To the Drawings and Project Manual Dated:

NOV 17, 2025

Entitled:

Indiana University
Launch Accelerator for Biosciences
1302 Indiana Ave.
Indianapolis, IN 46202

Prepared By:

BSA
175 S. Rangeline Rd., Suite 200
Carmel, IN 46032

_____

Addendum Dated: DEC 8, 2025

IU Project #: 20250072
BSALS Project #: 00360481

CONTRACTOR QUESTIONS

1. See attached list of bidder questions with design team responses.
2. See attached presentation from the 122/25 pre-bid meeting.

CHANGES TO THE PROJECT MANUAL

1. Specification 00 3100:
    a. Added reference to existing BRTC utility corridor drawings available to bidders.
    b. Revised date to newly issued Soil Management Plan (SMP), also included with this addendum.

2. Specification 23 6416:
    a. Revised per the attached.

3. Specification 23 6514:
    a. Revised per the attached.

4. Specification 26 0513:
    a. Revised per the attached.

5. Specification 26 0543:
    a. Revised per the attached.

6. Specification 26 1116:
    a. Revised per the attached.

7. Specification 26 3213:
    a. Revised per the attached.

8. Specification 26 3600:
    a. Revised per the attached.

CHANGES TO THE DRAWINGS

1. Sheet C400:
    a. Reissuing entire sheet due to previous overlapping graphics limiting plan content legibility.
    b. Revise the electrical ductbank routing.

2. Sheet C700:
    a. Revise the electrical ductbank routing.

3. Sheet C701:
    a. Reissuing entire sheet due to previous overlapping graphics limiting Electrical Ductbank Plans 1, 2, and 3 content legibility.
    b. Revise the electrical ductbank profiles to be shallower.

4. Sheet C702:
    a. Reissuing entire sheet due to previous overlapping graphics limiting Electrical Ductbank Plan 4 content legibility.
    b. Revise the electrical ductbank profiles to be shallower.

5. Sheet C703:
    a. Revise the electrical ductbank profiles to be shallower.

6. Sheet E120:
    a. Replace sheet in its entirety with the attached.

7. Sheet E600:
    a. Replace sheet in its entirety with the attached.

8. Sheet E752:
    a. Replace sheet in its entirety with the attached.

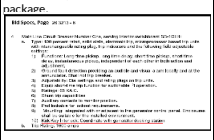
9. Sheet E756:
    a. Replace sheet in its entirety with the attached.

END OF BP2 CD: ADDENDUM NUMBER ONE

Attachments:

Specifications: 23 6416, 23 6514, 26 0513, 26 0543, 26 1116, 26 3600,
Drawings: C400, C700, C701, C702, C703, E120, E60, E752, E756
Bidder RFI responses, Pre-Bid Meeting Presentation

20250072 - IU LAB - BP2 Bidder RFI's

RFI #	Bid Package	Discipline	Sheet/Spec Section	Question	Answer	Response By	Addendum
1				From your ITB, it looks like this is bid package #2. However, on the iuplanroom website, I only saw bid package #1 for this project. Should I submit my plans to the bid package #1?	Submit bids to BP2 on the IU Plan Room, it is now posted on the site.	FAW	
2	BE2-31A	Electrical		In the prebid meeting, the re-feeding of an art building was brought up as being added scope. Is there reference to this scope of work in the drawings currently or will it be included in a new addendum that is to be released?	The added scope in question references the drawings currently. Specifically referencing sheet C400 note 17, as this was not captured previously in the initial scope of work distributed to bidders and will be adjusted in the project bid manual with the addendum issuance.	FAW	
3	BE2-31A	Electrical		Will Wilhelm be doing the excavation for the ductbank and setting the manholes or should we plan on including it in our proposal?	Wilhelm will not be doing the excavation for the ductbank or the setting of the manholes for this work. Please note item 5 in the BE2-31B scope of work in the project bid manual.	FAW	
4	BE2-31A	Electrical		1)Please confirm that Indiana University owns the existing manholes and existing circuits? This will clarify if we do, or do not, have to coordinate with AES for vault entry.	Manholes & existing circuit utilized for this project are owned by Indiana University.	BSA	
5	BE2-31A	Electrical	E752/E753	2)We see on drawings E752 and E753 what appear to be the existing directional bored conduits under Fall Creek with possible "measuring line" installed. Is it known what the footages are on both ends of those lines? This would help determine the total length with vertical elevation change below Fall Creek between MH202 and MH203, which impacts the footage of MV cabling.	The pathways in question were provided as part of IU Project 20016198B-6314 titled "Indiana University Foundation BRTC Utility Corridor" and dated July 11, 2002. These drawings are being made available for reference. The profile in question is illustrated on drawings E8 & E9.	BSA	
6	BE2-31A	Electrical		3)If the measured footage between MH202 and MH203 is not known, is there a vertical footage assumption that bidders should use for cable length estimating between MH202 and MH203?	See response to RFI 5.	BSA	
7	BE2-31A	Electrical		4)Is there a site plan available that accurately reflects the current road and civil conditions on the north side of Fall Creek (Around Waterway Blvd & Confluence Way)?	The most recent survey information was provided. Field verification will be needed to confirm existing conditions in this area.	JPS	
8	BE2-31A	Electrical		5)Where new duct bank has to cross new roads on the north side of Fall Creek, would directional bore with HDPE be allowed? Or will we have to close the road, cut & patch?	Feeders are to be encased in concrete ductbank	JPS	
9	BE2-26A	Equipment		As a material supplier only can the 10% retainage requirement be waived? We can only offer the terms that our suppliers offer, and most do not accept retainage.	Retainage requirement is 3% and cannot be waived.	FAW	
10	BE2-26A	Equipment		As a material supplier only can the bid bond requirement be waived?	Yes, the bid bond can be waived.	FAW	
11	BE2-31A	Civil		Will any of the excavation for the new duct bank require work in a 'floodplain' or other 'protected waterway' area, such that some additional precautions would be required?	Temporary dewatering of excavations may be required	JPS	
12	BE2-31A	Civil		Earthwork spec 31 20 00 refers to topsoil testing requirements. Please confirm this is applicable to BE2-31A scope?	Topsoil testing is not required for BE-31A scope.	JPS	
13	BE2-31A	Electrical		For encasing our electrical ducts, is 'bank-pouring' acceptable, or are 'concrete forms' required?	Ductbanks shall be provided per Division 26 Section "Electrical Underground Ducts, Ductbanks, and Manholes". (26 05 43)	BSA	
14	BE2-31A	Civil		Please confirm final landscape and/or grass seed/sod is not required following topsoil replacement?	All disturbed areas should be seeded after ductbank has been installed.	JPS	
15	BE2-31A	Civil		Is Soil Separator Fabric (31 20 00-2.1D) required for this bid package during backfill?	Soil Separator Fabric is not required for this bid package.	JPS	
16	BE2-31A	Civil		BE2-31A scope is to include specification 33 05 00. 33 05 00 refers to "33 30 00 SANITARY SEWERS". Please clarify if there is an expectation that BE2-31A will have to include some Sanitary Sewer work? We don't see it mentioned on the plans.	All sanitary sewer scope is included in BP #1. There is no sanitary sewer scope in BE2-31A. Please disregard this specification.	JPS	
17	BE2-31A	Civil		Do you know what existing roads/sidewalks are in the electrical duct bank route? I did not find any demo drawings. Given the changing nature of the site, I was not sure what condition each area will be in and when	Repair any sidewalks or roads that are impacted by the ductbank construction. The intent is to restore impacted areas back to original conditions after ductbank installation is complete.	JPS	
18	BE2-26A	Electrical		Bid specs call for Tier 3. Our Generac SD1000 is Tier 2. Will an exception be provided for Tier 3?	The genset shall be EPA certified for a stationary standby emergency application complying will all EPA and local emissions requirements.	BSA	
19	BE2-26A	Electrical		There is not a one-line. Drawings call for three ATS's (1200A, 1200A, 400A) and two output breakers on the 1000kW diesel generator (1600A and 150A). How are the three ATS's being fed from the two output breakers on the generator?	The two generator breakers will serve an interior switchboard (1600A) and a fire pump (150A) that are being provided in a future bid package. The three ATS's will be fed from the interior switchboard.	BSA	
20	BE2-26A	Electrical		Bid specs call for Kirk Key on the 1600A output breaker, fed to a docking station. Docking station is not mentioned in the remainder of the specs document. Is Kirk Key required on the 1600A output breaker on the generator?	Yes, kirk key is required on the 1600A generator breaker that will need coordinated with a dual purpose generator docking station that is being provided as part of a future bid package. 	BSA	
21	BE2-26A	Electrical		Does the project call for a docking station?	A dual purpose generator docking station will be provided in a future bid package.	BSA	
22				The mechanical schedules provided on drawings M600 and M601 list various equipment; however, none of these items appear on the corresponding plan views. Please confirm their locations or provide the relevant plan drawings.	The mechanical equipment scope is supply only, plan drawings to be included in a future bid package.	FAW	
23				Keynote 25 references a "New light pole base" and directs us to the electrical plans for further details. No such information is available on the electrical drawings. Kindly provide the required details.	This keynote is not a part of the BP2 scope of work and will be a part of a future bid package.	FAW	

24				Keynote 26 refers to "Site Light Bollard" with a note to see the electrical plans for more information, but these details are also not included. Please advise.	This keynote is not a part of the BP2 scope of work and will be a part of a future bid package.	FAW	
25				The keynote instructs to coordinate telecommunication conduit size, quantity, and location with ICT plans. However, no ICT drawings have been provided. Please confirm whether these will be issued.	This keynote is not a part of the BP2 scope of work and will be a part of a future bid package.	FAW	

Prebid Meeting Sign-in

Please scan the QR code and fill out the requested information to sign in for the prebid meeting.

IU Launch Accelerator for Biosciences Bid Event 02

F.A.WILHELM
CONSTRUCTION

IU Launch Accelerator for Biosciences Bid Event 02

Prebid Meeting \\ December 2nd, 2025

F.A.WILHELM CONSTRUCTION

Prebid Meeting Agenda

- Team Introductions
- Bid Information
- Project Overview
- Site Logistics
- Schedule

Project Team

Owner: The Trustees of Indiana University

Construction Manager: F.A. Wilhelm Construction Co., Inc.

Architect: BSA Lifestructures + Smithgroup – Eric Beaman

Structural Engineer: JPS Consulting Engineers

Site/Civil Engineering: JPS Consulting Engineers

Landscape Architecture: Terra Engineering

Vapor Mitigation: Keramida

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Project Overview

- The complete building will contain a combination of research and teaching labs, classrooms, administrative spaces.
- 5-stories~150,000 SF
- Site is located in a protected levy area from floodplain of Fall Creek.
- Current work is described as Bid Package 2
    - Early procurement package including Generator, Automatic Transfer Switches, Switchgear, Transformers, Custom Air Handling Units
    - Electrical Utility Package
    - Site Power Underground duct bank, structures, and incidentals.

F.A.WILHELM CONSTRUCTION

Bid Information

Document Access:

- Plans, Specifications, Addendums, etc. will be distributed via Building Connected by Wilhelm. If you need access to the Building Connected link please contact Shari Bernhardt, ShariBernhardt@fawilhelm.com.

Bid Schedule:

• Documents Issued to Bid	11/24/2025
• Pre-Bid Meeting	12/02/2025
• Questions Due	12/04/2025
• Bids Due	12/15/2025 @ 2:00 PM ET

Requests for Information (RFI)/Clarifications:

- All requests for information must be submitted in writing by 12/04/2025 to Shari Bernhardt, ShariBernhardt@fawilhelm.com.

Submission of Bids:

- Bids will be received until 2:00 PM ET on Monday, December 15th.

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Bid Information

Bid package Index

- BE2-23A – Air Handling Units (Furnish)
- BE2-23B – Chillers (Furnish)
- BE2-26A – Electrical Gear, Generator, & Transformers (Furnish)
- BE2-31A – Electrical Service from IU Substation

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Bid Information

Bid Checklist (due at bid submission):

- Bid Form (executed, including attachments)
  - Bid Package Standard Bid Form
  - Combined Bid Form (if applicable)
  - Supplemental Information
  - Form 96
  - Subcontractor Qualification Form
  - Contractor Asbestos Certification and Protocol for Contractors
  - Bid Bond of five percent (5%) on bids over $150,000

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Bid Information

Bid Submission:

- Bids must be submitted electronically through the IU Plan Room website by 2:00 PM on bid day. www.iuplanroom.com
- Bidders must be registered on the IU Plan Room, and signed into the plan room, in order to submit a bid
  - Click on the *Sign In/Register tab* (create a User ID and Password if you are not yet registered)
  - Click on the project listing
  - Click on *Submit Bid* next to the job name on the information tab. Attach bid forms.
  - After bid is uploaded, click *Submit Bid* at the bottom of the screen.
  - You will receive a confirmation screen, stating that, "Your Bid Submission has been saved successfully," as well as an email confirmation, indicating that your submission was received.
- Save your completed Bid form in PDF format. Title your bid as follows:

  [your company name] – Bid for IU Project_20250072 – IU Launch Accelerator for Biosciences – [Bid Package Number and Name]

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Bid Information

Bid Submission:

- Bids received electronically through the IU Plan Room will be virtually opened and read out loud at 2:00 PM EST on December 15th, 2025. To attend the virtual Bid Opening, click the Zoom link: https://iu.zoom.us/j/82623978895

  Meeting ID: 826 2397 8895
  Join By Telephone: 312-626-6799

- To view bid results after opening, click on the VPCPF Construction Procurement Bid Tabs & Awards on the home page of the plan room website

F.A.WILHELM
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Site Logistics

Site Address:1302 Indiana Ave. Indianapolis, IN 46202

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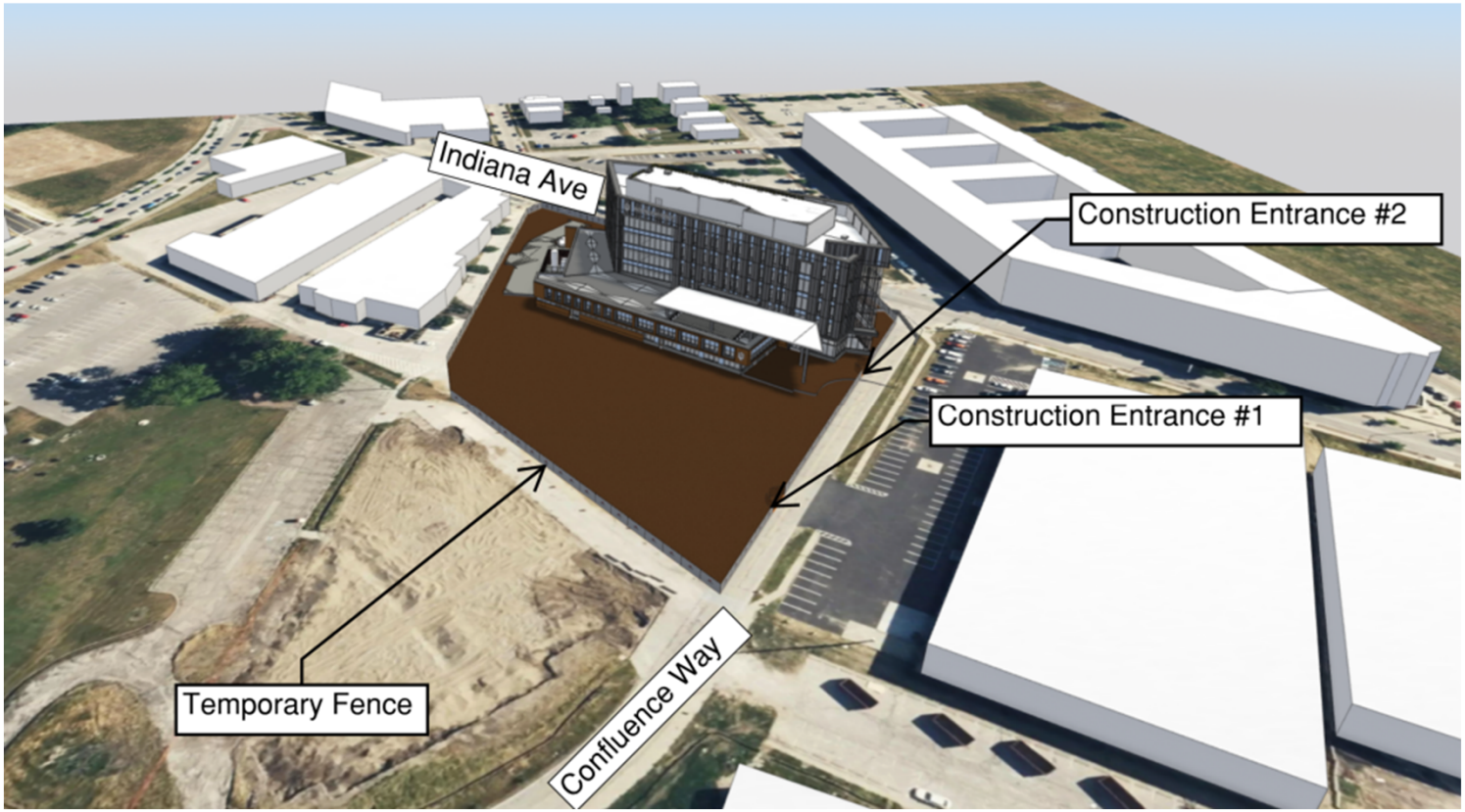
CONSTRUCTION

Site Logistics

Site Address: 1302 Indiana Ave. Indianapolis, IN 46202



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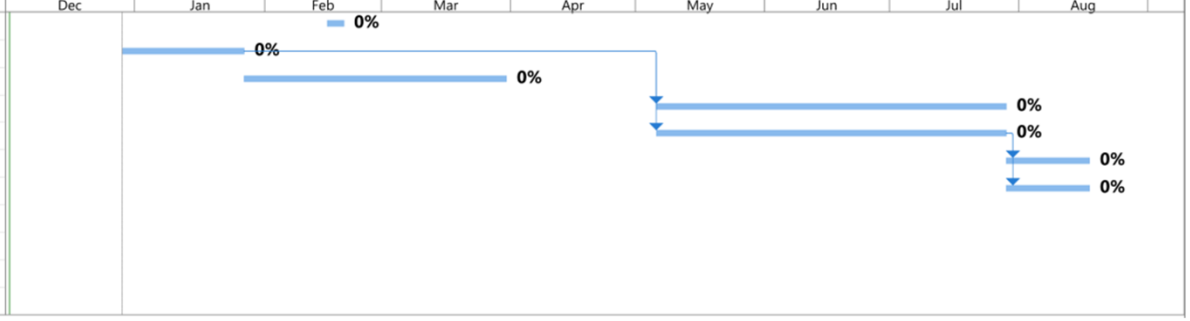
Schedule

Early Equipment Packages: Equipment to be delivered at the soonest available date.

Electrical Service:

IU LAB- Electrical Service Package Preliminary Schedule

ID	Task Mode	Task Name	Duration	Start	Finish
1		Refeed Eskenazi Fine Arts	4 days	Mon 2/16/26	Thu 2/19/26
2		Submittals & SDs	21 days	Mon 12/29/25	Mon 1/26/26
3		Material Procurement	45 days	Tue 1/27/26	Mon 3/30/26
4		Duct Bank Excavation	60 days	Wed 5/6/26	Tue 7/28/26
5		Ductbank and Manholes	60 days	Wed 5/6/26	Tue 7/28/26
6		Pull Circuit AE5	14 days	Wed 7/29/26	Mon 8/17/26
7		Pull Circuit AE7	14 days	Wed 7/29/26	Mon 8/17/26
8		Splice and Terminate Circuit AE5	2 days	Mon 11/9/26	Tue 11/10/26
9		Energize Circuit AE5	1 day	Wed 11/11/26	Wed 11/11/26
10		Terminate Circuit AE7	1 day	Mon 11/1/27	Mon 11/1/27
11		Energize Circuit AE7	1 day	Tue 11/2/27	Tue 11/2/27



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Site Visit

Thursday, December 4th at 1:00 PM

-Meet at Substation A/Manhole 1 in the parking lot just South of Regenstrief Institute

1101 W 10th St. Indianapolis, IN 46202

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THANK
YOU.
F.A.WILHELM
CONSTRUCTION

SECTION 00 3100
AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 EXISTING CONDITIONS

A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:

B. Existing Utility Drawings: Entitled BRTC Utility Corridor, dated July 11, 2002.
   1. Electronic copy is available for inspection upon request through the Construction Manager.

C. Geotechnical Report: Entitled Report Of Geotechnical Engineering Exploration, dated July 2, 2025.
   1. A copy is included in the Appendices.
   2. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
   3. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in Contract Documents.
   4. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to Owner.

1.02 PRELIMINARY DATA

A. Environmental Assessment Study: Entitled Phase I Environmental Site Assessment, dated January 16, 2002 and Phase II Environmental Site Investigation, dated January 22, 2002.
   1. Copies are included in the Appendices.

B. Soil Management Plan: Entitled Soil Management Plan, dated November 21, 2025.
   1. Copy is included in the Appendices.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Bidder (Subcontractor) or his representatives shall examine the site, inspect existing buildings, utilities, utility connection locations, site improvements, landscape and other site features, review existing plans, and become thoroughly familiar with the conditions under which the contract work is to be performed.

B. All such examination shall be completed during the bidding phase in order that bids for the proposed contract work include all costs for protection of existing construction and utilities, as well as connection to utilities. Each bid shall be deemed to include all costs and expenses in connection with all existing conditions, obstacles, and matters. No later claim for extra compensation will be considered.

END OF SECTION 00 3100

KERAMIDA
GLOBAL SUSTAINABILITY | CLIMATE | EHS

401 North College Avenue
Indianapolis, Indiana 46202
(317) 685-6600
WBENC-Certified
info@keramida.com | (800) 508-8034 | www.keramida.com

SOIL MANAGEMENT PLAN

INDIANA UNIVERSITY
LIFE SCIENCES AND ADVANCED RESEARCH BUILDING
1302 INDIANA AVENUE
INDIANAPOLIS, INDIANA

November 21, 2025

TABLE OF CONTENTS

REPORT TABLES

ATTACHMENTS

ACRONYM DEFINITIONS

BMP	Best Management Practice
C&E	Construction and Excavation
CFR	Code of Federal Regulations
COCs	Contaminants of Concern
EP	Environmental Professional
EPA	United States Environmental Protection Agency
ERC	Environmental Restrictive Covenant
HAZWOPER	Hazardous Waste Operations and Emergency Response (29 CFR 1920.120)
HASP	Health and Safety Plan
IDEM	Indiana Department of Environmental Management
IUF	Indiana University Foundation
IU	Indiana University
LAB	Life Sciences and Advanced Research Building
LUST	IDEM Leaking Underground Storage Tanks
MTGSLs	IDEM RCG Migration to Groundwater Screening Levels
NPD	IDEM Non Rule Policy Document
OSHA	Occupational Safety and Health Administration
PAHs	Polycyclic Aromatic Hydrocarbons
PCE	Tetrachloroethylene
Phase I	Phase I Environmental Site Assessment
Phase II	Phase II Environmental Site Assessment
PLs	IDEM R2 Published Levels
PPE	Personal Protective Equipment
RDCSL	IDEM RCG Residential Direct Contact Screening Levels
R2	IDEM Risk-based Closure Guide
RCG	IDEM Remediation Closure Guide
RCRA	Resource Conservation and Recovery Act
SCP	State Cleanup Program
SMP	Soil Management Plan
SO	Safety Officer
sVOCs	Semi-Volatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
UST	Underground Storage Tank
VFC	Virtual File Cabinet
VOCs	Volatile Organic Compounds

SOIL MANAGEMENT PLAN
INDIANA UNIVERSITY
LIFE SCIENCES AND ADVANCED RESEARCH BUILDING
1302 INDIANA AVENUE,
INDIANAPOLIS, INDIANA

1.0 INTRODUCTION

This Soil Management Plan (SMP) has been developed by KERAMIDA Inc. (KERAMIDA) for the construction of the Indiana University (IU) Life Sciences and Advanced Research building (LAB) located at 16 Tech, 1302 Indiana Avenue, Indianapolis, Indiana (Site), referred to as the IU LAB. The facility will include research and teaching labs, classrooms, collaborative workspaces, and startup and incubator space.

The property associated with the IU LAB project has a recorded Environmental Restrictive Covenant (ERC), which requires that the soil disturbed during excavation and construction activities be restored "in such a manner that the remaining contaminant concentrations do not present a threat to human health or the environment." The ERC also requires that, upon request of the Indiana Department of Environmental Management (IDEM), "written evidence (including sampling data) showing the excavated and restored area, and any other area affected by the excavation, does not represent such a threat" be provided. Finally, the ERC requires that contaminated soils that are excavated "must be managed in accordance with all applicable federal and state laws; and disposal of such soils must also be done in accordance with all applicable federal and state laws." The following must be done to comply with the ERC and project specifications.

- An SMP must be developed that complies with the ERC requirements to address the management of the soil disturbed by excavation and construction activities. The SMP must be written by an environmental professional with at least ten years of experience in the management of contaminated soil. The SMP must include an investigation to identify areas of contaminated soil, procedures for handling and disposing of contaminated soil, procedures for identifying and handling and disposing of suspect contaminated soil that were not known to be contaminated, soil restoration procedures, procedures to assure that remaining contaminated soil do not present a threat to human health or the environment, and procedures to create and maintain written evidence, including sampling data, that remaining contaminated soil do not present a threat to human health or the environment. The SMP must comply with all applicable federal, state, and local laws and IDEM's then-current Risk-based Closure Guide (R2).

- The sampling of the soil is to be performed by an environmental professional with at least five years of sampling experience.

- The contractors and subcontractors must comply with the SMP. Daily records are required to document compliance with the SMP and should be maintained to demonstrate compliance.

- Oversight is to be provided by an environmental professional with at least five years of experience with the management of contaminated soil when contaminated soil is being excavated and when suspect contaminated soil not known to be contaminated is encountered. An environmental professional with at least ten years of experience in managing contaminated soil must oversee the implementation of procedures to create and maintain written evidence, including sampling data, that the remaining contaminated soil does not pose a threat to human health or the environment. The professionals providing oversight must maintain daily written records of their observations and recommendations.

This SMP is limited to activities associated with soil disturbance related to the IU LAB project and provides procedures for managing and disposing of soil generated during construction and excavation (C&E) activities for the project. The guidance included in this SMP is for managing soil that may be disturbed, excavated, or moved during construction activities. The intent of the plan is to provide a consistent approach for the management of the excavated soil to ensure compliance with the regulatory requirements.

This SMP further defines responsibilities related to the implementation of minimum measures specific to health and safety. Contractors and subcontractors are responsible for ensuring environmental compliance and worker health and safety during all activities performed for this project. This document does not remove, reduce, or alter any contractor's responsibility to operate under their own health and safety program as required by the Occupational Safety and Health Administration (OSHA) and contracts governing the work.

2.0 ENVIRONMENTAL CONDITIONS

The project is located near other properties that are included in various state program databases, such as Brownfields and State Cleanup Program (SCP), and is considered to be potentially contaminated. Site-specific information is provided below.

In 2002, a Phase I Environmental Site Assessment (Phase I) and Phase II Environmental Site Investigation (Phase II) were conducted of the RIS Paper facility that was formerly located at 1302 Stadium Drive, Indianapolis, Indiana. The areas of environmental focus identified in the Phase I included possible off-Site sources, such as a former upgradient filling station, and past on-Site operations, including the presence of underground storage tanks (USTs). Two additional areas of focus included in Phase II were the presence of fill material of an unknown source and an off-Site property boundary bordering the Site that was used as a laboratory. Seven soil borings were advanced across the Site, and a total of seven soil samples and six groundwater samples were collected. Soil samples were analyzed for Resource and Conservation Recovery Act (RCRA) metals at all seven

locations and total petroleum hydrocarbons (TPH) at two locations near the former USTs. Groundwater samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (sVOCs), and RCRA metals. Based on the current IDEM R2 Published Levels (PLs), the soil RCRA metal concentrations from the Phase II are below the Long Term Residential PLs.

Tetrachloroethylene (PCE) was detected at a concentration of 28 micrograms per Liter (µg/L) in the one groundwater sample located at the west corner of the property, which was the only location where a chlorinated VOC was detected in groundwater at the Site. Reference documents are available at the IDEM Virtual File Cabinet (VFC) #82612870, which is a copy of the January 22, 2002, Phase II report. In correspondence dated April 21, 2020 (VFC #82953773), the IDEM concluded that an ERC was required for the property. In subsequent correspondence dated October 7, 2020, IDEM requested modifications to the ERC. The revised ERC was submitted to the Marion County Recorder's Office on December 15, 2022. The ERC places certain restrictions on the property, including the following:

- Groundwater use is restricted.
- The Site cannot be used for agricultural purposes;
- A vapor mitigation system must be installed for structures that will be occupied;
- Disturbed soil must be managed in a manner that does not present a threat to human health or the environment (i.e., in accordance with the SMP).

3.0 ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

The following key personnel will have responsibility for the implementation of this SMP and oversight of activities/operations involving hazardous substances.

3.1 Owner

The project owner is IU (Owner) and is considered the generator of the soil that is removed during the C&E activities. Key representatives for the Owner are provided in the following table.

Table 3-1
Owner Contacts

Name	Phone Number	Email
Kurt Fullbeck	(513) 508-8542	kfullbec@iu.edu
Rich Thompson	(317) 430-0829	rithomps@iu.edu

3.2 Owner's Representative

The Owner's representative has the overall responsibility for overseeing the C&E activities. The Owner's representative will consult KERAMIDA as the environmental professional (EP) for coordination with the contractors and subcontractors for implementation of the SMP elements, such as sampling and analysis, soil classification, waste profiling, approval of waste disposal, and reporting. KERAMIDA will coordinate with the Owner's representative to ensure regulatory compliance with the soil management from the C&E activities. Key representatives for the Owner's representative are provided in the following table.

Table 3-2
Owner's Representative Contacts

Company Name	Name	Phone Number	Email
Indiana University	Ryan Cox	(317) 513-9730	ryalcox@iu.edu

3.3 Contractor

The responsibilities of the Contractor include, but are not limited to, overall management of C&E activities, including coordination between subcontractors, management of the construction administrative activities, and confirmation of proper implementation of the SMP. The contact information for the Contractor key representatives is provided in the following table.

Table 3-3
Contractor Contacts

Contractor	Contact Name	Phone Number	Email
F.A. Wilhelm Construction	Todd France	(317) 524-9025	toddfrance@fawilhelm.com

3.4 Safety Officer

The responsibilities of the Contractor safety officer (SO) include, but are not limited to, the health and safety of the contractor's employees, the implementation of the minimum measures, and reporting to the designated Contractor key representative(s) relative to compliance with warranted health and safety protocols. The Owner's representative and the environmental professional (EP) SOs are responsible for providing technical assistance related to the project. The SOs for the project are listed in the table below.

Table 3-4
Safety Officer Contacts

Company	Safety Officer	Phone Number	Email
Owner Representative	Ryan Cox	(317) 513-9730	ryalcox@iu.edu
Contractor	Todd France	(317) 524-9025	toddfrance@fawilhelm.com
Environmental Professional	Diana Ludwig	O: (317) 685-8227 C: (317) 697-1901	dludwig@keramida.com

3.5 Site Workers

The responsibilities of workers include, but are not limited to, performance of all work in a safe manner, adherence to the contractor's Health and Safety Plan (HASP), and adherence to the minimum measures outlined in this SMP in Section 4.0.

3.6 Environmental Professionals

For this SMP, an EP is defined by meeting the following requirements:

- An EP is someone who possesses sufficient specific education, training, and experience necessary to exercise professional judgment to develop opinions and conclusions regarding conditions indicative of releases of hazardous substances on, at, in, or to a property, sufficient to meet the objectives and performance factors of the project.
- To be defined as an EP, the individual must have a state or tribal issued certification or license (PE, LPG, or CHMM) and five years of relevant hazardous materials management work experience and be 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) trained; or
- Has a Bachelor of Science degree in the environmental field with a minimum of ten years of experience with the management of nonhazardous and hazardous materials, and remediation and investigation.
- Individuals who do not meet the above requirements must work directly under the supervision of an EP who meets the requirements.

The responsibilities of the EP include, but are not limited to:

- Sampling and analysis of the soil
- Soil classification for management under the SMP prior to disposal
- Providing environmental field monitoring during C&E activities, when required
- Assisting with observation and documentation during field activities to advise on the proper implementation of the SMP, including engineering controls
- Providing guidance regarding the SMP on an as-needed basis
- Preparing a waste profile(s) for the accepting landfill(s) for excavation spoils

- Documentation and assistance with manifesting of any off-Site disposition of excavation spoils generated from the Site

The EPs for the project are listed in the following table.

Table 3-5
Environmental Professional Contacts

Company	Name	Phone Number	Email Address
KERAMIDA Inc.	Sara Guss	(317) 750-5334	sguss@keramida.com
KERAMIDA Inc.	Chelsea McCammack, L.P.G	(317) 605-7036	cmccammack@keramida.com
KERAMIDA Inc.	Brayton Pew, L.P.G.	(317) 447-7476	bpew@keramida.com

4.0 MINIMUM MEASURES

The following minimum measures are intended to reduce the potential for exposure to contaminated soil during C&E activities. The recommendations are not intended as global or comprehensive health and safety requirements for the project. The measures primarily consist of awareness, personal protective equipment (PPE), and Best Management Practice (BMPs) implementation.

4.1 Worker Awareness

Workers with the potential for exposure to contaminated media will be informed of this SMP as part of project orientation, including the known nature of environmental concerns and responsibilities of key personnel. The Contractor will be responsible for notifying workers of the SMP.

4.2 Hygiene

Proper hygiene as part of the daily construction worker's routine is intended to reduce the potential for contact with contaminated soil and/or inhalation/ingestion of soil particles. Hygiene practices include refraining from smoking, eating, and drinking during all C&E activities and within the vicinity of the work area.

4.3 Personal Protective Equipment

The minimum PPE recommended for all C&E activities is modified Level D or as determined by the EP. Modified Level D includes the following PPE:

- Safety glasses, goggles, or a face shield
- Safety boots
- Street clothes, uniform, or coveralls
- Latex or nitrile gloves, or nitrile-coated gloves

- Optional as hazards assessment indicates hard hat, hi-vis vest, boot covers, cloth face mask, or N-95 respirator

If a change in condition, such as the discovery of stained soil or odors, is identified, field staff should stop work and inform the Owner's representative. The Owner's representative will request that the EP conduct a hazards assessment to determine if there is a need to modify the PPE requirements.

4.4 Dust Control and Monitoring

The goal of dust control is to minimize or eliminate the formation of dust generated from vehicle traffic, foot traffic, and wind through the implementation of BMPs, thereby reducing the potential for inhalation by workers and area inhabitants. The Contractor will be responsible for continuously monitoring dust generation while work is in progress and ensuring dust generation is kept to a minimum.

To reduce the generation of dust during the C&E activities, the Contractor will be responsible for implementing BMPs, such as applying water, for the duration of the project. The Contractor will also be responsible for minimizing tracked soil onto the roads to reduce the potential for dust. A sample form for monitoring fugitive dust is provided in Attachment 1.

4.4.1 Dust Emission Controls

The type of work to be conducted during the project has the potential to generate dust. BMPs to mitigate dust generation are described in the following table.

Table 4-1
Dust Control Best Management Practices

Activity	Dust Control BMPs
Truck traffic	• Apply water at a rate to keep soil wet/moist as needed but not saturated. • If sweeping is conducted, wet the area(s) with water prior to the sweeping operation to aid in dust suppression. • Install vehicle tracking pads to provide a barrier and keep the truck wheels from coming in contact with wet, sticky underlying soils. • Dust controls must be used in accordance with the manufacturer's specifications and not be applied in a manner that would result in a discharge to waters of the state. Isolation distances from bridges, catch basins, and other drainage ways must be observed.
Soil excavation and loading	• Keep activities within the designated areas. • Exercise care to minimize the amount of dust generated and to minimize spillage. • Water spray/mist/adjust excavation activities, if necessary.

Activity	Dust Control BMPs
	• Suspend/adjust work under unfavorable conditions of sustained wind speed greater than 20 miles per hour.
Stockpiling	• Stockpiling of excavated soils will be minimized as much as possible. No stockpiling of soil classified as hazardous. • Stockpiled soil will be placed on plastic or an impervious surface and covered with plastic sheeting or tarps during sustained wind greater than 20 miles per hour and at the end of each day. • If necessary, a berm will be placed around stockpile(s) to prevent run-off. • Stockpile(s) will be located away from storm drains and receiving water.

4.4.2 Dust Suppression Measure Details

Covers/Tarping

Bulk piles will be kept to a minimum and covered with plastic or tarped as necessary to minimize wind-blown dust. All trucks used for transporting and disposing of excavated material will be fitted with solid, sliding, or slot-top type covers with no gaps when fully deployed or enclosed vacuum trucks. Dump trucks and roll-offs will be covered immediately after loading and remain covered throughout the transportation to the permitted disposal facility.

Watering

The Contractor will conduct operations and maintain the project area such that the creation and dispersion of dust is kept to a minimum. Clean water will be applied as necessary to prevent dust during excavation, loading/unloading, and backfilling activities. Excavation areas and roadways will be kept damp, as necessary, without creating ponding or mists that travel beyond the project Site boundaries. The watering operations will be sufficient to control fugitive dust. Water will be applied to prevent runoff.

Transfer Points

Transfer points refer to any time material is loaded or unloaded during removal activities. For this project, the primary transfer points of concern will be the transfer of excavated soil. The following guidelines will be maintained:

- During the loading of excavated impacted soil, the material drop will not exceed 4 feet
- Trucks entering and leaving will adhere to the posted speed limit
- Open trucks will adhere to the tarping policy
- Trucks leaving unpaved areas to paved areas of the public ROW (i.e., sidewalk or street) will be visually inspected for loose material
- Loading of excavated soil will be completed on the pavement where possible

Minimize Handling

As a BMP, waste soil will be handled as few times as possible. Therefore, the contractor should minimize the handling by directly loading soil into a roll-off box rather than stockpiling, depending on the quantity of soil being excavated.

Roadways

Roadway sweeping may be conducted as needed during the C&E activities to keep roadways clean and free of tracked soil. The Contractor is responsible for minimizing and monitoring soil tracking on roadways and for conducting sweeping.

4.4.3 Air Monitoring

Ambient air monitoring is not warranted based on the historical site investigation; therefore, no air monitoring will be conducted during the C&E activities.

5.0 EXCAVATED SOIL

The excavated soil must be sampled and analyzed for proper waste characterization. Therefore, the excavated soil must be staged for sampling by the EP. The following sections discuss the handling of the soil prior to being transported off-Site for proper disposal.

5.1 Soil Storage

The excavated soil should be placed into appropriate containers (i.e., lined and covered roll-off boxes), if feasible, or placed in a temporary stockpile. The stockpiles should be managed and maintained in a manner that minimizes contact with stormwater, reduces dust generation, and minimizes worker exposure. Placement should also be selected to avoid site drainage, roadsides, or culverts. Dust control measures (i.e., wetting) should also be maintained when the soil stockpile is uncovered.

The excavated soil that is stockpiled should be placed on an impervious surface or a minimum ten-mil or equivalent plastic ground cloth and covered with a six-mil minimum polyethylene sheeting or equivalent to protect against leaching or runoff of contaminants into groundwater, storm water, and surface water. The sheeting must be secured by appropriate means and seams sealed to prevent tearing or removal by weather. The covering must be maintained while the soil is stockpiled. Filter socks, or other sediment control measures, should be maintained around the soil piles to prevent sediment from spreading outside of the stockpiles.

5.2 Unexpected Contamination

Potentially hazardous conditions, such as the discovery and/or occurrence of strong odors, staining, discoloration, and/or other unusual or unexpected conditions, may be encountered during C&E activities, although this is unlikely. Contamination indicators of hazardous materials may include, but are not limited to, the following:

- Unusual odors
- Discolored or stained soil
- Fibrous materials discovery
- Petroleum hydrocarbon-stained soil and/or free product
- Liquid waste, putrescible waste
- Elevated field screening measurements

If these indicators are identified, the following actions should be taken:

In such an event, the Contractor should do the following:

- Excavation activity in the vicinity of the area where the suspect material has been encountered should stop
- Workers should be removed from the immediate area
- Measures should be taken to ensure the area is secure
- Steps should be taken to prevent contamination of the surrounding environment
- The Contractor should notify the Owner's representative
- The Owner's representative will notify the EP
- Work shall not resume in the vicinity of the area until the EP clears the area

The EP will be responsible for assessing the situation and performing the sampling. If suspected contaminated soil or hazardous materials are discovered, the EP will notify the Owner's representative, and they will contact the Contractor and subcontractors as needed. The EP will actively monitor for the identified field conditions and inform the Contractor and the Owner representative of the proper management requirements for handling the impacted soil. Activities may resume after the EP determines that a potentially hazardous situation does not exist and that all necessary steps have been taken to ensure compliance with applicable rules and regulations. The SO(s) will be consulted as needed.

6.0 SOIL CLASSIFICATION

The EP will serve as the primary point of contact for soil sampling, soil classification, waste profiling, and ensuring the proper management of the soil. The EP will be responsible for completing the waste profiles, obtaining disposal approval, and waste tracking. Waste approvals must be in place prior to transporting waste off-Site for disposal. The EP will be responsible for classifying the soil based on

the sampling and analysis, and informing the Contractor and the Owner's representative of the soil classification. The various types of soil classifications are described below.

6.1 Uncontaminated Soil

Soil that has been characterized by testing and that contains human-introduced chemicals at levels less than the IDEM Remediation Closure Guide (RCG) Residential Direct Contact Screening Levels (RDCSLs) and Migration to Groundwater Screening Levels (MTGSLs) is addressed in the IDEM Uncontaminated Soil Policy (WASTE-0064-NPD-R1) Nonrule Policy Document (NPD). A copy of the Uncontaminated Soil Policy is provided in Attachment 2. This NPD provides standards for excavated soil remaining on-Site, reused on-Site, or taken off-Site for reuse or disposal. Soil that meets the requirements of the IDEM Uncontaminated Soil Policy is considered uncontaminated soil. Excavated soil meeting the criteria mentioned above can be relocated on or off-Site, provided it is not placed in an environmentally sensitive area (i.e., residential usage, karst, wetland, floodway, surface runoff, or in standing water where the standing water reflects the water table, etc.) as outlined in the Uncontaminated Soil Policy.

6.2 Nonhazardous Contaminated Soil

Soil found to contain Contaminants of Concern (COCs) at concentrations above the IDEM RCG RDCSLs or MTGSLs but below applicable federal and IDEM hazardous waste criteria will be classified as nonhazardous contaminated soil. All nonhazardous contaminated soil will be managed in accordance with this SMP, and if excavated, must be removed from the project Site for disposal at the designated permitted solid waste facility.

6.3 Hazardous Soil

Hazardous soil is defined as a waste that, due to its properties (i.e., toxic, reactive, ignitable, or corrosive), or if it contains a listed waste, can cause harm to human health or the environment. Soil that has been characterized as hazardous based on the sampling and analysis must be managed as hazardous waste. The hazardous waste must be transported by a RCRA-permitted hauler and taken to an RCRA-permitted disposal facility. It is **not** anticipated that the soil will be classified as hazardous waste based on the historical information. Additional safety measures will be implemented if hazardous waste is encountered.

6.4 Mixed Loads

If uncontaminated soil is mixed with nonhazardous soil, the mixed load will be classified as nonhazardous. If any soil classification (i.e., uncontaminated, nonhazardous) is mixed with hazardous soil, the mixed load will be classified as hazardous.

7.0 SOIL DISPOSAL REQUIREMENTS

The disposal requirements based on the soil classifications are outlined in the following table.

Table 7-1
Soil Disposal Requirements

Soil Classification	Hydro-Excavated Soil Management	Excavated Soil Management
Uncontaminated	Reuse off-Site*, disposition at clean fill site*, or disposal at permitted solid waste facility	Reuse on-Site*, reuse off-Site, disposition at clean fill site*, or disposal at permitted solid waste facility
Nonhazardous	Disposal at a permitted solid waste facility	Disposal at a permitted solid waste facility
Hazardous	Cannot use hydro-excavation	Must be managed by a hazardous waste transporter to a hazardous waste disposal site

*****Provided soil is not placed in an environmentally sensitive area (i.e., residential usage, karst, wetland, floodway, surface runoff, or in standing water where the standing water reflects the water table, etc.) as outlined in the IDEM Uncontaminated Soil Policy

Trucks that contain uncontaminated soil mixed with nonhazardous soil must be taken to a permitted solid waste facility.

7.1 Waste Tracking

The Soil Tracking Log provided in Attachment 3 will be used to track the loads of soil removed from the Site to the disposal site. Each load, regardless of the soil classification, must be recorded on the tracking form to provide documentation of proper disposal, as specified by the soil classification. The addresses and final locations for the disposition (i.e., on-Site use/disposal) of each load must be recorded on a tracking form to provide documentation of proper disposal based on the soil classification.

7.2 Uncontaminated Soil

Uncontaminated soil does not require disposal at a permitted solid waste disposal facility. Dry excavated soil can be reused on-Site. Hydro-excavated soil cannot be reused on-Site unless proper stormwater management measures are implemented to prevent run-off and sedimentation from leaving the Site, and clean potable water is used in the hydro-excavation process. The disposal options for uncontaminated soil include clean fill sites approved by the Owner's representative, provided the soil is not placed in an environmentally sensitive area, and permitted solid waste disposal facilities.

7.3 Management of Nonhazardous Soil

Along with approval for the waste, an approval number will be issued for each waste profile. The approval number must appear on the waste shipping form that must accompany each load. The selected disposal site will provide the shipping form.

7.4 Management of Hazardous Soil

If any soil is classified as hazardous waste, only companies that have RCRA permits can manage the waste. The EP will work with the Owner's representative to select the appropriate contractor and permitted hazardous waste disposal facility. The EP will work with the Owner to obtain a hazardous waste RCRA identification number for the project's hazardous waste. Hazardous waste must be transported by a hazardous waste transporter using a manifest system. Hydro-excavation of hazardous waste is not permitted unless the company performing the work is permitted to transport hazardous waste.

Soil that contains a listed hazardous waste or is characteristically hazardous must be containerized. The container can be a drum or a lined roll-off box. If the container is a drum, it should be moved to a secure location. A roll-off box can be kept at a protected, centralized location. The container should be placed on a plastic sheet or pad to contain any fugitive soil that may spill during filling. The container (i.e., drum or roll-off) must be labeled when the waste is first placed in it. The label must include the name of the generator, the address, the material in the drum, along with the hazards of the contents, the process generating the waste, the date waste was first placed in the container, and a contact phone number. The EP will be responsible for the labeling and providing oversight to ensure the proper management of the soil classified as hazardous.

7.5 Contained-in Determination

If the results of the sampling and analysis indicate that the soil contains a listed waste, the soil impacted by a listed hazardous waste may be disposed of as nonhazardous waste, provided it is approved by IDEM, using the IDEM contained in policy (WASTE-0061-NPD-R1). A copy of this policy is presented in Attachment 4. Under this policy, IDEM can review a petition that hazardous waste is not "contained in" the generated waste. The listed waste concentration is based on health-based concentration criteria, such as comparison to the IDEM Risk-based Closure Guide (R2) Published Levels (PLs).

The EP will evaluate if the location qualifies for the submission of a contained in determination request to IDEM. The Owner will be responsible for determining whether the soil should be removed and transported for off-Site disposal at a permitted hazardous waste disposal facility, or if a contained-in determination request should be submitted to IDEM. The EP is responsible for obtaining IDEM approval under the contained-in policy and conducting the required additional sampling in accordance with the policy. If IDEM issues the approval for the contained in determination, the contaminated soil can be managed as nonhazardous waste. It must be taken to a permitted solid waste facility under a separate waste profile and shipping form. The EP will be responsible for obtaining the waste profile approval from the disposal site.

7.6 Soil Management Recordkeeping

The Contractor is responsible for providing the bills of lading and weight tickets associated with the disposition of the soil. The Contractor will also be responsible for documenting any re-use of the

uncontaminated on-Site. The documentation should support the loads tracked on the Waste Tracking Log. The information should be provided to the Owner's representative. The Owner's representative will provide the documentation to the EP for evaluation. The EP will be responsible for comparing the disposal documentation records to the completed Soil Tracking Log to ensure all loads of excavated soil have been properly documented for the project files. The Owner will maintain the disposal documentation with the project files.

8.0 EQUIPMENT DECONTAMINATION PLAN

The initial decontamination efforts to address large accumulations of soil should use hand methods to clean the equipment that is discernibly contaminated with soil. Visible remnants should be removed using a combination of hand (i.e., a shovel, brush, or broom)to the extent practical. The use of cleaning methods that involve wet cleaning (i.e., power washing) should only be used if needed, and water usage should be minimized to prevent the generation of wash waters. The use of portable misters/sprayers may be required for dust control. Wet methods for decontamination, if required, are to be used once significant accumulations of soil have been removed using hand methods. A decontamination area will need to be constructed for this purpose to allow for the on-Site accumulation of removed soil and wash waters. The accumulated soil and wash waters from decontamination activities should be managed in accordance with the designated soil classification for the area. Decontamination supplies should either be cleaned or discarded as solid. If the soil is classified as hazardous waste, the supplies in contact with it should be disposed of as hazardous waste.

Impacted soil should also be removed from rubber boots, rubber boot covers, boots, and gloves prior to leaving the Site at the end of each shift. Soiled disposable PPE materials should be disposed of as solid waste.

9.0 IMPORTED SOIL

If soil is imported, such as backfill, the source of the soil must be approved prior to use. The Contractor is responsible for identifying the source of the imported fill material for the project. The Contractor will notify the Owner's representative of the proposed source(s) for the backfill. The information will be provided to the EP for review.

9.1 Sampling and Analysis Requirements

The backfill should be sourced from a known native source. If the backfill is not from a native source (i.e., quarry), sampling and analysis will be required to demonstrate that the material is not impacted. Sampling must be conducted by or under the supervision of an EP. Sampling, at a minimum, must include one composite sample to be analyzed for the following:

- Volatile Organic Compounds (VOCs) - EPA 8260
- Polycyclic Aromatic Hydrocarbons (PAHs) - EPA Method 8270 SIM

- Resource Conservation and Recovery Act (RCRA) Mercury - EPA Method 7471, Other RCRA Metals - EPA Method 6010

The results of the sampling and analysis must be provided to the EP for review. The EP will evaluate the results to determine whether the material complies with regulatory requirements and will provide the results to the Owner or the Owner's representative, with a recommendation if the source(s) is acceptable. The Contractor may not bring imported soil on-Site without approval from the Owner or the Owner's representative.

9.2 Recordkeeping

Details of the material supplier of the imported soil source, and the total quantity of imported soil material must be documented for each distinct supplier and source of imported soil. Analytical data for testing on imported materials, if applicable. Shipping forms/manifests and weight tickets must be maintained for documentation of disposal. Analytical data must be provided to the Owner's representative and maintained with the project records to demonstrate that the imported material was not impacted.

ATTACHMENT 1

WEEKLY FUGITIVE DUST INSPECTION LOG

Weekly Fugitive Dust Inspection Log

Date: _____

Time: _____

Inspector: _____

Weather Conditions: Wind Speed, Wind Direction, and Humidity

_____

Location(s): _____

Observed Dust Levels: Visual Assessment (Light, Moderate, Heavy): _____

Dust Source(s):
Activity (e.g., excavation, material handling, vehicle traffic):

_____

Specific Area (e.g., stockpile, haul road):

_____

Corrective Action/Mitigation Actions Taken:
Water application (amount): _____

Dust suppression methods (e.g., tarpaulin, windbreaks): _____

_____

Sweeping: _____

Other actions taken: _____

_____

Responsible Personnel: _____

Comments/Observations: _____

_____

Follow-up Actions: _____

_____

Photo Documentation: Attach photos of dust emission sources and mitigation efforts.

ATTACHMENT 2

IDEM UNCONTAMINATED SOIL POLICY (WASTE-0064-NPD-R1)

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT	**STATUS:** Effective	**POLICY NUMBER:** WASTE-0064-NPD-R1	
AGENCY NONRULE POLICY DOCUMENT **SUBJECT:** Uncontaminated Soil Policy	**AUTHORIZED:** Brian Rockensuess, Commissioner		
	SUPERSEDES: WASTE-0064-NPD	**ISSUING OFFICE(S):** Office of Land Quality	
	ORIGINALLY EFFECTIVE: April 10, 2015	**RENEWED/REVISED:** April 10, 2024	

Disclaimer: *This non-rule policy document (NPD) is being established by the Indiana Department of Environmental Management (IDEM), consistent with its authority in state law under the Indiana Code at IC 13-14-1-11.5. It is intended solely to provide guidance and shall be used in conjunction with applicable rules or laws. It does not replace applicable rules and laws, and if it conflicts with these rules or laws, the rules or laws shall control. Pursuant to IC 13-14-1-11.5, this policy will be available for public inspection for at least 45 days prior to presentation to the appropriate State Environmental Board, and may be put into effect by IDEM 30 days afterward. If the non-rule policy is presented to more than one board, it will be effective 30 days after presentation to the last. IDEM also will submit the policy to the Indiana Register for publication.*

1.0 PURPOSE

The solid waste rules in the Indiana Administrative Code at 329 IAC 10-3-1(1) and 329 IAC 11-3-1(1) exclude from regulation the disposal of uncontaminated dirt (soil) and, alternatively, would consider contaminated soil to be a solid waste that is subject to solid waste regulations. Neither the rules nor the laws define 'uncontaminated,' so the policy of IDEM's solid waste program has been to interpret the presence of any non-natural constituent in a soil as being a contaminant, making the soil subject to the solid waste regulations.

IDEM has developed risk-based non-rule policy documents (NPDs) to address and drive the cleanup of contaminated soil. These NPDs include IDEM's Risk-based Closure Guide (R2) and the Remediation Program Guide (RPG). For the purpose of this Uncontaminated Soil Poincy, Table A-6: 2022 Screening Levels shall be used as the screening levels when determining the applicability of the policy.

This NPD applies to soils, which do not include waste streams that are specifically regulated by 329 IAC 10 and which contain human introduced constituents (or chemicals) below Table A-6: 2022 residential screening levels, and designates how those soils may be managed when excavated. Soils with concentrations of a human introduced chemical not exceeding Table A-6: 2022 residential screening levels are considered uncontaminated if they are handled in accordance with this NPD. Soils with concentrations of human introduced chemicals or contaminants exceeding Table A-6: 2022 residential screening levels are considered contaminated soil and are not exempt from the solid waste rules under this NPD.

This NPD is to provide consistent standards for excavated soil remaining on-site, reused on-site, or taken offsite for reuse or disposal.

2.0 SCOPE

The scope of this NPD applies to how excavated soil may be managed when found to contain human introduced chemicals below Table A-6: 2022 residential screening levels.

The scope of this NPD does not include soils impacted by spilled materials subject to the IDEM Spill Rule at 327 IAC 2-6.

This NPD is not intended to address naturally occurring chemical constituents in soil.

This NPD does not exempt from regulation historical fill material made up of specifically regulated wastes and waste streams, which include, but are not limited to, coal ash, foundry sand, or other waste streams. Such materials are considered solid waste and must either be disposed in a permitted landfill or be approved for a legitimate use project.

This NPD also does not address situations when soil is intermingled with regulated solid waste. Examples include, but are not limited to, ash and debris mixed with soil after a fire, municipal wastewater treatment sludge mingled with soil from a lagoon liner, or similar situations where soil has become part of a waste. If soil can be physically separated from the wastes and is found to be uncontaminated, as specified in this NPD, it would no longer need to be handled as a waste.

In general, this NPD is not intended to address soils containing identifiable industrial wastes, solid wastes, or hazardous wastes that are inseparable from the soil.

3.0 DEFINITIONS

3.1. "Agency" – The Indiana Department of Environmental Management (IDEM).

3.2. "Chemical" – A substance with unique properties consisting of a combination of one or more elements.

3.3. "Contaminant" – "Contaminant" for purposes of environmental management laws, means any solid, semi-solid, liquid, or gaseous matter, or any odor, radioactive material, pollutant (as defined by the federal Water Pollution Control Act (33 U.S.C. 1251 et seq.), as in effect on January 1, 1989), hazardous waste (as defined in the federal Solid Waste Disposal Act [42 U.S.C. 6901 et seq.], as in effect on January 1, 1989), any constituent of a hazardous waste, or any combination of the items described in this section, from whatever source, that:

(1) is injurious to human health, plant or animal life, or property;
(2) interferes unreasonably with the enjoyment of life or property, or otherwise violates:
(A) environmental management laws; or
(B) rules adopted under environmental management laws
(329 IAC 10-2-41, IC 13-11-2-42)

3.4. "Contaminants of concern" – Chemicals that are the focus of screening, investigation or closure in Office of Land Quality remediation programs. For petroleum sites, potentially harmful chemicals within a mixture that are present in sufficient quantity to serve as indicator compounds for that particular mixture.

3.5. "Dirt" – The term "dirt" is used in state rules at 329 IAC 10-3-1(1)(1), but is not defined in statute or rule. For the purpose of this policy, 'dirt' and 'soil' are considered synonymous terms. See 'Soil'.

3.6. "Endangered species" – Any species listed as endangered or threatened under rules of the Indiana Natural Resources Commission at 312 IAC 9-3-19, 312 IAC 9-4-14, 312 IAC 9-5-4, 312 IAC9-6-9, 312 IAC 9-9-4. (329 IAC 10-2-64)

3.7. "Flood plain" – The areas adjoining a river, stream, or lake that are inundated by the base flood. (329 IAC 10-2-75 and 329 IAC 10-2-22)

3.8. "Hazardous waste" – Hazardous waste as defined in the Code of Federal Regulations at 40 CFR 261 subpart B and Indiana Code at IC13-11-2-99.

3.9. "Karst physiographic feature" – Characteristic physiographic features present in karst terrains including any of the following: sinkholes, sinking streams, caves, large springs, blind valleys, grikes, karren, solution widened joints or bedding planes, loss of drilling fluid during core

drilling, anastomosis and conduits of less than one meter but more than two and five-tenths (2.5) millimeters, and karst aquifers.

3.10. “Non-rule policy” - The term IDEM assigns to those policies identified in IC 13-14-1-11.5 as any policy that: A. Interprets, supplements, or implements a statute or rule; B. Has not been adopted in compliance with IC 4-22-2; C. Is not intended by IDEM to have the effect of law; and D. Does not apply solely to the internal IDEM organization (is not an administrative policy).

3.11. “Remediation Closure Guide” – IDEM’s Remediation Closure Guide (RCG) was an NPD describing selected approaches to investigation and risk-based closure of contaminated or potentially contaminated sites. Its purpose is to provide for consistent application of Indiana Code (IC) 13-12-3-2 and IC 13-25-5-8.5, which form the statutory basis for risk-based cleanup in Indiana.

3.12. “Screening levels” – Screening levels and, more specifically, the 2022 residential screening levels, can be found in Table A-6 Screening Levels and are attached to this NPD.

3.13. “Soil” – Unconsolidated earth material composing the superficial geologic strata (material overlying bedrock), consisting of clay, silt, sand or gravel as classified by the U.S. Natural Resources Conservation Service. For the purpose of this NPD, ‘dirt’ and ‘soil’ are considered to be synonymous terms. (40 CFR 268.2(k) [not inclusive])

3.14. “Solid waste" - As defined in 329 IAC 10-2-174:
(a) Has the meaning as set forth in IC 13-11-2-205(a).
(b) The following are examples of other discarded material:
(1) Ash residue.
(2) Contaminated sediments.
(3) Commercial solid waste.
(4) Construction/demolition waste.
(5) Hazardous waste.
(6) Household waste.
(7) Infectious waste.
(8) Liquid waste.
(9) Pollution control waste.
(10) Municipal solid waste.
(11) Regulated hazardous waste.
(12) Residential waste.
(13) Industrial process waste.

3.15. “Wetlands“ – Areas classified as jurisdictional wetlands or jurisdictional waters of the United States by the United States Army Corps of Engineers under the authority from the federal Clean Water Act, 33 U.S.C. 1344, and areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include (1) swamps, (2) marshes (3) bogs, and (4) similar areas. (329 IAC10-2-207 and IC 13-11-2-265.7)

4.0 ROLES

4.1 The Site Owner/Consultant/Operator or other person responsible for the soil shall:
Be responsible for conducting an investigation of the soils and the site or area where the soil will be removed to determine if the soil contains contaminants. This can include, but is not limited to:

- Reviewing site records to determine previous uses of the property, including uses that may have adversely impacted the site. This could include, but is not limited to, records of ownership and taxation, property transfer disclosures, or descriptions of property use (i.e., Sanborn Maps.)
- Reviewing or inspecting the site to determine the presence of stained soil(s) or other indications of contaminated soil, if deemed necessary. During the record review or site inspection, conducting a characterization of the soil(s).

- Determining if the soil contains human introduced chemicals. This will likely require collecting and analyzing representative samples of the soil in accordance with SW846 or other accepted methods and standards.
- Inspecting for stained soils or other wastes and/or other indications of contamination during excavation.
- If present, determining if the concentration of the human introduced chemicals or contaminant in the soil are at levels greater than the 2022 residential soil screening levels.
- Maintaining records/documentation used as a basis for determining the concentration of the human introduced chemicals in the soil.
- If human introduced chemicals are present, maintaining records of where and how much soil was placed on-site or where and how much soil was sent off-site.
- Ensuring that the soils containing any level of human introduced chemicals are not placed in an environmentally sensitive area.

4.2 Excavator/Transporter responsible for the relocation of soils shall:

- Ensure that the soils containing any level of human introduced chemicals are not placed in an environmentally sensitive area.

4.3 IDEM Compliance and Response Branch

- IDEM has been tasked with protecting the environment and shall be responsible for:
  a. Answering questions related to this NPD, and
  b. Investigating improper application of this NPD.

5.0 POLICY

This NPD is meant to aid in determining and explaining when, through the use of Table A-6: 2022 residentialscreening levels, soil containing detectable levels of human introduced chemicals is considered “uncontaminated”. As “uncontaminated”” soil, the exclusion in 329 IAC 10-3-1(1) will apply according to the qualifications listed below.

Use of Residential Screening Levels

For excavated soils containing detectable amounts of human introduced chemicals, the residential screening levels provided in Table A-6: 2022 Screening Levels (also referred to as Screening Levels Table) should be used when the soils are:

- Not subject to RCRA hazardous waste regulatory requirements, and
- Going to be deposited on-site, or
- Used as fill on-site or off-site, or
- Managed in a way other than disposal at a municipal solid waste landfill

There are two residential screening levels in Table A-6; the “Migration to Groundwater” and the “Direct Contact” screening levels. The lower of the two screening levels must be used as the residential screening level when comparing the concentrations of the human introduced chemicals in the soil with the residential screening level.

Placement in Environmentally Sensitive Areas

In order to protect the environment, soils with any detectable levels of human introduced chemicals cannot be placed in environmentally sensitive areas.

Environmentally sensitive areas include the following locations:

- Areas of karst physiographic features.
- A wetland, floodway, or standing water, where the standing water reflects the water table.

Additionally, any placement of soil, on-site or off-site, could be subject to other regulations that include, but may not be limited to, the following regulations:

- 327 IAC 15-5 - Storm Water Run-Off Associated with Construction Activity.
- 327 IAC 15-6 - Storm Water Discharges Exposed to Industrial Activity.
- IC 14-28 - Flood Control Act (i.e., IC 14-28-1-22 Construction permits).
- 312 IAC 10 - Flood Plain Management (i.e., 312 IAC 10-4-1 License requirements for construction in a floodway).
- 312 IAC 10-2-39 - Unreasonable detrimental effects upon fish, wildlife, or botanical resources, and IC 14-28-1-22.
- Section 401 of the federal Clean Water Act - State Certification of Water Quality.
- 326 IAC 6-4 - Fugitive Dust Emissions.
- 326 IAC 6-5 - Fugitive Particulate Matter Emission Limitations
- IC 14-21 - Historic Preservation and Archeology.
- Section 404 of the federal Clean Water Act – Wetlands.
- The critical habitat of an endangered species as defined by the Code of Federal Regulations, 50 CFR 17.

Determination/Approval

At any given time, there are large numbers of excavations and large volumes of soil being excavated and moved throughout the state. Putting in place a formal process to require the review and assessment of every excavation by IDEM is not practical or an efficient use of IDEM's time. Therefore, this NPD is meant to be self-implementing.

The owner/operator will still be responsible for adhering to the statutory requirements, rules, and for following this NPD, but will not be required to obtain approval from IDEM.

Case-by-Case Site-Specific Levels

When a screening level does not exist Table A-6: 2022 Screening Levels, facilities may develop a site-specific risk analysis to establish a site specific 'screening level'. If a case-by-case site-specific risk analysis is necessary, the owner/operator must submit a written proposal to the IDEM Industrial Waste Compliance Section. A written approval from IDEM will be required before excavation may begin. The written proposal will be routed by the IDEM Industrial Waste Compliance Section to the IDEM Office of Land Quality Science Services Branch, Risk Services Section.

More Information and/or Questions

If there are questions regarding the application of this NPD, please contact staff of the Industrial Waste Compliance Section of IDEM's Office of Land Quality, at (317) 234-6923 or, toll free in Indiana, at (800) 451-6027, ext. 4-6923.

6.0 REFERENCES

6.1. Indiana Administrative Codes:

A. 329 IAC 3.1, Hazardous Waste Management Permit Program and Related Hazardous Waste Management

B. 329 IAC 10, Solid Waste Land Disposal Facilities

C. 329 IAC 11-3-1(1), Solid Waste Processing Facilities; Exclusions; general

D. 2022 A-6 of the Remediation Closure Guidance

https://www.in.gov/idem/cleanups/files/risc_screening_table_2022_a6.pdf

6.2. Indiana Statutes:

A. IC 13-13, Department of Environmental Management

6.3 Agency Policies:

A. Remediation Closure Guide NPD (Waste-0046-R1)

B. Contained-In Determination NPD (Waste-0061)

7.0 SIGNATURES

Commissioner
Indiana Department of Environmental Management

4/2/24
Date

Assistant Commissioner
Office of Land Quality

3/5/2024
Date

Assistant Commissioner
Office of Legal Counsel and Criminal Investigations

4/10/24
Date

This policy is consistent with agency requirements.

Quality Improvement Program
Office of Planning and Assessment
Indiana Department of Environmental Management

4-11-2024
Date

ATTACHMENT 3

SOIL TRACKING LOG

SOIL MANAGEMENT PLAN
INDIANA UNIVERSITY
LIFE SCIENCES AND ADVANCED RESEARCH BUILDING
1302 INDIANA AVENUE,
INDIANAPOLIS, INDIANA

SOIL TRACKING LOG

Date	Time	Truck Number	Waste Profile No	Shipping Form No.	Disposal Location	Notes

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ATTACHMENT 4

IDEM CONTAINED-IN DETERMINATION POLICY (WASTE-0061-NPD-R1)

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT	**STATUS:** Effective	**POLICY NUMBER:** WASTE-0061-NPD-R1	
AGENCY NONRULE POLICY DOCUMENT **SUBJECT:** "Contained-in Determination" Policy	**AUTHORIZED:** Brian Rockensuess, Commissioner		
	SUPERSEDES: WASTE-0052 WASTE-0061	**ISSUING OFFICE(S):** Office of Land Quality	
	ORIGINALLY EFFECTIVE: October 17, 2002	**RENEWED/REVISED:** April 10, 2024	

Disclaimer: *This Nonrule Policy Document (NPD) is being established by the Indiana Department of Environmental Management (IDEM) consistent with its authority under IC 13-14-1-11.5. It is intended solely to provide guidance and shall be used in conjunction with applicable rules or laws. It does not replace applicable rules and laws, and if it conflicts with these rules or laws, the rules or laws shall control. Pursuant to IC 13-14-1-11.5, this policy will be available for public inspection for at least 45 days prior to presentation to the appropriate State Environmental Board, and may be put into effect by IDEM 30 days afterward. If the nonrule policy is presented to more than one board, it will be effective 30 days after presentation to the last. IDEM also will submit the policy to the Indiana Register for publication.*

1.0 PURPOSE

This guidance is intended to clarify the application of Resource Conservation and Recovery Act (RCRA) hazardous waste regulations to environmental media (i.e., soil and groundwater). Environmental media that has become mixed with "listed" hazardous wastes must be managed as hazardous waste when generated (e.g., exhumed for discard during remedial activities) because it contains "listed" hazardous waste(s). Federal hazardous waste rules 40 CFR 260 through 270 are adopted by reference in 329 IAC 3.1 including the listing and characteristics of hazardous waste. Listed hazardous waste refers to solid wastes that have been determined to be hazardous waste by the US EPA based upon the specific process generating the waste or the specific source of the waste. Listed hazardous wastes are further described in 40 CFR 261 Subpart D as adopted by 329 IAC 3.1. Mixtures of listed hazardous waste and non-hazardous solid waste are considered to be RCRA hazardous waste per 40 CFR 261.3(a)(2)(iv). Characteristic hazardous waste refers to solid wastes that exhibit a "hazardous waste characteristic" such as 'ignitability', 'corrosivity', 'reactivity', and/or 'toxicity' as defined in 40 CFR 261 Subpart C as adopted by 329 IAC 3.1.

United States Environmental Protection Agency (US EPA) Regions and authorized states, including Indiana, may use site-specific, media-specific and contaminant-specific health-based criteria to determine when listed hazardous waste is not "contained-in" environmental media. If the concentration of the hazardous constituents in the environmental media fall below the specified health-based levels, the environmental media may be determined to no longer contain hazardous waste. Such a "contained-in determination" may be made by an authorized state before or after treatment of the contaminated environmental media and may include consideration of site-specific exposure pathways (e.g., potential for human exposure, soil permeability, leaching potential to groundwater). It should be noted that any treatment of hazardous waste may require a permit. For further information on this issue, see the IDEM guidance document *Treatment of Hazardous Waste On-site by Generators* at

http://www.in.gov/idem/5026.htm, or contact staff of the RCRA permit or compliance programs at IDEM.

Level of contaminants of concern found in the attached Table A-6: 2022 Screening Levels , represent an appropriate basis for making a risk-based "contained-in determination" for soil and groundwater. Screening levels in Table A-6: 2022 Screening Levels were generated using conservative models and default assumptions concerning exposure and site conditions. If applicable, the environmental media must also meet all Land Disposal Restriction (LDR) treatment standards (including treatment of underlying hazardous constituents as defined at 40 CFR §268.2(i) for material that exhibits a characteristic in addition to containing a listed waste).

2.0 SCOPE

The scope of this NPD applies to environmental media (soil and groundwater) which is not characteristically hazardous but is subject to RCRA regulation by containing listed hazardous waste at concentrations below specific screening levels.

Excavated nonhazardous soil, which is not subject to this policy, may be subject to solid waste regulations in 329 IAC 10 and/or policies as applicable.

This NPD is not meant to address naturally occurring contaminants of concern in soil or groundwater.

3.0 SUMMARY

The U.S. EPA "Contained-in Policy" states that soil and/or groundwater, which do not contain "listed" RCRA hazardous waste, and which is not otherwise hazardous, is not subject to RCRA regulation. A determination as to whether "listed" waste is "contained-in" soil and/or groundwater may be made by authorized states based on whether constituents from "listed" waste(s) are below health-based levels. Contamination levels specified in the attached Table A-6: 2022 Screening Levels developed by IDEM represent appropriate health-based levels for determining if soil or groundwater contains "listed" hazardous waste.

This NPD explains how the 2022 screening levels will be used to make determinations on whether constituents from listed hazardous wastes are contained-in soil or groundwater.

This NPD is applicable to soil and/or groundwater which is generated and subsequently managed, and does not replace or alter requirements for closure or clean-up requirements found in various regulatory authorities.

This NPD is applicable for soil which will be managed:

- Off-site as a solid waste in a permitted disposal facility (e.g., municipal solid waste landfill),
- Groundwater that is solidified and managed off-site as a solid waste in a permitted disposal facility (e.g., municipal solid waste landfill), and
- Groundwater that is managed in a unit subject to the Clean Water Act.

Consistent with US EPA policy, a written "contained-in" determination must be obtained from IDEM.

4.0 DEFINITIONS

4.1. "Agency" – The Indiana Department of Environmental Management (IDEM).

4.2. "Characteristic Hazardous Waste" – A solid waste as defined in 40 CFR 261.2 which is not excluded from regulation under 40 CFR 261.4(b), is a hazardous waste if it exhibits any of the following characteristics as defined by 40 CFR 261 Subpart C as adopted in 329 IAC 3.1:

A. Ignitability

B. Corrosivity

C. Reactivity

D. Toxicity

4.3. "Contained-in Determination" – Written determination granted by US EPA or an authorized state that certifies an environmental media (soil or groundwater) is no longer considered a hazardous waste.

4.4. "Contaminant of Concern" (COC) – Chemicals that are included in the hazardous waste 'Industry and US EPA hazardous waste number' sections listed in 40 CFR Subpart D. The contaminants of concern will consist and correlate to the listed hazardous waste identified as impacting the environmental media in the 'contained-in' determination request.

4.5. "Environmental media" – Naturally occurring soil and groundwater.

4.6. "Hazardous waste" – Hazardous waste as defined in 40 CFR 261 subpart B.

4.7. "Listed hazardous waste"- A solid waste as defined in 40 CFR 261.2, which is not excluded from regulation under 40 CFR 261.4(b), which is included in the lists in 40 CFR 261 Subpart D, and which has not been excluded under 40 CFR 260.20 and 40 CFR 260.22 as adopted in 329 IAC 3.1.

4.8. "Nonrule policy document" – The term assigned by the Indiana Department of Environmental Management (IDEM) to those policies identified in IC 13-14-1-11.5 as any policy that: A. Interprets, supplements, or implements a statute or rule; B. Has not been adopted in compliance with IC 4-22-2; C. Is not intended by IDEM to have the effect of law; and D. Does not apply solely to the internal IDEM organization (is not an Administrative Policy).

4.9. "Remediation Closure Guide" – An IDEM NPD describing selected approaches to investigation and risk-based closure of contaminated or potentially contaminated sites. Its purpose is to provide for consistent application of Indiana Code (IC) 13-12-3-2 and IC 13-25-5-8.5, which form the statutory basis for risk-based cleanup in Indiana.

4.10. "Resource Conservation and Recovery Act (RCRA)" – Refers to the federal Resource Conservation and Recovery Act as codified in 40 CFR and means the version of 40 CFR adopted in to the Indiana Administrative Code in 329 IAC 3.1.

4.11. "Screening levels" – Levels of hazardous substances and petroleum calculated by the department using standard equations and default values for particular hazardous substances or petroleum. (IDEM Remediation Closure Guide Appendix A)

4.12. "Soil" – Unconsolidated earth material composing the superficial geologic strata (material overlying bedrock), consisting of clay, silt, sand or gravel as classified by the U.S. Natural Resources Conservation Service.

4.13. "Solid waste" as defined in 40 CFR 261.2

5.0 ROLES

5.1 <u>The Site Owner/Consultant/Operator or whomever requests a "contained-in" determination shall:</u>

- Be responsible for conducting a waste determination/characterization of the environmental media, specific to the "contained-in" determination.
- Delineate areas to be removed as part of remediation removal and provide the volumes of material to be managed under this policy. Amounts of environmental media generated as investigation derived wastes (IDW) should be included in the "contained-in" request.
- Sample and analyze the environmental media to determine if it has been impacted with listed hazardous wastes and/or if the environmental media exhibits hazardous waste characteristics. This will require collecting and analyzing representative samples of the environmental media in accordance with SW846 or other accepted methods and standards.
- Identify the hazardous waste listing codes to be considered for the 'contained-in' determination.
- Identify any hazardous waste characteristics exhibited in the environmental media considered for the 'contained-in' determination.
- Determine the concentration of the contaminants of concern in the environmental media and how those levels compare to the Screening Levels contained in the attached 2022 Table A-6 .
- Submit a request for the environmental media to be exempted from being a hazardous waste through the "contained-in" determination process. At a minimum, the request should include the following:
  - A cover letter indicating the proposed "contained-in" request.
  - A completed 'Contained-in Checklist' (Included in Appendix 1).
  - Laboratory analytical results. Full QA/QC for the sample analyses should be available for submittal to IDEM upon request. Map(s) indicating sample locations and points of generation
- Maintain records/documentation used as a basis for determining the concentration of the contaminants of concern in the environmental media.
- Provide IDEM with the intended location of disposal of the environmental media identified in the 'contained-in' determination.
- Maintain records of where the 'contained-in' environmental media was sent off-site.
- Contact IDEM if the facility wishes to pursue a case-by-case exemption and for information on the development of a site-specific risk analysis to establish exit levels.

5.2 IDEM Technical Environmental Specialist E7 shall:

- Review contained-in determination request.
- Determine if data provided supports the approval of a contained-in request.
- Generate a letter responding to the "contained-in" request. That letter could be any one of the following:
  - Request for additional information.
  - Approval of the contained-in determination request.
  - Denial of the contained-in determination request.
- Route the letter to the branch chief for approval and signature.

5.3 IDEM branch chief shall:

- Receive and route "contained-in" requests to the E7.
- Review the letters and sign as appropriate.
- Route the signed letters to the Branch administrative assistant for mailing and entry into the IDEM Virtual File Cabinet (VFC) electronic file system.

6.0 POLICY

6.1 Use of Commercial/Industrial Screening Levels

The "Direct" Commercial/Industrial screening levels in Table A-6 may be used as the basis for a "contained-in" determination when:

- The environmental media is not characteristically hazardous,
- All applicable LDR requirements are met, and
- The soil will be disposed at a permitted disposal facility (e.g., municipal solid waste landfill).

Groundwater, solidified for disposal, which then meets the "Direct" Commercial/Industrial screening levels in the attached Table A-6: 2022 Screening Levels for soil may be disposed at a permitted facility (RCRA Subtitle C or Subtitle D landfill cell).

The Remediation Closure Guide does not contain Commercial/Industrial screening levels for groundwater. It has been determined that the Residential Groundwater Closure Level increased by a factor of ten (x10) may be used as the Commercial/Industrial groundwater "exit" level for groundwater that is managed in any unit subject to Federal Clean Water Act.

6.2 Determination Approval

In order to be approved for a "contained-in" determination, indicating that an environmental media no longer contains hazardous waste and is not subject to RCRA regulatory management requirements, the environmental media must meet the following requirements:

(1) Be below contaminant of concern (COC) concentration levels in attached Table A-6: 2022 Screening Levels, Commercial/Industrial Levels ,

(2) Not exhibit a hazardous characteristic,
(3) Meet US EPA Land Disposal Restriction (LDR) requirements, if applicable, including alternative standards established for contaminated soils (40 CFR 268.49), and
(4) Be disposed of in a permitted disposal facility (e.g., municipal solid waste landfill).

Due to the complexity of establishing the appropriate 'exit level' from RCRA regulations, and the need to be consistent with US EPA policy, any facility that intends to demonstrate that environmental media no longer contains a listed hazardous waste must obtain a written "contained-in" determination approval from IDEM.

If the environmental media is deemed to meet the aforementioned criteria, the agency will notify the requesting entity of a "contained-in" determination approval. The approvals are based on either set amounts of environmental media to be disposed during a short duration one-time approval or for repeatedly generated investigation derived wastes that will be generated over a set period of time. Any on-going approval would be based on the future generated environmental media meeting the required contained-in criteria specified above.

All approvals for a one-time generation of a "contained-in" waste will expire one calendar year after issuance.

All approvals for reoccurring investigative derived "contained-in" wastes will expire two calendar years after the date of issuance and will require a resubmittal for consideration of continued approval at the completion of the two-year period. Screening levels at the time of the renewal/resubmittal will be used when evaluating the "contained-in" determination for renewal.

6.3 Other Options

On a case by case basis, facilities may develop site-specific risk analysis to establish non-default exit levels. If a case-by-case site-specific risk analysis is requested by the owner/operator, a written request will need to be submitted to the agency and a written approval will be required.

Please contact the staff of the Hazardous Compliance Program, Office of Land Quality, at 317-234-6923 for additional information on case-by-case approvals.

7.0 REFERENCES

7.1. Indiana Administrative Codes:

A. 329 IAC 3.1, Hazardous Waste Management Permit Program and Related Hazardous Waste Management
B. 329 IAC 10, Solid Waste Disposal Facilities

7.2. Indiana Statutes:

A. IC 13

7.3. Agency Policies:

A. Remediation Closure Guide NPD (Waste-0046-R1)

B. Contained-In Determination NPD (Waste-0052)

7.4 U.S. EPA Contained-in Policy:

This document is 56 pages long and rather than it being included in this document, it is referenced by website address.

http://www.epa.gov/osw/hazard/correctiveaction/resources/guidence/remwaste/refrnces/12cntdin.pdf

7.5 2022 A-6 of the Remediation Closure Guidance

https://www.in.gov/idem/cleanups/files/risc_screening_table_2022_a6.pdf

8.0 SIGNATURES

Commissioner
Indiana Department of Environmental Management

4/2/24
Date

Assistant Commissioner
Office of Land Quality

3/19/24
Date

Assistant Commissioner Date
Office of Legal Counsel and Criminal Investigations

4/10/24
Date

This policy is consistent with agency requirements.

Quality Improvement Program
Office of Planning and Assessment
Indiana Department of Environmental Management

4-11-2024
Date

Appendix 1

Information Checklist for Contained-In Request

1. Name of responsible party (property owner/operator).

2. Site description (Name, Address, Size of Site, and Number of Areas Involved). Please provide any site ID# such as EPA ID#, VRP number, etc.

3. Is the site subject to RCRA corrective action, enforcement orders?

4. Is the site being remediated under state or federal oversight? Identify Agency and Agency contacts.

5. How was the site contaminated? (Spill of hazardous waste, product release, process waste release, other?)

6. When was the site contaminated?

7. What EPA waste codes apply and why? Indicate all listed and characteristics codes applicable to the material which contaminated the site.

8. Does the environmental media exhibit any characteristics of hazardous waste, in addition to being contaminated with a listed waste? If it does, the environmental media would be subject to hazardous waste rules regardless of listed waste concentration. Environmental media cannot exit the hazardous waste system unless treated to remove the hazardous waste characteristics.

9. Which specific hazardous substances/constituents are present based on analytical results? Be sure to include all the breakdown products of the listed waste.

10. What is the volume/quantity of environmental media involved? An estimate of the volume/quantity will provide some idea of what size project is being addressed.

11. Will the environmental media in question be generated one time only, as a batch or in a continuous manner?

12. Is treatment of the environmental media involved or necessary?

13. Analytical sample results from the laboratory conducting the analysis and the test methods used to analyze the environmental media. Results must be based upon representative sampling.

14. A description of the sampling plan and methods used to assure representative sampling.

15. QA/QC documentation should be provided. Analytical data submitted to IDEM in support of a “contained-in” determination should include the items listed for Full QA/QC in Section 3.9, Table 3-A of the Remediation Closure Guide.

16. How will the environmental media be managed at the generation site, intermediate sites, and final destination? What time periods are involved?

17. What is the final destination of the environmental media and how is it to be managed at the final destination site?

18. How will the company assure contained-in threshold levels are attained for environmental media that will be generated on an ongoing basis?

SECTION 23 6416
CENTRIFUGAL WATER CHILLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Centrifugal water chiller.

1.02 REFERENCE STANDARDS

A. AHRI 550/590 (I-P) - Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.

E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.

F. UL 508 - Industrial Control Equipment.

G. UL 1995 - Heating and Cooling Equipment.

1.03 GENERAL REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. The Owner shall evaluate the price of each chiller manufacturer submitted, as well as the *Initial Submittal* information provided, and then select a manufacturer.

C. Acceptance of pricing associated with a manufacturer does not imply that a manufacturer's alternate construction standard is acceptable. Requested deviations from the project manual specification and drawings shall be processed in accordance with the Project Manual prior to Bid submission and all deviations shall be repeated and included in the *Initial Submittal*. Pricing shall be submitted for each of the manufacturers requested and their *Initial Submittal* shall be generated by each chiller manufacturer representatives. After the bids are received the Owner and Engineer will evaluate the *Initial Submittals* to determine the most responsive and responsible manufacturer bid.

1. The pricing submitted shall be that which incorporates all costs to achieve the following schedule requirements:
    a. Final Product Data Submittals shall be submitted to the Engineer **no more than seven calendar days** after the award of the contract. Note that the *Initial Submittal* does not constitute the Final Product Data Submittal.
    b. Chiller delivery schedule as identified by the Contractor.
2. Any Contractor related costs of architectural, mechanical piping and insulation, structural, acoustical, seismic, plumbing, sheet metal, electrical and controls changes required to match final installed performance, fit and operational characteristics of the required chillers shall be borne by the Contractor.

D. In order for the manufacturer's price to be valid, the chiller manufacturer must complete and submit an *Initial Submittal* with the project bid. An electronic PDF of the *Initial Submittal* must be included for review at the time and location the bids are received for this project.

E. The *Initial Submittal* shall contain product information containing adequate information to demonstrate that all proposed equipment complies fully with the contract documents. Include all of the following information in the *Initial Submittal* at a minimum:
   1. An acknowledgement statement to the Contractor that the proposed chiller can be transported into and installed via the method outlined by the Contractor.
   2. Refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
   3. Dimensioned equipment assemby drawing with manufacturer required clearances noted.
   4. Performance at AHRI standard conditions and at conditions indicated.
   5. Performance at AHRI standard IPLV unloading conditions and nonstandard NPLV unloading condions. NPLV shall be calculated with the scheduled water temperature operating conditions per AHRI 550/590.
   6. Pounds of refrigerant capacity of chiller.
   7. Characteristics of safety relief valves (size, connection sizes, etc..).
   8. Minimum flow requirements for condenser tube bundles and evaporator tube bundles with temperature and load ranges stated. Include minimum differential pressure requirements which correlate to these minimum flow rates.

1.04 SUBMITTALS

A. Refer to front end section for submittal procedures and operation / maintenance manuals requirement.

B. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
   1. Performance at AHRI standard conditions and at conditions indicated.
   2. Performance at AHRI standard IPLV unloading conditions and nonstandard NPLV unloading condions. NPLV shall be calculated with the scheduled water temperature operating condions per AHRI 550/590.
   3. Pounds of refrigerant capacity of chiller.
   4. Oil capacity of chiller.
   5. Fluid capacity of evaporator, condenser.
   6. Characteristics of safety relief valves. (size, connection sizes, etc..)
   7. Minimum entering condenser-fluid temperature.
   8. Performance at varying capacities with constant design condenser-fluid temperature. Repeat performance at varying capacities for different condenser-fluid temperatures from design to minimum in 5 deg. F (3 deg. C) increments.
   9. Weight of operating refrigerant charge.
   10. Minimum flow requirements for condenser tube bundles and evaporator tube bundles with temperature and load ranges stated. Include minimum differential pressure requirements which correlate to these minimum flow rates.
   11. Acoustic performance by octave band.
   12. Minimum circuit ampacity required.
   13. Structural support requirements including soleplates and anchorage details.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances and method of field assembly, components, and location and size of each field connection. Identify tube pull clearances, tube cleaning clearances, and other service clearances. Indicate valves, strainers, and thermostatic valves required for complete system.
   2. Wiring diagrams: For power, signal, and control wiring.

D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

E. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with all applicable codes, standards and regulations. Include Global Warming Potential (GWP) and Ozone Depleting Potential (ODP) characteristics.

F. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble- shooting guide.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. AHRI Rating: Rate chiller performance according to requirements in AHRI 550/590 (I-P). Test loop shall be AHRI certified.

B. ASHRAE Compliance:
   1. ASHRAE Std 15 for safety code for mechanical refrigeration.
   2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.
   3. ASHRAE 90.1 for energy efficiencies and standards.

C. ASME Compliance: Fabricate and label chillers to comply with ASME BPVC-VIII-1 Boiler and Pressure Vessel Code. Include an ASME U-stamp and nameplate certifying compliance.

D. Comply with NFPA 70.

E. Comply with UL 465 at the specified short circuit rating.

F. Comply with UL 1995 Heating and Cooling Equipment.

G. Comply with requirements of UL and include label by a qualified testing agency showing compliance.

1.06 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Ship chillers from factory fully charged with refrigerant and oil. Factory charge each chiller with nitrogen if refrigerant is shipped in containers separate from chiller and provide on site installation of refrigerant by factory personnel.

C. Do not disassemble chiller without prior written approval from the Engineer. If disassembly is required and approved, then disassemble chiller into major assemblies as required by the installation at the factory, after factory testing and before packaging for shipment. Reassembly on site shall be performed by factory personnel and reassembly instructions shall be submitted prior to performing the work. Provide new gaskets and components as required.

D. Protect Units from physical damage. Leave factory covers in place until installation.

1.08 WARRANTY

A. Provide a five year warranty to include coverage for compressor, compressor motor, evaporator, condenser, and and the remainder of the complete chiller package as manufactured and delivered to site including materials and labor and refrigerant use associated with the work. The warranty shall start on the date of substantial completion, as accepted by the A/E/Owner team.

1.09 MAINTENANCE SERVICE CONTRACT

A. The manufacturer shall provide a written Manufacturer's Alternate Bid for a Maintenance Service Contract which is a separate dollar amount from the Base Bid dollar amount for the equipment. Provide two separate dollar amounts on the Bid Form.

B. Provide a proposed Maintenance Service Contract scope for the first five years of service beginning at the project Substantial Completion when the Warranty starts.

C. The Maintenance Service Contract shall, at a minimum, provide all annual tasks and activities as identified in the Manufacturer's Maintenance Manual relating to inspection of and replacement of consumable items. The Maintenance Service Contract shall additionally include any recommended replacement of these items:
   1. Replacement of fluids (oils, cooling fluids).
   2. Replacment of fluid filters/filter media (oil filters, coolant filters, refrigerant filters).

D. The Maintenance Service Contract shall, at a minimum, provide all annual tasks and activities as identified in the Manufacturer's Maintenance Manual relating to inspection of and checking acceptability of unit operating pressures and temperatures. The Maintenance Service Contract shall additionally include any recommended calibration of the temperature sensors and pressure sensors associated with determining acceptable operational parameters.

E. The Maintenance Service Contract shall, at a minimum, provide all annual tasks and activities as identified in the Manufacturer's Maintenance Manual relating to inspection of and checking acceptability of unit motors and speed controllers and associated cooling system and filters. The Maintenance Service Contract shall additionally include any recommended resistance testing associated with determining acceptable operational parameters.

F. The Maintenance Service Contract shall, at a minimum, provide all annual tasks and activities as identified in the Manufacturer's Maintenance Manual relating to inspection of and checking acceptability of unit heat exchanger tubes. The Maintenance Service Contract shall additionally include any recommended tube cleaning associated with determining acceptable operational parameters.

G. The Maintenance Service Contract shall, at a minimum, provide all annual tasks and activities as identified in the Manufacturer's Maintenance Manual relating to inspection of and checking acceptability of unit refrigerant including checking the refrigerant moisture indicator. The Maintenance Service Contract shall additionally include any recommended refrigerant leak testing associated with determining acceptable operational parameters.

H. The Maintenance Service Contract shall, at a minimum, provide all annual tasks and activities as identified in the Manufacturer's Maintenance Manual relating to inspection of and checking acceptability of the oil pump, oil sump, oil pressure relief valve, oil pressure transducer, oil heater, oil filter, oil cooler, and oil fluid. The Maintenance Service Contract shall additionally include any recommended oil laboratory testing associated with determining acceptable operational parameters of bearing wear and refrigerant condition. The Maintenance Service Contract shall provide an biannual oil filter change. The Maintenance Service Contract shall provide an a complete oil change in the fifth year.

I. Provide a highlighted copy of the equipment Maintenance Manual which identifies each daily activity, monthly activity, and annual activity in the Maintenance Manual as either “task provided by the Maintenance Service Contract provider” or “task assumed to be undertaken by Owner’s maintenance personnel”.

J. Provide a written statement regarding any potential items which are not included in this Maintenance Service Contract where these potential items may not be included in this specification's Warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carrier Corporation.

B. Trane Technologies.

C. York, a brand of Johnson Controls International.

2.02 CENTRIFUGAL WATER CHILLER PERFORMANCE REQUIREMENTS

A. Condenser-Fluid Temperature Performance:
   1. Startup condenser fluid temperature: Chiller shall be capable of starting with an entering condenser-fluid temperature of 60 deg F and providing stable operation until the system temperature is elevated to the minimum operating entering condenser-fluid temperature.
   2. Minimum operating condenser fluid temperature: Chiller shall be capable of continuous operation over the entire capacity range indicated with an entering condenser-fluid temperature of 65 deg F.
   3. Make factory modifications to standard chiller design if necessary to comply with performance indicated.

B. Performance Tolerance: Comply with AHRI 550/590, latest edition:

2.03 CENTRIFUGAL WATER CHILLER CONSTRUCTION REQUIREMENTS

A. Factory assembled and tested, packaged, water cooled chillers consisting of centrifugal compressors, compressor motor, condenser, evaporator, refrigeration accessories, instrument and control panel including gauges and indicating lights, auxiliary components and accessories, motor starters and motor speed controllers.
   1. Rating: Comply with AHRI 550/590 (I-P).
   2. Safety: Comply with UL 1995.
   3. Comply with ASME BPVC-VIII-1 for construction and testing of centrifugal chillers.
   4. Comply with ASHRAE Std 15 for safe construction and operation of centrifugal chillers.

B. Energy Efficiency: ASHRAE Std 90.1.

C. Evaporator Side:
   1. Provide evaporator of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Position intermediate tube support sheets along length of shell to avoid contact and relative motion between adjacent tubes.
   2. Tubes: minimum 0.028 wall thickness.
   3. Test and, where applicable, stamp refrigerant side for 45 psi working pressure and water side for 150 psi working pressure, in accordance with ASME BPVC-VIII-1.
   4. Provide marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint piping connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping. Provide hinged water box covers or lifting lugs. Provide the water box with 3/4- or 1-inch drain connection at low point and vent connection at high point, each with threaded plug.
   5. Insulate evaporator and cold surfaces with 0.75 inch minimum thick flexible expanded polyvinyl chloride insulation with maximum K factor of 0.28.
   6. Provide thermometer wells or thermistors for temperature controller and low temperature cutout.

7. Design and construct evaporator to prevent liquid refrigerant from entering the compressor.
8. Provide reseating type relief valve(s) on shell in accordance with ASHRAE Std 15.
9. Construction and materials to comply with ASME BPVC-VIII-1 or ASHRAE Std 15 as applicable to chiller manufacturer and chiller model.

D. Condenser Side:
1. Provide condensers of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Position intermediate tube support sheets along shell length to avoid contact and relative motion between adjacent tubes. Provide additional condensers on heat recovery units.
2. Tubes: minimum 0.028 wall thickness.
3. Test and, where applicable, stamp refrigerant side for 45 psi working pressure and water side for 150 psi working pressure, in accordance with ASME BPVC-VIII-1.
4. Provide marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint piping connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping. Provide hinged water box covers or lifting lugs. Provide the water box with 3/4- or 1-inch drain connection at low point and vent connection at high point, each with threaded plug.
5. Provide reseating type relief valve(s) on shell in accordance with ASHRAE Std 15.
6. Provide baffles to ensure even distribution of incoming gas and to concentrate noncondensible gases.
7. Construction and materials to comply with ASME BPVC-VIII-1.

E. Centrifugal Compressor:
1. Compressor Casing: Cast iron, horizontally or vertically split with machined passages and leak tested to at least 185 psi. Provide refrigerant sight glass.
2. Impellers: Single or multi-stage, in-line design, fully shrouded, statically and dynamically balanced, tested to 20 percent over operating speed, mounted on heat treated forged or rolled steel shaft, nonferrous, labyrinth seals between stages.
3. Bearings: Permanent magnet synchronous motor, oil lubricated bearings, integral variable speed controller and digital electronic controls.
4. Gear Box: Double helical design, symmetrical and center supported by spherically seated, self-aligning bearing, arranged for inspection without disassembly.
5. Motor: Chiller manufacturer's standard, rated for the variable speed duty created by the Chiller manufacturer's Variable Frequency Drive.
6. Lubrication: Oil pump, with oil cooler, pressure regulator, pressure relief valve, pressure transducer, oil filters, thermostatically controlled oil heater, and motor controls. Interlock to start before chiller motor and run after motor is shut down. Provide sight glass or electronic sensors for monitoring oil level.
7. Refrigerant: Factory precharged with the scheduled refrigerant.

F. Refrigerant System:
1. Refrigerant Isolation: Factory install positve shutoff, manual isolation valves in the compressor discharge line to the condenser and the refrigerant liquid line leaving the condenser to allow for isolation and storage of full refrigerant charge in the chiller condenser shell. In addition, provide isolation valve on the suction side of the compressor from the evaporator to allow for isolation and storage of full refrigerant charge in of the chiller shells.
2. Refrigerant Flow Control: Manufacturer's standard components and control.

G. Insulation:
   1. Closed-cell, flexible elastomeric thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials. 3/4 inch thickness.
   2. Provide insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, purge chamber, refrigerant-cooled motor, and auxiliary piping.
      a. Apply adhesive to 100 percent of insulation contact surface.
      b. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
      c. Seal seams and joints to provide a vapor barrier.
      d. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.

H. Miscellaneous Features:
   1. Vibration Isolation: Furnish vibration isolation springs sized and selected by the Chiller Manufacturer as detailed per Section 230548, Vibration and Seismic Controls for HVAC.

I. Electrical Starters and Drives, Low Voltage (208 to 600 VAC):
   1. Air-cooled or Fluid-cooled, Unit-Mounted Variable Frequency Drive (VFD):
      a. Specifically design VFD to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. VFD-control logic is to optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If surge is detected, VFD is to move away from and avoid surge at similar conditions in the future.
      b. Efficiency: 97 percent or better at full speed and full load.
      c. Fundamental Displacement Power Factor: Minimum of 0.97.
      d. Provide voltage and current regulated, solid state, microprocessor-based pulse-width modulated (PWM). Output power devices to be IGBT transistors.
      e. Provide liquid- or air-cooled heatsink to cool power semiconductor and capacitor.
      f. House VFD in NEMA Type 1 metal enclosure having a minimum short circuit withstand rating of 65,000 amps per UL 508. Include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and components properly segregated and completely enclosed in a single metal enclosure.
         1) Enclosure to include padlockable, door-mounted circuit breaker with minimum AIC rating of 65,000 amps.
         2) Entire chiller package to be listed by Underwriter's Laboratories Inc.
      g. Test VFD according to UL 508 and listed by a National Recognized Testing Laboratory (NRTL) as designated by OSHA.
      h. Comply with recommendations for harmonic mitigation.
         1) Include a DC link reactor on positive and negative rails to minimize power line harmonics and protect the VFD from power line transients.
      i. Line Frequency: 38 to 60 Hertz with plus or minus 10 percent tolerance.
      j. VFD is to include the following features:
         1) Control circuit voltages physically and electrically isolated from power circuit voltage.
         2) 150 percent instantaneous torque available for improved surge control.
         3) Soft start, adjustable linear acceleration, coast-to-stop.

4) Adjustable current limiting and UL-approved electronic motor overload protection.
5) Insensitivity to incoming power phase sequence.
6) VFD and motor protection from the following faults:
(a) Output line-to-line short circuit.
(b) Line-to-ground short circuit.
(c) Phase loss at AFD input.
(d) Phase reversal/imbalance.
(e) Over-voltage.
(f) Under-voltage.
(g) Over-temperature.

k. VFD Status Indicators:
1) Output speed in hertz and rpm.
2) Input line voltage.
3) Input line kW.
4) Output/load amps.
5) Average current in percent RLA.
6) Load power factor.
7) Fault.
8) VFD transistor temperature.

l. Service Conditions:
1) Operating Ambient Temperature: 14 to 104 degrees F.
2) Room Ambient Relative Humidity: Up to 95 percent.
3) Elevation: Up to 3,300 feet. For every 3,300 feet above 3,300 feet, decrease the rated output current by 4 percent up to 9,900 feet.

J. Controls Package:
1. Unit Controls: Factory-supplied DDC:
a. Control-panel mounted with required input-output expansions, power supply, fused disconnect, hand switches, knobs, and accessories required to control chiller unit to manufacturer required sequences to meet intended use with listed performance.
b. Factory configured to interface prewired sensors, switches, and safeties with allowance to add up to four chiller valves and flow sensors.
c. Graphic-based touchscreen to include unit operation controls and user filter based interface for faults, alarms, performance, unit diagnostics, and data recording up to 12 months.
d. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
e. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.
f. Hard wired points connected from the Building Automation System (BAS):
1) Monitoring output: On-off status, common trouble alarm.
2) Control input: On-off operation.
3) Control input: Chilled Water Supply Temperature setpoint.
g. Integration with BAS; provide the following factory authorized support features and technical support effort:
1) All hardware, firmware and software components required to provide the protocol interface necessary to transmit the specified data points to the BAS

system. The equipment manufacturer and/or equipment supplier is responsible for identifying and coordinating the required controls protocol with the successful BAS Contractor. The final result of the coordination shall be indicated on the written equipment submittal.

2) On-site technical labor to assist the BAS Contractor with the data integration and to verify the specified data points, including data values, change of state values and units and are communicated properly and completely to the BAS system. On-site technical assistance shall not be less than a minimum of 4 hours total time on the job site for each piece of equipment installed with this time split over two separate site visits. Allow a minimum of 2 hours to assist the BAS Electrician and coordinate wiring terminations and a minimum of 2 hours to assist the ECC Programmer to confirm data connectivity.

2. Disconnect Switch: Factory mount disconnect switch in starter control panel.
3. On or near chiller, provide microprocessor based control panel containing solid state, fully automatic operating and safety controls.
4. Provide the following manufacturer's standard safety controls, including the following minimum functions, so that operating any one will shut down machine and require manual reset:
   a. Low evaporator refrigerant temperature.
   b. High condenser refrigerant pressure.
   c. Low oil pressure.
   d. Low refrigerant evaporator pressure.
5. Provide the manufacturer's standard safety controls arranged so that operating any one will shut down machine and automatically reset.
6. Provide the following devices on control panel:
   a. Manual Switches:
      1) Machine off-auto switch.
      2) Oil pump switch, manual or automatic.
      3) Purge pump switch, manual-off-auto.
      4) Machine selector switch to allow load, unload, hold or automatic operation.
   b. Manual Setpoint Adjustments:
      1) Leaving chilled water temperature.
      2) Current demand limit.
   c. Status Lights:
      1) Chilled water flow proven.
      2) Cooling required.
      3) Unit running.
      4) Unit loading.
      5) Unit unloading.
      6) Manual reset required.
      7) Remote chilled water setpoint active.
      8) Remote current water setpoint active.
   d. Setpoint and Temperature Display:
      1) Chilled water setpoint.
      2) Current limit setpoint.
      3) Entering evaporator water temperature.
      4) Leaving evaporator water temperature.
      5) Entering condenser water temperature.
      6) Leaving condenser water temperature.

7. Provide the following operating controls:
   a. Solid state, chilled water temperature controller that controls cmpressor speed and electronic guide vane operator. Include hot gas bypass, if necessary, to achieve performance indicated. Locate temperature sensor in entering chilled water.
   b. Adjustable thirty minute off timer prevents compressor from short cycling.
   c. Demand limit device to manually set maximum current infinitely between 40 percent and 100 percent of full load amperes.
   d. Automatic start that determines demand for chilled water from proof of chilled water flow and temperature differential between chilled water setpoint and supply temperature.
   e. Flow switches, differential pressure, screw typed field adjustable, DPDT with one pole wired to the chiller control panel and one pole wired to the BAS.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Align chiller on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place.

C. Install units on vibration isolation as detailed per Section 230548, Vibration and Seismic Controls for HVAC.

D. Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers.

E. Insulate evaporator and cold surfaces.

F. Arrange piping for easy dismantling to permit tube cleaning.

G. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a flange or mechanical coupling.

H. Condenser-Fluid Connections: Connect to condenser inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage. Connect to condenser outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a flange or mechanical coupling.

I. Refrigerant Pressure Relief Device Connections: For chillers installed indoors, extend separate vent piping full line size of connection for each chiller to the outdoors without valves or restrictions. Comply with ASHRAE 15. Piping size as recommended by manufacturer. Connect to chiller pressure relief device with flexible connector and dirt leg with drain valve.

J. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s).

K. The Contractor shall set the chiller in place as shown on the submittal drawings and in such a position that all tubes, compressor, and motor can be pulled and removed from the equipment room.

L. Flow switches and differential pressure switches shall be provided, mounted, and wired complete in the chilled liquid and in the condenser water circuits.

M. Power wiring shall be provided for the oil pump starter, oil heater, purge unit (if required) and other equipment requiring power. This power shall be independent of the main compressor starter.

N. Reassemble chiller components shipped loose under the direct supervision of factory service personnel. Provide new gaskets of all component interfaces. Provide temporary dust barriers during all work such that the reassembly occurs in a clean space. Submit written reassembly report.

O. Independently support chiller piping so that the weight of piping above the chiller flexible connector is not supported by the chiller flexible connector. Install continuous thread hanger rods and spring hangers of sufficient size to support the piping weight above the chiller flexible connector. Provide spring hangers consisting of coil springs and elastomeric-inserts on all of the piping connected to the chiller for the first three pipe hangers in each piping connection. Adjust all the spring hangers so that the insert is in compression when the system is full of work.

3.02 SYSTEM STARTUP

A. Engage a factory-authorized service representative to perform startup service:
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that refrigerant charge is sufficient and chiller has been leak tested as installed, while under operating pressures.
   3. Verify that pumps are installed and functional.
   4. Verify that thermometers and gages are installed.
   5. Operate chiller for run-in period.
   6. Check bearing lubrication and oil levels.
   7. Verify that refrigerant pressure relief device is vented outside.
   8. Verify proper motor rotation.
   9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
   10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator, condenser, and heat-reclaim condenser.
   11. Verify and record performance of chiller protection devices.
   12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

B. Owner’s operating personnel shall be briefed (and the unit operation demonstrated) in the normal startup of the system, operation under light and full load and normal and emergency shutdown of the chillers and other related equipment.
   1. Routine maintenance, yearly maintenance, winterization, spring startup, and preventative maintenance shall be fully discussed and documented with the Owner’s operating personnel.
   2. Names of those instructed, dates of instruction, as well as a list of information turned over to the Owner, shall be included in the startup report.
   3. Training shall consider of a minimum of **two 8 hour** sessions spanning across two separate maintenance shift changes or as mutually agreed upon. Training dates shall be scheduled with the Maintenance Manager a minimum of five days in advance. All maintenance manual submittals for the equipment to be trained on shall have been completed prior to scheduling training. Training shall be accomplished by a factory authorized representative of the equipment to be trained upon.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two eight hour long visits to site outside normal occupancy hours for this purpose.

D. Supply initial charge of refrigerant and oil.

3.03 CLOSEOUT ACTIVITIES

A. Train operating personnel in operation and maintenance of units.

B. Provide the services of the manufacturer's field representative to conduct training.

END OF SECTION 23 6416

SECTION 23 6514
INDUCED-DRAFT COOLING TOWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Induced-draft cross-flow cooling towers with a single sided air inlet.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Cooling tower support structure shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

B. Cooling tower designed to resist wind load of 30 lbf/sq. ft.

1.03 GENERAL REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. The Owner shall evaluate the price of each cooling tower manufacturer submitted, as well as the *Initial Submittal* information provided, and then select a manufacturer.

C. Acceptance of pricing associated with a manufacturer does not imply that a manufacturer's alternate construction standard is acceptable. Requested deviations from the project manual specification and drawings shall be processed in accordance with the Project Manual prior to Bid submission and all deviations shall be repeated and included in the *Initial Submittal*. Pricing shall be submitted for each of the manufacturers requested and their *Initial Submittal* shall be generated by each cooling tower manufacturer representatives. After the bids are received the Owner and Engineer will evaluate the *Initial Submittals* to determine the most responsive and responsible manufacturer bid.

1. The pricing submitted shall be that which incorporates all costs to achieve the following schedule requirements:
    a. Final Product Data Submittals shall be submitted to the Engineer no more than seven calendar days after the award of the contract. Note that the *Initial Submittal* does not constitute the Final Product Data Submittal.
    b. Cooling tower delivery schedule as identified by the Contractor.
2. Any Contractor related costs of architectural, mechanical piping and insulation, structural, acoustical, seismic, plumbing, sheet metal, electrical and controls changes required to match final installed performance, fit and operational characteristics of the required chillers shall be borne by the Contractor.

D. In order for the manufacturer's price to be valid, the cooling tower manufacturer must complete and submit an *Initial Submittal* with the project bid. An electronic PDF of the Initial Submittal must be included for review at the time and location the bids are received for this project.

E. The *Initial Submittal* shall contain product information containing adequate information to demonstrate that all proposed equipment complies fully with the contract documents. Include all of the following information in the *Initial Submittal* at a minimum:

1. An acknowledgement statement to the Contractor that the proposed cooling tower can be transported into and installed via the method outlined by the Contractor.
2. Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections.

3. Volume of water in suspension for purposes of sizing a remote storage tank.
4. Fan airflow, brake horsepower, and drive losses.
5. Thermal capability of cooling tower (gpm/HP) per CTI ATC-105 latest edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
   1. Maximum flow rate.
   2. Minimum flow rate.
   3. Drift loss as percent of design flow rate.
   4. Volume of water in suspension for purposes of sizing a remote storage tank.
   5. Sound power levels (dB) in eight octave bands for operation at full load per CTI ATC-128 latest edition.
   6. Performance curves for the following:
      a. Varying entering-water temperatures from design to minimum.
      b. Varying ambient wet-bulb temperatures from design to minimum.
      c. Varying water flow rates from design to minimum.
      d. Varying fan operation (off, minimum, and design speed).
   7. Fan airflow, brake horsepower, and drive losses.
   8. Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
   9. Electrical power requirements for each cooling tower component requiring power.
   10. Thermal capability of cooling tower (gpm/HP) per CTI ATC-105 latest edition.

C. Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes. Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:
   1. Assembled unit dimensions.
   2. Weight and load distribution.
   3. Required clearances for maintenance and operation.
   4. Sizes and locations of piping and wiring connections.
   5. Wiring diagrams: For power, signal, and control wiring.
   6. All personnel access components.

D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

E. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

G. Field quality-control reports.

H. Startup service reports.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Factory assemble unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.

B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide a five year warranty to include labor and materials coverage for failure due to corrosion resistance of cooling tower structure.

C. Provide a five year warranty to include labor and materials coverage of the fan, fan drive, gearbox, motor, and couplings to be free from all defects in material and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Baltimore Aircoil Company.

B. SPX Cooling Technologies/Marley.

2.02 INDUCED-DRAFT COOLING TOWERS

A. General Requirements:
   1. Provide units for outdoor use, factory assembled, sectional, crossflow, vertical discharge, draw-through design, with fan assemblies built into pan and casing.
   2. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

B. Open-Circuit, Induced-Draft, Cross-Flow Cooling Tower
   1. Casing and Frame
      a. Stainless steel.
      b. Casing personnel access doors at both ends of tower into the air plenum.
   2. Cold Water Basin:
      a. Type 304 welded stainless steel basin panels and basin structural members.
      b. Sloped with depressed section with drain/clean-out connection.
      c. Removable stainless-steel strainer.
      d. Overflow connection and drain connection.
      e. Outlet connection: ASME B16.5, Class 150 flange.
      f. Designed to withstand a 50 PSF live load and a 250 pound concentrated load.
   3. Hot Water Basin:
      a. Non-pressurized design with the head (height) of the water level in the basin adequate to overcome spray nozzle losses and designed to evenly distribute water over the fill throughout the flow range indicated.
      b. Stainless steel basin panels and basin structural members.
      c. Inlet connection: ASME B16.5, Class 150 flange.
      d. Flow control valve: to adjust water operating height in the Hot Water Basin.
      e. Replaceable plastic spray nozzles mounted in bottom of basin.
      f. Partitioning devices: Manufacturer provided Weir dams, nozzle cups or combination of the same material as basin to distribute water over the fill throughout the flow range indicated. Minimum acceptable flow range shall be at least as low as one half of the scheduled flow rate which the thermal performance is scheduled at.
      g. Removable panels: Same material as basin to completely cover top of basin. Secure panels to basin with removable stainless hardware.
   4. Fan:
      a. Aluminum blade and hub
      b. Blade pitch: Field adjustable.

c. Fan shaft bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F (minus 29 and plus 149 deg C). Bearings shall be designed for an L-10 life of 80,000 hours.
d. Bearings grease fittings: Extended lubrication lines to an easily accessible location.

5. Motors and Drives:
   a. Motor:
      1) General requirements for fan motors: Comply with NEMA designation and temperature-rating requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment" and not indicated below
      2) Single speed (1,800 rpm) mounted on adjustable steel base.
      3) Motor enclosure: Totally enclosed fan cooled (TEFC) with epoxy or polyurethane finish.
      4) Energy efficiency: NEMA Premium Efficient.
      5) Service factor: 1.15.
      6) Insulation: Class F or H.
      7) Variable-speed motors: Inverter-duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."
      8) Anti-condensation internal heater.
      9) Motor location: Mounted inside of cooling tower casing and inside of cooling tower discharge airstream.
   b. Fan Drive System:
      1) Belt Drive: Belts and bearings designed for minimum 150 percent motor nameplate power.
      2) Bearings: Self-aligning tapered roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F (minus 29 and plus 149 deg C). Bearings shall be designed for an L-10 life of 80,000 hours.
      3) Rigid welded fan and drive assembly support.
      4) Drive belt tensioning hardware.
6. Fan Discharge Guard: Welded steel rod and wire guard, hot-dipped-galvanized after fabrication.
7. Safety: Safety railings, and ladder with safety cage from roof to access and clean the Hot Water Basin.
8. Fill:
   a. Self-supporting, fluted polyvinyl chloride plastic with a flame spread rating not exceeding 25 per ASTM E-84 latest Edition.
   b. Fill type sheets, fabricated, formed, and individually hung or bonded together after forming removable assemblies that are factory installed by the manufacturer.
   c. Fungal Resistance: No growth when tested in accordance with ASTM G21.
   d. Fill material operating temperature: Suitable for entering-water temperatures up through 120 degF.
9. Drift Eliminators: Two- or three-pass; hot-dipped-galvanized steel, FRP, or PVC; drift loss water carryover limited to 0.002 percent of total water circulated at 550 fpm fill velocity. Provide a flame spread rating not exceeding 25 per ASTM E-84 latest Edition.
10. Air-Intake Louvers:
    a. stainless steel, FRP, or PVC. Provide a flame spread rating not exceeding 25 per ASTM E-84 latest Edition.

b. Arranged to uniformly direct air into cooling tower, to minimize air resistance, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

11. Galvanized Hardware: Galvanized steel nuts, bolts, washers, and nails; assembled with phenolic-epoxy-coated, corrosion-resistant washer head fasteners.
12. Galvanized Steel Sheet Components: Hot-dipped-galvanized steel, ASTM A653/A653M, with G210/Z600 coating, and finished with zinc-chromatized-aluminum paint.
13. Galvanized Steel Angles, Plates, Bars, and Shapes: Galvanized after fabrication to comply with ASTM A123/A123M, Coating Thickness Grade 100.

2.03 ACCESSORIES

A. Provide with factory-assembled platforms and ladders from cooling tower manufacturer.
   1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.
   2. External ladders (with safety cages if greater than sixteen feet tall vertical distance): Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and to access the Hot Water Basin from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
   3. External platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at cooling tower access door. Locate one external platform per cooling tower unless quantity two are reached per the Drawings.
   4. Handrail: Aluminum, galvanized steel, or stainless steel complete with kneerail and toeboard, around top of cooling tower. Comply with 29 CFR 1910.23.
   5. Internal platforms: Aluminum, FRP, or galvanized-steel bar grating. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all walking surface parts of the platform are above the high water level (overflow level) of the collection basin.
      a. Provide manufacturer's portable ladder for access to components located less than twelve feet above the collection basin internal platform

B. Vibration Switch: NEMA 250 Type 4; Electronic vibration detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection; Manual reset button.

C. Termination panel: NEMA 3R with termination strips, relays, and wiring for a single point 120V power connection for motor heaters and accessories. Provide contacts and relays for all BAS points.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Coordination:
   1. Coordinate sizes and locations of concrete bases with actual equipment provided.
   2. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.
   3. Coordinate sizes and locations of roof curbs, pipe supports, equipment supports, and roof penetrations with actual equipment provided.

C. Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of one 8-hour day per tower.

D. Install tower on structural steel beams as instructed by manufacturer.

E. Equipment Mounting: Install cooling tower on concrete bases and steel structure using **bolted connections** directly to the structure. Comply with requirements for vibration isolation devices specified in Division 230548 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

F. Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower.

G. Connect overflow, bleed, and drain piping. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Tests and Inspections: Comply with CTI ATC 105, "Acceptance Test Code for Water Cooling Towers."

C. Provide the services of the manufacturer's authorized field representative to supervise the assembly of the tower by the installing trades, the installation of accessories, and the mounting and routing of conduit, verifying that the installation is in accordance with these specifications and the manufacturer's recommendations and written installation instructions. On-site technical assistance shall not be less than a minimum of twelve hours total time on the job site and shall be utilized for the first piece of equipment installed on the project, with this time split over three separate site visits on three separate days.

D. Provide the services of the manufacturer's authorized field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

E. Cooling towers will be considered defective if they do not pass Startup tests and inspections.

3.03 SYSTEM STARTUP

A. Start-up tower in presence of and instruct Owner's operating personnel.

B. Provide On-site technical labor to assist the ECC Contractor with the data integration and to verify the specified data points, including data values, change of state values and units and are communicated properly and completely to the BAS system. On-site technical assistance shall not be less than a minimum of 4 hours total time on the job site for each piece of equipment installed with this time split over two separate site visits. Allow a minimum of 2 hours to assist the ECC Electrician and coordinate wiring terminations and a minimum of 2 hours to assist the ECC Programmer to confirm data connectivity. On-site technical assistance shall continue beyond these minimum times stated at no cost to the Owner nor revisions to the Contract amount nor schedule until such time as the Engineer of Record determines that the equipment operation, startup and graphics are satisfactory.
   1. The equipment submittal shall state whether the equipment manufacturer or the equipment supplier is providing each of these items with personnel names and mobile phone numbers included in the submittal:
      a. On-site technical labor to assist the ECC Electrician.
      b. On-site technical labor to assist the ECC Programmer with data connectivity and graphics.

C. Engage a factory-authorized service representative to perform-startup service.
   1. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

2. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
   a. Clean entire unit including basins.
   b. Verify that accessories (safeties and switches) are properly installed.
   c. Verify clearances for airflow and for cooling tower servicing.
   d. Check for vibration isolation and structural support.
   e. Align motor, shaft, and adjust belts.
   f. Lubricate bearings.
   g. Verify fan rotation for correct direction and for vibration or binding and correct problems.
   h. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
   i. Check vibration switch setting. Verify operation.
   j. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
   k. Set and balance water flow to each tower inlet.
   l. Adjust water-level control, pump control, and make other revisions to obtain proper Hot Water Basin operating level. Confirm Hot Water Basin water levels with all operating conditions (one cell, two cells, one pump, two pumps, etc.).
   m. Prepare a written startup report that records the results of tests and inspections.

END OF SECTION 23 6514

SECTION 26 0513
MEDIUM-VOLTAGE CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Medium voltage cables.

B. Medium voltage cable accessories.

1.02 RELATED REQUIREMENTS

A. Section 26 0543 - Electrical Underground Ducts, Ductbanks, and Manholes33 7119 - Electrical Underground Ducts, Ductbanks, and Manholes:

1.03 SUMMARY

A. This Section includes cables and related splices, terminations, and accessories for medium-voltage electrical distribution systems.

B. Verify existing MV cables in manhole where new modular splices are to be provided for new feeders to the project area.

C. Owner's high voltage team will do existing medium voltage switching to assist the contractor. New medium voltage equipment operation must be done by the contractor in presence of the owner's medium voltage team. The contractor to provide minimum five working day notice to the owner prior to operating medium voltage new equipment.

D. Existing medium voltage cables shall not to be tested for Hi-Pot test. The contractor shall test new cables prior to connection/splicing to existing cables.

1.04 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)).

B. NEMA WC 74 - 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.

C. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

D. NFPA 70 - National Electrical Code.

1.05 SUBMITTALS

A. Product Data: For each type of cable indicated. Include splices and terminations for cables and cable accessories.

B. Pulling Calculations: Provide pulling calculations for all cable pulls over 200 feet and/or having multiple bends. Submit calculations and results prior to any related work be completed. Also include this information in the close out documentation.

C. Work Plan: Submit a detailed work plan to Indiana University Engineering Services for approval.

D. Material Certificates: For each cable and accessory type, signed by manufacturers.

E. Source quality-control test reports.

F. Field quality-control test reports.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70 and IEEE C2.

B. Installer Qualifications: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable. Contractor shall have minimum of 10 years experience in installation, splicing and testing of medium voltage cables.within 100 miles of Project.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
   1. Testing agency's field supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain medium voltage cables for the entire project through one source from a single manufacturer. Similarly obtain any accessories for the cable for the entire project through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.07 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions.
   1. Notify Owner no fewer than five working days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without Owner's written permission.
   3. When a building is served from two circuits via the Campus loop, minimize the time a building is without one of these circuits to minimize risk. Create a detailed plan including anticipated time on a single circuit.

1.08 COORDINATION

A. The Electrical Contractor shall schedule a meeting with Indiana University to review and coordinate the medium voltage scope of work, including, but not limited to, manholes, duct bank, cabling, splicing, switching, shutdowns, etc. Do not proceed without written approval of submitted work plan.

PART 2 PRODUCTS

2.01 MEDIUM-VOLTAGE CABLE

A. Manufacturers:
   1. General Cable Technologies Corporation.
   2. Okonite Company
   3. Prysmian Cables and Systems.
   4. Southwire Company.

B. Medium Voltage Cable: NEMA WC 70 MV105 insulated cable.
   1. Cable Type: Single conductor type rated MV105.
   2. Comply with UL 1072, AEIC CS 8, ICEA S-94-649.
   3. Conductor: Copper.
   4. Conductor Stranding: Class B, compressed or compact stranded copper conductor.
   5. Conductor Insulation: Ethylene-propylene rubber (EPR) insulation complying with ICEA S-93-639.

a. Voltage: 15 kV.
b. Inslutation thickness: 133 percent insulation level.

6. Shielding: 5 mil copper tape, helically applied over semi-conducting insulation shield.
7. Shielding and Jacket: Combination insulation shield and jacket consisting of corrugated copper drain wires embedded in extruded non-conducting lead-free ethylene propylene rubber (EPR) or a combination insulation shield and jacket consisting of 25% overlapped annealed copper tape ribbon embedded in extruded non-conducting PVC or lead free ethylene propylene rubber (EPR).
8. Cable shall be sealed against longitudinal water penetration at 5 psi water pressure per ICEA T-31-610.
9. Size: 500 MCM.

C. Ground conductor: Required for each medium voltage circuit. Ground conductor should be 600 volt THW or THWN-2 insulated cable. Size: #4/0 awg.

2.02 CABLE ACCESSORIES

A. TERMINATIONS AND SPLICING
1. Use manufactured kits for termination and splicing of medium voltage cables. Only compression type sleeves and lugs, specifically listed for use on medium voltage systems, shall be used to splice or terminate conductors.
2. Use 3M Scotch Cold Shrink QT-III 7620 Series termination kits for connecting to live front equipment.
3. Separable Insulated Connectors (IEEE Standard 386) – 600A deadbreak tees are to be used for splicing conductors. The separable connectors shall have test points. Use manufacturers whose kits require a use of a spanner wrench - Elastimold 600 Series or equivalent by Hubbell. Manufacturers (Cooper and 3M) kits that are tightened by use of Allen wrenches are not approved.
4. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.
5. Outdoor terminations shall be Scotch 7630.
6. Compression type sleeves and lugs specifically listed for use on medium voltage system shall be used.
7. Modular splicing systems with tightening by spanner wrench shall be Elastimold 600 series with test point or equivalent by Hubbell. Copper or 3M are not approved for this purpose.

B. ARC-PROOFING MATERIALS
1. Shall be as manufactured by 3M; Electrical Products Division.
2. Tape for First Course on Metal Objects: 10-mil- (250-micrometer-) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
3. Arc-Proofing Tape: 3M 69 fireproof tape, flexible, conformable, intumescent to 0.3 inch (8 mm) thick, compatible with cable jacket.
4. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1/2 inch (13 mm) wide.

C. SOURCE QUALITY CONTROL
1. Test and inspect cables according to ICEA S-97-682 before shipping.
2. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig (35 kPa).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conduit, duct, trench, or manholes are ready to receive cable.

B. Verify that field measurements are as indicated.

C. Verify routing and termination locations of cable bank prior to rough-in.

D. Cable routing is shown in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 PREPARATION

A. Use swab to clean conduits before pulling cables.

3.03 INSTALLATION

A. Avoid abrasion and other damage to cables during installation.

B. Use suitable lubricants and pulling equipment.

C. Sustain cable pulling tensions and bending radii below recommended limits.

D. Ground cable shield at each termination and splice.

E. Install cables according to IEEE 576.

F. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values. Pull cable as a circuit off of spools and not laid on ground.
   1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
   2. Use pulling eyes connected to conductor. Do not use pulling baskets or steel cable.

G. Support cables according to Division 26 Section "Underground Electrical Ductbanks and Manholes."

H. In manholes, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag. Adequate slack shall be provided in the cable routing and shall be approved by the project manager.

I. Install terminations at ends of conductors and seal single conductor cable ends with standard kits.

J. Termination and splicing of cable shall be done utilizing manufactured kits. Scotch 7630 for outdoor termination shall be used. Terminations and splices shall be installed by journeyman electricians who have been trained by the manufacturer for the type of equipment installed. Only compression type sleeves and lugs, specifically listed for use on medium voltage systems, shall be used to splice or terminate conductors. Coordinate installation requirements with Engineering Services..

K. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit or termination materials. Cables shall be wrapped as a circuit with fireproofing in manholes. Scotch 77 fireproofing tape spirally over-wrapped with Scotch 69 glass cloth electrical tape on 6-inch centers. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
   1. Clean cable sheath.
   2. Wrap metallic cable components with 10-mil (250-micrometer) pipe-wrapping tape.
   3. Smooth surface contours with electrical insulation putty.
   4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.

5. Band arc-proofing tape with 1-inch- (25-mm-) wide bands of half-lapped, adhesive, glass-cloth tape 2 inches (50 mm) o.c.

L. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

M. Identify all new and existing cables within the manholes within the project scope. Provide a label of all new and existing cables within all manholes. Arrange labels to allow reading without needing to enter the manhole. Use two UV stabilized wire ties to attach each label. Lettering on labels shall be at least one inch tall.

3.04 FIELD QUALITY CONTROL

A. Inspect exposed cable sections for physical damage.

B. Inspect cable for proper connections as indicated.

C. Inspect shield grounding, cable supports, and terminations for proper installation.

D. Inspect and test in accordance with NETA ATS, except Section 4.

E. Unless noted otherwise, the Electrical Contractor shall engage an independent, third party, approved testing agency to perform the following tests and prepare test reports. Cables shall be tested three times during construction. Meggar tests can be performed by the Contractor in lieu of third party.
   1. Meggar test cable on reels at 5000 VDC for one minute.
   2. After the installation of new cable in conduit or ductbank, and prior to termination, cables shall again be meggar tested at 5000 VDC for one minute.
   3. After termination and splice kits are installed, the following tests shall be conducted according to current InterNational Electrical Testing Association (INETA) acceptance test standards in the presence of the Owner's representative.
      a. Megger test cables at 5000VDC for one minute.
      b. The new cables shall be DC Hi-pot tested. This test shall not exceed 80% of factory test value. Maintain the final test voltage level applied to the cable for 10 minutes.
      c. The cable shall be tested using the Tan Delta method.

F. Perform the following field tests and inspections and prepare test reports:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
   2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
   3. Test the cable for high potential test after installation, splices and termination have been made, but before final connections to equipment. Record time, voltage applied, leakage current and plot on graph paper.
   4. High potential test:
      a. Existing cables shall not be high potential tested. Test new cables prior to connection to existing cables.
      b. Leakage current test shall be by high potential DC step voltage method.
      c. Prior to high potential test, test the cable and shields for continuity, shorts and grounds.
      d. ~~Prior to high potential test, test the cable and shields for continuity, shorts and grounds.~~
   5. Safety precautions:

a. Exercise suitable and adequate safety measures prior to, during and after the high potential tests, including placing warning signs and preventing people and equipment from being exposed to the test voltages.

6. Test voltages:
   a. New shielded EPR and CCLP cable DC test voltages shall be as follows:

Rated Circuit Voltage Phase-to-Phase Volts	Wire Size AWG or MCM	100 Percent Insulation Level	Test Voltage KV 133 Percent Insulation Level
2001-5000	8-1000	25	25
5001-8000	6-1000	35	35
8001-15000	2-1000	55	65

7. High Potential Test Methods:
   a. Apply voltage in approximately 8 to 10 equal steps.
   b. Raise the voltage slowly between steps.
   c. At the end of each step, allow the charging currents to decay and time the interval of decay.
   d. Read the leakage current and plot a curve of leakage current versus test voltage on graph paper as the test progresses. Read the leakage current at the same time interval for each voltage step.
   e. Stop the test if leakage currents increase excessively or a "knee" appears in the curve before maximum test voltage is reached.
      1) For new cable, repair or replace the cable and repeat the test.
   f. Upon reaching maximum test voltage, hold the voltage for five minutes. Read the leakage current at 30 second intervals and plot a curve of leakage current versus time on the same graph paper as the step voltage curve.
      1) Stop the test if leakage current starts to rise, or decreases and again starts to rise. Leakage current should decrease and stabilize for good cable.
   g. Terminate test and allow sufficient discharge time before testing the next conductor.

G. Phase and Rotation Check: The Electrical Contractor shall complete a check of phase and rotation at all new and existing facilities affected by the project scope of work. Coordinate facility location with Owner.

H. Record and submit test results to the Owner for approval prior to energization. The following information shall be included on test reports; date, project, circuit identification, cable manufacturer, insulation rating, conductor size, temperature and humidity at time of test, voltage increments, stabilization time, leakage current at final test voltage after 10 minutes, test graphs, megohm meter readings and names and mode numbers of instruments used. If any single cable fails testing, all three cables in raceway system shall be replaced and then retested per the above requirements. No hi-pot testing of existing cable shall be permitted. During circuit upgrade re-conductoring projects, Contractor shall be responsible for disconnection and reconnection of instrument transformers and lightning arrestors to facilitate acceptance testing.

I. END OF SECTION 26 05 13

END OF SECTION 26 0513

SECTION 26 0543
ELECTRICAL UNDERGROUND DUCTS, DUCTBANKS, AND MANHOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Conduit and duct:
   1. Galvanized steel rigid metal conduit (RMC).
   2. Rigid polyvinyl chloride (PVC) conduit.

B. Precast concrete manholes.

C. Accessories:
   1. Duct Spacers.
   2. Underground warning tape.

1.02 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

B. ASTM A48/A48M - Standard Specification for Gray Iron Castings.

C. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.

D. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.

E. ASTM C1037 - Standard Practice for Inspection of Underground Precast Concrete Utility Structures.

F. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.

G. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

H. NFPA 70 - National Electrical Code.

I. UL 6 - Electrical Rigid Metal Conduit-Steel.

J. UL 514B - Conduit, Tubing, and Cable Fittings.

K. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

1.03 SUBMITTALS

A. Product Data:
   1. Duct-bank materials, including separators and miscellaneous components.
   2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Manholes and accessories.
   4. Warning tape

B. Shop Drawings: For each new manhole, indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes.
   1. Manholes, vaults, and other larger access and junction structures. Provide information on all required features, such as access lids, ladders, steps, sumps, grounding, cable routing, sealing, etc.
   2. Precast structures shall state that they meet the required standards referenced herewithin.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

1.05 EXISTING UTILITIES

A. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

B. Notify Architect/Engineer and Owner at least two days in advance of proposed utility interruptions.

C. Do not proceed with utility interruptions without written permission from Architect/Engineer and Owner.

1.06 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions.

1.07 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Comply with ANSI C2.

PART 2 PRODUCTS

2.01 CONDUIT AND DUCT

A. Galvanized Steel Rigid Metal Conduit (RMC): NFPA 70, Type RMC; comply with ANSI C80.1 and list and label as complying with UL 6.
   1. Manufacturers:
      a. Allied Tube & Conduit.
      b. Republic Conduit.
      c. Wheatland Tube Company.
   2. Fittings: Comply with NEMA FB 1 and list and label as complying with UL 514B; steel, threaded type.
      a. Manufacturers:
         1) O-Z/Gedney, a brand of Emerson Electric Co.
         2) Thomas & Betts Corporation.
      b. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

B. Rigid Polyvinyl Chloride (PVC) Conduit: NFPA 70, Type PVC; comply with NEMA TC 2 and list and label as complying with UL 651; Schedule 40 unless otherwise indicated; rated for use with conductors rated 90 degrees C; suitable for use being encased in concrete.
   1. Manufacturers:
      a. Cantex Inc.

b. Carlon.
c. Hubbell Company.
d. Manhattan/CDT/Cole-Flex.
e. Thomas & Betts Corporation.

2. Fittings: Comply with NEMA TC 3 and list and label as complying with UL 651.
   a. Manufacturer: Same as manufacturer of conduit to be connected.

2.02 CAST-IN-PLACE UNDERGROUND DUCTBANK

A. Verify that field measurements are as indicated.

B. Verify routing and termination locations of ductbank prior to excavation for rough-in.

C. Verify locations of manholes prior to excavation for installation.

D. Ductbank routing is shown in approximate locations unless dimensions are indicated. Route as required, completing duct systems.

E. Manhole locations are shown in approximate locations unless dimensions are indicated. Locate as required, completing duct systems.

F. Concrete and related work shall be mixed, placed and cured in accordance with the “Building Code Requirements for Reinforced Concrete,” ACI-318.

G. Concrete shall be 6 bag cement mix, air entrained, ready mixed per ATSM-94. Concrete shall develop an ultimate compressive strength of 4000 PSI in 28 days with a maximum slump of 6 inches at time of placing. The top aggregate size shall be 1/2-inch to ensure good placement between embedded items.

H. Color top layer of electric ductbank concrete encasement red by sprinkling with red coloring agent while still wet. Coloring agent shall be Master Builder Technologies – “Colorcron” (tile red) or approved equal. Color to the satisfaction of the Owner.

I. Reinforcing bars shall conform to ASTM A615, Grade 60 and deformed type.

J. Unless otherwise noted, concrete cover for reinforcing bars shall conform to the minimum requirements of ACI-318.

K. Fabrication of reinforcing steel shall be in accordance with the “ACI Detailing Manual,” ACI-315 (SP-66).

L. Unless otherwise noted, lap splices shall be Class B according to ACI-318 for the respective steel grade and concrete ultimate strength.

M. The number, size, and arrangement of conduits in the cast-in-place underground ductbank sections shall be as indicated on the drawings. Outer encasement of concrete shall be 3” minimum with 1-1/2” between conduits.

N. Conduit spacers shall be Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts. The use of solid plane spacers will not be allowed. Sized to allow for the full separation of conduits as indicated on the drawings and spaced a maximum of eight (8) feet on centers. No conduits, wood stakes, etc., shall be used to separate conduits in the ductbank.

O. Design structure according to details on Drawings.

P. Structural Design Loading: ASTM C 857, Class A-16 (HS20-44).

Q. Joint Sealant: Continuous extrusion of asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

R. Source Quality Control: Inspect structures according to ASTM C 1037

S. Conduit and fittings used in the construction of this cast-in-place underground ductbank shall conform to Section 2.01 of this specification. Make all joints and connections in conduit using fittings designed for the purpose bonded permanently and watertight using solvent cement.

T. Duct runs shall slope from buildings to manholes and from manhole to manhole a minimum of three inches (3") in one hundred feet (100'), except where indicated otherwise on drawings.

U. Ductbanks shall be installed using long radius sweeps, unless otherwise noted on drawings or in job scope. Minimum allowable radius of 36-inches.

V. Underground warning tape: Permanent, colored red, detectable-type, continuous-printed, polyethylene tape; not less than 6 inches wide by 4 mils thick; suitable for permanent direct-burial; embedded continuous metallic strip or core; printed warning legend suitable for describing buried electrical lines.

2.03 PRECAST CONCRETE MANHOLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Underground precast concrete utility structures:
      a. Hartford Concrete Products.
      b. Oldcastle Precast.
      c. Smith-Midland Corporation.
      d. Utility Concrete Products
   2. Frames and covers:
      a. Campbell Foundry Co.
      b. East Jordan Iron Works, Inc.
      c. McKinley Iron Works, Inc.
      d. Neenah Foundry Co.

B. Design structure according to details on Drawings.

C. Structural Design Loading: ASTM C 857, Class A-16 (HS20-44). All manholes shall meet AASHO-H20 truck loading with 20% impact rating.

D. Joint Sealant: Continuous extrusion of asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

E. Source Quality Control: Inspect structures according to ASTM C 1037

F. Description: Precast manhole designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories.

G. Shape: Rectangular.

H. Nominal Inside Dimensions: 6 feet x 10 feet.

I. Inside Depth: ~~7 feet.~~ Varies. Shall be minimum of 7'-0" inside depth, but shall vary based on ductbank entry/exit locations. Provide height such that the bottom of any duct is no closer than 24" to manhole floor and the top of any duct is no closer than 12" to manhole ceiling. Provide shop drawings of each manhole illustrating height along with all entry/exit locations based on profiles and field conditions.

J. Frames and Covers: ASTM A48/A48M; Comply with AASHTO loading specified for manhole; Class 35B gray cast iron, 30 inch size, machine finished with flat bearing surfaces. Provide cover marked ELECTRIC to indicate utility and shall also have an identification number attached. Cover shall have pick holes in lieu of dropped handles.

1. Special covers: Recess on cover designed to accept finish material in paved areas.
2. Chimney Components: Precast concrete rings; quantity as required. Provide without steps to match to finished grade. Seal joints watertight per ASTM C990.

K. Duct Entry Provisions: Single duct knockouts and windows with plastic duct terminators as illustrated on each manhole detail.

L. Duct Entry Locations: As illustrated on each manhole detail.

M. Pulling Eyes in Walls: Eyebolt with reinforcing-bar fastening insert 2-inch diameter eye and 1-by-4-inch bolt. Working Load Embedded in 6-Inch, 4000-psi Concrete, 13,000-lbf minimum tension.

N. Cable Pulling Irons: Use galvanized rod and hardware. Locate opposite each duct entry. Provide watertight seal. 7/8-inch- diameter, hot-dip-galvanized, bent steel rod; stress relieved after forming; and fastened to reinforced rod. Exposed triangular opening. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

O. Bolting Inserts for Cable Stanchions:
1. Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
2. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

P. Cable Rack Assembly: Non-conductive, fiberglass components. Shall be manufactured by Underground Devices, Inc or University approved equivalent.
1. Provide on each wall to adequately support cables. Provide not more than 12-inches from each duct entrance and spaced on 24-inch to 30-inch centers between supports.
2. Cable Stanchions: 72-inches in length punched with multiple cable arm attachment holes.
3. Cable Arms: 4 inches wide by 14 inches long and arranged for secure mounting in horizontal position at any location on cable stanchions.

Q. Ladder: UL-listed, heavy-duty fiberglass specifically designed for electrical manhole use, with top hook to engage manhole step in riser casting. Provide one ladder for each manhole.

R. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

S. Grounding: ~~Provide continuous 1/4" x 1-1/4" copper ground bus on all four sides. Ground bus shall be connect to ground rod as illustrated on details.~~ Provide 5/8" x 10'-0" copper clad ground rod as illustrated by the details on the drawings. Connect to all non-current carrying metal parts. All connections shall be made via caldweld or irreversible means.

T. Sump: 12-inch by 12-inch sump located in the corner of the floor. Sump drain as illustrated on details.

U. Sump Covers: ASTM A48/A48M; Class 30B gray cast iron.

2.04 ACCESSORIES

A. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for the conduit/duct arrangement to be installed. Conduit spacers shall be Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts. Sized to allow for the full separation of conduits as indicated on the drawings and spaced a maximum of eight (8) feet on centers. No conduits, wood stakes, etc., shall be used to separate conduits in the ductbank

B. Underground Warning Tape: Polyethylene tape suitable for direct burial. Permanent, colored red, detectable-type, continuous-printed, polyethylene tape; not less than 6 inches wide by 4 mils thick; suitable for permanent direct-burial; embedded continuous metallic strip or core; printed warning legend suitable for describing buried electrical lines.
   1. Legend: Type of service, continuously repeated over full length of tape.
   2. Color:
      a. Tape for Buried Power Lines: Black text on red background.

2.05 SOURCE QUALITY CONTROL

A. Precast Manholes: Inspect in accordance with ASTM C1037.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify routing and termination locations of duct bank prior to excavation for rough-in.

C. Verify locations of manholes prior to excavating for installation.

D. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to complete duct system.

E. Manhole locations are shown in approximate locations unless dimensions are indicated. Locate as required to complete ductbank system.

3.02 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving" but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turfs and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 1 Section "Cutting and Patching".

3.03 CAST-IN-PLACE UNDERGROUND DUCTBANK INSTALLATION

A. Inspection: Verify that conduits and supports are properly placed and other items to be cast into concrete are accurately placed, held securely.

B. Preparation:
   1. If trenching, ensure that trench for ductbank is clear and free from loose matter. If sides of trench do not conform to shape of ductbank, install all forms and bracing necessary for proper ductbank shape.
   2. Sides of trench shall be shaped to act as forms for new ductbank and shall allow for minimum thicknesses of concrete as described on the drawings.
   3. Top soil shall be carefully removed and stored for replacement after the trench is backfilled. Backfill shall be in accordance with the latest NEC Article 300-5, as a minimum. Backfilling will not be permitted until at least 24 hours after concrete is poured. All excess earth, rock, etc. from trenching shall be deposited where directed by the Owner. Frozen materials shall not be used for backfill.
   4. Concrete shall be poured only on virgin earth, or watered and impacted backfill.

C. Installation of Cast-In-Place Underground Ductbank:
   1. The number, size, and arrangement of the conduits in each ductbank shall be as indicated on the drawings. Outer encasement of concrete shall be 3" minimum with 1-1/2" between conduits.
   2. The entire length of excavation, except as otherwise approved between combination of manholes and buildings, shall be opened before installing any duct, to determine all interferences and adjust elevations accordingly, if necessary. The Contractor is responsible for providing accurate locations of the manholes using x, y, and z coordinates as shown on the appropriate drawings for the project.
   3. Contractor shall provide all excavating necessary to accomplish his work. After the ductbank is installed, inspected and approved by the Owner, all trenches and excavations shall be backfilled. Backfill trenches under provisions of Section 312300. Interface installation of underground warning tape with backfilling specified in Section 312300.
   4. Install warning tape 12 inches (12") below finished surface.
   5. A minimum distance between top of ductbank and ground surface of two feet six inches (2'-6") is preferred, for all points of all duct runs, but some exceptions will be granted to avoid serious conflicts with existing utilities, and for obtaining correct grades, where necessary. Where curves are necessary in duct run (both vertical curves and horizontal curves) same shall be the least curvature practical, and without any abrupt changes in the direction of the ducts.
   6. After excavating and installing concrete bases, the full height of the conduit formation shall be formed to provide a concrete encasement reasonably rectangular in cross-section. The conduits shall be spaced and supported off the concrete base using PVC conduit spacers at intervals of not greater than eight feet (8'); stagger conduit joints in concrete encasement 12 inches (12") minimum and support each length of conduit with not less than two spacers. Install an intermediate spacer over top tier of conduits to prevent floating during concrete encasing. No conduits, wood stakes, etc., shall be used to separate conduits in the ductbank.
   7. Furnish and install suitable fittings to accommodate expansion and deflection where required.
   8. Install 4 #4 continuous reinforcing bars (one in each corner of ductbank) throughout the length of ductbank runs. Provide cross-ties as required to form these bars in place. Where the ductbank enters a manhole or crosses a roadway, provide all additional reinforcement in the ductbank as directed by the Owner. Provide four (4) 3/4-inch rebars doweled into the manhole wall extending into the ductbank at ductbank entrances/exits into a manhole.
   9. Anchor ductbank assembly securely to the concrete base to prevent conduits from floating during concrete placement. Metal wire is not an acceptable fastening media.
   10. Concrete placement to a height at least three inches (3") above the top tier of conduit shall follow as soon as possible after the Owner has inspected and approved ductbank assembly for concrete placement.
   11. Color top layer of concrete encasement red by heavily sprinkling oxide cement coloring while still wet. Color to the satisfaction by the Owner.
   12. Ensure that the reinforcement, inserts, embedded parts, formed joints, and conduit are not disturbed during concrete placement. Adjust delivery chute so that the fail of concrete into trench is a minimum.
   13. Concrete for ductbank shall be poured continuous from buildings and/or manhole to manhole. Due to expansion and contraction of ducts during encasement, all pours shall originate at one end and proceed toward the opposite end. No pours shall originate in between manholes and buildings.

14. If continuous pour is impractical, or cannot be maintained because of length of pour, provide a diagonal form at end of pour. Provide four (4) #4 reinforcing rods in concrete. Rods shall be embedded six feet (6') into first pour and six feet (6') into second pour (minimum).
15. Make all joints and connections in conduit using fittings designed for the purpose bonded permanently and watertight using solvent cement.
16. Comply with manufacturer's recommendations for bending and cutting. Cut duct square using saw or pipe cutter; de-burr cut ends.
17. Wipe non-metallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
18. Where conduits enter manholes or building basement walls, provide end bells flush with inside wall of manhole or building basement wall. Each conduit wall penetration shall be made watertight. All penetrations shall be core drilled sufficiently large to accommodate conduit plus flush mounted end bell. The ductbank shall be sufficiently doweled to the structure using epoxy bonded dowel rods to improved sheet stress at point of entrance. The concrete shall be vibrated during installation to penetrate around conduits and seal against end bells.
19. Conduits to be stubbed up out of the finished floor shall be stubbed up six (6) inches above the finished grade or equipment housekeeping pad. Final ten foot (10') length of conduit stubbed out of the finished floor shall be rigid galvanized steel.
20. Provide ductbank stub-outs for future use as shown on the drawings. Provide a diagonal form at end of stubout pour. Provide four (4) #4 reinforcing rods in concrete. Rods shall be embedded six feet (6') into pour and extend six feet (6') out of pour for connection to future ductbank. Conduit shall extend one foot (1') out of concrete and shall be capped.
21. During the ductbank construction, the completed and uncompleted ends of all conduits shall be carefully protected to prevent the entrance of concrete or any other foreign matter. All conduits shall be sealed against the entrance of moisture, concrete, and debris. Dead ends of conduits shall be closed and sealed.
22. Duct runs shall slope from buildings to manholes and from manhole to manhole a minimum of three inches (3") in one hundred feet (100') except where indicated otherwise on drawings.
23. After completion of ductbank section, same shall be thoroughly cleaned by passing a mandrel, no smaller in diameter than 1/4 inch less than conduit size, through each conduit. After this initial cleaning with the mandrel, each conduit shall be thoroughly cleaned and dried by pulling an approved swab and spiral wire brush back and forth until a satisfactorily clean condition has been obtained and all foreign materials and water are removed. Contractor shall then pull three (3) 10 feet (10') long pieces of 500 MCM cable through each conduit 3" and larger and examine for any damage after each pass. Broken or obstructed conduits shall be repaired and rechecked with the mandrel.
24. After cleaning of conduits, install 3/16" Kevlar pull string with marked footage in each spare conduit.
25. Where underground conduits run parallel with pipelines, a one (1) foot minimum clearance shall be maintained and at crossings, a one (1') minimum clearance will be maintained below the bottom of the pipes. Conduits should cross under existing pipes when practical and reasonable.
26. The minimum bending radius for underground conduits shall be 48" for all horizontal bends with no more than a combined total of ninety degrees (90 deg) of directional change per run without the Owner's approval.
27. Conduits shall not be placed under building footings on foundations except as specified by the contract drawings.

28. All conduits shall be sealed against the entrance of moisture, concrete, and debris. Dead ends of conduits shall be closed and sealed.
29. The Contractor shall record actual routing and elevations of underground conduit and duct and locations and sizes of manholes. The Contractor is responsible for providing accurate locations of the manholes using x, y, and z coordinates on the appropriate drawings for the project.
30. Provide a minimum of 12” separation between electric power and telecommunications/data ducts.
31. Transition from PVC to GRC at 5-feet from building foundation wall.

D. Install duct with minimum slope of 4 inches per 100 feet (0.33 percent). Slope duct away from building entrances and towards manholes.

E. Install no more than equivalent of three 90-degree bends between pull points.

F. Provide suitable fittings to accommodate expansion and deflection where required.

G. Terminate duct at manhole entries using end bell.

H. Stagger duct joints vertically in concrete encasement 6 inches minimum.

I. Band ducts together before backfilling.

J. Securely anchor duct to prevent movement during concrete placement.

K. Provide suitable pull string in each empty duct except sleeves and nipples.

L. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.

3.04 PRE-CAST MANHOLE INSTALLATION

A. Install and seal precast sections in accordance with ASTM C891.

B. Install manholes plumb.

C. Use precast neck and shaft sections to bring manhole cover to finished elevation.

D. Elevation: Install manholes with rooftop at least 15 inches below finished grade. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated.

E. Access: Install cast-iron frame and cover. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

G. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

H. Grounding: Install ground rod through floor in each structure with top protruding 4 inches above floor. Seal floor opening against water penetration with waterproof nonshrink grout. Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.

I. Precast Concrete Manhole Installation: Unless otherwise indicated, comply with ASTM C 891.
1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

2. Unless otherwise indicated, support units on a level 8” bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

J. Attach cable racks to inserts after manhole installation is complete.

3.05 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Grounding: Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 16 Section "Grounding and Bonding."

C. Duct Integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

D. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.06 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 0543

SECTION 26 1116
SECONDARY UNIT SUBSTATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Unit substation.
   1. Fused primary incoming sections.
   2. Dry-type transformers with forced air cooling fans.
   3. Secondary main-tie-main switchgear distribution.
   4. Meters.
   5. Surge Protection Devices.

B. Dimensions: The dimensions as illustrated on the drawings are the maximum allowable sizes. Equipment with any dimension larger than shown will not be allowed without Engineer of Record written approval.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Pads for substation support.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

D. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.03 REFERENCE STANDARDS

A. ANSI C12.1 - Electric Meters - Code for Electricity Metering.

B. IEEE C37.04 - IEEE Standard for Ratings and Requirements for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V.

C. IEEE C37.20.3 - IEEE Standard for Metal-Enclosed Interrupter Switchgear Rated above 1 kV AC up to and Including 48.3 kV AC.

D. IEEE C57.12.01 - IEEE Standard for General Requirements for Dry-Type Distribution and Power Transformers.

E. IEEE C57.12.91 - IEEE Standard Test Code for Dry-Type Distribution and Power Transformers.

F. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers.

G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

H. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

A. Shop Drawings: Indicate electrical characteristics and connection requirements, outline dimensions, connection and support points, weight, specified ratings and materials.
   1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
      a. Tabulation of installed devices with features and ratings.
      b. Enclosure types and details.

c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
e. Current rating of buses.
f. Short-time and short-circuit current rating of switchgear assembly.
g. Nameplate legends.
h. Mimic-bus diagram.
i. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
j. Shop drawings shall clearly illustrate the metering, SPD, and auxillary compartments are completely isolated and barriered from bussing and/or any component or wiring greater than 120V.

B. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where pipe and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that switchgear, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis of certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned outline drawings of equipment unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

F. Updated mimic-bus diagram reflecting field changes after final switchgear load connections have been made, for record.

G. Operation and Maintenance Data: For switchgear and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Comply with UL 1558.

C. Source Limitations: Obtain switchgear through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.06 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient temperature: Not exceeding 40 deg C.
   2. Altitude: Not exceeding 6600 feet.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchgear in sections of lengths that can be moved past obstructions in delivery path.

B. Store secondary unit substation components protected from weather and so condensation will not form on or in units. Provide temporary heating according to manufacturer's written instructions.

C. Handle secondary unit substation components according to manufacturer's written instructions. Use factory-installed lifting provisions.

1.08 COORDINATION

A. Coordinate layout and installation of switchgear and components with other construction that penetrates ceilings or is supported by them, including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Six (6) of each type and rating used. Include spares for potential transformer fuses, control power fuses, and fusible devices.
   2. Indicating lights: Six (6) of each type installed.
   3. Touchup paint: Three (3) containers of paint matching enclosure finish, each 0.5 pint.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace equipment and associated components that fail in materials or workmanship within a minimum warranty period of 36 months from date of Project Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE.

B. Eaton Corporation.

C. Schneider Electric.

D. Siemens Industry, Inc.

2.02 UNIT SUBSTATIONS

A. Description: Secondary unit substation comprising fused air switch primary sections on either end, transformer sections, and low-voltage switchgear secondary section.

B. Seismic Qualification: Provide unit substations and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

2.03 PRIMARY SWITCH RATINGS

A. Nominal Voltage: 13.8 kV, three phase, 60 Hz.

B. Voltage and Insulation Levels: Comply with IEEE C37.20.1.

C. Main Bus Ampacity: 600 amperes, continuous.

D. Momentary Current Rating: To IEEE C37.20.1.

2.04 TRANSFORMER RATINGS

A. Capacity: 2000/2667 kVA.

B. Primary Voltage: 13.8 kV delta connected.

C. Taps: Standard primary taps.

D. Secondary Voltage: 480/277 volts, wye connected.

2.05 INCOMING SECTION EQUIPMENT

A. Primary Incoming Section: Terminal assembly with adequate space for incoming-cable terminations and surge arresters

B. Fused Air Interrupter Switch: IEEE C37.20.3, two position.

C. Enclosed, air-interrupter, primary switch.

D. Configuration: One incoming lines .

E. System Voltage: 13.8 kV, three phase, 60 Hz.

F. Maximum Design Voltage: 15 kV.

G. Basic Impulse Level: 95 kV.

H. Continuous Rating: 600 amperes.

I. Three pole, single throw, dead front, metal enclosed, with manual stored energy operator, with fuses mounted on a single frame, complying with IEEE C37.20.3.

J. Key interlocking system to prevent fuse access door from being opened unless switch is open. Additionally, interlock air-interrupter switch with transformer secondary main circuit breaker, preventing switch from being opened or closed unless secondary main circuit breaker is open.

K. Phase Barriers: Located between blades and fuses of each phase, designed for easy removal, allows visual inspection of switch components when barrier is in place.

L. Window: Permits viewing switch-blade positions when door is closed.

M. ~~e~~

N. Accessory Set: Tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation. Include fuse-handling tool as recommended by switchgear manufacturer.

O. Short-Circuit Rating:
   1. Short-time momentary asymmetrical fault rating of 40 kA.
   2. 3-second symmetrical rating of 25-kA RMS.
   3. Fault close asymmetrical rating of 40 kA.

P. Fuses: Sizes recommended by secondary unit substation manufacturer, considering fan cooling, temperature-rise specification, and cycle loading. Comply with the following:
   1. Current-limiting type, rated for not less than 50-kA RMS symmetrical current-interrupting capacity.
   2. Indicator integral with each fuse to show when it has blown.
   3. Spares: Include three fuses in use and three spare fuses in storage clips in each switch.

Q. Surge Arresters: Comply with IEEE C62.11, Distribution class; metal-oxide-varistor type, with ratings as indicated, connected in each phase of incoming circuit and ahead of any disconnecting device.

2.06 DRY TYPE TRANSFORMERS

A. Description: IEEE C57.12.01; IEEE C57.12.52; NEMA ST 20; Dry-type with either copper or aluminum windings; secondary unit substation arrangement. Cast coil/encapsulated coil, with primary and secondary windings individually cast in a stabilized epoxy resin or totally encapsulated in epoxy resin..

B. Enclosure: ANSI C57; Indoor, ventilated, cast coil/encapsulated coil, with primary and secondary windings individually cast in a stabilized epoxy resin or totally encapsulated in epoxy resin.

C. Cooling and Temperature Rise: IEEE C57.12.01; Class AA/FAA, air cooled, provided with fans ure forced-air rating.
   1. Automatic forced-air cooling system controls, including thermal sensors, fans, control wiring, temperature controller with test switch, power panel with current-limiting fuses, indicating lights, alarm, and alarm silencing relay.
   2. Factory mount fans including all wiring, contr.

D. Insulation Materials: IEEE C57.12.01, rated 220 deg C.

E. Insulation Temperature Rise: 80 deg C rise with an insulation system hot spot capability of 140 deg C.

F. Basic Impulse Level: 95 kV.

G. Full-Capacity Voltage Taps: 4 nominal 2.5 percent taps, 2 above and 2 below rated primary voltage

H. Target Impedance: 5.75% ±7.5% ANSI tolerance.

I. Efficiency: Shall meet or exceed NEMA TP-1 efficiency requirements and 2016 DOE requirements.

J. Sound Level: Shall meet or exceed the most recent version of NEMA TR-1.

K. Provide IR viewing ports for scanning.

L. Accessories:

1. High-Temperature Alarm: Sensor at transformer with local audible alarm, local visual alarm, and contacts for remote alarm. Gauge shall show the highest reading.
2. Distribution class lightning arrestors: 10 kV.
3. Provide with factory mounted fans to achieve forced air rating.
4. Transformer accessories requiring power shall be powered from the transformer and not an external source.
5. Outgoing Termination: Coordinate with electrical switchgear sections.

2.07 SECONDARY DISTRIBUTION SECTION

A. Description: Power switchgear manufactured to IEEE C37.20.1.

B. Accessible from the front and rear, suitable for the conductor materials used.

C. Main and tie devices: Individually mounted and compartmented. Capable of automatic and/or manaul main-tie-main (MTM) operation.

D. Distribution Section Devices: Individually mounted.

E. Compartmentalization: The metering, control power, unit power supplies, and surge protection compartments shall be completely isolated from any energized bus. These compartments shall not have any access to anything over 120V.

F. RATINGS
1. Nominal System Voltage: 480/277 V, 4 wire, 60 Hz
2. Main-Bus Continuous: As scheduled on the Contract Documents.
3. Short-Circuit Current: Match rating of highest-rated circuit breaker in switchgear assembly.

G. FABRICATION
1. Switchgear Construction; UL 1558.
2. Factory assembled and tested and complying with IEEE C37.20.1.
3. Indoor Enclosure Material: Steel.
4. Finish: IEEE C37.20.1, manufacturer's standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.
5. Section barriers between main and tie circuit-breaker compartments shall be extended to rear of section. Barriers shall be heavy gauge steel at least equal to the gauge of the section housing.
6. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main and tie circuit breaker.
7. Circuit-breaker compartments shall be equipped to house drawout-type circuit breakers and shall be fitted with hinged outer doors.
8. Fabricate enclosure with removable, rear cover panels to allow access to rear interior of switchgear.
9. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
10. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:
    a. Bus transition sections.
    b. Hinged front panels for access to metering, surge protection devices, accessory, and blank compartments.
11. Bus bars connect between vertical sections and between compartments. Cable connections are not permitted.
    a. Bus material: Silver plated, hard drawn copper of 98 percent conductivity with silver plated copper feeder circuit breaker line connections.

b. Load terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
c. Ground bus: 1/4-by-2-inch comply with hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. Ground bus shall be installed for its entire length.
d. Main phase bus and equipment ground bus: Uniform capacity the entire length of assembly.

12. Neutral bus: 100 percent of phase-bus ampacity. Equip bus with pressure-connector terminations for outgoing circuit neutral conductors. Include braces for neutral-bus extensions for busway feeders.
13. Vertical section bus size: Comply with IEEE C37.20.1, including allowance for spare circuit breakers and spaces for future circuit breakers.
14. Use copper for connecting circuit-breaker line to copper bus.
15. Contact surfaces of buses: Silver plated.
16. Feeder circuit breaker load terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.
17. Ground bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size 1/4 by 2 inches.
18. Supports and bracing for buses: Adequate strength for indicated short-circuit currents.
19. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.
20. Neutral disconnect link: Bolted, uninsulated, 1/4-by-2-inch (6-by-50-mm) copper bus, arranged to connect neutral bus to ground bus.
21. Bus-bar insulation: Individual bus bars wrapped with epoxy coated, flame-retardant insulation.
22. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
23. Each main section shall be protected by an integral mounted surge protection device and shall comply with the requirements of this Section.
24. Each main section shall be equipped with an integral mounted meter and shall comply with the requirements of this Section.

H. Main and Tie Breakers: 100 percent rated, solid-state, electronic-trip circuit breaker with interrupting capacity rating to match gear. Main and tie breakers shall be 4-pole, mounted in a draw-out arrangement and shall be in their own dedicated compartments.
1. Shall be capable of automatic and manual MTM operation.
2. Solid-state, electronic-trip circuit breakers having microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field adjustable settings:
a. Functions: Long-time-pickup, long-time-delay, short-time-pickup, short-time-delay, and instantaneous-pickup functions, independent of each other in both action and adjustment.
b. Ground-fault protection shall be provided and have at least three pickup settings and three delay settings independent of any other adjustment.
c. Metering function: Shall be provided with power metering functions with individual digital displays at each breaker trip unit.
3. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
4. Compartments fitted with hinged outer doors.

5. Certification Marking: Provide all breakers with a certification marking visible on the breaker illustrating the breaker received and passed factory testing.
6. Arc Flash Reduction Mode: Breakers shall be provided with arc flash reduction functionality causing changes to breaker settings.
   a. Provide control of arc flash reduction on face of gear adjacent to breaker being controlled.
   b. Shall illuminate a blue LED indicator when placed in Arc Flash Reduction Mode.
   c. Provide with a contact closure for remote monitoring capability. External wiring and integration into Building Management System will be completed by the University.
7. Lugs shall accommodate a minimum of 600MCM feeder size.

I. Feeder (Distribution) Breakers: 100 percent rated, solid-state, electronic-trip circuit breaker with interrupting capacity rating to match gear. Mounted in a draw-out arrangement and shall be in their own dedicated compartment.
   1. Solid-state, electronic-trip circuit breakers having microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field adjustable settings:
      a. Functions: Long-time-pickup, long-time-delay, short-time-pickup, short-time-delay, and instantaneous-pickup functions, independent of each other in both action and adjustment.
      b. Ground-fault protection shall be provided and have at least three pickup settings and three delay settings independent of any other adjustment.
      c. Metering function: Shall be provided with power metering functions with individual digital displays at each breaker trip unit.
   2. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
   3. Compartments fitted with hinged outer doors.
   4. Certification Marking: Provide all breakers with a certification marking visible on the breaker illustrating the breaker received and passed factory testing.
   5. Arc Flash Reduction Mode: Breakers shall be provided with arc flash reduction functionality causing changes to breaker settings.
      a. Provide control of arc flash reduction on face of gear adjacent to breaker being controlled.
      b. Shall illuminate a blue LED indicator when placed in Arc Flash Reduction Mode.
      c. Provide with a contact closure for remote monitoring capability. External wiring and integration into Building Management System will be completed by the University.
   6. Lugs shall accommodate a minimum of 600MCM feeder size.

J. MAIN-TIE-MAIN
   1. The normal power switchgear shall be provided in an automatic main-tie-main arrangement with manual override.
      a. Furnish automatic throw-over equipment to transfer a load bus to an alternate source immediately after detection of an abnormal condition on the normal source.
      b. Return to normal shall be automatic with time delay. Time delay shall be adjustable up to 5 minutes.
      c. Operation is via discrete industrial grade control relays. PLC operation is not acceptable. Schweitzer Engineering Labs relays may be utilized.
      d. When AC control power is derived within the switchgear, a ride through power supply shall be provided so that the operation is executed without interruption during an under-voltage condition.
      e. Refer to the sequence of operation on sheet E600.

K. COMPONENTS
1. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.
2. Control Power Supply: Control power transformer supplying 120-V control circuits through secondary disconnect devices. Include the following features:
3. Dry-type transformers, in separate compartments for units larger than 3 kVA, including primary and secondary fuses.
4. Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker.
   a. Secondary windings connected through a relay or relays to control bus to effect an automatic transfer scheme.
5. Control power fuses: Primary and secondary fuses with current-limiting and overload protection.

L. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:
1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges and for conductors for interconnections between shipping units.
2. Conductors sized according to NFPA 70 for duty required.

M. Electrically Interlocked Main Tie Main Breaker: Two (2) control power transformers in separate compartments with interlocking relays, connected to the primary side of each control power transformer at the line side of the associated main circuit breaker. 120 volt secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.

2.08 POWER CIRCUIT BREAKERS AND CIRCUIT BREAKER SWITCHGEAR

A. Circuit Breaker: IEEE C37.04.

B. Circuit Breaker Operator: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
1. Normal closing speed: Independent of both control and operator.
2. Slow closing speed: Optional with operator for inspection and adjustment.
3. Stored energy mechanism:
   a. 2500A and larger: Electrically charged with optional manual charging.
   b. 2000A and smaller: Manually charged.
4. Operation counter.

C. Trip Devices: Solid-state, overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features:
1. Functions: Long time trip, long-time-delay, short time trip, short-time-delay, and instantaneous-trip functions, independent of each other in both action and adjustment.
2. Temperature compensation: Ensures accuracy and calibration stability from minus 5 to plus 40 deg C.
3. Field-adjustable, time-current characteristics.
4. Current adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers, or a combination of these methods.
5. Three bands, minimum, for long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum."
6. Pickup points: Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I^2t operation.
7. Pickup points: Five minimum, for instantaneous-trip functions.

8. Ground-fault protection with at least three short-time-delay settings and three trip-time-delay bands; adjustable current pickup. Arrange to provide protection for the following:
   a. Four-wire, double-ended substation.
9. Trip indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
10. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

D. Auxiliary Contacts: For interlocking or remote indication of circuit-breaker position, with spare auxiliary switches and other auxiliary switches required for normal circuit-breaker operation, quantity as indicated. Each consists of two Type "a" and two Type "b" stages (contacts) wired through secondary disconnect devices to a terminal block in stationary housing.

E. Draw-Out Features: Circuit-breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features:
   1. Interlocks: Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.
   2. Circuit-breaker positioning: An open circuit breaker may be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker may be manually withdrawn to a position for removal from the structure with the door open. Status for connection devices for different positions includes the following:
      a. Test position: Primary disconnect devices disengaged, and secondary disconnect devices and ground contact engaged.
      b. Disconnected position: Primary and secondary devices and ground contact disengaged.

F. Arc Chutes: Readily removable from associated circuit breaker when it is in disconnected position, and arranged to permit inspection of contacts without removing circuit breaker from switchgear.

G. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of draw-out mechanism.

H. Operating Handle: One for each circuit breaker capable of manual operation. Provide pistol grip style trip/close switches for main and tie breakers.

I. Electric Close Button: One for each electrically operated circuit breaker.

J. Mechanical Interlocking of Circuit Breakers: Uses a mechanical tripping lever or equivalent design and electrical interlocks.

K. Key Interlocks: Arranged so keys are attached at devices indicated. Mountings and hardware are included where future installation of key-interlock devices is indicated.

L. Under-voltage Trip Devices: Adjustable time-delay and pickup voltage.

M. Indicating Lights: To indicate circuit breaker is open or closed, for main and bus tie circuit breakers interlocked either with each other or with external devices.

2.09 METERING

A. Manufacturers: Subject to compliance with requirements, provide the following product:
   1. Schneider Electric PowerLogic ION95040 (9000T).

B. Instrumentation: IEEE C57.13, NEMA EI 21.1 and the following:

1. Current transformers: IEEE C57.13 bar or window type, single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices. ANSI 0.3% accuracy, solid core, one CT per phase and one for neutral.
2. Control power transformers: ~~ANSI 0.3% accuracy, solid core, one CT per phase and one for neutral.~~ Dry type, mounted in separate compartment.
3. Current transformers for neutral and ground fault current sensing: Connect secondary wiring to ground overcurrent relays via shorting terminals to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit breaker, ground fault protection.

C. Miscellaneous:
1. ~~Provide ANSI Accuracy Class 0.3 current transformers. CT range shall be selected appropriately for the load and shall not exceed the load by more than 50%.~~
2. ~~Sensors: Split core type; current sensing type with current or voltage output, selected for optimum range and accuracy for ratings of circuits indicated for this application.~~
3. Provide CT shorting block and/or test switches.
4. Provide voltage transformers as necessary.
5. Meters shall have fuse protection for voltage and power supply inputs.
6. Supply a data jack in the metering enclosure, connected to the campus Ethernet.
7. ~~Building management interface: Coordinate with University and existing monitoring systems.~~

D. Installation: Install meters integral to the equipment in dedicated compartments within each main section. The compartments shall be completed isolated and barriered from any live bussing or any device/wiring over 120V.

2.10 SURGE PROTECTION DEVICES

A. SUPPRESSORS DESCRIPTION
1. Surge Protection Device Description: Sine-wave-tracking type with the following features and accessories:
a. Surge Protection Device Description: Sine-wave-tracking type with the following features and accessories:
b. MOV’s shall be large block and individually protected.
c. Fabrication using bolted lugs for internal wiring.
d. Integral disconnect switch or feeder breaker which allows to remove device for replacement without shutdown of panel/switchboard.
e. Arrangement with bus/wire connections to phase buses, neutral bus, and ground bus.
f. LED indicator lights for power and protection status.
g. Audible alarm, with silencing switch, to indicate when protection has failed.
h. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
i. Surge-event operations counter.
2. UL 1449-4 Tested Inominal: 20 KA.
3. UL 1449-4 Tested SCCR: 200 KA.
4. UL 1449-4 Tested MCOV:
a. 480Y/277V: 320 V.
5. Protection Modes: The voltage protection rating (VPR) per UL 1449 4th Edition 6KV/20KA testing shall be as follows:
a. 480/277 volt, 3 phase, 4 wire system.
1) L-N, L-G and N-G: 1,100V-1,300V.
2) L-L: 1,900V-2,100V.

6. Fuses:
    a. All protection modes shall be internally individually fused. The fuses I2t capacity shall allow the suppressor's maximum rated transient current to pass through the suppressor without fuse operation. If the rated I2t of the fuse is exceeded, the fuse shall open and clear both high and low impedance fault conditions. All overcurrent devices shall be monitored including those on the N-G mode and will provide indication of suppressor component failure or operability. Internal protection shall be included to protect against overheating for temporary over voltage condition.
7. Short Circuit Rating:
    a. The SPD shall be marked with a short circuit rating and shall not be installed at a point on the system where the available fault current is in excess of that rating.

B. SUPPRESSORS
1. Minimum surge current rating: 200 KA per mode/400 KA per phase.
    a. Connection AWG: Per manufacturer.
    b. Overcurrent protection (breaker): Per manufacturer.
    c. Shall comply to Category Type "1."
    d. Provide unit with integral disconnect, allow unit to be replaced without interruption of power to board.
    e. Mounting: Integral to switchgear in an isolated, dedicated compartment, completely isolated from any energized bus.

C. INSTALLATION
1. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
2. Provide multi-pole circuit breaker as a dedicated disconnect for suppressor, where applicable, unless otherwise indicated.
3. Do not energize the source until surge protection devices are installed, connected and tested.
4. Install surge protection devices integral to the equipment in dedicated compartments within each main section.

2.11 ACCESSORIES

A. Accessory Set: Furnish tools and miscellaneous items required for circuit-breaker and switchgear test, inspection, maintenance, and operation.
1. Racking handle to manually move circuit breaker between connected and disconnected positions.
2. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
3. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.

B. Circuit-Breaker Removal Apparatus: Overhead-circuit-breaker lifting device, track mounted at top front of switchgear and complete with hoist and lifting yokes matching each size of drawout circuit breaker installed.

C. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

2.12 IDENTIFICATION

A. Compartment Nameplates: Engraved, laminated-plastic or metal nameplate for each compartment, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

B. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

C. Arc Flash Label: Refer to Division 26 Section “Electrical System Studies” for arc flash labeling requirements.

D. Mimic Bus: Continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic-bus diagram.
   1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
   2. Medium: Painted graphics, as selected by Architect.
   3. Color: Contrasting with factory-finish background; as selected by Architect from manufacturer's full range.

E. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads. Include as-built data for low-voltage power switchgear and connections as follows:
   1. Frame size of each circuit breaker.
   2. Trip rating for each circuit breaker.
   3. Conduit and wire size for each feeder.

2.13 SOURCE QUALITY CONTROL

A. Provide factory tests to IEEE C57.12.91 and IEEE C57.12.01. Include the routine tests as defined in the standards and the following other tests:
   1. Resistance measurements of all windings on the rated voltage connection and on tap extreme connections.
   2. Ratios on the rated voltage connection and on tap extreme connections.
   3. Polarity and phase relation on the rated voltage connection.
   4. No-load loss at rated voltage on the rated voltage connection.
   5. Exciting current at rated voltage on the rated voltage connection.
   6. Impedance and load loss at rated current on the rated voltage connection and on tap extreme connections.
   7. Applied potential.
   8. Induced potential.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces where switchgear will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install in accordance with IEEE C57.94.

B. Comply with applicable portions of NECA 400.

C. Provide required support and attachment in accordance with Section 26 0529.

D. Install substation plumb and level and with each section aligned properly.

E. Make electrical connections between equipment sections using connectors furnished by manufacturer.

F. Connect transformer forced air fans including control wiring as required by the Manufacturer for proper operation.

G. Anchor switchgear assembly to 4-inch, channel-iron floor sill embedded in concrete base and attach by bolting.
   1. Sills: Select to suit switchgear; level and grout flush into concrete base.
   2. Concrete bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 3 inches in all directions beyond the maximum dimensions of switchgear unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26Sections "Hangers and Supports for Electrical Systems" and "Vibration and Seismic Controls for Electrical Systems."

H. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from switchgear units and components.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26Section "Identification for Electrical Systems."

B. Diagram and Instructions:
   1. Frame and mount under clear acrylic plastic on the front of switchgear.
      a. Operating instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
      b. System power riser diagrams: Depict power sources, feeders, distribution components, and major loads.
   2. Storage for maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

C. Nameplates: Label switchgear and each main cubicle in switchgear with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems." In addition, provide additional, separate nameplate identifying designation of utility transformer fed from.

D. Label each distribution cubicle in switchgear with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems." In addition, provide the following information:
   1. Cubicle load name.
   2. Breaker frame size: AF.
   3. Breaker trip size: AT.

E. Arc Flash Labeling: Comply with the requirements of Division 26 Section “Electrical System Fault Analysis Coordination and Arc Flash Study”.

F. Label switchgear with the following information:
   1. Switchgear designation.
   2. Voltage, phase and wire.
   3. Ampere.
   4. Fed from.
   5. Short circuit withstand rating.
   6. Arc flash incident energy value.
   7. Feeder size.

3.04 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables".

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Primary Switch: Perform inspections and tests listed in NETA ATS, Section 7.5

D. Transformer: Perform inspections and tests listed in NETA ATS, Section 7.2. Tests listed as optional are not required.

E. Secondary Equipment: Perform inspections and tests listed in NETA ATS, Section 7.1.

F. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

G. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
   1. Inspect switchgear installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.
   2. Complete installation and startup checks according to manufacturer's written instructions.
   3. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
   4. Report results in writing.

H. Third-Party Testing and Inspections: Engage a qualified, third-party testing and inspecting agency. Perform the following field tests and inspections and prepare test reports:
   1. Perform each visual and mechanical inspection and electrical test according to NETA ATS applicable to medium voltage switches, transformers switchgear, breakers, relays, instrument transformers, metering, ground-fault, and surge protection. Certify compliance with test parameters.
   2. After installing secondary unit substation but before primary is energized, verify that grounding system at the substation tested at the minimum 5 ohms.
   3. After installing secondary unit substation and after electrical circuitry has been energized, test for compliance with requirements.
   4. Set field-adjustable switches and circuit-breaker trip ranges as indicated in the coordination study.
   5. Verify arc flash reduction mode operation.
   6. Perform main-tie-main operation for every scenario.
   7. Perform visual and mechanical inspection and electrical tests.
   8. Perform electrical test and visual and mechanical inspection as follows. Certify compliance with test parameters
      a. Visual and mechanical inspection:
         1) Compare equipment nameplate data with drawings and specifications.
         2) Inspect physical and mechanical condition.
         3) Inspect anchorage, alignment and grounding.
         4) Verify that resilient mounts are free and that any shipping brackets have been removed.
         5) Verify the unit is clean.

6) Inspect bolted electrical connections for high resistance using one of the following methods:
   (a) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
7) Perform specific inspections and mechanical tests are recommended by the manufacturer.
8) Verify that as-left tap connections are as specified.
9) Verify the presence of surge arrestors.
10) Circuit Breakers:
   (a) Compare equipment nameplate data with drawings and specifications.
   (b) Inspect physical and mechanical condition.
   (c) Inspect anchorage and alignment.
   (d) Verify the unit is clean.
   (e) Operate the circuit breaker to insure smooth operation.
   (f) Inspect bolted electrical connections for high resistance using bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.
   (g) Inspect operating mechanism, contacts and arc chutes in unsealed units.
   (h) Verify correct operation of any auxiliary features such as trip and pickup indicators, electrical close and trip operation, trip-free and anti-pump functions.
11) Electrical tests:
   (a) Perform turns-ratio tests at all tap positions.
   (b) Measure core insulation-resistance at 500 volts dc if the core is insulated and the core ground strap is removable.
   (c) Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
   (d) Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
   (e) Test continuity of each circuit.

I. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.
   1. Follow-up infrared scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3.06 ADJUSTING

A. Set field-adjustable, protective-relay trip characteristics according to results in Division 26 Section " Electrical System Fault Analysis Coordination and Arc Flash Study."

B. Set field-adjustable, protective-relay trip characteristics.

3.07 CLEANING

A. On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.08 PROTECTION

A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturers' stipulated service conditions.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 26 1116

SECTION 26 3213
ENGINE GENERATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged engine generator system and associated components and accessories:
   1. Engine and engine accessory equipment.
   2. Alternator (generator).
   3. Unit-mounted cooling system.
   4. Sub-base fuel tank.
   5. Unit-mounted generator set control system.
   6. Outdoor sound attenuated generator set enclosure.
   7. Multiple generator breakers.
   8. Remote annunciator.
   9. Generator Access Platform.
   10. Unit shall meet EPA Tier 3 requirements and shall be EPA certified for emergency standby use.
   11. Alarm remote monitoring by Building Management System.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 3600 - Transfer Switches.

1.03 REFERENCE STANDARDS

A. ASTM D975 - Standard Specification for Diesel Fuel.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NECA/EGSA 404 - Standard for Installing Generator Sets.

D. NEMA MG 00001 - Motors and Generators.

E. NFPA 30 - Flammable and Combustible Liquids Code.

F. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.

G. NFPA 70 - National Electrical Code.

H. NFPA 110 - Standard for Emergency and Standby Power Systems.

I. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids.

J. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries.

K. UL 2200 - Stationary Engine Generator Assemblies.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
      a. Transfer Switches: See Section 26 3600.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
   1. Thermal damage and decrement curve for generator.
   2. Time-current characteristic curves for generator protective device.
   3. Engine and generator specifications and operating characteristics.
   4. Muffler, radiator, and sound attenuation specifications. Include dB levels at the following distances: 1, 7 and 15 meters.
   5. Engine instruments and control panel.
   6. Radiator coolant system.
   7. Include characteristic trip curves for overcurrent protective devices.
   8. Include alternator thermal damage curve.

C. Color Sample: Provide paint sample of specified generator enclosure custom color for review and approval.

D. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
   1. Identify mounting conditions required for equipment seismic qualification.
   2. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
   3. Design calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   4. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
   5. Wiring diagrams: Power, signal, and control wiring.
   6. Sub-base tank dimension and wiring diagram.
   7. Battery and charger data, including sizing calculations. Also include details of lockable battery disconnect switch.
   8. Mechanical piping schematics.

E. Submit certification that sub-base tank engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces. Include the following:
   1. Basis for certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   3. Dimensioned outline drawings of equipment unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Source quality-control test reports.

G. Manufacturer's factory test reports.

H. Manufacturer's factory emissions certification.

I. Source quality control test reports.

J. Provide NFPA 110 required documentation from manufacturer including but not limited to:
   1. Certified test reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
   2. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   3. Report of sound generation.
   4. Report of exhaust emissions showing compliance with applicable regulations.
   5. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

K. Manufacturer’s detailed field testing procedures.

L. Field quality control test reports.

M. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

N. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

1.06 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70 (National Electrical Code).
   2. NFPA 110 (Standard for Emergency and Standby Power Systems).
   3. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
   4. NFPA 30 (Flammable and Combustible Liquids Code).

B. System shall be UL 2200 listed and labeled.

C. System shall be FM approved.

D. The system shall be a standard production model in commercial use for the past five years and capable of satisfactory performance on commercial grade distilled petroleum such as DF-2.

E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other

components of installation. Noise level shall be no greater than 75 dB measured at 23 feet from the unit in all directions.

F. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

G. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.
   1. Power output ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.

H. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum three year manufacturer warranty from project substantial completion covering repair or replacement due to defective materials or workmanship.

1.10 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 24 months full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Packaged Engine Generator Set:
   1. Caterpillar Inc.
   2. Cummins Power Generation Inc.
   3. Generac Power Systems.
   4. Kohler Power Systems.

2.02 PACKAGED ENGINE GENERATOR SYSTEM

A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
   1. Rigging diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

D. Capacities and Characteristics:
   1. Power output ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
   2. Description: Fuel system complete with fuel filter and priming pump.
   3. Main fuel pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
   4. Relief-bypass valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
   5. Output connections: Three-phase, four wire.
   6. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
   7. Harmonic distortion: Less than 5 percent.

E. Generator-Set Performance:
   1. Steady-state voltage operational bandwidth: 1 percent of rated output voltage from no load to full load.
   2. Transient voltage performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
   3. Steady-state frequency operational bandwidth: 0.25 percent of rated frequency from no load to full load.
   4. Steady-state frequency stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   5. Sustained short circuit current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
   6. Start and load transfer time: Comply with NFPA 110, Type 10, system requirements (load transfer under 10 seconds).
   7. Excitation system: Performance shall be unaffected by voltage distortion caused by non-linear load. Provide permanent magnet excitation for power source to voltage regulator.

F. System Description:
   1. Application: Emergency/standby.
   2. Configuration: Single packaged engine generator set operated independently (not in parallel).

G. Packaged Engine Generator Set:
   1. Type: Diesel (compression ignition).

2. Power Rating: 1000 kW, 1250kVA, emergency standby use.
3. Voltage: 480Y/277 V, 3 phase, 60 Hz.
4. Main Line Circuit Breaker Number One, serving interior switchboard SB-1GH1:
    a. Type: 100 percent rated, solid state, electronic trip, microprocessor based trip units with interchangeable rating plug, trip indicators and the following field adjustable settings:
        1) Functions: Long time pickup, long time delay, short time pickup, short time delay, instantaneous pickup, independent of each other in both action and adjustment.
        2) Ground fault detection providing an audible and visual alarm locally and at the annunciator. Shall not trip breaker.
        3) Adjustability: Dial settings and rating plugs on trip units.
        4) Equip short-time trip function for switchable I^2t operation.
        5) Ratings: 65 KAIC.
        6) Shunt trip capabilities.
        7) Auxiliary contacts to monitor position.
        8) Pad lockable for lockout requirements.
        9) Mounting: Integrated with or adjacent to the generator control panel. Enclosures shall be suitable for the installed environment.
        10) Kirk Key Interlock: Coordinate with generator docking station.
    b. Trip Rating: 1600 amps.
    c. Lugs: Shall accommodate a minimum of 600MCM feeder size.
5. Main Line Circuit Breaker Number Two, serving fire pump controller:
    a. Type: 100 percent rated, solid state, electronic trip, microprocessor based trip units with interchangeable rating plug, trip indicators and the following field adjustable settings:
        1) Functions: Long time pickup, long time delay, short time pickup, short time delay, instantaneous pickup, independent of each other in both action and adjustment.
        2) Ground fault detection providing an audible and visual alarm locally and at the annunciator. Shall not trip breaker.
        3) Adjustability: Dial settings and rating plugs on trip units.
        4) Equip short-time trip function for switchable I2t operation.
        5) Ratings: 65 KAIC.
        6) Shunt trip capabilities.
        7) Auxiliary contacts to monitor position.
        8) Pad lockable for lockout requirements.
        9) Mounting: Integrated with or adjacent to the generator control panel. Enclosures shall be suitable for the installed environment.
    b. Trip Rating: 150 amps.
6. Main breaker separation: Maintain independent wiring requirements as defined by NEC Article 700 by locating breakers within separate enclosures at the generator control panel.

H. Generator Set General Requirements:
1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
2. Factory-assembled, with components mounted on suitable base.
3. List and label engine generator assembly as complying with UL 2200.
4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.

5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.

I. Seismic Qualification: Provide engine generator assemblies and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

J. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.

K. Starting and Load Acceptance Requirements:
1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
4. Maximum Load Step: Supports 100 percent of rated load in one step.

L. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity

M. Exhaust Emissions Requirements:
1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

2.03 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B. Rated Engine Speed: 1800 rpm.

C. Type: Industrial, multi-cylinder four stroke.

D. Output Connections:
1. Frequency drop acceptable to load.
2. Stable frequency regulating.
3. Accept 100 percent block load.
4. Frequency dip acceptable to load.

E. Engine Fuel System - Diesel (Compression Ignition):
1. Fuel Source: Diesel, ASTM D975 No. 2-D or approved cold weather diesel blends.
2. Fuel Storage: Sub-base fuel tank.
3. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve. Provide fuel cooler where recommended by manufacturer.
4. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.

5. Sub-Base Fuel Tank:
    a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with UL 142.
    b. Tank Capacity: Size for minimum of 24 hours of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.
    c. Features:
        1) Direct reading fuel level gauge.
        2) Normal atmospheric vent.
        3) Emergency pressure relief vent.
        4) Fuel fill opening with lockable cap.
        5) Dedicated electrical conduit stub-up area.
        6) Vandal-resistant fill cap.
        7) Fuel level gage at fill pipe location.
        8) The tank shall be supplied with a 2" threaded fill connection, engine fuel supply and return connections with standpipes.
        9) The tank shall also be supplied with mounting rails that will support the spring isolators that are between the tank and the engine/generator base.
        10) Vent lines, include working and emergency vent for both inner and outer tank.
        11) Low-level alarm sensor: Separate device operates alarm contacts at 50 percent of normal fuel level.
        12) Leak detection service: Provide in the tank interstitial space and arranged to provide full leak alarm at control panel.
        13) Sight glass and fuel spill protection.
    d. Spill Container: Provide with a fuel spill container similar to the Morrison Brothers Co., Fig. 517 Series. Coordinate with tank being provided and supplies as required. Spill container shall comply with the following:
        1) Shall contain spills that occur at the fill point on the above ground storage tank.
        2) Shall have a hinged cover that is lockable with a padlock.
        3) Steel construction, powder coated inside and out. Shall match tank color.
        4) 4 inch NPT threads.
        5) UL listed.

F. Engine Starting System:
1. System Type: Electric, with DC solenoid-activated starting motor(s).
2. Battery(s):
    a. Battery Type: Lead-acid.
    b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
    c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
4. Battery Charger:
    a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.

b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
c. Listed as complying with UL 1236.
d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
f. Provide alarm output contacts as necessary for alarm indications.

5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.

G. Engine Speed Control System (Governor):
1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
2. Generator Sets Used with Closed Transition Transfer Switches: Provide electronic isochronous governor with frequency regulation suitable for transfer.
3. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.
4. Shall comply with NFPA 110 requirements for block load capacity.
5. Manual speed adjustment available while engine is running.

H. Engine Lubrication System:
1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.

I. Engine Cooling System:
1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
3. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.
4. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
5. Size of radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition and rated for 115 deg F ambient temperature.
6. Temperature control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

J. Engine Air Intake and Exhaust System:
1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
3. Exhaust Silencer: Provide critical grade or better exhaust silencer with minimum sound attenuation of 25 dBA at 500 Hz; select according to manufacturer's recommendations to meet sound performance requirements, where specified.
4. Muffler/silencer shall be completely contained within the sound attenuated, outdoor enclosure.

2.04 ALTERNATOR (GENERATOR)

A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 00001; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B. Exciter:
   1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
   2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
   3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.

C. Temperature Rise: Comply with UL 2200.

D. Insulation System: NEMA MG 00001, Class H; rated at maximum 105 deg. Celsius rise over a 40 deg Celsius ambient at 100 percent rating and suitable for alternator temperature rise.

E. Enclosure: NEMA MG 00001, drip-proof.

F. Total Harmonic Distortion: Not greater than five percent.

G. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding

2.05 GENERATOR SET CONTROL SYSTEM

A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

B. Control Panel:
   1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
   2. Generator Set Control Functions:
      a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
      b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
      c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
      d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
      e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
      f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
      g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
   3. Generator Set Status Indications:
      a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
      b. Current (Amps): For each phase.
      c. Frequency (Hz).
      d. Real power (W/kW).
      e. Reactive power (VAR/kVAR).
      f. Apparent power (VA/kVA).
      g. Power factor.
      h. Duty Level: Actual load as percentage of rated power.
      i. Engine speed (RPM).
      j. Battery voltage (Volts DC).
      k. Engine oil pressure.

l. Engine coolant temperature.
m. Engine run time.
n. Generator powering load (position signal from transfer switch).

4. Generator Set Protection and Warning/Shutdown Indications:
   a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
      1) Overcrank (shutdown).
      2) Low coolant temperature (warning).
      3) High coolant temperature (warning).
      4) High coolant temperature (shutdown).
      5) Low oil pressure (shutdown).
      6) Overspeed (shutdown).
      7) Low fuel level (warning).
      8) Low coolant level (warning/shutdown).
      9) Generator control not in automatic mode (warning).
      10) High battery voltage (warning).
      11) Low cranking voltage (warning).
      12) Low battery voltage (warning).
      13) Battery charger failure (warning).
   b. In addition to NFPA 110 requirements, provide the following protections/indications:
      1) High AC voltage (shutdown).
      2) Low AC voltage (shutdown).
      3) High frequency (shutdown).
      4) Low frequency (shutdown).
      5) Overcurrent (shutdown).
   c. Provide contacts for local and remote common alarm.
   d. Provide lamp test function that illuminates all indicator lamps.
5. Other Control Panel Features:
   a. Event log.
   b. Communications Capability: Modbus on a dedicated serial port connected to either of the two main ion meters. Compatible with system indicated. Provide all accessories necessary for proper interface.
   c. Remote monitoring capability via building management system (BMS).
   d. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Control panel shall include Ethernet port for interface with building automation on RS 485 and TCP/IP connection for all alarm and status function.
6. Building Management Monitoring: The building management system (BMS) will monitor the following points:
   a. Generator running.
   b. Generator system alarm or trouble.
   c. Leak detection system alarm.
   d. Fuel tank level.Fuel overfill alarm.
   e. Breaker position for each generator breaker.
   f. Provide contact closures as required to allow for monitoring. Coordinate work with Owner.

C. Remote Annunciator:

1. Remote Annunciator Mounting: Wall-mounted; Provide surface mounted enclosure that will be installed in the Emergency Power Electrical Room.
2. Generator Set Status Indications:
   a. Generator powering load (via position signal from transfer switch).
   b. Communication functional.
   c. Generator running.
   d. Generator system alarm or trouble.
   e. Leak detection system alarm.
   f. Fuel tank low level (less than 25% capacity). The generator should automatically shut down before the fuel level drops below unsafe limits.
   g. Fuel overfill alarm.
   h. Main circuit breaker positions.
3. Generator Set Warning/Shutdown Indications:
   a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following indications:
      1) Generator running.
      2) Generator system alarm or trouble.
      3) Leak detection system alarm.
      4) Fuel tank level.
      5) Fuel overfill alarm.
      6) Main circuit breaker positions.
      7) Overcrank (shutdown).
      8) Low coolant temperature (warning).
      9) High coolant temperature (warning).
      10) High coolant temperature (shutdown).
      11) Low oil pressure (shutdown).
      12) Overspeed (shutdown).
      13) Low fuel level (warning).
      14) Low coolant level (warning/shutdown).
      15) Generator control not in automatic mode (warning).
      16) High battery voltage (warning).
      17) Low cranking voltage (warning).
      18) Low battery voltage (warning).
      19) Battery charger failure (warning).
   b. Provide audible alarm with silence function.
   c. Provide lamp test function that illuminates all indicator lamps.

D. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation. Locate emergency stop mushroom red pushbutton switch quantity two (2) next to automatic transfer switches (ATS) in emergency power electrical room and within generator sound attenuated enclosure adjacent to generator control panel. Provide “Emergency Stop” label on the box.

2.06 GENERATOR SET ENCLOSURE

A. Enclosure Type: Sound attenuating, weather protective.

B. Enclosure Material: Heavy duty, 14 gauge steel.

C. Hardware Material: Stainless steel.

D. Finish/Color: The generator enclosure exterior shall be a factory painted, custom color finish. The color will be selected by the Architect during submittal review and shall be allowed to be

any RAL or Sherwin Williams color.. Finish shall be over corrosion-resistant pretreatment and compatible primer.

E. Access Doors: Lockable, with all locks keyed alike.

F. Openings: Designed to prevent bird/rodent entry.

G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

I. Exhaust Silencers: Where exhaust silencers are mounted within enclosure in main engine compartment, insulate silencer to minimize heat dissipation as necessary for operation at rated load under worst case ambient temperature.

J. Description: Vandal-resistant, sound attenuation type, reach-in type (not walk-in type), heated, weather-tight steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, silencer/muffler, and load center panel shall be mounted within enclosure. No components shall be located outside of the enclosure.
   1. Construction: Sheet metal, integral structural steel framed set on concrete foundation. Stainless steel fasteners. Constructed upon a skid base of sufficient stiffness to allow transportation and handling of the entire package with all equipment mounted and ready for operation.
   2. Structural design and anchorage: Comply for wind loads.
   3. Louvers: Arranged to permit air circulation while excluding exterior dust, birds and rodents.
   4. Hinged doors: All doors shall be hinged type with padlocking provisions. Doors shall also be provided with hardware for removing of panels. Lift off panels are not acceptable unless they are hinged.
   5. Insulated metal panels: To limit the sound level to maximum 75 dB at 23 ft. away.
   6. Internally mounted critical exhaust silencing system.
   7. Provide a means of access to all fluid fill and inspection points.
   8. The enclosure color shall be custom color as selected by the Architect during submittal review. There shall be no manufactuer names or logos on the outside of the enclosure.
   9. Wall framing, dampers, shutters and bird screens shall be aluminum.
   10. Generator enclosure shall be completely assembled from the factory with all components, control, wiring, circuit breakers, silencer, load center panel, batteries, charger, lights, heaters, receptacles and all accessories installed within enclosure and ready to be set on a concrete pad and anchor to pad.

K. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
   1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

L. Interior Lights with Switch: Factory-wired, vapor-proof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
   1. AC lighting system and connection point for operation when remote source is available.

M. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.07 POWER DISTRIBUTION PANEL

A. Description: Power distribution panel located within the sound attenuation, outdoor enclosure to serve all auxiliary power requirements including, but not limited to lights, receptacles, heaters and chargers, etc. Panel shall be a single point connection with all circuits pre-wired by the manufacturer. Size all breakers and feeders per NEC requirement.

B. Rating: 120/208 volt, three phase, four wire, 60 amp with main breaker.

C. Acceptable Manufactures: Eaton, Square D, Siemens and General Electric.

D. Provide minimum of four (4) 20A/1 pole spare breakers and six (6) single pole provision/spaces over and above what is required for all breakers for all accessories wiring and controls including, but not limited to, lights and receptacles.

2.08 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
   2. Outside spring diameter: Not less than 80 percent of compressed height of the spring at rated load.
   3. Minimum additional travel: 50 percent of required deflection at rated load.
   4. Lateral stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.09 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

C. Diesel Fuel Storage Tanks: Perform pressurized leak test prior to shipment.

D. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
   1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   2. Full load run.
   3. Maximum power.
   4. Voltage regulation.
   5. Transient and steady-state governing.
   6. Single-step load pickup.
   7. Safety shutdown.
   8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
   9. Report factory test results within 10 days of completion of test.

2.10 GENERATOR ACCESS PLATFORM

A. Comply with OSHA 3124 – Stairways and Ladders.

B. Comply with NEC 2008 for minimum working clearance requirements and height requirements to equipment.

C. Construction:

D. Shall be a commercially available platform assembly allowing access to all service points without the use of a ladder. The platform elevation shall establish a maximum of 72-inches above platform to the top of all access doors.
   1. Shall have stairs or ship's ladders on each end of the platform to allow access around the unit.
   2. Platform shall allow a 180 degree, full-swing opening of all service doors.

E. The platform, rails, and ladders shall be removable to allow for major servicing. Shall be connected utilizing bolts only. Welding will not be permitted.
   1. Maintain bonding integrity within the generator assembly and service platforms.
   2. The platform shall be cantilever supported off of the engine generator sub-base with formed aluminum frame, structural members, toe plates, railing posts, rails and floor assemblies.
   3. Design of platform shall permit inspection of all serviceable components including visual inspection of any radiation discharge plenum to confirm that radiator is "free" of any foreign obstructions.
   4. Platform height shall be no greater than 1.5" above the bottom of the generator base frame.
   5. The platform frame shall be of .125 gauge formed aluminum.
   6. Frame design shall be pre-drilled to accept handrail mounting vertical supports. Structural frame members shall serve as the walkway toe-board supports. Vertical railing supports shall be secured to the toe-plates and horizontal structural members using 5/16" bolts on 6" centers.
   7. All bolts shall be 5/16" minimum.
   8. Compression members shall be predrilled to connect the ladder assembly and frame to the tank and utilize ¼ inch formed aluminum construction of the "ladder toe plate".
   9. No connection to the sub-base tank is permitted, but rather all connections shall be through the engine base.
   10. The walkway tread shall utilize .125" 1 inch thick minimum aluminum tread plate to provide sufficient cross section to resist vertically applied loads.
   11. Handrails shall be a nominal 42" from the walkway surface.
   12. All hand rails are to be .125 formed aluminum, at a 2 inch angle. The walkway (ladder and platform) shall meet standards of OSHA 3124 – Stairways and Ladders.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive equipment.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 FACTORY TESTING

A. Unit shall be completely factory tested. Factory report shall be submitted prior to startup.

3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.

D. Arrange equipment to provide minimum clearances and required maintenance access.

E. Unless otherwise indicated, mount generator set on properly sized, minimum 6 inch high concrete pad constructed in accordance with Section 03 3000.

F. Provide required support and attachment in accordance with Section 26 0529.

G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

H. Provide diesel fuel piping and venting in accordance with Section 23 1113, where not factory installed.

I. Provide engine exhaust piping in accordance with Section 23 5100, where not factory installed.
   1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
   2. Do not exceed manufacturer's maximum back pressure requirements.

J. Do not insulate piping for engine components restricted by manufacturer.

K. Install exhaust silencer in accordance with Section 23 5100, where not factory installed.

L. Provide grounding and bonding in accordance with Section 26 0526.

M. Identify system wiring and components in accordance with Section 26 0553.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.

D. Tests and Inspections:
   1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. NFPA 110 acceptance tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
   3. Battery tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
      a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
      b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
      c. Verify acceptance of charge for each element of the battery after discharge.
      d. Verify that measurements are within manufacturer's specifications.
   4. Battery-charger tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System integrity tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-system back pressure test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.

E. Coordinate tests with tests for transfer switches and run them concurrently.

F. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

G. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

H. Preliminary inspection and testing to include, at a minimum:
1. Inspect each system component for damage and defects.
2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
3. Check for proper oil and coolant levels.

I. Prepare and start system in accordance with manufacturer's instructions.

J. Perform acceptance test in accordance with NFPA 110.

K. Provide field emissions testing where necessary for certification.

L. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.05 LOAD BANK FOR GENERATOR TESTING

A. Load Bank Test. Apply the following loads using a portable load bank with recording kilowatt hours metering:
1. Start and idle for 10 minutes.
2. Operator generator at 25 percent rated load for 30 minutes.
3. Operator generator at 50 percent rated load for 30 minutes.
4. Operator generator at 75 percent rated load for 30 minutes.
5. Operator generator at 100 percent rated load for 120 minutes.

B. Test log: A test log shall be made of the above installation tests and readings shall be taken and recorded at 15 minute intervals noting:
1. Engine oil pressure: If unit includes an after-cooler, also record leaving oil temperature.
2. Water temperature of block, entering and leaving the radiator. If installation includes a heat exchanger, water temperature of entering and leaving engine and heat exchanger.
3. Voltage of each phase.
4. Ampere of each phase, neutral and grounding conductor.
5. Time delay on start and time required to come up to operating speed.
6. Frequency.
7. Battery charge rated at 5 minute intervals for the first 15 minutes and at 15 minute intervals thereafter.
8. Voltage and frequency variation due to load changes during testing.

C. After testing, correct any problems or deficiencies discovered during testing.

D. Block Load Test: Perform a 100 percent block load test with resistive load bank. Additional run time after this test is not required. Cool down engine and shutdown. Log load data, voltage and frequency during test.

E. Single Step Full Load Pickup Test with Building Load:

F. Simulate power failure at all automatic transfer switches individually and simultaneously run genset for minimum 30 minutes under single step full load pickup test. Cool down engine and shutdown. Log load data, voltage and frequency during test

3.06 GENERATOR ACCESS PLATFORM

A. Comply with OSHA 3124 – Stairways and Ladders.

B. Comply with NEC 2008.

C. Construct per manufacturer's requirements and per the requirements of this Section. Demonstrate to the Owner that all access point requirements are met

3.07 FUEL

A. The Contractor shall be responsible for providing fuel. This shall include the initial fuel, fuel required during testing, and final filling after testing is complete. The Owner shall be provided with a full tank at handover at project Substantial Completion.

3.08 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.09 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Instructor: Manufacturer's authorized representative.
   3. Location: At project site.

C. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters and fill fuel storage tank.

END OF SECTION 26 3213

SECTION 26 3600
TRANSFER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
   1. Automatic, closed-transition, bypass isolation ty transfer switches.
   2. Access: Each transfer switch shall be front and/or rear accessible. Switches requiring side access and/or the addition of a side enclosure will not be allowed.
   3. Dimensions: The maximum dimensions allowed for each transfer switch shall be 38-inches wide by 60-inches deep. Switches with dimensions larger than these will not be approved without Engineer of Record written permission.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 0573 - Power System Studies: Additional criteria for the selection of equipment specified in this section.

G. Section 26 3213 - Engine Generators: For interface with transfer switches.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA IA 10042-1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment.

D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems.

E. NFPA 70 - National Electrical Code.

F. UL 1008 - Transfer Switch Equipment.

G. NEMA ICS 2-447.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
      a. Engine Generators: See Section 26 3213.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
5. Closed Transition Transfer Switches:
   a. Coordinate source interconnection requirements with Utility Company.
   b. Where applicable, coordinate the work to provide engine generators with isochronous governors suitable for closed transition transfer.
   c. Coordinate the work to provide shunt trip breakers necessary for protection from source interconnection for longer than specified maximum interconnection time.
   d. Arrange for inspections necessary to obtain Utility Company approval of installation.
6. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
   1. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

F. Source quality control test reports.

G. Manufacturer’s detailed field testing procedures.

H. Field quality control test reports.

I. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

J. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

K. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

1.06 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70 (National Electrical Code).
   2. NEMA ICS 1.
   3. NFPA 110.
   4. UL 1008 unless requirements of these Specifications are stricter.
   5. IBC for seismic requirements.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

D. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within 60 miles of the project site.

E. Source Limitations: Obtain automatic closed transition bypass isolation switches through one source from a single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum three year manufacturer warranty covering repair or replacement due to defective materials or workmanship. Manufacturer's standard form in which manufacturer agrees to repair or replace equipment and associated components that fail in materials or workmanship within a minimum warranty period of 3 years from date of Project Substantial Completion

1.10 COMMISSIONING

A. Commissioning of components, equipment and/or system specified in this division is part of the construction process. Documentation and testing of these components, equipment and/or system, as well as training of the Owner's operation and maintenance personnel on these components, equipment and/or system, is required in cooperation with the Owner's Representative and Commissioning Agent. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Transfer Switches:
   1. Emerson; ASCO Power Technologies, LP; 7000 Series.
   2. Russelectric, Inc.

2.02 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Applications:

1. Neutral Switching (Single Phase, Three Wire and Three Phase, Four Wire Systems):
   a. Unless otherwise indicated or required, provide neutral switching:
2. Provide signal before transfer contacts in all transfer switches for the ability to communicate with elevators.

D. Construction Type: Only "contactor type" (open contact) transfer switches are acceptable. Do not use "breaker type" (enclosed contact) transfer switches.

E. Automatic Transfer Switch:
1. Transfer Switch Type: Bypass/isolation automatic transfer switch.
2. Transition Configuration: Closed-transition.
3. Voltage: As indicated on the drawings.
4. Ampere Rating: As indicated on the drawings.
5. Neutral Configuration: Switched neutral.
6. Lugs: Shall accommodate a minimum of 600MCM feeder size.

F. Basis of Design - Automatic Transfer Switch: Schneider Electric; ASCO 7000 Series: www.ascopower.com/#sle.
1. Provide the following:
   a. Microprocessor- based metering device that provides real time measurements of single and three phase power system.
   b. Provide with dedicated Modbus serial communication port and connect to either of the two main ION meters
   c. Under-voltage sensing for each phase of normal source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
   d. Adjustable time delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
   e. Voltage/frequency lockout relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
   f. Time delay for retransfer to normal source: Adjustable from 0 to 30 minutes, and factory set for 15 minutes. Automatically defeat delay on loss of voltage or sustained under-voltage of emergency source, provided normal supply has been restored.
   g. Test switch: Simulate normal-source failure.
   h. Switch position pilot lights: Indicate source to which load is connected.
   i. Source available indicating lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
      1) Normal power supervision: Green light with nameplate engraved "Normal Source Available."
      2) Emergency power supervision: Red light with nameplate engraved "Emergency Source Available."
   j. Unassigned auxiliary contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
   k. Transfer override switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

l. Engine starting contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
m. Engine shutdown contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
n. Engine generator exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    1) Exerciser transfer selector switch: Permits selection of exercise with and without load transfer.
    2) Push-button programming control with digital display of settings.
    3) Integral battery operation of time switch when normal control power is not available.
o. Generator load bank load dump feature: Provide a load dump auxiliary contact within each automatic transfer switch that will initiate the load dump feature at a portable load bank and/or permanent load bank. The purpose of this feature is to prevent the generator from seeing load applied via a load bank when the building calls for emergency power via the transfer switches.
p. Provide the transfer switch with the following accessories (Assumes ASCO 7000 series – provide similar from other manufacturers):
    1) #150A Tech Package (135L ASCO Digital Power Meter, 1PS1 Extended Control Power Ride Thru, 72EE2 Ethernet Monitoring)
    2) #77CC3 (Load Side Surge Protection) for Research Load ATS-0S1.
    3) #31BG (Status Relay Bundle – 18B Emergency Source Present Contacts, 18G Normal Source Present Contact and 31Z Selective Load Disconnect – For interfacing with elevator controllers) for ATS-EM1.
    4) #30A (Load-shed circuit) for Research Load ATS-OS1.

G. Comply with NEMA IA 10042-1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

H. The ATS shall consist of a power transfer module and a microprocessor control module interconnected to provide complete automatic operation. The power transfer module shall be mechanically held and electrically operated by a single solenoid mechanism momentarily energized from the source to which the load is to be transferred. The control module shall have solid-state sensing and control logic. Interfacing relays shall be industrial control grade. The ATS shall include a microprocessor- based metering device that provides real time measurements of single and three phase power system. The following shall be measured: current per phase, real, reactive, and apparent power, and bi-directional energy.

I. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

J. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

K. Switching Methods:
    1. Closed Transition:

a. When both sources are available and synchronized, provide make-before-break transfer without interruption of power to the load and with momentary interconnection of both sources for not more than 100 ms, unless otherwise approved by Utility Company.
b. Provide synchronization/in-phase monitor to initiate transfer when voltage and phase angle difference between sources are within predetermined requirements for synchronization.
c. Source Synchronization Requirements: Phase angle differential within five degrees; voltage differential within five volts.
d. When sources fail to synchronize within a predetermined time period, remain connected to current source and initiate an alarm.
e. When sources remain interconnected for longer than specified maximum interconnection time, provide contact closure signal to shunt trip designated circuit breaker and initiate an alarm.
f. Provide additional protective relaying where required by Utility Company.
g. When only one source is available, automatically utilizes open transition (break-before-make) transfer.

2. Neutral Switching: Use simultaneously switched neutral (break-before-make) method. Overlapping neutral method is not acceptable.
3. Obtain control power for transfer operation from line side of source to which the load is to be transferred.

L. Seismic Qualification: Provide transfer switches and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

M. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

N. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated
1. Environment Type per NEMA EN 10250: As indicated on the drawings.
2. Finish: Manufacturer's standard unless otherwise indicated.

O. Short Circuit Current Rating: As noted on the drawings. Rating shall be independent of the breaker serving the equipment. Ratings established by use of a specific breaker type will not be allowed.

P. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
2. Shall be a minimum of 18-cycle rated and tested.

Q. Automatic Transfer Switches:
1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
2. Control Functions:
a. Automatic mode.
b. Test Mode: Simulates failure of primary/normal source.
c. Voltage and Frequency Sensing:
1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.

2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.

d. Outputs:
1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
2) Auxiliary contacts; one set(s) for each switch position.
3) Signal before transfer (load disconnect) contacts; for selective load disconnection prior to transfer.

e. Adjustable Time Delays:
1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
2) Transfer to alternate/emergency source time delay.
3) Retransfer to primary/normal source time delay.
4) Signal before transfer (load disconnect) contact time delay.
5) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.

f. Synchronization/In-Phase Monitor (Closed Transition Transfer Switches): Monitors voltage and phase angle difference between sources for initiating synchronized transfer.

g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.

3. Status Indications:
a. Connected to alternate/emergency source.
b. Connected to primary/normal source.
c. Alternate/emergency source available.

4. Alarm Indications for Closed Transition Transfer Switches:
a. Failure to synchronize.
b. Extended source interconnection/transfer switch locked out.

5. Terminal provisions for a remote contact which opens to signal, the CTTS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.

6. One set of double pole, double throw contacts that operate when normal source voltage is available and one set of double pole, double throw contacts that operate when emergency source voltage is available.

7. Load shedding circuit initiated by the removal of the control voltage to a relay to match generator capacity to the load. Relay de-energization transfer load to the normal source, regardless of its acceptability. 24 VDC customer supplied control voltage.

8. The power monitor shall flush mount to an enclosure.
a. The power monitor shall be equipped with an continuous duty, LCD backlit display to provide local access to the following metered quantities:
1) Current, per phase RMS and neutral (if applicable).
2) Current unbalance percentage.
3) Voltage, phase-to-phase and phase-to-neutral.
4) Voltage unbalances percentage.

5) Real power, per phase and 3-phase total.
6) Apparent power, per phase and 3-phase total.
7) Reactive power, per phase and 3-phase total.
8) Power factor, 3-phase total and per phase.
9) Frequency.
10) Accumulated energy (MWH, MVAH and MVARH).

b. Displaying each of the power monitor quantities shall be accomplished through the use of menu scroll buttons.
c. Reset of the following electrical parameters shall be allowed from the front of the power monitor:
d. All reset and setup functions shall provide a means for protection against unauthorized/accidental changes.The power monitor shall be connected to power management system through RS485 serial port and/or TCP/IP Ethernet port without translator.
e. Power monitor shall include the following:
   1) Accurate to 1% measured, 2% computed values and display resolution to .1%. Voltage and current for all phases are sampled simultaneously to assure high accuracy in conditions of low power factor or large harmonics waveform distortions.
   2) Capable of operating at frequencies of 45 to 66 Hz and over a control power input voltage range of 20 to 32 VDC.
   3) Interfaced with a communications module to permit information to be sent to remote location for display, analysis and logging.
   4) Accept inputs from industry standard instrument transformers (120 VAC secondary PT's and 5A secondary CTS). Direct phase voltage connections, 600 VAC and under, shall be possible without the use of PT's.
   5) Monitor shall be applied in 3-phase, three and four wire circuits. A fourth CT input shall be available to measure neutral or ground current.
   6) All setup parameters required by the power monitors shall be stored in non-volatile memory and retained in the event of a control power interruption.
   7) The following metered readings shall be communicated by the power monitor, via serial communication:
      (a) Current, per phase RMS and neutral (if applicable).
      (b) Current unbalance percentage.
      (c) Voltage, phase-to-phase and phase-to-neutral.
      (d) Voltage unbalances percentage.
      (e) Real power (kW), per phase and 3-phase total.
      (f) Apparent power (kVA), per phase and 3-phase total.
      (g) Reactive power (kVAR), per phase and 3-phase total.
      (h) Power factor, 3-phase total and per phase.
      (i) Frequency.
      (j) Accumulated energy (MWH, MVAH and MVARH).
      (k) Accumulated real energy kWh.
      (l) Accumulated reactive energy KVAH.
      (m) Accumulated apparent energy KVARH.
   8) Monitors shall be equipped with the following I/O:
      (a) Provide eight (8) solid state status inputs.
      (b) Provide four (4) relay output contacts.

9. Building Management System: The building management system (BMS) will monitor the following points:
    a. Generator status.
    b. Generator low fuel.
    c. Generator general alarm.
    d. Transfer switches position at each ATS.
    e. Provide contact closures as required to allow for monitoring. Coordinate work with Owner
10. Other Features:
    a. Event log.
    b. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
11. Automatic Sequence of Operations:
    a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
    b. Where applicable, initiate signal before transfer (load disconnect) contacts at programmable time before transfer.
    c. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
    d. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
    e. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

R. Bypass/Isolation Transfer Switches:
1. Description: Factory-assembled units consisting of interconnected transfer switch and bypass/isolation switch that permits manual bypass and isolation of the transfer switch with connection of the load to either source.
2. Bypass/Isolation Switch Type: Provide overlapping (make-before-break) switches with no interruption of power to load. Load break (break-before-make) switches that interrupt power to load are not acceptable.
3. Bypass/Isolation Operation:
    a. Operable from exterior of enclosure.
    b. Normal Mode: Provides for normal operation of transfer switch.
    c. Test Mode: Provides for operational testing of bypassed transfer switch without affecting power to load.
    d. Isolate Mode: Provides for complete isolation of transfer switch from all power sources, permitting removal from unit.

2.03 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive transfer switches.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Provide required seismic controls in accordance with Section 26 0548.

F. Install transfer switches plumb and level.

G. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Identify transfer switches and associated system wiring in accordance with Section 26 0553.

J. Floor-Mounting Switch: Anchor to floor by bolting.
   1. Concrete bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

K. Arc Flash Labeling: Comply with Division 26 Section “Electrical Fault Current, Coordination, and Arc Flash Studies” for arc flash labeling requirements.

L. Identify components according to Division 26 Section “Identification for Electrical Systems”. The labels shall be viewable from the front of the equipment without opening any doors or covers. Include the following information:
   1. Designation.
   2. Fed from normal and emergency.
   3. Equipment served.
   4. Voltage, phase and wire.
   5. Ampere.
   6. Feeder sizes.

M. Identify components according to Division 26 Section "Identification for Electrical Systems."

N. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

O. The delay for transferring from generator to normal power after utility power is restored shall be set at 15 minutes.

3.03 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

D. Generator Load Bank Load Dump Feature: Provide wiring from the load damp auxiliary contact within each automatic transfer switch to the generator load bank docking station to prevent load bank operation when building calls for emergency power. Independent and separate sets of conductors shall be provided from each transfer switch out to the terminal strip in the first load dump enclosure.

E. Provide a data cable to each ATS to allow for remote conneciton to the ATS controller.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Prepare and start system in accordance with manufacturer's instructions.

C. Automatic Transfer Switches:
   1. Inspect and test in accordance with NETA ATS, except Section 4.
   2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The insulation-resistance tests listed as optional are not required.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

E. Perform tests and inspections and prepare test reports.
   1. Manufacturer's field service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
   2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
   3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
      a. Check for electrical continuity of circuits and for short circuits.
      b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
      c. Verify that manual transfer warnings are properly placed.
      d. Perform manual transfer operation.
   5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
      a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
f. Test closed transition unit functional modes and related automatic transfer switch operations

F. Coordinate tests with tests of generator and run them concurrently.

G. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

H. Remove and replace malfunctioning units and retest as specified above.

I. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

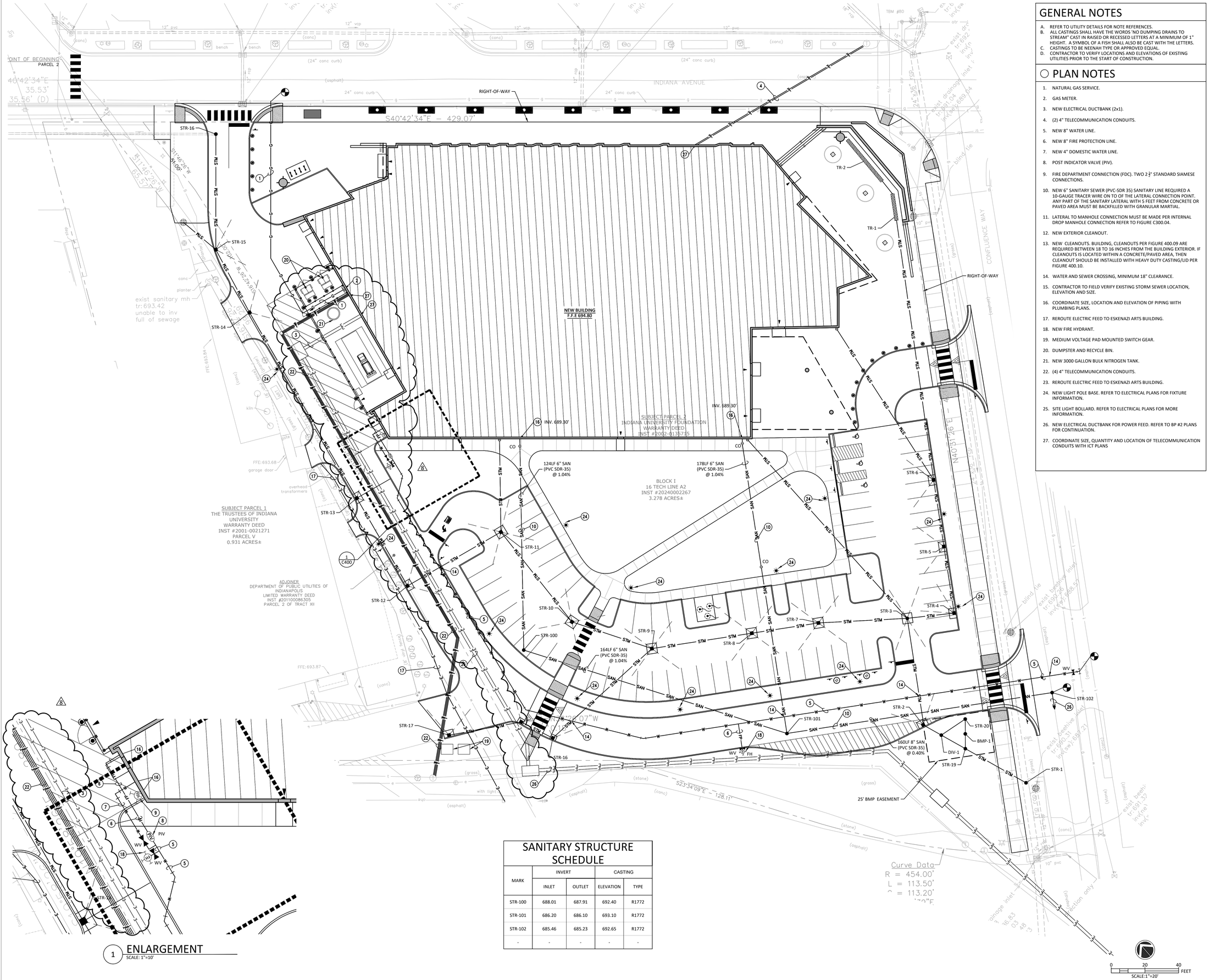
A. Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of transfer switches.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

C. Coorindate demonstration and training with that for the generator equipment.

END OF SECTION 26 3600

BINDING AREA



GENERAL NOTES

A. REFER TO UTILITY DETAILS FOR NOTE REFERENCES.
B. ALL CASTINGS SHALL HAVE THE WORDS "NO DUMPING DRAINS TO STREAM" CAST IN RAISED OR RECESSED LETTERS AT A MINIMUM OF 1" HEIGHT. A SYMBOL OF A FISH SHALL ALSO BE CAST WITH THE LETTERS.
C. CASTINGS TO BE NEENAH TYPE OR APPROVED EQUAL.
D. CONTRACTOR TO VERIFY LOCATIONS AND ELEVATIONS OF EXISTING UTILITIES PRIOR TO THE START OF CONSTRUCTION.

○ PLAN NOTES

1. NATURAL GAS SERVICE.
2. GAS METER.
3. NEW ELECTRICAL DUCTBANK (2x1).
4. (2) 4" TELECOMMUNICATION CONDUITS.
5. NEW 8" WATER LINE.
6. NEW 8" FIRE PROTECTION LINE.
7. NEW 4" DOMESTIC WATER LINE.
8. POST INDICATOR VALVE (PIV).
9. FIRE DEPARTMENT CONNECTION (FDC). TWO 2½" STANDARD SIAMESE CONNECTIONS.
10. NEW 6" SANITARY SEWER (PVC-SDR 35) SANITARY LINE REQUIRED A 10-GAUGE TRACER WIRE ON TO OF THE LATERAL CONNECTION POINT. ANY PART OF THE SANITARY LATERAL WITH 5 FEET FROM CONCRETE OR PAVED AREA MUST BE BACKFILLED WITH GRANULAR MARTIAL.
11. LATERAL TO MANHOLE CONNECTION MUST BE MADE PER INTERNAL DROP MANHOLE CONNECTION REFER TO FIGURE C300.04.
12. NEW EXTERIOR CLEANOUT.
13. NEW CLEANOUTS. BUILDING, CLEANOUTS PER FIGURE 400.09 ARE REQUIRED BETWEEN 18 TO 16 INCHES FROM THE BUILDING EXTERIOR. IF CLEANOUTS IS LOCATED WITHIN A CONCRETE/PAVED AREA, THEN CLEANOUT SHOULD BE INSTALLED WITH HEAVY DUTY CASTING/LID PER FIGURE 400.10.
14. WATER AND SEWER CROSSING, MINIMUM 18" CLEARANCE.
15. CONTRACTOR TO FIELD VERIFY EXISTING STORM SEWER LOCATION, ELEVATION AND SIZE.
16. COORDINATE SIZE, LOCATION AND ELEVATION OF PIPING WITH PLUMBING PLANS.
17. REROUTE ELECTRIC FEED TO ESKENAZI ARTS BUILDING.
18. NEW FIRE HYDRANT.
19. MEDIUM VOLTAGE PAD MOUNTED SWITCH GEAR.
20. DUMPSTER AND RECYCLE BIN.
21. NEW 3000 GALLON BULK NITROGEN TANK.
22. (4) 4" TELECOMMUNICATION CONDUITS.
23. REROUTE ELECTRIC FEED TO ESKENAZI ARTS BUILDING.
24. NEW LIGHT POLE BASE. REFER TO ELECTRICAL PLANS FOR FIXTURE INFORMATION.
25. SITE LIGHT BOLLARD. REFER TO ELECTRICAL PLANS FOR MORE INFORMATION.
26. NEW ELECTRICAL DUCTBANK FOR POWER FEED. REFER TO BP #2 PLANS FOR CONTINUATION.
27. COORDINATE SIZE, QUANTITY AND LOCATION OF TELECOMMUNICATION CONDUITS WITH ICT PLANS

1 ENLARGEMENT
SCALE: 1"=10'

SANITARY STRUCTURE SCHEDULE

MARK	INVERT		CASTING	
	INLET	OUTLET	ELEVATION	TYPE
STR-100	688.01	687.91	692.40	R1772
STR-101	686.20	686.10	693.10	R1772
STR-102	685.46	685.23	692.65	R1772
-	-	-	-	-

0 20 40 FEET
SCALE:1"=20'

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LAUNCH ACCELERATOR FOR BIOSCIENCES

INDIANAPOLIS, INDIANA

CLIENT PROJECT NO. - 20250072

CUMULATIVE DOCUMENTS
BP2-CD: EARLY EQUIPMENT PACKAGE

ISSUED / REVISIONS SCHEDULE

MARK	DATE	DESCRIPTION
8	12/08/2025	BP2-CD: ADDENDUM #1
7	11/17/2025	BP2-CD: EARLY EQUIPMENT PACKAGE
6	11/17/2025	BP1-CD: ASI #2
5	10/31/2025	BP1-CD: ASI #1
4	10/21/2025	BP1-CD ADDENDUM #2
3	10/15/2025	BP1-CD ADDENDUM #1
2	09/29/2025	BP1-CD: SITE AND FOUNDATION
1	08/15/2025	CITY SUBMITTAL

ANDREW D. SWANSON
REGISTERED
NO.
PE10200271
STATE OF
INDIANA
PROFESSIONAL ENGINEER

SITE UTILITY PLAN

DATE
BSA PROJECT NO. 00360481

REF. SHEET INDEX

C400

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BINDING AREA

0 80 160 FEET
SCALE:1"=80'

GENERAL NOTES

A. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING, AND VERIFYING, THAT ALL PERMITS AND APPROVALS ARE OBTAINED FROM THE RESPECTIVE CITY, COUNTY, STATE AND FEDERAL AGENCIES PRIOR TO STARTING CONSTRUCTION.

B. CONTRACTOR SHALL VERIFY LOCATION AND INVERT ELEVATIONS OF EXISTING SEWERS PRIOR TO START OF CONSTRUCTION.

C. CONTRACTOR SHALL MAINTAIN A COMPLETE AND OPERABLE UTILITY SYSTEM AT ALL TIMES.

D. CONTRACTOR SHALL INCLUDE COSTS FOR CUTTING AND PATCHING AS REQUIRED IN THEIR BID PROPOSAL TO COMPLETELY INSTALL THE WORK INDICATED.

E. CONTRACTOR SHALL INCLUDE ALL TAP FEES, PERMIT FEES AND APPLICATION FEES IN THEIR BID PROPOSAL AS NECESSARY TO COMPLETELY INSTALL THE WORK INDICATED.

F. LOCATION OF ALL EXISTING UTILITIES IS BASED ON BEST AVAILABLE INFORMATION. CONTRACTOR TO FIELD VERIFY EXISTING UTILITY LOCATIONS, SIZES AND DEPTHS PRIOR TO CONSTRUCTION AND NOTIFY ENGINEER OF ANY DISCREPANCIES.

G. CONTRACTOR SHALL COORDINATE EXACT UTILITY LOCATIONS WITH THE OWNER AND LOCAL UTILITY COMPANIES PRIOR TO COMMENCING ANY WORK. UTILIZE THE INDIANA UNDERGROUND UTILITY LOCATION SERVICE AT 811 OR 800-382-5544 PRIOR TO ANY EXCAVATION ON THE SITE.

H. REFER TO ELECTRICAL PLANS FOR MANHOLE, DUCTBANK AND CONDUIT DETAILS.

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LAUNCH ACCELERATOR FOR BIOSCIENCES

INDIANAPOLIS, INDIANA

CLIENT PROJECT NO. - 20250072

CUMULATIVE DOCUMENTS

BP2-CD: EARLY EQUIPMENT PACKAGE

ISSUED / REVISIONS SCHEDULE

MARK	DATE	DESCRIPTION
2	12/08/2025	BP2-CD: ADDENDUM #1
1	11/17/2025	BP2-CD: EARLY EQUIPMENT PACKAGE

ANDREW D. SWANSON
REGISTERED
No. PE10200271
STATE OF INDIANA
PROFESSIONAL ENGINEER

OVERALL DUCTBANK PLAN

DATE
BSA PROJECT NO. 00360481

REF. SHEET INDEX

2 C700

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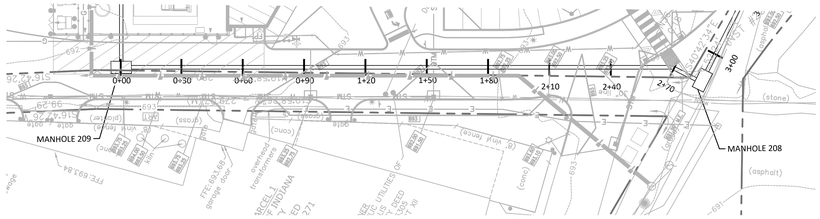
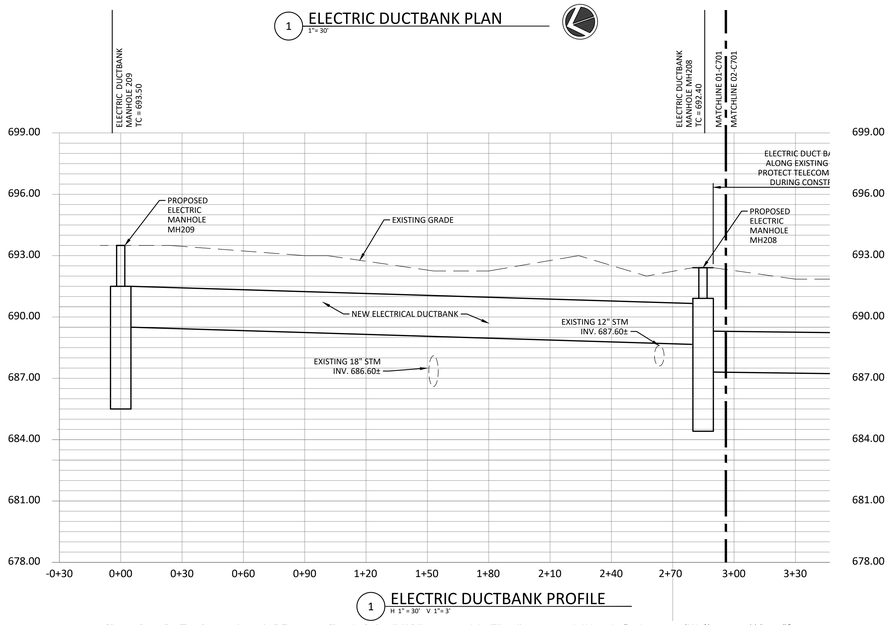
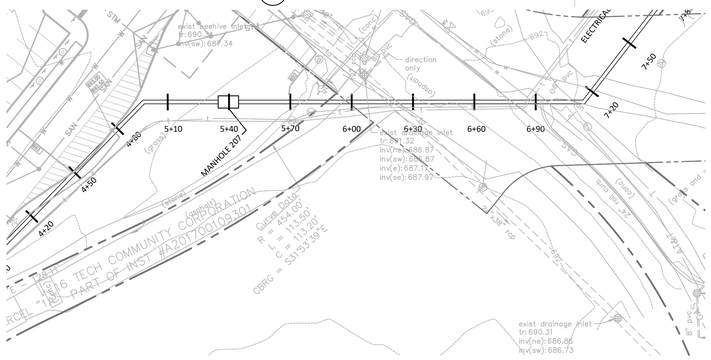


1 ELECTRIC DUCTBANK PLAN
1" = 30'



1 ELECTRIC DUCTBANK PROFILE
H 1" = 30' V 1"= 3'



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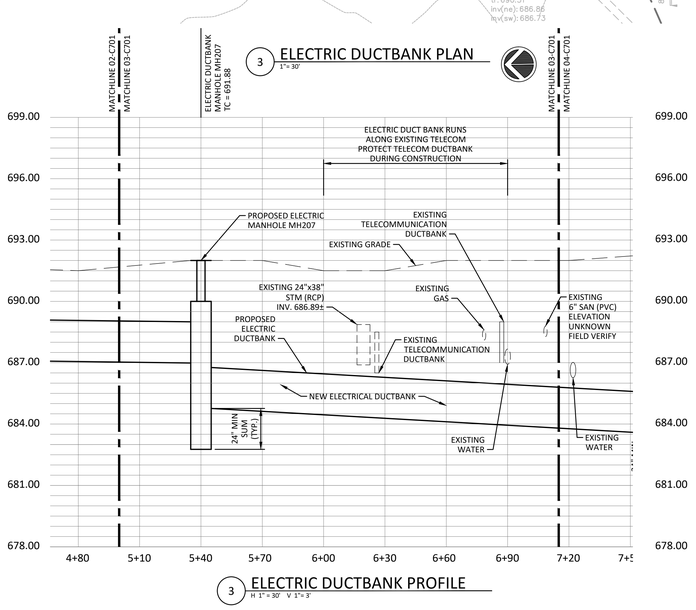
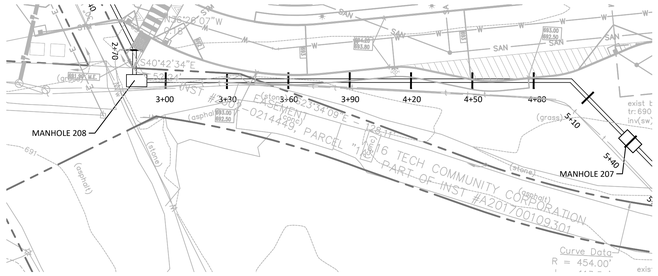
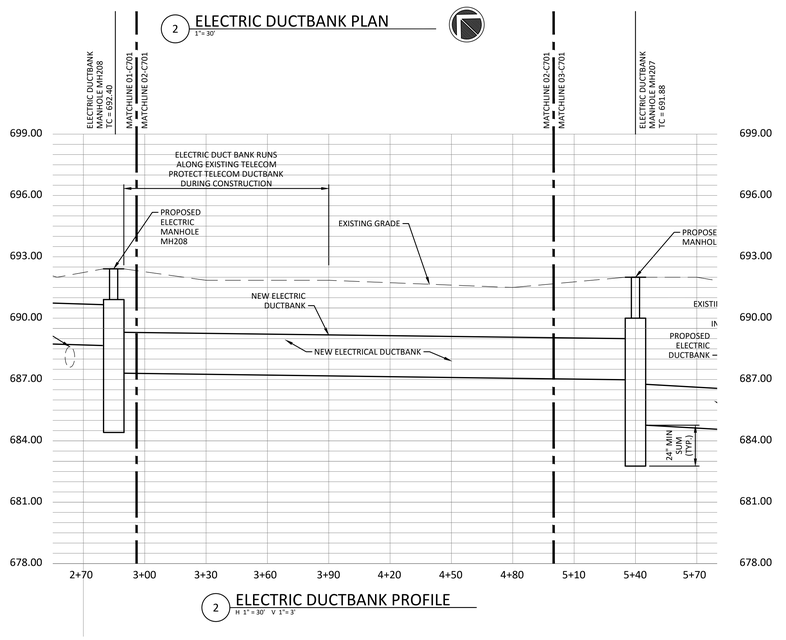


3 ELECTRIC DUCTBANK PROFILE
H 1" = 30' V 1"= 3'





2 ELECTRIC DUCTBANK PLAN
1" = 30'

2 ELECTRIC DUCTBANK PROFILE
H 1" = 30' V 1"= 3'

GENERAL / PROFILE NOTES

1. ASSUMED EXISTING WATER DEPTH 5' BELOW EXISTING GRADE, UNLESS NOTED OTHERWISE.
2. ASSUMED EXISTING GAS ELEVATION IS DEPTH 3' BELOW FINISHED GRADE, UNLESS NOTED OTHERWISE.
3. ASSUMED EXISTING TELECOMMUNICATION DEPTH 3' BELOW FINISHED GRADE, UNLESS NOTED OTHERWISE.
4. ASSUMED EXISTING OXYGEN DEPTH 3' BELOW FINISHED GRADE, UNLESS NOTED OTHERWISE.

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INDIANAPOLIS, INDIANA

CLIENT PROJECT NO. - 20250072

CUMULATIVE DOCUMENTS

BP2-CD: EARLY EQUIPMENT PACKAGE

ISSUED / REVISIONS SCHEDULE

MARK	DATE	DESCRIPTION
2	12/08/2025	BP2-CD: ADDENDUM #1
1	11/17/2025	BP2-CD: EARLY EQUIPMENT PACKAGE

REGISTERED No. PE10200271 STATE OF INDIANA PROFESSIONAL ENGINEER

Andrew D. Swanson

DUCTBANK PLAN AND PROFILE

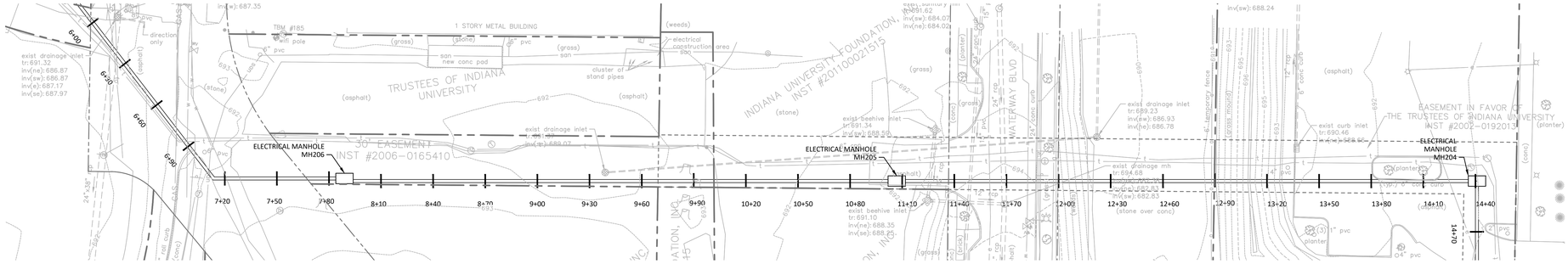
DATE

BSA PROJECT NO. 00360481

REF. SHEET INDEX

2 C701

BINDING AREA



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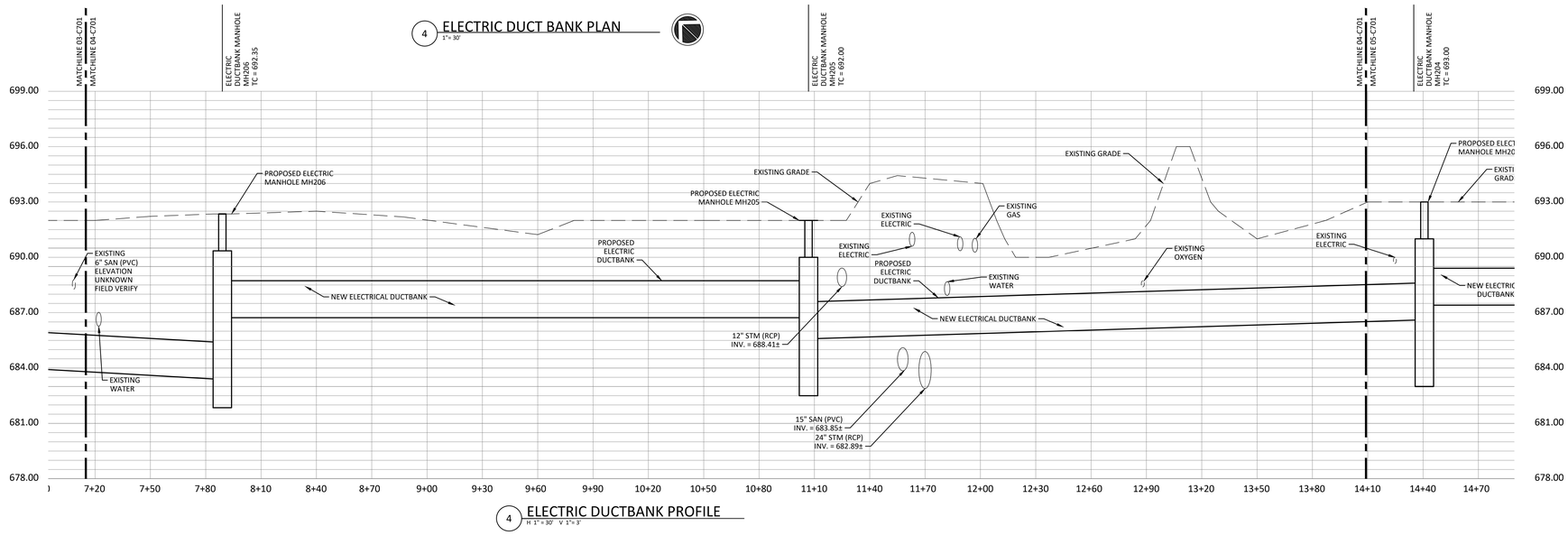

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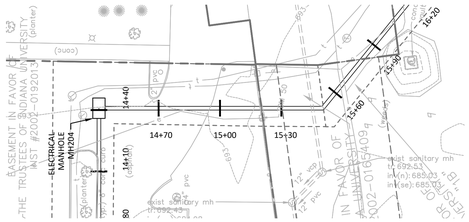
H 1" = 30' V 1"= 3'



5 ELECTRIC DUCT BANK PLAN
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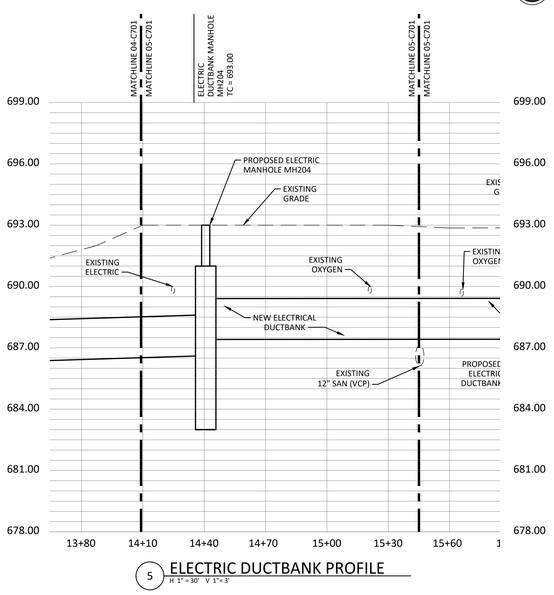
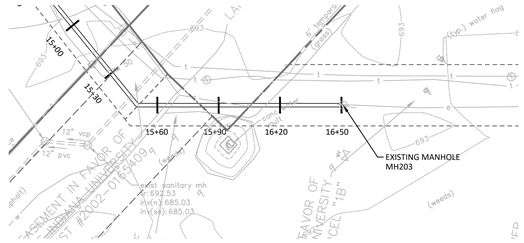


5 ELECTRIC DUCTBANK PROFILE
H 1" = 30' V 1"= 3'



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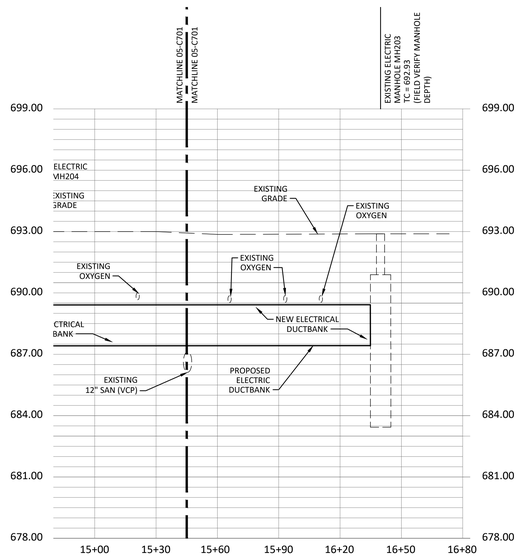
1" = 30'



6 ELECTRIC DUCTBANK PROFILE
H 1" = 30' V 1"= 3'

GENERAL / PROFILE NOTES

1. ASSUMED EXISTING WATER DEPTH 5' BELOW EXISTING GRADE, UNLESS NOTED OTHERWISE.
2. ASSUMED EXISTING GAS ELEVATION IS DEPTH 3' BELOW FINISHED GRADE, UNLESS NOTED OTHERWISE.
3. ASSUMED EXISTING TELECOMMUNICATION DEPTH 3' BELOW FINISHED GRADE, UNLESS NOTED OTHERWISE.
4. ASSUMED EXISTING OXYGEN DEPTH 3' BELOW FINISHED GRADE, UNLESS NOTED OTHERWISE.

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CUMULATIVE DOCUMENTS
BP2-CD: EARLY EQUIPMENT PACKAGE

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MARK	DATE	DESCRIPTION
2	12/08/2025	BP2-CD: ADDENDUM #1
1	11/17/2025	BP2-CD: EARLY EQUIPMENT PACKAGE

REGISTERED No. PE10200271 STATE OF INDIANA PROFESSIONAL ENGINEER
Andrew D. Zumwalt

DUCTBANK PLAN AND PROFILE

DATE
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2 C702

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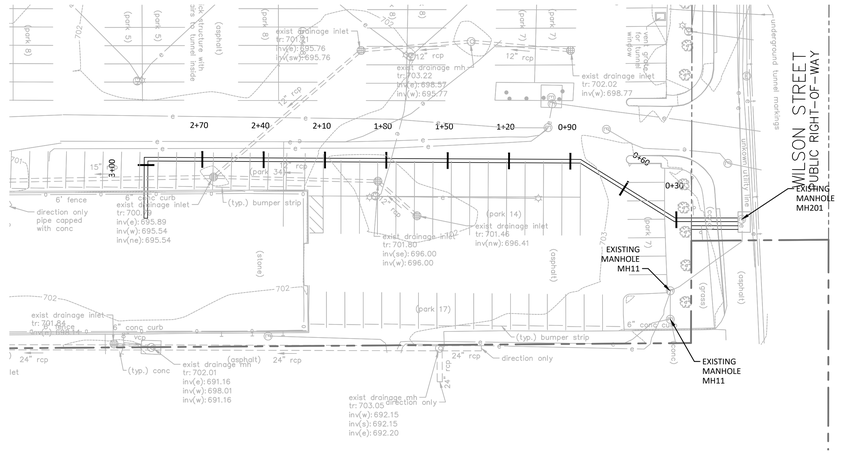
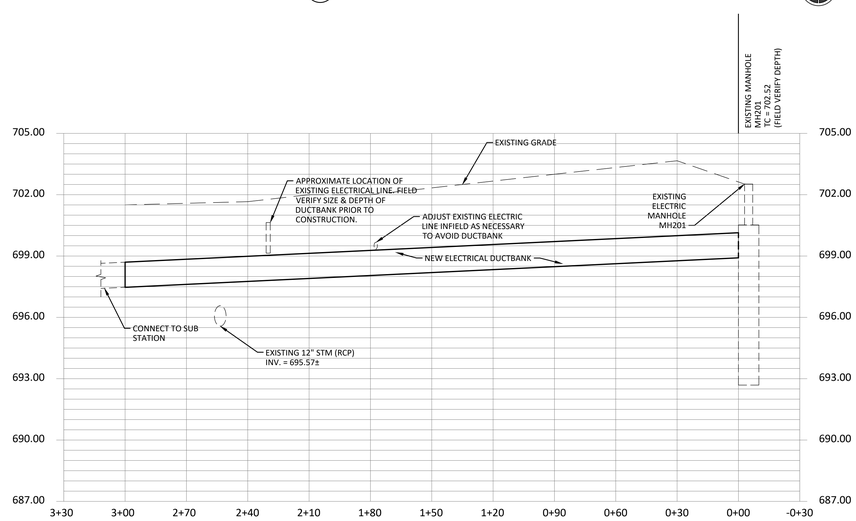
BINDING AREA



7 ELECTRIC DUCT BANK PLAN
1" = 30'



7 ELECTRIC DUCTBANK PROFILE
H 1" = 30' V 1" = 3'

GENERAL / PROFILE NOTES

1. ASSUMED EXISTING WATER DEPTH 5' BELOW EXISTING GRADE, UNLESS NOTED OTHERWISE.
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4. ASSUMED EXISTING OXYGEN DEPTH 3' BELOW FINISHED GRADE, UNLESS NOTED OTHERWISE.

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LAUNCH ACCELERATOR FOR BIOSCIENCES

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1	11/17/2025	BP2-CD: EARLY EQUIPMENT PACKAGE

ANDREW D. SWANSON
REGISTERED
No. PE10200271
STATE OF INDIANA
PROFESSIONAL ENGINEER

DUCTBANK PLAN AND PROFILE

DATE
BSA PROJECT NO. 00360481

REF. SHEET INDEX
2 C703

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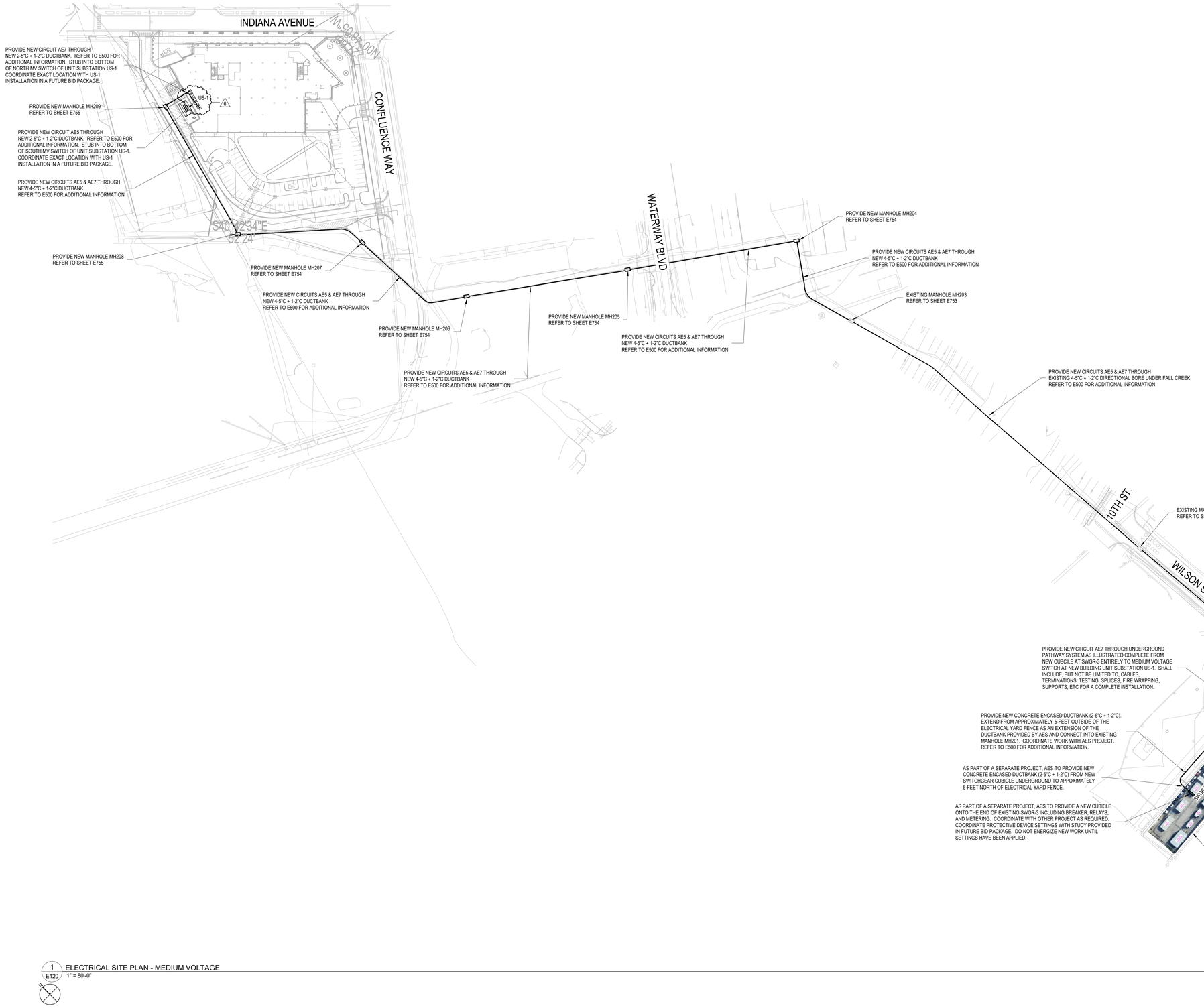
MEDIUM VOLTAGE GENERAL NOTES

A. THIS INFORMATION IS INTENDED TO ILLUSTRATE THE BASIC SCOPE OF WORK ASSOCIATED WITH THE MANHOLES.
B. WORK WITHIN MANHOLES CONTAINING OTHER ENERGIZED CIRCUITS WILL BE REQUIRED. THE CONTRACTOR SHALL DEVELOP A PLAN ACCORDINGLY. CLOSE COORDINATION WITH THE UNIVERSITY WILL BE REQUIRED FOR THE WORK ASSOCIATED WITH THIS SYSTEM.
C. THE SCHEDULE FOR THE MEDIUM VOLTAGE SCOPE OF WORK SHALL BE CLOSELY COORDINATED WITH THE OVERALL PROJECT SCHEDULE. A DETAILED PLAN SHALL BE SUBMITTED FOR REVIEW. REFER TO THE MEDIUM VOLTAGE DISTRIBUTION DIAGRAMS FOR ADDITIONAL INFORMATION.
D. THE CONTRACTOR SHALL LABEL ALL NEW AND ALL EXISTING CIRCUITS WITHIN ALL NEW AND EXISTING MANHOLES. PROVIDE AS-BUILT DRAWINGS DOCUMENTING THE FINAL STATE OF EACH NEW AND EXISTING MANHOLE MODIFIED BY THIS PROJECT INCLUDING PHOTOGRAPHS OF EACH CIRCUIT LABEL AND OVERALL PHOTOS OF EACH WALL.
E. CONTRACTOR SHALL PERFORM PULLING CALCULATIONS FOR ALL CABLE PULLS OVER 200 FEET AND/OR HAVING MULTIPLE BENDS. CONTRACTOR SHALL SUBMIT CALCULATIONS FOR REVIEW AND SHALL NOT PROCEED UNTIL THEY HAVE BEEN REVIEWED AND APPROVED BY THE UNIVERSITY.
F. REFER TO C700 SERIES DRAWINGS FOR ELECTRICAL DUCTBANK PROFILES. COORDINATE DUCT BANK ENTRY INTO MANHOLES WITH DUCTBANK PROFILES.



1 E120 ELECTRICAL SITE PLAN - MEDIUM VOLTAGE
1" = 80'-0"

BSA LifeStructures
175 S. Rangeline Rd, Suite 200
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LAUNCH ACCELERATOR FOR BIOSCIENCES

INDIANAPOLIS, INDIANA

CLIENT PROJECT NO. - 20250072

BID PACKAGE 2: EARLY EQUIPMENT PACKAGE

BP2-CD: EARLY EQUIPMENT PACKAGE

ISSUED / REVISIONS SCHEDULE

MARK	DATE	DESCRIPTION
6	12/08/2025	BP2-CD: ADDENDUM #1
5	11/17/2025	BP2-CD: EARLY EQUIPMENT PACKAGE

BRIAN D. HOAGLAND REGISTERED PE10606505 STATE OF INDIANA PROFESSIONAL ENGINEER

ELECTRICAL SITE PLAN - MEDIUM VOLTAGE

DATE
BSA PROJECT NO. 00360481

REF: SHEET INDEX

E120

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MAIN-TIE-MAIN AUTOMATIC TRANSFER SCHEME SEQUENCE OF OPERATION

GENERAL DESCRIPTION:

A. THE SWITCHGEAR LINE-UP CONTAINS TWO MAIN BREAKERS (MAIN 1 & MAIN 2) AND ONE TIE BREAKER. TWO SOURCES ARE AVAILABLE WHICH WILL BE REFERRED TO AS SOURCE 1 AND SOURCE 2. UNDER NORMAL CONDITIONS BOTH MAIN BREAKERS ARE CLOSED AND THE TIE BREAKER IS OPEN.

B. THE AUTOMATIC CONTROLS ARE DESIGNED TO TRANSFER THE LOAD OF THE MAIN ASSOCIATED WITH THE LOST SOURCE TO THE MAIN ASSOCIATED WITH THE GOOD SOURCE BY OPENING THE LOST SOURCE MAIN AND CLOSING THE TIE BREAKER. IF THE AUTO/MANUAL RETURN SELECTOR IS IN THE AUTO POSITION, ONCE THE LOST SOURCE HAS RETURNED THE MAIN BREAKER WILL CLOSE AND THEN THE TIE BREAKER WILL OPEN (CLOSED TRANSITION RESTORE).

C. OPERATION IS VIA DISCRETE INDUSTRIAL GRADE CONTROL RELAYS. PLC OPERATION IS NOT ACCEPTABLE.

MODES OF OPERATION:

A. AUTOMATIC OPERATION: AUTOMATIC OPERATION IS DEFINED AS OPENING OR CLOSING OF THE BREAKERS IN RESPONSE TO A LOW VOLTAGE, LOSS OF VOLTAGE, OR INCORRECT PHASE SEQUENCE CONDITION WHICH PROMPTS THESE UNSUPERVISED OPERATIONS.

B. MANUAL OPERATION: MANUAL OPERATION IS DEFINED AS OPENING OR CLOSING OF THE BREAKERS IN RESPONSE TO OPERATOR ACTUATION OF THE MANUAL CONTROL SWITCHES LOCATED ON THE BREAKER COMPARTMENT DOORS. MANUAL OPERATION ALLOWS A QUALIFIED OPERATOR TO CONTROL OPERATION OF THE BREAKER.

SEQUENCE OF OPERATION:

A. PROVIDE LED INDICATOR LIGHTS FOR OPEN, CLOSED AND SYNCH.
B. DISCRETE INDUSTRIAL GRADE CONTROL RELAYS SHALL BE USED. PLC OPERATION IS NOT ACCEPTABLE. SCHWEITZER ENGINEERING LABS RELAYS MAY BE USED.
C. NO "SELECT TO TRIP" SWITCHES ARE ALLOWED ON THE ASSOCIATED BREAKER DOOR.
D. PROVIDE PISTOL GRIP STYLE TRIP/CLOSE SWITCHES FOR MAIN AND TIE BREAKERS.
E. PROVIDE AUTO/MANUAL SWITCH ON TIE BREAKER DOOR.
F. PROVIDE ALARM AND CONNECTIONS TO EXISTING TRANSFORMER TEMPERATURE MONITORS.
G. PROVIDE BREAKER TRIP FUNCTIONS IN RESPONSE TO ALARM CONDITION.
H. TESTING SHALL INCLUDE CUSTOMER DEMONSTRATION THAT CIRCUITS ARE IN PHASE.
I. AUTOMATIC OPERATION – NO FAULT OF OVERCURRENT CONDITION EXISTS. WITH BOTH MAIN BREAKERS CLOSED AND THE TIE BREAKER OPEN:
   1. UPON LOSS OF EITHER MAIN SOURCE, INCLUDING PHASE LOSS OR REVERSAL, AND AFTER AN ADJUSTABLE TIME DELAY FROM 0 TO 5 SECONDS, MAIN BREAKER WITH LOST SOURCE SHALL OPEN.
   2. TIE BREAKER SHALL CLOSE.
   3. UPON RESTORATION OF THE LOST SOURCE, AND AFTER AN ADJUSTABLE TIME DELAY OF UP TO 5 MINUTES MAIN BREAKER SHALL CLOSE. (CLOSED TRANSITION.)
   4. AFTER AN ADJUSTABLE TIME DELAY OF UP TO 5 SECONDS, TIE BREAKER SHALL OPEN.
   5. ON LOSS OF POWER TO BOTH TRANSFORMERS, ONE MAIN BREAKER TO REMAIN CLOSED TO RESTORE POWER TO CONTROLS UPON POWER RETURN NAD RESTORE POWER TO ALL UNIT SUB LOADS.
J. MANUAL MODE:
   1. AUTOMATIC OPERATION SHALL BE DISABLED.
   2. BOTH MAIN BREAKERS AND THE TIE BREAKER MAY BE OPERATED MANUALLY WITH TRIP/CLOSE SWITCHES. BREAKERS MAY BE CLOSED SIMULTANEOUSLY TO ALLOW PARALLELING OF SOURCES FOR MANUAL CLOSED TRANSITION OPERATION OF MAIN AND TIE CIRCUIT BREAKERS.
   3. FAULT AND OVERCURRENT PROTECTION SHALL BE IN SERVICE WHILE IN MANUAL MODE.
   4. AFTER AN ADJUSTABLE TIME DELAY OF 20 TO 200 SECONDS, IF BOTH MAIN AND TIE CIRCUIT BREAKERS ARE CLOSED, THE TIE WILL OPEN AUTOMATICALLY.
   5. MANUAL MODE TIME DELAY FOR AUTOMATIC OPERATION OF TIE BREAKER SHALL BE INDEPENDENT OF AUTOMATIC MODE TIME DELAYS.
   6. LAMP REPLACEMENT AND OTHER GENERAL MAINTENANCE MAY BE PERFORMED IN MANUAL MODE WITHOUT TRIP.
   7. TIE BREAKER SHALL NOT TRIP AUTOMATICALLY WHEN EITHER MAIN BREAKER IS OPEN.
   8. MAIN CIRCUIT BREAKERS MAY BE PARALLELED FOR 20 TO 200 SECONDS.

Switchgear: MAIN #1 (SOUTH)

Location: ELECTRICAL 198L
Supplied From: TRANSFORMER #1 (SOUTH)
Mounting: Equipment Pad
Enclosure Type: NEMA 1

Voltage: 480/277 Wye
Phase: 3
Wire: 4
Ground: Equipment Ground Bus

Branch: Normal
A.I.C. Rating: 100,000
Main Type: MCB
Main Rating: 3200 A

General Panel Comments:
A. The equipment shall be rated for service entrance. Provide an acrylic label denoting this rating at main breakers.
B. The equipment shall be front and rear access.
C. The equipment shall be provided with integral power and analog volt/amp meters in a barriered compartment per Division 26 Section "Secondary Unit Substations"
D. The equipment shall be protected via integral surge protection devices (SPD) in a barriered compartment per Division 26 Section "Secondary Unit Substations".
E. The horizontal bus and each vertical bus shall be rated for 3200 A.
F. Provide lift rods for testing.
G. Main, tie, and feeder breakers shall be 100% rated, individually-mounted, draw-out, stored-energy, electronic-trip with field adjustable LSIG settings.
H. Main, tie, and feeder breakers shall be provided with arc-flash reduction mode opertion with control at face of equipment....

		Breaker Information										
		Thermal Mag		Electronic Trip								
CKT	Circuit Description	Fixed	Adj. Inst.	L	S	I	G	100% Rated	Poles	Frame Size	Trip Rating	Load	Remarks:
1	SPARE			X	X	X	X	X	3	1200 A	1200 A	0.0	1
2	ATS-EM1			X	X	X		X	3	400 A	400 A	54.8	1
3	FIRE PUMP			X	X	X		X	3	800 A	600 A	54.0	1
4	SPARE			X	X	X	X	X	3	1200 A	1200 A	0.0	1
5	ATS-OS1			X	X	X	X	X	3	1200 A	1200 A	52.3	1
6	DP-6NH2			X	X	X	X	X	3	1200 A	1200 A	662.0	1
7	Photvoltaic Input			X	X	X		X	3	400 A	400 A	0.0	1, 2
											Total Connected Load (kVA):		823.1
											Total Connected Load...		990.1

Remarks:
1. Breaker shall be individually-mounted, draw-out, stored energy, electronic-trip with field adjustable settings.
2. Breaker to be capable of back-feeding the unit substation from the photvoltaic system. Provide in accordance with NEC 705.

Switchgear: MAIN #2 (NORTH)

Location: ELECTRICAL 198L
Supplied From: TRANSFORMER #2 (NORTH)
Mounting: Equipment Pad
Enclosure Type: NEMA 1

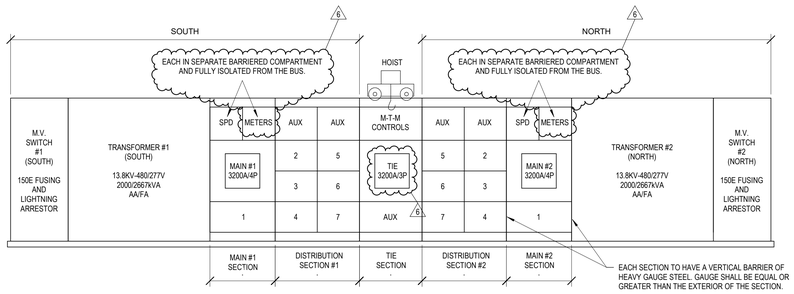
Voltage: 480/277 Wye
Phase: 3
Wire: 4
Ground: Equipment Ground Bus

Branch: Normal
A.I.C. Rating: 100,000
Main Type: MCB
Main Rating: 3200 A

General Panel Comments:
A. The equipment shall be rated for service entrance. Provide an acrylic label denoting this rating at main breakers.
B. The equipment shall be front and rear access.
C. The equipment shall be provided with integral power and analog volt/amp meters in a barriered compartment per Division 26 Section "Secondary Unit Substations"
D. The equipment shall be protected via integral surge protection devices (SPD) in a barriered compartment per Division 26 Section "Secondary Unit Substations".
E. The horizontal bus and each vertical bus shall be rated for 3200 A.
F. Provide lift rods for testing.
G. Main, tie, and feeder breakers shall be 100% rated, individually-mounted, draw-out, stored-energy, electronic-trip with field adjustable LSIG settings.
H. Main, tie, and feeder breakers shall be provided with arc-flash reduction mode opertion with control at face of equipment....

		Breaker Information										
		Thermal Mag		Electronic Trip								
CKT	Circuit Description	Fixed	Adj. Inst.	L	S	I	G	100% Rated	Poles	Frame Size	Trip Rating	Load	Remarks:
1	SPARE			X	X	X	X	X	3	1200 A	1200 A	0.0	1
2	DP-6NH1			X	X	X	X	X	3	1200 A	1200 A	502.0	1
3	DP-1NH11			X	X	X	X	X	3	1200 A	1200 A	0.0	1
4	SPARE			X	X	X	X	X	3	1200 A	1200 A	0.0	1
5	ATS-OS2			X	X	X	X	X	3	1200 A	1200 A	959.4	1
6	DP-1NH12			X	X	X	X	X	3	1200 A	1200 A	228.4	1
7	SPARE			X	X	X	X	X	3	1600 A	1600 A	0.0	1
											Total Connected Load (kVA):		1689.7
											Total Connected Load...		2032.4

Remarks:
1. Breaker shall be individually-mounted, draw-out, stored energy, electronic-trip with field adjustable settings.



1 UNIT SUBSTATION US-1
NO SCALE

GENERATOR SCHEDULE

DESIGNATION	LOCATION	KW/KVA	VOLTAGE	PHASE/WIRE	MODE	FUEL			COMMENTS
						CIRCULATED	CONSUMED	TYPE	
GEN-1EMH1	ELECTRICAL YARD	1000kW/1250kVA	277/480	3/4	STANDBY	0 GPM	1 GPM	DIESEL	1, 2, 3, 4

COMMENTS:

1. UNIT SHALL BE EPA CERTIFIED FOR A STATIONARY STANDBY EMERGENCY APPLICATION.
2. UNIT SHALL BE PROVIDED WITH A SOUND ATTENUATED OUTDOOR ENCLOSURE RATED A MAXIMUM AVERAGE OF 75 dB AT 23 FEET AWAY.
3. THE GENERATOR SYSTEM SHALL BE A SEPARATELY DERIVED SYSTEM.
4. REFER TO DIVISION 26 SECTION 'ENGINE GENERATORS" FOR ADDITIONAL REQUIREMENTS

AUTOMATIC TRANSFER SWITCH SCHEDULE

DESIGNATION	LOCATION	AMP	PHASE	WIRE	VOLTAGE	NEUTRAL CONFIGURATION	INTERRUPTION RATING (A)	TYPE (OPEN/CLOSED TRANSITION)	BYPASS ISOLATION TYPE (YES/NO)	LOAD SERVED	COMMENTS
ATS-EM1	EMERGENCY ELECTRIC 198K	400 A	3	4	277/480	SWITCHED	100,000	CLOSED	YES	EMERGENCY	1
ATS-OS1	EMERGENCY ELECTRIC 198K	1200 A	3	4	277/480	SWITCHED	100,000	CLOSED	YES	OPTIONAL STANDBY	1
ATS-OS2	EMERGENCY ELECTRIC 198K	1200 A	3	4	277/480	SWITCHED	100,000	CLOSED	YES	OPTIONAL STANDBY	1

COMMENTS:

1. REFER TO DIVISION 26 SECTION "TRANSFER SWITCHES" FOR ADDITIONAL REQUIREMENTS.

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LAUNCH ACCELERATOR FOR BIOSCIENCES

INDIANAPOLIS, INDIANA

CLIENT PROJECT NO. - 20250072

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BP2-CD: EARLY EQUIPMENT PACKAGE

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BRIAN D. HOAGLAND REGISTERED PE10606505 STATE OF INDIANA PROFESSIONAL ENGINEER

ELECTRICAL SCHEDULES

DATE
BSA PROJECT NO. 00360481

REF: SHEET INDEX

E600

EXISTING MH 202 - NORTH WALL

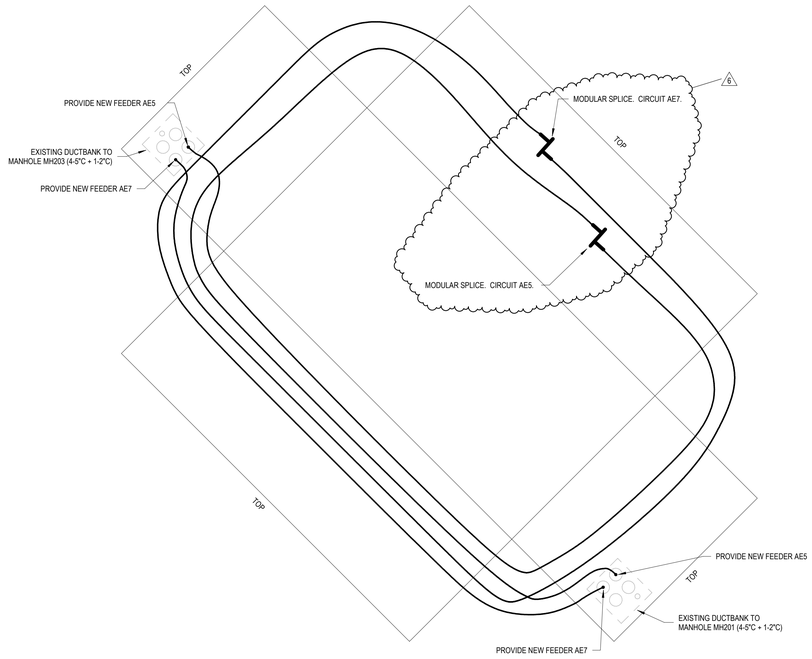
EXISTING MH 202 - EAST WALL

EXISTING MH 202 - WEST WALL

EXISTING MH 202 - SOUTH WALL

MEDIUM VOLTAGE GENERAL NOTES

A. THE EXISTING CONDITIONS OF THE MANHOLES ILLUSTRATED ON THIS SHEET IS BASED ON EXISTING DRAWINGS AND PHOTOS. THE CONTRACTOR SHALL FIELD VERIFY THE EXISTING CONDITIONS AND COMMUNICATE ANY DISCREPANCIES. THIS INFORMATION IS INTENDED TO ILLUSTRATE THE BASIC SCOPE OF WORK ASSOCIATED WITH THE MANHOLES.
B. WORK WITHIN MANHOLES CONTAINING OTHER ENERGIZED CIRCUITS WILL BE REQUIRED. THE CONTRACTOR SHALL DEVELOP A PLAN ACCORDINGLY. CLOSE COORDINATION WITH THE UNIVERSITY WILL BE REQUIRED FOR THE WORK ASSOCIATED WITH THIS SYSTEM.
C. THE SCHEDULE FOR THE MEDIUM VOLTAGE SCOPE OF WORK SHALL BE CLOSELY COORDINATED WITH THE OVERALL PROJECT SCHEDULE. A DETAILED PLAN SHALL BE SUBMITTED FOR REVIEW. REFER TO THE MEDIUM VOLTAGE DISTRIBUTION DIAGRAMS FOR ADDITIONAL INFORMATION.
D. THE CONTRACTOR SHALL LABEL ALL NEW AND ALL EXISTING CIRCUITS WITHIN ALL NEW AND EXISTING MANHOLES. PROVIDE AS-BUILT DRAWINGS DOCUMENTING THE FINAL STATE OF EACH NEW AND EXISTING MANHOLE MODIFIED BY THIS PROJECT INCLUDING PHOTOGRAPHS OF EACH CIRCUIT LABEL AND OVERALL PHOTOS OF EACH WALL.
E. THE CONTRACTOR SHALL PROVIDE ALL SUPPORTS WITHIN ALL EXISTING MANHOLES PER THE SPECIFICATIONS FOR A COMPLETE INSTALLATION.
F. CONTRACTOR SHALL PERFORM PULLING CALCULATIONS FOR ALL CABLE PULLS OVER 200 FEET AND/OR HAVING MULTIPLE BENDS. CONTRACTOR SHALL SUBMIT CALCULATIONS FOR REVIEW AND SHALL NOT PROCEED UNTIL THEY HAVE BEEN REVIEWED AND APPROVED BY THE UNIVERSITY.



1 E752 MANHOLE MH 202 (EXISTING)
NO SCALE

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BRIAN D. HOAGLAND REGISTERED PE10606505 STATE OF INDIANA PROFESSIONAL ENGINEER

ELECTRICAL MANHOLE DETAILS - EXISTING MH 202

DATE	REF: SHEET INDEX
BSA PROJECT NO.	00360481

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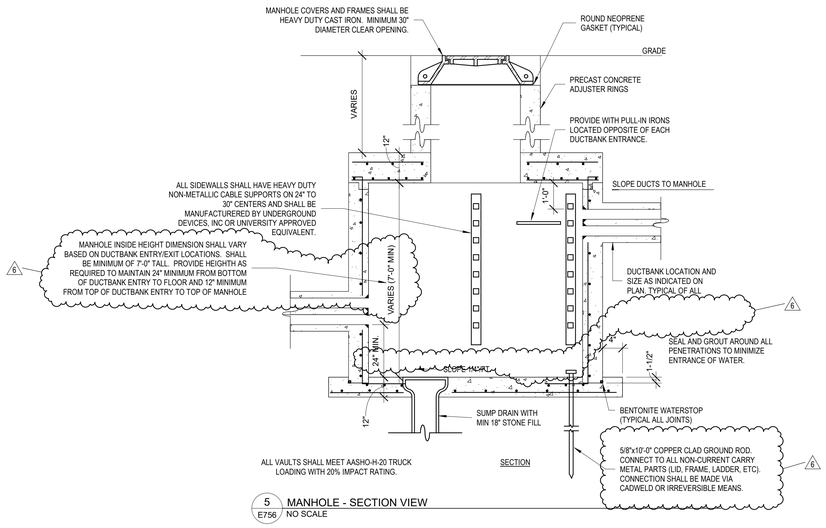
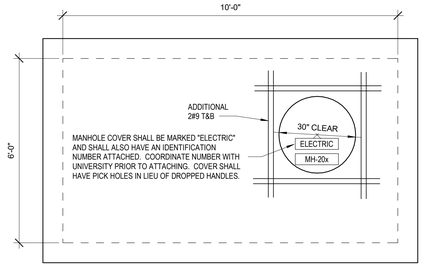
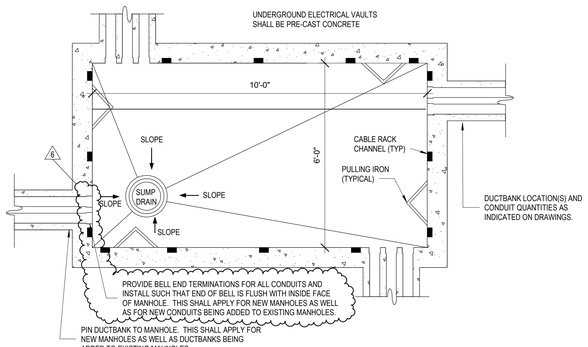


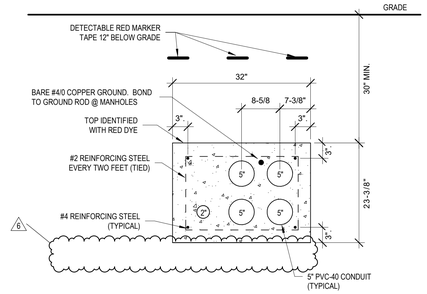
5 E756 MANHOLE - SECTION VIEW
NO SCALE



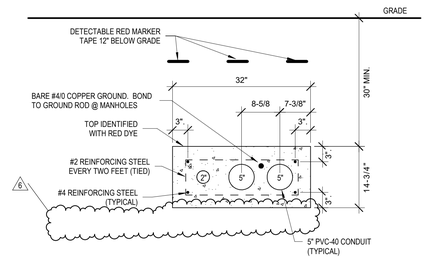
4 E756 MANHOLE - TOP VIEW
NO SCALE



3 E756 MANHOLE - PLAN VIEW
NO SCALE



2 E756 CONCRETE ENCASED DUCTBANK DETAIL - FOUR 5"C + ONE 2"C
NO SCALE



1 E756 CONCRETE ENCASED DUCTBANK DETAIL - TWO 5"C + ONE 2"C
NO SCALE

DUCTBANK GENERAL NOTES

A. THE DUCTBANK DETAILS ARE AN ILLUSTRATION OF THE BASIC REQUIRMENTS. THE CONDUIT QUANTITIES AND ARRANGEMENTS SHALL BE COORDINATED WITH OTHER DRAWINGS, OTHER TRADES, AND WITH THE OWNER PRIOR TO INSTALLATION.
B. REFER TO SPECIFICATION DIVISION 26 SECTION "UNDERGROUND DUCTS AND UTILITY STRUCTURES FOR ELECTRICAL SYSTEMS" FOR ADDITIONAL INFORMATION.
C. USE END BELL FITTINGS WHERE CONDUITS TERMINATE IN UNDERGROUND MANHOLES.
D. CONDUITS SHALL TERMINATE IN UNDERGROUND MANHOLES AT A RIGHT ANGLE.
E. PLASTIC CONDUIT SPACERS SHALL BE USED TO SUPPORT CONDUITS AND TO MAINTAIN PROPER SPACING.
F. INSTALL POLYETHYLENE PLUGS ON UNUSED CONDUITS.
G. WHERE CONNECTING TO A MAHNOLE, DOWEL THE #4 REBAR ONE-HALF THICKNESS INTO THE WALL USING A SUITABLE EPOXY ADHESIVE.
H. TRANSITION TO GRC AT 5'-0" FROM BUILDING FOUNDATION WALL.
I. PULL A MANDREL AND BRUSH THROUGH ALL CONDUITS TO VERIFY ACCESSIBILITY AND CLEANLINESS. THIS TASK SHALL BE WITNESSED BY THE UNIVERSITY.
J. PROVIDE PULL STRINGS IN ALL SPARE CONDUITS.
K. BOND #4/0 AWG BARE COPPER GROUND WIRE INSTALLED WITHIN DUCTBANK TO GROUND ROD AT MANHOLE AND AT EQUIPMENT/ROOM GROUND BAR AT EACH END.

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ELECTRICAL MANHOLE DETAILS

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