

Ballston Spa School

210 Ballston Ave

Ballston Spa, NY 12020

As-Built March 2021

Submitted to:

Frontier Energy
2695 Bingley Road
Cazanovia, NY 13035

Submitted by:

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Measurement & Verification Plan for CHP System at Ballston Spa School

Project Team:

Principal Engineer:

Integrated Energy Concepts Engineering, PC

Developer/Contractors:

RMB Mechanical

O'Connell Electric

TBS Controls

Site Contact:

Edwin Martin

Ballston Spa School District

Measurement & Verification Plan for CHP System at Ballston Spa School

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 seven (7) Tecogen InVerde Ultera 125kW engine generator units. The inverter-based system is intended to produce a gross output of 125 kW and recover 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

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.

Measurement & Verification Plan for CHP System at Ballston Spa School

Table 1. Overview of CHP System Monitoring Instrumentation

Data Point	Equipment Label	Data Point	Description	Units	Instrument / Sensor	Output Type	Location
P _{NET}	DMD		Generator NET Electrical Output	kW/ kWh		ModBus	Electric Room
P _{OUT}	CG-1 CG-2 CG-3 CG-4 CG-5 CG-6 CG-7		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-1	CGP0XIO1:U: 8	Cogen Loop - Hot Water Flow	GPM	Onicon F-1200	ModBus	CHP Area
Q _{NET1}			CHP System Heat Recovered	BTUH	$(T_{CGWS} - T_{CGWR}) * 500 * F_{NET1}$	Calculated	
T _{CGWS}	TS-15	CGP0XIO1:U: 6	CHP HW Supply Temperature to Building Loop	°F	ACI Thermistor Immersion	ModBus	CHP Area
T _{CGWR}	TS-16	CGP0XIO1:U: 7	CHP HW Return Temperature from Building Loop	°F	ACI Thermistor Immersion	ModBus	CHP Area
T _{USEFUL}		CG-1 to CG-7 Supply and Return TS	Total Heat Produced by CHP	BTUH	$(T_{CGWS (1-7)} - T_{CGWR (1-7)}) * 500 * 30 \text{ GPM}$	Calculated	

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

Measurement & Verification Plan for CHP System at Ballston Spa School

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

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

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: $C_p = 500 \text{ Btu/h-gpm-}^\circ\text{F}$ for Water;
 $n = \text{Number of 1-minute intervals included in period of interest}$

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

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

BALLSTON SPA HIGH SCHOOL 210 BALLSTON AVE. BALLSTON SPA, NY 12020 CHP SYSTEM

AS-BUILT
APRIL 14, 2021



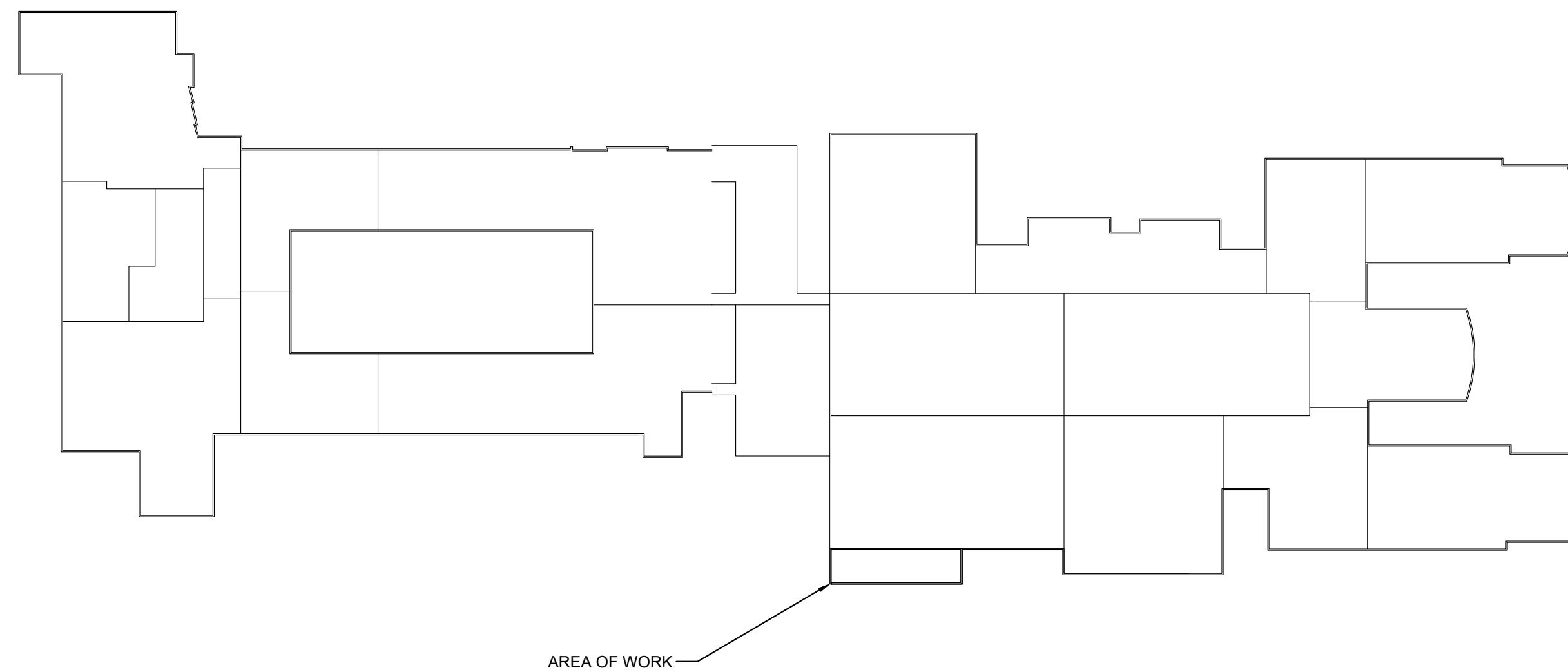
INTEGRATED ENERGY CONCEPTS
ENGINEERING, P.C.

3445 Winton Place, Suite 240
Rochester, NY 14623
Phone: (585) 272-4650
www.nrg-concepts.com

Combined Heat & Power,
Energy, Mechanical and
Electrical - Consultants

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CLIENT INFORMATION



1
T-101

SCALE: NONE

PLOT PLAN

BALLSTON SPA - CHP SYSTEM

DRAWING NUMBER	DRAWING TITLE	LATEST REVISION NUMBER	LATEST REVISION DATE	LATEST REVISION DESCRIPTION
T-101	COVER SHEET WITH DRAWING INDEX	2	4/14/2021	AS-BUILT
<u>MECHANICAL</u>				
M-001	MECHANICAL LEGEND AND ABBREVIATIONS	2	4/14/2021	AS-BUILT
M-101	FIRST FLOOR REMOVAL PLAN - MECHANICAL	2	4/14/2021	AS-BUILT
M-201	BOILER & COGEN PIPING NEW WORK PLAN - MECHANICAL	2	4/14/2021	AS-BUILT
M-202	BOILER & COGEN DUCTWORK NEW WORK PLAN - MECHANICAL	2	4/14/2021	AS-BUILT
M-203	COOLING TOWER PLAN - MECHANICAL	2	4/14/2021	AS-BUILT
M-301	CHP PLANT HOT WATER FLOW SCHEMATIC	2	4/14/2021	AS-BUILT
M-401	SCHEDULES - MECHANICAL	2	4/14/2021	AS-BUILT
M-402	CONTROL POINTS SCHEDULE - MECHANICAL	2	4/14/2021	AS-BUILT
M-501	DETAILS - MECHANICAL	2	4/14/2021	AS-BUILT
M-502	DETAILS - MECHANICAL	2	4/14/2021	AS-BUILT
M-503	DETAILS - MECHANICAL	2	4/14/2021	AS-BUILT
<u>PLUMBING</u>				
P-001	PLUMBING LEGEND AND ABBREVIATIONS	2	4/14/2021	AS-BUILT
P-101	BOILER & COGEN ROOM REMOVAL PLAN - PLUMBING	2	4/14/2021	AS-BUILT
P-201	BOILER & COGEN ROOM NEW WORK PLAN - PLUMBING	3	4/14/2021	AS-BUILT
<u>ELECTRICAL</u>				
E-001	ELECTRICAL LEGEND AND ABBREVIATIONS	3	4/14/2021	AS-BUILT
E-100	OUTDOOR REMOVAL WORK PLAN - ELECTRICAL	3	4/14/2021	AS-BUILT
E-101	BOILER ROOM REMOVAL PLAN - ELECTRICAL	3	4/14/2021	AS-BUILT
E-200	OUTDOOR NEW WORK PLAN - ELECTRICAL	5	4/14/2021	AS-BUILT
E-201	BOILER & COGEN NEW WORK FIRST FLOOR PLAN - ELECTRICAL	4	4/14/2021	AS-BUILT
E-202	BOILER ROOM NEW WORK SECOND FLOOR PLAN - ELECTRICAL	3	4/14/2021	AS-BUILT
E-301	ONE-LINE DIAGRAM - OVERALL	6	4/14/2021	AS-BUILT
E-302	ONE-LINE DIAGRAM - SERVICE 2 MDP-B	3	4/14/2021	AS-BUILT
E-303	ONE-LINE DIAGRAM - SERVICE 2 MDP-B EMERGENCY	3	4/14/2021	AS-BUILT
E-304	THREE-LINE DIAGRAM	6	4/14/2021	AS-BUILT
E-305	THREE-LINE DIAGRAM	5	4/14/2021	AS-BUILT
E-401	ELECTRICAL SCHEDULES	6	4/14/2021	AS-BUILT
E-402	ELECTRICAL SCHEDULES	4	4/14/2021	AS-BUILT
E-501	ELECTRICAL DETAILS	2	4/14/2021	AS-BUILT
E-502	ELECTRICAL DETAILS	3	4/14/2021	AS-BUILT
E-503	COGEN CONTROL AND RELAY CABINETS	3	4/14/2021	AS-BUILT
E-504	WIRING DETAIL	5	4/14/2021	AS-BUILT
E-505	ELECTRICAL DETAILS	4	4/14/2021	AS-BUILT
E-506	ELECTRICAL DETAILS	4	4/14/2021	AS-BUILT
E-507	INTERCONNECTION LABELS	4	4/14/2021	AS-BUILT
E-601	CONTROL WIRING SCHEMATIC	5	4/14/2021	AS-BUILT
E-602	CONTROL WIRING SCHEMATIC - CONT.	5	4/14/2021	AS-BUILT

REVISIONS

NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
2	4/14/2021	AS-BUILT

BALLSTON SPA HIGH SCHOOL
210 BALLSTON AVE.
BALLSTON SPA, NY 12020

SED PROJECT #: 52130106-0001-032

PROJECT NAME

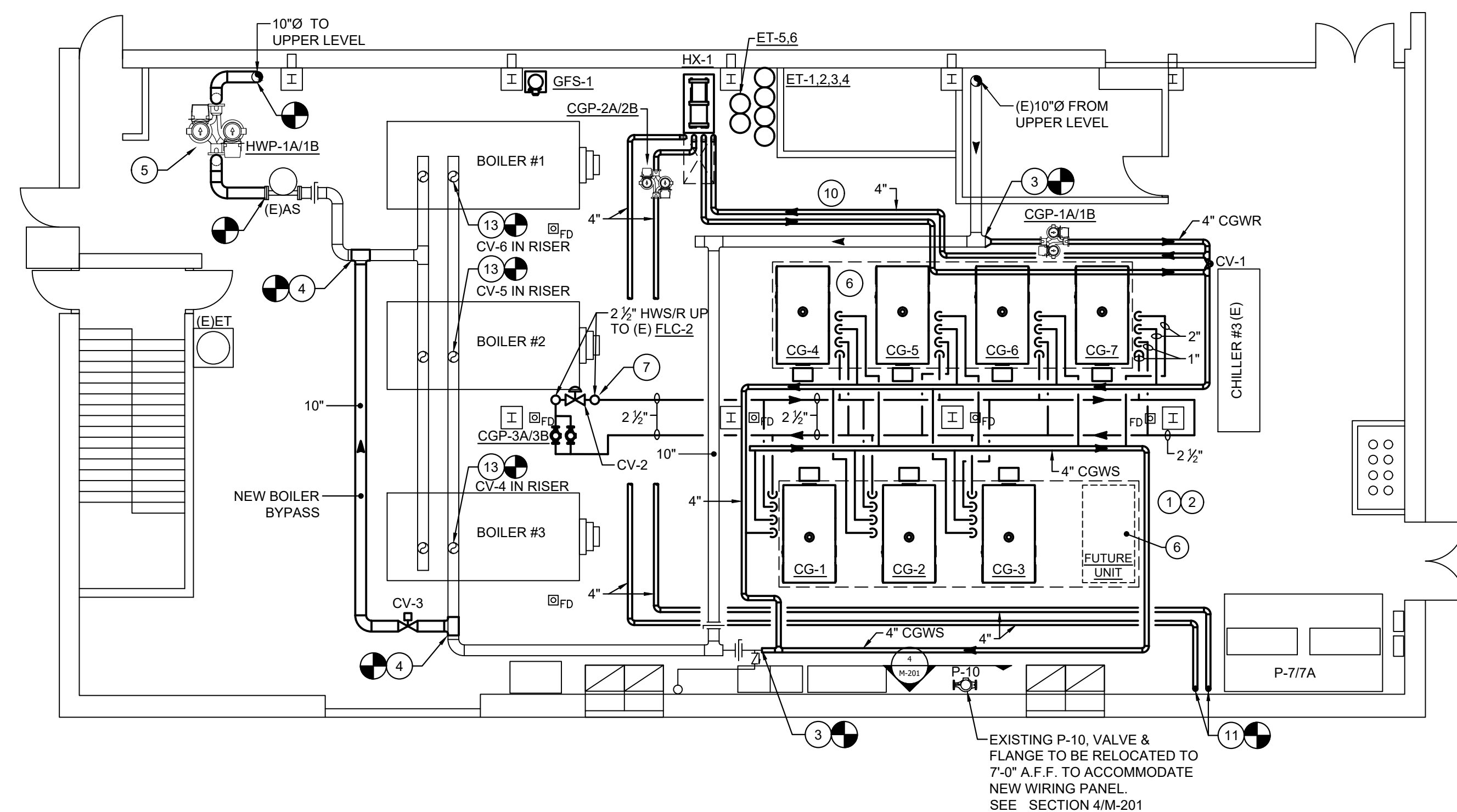
SCALE PHASE

COVER SHEET WITH
DRAWING INDEX

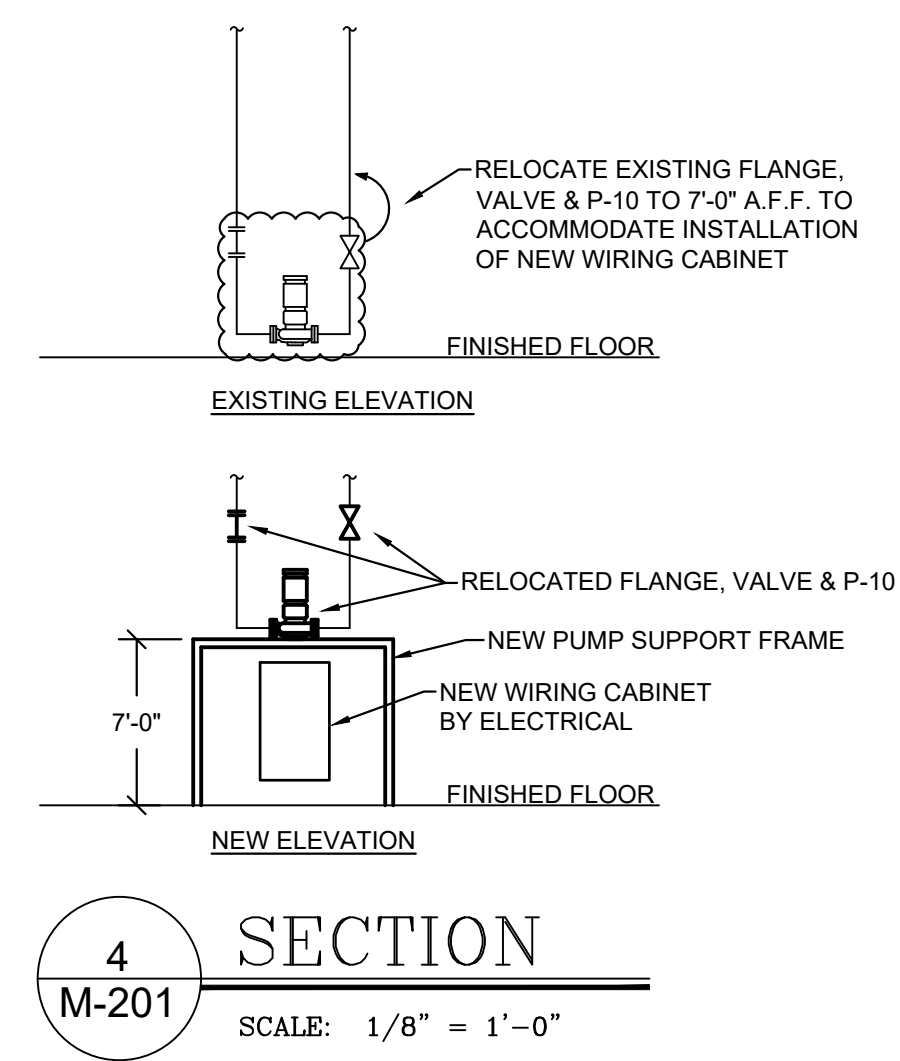
DRAWING TITLE

DATE: 5-3-2019	PROJECT No.: 18202
DRAWING BY: IEC	CHK BY: IEC
DWG No:	T-101
CADD FILE No:	of

THE DESIGN OF THIS PROJECT CONFORMS TO APPLICABLE PROVISIONS OF THE NEW YORK STATE UNIFORM FIRE PREVENTION AND BUILDING CODE, THE NEW YORK STATE ENERGY CONSERVATION CONSERVATION CONSTRUCTION CODE, AND THE MANUAL OF PLANNING STANDARDS OF THE NEW YORK STATE EDUCATION DEPARTMENT.



1
M-201
FIRST FLOOR BOILER ROOM PLAN - PIPING
SCALE: 1/8" = 1'-0"



4
M-201
SECTION
SCALE: 1/8" = 1'-0"

GENERAL NOTES:

- MECHANICAL CONTRACTOR SHALL OBTAIN ALL REQUIRED PERMITS IN ACCORDANCE WITH STATE AND LOCAL CODES, RULES AND REGULATIONS.
- MECHANICAL CONTRACTOR SHALL COORDINATE ALL REQUIRED UTILITY CONNECTIONS WITH AUTHORITIES HAVING JURISDICTION.
- INSTALL ALL PIPING AND EQUIPMENT IN ACCORDANCE WITH ALL STATE AND LOCAL CODES, RULES AND REGULATIONS.
- COORDINATE ALL PIPE ROUTING AND EQUIPMENT INSTALLATION WITH ALL OTHER TRADES. PIPE ROUTING SHOWN ON DOCUMENTS IS CONCEPTUAL. ACTUAL ROUTING SHALL BE DETERMINED IN FIELD BY MECHANICAL CONTRACTOR TO AVOID CONFLICT WITH STRUCTURE AND OTHER TRADES.
- COORDINATE WITH ELECTRICAL CONTRACTOR FOR REQUIRED DUCT OR EQUIPMENT MOUNTED ELECTRICAL DEVICE LOCATIONS. COORDINATE SIZE AND TYPE OF CONNECTION REQUIRED. COORDINATE MOUNTING METHOD AND RESPONSIBILITY.
- ALL PIPING SHALL BE INSTALLED AS HIGH AS PRACTICAL ABOVE FINISHED FLOOR. HORIZONTAL PIPING RUNS SHALL NOT BE INSTALLED LESS THAN 8'-0" ABOVE FINISHED FLOOR WITHOUT APPROVAL OF OWNER. FOR ROOMS WITH CEILINGS TO BE INSTALLED, FIELD COORDINATE DUCT/PIPE ELEVATIONS WITH ALL OTHER TRADES.
- ALL PIPING SHALL BE INSTALLED SO AS TO AVOID BULLHEAD TEE CONFIGURATIONS WITH BOTH CONVERGING AND DIVERGING FLOW.
- INSTALL AUTOMATIC AIR VENTS AT ALL SYSTEM HIGH POINTS AND DRAINS AT ALL SYSTEM LOW POINTS.
- PROVIDE FULLY WELDED 2" DEEP ALUMINUM DRIP PANS BELOW ALL PIPING SUSPENDED OVER ELECTRICAL EQUIPMENT. PROVIDE DRAIN OUTLET AND PIPE TO 0'-6" ABOVE FINISHED FLOOR.
- ALL PIPING SHALL BE FULLY PAINTED, COLOR CODED OR LABELED AS INDICATED IN THE PROJECT SPECIFICATIONS.
- PROVIDE BLOWDOWN VALVES ON ALL STRAINERS.
- PROVIDE TEMPERATURE AND PRESSURE GAUGES AT INLET AND OUTLET PIPING CONNECTIONS TO ALL EQUIPMENT.

INSTALLATION NOTES:

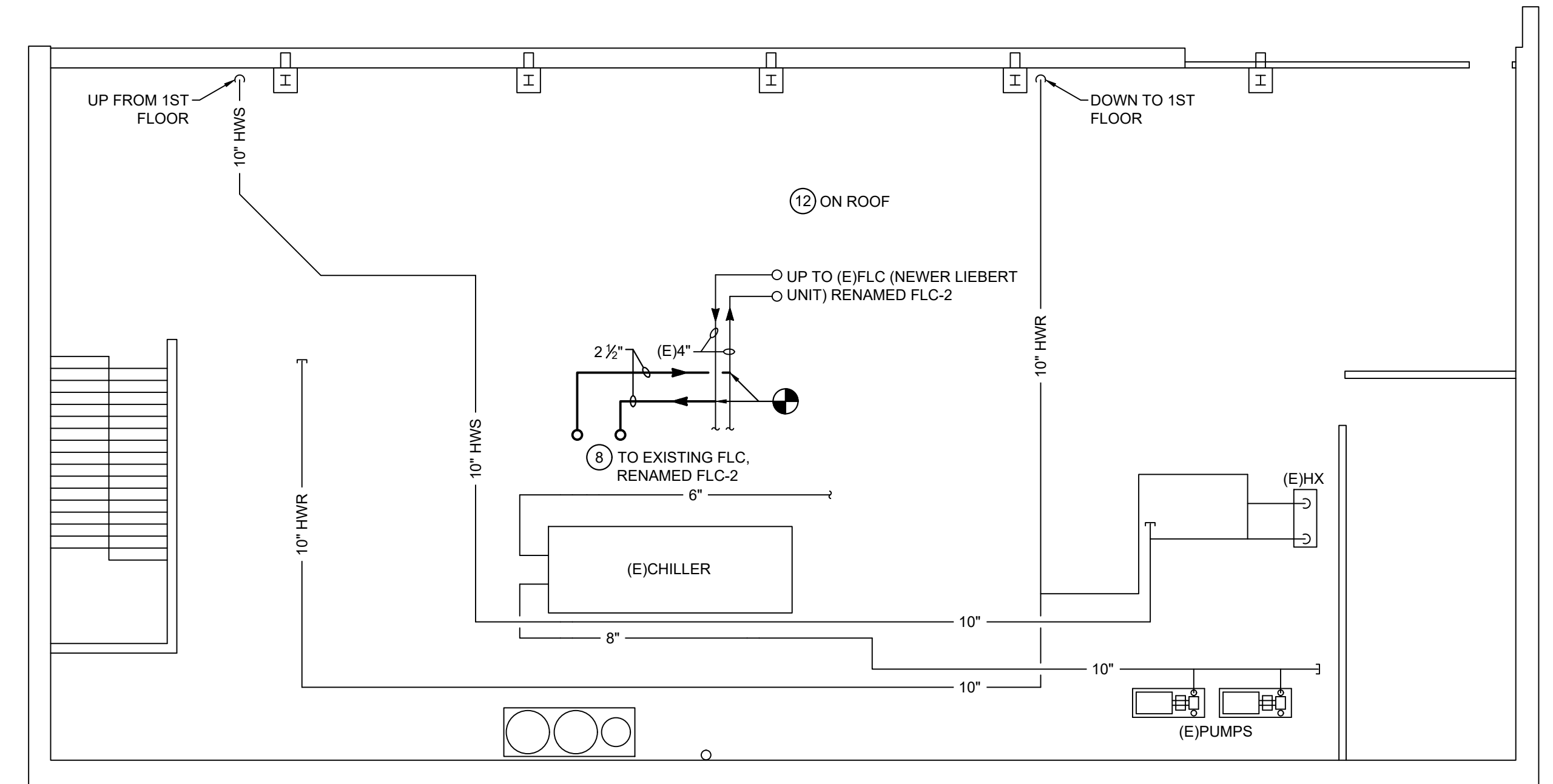
- PROVIDE COGEN VENDORS RECOMMENDED CLEARANCE FOR ALL COGEN UNITS AND COORDINATE FINAL LOCATIONS BASED ON CLEARANCES, EXISTING FLOOR DRAINS, REMAINING EQUIPMENT AFTER DEMO.
- PIPING INSTALLATION AND CONNECTIONS SHALL CONFORM TO SCHEMATIC DIAGRAM ON DRAWING M-301. CONSULT WITH MECHANICAL ENGINEER PRIOR TO ANY PIPING RECONFIGURATION.
- CONNECT NEW 4" COGEN HOT WATER PIPING TO (E)10" PIPING.
- CONNECT NEW 10" COGEN HOT WATER BYPASS PIPING TO (E)10" PIPING.
- NEW PUMPS TO BE INSTALLED FOR MAIN HOT WATER LOOP.
- ALL MECHANICAL EQUIPMENT PADS BY THIS CONTRACT, TO INCLUDE HEAT EXCHANGERS, EXPANSION TANKS, PUMPS, COGEN UNITS, GFS. PADS CAN BE CONTINUOUS FOR EACH ROW.
- COORDINATE LOCATION WITH EXISTING EQUIPMENT ON SECOND FLOOR.
- 2 1/2" HWS/R (ELECTRONICS COOLING) UP TO (N)FLC-2 (RENAMED ORIGINAL LIEBERT)
- M.C. TO PROVIDE ALL ELECTRICAL DEVICES FOR MECHANICAL EQUIPMENT FOR MOUNTING TO ELECTRICAL CONTRACTOR.
- AVOID ROUTING PIPING OVER ELECTRICAL EQUIPMENT. WHERE EQUIPMENT CANNOT BE AVOIDED, PROVIDE AND INSTALL STAINLESS STEEL DRIP PANS WITH DRAINS.
- CONNECT TO EXISTING CTS/R. SEE SCHEMATIC SHEET M-301.
- EXISTING FLC (OLDER UNIT) TO BE VALVED OFF USING EXISTING ISOLATION VALVES.
- INSTALL NEW MECHANICAL ON EXISTING BUTTERFLY VALVE.

REVISIONS		
NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
2	4/14/2021	AS-BUILT

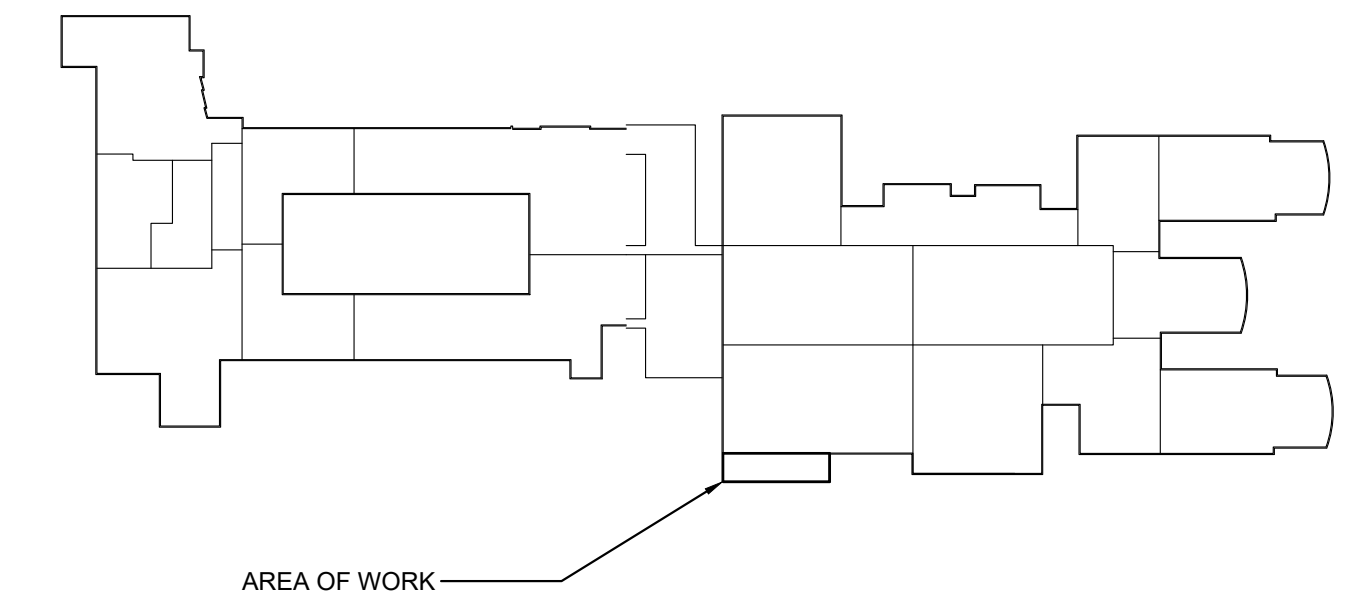
BALLSTON SPA HIGH SCHOOL
210 BALLSTON AVE.
BALLSTON SPA, NY 12020
SED PROJECT #: 52130106-0001-032

PROJECT NAME
SCALE PHASE
**BOILER & COGEN PIPING
NEW WORK PLAN -
MECHANICAL**

SEAL & SIGNATURE	DATE: 5-3-2019
	PROJECT No.: 18202
	DRAWING BY: IEC
	CHK BY: IEC
	DWG No: M-201
	CADO FILE No: 12 of



2
M-201
SECOND FLOOR BOILER ROOM PLAN - PIPING
SCALE: 1/8" = 1'-0"



3
M-201
SITE PLAN

CLIENT INFORMATION

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1	11/6/2019	ISSUED TO BID
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BALLSTON SPA HIGH SCHOOL
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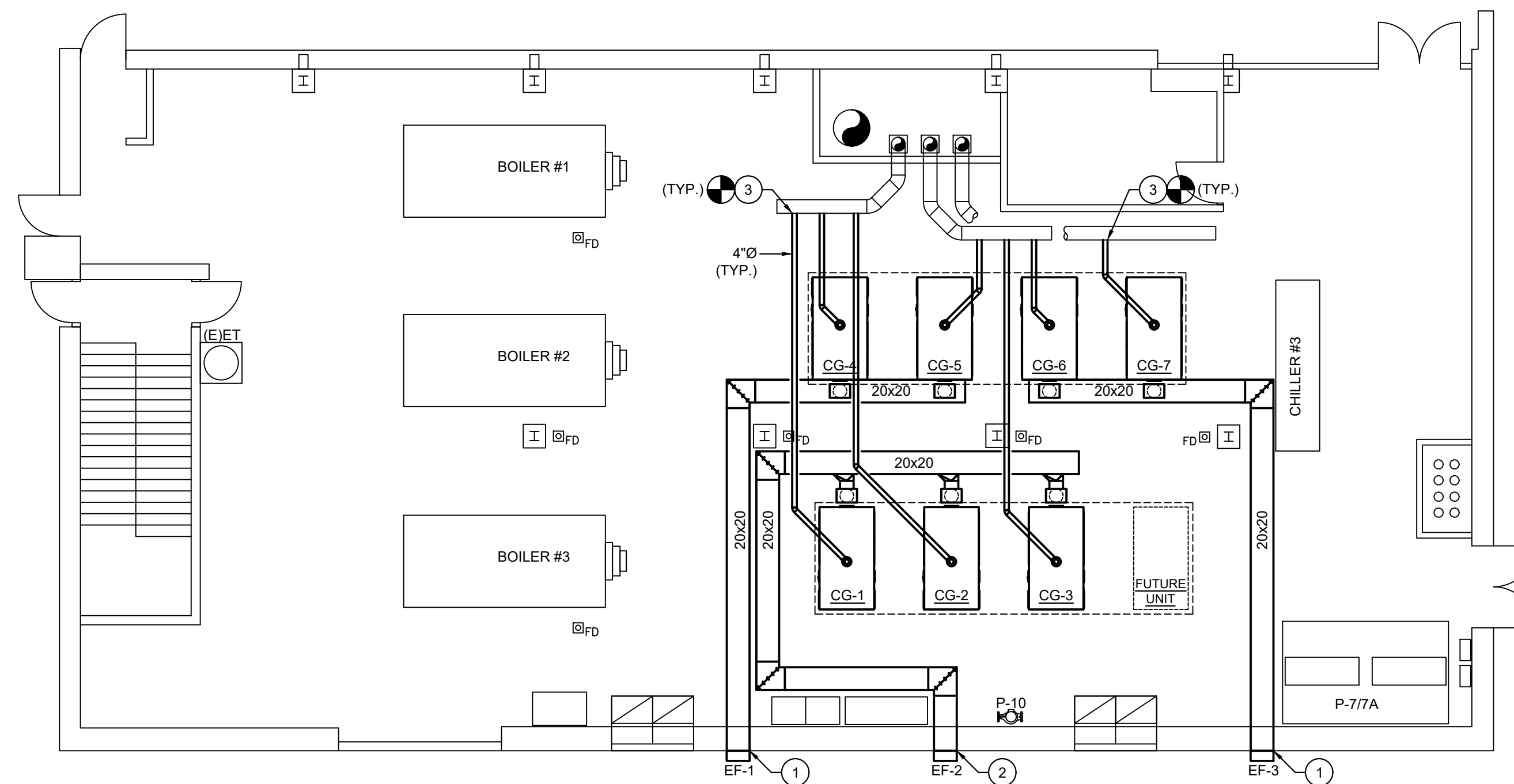
PROJECT NAME

SCALE PHASE

BOILER & COGEN
DUCTWORK NEW WORK
PLAN - MECHANICAL

DRAWING TITLE

SEAL & SIGNATURE	DATE: 5-3-2019
	PROJECT No.: 18202
	DRAWING BY: IEC
	CHK BY: IEC
	DWG No:
	M-202
CADD FILE No:	of
12	



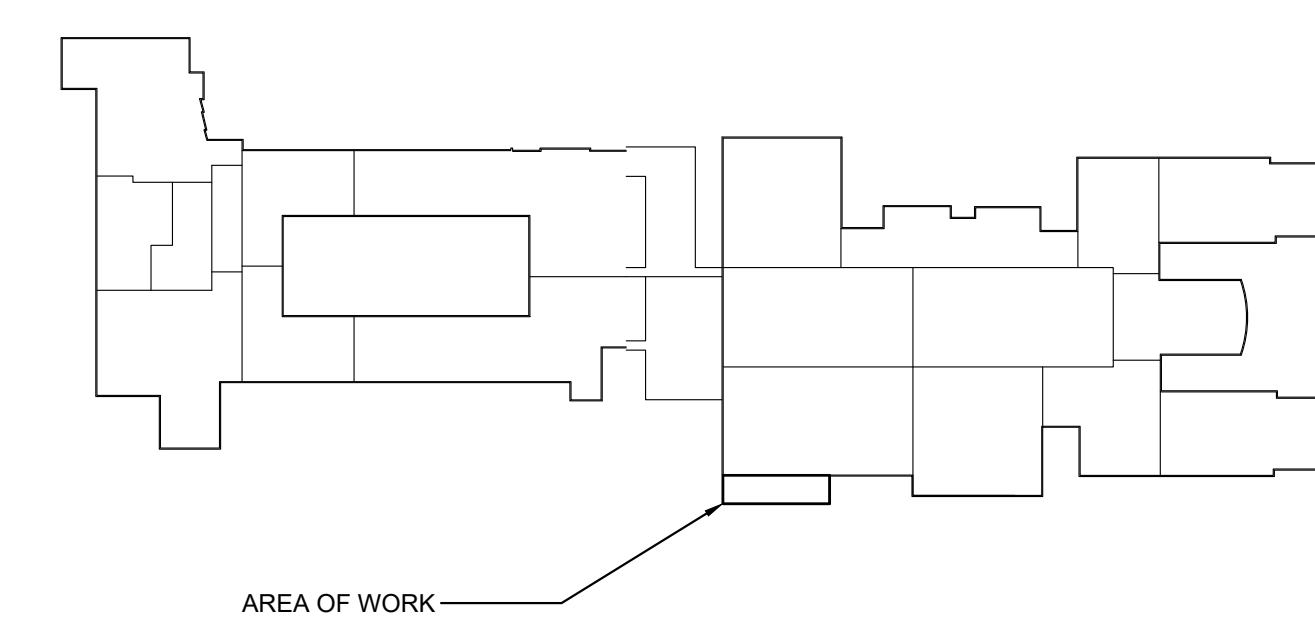
GENERAL NOTES:

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- MECHANICAL CONTRACTOR SHALL COORDINATE ALL REQUIRED UTILITY CONNECTIONS WITH AUTHORITIES HAVING JURISDICTION.
- INSTALL ALL DUCTWORK AND EQUIPMENT IN ACCORDANCE WITH ALL STATE AND LOCAL CODES, RULES AND REGULATIONS.
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- COORDINATE WITH ELECTRICAL CONTRACTOR FOR REQUIRED DUCT OR EQUIPMENT MOUNTED ELECTRICAL DEVICE LOCATIONS. COORDINATE SIZE AND TYPE OF CONNECTION REQUIRED. COORDINATE MOUNTING METHOD AND RESPONSIBILITY.

INSTALLATION NOTES:

- R.O. REQUIRED 18"x18"
- R.O. REQUIRED 21"x21"
- 4"Ø SCH. 10, S.S., RE-CONNECT TO EXISTING EXHAUST HEADER.

1 M-202 **FIRST FLOOR BOILER ROOM PLAN - EXHAUST**
SCALE: 1/8" = 1'-0"



2 M-202 **SITE PLAN**

REVISIONS

NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
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BALLSTON SPA HIGH SCHOOL
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PROJECT NAME

SCALE PHASE

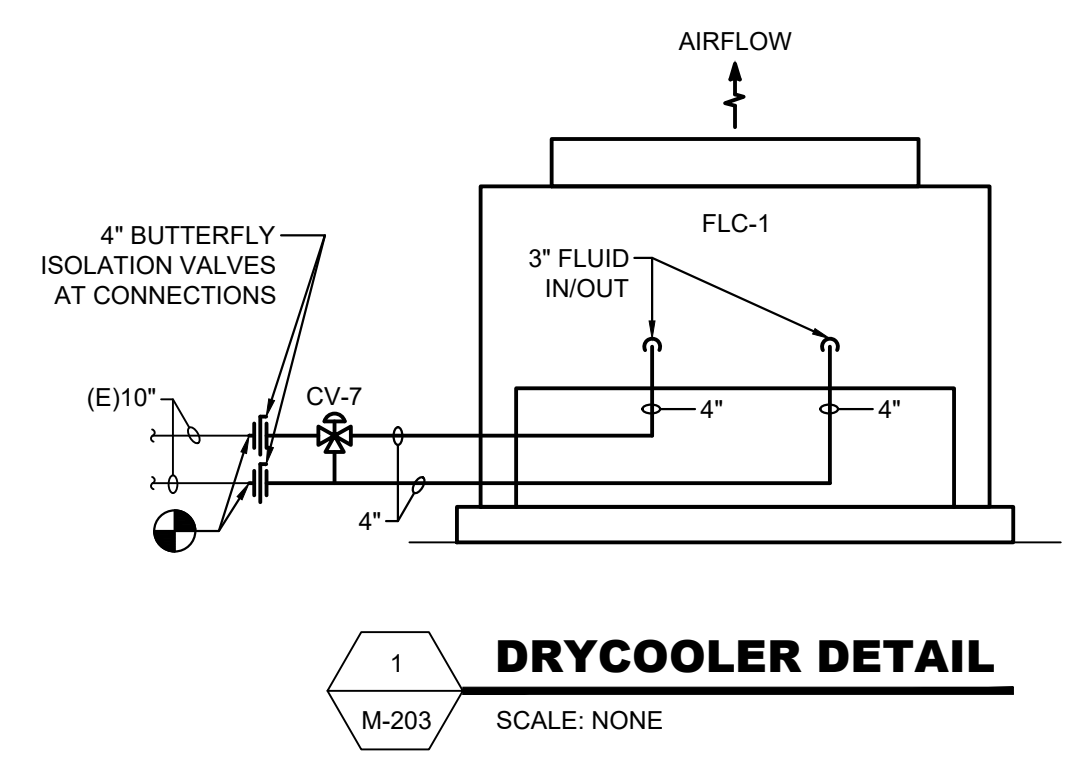
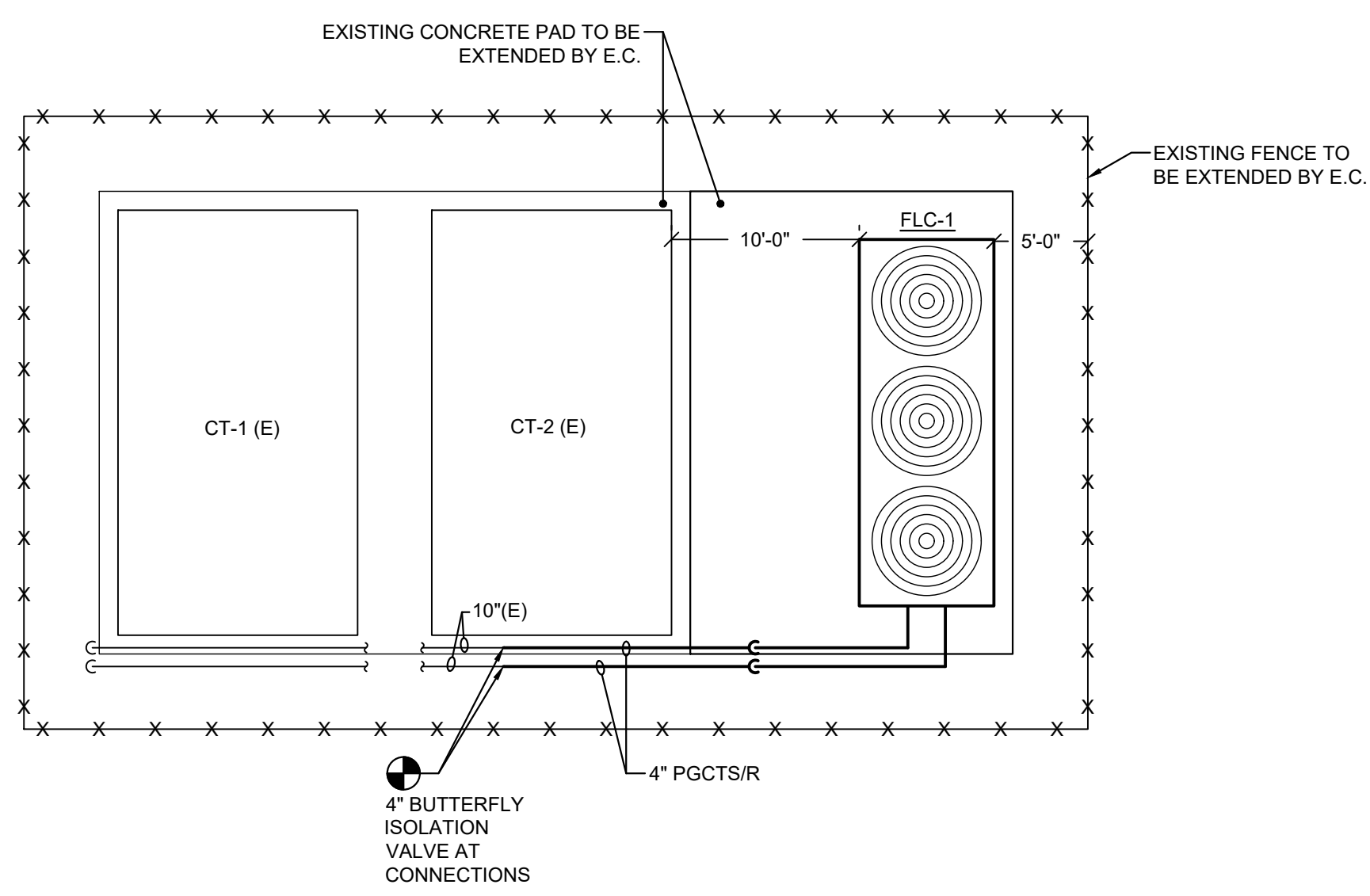
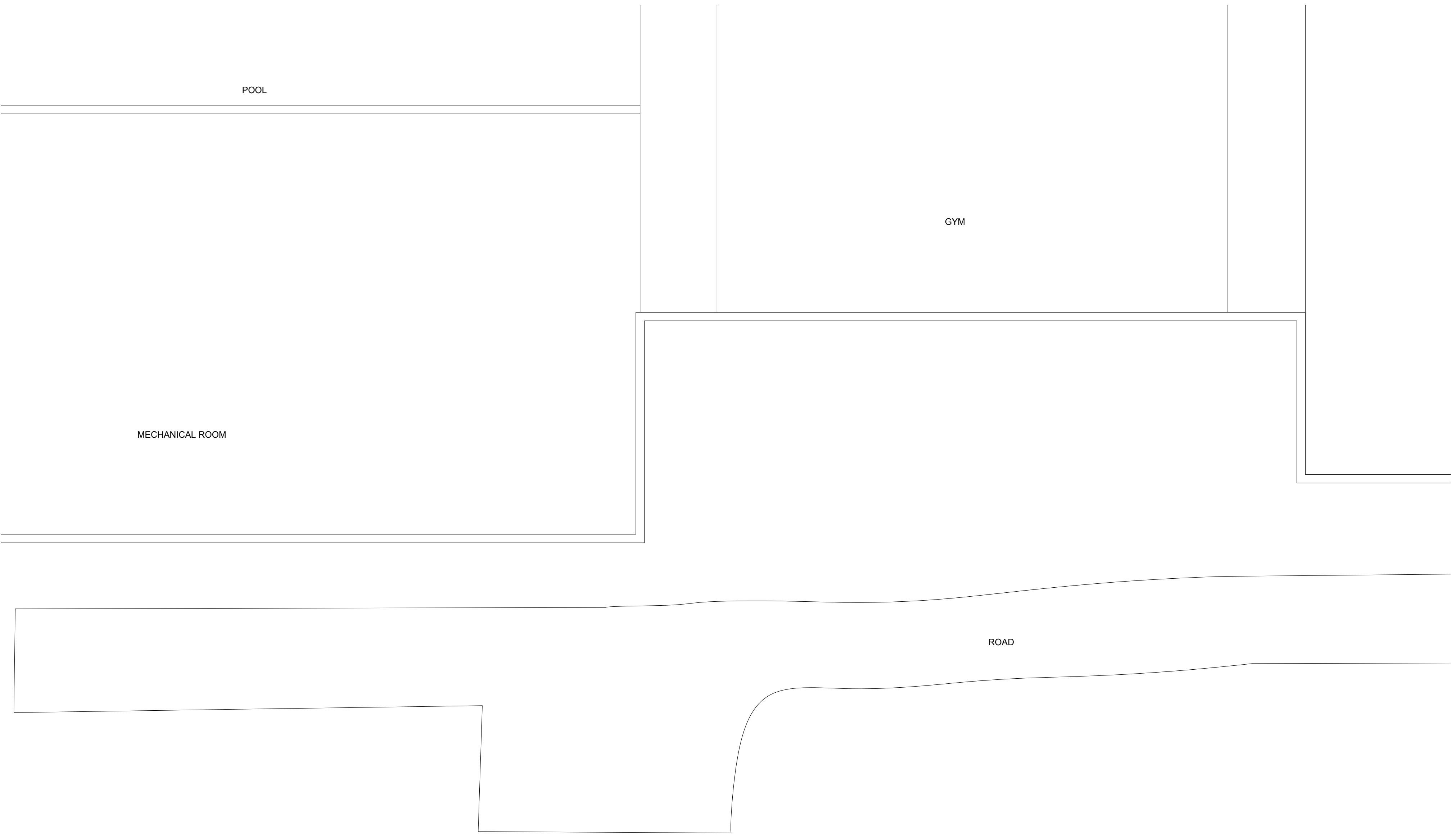
COOLING TOWER PLAN -
MECHANICAL

DRAWING TITLE

SEAL & SIGNATURE	DATE: 5-3-2019
	PROJECT No.: 18202
	DRAWING BY: IEC
	CHK BY: IEC
	DWG No:
	M-203
	CADD FILE No:
	of

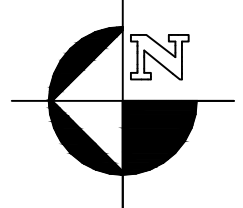
GENERAL NOTES:

- MECHANICAL CONTRACTOR SHALL OBTAIN ALL REQUIRED PERMITS IN ACCORDANCE WITH STATE AND LOCAL CODES, RULES AND REGULATIONS.
- MECHANICAL CONTRACTOR SHALL COORDINATE ALL REQUIRED UTILITY CONNECTIONS WITH AUTHORITIES HAVING JURISDICTION.
- INSTALL ALL PIPING AND EQUIPMENT IN ACCORDANCE WITH ALL STATE AND LOCAL CODES, RULES AND REGULATIONS.
- COORDINATE WITH CHEMICAL TREATMENT CONTRACTOR FOR REQUIRED PIPE CONNECTION LOCATIONS. COORDINATE SIZE AND TYPE OF CONNECTIONS REQUIRED. PIPE TAPPINGS BY MECHANICAL CONTRACTOR.
- COORDINATE ALL PIPE ROUTING AND EQUIPMENT INSTALLATION WITH ALL OTHER TRADES. PIPE ROUTING SHOWN ON DOCUMENTS IS CONCEPTUAL. ACTUAL ROUTING SHALL BE DETERMINED IN FIELD BY MECHANICAL CONTRACTOR TO AVOID CONFLICT WITH STRUCTURE AND OTHER TRADES.
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- PROVIDE BLOWDOWN VALVES ON ALL STRAINERS.
- PROVIDE TEMPERATURE AND PRESSURE GAUGES AT INLET AND OUTLET PIPING CONNECTIONS TO ALL EQUIPMENT.



1 DRYCOOLER DETAIL
SCALE: NONE

1 M-203 COOLING TOWER PLAN - MECHANICAL
SCALE: 1/8" = 1'-0"



REVISIONS

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1	11/6/2019	ISSUED TO BID
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BALLSTON SPA HIGH SCHOOL
210 BALLSTON AVE.
BALLSTON SPA, NY 12020
SED PROJECT #: 52130106-0001-032

PROJECT NAME

SCALE PHASE
**CHP PLANT HOT WATER
FLOW SCHEMATIC**

DRAWING TITLE

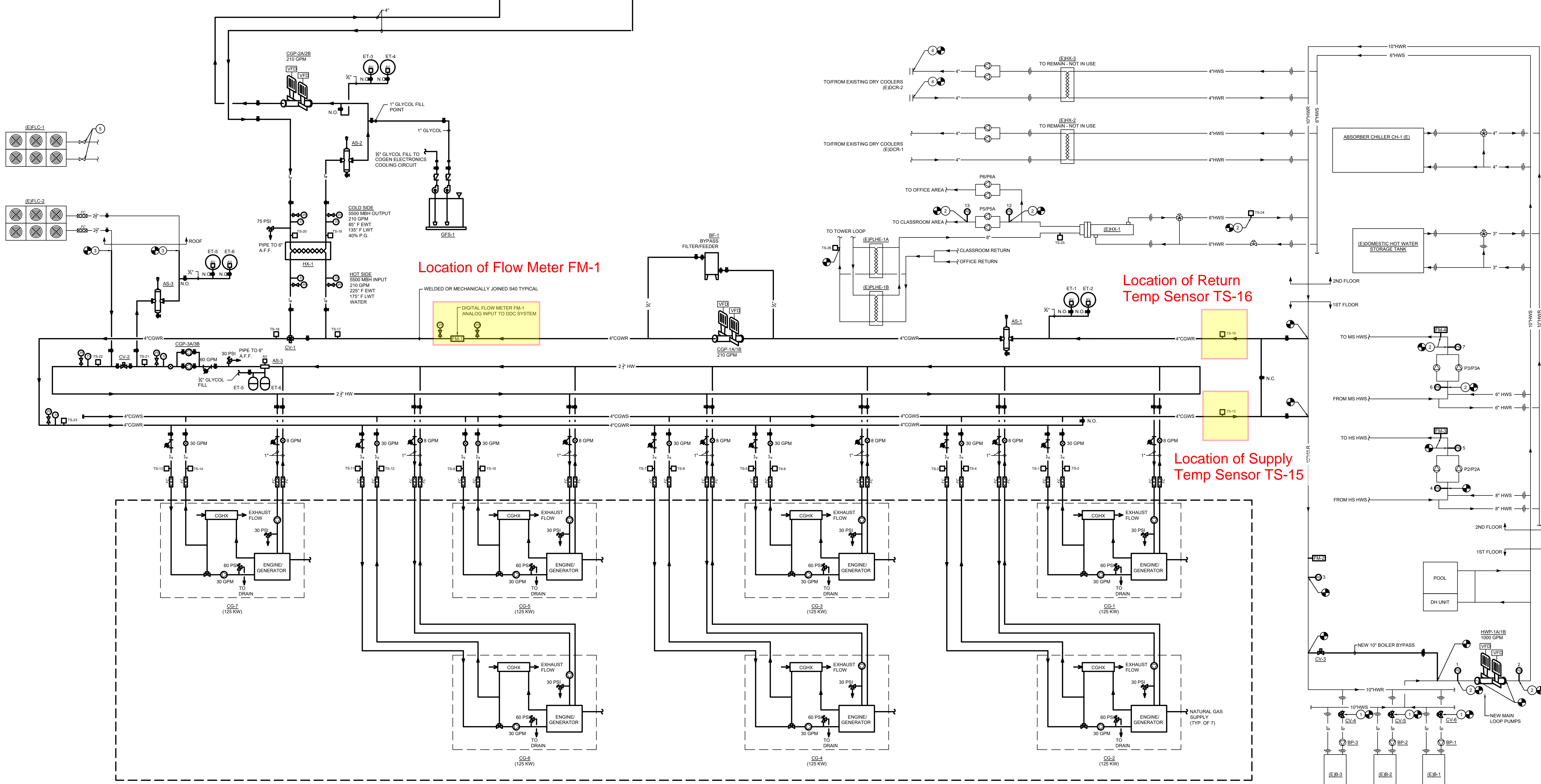
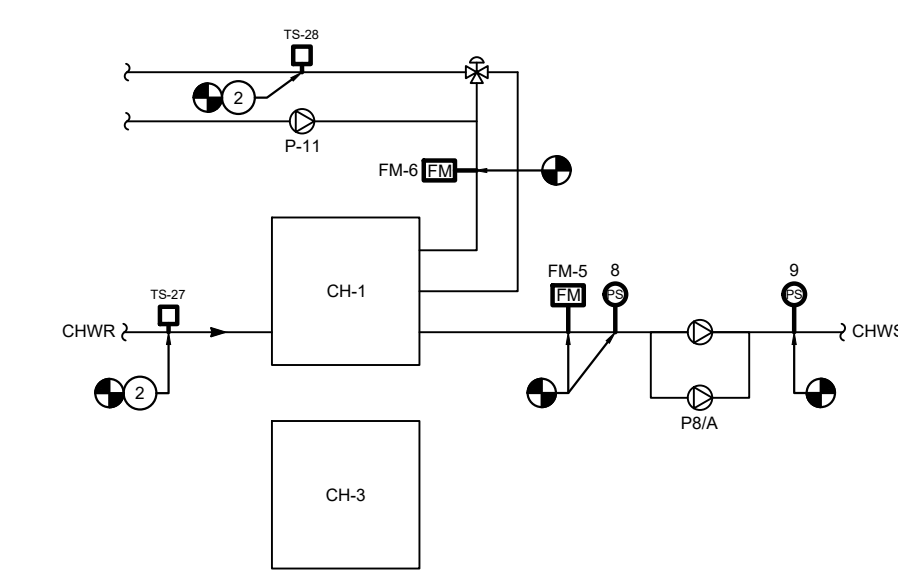
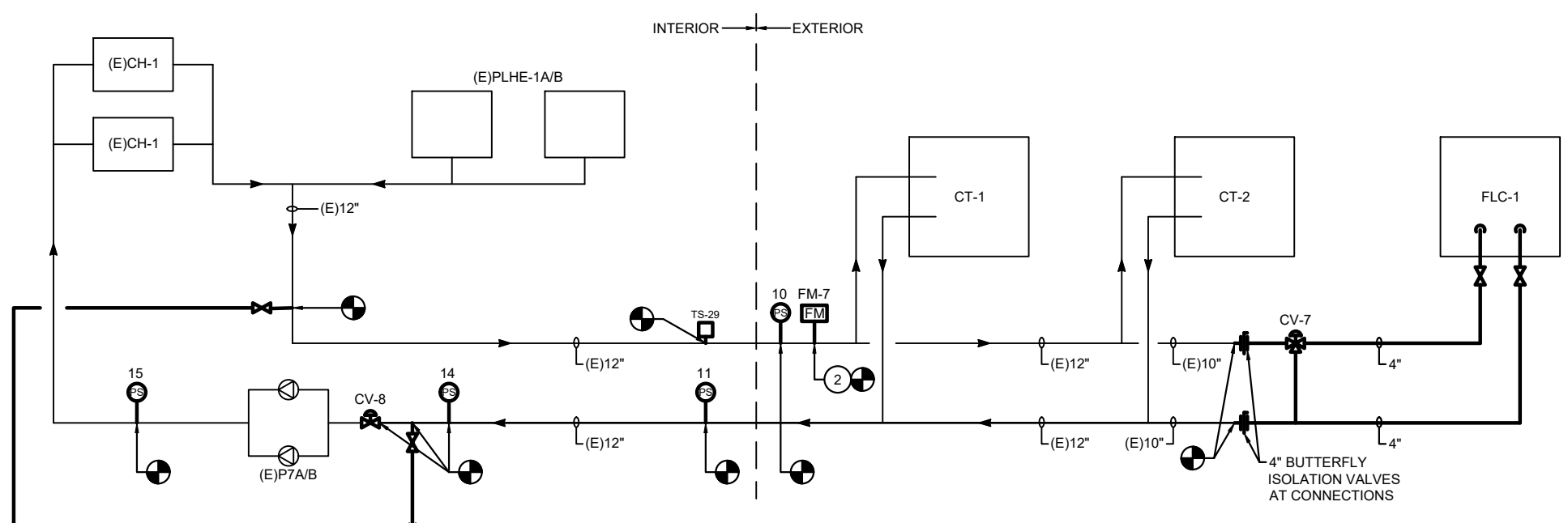
DATE: 5-3-2019
PROJECT No.: 18202
DRAWING BY: IEC
CHK BY: IEC
DWG No:
M-301
CADO FILE No:
of

GENERAL NOTES:

1. GENERAL OVERALL ARRANGEMENTS SHOWN ON THIS DRAWING. REFER TO SPECIFIC PIPING DETAILS AND MANUFACTURERS RECOMMENDED INSTALLATION PROCEDURES FOR EACH PIECE OF EQUIPMENT FOR FURTHER REQUIREMENTS.
2. PROVIDE SENSOR WELLS, SENSORS PROVIDED BY TBS CONTROLS. TYPICAL OF ALL TS-, PS-, FM-. WHERE INDICATED, RE-USE EXISTING SENSOR WELLS. COORDINATE LOCATIONS WITH TBS CONTROLS.
3. REMOVE HANDLES FROM ALL BALL VALVES ISOLATING EXPANSION TANKS TO PREVENT INADVERTENT CLOSING.
4. MAKE UP WATER SERVICE, BACKFLOW PREVENTERS AND PRESSURE REDUCING VALVES FURNISHED AND INSTALLED BY PLUMBING CONTRACTOR.

INSTALLATION NOTES:

1. INSTALL NEW ACTUATOR ONTO EXISTING BUTTERFLY VALVE.
2. RE-USE EXISTING SENSOR WELL.
3. CONNECT TO EXISTING PIPING BELOW ROOF DECK.
4. FLANGE, RE-USE REMAINDER TO ROOF DECK.
5. POSITION (E)VALVES TO N.C.



1 CHP PLANT HOT WATER FLOW SCHEMATIC
M-301 SCALE: NONE

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PACKAGED COGENERATION UNIT SCHEDULE

UNIT TAG	DESCRIPTION	MANUFACTURER AND MODEL	TYPE DRIVER	FUEL TYPE	MAX FUEL RATE THERM/SHR	MIN. INLET FUEL PRESSURE (N. W.C.)	CABINET EXHAUST CFM	OPERATING WEIGHT (LBS.)	THERMAL DATA										ELECTRICAL DATA				UL LISTING	COMMENTS
									NET HEAT OUTPUT MBH	MAX INLET TEMP °F	MAX OUTLET TEMP °F	DESIGN INLET TEMP °F	DESIGN OUTLET TEMP °F	GPM	HP	DELTA TEMP	FULL OUTPUT KW	VOLTS	PHASE	TYPE GENERATOR				
CG-1	COGEN UNIT	TECOGEN INVERDE e+		N.G.	14.55	4"-12"	1500	4500	780	180	230	175	225	30	50	125	480	3	INVERTER	1741				
CG-2	COGEN UNIT	TECOGEN INVERDE e+		N.G.	14.55	4"-12"	1500	4500	780	180	230	175	225	30	50	125	480	3	INVERTER	1741				
CG-3	COGEN UNIT	TECOGEN INVERDE e+		N.G.	14.55	4"-12"	1500	4500	780	180	230	175	225	30	50	125	480	3	INVERTER	1741				
CG-4	COGEN UNIT	TECOGEN INVERDE e+		N.G.	14.55	4"-12"	1500	4500	780	180	230	175	225	30	50	125	480	3	INVERTER	1741				
CG-5	COGEN UNIT	TECOGEN INVERDE e+		N.G.	14.55	4"-12"	1500	4500	780	180	230	175	225	30	50	125	480	3	INVERTER	1741				
CG-6	COGEN UNIT	TECOGEN INVERDE e+		N.G.	14.55	4"-12"	1500	4500	780	180	230	175	225	30	50	125	480	3	INVERTER	1741				
CG-7	COGEN UNIT	TECOGEN INVERDE e+		N.G.	14.55	4"-12"	1500	4500	780	180	230	175	225	30	50	125	480	3	INVERTER	1741				

- NOTES:
- PROVIDE FULL EMS INTERFACE AND MICROPROCESSOR CONTROLLER, EACH UNIT.
 - PROVIDE UNITS WITH BATTERY STARTERS.
 - PROVIDE FULL LINEAR RAMPING ABILITY, EACH UNIT.
 - PROVIDE UNITS WITH FULL OIL JACKET AND COMBUSTION EXHAUST HEAT RECOVERY.
 - PROVIDE UNIT MOUNTED HAND/OFF/AUTO SWITCH.
 - PROVIDE UNIT MOUNTED STATUS DISPLAY AND OPERATOR INTERFACE.
 - THERMAL RATING INCLUDES EXHAUST HEAT RECOVERY.
 - PROVIDE UNIT WITH 4" FLANGED COMBUSTION EXHAUST CONNECTION.
 - PROVIDE ALL EXHAUST ACCESSORIES WITH 4" FLANGED CONNECTIONS.
 - PROVIDE ALL UNITS WITH MOUNTED CATALYTIC CONVERTER, EXHAUST HEAT RECOVERY HEAT EXCHANGER AND EXHAUST SILENCER.
 - PROVIDE UNIT W/ INTEGRAL PUMP & 3-WAY VALVE ON HEATING RECOVERY.
 - UNIT INCLUDES GENERATOR & ELECTRONICS COOLING CIRCUIT - 8 GPM. CIRCUIT COOLING PUMP PROVIDED BY UNIT MANUFACTURER.
 - INCLUDE POWER RECTIFIER AND INVERTER SYSTEM.

PUMP SCHEDULE

TAG	LOCATION	SERVICE	PUMP TYPE	FLUID	GPM	HEAD (FT.)	MAX TEMP	MAX W.P. PSI	MOTOR RPM	HP	VOLTS	PH	ELECTRICAL STARTER	MAKE & MODEL
CGP-1A/B	MECHANICAL ROOM	PRIMARY COGEN LOOP	DUAL ARM	WATER	240	40	250	150	1624	5	460	3	VFD	ARMSTRONG SERIES 4382
CGP-2A/B	MECHANICAL ROOM	FLC-1 LOOP	DUAL ARM	40% P.G.	240	65	250	150	1689	5	460	3	VFD	ARMSTRONG SERIES 4382
CGP-3A/B	MECHANICAL ROOM	FLC-2 ELECTRONICS LOOP	INLINE	40% P.G.	60	30	250	150	3886	1	460	3	VFD	ARMSTRONG SERIES 4380
HWP-1A/B	MECHANICAL ROOM	MAIN HOT WATER LOOP	DUAL ARM	WATER	1500	75	250	150	1780	60	460	3	VFD	ARMSTRONG SERIES 4302

- NOTES:
- ALL PUMP MOTORS TO BE SELECTED TO BE NON-OVERLOADING THROUGH ENTIRE OPERATING CURVE OF PUMP.
 - MOTOR STARTERS/VFDS FURNISHED BY M.C., MOUNTED AND WIRED BY E.C.

DRYCOOLER

TAG	LOCATION	SERVICE	FLUID CIRCUIT		AIR SIDE			ELECTRICAL DATA			OPERATING WEIGHT (LBS.)	DESIGN EQUIPMENT			
			GPM	EWT °F	LWT °F	MBH	PD (PSI)	FLUID CFM	EAT (°F) DB	NO. MOTORS	HP	VOLTS/PH/Hz			
FLC-1	EXTERIOR - ADJACENT TO EXISTING TOWERS	COGEN/CONDENSER	210	215	160	5,460	13.4	40% P.G.	91,394	89	3	5	460/3/60	5240	EVAPCO EAFWD-1SS3PK370K4-321AXSP04

AIR SEPARATOR SCHEDULE

TAG	SERVICE	SIZE (in.)	FLOW (gpm)	VELOCITY (fps)	FLUID PD (R)	MWP (psi)	DESIGN EQUIPMENT
AS-1	COGEN LOOP	4	210			125	ARMSTRONG DAS-4
AS-2	FLC-1 LOOP	4	210			125	ARMSTRONG DAS-4
AS-3	FLC-2 LOOP	2.5	60			125	ARMSTRONG DAS-2.5

- NOTES:
- PROVIDE UNIT WITH AUTOMATIC AIR VENT AND 3/4" BLOW DOWN VALVE WITH HOSE END CONNECTION.
 - UNITS TO BE COMBINATION AIR ELIMINATOR/DIRT SEPARATOR.

EXPANSION TANK SCHEDULE

TAG	SERVICE	TANK VOL.(gals.)	ACCPT. VOL.(gals.)	FLUID	SYSTEM VOL.(gals.)	MIN. TEMP.(°F)	MAX. TEMP.(°F)	MIN. PRESS.(psi)	MAX. PRESS.(psi)	ASME RATING(psi)	EXPANSION VOL.(gals.)	DESIGN EQUIPMENT
ET-1.2	MAIN COGEN LOOP	23	23	WATER	350	50	240	15	45	125		TACO CA-90
ET-3.4	COGEN FLC-1 LOOP	23	23	40% P.G.	200	50	240	15	45	125		TACO CA-90
ET-5.6	COGEN FLC-2 LOOP	8	5	40% P.G.	150	50	150	15	45	125		TACO CX-30

- NOTES:
- REMOVE ALL HANDLES FROM BALL VALVES SERVING SYSTEM EXPANSION TANKS TO AVOID INADVERTANT CLOSING.

HEAT EXCHANGER SCHEDULE - WATER TO WATER

TAG	LOCATION	SERVICE	TYPE	HOT WATER						COLD WATER						SF HTG SURFACE	OPERATING WEIGHT (LBS.)	DESIGN EQUIPMENT
				MBH	GPM	PD(PSI)	EWT	LWT	SYS. MEDIA	MAX W.P. PSI	MBH	GPM	PD(PSI)	EWT	LWT			
HX-1	MECHANICAL ROOM	COGEN HEAT REJECTION - FLC-1	PLATE & FRAME	5,460	210	3	225	175	WATER	150	5,460	210	3	210	160	40% P.G.	150	

FAN SCHEDULE

TAG	LOCATION	SERVICE	CFM AIR	TSP (N.W.C.)	BLADE TYPE	FAN RPM	DRIVE TYPE	MOTOR RPM	HP	VOLT	PH	STARTER	DESIGN EQUIPMENT	WEIGHT (LBS.)	NOTES
EF-1	SIDE WALL	COGEN CABINET EXHAUST	3000	1.5	FC	1443	BELT	1725	1.5	460	3	COMB.	GREENHECK CWB-180HP	116	
EF-2	SIDE WALL	COGEN CABINET EXHAUST	4500	1.5	FC	1023	BELT	1725	2	460	3	COMB.	GREENHECK CWB-240HP	146	
EF-3	SIDE WALL	COGEN CABINET EXHAUST	3000	1.5	FC	1443	BELT	1725	1.5	460	3	COMB.	GREENHECK CWB-180HP	116	

- NOTES:
- PROVIDE FAN WITH FACTORY MOUNTED DISCONNECT.
 - MOTOR STARTERS/VFDS FURNISHED BY M.C., MOUNTED AND WIRED BY E.C.

MISCELLANEOUS EQUIPMENT

TAG	DESCRIPTION	LOCATION	VOLTS	PH	AMPS
GFS-1	GLYCOL FEED STATION	MECHANICAL ROOM	120	1	
	HVAC DDC CONTROL PANEL	MECHANICAL ROOM	120	1	
	COGEN GAS TRAIN	MECHANICAL ROOM	120	1	
BF-1	BYPASS FILTER/FEEDER	MECHANICAL ROOM			

- NOTES:
- ELECTRICAL POWER PROVIDED BY ELECTRICAL CONTRACTOR.

GENERAL NOTES:

A. ALL SCHEDULED EQUIPMENT SHOWS REQUIRED PERFORMANCE AND EXPECTED STANDARD OF QUALITY. AS EQUALS MAY BE ACCEPTED UPON SUBMITTAL APPROVAL.



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CLIENT INFORMATION

REVISIONS

NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
2	4/14/2021	AS-BUILT

BALLSTON SPA HIGH SCHOOL
 210 BALLSTON AVE.
 BALLSTON SPA, NY 12020
 SED PROJECT #: 52130106-0001-032

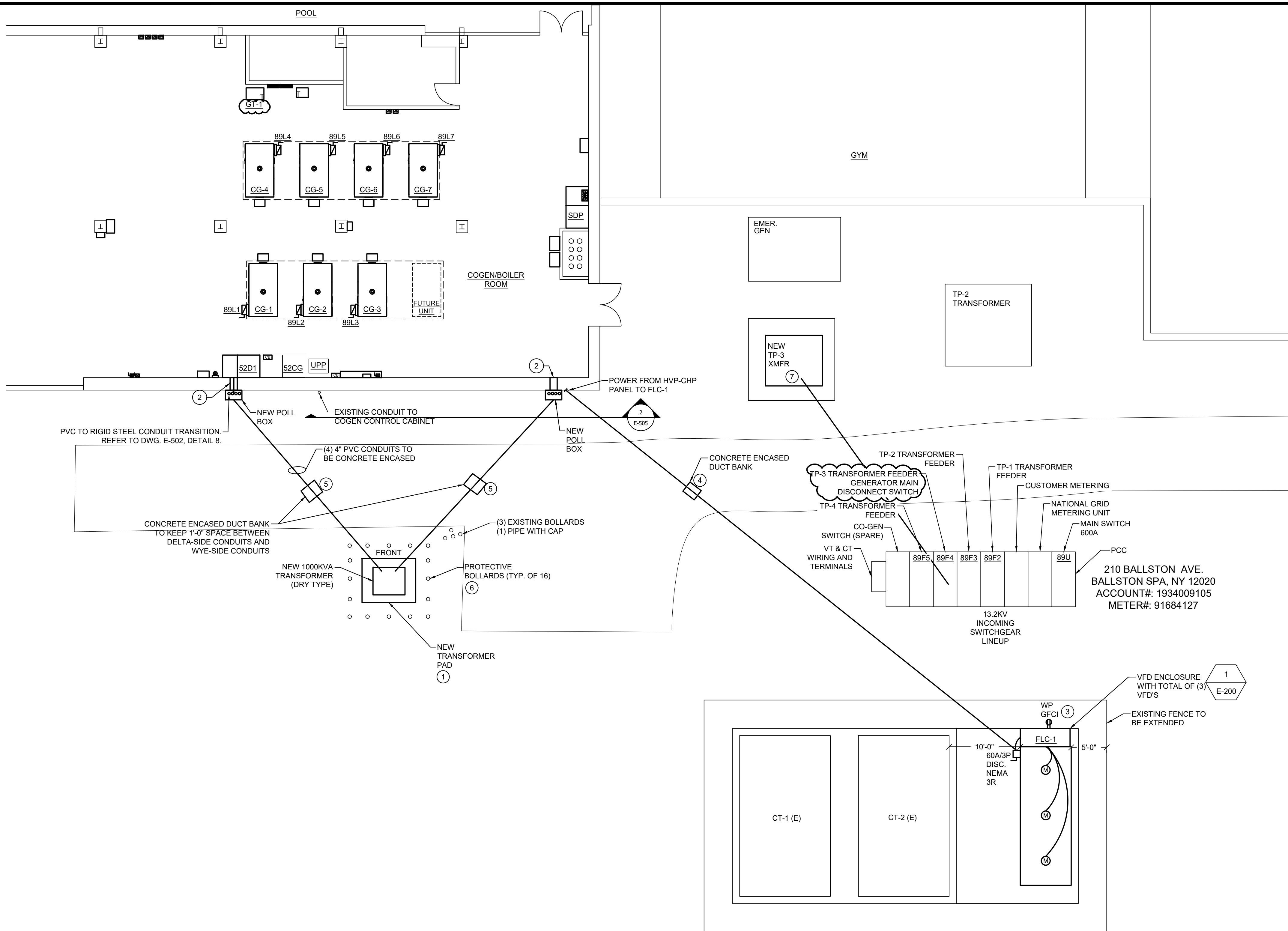
PROJECT NAME

SCALE PHASE

SCHEDULES - MECHANICAL

DRAWING TITLE

SEAL & SIGNATURE	DATE: 5-3-2019
	PROJECT No.: 18202
	DRAWING BY: IEC
	CHK BY: IEC
	DWG No: M-401
	CADO FILE No: 12
	of



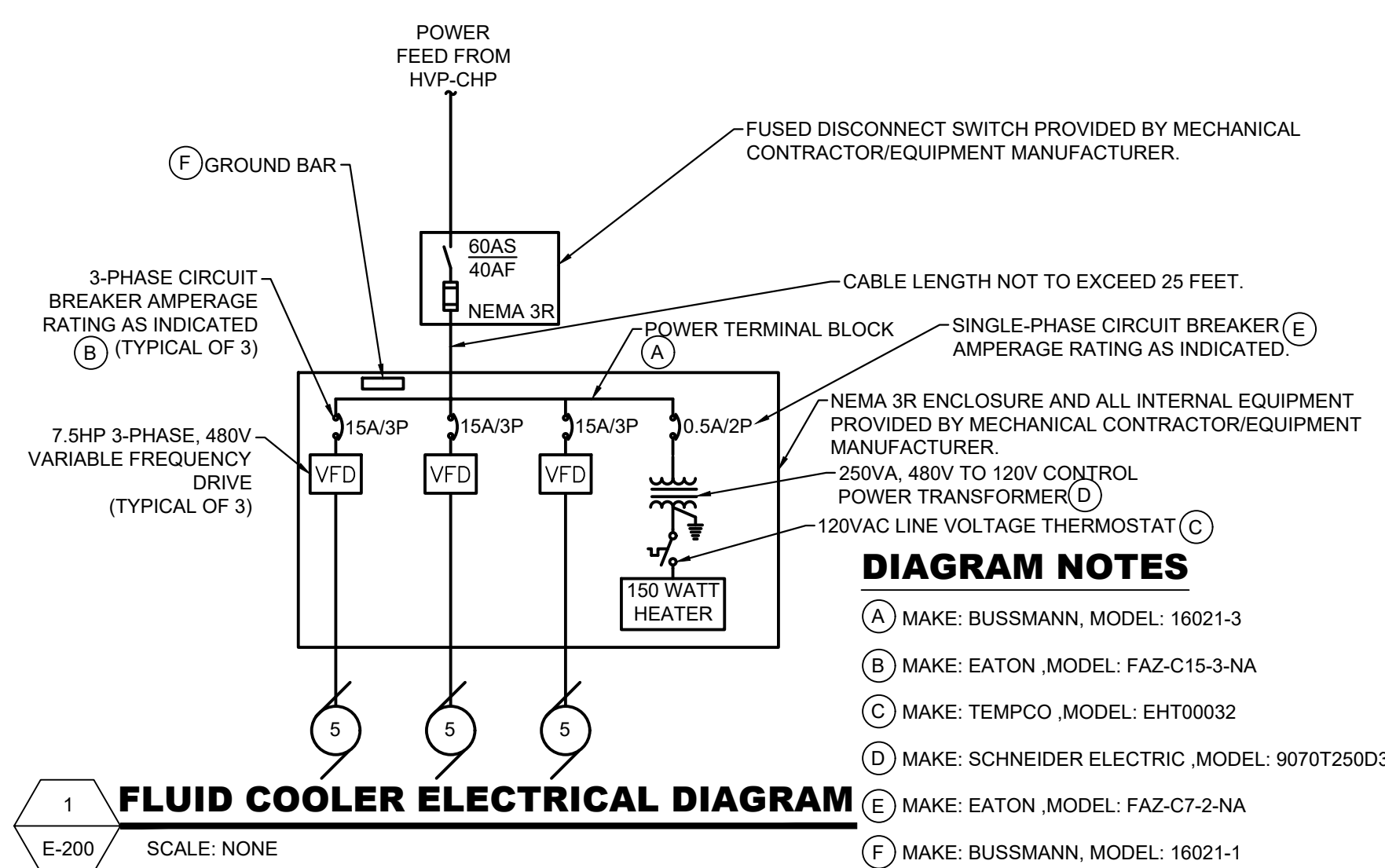
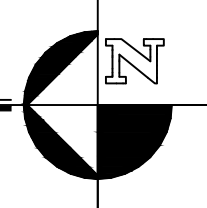
GENERAL NOTES:

- A. THIS INFORMATION REPRESENTS EXISTING CONDITIONS BASED ON ORIGINAL SITE DRAWINGS AND OBSERVED SITE CONDITIONS. NOT ALL WIRING, CONDUIT, AND DEVICES ARE SHOWN. THE CONTRACTOR SHALL FIELD VERIFY CIRCUITING, ROUTING, AND EXACT QUANTITIES.
- B. COORDINATE ALL CONDUIT RUNS WITH OTHER TRADES AND EXISTING CONDITIONS PRIOR TO STARTING WORK.
- C. ELECTRICAL CONTRACTOR SHALL PROVIDE ALL ELECTRICAL CABLE AND TERMINATIONS.
- D. COORDINATE EXACT INSTALLATION LOCATIONS WITH OWNER.
- E. COORDINATE ALL SHUTDOWNS WITH OWNER. OWNER WILL CONTACT LOCAL FIRE DEPARTMENT TO PLACE FIRE ALARM CONTROL PANEL (FACP) IN MAINTENANCE MODE.
- F. FIRE STOP ALL PENETRATIONS THROUGH FIRE WALLS.
- G. COORDINATE ORIENTATION OF BUILDING PRIOR TO ROUGHING CONDUITS.
- H. THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING THE PROPER UTILITIES INCLUDING ALL UTILITIES PRIVATELY OWNED AND STAKING OUT ALL UTILITIES PRIOR TO BEGINNING ANY WORK. VERIFY ALL UTILITY LOCATIONS PRIOR TO TRENCHING TO AVOID DAMAGE TO EXISTING UTILITIES. SPRAY PAINT LOCATION OF UTILITIES ON ASPHALT AND CONCRETE AND PROVIDE STAKES ON GRASS OR DIRT SURFACES. REMOVE SPRAY PAINT OR ASPHALT ONCE PROJECT IS COMPLETE.
- I. HAND EXCAVATE WHERE NECESSARY TO AVOID CAUSING DAMAGE TO EXISTING UTILITIES AND SERVICES.
- J. COORDINATE ALL CUTTING AND PATCHING OF SIDEWALKS AND DRIVEWAYS WITH OWNER'S REPRESENTATIVES PRIOR TO BEGINNING CONSTRUCTION. E.C. IS TO REPAIR ALL EXISTING ASPHALT AND CONCRETE AS REQUIRED FOR INSTALLATION OF CONDUITS.
- K. ALL EXCAVATION AND BACKFILL FOR THE ELECTRICAL SITE WORK IS BY ELECTRICAL CONTRACTOR. COORDINATE ALL WORK WITH THE SITE MANAGER.
- L. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR ALL TRAFFIC MAINTENANCE AND SAFETY, ASPHALT CUTTING, EXCAVATION, BACKFILL, AND CONCRETE WORK REQUIRED FOR THE INSTALLATION OF ELECTRICAL WORK. ALL REPAIR SHALL BE BY THE ELECTRICAL CONTRACTOR AFTER ALL ELECTRICAL WORK IS COMPLETE.

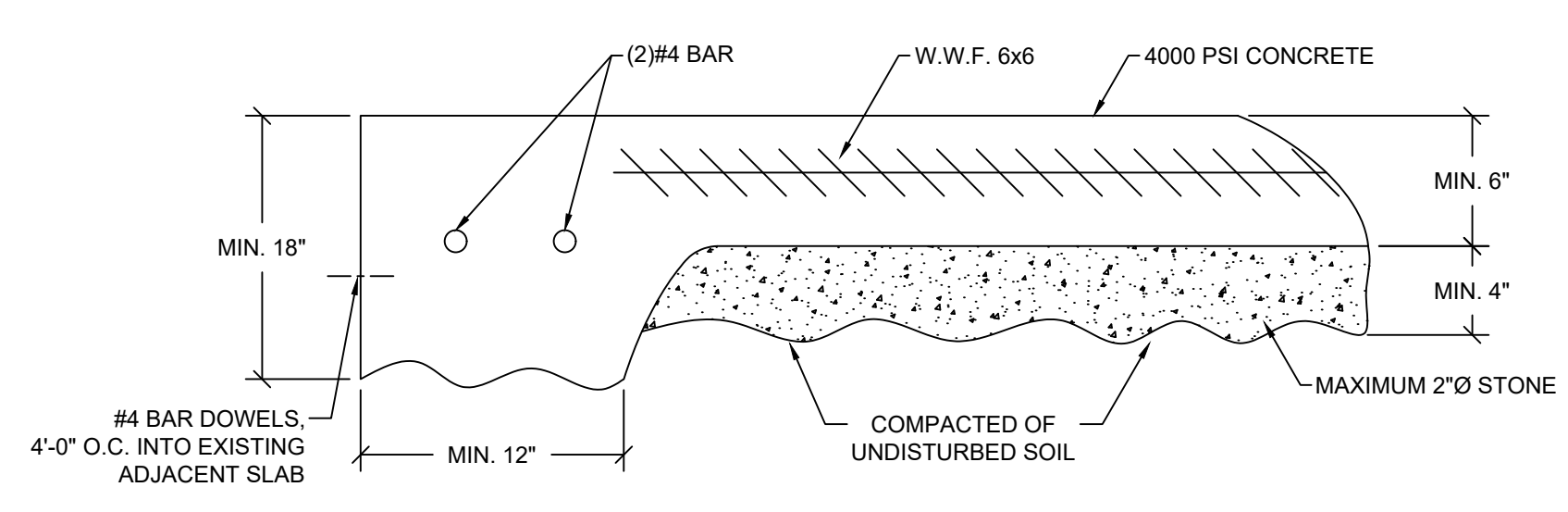
INSTALLATION NOTES:

- 1 PROVIDE 2'-0" THICK CONCRETE PAD FOR OUTDOOR TRANSFORMER. REFER TO DWG. E-501, DETAIL 1 FOR TRANSFORMER PAD DETAILS.
- 2 PROVIDE 4" SCH 80 PVC SLEEVE THROUGH EXISTING WALL. CORE DRILL WALL AS REQUIRED. COORDINATE WORK WITH STRUCTURAL ENGINEER AND STRUCTURAL CONTRACTOR.
- 3 CONNECT RECEPTACLES TO PANEL LVP-CHP, CIRCUIT 7. REFER TO DETAIL 3 ON DRAWING E-502 FOR EXTERIOR RECEPTACLES INSTALLATION.
- 4 PROVIDE DUCT BANK FOR UNDERGROUND CONDUITS. REFER TO DRAWING E-502, DETAIL 6.
- 5 PROVIDE DUCT BANK FOR UNDERGROUND CONDUITS. REFER TO DRAWING E-502, DETAIL 7. KEEP 1'-0" SPACE BETWEEN DELTA-SIDE CONDUITS AND WYE-SIDE CONDUITS
- 6 PROVIDE PROTECTIVE BOLLARD. REFER TO DRAWING E-501, DETAIL 2.
- 7 RECONNECT EXISTING 480V FEEDER TO NEW TP-3 TRANSFORMER. PROVIDE NEW 15KV FEEDER WITH 15KV NEUTRAL CABLE IN EXISTING CONDUIT TO OUTDOOR SWITCHGEAR LINEUP.
- 8 EC TO PROVIDE ALL WORK ASSOCIATED WITH THE INSTALLATION OF THE NEW FLC-1 TO INCLUDE CONCRETE PAD, FENCE, ELECTRICAL AND SITE WORK. FLC-1 PROVIDED BY THE MC.

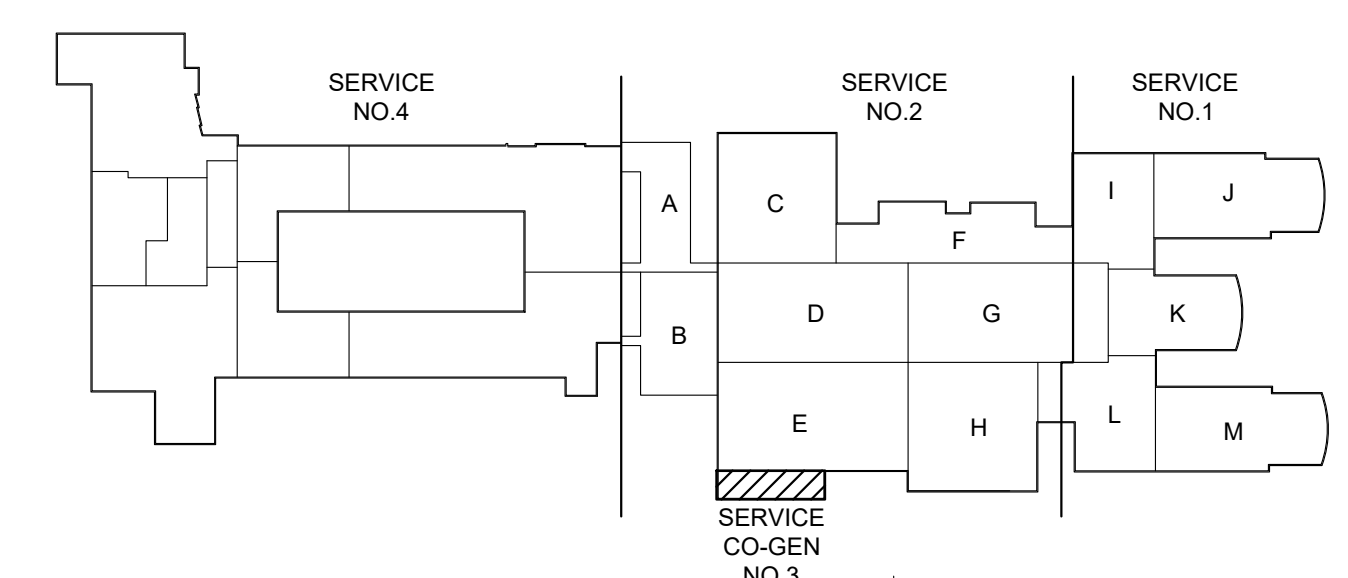
1 OUTDOOR NEW WORK PLAN - ELECTRICAL
E-200 SCALE: 1/8" = 1'-0"



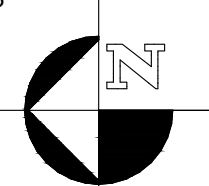
1 FLUID COOLER ELECTRICAL DIAGRAM
E-200 SCALE: NONE



2 STRUCTURAL SLAB DETAIL
E-200 SCALE: NONE



PLOT PLAN
SCALE: NONE



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CLIENT INFORMATION

REVISIONS		
NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
2	01/07/2020	CIC # 001 Electrical 07, UPDATED FOR REMOVING LTS-1
3	09/29/2020	NATIONAL GRID POST CESIR SUBMISSION
4	11/17/2020	REVISED PER NATIONAL GRID CONSTRUCTION REVIEW
5	4/14/2021	AS-BUILT

REVISIONS		
NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
2	01/07/2020	CIC # 001 Electrical 07, UPDATED FOR REMOVING LTS-1
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4	11/17/2020	REVISED PER NATIONAL GRID CONSTRUCTION REVIEW
5	4/14/2021	AS-BUILT

BALLSTON SPA HIGH SCHOOL
210 BALLSTON AVE.
BALLSTON SPA, NY 12020
SED PROJECT #: 52130106-0001-032

PROJECT NAME

SCALE

PHASE

OUTDOOR NEW WORK PLAN - ELECTRICAL

DRAWING TITLE

DATE: 5-3-2019
PROJECT No.: 18202
DRAWING BY: IEC
CHK BY: IEC
DWG No: E-200
CADD FILE No: 12

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CLIENT INFORMATION

REVISIONS

NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
2	01/07/2020	CIC # 001 Electrical 07, UPDATED FOR REMOVING LTS-1
3	09/28/2020	NATIONAL GRID POST CESIR SUBMISSION
4	4/14/2021	AS-BUILT

BALLSTON SPA HIGH SCHOOL
210 BALLSTON AVE.
BALLSTON SPA, NY 12020
SED PROJECT #: 52130106-0001-032

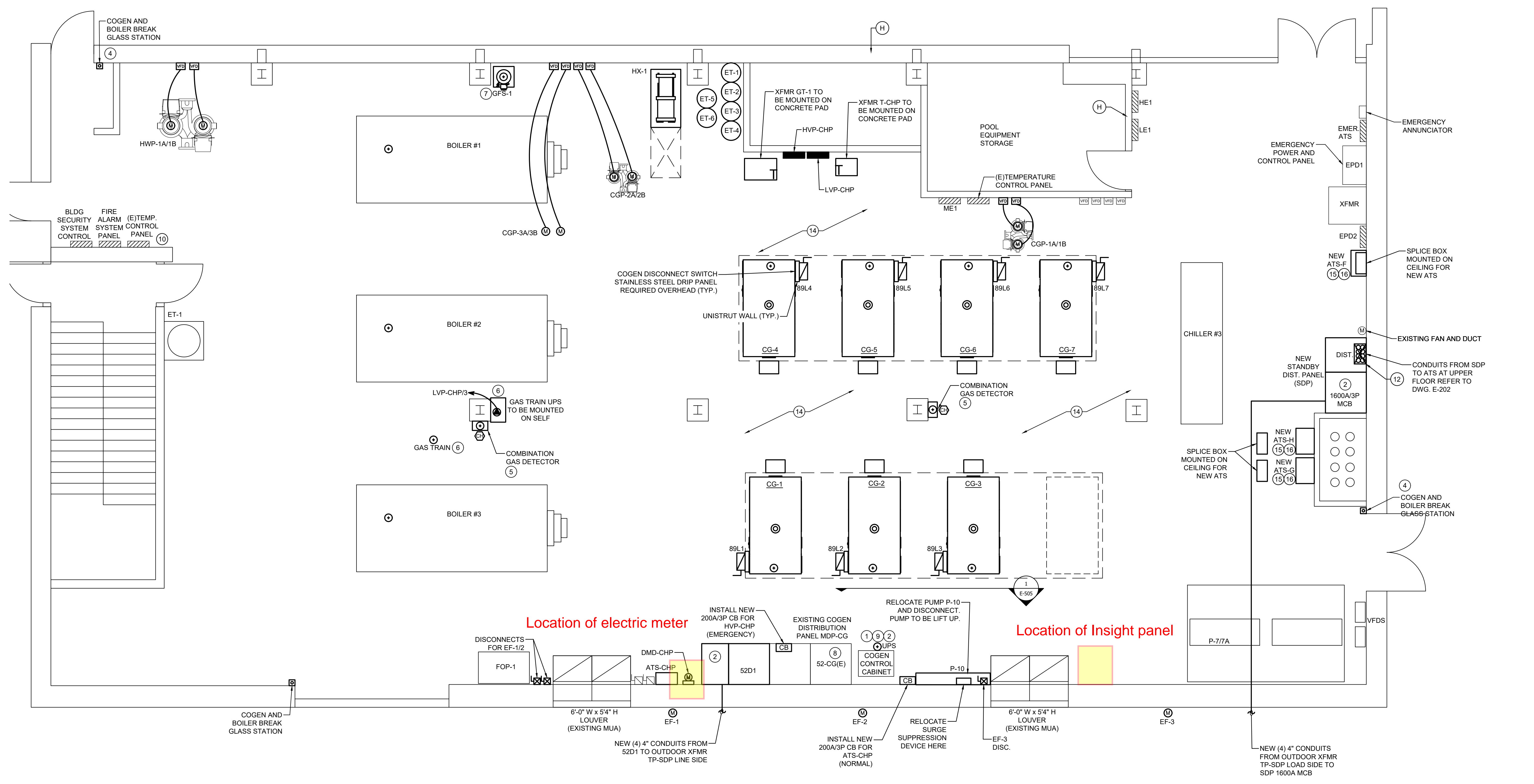
PROJECT NAME

SCALE: PHASE

BOILER & COGEN NEW WORK FIRST FLOOR PLAN - ELECTRICAL

DRAWING TITLE

DATE: 5-3-2019	PROJECT No.: 18202
DRAWING BY: IEC	CHK BY: IEC
DWG No:	E-201
CADD FILE No:	of



GENERAL NOTES:

- A. THIS INFORMATION REPRESENTS EXISTING CONDITIONS BASED ON ORIGINAL SITE DRAWINGS AND OBSERVED SITE CONDITIONS. NOT ALL WIRING, CONDUIT, AND DEVICES ARE SHOWN. THE CONTRACTOR SHALL FIELD VERIFY CIRCUITING, ROUTING, AND EXACT QUANTITIES.
- B. COORDINATE ALL CONDUIT RUNS WITH OTHER TRADES AND EXISTING CONDITIONS PRIOR TO STARTING WORK.
- C. ELECTRICAL CONTRACTOR SHALL PROVIDE ALL ELECTRICAL CABLE AND TERMINATIONS.
- D. COORDINATE EXACT INSTALLATION LOCATIONS WITH OWNER.
- E. COORDINATE ALL SHUTDOWNS WITH OWNER. OWNER WILL CONTACT LOCAL FIRE DEPARTMENT TO PLACE FIRE ALARM CONTROL PANEL (FACP) IN MAINTENANCE MODE.
- F. FIRE STOP ALL PENETRATIONS THROUGH WALLS.
- G. ALL POWER CONDUIT BELOW 10'-0" SHALL BE RIGID STEEL CONDUIT.
- H. FIRE RATED WALL.

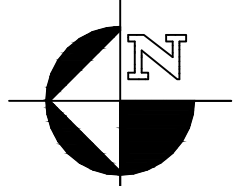
INSTALLATION NOTES:

- ① PROVIDE 208V 3 PHASE POWER CONNECTION FROM LVP-CHP TO NEW UPS, VIA 4-#10 & 1-#10 E.G IN 1" C.
- ② EXTEND EXISTING HOUSEKEEPING PADS BY M.C.
- ③ COORDINATE LOCATION WITH EXISTING CONDENSER WATER PIT.
- ④ MODIFY EXISTING BOILER GLASS BREAK STATION CIRCUIT TO ADD EMERGENCY SHUTDOWN FOR COGEN UNITS. FURNISH AND INSTALL 8-#14 (4 SPARE) 1/2" C AND WIRE TO COGEN GAS TRAIN AND GAS TRAIN UPS IN ACCORDANCE WITH DETAIL 1 AND 2 ON DRAWING E-502.
- ⑤ 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 ESSAH + ESSCO OR APPROVED EQUIVALENT. REFER TO DETAIL 2 ON DRAWING E-501.
- ⑥ PROVIDE 120VAC POWER CONNECTION TO GAS TRAIN FROM PROVIDED ON-LINE UPS. COORDINATE INSTALLATION LOCATION WITH MECHANICAL CONTRACTOR. REFER TO GAS TRAIN DETAIL FOR ADDITIONAL INFORMATION. CONNECT RECEPTACLE TO PANEL LVP-CHP. CIRCUITS 4. PROVIDE 30A TWISTLOCK NEMA L5-30P ON SJO CORD WHIP TO PLUG INTO UPS. PROVIDE NEMA L5-20R NEAR UPS TO CONNECT UPS TO NORMAL POWER. SEE GAS TRAIN DETAIL ON DRAWING E-502 FOR ADDITIONAL INFORMATION. PROVIDE ADDITIONAL QUAD-RECEPTACLE FOR UPS FAILURE BACKUP POWER.
- ⑦ PROVIDE 120VAC RECEPTACLE FOR GLYCOL FILL STATION FROM PANEL LVP-CHP. CIRCUITS 2. COORDINATE INSTALLATION LOCATION WITH MECHANICAL CONTRACTOR.
- ⑧ DRILL AND TAP EXISTING MDP-CG LOAD SIDE BUS TO ADD LUGS TO ACCOMMODATE 5 SETS OF 500MCM CABLES TO CONNECT NEW 52D1 BREAKER. COORDINATE WORK WITH SWITCHGEAR MANUFACTURER TO MAINTAIN UL RATINGS. REFER TO DRAWING E301 FOR ADDITIONAL INFORMATION.
- ⑨ MODIFY EXISTING COGEN CONTROL CABINET TO MOUNT NEW SEL-751 AND SEL-2440 RELAYS. PROVIDE NECESSARY MOUNTING ACCESSORIES. REFER TO DRAWING E-503 FOR MOUNTING LOCATION.
- ⑩ PREFERRED T.C. PANEL FOR NEW WORK INTEGRATION.
- ⑪ FIRE RATED WALL.
- ⑫ COORDINATE WITH CORE DRILLING LOCATIONS.
- ⑬ NOT USED.
- ⑭ RELOCATE EXISTING LUMINAIRES AS NECESSARY TO ACCOMMODATE NEW EQUIPMENT LAYOUT.
- ⑮ CUT CABLES AND PROVIDE NEW CABLES FROM MDP-B TO NEW AUTOMATIC TRANSFER SWITCH (ATS) AS NORMAL SOURCE. PROVIDE SPLICE BOX AND EXTENDED CABLES. UTILIZE BURNDY LONG BARREL HYDRAULIC BUTT SPLICE. PROVIDE NEW CABLES FROM SDP TO NEW ATS AS EMERGENCY SOURCE.
- ⑯ INTERCEPT EXISTING FEEDERS. UTILIZE SPLICE BOX TO REROUTE EXISTING FEEDER FROM MDP-B TO LOAD SIDE OF NEW ATS. MODIFY AND EXTEND EXISTING POWER FEEDER UTILIZING BURNDY LONG BARREL HYDRAULIC BUTT SPLICE.

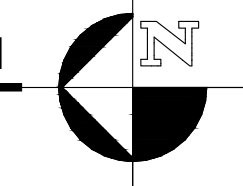
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E-201

BOILER & COGEN NEW WORK FIRST FLOOR PLAN - ELECTRICAL

SCALE: 1/4" = 1'-0"



PLOT PLAN
SCALE: NONE



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REVISIONS

NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
2	01/07/2020	CIC # 001 Electrical 07, UPDATED FOR REMOVING LTS-1
3	06/18/2020	CIC # 004, INSTALLATION OF CTS
4	09/29/2020	NATIONAL GRID POST CESIR SUBMISSION
5	11/04/2020	REVISED PER NATIONAL GRID CONSTRUCTION REVIEW
6	4/14/2021	AS-BUILT

BALLSTON SPA HIGH SCHOOL
210 BALLSTON AVE.
BALLSTON SPA, NY 12020
SED PROJECT #: 52130106-0001-032

PROJECT NAME

SCALE PHASE

ONE-LINE DIAGRAM - OVERALL

DRAWING TITLE

DATE: 5-3-2019	PROJECT No.: 18202
DRAWN BY: YR	CHECK BY: JW
DWG No.:	E-301
CADD FILE No.:	of

GENERAL NOTES:

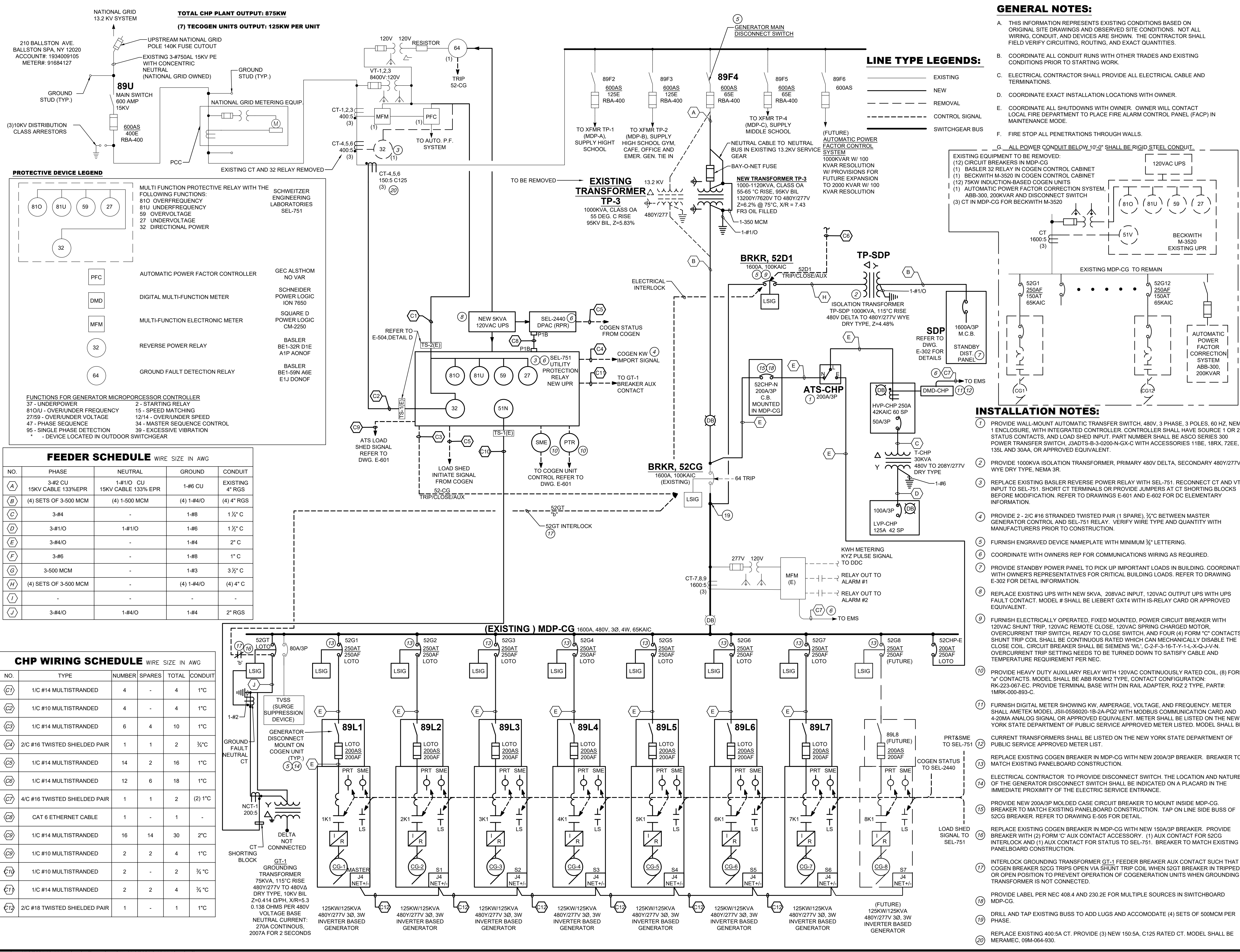
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- F. FIRE STOP ALL PENETRATIONS THROUGH WALLS.
- G. ALL POWER CONDUIT BELOW 10'-0" SHALL BE RIGID STEEL CONDUIT.

LINE TYPE LEGENDS:

- EXISTING
- NEW
- - - REMOVAL
- · - · - CONTROL SIGNAL
- SWITCHGEAR BUS

INSTALLATION NOTES:

1. PROVIDE WALL-MOUNT AUTOMATIC TRANSFER SWITCH, 480V, 3 PHASE, 3 POLES, 60 HZ, NEMA 1 ENCLOSURE, WITH INTEGRATED CONTROLLER. CONTROLLER SHALL HAVE SOURCE 1 OR 2 STATUS CONTACTS, AND LOAD SHED INPUT. PART NUMBER SHALL BE ASCO SERIES 300 POWER TRANSFER SWITCH, 3ADTS-B-3-0200-N-GX-C WITH ACCESSORIES 11BE, 18RX, 7ZEE, 13SL AND 30AA, OR APPROVED EQUIVALENT.
2. PROVIDE 1000KVA ISOLATION TRANSFORMER, PRIMARY 480V DELTA, SECONDARY 480Y/277V WYE DRY TYPE, NEMA 3R.
3. REPLACE EXISTING BASLER REVERSE POWER RELAY WITH SEL-751. RECONNECT CT AND VT INPUT TO SEL-751. SHORT CT TERMINALS OR PROVIDE JUMPERS AT CT SHORTING BLOCKS BEFORE MODIFICATION. REFER TO DRAWINGS E-601 AND E-602 FOR DC ELEMENTARY INFORMATION.
4. PROVIDE 2 - 2/C #16 STRANDED TWISTED PAIR (1 SPARE), 3/4" C BETWEEN MASTER GENERATOR CONTROL AND SEL-751 RELAY. VERIFY WIRE TYPE AND QUANTITY WITH MANUFACTURERS PRIOR TO CONSTRUCTION.
5. FURNISH ENGRAVED DEVICE NAMEPLATE WITH MINIMUM 3/8" LETTERING.
6. COORDINATE WITH OWNERS REP FOR COMMUNICATIONS WIRING AS REQUIRED.
7. PROVIDE STANDBY POWER PANEL TO PICK UP IMPORTANT LOADS IN BUILDING. COORDINATE WITH OWNER'S REPRESENTATIVES FOR CRITICAL BUILDING LOADS. REFER TO DRAWING E-302 FOR DETAIL INFORMATION.
8. REPLACE EXISTING UPS WITH NEW 5KVA, 208VAC INPUT, 120VAC OUTPUT UPS WITH UPS FAULT CONTACT. MODEL # SHALL BE LIEBERT GXT4 WITH IS-RELAY CARD OR APPROVED EQUIVALENT.
9. FURNISH ELECTRICALLY OPERATED, FIXED MOUNTED, POWER CIRCUIT BREAKER WITH 120VAC SHUNT TRIP, 120VAC REMOTE CLOSE, 120VAC SPRING CHARGED MOTOR, OVERCURRENT TRIP SWITCH, READY TO CLOSE SWITCH, AND FOUR (4) FORM "C" CONTACTS. SHUNT TRIP COIL SHALL BE CONTINUOUS RATED WHICH CAN MECHANICALLY DISABLE THE CLOSE COIL. CIRCUIT BREAKER SHALL BE SIEMENS "WL" C-2-F-16-T-X-L-Q-V-N. OVERCURRENT TRIP SETTING NEEDS TO BE TURNED DOWN TO SATISFY CABLE AND TEMPERATURE REQUIREMENT PER NEC.
10. PROVIDE HEAVY DUTY AUXILIARY RELAY WITH 120VAC CONTINUOUSLY RATED COIL, (8) FORM "F" CONTACTS. MODEL SHALL BE ABB RKM2 TYPE. CONTACT CONFIGURATION: RK-223-067-EC. PROVIDE TERMINAL BASE WITH DIN RAIL ADAPTER, RZX2 TYPE, PART#: 1MRK-000-893-C.
11. FURNISH DIGITAL METER SHOWING KW, AMPERAGE, VOLTAGE, AND FREQUENCY. METER SHALL AMETEK MODEL JSI-0558020-1B-2A-PQ2 WITH MODBUS COMMUNICATION CARD AND 4-20MA ANALOG SIGNAL OR APPROVED EQUIVALENT. METER SHALL BE LISTED ON THE NEW YORK STATE DEPARTMENT OF PUBLIC SERVICE APPROVED METER LISTED. MODEL SHALL BE 1MRK-000-893-C.
12. CURRENT TRANSFORMERS SHALL BE LISTED ON THE NEW YORK STATE DEPARTMENT OF PUBLIC SERVICE APPROVED METER LIST.
13. REPLACE EXISTING COGEN BREAKER IN MDP-CG WITH NEW 200A/3P BREAKER. BREAKER TO MATCH EXISTING PANELBOARD CONSTRUCTION.
14. ELECTRICAL CONTRACTOR TO PROVIDE DISCONNECT SWITCH. THE LOCATION AND NATURE OF THE GENERATOR DISCONNECT SWITCH SHALL BE INDICATED ON A PLACARD IN THE IMMEDIATE PROXIMITY OF THE ELECTRIC SERVICE ENTRANCE.
15. PROVIDE NEW 200A/3P MOLDED CASE CIRCUIT BREAKER TO MOUNT INSIDE MDP-CG. BREAKER TO MATCH EXISTING PANELBOARD CONSTRUCTION. TAP ON LINE SIDE BUSS OF 52CG BREAKER. REFER TO DRAWING E-505 FOR DETAIL.
16. REPLACE EXISTING COGEN BREAKER IN MDP-CG WITH NEW 150A/3P BREAKER. PROVIDE BREAKER WITH (2) FORM "C" AUX CONTACT ACCESSORY, (1) AUX CONTACT FOR 52CG INTERLOCK AND (1) AUX CONTACT FOR STATUS TO SEL-751. BREAKER TO MATCH EXISTING PANELBOARD CONSTRUCTION.
17. INTERLOCK GROUNDING TRANSFORMER GT-1 FEEDER BREAKER AUX CONTACT SUCH THAT COGEN BREAKER 52CG TRIPS OPEN VIA SHUNT TRIP COIL WHEN 52GT BREAKER IN TRIPPED OR OPEN POSITION TO PREVENT OPERATION OF COGENERATION UNITS WHEN GROUNDING TRANSFORMER IS NOT CONNECTED.
18. PROVIDE LABEL PER NEC 408.4 AND 230.2E FOR MULTIPLE SOURCES IN SWITCHBOARD MDP-CG.
19. DRILL AND TAP EXISTING BUSS TO ADD LUGS AND ACCOMMODATE (4) SETS OF 500MCM PER PHASE.
20. REPLACE EXISTING 400-5A CT. PROVIDE (3) NEW 150-5A, C125 RATED CT. MODEL SHALL BE MERAMEC, 09M-064-930.



TOTAL CHP PLANT OUTPUT: 875KW
(7) TECOGEN UNITS OUTPUT: 125KW PER UNIT

PROTECTIVE DEVICE LEGEND

81O, 81U, 59, 27, 32

MULTI FUNCTION PROTECTIVE RELAY WITH THE FOLLOWING FUNCTIONS:
81O OVERFREQUENCY
81U UNDERFREQUENCY
59 OVERVOLTAGE
27 UNDERVOLTAGE
32 DIRECTIONAL POWER

SCHWEITZER ENGINEERING LABORATORIES SEL-751

37 - UNDERPOWER
81O/U - OVER/UNDER FREQUENCY
27/59 - OVER/UNDER VOLTAGE
47 - PHASE SEQUENCE
95 - SINGLE PHASE DETECTION
* - DEVICE LOCATED IN OUTDOOR SWITCHGEAR

2 - STARTING RELAY
15 - SPEED MATCHING
12/14 - OVER/UNDER SPEED
34 - MASTER SEQUENCE CONTROL
39 - EXCESSIVE VIBRATION

AUTOMATIC POWER FACTOR CONTROLLER: GEC ALSTHOM NO VAR

DIGITAL MULTI-FUNCTION METER: SCHNEIDER POWER LOGIC ION 7650

MULTI-FUNCTION ELECTRONIC METER: SQUARE D POWER LOGIC CM-2250

REVERSE POWER RELAY: BASLER BE1-32R D1E A1P AONOF

GROUND FAULT DETECTION RELAY: BASLER BE1-59N AGE E1J DONOF

FEEDER SCHEDULE WIRE SIZE IN AWG

NO.	PHASE	NEUTRAL	GROUND	CONDUIT
A	3-#2 CU	1-#1/0 CU	1-#6 CU	EXISTING 4" RGS
B	(4) SETS OF 3-500 MCM	(4) 1-500 MCM	(4) 1-#4/O	(4) 4" RGS
C	3-#4	-	1-#8	1 1/2" C
D	3-#1/0	1-#1/0	1-#6	1 1/2" C
E	3-#4/O	-	1-#4	2" C
F	3-#6	-	1-#8	1" C
G	3-500 MCM	-	1-#3	3 1/2" C
H	(4) SETS OF 3-500 MCM	-	(4) 1-#4/O	(4) 4" C
I	-	-	-	-
J	3-#4/O	1-#4/O	1-#4	2" RGS

CHP WIRING SCHEDULE WIRE SIZE IN AWG

NO.	TYPE	NUMBER	SPARES	TOTAL	CONDUIT
C1	1/C #14 MULTISTRANDED	4	-	4	1" C
C2	1/C #10 MULTISTRANDED	4	-	4	1" C
C3	1/C #14 MULTISTRANDED	6	4	10	1" C
C4	2/C #16 TWISTED SHIELDED PAIR	1	1	2	3/4" C
C5	1/C #14 MULTISTRANDED	14	2	16	1" C
C6	1/C #14 MULTISTRANDED	12	6	18	1" C
C7	4/C #16 TWISTED SHIELDED PAIR	1	1	2	(2) 1" C
C8	CAT 6 ETHERNET CABLE	1	-	1	-
C9	1/C #14 MULTISTRANDED	16	14	30	2" C
C9	1/C #10 MULTISTRANDED	2	2	4	1" C
C10	1/C #10 MULTISTRANDED	2	-	2	3/4" C
C11	1/C #14 MULTISTRANDED	2	2	4	3/4" C
C12	2/C #18 TWISTED SHIELDED PAIR	1	-	1	1" C

GENERAL NOTES:

- A. THIS INFORMATION REPRESENTS EXISTING CONDITIONS BASED ON ORIGINAL SITE DRAWINGS AND OBSERVED SITE CONDITIONS. NOT ALL WIRING, CONDUIT, AND DEVICES ARE SHOWN. THE CONTRACTOR SHALL FIELD VERIFY CIRCUITING, ROUTING, AND EXACT QUANTITIES.
- B. COORDINATE ALL CONDUIT RUNS WITH OTHER TRADES AND EXISTING CONDITIONS PRIOR TO STARTING WORK.
- C. ELECTRICAL CONTRACTOR SHALL PROVIDE ALL ELECTRICAL CABLE AND TERMINATIONS.
- D. COORDINATE EXACT INSTALLATION LOCATIONS WITH OWNER.
- E. COORDINATE ALL SHUTDOWNS WITH OWNER. OWNER WILL CONTACT LOCAL FIRE DEPARTMENT TO PLACE FIRE ALARM CONTROL PANEL (FACP) IN MAINTENANCE MODE.
- F. FIRE STOP ALL PENETRATIONS THROUGH WALLS.
- G. ALL POWER CONDUIT BELOW 10'-0" SHALL BE RIGID STEEL CONDUIT.

INSTALLATION NOTES:

- ① CUT CABLES AND RECONNECT THE END OF TERMINATED CABLES TO NEW AUTOMATIC TRANSFER SWITCH (ATS) AS NORMAL SOURCE. PROVIDE NEW CABLES AND CONDUITS.
- ② CONNECT CABLES BETWEEN NEW ATS AND EXISTING LOAD SIDE PANELS. UTILIZE BURNDY LONG BARREL HYDRAULIC BUTT SPLICE. MODEL NUMBER SHALL BE YS31 OR APPROVAL EQUIVALENT. PROVIDE SPLICE BOX TO HOUSE CABLE SPLICE.
- ③ PROVIDE WALL-MOUNT AUTOMATIC TRANSFER SWITCH, 480V, 3 PHASE, 3 POLES, 60 HZ, NEMA 1 ENCLOSURE, WITH INTEGRATED CONTROLLER. CONTROLLER SHALL HAVE SOURCE 1 OR 2 STATUS CONTACTS, AND LOAD SHED INPUT. PART NUMBER SHALL BE ASCO SERIES 300 POWER TRANSFER SWITCH, J3ADTS-B-3-0200-N-GX-C WITH ACCESSORIES 11BE, 16RX, 72EE, 135L AND 30AA, OR APPROVED EQUIVALENT.
- ④ PROVIDE WALL-MOUNT AUTOMATIC TRANSFER SWITCH, 480V, 3 PHASE, 3 POLES, 60 HZ, NEMA 1 ENCLOSURE, WITH INTEGRATED CONTROLLER. CONTROLLER SHALL HAVE SOURCE 1 OR 2 STATUS CONTACTS, AND LOAD SHED INPUT. PART NUMBER SHALL BE ASCO SERIES 300 POWER TRANSFER SWITCH, J3ADTS-B-3-0200-N-GX-C WITH ACCESSORIES 11BE, 16RX, 72EE, 135L AND 30AA, OR APPROVED EQUIVALENT.

FEEDER SCHEDULE WIRE SIZE IN AWG				
NO.	PHASE	NEUTRAL	GROUND	CONDUIT
A	(8) SETS OF 3-500 MCM	(8) 1-500 MCM	(8) 1-400 MCM	4" RGS
B	(2) SETS OF 3-350 MCM	(2) 1-350 MCM	(2) 1-#4	(2) 3 1/2" RGS
C	(2) SETS OF 3-500 MCM	(2) 1-500 MCM	(2) 1-#3	(2) 3 1/2" C
D	3-#4/O	1-#4/O	1-#4	2 1/2" RGS
E	3-#1/O	1-#1/O	1-#6	2" C
F	3-500 MCM	-	#3	3 1/2" C
G	3-#2	1-#2	1-#8	1 1/2" C
H	3-#1/O	-	1-#6	2" C
I	3-#4/O	2-#4/O (NON LINEAR, 200% NEUTRAL)	1-#4	3" C
J	3-#2	2-#1/O (NON LINEAR, 200% NEUTRAL)	1-#8	2" C
K	3-#4	1-#4	1-#8	1 1/2" C
L	3-#3/O	1-#3/O	1-#6	2 1/2" C
M	3-#6	-	1-#10	1 1/2" C
N	(2) SETS OF 3-400 MCM	(2) 1-400 MCM	(2) 1-#3	(2) 4" C
O	3-#2/O	-	1-#6	2" C
P	3-350 MCM	1-350 MCM	1-#4	4" C
Q	3-#4/O	-	1-#4	2 1/2" C
R	3-#4	-	1-#8	1 1/2" C
S	3-#2/O	1-#2/O	1-#6	2" C
T	3-500 MCM	1-500 MCM	#3	4" C

LINE TYPE LEGENDS:

- EXISTING
- - - NEW
- - - - REMOVAL
- - - - - CONTROL SIGNAL
- SWITCHGEAR BUS

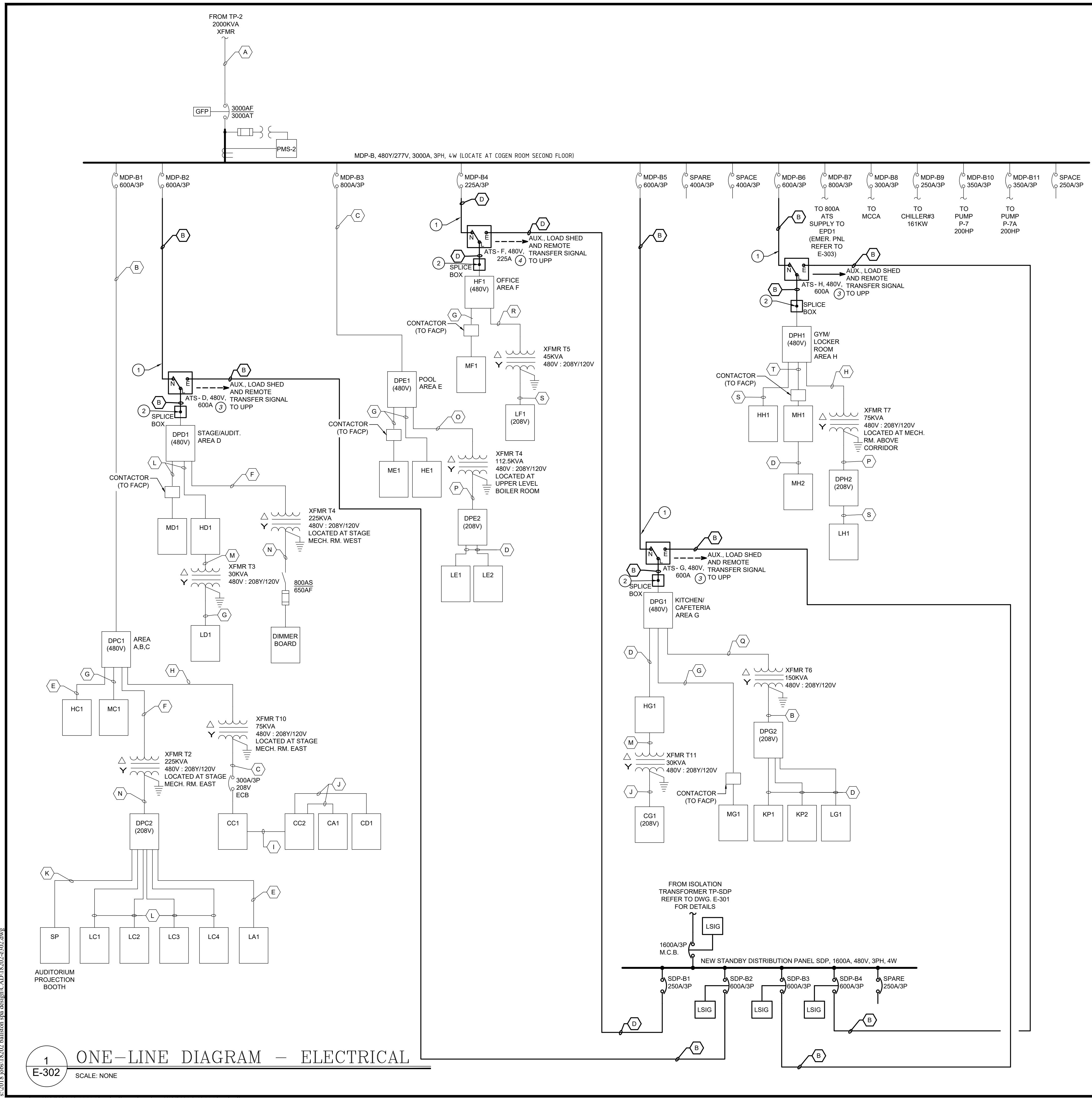
REVISIONS		
NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
2	09/29/2020	NATIONAL GRID POST CESIR SUBMISSION
3	4/14/2021	AS-BUILT

BALLSTON SPA HIGH SCHOOL
210 BALLSTON AVE.
BALLSTON SPA, NY 12020
SED PROJECT #: 52130106-0001-032

PROJECT NAME
SCALE PHASE

ONE-LINE DIAGRAM - SERVICE 2 MDP-B

DRAWING TITLE
SEAL & SIGNATURE
DATE: 5-3-2019
PROJECT No.: 18202
DRAWING BY: YR
CHK BY: JW
DWG No.: E-302
CADD FILE No.:
12 of



ONE-LINE DIAGRAM - ELECTRICAL
SCALE: NONE

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INTEGRATED ENERGY CONCEPTS
ENGINEERING, P.C.

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Combined Heat & Power,
Energy, Mechanical and
Electrical - Consultants

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CLIENT INFORMATION

REVISIONS

NO.	DATE	DESCRIPTION
1	11/6/2019	ISSUED TO BID
2	09/29/2020	NATIONAL GRID POST CESIR SUBMISSION
3	4/14/2021	AS-BUILT

BALLSTON SPA HIGH SCHOOL
210 BALLSTON AVE.
BALLSTON SPA, NY 12020
SED PROJECT #: 52130106-0001-032

PROJECT NAME

SCALE PHASE

ONE-LINE DIAGRAM -
SERVICE 2 MDP-B
EMERGENCY

DRAWING TITLE

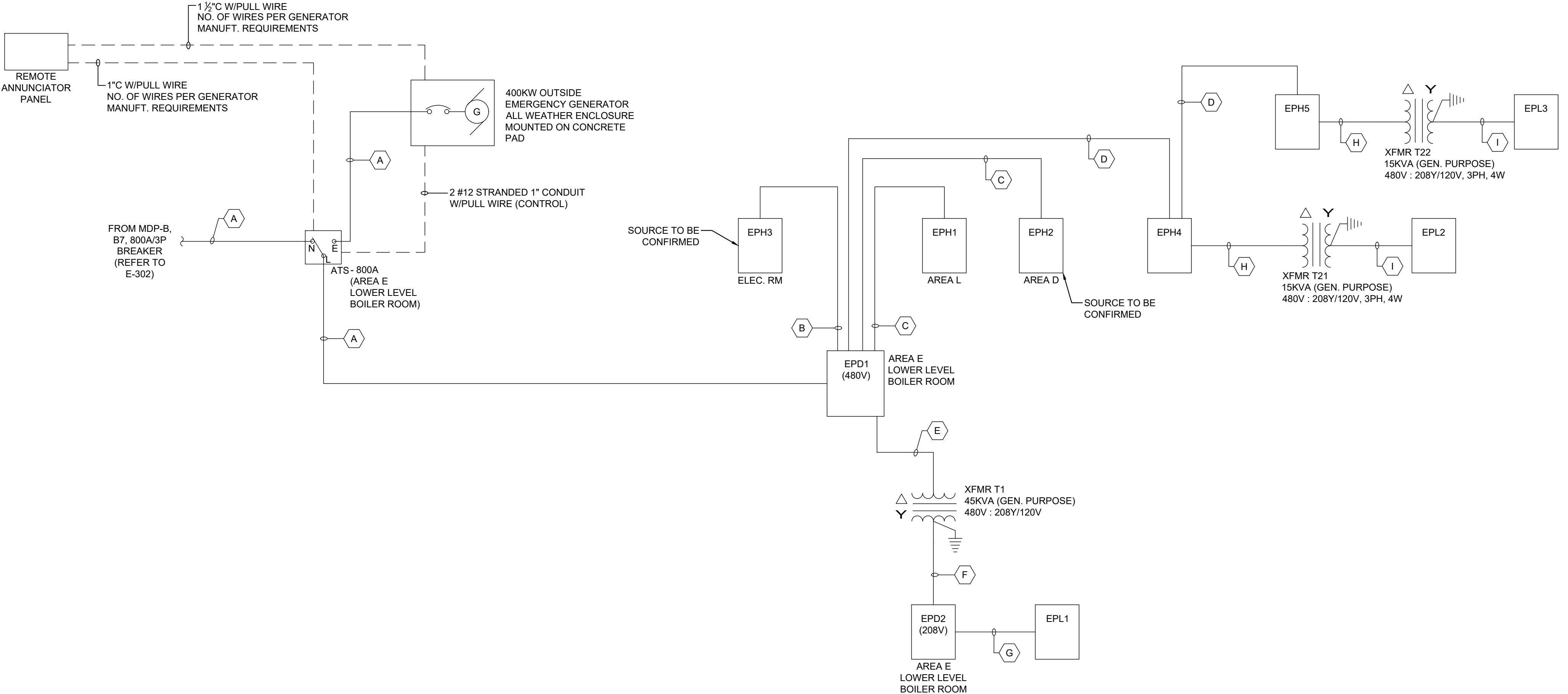
SEAL & SIGNATURE	DATE: 5-3-2019
	PROJECT No.: 18202
	DRAWING BY: YR
	CHK BY: JW
	DWG No: E-303
	CADD FILE No: 12
	of

GENERAL NOTES:

- A. THIS INFORMATION REPRESENTS EXISTING CONDITIONS BASED ON ORIGINAL SITE DRAWINGS AND OBSERVED SITE CONDITIONS. NOT ALL WIRING, CONDUIT, AND DEVICES ARE SHOWN. THE CONTRACTOR SHALL FIELD VERIFY CIRCUITING, ROUTING, AND EXACT QUANTITIES.
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- F. FIRE STOP ALL PENETRATIONS THROUGH WALLS.
- G. ALL POWER CONDUIT BELOW 10'-0" SHALL BE RIGID STEEL CONDUIT.

FEEDER SCHEDULE WIRE SIZE IN AWG

NO.	PHASE	NEUTRAL	GROUND	CONDUIT
A	(2) SETS OF 3-500 MCM	(2) 1-500 MCM	(2) 1-#3	(2) 4" C
B	3-500 MCM	1-500 MCM	1-#3	4" C
C	3-#4	1-#4	1-#8	1 1/2" C
D	3-#4/O	1-#4/O	1-#4	2 1/2" C
E	3-#4	--	1-#8	1 1/2" C
F	3-#2/O	1-#2/O	1-#6	2" C
G	3-#2	1-#2	1-#8	1 1/2" C
H	3-#10	--	1-#10	3/4" C
I	3-#6	1-#6	1-#10	1 1/2" C



LINE TYPE LEGENDS:

- EXISTING
- NEW
- - - - REMOVAL
- - - - CONTROL SIGNAL
- SWITCHGEAR BUS

ONE-LINE DIAGRAM -
EMERGENCY POWER DISTRIBUTION

1
E-303

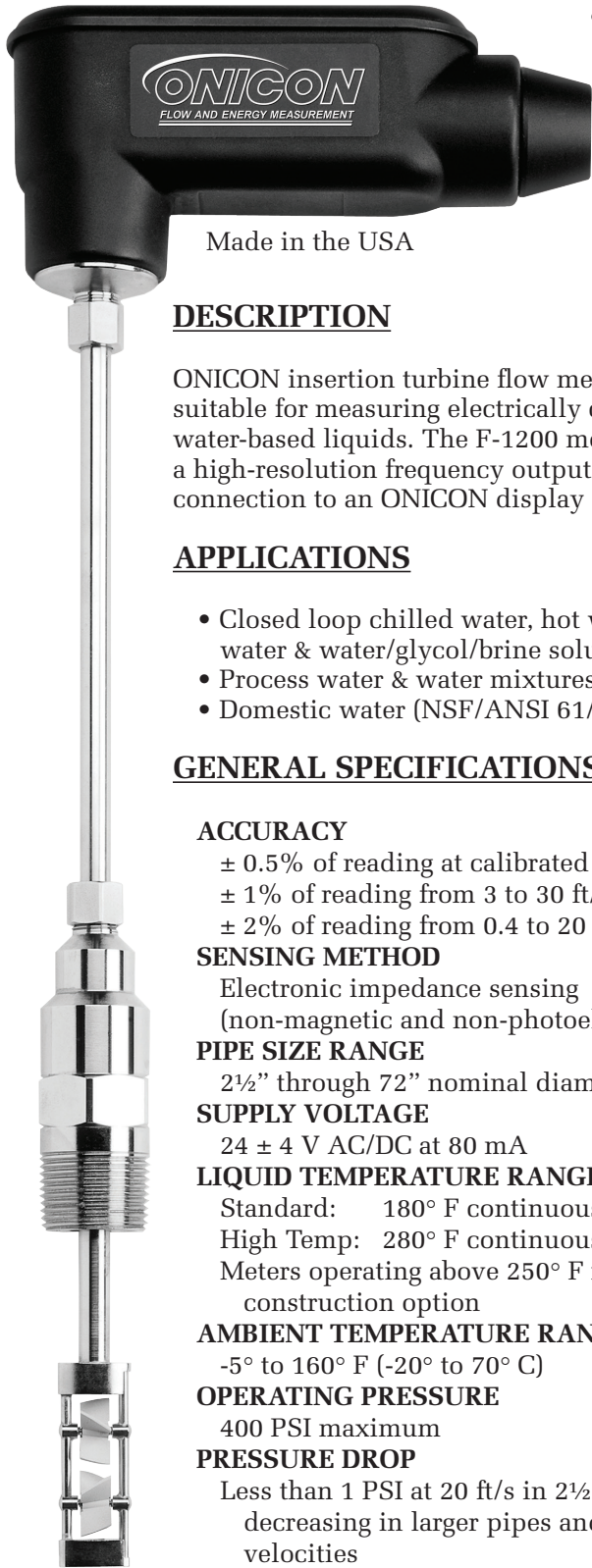
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Appendix B

Cut Sheets for Key Sensors and Instruments



• **F-1200 DUAL TURBINE** •
INSERTION FLOW METER
FREQUENCY OUTPUT



Made in the USA

DESCRIPTION

ONICON insertion turbine flow meters are suitable for measuring electrically conductive water-based liquids. The F-1200 model provides a high-resolution frequency output for connection to an ONICON display or Btu meter.

APPLICATIONS

- Closed loop chilled water, hot water, condenser water & water/glycol/brine solutions for HVAC
- Process water & water mixtures
- Domestic water (NSF/ANSI 61/372 version*)

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

2½” through 72” nominal diameter

SUPPLY VOLTAGE

24 ± 4 V AC/DC at 80 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 2½” pipe, decreasing in larger pipes and lower velocities

OUTPUT SIGNALS PROVIDED

Frequency Output
 0 – 15 V peak pulse

(continued on back)

CALIBRATION

Every ONICON flow meter is wet calibrated in our 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)
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

F-1200 SPECIFICATIONS (cont.)

MATERIAL

Wetted metal components:

Standard: Electroless nickel plated brass

Optional: 316 stainless steel

Optional: NSF/ANSI 61/372 version*

ELECTRONICS ENCLOSURE

Standard: Weathertight aluminum enclosure

Optional: Submersible enclosure

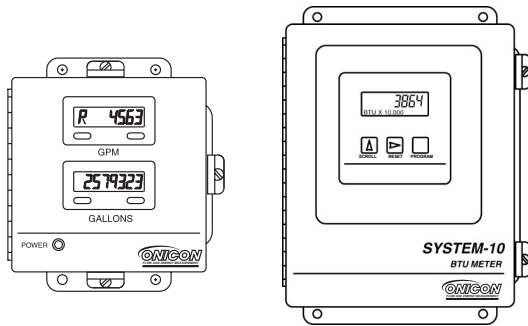
ELECTRICAL CONNECTIONS

3-wire for frequency output

Standard: 10' of cable with 1/2" NPT conduit connection

Optional: Indoor DIN connector with 10' of plenum rated cable

ALSO AVAILABLE



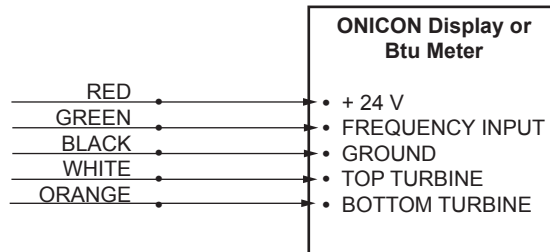
Display Modules

Btu Measurement Systems

F-1200 WIRING INFORMATION

WIRE COLOR	DESCRIPTION	NOTES
RED	(+) 24 V AC/DC supply voltage, 30 mA	Connect to power supply positive
BLACK	(-) Common ground (Common with pipe ground)	Connect to power supply negative
GREEN	(+) Frequency output signal: 0-15 V peak pulse	Signal for ONICON display or Btu meter
DIAGNOSTIC SIGNALS		
ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or Btu meter
WHITE	Top turbine frequency	

F-1200 WIRING DIAGRAM



NOTE:

1. Black wire is common with the pipe ground (typically earth ground).



* CLASSIFIED
TURBINE INSERTION FLOW METER
NSF/ANSI 61 <MH60590>
ALSO CLASSIFIED
IN ACCORDANCE WITH
NSF/ANSI 372

TYPICAL METER INSTALLATION

(New construction or scheduled shutdown)

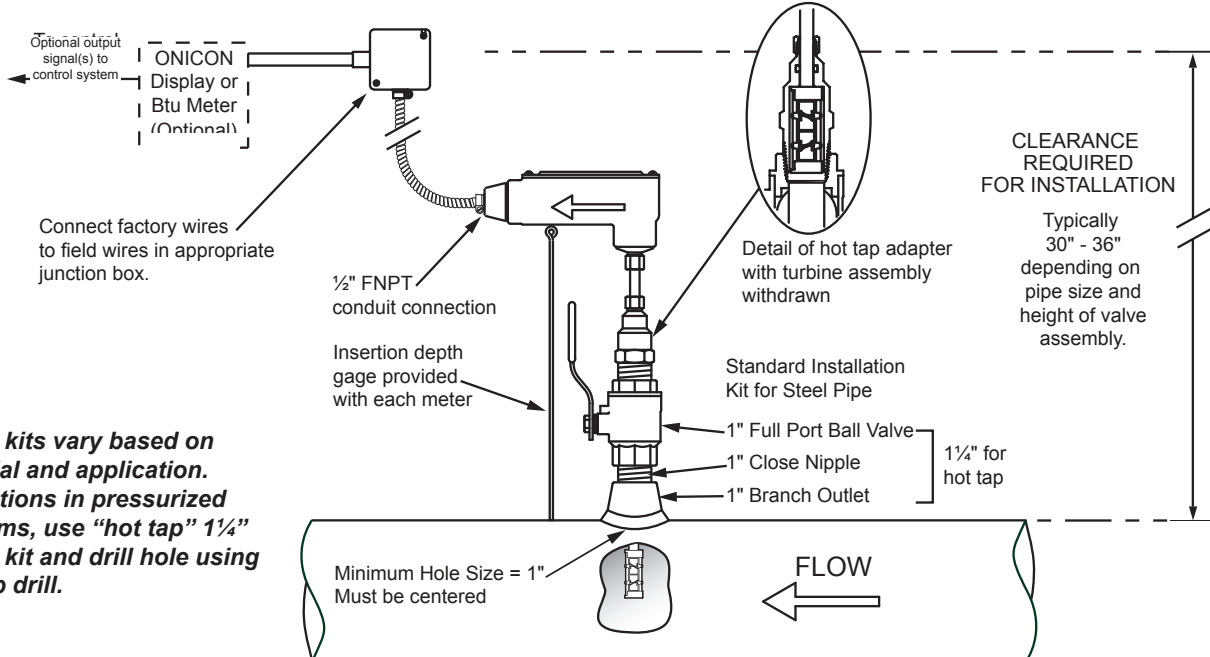
• Acceptable to install in vertical pipe

• Position meter anywhere in upper 240° for horizontal pipe

THIS AREA ACCEPTABLE

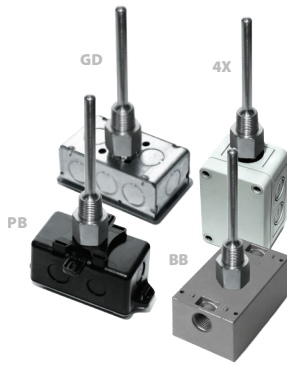


Horizontal Run Pipe



NOTE:

Installation kits vary based on pipe material and application. For installations in pressurized (live) systems, use "hot tap" 1 1/4" installation kit and drill hole using a 1" wet tap drill.



IMMERSION

Stainless Steel Immersion, Thermistor

The ACI Thermistor Immersion Series features a 1/4" diameter stainless steel probe with two, 14 inch 22 AWG Etched Teflon colored lead wires depending on the probe length ordered to differentiate the different sensor types. The sensors in this series are manufactured using ACI's proven double encapsulation process to eliminate the effects of moisture and to increase the response times using our high quality, thermally conductive epoxy. The immersion sensors include a welded thermowell "-I" version but can be ordered without the welded thermowell "-INW" version. The "INW" version includes a standard 1/2" NPS Male process thread to be used with an optional machined thermowell or in an existing thermowell application. Optional NEMA/IP rated enclosures and NIST certificates are available the back of the product data sheet.

Applications: Chilled Water Systems, Hot Water Systems, Boilers, Pumps, Compressor, Chillers

The ACI Thermistor Immersion Series is covered by ACI's Five (5) Year Limited Warranty. The warranty can be found in the front of ACI's Sensors & Transmitters catalog, as well as on ACI's website, www.workaci.com.

PRODUCT SPECIFICATIONS

Sensor Type Sensor Curve:	Thermistor Non-Linear, NTC (Negative Temperature Coefficient)
Number Sensing Points Number Wires:	One Two (Non-Polarity Sensitive)
Sensor Output @ 25°C (77°F) 	A/1.8K: 1.8KΩ nominal Red/Yellow A/10KS: 10KΩ nominal (White/Blue)
Lead Wire Colors:	A/3K: 3KΩ nominal White/Brown A/10K-E1: 10KΩ nominal (Gray/Orange)
	A/AN (Type III): 10KΩ nominal White/White A/20K: 20KΩ nominal (Brown/Blue)
	A/AN-BC: 5.238KΩ nominal White/Yellow A/50K: 50KΩ nominal (Brown/Yellow)
	A/CP (Type II): 10KΩ nominal White/Green A/100KS: 100KΩ nominal (Black/Yellow)
	A/CSI: 10KΩ nominal (Green/Yellow)
Accuracy 0-70°C (32-158°F):	+/-0.2°C (+/-0.36°F) except A/10K-E1 Series: +/- 0.3°C (+/-0.54°F) A/1.8K Series: +/-0.5°C @ 25°C (77°F) and (+/-1.0°C) (+/-1.8°F)
Stability:	Sensor Dependent; Contact ACI for more information on specific sensor
Response Time (63% Step Change):	10 Seconds nominal
Power Dissipation Constant:	3 mW/°C except A/1.8K Series: 1 mW/°C A/10K-E1 Series: 2 mW/°C
Sensor Operating Temperature Range:	-40 to 150°C (-40 to 302°F)
Enclosure Specifications (Temperature, Flammability, NEMA/IP Ratings):	"-GD" Enclosure: Galvanized Steel, -40 to 121°C (-40 to 250°F), NEMA 1 (IP10) "-PB" Enclosure: ABS Plastic, -30 to 90°C (-22 to 194°F), UL94-HB, Plenum Rated "-BB" Enclosure: Aluminum, -40 to 121°C (-40 to 250°F), NEMA 3R "-4X" Enclosure: Polystyrene Plastic, -40 to 70°C (-40 to 158°F), UL94-V2, NEMA 4X (IP 66)
Storage Temperature Range:	-40 to 85°C (-40 to 185°F)
Operating Humidity Range:	10 to 95% RH, non-condensing
Probe Diameter Thermowell Bore Diameter:	0.250" (6.35mm) 0.260"
Probe Material Thermowell Material:	304 Stainless Steel 304 Series Stainless Steel
Thermowell Instrument Process Thread Size:	1/2" NPS (National Pipe Straight) Female Thread 1/2" NPT (National Pipe Tapered) Male Thread
Fitting Material Flammability Rating:	Polyamide 66 (High Performance Nylon 66) UL94-HB
Foam Pad Material Flammability Rating:	Neoprene/EPDM/SBR Polymer UL94-HBF; FMVSS-302; MIL-R-6130C
Lead Length Conductor Size:	14" (35.6 cm) 22 AWG (0.65mm)
Lead Wire Insulation Wire Rating:	Etched Teflon (PTFE) Colored Leads Mil Spec 16878/4 Type E)
Conductor Material:	Silver Plated Copper
Product Dimensions Product Weight:	See table on back of Product Data sheet
Agency Approvals:	CE, RoHS2, WEEE





MAXIMUM VELOCITY VS THERMOWELL INSERTION LENGTH Machined Thermowell

Straight Shank Insertion Length "U"					Stepped Shank Insertion Length "U"	
Material:	Media Type:	1.0" (25.4 mm)	2.5" (63.5 mm)	8.0" (203.2 mm)	4.0" (101.6 mm)	6.0" (152.4 mm)
304/316 SS	Air/Gas/Steam ¹	349 ft/s (106.3 m/s)	349 ft/s (106.3 m/s)	71.9 ft/s (21.9 m/s)	109 ft/s (33.2 m/s)	39.5 ft/s (12.0 m/s)
304/316 SS	Water	360 ft/s (109.7 m/s)	360 ft/s (109.7 m/s)	71.9 ft/s (21.9 m/s)	82.2 ft/s (25.1 m/s)	39.5 ft/s (12.0 m/s)

Note 1: Values are for Air/Gas/Steam and similar density media | All velocity ratings are based upon an operating temperature of 1000°F (537.8°C)

MAXIMUM PRESSURE VS TEMPERATURE RATINGS Two-Part Fabricated / Welded Thermowell

Material:	70°F (21.1°C)	200°F (93.3°C)	400°F (204.4°C)	600°F (315.6°C)	800°F (426.7°C)	1000°F (537.8°C)	1200°F (648.9°C)
304/316 SS	982 PSI (67.7 Bar)	820 PSI (56.5 Bar)	675 PSI (46.5 Bar)	604 PSI (41.6 Bar)	550 PSI (37.9 Bar)	510 PSI (35.1 Bar)	290 PSI (20.0 Bar)

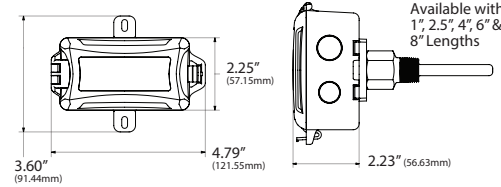
MAXIMUM FLUID VELOCITY RATINGS Two-Part Fabricated / Welded Thermowell

Straight Shank Insertion Length "U"		2.5" (63.5 mm)	4.0" (101.6 mm)	6.0" (152.4 mm)
Material:	Media Type:			
304/316 SS	Air/Gas/Steam ²	169 ft/s (51.5 m/s)	61 ft/s (18.6 m/s)	20 ft/s (6.1 m/s)
304/316 SS	Water	88 ft/s (26.8 m/s)	20 ft/s (6.1 m/s)	10 ft/s (3.05 m/s)

Note 2: Values are for Air/Gas/Steam and similar density media

DIMENSIONAL DRAWING. WEIGHTS

Plastic Box Enclosure [PB]



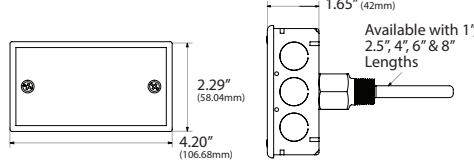
xx = Sensor Type | yy = Insertion Length

Plastic Box Enclosure [PB] Weights

ACI Model #	1.0"	2.5"	4.0"	6.0"	8.0"
A/xx-INW-yy-PB	0.20 lbs. (0.091 kg)	0.24 lbs. (0.109 kg)	0.28 lbs. (0.127 kg)	0.32 lbs. (0.145 kg)	0.36 lbs. (0.163 kg)
A/xx-I-yy-PB	N/A	0.56 lbs. (0.254 kg)	0.60 lbs. (0.272 kg)	0.64 lbs. (0.290 kg)	N/A
A/xx-IM-yy-PB	0.40 lbs. (0.182 kg)	0.58 lbs. (0.263 kg)	0.74 lbs. (0.336 kg)	0.92 lbs. (0.417 kg)	1.15 lbs. (0.522 kg)

N/A = Not Available

Galvanized Enclosure [GD]



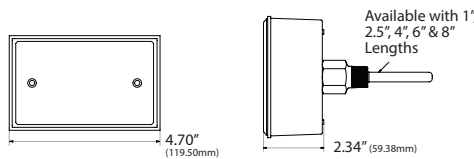
xx = Sensor Type | yy = Insertion Length

Galvanized Enclosure [GD] Weights

ACI Model #	1.0"	2.5"	4.0"	6.0"	8.0"
A/xx-INW-yy-GD	0.62 lbs. (0.281 kg)	0.66 lbs. (0.299 kg)	0.70 lbs. (0.318 kg)	0.74 lbs. (0.336 kg)	0.78 lbs. (0.354 kg)
A/xx-I-yy-GD	N/A	0.88 lbs. (0.399 kg)	1.00 lbs. (0.454 kg)	1.04 lbs. (0.472 kg)	N/A
A/xx-IM-yy-GD	0.81 lbs. (0.367 kg)	1.00 lbs. (0.454 kg)	1.16 lbs. (0.526 kg)	1.32 lbs. (0.599 kg)	1.55 lbs. (0.703 kg)

N/A = Not Available

Bell Box Enclosure [BB]



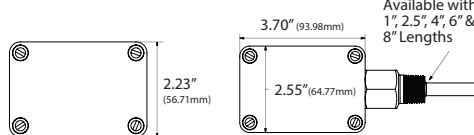
xx = Sensor Type | yy = Insertion Length

Bell Box Enclosure [GD] Weights

ACI Model #	1.0"	2.5"	4.0"	6.0"	8.0"
A/xx-INW-yy-BB	0.64 lbs. (0.290 kg)	0.68 lbs. (0.308 kg)	0.70 lbs. (0.318 kg)	0.74 lbs. (0.336 kg)	0.80 lbs. (0.363 kg)
A/xx-I-yy-BB	N/A	1.02 lbs. (0.463 kg)	1.00 lbs. (0.454 kg)	1.04 lbs. (0.472 kg)	N/A
A/xx-IM-yy-BB	0.83 lbs. (0.376 kg)	1.02 lbs. (0.463 kg)	1.16 lbs. (0.526 kg)	1.32 lbs. (0.599 kg)	1.59 lbs. (0.721 kg)

N/A = Not Available

NEMA 4X Enclosure [4X]



xx = Sensor Type | yy = Insertion Length

NEMA 4X Enclosure [4X] Weights

ACI Model #	1.0"	2.5"	4.0"	6.0"	8.0"
A/xx-INW-yy-4X	0.28 lbs. (0.127 kg)	0.32 lbs. (0.145 kg)	0.36 lbs. (0.163 kg)	0.40 lbs. (0.181 kg)	0.44 lbs. (0.200 kg)
A/xx-I-yy-4X	N/A	0.64 lbs. (0.290 kg)	0.68 lbs. (0.308 kg)	0.72 lbs. (0.327 kg)	N/A
A/xx-IM-yy-4X	0.48 lbs. (0.218 kg)	0.66 lbs. (0.299 kg)	0.82 lbs. (0.372 kg)	1.00 lbs. (0.454 kg)	1.27 lbs. (0.576 kg)

N/A = Not Available

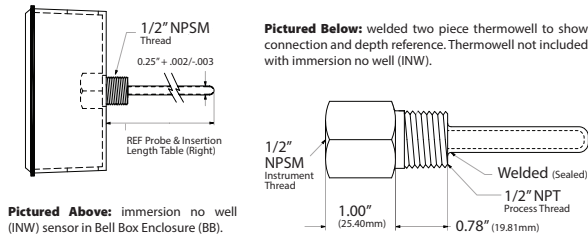
Standard Views

Product Weights





PROBE AND INSERTION LENGTH IMMERSION NO WELL



Probe & Insertion Length

Probe Length	Insertion Length	ACI Part #	Thermowell Part #
3"	2.81 +/- 0.13"	A/xx-INW-1"-yy-zz	A/M1"
4.5"	4.31 +/- 0.13"	A/xx-INW-2.5"-yy-zz	A/2.5" or A/M2.5"
6"	5.81 +/- 0.13"	A/xx-INW-4"-yy-zz	A/4" or A/M4"
8"	7.81 +/- 0.13"	A/xx-INW-6"-yy-zz	A/6" or A/M6"
10"	9.81 +/- 0.13"	A/xx-INW-8"-yy-zz	A/M8"

ORDERING Welded Thermowell or No Thermowell

Model # Example: **A/** **1.8K** **I** **4"** **GD** **NIST**
A. B. C. D. E. F.

MODEL #

A. Sensor Series No Selection Required	A/ _____	A/
B. Model Series Select One (1)	1.8K 3K AN AN-BC CP CSI 10KS 10K-E1 20K 100KS	
C. Configuration Select One (1)	I = Immersion with Welded Thermowell INW = Immersion without Welded Thermowell	
D. Insertion Length Select One (1)	2.5" = 2.5" Insertion 4" = 4" Insertion 6" = 6" Insertion	
E. Enclosure Select One (1)	GD = Galvanized PB = Plastic BB = Aluminum, NEMA 3R 4X = NEMA 4X	
F. NIST Select One (1)	---- = No NIST Certificate NIST = NIST Certificate (3 Points)	

ORDERING Machined Thermowells or No Thermowell

Model # Example: **A/** **1.8K** **IM** **4"** **GD** **NIST**
A. B. C. D. E. F.

MODEL #

A. Sensor Series No Selection Required	A/ _____	A/
B. Model Series Select One (1)	1.8K 3K AN AN-BC CP CSI 10KS 10K-E1 20K 50K 100KS	
C. Configuration Select One (1)	IM = Immersion with Machined Well INW = Immersion without Thermowell	
D. Insertion Length Select One (1)	1" = 1" Insertion 2.5" = 2.5" Insertion 4" = 4" Insertion 6" = 6" Insertion 8" = 8" Insertion	
E. Enclosure Select One (1)	GD = Galvanized PB = Plastic BB = Aluminum, NEMA 3R 4X = NEMA 4X	
F. NIST Select One (1)	---- = No NIST Certificate NIST = NIST Certificate (3 Points)	

Note: Thermowells with lengths of 12", 18", and 24" are available and must be ordered separately | See the Machined Thermowells Data Sheet (Accessories)

ACCESSORIES ORDERING

Model # Example: **NSG HEAT TRANSFER PASTE 20Z** -OR- **102595**

Model #	Item #	Description
NSG HEAT TRANSFER PASTE 20Z	102595	Thermal Grease, 2 oz. Tube, Silicone Free, -40 to 320°F (-40 to 160°C)
NSG HEAT TRANSFER PASTE 160Z	140574	Thermal Grease, 16 oz. Jar, Silicone Free, -40 to 390°F (-40 to 198°C)
A/2.5"	128349	2.5" (63.5mm) Insertion, 304 Stainless, Welded, 1/2" NPT Thermowell
A/4"	128350	4" (101.6mm) Insertion, 304 Stainless, Welded, 1/2" NPT Thermowell
A/6"	128351	6" (152.4mm) Insertion, 304 Stainless, Welded, 1/2" NPT Thermowell
A/M1"	128337	1" (25.4mm) Insertion, 304 Stainless, Machined, 1/2" NPT Thermowell
A/M2.5"	128338	2.5" (63.5mm) Insertion, 304 Stainless, Machined, 1/2" NPT Thermowell
A/M4"	128343	4" (101.6mm) Insertion, 304 Stainless, Machined, 1/2" NPT Thermowell
A/M6"	128344	6" (152.4mm) Insertion, 304 Stainless, Machined, 1/2" NPT Thermowell
A/M8"	138725	8" (203.2mm) Insertion, 304 Stainless, Machined, 1/2" NPT Thermowell
A/M2.5"-316SS	128352	2.5" (63.5mm) Insertion, 316 Stainless, Machined, 1/2" NPT Thermowell
A/M4"-316SS	128353	4" (101.6mm) Insertion, 316 Stainless, Machined, 1/2" NPT Thermowell
A/M6"-316SS	128354	6" (152.4mm) Insertion, 316 Stainless, Machined, 1/2" NPT Thermowell





ROOTS® Meters & Instruments

DATA SHEET

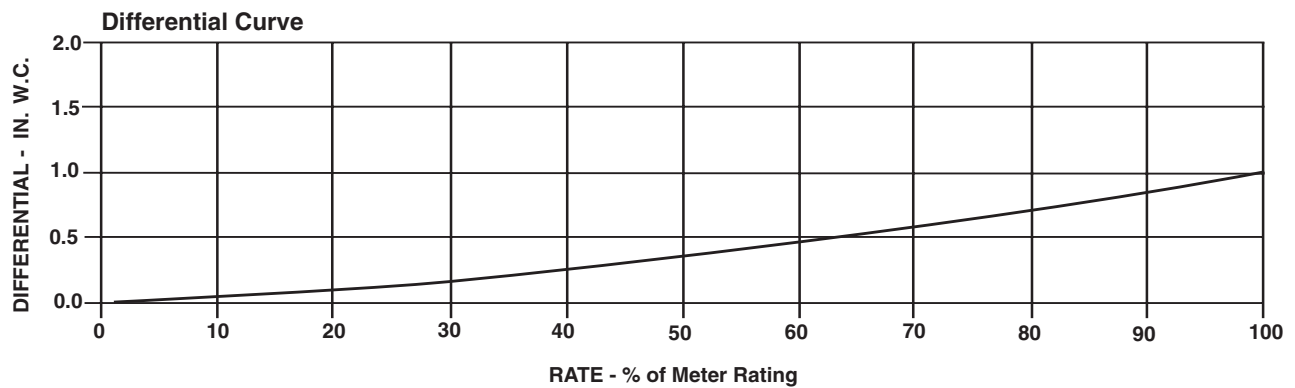
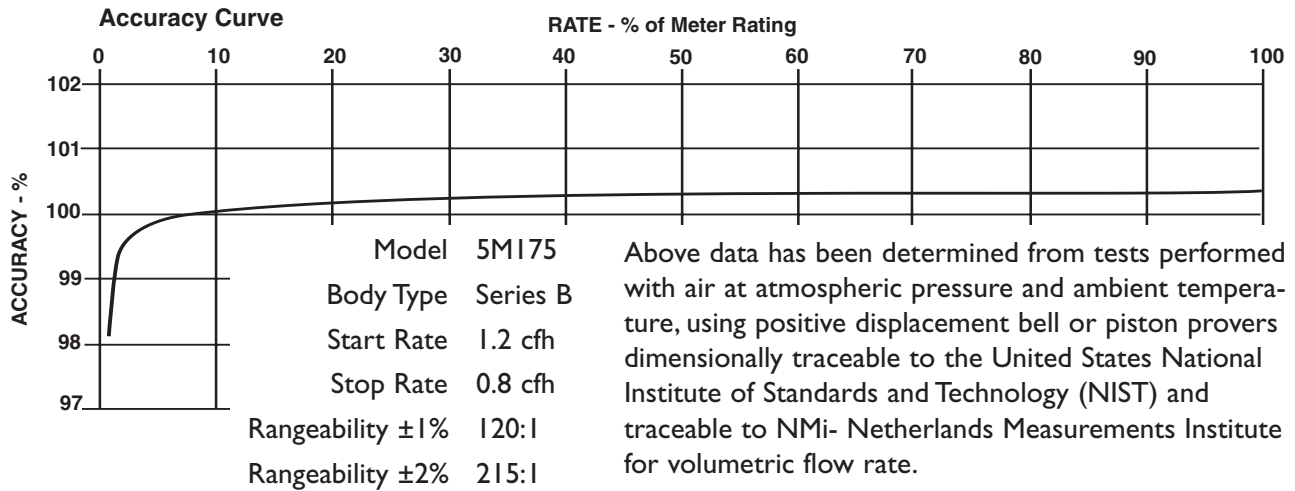
SERIES B3: 5MI75 ROOTS® Meter

	UNITS Imperial	UNITS Metric
Temperature Range	deg. F -40 to +140	deg. C -40 to +60
Base Rating (Q Max.)	acfh 5000	m ³ /h 141,5
Max. Operating Pressure (MAOP)	psig 175	kPa 1200
Leak Test (125% MAOP)	psig 219	kPa 1510
Static Test (2 x MAOP)	psig 350	kPa 2400
Rangeability +/- 1%	ratio 120:1	ratio 120:1
Rangeability +/- 2%	ratio 215:1	ratio 215:1
Start Rate	cfh 1.2	m ³ /h 0,0340
Stop Rate	cfh 0.8	m ³ /h 0,0227
Flow Rate @ 0.5" w.c., Gas	cfh 3975	m ³ /h 112,6
Avg. Differential, 100% Flow	in. w.c. 1.1	mbar 2,6
Max. Pressurization Rate	psig/sec 5	kPa/sec 35
Max. Operating Speed	rpm 2250	rpm 2250
Gear Ratio	ratio 270:1	ratio 953,125:1
Displaced Volume/Revolution	cf 0.037037	m ³ 0,0001049
Drive Rate, CD	cf/rev 10	m ³ /rev 1
Drive Rate, TD	cf/rev 100	m ³ /rev 10
Temp. Compensating Range (TC,TD)	deg. F -20 to +120	deg. C -29 to +49
Min. Odometer Reading	cf 0.2	m ³ 0.002
Odometer Turnover	yrs. 2.28	yrs. 8,06
Nominal Pipe Size	in. 3	mm 80
Flange-to-Flange	in. 6-3/4	mm 172
Flange Connection	ANSI 150#FF	ANSI 150#FF
Bolts per Flange	qty. 4	qty. 4
Bolt Size ¹	in. 5/8 - 11	in. 5/8 - 11
Flange Bolt Hole Depth	in. 15/16	mm 23,8
Bolt Torque: Lubricated/Non-Lub.	ft.-lb. 55/60	N-m 74/81
Restricting Orifice (120%)	in. 23/32	mm 18,256
Oil Capacity – Side Inlet	oz. 1.25	ml 37
Oil Capacity – Top Inlet	oz. 7.65	ml 226
<i>Counter Version (CTR)²</i>		
Net Weight	lbs. 35	kg 15,9
Shipping Weight	lbs. 38	kg 17,2
Carton Size	in. 27 x 11 x 9	cm 69 x 28 x 23
<i>Counter with Instrument Drive (CD)²</i>		
Net Weight	lbs. 38	kg 17,2
Shipping Weight	lbs. 41	kg 18,6
Carton Size	in. 31 x 15 x 13	cm 79 x 38 x 33

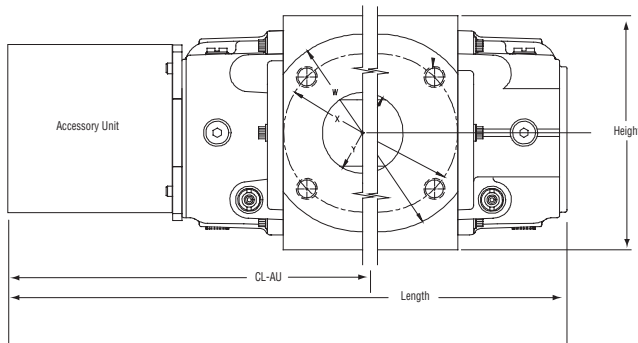
NOTES:

¹ Bolt Length varies by application.

² Weights and dimensions available for CPS, TC, TD, TPS upon request.



5M175 Series B3	Overall Length		Overall Height		Width (Flange/Flange)		Centerline to Accessory End (CL-AU)		Request Detailed Drawing Number
	inches	mm	inches	mm	inches	mm	inches	mm	
CTR / TC	20	508	6-31/32	177	6-3/4	172	12-5/16	313	D054517-000
CD / TD	23-27/32	606	6-31/32	177	6-3/4	172	16-5/32	411	D054431-000
CPS / TPS	22-1/8	562	6-31/32	177	6-3/4	172	14-7/16	368	D054670-000
IMC/C	23-1/2	597	6-31/32	177	6-3/4	172	15-13/16	402	D056486-000
IMC/W	24-1/2	622	6-31/32	177	6-3/4	172	16-13/16	427	D056702-000



To order

Specify: Meter Series, Size and Type (i.e., ROOTS Meter Series B3 5M175 CD).
 For CD or TD, specify Inlet (Top or Side) and ID Rotation (CW-B or CCW-A).
 For Pulsar, specify Single or Dual Connectors and Connector Type (MS Circular, Conduit or Cable Gland).
 For more specific ordering information on the electronic products, request: TS:SSP, TS:IMC/C or S:IMC/W.
 Contact the factory for other available information, options, or special requests.



Dresser Roots Meters & Instruments

P. O. Box 42176
 Houston, TX USA 77242-2716
 website: www.dresser.com

Dresser, Inc.

Inside US Ph: 800.521.1114 Fax: 800.335.5224
 Outside US Ph: 832.590.2303 Fax: 832.590.2494
 www.rootsmeters.com

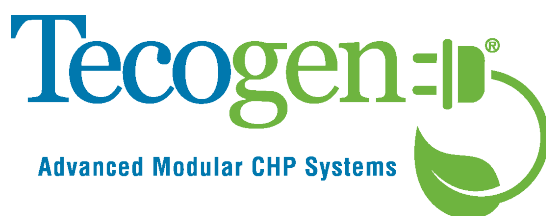
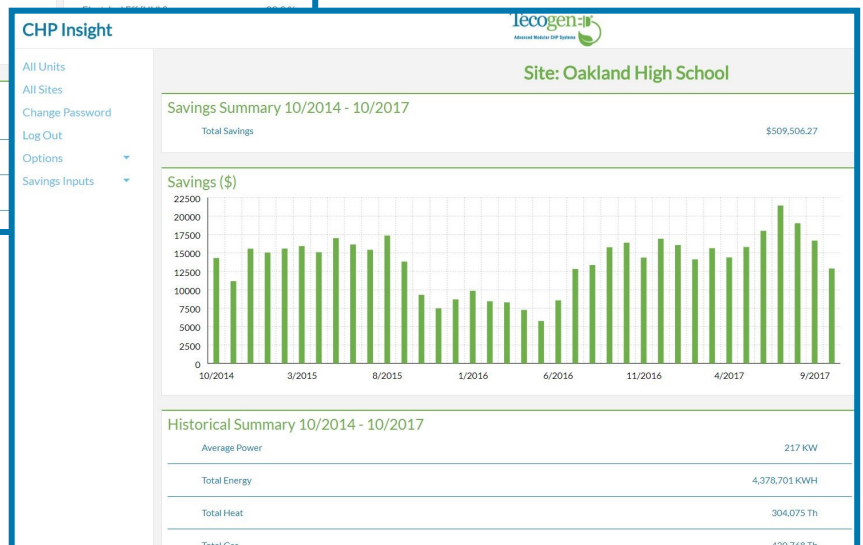
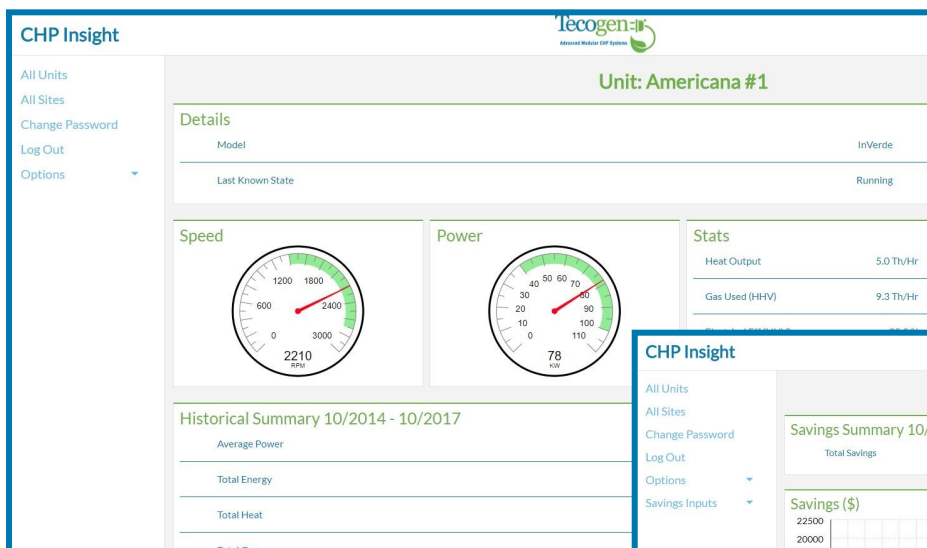
SERVICE & PERFORMANCE



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 Inc., 45 First Avenue, Waltham, MA 02451

781.466.6400 • www.tecogen.com • FactoryService@tecogen.com



Remote Internet Connectivity Requirements | *CHPInsight*

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 *CHPInsight* 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 *CHPInsight* 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 *CHPInsight* 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 *CHPInsight* 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 *CHPInsight* 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 *CHPInsight* 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

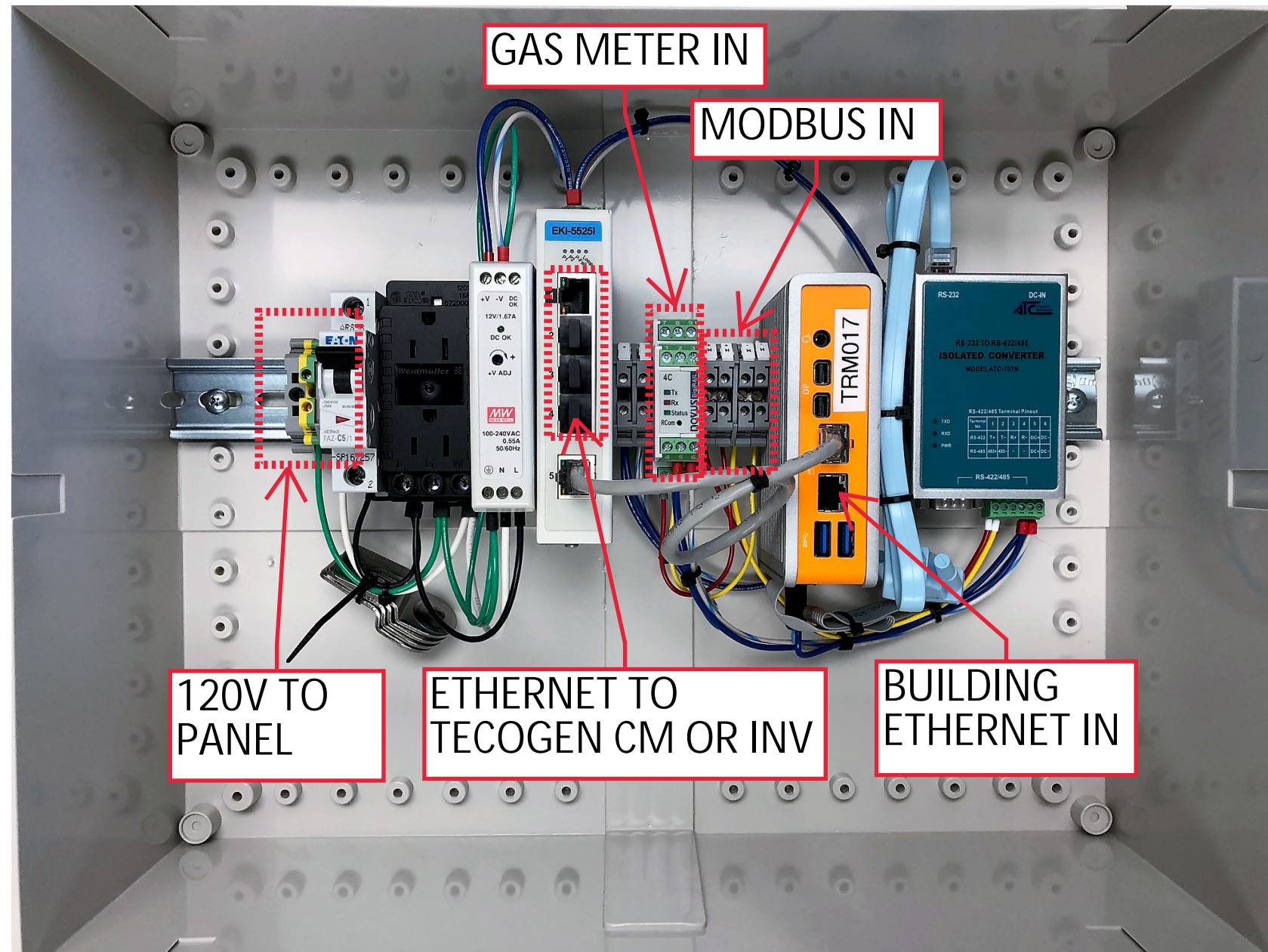
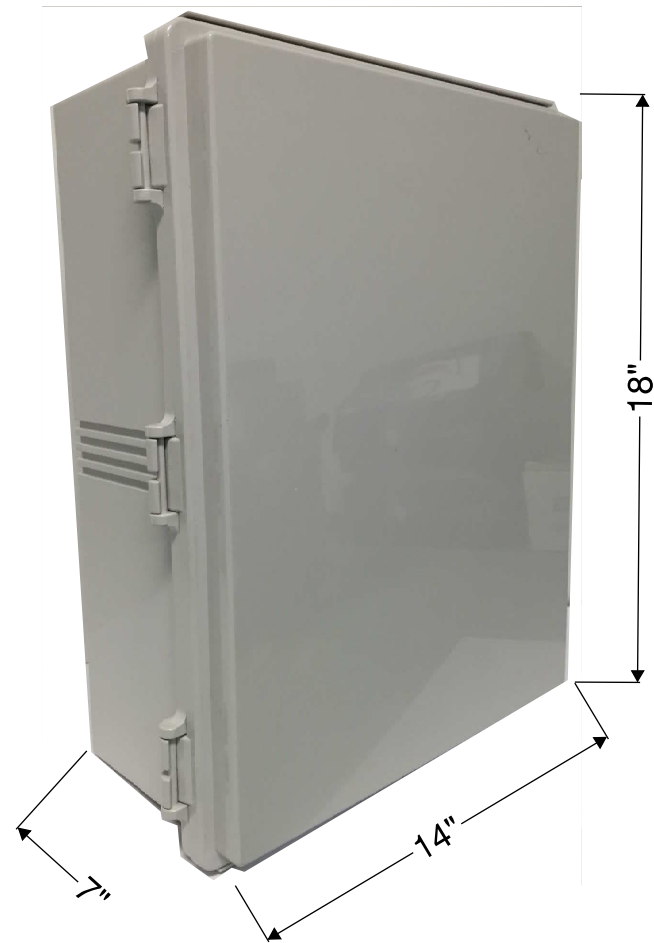
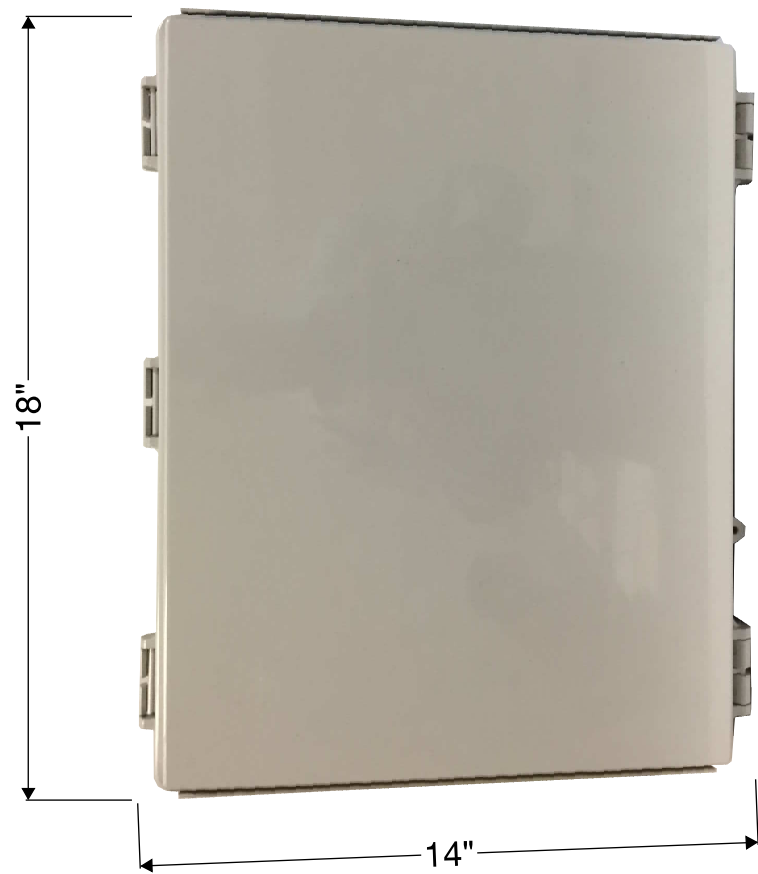
Gateway: 10.51.141.1

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 *CHPInsight* panel. Connections to the individual units are forwarded from the *CHPInsight* panel on a separate, private network.



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 DATE BJGE DRAWN BY

DRAWING TITLE
83041
 DRAWING NUMBER