UNIVERSITY OF LOUISVILLE

PROCUREMENT SERVICES
ADDENDUM

Date of Notice:	4/10/2025
Solicitation No.:	RP-022-25
Title:	JB Speed Microgrid
Addendum No.:	1

The following pages shall clarify and/or modify the original RFP document(s) as issued by the University of Louisville.

The due date has been extended to 4/17/2025 at 12:00PM, EST.

Proposer must acknowledge receipt of this and any addenda either with proposal or by separate letter. Acknowledgement must be received in the Department of Procurement Services, Service Complex Building, University of Louisville no later than **4/17/2025 at 12:00PM, EST.** If by separate letter, the following information must be placed in the lower left-hand corner of the envelope:

Solicitation No.:	**RP-022-25**
Title:	**JB Speed Microgrid**
Due Date:	**4/17/2025 at 12:00PM, EST.**

Authorized By:

Procurement Services	Evan Riddell Digitally signed by Evan Riddell Date: 2025.04.10 12:15:21 -04'00'

Receipt Acknowledged:

Company	
Signature	
Name (print)	
Date	

BID PACKAGE #5 - Microgrid

April 4, 2025

ADDENDUM NO. 1

The following shall clarify and/or modify the construction documents.

GENERAL

Bidder's Questions with University Answers (attached)

Attachments

1. Bidder's Questions with University Answers
2. Basis of Design Equipment Cut Sheets (for reference only)
3. RFP # 18 - Site Electrical Drawings (fro reference only)
4. Linde Drawings (for reference only)

End of Addendum # 1

Luckett & Farley
University of Louisville
Speed School of Engineering
Student Success Building

2024.049 Microgrid – Bid Package #5

BIDDER QUESTIONS

1. All of these questions are based on the keynotes on sheet C101;
    a. Note 12: Will need details on bollard (size, material, finish)

University answer: See attached Linde reference drawings for details.

    b. Note 13: Will need details on pipe type, diameter, and depth. Also I assume final connection on both ends will be by others

University answer: Yes, final connections by others.

    c. Note 14: Will need detail on the pad (stone base, thickness, reinforcement, concrete strength, and finish)

University answer: See attached Linde reference drawings for details.

2. Per Section 2.4.D.2 - The Schneider Electric team was told by L&F / U of L that the microgrid system would be grid-tied only, with no islanding capability. The specification conflicts with this understanding and calls out islanding as a functional requirement. Please confirm if this system is grid-tied only or islandable.

University answer: Grid tied only, islanding not required.

    a. If Islanding is NOT required, would the customer be open to a value-engineered equipment design due to the reduced functionality of a grid-tied only system?

University answer: Grid tied only. The owner is open to alternative solutions.

    b. Per Section 2.5.A.2 - Please provide the utility tariff if known at this time so the tariff management use case can be validated.

University answer: The Utility Tariff is unknown.

    c. Per Section 2.5.A.5 - Please provide details for the utility or ISO demand response program that the microgrid is expected to participate in, or confirm that demand response is not required.

University answer: Not required.

    d. Per Section 2.3.2 - Clarification: utility meters and CTs are provided by the utility.

University answer: Yes. They will be located in the Microgrid Controller. (Relocated from indoor existing switchboard)

    e. If islanding is NOT required, disregard the following questions. If islanding IS required, the following questions are relevant:

University answer: Islanding is not required.

f. Per Section 2.4.D.2 - Has it been verified with the BESS vendor that their BESS can achieve a black start and be the grid forming? We need some use cases for this BESS model to determine the risk of implementing it into our system.

University answer: Islanding is not required.

g. Per Section 2.4.D.2 - Will the fuel cell run during islanding operation as well? Due to the fact that its size is double the size of the BESS (anchor resource), this can cause instability of the system.

University answer: Islanding is not required.

h. Per Section 2.4.B.4 - Load priority is mentioned, which insinuates that load shed is required, but all load breakers are upstream of the ECC on the ABB SWBD. Please clarify if the microgrid controller are expected to control upstream load breakers, and if so, please confirm that ABB SWBD breakers are electrically operated.

University answer: Islanding is not required.

3. Please provide the equipment orientation in relation to the building and site. (conduit layout).
    a. Microgrid Controller
    b. Fuel Cell and Fuel Cell Cooler
    c. Battery Grid Box
    d. Hydrogen Storage

University answer: Equipment orientation is shown on Civil and Electrical drawings.

4. Please provide cut sheets for the following equipment. (conduit layout and Lightning protection).
    a. Microgrid Controller
    b. Fuel Cell and Fuel Cell Cooler
    c. Battery Grid Box
    d. Hydrogen Storage

University answer: Equipment specified is basis of design, contractor to provide cut sheets of equipment they propose to use.
Cutsheets representing the Basis of design are attached, for reference only.

5. Sheet ES004 Calls out a Handhole with 16' of extra conductors. Neither one of those Items exist. I have reviewed the site plans ES001dated 12/01/23 with revisions. Addendum 2 dated 1/02/24, and addendum 6 dated1/27/24. The drawing shows only a dashed line connection from the paralleling switch gear to the utility transformer with no instruction notes for that line. The same drawings indicate a direct path from the utility transformer into the building of twelve (12) 4” PVC conduits encased in concrete. There has been no change or drawings issued to modify this installation. During pre-contract negotiations, it was agreed and approved to remove the paralleling/microgrid controller from bid package #3 for cost saving purposes. Therefore, with no instructions to change the basic layout of the underground electrical service conduits they have been installed per sheet ES004 Addendum# 6 dated 2/27/24.

Suggestion: Excel Services will issue several follow-up RFIs and installation options to incorporate the Microgrid and Fuel Cell Controller with the existing electrical service.

University answer: See attached RFP #18 for revisions.

6. Is the Microgrid controller Rated as a service disconnect? 4000-amp main breaker?

University answer: Yes, 5000 amp, with 4000 amp to existing switchgear. See drawing E-403.

7. Is there a CT Metering compartment in the Microgrid Controller?

University answer: Yes, it will be located at the microgrid controller and the CT's and Meter currently in the main switchgear will be relocated.

8. Has this service lay out been reviewed by LG&E?

University answer: Yes

9. Who is providing the fuel cell cooler per keynote #5 C101? 481800 2.2A indicates it shall be provided with the fuel cell. Confirm this is correct.

University answer: Correct, provided with the fuel cell.

10. Keynote #8 is listed in the notes on C101 but not indicated on the drawings. Where does it apply?

University answer: Delete Key Note #8.

11. Provide Linde drawings referenced in keynotes #10-#14 on C101.

University answer: See attached Linde reference drawings for details. These drawings are for reference only. Exact configuration of utility pad and enclosure is as shown on drawings.

12. Keynote #15 on the left side of the page does not appear to be indicated a handhole. Review and confirm.

University answer: Should be keynote 11, no handhole at that location?

13. Some of the underground lines are already installed or installed differently than shown. Attached is a drawing. The lines in green are already installed.
    1. -Revise layout of UGC line and keep dashed/unhighlighted as it is already installed
    2. -Show the secondary line from the transformer into the building. It is already installed and can be kept dashed/unhighlighted.

University answer: See attached RFP #18

Service needs to go from utility transformer to microgrid controller and then into the building switchboard.

14. The existing secondary service conductors from the utility transformer to the (MSB) will not be long enough to be pulled out of the utility transformer and terminated in the Microgrid Controller. Will it be permissible to extend the conductors up to approximately 55' by irreversible means ie.. compression butt splice with heat shrink tube insulation. The conductors are to be spliced together in the new manhole at the transformer location

University answer: Irreversible exothermic type welds for the cables are acceptable.

15. Since the first disconnecting means now will be the Microgrid Controller. The existing service feeders will become sub-feeders (12 - 4" PVC conduits with 4 - 500 kcmil copper in each). It will be necessary to add an equipment grounding conductor with each set per NEC - 250. Please provide the size of the equipment grounding conductor required.

University Answer: Irreversible exothermic type welds for the cables are acceptable.

End of Bidder Questions

CUT SHEETS, FOR REFERENCE ONLY:

1. MICROGRID CONTROLLER

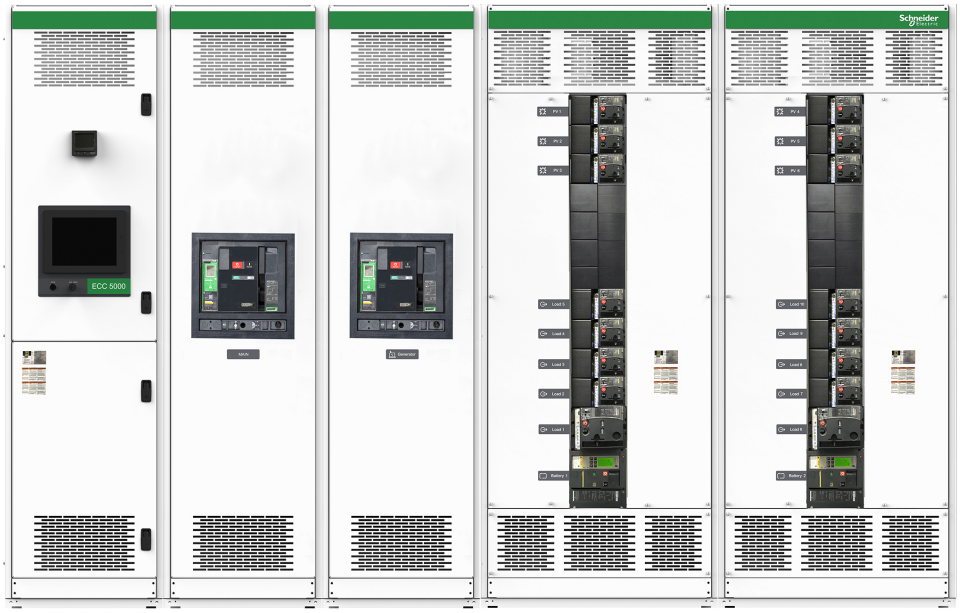
Energy Control Center

ECC 5000 for medium and large buildings

An energy control center (ECC) is an intelligent, modular and scalable power control center designed to simplify and optimize the integration of distributed energy resources (DER).

A first-of-its-kind design, the Schneider Electric ECC brings together the hardware, software, advanced controls and electrical distribution needed to manage DERs in a singlesource solution.

- 500 kW+ with complex use cases
- No limit on sections
- DER agnostic and customized support of multiple DERs
- PowerPact™ and MasterPact™ group mounted and/or individually mounted circuit breakers
- Vertical bus ampacity ≤ 3,000 A
- Horizontal bus ampacity ≤ 5,000 A



- Utility CTs, metering, and pull sections
- Fast load shedding via IEC 61850
- Custom protective relaying to meet utility interconnection requirements
- Engineered to order

schneider-electric.us/ecc

November 2019
Document Number: 2742HO1904

Life Is On

SQUARE D™ by Schneider Electric

CUT SHEET FOR REFERENCE ONLY

2. FUEL CELL, FUEL CELL COOLER

HyAxiom
A Doosan Company

PureCell® Model 400 Hydrogen

PURECELL SYSTEM BENEFITS

Energy Security

Proven PAFC fuel cell technology that is setting durability records

Energy Productivity

Increased efficiency and continuous on-site generation reduces energy costs

Energy Responsibility

No emissions equals sustainability

PURECELL SYSTEM COMPETITIVE ADVANTAGES

Long Life

Industry leading 10-year cell stack life assures high availability and low service cost

Modular & Scalable

Solutions for multi-megawatt applications to meet growing energy demand

Experience

60+ years of fuel cell development

High Efficiency

Up to 90% total CHP Efficiency

Small Footprint

Highest power density among clean generation technologies

Flexible Siting

Indoor, outdoor, rooftop, multi-unit

RATED POWER OUTPUT: 440KW, 480VAC, 60HZ

Characteristic		Units	Value[1]
Electric Power Output		kW/kVA	440/517
Electrical Efficiency		%, LHV	50
Peak Overall Efficiency		%, LHV	90
Hydrogen Purity, Minimum[2]		%	99.9
Hydrogen Input	Energy	kW (MMBtu/h), HHV	1,039 (3.59)
	Volume[3]	Nm3/h (SCFH)	295 (10,328)
	Mass	kg/h (lbs/h)	26.4 (58.1)
Heat Output @ up to 121°C (250°F)		kW (MMBtu/h)	352 (1.20)

FUEL

Supply..... Hydrogen Gas
Inlet Pressure[4] ..... 5 ± 0.25 bar(g)

EMISSIONS

Zero emissions of CO_2, NO_x, SO_x, CO, and VOCs. Heat output can offset additional CO_2 from combustion heat generation (e.g., boilers).

OTHER

Ambient Operating Temp ..... Max Power -20°F to 104°F (-29°C to 40°C)[5]
Sound Level ..... < 65 dBA @ 33 ft. (10m)
Water Consumption ..... None

Daesan Green Energy Project

50 MW | 114 Units | South Korea

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. Contact HyAxiom for requirements on other gas constituents or for lower purity H_2.
3. Based on Hydrogen gas higher heating value of 343 Btu / SCF (12.8 MJ/Nm3).
4. Contact HyAxiom for lower inlet pressures.
5. Derate at ambient temperatures outside of specified range. Contact HyAxiom for details.

HyAxiom, Inc.
Corporate Headquarters
101 East River Drive
East Hartford, CT 06108
860.727.2253
www.hyaxiom.com

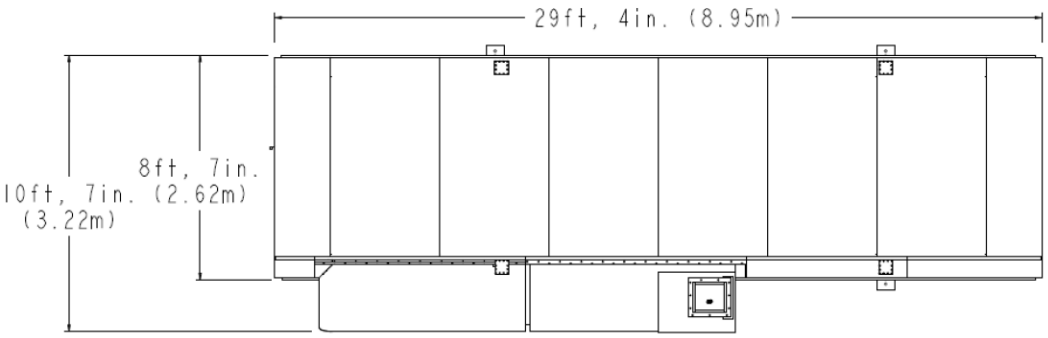
FCM107865 Rev. B | May 2023

HyAxiom
A Doosan Company

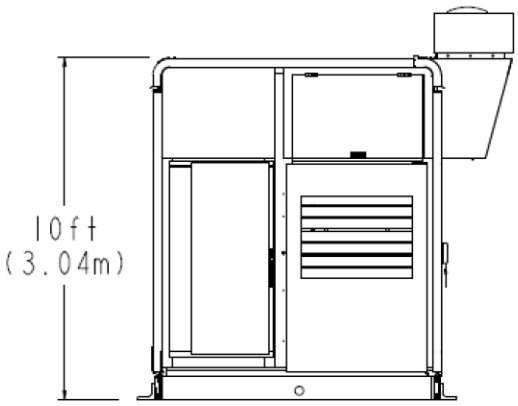
PureCell® Model 400 Hydrogen

SYSTEM DIMENSIONS

Power Module

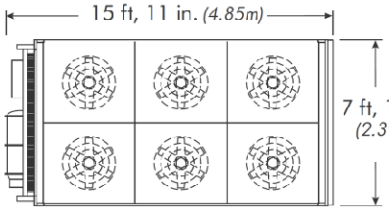


Top View

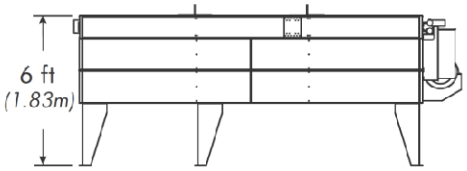


Side View

Cooling Module



Top View



Side View

PHYSICAL SPECIFICATIONS

	Power Module	Cooling Module
Length	29′ 4″ (8.95m)	15′ 11″ (4.85m)
Width	8′ 7″ (2.62m)	7′ 10″ (2.39m)
Height	10′ 0″ (3.04m)	6′ 0″ (1.83m)
Weight	49,428 lb (22,420 kg)	3,190 lb (1,447 kg)

Typical outdoor applications require a 30′ x 40′ area, including for customer interface equipment. Larger installations typically require less area for subsequent units.

PureCell® ADVANTAGE

Take Control of Your Power

Load Following
Dynamically ramp power up & down based on demand

Continuous Operation
Operate with or without grid power and handle long-duration intermittency

Performance Monitoring
Manage performance with HyAxiom monitoring and service

Advance ESG Goals

Zero-Carbon
Zero CO_2 emissions helps you achieve challenging carbon footprint goals

Clean Heat
Eliminate or reduce carbon from combustion boilers by using both heat & power

Clean Air
- Zero NO_x & SO_x
- Zero CO
- Zero VOCs

Power Where You Need It

Flexible Siting
- Indoor / Outdoor
- Urban Environments
- Multi-story, Rooftop
- Scalable Building Block

Quiet Operation
65 dBA @ 33 ft., equivalent to normal conversation

HyAxiom, Inc.
Corporate Headquarters
101 East River Drive
East Hartford, CT 06108
860.727.2253
www.hyaxiom.com

FCM107865 Rev. B | May 2023

PureCell® Model 400 H2

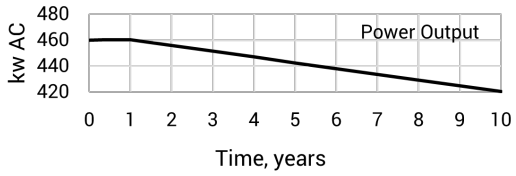
POWER YOUR INDEPENDENCE®

PureCell® M400 is a clean reliable stationary power and heat source for facilities and utilities. The heart of the system is a phosphoric acid fuel cell (PAFC) which safely converts hydrogen and air electrochemically with an efficiency of up to 90% CHP. The M400 design can be configured for use with natural gas, pure hydrogen, hydrogen blends and propane (LPG). The PureCell® unit helps customers meet rigorous emissions requirements by generating power without combustion, eliminating the formation of NOx. It also provides heat that can be used for space heating, hot water, or driving absorption chillers.

PRODUCT SPECIFICATIONS

ELECTRIC OUTPUT

460 kW/unit, maximum at year 1 (532 kVA with 0.86 power factor), 420 kW at year 10



Adjustable Power Factor 1, down to +/-0.86, max apparent power of 532 kVA

480 Volts, 3-Phase, 3-Wire, 50/60 Hz

Distributed Generation with Grid Independent Options for Backup Power

Electrical Load-Following Control

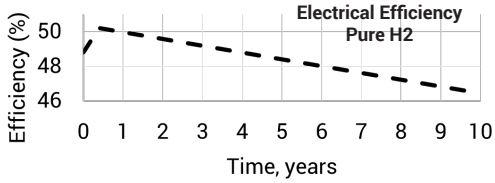
Harmonics: Compliant with IEEE 1547 Section 4.3.3 Table 3

Protection: In accordance with UL1741SB and IEEE1547

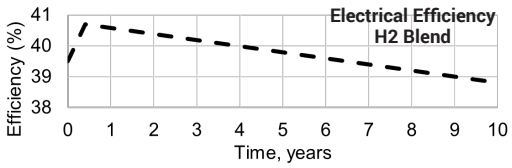
Transition times

- 400 kW in 10 min; full power in 30
- 10 kW/sec load setpoint change

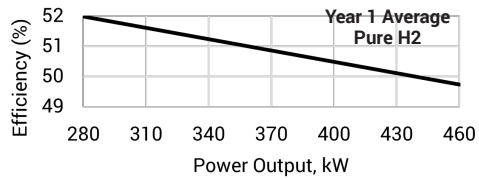
Pure H2: Average lifetime efficiency of 48.3 ±1.3% at max power based on LHV. Average year 1 efficiency 49.7%.

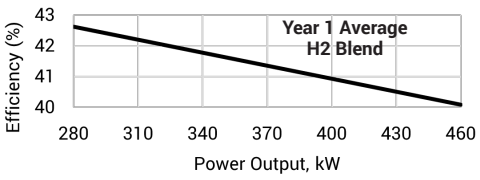


H2 Blend: Average lifetime efficiency of 39.8 ±1.3% at max power based on LHV. Average year 1 efficiency 40.3%.



Operating at lower power levels will offer increased efficiency:





LIFE and RELIABILITY
20 yr Product Life
97% + Availability

EMISSIONS COMPLIANCE
Zero emissions: CO, CO2, NOx, SOx

SAFETY
Certified to FC 1-2021 North American Standard for Stationary Fuel Cell Power Systems

NOISE
<65 dBA @ 10 m, 32.8 ft

HyAxiom, Inc.
101 East River Dr. East Hartford, Connecticut 06108
www.HyAxiom.com,

PRODUCT SPECIFICATIONS (HEAT MAP)

Nominal average heat in 1st year of operation in table below:

Cooling:

Up to 75 RT, assuming absorption chiller COP 0.83

Flow	Inlet Temp		Heat Available		Outlet Temp	
GPM	°C	°F	kW	MMBTU/hr	°C	°F
30	30	86	451	1.54	87	189
30	60	140	324	1.10	101	215
30	90	194	238	0.81	121	250
50	30	86	465	1.59	65	150
50	60	140	325	1.11	85	185
50	90	194	291	0.99	113	235
90	30	86	470	1.60	50	122
90	60	140	326	1.11	74	165
90	90	194	298	1.02	103	217

INPUT REQUIREMENTS

FUEL SOURCE

Fuel Composition: Hydrogen, Hydrogen Mix

- **Supply pressure:** 5+/- 0.25 bar(g), Particle Size: <1µm
- **Max Design Flow:** 4.3 MMBTU/hr (11690 SCFH)
- **Average consumption in first year in Pure H2 mode:** 3.8 MMBTU/hr (1109 kW) based on HHV when operating at 460 kW/ 532 kVA

1. Some accommodations can be made for fuel standards that do not meet this specification. Contact HyAxiom for further discussion if the site fuel composition exceeds any of these limits.

Fuel Component	Standard Allowable Content Limit [1]
Hydrogen	H2 blend > 80%, Pure H2 > 99%
Total Sulfur	H2 blend < 1.0 ppm (single path) Pure H2 < 0.01 ppm
NH_3	< 0.5 ppm
Halides	< 1 ppm
CO	H2 blend < 3000 ppm, Pure H2 < 30 ppm
O_2	< 2000 ppm

HEAT TRANSFER FLUID

- **Optional.** 30+ GPM, supply temperatures up to 212°F
- **Fluid:** Water, glycol/water mix can be used instead, standard derate applies
- **The chloride content** must be less than 0.5 ppmw and free chlorine content less than 0.25 ppmw

INITIAL FILL WATER SUPPLY

Pressure Range: 40 psig (275 kPag) - 80 psig (550 kPag)

Water is only required for startup and select servicing events.

Condition	Max Allowable Level
Total Dissolved Solids (TDS)	500 mg/L [1]
Turbidity (NTU)	<1.0
Silica (Si, all forms)	<25 ppmw, mg/L[1]

PRODUCT WATER DRAIN

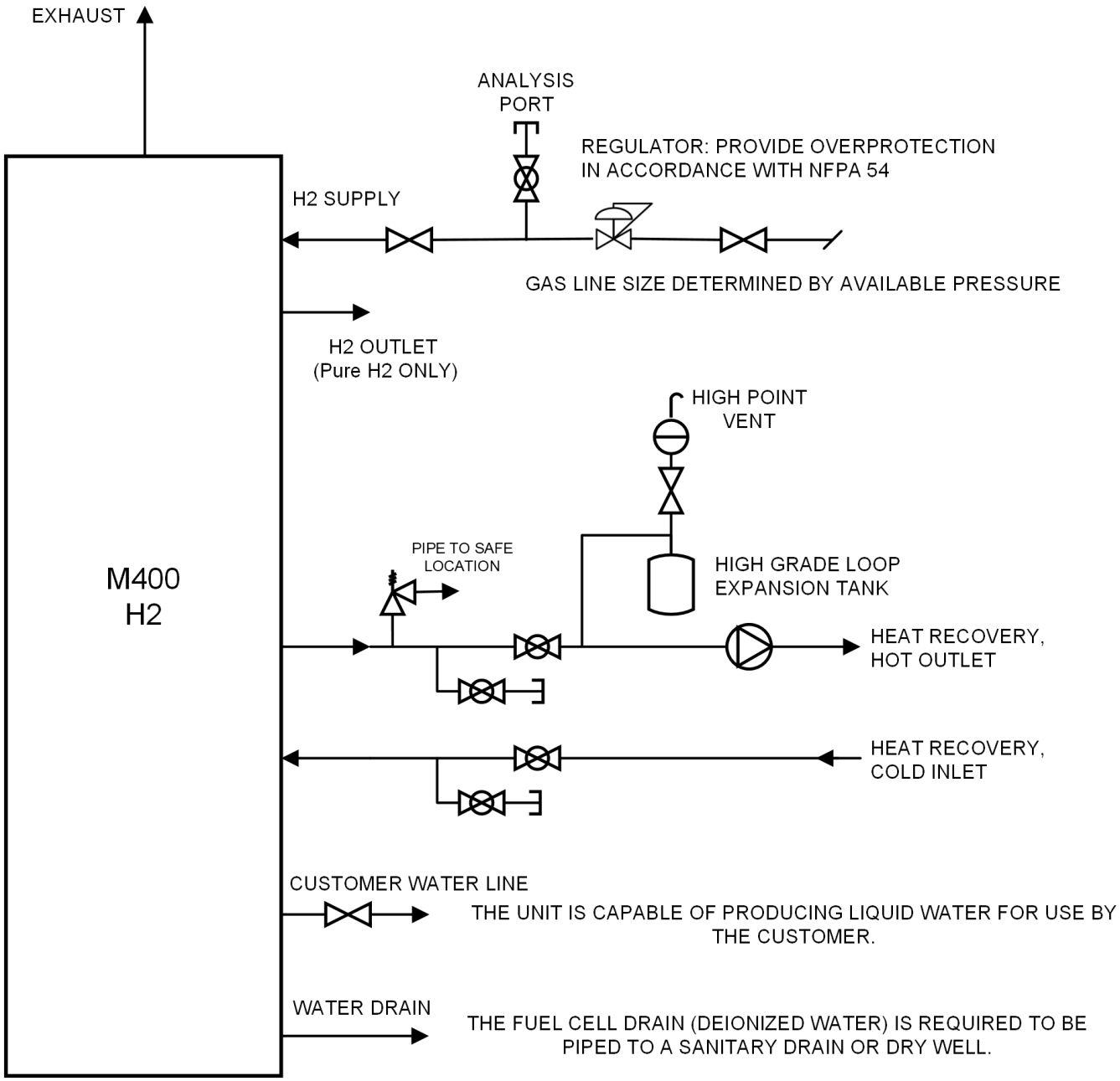
Permanently installed drain per local code requirements will accommodate overflow water: pH 6-9, temperature <140°F (60°C) flow is 0 to 42 GPH (159 L/h). Drain should be sized to accommodate maximum water production rate. The unit has the capability of producing up to 42 GPH of liquid water for use by the customer. If desired, the system can be configured to direct this water as per the customer site needs.

HyAxiom, Inc.
101 East River Dr. East Hartford, Connecticut 06108
www.HyAxiom.com,

INPUT REQUIREMENTS

CUSTOMER FLUID INTERFACES

Diagram shows typical hardware that interfaces with the PureCell® Model 400 and would be owned by the customer.



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101 East River Dr. East Hartford, Connecticut 06108
www.HyAxiom.com,

INPUT REQUIREMENTS

REMOTE MONITORING SYSTEM (RMS)

Industry-leading servicing and maintenance reporting provides 24/7 monitoring of systems. HyAxiom maintains remote access to each Model 400 to initiate startups, power output setpoints and shutdown commands. The RMS provides HyAxiom notification if any service is needed to the unit. An internet connection is needed via a customer-provided secured ethernet connection. Customer access to remote data is available upon request.

CONTROLLER CONNECTIONS

Optional. Real time data available through RMS Customer Portal

- Power Output
- Operating Mode
- Operating Hours
- Cumulative Electricity Generated
- Return and Supply Temperatures
- Fuel Flowrate
- Cumulative Fuel Consumed
- Instantaneous Electricity Efficiency
- Instantaneous Heat Recovery
- Heat Recovery Flowrate
- Cumulative Heat Recovery

Optional. Customer-provided control devices and wiring can interface with the M400 to collect additional data and issue commands

ENVIRONMENTAL CONDITIONS

Ideal environmental conditions are given below; conditions outside of those specified can be evaluated for feasibility.

Elevation

Up to 365 meters (1200 ft) to achieve maximum power production and efficiency, derating at higher elevations.

Temperature Range

-29ºC to 40ºC (-20°F to 104°F). The unit is capable of operating at temperatures exceeding 40°C with a derate. Please consult HyAxiom for further details.

Seismic Parameters

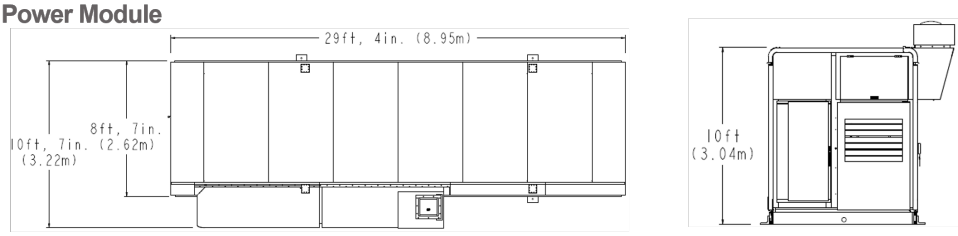
M400 is designed to ASCE 7-05 Occupancy Category IV, Site Class D, Ss=3.0, S1=1.3, I=1.5, Ip=1.5, Fa=1.0, Fv=1.5.

SITE INSTALL

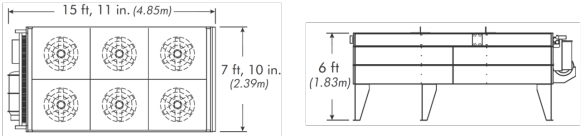
Outdoor, roof, and indoor installation possible with the following clearances for installation and servicing: I.5 m (5ft) of clearance on all sides of the unit, 3m (10ft) of clearance on the long non-hooded side of the unit, 1.8 m (6ft) of clearance above the unit.

SYSTEM DIMENSIONS

Power Module



Top View *Side View*



Top View *Side View*

Cooling Module (can be sited remotely from the power module or on top of Power Module roof)

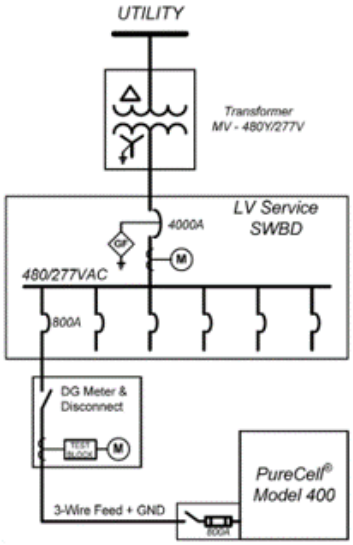
HyAxiom, Inc.
101 East River Dr. East Hartford, Connecticut 06108
www.HyAxiom.com,

INPUT REQUIREMENTS

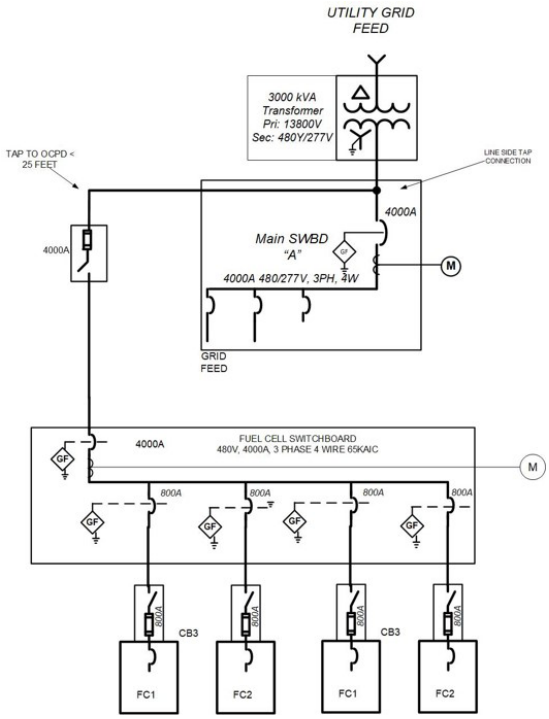
POWER INTERFACES

Connection: 4-wire grounded Wye power distribution with dedicated feeder circuit breaker or fused switch connects to the M400

480 VAC, 3-phase, 3-wire plus ground, 60 Hz electrical input/output



Single -Unit Site



PRODUCT OPTIONS

GRID INDEPENDENT (GI) OPERATION

- Automatic synchronization with facility grid; no additional synchronizing equipment required
- 400 kW/471 kVA
- Transition from grid to GI mode occurs within 10 seconds

ENERGY STORAGE SYSTEM (ESS)

An option for more seamless Grid to Grid Independent operation transition, offering a near-instantaneous transition.

MULTI UNIT LOAD SHARING (MULS)

Applicable to sites that include multiple units that are operating together as a single-generation entity in grid independent mode. This option utilizes an energy storage system (ESS) combined with an energy management system to facilitate near-instantaneous load transitions and provide complete microgrid solution.

PRODUCT WATER

The M400 H2 has the capability of producing up to 42 GPH of liquid water for use by the customer. If desired, the system can be configured to direct this water as per the customer site needs. Otherwise, the system will be programmed to exhaust product water as vapor.

PRODUCT LIFE

10 year or 20 years, with an overhaul service required at 10 years.

FREQUENCY

The unit can be configured to operate at 50 Hz or 60 Hz.

HyAxiom, Inc.
101 East River Dr. East Hartford, Connecticut 06108
www.HyAxiom.com,

CUT SHEET FOR REFERENCE ONLY

3. BATTERY

Gridbox 10GB
Microgrid System

GRIDBOX

POWERED BY LITHION

PRODUCT OVERVIEW

Gridbox 10GB Battery Energy Storage System (BESS) is a high-energy-density product specifically designed for Utility, Commercial & Industrial applications. The 10GB BESS Solution includes Battery Modules, bi-directional inverter, isolation transformer, fire detection/ suppression system, thermal management system, overcurrent protection, and our Gridbox Control System.

The purpose-built enclosure's environmental control system increases service life of the battery system. Intelligent battery management technology is leveraged to improve the safety of the system and its lifespan.

KEY FEATURES

Inverter Battery Combo: 9.8 x 8 x 8.5 Feet

- LiFePO4 chemistry, stable discharge platform, excellent safety performance, long cycle life.
- Three-level battery management system, ensures overcharge, over-discharge, over-voltage and other functional protection with fault classification processing.
- Modular design, support flexible expansion and front access for maintenance.
- Utility approved inverters to streamline utility interconnection.
- Equipped with Gridbox controller (GBC) to achieve 24/7 remote monitoring of the entire energy storage system.
- Supports 200kWDC PV solar DC coupled.

PRODUCT MODEL DEFINITION

10GB	0100	0129
ENCLOSURE SIZE	INVERTER (Kw/KVA)	ENERGY CAPACITY (Kwh)

CONFIGURATION EXAMPLE

Gridbox 10GB
Microgrid System

GRIDBOX

POWERED BY LITHION

ITEM	10GB-0100-0129	10GB-0100-0193
Battery Chemistry	Lithium Iron Phosphate (LFP)	
Cell Life Cycle	80% Retention with 5,000 Cycles @ 1° C to 25° C	
Cell Spec	3.2V / 90Ah	
Energy Capacity	129 kWh	193 kWh
Rated Voltage	358.4V	
Voltage Range	313.6V ~ 397.6V	
C DATA		
Rated AC Power	100kW / kVA	
Maximum AC Power	110kW / kVA	
Rated Grid Voltage	480V	
ContinuousCurrent	144A	
Output THDi	≤3%	
AC PF	Listed: 0.8 ~ 1 Leading or Lagging (Controllable). Acutal: 0.1 ~ 1 Leading or Lagging (Controllable)	
Grid Frequency Range	50/60 ±2.5Hz	
Isolation Method	3 Phase 4 Wire Transformer	
GENERAL DATA		
Dimensions w/o Clearences	9.8′ L x 8′ W x 8.5′ H	
Total Weight	22,046 LBS	
Degree of Protection	IP54	
Operating Temperature Range	-4° ~ 104° F / -20° ~ 40° C	
Relative Humidty	0 ~ 95% (Non-Condensing)	
Max Working Altitude	9,842 Feet / 3,000 Meters	
Cooling Concept	Heat-Pump HVAC	
Communication Interfaces	RS485, Ethernet, GPRS	
Certifications	UL1741SA, UL9540, UL9540A Tested	
Communication Protocols	DNP 3.0 Modbus, IEC 103, IEC 104, WEB APIs, IEC 61850	

Luckett & Farley
Architecture | Engineering | Interior Design

REQUEST FOR PROPOSAL: RFP-18

Proj. No:	2022.091	**Date:**	December 17, 2024
Project:	University of Louisville Speed School of Engineering Student Success Building	**Owner:**	University Planning Design & Construction University of Louisville 421 W. Cardinal Blvd
From Architect:	Luckett and Farley Architects 737 South Third Street Louisville KY 40202	**To Contractor:**	Whittenberg Construction Company 4774 Allmond Ave. Louisville, KY 40209-9429
UL Proj. No.:	BG 20-040	**Contract:**	BP 3

Please submit an itemized proposal for changes to Contract Sum and Contract Time for proposed modifications to the Contract Documents described herein. The Contractor shall submit this proposal by 02/29/2024.

THIS IS NOT A CHANGE ORDER, A CONSTRUCTION CHANGE DIRECTIVE, OR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED IN THE PROPOSED MODIFICATIONS.

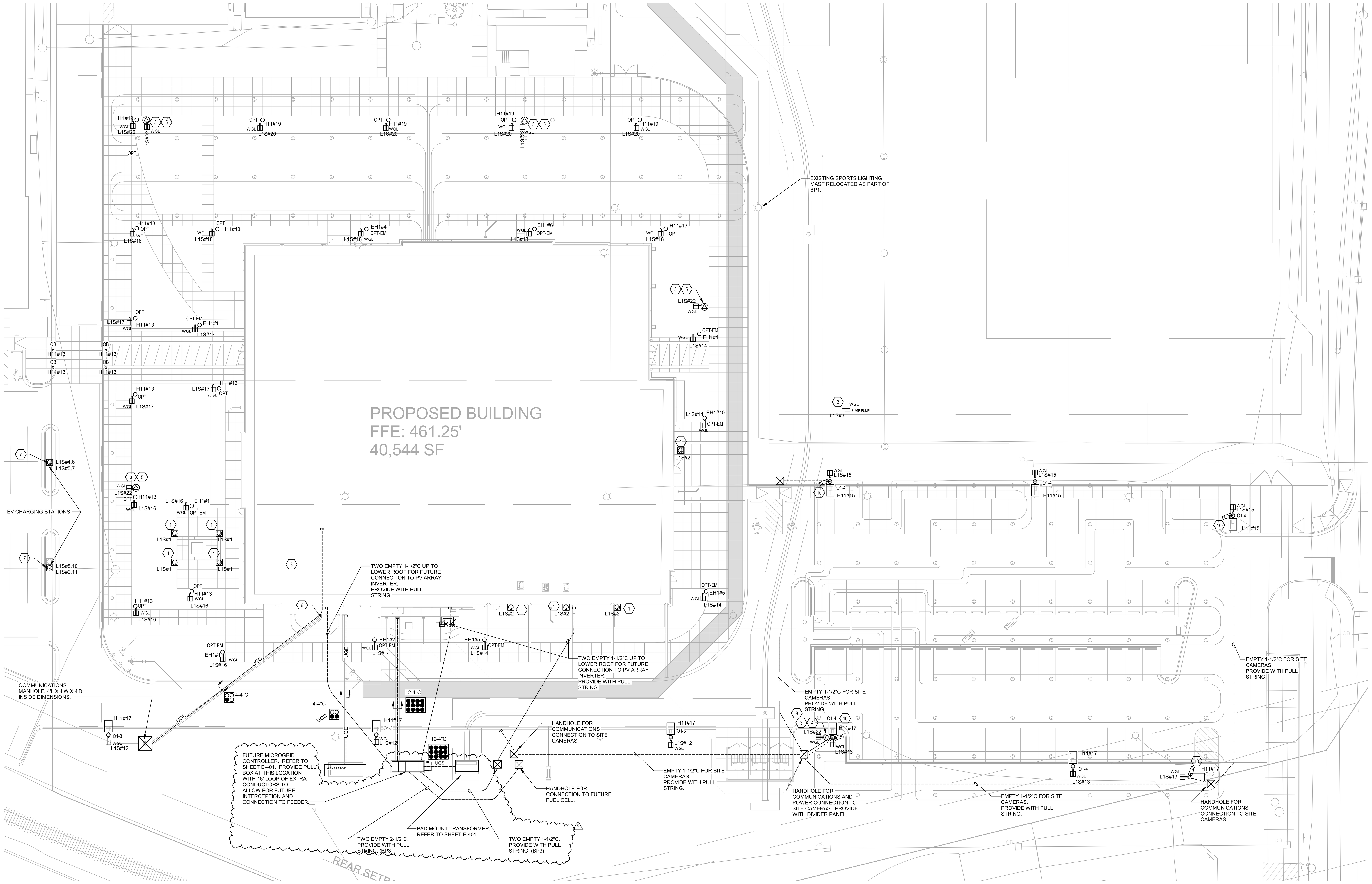
DESCRIPTION:
Provide a cost / credit (broken down by materials and labor) for all work associated with the following changes shown in the attached sketch:

1. Revise the main service in preparation for a future microgrid controller.
2. Provide handhole and 16’ loop of conductors at the future microgrid controller location to allow interception of the electrical service from the utility transformer.

ATTACHMENTS:

1. ES001 – ELECTRICAL SITE PLAN

Luckett and Farley Architects



ELECTRICAL SITE PLAN

SCALE: 1" = 20'-0"

GENERAL NOTES - SITE:

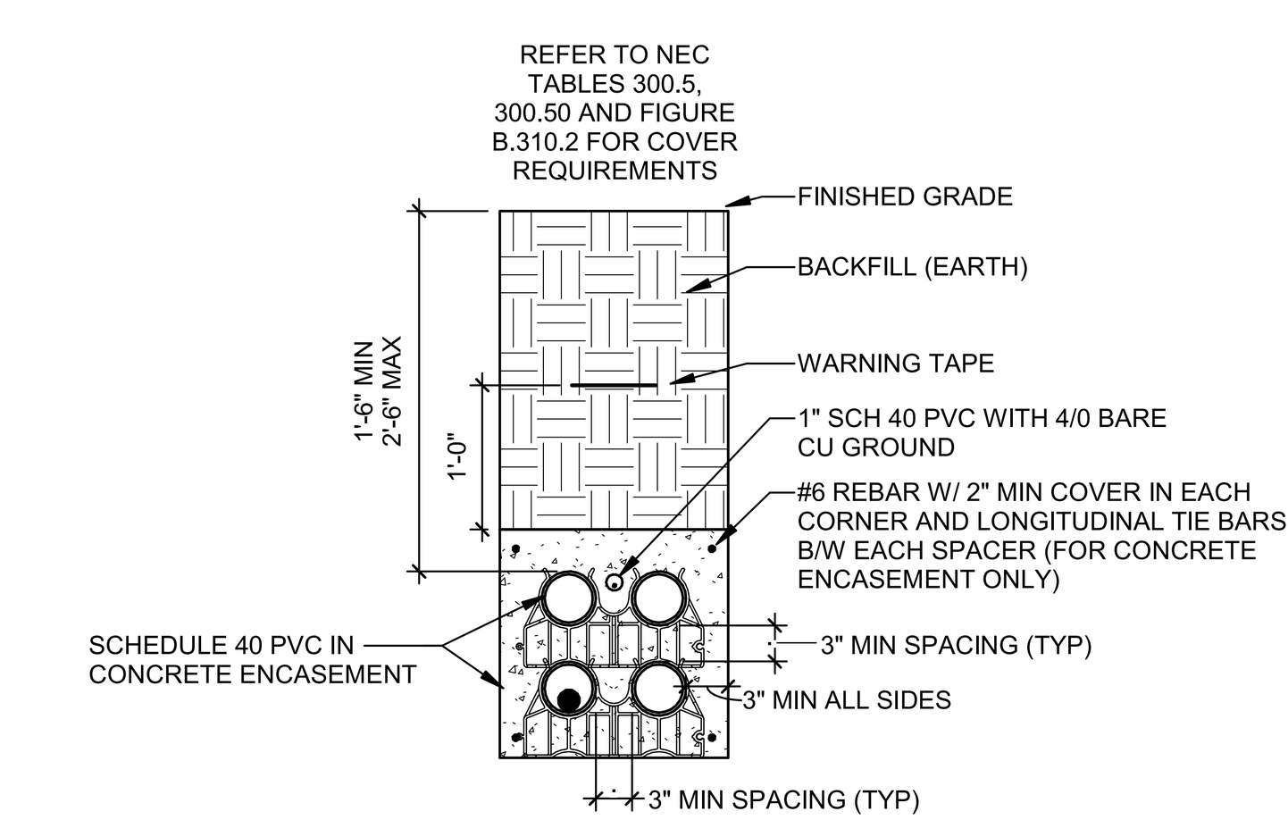
A. SEE SHEET E-001 FOR ADDITIONAL GENERAL NOTES.
B. COORDINATE TRENCHING AND EARTH PREPARATION REQUIREMENTS WITH SPECIFICATIONS AND OTHER TRADES PRIOR TO CONSTRUCTION.
C. COORDINATE UNDERGROUND SITE WORK WITH EXISTING UTILITIES. CONTACT LOCAL UTILITY COMPANIES OR LOCATING SERVICES FOR MARKING OF EXISTING UTILITIES. PERFORM WORK IN ACCORDANCE WITH LOCAL AND STATE REGULATIONS REGARDING UNDERGROUND UTILITY DAMAGE PREVENTION.
D. PROVIDE LONG RADIUS ELBOWS FOR UNDERGROUND CONDUIT BENDS.
E. PROVIDE GALVANIZED RIGID CONDUIT FOR EXTERIOR UNDERGROUND TRANSITIONS TO ABOVE GRADE; EXTEND CONDUIT A MINIMUM OF 3" ABOVE GRADE.
F. CONDUCTORS AND CABLES INSTALLED UNDERGROUND SHALL BE SUITABLE FOR WET LOCATIONS.
G. CONTRACTOR SHALL CONTACT ENGINEER FOR INSPECTION OF TRENCHES PRIOR TO INSTALLATION OF CONDUITS OR RACEWAYS.
H. CONTRACTOR SHALL USE AIR SPADE IN TRENCHES WITHIN THE DRIP LINE OF EXISTING TREES TO REMAIN. DO NOT CUT ANY ROOT SYSTEM LARGER THAN 1" WITHOUT APPROVAL FROM OWNER'S PROJECT MANAGER.
I. CONTRACTOR SHALL NOT PARK VEHICLES OR STORE MATERIALS WITHIN THE DRIP LINE OF ANY TREE TO REMAIN.
J. PROTECT EXISTING EQUIPMENT AND SURFACES TO REMAIN THROUGHOUT CONSTRUCTION.
K. PATCH AND REPAIR SURFACES DAMAGED DURING CONSTRUCTION. RESEED GRASSED AREAS WITH APPROVED SEED MIX. PHOTOGRAPH EXISTING DAMAGE AND DELIVER TO OWNER PRIOR TO COMMENCING WORK.
L. NOTIFY OWNER IN WRITING WITHIN 48 HOURS OF ANY PLANNED INTERRUPTIONS TO EXISTING UTILITY SERVICES.

KEYNOTES:

1 CHARGING STATION PEDESTAL FURNISHED AS PART OF BP1 BY LANDSCAPE CONTRACTOR. CONNECT TO CIRCUIT INDICATED ACCORDING TO CHARGING STATION PEDESTAL MANUFACTURER REQUIREMENTS.
2 REFER TO GEOTHERMAL VAULT SECTION DETAIL ON SHEET MS103 FOR MOUNTING LOCATION.
3 PROVIDE LEVITON PN#PDP006AB0707-I/O(YEL) 6 FIBER TIGHT BUFFERED, PLENUM, SINGLE-MODE, INDOOR/OUTDOOR, YELLOW JACKET(NO SUBSTITUTES) BETWEEN MDF AND WI-FI BOLLARDS IN 3/4" CONDUIT.
4 PROVIDE OUTDOOR WIRELESS ACCESS POINT MOUNTED ON SITE LIGHTING POLE AT THIS LOCATION. COORDINATE MOUNTING HEIGHT WITH OWNER
5 PROVIDE ACCELTEX 46"X11" BOLLARD WITH A BLACK FINISH, PN#ATS-BOLMNT-11-STDBLK FOR MOUNTING OF OUTDOOR WIRELESS ACCESS POINT.
6 LEVITON PN#PDP12B048AB0707-I/O(YEL) 48 FIBER TIGHT BUFFERED, PLENUM, SINGLE-MODE, INDOOR/OUTDOOR, YELLOW JACKET, NO SUBSTITUTE UPLINK FIBER
7 PROVIDE DUAL HEAD NETWORKED EV CHARGING STATION. LEVITON CPHU2 DUAL HEAD UNIT, CPMBX BOLLARD BODY, CPCAP-B BOLLARD CAP, CPCBX CABLE MANAGEMENT ASSEMBLY AND CONCRETE MOUNTING KIT CPCMK.
8 PROVIDE LC TERMINATION OF FIBER IN MDF, ROOM 113G . OWNER TO MAKE FINAL CONNECTION TO MDF IN ROOM 113G.
9 EXTEND 120V CIRCUIT FROM WIRELESS ACCESS POINT TO COMMUNICATIONS HANDHOLE FOR SITE CAMERAS WITH 2#12, 1#12G IN 3/4"C.
10 PROVIDE POLE WITH LOW VOLTAGE DIVIDER AT THIS LOCATION.

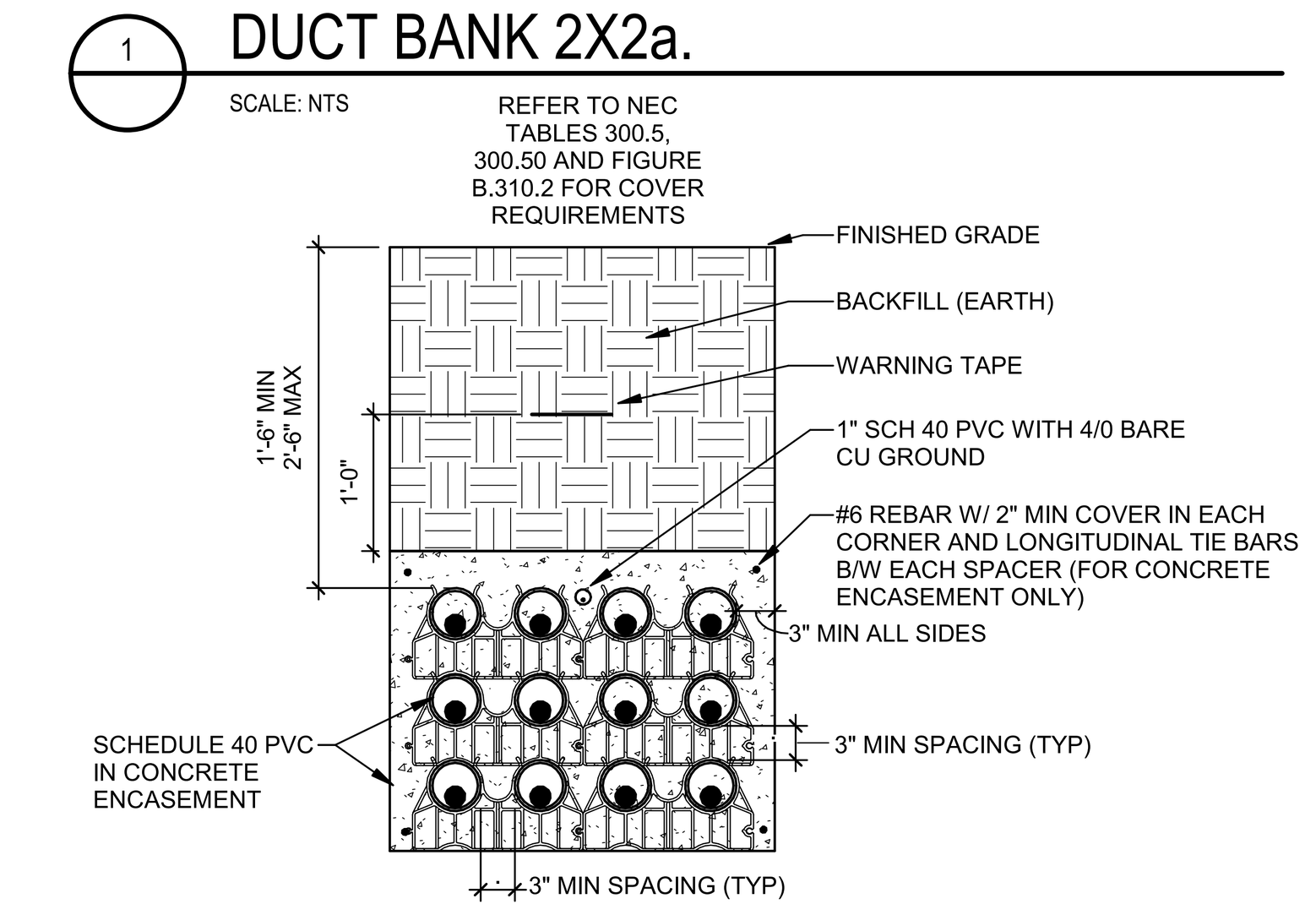
ELECTRICAL SITE LEGEND

SYMBOL	DESCRIPTION
—— UGC ——	UNDERGROUND COMMUNICATION.
—— UGE ——	UNDERGROUND ELECTRIC.
—— UGP ——	UNDERGROUND PRIMARY ELECTRIC.
—— UGS ——	UNDERGROUND SECONDARY ELECTRIC.
⍁	POWER AND LIGHTING HANDHOLE.
⍁	POWER AND LIGHTING MANHOLE.
⊠	COMMUNICATIONS HANDHOLE.
⊠	COMMUNICATIONS MANHOLE.
↑ ↑	DUCT BANK SECTION MARKER.
4-4"	DUCT BANK SECTION LABEL INDICATING GENERAL ARRANGEMENT OF CONDUITS. TEXT INDICATES QUANTITY AND SIZE OF CONDUITS.
●	NEW CABLE IN DUCT BANK.
⊙	EXISTING CABLE IN DUCT BANK TO REMAIN.
⊗	EXISTING CABLE IN DUCT BANK TO BE REMOVED.



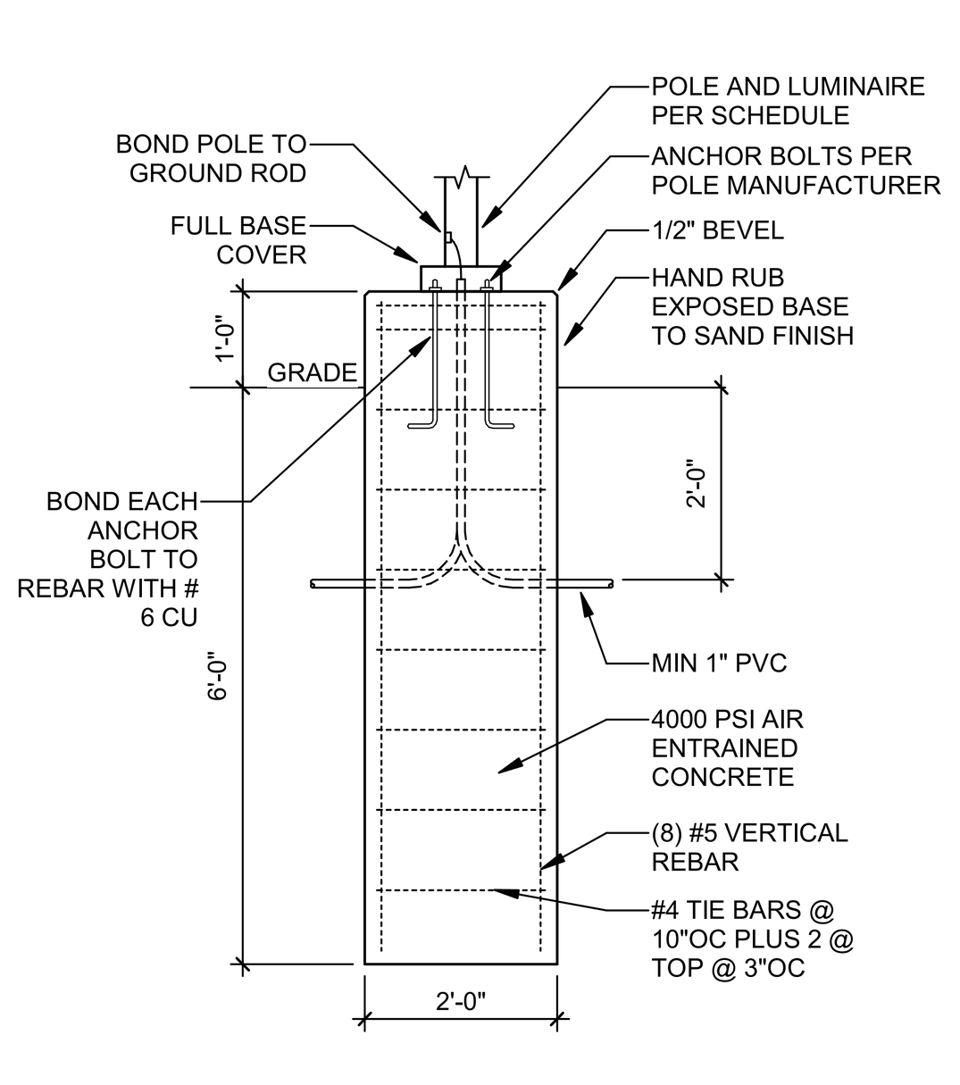
1 DUCT BANK 2X2a.

SCALE: NTS



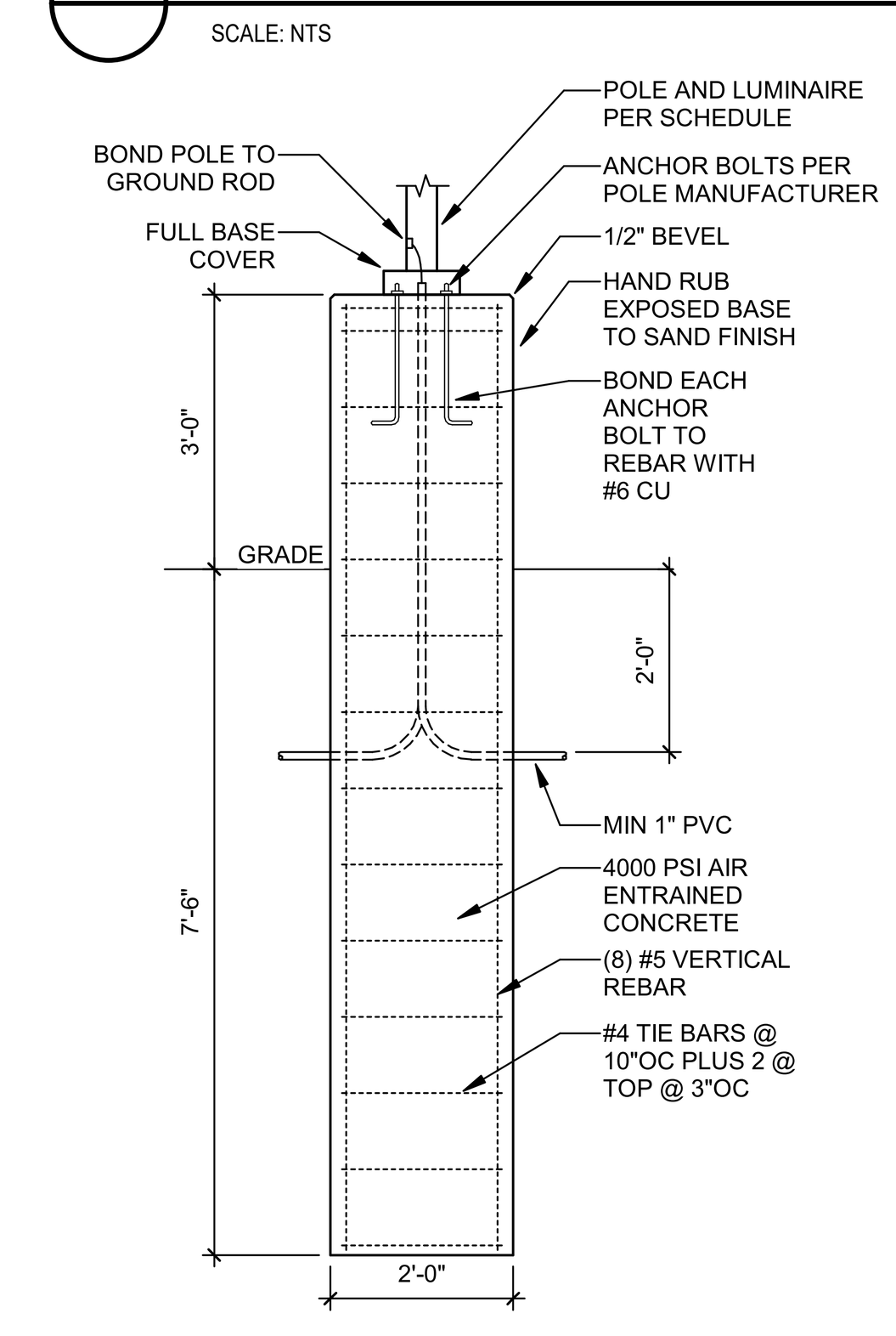
2 DUCT BANK 3X4a

SCALE: NTS



4 POLE-1 FT BASE - OPT, OPT-EM

SCALE: NTS



3 POLE BASE 3' O1-3&4

SCALE: NTS

UofL SPEED SCHOOL STUDENT SUCCESS BUILDING

UL BUILDING 132
201 ENGINEERING DRIVE,
LOUISVILLE, KY 40208

OWNER
UNIVERSITY PLANNING, DESIGN & CONSTRUCTION
421 WEST CARDINAL BOULEVARD,
LOUISVILLE,KY, 40208
502-852-6176

ARCHITECT, LANDSCAPE ARCHITECT, CIVIL ENGINEER
LUCKETT & FARLEY
737 SOUTH THIRD STREET
LOUISVILLE, KY 40202-2100
502-585-4181

PROGRAMMING, DESIGN, STRUCTURAL ENGINEER, LAB PLANNING
SMITHGROUP
500 GRISWOLD ST #1700
DETROIT, MICHIGAN,48104
313-442-8120

FIRE PROTECTION, MECHANICAL, PLUMBING, ELECTRICAL ENGINEERING
LUCKETT & FARLEY
737 SOUTH THIRD STREET
LOUISVILLE, KY 40202-2100
502-585-4181

AV - ACOUSTICAL CONSULTANT
ACENTECH
33 MOULTON STREET
CAMBRIDGE, MA 02138
617-499-8000

CONSTRUCTION MANAGER
WHITTENBERG CONSTRUCTION
4774 ALLMOND AVE
LOUISVILLE, KY 40209
502-361-8891

SHEET ISSUE

1	ADDENDUM #2	1-2-2024
2	ADDENDUM #6	1-27-2024
3	ASI	Date 4
4	RFP-15 DURESS BUTTONS AND NETWORK DROPS	12-05-2024
5	RFP-XX	12/17/2024

SEAL

PROJECT ORIENTATION

PROJECT NORTH　TRUE NORTH

Luckett&Farley
Architecture | Engineering | Interior Design

COMM. NO.
2022.091

DATE
12/01/2023

BID PACKAGE #3 - FULL BUILDING

DRAWN BY
DAH

CHECKED BY
JNJ

SHEET TITLE
ELECTRICAL SITE PLAN

SHEET NUMBER
ES001

0 1/2" 1"
SCALE SHOWN TO ENSURE REPRODUCTION ACCURACY

PROJECT DESIGN CRITERIA

1). REFERENCE THE "BILL OF MATERIAL" ON THIS SHEET. THE SITE WORK, ie CIVIL, ELECTRICAL, PERMITTING etc, SHOWN. THE PRODUCT SUPPLY SYSTEM, ie TANK, VAPORIZERS & INTERCONNECTING PIPING, IS THE RESPONSIBILITY AND IS OWNED by "PRAXAIR INC"/ "LINDE".

2). ALL ACCESS ROADWAYS ARE THE RESPONSIBILITY OF THE CUSTOMER AND ARE TO BE CAPABLE OF SUPPORTING 80,000 lbs. AASHTO HS-20 LOADING.

3). THIS FOUNDATION SYSTEM IS DESIGNED ASSUMING THE FOLLOWING CONDITIONS; 2000 psf SOIL BEARING CAPACITY
115 MPH WIND LOAD EXPOSURE 'C'
(IBC 2012) SEISMIC VALUES: Ss=11.1% S1=6.4%

NORMAL WATER TABLE CONDITIONS IN ACCORDANCE WITH A.C.I.318 LATEST EDITION FOR CONDITIONS OUTSIDE THESE CRITERIA IT IS THE CUSTOMERS RESPONSIBILITY TO PROVIDE SUITABLE FOUNDATION DESIGNS THAT MUST BE APPROVED BY "PRAXAIR INC"/ "LINDE" BEFORE CONSTRUCTION.

4). CONTRACTOR TO REMOVE TOPSOIL UNTIL A SUITABLE BASE IS ESTABLISHED FOR GRAVEL UNDERLAYMENT IF CONDITIONS CANNOT BE MEET AT DRAWING DEPTHS.

5). CONTRACTOR TO USE AIR ENTRAINED, 4"-5" SLUMP CONCRETE;
ASTM #C-150 TYPE I, FC=4500psi @ 28 DAYS.
OR
ASTM #C-150 TYPE III, FC=4500psi @ 7 DAYS.

6). ROUND EDGES OF PADS WITH SIDEWALK EDGING TOOL.

7). TOP OF PADS TO BE BROOM FINISHED AND LEVEL, ALL PAD ELEVATIONS TO BE REFERENCED FROM CHOSEN BENCHMARK.

8). SKIRTING OF PAD TO BE BELOW FROST LINE PER LOCAL BUILDING CODES.

9). BUMPER POSTS TO BE FILLED WITH CONCRETE. IN MULTIPLE POST INSTALLATIONS, ALL POST TOPS ARE TO BE IN A LINE.

10). BUMPER POSTS TO BE PAINTED; BLAST=SSPC-SP6
PRIME=2.5mil RED OXIDE
PAINT=2.5mil SAFETY YELLOW
W/3 STRIPS OF REFLECTIVE TAPE AT TOP OF POST.

11). INDIVIDUAL PADS, i.e., TANK, TRANSFER, etc, TO BE SEPARATED WITHIN ISOLATION JOINT; USE PLYWOOD TREATED WITH WAX (OR EQUIV. BOND-BREAKER), EXCEPT ON TOP FACE; TOP OF PLYWOOD TO BE 1" FROM TOP OF CONCRETE; THIS SURFACE TO BE SEALED w/ "CS-2727"FLEXIBLE EPOXY JOINT SEALER (OR EQUIV).

12). ALL OUTDOOR RECEPTACLES AT SITE TO BE PROTECTED WITH GROUND FAULT INTERRUPTERS.

13). ALL ELECTRICAL COMPONENTS NOT INSTALLED WITHIN A BUILDING MUST BE IN WEATHERTIGHT ENCLOSURES.

14). SELECT FILL SHALL BE COMPACTED WELL GRADED CRUSHED STONE WITH LESS THAN 10 PERCENT PASSING A 200 SIEVE.

15.) 4 MILL POLYETHYLENE VAPOR BARRIER SHALL BE PLACED AROUND (ON THE TOP AND BOTTOM, AND SIDES) OF THE SELECT FILL. ALL SEAMS IN THE VAPOR BARRIER SHALL BE SEALED WITH POLYVINYL-CHLORIDE PACKING OR POLYETHYLENE TAPE. VAPOR BARRIER MAY BE PROTECTED FROM PUNCTURE WITH 2" OF SAND IF REQUIRED BY CONSTRUCTION CONDITIONS.

16.) RIGID INSULATION SHALL BE STYROFOAM SB BRAND EXTRUDED POLYSTYRENE FOAM INSULATION, MANUFACTURED BY THE DOW CHEMICAL COMPANY OR APPROVED EQUAL. ALL JOINTS SHALL BE SEALED WITH POLYVINYL-CHLORIDE PACKING OR APPROVED EQUAL.

BILL of MATERIAL

ITEM	QTY	U/M	DESCRIPTION	SUPPLIER
1	1	EA	HYDROGEN VESSEL, CRYOGENIC STORAGE, VLH-15,000	LINDE
2	2	EA	VAPORIZER, ATMOSPHERIC PRODUCT, THERMAX 5LWS-12M-SS	LINDE
3	1	EA	MANIFOLD, COMB, LTPP/REG W/ 2" K&M REGULATOR S.S.	LINDE
4	1	EA	WIRELESS TELEMETRY UNIT	LINDE
5	AS REQ'D		ROD, GRND, 3/4"DIA, SUFFICIENT LGTH FOR 25ohms	CUSTOMER
6	AS REQ'D		BUSHING, FOR 1" PVC CONDUIT	CUSTOMER
7	AS REQ'D		CONDUIT, PVC, 1" PS	CUSTOMER
8	AS REQ'D		WIRE, GROUNDING, #4/0 BARE STRANDED COPPER	CUSTOMER
9	AS REQ'D		PIPE, 6" SCH 40 x 84" lg, (MIN) C-STL	CUSTOMER
10	AS REQ'D		FENCE GROUNDING DEVICE,BURNDY TYPE "GAR"	CUSTOMER
11	AS REQ'D		BAR, NO.7, ASTM TYPE A-615, GRADE 60	CUSTOMER
12	AS REQ'D		CONNECTOR,GROUNDING,BURNDY TYPE "GCM"	CUSTOMER
13	AS REQ'D		BAR, NO.5, ASTM TYPE A-615, GRADE 60	CUSTOMER
14	AS REQ'D		FENCE, CHAIN LINK, 9 GA. X 72" HIGH	CUSTOMER
15	1	EA	GATE, SLIDING, 72" WIDE MIN, CHAIN LINK, 9 GA. X 72" HIGH	CUSTOMER
16	1	EA	GATE, SWING 36" WIDE MIN, CHAIN LINK, 9 GA. X 72" HIGH	CUSTOMER
17	AS REQ'D		CONCRETE, SEE NOTE # 5.	CUSTOMER
18				
19				
20	2	EA	1/2" S.S. TUBING STUB UP, H2 EMERGENCY SHUT OFF LOOP	CUSTOMER
21	1	EA	CHAN,C4x5.4lb/ft, ASTM A-36, GALV ASTM A123	CUSTOMER
22	2	EA	VALVES, ISOLATION, 1" BALL, DUAL PURGE, 300psi. W.O.G.	CUSTOMER
23			** TO BE CLEANED FOR OXYGEN SERVICE **	
24	AS REQ'D		CABLE, GROUNDING, #4 EXTRA FLEX, COPPER	CUSTOMER
25	1	EA	HOOK, GROUND HANGER,STN.STL; 1/4".	CUSTOMER
26	1	EA	CLAMP, MECH GRD,STEWART R. BROWNE P/N 2178	CUSTOMER
27	1	EA	VAPORIZER, ATMOSPHERIC PRESSURE BUILDING, 810	LINDE
28				
29				
30				
31				

LINDE NEW EQUIPMENT TABLE

EQUIPMENT ITEM	EQUIPMENT NAME	REMARKS	DIMENSIONS (in) Length	Width	Height	WEIGHT (pounds) Empty	Full	ANCHOR BOLTS (in) Type	Diameter	Embedment
1	VLH-15000 LH2 Vert. Tank	on new foundation	128	= dia.	496	63,700	72,000	Red Head Trubolt	1	4.5
2	5LWS-12M Vaporizer	on new foundation	102	102	287	2,600	NA			

BUSINESS CONFIDENTIAL
MIDWEST
SERVICE CENTER
EAST CHICAGO, IN

No.	Description	Dwg By	Aprvd By	Date

NOT FOR CONSTRUCTION

Drawn By: JPG	Date: 5/16/23
Released:	Plot Date: 5/16/23
Checked:	Scale: NONE

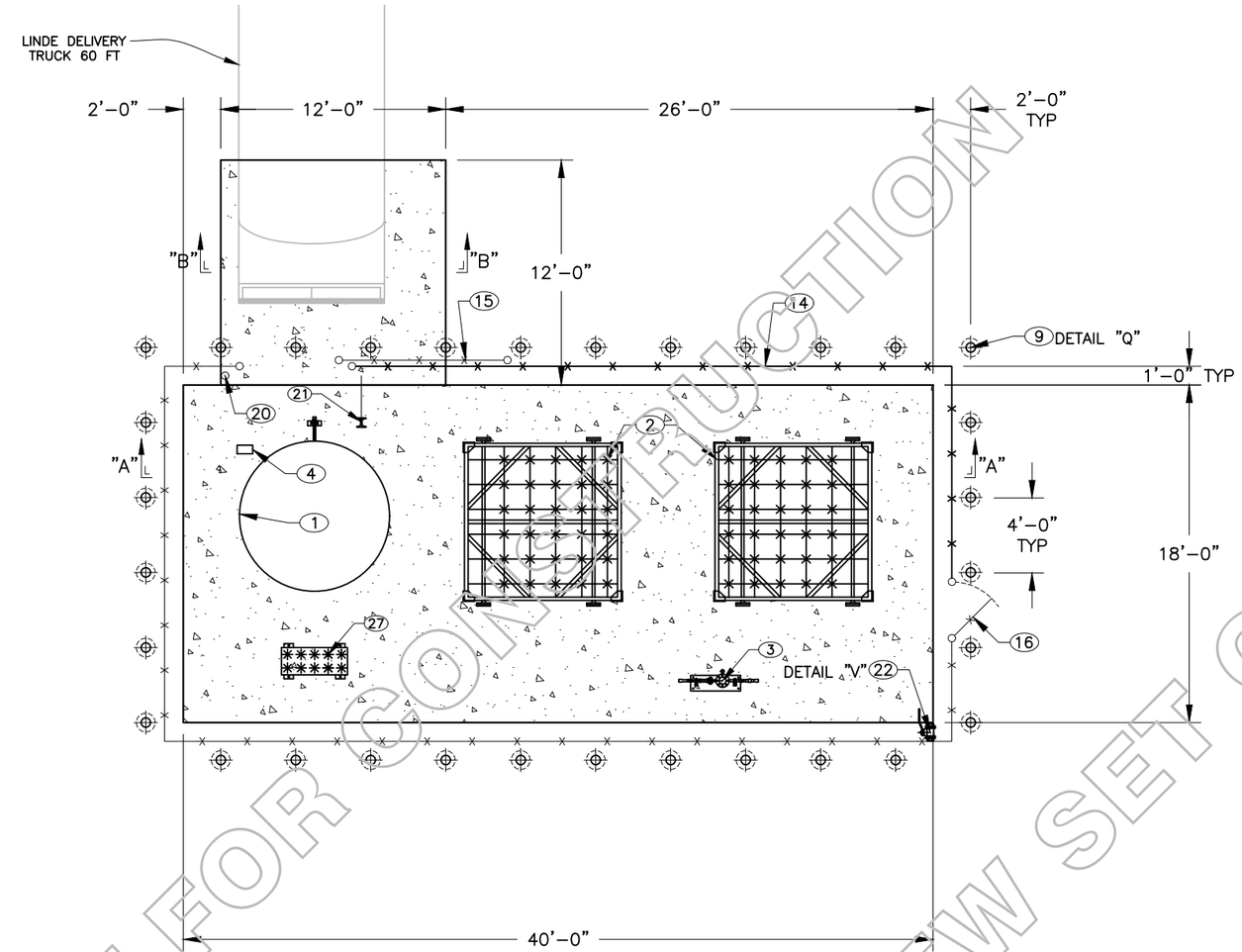
Client:
NFC VLH15000
WITH (2) MODEL 5

Drawing Type:
HYDROGEN SYSTEM

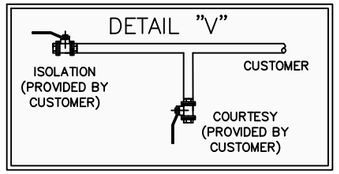
Title:
B.O.M., SYSTEM LAYOUT, & FOUNDATION

Project No.
NFC VLH

Sheet Number: 1	Total Sheets: 6



DETAIL "V"



BUSINESS CONFIDENTIAL
MIDWEST
SERVICE CENTER
EAST CHICAGO, IN

No.	Description	Dwg By	Apvd By	Date

NOT FOR CONSTRUCTION

Drawn By: JPG	Date: 5/16/23
Released:	Plot Date: 5/16/23
Checked:	Scale: NONE

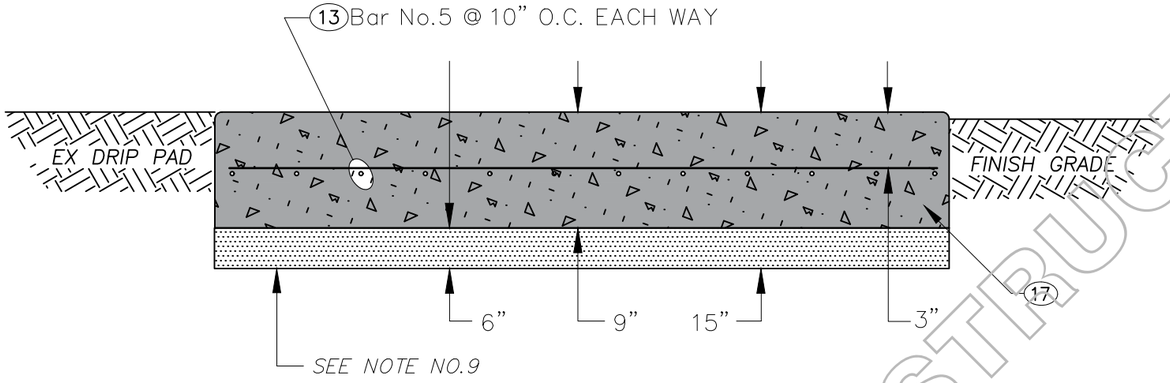
Client:
NFC VLH15000
WITH (2) MODEL 5

Drawing Type:
HYDROGEN SYSTEM

Title:
B.O.M., SYSTEM LAYOUT, & FOUNDATION

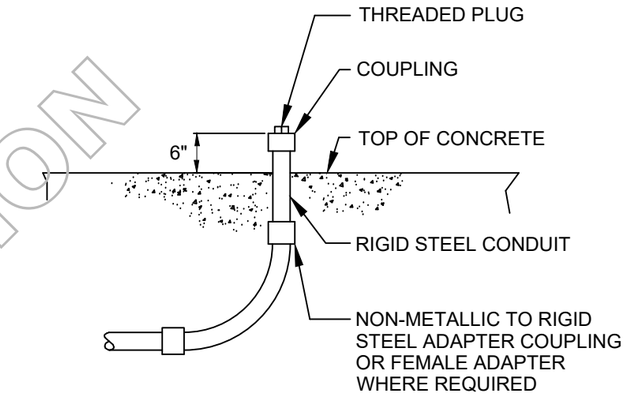
Project No.
NFC VLH

Sheet Number:	Total Sheets:
2	6



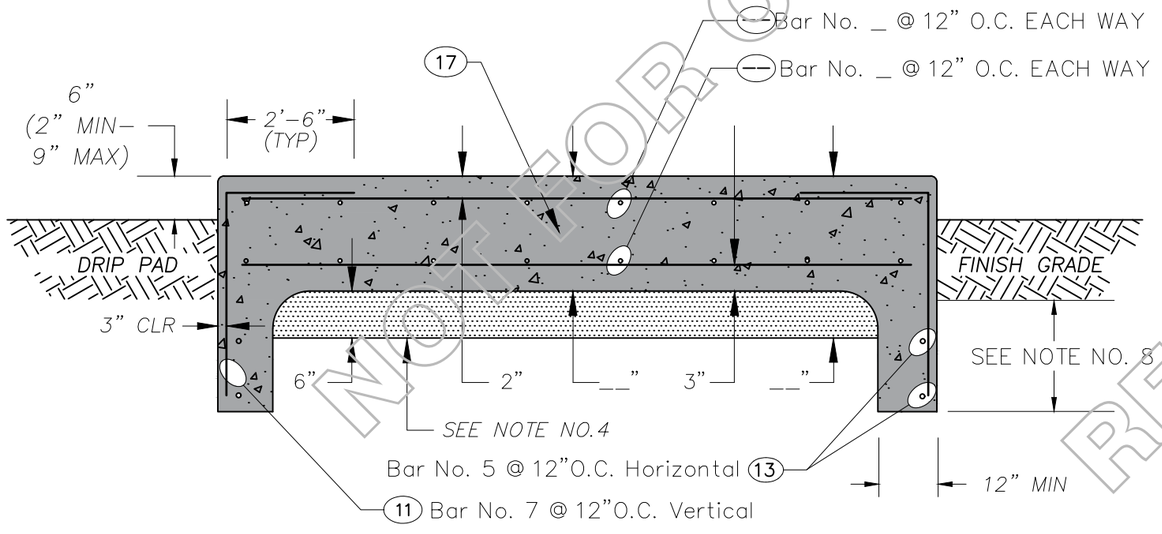
DRIP PAD - VIEW AT 'C'-'C'

SCALE: NONE



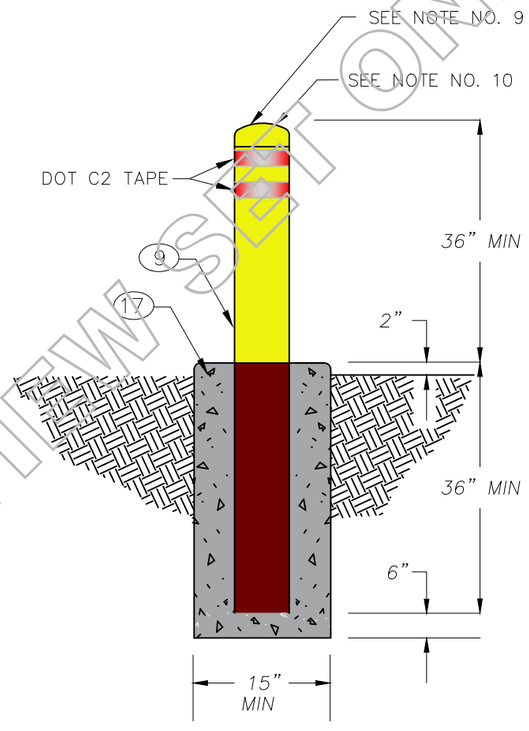
ELECTRICAL STUB UPS

SCALE: NONE



TANK PAD - VIEW AT 'A'-'A'

SCALE: NONE



DETAIL 'Q' - GUARD POST

SCALE: NONE

BUSINESS CONFIDENTIAL
MIDWEST
SERVICE CENTER
EAST CHICAGO, IN

No.	Description	Dwg By	Apvd By	Date

NOT FOR CONSTRUCTION

Drawn By: JPG	Date: 5/16/23
Released:	Plot Date: 5/16/23
Checked:	Scale: NONE

Client:
NFC VLH15000
WITH (2) MODEL 5

Drawing Type:
HYDROGEN SYSTEM

Title:
B.O.M., SYSTEM LAYOUT, & FOUNDATION

Project No.
NFC VLH

Sheet Number:	Total Sheets:
3	6

ELECTRICAL UNDERGROUND SPECIFICATIONS

SECTION UGE-1
GENERAL REQUIREMENTS

1.0 Scope

This section of the specification is for general requirements and defines all applicable codes, materials, material supply responsibility and general procedures that shall be adhered to by This Contractor. This Contractor shall provide and install a complete and acceptable underground electrical system as defined by these specifications and/or on The Owner's Electrical Underground Construction Drawings.

1.1 Applicable Codes

All Contractor purchased items and Contractor installation techniques shall be in complete accordance with all local laws and/or ordinances having jurisdiction and also the latest editions and supplements thereto of the "National Electrical Code" (N.E.C.), the "National Electrical Manufacturers Association" (NEMA), the "American National Standards Institute" (ANSI), the "Institute of Electrical and Electronic Engineers" (IEEE), the Federal "Occupational Safety and Health Administration" (OSHA) rules and regulations and the "National Electrical Safety Code" (NESC).

The above local laws, and standards shall constitute the minimum electrical standards to be followed by This Contractor in fulfilling the obligations of the construction drawings and specifications made a part of this contract. This Contractor is fully responsible for all work performed to guarantee a safe and reliable underground electrical system.

All materials and/or equipment supplied by This Contractor shall be listed by Underwriters Laboratories, Inc. or by a qualified Electrical Testing Laboratory recognized by the body having legal jurisdiction over electrical installations, except for classes of materials and equipment not available with such listing.

1.2 Material and Material Responsibility

All the materials required for a complete electrical underground installation, as defined in this specification and/or on the electrical underground drawings shall be furnished by This Contractor unless specifically noted otherwise.

Handling and storage of all material furnished by This Contractor, including material furnished by others for his use, shall be the responsibility of This Contractor.

1.3 General Procedures

All work shall be performed as indicated on the drawings and are made part of this specification.

In case of a conflict between the drawings and specifications, This Contractor is to notify the Owner's Engineer. Failure to do so could result in additional costs to This Contractor.

This Contractor shall furnish all manpower, tools and instruments required to properly install, inspect and test all electrical systems or equipment as described in this specification and/or on the Owner's Electrical Underground Drawings.

1.4 Temporary Underground Installations

All temporary underground installations installed by This Contractor shall be marked on the site layout drawings and kept up-to-date with respect to the addition or removal of such installations. If any such installations are abandoned in place, this information must be transmitted to the Owners Engineer for incorporation in as-built documentation.

During backfill operations, red polyethylene "Warning" tape will be buried 6" [152mm] to 12" [305mm] below grade, and directly above the temporary underground cable, conduit, pipe, etc. for its entire length.

If the installation is near the perimeter of the work site, where it is possible that excavating or digging may be done by an outside agency (customer, utility, municipality, etc.), the location should be marked with small flags at intervals no greater than ten feet (10') [3 meters].

This information, i.e., the location of any temporary underground installations, must be transmitted to all other Contractors as they begin work on the site.

1.5 As Built Drawings

Upon completion of the contracted work, This Contractor shall submit to the Owner's Engineer one (1) complete set of marked-up Electrical Underground Drawings. These drawings shall be marked-up to reflect the as-built conditions of the electrical underground installation.

SECTION UGE-2
ELECTRICAL GROUNDING

2.0 Scope

This section of the specification is for electrical grounding and defines all material, installation requirements and general procedures, that shall be adhered to by This Contractor. This Contractor shall provide and install a complete and acceptable underground grounding system, as defined in these specifications and/or on The Owner's Electrical Underground Drawings.

2.1 Material

This Contractor shall furnish all material for a complete grounding system. Exceptions to the materials furnished by This Contractor will be noted as "By Others" or "By Owner".

The following materials are the major items required. Additional material requirements are shown, noted or listed on the drawings.

2.1.1 Grounding conductors shall be #4/0 AWG [95mm], medium hard drawn, bare, stranded copper unless noted otherwise.

2.1.2 All ground rods (electrodes) shall be 0.75 inch [19mm] diameter by 10 feet [3 meters] long copper clad.

2.2 Installation Requirements

This Contractor shall install a complete grounding system as required by this specification and as shown, noted or listed on the drawings. Additional installation requirements to be adhered to by This Contractor are as follows:

2.2.1 All ground conductors shall be installed a minimum of 18 inches [457mm] below grade, with sufficient slack to prevent damage to the conductors. Ground conductors installed under streets, roads, driveways and parking lots shall be installed a minimum of 24 inches [610mm] below grade.

2.2.2 Where grounding conductors emerge through concrete foundations, building floors, or from below grade, a PVC conduit sleeve shall be installed to protect the grounding conductor from mechanical injury.

2.2.3 All below grade connections shall be made with approved compression type fittings, using a full-cycle tool such as "Burndy" type "Y35 HYPRESS-Hydraulic Tool", or by brazing or by an exothermic type welding process such as "Cadweld". Soldered connections are prohibited.

2.2.4 Where ground conductors are extended above grade for future termination, they shall have a minimum length of four (4) feet [1.2 meters]. Loose ends of ground wires shall be coiled and tied for protection and to avoid a tripping hazard.

2.2.5 Where ground conductors are installed in a common trench with underground metal piping of any type, adequate separation shall be maintained. The ground conductor shall not be allowed any direct contact with any of the metal piping. If contact can not be avoided, a green insulated ground conductor shall be installed.

2.3 General Procedures

2.3.1 Testing

This Contractor shall measure the ground resistance of the grounding system. A megger type ground tester (two test probe type) as manufactured by the "James G. Biddle Company", or "Vibraground" as manufactured by "Associated Research Inc." shall be used. Tests shall be made in three widely separated locations as specified by The Owner and shall show a resistance of 3 ohms or less. A megger insulation tester is not suitable for this application. Upon completion of testing, This Contractor shall submit all readings, in writing, to The Owner's Engineer.

NOTE: When the resistance test is being performed, all aboveground ground conductors connected at the test point must be disconnected for the duration of the test.

SECTION UGE-3
CONDUIT AND CONDUIT WORK

3.0 Scope

This section of the specifications is for underground conduit and conduit work and defines all material, installation requirements and general procedures that shall be adhered to by This Contractor. This Contractor shall provide and install a complete and acceptable underground conduit system, as defined in these specifications and/or on The Owner's Electrical Underground Drawings.

3.1 Material

This Contractor shall furnish all material for a complete conduit system. Exceptions to the materials furnished by This Contractor will be noted as "By Others" or "By Owner".

The following materials are the major items required. Additional material requirements are shown, noted or listed on the drawings.

3.1.1 Underground conduit material shall be schedule 40 PVC, and/or rigid, galvanized steel as noted on the drawings. Minimum underground conduit size shall be 1 inch [25mm], unless otherwise noted. All conduits shall be listed for 90° wire and shall be sized as indicated on the drawings.

3.1.2 Rigid and intermediate metal conduit shall be of high ductile quality, hot dipped galvanized inside and out, including threads, and lacquer finished. Conduits shall be delivered to site in 10 foot [3 meter] lengths, threaded, with one coupling on one end and a thread protector on the other end.

3.1.3 PVC conduit will be schedule 40 and delivered in 10 foot [3 meter] lengths, with one coupling on each section.

3.1.4 Concrete encasements shall be 2,000 PSI at 28 days with a maximum aggregate size of 0.5 inch [15mm]. The surface of all concrete duct banks shall be colored red by either mixing or troweling a red dye into the concrete surface.

3.1.5 Refer to the "Electrical Underground Conduit Schedule" for required conduit sizes and types (PVC or Rigid).

3.1.6 Under no circumstances shall This Contractor use smaller conduits than those called for in the "Electrical Underground Conduit Schedule".

3.1.7 Where required, manholes may be either pre-cast, or field constructed.

3.2 Installation Requirements

This Contractor shall install a complete underground conduit system as required by this specification and as shown, noted or listed on the drawings. Additional installation requirements to be adhered to by This Contractor as follows:

3.2.1 This Contractor shall provide all excavation, backfilling and tamping in connection with the underground conduit work. This Contractor shall backfill carefully with selected material (rock free) approved by the Owner's Engineer and thoroughly tamp it in layers. If settlement does occur, those areas must be further filled and tamped. All conduits installed underground shall be a minimum of three (3) feet [1 meter] below finished grade unless noted otherwise on The Owner's drawings.

3.2.2 All PVC conduits, unless shown otherwise on The Owner's drawings, shall be encased in a concrete envelope with a minimum of three (3) inches [76mm] of cover all around, and a minimum of three (3) inches [76mm] between ducts. This Contractor shall use standard spacers every four (4) feet [1.2 meters] to maintain proper conduit spacing. All PVC joints shall be properly cleaned and cemented.

3.2.3 PVC conduit banks shall be reinforced only if shown or noted on the drawings. Reinforcing is required under all roadways.

3.2.4 Rigid galvanized conduit banks need not be concrete encased, unless routed under roadways or specifically shown as concrete encased on The Owner's drawings. All rigid underground conduit joints shall be coated with coal tar epoxy or epoxy mastic after they are assembled and before any concrete is poured.

3.2.5 Where conduits enter building foundations, floor slabs or equipment foundations, these conduits shall be placed before concrete foundations are poured.

3.2.6 After conduits are installed, This Contractor shall pull a flexible mandrel, sized 0.25 inch [6.4mm] less in diameter than the bore of the conduit, through the conduit to clean out any obstructions. This Contractor shall install a #9 nylon fish-wire in each conduit upon completion.

3.2.7 This Contractor shall plug all conduits and ducts to prevent the entrance of dirt or foreign particles.

3.2.8 For conduit stub-up details and dimensions, refer to The Owner's drawings.

3.2.9 All underground conduit and duct banks shall be located as shown on The Owner's drawings. Any rerouting of underground conduit or duct banks will require the Owner's Engineer's approval. This Contractor shall provide as-built drawings showing the location of all underground duct banks and manholes.

3.2.10 The number of 90° bends allowed between pulling points shall not exceed the following:

Distance	Number of 90° Bends
Up to 100 Ft [30.5 M]	4
100 [30.5] - 300 Ft [91.5 M]	3
Above 300 Ft [91.5 M]	2

NOTE: Two 45° bends are equivalent to one 90° bend.

3.2.11 The minimum allowable underground bending radius, unless specifically noted otherwise on The Owner's drawings, is as follows:

Conduit Size	Steel	PVC Fiber or Transite
1" [25mm]	12" [305mm]	12" [305mm]
2" [50mm]	24" [610mm]	24" [610mm]
3" [80mm]	36" [915mm]	36" [915mm]
4" [100mm]	36" [915mm]	36" [915mm]
5" [125mm]	--	48" [1219mm]
6" [150mm]	--	48" [1219mm]

3.2.12 Refer to the "Electrical Underground Conduit Schedule" for conduit routing, termination details and identification numbers.

3.2.13 When manholes are used, all conduit runs shall drain towards the manholes.

3.2.14 Manholes shall have a pulling hook provided in the opposite wall from each conduit entrance.

3.2.15 Manholes shall be provided with a low point pump-out area and an aligned opening in the cover so that water may be easily removed before entry.

3.3 General Procedure

3.3.i Conduit Identification

All conduits identified by numbers on The Owner's Electrical Underground Conduit Schedule" shall also be identified at both ends and in any manholes using one of the following methods:

a) A non-corrosive metal or fiber tag, securely fastened to the conduit with an annealed brass wire. All tags shall have clearly readable letters and numbers no smaller than 0.375 inch [10mm] in height.

b) Where practical conduit identification numbers may be stenciled on or adjacent to conduits with a permanent, weatherproof paint.

No.	Description	Dwg By	Apvd By	Date

NOT FOR CONSTRUCTION

Drawn By: JPG	Date: 5/16/23
Released:	Plot Date: 5/16/23
Checked:	Scale: NONE

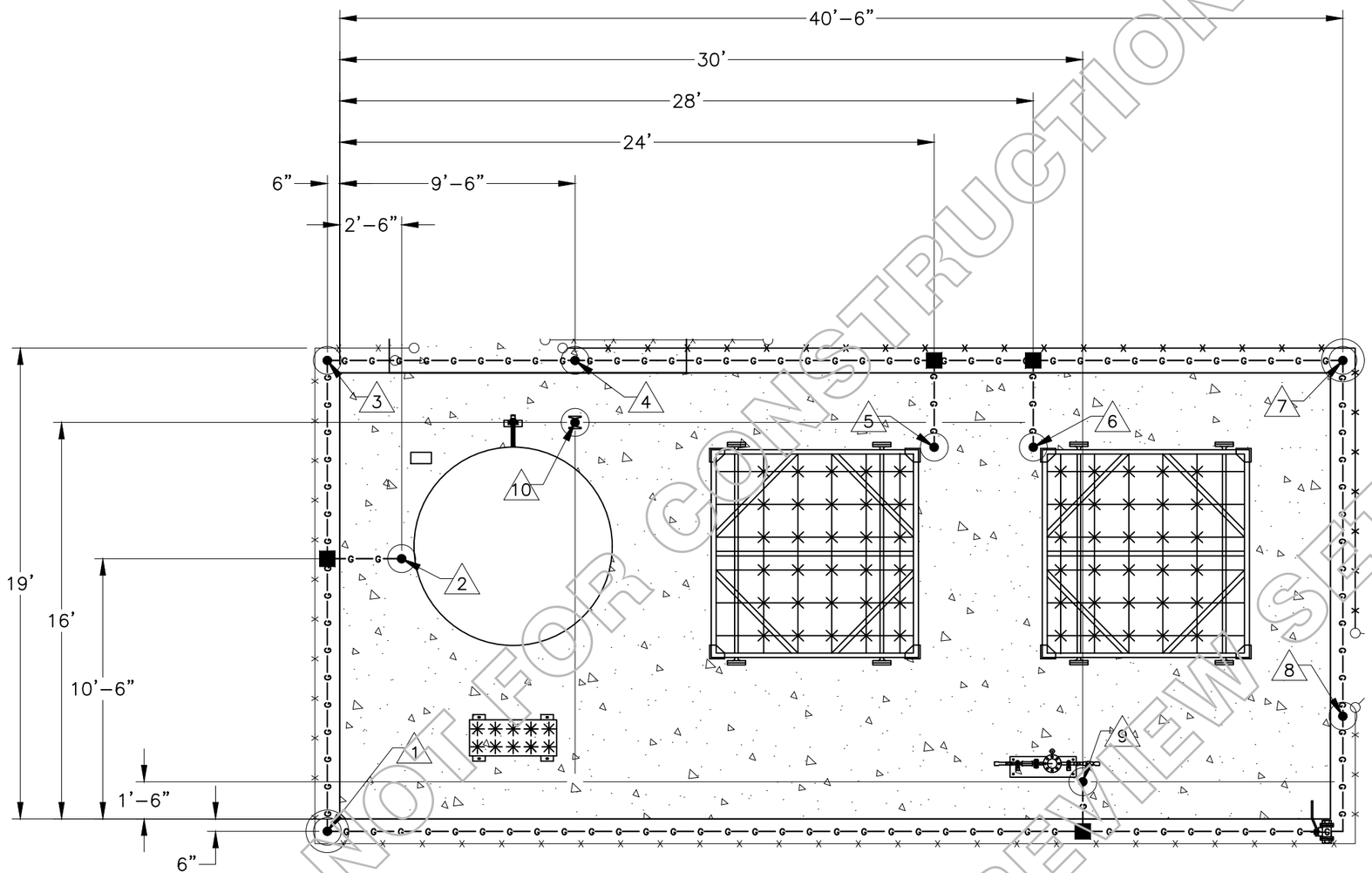
Client:
NFC VLH15000
WITH (2) MODEL 5

Drawing Type:
HYDROGEN SYSTEM

Title:
B.O.M., SYSTEM LAYOUT, & FOUNDATION

Project No.
NFC VLH

Sheet Number:	Total Sheets:
4	6



GROUNDING TABLE

CONDUIT No.	SEE DETAIL No.
1	DETAIL ”E–1”
2	DETAIL ”E–2”
3	DETAIL ”E–4”
4	DETAIL ”E–4”
5	DETAIL ”E–3”
6	DETAIL ”E–3”
7	DETAIL ”E–1”
8	DETAIL ”E–4”
9	DETAIL ”E–3”
10	DETAIL ”E–3”
11	DETAIL ”E–5”

GROUNDING LEGEND

- GROUND WIRE STUB–UP
- #4/0 BARE (STRANDED COPPER) GROUND WIRE
- BRAZED OR WELDED CONNECTION
- 3/4”DIA GROUND ROD

BUSINESS CONFIDENTIAL
MIDWEST
SERVICE CENTER
EAST CHICAGO, IN

No.	Description	Dwg By	Apvd By	Date

NOT FOR CONSTRUCTION

Drawn By: JPG	Date: 5/16/23
Released:	Plot Date: 5/16/23
Checked:	Scale: NONE

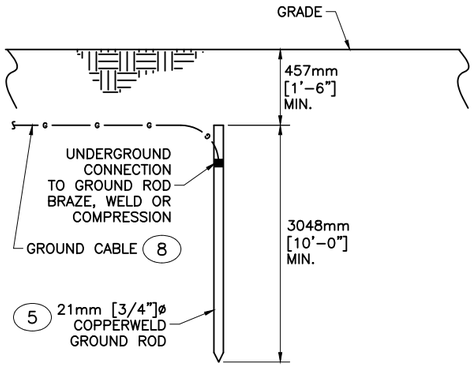
Client:
NFC VLH15000
WITH (2) MODEL 5

Drawing Type:
HYDROGEN SYSTEM

Title:
B.O.M., SYSTEM LAYOUT, & FOUNDATION

Project No.
NFC VLH

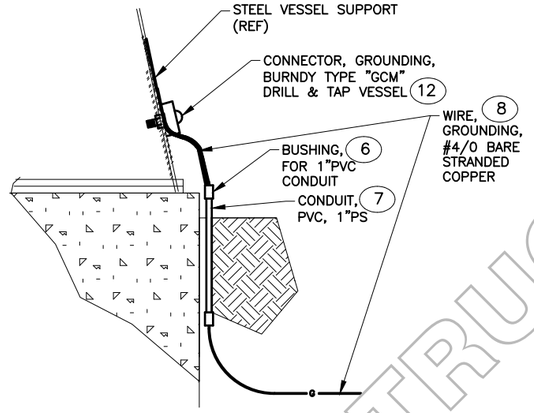
Sheet Number:	Total Sheets:
5	6



DETAIL "E-1"

GROUND ROD INSTALLATION

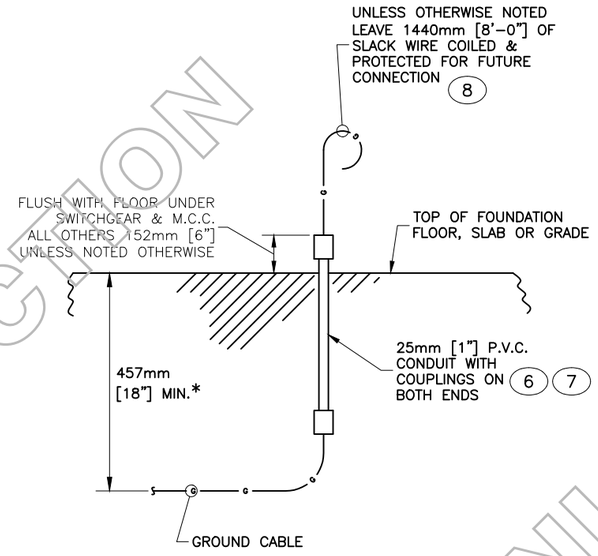
SYMBOL USED ON DRAWINGS



DETAIL "E-2"

TERMINATION FOR VESSEL

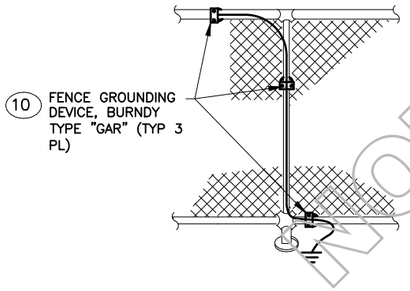
SYMBOL USED ON DRAWINGS



DETAIL "E-3"

* GROUND WIRE STUB-UP INSTALLATION
610mm [24"] UNDER STREETS, ROADS, DRIVEWAYS AND PARKING LOTS

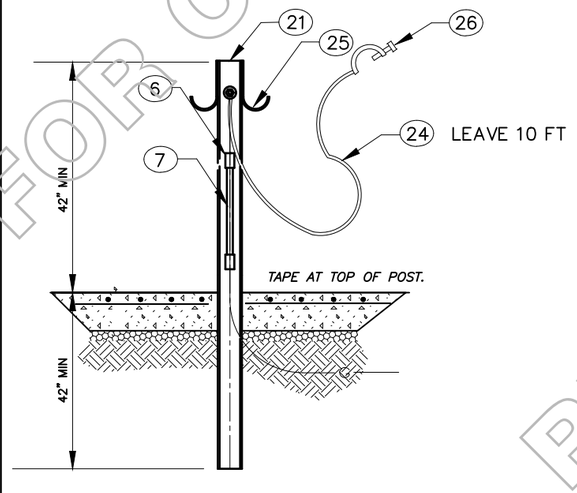
SYMBOL USED ON DRAWINGS



DETAIL "E-4"

TYPICAL FENCE GROUNDING

SYMBOL USED ON DRAWINGS



DETAIL "E-5"

TRAILER GROUNDING STATION

SYMBOL USED ON DRAWINGS

BUSINESS CONFIDENTIAL
MIDWEST
SERVICE CENTER
EAST CHICAGO, IN

No.	Description	Dwg By	Apvd By	Date

NOT FOR CONSTRUCTION

Drawn By:	Date:
JPG	5/16/23
Released:	Plot Date: 5/16/23
Checked:	Scale: NONE

Client:
NFC VLH15000
WITH (2) MODEL 5

Drawing Type:
HYDROGEN SYSTEM

Title:
B.O.M., SYSTEM LAYOUT, & FOUNDATION

Project No.
NFC VLH

Sheet Number:	Total Sheets:
6	6