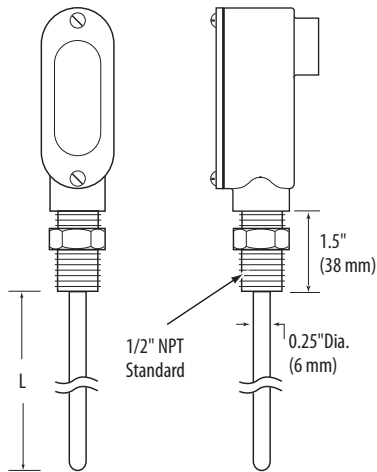
ORDERING INFORMATION

Enclosure	Immersion Probe Length "L"	Thermowell	Sensor Type	OPTIONS Cal Certificate	Threads

T I ☐ ☐ ☐ ☐ ☐ ☐

Enclosure
D = Duct
G = Service Entry Body
H = Threaded NPT Only
W = Water resistant housing

Immersion Probe Length "L"
A = 2 1/2" (64mm)
B = 4" (102mm)
C = 6" (152mm)
D = 8" (203mm)
E = 12" (305mm)

Thermowell
0 = None
1 = Add Thermowell

Sensor Type
B = 100R Platinum, RTD
C = 1k Platinum, RTD
D = 10k T2, Thermistor
E = 2.2k, Thermistor
F = 3k, Thermistor
G = 10k CPC, Thermistor
H = 10k, T3, Thermistor
J = 10k Dale, Thermistor
K = 10k w/11k shunt,Thermistor
M = 20k NTC, Thermistor
N = 1800 ohm, Thermistor
P = 10mV/°C, Linitemp
R = 10k US, Thermistor
S = 10k 3A221, Thermistor
T = 100k, Thermistor
U = 20k "D", Thermistor
W = 10k T2 high accuracy, Thermistor
Y = 10k T3 high accuracy, Thermistor
Z = 10k E1, Thermistor

Cal Certificate
0 = None
1 = 1 point Cal validation
2 = 2 point Cal validation

Threads
Blank = NPT
A = BSPT
B = DIN 2999

NOTE:
For 4-20mA transmitter output, order any TI with the 100Ω platinum RTD and accessory AA10xx

Thermowell Sizing

Probe Length	Thermowell Length
A (2 1/2") (64mm)	1 1/2" (38mm)
B (4") (102mm)	3" (76mm)
C (6") (152mm)	5" (127mm)
D (8") (203mm)	7" (178mm)
E (12") (305mm)	11" (279mm)

ACCESSORIES

Thermowells (AA22, AA24, AA25, AA33)

AA24

Example:

T I D B 1 D 2 A
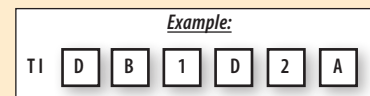
Appendix B

Logger Wiring Diagram and Details

Instrumentation, Wiring Schematic, and Installation Details

Site Visits

March 16, 2012	Initial site visit (Adam Walburger)
March 22, 2012	Datalogger and sensors rough in. DAS system operational but incomplete (Adam Walburger).
May 2, 2012	Datalogger and sensors rough in completed. DAS system operational, awaiting gas meter installation and engine startup (Adam Walburger).
July 12,2012	Temperature sensors, power meters, steam flow rates verified. TLS1 and TLR1 wires switched and TLS2 and TLR3 wires switched. Cellular modem installed. System operational. Awaiting gas meter installation (Adam Walburger & Pilar Lyons).
September 7, 2012	Temperature sensors and flow meters verified. Boiler loop flow meter (FL2) flipped to face correct direction. System operational. Awaiting gas meter installation (Adam Walburger).

Description of Monitored Data Points and Schematics

Table B-1 lists the monitored points installed at the site. The wiring schematic for the logger are shown in Figure B-1 and Figure B-2.

Table B-1. Monitored Data Point List

Parker Jewish Hospital Logger Terminations							
Logger Input	Data Point	Description	Units	Sensor	Signal Type	Multiplier/Pulse Rate	Note
CH-1	WG	Generator Electrical Output (Combined)	kW/kWh	WattNode WNB-3Y-208-P 1200 A Cts	Pulse	0.025 kWh/pulse	
CH-2	WPAR	Parasitic Load Electrical Consumption	kW/kWh	WattNode WNB-3Y-208-P 200 A Cts	Pulse	0.005 kWh/pulse	
CH-3	FL1	Glycol DHW Loop Flow Rate	GPM	Onicon F-1110	4-20 mA	0-150 GPM	
CH-4	FL2	Boiler Water Loop Total Flow Rate	GPM	TLS	4-20 mA	8.375 - 190.4 GPM	
CH-5	FG	Combined Generator Fuel Input	CF	Utility Pulser	Pulse	TBD	
CH-6							
CH-7							
CH-8							
EXP-1-1	TLS1	Glycol DHW Loop Supply Temperature	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	Thermistor # 4-76
EXP-1-2	TLR1	Glycol DHW Loop Return Temperature from HX loads, upstream of dump radiator	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	Thermistor # 4-77
EXP-1-3	TLR2	Glycol DHW Loop Return Temperature down stream of dump radiator	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	Strap on thermistor
EXP-1-4	TLS2	Boiler Water Loop Supply Temperature	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	Thermistor # 4-74
EXP-1-5	TLR3	Boiler Water Loop Return Temperature	deg F	Veris TIG 10k Type II Thermistor	Resistance	n/a	Thermistor #4-75
EXP-1-6							
EXP-1-7							
EXP-1-8							

Obvius Acquisuite A8812 Data Logger
Main Board Input Terminals

(+) 24 VDC
IN1
G

Red — WG — Black

WattNode WNB-3Y-208-P 1200 A Cts
0.025 kWh/pulse

(+) 24 VDC
IN2
G

Red — WPAR — Black

WattNode WNB-3Y-208-P 200 A Cts
0.005 kWh/pulse

(+) 24 VDC
IN3
G

Red   Red
Red   Blue — FL1
Black   Black
Black   Yellow

Onicon F1110
4-20 mA, 0-150 GPM

(+) 24 VDC
IN4
G

Black   Black — FL2
Red   Blue

Nice Titan
4-20 mA, 8.375 - 190.4 GPM

(+) 24 VDC
IN5
G

Red — FG — Black

Utility Pulse Output
TBD CF/pulse

(+) 24 VDC
IN6
G

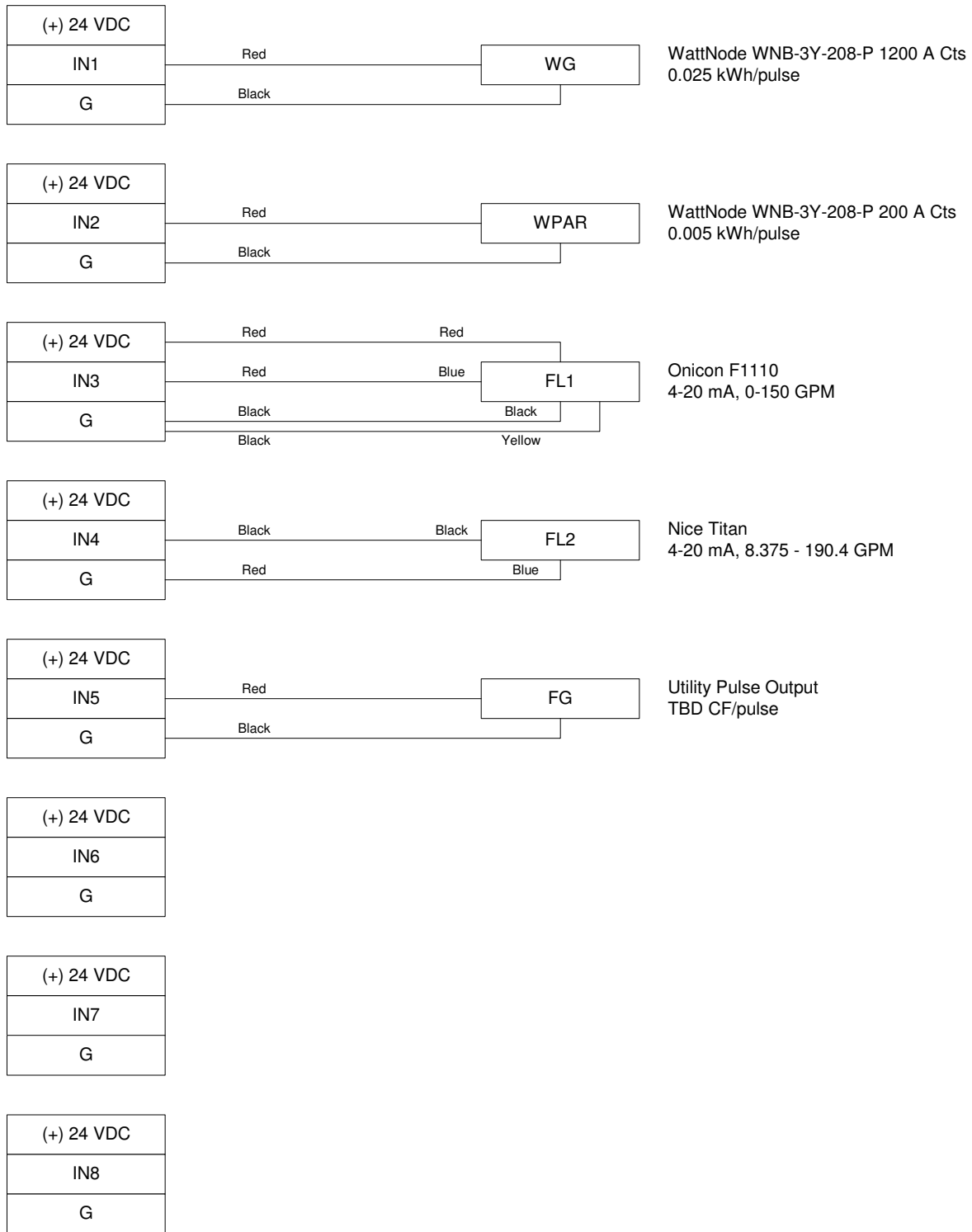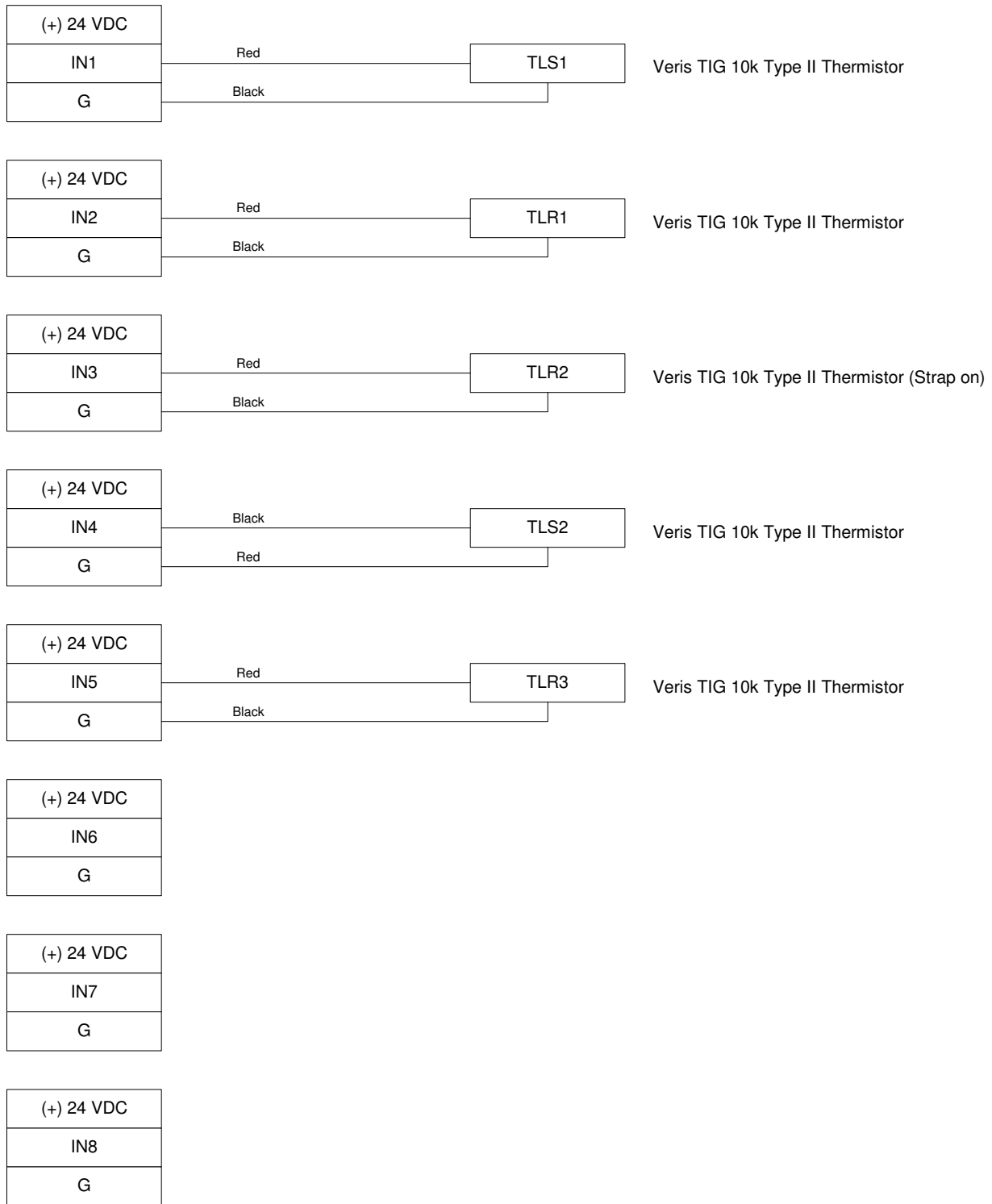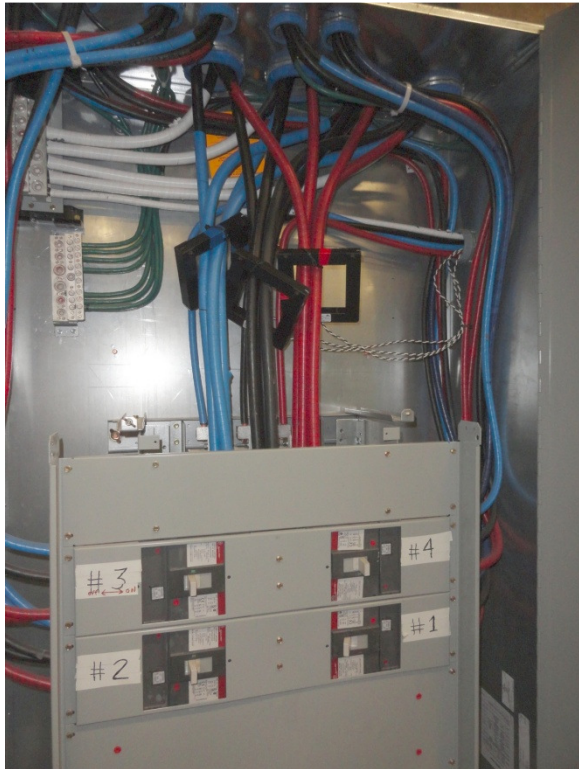| (+) 24 VDC |
| --- |
| IN7 |
| G |

(+) 24 VDC
IN8
G

Figure B-1. Obvius Data Logger Wiring Schematic

Obvius Acquisuite A8332-8F2D Flex IO Module
Expansion Board Input Terminals

(+) 24 VDC		
IN1	Red	TLS1	Veris TIG 10k Type II Thermistor
G	Black		

(+) 24 VDC		
IN2	Red	TLR1	Veris TIG 10k Type II Thermistor
G	Black		

(+) 24 VDC		
IN3	Red	TLR2	Veris TIG 10k Type II Thermistor (Strap on)
G	Black		

(+) 24 VDC		
IN4	Black	TLS2	Veris TIG 10k Type II Thermistor
G	Red		

(+) 24 VDC		
IN5	Red	TLR3	Veris TIG 10k Type II Thermistor
G	Black		

| (+) 24 VDC |
| IN6 |
| G |

| (+) 24 VDC |
| IN7 |
| G |

| (+) 24 VDC |
| IN8 |
| G |

Figure B-2. Obvius Expansion Board Wiring Schematic
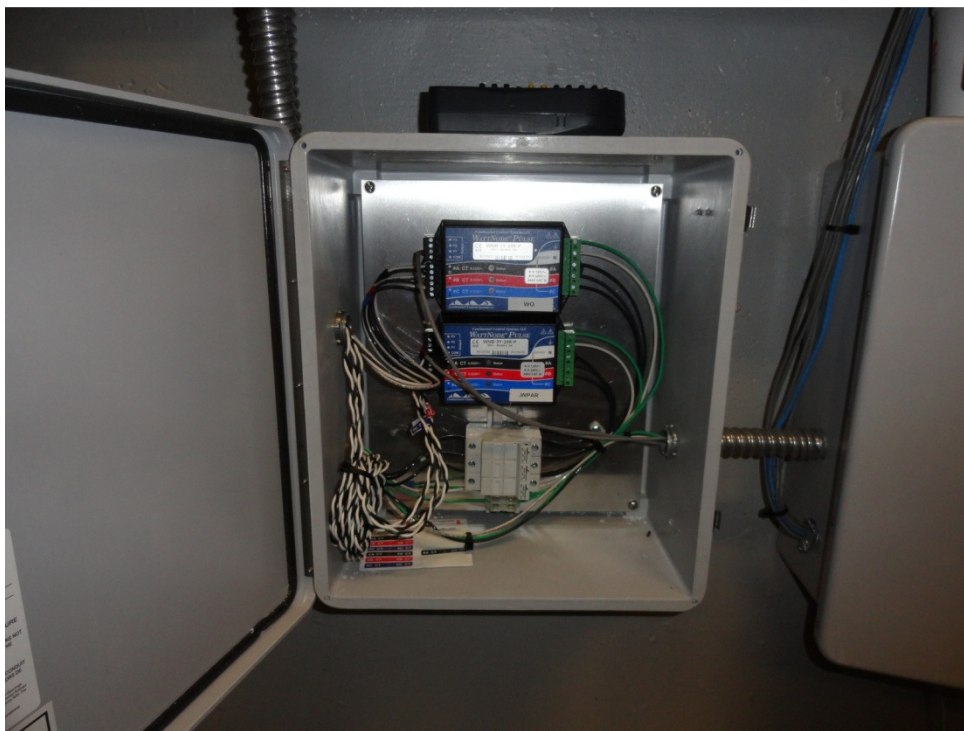
Photos of Installed Sensors

WG – CT Location

WPAR – CT Location

WG, WPAR – Power Transducer Location

Data Logger and Power Transducer Panel Location

HX 1 and TLS1, TLR1 Location on DHW Loop Piping

TLR2 Location (Overhead) Returning from Dump HX (Above Roof)

TLS2, TLR3, FL2 Location on Boiler Loop Piping (Overhead)

FL2 Transmitter

Cellular Modem on Top of Data Logger Panel in Boiler Room

Obvius Data Logger

Gas Meter (No Pulse Output as of 2012 July 12)

Instrumentation, Wiring Schematic, and Installation Details

Site Visits

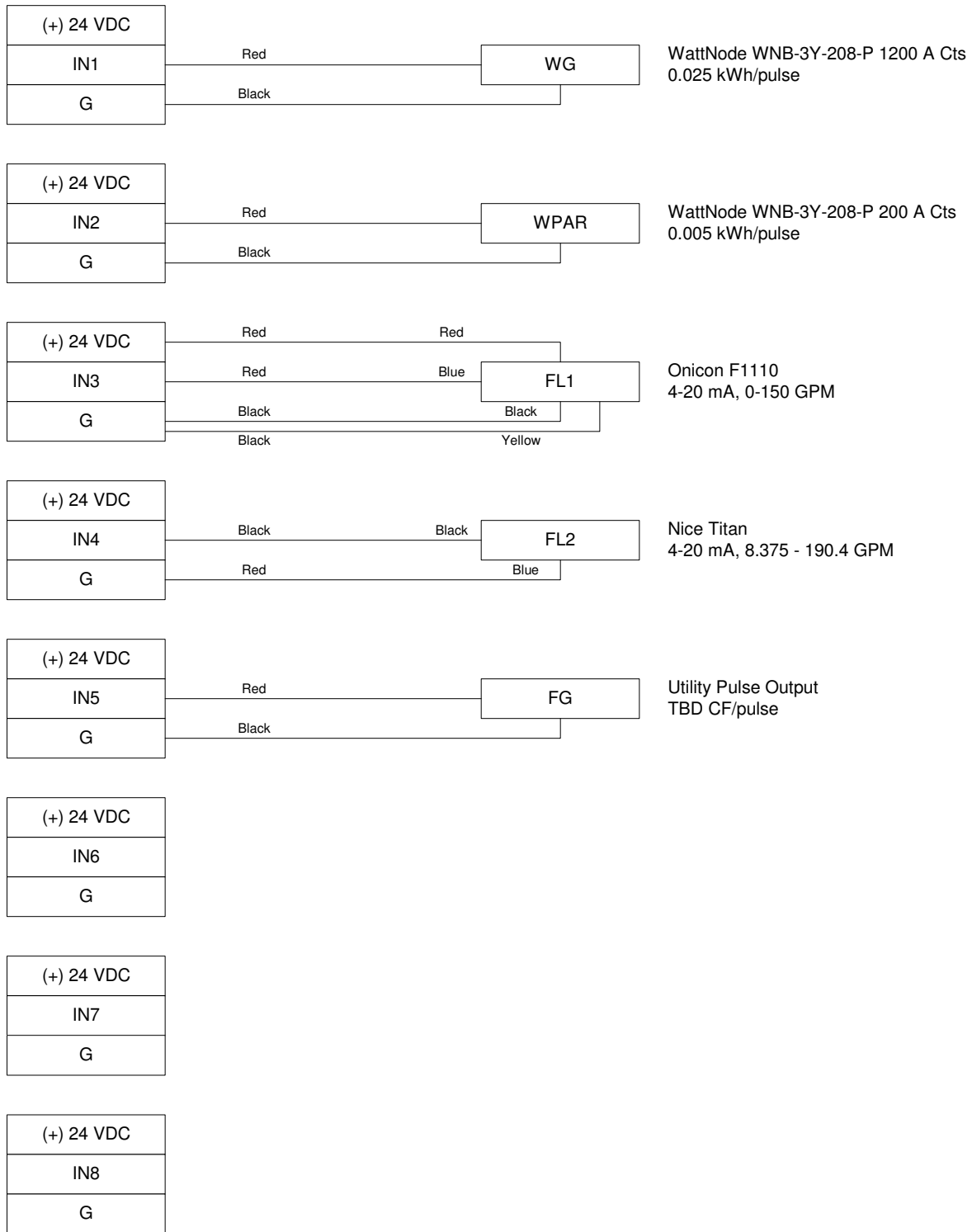|	
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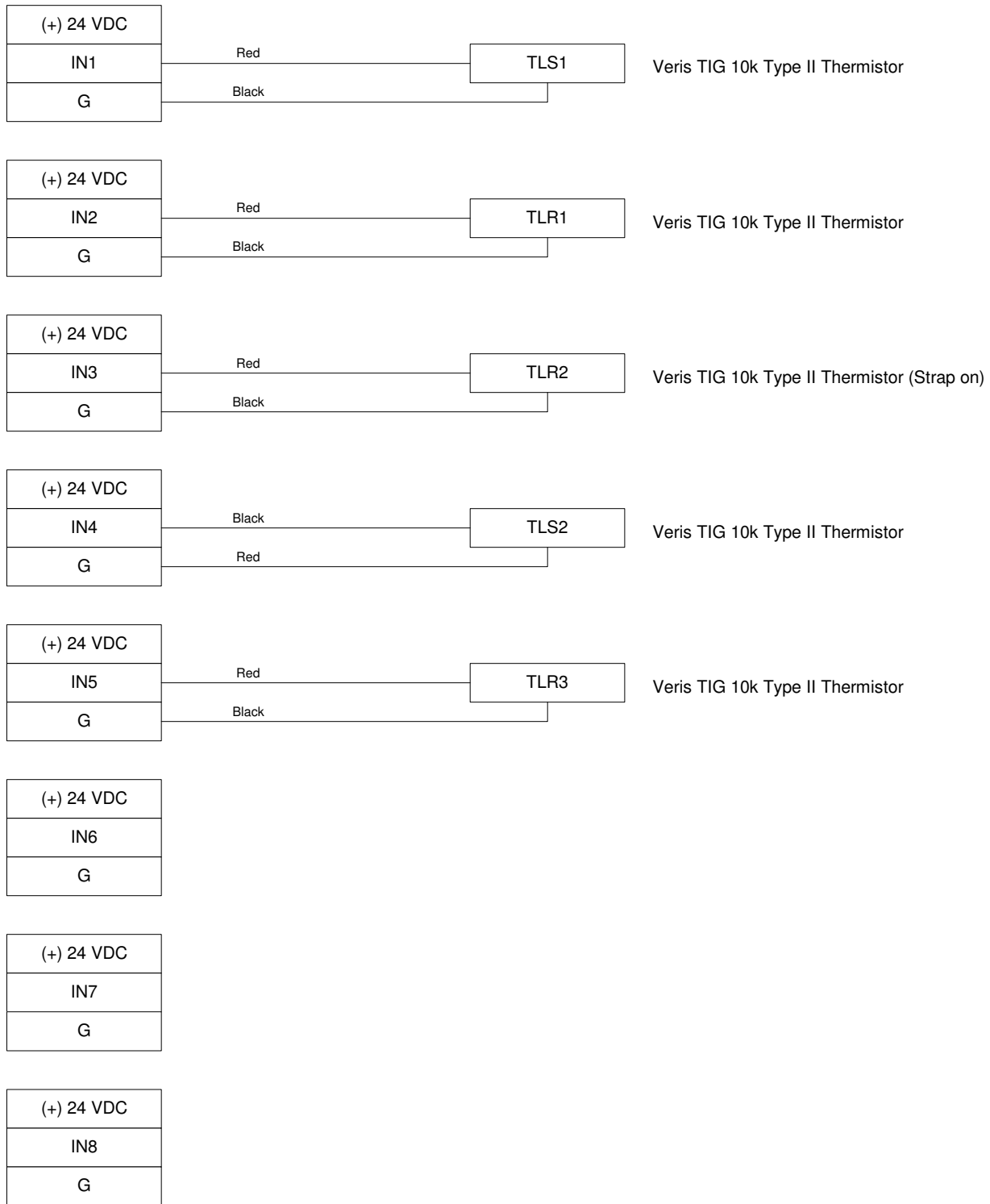
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CH-5	FG	Combined Generator Fuel Input	CF	Utility Pulser	Pulse	TBD	
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CH-7							
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Black ———

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0.025 kWh/pulse

(+) 24 VDC
IN2
G

Red ——— WPAR
Black ———

WattNode WNB-3Y-208-P 200 A Cts
0.005 kWh/pulse

(+) 24 VDC
IN3
G

Red   Red
Red   Blue — FL1
Black   Black
Black   Yellow

Onicon F1110
4-20 mA, 0-150 GPM

(+) 24 VDC
IN4
G

Black   Black — FL2
Red   Blue

Nice Titan
4-20 mA, 8.375 - 190.4 GPM

(+) 24 VDC
IN5
G

Red ——— FG
Black ———

Utility Pulse Output
TBD CF/pulse

(+) 24 VDC
IN6
G

(+) 24 VDC
IN7
G

(+) 24 VDC
IN8
G

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G	Black		

(+) 24 VDC		
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G	Black		

(+) 24 VDC		
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G	Red		

(+) 24 VDC		
IN5	Red	TLR3	Veris TIG 10k Type II Thermistor
G	Black		

| (+) 24 VDC |
| IN6 |
| G |

| (+) 24 VDC |
| IN7 |
| G |

| (+) 24 VDC |
| IN8 |
| G |

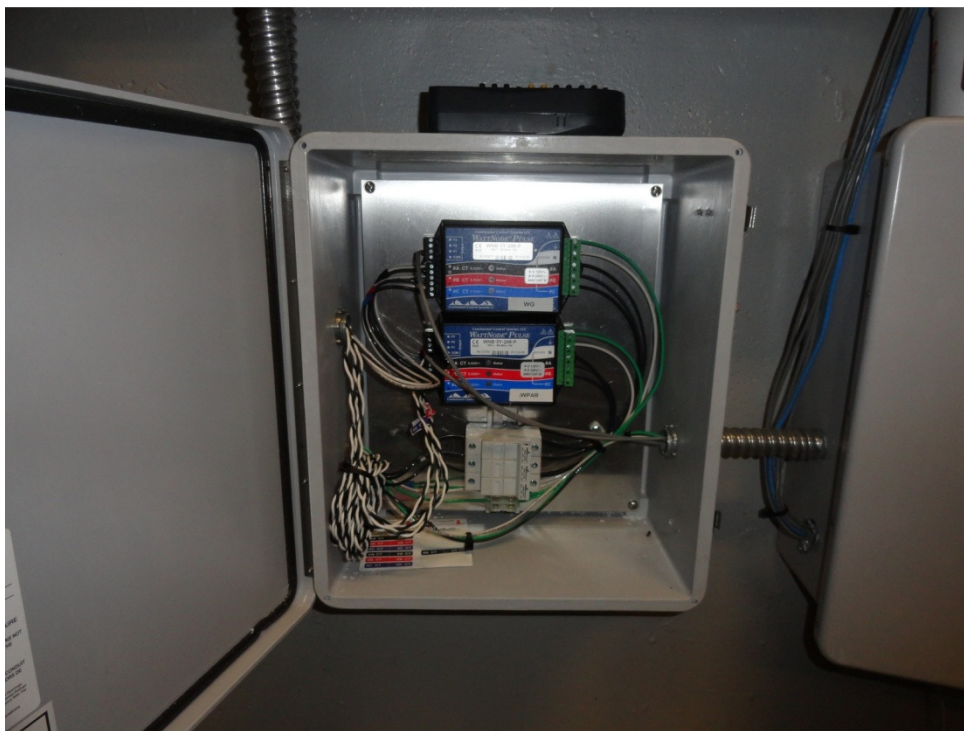**Figure B-2. Obvius Expansion Board Wiring Schematic**

Photos of Installed Sensors

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WPAR – CT Location

WG, WPAR – Power Transducer Location

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HX 1 and TLS1, TLR1 Location on DHW Loop Piping

TLR2 Location (Overhead) Returning from Dump HX (Above Roof)

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