

Petition For A Declaratory Ruling That No Certificate Of Environmental Compatibility And Public Need Is Required For The Installation Of A Customer-Side two(2)- 400 kW Fuel Cell Project To Be Located At Amgraph Packaging Inc., 60 Versailles Road, Sprague, CT 06383.

I. INTRODUCTION

Pursuant to Connecticut General Statutes Section 16-50k, Doosan Fuel Cell America Inc. hereby petitions the Connecticut Siting Council (the “Council”) for a declaratory ruling (“Petition”) that a Certificate of Environmental Compatibility and Public Need (“Certificate”) is not required for the installation of two (2) 400 kW fuel cell in support of a customer-side distributed resources project in Sprague, Connecticut (the “Project”) as described below. Doosan Fuel Cell America Inc. submits that no Certificate is required because the proposed installation would not have a substantial adverse environmental effect.

II. DESCRIPTION AND LOCATION OF THE PROJECT

The fuel cell is a customer-side installation distributed generation resource with grid interconnection and is to be located at the Amgraph Packaging facility in Sprague, CT (see project site – Attachment A). The installation consists of two (2) natural-gas fueled 400 kW PureCell[®] Model 400 phosphoric acid fuel cell system (“Fuel Cell”) manufactured by Doosan Fuel Cell America, Inc. in South Windsor, Connecticut (see Attachment B for Model 400 datasheet). The overall dimensions of each of the Fuel Cell power plants are nine feet wide by twenty-nine feet long by ten feet tall. The units are totally enclosed and factory-assembled and tested prior to shipment.

The Fuel Cell is intended for a distributed generation and combined heat and power application. The system for Amgraph Packaging Inc. will be capable of producing a total of 800 kW of continuous, reliable electric power while generating heat that will be used for space heating. It will operate in parallel with the utility grid and provide a portion of the electrical requirements of the facility. When all of the heat is used, the overall efficiency of the system will be up to 90%, including both electric and thermal output. The fuel cell system will be used to preheat the new boiler system Amgraph Packaging Inc. is planning for the facility. As long as natural gas is available, electric power and heat can be generated.

The PureCell[®] Model 400 fuel cell system has been certified to meet the strict ANSI/CSA FC-1 fuel cell safety standard to protect against risks from electrical, mechanical, chemical, and combustion safety hazards. Numerous safety features have been incorporated into the design. A combustible gas sensor and thermal fuses located throughout the power module cabinet detect any over-temperature. The detection of a potential combustible gas mixture, over-temperature, or the failure of this detection circuit will result in a power plant shutdown and a subsequent inert gas (nitrogen) purge of the fuel cell stack and fuel processing system. This event will also result in a system alarm notification to the power plant operator (Doosan Fuel Cell America, Inc.).

The power plant is designed with an integral emergency-stop button on the outside of the enclosure to enable immediate shutdown in the event of an emergency. There is also a gas shut-off valve and electrical disconnect switch easily accessible to emergency personnel.

The fuel cell stack is wrapped in a fire retardant blanket. There are no materials inside the unit that would sustain a flame. There is no large volume of gas or any ignition that occurs within the cell stack. The power plant does not store hydrogen; it consumes hydrogen-rich gas equal to what it requires to produce power.

Phosphoric acid is an integral part of the fuel cell system, acting as the electrolyte within the fuel cell stack. Phosphoric acid is a surprisingly common substance that is contained in common cola drinks. There is no reservoir of liquid; phosphoric acid is contained in the porous structure of the fuel cell stack material by capillary action, similar to how ink is absorbed into a blotter.

The only fluid in the power plant is water. All pressurized water vessels are designed to ASME boiler codes and inspected annually. All piping, welds, etc. meet pressurized piping standards. Water produced through the electrochemical process is “pure” water and is reclaimed and reused by the process. The other source of water is water used in the external cooling module, which is mixed with a propylene glycol and a rust inhibitor to prevent rust and freezing in colder climates.

The fuel cell does not produce any hazardous waste during normal operation. Standard Material Safety Data Sheets (MSDS) are available in the product service manual.

III. PROJECT BENEFITS

Fuel cell technology represents an important step in advancing Connecticut’s goal of diversifying its energy supply through the use of renewable energy, as expressed in Connecticut General Statutes Section 16-244 et seq. The Project will serve as a cost-effective clean energy source while also reducing the demand for grid electricity from this location. Further, this fuel cell installation will support the efforts of the State of Connecticut to be a leader in the utilization of fuel cell technology.

Because a fuel cell does not burn fuel, the system will significantly reduce air emissions associated with acid rain and smog, and dramatically reduce those emissions associated with global warming. The application of the Fuel Cell for Amgraph Packaging Inc. is estimated to

reduce the facility's annual carbon emissions by over 240 metric tons when compared to the build margin emissions in the Northeast grid utility system (per the Green-e Climate Protocol for Renewable Energy). The Fuel Cell is designed to operate in total water balance – no make-up water is normally required after start-up and no water discharges to the environment will occur under normal operating circumstances. Furthermore, unlike many traditional power generation systems, fuel cells produce very little sound and typically do not require sound proofing or cause the need for hearing protection.

IV. NO SUBSTANTIAL ADVERSE ENVIRONMENTAL EFFECT

The proposed installation will have no substantial adverse environmental effect. The installation and operation of the Fuel Cell will meet all air and water quality standards of the Connecticut Department of Environmental Protection (“DEP”).

Section 22a-174-42 of the Regulations of Connecticut State Agencies (RCSA) governing air emissions from new distributed generators exempts fuel cells from air permitting requirements. Notwithstanding this exemption, the Fuel Cell system meets the CT emissions standards for a new distributed generator as shown in Table 1 below, and no permits, registrations or applications are required under rules based on the actual emissions of the fuel cell. Furthermore, the Fuel Cell system has been certified by the California Air Resources Board to meet the Distributed Generation Certification Regulation 2007 Fossil Fuel Emissions Standards (see Attachment C). Please note that Doosan Fuel Cell America, Inc. is in the process of reapplying for this certification as the manufacturer.

Table 1: CT Emissions Standards for a New Distributed Generator

Air Pollutant	CT Emissions Standard (lbs/MWh)	Each PureCell Model 400 Fuel Cell System at Rated Power (lbs/MWh)
Oxides of Nitrogen	0.3	.02
Carbon Monoxide	2	.02
Carbon Dioxide	1900	1050

With respect to water discharges, the Model 400 Fuel Cell is designed to operate without water discharge under normal operating conditions. To the extent that minimal water overflow may occasionally occur, such discharges will consist of de-ionized water and will be directed to a site sanitary drain or dry well. This discharge will be incorporated into the overall site design, and will be covered by the site’s water discharge permit, if necessary.

Further, the Fuel Cell installation and operation will have no substantial adverse effect on listed endangered species or listed Connecticut historical places. Attachment D contains the relevant portion of the CT DEP’s Sprague Endangered Species map. The installation of the two (2) PureCell Model 400 fuel cells will be located on the south side of the main Amgraph Packaging facility along the paved the delivery road and is outside of identified locations of endangered species populations. The Amgraph Packaging facility site had been a gravel pit before the entire site become home to modern industrial plants, so it is not believed to be considered “historical.”

The Fuel Cell will not emit noise in excess of limitations set forth in CT regulations. The Fuel Cell location will be on the side of the Amgraph Packaging facility facing 28 acres of open field, which is also owned by Amgraph Packaging Inc. The closest neighbor/residence is across Inland Road-over 600 feet distance from the fuel cells. CT’s most strict applicable regulation requires a noise level of no greater than 45dBA from a Class B emitter (Amgraph Packaging) to a Class A receptor (residential houses). The fuel cell is expected to operate at full power (800

kW), with a noise level in free field of below 45dBA at 200 feet. Therefore, the fuel cell is not expected to emit “excessive noise” to any neighboring buildings.

V. LOCAL INPUT AND STATE-UTILITY INCENTIVES

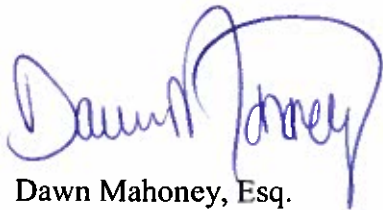
Doosan Fuel Cell America Inc. met with local officials and then presented to the Sprague Planning and Zoning Commission on July 1, 2015 the plans for the installation of the two fuel cells. On July 7th, the Sprague Planning and Zoning Commission approved the zoning permit for the fuel cell installation “for the Amgraph property located at 90 Inland Road” (also known as 90 Versailles Road)—see Attachment E. Eversource Energy awarded Amgraph Packaging Inc. a 15 year Low Emissions Renewable Energy Credit (LRECs) contract for the electricity the new fuel cell systems generates-[CLP Docket N. 11-12-06, Compliance-Order 5, December 4, 2013, Bid Number 916].

VI. CONCLUSION

As set forth above, Doosan Fuel Cell America Inc. requests that the Council issue a determination, in the form of a declaratory ruling, that the proposed installation above is not one that would have a substantial adverse effect, and, therefore, that a Certificate is not needed.

Respectfully submitted,

By:

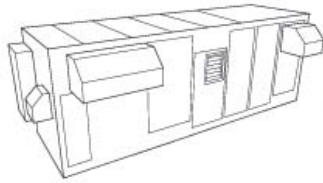


Dawn Mahoney, Esq.
General Counsel
Doosan Fuel Cell America Inc.

Attachment A: Project Site. The fuel cell systems will be located in an area along the southern Amgraph Packaging facility's maintenance road.



Attachment B: PureCell® Model 400 Datasheet



Model 400 FUEL CELL SYSTEM

PURECELL® SYSTEM BENEFITS

Energy security

proven, continuous generation that is setting durability records

Energy productivity

increased efficiency that is reducing energy costs

Energy responsibility

clean operation that is driving greener customer facilities

PURECELL SYSTEM COMPETITIVE ADVANTAGE

Long life

industry best, 10-year cell stack life assures high availability and low service cost

High efficiency

up to 90% overall efficiency

Modular and scalable

systems can be clustered to meet growing energy demands

Experience

most knowledgeable and experienced team in the industry

Grid-independence

proven performance in providing power when the utility grid fails

Load-following

can modulate power output to match building needs

Small footprint

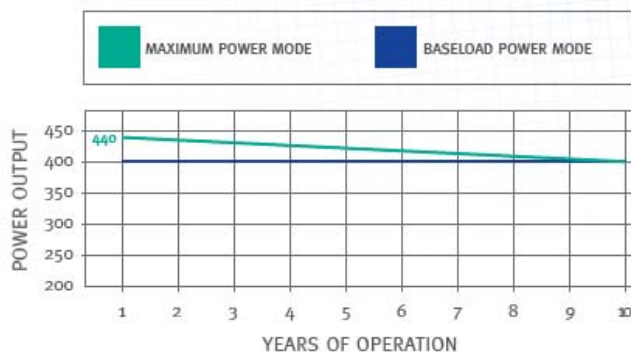
high power density takes less space on site

Flexible siting

indoor, outdoor, rooftop, multi-unit

RATED POWER OUTPUT: 440kW, 480VAC/60HZ

Characteristic	Units	Operating Mode	
		Maximum Power ¹	Baseload Power ¹
Electric Power Output	kW/kVA	440/440	400/471
Electrical Efficiency	%, LHV	41%	42%
Peak Overall Efficiency	%, LHV	90%	90%
Gas Consumption	MMBtu/h, HHV (kW)	4.06 (1,190)	3.60 (1,056)
Gas Consumption ²	SCFH (Nm ³ /h)	3,961 (106.1)	3,515 (94.2)
High Grade Heat Output @ up to 250°F	MMBtu/h (kW)	0.76 (223)	0.64 (188)
Low Grade Heat Output @ up to 140°F	MMBtu/h (kW)	0.99 (290)	0.88 (258)



FUEL

Supply.....Natural Gas
Inlet Pressure..... 10 to 14 in. water (25 - 35 mbar)

EMISSIONS ^{3, 4}

NOx0.01 lbs/MWh (0.006 kg/MWh)
CO 0.02 lbs/MWh (0.009 kg/MWh)
VOC 0.02 lbs/MWh (0.009 kg/MWh)
SO₂ Negligible
Particulate Matter..... Negligible
CO₂ (electric only) 1,049 lbs/MWh (476 kg/MWh)
(with full heat recovery) 495 lbs/MWh ⁵ (225 kg/MWh)

OTHER

Ambient Operating Temp. -20°F to 104°F (-29°C to 40°C)
Sound Level <65 dBA @ 33 ft. (10m)
Water Consumption.....None (up to 85°F (30°C Ambient Temp.)
Water DischargeNone (Normal Operating Conditions)

CODES AND STANDARDS

ANSI/CSA FC1-2012: Stationary Fuel Cell Power Systems
UL1741: Inverters for Use With Distributed Energy Resources

NOTES

1. Average performance during 1st year of operation. Refer to the Product Data and Applications Guide for performance over the operating life of the powerplant.
2. Based on natural gas higher heating value of 1025 Btu/SCF (40.4 MJ/Nm³)
3. Emissions based on 400 kW operation.
4. Fuel cells are exempt from air permitting in many U.S. states.
5. Includes CO₂ emissions savings due to reduced on-site boiler gas consumption.

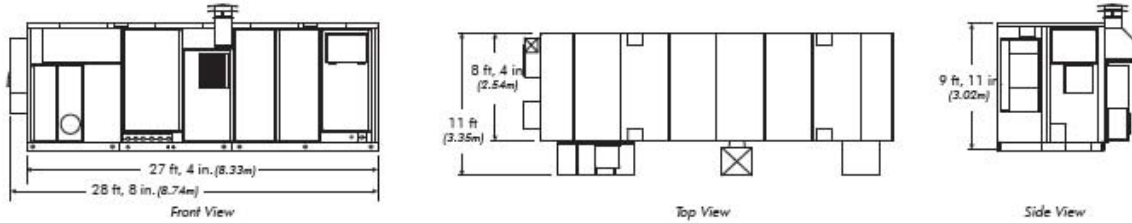




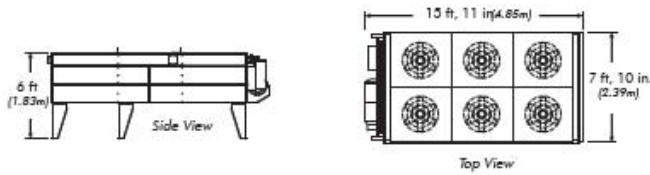
PureCell Model 400 FUEL CELL SYSTEM

SYSTEM DIMENSIONS

Power Module



Cooling Module



Shipping Dimensions

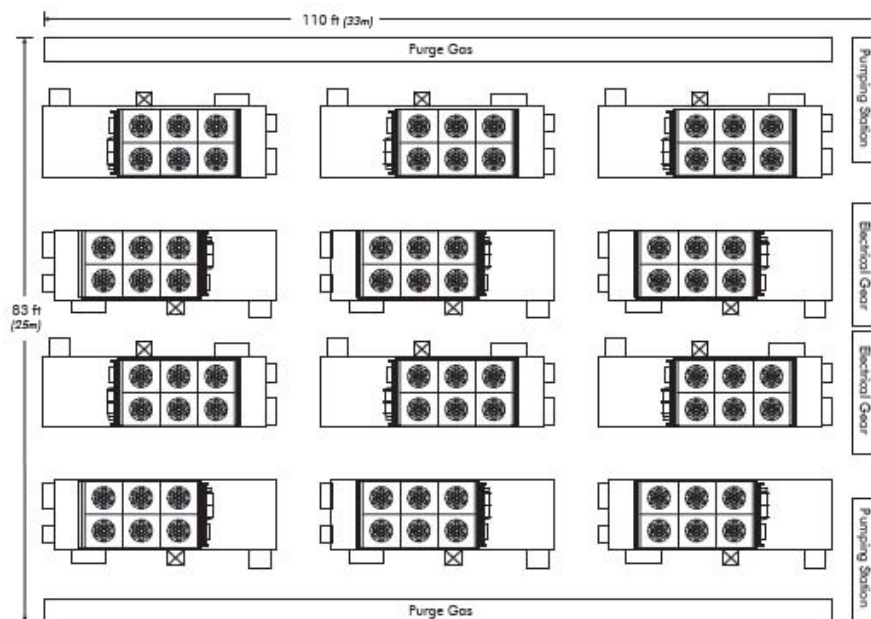
	Power Module	Cooling Module
Length	28 ft, 8 in. (8.74m)	15 ft, 11 in. (4.85m)
Width	8 ft, 4 in. (2.54m)	7 ft, 10 in. (2.39m)
Height	9 ft, 11 in. (3.02m)	6 ft (1.83m)
Weight	60,000 lb (27,216 kg)	3,190 lb (1,447 kg)

MULTI-MEGAWATT CAPABILITY

For multi-megawatt sites, individual power plants can be arranged in multiple orientations. The 12-unit layout defined below represents one option with cooling modules located on the roof of the power plants minimizing the overall footprint of the site.

No. of Units	Baseload Electric Output	High-Grade Heat	Low-Grade Heat	Fuel Consumption	Site Area
	MW	MMBtu/h (kW)	MMBtu/h (kW)	MMBtu/h, HHV (kW)	ft ² (m ²)
6	2.4	3.8 (1,128)	5.3 (1,548)	21.6 (6,334)	4,400 (410)
12	4.8	7.7 (2,256)	10.6 (3,096)	43.2 (12,668)	8,900 (830)
24	9.6	15.4 (4,512)	21.1 (6,192)	86.5 (25,337)	17,800 (1,650)
36	14.4	23.1 (6,768)	31.7 (9,288)	129.7 (38,005)	26,700 (2,480)
48	19.2	30.8 (9,024)	42.3 (12,384)	172.9 (50,673)	35,600 (3,310)
60	24.0	38.5 (11,280)	52.8 (15,480)	216.2 (63,341)	44,500 (4,140)

12-Unit System Layout



NOTES

- Space required for electrical gear and pumping stations is representative only.
- Purge gas is required to purge the system of unspent fuel during shutdowns and prior to start-up.

The manufacturer reserves the right to change or modify, without notice, the design or equipment specifications without incurring any obligation either with respect to equipment previously sold or in the process of construction. The manufacturer does not warrant the data on this document. Warranted Specifications are documented separately.

Doosan Fuel Cell America, Inc.
Corporate Headquarters
195 Governor's Highway
South Windsor, CT 06074

www.doosanfuelcellamerica.com

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A0290

Attachment C: California Air Resources Board Emissions Certification

State of California
AIR RESOURCES BOARD
Executive Order DG-029
Distributed Generation Certification of
UTC Power Corporation
PureCell® System Model 400

WHEREAS, the Air Resources Board (ARB) was given the authority under California Health and Safety Code section 41514.9 to establish a statewide Distributed Generation (DG) Certification Program to certify electrical generation technologies that are exempt from the permit requirements of air pollution control or air quality management districts;

WHEREAS, this DG Certification does not constitute an air pollution permit or eliminate the responsibility of the end user to comply with all federal, state, and local laws, rules and regulations;

WHEREAS, on September 3, 2009, UTC Power Corporation applied for a DG Certification of its 400 kW PureCell® System Model 400 fuel cell and whose application was deemed complete on November 25, 2009;

WHEREAS, UTC Power Corporation has demonstrated, according to test methods specified in title 17, California Code of Regulations (CCR), section 94207, that its natural-gas-fueled PureCell® System Model 400 fuel cell has complied with the following emission standards:

1. Emissions of oxides of nitrogen no greater than 0.07 pounds per megawatt-hour;
2. Emissions of carbon monoxide no greater than 0.10 pounds per megawatt-hour; and
3. Emissions of volatile organic compounds no greater than 0.02 pounds per megawatt-hour;

WHEREAS, UTC Power Corporation has demonstrated that its PureCell® System Model 400 fuel cell complies with the emissions durability requirements in title 17, CCR, section 94203 (d);

WHEREAS, I find that the Applicant, UTC Power Corporation, has met the requirements specified in article 3, title 17, CCR, and has satisfactorily demonstrated that the PureCell® System Model 400 fuel cell meets the DG Certification Regulation 2007 Fossil Fuel Emission Standards;

NOW THEREFORE, IT IS HEREBY ORDERED, that a DG Certification, Executive Order DG-029 is granted.

This DG Certification:

- 1) is subject to all conditions and requirements of the ARB's DG Certification Program, article 3, title 17, CCR, including the provisions relating to inspection, denial, suspension, and revocation;
- 2) shall be void if any manufacturer's modification results in an increase in emissions or changes the efficiency or operating conditions of a model, such that the model no longer meets the DG Certification Regulation 2007 Fossil Fuel Emission Standards;
- 3) shall expire on the 17th day of February, 2015.

Executed at Sacramento, California, this 17 day of February 2010,

James Goldstene
Executive Officer
by

/s/

Michael Tollstrup, Acting Chief
Stationary Source Division

Attachment D: Connecticut DEEP Sprague, CT Endangered Species Map (shaded areas denote known locations of State and federally listed species).

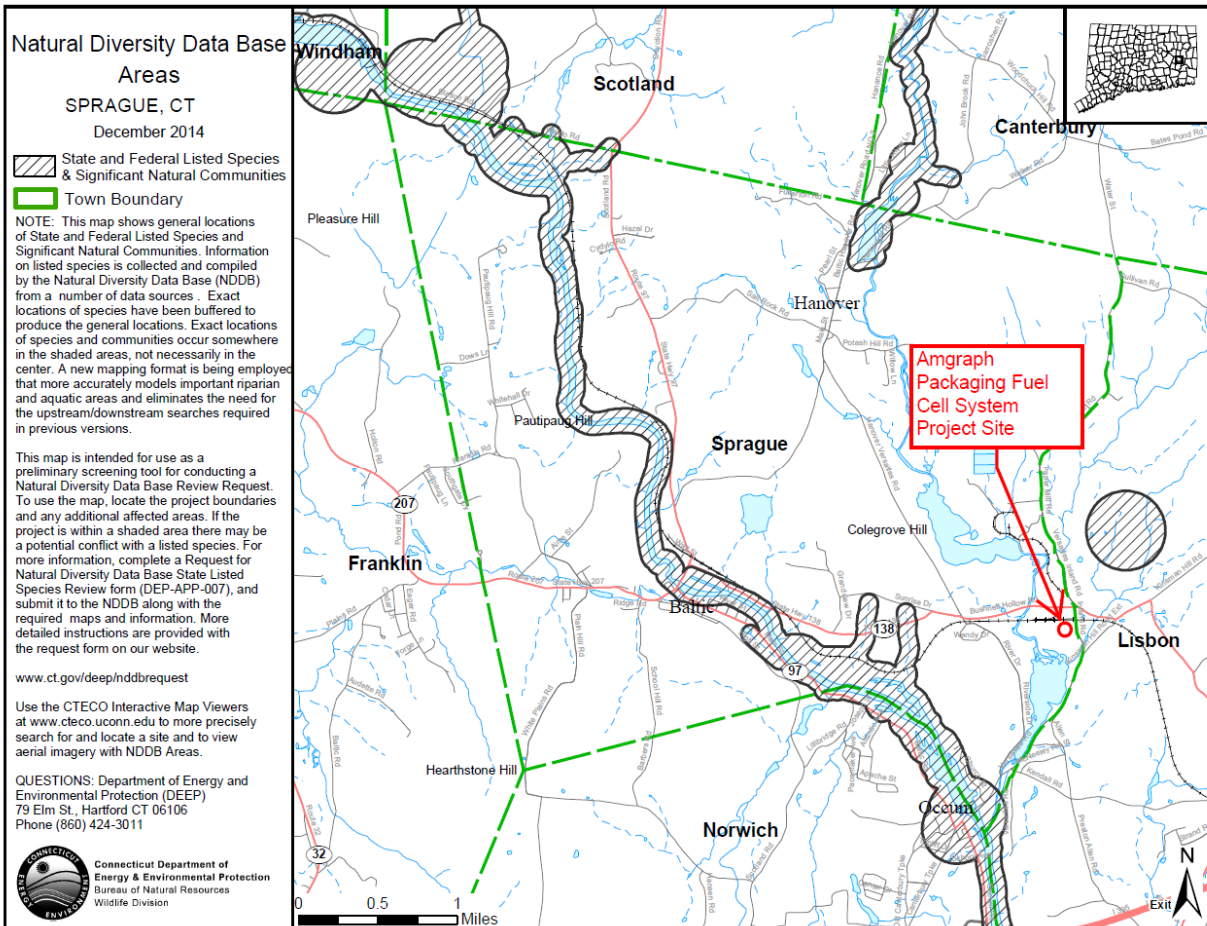


Exhibit E: Town of Sprague Planning and Zoning Commission approval



TOWN OF SPRAGUE

Planning and Zoning Commission

1 Main Street

Baltic, Connecticut 06330

860-822-3000 Ext. 223

Fax: 860-822-3016

landuse@ctsprague.org

July 7, 2015

Josh Abrams
Doosan Fuel Cell America
195 Governor's Highway
South Windsor, CT 06074

Dear Mr. Abrams:

At the regular meeting of the Sprague Planning and Zoning Commission held on July 1, 2015, your request for a zoning permit for two fuel cell units and ancillary equipment for the Amgraph property located at 90 Inland Road was reviewed. Please be advised that the Commission voted to approve your application.

If you have any questions, please contact us.

Sincerely yours,

Sander Bittman cjh

Sander Bittman, Chairman

SB/cjh

Cc: Ken Fontaine, Amgraph Packaging
Joseph Smith, ZEO



AMGRAPH PACKAGING INC.
 SPRAGUE, CT
FUEL CELL INSTALLATION

OWNER: AMGRAPH PACKAGING INC.
 90 VERSAILLES ROAD.
 SPRAGUE, CT

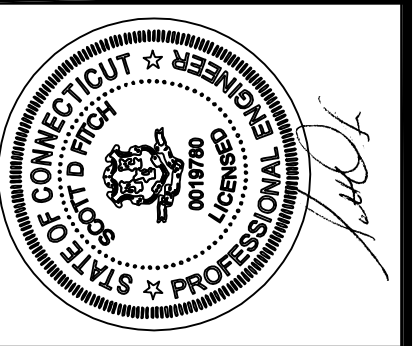
MECHANICAL/ELECTRICAL ENGINEER: INNOVATIVE CONSTRUCTION & DESIGN SOLUTIONS, LLC
 419A WHITFIELD STREET
 GUILFORD, CT 06437
 (203) 453-8596

PROJECT MANAGER: DOOSAN
 195 GOVERNOR'S HIGHWAY
 SOUTH WINDSOR, CT 06074
 (860) 727-2200

DRAWING INDEX:

CS1.0	COVER SHEET	M1.0	GENERAL NOTES, SPECS & LEGEND	E1.0	ELECTRICAL ONE-LINE DIAGRAM
GA1.0	GENERAL ARRANGEMENT	M2.0	MECHANICAL PLAN	E2.0	ELECTRICAL PLAN
S1.0	STRUCTURAL CONCRETE PLAN	M3.0	MECHANICAL DETAILS	E3.0	ELECTRICAL DETAILS AND DIAGRAMS
S1.1	STRUCTURAL SECTOINS AND DETAILS	M3.1	MECHANICAL DETAILS	E3.1	ELECTRICAL DETAILS AND DIAGRAMS
		M4.0	PIPING AND INSTRUMENTATION DIAGRAM	E3.2	ELECTRICAL DETAILS AND DIAGRAMS
				E3.3	ELECTRICAL DETAILS AND DIAGRAMS
				E4.0	ELECTRICAL SPECIFICATIONS

Rev.	Date	Description
A	07/06/15	ISSUED FOR PERMIT



ICDS
 Innovative Construction & Design Solutions, LLC

419A Whitfield Street
 Guilford, CT 06437
 Phone: (203) 453-8596
 Fax: (203) 453-7012
 Email: info@icdsllc.com

AMGRAPH PACKAGING INC.
 90 VERSAILLES ROAD
 SPRAGUE, CT 06383
COVER SHEET

Project No.:	Drawn By: KFH
Date: 07/06/15	Design By: SDF
Scale: AS NOTED	Check By: DSF

Drawing No.:
CS1.0

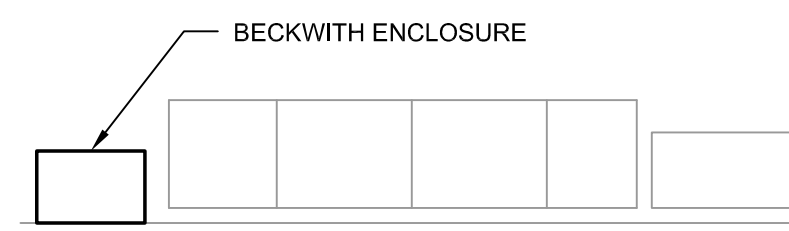
STORAGE

MACHINE SHOP

AGE

NOTES:

1. CONTRACTOR SHALL VERIFY ALL SITE DIMENSIONS, EASEMENTS, EASEMENT LOCATIONS ETC.
2. PROVIDE INLET EROSION PROTECTION AROUND EXISTING CATCH BASIN DURING DEMOLITION AND CONSTRUCTION.
3. CONTRACTOR SHALL CONTACT "CALL BEFORE YOU DIG" AND A PRIVATE UTILITY LOCATOR SERVICE PRIOR TO START OF WORK.
4. CONTRACTOR SHALL HAND DIG IN ALL LOCATIONS WHERE POWER CONDUITS, CONTROL CONDUITS, AND PIPING CROSS THE CL&P UNDERGROUND PRIMARY FEEDERS, WATER LINES AND GAS LINES
5. CONTRACTOR SHALL FIELD VERIFY ALL LAYOUT DIMENSIONS AND LOCATE ALL UTILITIES PRIOR TO COMMENCEMENT OF ANY WORK. PROVIDE VISUAL INSPECTION HOLES AT ALL FUEL CELL PIPING/CONDUIT CROSSING POINTS OF THE EXISTING UTILITIES (INCLUDING ELECTRIC, GAS, WATER, ETC) AND PROVIDE A DETAILED ELEVATION SKETCH TO OWNER AND ENGINEER IDENTIFYING ALL UTILITY LOCATIONS/DEPTHS. IMMEDIATELY NOTIFY OWNER/ENGINEER OF ANY EQUIPMENT/PIPING/CONDUIT LAYOUT CONFLICTS PRIOR TO STARTING WORK.
6. A MINIMUM OF 7'-0" IS REQUIRED BETWEEN THE COOLING MODULE/EDGE OF SLAB AND THE SOUTH SIDE HILL DROP-OFF POINT.



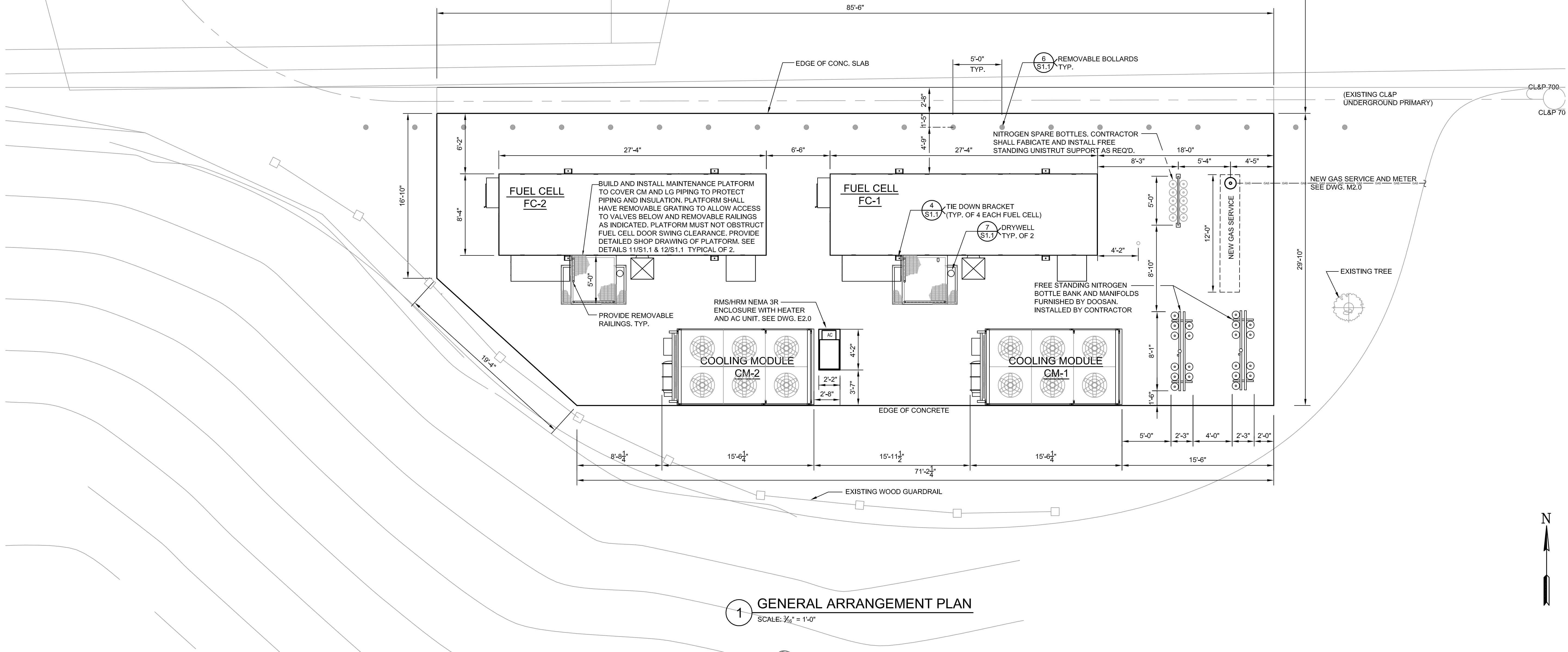
5" CONC. PAD FOR DG METER UTILITY ISOLATION SWITCH 2. COORDINATE DIMENSIONS WITH EATON CABINET SHOP DRAWINGS. SEE DRAWING E3.3



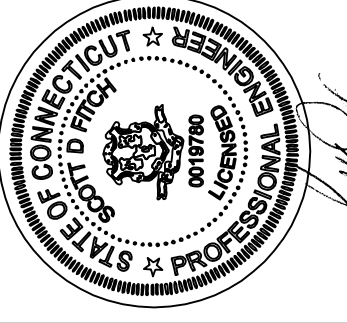
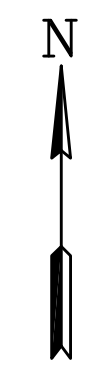
GAS RISER

EXISTING PROPANE

5" CONC. PAD FOR DG METER UTILITY ISOLATION SWITCH 1. COORDINATE DIMENSIONS WITH EATON CABINET SHOP DRAWINGS. SEE DRAWING E3.3



1 GENERAL ARRANGEMENT PLAN
SCALE: 1/8" = 1'-0"



ICDS
Innovative Construction & Design Solutions, LLC
419A Whitefield Street
Guttenberg, CT 06437
Phone: (203) 453-8595
Fax: (203) 453-7012
Email: info@icdsllc.com

AMGRAPH PACKAGING INC.
90 VERSAILLES ROAD
SPRAGUE, CT 06383

GENERAL ARRANGEMENT PLAN

Project No.:	Drawn By:
Date:	Design By:
Scale:	Check By:

Drawn By: KFH
Design By: SDF
Check By: DSF

GA1.0

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Rev.	Date	Description
A	07/06/15	ISSUED FOR PERMIT

STORAGE

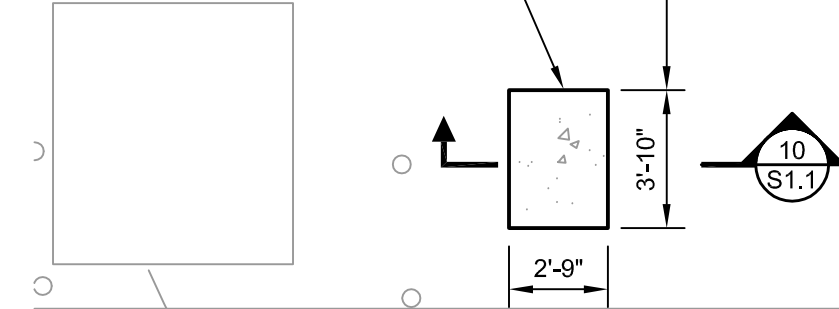
MACHINE SHOP

AGE

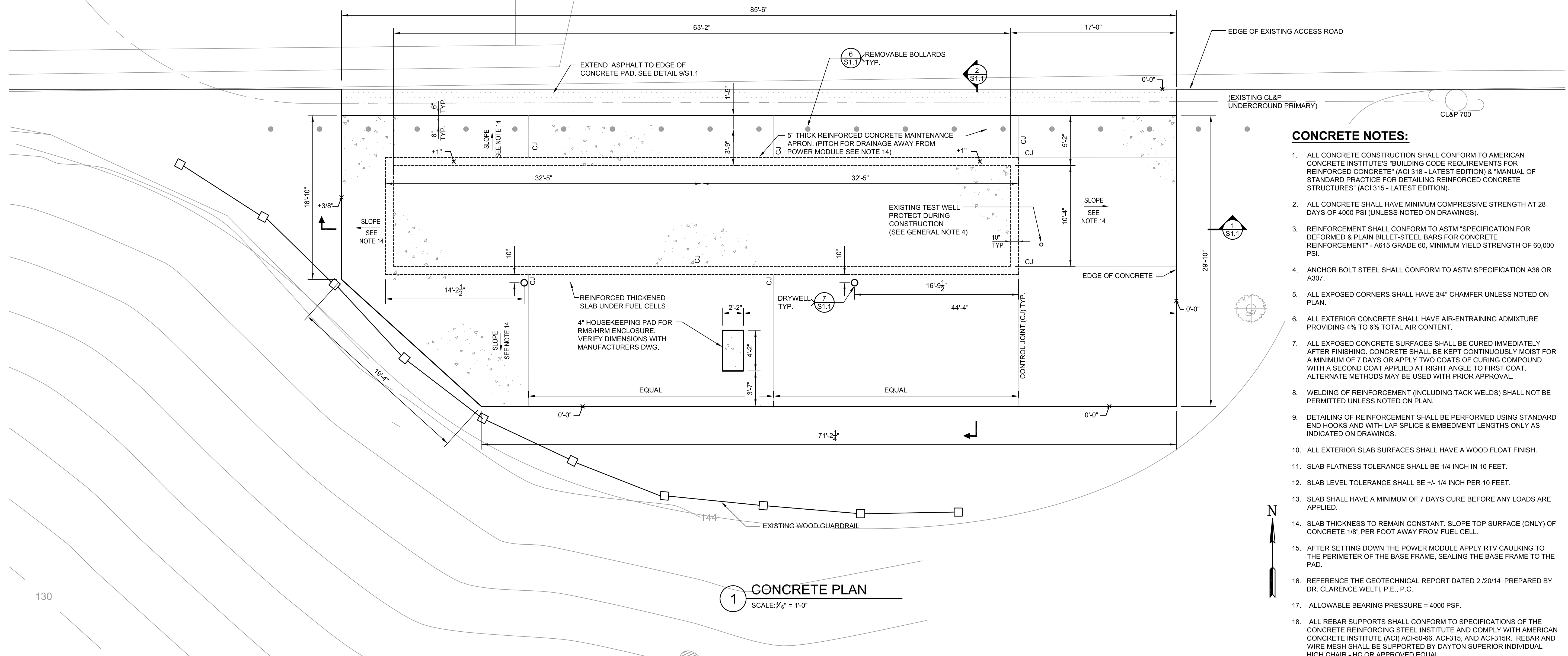
GENERAL NOTES:

1. CONTRACTOR SHALL VERIFY THAT ALL UNDERGROUND PIPING AND ELECTRICAL CONDUITS ARE IN PLACE PRIOR TO POURING CONCRETE SLAB.
2. ALL EXISTING CONSTRUCTION AND UTILITIES SHALL BE SAFEGUARDED AND PROTECTED FROM DRAINAGE OR SETTLEMENT DURING EXCAVATION AND CONSTRUCTION.
3. THE SUB GRADES SHALL BE PROOF COMPACTED BY AT LEAST FIVE PASSES OF A VIBRATORY COMPACTOR HAVING A STATIC WEIGHT OF AT LEAST 2 TONS.
4. CONTRACTOR SHALL PROVIDE ADEQUATE PROTECTION MEANS (LARGEST PIPE TO SLEEVE EXISTING TEST WELL) DURING SITE WORK AS TO NOT DAMAGE THE EXISTING TEST WELL.

5" CONC. PAD FOR DG METER UTILITY ISOLATION SWITCH 2. COORDINATE DIMENSIONS WITH EATON CABINET SHOP DRAWINGS.



5" CONC. PAD FOR DG METER UTILITY ISOLATION SWITCH 1. COORDINATE DIMENSIONS WITH EATON CABINET SHOP DRAWINGS.



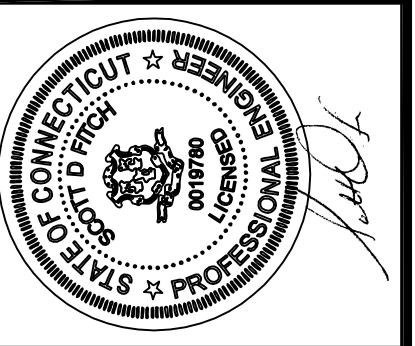
1 CONCRETE PLAN
SCALE: 3/8" = 1'-0"

CONCRETE NOTES:

1. ALL CONCRETE CONSTRUCTION SHALL CONFORM TO AMERICAN CONCRETE INSTITUTE'S "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE" (ACI 318 - LATEST EDITION) & "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES" (ACI 315 - LATEST EDITION).
2. ALL CONCRETE SHALL HAVE MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS OF 4000 PSI (UNLESS NOTED ON DRAWINGS).
3. REINFORCEMENT SHALL CONFORM TO ASTM "SPECIFICATION FOR REINFORCED & PLAIN BILLET-STEEL BARS FOR CONCRETE REINFORCEMENT" - A615 GRADE 60, MINIMUM YIELD STRENGTH OF 60,000 PSI.
4. ANCHOR BOLT STEEL SHALL CONFORM TO ASTM SPECIFICATION A36 OR A307.
5. ALL EXPOSED CORNERS SHALL HAVE 3/4" CHAMFER UNLESS NOTED ON PLAN.
6. ALL EXTERIOR CONCRETE SHALL HAVE AIR-ENTRAINING ADMIXTURE PROVIDING 4% TO 6% TOTAL AIR CONTENT.
7. ALL EXPOSED CONCRETE SURFACES SHALL BE CURED IMMEDIATELY AFTER FINISHING. CONCRETE SHALL BE KEPT CONTINUOUSLY MOIST FOR A MINIMUM OF 7 DAYS OR APPLY TWO COATS OF CURING COMPOUND WITH A SECOND COAT APPLIED AT RIGHT ANGLE TO FIRST COAT. ALTERNATE METHODS MAY BE USED WITH PRIOR APPROVAL.
8. WELDING OF REINFORCEMENT (INCLUDING TACK WELDS) SHALL NOT BE PERMITTED UNLESS NOTED ON PLAN.
9. DETAILING OF REINFORCEMENT SHALL BE PERFORMED USING STANDARD END HOOKS AND WITH LAP SPLICE & EMBEDMENT LENGTHS ONLY AS INDICATED ON DRAWINGS.
10. ALL EXTERIOR SLAB SURFACES SHALL HAVE A WOOD FLOAT FINISH.
11. SLAB FLATNESS TOLERANCE SHALL BE 1/4 INCH IN 10 FEET.
12. SLAB LEVEL TOLERANCE SHALL BE +/- 1/4 INCH PER 10 FEET.
13. SLAB SHALL HAVE A MINIMUM OF 7 DAYS CURE BEFORE ANY LOADS ARE APPLIED.
14. SLAB THICKNESS TO REMAIN CONSTANT. SLOPE TOP SURFACE (ONLY) OF CONCRETE 1/8" PER FOOT AWAY FROM FUEL CELL.
15. AFTER SETTING DOWN THE POWER MODULE APPLY RTV CAULKING TO THE PERIMETER OF THE BASE FRAME, SEALING THE BASE FRAME TO THE PAD.
16. REFERENCE THE GEOTECHNICAL REPORT DATED 2/20/14 PREPARED BY DR. CLARENCE WELTI, P.E., P.C.
17. ALLOWABLE BEARING PRESSURE = 4000 PSF.
18. ALL REBAR SUPPORTS SHALL CONFORM TO SPECIFICATIONS OF THE CONCRETE REINFORCING STEEL INSTITUTE AND COMPLY WITH AMERICAN CONCRETE INSTITUTE (ACI) ACI-50-46, ACI-315, AND ACI-315R. REBAR AND WIRE MESH SHALL BE SUPPORTED BY DAYTON SUPERIOR INDIVIDUAL HIGH CHAIR - HC OR APPROVED EQUAL.



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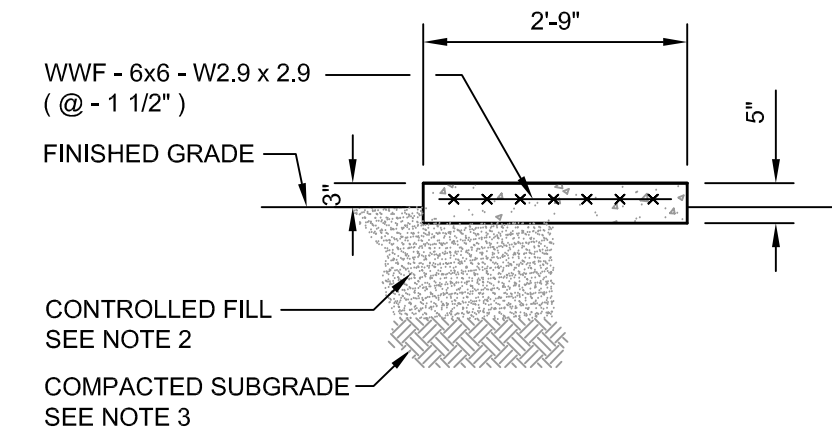
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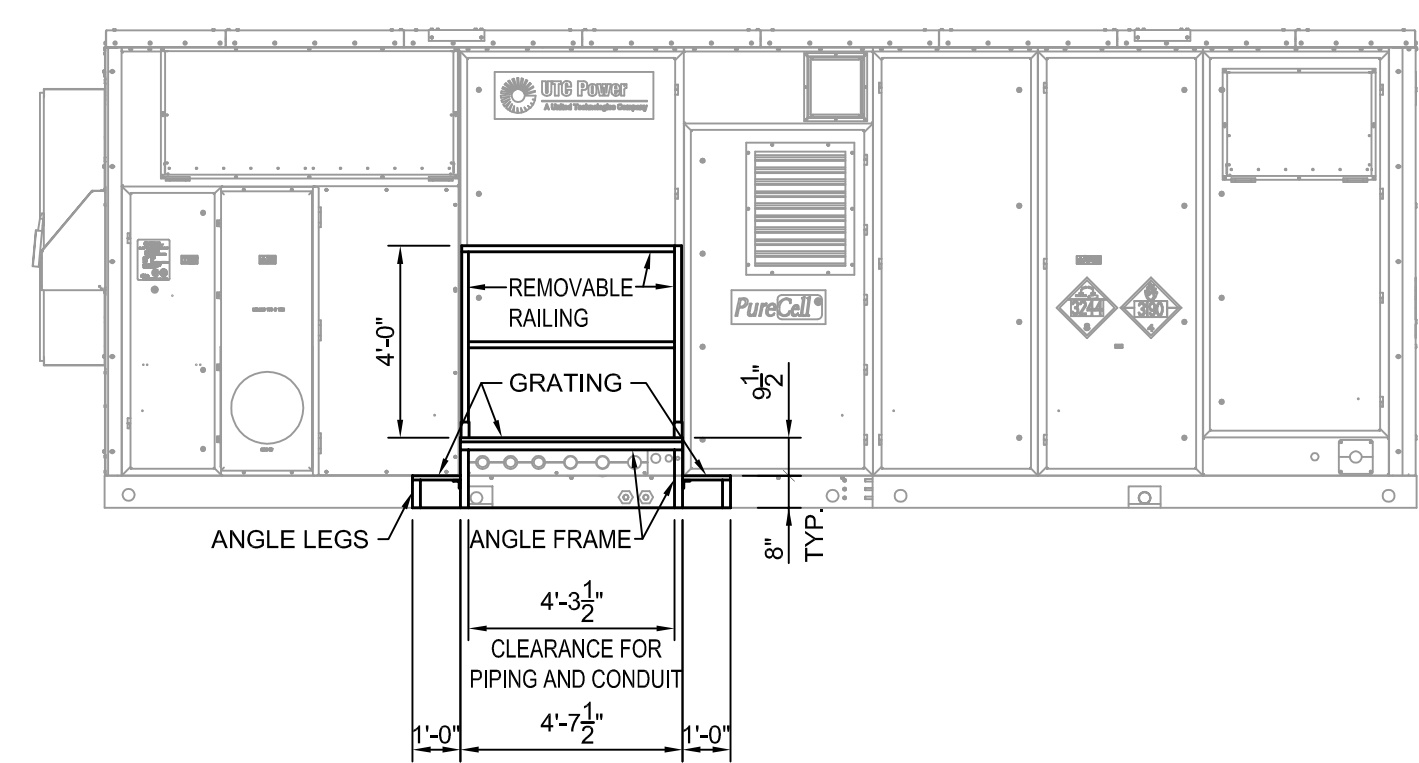
AMGRAPH PACKAGING INC.
90 VERSAILLES ROAD
SPRAGUE, CT 06383
**STRUCTURAL
CONCRETE PLAN**

Project No.:	Drawn By:
Date:	Design By:
Scale:	Check By:

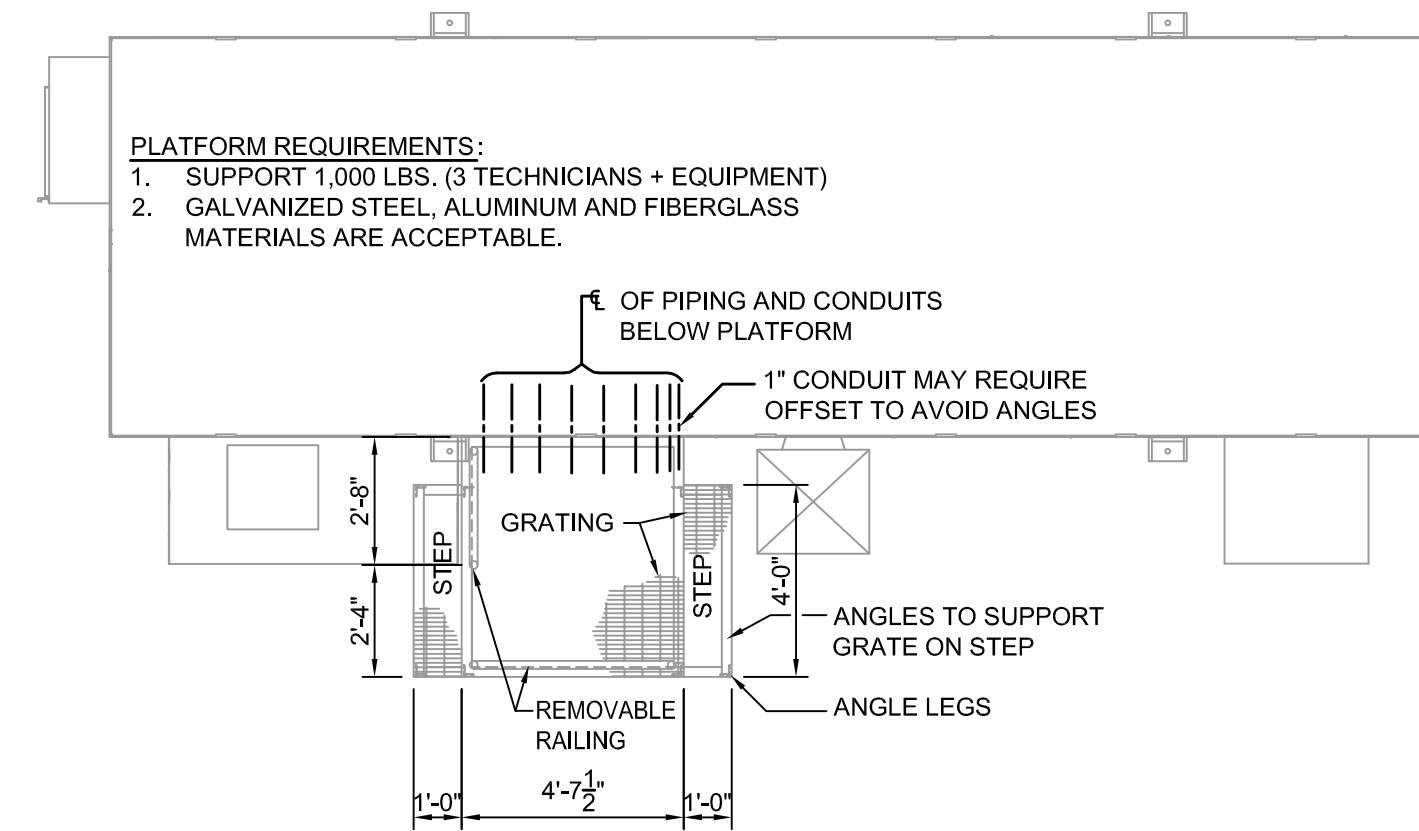
Drawing No.: **S1.0**



10 METER CABINET PAD DETAIL
SCALE: N.T.S.

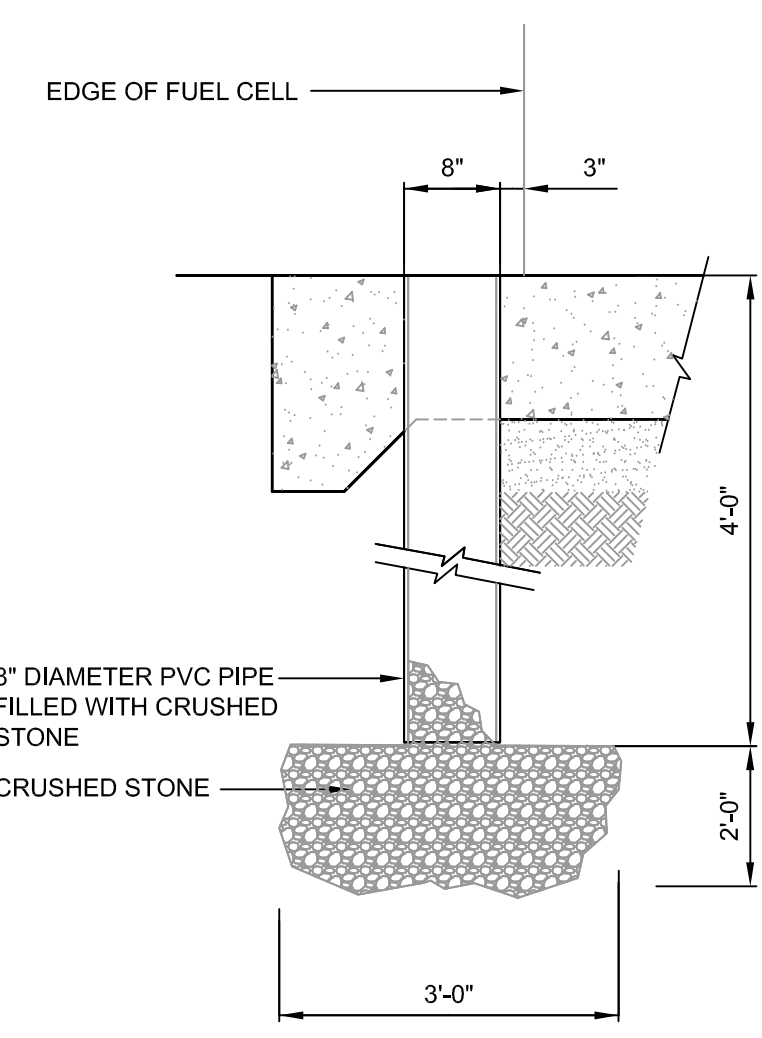


11 PIPING PLATFORM ELEVATION
SCALE: N.T.S.

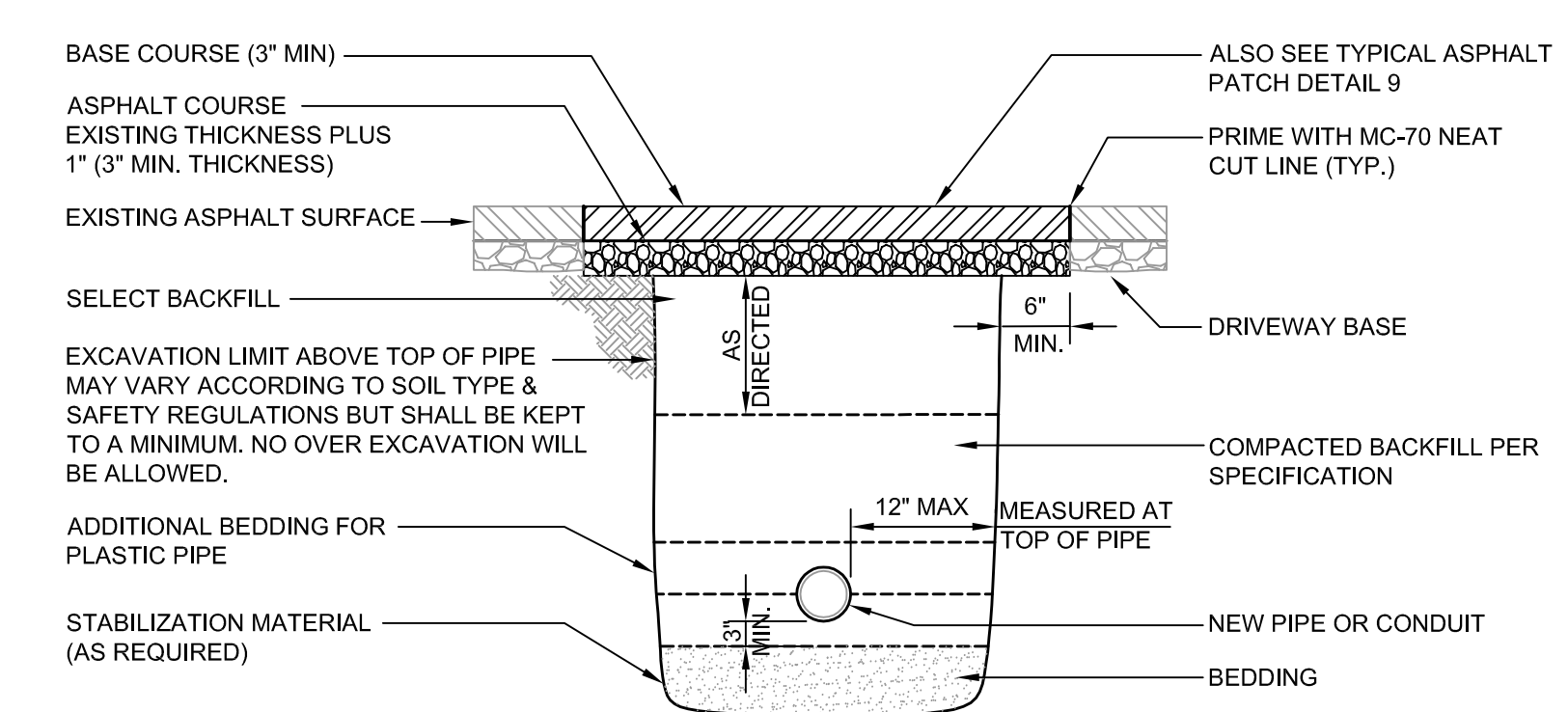


12 PIPING PLATFORM PLAN
SCALE: N.T.S.

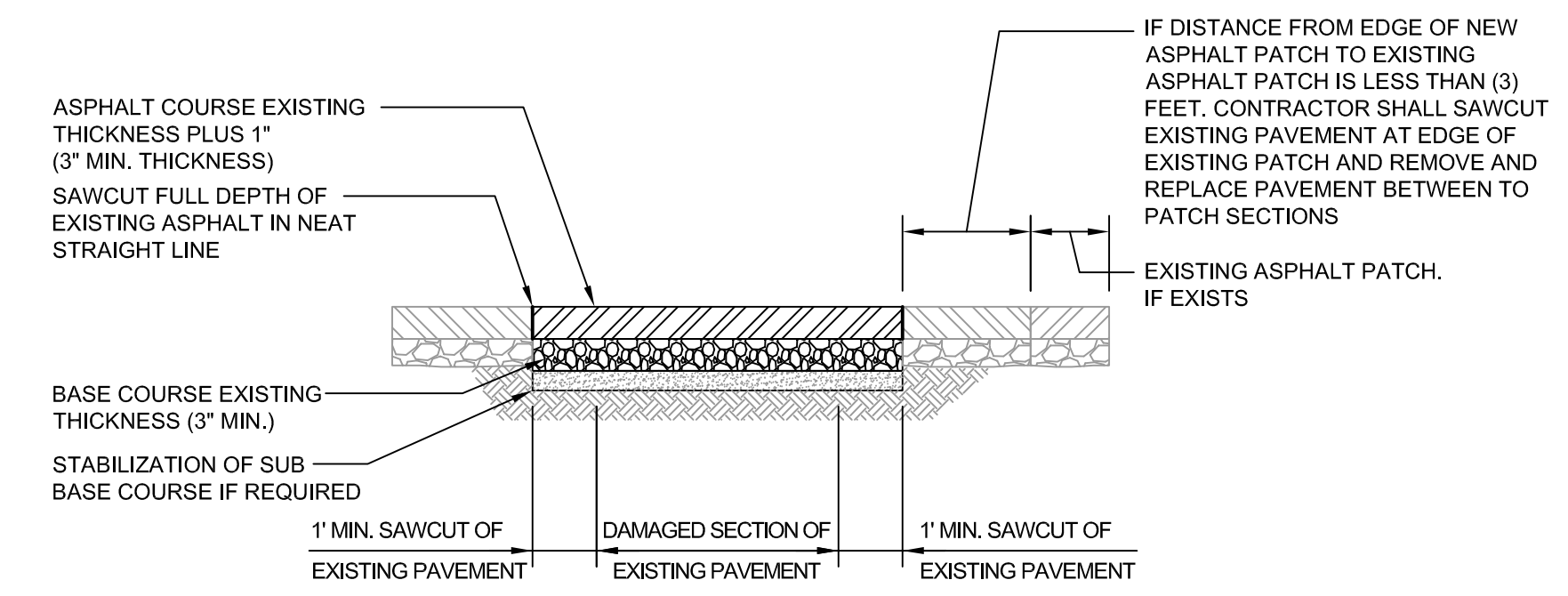
- NOTES:**
- FOR GENERAL NOTES AND CONCRETE NOTES, SEE DRAWING S1.0
 - REFER TO THE SOILS REPORT, SEE NOTE #16 ON S1.0. CONTROLLED FILL: ALL TOPSOIL AND DISTURBED SOILS SHALL BE REPLACED WITH A CONTROLLED FILL. THE MATERIAL USED FOR CONTROLLED FILL SHALL CONFORM TO THE FOLLOWING GRADATION OR 3/4" CRUSHED STONE CAN BE UTILIZED. GRADATION: (IF 3/4" CRUSHED STONE IS NOT USED): 100% PASSING THE 3.5" SIEVE, 50 TO 100% PASSING THE 3/4" SIEVE, 25 TO 80% PASSING THE NUMBER 4 SIEVE AND THE FRACTION PASSING THE NUMBER 200 SIEVE SHALL HAVE LESS THAN 10% PASSING THE NUMBER 200 SIEVE. COMPACTION: TO AT LEAST 95% OF MODIFIED OPTIMUM DENSITY, ASTM D-1557.
 - REFER TO THE SOILS REPORT, SEE NOTE #16 ON S1.0. COMPACTED SUBGRADE: THE SUBGRADES SHALL BE PROOF COMPACTED BY AT LEAST FIVE PASSES OF A VIBRATORY COMPACTOR HAVING A STATIC WEIGHT OF AT LEAST 2 TONS.



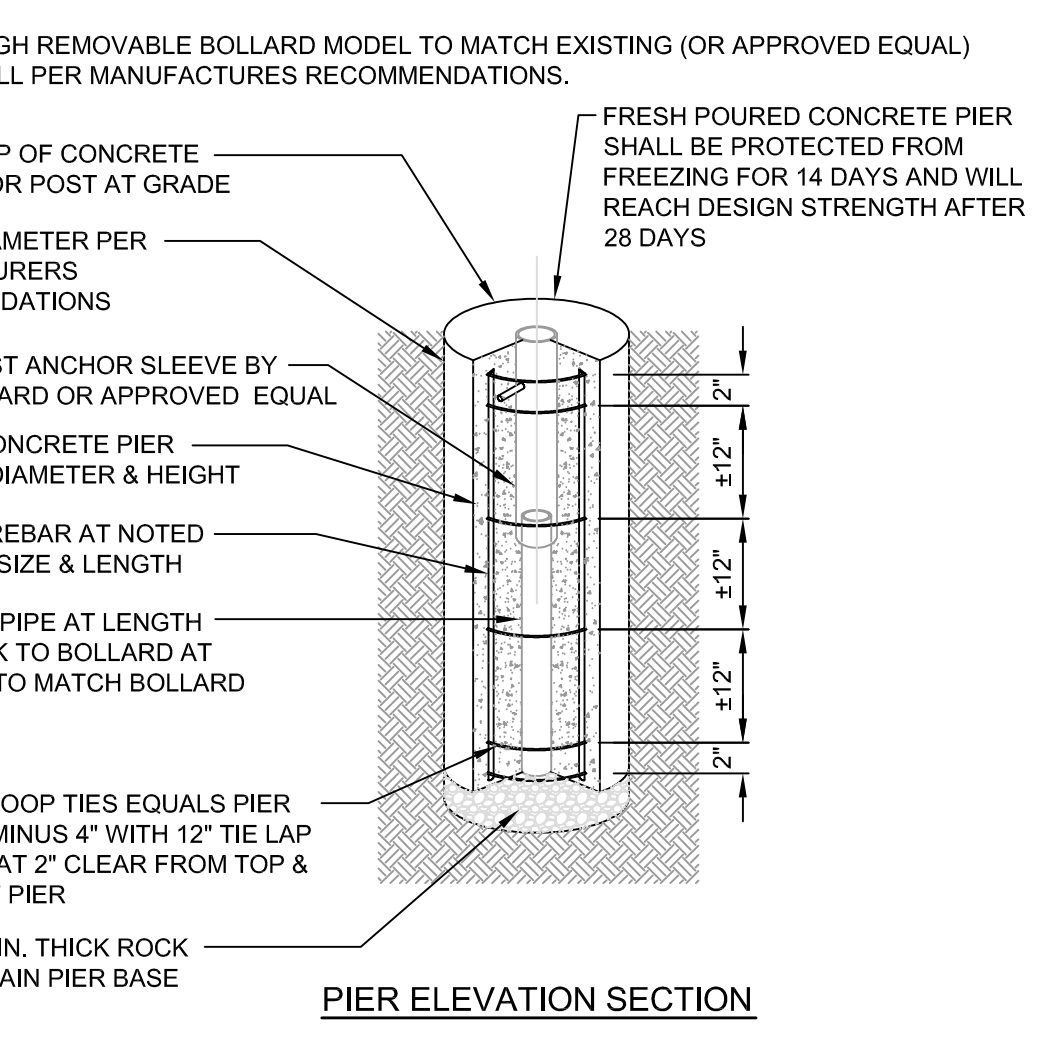
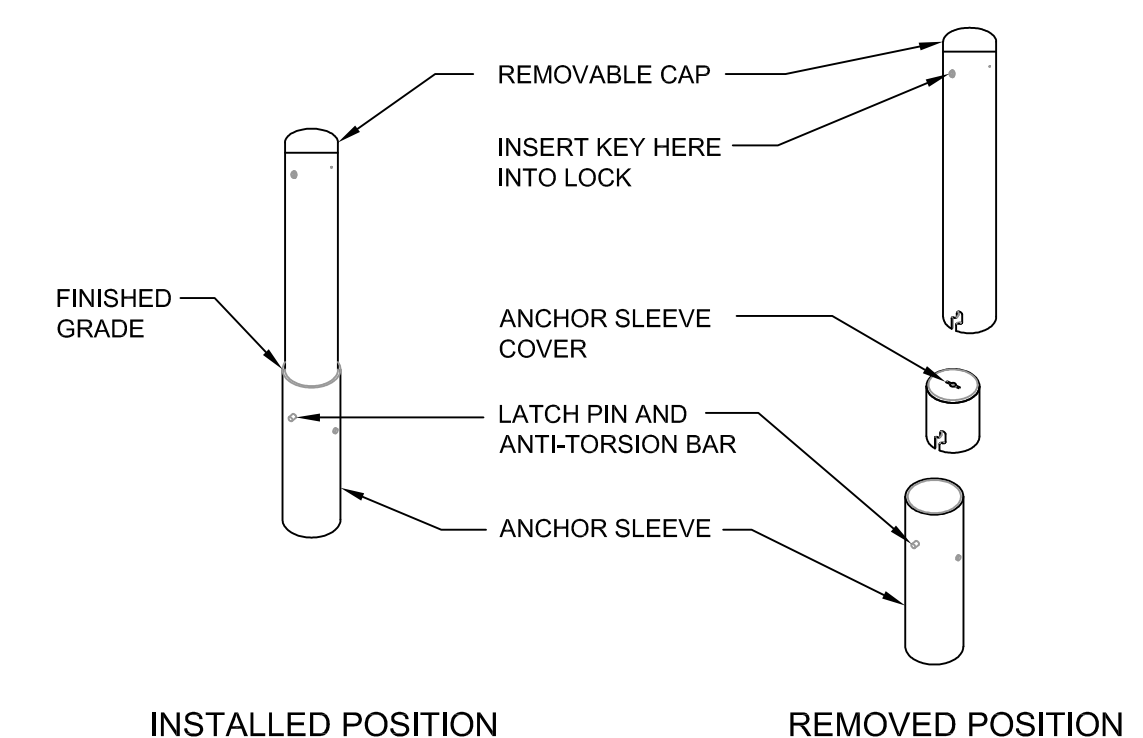
7 DRY WELL DETAIL
SCALE: N.T.S.



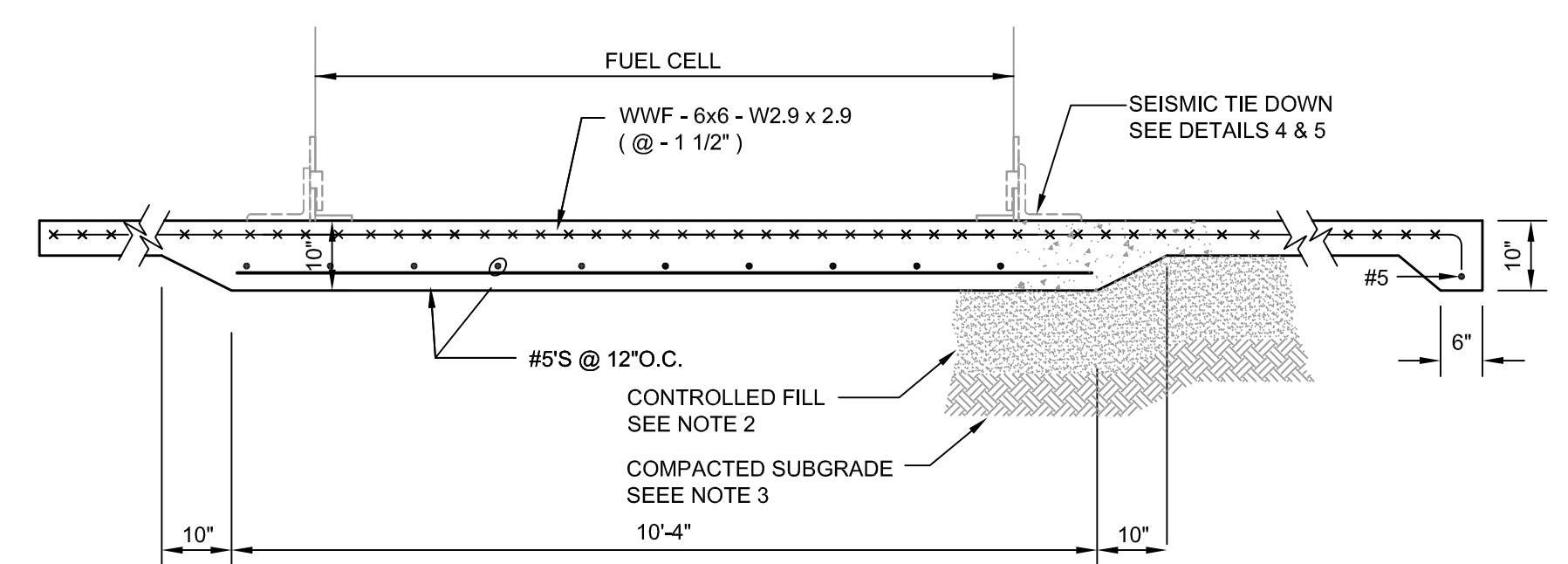
8 PIPING / CONDUIT INSTALLATION AND DRIVEWAY REPAIR
SCALE: N.T.S.



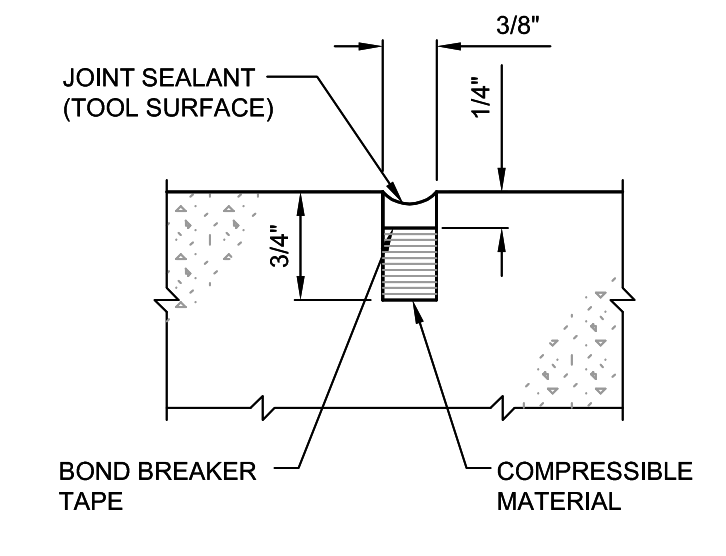
9 TYPICAL ASPHALT PATCH DETAIL
SCALE: N.T.S.



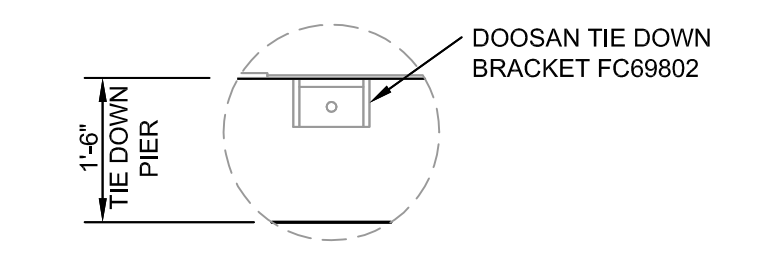
6 REMOVABLE BOLLARD DETAIL
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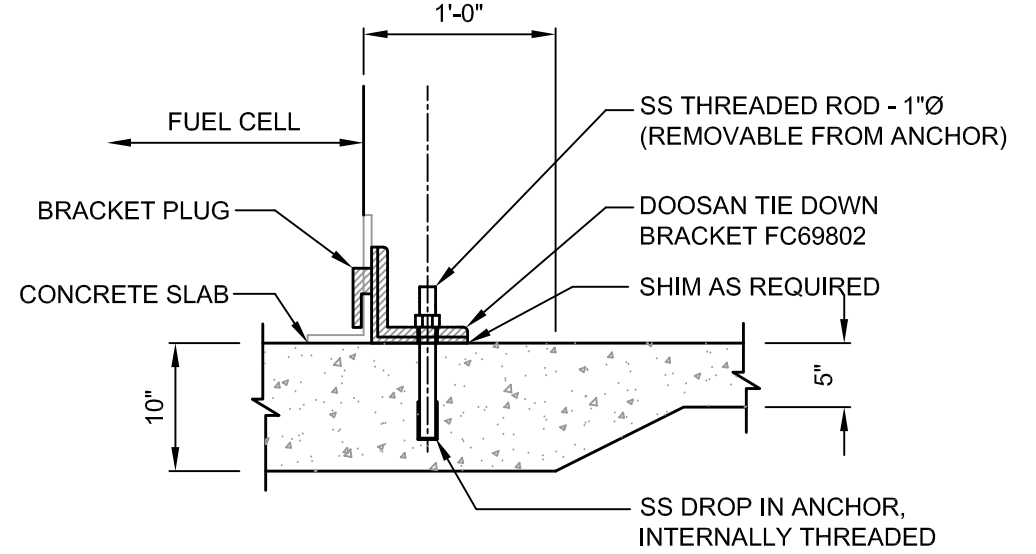
2 SLAB SECTION
SCALE: 1/2" = 1'-0"



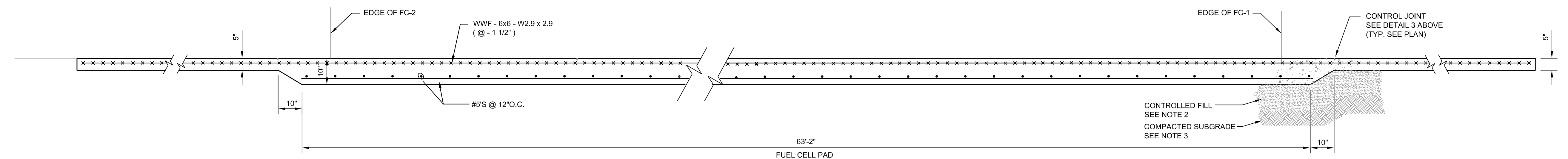
3 CONTROL JOINT DETAIL
SCALE: N.T.S.



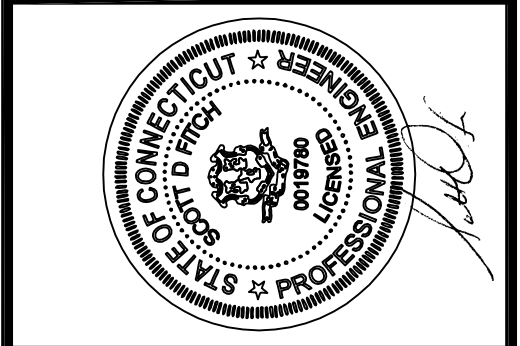
4 SEISMIC TIE DOWN (PLAN VIEW)
SCALE: N.T.S.



5 TYPICAL SEISMIC TIE DOWN DETAIL
SCALE: N.T.S.



1 SLAB SECTION
SCALE: 1/2" = 1'-0"



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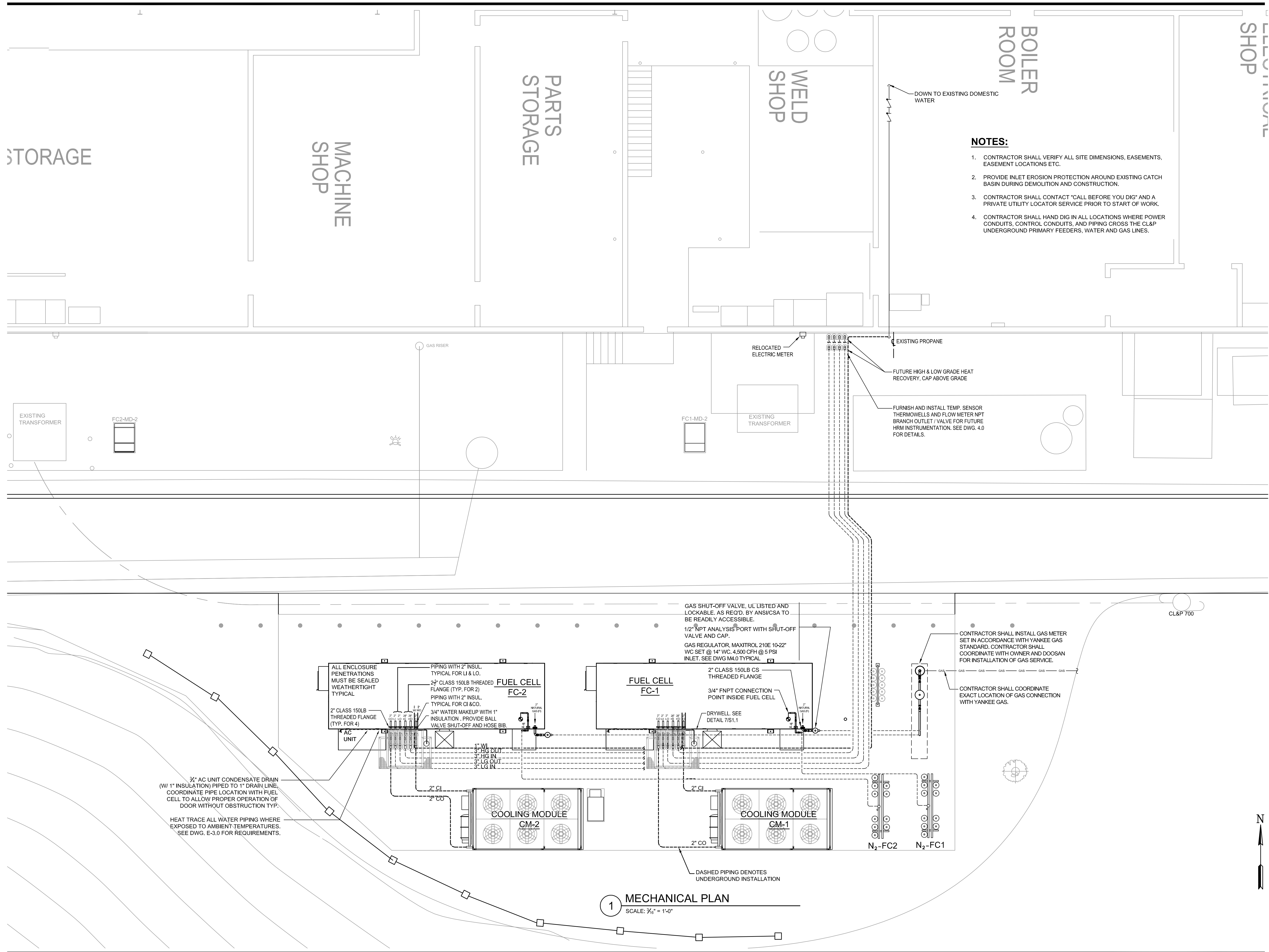
STRUCTURAL SECTIONS AND DETAILS

Project No.:	Drawn By:
Date:	Design By:
Scale:	Check By:

Drawing No.:

S1.1

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STORAGE

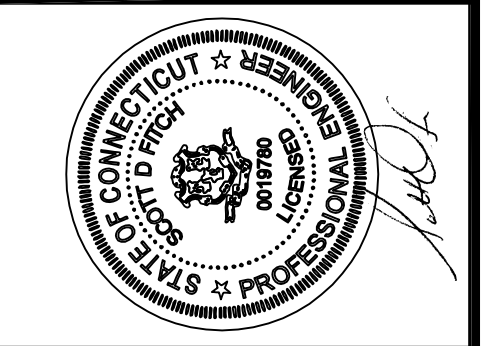
MACHINE SHOP

PARTS STORAGE

WELD SHOP

BOILER ROOM

SHOP



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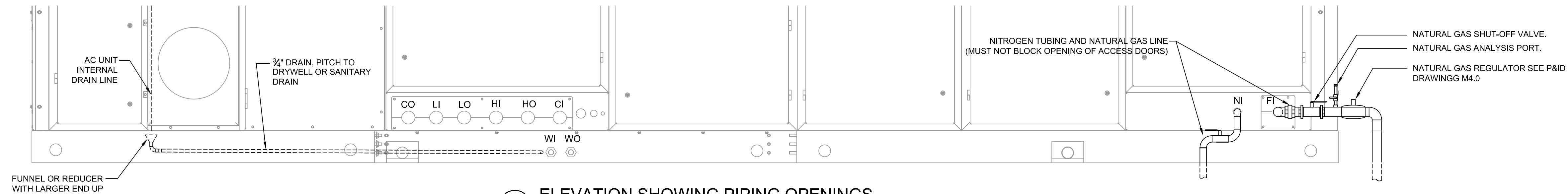
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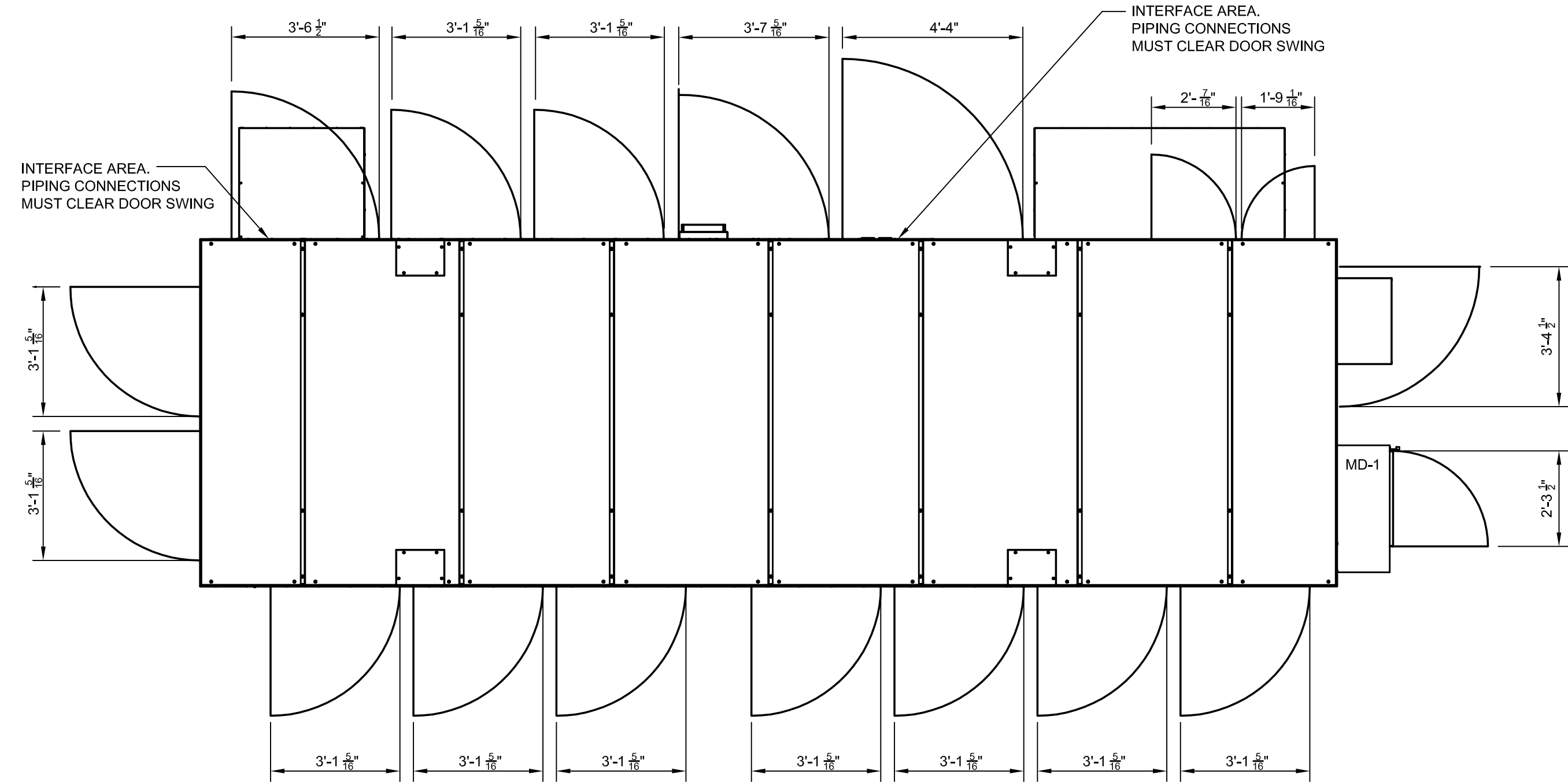
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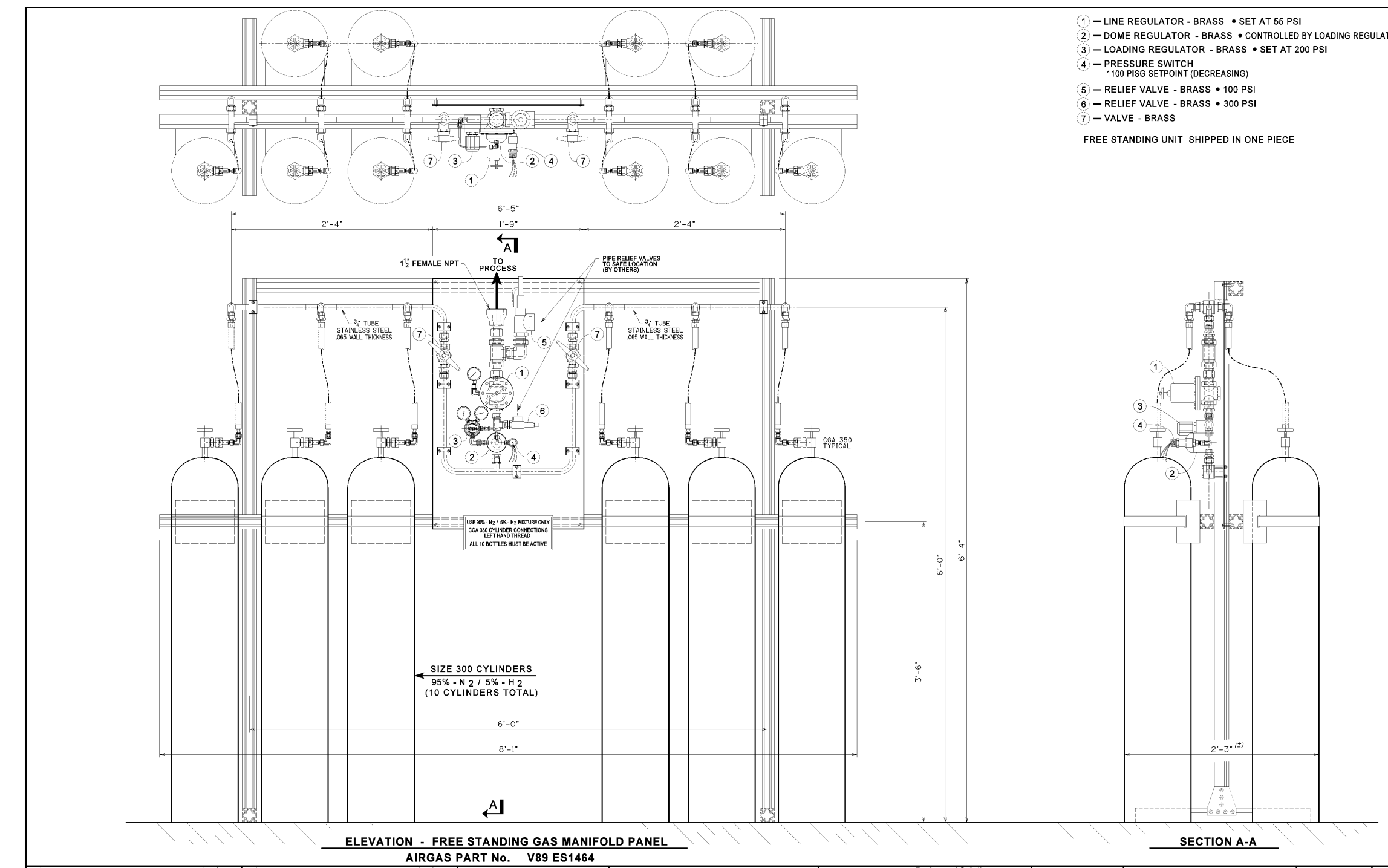
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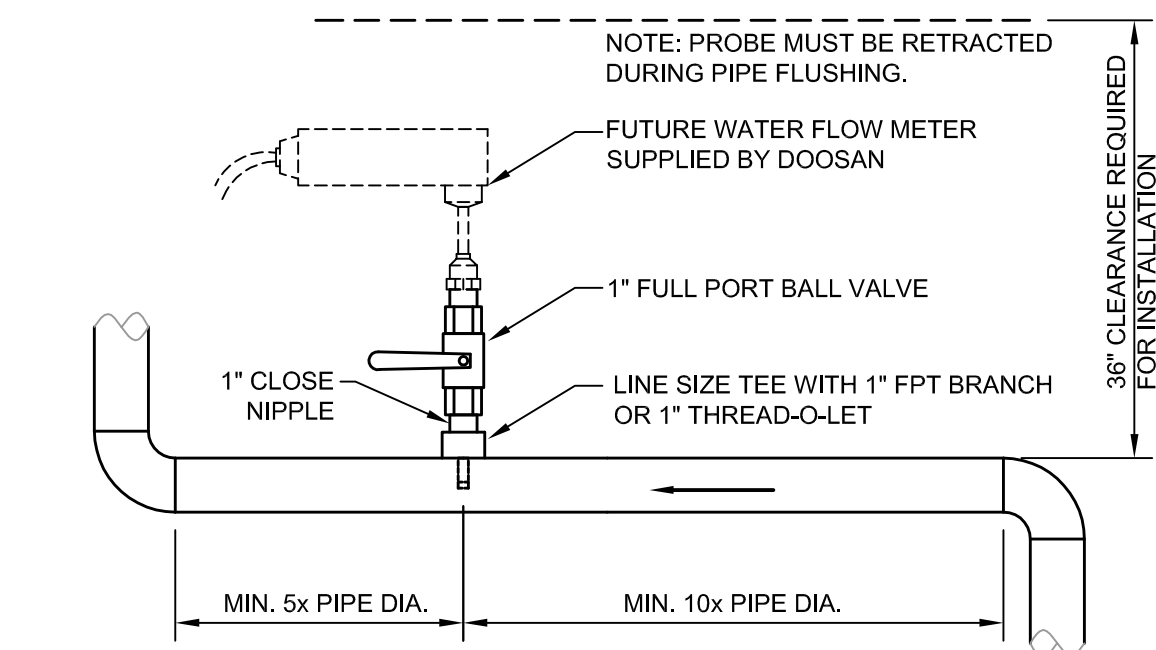
9 ELEVATION SHOWING PIPING OPENINGS
SCALE: NTS



8 DOOR SWING CLEARANCE PLAN
SCALE: NTS



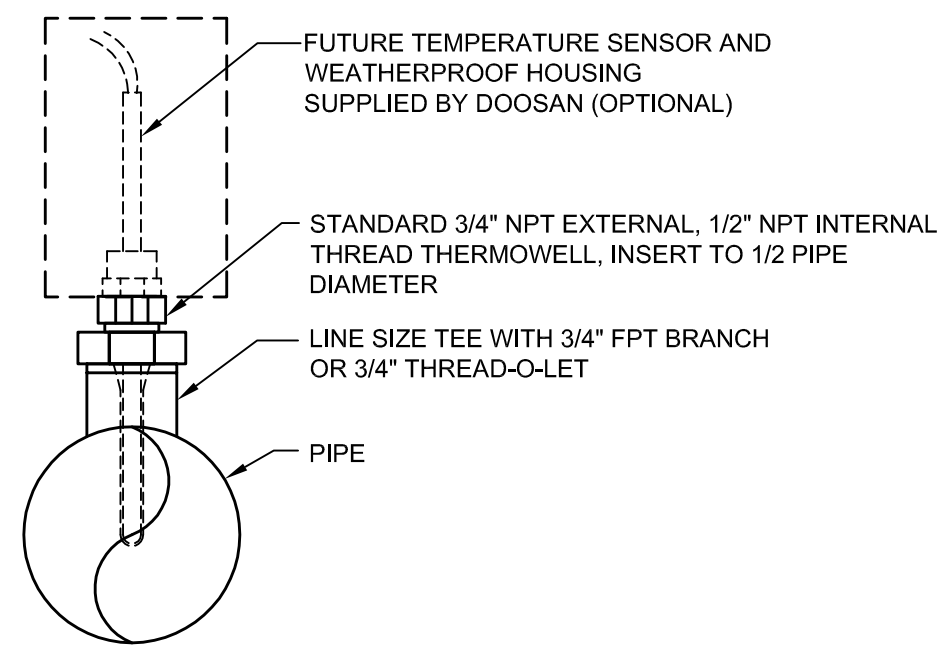
7 NITROGEN BOTTLES, MANIFOLD AND BOTTLE MOUNTING FRAME DETAIL
SCALE: NTS



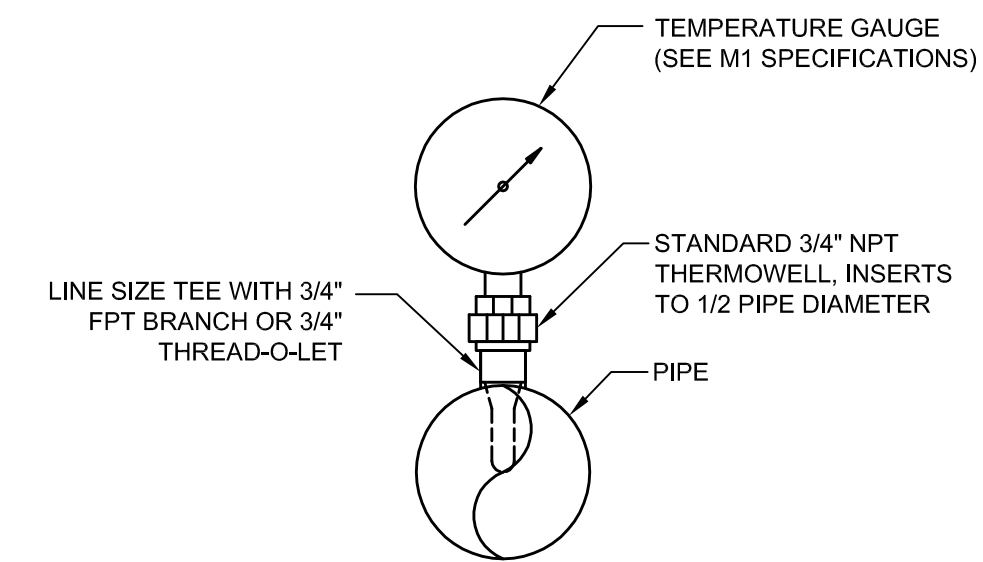
6 WATER FLOW METER DETAIL
SCALE: NTS

SWAGELOK FITTING (SS-300-1-48T, OR SIMILAR TO MATCH SENSOR DIAMETER)

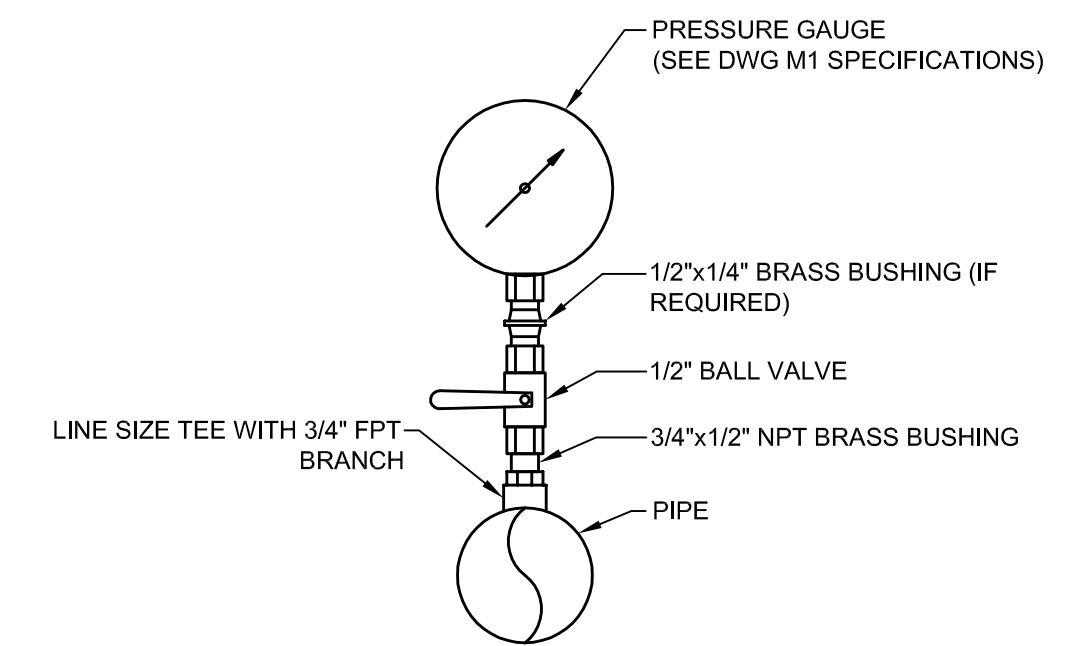
CONSULT DOOSAN FOR LATEST METER & SENSOR PIPING PROVISIONS. INSTRUMENTS MAY BE FURNISHED BY A SUB VENDOR.



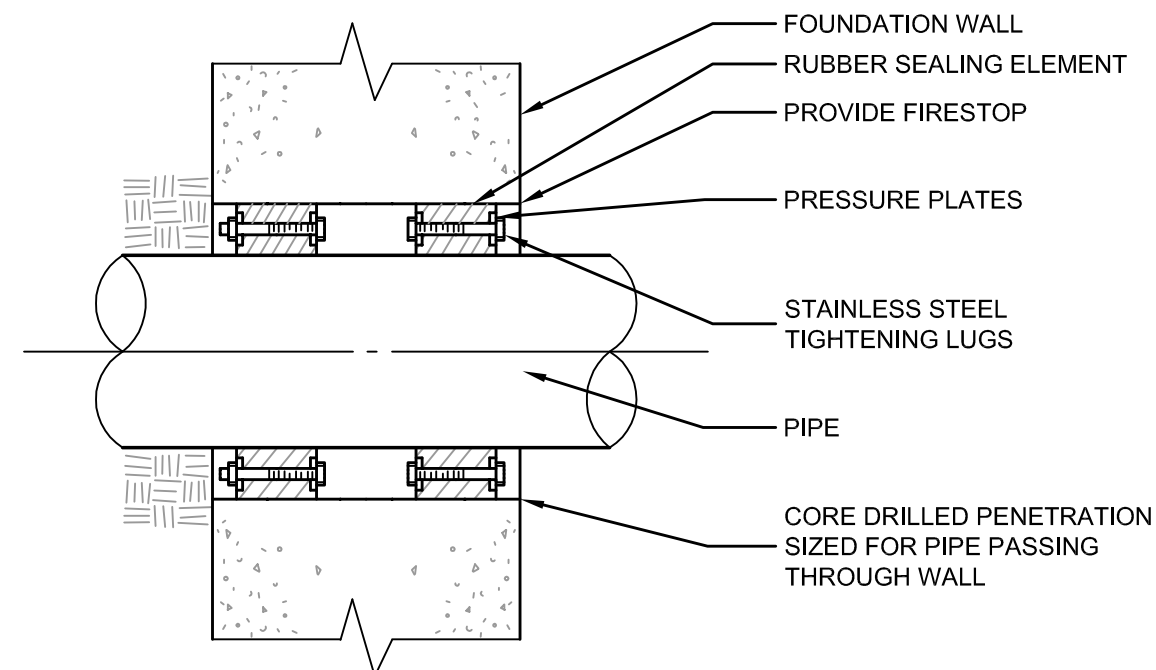
5 TEMPERATURE SENSOR AND THERMOWELL DETAIL
SCALE: NTS



4 THERMOMETER AND WELL DETAIL
SCALE: NTS



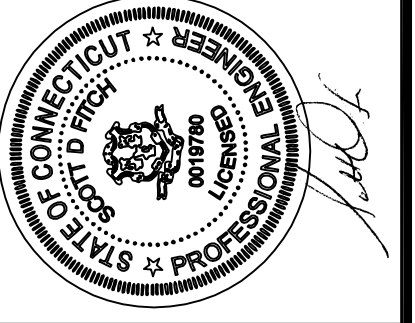
3 PRESSURE GAUGE CONNECTION DETAIL
SCALE: NTS



2 PIPE THRU EXTERIOR WALL
SCALE: NTS

1 NOT USED
SCALE: NTS

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MECHANICAL DETAILS

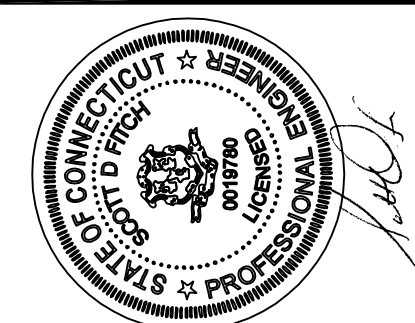
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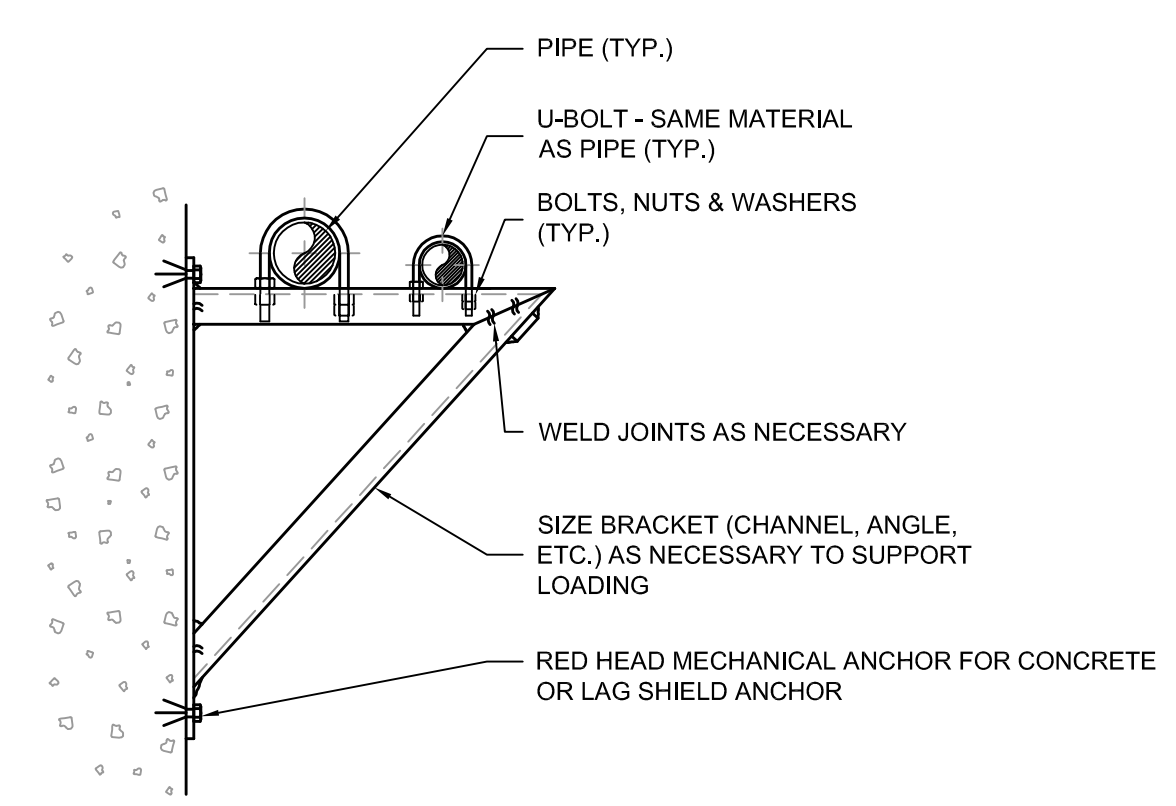
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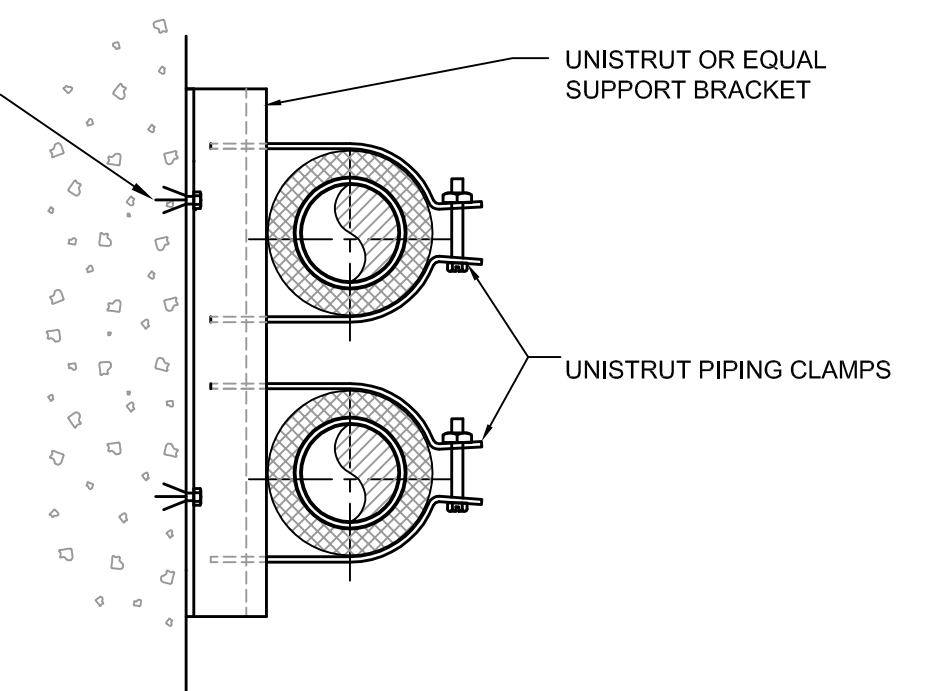
MECHANICAL DETAILS

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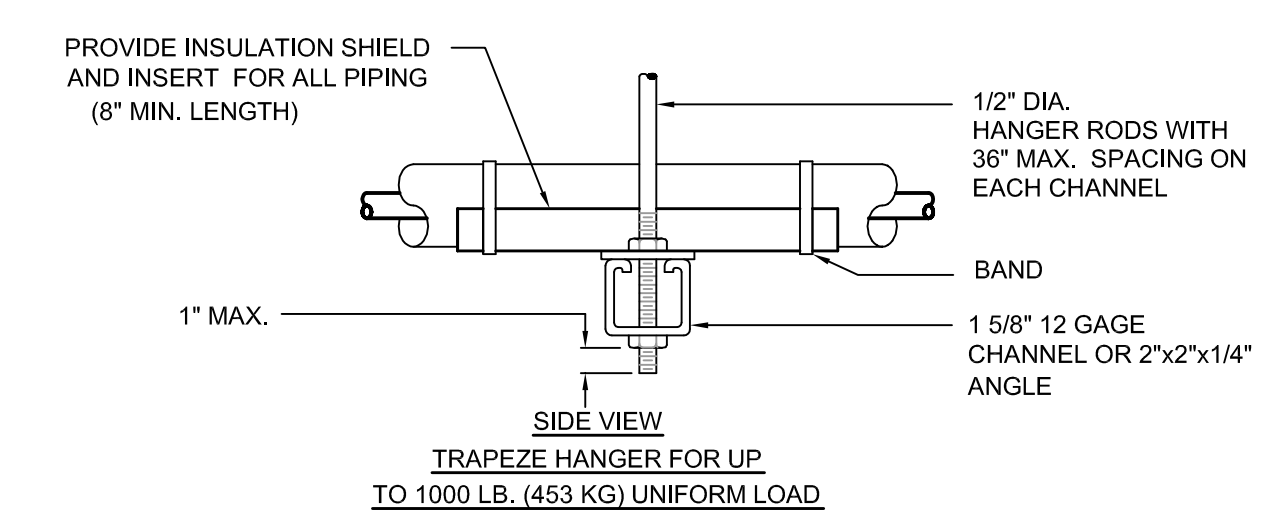
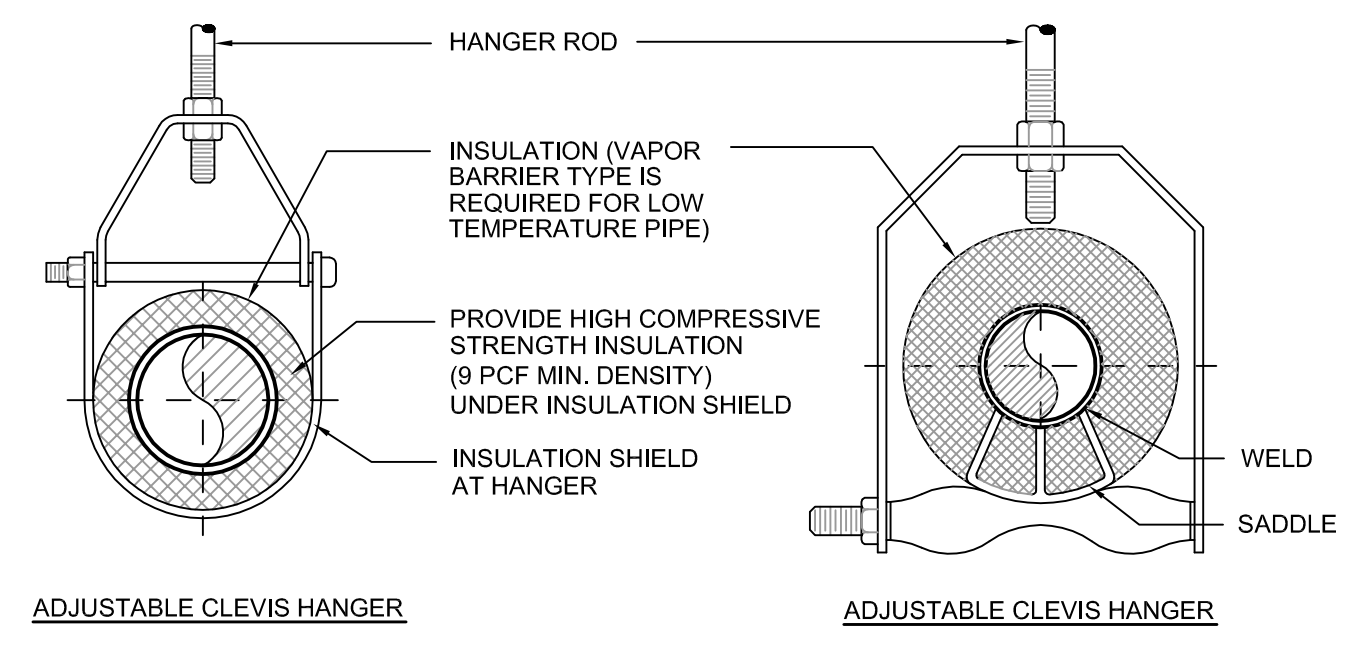
Project No.:
M3.1



8 WALL-MOUNT PIPE SUPPORT
SCALE: NTS



7 WALL-MOUNT PIPE SUPPORT
SCALE: NTS

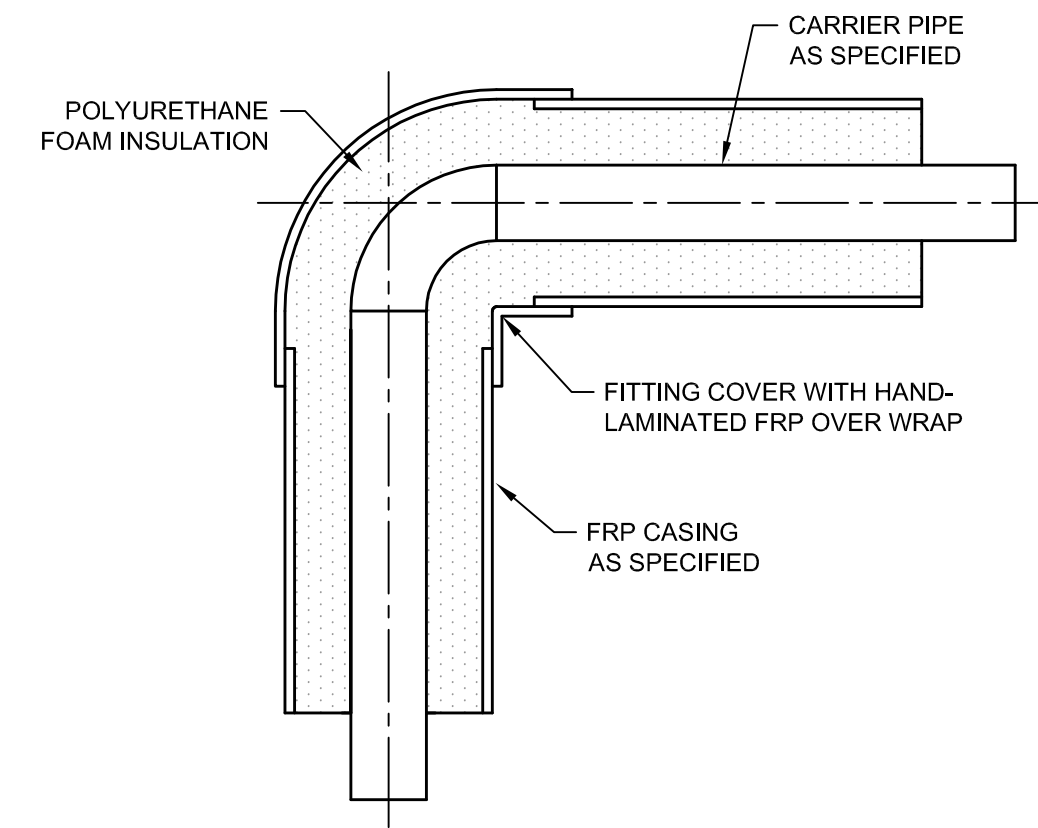


TYPICAL PIPE HANGERS
NOTE: ALL EXTERIOR PIPE HANGERS SHALL BE GALVANIZED

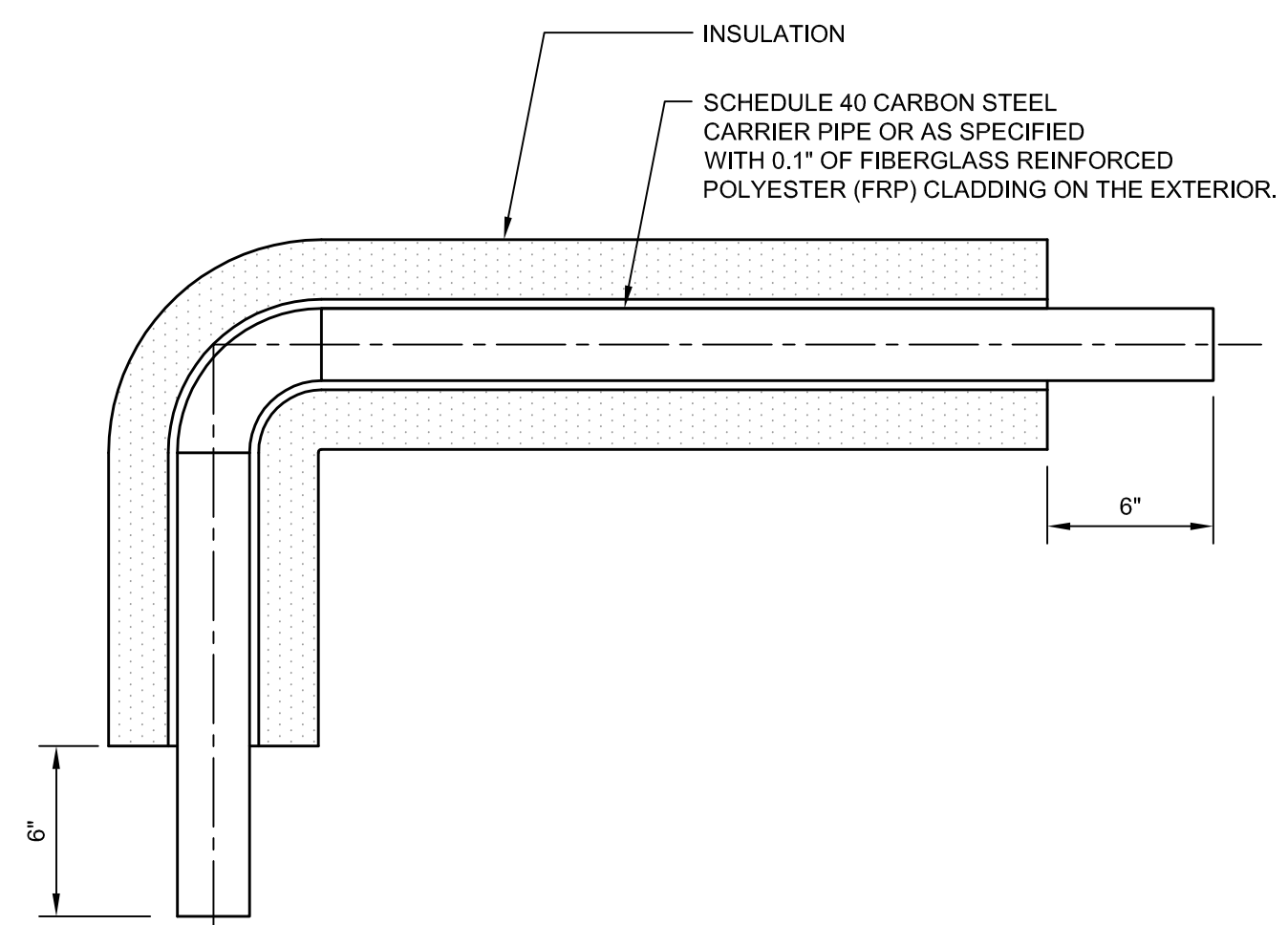
		MAXIMUM PIPE/TUBING SUPPORT SPACING																							
NOM. SIZE IN.	THRU 3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8	10	12	14	16	18	20	24							
PIPE FT.	7	7	7	9	10	11	12	14	16	17	19	22	23	25	27	28	30	32							
TUBING FT.	5 FT	6	7	8	8	9	10	12	13	14	16	-	-	-	-	-	-	-							

NOTE: FOR TRAPEZE HANGER TAKE SPACING OF SMALLEST SIZE ON TRAPEZE.

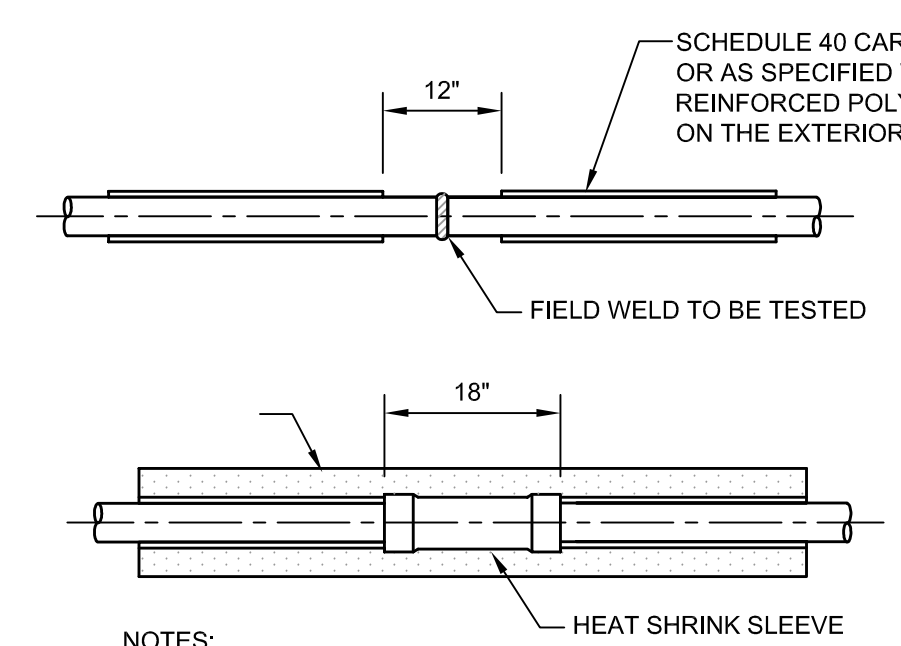
9 PIPE SUPPORT DETAIL
SCALE: NTS



6 90° EXPANSION ELBOW DETAIL
SCALE: NTS



5 PRE-FABRICATED FITTING W/ FRP CLADDING
SCALE: NTS

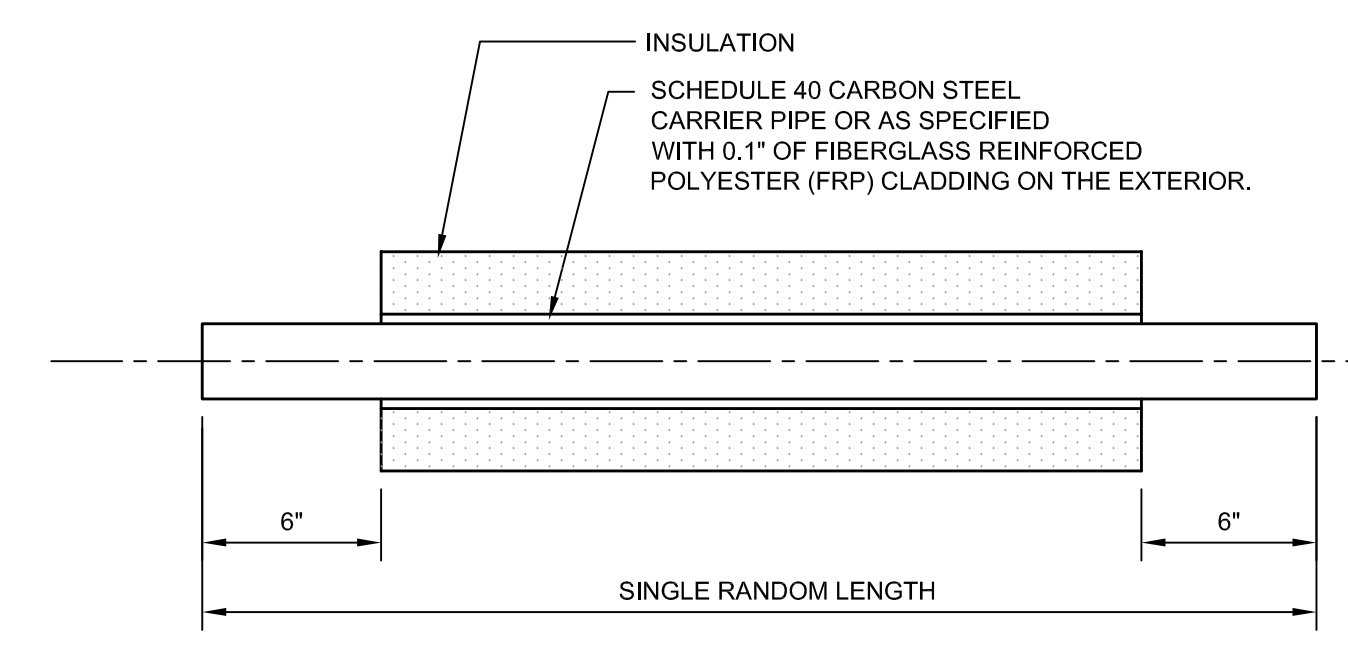


4 FIELD JOINT W/ FRP CLADDING
SCALE: NTS

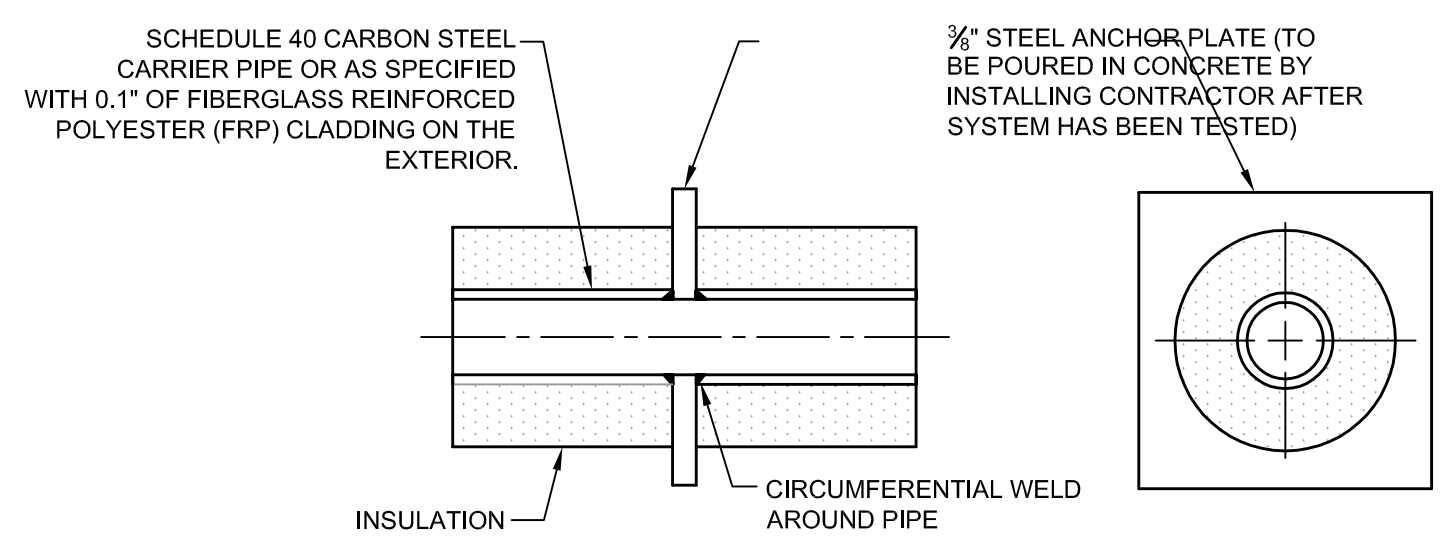
SYMBOL:	DESCRIPTION:
⊖	90° ELBOW TURNED UP
⊗	90° ELBOW TURNED DOWN
X	ANCHOR
[END SEAL (WELD, GLAND, OR HEAT SHRINK)
+	EXPANSION PIPING
+	FIELD JOINT

UNDERGROUND PIPING SPECIFICATION

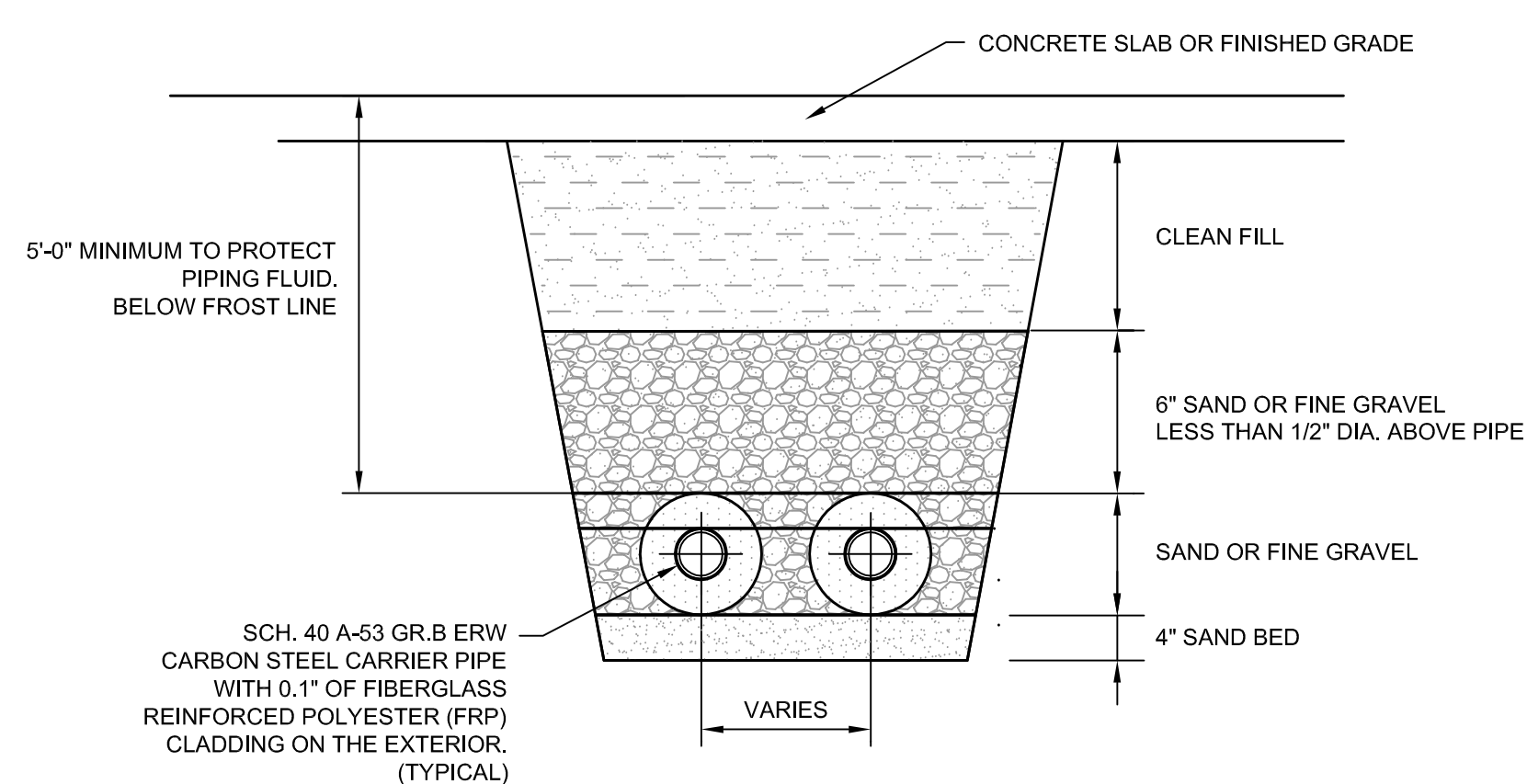
- CARRIER PIPE: SCHEDULE 40 A-53 GRADE B ERW CARBON STEEL
- FRP CLADDING: CLADDING ON STRAIGHT SECTIONS CONSIST OF MULTIPLE LAYERS OF FIBERGLASS REINFORCED PLASTIC (FRP) 90-100 MILS THICK WOUND DIRECTLY ON THE CARRIER PIPE OR OVER THE SPRAY-IN POLYURETHANE FOAM INSULATION.
- FITTINGS: PREFABRICATED FITTINGS UTILIZING BUTT WELD FITTINGS, WITH HAND LAMINATED GLASS MATT SATURATED WITH RESIN AND CATALYST TO A MINIMUM THICKNESS OF 100 MILS APPLIED DIRECTLY ONTO THE STEEL CARRIER PIPE AND FITTINGS.
- ANCHORS: PREFABRICATED UTILIZING 3/8" STEEL PLATE WELDED TO THE CARRIER PIPE. THE ANCHOR PLATE SHALL BE 6" LARGER THAN THE PIPE AND POURED IN CONCRETE BY THE INSTALLING CONTRACTOR.
- FIELD JOINTS: FIELD JOINTS SHALL CONSIST OF HAND LAY-UP FIBERGLASS MATT SATURATED WITH A RESIN AND CATALYST. THICKNESS SHALL BE 100 MILS THICK IDENTICAL TO THE STRAIGHT LENGTH SECTIONS.
- INSULATION SHALL BE 2" THICK POLYURETHANE FOAM WITH FRP CASING



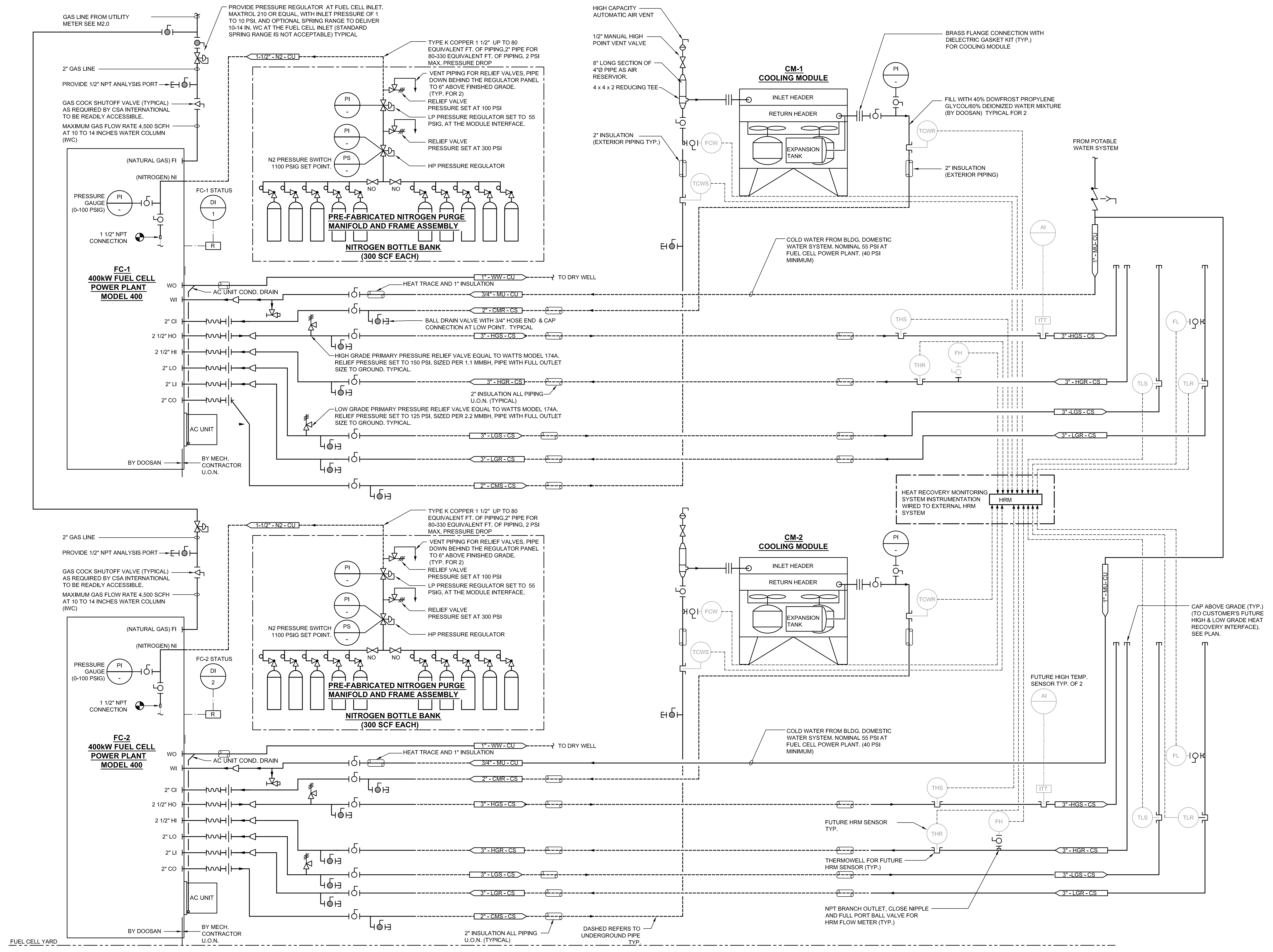
3 SINGLE RANDOM PIPE W/ FRP CLADDING
SCALE: NTS



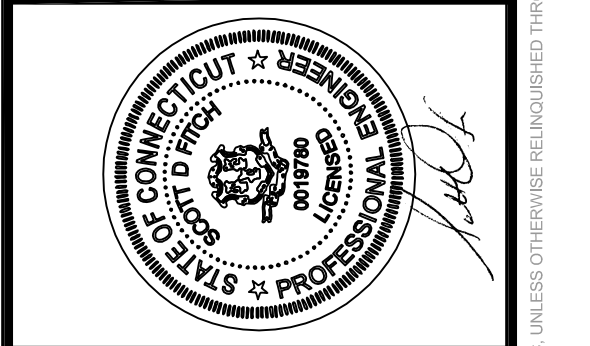
2 ANCHOR DETAILS
SCALE: NTS



1 TYPICAL TRENCH DETAIL
SCALE: NTS



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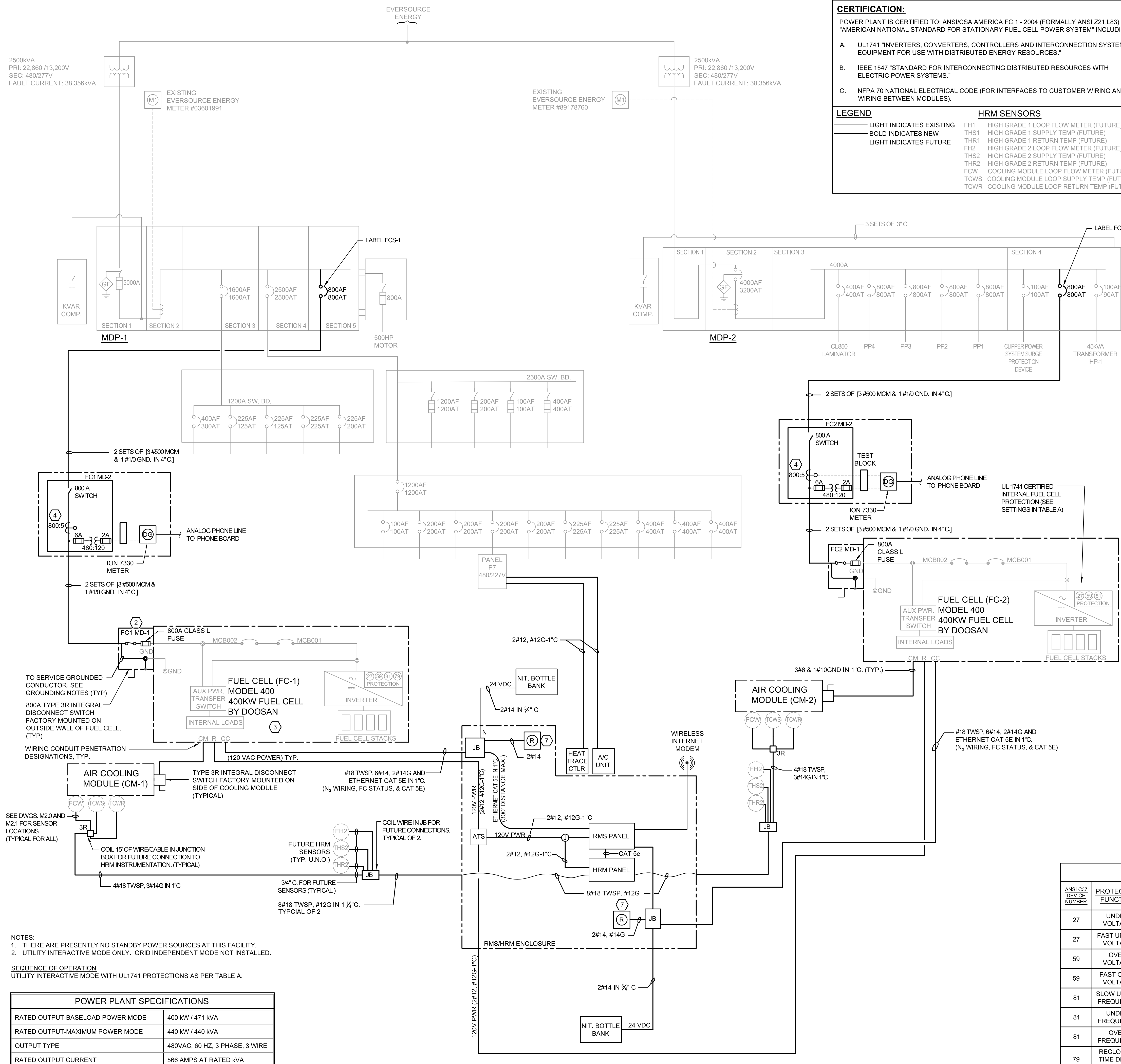
**SCHEMATIC
 PIPING & INSTRUMENTATION DIAGRAM**

Project No.:	Drawn By:
Date:	Design By:
Scale:	Check By:

Project No.:
 Drawn By: KFH
 Date: 07/06/15
 Design By: SDF
 Scale: AS NOTED
 Check By: DSF

Drawing No.:
M4.0

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CERTIFICATION:
POWER PLANT IS CERTIFIED TO: ANSICSA AMERICA FC 1 - 2004 (FORMALLY ANSI Z21.L83) "AMERICAN NATIONAL STANDARD FOR STATIONARY FUEL CELL POWER SYSTEM" INCLUDING:

- UL1741 "INVERTERS, CONVERTERS, CONTROLLERS AND INTERCONNECTION SYSTEM EQUIPMENT FOR USE WITH DISTRIBUTED ENERGY RESOURCES."
- IEEE 1547 "STANDARD FOR INTERCONNECTING DISTRIBUTED RESOURCES WITH ELECTRIC POWER SYSTEMS."
- NFPA 70 NATIONAL ELECTRICAL CODE (FOR INTERFACES TO CUSTOMER WIRING AND WIRING BETWEEN MODULES).

LEGEND
 LIGHT INDICATES EXISTING
 BOLD INDICATES NEW
 LIGHT INDICATES FUTURE

HRM SENSORS
 FH1 HIGH GRADE 1 LOOP FLOW METER (FUTURE)
 THS1 HIGH GRADE 1 SUPPLY TEMP (FUTURE)
 THR1 HIGH GRADE 1 RETURN TEMP (FUTURE)
 FH2 HIGH GRADE 2 LOOP FLOW METER (FUTURE)
 THS2 HIGH GRADE 2 SUPPLY TEMP (FUTURE)
 THR2 HIGH GRADE 2 RETURN TEMP (FUTURE)
 FCW COOLING MODULE LOOP FLOW METER (FUTURE)
 TCWS COOLING MODULE LOOP SUPPLY TEMP (FUTURE)
 TCWR COOLING MODULE LOOP RETURN TEMP (FUTURE)

SCOPE OF WORK

- PROVIDE AND INSTALL ALL NEW ELECTRICAL WORK INDICATED ON DRAWINGS UNLESS OTHERWISE NOTED, INCLUDING BUT NOT LIMITED TO THE FOLLOWING:
 - PROVIDE AND INSTALL NEW 800 AMP CIRCUIT BREAKER LISTED SUITABLE FOR BACKFEED IN SERVICE MDP-1 & MDP-2 SWITCHBOARDS, PROVIDE WARNING LABEL PER NEC 2008 ART. 692.65.B.7. CB SETTINGS TO BE FURNISHED BY ENGINEER LATER.
 - PROVIDE ALL POWER WIRING IN CONDUIT FROM CUSTOMER SWITCHGEAR TO FUEL CELL DISCONNECT - PROVIDE MEGGER TEST REPORT.
 - FUEL CELL STATUS SIGNAL, FURNISH AND INSTALL RELAY NEAR THE RMS / HRM ENCLOSURE FOR FUEL CELL STATUS FURNISH AND INSTALL SIGNAL CONDUCTORS AND CONDUIT PER THE DRAWINGS, COORDINATE SIGNAL CONNECTION REQUIREMENTS TO CUSTOMER'S BMS
 - FURNISH AND INSTALL CM POWER WIRING IN CONDUIT FROM DISCONNECT SWITCH ON CM TO FC INTERFACE AND LEAVE 15FT OF WIRE IN THE FUEL CELL FOR DOOSAN TO TERMINATE.
 - FURNISH AND INSTALL NITROGEN PRESSURE SWITCH WIRING AND CONDUIT FROM NITROGEN MANIFOLD TO THE FUEL CELL AND LEAVE 15FT OF WIRE IN THE FUEL CELL FOR DOOSAN TO TERMINATE. FURNISH AND INSTALL CONDUIT TO PRESSURE SWITCH.
 - FURNISH AND INSTALL SELF REGULATED HEAT TRACE WITH AMBIENT THERMOSTAT CALIBRATED TO TO 40°F. POWER SOURCE FOR HEAT TRACE SHALL BE AS INDICATED ON DETAIL 2/E3.0. REFER TO MECHANICAL DRAWINGS FOR PIPING LAYOUT / HEAT TRACE REQUIREMENTS AND COORDINATE WITH MECHANICAL CONTRACTOR.
 - FURNISH AND INSTALL NEMA 3R ENCLOSURE WITH HEATER/AC TO HOUSE DOOSAN PROVIDED RMS AND HRM PANELS IN FUEL CELL YARD. PROVIDE WIRING AS SHOWN.
 - FURNISH AND INSTALL CAT5E OR BETTER ETHERNET CABLES FROM THE RMS WIRELESS DIGI TO THE FC'S INTERFACE AND LEAVE 16FT FOR DOOSAN TO TERMINATE. CONTRACTOR TO VERIFY ADEQUATE CELL SIGNAL STRENGTH IS PRESENT AT PROPOSED LOCATION OF THE RMS. NOTIFY DOOSAN IMMEDIATELY IF CELLULAR SERVICE IS NOT ADEQUATE.
 - FURNISH AND INSTALL A CAT5E OR BETTER ETHERNET CABLE FROM RMS TO HRM
 - FURNISH AND INSTALL SENSOR WIRING PER DRAWINGS
 - ROUTE TEMPERATURE SENSOR AND FLOW SENSOR WIRING TO HRM BOX WITH 5FT OF EXTRA WIRE FOR HRM VENDOR TO TERMINATE
 - FURNISH AND INSTALL PULL BOXES AS REQUIRED PER NEC.
 - CONTRACTOR SHALL PROVIDE TYPED PANEL SCHEDULES FOR ALL PANELS EFFECTED BY NEW WORK.
 - FURNISH AND INSTALL NEW 20A, 480V, 1 POLE, GFP BREAKER IN EXISTING PANEL 7P FOR HEAT TRACE CIRCUIT, DETAIL 2/E3.0.
 - FIRESTOP ALL CONDUIT PENETRATIONS PER APPLICABLE CODE.
- REFERENCE DRAWING E2.0 FOR PLAN LOCATIONS AND REQUIRED SIGNAGE. ALL SIGNAGE SHALL BE ON 3 PLY PHENOLIC NAMEPLATES.
- ALL FITTINGS SHALL BE THREADED OR COMPRESSION TYPE. NO SET-SREW FITTINGS SHALL BE USED.
- CONDUIT SUPPORTS SHALL BE "U" BOLT TYPE, KINDORF OR APPLETON CLAMPS. MINIMUM 1/2" DIAMETER THREADED RODS SHALL BE USED
- ARMORED CABLES OR FLEX STEEL CONDUITS ARE NOT PERMITTED TO BE USED, WHERE TERMINATING TO EQUIPMENT THAT MOVES OR VIBRATES (IE. TRANSFORMERS) USE SEALTITE.

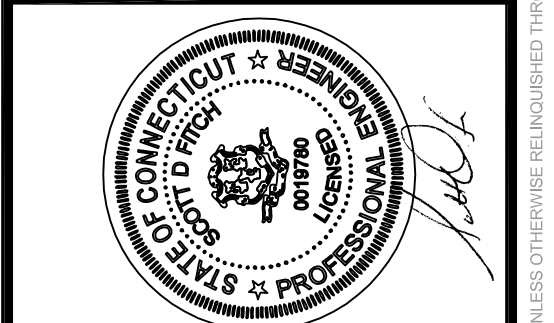
KEYED NOTES

- REFER TO DETAILS ON SHEET E3.0 FOR SCHEMATICS
- PROVIDE SIGNAGE AS INDICATED ON DWG. E2.0
- CONSULT DOOSAN MODEL 400 INSTALLATION DESIGN GUIDE (FUEL CELL POWER PLANT) AND STANDARD INSTALLATION DRAWINGS FOR TECHNICAL REFERENCE.
- UTILITY DG METER (DG) (FURNISHED AND INSTALLED BY CONTRACTOR) MANUFACTURER / MODEL : ION 7330 METER IN CUSTOM METER CABINET (SEE EATON DWGS. - CLASP (1) SWITCH & METER SHT. 1&2) COORDINATE DISCONNECT LINE AND LOAD LUGS CONFIGURATION BASED UPON CONDUCTOR SIZES AND QUANTITIES ON THIS DWG. CT: GE MODEL 110-801, 800.5 PT: INSTRUMENT TRANSFORMERS, INC., MODEL: 450-480FF, 480-120
- NOT USED
- TEST BLOCK - ABB TYPE FT-1, PIN: 129A514G01 (TYPICAL FOR ALL)
- CONTRACTOR PROVIDED INTERPOSING RELAY MOUNTED IN ENCLOSURE. DRY CONTACT SHALL BE USED TO DETERMINE FUEL CELL AVAILABLE HEAT. SEE DETAIL 1/E3.0

GROUNDING NOTES

- THE FUEL CELL GROUND LUG INSIDE DISCONNECT SWITCH MD-1 SHALL BE CONNECTED TO AN EXTERNAL #10 COPPER EQUIPMENT GROUNDING CONDUCTOR FROM MAIN SWITCHBOARD'S GROUNDING CONDUCTOR PER NEC ART 692.44. IN ORDER TO PROVIDE THE REQUIRED SINGLE POINT GROUND PER NEC ART 250.24 A & D.
- NOTE THAT THE FUEL CELL GROUND LUG INSIDE MD-1 IS BONDED TO ALL METALLIC NON-CURRENT CARRYING METAL PARTS BOTH INSIDE THE FUEL CELL AND ALSO AT EXTERNAL FUEL CELL ASSEMBLIES SUCH AS THE COOLING MODULE, SO ALL FUEL CELL PARTS ARE CONNECTED TO THE EQUIPMENT GROUNDING CONDUCTOR AS REQUIRED BY ART. 250.110.
- NOTE ALSO THAT THERE IS TO BE NO OTHER GROUNDING ELECTRODE AT THE FUEL CELL OR ANY OF ITS EXTERNAL SUBASSEMBLIES SUCH AS THE COOLING MODULE. ALL OF THE SUBASSEMBLIES ARE TO BE CONNECTED TO THE EQUIPMENT GROUNDING CONDUCTOR INCLUDED WITH THE CIRCUIT CONDUCTORS FROM THE FUEL CELL PER ART. 250.134.B. WHERE THE FUEL CELL GROUND LUG IN MD-1 CARRIES THESE GROUND WIRES BACK TO THE GROUNDING SERVICE CONDUCTOR AT THE MAIN SWITCHBOARD.
- ANY SUBASSEMBLY ELECTRICAL PANELS CONNECTED TO THE FUEL CELL SHALL BE GROUND TO THE EQUIPMENT GROUNDING CONDUCTOR FROM THE FUEL CELL PER ART 250.148 AND SHALL NOT HAVE THEIR OWN GROUND ELECTRODE.

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 ELECTRICAL ONE-LINE DIAGRAM

Project No.:	Drawn By:
Date:	Design By:
Scale:	Check By:
Drawing No.:	

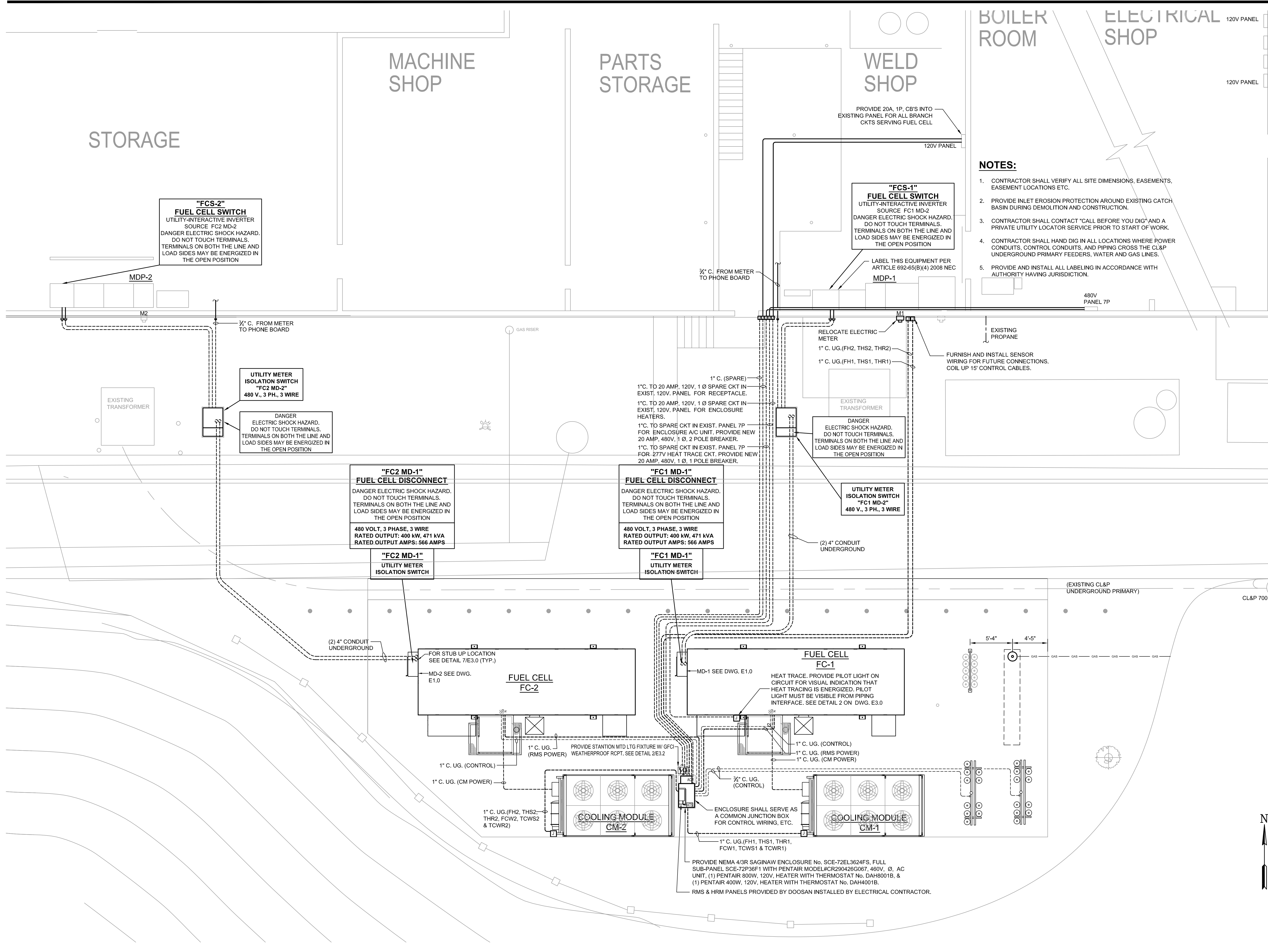
E1.0

NOTES:
 1. THERE ARE PRESENTLY NO STANDBY POWER SOURCES AT THIS FACILITY.
 2. UTILITY INTERACTIVE MODE ONLY. GRID INDEPENDENT NOT INSTALLED.

SEQUENCE OF OPERATION
 UTILITY INTERACTIVE MODE WITH UL1741 PROTECTIONS AS PER TABLE A.

POWER PLANT SPECIFICATIONS	
RATED OUTPUT-BASELOAD POWER MODE	400 kW / 471 kVA
RATED OUTPUT-MAXIMUM POWER MODE	440 kW / 440 kVA
OUTPUT TYPE	480VAC, 60 HZ, 3 PHASE, 3 WIRE
RATED OUTPUT CURRENT	566 AMPS AT RATED KVA

NOTE: THESE ARE SETTINGS INTERNAL TO THE FUEL CELL. BASE VOLTAGES ARE THE NORMAL SYSTEM VOLTAGES STATED IN ANSI C84.1-1995



"FCS-2"
FUEL CELL SWITCH
 UTILITY-INTERACTIVE INVERTER
 SOURCE FC2 MD-2
 DANGER ELECTRIC SHOCK HAZARD.
 DO NOT TOUCH TERMINALS.
 TERMINALS ON BOTH THE LINE AND
 LOAD SIDES MAY BE ENERGIZED IN
 THE OPEN POSITION

"FCS-1"
FUEL CELL SWITCH
 UTILITY-INTERACTIVE INVERTER
 SOURCE FC1 MD-2
 DANGER ELECTRIC SHOCK HAZARD.
 DO NOT TOUCH TERMINALS.
 TERMINALS ON BOTH THE LINE AND
 LOAD SIDES MAY BE ENERGIZED IN
 THE OPEN POSITION

**UTILITY METER
 ISOLATION SWITCH
 "FC2 MD-2"**
 480 V., 3 PH., 3 WIRE

 DANGER
 ELECTRIC SHOCK HAZARD.
 DO NOT TOUCH TERMINALS.
 TERMINALS ON BOTH THE LINE AND
 LOAD SIDES MAY BE ENERGIZED IN
 THE OPEN POSITION

**DANGER
 ELECTRIC SHOCK HAZARD.
 DO NOT TOUCH TERMINALS.
 TERMINALS ON BOTH THE LINE AND
 LOAD SIDES MAY BE ENERGIZED IN
 THE OPEN POSITION**

"FC2 MD-1"
FUEL CELL DISCONNECT
 DANGER ELECTRIC SHOCK HAZARD.
 DO NOT TOUCH TERMINALS.
 TERMINALS ON BOTH THE LINE AND
 LOAD SIDES MAY BE ENERGIZED IN
 THE OPEN POSITION

 480 VOLT, 3 PHASE, 3 WIRE
 RATED OUTPUT: 400 kW, 471 KVA
 RATED OUTPUT AMPS: 566 AMPS

"FC1 MD-1"
FUEL CELL DISCONNECT
 DANGER ELECTRIC SHOCK HAZARD.
 DO NOT TOUCH TERMINALS.
 TERMINALS ON BOTH THE LINE AND
 LOAD SIDES MAY BE ENERGIZED IN
 THE OPEN POSITION

 480 VOLT, 3 PHASE, 3 WIRE
 RATED OUTPUT: 400 kW, 471 KVA
 RATED OUTPUT AMPS: 566 AMPS

"FC2 MD-1"
**UTILITY METER
 ISOLATION SWITCH**
 480 V., 3 PH., 3 WIRE

"FC1 MD-1"
**UTILITY METER
 ISOLATION SWITCH**
 480 V., 3 PH., 3 WIRE

**FUEL CELL
 FC-2**
 FOR STUB UP LOCATION
 SEE DETAIL 7/E3.0 (TYP.)
 MD-2 SEE DWG. E1.0

**FUEL CELL
 FC-1**
 MD-1 SEE DWG. E1.0
 HEAT TRACE. PROVIDE PILOT LIGHT ON
 CIRCUIT FOR VISUAL INDICATION THAT
 HEAT TRACING IS ENERGIZED. PILOT
 LIGHT MUST BE VISIBLE FROM PIPING
 INTERFACE. SEE DETAIL 2 ON DWG. E3.0

**COOLING MODULE
 CM-2**

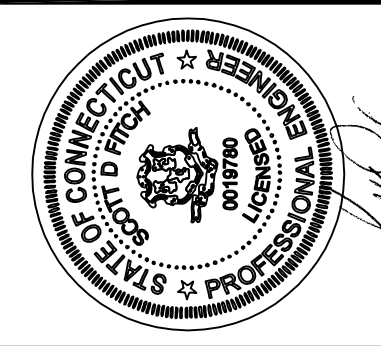
**COOLING MODULE
 CM-1**

PROVIDE NEMA 4/3R SAGINAW ENCLOSURE No. SCE-72EL3624FS, FULL
 SUB-PANEL SCE-72P36F1 WITH PENTAIR MODEL MCR290428G067, 480V, Ø, AC
 UNIT, (1) PENTAIR 800W, 120V, HEATER WITH THERMOSTAT No. DAH6001B, &
 (1) PENTAIR 400W, 120V, HEATER WITH THERMOSTAT No. DAH4001B.
 RMS & HRM PANELS PROVIDED BY DOOSAN INSTALLED BY ELECTRICAL CONTRACTOR.

NOTES:

- CONTRACTOR SHALL VERIFY ALL SITE DIMENSIONS, EASEMENTS, EASEMENT LOCATIONS ETC.
- PROVIDE INLET EROSION PROTECTION AROUND EXISTING CATCH BASIN DURING DEMOLITION AND CONSTRUCTION.
- CONTRACTOR SHALL CONTACT "CALL BEFORE YOU DIG" AND A PRIVATE UTILITY LOCATOR SERVICE PRIOR TO START OF WORK.
- CONTRACTOR SHALL HAND DIG IN ALL LOCATIONS WHERE POWER CONDUITS, CONTROL CONDUITS, AND PIPING CROSS THE CL&P UNDERGROUND PRIMARY FEEDERS, WATER AND GAS LINES.
- PROVIDE AND INSTALL ALL LABELING IN ACCORDANCE WITH AUTHORITY HAVING JURISDICTION.

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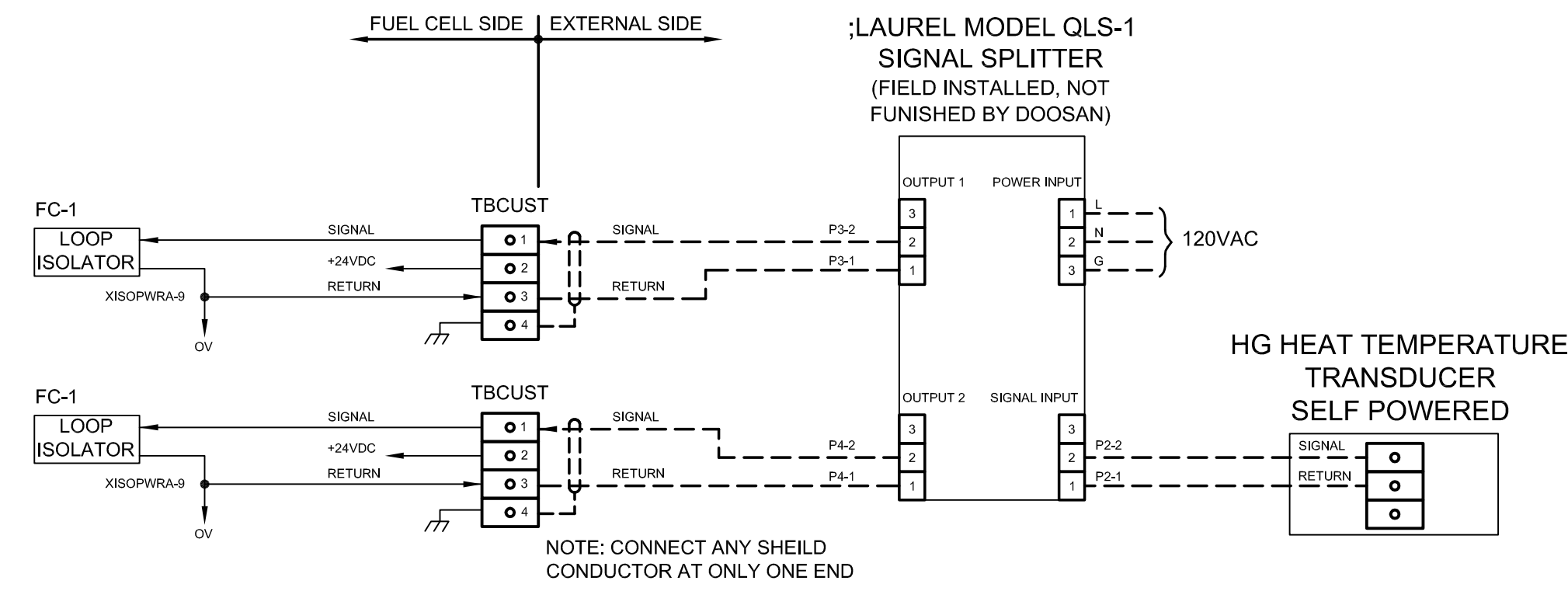
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5 MULTIPLE POWER PLANT CONNECTION FOR HG HEAT TEMPERATURE TRANSDUCER WITH EXTERNAL POWER SOURCE (SELF POWERED TRANSDUCER)
SCALE: NTS

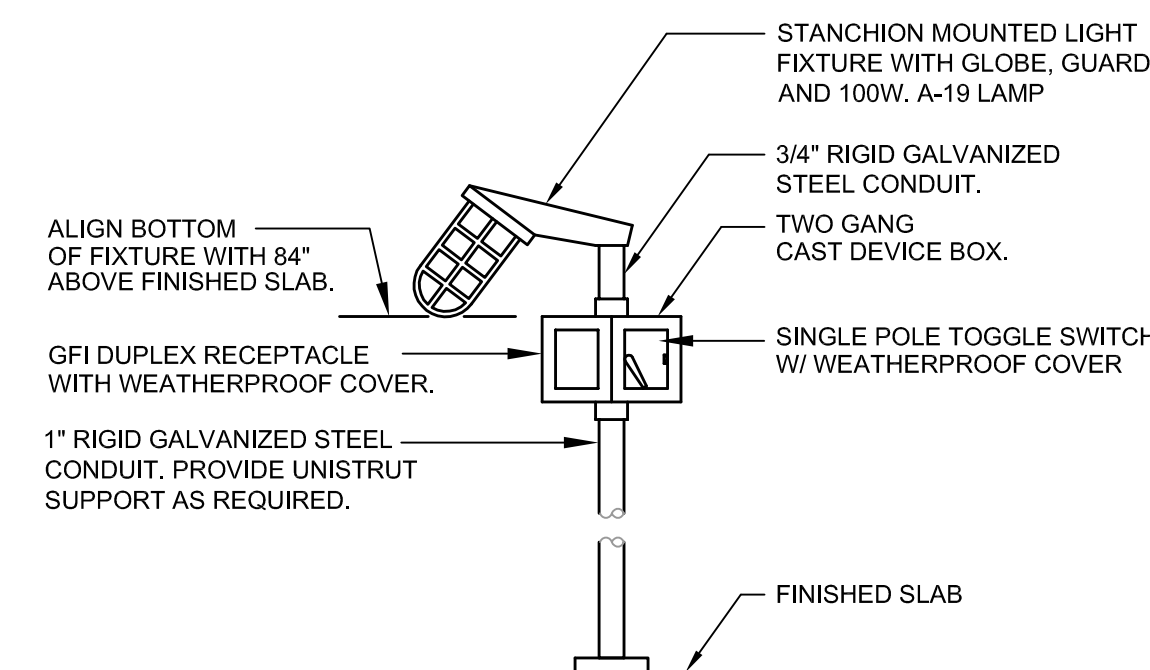
5

4 NOT USED
SCALE: NTS

4

3 NOT USED
SCALE: NTS

3



2 STANCHION MOUNTED LIGHT/RECEPTACLE
SCALE: NTS

2

1 NOT USED
SCALE: NTS

1

ELECTRICAL SEQUENCE OF OPERATION: GRID CONNECT ONLY

CONFIGURATION OVERVIEW: THE PURECELL MODEL 400 IS A 400KW/471 KVA "DUAL MODE" FUEL CELL THAT CAN OPERATE EITHER GRID-INTERACTIVE OR GRID-INDEPENDENT. AT AMGRAPH PACKAGING IT WILL BE EMPLOYED ONLY AS GRID CONNECTED. THERE ARE (2) CL&P SERVICE FEEDERS AT THIS SITE. FUEL CELL FC-1 WILL HAVE ITS 3 PHASE, 3 WIRE 480 VOLT AC GRID OUTPUT TERMINALS CONNECTED THROUGH A NEW 480/208 VOLT 800AMP CIRCUIT BREAKER IN THE CUSTOMER'S EXISTING 5000 AMP MAIN SERVICE SWITCHGEAR #1. FUEL CELL FC-2 WILL HAVE ITS 3 PHASE, 3 WIRE 480 VOLT AC GRID OUTPUT TERMINALS CONNECTED THROUGH A NEW 480/208 VOLT 800AMP CIRCUIT BREAKER IN THE CUSTOMER'S EXISTING 4000 AMP MAIN SERVICE SWITCHGEAR #2.

A BECKWITH MODEL 3520 PROTECTION RELAY INSTALLED ADJACENT TO MDP-2 TO PREVENT EXPORT POWER IN EXCESS OF 420KW (ADJ.) TO CL&P'S NETWORK (FUNCTION 32) AS WELL AS PROVIDE VOLTAGE AND FREQUENCY PROTECTION (27, 59, 81, 79) WHICH IS REDUNDANT WITH THE FUEL CELL'S UL1741 CERTIFIED GRID PROTECTION. SUMMING CT'S SHALL BE UTILIZED TO SUM THE CURRENT AT MDP-1 & MDP-2 AND PROVIDE AN INPUT INTO THE BECKWITH 3520 RELAY.

A LOAD FOLLOWING CONTROL SCHEME SHALL BE INSTALLED TO LIMIT THE KW EXPORT TO CL&P (100KW). THIS SCHEME WILL BE IMPLEMENTED BY USING A KYZ TO mA CONVERTER WHICH WILL CONVERT THE SUM OF THE UTILITY METERS TO A 4-20mA LOAD FOLLOWING SIGNAL TO THE FUEL CELL, AND ITS IMPORT/EXPORT KW OUTPUT IS SUPPLIED TO THE FUEL CELL WHICH WILL REGULATE ITS KW OUTPUT DISPATCH TO KEEP THE KW IMPORT AT THE PCC WITHIN A PRESET VALUE BASED UPON THE LARGEST LOAD IN THE BUILDING

ITS 3 PHASE, 3 WIRE GRID-INDEPENDENT TERMINALS ARE NOT USED

STARTUP: DURING STARTUP, THE PURECELL MODEL 400 CONSUMES APPROXIMATELY 158KW (APPROX. 70 KW AVERAGE) OF 480 VOLT 3 PHASE POWER FOR 5 HOURS THROUGH ITS GRID OUTPUT TERMINALS, WHICH ALSO SERVE AS INPUT TERMINALS DURING STARTUP.

GRID-CONNECTED OPERATION: ONCE STARTED IN GRID-CONNECTED OPERATING MODE, EACH FUEL CELL DELIVERS UP TO 400 KW CONTINUOUSLY THROUGH ITS OUTPUT TERMINALS TO 90 VERSAILLES ROAD. ALL OF THE POWER WILL BE CONSUMED BY THE BUILDING LOADS. THE LOAD FOLLOWING CONTROL (SEE ABOVE) WILL ADJUST THE FUEL CELL OUTPUT TO ALLOW A MAXIMUM OF 100KW EXPORT TO CL&P. IF FOR SOME REASON THE LOAD FOLLOWING CONTROL DID NOT KEEP THE KW EXPORT BELOW 100KW AS INTENDED, THE BECKWITH M3520 REVERSE POWER RELAY WILL TRIP THE FUEL CELLS OFF-LINE; DISCONNECTING THEM FROM THE CL&P GRID.

THE FUEL CELL IS INVERTER BASED AND WILL AUTOMATICALLY SYNCHRONIZE TO THE UTILITY GRID.

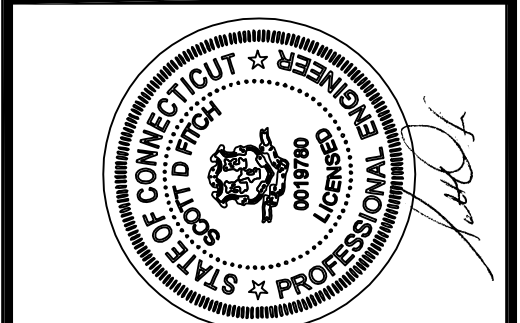
NOTE THAT THE INTENDED OPERATION FOR POWER FACTOR WILL BE 1.0 (UNITY)

LOSS OF UTILITY SUPPLY: UPON LOSS OF UTILITY SUPPLY, BOTH THE FUEL CELL'S UL1741 CERTIFIED INTERNAL GRID PROTECTION AND ALSO THE BECKWITH PROTECTION RELAY WILL DETECT THE UTILITY LOSS AND TRIP THE FUEL CELL OUTPUT BREAKER MCB001. THE FUEL CELL WILL THEN GO TO IDLE MODE WHERE IT IS PRODUCING ELECTRICITY FOR ITS INTERNAL LOADS.

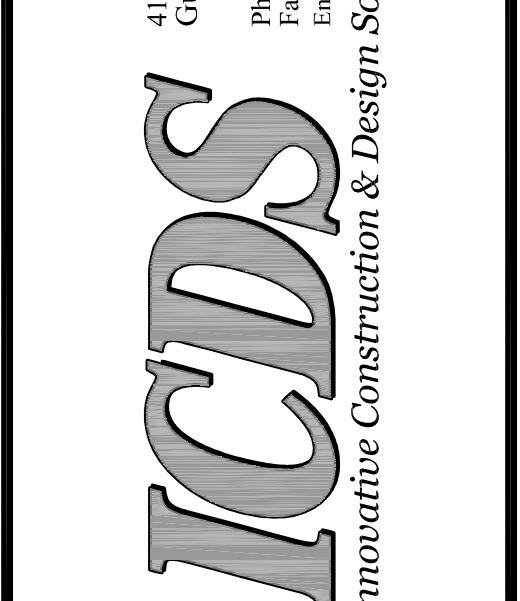
RETURN TO GRID CONNECTED MODE: UPON RETURN OF THE GRID SUPPLY AND RESET OF THE EXTERNAL BECKWITH RELAY FUNCTION 79 (5 MINUTE RECONNECT DELAY), THE FUEL CELL WILL AUTOMATICALLY RETURN TO GRID CONNECTED OPERATION AFTER A 5 MINUTE DELAY. IT WILL RECONNECT INITIALLY AT ZERO POWER AND RAMP BACK TO FULL POWER AT 10KW/SEC. NOTE THAT SYNCHRONIZATION IS PERFORMED BY THE UL1741 CERTIFIED INVERTER PROTECTION/CONTROLS

SHUTDOWN: UPON OPERATOR SELECTION OF A MANUAL SHUTDOWN, OR AUTOMATIC SHUTDOWN DUE TO CERTAIN INTERNAL POWER PLANT PROTECTION EQUIPMENT, THE POWER PLANT WILL CEASE PRODUCING ELECTRICAL POWER. ITS GENERATOR OUTPUT BREAKER MCB001 WILL OPEN AND THE GAS SUPPLY WILL SHUT OFF. AT THIS POINT THE POWER PLANT BEINGS AN AUTOMATIC "COOL DOWN" DURING WHICH THE CSA COOLANT TEMPERATURE IS REDUCED FROM ITS 350 DEGREE OPERATING TEMPERATURE BACK TO ITS 130 DEGREE STANDBY TEMPERATURE. COOL DOWN IS ACCOMPLISHED BY REJECTING HEAT TO THE POWER PLANT COOLING MODULE. DURING THIS COOL DOWN, THE POWER PLANT WILL CONSUME ABOUT 6 TO 25 KW OF PARASITE POWER FOR ITS COOLING PUMPS, ELECTRIC HEATERS, AND CONTROLS.

SERVICING: OCCASIONALLY, WHEN SERVICING THE FUEL CELL, EXTERNAL GRID POWER MUST BE DISCONNECTED BY OPENING THE DISCONNECT SWITCH MD-1 INSTALLED ON THE SIDE OF THE FUEL CELL.



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ELECTRICAL
DETAILS AND DIAGRAMS

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BASIC ELECTRICAL REQUIREMENTS

A. NOTES

- DRAWINGS AND GENERAL PROVISIONS OF CONTRACT, INCLUDING GENERAL AND SUPPLEMENTARY CONDITIONS AND ALL OTHER SPECIFICATION SECTIONS, APPLY TO THIS SECTION.
- THE CONTRACTOR FOR THIS WORK IS REQUIRED TO READ THE SPECIFICATIONS AND REVIEW DRAWINGS FOR ALL DIVISIONS OF WORK AND IS RESPONSIBLE FOR THE COORDINATION OF THIS WORK AND THE WORK OF ALL DIVISIONS. IT IS THIS CONTRACTOR'S RESPONSIBILITY TO PROVIDE SUBCONTRACTORS WITH A COMPLETE SET OF BID DOCUMENTS.
- THE CONTRACTOR IS RESPONSIBLE FOR SCHEDULING THE COMPLETION AND INSPECTION OF THIS WORK AND THE SUBCONTRACTORS WORK TO COMPLY WITH OWNER'S SCHEDULE AND THE PROJECT COMPLETION DATE.
- THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTAL OF BID TO DETERMINE CONDITIONS AFFECTING THE WORK. ANY ITEMS WHICH ARE NOT COVERED IN THE BID DOCUMENTS OR ANY PROPOSED SUBSTITUTIONS SHALL BE LISTED SEPARATELY AND QUALIFIED IN THE CONTRACTOR'S BID. SUBMITTAL OF BID SHALL SERVE AS EVIDENCE OF KNOWLEDGE OF EXISTING CONDITIONS AND ANY MODIFICATIONS WHICH ARE REQUIRED TO MEET THE INTENT OF THE DRAWINGS AND SPECIFICATIONS. FAILURE TO VISIT THE SITE DOES NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY IN PERFORMANCE OF WORK.

B. GENERAL REQUIREMENTS

- THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, EQUIPMENT, SERVICES, TOOLS, TRANSPORTATION, INCIDENTALS AND DETAILS NECESSARY TO PROVIDE COMPLETE ELECTRICAL SYSTEMS AS SHOWN ON THE DRAWINGS, CALLED FOR IN THE SPECIFICATIONS, AND AS REQUIRED BY JOB CONDITIONS. ALL WORK NOT SPECIFICALLY NOTED AS BEING BY POWER COMPANY SHALL BE PROVIDED BY THE ELECTRICAL CONTRACTOR. CLOSELY COORDINATE THE ENTIRE INSTALLATION WITH THE POWER COMPANY AND WITH DOOSAN AS REQUIRED. FURNISH AND INSTALL EQUIPMENT THAT IS RATED FOR AVAILABLE FAULT CURRENT LEVELS. FURNISH AND INSTALL "CABLE LIMITERS" IF NECESSARY TO LIMIT FAULT CURRENT. FIELD VERIFY THE EXACT TYPE, SIZE, LOCATION, REQUIREMENTS, ETC. OF EXISTING POWER AND TELEPHONE FACILITIES PRIOR TO SUBMISSION OF BID.
- ALL MATERIALS, PRODUCTS, AND EQUIPMENT, INCLUDING ALL COMPONENTS THEREOF, SHALL BE NEW, RECONDITIONED OR RE-CERTIFIED EQUIPMENT SHALL NOT BE USED UNLESS SPECIFICALLY APPROVED BY DOOSAN. EQUIPMENT SHALL BE UNDERWRITERS LABORATORIES LISTED FOR ITS APPLICATION, AND BEAR THE UL LABEL. EQUIPMENT SHALL BE SIZED IN CONFORMITY WITH REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE, STATE AND LOCAL CODES, WHICHEVER IS MORE STRINGENT.
- THE DRAWINGS AND SPECIFICATIONS ARE INTENDED TO SUPPLEMENT EACH OTHER AND ANY MATERIAL OR LABOR CALLED FOR IN ONE SHALL BE PROVIDED EVEN THOUGH NOT SPECIFICALLY MENTIONED IN BOTH. ANY MATERIAL OR LABOR WHICH IS NEITHER SHOWN ON THE DRAWINGS NOR CALLED FOR IN THE SPECIFICATIONS, BUT WHICH IS OBVIOUSLY NECESSARY TO COMPLETE THE WORK OR WHICH IS USUALLY INCLUDED IN WORK OF SIMILAR CHARACTER, SHALL BE PROVIDED AS PART OF CONTRACT.
- WHERE THE DRAWINGS OR SPECIFICATIONS CALL FOR ITEMS WHICH EXCEED CODES, THE CONTRACTOR IS RESPONSIBLE FOR FURNISHING AND INSTALLING THE SYSTEM WITH THE MORE STRINGENT REQUIREMENTS AS DESIGNED AND DESCRIBED ON THESE DRAWINGS, UNLESS NOTED OTHERWISE.
- ALL ELECTRICAL WORK SHALL BE INSTALLED SO AS TO BE READILY ACCESSIBLE FOR OPERATING, SERVICING, MAINTAINING AND REPAIRING. THIS CONTRACTOR IS RESPONSIBLE FOR PROVIDING SUFFICIENT SERVICE ACCESS TO ALL EQUIPMENT.
- THE CONTRACTOR SHALL DO ALL CUTTING, CHASING, OR CHANNELING AND PATCHING REQUIRED FOR ANY WORK UNDER THIS DIVISION. ALL CUTTING SHALL HAVE PRIOR APPROVAL BY THE OWNER. ALL PATCHING IS TO MATCH SURROUNDING SURFACES.
- THE CONTRACTOR SHALL MAKE ALL FINAL ELECTRICAL CONNECTIONS AS REQUIRED FOR A COMPLETE AND OPERATING SYSTEM.

C. TEMPORARY LIGHT AND POWER

- THE CONTRACTOR SHALL FURNISH AND INSTALL ALL TEMPORARY WIRING AND RELATED GROUND FAULT PROTECTION FOR LIGHT AND FOR ALL CONTRACTORS POWER REQUIREMENTS AND IS RESPONSIBLE FOR ITS REMOVAL.

D. CODES

- ALL WORK SHALL BE PERFORMED IN A NEAT AND PROFESSIONAL MANNER AND CONFORM TO THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE, THE STATES, COUNTY'S, CITY'S AND LOCAL CODES AND ORDINANCES, SAFETY AND HEALTH CODES, NFPA CODES, ENERGY CODES, AND ALL OTHER APPLICABLE CODES AND REQUIREMENTS. THE CONTRACTOR SHALL INQUIRE INTO AND COMPLY WITH ALL APPLICABLE CODES, ORDINANCES, AND REGULATIONS. THE CONTRACTOR SHALL INCLUDE ANY CHANGES REQUIRED BY CODES IN THE BID AND IF THESE CHANGES ARE NOT INCLUDED IN THE BID, THEY MUST BE QUALIFIED AS A SEPARATE LINE ITEM IN THE BID. AFTER CONTRACT IS ISSUED, NO ADDITIONAL COST DUE TO CODE ISSUES SHALL BE REIMBURSED TO THE CONTRACTOR.

E. LICENSES, PERMITS, INSPECTIONS AND FEES

- THE CONTRACTOR SHALL OBTAIN AND PAY FOR ALL LICENSES, PERMITS, INSPECTIONS, AND FEES REQUIRED OR RELATED TO HIS WORK.
- FURNISH TO OWNER ALL CERTIFICATES OF INSPECTION AND FINAL INSPECTION APPROVAL AT COMPLETION OF PROJECT.

F. TRADE NAMES, MANUFACTURERS AND SHOP DRAWINGS

- WHERE TRADE NAMES AND MANUFACTURERS ARE USED ON THE DRAWINGS OR IN THE SPECIFICATIONS, THE EXACT EQUIPMENT SHALL BE USED AS A MINIMUM FOR THE BASE BID. MANUFACTURERS CONSIDERED AS AN EQUAL OR BETTER IN ALL ASPECTS TO THAT SPECIFIED WILL BE SUBJECT TO APPROVAL. IN WRITING, THROUGH SHOP DRAWING SUBMITTAL PROCESS, BY THE CONSTRUCTION MANAGER PRIOR TO ACCEPTANCE. THE USE OF ANY UNAUTHORIZED EQUIPMENT SHALL BE SUBJECT TO REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.
- THE CONTRACTOR SHALL PROVIDE SUBMITTALS FOR ALL EQUIPMENT TO DOOSAN/OWNER FOR APPROVAL. SUBMISSIONS SHALL BE MADE EARLY ENOUGH IN PROJECT TO ALLOW FOUR (10) WORKING DAYS FOR DOOSAN AND ENGINEER REVIEW WITHOUT CAUSING DELAYS OR CONFLICTS TO THE JOB'S PROGRESS. SUBMITTALS SHALL BEAR THE STAMP OF THE ARCHITECT/ENGINEER OFFICE AND SUB-CONTRACTOR SHOWING THAT HE HAS REVIEWED AND CONFIRMED THAT THE SUBMITTALS ARE IN CONFORMANCE WITH THE CONTRACT DRAWINGS AND SPECIFICATIONS OR INDICATE WHERE EXCEPTIONS HAVE BEEN TAKEN.

G. GUARANTEE

- THE CONTRACTOR SHALL GUARANTEE ALL MATERIALS AND WORK PROVIDED UNDER HIS CONTRACT AND SHALL MAKE GOOD, REPAIR OR REPLACE AT HIS OWN EXPENSE, ANY DEFECTIVE WORK, MATERIAL, REQUIREMENT WHICH MAY BE DISCOVERED WITHIN A PERIOD OF 12 MONTHS FROM THE DATE OF ACCEPTANCE (IN WRITING) OF THE INSTALLATION BY THE CEP/OWNER. EXTENDED WARRANTIES ARE SPECIFIED WITH INDIVIDUAL EQUIPMENT.

H. RECORD DRAWINGS

- THE CONTRACTOR SHALL MAINTAIN ONE COPY OF DRAWINGS ON THE JOB SITE TO RECORD DEVIATIONS FROM CONTRACT DRAWINGS, SUCH AS:
 - LOCATION OF JUNCTION BOXES AND RECEPTACLES,
 - LOCATION OF ALL HOMERUNS SHOWING WIRE/CONDUIT SIZES,
 - REVISIONS, ADDENDUMS, AND CHANGE ORDERS,
 - SIGNIFICANT DEVIATIONS MADE NECESSARY BY FIELD CONDITIONS, APPROVED EQUIPMENT SUBSTITUTIONS, AND CONTRACTOR'S COORDINATION WITH OTHER TRADES.
- AT COMPLETION OF PROJECT AND BEFORE FINAL APPROVAL, THE CONTRACTOR SHALL MAKE ANY FINAL CORRECTIONS TO DRAWINGS AND CERTIFY THE ACCURACY OF EACH PRINT BY SIGNATURE THEREON.
- A COPY OF THESE ASBUILT DRAWINGS WILL BE GIVEN TO DOOSAN / OWNER.

I. DISCREPANCIES IN DOCUMENTS

- DRAWINGS (PLANS, SPECIFICATIONS, AND DETAILS) ARE DIAGRAMMATICAL AND INDICATE THE GENERAL LOCATION AND INTENT OF THE ELECTRICAL SYSTEMS. WHERE DRAWINGS, EXISTING SITE CONDITIONS, SPECIFICATIONS OR OTHER TRADES CONFLICT OR ARE UNCLEAR, ADVISE THE CONSTRUCTION MANAGER IN WRITING PRIOR TO SUBMITTAL OF BID. OTHERWISE, OWNER'S INTERPRETATION OF CONTRACT DOCUMENTS OR COMMENTS SHALL BE FINAL WITH NO ADDITIONAL COMPENSATION PERMITTED.
- THE LOCATION OF OUTLETS AND EQUIPMENT SHOWN ON THE DRAWINGS ARE APPROXIMATE AND SCHEMATIC IN NATURE. OWNER SHALL HAVE THE RIGHT TO RELOCATE ANY OUTLETS OR FIXTURES BEFORE THEY ARE INSTALLED WITHOUT ADDITIONAL COST.
- HOMERUNS SHOWN ARE SCHEMATIC. ELECTRICAL CONTRACTOR MAY ORIGINATE HOMERUNS FROM DIFFERENT LOCATIONS.

J. DEMOLITION

- THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COORDINATION OF EQUIPMENT REMOVAL AND EXISTING WORK. COORDINATE WITH OWNER, EXISTING EQUIPMENT REQUIRED TO BE LEFT INTACT.

K. SLEEVES

- THE CONTRACTOR SHALL PROVIDE SLEEVES TO PROTECT EQUIPMENT OR FACILITIES IN THE INSTALLATION. EACH SLEEVE SHALL EXTEND THROUGH ITS RESPECTIVE FLOOR, WALL OR PARTITION AND SHALL BE CUT FLUSH WITH EACH SURFACE EXCEPT SLEEVES THAT PENETRATE THE FLOOR, WHICH SHALL EXTEND 4" ABOVE THE FLOOR.
- ALL SLEEVES AND OPENINGS THROUGH FIRE RATED WALLS AND/OR FLOORS SHALL BE FIRE SEALED WITH CALCIUM SILICATE, SILICONE "RTV" FOAM, "3M" FIRE RATED SEALANTS OR EQUAL, SO AS TO RETAIN THEIR FIRE RATING.
- SLEEVES IN BEARING AND MASONRY WALLS, FLOORS AND PARTITIONS SHALL BE STANDARD WEIGHT STEEL PIPE FINISHED WITH SMOOTH EDGES. FOR OTHER THAN MASONRY PARTITIONS, THROUGH SUSPENDED CEILINGS, OR FOR CONCEALED VERTICAL CONDUIT, SLEEVES SHALL BE NO. 22 U.S.G. GALVANIZED STEEL MINIMUM.

L. HANGERS

- HANGERS SHALL INCLUDE ALL MISCELLANEOUS STEEL SUCH AS IRON, WIRE, UNISTRUT, C-CLAMPS WITH RETAINING CLIPS, CHANNELS, HANGER RODS, ETC., NECESSARY FOR THE INSTALLATION OF WORK.
- HANGERS SHALL BE FASTENED TO BUILDING STEEL, CONCRETE, OR MASONRY, BUT NOT TO OTHER CONDUIT OR PIPING. HANGERS UPPER ATTACHMENT MUST BE SUPPORTED FROM THE TOP OF THE BAR JOIST, HANGING FROM METAL DECK IS NOT PERMITTED. WHERE INTERFERENCE OCCUR, IN ORDER TO SUPPORT CONDUIT, THE CONTRACTOR MUST INSTALL TRAPEZE TYPE HANGERS OR SUPPORTS WHICH SHALL BE LOCATED WHERE THEY DO NOT INTERFERE WITH ACCESS TO FIRE DAMPERS, VALVES, JUNCTION BOXES, ACCESS DOORS, OTHER EQUIPMENT SERVICE REQUIREMENTS AND/OR OTHER TRADES.

BASIC ELECTRICAL MATERIALS AND METHODS

M. SCOPE OF WORK

- THE CONTRACTOR SHALL FURNISH ALL LABOR, MATERIALS, EQUIPMENT, SERVICES, TOOLS, TRANSPORTATION NECESSARY FOR EQUIPMENT, SERVICES, TOOLS, TRANSPORTATION, AND FACILITIES NECESSARY FOR, REASONABLY IMPLIED AND INCIDENTAL TO, THE FURNISHING, INSTALLATION, COMPLETION AND TESTING OF ALL THE WORK FOR THE ELECTRICAL SYSTEMS AS SHOWN ON THE DRAWINGS, CALLED FOR IN THE SPECIFICATIONS, AND AS REQUIRED BY JOB CONDITIONS, TO INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING:
 - A COMPLETE ELECTRICAL DISTRIBUTION SYSTEM INCLUDING THE INSTALLATION OF PANELBOARDS, SAFETY AN DISCONNECT SWITCHES, LIGHTING AND RECEPTACLES, IT IS THE ELECTRICAL CONTRACTOR'S RESPONSIBILITY TO INCLUDE IN HIS BID FOR PROVIDING SERVICE EQUIPMENT NECESSARY TO OBTAIN SERVICE FROM LOCAL UTILITY COMPANY. REFER TO ELECTRICAL ONE-LINE DIAGRAM FOR ADDITIONAL INFORMATION.
 - THE CONTRACTOR MUST ALSO INCLUDE IN BID ALL NECESSARY MATERIALS REQUIRED TO COMPLETE THE SYSTEM INCLUDING, BUT NOT LIMITED TO, FEEDERS, BRANCH CIRCUITS, JUNCTION BOXES, OUTLET BOXES, WIRING DEVICES, COVERPLATES, CONDUITS, ETC.
 - METERING AND CURRENT TRANSFORMERS AS REQUIRED BY DRAWINGS, UTILITY COMPANY.
 - THE WIRING OF MECHANICAL EQUIPMENT AS OUTLINED ON THE DRAWINGS AND IN THE SPECIFICATIONS. WORK SHALL INCLUDE WIRING OF ALL STARTERS, DISCONNECTS, AND POWER WIRING OF MECHANICAL EQUIPMENT EXCEPT AS SPECIFICALLY NOTED OTHERWISE. ALL LOW VOLTAGE (24 VOLT) TEMPERATURE CONTROL WIRING SHALL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR UNLESS NOTED SPECIFICALLY ON DRAWING.
 - INSTALLATION OF LIGHT FIXTURES AND LAMPS AS SHOWN ON THE DRAWINGS INCLUDING ALL DEVICES, EQUIPMENT, ETC. REQUIRED FOR MOUNTING.
 - TEMPORARY SERVICE AS INDICATED IN THE SPECIFICATIONS, INCLUDING ITS REMOVAL.
 - SMOKE/FIRE ALARM WIRING, DEVICES AND CONDUIT, AS SHOWN OR DESCRIBED ON DRAWINGS OR AS NECESSARY TO MEET STATE, LOCAL, INSURANCE AND FIRE DEPARTMENT REQUIREMENTS.
 - INSTALLATION OF CONDUITS AND WIRING TO CONTROL PANEL. CABLES ARE NOT PERMITTED. SEE SECTION G FOR LOW VOLTAGE CONTROLS REQUIREMENTS.
 - VERIFY FUEL CELL PHASE ROTATION MATCHES THE BUILDING ELECTRICAL SERVICE. MEASURE VOLTAGE ACROSS EACH PHASE OF MCB001AND VERIFY THAT EACH PHASE IS SIMILAR IN MAGNITUDE.
 - CONDUCTOR MARKING SHALL BE IN ACCORDANCE TO NEC 408.3(E) REGARDING PHASE ROTATION.
- THE FOLLOWING ITEMS OF ELECTRICAL CONSTRUCTION ARE NOT INCLUDED IN THIS CONTRACT:
 - 24 VOLT TEMPERATURE CONTROL WIRING UNLESS NOTED OTHERWISE
 - TELEPHONE INSTRUMENTS AND WIRING UNLESS NOTED OTHERWISE
- BEFORE STARTING WORK, THE CONTRACTOR SHALL EXAMINE THE STRUCTURAL AND MECHANICAL PLANS, SHOP DRAWINGS AND SPECIFICATIONS TO SEQUENCE, COORDINATE, AND INTEGRATE THE VARIOUS ELEMENTS OF THE ELECTRICAL SYSTEM, MATERIALS AND EQUIPMENT WITH OTHER CONTRACTORS TO AVOID INTERFERENCES AND CONFRONTATIONS.

B. CONDUIT

- THE CONTRACTOR SHALL FURNISH AND INSTALL ALL CONDUITS SERVING ALL EQUIPMENT, INCLUDING BUT NOT LIMITED TO, LIGHTING, RECEPTACLES, HEATING AIR CONDITIONING, MECHANICAL EQUIPMENT, TELEPHONE, DATA AND ELECTRICAL EQUIPMENT.
- ALL CONDUITS SHALL BE GALVANIZED RMC OR EMT UNLESS OTHERWISE SPECIFIED. ALL CONDUIT IS TO BE UL LABELS. EMT CONNECTORS SHALL BE STEEL COMPRESSION TYPE. CONDUIT UNDER SLAB ON GRADE SHALL BE RIGID STEEL, OR SCHEDULE 40 PVC WITH RIGID STEEL ELLS WHERE PERMITTED BY CODE.
- ALL CONDUIT INSTALLATIONS SHALL BE COMPLIANT WITH OWNERS BUILDING STANDARD. MINIMUM SIZE OF CONDUIT SHALL BE 3/4 INCH.
- SUPPORT ALL CONDUIT, INCLUDING SEISMIC AND SWAY BRACING, IN ACCORDANCE WITH THE NEC AND LOCAL CODES.
- GENERALLY, ALL CONDUIT SHALL BE CONCEALED EXCEPT FOR UNFINISHED AREAS, SUCH AS EQUIPMENT ROOMS. EXPOSED CONDUIT SHALL BE ALLOWED ONLY AS NOTED ON PLAN AND AS APPROVED BY DOOSAN.
- LIQUID TIGHT FLEXIBLE CONDUIT (LTFC)
 - LIQUID TIGHT FLEXIBLE CONDUIT AND ASSOCIATED FITTINGS SHALL BE INSTALLED PER MANUFACTURER'S GUIDELINES WITH SPECIAL ATTENTION TO FITTING TORQUES.
 - LIQUID TIGHT FLEXIBLE CONDUIT SHALL BE USED FOR THE FOLLOWING APPLICATIONS: FINAL CONNECTIONS TO MOTORS, FINAL CONNECTIONS TO VIBRATING EQUIPMENT.
 - LIQUID TIGHT FLEXIBLE CONDUIT MUST BE THE SAME SIZE AS THE RMC OR EMT CONDUIT TO WHICH IT IS CONNECTED. BOTH THE FLEXIBLE METAL CONDUIT AND ITS FITTINGS ARE TO BE LISTED FOR GROUNDING. A GREEN GROUNDING CONDUCTOR SHALL BE INSTALLED. ALL CONNECTORS ARE TO BE OF A NEMA APPROVED TYPE.
 - THE USE OF MC CABLE OR GREENFIELD IS NOT PERMITTED. A CONNECTION TO OUTDOOR EQUIPMENT MUST BE WEATHERPROOF (LIQUID TIGHT OR SEALTIGHT).

- PROVIDE PULL-WIRE IN ALL EMPTY CONDUITS EXCEPT AS NOTED OTHERWISE ON DRAWINGS.

- HOME RUNS AND MAIN CONDUIT RUNS ARE TO BE HELD TIGHT TO STRUCTURE ABOVE OR AS REQUIRED TO ALLOW PROPER SERVICE ACCESS AND OTHER TRADES WORK.

- ALL CONDUITS MUST BE SIZED PER NEC AND LOCAL CODES.

C. OUTLET BOXES

- ALL OUTLET BOXES SHALL BE GALVANIZED PRESSED STEEL OF THE STANDARD KNOCKOUT TYPE. NO ROUND OUTLET BOXES SHALL BE PERMITTED, EXCEPT AS SPECIFICALLY NOTED ON DRAWINGS BOXES SHALL NOT BE LESS THAN 4" SQUARE AND 1 1/2" DEEP.
- ALL KNOCKOUT BOXES, UPON WHICH LIGHTING FIXTURES ARE TO BE INSTALLED, SHALL BE EQUIPPED WITH 3/8" FIXTURE STUDS.
- EXTERIOR BOXES SHALL BE CAST RUST-RESISTING METAL WITH GASKETED COVERS.
- INSTALL BOXES RIGIDLY FROM BUILDING STRUCTURE AND SUPPORT INDEPENDENTLY OF THE CONDUIT SYSTEM. ALSO PROVIDE SUITABLE BOX EXTENSIONS TO EXTEND BOXES TO FINISHED FACE OF CEILINGS. ALL OUTLET BOXES TO BE PROVIDED WITH CADDY "CLICK-MOUNT BOX SUPPORT" TO MINIMIZE THE DEFLECTION THAT OCCURS WHEN PLUGGING/UNPLUGGING INTO THESE DEVICES.
- UNLESS OTHERWISE NOTED ON DRAWINGS OR OTHERWISE REQUIRED BY THE NATIONAL ELECTRICAL CODE, HANDICAP CODES OR LOCAL CODES, OUTLET HEIGHTS SHALL BE AS FOLLOWS:
 - SWITCH HEIGHT 48" FROM FINISHED FLOOR TO CENTERLINE OF OUTLET.
 - CONVENIENCE OUTLETS: 24" FROM FINISHED FLOOR TO CENTERLINE OF OUTLET.

D. JUNCTION AND PULL BOXES

- THE DRAWINGS INDICATE SCHEMATIC ROUTINGS FOR CONDUIT RUNS. CONTRACTOR SHALL FURNISH AND INSTALL ADDITIONAL BOXES WHERE REQUIRED BY FIELD CONDITIONS OR BY CODE.
- BOXES AND COVERS SHALL BE GALVANIZED/PAINTED STEEL OF CODE GAUGE SIZE.
- INSTALL BOXES RIGIDLY SUPPORTED FROM THE BUILDING STRUCTURE AND SUPPORTED INDEPENDENT OF THE CONDUIT SYSTEM.
- ARRANGE CIRCUITS TO AVOID THE USE OF JUNCTION BOXES IN INACCESSIBLE LOCATIONS.
- JUNCTION AND PULL BOXES MUST BE LABELED WITH CIRCUIT NUMBER IDENTIFICATION AND SYSTEM TYPE ON COVER.

E. WIRING

- CONDUCTORS FOR FEEDERS AND BRANCH CIRCUITS SHALL BE COPPER AND THE AWG SIZE AND TYPE AS SHOWN ON DRAWINGS. MINIMUM WIRE SIZE #12. THE CONDUCTORS SHALL BE 600 VOLT INSULATION TYPE THW, THWN OR THHN.
- ON ALL 20 AMP BRANCH CIRCUITS, CONDUCTORS LARGER THAN #10 AWG SHALL BE REDUCED TO #10 AWG WITHIN 10 FEET OF PANEL BOARD AND DEVICE IN JUNCTION BOXES ON RATED TERMINAL STRIPS.
- CONDUCTORS SHALL BE STRANDED.
- ALUMINUM CONDUCTORS ARE NOT PERMITTED.
- ALL WIRING SHALL BE IN CONDUIT, UNLESS SPECIFICALLY NOTED OTHERWISE (IE. LOW VOLTAGE PLENUM RATED WIRE)
- EACH CIRCUIT SHALL HAVE A DEDICATED NEUTRAL CONDUCTOR WHEN REQUIRED AND SHALL BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL CODES.
- THE USE OF MC CABLE, ETC. IS NOT PERMITTED.
- WIRE CONNECTORS SHALL NOT BE EQUAL TO "SCOTCH LOCK" FOR #8 AWG WIRE AND SMALLER AND EQUAL TO T & B "LOCKTIGHT" FOR #6 AWG AND LARGER.
- ALL WIRING TO BE COLOR-CODED AS FOLLOWS:

<u>120/208 VOLT SYSTEM</u>	<u>277/480 VOLT SYSTEM</u>
NEUTRAL - WHITE	NEUTRAL - GREY
PHASE A - BLACK	PHASE A - BROWN
PHASE B - RED	PHASE B - ORANGE
PHASE C - BLUE	PHASE C - YELLOW
GROUND - GREEN	GROUND - GREEN

F. WIRING DEVICES

- CONTRACTOR SHALL FURNISH AND INSTALL SWITCHES AND RECEPTACLES, UNLESS NOTED OTHERWISE. AS NECESSARY FOR A COMPLETE INSTALLATION, COLOR OF DEVICES AND PLATES SHALL BE WHITE UNLESS OTHERWISE NOTED. THE DEVICES SHALL BE OF THE TYPES AND RATINGS LISTED, OR EQUALS BY HUBBELL, BRYANT OR PASS & SEYMOUR. WEATHERPROOF GFI RECEPTACLES SHALL BE INSTALLED WHERE SHOWN ON DRAWINGS OR AS REQUIRED BY CODE.
- ALL WIRING DEVICES SHALL BE HEAVY DUTY GRADE, CONFIGURATION TO SUIT SERVICE.

G. HEATING, VENTILATION, PROCESS AND CONTROLS WIRING

- THE ELECTRICAL CONTRACTOR SHALL REFER TO MECHANICAL AND CONTROL DETAILS ON MECHANICAL DRAWINGS FOR ADDITIONAL ELECTRICAL WORK TO BE INCLUDED IN HIS BID.
- ELECTRICAL CONTRACTOR SHALL DO ALL POWER WIRING, LINE VOLTAGE WIRING, AND LINE VOLTAGE CONTROL WIRING INDICATED UNDER THE HEATING AND VENTILATION SPECIFICATIONS AND DRAWINGS. THIS CONTRACTOR SHALL ALSO DO ALL INTERCONNECTING LINE VOLTAGE WIRING BETWEEN RELAYS AND DEVICES AS REQUIRED.
- ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR FURNISHING AN INSTALLING CONDUIT FOR HVAC CONTROL WIRING. ELECTRICAL CONTRACTOR SHALL GROUP DEVICES TOGETHER AS NEEDED TO MINIMIZE THE QUANTITY OF CONTROL CONDUITS. SIZE CONDUITS IN ACCORDANCE WITH NEC.

H. SAFETY AND DISCONNECT SWITCHES

- SAFETY AND DISCONNECT SWITCHES SHALL BE HEAVY DUTY TYPE, QUICK-MAKE, QUICK-BREAK FUSED OR NON-FUSIBLE WITH RATINGS AND SIZES AS NOTED ON PLANS AND REQUIRED BY CODES.
- AT SERVICE ENTRANCE, DISCONNECT SHALL BEAR THE MANUFACTURER'S LABEL INDICATING THE EQUIPMENT IS UL RATED FOR APPLICATION IN ACCORDANCE WITH ALL CODES.
- MANUFACTURER SHALL BE GENERAL ELECTRIC, SQUARE D, EATON OR APPROVED EQUAL.

I. GROUNDING

- FURNISH AND INSTALL COMPLETE WIRED GROUNDING CONDUCTOR SYSTEM, #12 AWG MINIMUM, SIZED AND INSTALLED IN ACCORDANCE WITH THE LATEST ADOPTED EDITION OF THE NATIONAL ELECTRICAL CODE, STATE AND LOCAL CODES, AND AS NOTED IN THE SPECIFICATIONS AND AS INDICATED ON THE DRAWINGS.
- ALL CONDUIT, INCLUDING FLEXIBLE CONDUIT, SHALL BE GROUNDED WITH A GREEN GROUNDING CONDUCTOR.
- GROUNDING CONNECTIONS MADE TO THE WATER PIPING SYSTEM SHALL BE COORDINATED WITH THE PLUMBING CONTRACTOR AND A BONDING JUMPER INSTALLED AROUND WATER METER PER CODES AND AS INDICATED ON DRAWINGS.
- ALL DEVICES SHALL BE BONDED TO THE CONDUIT SYSTEM. USE A BONDING JUMPER BETWEEN THE OUTLET BOX AND THE DEVICE GROUNDING TERMINAL. METAL-TO-METAL CONTACT BETWEEN THE DEVICE YOKE AND THE OUTLET BOX IS NOT ACCEPTABLE AS A BOND FOR EITHER SURFACE MOUNTED BOXES OR FLUSH TYPE BOXES. ALL JUNCTION BOXES, OUTLET BOXES, AND PULL BOXES SHALL BE BONDED TO THE CONDUIT SYSTEM.

- FOR PANEL FEEDERS, BOND THE GROUNDING CONDUCTOR TO THE CONDUIT, WHERE ENTERING AND LEAVING THE CONDUIT. THE GROUNDING CONDUCTOR SHALL BE COPPER WITH GREEN IDENTIFICATION AND SIZED PER N.E.C.

- ALL ENCLOSURES AND NON-CURRENT CARRYING METAL PARTS ARE TO BE GROUNDED. CONDUIT SYSTEM IS TO BE ELECTRICALLY CONTINUOUS. ALL LOCKNUTS MUST CUT THROUGH NAMELED OR PAINTED SURFACES ON ENCLOSURES. WHERE ENCLOSURES AND NON-CURRENT CARRYING METAL PARTS ARE ISOLATED FROM THE CONDUIT SYSTEM, USE BONDING JUMPERS WITH APPROVED CLAMPS. ALL GROUND CLAMPS SHALL BE "PENN-JUNIOR" OR EQUAL, SIMILAR TO "GPL" TYPE.

J. LIGHTING FIXTURES

- THE CONTRACTOR SHALL INSTALL ALL LIGHTING FIXTURES AND LAMPS AS SHOWN ON THE DRAWINGS. CONTRACTOR IS TO REPLACE ALL NON-WORKING LAMPS PRIOR TO ACCEPTANCE BY DOOSAN/OWNER.

K. SUBMITTALS

- THE CONTRACTOR SHALL PROVIDE 5 COPIES OF (AS WELL AS ELECTRONIC) SUBMITTALS OF ALL INSTALLATION METHODS, MATERIALS AND ACCESSORIES FOR REVIEW AND APPROVAL. SUBMITTALS FOR EQUIPMENT SHALL SPECIFICALLY STATE "NEW" OR "RECONDITIONED" FOR EACH ITEM. RECONDITIONED EQUIPMENT SHALL REQUIRE SPECIFIC APPROVAL BY DOOSAN. SUBMITTALS SHALL BE ASSEMBLED AND SUBMITTED PRIOR TO ANY INSTALLATION WORK, AND SHOULD INCLUDE:
 - WIRE
 - CONDUIT
 - DISCONNECT SWITCH
 - SWITCHGEAR MODIFICATIONS AND ACCESSORIES
 - ENCLOSURES
 - CURRENT TRANSFORMERS, POTENTIAL TRANSFORMERS AND TEST BLOCKS
 - HEAT TRACE
 - UTILITY METER
 - WIREWAY, PULL BOX

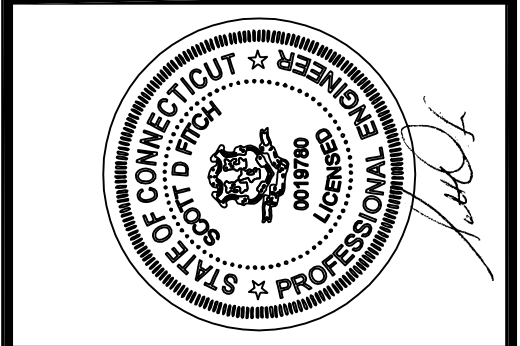
L. TESTS AND ADJUSTMENTS

- ALL CONNECTIONS AT PANELS AND SWITCHES ARE TO BE MADE. ALL SPLICES COMPLETE, ALL FUSES IN PLACE, AND ALL CIRCUITS CONTINUOUS FROM POINT OF SERVICE CONNECTION TO ITS FINAL DESTINATION, AND ALL COVERS AND PLATES INSTALLED PRIOR TO THE TIME OF FINAL INSPECTION BY CEP OR OWNERS ENGINEER.
- UPON COMPLETION OF THE WORK, ALL PARTS OF THE ELECTRICAL INSTALLATION SHALL BE TESTED AND PROVED FREE OF UNWANTED GROUNDS AND OTHER DEFECTS.
- ALL OVERLOAD DEVICES, INCLUDING EQUIPMENT FURNISHED UNDER OTHER CONTRACTS, SHALL BE SET AND ADJUSTED TO SUIT THE LOAD CONDITIONS.
- TEST AND MAKE CORRECTIONS/ADJUSTMENTS FOR PHASE BALANCING.
- PROVIDE FINAL REPORT TO CEP AT TIME OF PUNCH-OUT.

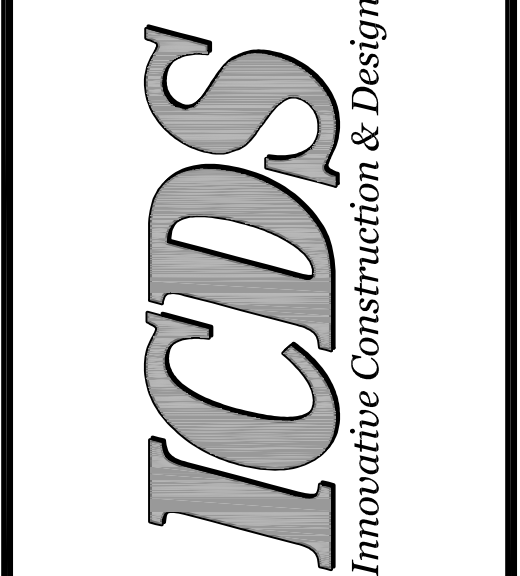
M. CLEANING

- AT THE END OF THE PROJECT, THE CONTRACTOR SHALL CLEAN ALL EQUIPMENT, TO THE SATISFACTION OF OWNER. ALL DUST, DIRT, DEBRIS, AND FOREIGN MATTER SHALL BE REMOVED FROM ALL EQUIPMENT.

ISSUED FOR PERMIT	Date	Description
A	07/06/15	Rev.



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ELECTRICAL SPECIFICATIONS

Project No.:	Drawn By:
	KFH
Date:	Design By:
07/06/15	SDF
Scale:	Check By:
AS NOTED	DSF

Drawing No.:

E4.0