Bedford Union Armory

1555 Bedford Ave

Brooklyn, NY 11225

As-Built July 2021

Submitted to:

Frontier Energy
2695 Bingley Road
Cazanovia, NY 13035

Submitted by:

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Tritech Electric
C&S Controls

Site Contact:
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BFC Partners

1. Introduction

Tecogen, Inc. (Tecogen) supported the installation of a combined heat and power (CHP) system at Ballston Spa School. The site is receiving an incentive from NYSERDA, of which the first two milestones have been paid out in full. The CHP system includes five (5) Tecogen InVerde Ultera 125kW engine generator units. The inverter-based system is intended to produce a gross output of 125 kW and recovers engine jacket water and exhaust heat recovery for:

a) Pre-heating the facility hot water loop which in turn heats:
    i. DHW Heating
    ii. HVAC Heating
    iii. Absorption Chillers

The CHP system will provide power in parallel with the existing utility service, as well as the capabilities to operate in island-mode and provide backup power during an outage scenario.

2. Instrumentation

In order to quantify the performance of the CHP system, the CHP system fuel input, net electrical output, and useful thermal output will be measured. To capture that data, meters and instrumentation listed in **Table 1 on page 4** was installed**.**

Plant Trends

Trend data for the installed instrumentation are recorded by the BMS. The BMS samples all sensors approximately once every 15 minutes and records the information. The readings of heat recovery temperatures and flow rates will be used to provide an accurate calculation of heat transfer on the heat recovery loops, which are all continuous flow loops. Based on the number of monitored data points, the system has sufficient memory to store 5-days of data if communications with the BMS are interrupted.

The data will be downloaded once per day via an Internet connection provided by the Site.

Onsite Installation

The BMS was installed in the boiler/cogen room. The monitoring system panel is approximately 2 ft x 16 in x 10 in. The panel is supplied with 120 VAC power (it requires 1 amp or less). The panel is conveniently located relative to the sensors listed above as well as the communications line provided by the site.

Communications

The datalogger has a connection to the Internet. An IP address has been supplied. The logger uploads data every night to servers, is compiled into a csv file, and then distributed and provided to NYSERDA based on their monitoring requirements.

On Site Support
The facility has assisted in providing a network connection for the BMS system.

Table 1. Overview of CHP System Monitoring Instrumentation

Data Point	Equipment Labels	Data Point	Description	Units	Instrument / Sensor/Formula	Output Type	Location
P_{NET}	DMD-52IT DMD-52CHP		Generator NET Electrical Output	kW/ kWh	(DMD-52IT) – (DMD-52CHP)	ModBus	Electric Room
P_{OUT}	CG-1 CG-2 CG-3 CG-4 CG-5		Generator Gross Electrical Output	kW/ kWh	InVerde	On-Board	CHP Area
G_{IN}	M-1		Net Generator Fuel Input	CF	Pulse Meter	Pulse	CHP Area
F_{NET1}	FM-2		Main Hot Water Loop - Hot Water Flow	GPM	Onicon F-1000	ModBus	CHP Area
Q_{NET1}			CHP System Heat Recovered	BTUH	$(T_{CGWS} – T_{CGWR})$ *500* F_{NET1}	Calculated	
T_{CGWR}	TS-320	PT53	HW Return Temperature before Cogen Loop	°F		ModBus	CHP Area
T_{CGWS}	TS-300	PT55	HW Supply Temperature after Cogen Loop	°F		ModBus	CHP Area

3. Data Analysis

The collected data listed in Table 1 on page 4 will be used to determine the net power output of the system as well as the fuel conversion efficiency (FCE).

Peak Demand or Peak kW

The peak electric output or demand for each power reading will be taken as the average kW in a fixed 15-minute interval (0:00, 0:15, 0:30, etc.), defined as:

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

Net Power Output

The power meter will measure the generator power output (P_{OUT}). The internal generator meter will measure the gross output of the engine generator as a check.

The parasitic power (P_{PAR}) is found by referencing demand meter DMD-CHP. The Net Power has already subtracted parasitic loads.

Heat Recovery Rates - Calculated

The heat recovery rates will be calculated based on the 15 minute interval data collected. The piping arrangement at this site allows for the total recoverable heat rate to be determined at the supply and return to the main building heat loop:

The rate of useful heat recovery in Btu/h is calculated as:

$$Q_{NET} = C_P \times \sum (F_{NET} \times (T_{HXS} - T_{HXR}) \times n)$$

where: C_p = 500 Btu/h-gpm-°F for Water;
n = Number of 1-minute intervals included in period of interest

The building heat recovery loop fluid is water.

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

Fuel Conversion Efficiency - Calculated

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

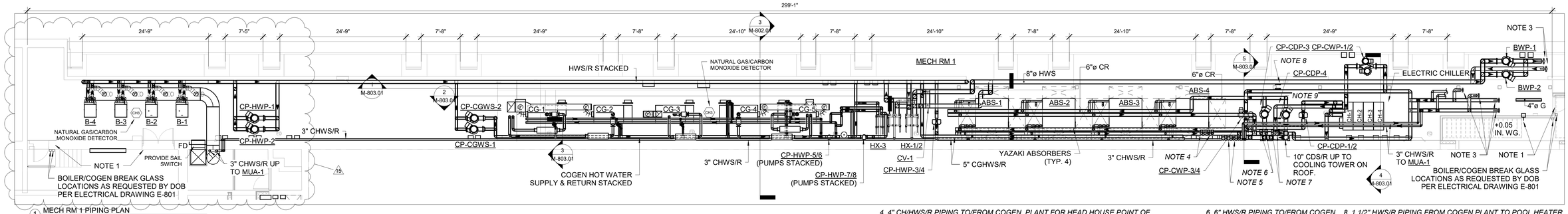
$$FCE = \frac{Q_{NET} + (3413 \times P_{NET)}}{G_{IN} \times HHV_{Gas}}$$

where: Q_{Net} = Total Useful heat recovery (Btu) (QU)
P_{Net} = Engine generator net output (kWh)
G_{In} = Generator gas consumption (Std CF)
HHV_{gas} = Higher heating value for natural gas (~1020 Btu/CF)

The FCE can be calculated for any time interval of interest (hourly, daily, monthly, etc.), depending on the resolution available for the gas meter reading.

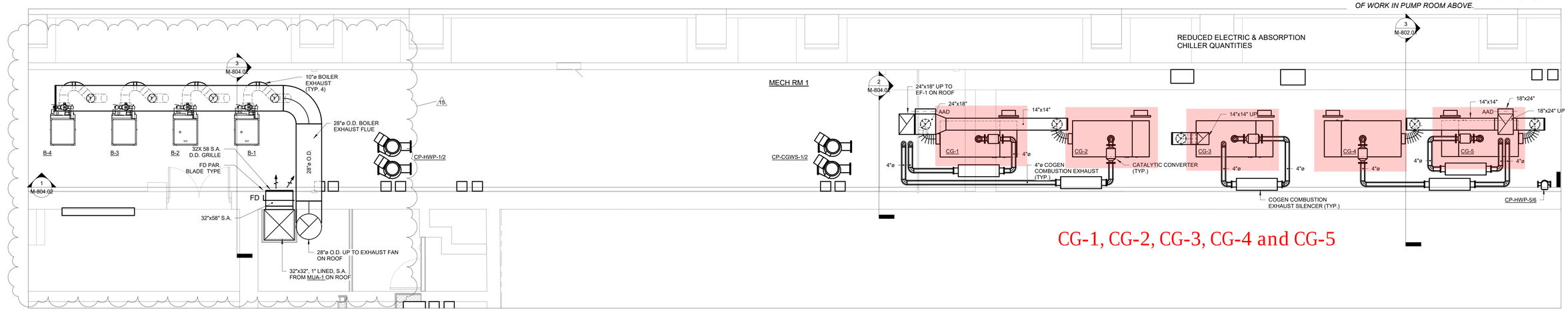
Appendix A

System Schematics

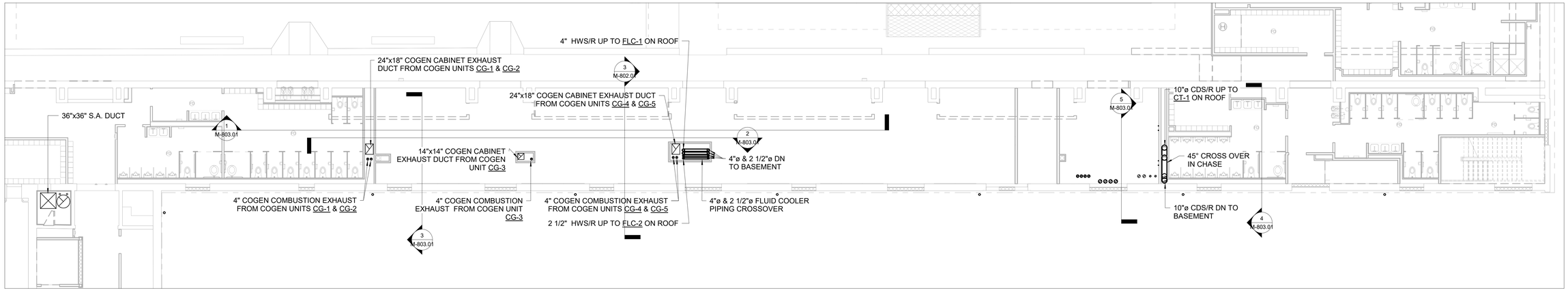


1 MECH RM 1 PIPING PLAN
1/8" = 1'-0"

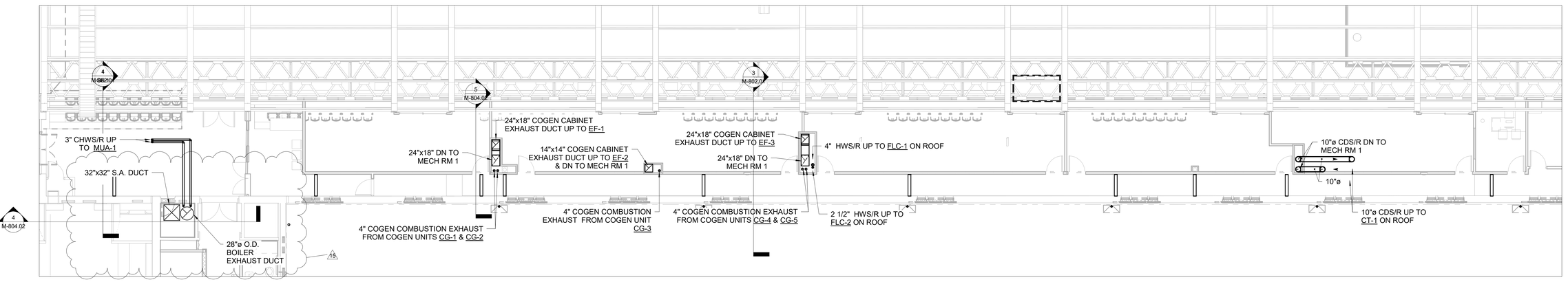
1. STATIC PRESSURE DIFFERENTIAL SENSOR FOR MUA-1. MAINTAIN POSITIVE PRESSURE IN MECH RM 1 vs. EXTERIOR ROOMS. PROVIDE DOOR SENSORS FOR. UNIT TO MAINTAIN CURRENT FAN SPEED WHEN DOOR(S) ARE OPENED. SENSOR READING TO BE ACTIVATED AGAIN AFTER ONE MINUTE AND ALL DOORS ARE CLOSED.
2. ALL EQUIPMENT AND PIPING SHALL BE VIBRATION ISOLATED. REFER TO SPECIFICATIONS. PIPING ISOLATED FOR 50 FT BEYOND THE MECHANICAL ROOM. ALL PENETRATIONS SEALED FOR NOISE AND FIRE REQUIREMENTS.
3. POINT OF WHERE COGENERATION WORK ENDS.
4. 4" CH/HWS/R PIPING TO/FROM COGEN PLANT FOR HEAD HOUSE POINT OF CONNECTION FROM COGEN BUILDING & SCOPE OF WORK IN PUMP ROOM ABOVE
5. 6" CH/HWS/R PIPING TO/FROM COGEN PLANT TO AH-1/2 (BY COGEN CONSULTANT). POINT OF CONNECTION FROM COGEN TO BLDG 1 WORK IN PUMP ROOM ABOVE.
6. 6" HWS/R PIPING TO/FROM COGEN PLANT BELOW OVER TO BLDG. 2.
7. 4" CHWS/R PIPING TO/FROM COGEN PLANT BELOW OVER TO BLDG. 2.
8. 1 1/2" HWS/R PIPING FROM COGEN PLANT TO POOL HEATER. POINT OF CONNECTION FROM COGEN TO BLDG. 1 SCOPE OF
9. 4" HWS/R PIPING FROM COGEN PLANT TO DHAH-1. POINT OF CONNECTION FROM COGEN TO BLDG. 1 SCOPE OF WORK IN PUMP ROOM ABOVE.



2 MECH RM 1 EXHAUST PLAN
1/4" = 1'-0"



3 FLOOR 01 MECHANICAL PLAN
1/8" = 1'-0"



4 FLOOR 02 MECHANICAL PLAN
1/8" = 1'-0"

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CLIENT **BFC PARTNERS**
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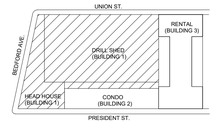
MEP ENGINEER **RODKIN CARDINALE, P.C. CONSULTING ENGINEERS**
GEOTECNICAL **GEODESIGN**
POOL CONSULTANT **TRACE POOL DESIGN**
EXPEDITING/CODE CONSULTING **IM ZONING**
CIVIL **BROOKER ENGINEERING**
FACADES **BURO HAPPOLD**
SUSTAINABILITY **BRIGHT POWER**
LANDSCAPE **XX**
COGEN ENGINEER **INTEGRATED ENERGY CONCEPTS**

REV	DATE	DESCRIPTION
2	5/24/2018	50% CD SET
3	6/25/2018	75% PROGRESS SET
4	7/19/2018	100% CD SET
5	8/27/2018	ISS. FOR REVIEW
6	10/31/2018	DEMARCATION UPDATES
7	12/21/2018	REVISED PER TEAM COMMENTS
8	6/17/2019	CONFORMANCE SET
9	11/1/2019	CONFORMANCE SET
10	2/10/2020	BULLETIN 1
11	3/27/2020	DOB PAA #1
12	6/26/2020	BULLETIN 2
13	9/21/2020	DOB PAA #3
14	1/12/2021	OTRC SUBMISSION
15	2/5/2021	DOB PAA #4

03/20/18



KEY PLAN

PROJECT NO.
BEDFORD UNION ARMORY- BUILDING 01 HEAD HOUSE

COGEN & BOILER PLANS

DRAWING #:
M-801.02.

DOB #: 340660314

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GENERAL NOTES:

1. GENERAL OVERALL ARRANGEMENTS SHOWN ON THIS DRAWING. REFER TO SPECIFIC PIPING DETAILS AND MANUFACTURE'S RECOMMENDED ISTALLATION PROCEDURES FOR EACH PIECE OF EQUIPMENT FOR FURTHER REQUIREMENTS.
2. PROVIDE SENSOR WELL AND DDC TEMPERATURE SENSOR, TYPICAL OF ALL TS-* DEVICES. COORDINATE LOCATIONS WITH CONTROLS SUBCONTRACTOR.
3. ALL TEMPERATURE SENSORS AND CONTROL EQUIPMENT SHALL BE MONITORED/CONTROLLED BY THE BUILDING DDC SYSTEM. PROVIDE GRAPHIC SCREEN FOR COGENERATION/HOT WATER SYSTEMS.
4. REMOVE HANDLES FROM ALL BALL VALVES ISOLATING EXPANSION TANKS TO PREVENT INADVERTANT CLOSING.
5. MAKE UP WATER SERVICE, BACKFLOW PREVENTERS AND PRESSURE REDUCING VALVES FURNISHED AND INSTALLED BY MECHANICAL CONTRACTOR.
6. REFER TO DRAWING M-903 FOR CONTINUATION OF HWS/R PIPING TO BUILDINGS NO. 01, 02 & 03.
7. SEDIMENT TRAPS TO BE PROVIDED IN PIPING WHERE APPROPRIATE BEFORE CONNECTIONS TO BOILERS AND COGEN UNITS.

SIZED BY RODKIN/ENERGY CONCEPTS

(BY RODKIN ENGINEERING)

ET-5 ET-6 ET-7 ET-8 ET-9 N.O. N.O. N.O. N.O. N.O. ¾"

* REMOVE HANDLES FROM ALL BALL VALVES ISOLATING EXPANSION TANKS

60 PSI

RPZ

1" CW MAKE-UP (SEE NOTE 5)

SYSTEM PRESSURE AND LOW WATER MAKE-UP ALARM TO BMS/DDC

AS-3

GENERAL NOTE 6

FM-3

TS-402

8" HWS

TS-401

CENTRAL PLANT HOT WATER PUMPS

VFD 1 BWP-2 1600 GPM HW

VFD 2 BWP-1 1600 GPM HW

5 GAL. BYPASS FEEDER/FILTER

SET FOR 2.5 GPM

8" HWR

TS-403

TS-400

HW HEAT EXCHANGER HX-1
12,000 MBH
HOT SIDE: 711.5 GPM, 209°F EWT - 170°F LWT
COLD SIDE: 1230 GPM, 160°F EWT - 180°F LWT

HW HEAT EXCHANGER HX-2
12,000 MBH
HOT SIDE: 711.5 GPM, 209°F EWT - 170°F LWT
COLD SIDE: 1230 GPM, 160°F EWT - 180°F LWT

8"HWS 8"HWR 100 PSI HX-1 PIPE TO 6" A.F.F. 6" HWS 6" HWR

8"HWS 8"HWR 100 PSI HX-2 PIPE TO 6" A.F.F. 5" HWS 6" HWR

TS-318 TS-319 TS-317 6" N.C. CV-1 N.C.

60 PSI SYSTEM

8" HWR

HAYES OR EQUAL AUTOMATIC BALANCING VALVE, SET FOR 69 GPM. TYP. OF 4.

ABSORBER ABS-4 50 TON 857 MBH HW INPUT 190.4 GPM HW 190.4°F EWT - 181.4°F LWT

ABSORBER ABS-3 50 TON 857 MBH HW INPUT 190.4 GPM HW 190.4°F EWT - 181.4°F LWT

ABSORBER ABS-2 50 TON 857 MBH HW INPUT 190.4 GPM HW 190.4°F EWT - 181.4°F LWT

ABSORBER ABS-1 50 TON 857 MBH HW INPUT 190.4 GPM HW 190.4°F EWT - 181.4°F LWT

TS-320 TS-321 TS-322 TS-323 TS-324 TS-325 TS-326 TS-327 4" 6" C1 C2 C3 C4

FULL RADIUS ELBOW WITH METRAFLEX STRAIGHTENING VANE

VFD 1 VFD 2 CP-HWP-3/4 760 GPM

8" HWS 928 GPM 209°F MAX TS-103 928 GPM 170°F MIN

VFD VFD VFD VFD VFD VFD FC 4" GWS 4" GWR

FLUID COOLER FLC-1 4,200 MBH HEAT REJ. 220° F EWT 170° F LWT 40% P.G./WATER

SYSTEM PRESSURE AND LOW WATER MAKE-UP ALARM TO BMS/DDC

ET-10 ET-11 N.O. N.O. ¾"

1" GLYCOL FILL POINT

N.O.

RPZ 1 VFD CP-HWP-7/8 201 GPM

AS-4

1" GLYCOL

¾" GLYCOL FILL TO COGEN ELECTRONICS COOLING CIRCUIT

60 PSI RPZ 1" CW MAKE-UP (SEE NOTE 5)

(BY RODKIN ENGINEERING)

4" GWR 4" GWS

HW HEAT EXCHANGER HX-3

DESIGN SELECTION:
4,680 MBH
HOT SIDE: 195 GPM, 220°F EWT - 170°F LWT
COLD SIDE: 201 GPM, 215°F LWT - 165°F EWT

BALANCE:
3,900 MBH
HOT SIDE: 165 GPM, 220°F EWT - 170°F LWT
COLD SIDE: 170 GPM, 166°F EWT - 215.5°F LWT

75 PSI TS-200 75 PSI PIPE TO 6" A.F.F. HX-3

FC FLUID COOLER FLC-2 250 MBH HEAT REJECT. 120° F EWT 110° F LWT 40% P.G./WATER

2 1/2" 2 1/2" TS-204 TS-203

Cogen Usable Heat Loop Return Sensor TS-320 (PT53)

Cogen Loop Flow Meter FM-2

DIGITAL FLOW METER FM-2 ANALOG INPUT TO DDC SYSTEM

ET-1 ET-2 N.O. N.O. ¾"

(BY RODKIN) 1" MAKE-UP WATER (SEE NOTE 5) 35 PSI RPZ 1" 1" ¾" N.O. AS-2

170°F TS-111 N.C. TS-110 205°F MAX 170°F MIN

WELDED OR MECHANICALLY JOINED S40 TYPICAL

4" CGWR 150 GPM

COGEN HEAT RECOVERY METER FM-1 DIGITAL FLOW METER ANALOG INPUT TO DDC SYSTEM

CP-CGWS1/2 (LEAD/LAG) SHALL VARY ITS SPEED TO MAINTAIN REQUIRED PIPE FLOW BASED ON HOW MANY COGEN UNITS, AT 30 GPM EACH, ARE IN OPERATION. FLOW SHALL CHANGE ONLY WHEN A UNIT IS TURNED ON OR ALL HEAT IS DISSIPATED FROM THE COGEN UNIT CYCLED OR TURNED OFF WHILE IN OPERATION AND SIGNAL IS RECEIVED FROM UNIT(S) TO DO SO.

4" CGWR 890 GPM 209°F MAX 170°F MIN 6" HWS

BOILERS (15,470 MBH TOTAL OUTPUT)

#1 4,000 MBH INPUT 3,480 MBH OUTPUT 232 GPM 170°F EWT - 205°F LWT

#2 4,000 MBH INPUT 3,480 MBH OUTPUT 232 GPM 170°F EWT - 205°F LWT

#3 4,000 MBH INPUT 3,480 MBH OUTPUT 232 GPM 170°F EWT - 205°F LWT

#4 4,000 MBH INPUT 3,480 MBH OUTPUT 232 GPM 170°F EWT - 205°F LWT

60 PSI RELIEF VALVE (TYP.)

B-1 B-2 B-3 B-4 BP-1 200 GPM BP-2 200 GPM BP-3 200 GPM BP-4 200 GPM

5" HWS 18" MAX. (TYP.) 6" HWS 6" HWR

CV-3 TS-206 TS-205 30 PSI PIPE TO 6" A.F.F. AS-5 ¾" GLYCOL FILL ET-12 ET-13

2 1/2" 2 1/2" 2 1/2" 2 1/2" 2 1/2" 2 1/2"

VFD 1 CP-HWP-5/6 48 GPM

4" CGWS 4" CGWR

TS-112

30 GPM 8 GPM TS-109 TS-108 TS-107 TS-106 TS-105 TS-104 TS-103 TS-102 TS-101 TS-100

ELECTRONICS COOLING CIRCUIT (TYP.)

CGHX EXHAUST FLOW 30 PSI 60 PSI ENGINE/ GENERATOR NG TO DRAIN

CG-5 (125 KW) CG-4 (125 KW) CG-3 (125 KW) CG-2 (125 KW) CG-1 (125 KW)

NATURAL GAS SUPPLY (TYP. OF 5)

TECOGEN INV-125
1,455 SCFH (1,484 MBH) NAT GAS INPUT
125 kW (426 MBH) OUTPUT
780 MBH HEAT REJECTION FOR RECOVERY
31 MBH HEAT REJECTION ELEC. COOLER
30 GPM, 170°F EWT - 220°F LWT
(TYP. OF 5)

TOTAL COGEN PLANT HEAT OUTPUT FOR RECOVERY: 3,900 MBH

150 GPM 220°F 1,000 GPM 170°F MIN

VFD 1 CP-CGWS-1 180 GPM VFD 1 CP-CGWS-2 180 GPM

Cogen Usable Heat Loop Supply Sensor TS-300 (PT55)

* REMOVE HANDLES FROM ALL BALL VALVES ISOLATING EXPANSION TANKS

ET-3 ET-4 N.O. N.O. ¾"

PROVIDE PIPE WELL AND DDC TEMPERATURE SENSOR, TYPICAL OF ALL TS-* DEVICES. COORDINATE LOCATIONS WITH CONTROLS SUBCONTRACTOR. TS-301

(BY RODKIN ENGINEERING)

35 PSI RPZ 1" MAKE-UP WATER (SEE NOTE 5)

TS-302 AS-1 N.O. 60 PSI PIPE TO 6" 8" HWS

PRESSURE AND FLOW/WATER MAKE-UP ALARM TO DDC SET AT 20 PSI

SET FOR 2.5 GPM

VFD 1 CP-HWP-1 1,000 GPM VFD 1 CP-HWP-2 1,000 GPM

5 GAL. BYPASS FEEDER/FILTER

INSTALLATION NOTES:

1. PUMPS TO SEND OUTPUTS TO DDC SYSTEM FOR GRAPHIC DISPLAY AND BALANCING SYSTEM.
2. PIPE EXPANSION TANK CONNECTION TO THE BOTTOM OF THE PIPE.
3. ALL STRAINERS LOW PRESSURE DROP TYPE. METRAFLEX OF APPROVED EQUAL.
4. ALL CHECK VALVES SHALL DUAL DISK FULL PORT TYPE.
5. HX CONNECTIONS ARE TO BE AT THE SIDE OR BOTTOM OF THE PIPE.

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GEOTECNICAL **GEODESIGN**

POOL CONSULTANT **TRACE POOL DESIGN**

EXPEDITING/CODE CONSULTING **JM ZONING**

CIVIL **BROOKER ENGINEERING**

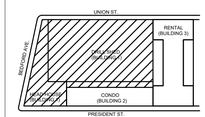
FACADES **BURO HAPPOLD**

SUSTAINABILITY **BRIGHT POWER**

LANDSCAPE **XX**

MEP ENGINEER **INTEGRATED ENERGY CONCEPTS**

REV	DATE	DESCRIPTION
11	3/27/2020	DOB PAA #1
12	6/26/2020	BULLETIN 2
13	9/21/2020	DOB PAA #3
14	1/12/2021	OTRC SUBMISSION
15	2/5/2021	DOB PAA #4
6	10/31/2018	DEMARCATION UPDATES
7	12/19/2018	REVISED PER TEAM COMMENTS
8	6/17/2019	CONFORMANCE SET
9	11/1/2019	CONFORMANCE SET
10	2/10/2020	BULLETIN 1



KEY PLAN

PROJECT NO. 16008

BEDFORD UNION ARMORY - BUILDING 01 DRILL SHED AND HEAD HOUSE

1555 Bedford Ave. Brooklyn, NY 11225

CENTRAL PLANT SYSTEM SCHEMATIC

DRAWING #:

M-901.02

55 of 222

DOB #: 340660314

1/12/2021 11:35:28 AM

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BUILDING 01 - COGEN AND BOILER PLANT NOTES:

1. THE SUBJECT BUILDING 01 CO-GENERATION PLANT IS HOUSED IN A MASONRY AND CONCRETE CONSTRUCTION WITH 3-HOUR FIRE RATED CONSTRUCTION.
2. A FIRE SPRINKLER PROTECTION SYSTEM OR EQUIVALENT FIRE PROTECTION SYSTEM SHALL BE DESIGNED AND INSTALLED IN THE CO-GEN PLANT AS REQUIRED BY NYC CONSTRUCTION CODES. SEE RELATED DOCUMENT CCD1, SPRINKLER SYSTEM PROVIDED PER CCD1 DETERMINATION.
3. AN OUTDOOR AIR VENTILATION SYSTEM SHALL BE PROVIDED WITH ADEQUATE CAPACITY TO SATISFY THE FRESH AIR REQUIREMENTS FOR THE CO-GENERATION CENTRAL PLANT. THE FAN SPEED AND AIR VOLUME SHALL BE MODULATED TO MAINTAIN NEUTRAL AIR PRESSURE IN THE CENTRAL PLANT ROOM. REFERENCE APPROVED CO-GEN PAA DRAWINGS.
4. NATURAL GAS DETECTION: THERE ARE 2 HONEYWELL E3SARH DUAL NATURAL GAS AND CARBON MONOXIDE SENSORS LOCATED IN THE CENTRAL PLANT. ONE SENSOR IS LOCATED AT THE BOILER AREA AND ANOTHER IS LOCATED AT THE CO-GENERATION UNIT AREA. THE SYSTEM IS SPECIFIED TO SEND ALARMS TO THE BMS COMPUTER CONTROL SYSTEM AND ON HIGH LEVEL ALARM A STROBE LIGHT AND AUDIBLE ALARM WILL BE ACTIVATED. THE BMS CONTROL SYSTEM IS SPECIFIED TO BE PROGRAMMED TO SHUTDOWN GAS FIRED EQUIPMENT IN THE CENTRAL PLANT ACCORDING TO THE ALARM LEVEL SEQUENCE. THE DRAWINGS INDICATING THESE LOCATIONS AND THE VULCAN DETAIL PER ATTACHED DOCUMENT TO SET.
5. GAS SERVICE ROOM VENTILATION: THE GAS METER ROOM VENTILATION SYSTEM IS DESIGNED PER APPENDIX E OF THE 2014 FUEL GAS CODE AND INCLUDE AN EXTERIOR BIRD SCREEN.
6. DRAWING M-925 HAS BEEN REVISED TO INDICATE THE SIZE OF THE GAS LINE ENTERING THE GAS SERVICE ROOM FROM NATIONAL GRID. THIS IS A 4-INCH HIGH PRESSURE LINE FROM NATIONAL GRID AT MAXIMUM 15PSIG. THE GAS PRESSURE IS REDUCED TO 14 INCHES WC IN THE GAS SERVICE ROOM FOR BOTH THE BOILER GAS SERVICE AND THE CO-GEN GAS SERVICE. FUEL GAS PIPING 4IN. AND ABOVE SHALL BE WELDED/FLANGED. FUEL GAS PIPING SHALL BE INSTALLED PER 2014 NYC FUEL GAS CODE.
7. WEIGHTS OF ALL MECHANICAL EQUIPMENT AND MECHANICAL ROOF EQUIPMENT WERE PROVIDED BY SEVERUD ASSOCIATES STRUCTURAL ENGINEERS OF NYC. STRUCTURAL SUPPORTS WERE COORDINATED WITH SEVERUD ASSOCIATES WITH PROJECT SHOP DRAWINGS. A STRUCTURAL ANALYSIS WAS PERFORMED BY THE STRUCTURAL ENGINEER TO ENSURE THAT THE EXISTING BUILDING CAN SAFELY SUPPORT THE STRUCTURAL LOADS OF THE CO-GEN PLANT EQUIPMENT.
8. CO-GENERATION MAINTENANCE AND WARRANTY CONTRACT: THE OWNERS HAVE SIGNED A FULL WARRANTY AND MAINTENANCE CONTRACT WITH TECOGEN THE CO-GENERATION UNIT VENDOR. THE MAINTENANCE AND WARRANTY CONTRACT PROVIDES BOTH CO-GEN UNIT MAINTENANCE AND EXTENDED FULL LABOR AND MATERIALS WARRANTY THROUGH THE LENGTH OF THE CONTRACT. THE OWNER PAYS A RATE PER MONTH BASED ON THE RUN HOURS OF THE CO-GENERATION UNITS. THE FULL MAINTENANCE AND WARRANTY CONTRACT BEGINS ONCE THE CO-GEN SYSTEM IS MADE OPERATIONAL.
9. PLANT OPERATIONS: THE PLANT OPERATING PERMITS SHALL BE OBTAINED FROM NYC FIRE DEPARTMENT. ON-SITE BUILDING ENGINEERS WILL BE TRAINED ACCORDING TO REQUIREMENTS OF NYC FIRE DEPARTMENT TO ENSURE SAFE OPERATION OF CO-GENERATION SYSTEMS. THE PLANT OPERATING ENGINEERS SHALL OBTAIN A CERTIFICATE OF FITNESS FROM NYC FIRE DEPARTMENT.
10. A CENTRAL BMS MONITORING AND CONTROL SYSTEM CONSOLE IS PROVIDED IN THE FACILITY. AT THE CONSOLE OPERATORS CAN REVIEW AND MONITOR PLANT OPERATIONS. IN NORMAL OPERATION PROGRAMMED SEQUENCES OPERATE AND CONTROL THE CENTRAL PLANT EQUIPMENT. HOWEVER, BUILDING OPERATING PERSONNEL HAVE THE ABILITY IF DESIRED TO SHUT DOWN EQUIPMENT FROM THE CENTRAL CONSOLE. IN ADDITION, THE CENTRAL PLANT BMS SYSTEM IS ACCESSIBLE REMOTELY BY BUILDING OPERATORS, THE CO-GEN MAINTENANCE TEAM AND THE DESIGN ENGINEERS.
11. BREAK GLASS STATIONS FOR BOILER AND CO-GENERATION SYSTEM MANUAL FUEL GAS SHUTOFF ARE LOCATED OUTSIDE EACH ENTRANCE TO THE CENTRAL PLANT MECHANICAL ROOM. UPON ACTIVATION OF THE BREAK GLASS STATION THE ASSOCIATED FUEL BURNING EQUIPMENT (BOILERS/ CO-GENERATION) ARE SHUT DOWN AND ASSOCIATED GAS STOP SWITCH IN THE GAS TRAIN(S) IS ACTIVATED.
12. SEDIMENT TRAPS TO BE PROVIDED IN GAS PIPING, WHERE APPROPRIATE BEFORE CONNECTIONS TO BOILERS AND COGEN UNITS.
13. ALL BOILER AND COGEN EQUIPMENT TO HAVE ADEQUATE CLARENCE FOR ALL SERVICE AND MAINTENANCE.
14. BOILER MUST HAVE "H" STAMP AND SHALL BE EQUIPPED WITH TWO LOW WATER CUT OFF SWITCHES.
15. GAS METER ROOM VENTILATION SHALL BE IN ACCORDANCE WITH APPENDIX E OF THE 2014 NYC FUEL GAS CODE.

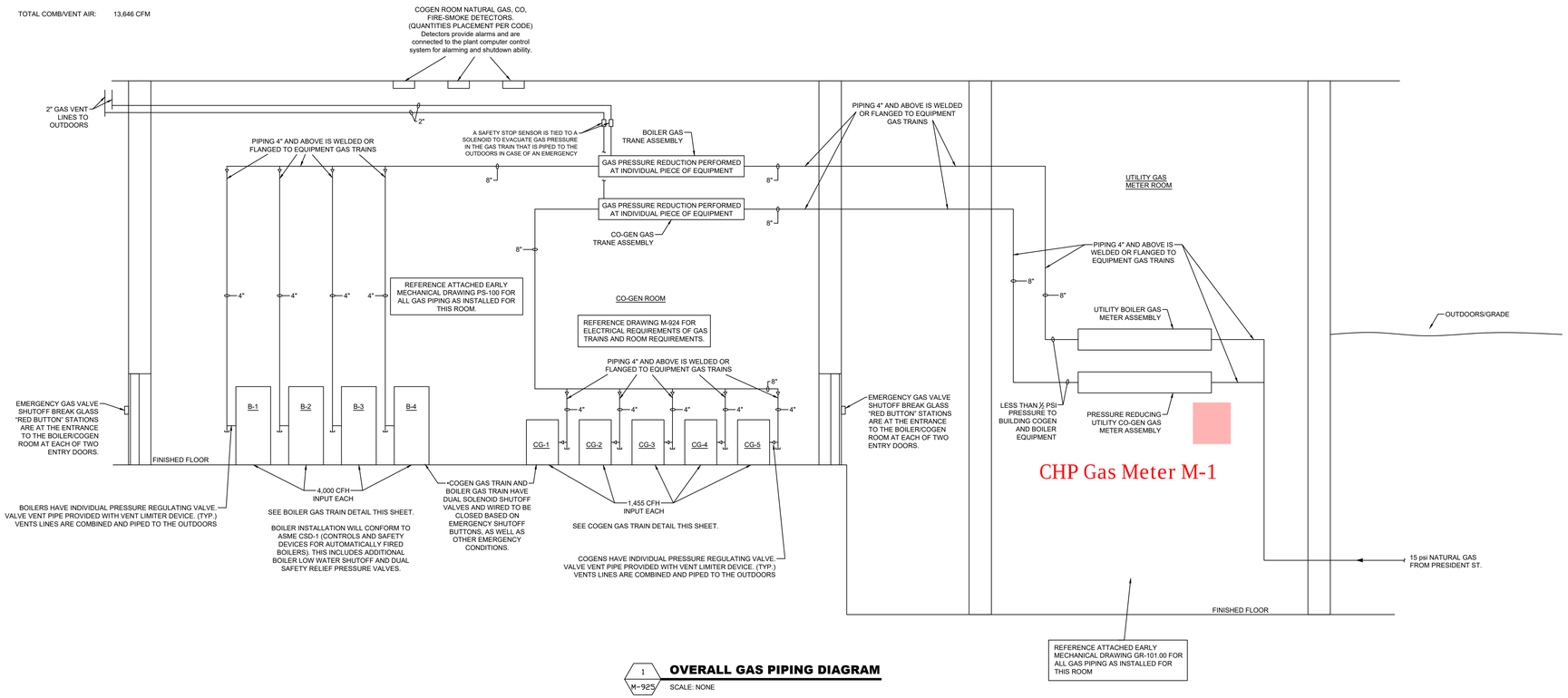
BOILER AND COGEN COMBUSTION AND VENTILATION AIR CALCULATIONS:

2014 NYC MECHANICAL CODE, SECTION 706:
COMBUSTION AIR SUPPLIED AT A RATE NOT LESS THAN 0.35 CFM/1000 BTU/H OF TOTAL INPUT RATING FOR ALL FUEL BURNING APPLIANCES.

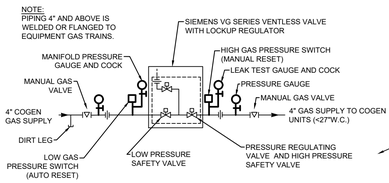
BOILER INPUT (4 UNITS): 16,000,000 BTU/H
COMBUSTION AIR: 5,600 CFM

COGEN INPUT (5 UNITS): 7,275,000 BTU/H
COMBUSTION AIR: 2,546 CFM
VENTILATION AIR: 5,500 CFM

TOTAL COMB/VENT AIR: 13,646 CFM



1 M-925 **OVERALL GAS PIPING DIAGRAM**
SCALE: NONE



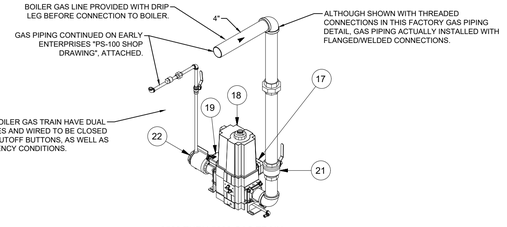
GAS TRAIN DETAIL - COGEN GAS
NO SCALE

GENERAL NOTES:
A. COMPONENTS MAY BE COMBINED WHEN AN APPROVED DEVICE IS AVAILABLE THAT SERVES MULTIPLE FUNCTIONS.

2 M-925 **GAS TRAIN COMPONENTS**

COGEN GAS TRAIN HAS DUAL SOLENOID SHUTOFF VALVES AND WIRED TO BE CLOSED BASED ON EMERGENCY SHUTOFF BUTTONS, AS WELL AS OTHER EMERGENCY CONDITIONS.

REFER TO DRAWING M-924 FOR ELECTRICAL CONNECTIONS AND CONTROL.



3500 THRU 5000 GAS TRAIN

FUTERA XLF MODEL 4000 BOILER

REF#	PART NAME	MODEL SIZE	QUANTITY
17	HIGH GAS PRESSURE SWITCH (MANUAL RESET)	4000	1
	GAS VALVE, MCB (NG)	4000	1
	TEST PORT (CSD-1)	4000	2
NS	FLANGE 2" (INLET)	4000	2
19	LOW GAS PRESSURE SWITCH (MANUAL RESET)	4000	1
21	FIRING VALVE, 2"	4000	1
22	"A" VALVE, 2"	4000	1

3 M-925 **B-1/4 BOILER GAS TRAIN DETAIL AND COMPONENTS**
SCALE: NONE

145 HUDSON STREET, FLR. 3 NEW YORK, NY 10013 212.616.0420

CLIENT **BFC PARTNERS**
STRUCTURAL ENGINEER **SEVERUD ASSOCIATES**
MEP ENGINEER **RODKIN CARDINALE, P.C. CONSULTING ENGINEERS**
GEOTECNICAL **GEODESIGN**
POOL CONSULTANT **TRACE POOL DESIGN**
EXPEDITING/CODE CONSULTING **JM ZONING**
CIVIL **BROOKER ENGINEERING**
FACADES **BURO HAPPOLD**
SUSTAINABILITY **BRIGHT POWER**
LANDSCAPE **XX**
MEP ENGINEER **INTEGRATED ENERGY CONCEPTS**

REV	DATE	DESCRIPTION
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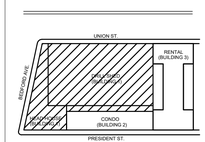
2	2/5/2021	DOB PAA #4



KEY PLAN

PROJECT NO. 16008

BEDFORD UNION ARMORY - BUILDING 01 DRILL SHED AND HEAD HOUSE

1555 Bedford Ave. Brooklyn, NY 11225

DETAILS - MECHANICAL GAS PIPING COORDINATION

DRAWING #:
M-925.00
55 of 222

DOB #: 340660314

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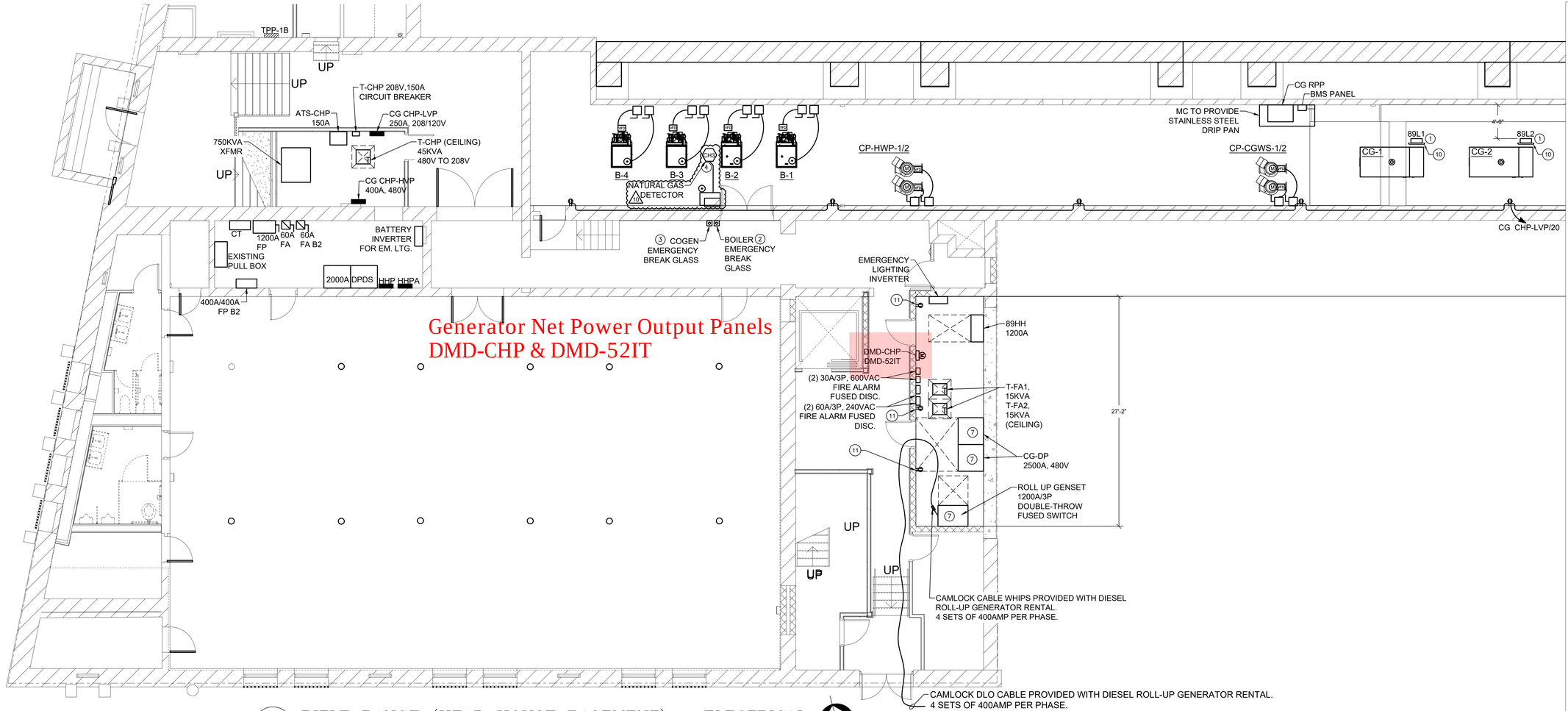
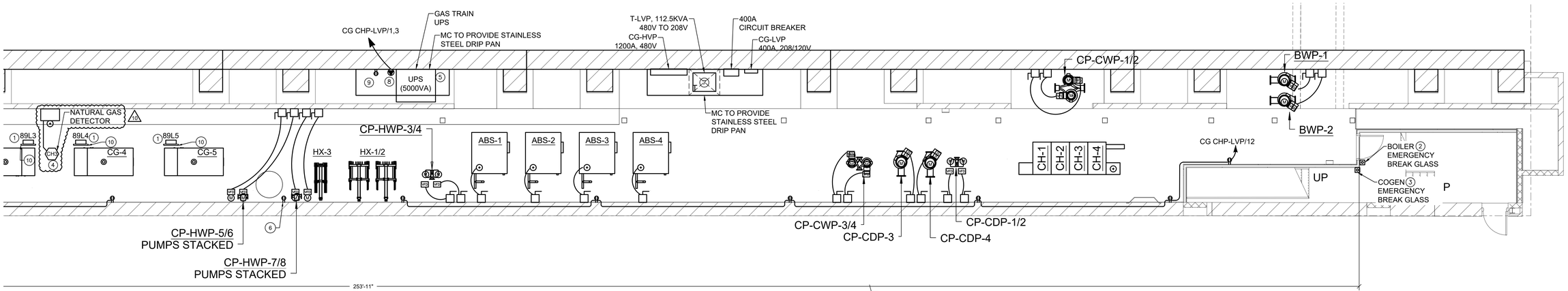


Generator Net Power Output Panels
DMD-CHP & DMD-52IT

1 RIFLE RANGE (HEAD HOUSE BASEMENT) – ELECTRICAL

E-801.00

SCALE: 3/16" = 1'-0"



2 RIFLE RANGE (HEAD HOUSE BASEMENT) – ELECTRICAL

E-801.00

SCALE: 3/16" = 1'-0"

GENERAL NOTES:

A. COORDINATE ALL CONDUIT RUNS WITH OTHER TRADES PRIOR TO STARTING WORK.

B. ELECTRICAL CIRCUITS/ PANEL BOARDS SHALL BE IDENTIFIED PER NEC STANDARDS.

C. REFER TO ARCHITECTURAL PLANS FOR FINAL LOCATIONS OF LIGHTS, SWITCHES AND OUTLETS PRIOR TO ROUGH-INS, REFER TO ELEVATIONS AND REFLECTED CEILING PLANS.

D. CLOSE OFF ALL EXISTING VENTS AND LOUVERS DURING CONSTRUCTION TO AVOID DUST INFILTRATION TO OTHER APARTMENTS. THIS IS MANDATORY.

E. PROVIDE TEMPORARY PROTECTION AT HALL TO AVOID DUST TRANSMISSION.

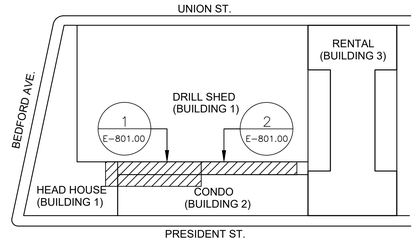
F. ALL POWER CONDUIT BELOW 10'-0" SHALL BE RIGID STEEL CONDUIT.

G. ALL 120VAC RECEPTACLES SHALL BE GFCI TYPE.

H. COORDINATE INSTALLATION OF MECHANICAL EQUIPMENT WITH MECHANICAL CONTRACTOR.

INSTALLATION NOTES:

1. ELECTRICAL CONDUIT FROM THE COGEN UNITS TO THE MAIN PANEL SHOULD BE PROPERLY SUPPORTED. GENERATOR DISCONNECT SWITCH LABELING TO BE PERMANENT AND WITH ½" HIGH LETTERS OR LARGER. THE LOCATION AND NATURE OF THE 89L DISCONNECT SWITCH SHALL BE INDICATED ON A PLACARD IN THE IMMEDIATE PROXIMITY OF THE ELECTRIC SERVICE ENTRANCE.
2. PROVIDE EMERGENCY SHUTDOWN STATION, BREAK GLASS TYPE WITH NEMA 1 ENCLOSURE AND ENGRAVED NAMEPLATE FOR BOILER SHUTDOWN. FURNISH AND INSTALL 4-#14 (2 SPARE), ¾"C AND WIRE TO EACH BOILER CONTROL IN ACCORDANCE WITH DETAIL 4 ON DRAWING E-951.
3. PROVIDE EMERGENCY SHUTDOWN STATION, BREAK GLASS TYPE WITH NEMA 1 ENCLOSURE AND ENGRAVED NAMEPLATE FOR COGENERATION UNIT SHUTDOWN. FURNISH AND INSTALL 4- #14 (2 SPARE), ¾"C AND WIRE TO EACH COGEN CONTROL IN ACCORDANCE WITH DETAIL 4 ON DRAWING-E951.
4. FURNISH AND INSTALL COMBINATION COMBUSTIBLE GAS AND CO GAS DETECTOR, WITH SEPERATE DRY CONTACT OUTPUT FOR LEL ALARM, CO ALARM, AND GAS DETECTOR FAILURE. PROVIDE 8-#14 (2 SPARE), 1"C TO EMS CONTROL PANEL FOR REMOTE MONITORING. MODEL E3SAH + E3SCO OR APPROVED EQUIVALENT. REFER TO DETAIL 2 ON DRAWING E-951.
5. PROVIDE A FIELD CONSTRUCTION UNISTRUT SHELVE TO MOUNT NEW 5000VA UPS AT EYE LEVEL.
6. PROVIDE 120VAC RECEPTACLE FOR GLYCOL FILL STATION FROM PANEL GC CHP-LVP, CIRCUITS 2. COORDINATE INSTALLATION LOCATION WITH MECHANICAL CONTRACTOR.
7. PROVIDE 4" THINK CONCRETE HOUSE KEEP PAD. CONCRETE PAD BY BY ELECTRICAL CONTRACTOR.
8. PROVIDE 30A, 250V TWIST LOCK RECEPTACLE TYPE L14-30R THAT MATCHES UPS INPUT POWER CORD.
9. PROVIDE 20A, 120V RECEPTACLE TYPE 5-15P THAT MATCHES UPS INPUT POWER RECEPTACLE. PROVIDE A#10 AWG SJO CORD WHIP WITH THE PLUG LONG ENOUGH TO ALLOW THE PLUG TO CONNECT TO UPS'S INPUT POWER RECEPTACLE TO BYPASS UPS WHEN NEEDED.
10. PROVIDE 5' HALF HEIGHT UNISTRUT WALL WITH ¾" PLYWOOD BACKBOARD WITH TWO COATS OF GREY FIREPROOF PRIMER TO MOUNT COGEN UNIT DISCONNECT SWITCH 89L.
11. CIRCUIT 120VAC GENERAL PUPOSE RECEPTACLE TO PANEL GC CHP-LVP, CIRCUITS 4.



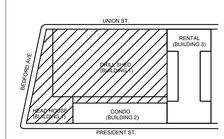
KEY PLAN

SCALE: NONE

145 HUDSON STREET, FLR. 3 NEW YORK, NY
10013 212.616.0420

CLIENT **BFC PARTNERS**
STRUCTURAL ENGINEER **SEVERUD ASSOCIATES**
MEP ENGINEER **RODKIN CARDINALE, P.C. CONSULTING ENGINEERS**
GEOTECNICAL **GEODESIGN**
POOL CONSULTANT **TRACE POOL DESIGN**
EXPEDITING/CODE CONSULTING **JM ZONING**
CIVIL **BROOKER ENGINEERING**
FACADES **BURO HAPPOLD**
SUSTAINABILITY **BRIGHT POWER**
LANDSCAPE **XX**
MEP ENGINEER **INTEGRATED ENERGY CONCEPTS**

REV	DATE	DESCRIPTION
2	6/25/2018	75% PROGRESS SET
3	7/27/2018	100% CD SET
4	6/17/2019	CONFORMANCE SET
5	11/1/2019	CONFORMANCE SET
6	1/22/2020	ELECTRICAL COORDINATION
7	2/10/2020	BULLETIN 1
8	3/27/2020	DOB PAA #1
9	6/26/2020	BULLETIN 2
10	9/8/2020	DOB SUBMISSION



KEY PLAN

PROJECT NO. 16008

BEDFORD UNION ARMORY - BUILDING 01 DRILL SHED AND HEAD HOUSE

1555 Bedford Ave. Brooklyn, NY 11225

RIFLE RANGE (HEAD HOUSE BASEMENT) - ELECTRICAL

DRAWING #:

E-801.00

55 of 222

DOB #: 340640756

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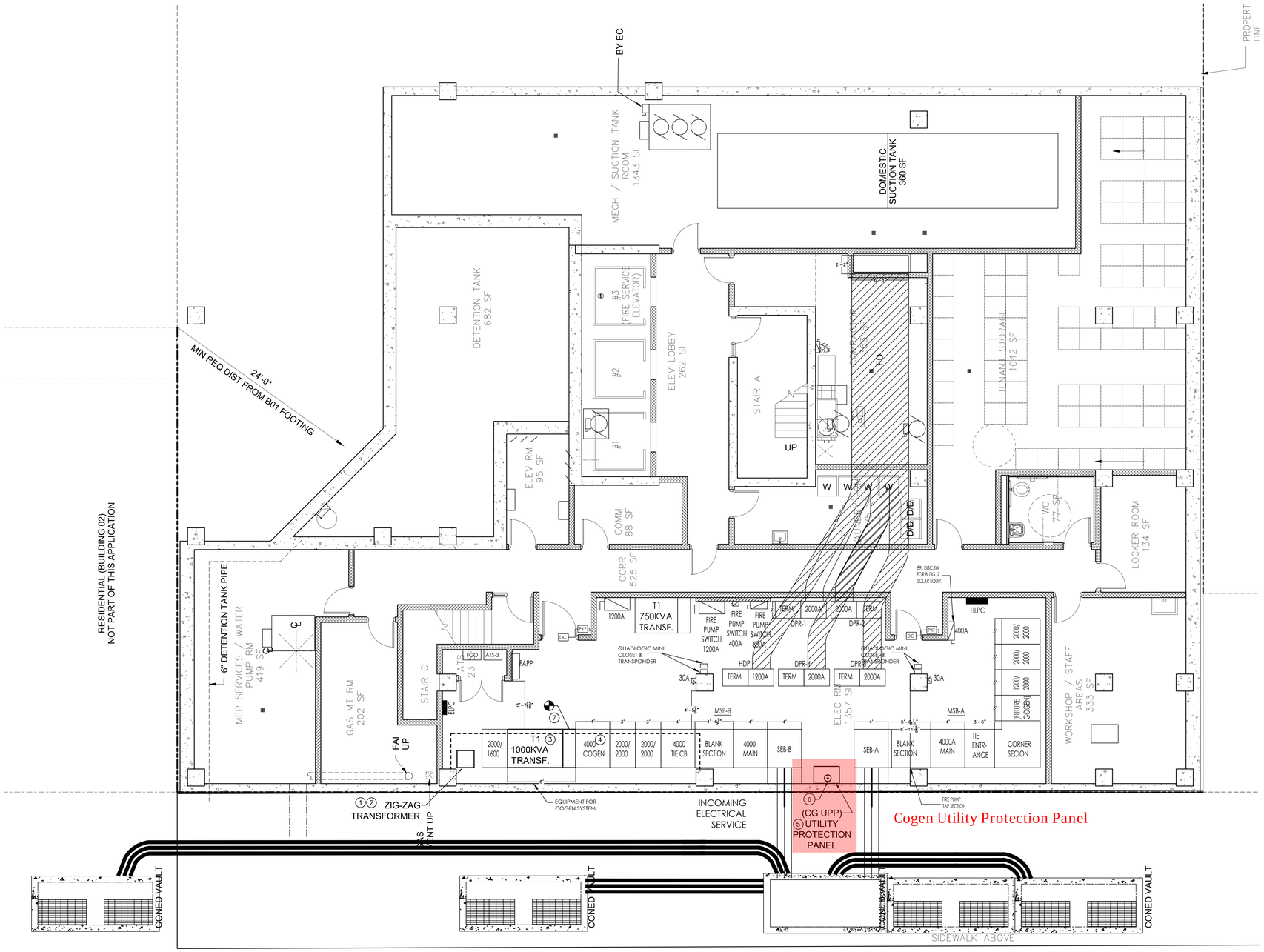


1 / E-803.00 BUILDING 3 – ELECTRICAL ROOM

SCALE: 3/16" = 1'-0"

GENERAL NOTES:

A. COORDINATE ALL CONDUIT RUNS WITH OTHER TRADES PRIOR TO STARTING WORK.

B. ELECTRICAL CIRCUITS/ PANEL BOARDS SHALL BE IDENTIFIED PER NEC STANDARDS.

C. REFER TO ARCHITECTURAL PLANS FOR FINAL LOCATIONS OF LIGHTS, SWITCHES AND OUTLETS PRIOR TO ROUGH-INS, REFER TO ELEVATIONS AND REFLECTED CEILING PLANS.

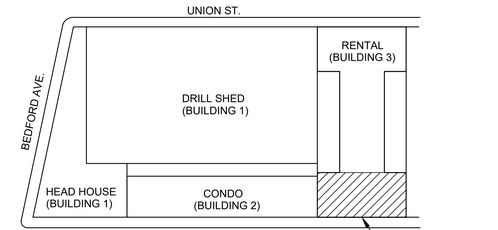
D. CLOSE OFF ALL EXISTING VENTS AND LOUVERS DURING CONSTRUCTION TO AVOID DUST INFILTRATION TO OTHER APARTMENTS. THIS IS MANDATORY.

E. PROVIDE TEMPORARY PROTECTION AT HALL TO AVOID DUST TRANSMISSION.

F. ALL POWER CONDUIT BELOW 10'-0" SHALL BE RIGID STEEL CONDUIT.

INSTALLATION NOTES:

1. FURNISH AND INSTALL ZIG-ZAG TRANSFORMER.
2. EXTEND REQUIRED CABLES FROM MAIN PANEL IN THE RIFLE RANGE AT BUILDING 1 TO ZIG-ZAG TRANSFORMER.
3. UPGRADE TRANSFORMER (T1) SIZE TO BE 1500KVA.
4. UPGRADE COGEN SWITCH TO BE 4000A.
5. FURNISH AND INSTALL UTILITY PROTECTION PANEL.
6. PROVIDE 120VAC, 20A/1P POWER CONNECTION TO UTILITY PROTECTION PANEL (UPP) FROM CG CHP-LVP.
7. POINT WHERE COGEN SYSTEM TIES WITH MAIN SWITCH BOARD B (MSB-B).



KEY PLAN

SCALE: NONE

1 / E-803.00

145 HUDSON STREET, FLR. 3 NEW YORK, NY 10013 212.616.0420

CLIENT **BFC PARTNERS**

STRUCTURAL ENGINEER **SEVERUD ASSOCIATES**

MEP ENGINEER **RODKIN CARDINALE, P.C. CONSULTING ENGINEERS**

GEOTECNICAL **GEODESIGN**

POOL CONSULTANT **TRACE POOL DESIGN**

EXPEDITING/CODE CONSULTING **JM ZONING**

CIVIL **BROOKER ENGINEERING**

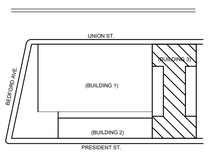
FACADES **BURO HAPPOLD**

SUSTAINABILITY **BRIGHT POWER**

LANDSCAPE **XX**

MEP ENGINEER **INTEGRATED ENERGY CONCEPTS**

REV	DATE	DESCRIPTION
1	6/25/2018	75% PROGRESS SET
2	7/27/2018	100% CD SET
3	10/31/2018	DEMARCATION UPDATES
4	6/17/2019	CONFORMANCE SET
5	11/1/2019	CONFORMANCE SET
6	6/26/2020	BULLETIN 2



KEY PLAN

PROJECT NO. 16008

BEDFORD UNION ARMORY - BUILDING 03

1555 Bedford Ave. Brooklyn, NY 11225

BUILDING 3 - ELECTRICAL ROOM

DRAWING #:

E-803.00

DOB #:

6/26/2020 9:26:25 AM

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Appendix B

Cut Sheets for Key Sensors and Instruments

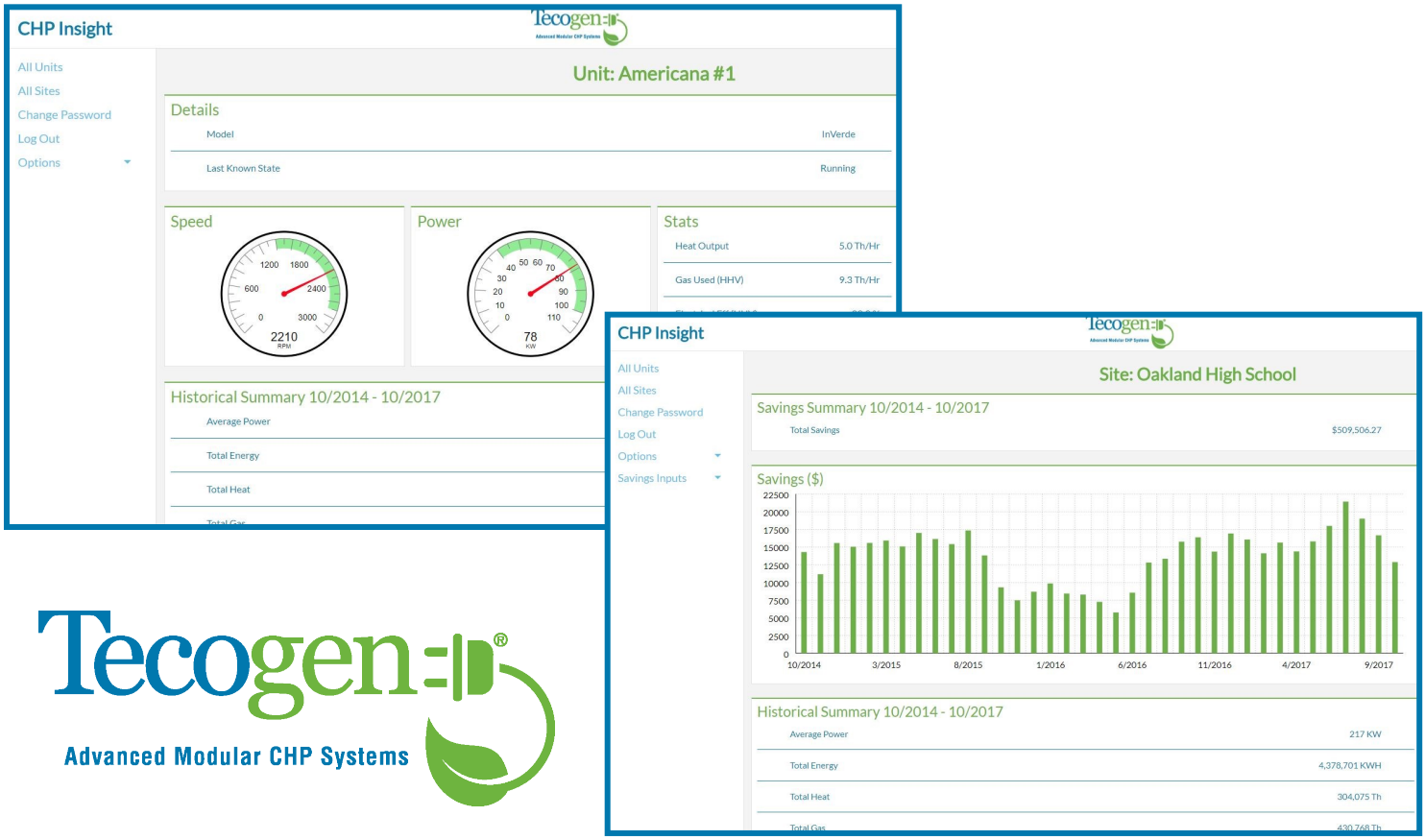
SERVICE & PERFORMANCE

CHP Insight

Real-time data analytics for our customers with service programs

CHP Insight allows Tecogen to collect, analyze and manage data continuously and in real time, providing improved insight into the functioning of its CHP units, chillers and water heaters.

- *Ensures peak performance for maximum runtime and maximum customer savings*
- *Provides secure, continuous monitoring of key operating parameters*
- *Delivers real-time information to the factory, service technicians and customers*
- *Uses advanced diagnostics to provide predictive maintenance*
- *Enables Tecogen to create custom dashboards that allow customers to view their unit's operating history and the savings they have produced*



Tecogen®
Advanced Modular CHP Systems

Tecogen Inc., 45 First Avenue, Waltham, MA 02451
781.466.6400 • www.tecogen.com • FactoryService@tecogen.com

Tecogen®
Advanced Modular CHP Systems

Remote Internet Connectivity Requirements | CHP*Insight*

Why is the connection needed and who is connecting?

The purpose of internet connectivity is to allow the use of our proprietary Remote Monitoring and Control Software (RMCS) to connect to the machines remotely for diagnostics and configuring the machine in certain situations. It also allows for the utilization of Tecogen's CHP*Insight* Panel. This panel is responsible for acquiring all metering and unit data and providing real-time alarm notifications for rapid service response. If the machine is under a factory service contract, receiving utility incentives or obtaining state credits, it is a mandatory requirement to allow the CHP*Insight* to connect through the facilities network.

What is needed from the customer?

The preferred method of connectivity is with DHCP. Used on IP networks, DHCP is a network protocol that automatically assigns an IP address, subnet mask, gateway address, domain name server (DNS) addresses and other relevant configuration parameters to each device on a network, allowing them to communicate via IP. When this is provided by the site, no further information will be needed by the customer. Often, a facility will not permit DHCP, which will then require the use of a static IP address.

Regardless of the network configuration, the CHP*Insight* Panel requires a single drop location. A CAT5 cable, or CAT6 for runs exceeding 200ft, is required to be installed from the facility provided drop location to the panel. A separate CAT5 is wired from this panel to the VLINX, located in each piece of Tecogen equipment. The CHP*Insight* system must be able to reach the following two addresses:

WinRMCS.Tecogen.com @ 34.216.170.3 on TCP ports 443 and 943, and UDP port 1194.

Gm21.Secomea.com @ 68.70.163.19 on TCP ports 80, 443, and 11444.

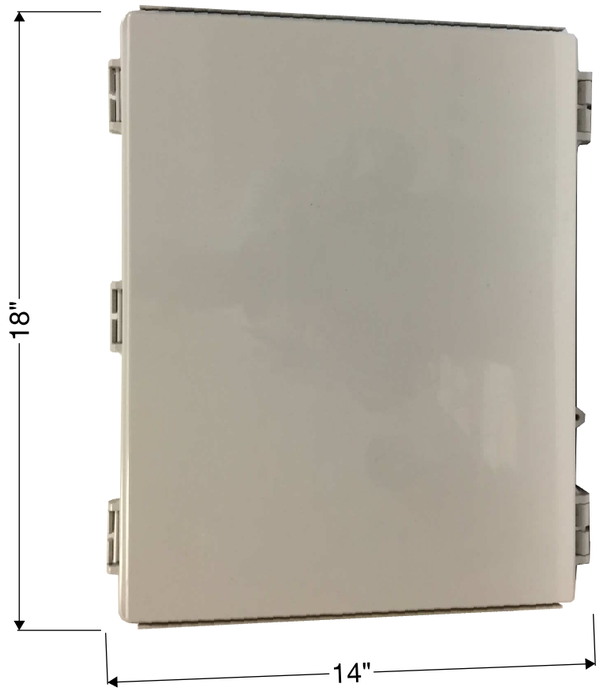
Static IP Address Requirements:

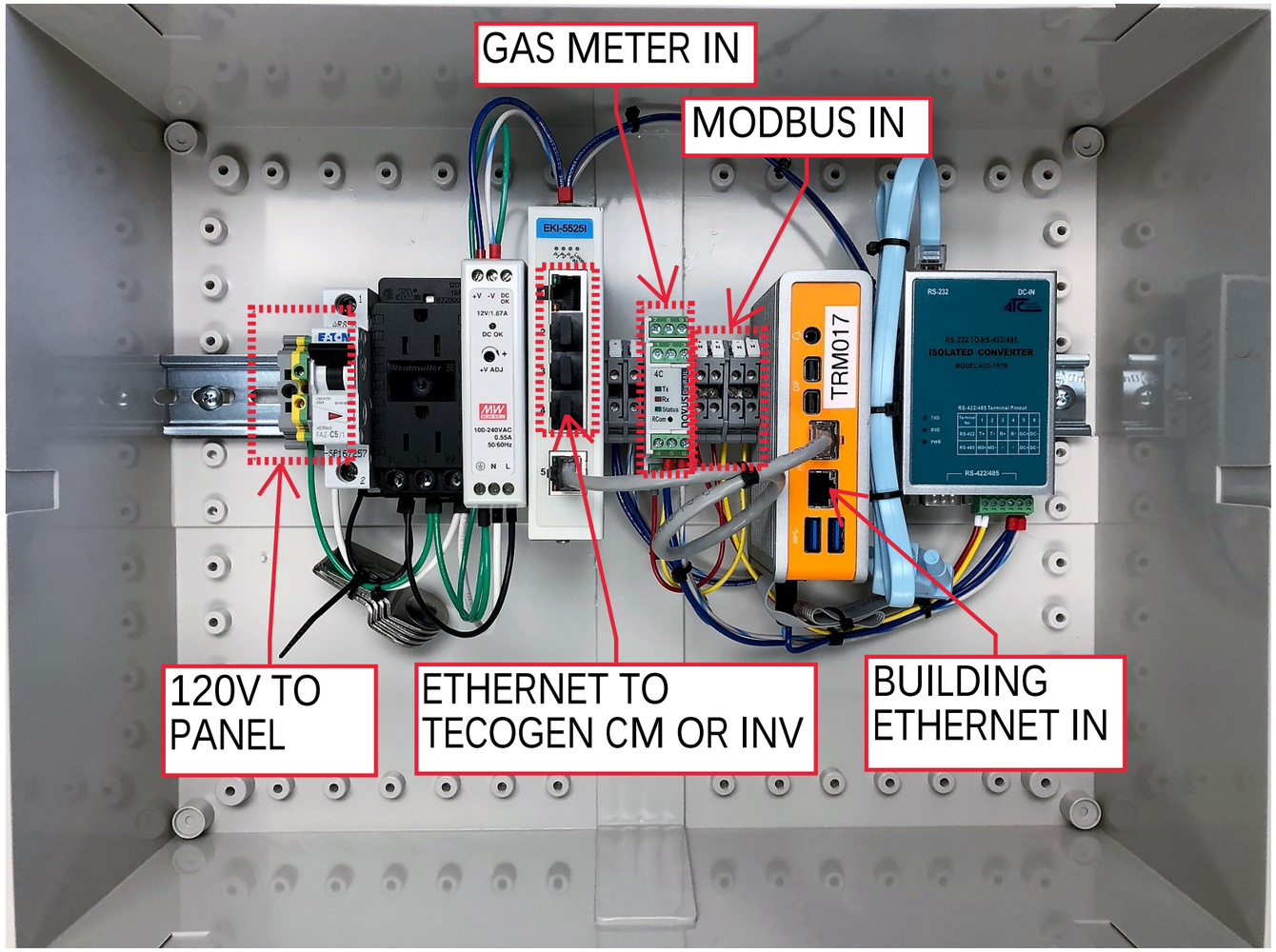
In lieu of using DHCP, the customer may assign the Tecogen CHP*Insight* Panel a static private IP address, subnet mask, gateway address, and domain name server (DNS) addresses. This should be completed before start-up/commissioning. The CHP*Insight* cannot be provided until Tecogen has received this information. Tecogen technicians do not have the ability to program this in field. The following is a sample of what is required:

IP address: 10.51.141.57
Subnet: 255.255.255.0
Gateway: 10.51.141.1
Primary DNS: 8.8.8.8
Secondary DNS: 8.8.4.4

Case of Multiple Machines with Static IP Address:

If multiple machines are installed at a site, the customer needs to provide only a single network drop to the CHP*Insight* panel. Connections to the individual units are forwarded from the CHP*Insight* panel on a separate, private network.





Tecogen
45 FIRST AVE, WALTHAM, MA 02451
(781) 466-6400
WWW.TECOGEN.COM

MECHANICAL ENGINEER

ELECTRICAL ENGINEER

PE STAMP/SEAL

DATE	REV	DESCRIPTION

CHP INSIGHT PANEL
2019 REVISION

PROJECT

5/17/19	BJGE
DATE	DRAWN BY

DRAWING TITLE

83041

DRAWING NUMBER

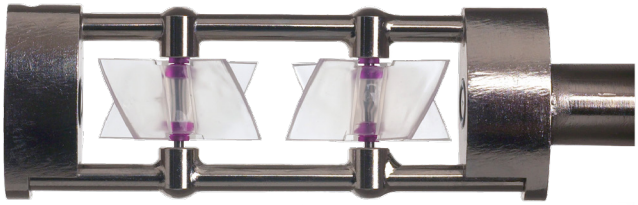
ONICON
Flow and Energy Measurement

F-1000 SERIES
TURBINE FLOW METERS

Bluetooth®

The F-1000 Series family of inline and insertion style turbine flow meters are designed to provide accurate and reliable flow measurement in a variety of applications in the HVAC market.

• Chilled Water • Heating Hot Water • Domestic/Municipal Water • • Clean Process Water •



DESCRIPTION

ONICON's F-1000 Series is a family of insertion and inline style turbine flow meters that provide accurate, reliable flow measurement in a variety of applications.

The F-1000 Series flow meters are suitable for use in pipes ranging in size from ¾" to 72" in diameter. Each model utilizes ONICON's patented electronic turbine rotation sensing system and unique low mass turbine design that is accurate over wide flow ranges with excellent low flow measurement capability.

APPLICATIONS

- HVAC hydronic applications including chilled water, heating hot water and water/glycol solutions
- Domestic/municipal water*
- Clean process water*

FEATURES

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

Simplified Hot Tap Insertion Design
This feature allows insertion meters to be removed, by hand, without system shutdown.

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.

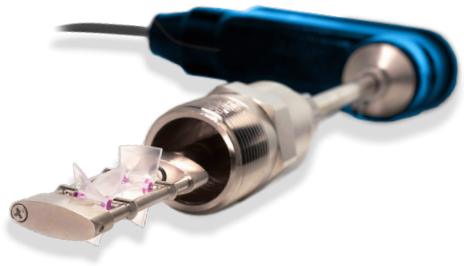
The Dual Turbine Advantage
Dual counter-rotating turbines with mirrored helixes reduce the effects of the most common type of flow distortion, the swirl caused by bends and elbows. This reduces the upstream straight run requirements in some applications.

Programmable with Built-in Diagnostics
The USB interface makes field programming simple. Advanced diagnostics provide real-time data from the meter.

Bluetooth® Connectivity
Optional Bluetooth® interface enables wireless access to real-time data for fast commissioning and advanced diagnositcs.

CALIBRATION

All F-1000 Series flow meters are wet calibrated in a flow laboratory against standards that are directly traceable to National Institute of Standards and Technology (N.I.S.T.). A certificate of calibration accompanies every meter.



*Insertion meters only

SPECIFICATIONS*

MODEL F-11XX AND F-12XX TRANSMITTER		
PERFORMANCE	INSERTION ACCURACY	± 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)
	INLINE ACCURACY	± 2% of reading from 0.8 to 38 GPM (50:1 range)
	MINIMUM CONDUCTIVITY[1]	Default range: 100-5000 µS/cm Extended range as low as 5 µS/cm
INPUT POWER	Input power based on model number	
	F-1XXX-00	24 VAC @ 65 mA, 1.6 VA 24 VDC @ 30 mA, 1 W
	F-1XXX-10	24 VAC @ 115 mA, 2.8 VA 24 VDC @ 60 mA, 1.5 W
	F-1XXX-11	24 VAC @ 150 mA, 3.6 VA 24 VDC @ 75 mA, 2W
I/O SIGNAL**	AVAILABLE OPTIONS	• Frequency output • Scaled pulse (dry contact) output • Analog output • Isolated analog output
	FREQUENCY OUTPUT	0-15V peak pulse, maximum Hz
	SCALED PULSE/ ALARM OUTPUT	Isolated solid state dry contact Contact rating: 100 mA, 50 V Contact duration: Field programmable; 50, 100, 500 or 1000 ms
	ANALOG OUTPUT	Field programmable, 4-20 mA, 0-10 V, or 0-5 V
	ISOLATED ANALOG OUTPUT	Field programmable, 4-20 mA, 0-10 V, or 0-5 V
ELECTRONICS ENCLOSURE**	AVAILABLE OPTIONS	• Default Configuration: Cast aluminum, epoxy coated weathertight NEMA 4 rated enclosure. • Bluetooth Configuration: Cast aluminum, acetal plastic, and epoxy coated weathertight NEMA 4 rated enclosure. • Submersible Configuration: Aluminum, epoxy coated submersible NEMA 6 rated enclosure.[2]
	AMBIENT CONDITIONS	-5°F to 160°F
ELECTRICAL CONNECTIONS**	AVAILABLE OPTIONS	• PVC jacketed cable, pig tail with ½" NPT conduit connection • Plenum rated cable with indoor DIN connector • Submersible cable with connector[2]
BLUETOOTH®	VERSION	Bluetooth v5.1, Low Energy (BLE)
	MODE	Single
	CONNECTIVITY RANGE	Up to 50 ft

[1] Conductivity can be lower depending on application criteria . Contact factory for application assistance.
[2] Insertion meters only
*Specifications subject to change without notice.
**See model codification for additional information regarding option selections.

SPECIFICATIONS CONTINUED*

MODEL F-11XX AND F-12XX SENSOR		
PERFORMANCE	SENSING METHOD	Electronic impedance sensing (non-magnetic and non-photoelectric)
	ACCURACY	± 0.5% of reading at calibrated velocity
OPERATING CONDITIONS	FLUID TEMPERATURE	Low temp: -20°F to 150°F continuous High temp: 150°F to 280°F continuous, 300°F peak[3]
	MAXIMUM OPERATING PRESSURE	400 psi maximum
	INSERTION PRESSURE DROP	Less than 0.16 psi at 8 ft/s, decreasing in larger pipes and lower velocities
	INLINE PRESSURE DROP	0.48 psi at maximum flow rate
CONSTRUCTION MATERIALS**	AVAILABLE OPTIONS	• Electroless nickel plated brass • 316 stainless steel, required for certain applications and non-metallic pipes[2] • Bronze body[4]
PIPE SIZE RANGE	INSERTION	1¼ - 72" nominal diameter (1" available with ONICON copper tee)
	INLINE	Threaded or sweat union fittings - ¾" or 1" nominal diameter
PROCESS CONNECTIONS	INSERTION	1" NPT adapter
	INLINE	Coupling adapters based on pipe material
APPROVAL	SAFE DRINKING WATER[2]	NSF/ANSI 61
	LEAD CONTENT VERIFICATION[2]	NSF/ANSI 372

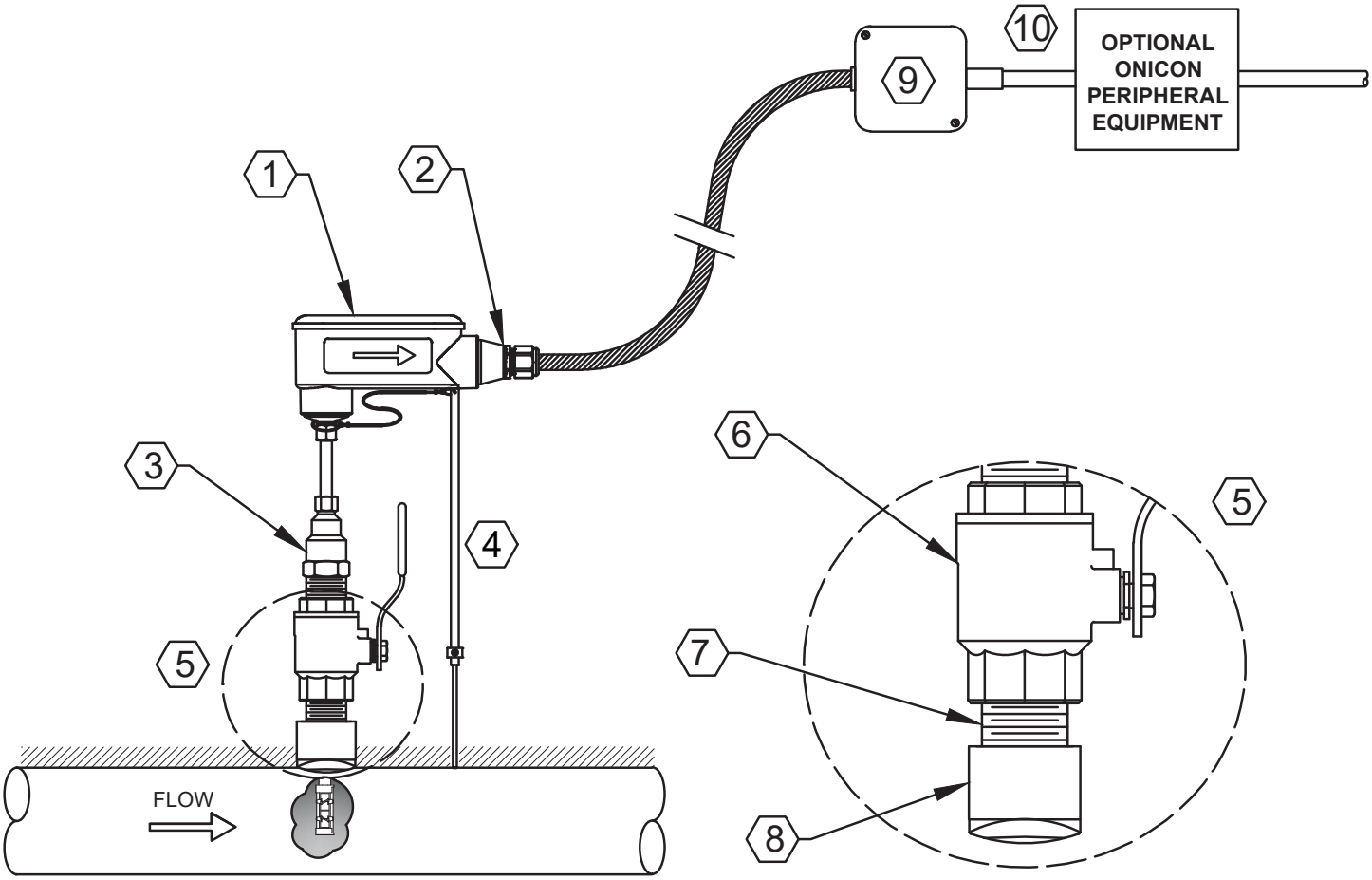
OPERATING RANGE FOR COMMON PIPE SIZES
(±2% accuracy begins at 0.4 ft/s)

PIPE SIZE (inches)	FLOW RATE (GPM) (0.1 ft/s to 20 ft/s)	PIPE SIZE (inches)	FLOW RATE (GPM) (0.1 ft/s to 20 ft/s)	PIPE SIZE (inches)	FLOW RATE (GPM) (0.1 ft/s to 20 ft/s)
¾	0.4 - 38	4	8 - 800	18	120 - 14,600
1	0.4 - 38	6	15 - 1,800	20	150 - 18,100
1¼	0.8 - 95	8	26 - 3,100	24	230 - 26,500
1½	1 - 130	10	42 - 4,900	30	360 - 41,900
2	2 - 210	12	60 - 7,050	36	510 - 60,900
2½	2.5 - 230	14	72 - 8,600		
3	4 - 460	16	98 - 11,400		

[2] Insertion meters only
[3] Insertion meters operating at or above 250°F require 316 SS construction option.
[4] Inline meters only
*Specifications subject to change without notice.
**See model codification for additional information regarding option selections.

TYPICAL INSTALLATION

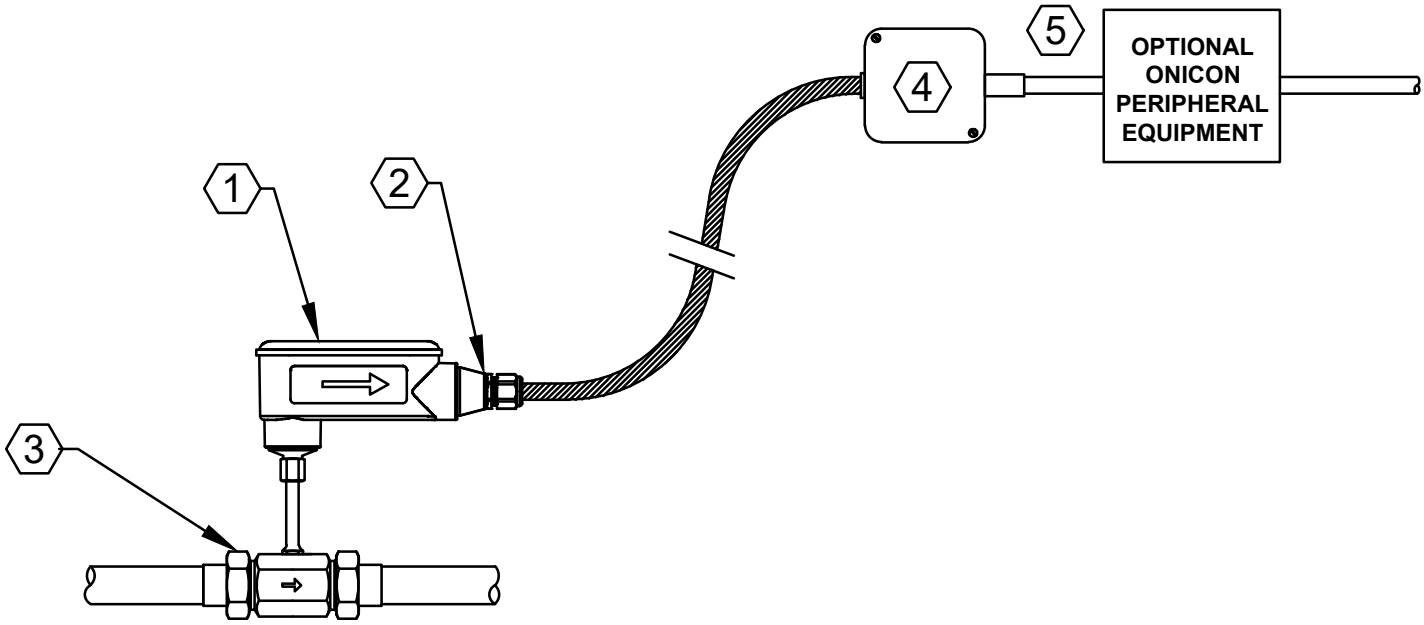
Insertion Style Turbine Meter



1. Electronics enclosure with flow direction indicator
2. ½" FNPT conduit connection
3. Hot tap adapter
4. Depth gauge
5. Typical installation kit for steel pipe
6. Full port isolation valve, 1" NPT minimum (1¼" NPT minimum required for Hot Tap installations)
7. Threaded close nipple, 1" NPT minimum (1¼" NPT minimum required for Hot Tap installations)
8. Welded branch outlet, 1" NPT minimum (1¼" NPT minimum required for Hot Tap installations)
9. Connect factory wires to field wires in appropriate junction box
10. Flow meter output signals provided for connection to control system or ONICON peripheral equipment.

TYPICAL INSTALLATION (CONTINUED)

Inline Style Turbine Meter



1. Electronics enclosure with flow direction indicator
2. ½" FNPT conduit connection
3. Sweat or NPT process connection
4. Connect factory wires to field wires in appropriate junction box
5. Flow meter output signals provided for connection to control system or ONICON peripheral equipment.

METER ORDERING INFORMATION
F-1000 Meter Model Number Codification = F-1ABB-CC-DD-EFGH-SPC

A = Number of Turbines
1 = Single turbine
2 = Dual turbine

BB = Meter Type
00 = Insertion
34 = ¾″ Inline
01 = 1″ Inline

CC = Outputs
00 = Frequency and scaled pulse (dry contact) output
10 = Frequency, analog and scaled pulse (dry contact) output
11 = Frequency, isolated analog and scaled pulse (dry contact) output

DD = Pipe Size Range
A1 = 1″ - 2.5″ (F-1100 only)
B2 = 1″ - 4.0″ (F-1100 only)
C3 = 2.5″ - 10″
D4 = 2.5″ - 16″
E5 = 2.5″ - 22″
F6 = 2.5″ - 72″
00 = Inline

E = Wetted Materials
1 = Ni plated brass
2 = 316 SS[1]
3 = Bronze body, inline

F = Electronics Enclosure
2 = NEMA 4 weathertight enclosure
3 = NEMA 6 submersible enclosure[2]

G = Wiring Connection
2 = 10′ PVC jacketed cable, pig tail with ½″ conduit adapter
5 = 10′ Plenum rated cable, DIN connector with ½″ conduit adapter
7 = 10′ Submersible cable with connector[3]

H = Process Adapter
1 = 1″ NPT adapter, medium temperature (temp. ≤ 150°F)
2 = 1″ NPT adapter, high temperature (temp. ≤ 280°F)
3 = 1″ NPT adapter, NSF certified, domestic water (temp. ≤ 200°F)
9 = Inline, coupling adapters based on pipe material

SPC = Special Configurations
503 = Bluetooth interface (For F = 2 only)

[1] Required for certain applications and non-metallic pipes.
[2] Insertion meters only. Requires wetted materials option E = 2 and wiring connection option G = 7.
[3] Requires wetted materials option E = 2 and electronics enclosure option F = 3.

System-40

BTU MEASUREMENT SYSTEM

The System-40 Series is a family of inline BTU meters that provide accurate and reliable energy, flow, and temperature measurement for a variety of applications.

• Chilled Water • Hot Water • Condenser Water •

DESCRIPTION

System-40 Series BTU Meters provide highly accurate thermal energy measurement in water and water/glycol heating and cooling systems. Each meter includes an integral inline flow sensor and a pair of precision matched temperature sensors. The compact design also features an easy to operate user interface and is available in several different configurations.

APPLICATIONS

Monitoring chilled water, hot water and condenser water in AHU and CRAC units for:

- Commercial office tenant billing
- Residential apartment and condominium tenant billing

Monitoring renewable energy resources for:

- Solar thermal applications
- Ground source heat pumps
- Geothermal heating systems

CALIBRATION

Each System-40 is subjected to a comprehensive series of conformance tests which ensures that each meter is fully functional and meets the published performance and accuracy specifications. The absolute accuracy of conformance test equipment is directly traceable to NIST*. A certificate of conformance is provided.

FEATURES

Reliable No-Moving-Parts Design - Wetted transducers measure the ultrasonic signal transit time differential, which correlates directly to the flow rate. The direct beam path orientation significantly enhances signal strength and long term reliability.

Highly Accurate Over a Wide Flow Range - The flow sensor is accurate to within ±1% of reading over the normal (25:1 turndown) operating range and within ±2% of reading over an extended (100:1 turndown) range.

User Friendly Backlit Display - The bright, easy-to-read, backlit display uses smart button technology to simplify page navigation and programming. This eliminates the need for special configuration tools.

Matched Platinum 1000Ω RTD Temperature Sensors - Sensors are paired in a matching process that ensures a differential measurement uncertainty of better than ±0.18°F.

Suitable for Water and Water/Glycol Solutions - The System-40 is field programmable for both water and water/glycol solutions to ensure accurate flow and energy measurement.

Detachable Display - The display for the System-40 is easily detached from the flow sensor. This allows for remote mount installation up to 5ft from the sensor body.

Built-in Interval Data Logger - Energy and volume totals are date/time stamped and logged within the meter along with other analytical data. This data is available via BACnet®.

APPROVALS

- FCC: Part 15, Subpart B
- NSF/ANSI 61 & 372
- BTL Certified to ASHRAE 135:2009

*National Institute of Standards and Technology

SPECIFICATIONS*

SYSTEM-40 TRANSMITTER		
PERFORMANCE	CALCULATOR ACCURACY	Meets EN1434 Class 1 requirements with 3K minimum Δt Computation Error: ≤ 0.09% at 30°F Δt
	REPEATABILITY	≤ ±0.2%
OPERATING CONDITIONS	OPERATING TEMPERATURE	-13°F to 131°F
	STORAGE TEMPERATURE	-14°F to 158°F
INPUT POWER**	20-28V AC/DC, 50/60 Hz, 5 VA maximum	
I/O SIGNAL**	AVAILABLE OPTIONS	• Two (2) aux pulsed inputs & one (1) aux pulsed output • One (1) aux pulsed input, one (1) aux pulsed output & one (1) analog output
	ISOLATED ANALOG OUTPUT	May be programmable for energy rate, flow rate, supply temperature, return temperature or ΔT Configurable: 4-20 mA, 0-5 V or 0-10 V output
	ISOLATED TOTALIZING SOLID STATE CONTACT CLOSURE PULSE OUTPUTS	May be programmed for energy, volume, alarm indication, mode indication or MODBUS coil indication Contact Rating: 50 mA, 30 V Contact Pulse Duration: 50, 100, 500 or 1000 ms
	ISOLATED TOTALIZING PULSE INPUTS	For use with devices providing sinking open collector or dry contact outputs Input Rating: 30 VDC, 10 mA maximum Pulse Duration: 50 ms minimum
ELECTRONICS ENCLOSURE**	IP65 polycarbonate with display	
	WETTED COMPONENTS	Lead-free brass, PEEK
NETWORK CONNECTIONS**	Isolated RS485 serial interface	
	AVAILABLE OPTIONS	• BACnet® MS/TP per ASHRAE Standard 135.1: 2009 • MODBUS® RTU
NETWORK CONFIGURATION & ADDRESSING	BAUD RATES	4800, 9600, 19200, 38400, 76800, or 115200
	DEVICE ADDRESS RANGE	1 – 127 (1 - 247 MODBUS® RTU)
	DEVICE INSTANCE RANGE	1 – 4,194,302 (BACnet® only)
	PARITY	None, Even, Odd (MODBUS® RTU only)
APPROVALS	FCC	Part 15, Subpart B
	BTL	Certified to ASHRAE 135:2009

*Specifications subject to change without notice.

**See model codification for additional information regarding option selections.

SPECIFICATIONS CONTINUED*

SYSTEM-40 FLOW SENSOR		
PERFORMANCE	SENSING METHOD	Inline wetted ultrasonic sensing (no moving parts)
	ACCURACY	±1% of reading over 25:1 turndown ±2% of reading over 100:1 turndown Overall turndown exceeds 500:1 Meets EN1434 Class 1 accuracy requirements
OPERATING CONDITIONS	Meets EN1434/C900.1 Class A requirements	
	FLUID TEMPERATURE	32°F to 250°F
	MAXIMUM OPERATING PRESSURE	400 psi (threaded only)
	PRESSURE DROP	Less than 1 psi at 4 ft/s, decreasing at lower velocities
TEMPERATURE SENSORS	Field serviceable MID certified matched pair of 2-wire 1000Ω platinum RTDs Calibrated to a differential measurement uncertainty of ±0.18°F Meets EN1434/C900.1 accuracy requirements for 3K sensors	
PIPE SIZE RANGE**	½ - 2½" nominal diameter	
PROCESS CONNECTIONS**	AVAILABLE OPTIONS	• Male NPT threads • 2½" meter provided with ANSI Class 150 raised face flanges
APPROVALS	NSF/ANSI	61
	NSF/ANSI	372

*Specifications subject to change without notice.

**See model codification for additional information regarding option selections.

TYPICAL INSTALLATION

(Meter may be installed in either supply or return line)

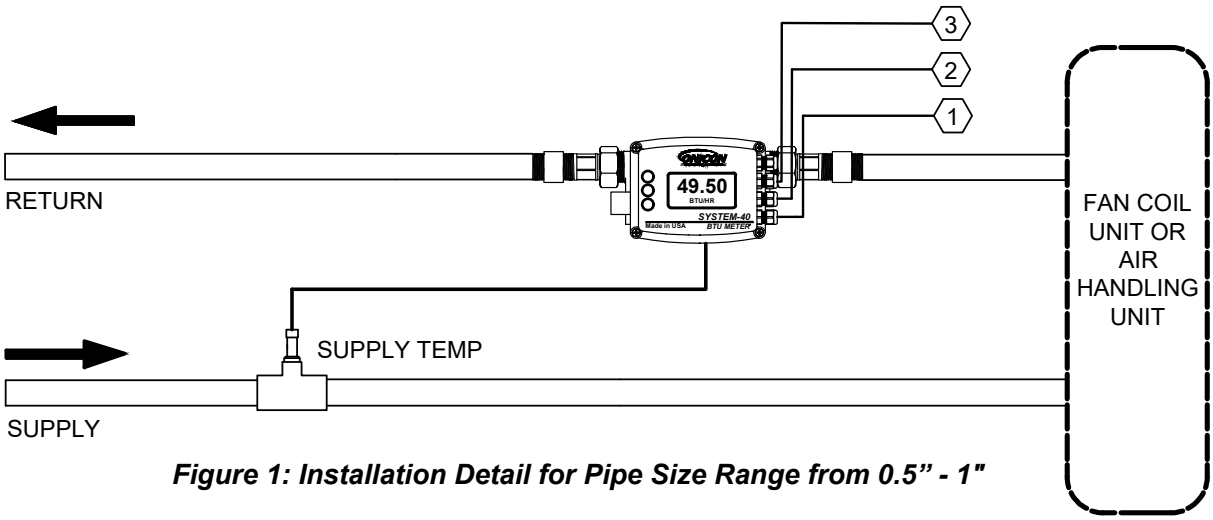


Figure 1: Installation Detail for Pipe Size Range from 0.5" - 1"

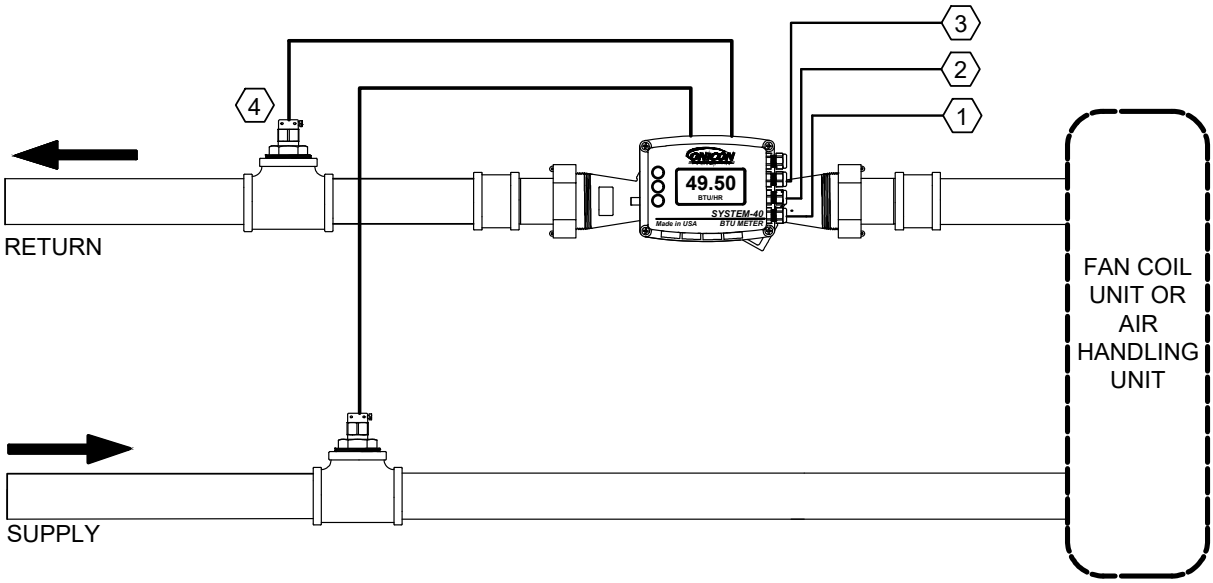


Figure 2: Installation Detail for Pipe Size Range from 1.25" - 2.5"

1. Input Power: 24 VAC/VDC, 5 VA maximum
2. Three (3) auxiliary signals can be configured as pulse inputs/ outputs or as an analog output
3. Isolated RS485 serial interface, BACnet MS/TP or MODBUS RTU
4. Remote temperature sensor installed downstream of flow meter body

METER DESIGN DETAILS

Meter Models with Flow Ranges in GPM							
Meter Size	**Process Connection Type**	**Typical Design Flow**	**1% of Rate Range**	**2% of Rate Range**	**Min Flow**	**C_v**	**Length with Couplings or Flanges**
(Nominal Size)		(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(in)
½"	Male NPT	6.6	0.6 - 15	0.15 - 15	0.03	6.08	11.2
¾"	Male NPT	6.6	0.6 - 15	0.15 - 15	0.03	6.08	11.7
¾" (high flow)	Male NPT	11	1 - 25	0.25 - 25	0.05	8.81	11.7
1"	Male NPT	11	1 - 25	0.25 - 25	0.05	8.81	12.3
1" (high flow)	Male NPT	15.4	1.4 - 35	0.35 - 35	0.07	12.17	15
1¼"	Male NPT	26.4	3 - 60	0.6 - 60	0.12	20.26	15.25
1½"	Male NPT	44	5 - 100	1 - 100	0.2	33.85	17
2"	Male NPT	66	8 - 150	1.5 - 150	0.3	101.2	17.6
2½"	Class 150 Flange	110	12 - 225	2.5 - 250	0.5	156.2	11.81

METER ORDERING INFORMATION
System-40 Meter Model Number Codification = SYS-40-AAA-BCD-EFG

SYS-40 = Integral BTU Meter

AAA = Nominal Meter Size (inches)

050 = ½"
340 = ¾"
341 = ¾" High Flow
010 = 1"
011 = 1" High Flow
130 = 1¼"
150 = 1½"
020 = 2"
250 = 2½"

B = Process Connection Type

0 = NPT Threads
1 = ANSI Class 150 flange[1]

C = Display / Interface

1 = IP65 enclosure with display

D = Input Power

0 = 24 V AC/DC

E = Serial Communications

1 = RS485 (BACnet MS/TP or MODBUS RTU)

F = Analog & Pulse Input/Output Configuration

2 = Two (2) aux pulse inputs and one (1) aux pulse output[2]
6 = One (1) aux pulse input, one (1) aux pulse output and one (1) analog output

G = Temperature Sensor Type

0 = Threaded RTDs w/gaskets for direct insertion (wetted sensors) - One (1) integral, one (1) remote[3]
1 = Threaded RTDs for use with thermowells – Two (2) remote[4]
2 = Push-in RTDs for use with thermowells – Two (2) remote[5]

[1] Required for 2½" meter, NOT available on ½" to 2" meters

[2] Default configuration, pulse inputs and outputs can be configured in the field

[3] Valid for "AAA" meter size = 050-011. Requires reducer bushing INSTL4002-TSI or INSTL4004-TSI

[4] Valid for "AAA" meter size = 050-011. Requires thermowell INSTL kit INSTL4001-TSD or INSTL4003-TSD

[5] Valid for "AAA" = 050-250. Requires thermowell INSTL kit INSTL4005-TSD, INSTL4007-TSD, INSTL4008-TSD or INSTL4009-TSD