

**ADDENDUM NUMBER ONE  
LONGWOOD ROAD SEWER PROJECT - REBID  
DWI PROJECT NO. SRP-W-ARP-0297  
BRUNSWICK COUNTY PUBLIC UTILITIES  
BRUNSWICK COUNTY, NORTH CAROLINA**

This Addendum Number One is issued this 21st day of May 2025, to all parties who hold a set of Bid Documents for the project entitled "LONGWOOD ROAD SEWER PROJECT, DWI PROJECT NO. SRP-W-ARP-0297." This Addendum Number One shall become part of the Contract Documents, and its receipt acknowledged on the Bid Documents at the time of bidding.

The following changes and clarifications shall be made to the Contract Documents:

**General**

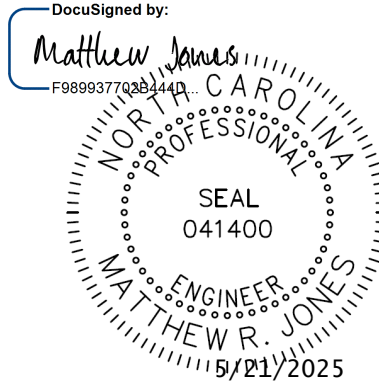
1. **RE-BID DATE:** A minimum of three bids were not received at the initial bid opening on May 16, 2025. This project is re-advertised and sealed bids will be received at the Brunswick County Public Utilities Operations Center, located at 250 Grey Water Road NE, Supply, North Carolina, until **2:00 p.m. on June 3, 2025**, and will then be publicly opened and read aloud. Bidder inquiries will be received until 5:00 p.m. on May 29, 2025.
2. Being a re-advertisement, three bids will not be required to open on June 3, 2025. Additionally, Addenda No. 1 through 4 from the prior bid are attached to this Addendum and shall be a part of the Contract Documents. Bidders shall only need to acknowledge Addendum Number One (this addendum), since all prior addenda are attached and incorporated as such. No changes beyond this or the attached addenda have been made to the project Bid Documents at this time.
3. The Revised Invitation to Bidders is attached.

This Addendum Number One is issued this 21st day of May 2025.

**Matthew R. Jones, P.E.**



**712 Village Rd SW, Suite 103  
Shallotte, North Carolina 28470**



# BRUNSWICK COUNTY PUBLIC UTILITIES

## OPERATIONS CENTER

250 GREY WATER ROAD NE  
SUPPLY, NORTH CAROLINA 28462

### **ITB: Longwood Road Sewer Project**

Pursuant to North Carolina General Statutes § 143-129 et. seq. and 2 C.F.R. 200.320(b)(1), Brunswick County (“County” or “Owner”) is soliciting sealed bids for the construction of: **LONGWOOD ROAD SEWER, DWI PROJECT NO. SRP-W-ARP-0297**. Sealed bids must be received by **2:00 p.m. ET on June 3, 2025**, in the Brunswick County Public Utilities Operations Center located at 250 Grey Water Road NE, Supply, NC 28462. Bids will be for the furnishing of all labor and materials, including all equipment required, as detailed in the technical specifications, construction drawings, and summary of work contained herein. Any changes to the specifications or summary of work or clarifications to the bidding documents will be made in the form of an Addendum hereto and will be supplied to all known prospective bidders and posted on the County’s website. Notwithstanding the foregoing, bidders will be responsible for ensuring that they have all Addenda.

Each bid must be made on the forms provided. Brunswick County will not be responsible for the failure of any mail or delivery service to deliver a bid by the aforementioned date and time. Regardless of the manner of submission, bids received after the aforementioned date and time, incomplete bids, or bids not submitted at the correct location or in the designated manner will not be accepted. Sealed bids will be opened publicly and read aloud on **June 3, 2025 at 2:00 p.m. ET** in the Brunswick County Public Utilities Operations Center located at 250 Grey Water Road NE, Supply, NC 28462. The contract shall be Single Prime.

A general description of the work includes, without limitation: The extension of the County’s wastewater collection system to serve previously unserved residents in the vicinity of Longwood Road with the construction of approximately 51,200 LF of 12-inch force main, 85,000 LF of low pressure sewer pipe, 1,200 LF of 8-inch gravity sewer, and sewer connections with grinder pumps and associated appurtenances, as well as an anchor lift station at Waccamaw School.

**Pre-Bid Meeting:** An optional pre-bid meeting was held for all interested bidders and vendors on **April 15, 2025**, at 2:00 p.m. ET at the Brunswick County Public Utilities Operations Center located at 250 Grey Water Road NE, Supply, NC 28462. Minutes for this meeting will be provided via Addendum.

**Site Visitation:** Individual inspection of the proposed construction site at Waccamaw School may be allowed only by approval of Brunswick County. Telephone or email at **Regina Quintos-Pascual**, [regina.quintos@brunswickcountync.gov](mailto:regina.quintos@brunswickcountync.gov), **(910) 253-1714 (Office)** to schedule a visit.

Digital copies of Bidding Documents are available for purchase for a fee of \$100.00 per set through Quest by visiting [www.mcgillbidline.com](http://www.mcgillbidline.com). These documents may be downloaded by selecting this project from the “Bids” link and by entering Quest Project Number **9706164**. For assistance and free membership registration, contact QuestCDN at (952) 233-1632 or [info@questcdn.com](mailto:info@questcdn.com). County will not be responsible for full or partial sets of Contract Documents, including any addendum, obtained from any other source.

All bidder questions and/or clarifications must be submitted in writing to Matthew Jones, PE with McGill Associates, PA. at [matthew.jones@mcgillassociates.com](mailto:matthew.jones@mcgillassociates.com) no later than **5:00 p.m. ET on May 29, 2025**. Bidder questions and/or clarifications received after this date and time will not receive a response. Questions and/or clarifications will be answered in the form of an Addendum and supplied to all known prospective bidders and posted on the County’s website. Notwithstanding the foregoing, bidders will be responsible for ensuring that they have all Addenda.

Sealed bids will be received until **2:00 p.m. ET on June 3, 2025**, in the Brunswick County Public Utilities Operations Center located at 250 Grey Water Road NE, Supply, NC 28462 for the furnishing of labor, material, and equipment for the construction of: **LONGWOOD ROAD SEWER, DWI PROJECT NO. SRP-W-ARP-0297**. Shortly thereafter, the sealed bids will be opened publicly and read aloud.

**Sealed bids may only be received by mail or hand delivery. Sealed bids shall be labeled with the project name, Contractor’s name, address, and license number and must be marked “SEALED BID, DO NOT OPEN.” Bids shall be sent to:**

Alternate Shipping Service or Hand Delivery  
Brunswick County Public Utilities  
Utilities Operations Center  
Attention: Regina Quintos-Pascual  
250 Grey Water Road NE  
Supply, NC 28462  
(910) 253-1714

US Post Office  
Brunswick County Public Utilities  
Attention: Regina Quintos-Pascual  
P. O. Box 249  
Bolivia, NC 28422

**ADDENDUM NUMBER ONE  
LONGWOOD ROAD SEWER PROJECT  
DWI PROJECT NO. SRP-W-ARP-0297  
BRUNSWICK COUNTY PUBLIC UTILITIES  
BRUNSWICK COUNTY, NORTH CAROLINA**

This Addendum Number One is issued this 23rd day of April 2025, to all parties who hold a set of Bid Documents for the project entitled "LONGWOOD ROAD SEWER PROJECT, DWI PROJECT NO. SRP-W-ARP-0297." This Addendum Number One shall become part of the Contract Documents, and its receipt acknowledged on the Bid Documents at the time of bidding.

The following changes and clarifications shall be made to the Contract Documents:

**General**

1. As a reminder, sealed bids will be received at the Brunswick County Public Utilities Operations Center, located at 250 Grey Water Road NE, Supply, North Carolina, until **2:00 p.m. on May 6, 2025**, and will then be publicly opened and read aloud.
2. Please find attached the minutes and attendance sheet from the Pre-Bid meeting held on April 15, 2025. The minutes, and answers to questions therein, are considered part of this addendum.

**Questions**

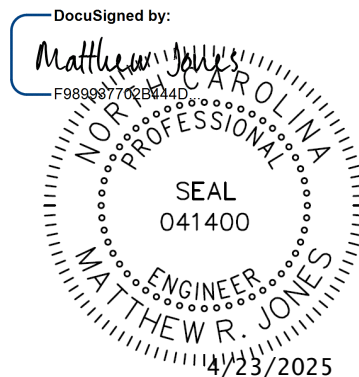
1. Please clarify if either Standard DOMESTIC or AIS requirements are applicable to this project.  
RESPONSE: AIS requirements do not apply to this project. Please note the domestic preference section included in the Form of Agreement, Section 17.

This Addendum Number One is issued this the 23rd day of April 2025.

**Matthew R. Jones, P.E.**



**712 Village Rd SW, Suite 103  
Shallotte, North Carolina 28470**





## Pre-Bid Meeting Minutes

**Project Name:** Longwood Road Sewer Project  
**NCDWI Project No. SRP-W-ARP-0297**

**Owner:** Brunswick County Public Utilities

**McGill Project #:** 23.07095

**Organizer:** Matthew Jones, P.E.

**Today's Date:** April 15, 2025, at 2:00 P.M.

**Bid Opening Date:** Tuesday, May 6th, 2025, at 2:00 p.m. at 250 Grey Water Road NE, Supply, NC, 28462.

1. Welcome, introductions and distribute sign-in sheet.

Name	Representing/Company	Phone	E-mail
Michael Norton, PE	McGill Associates, P.A.	910-755-5872	michael.norton@mcgillassociates.com
Matthew Jones, PE	McGill Associates, P.A.	910-755-5872	matthew.jones@mcgillassociates.com
Jay Murray	McGill Associates, P.A.	910-755-5872	james.murray@mcgillassociates.com
Andy Lovingood, PE	McGill Associates, P.A.	910-755-5872	andy.lovingood@mcgillassociates.com
John Nichols, PE	Brunswick County Public Utilities		john.nichols@brunswickcountync.gov
Donald Dixon	Brunswick County Public Utilities		donald.dixon@brunswickcountync.gov
Regina Quintos-Pascual	Brunswick County Public Utilities	910.253.1714	regina.quintos@brunswickcountync.gov
Brent Lochamy (Online)	Brunswick County Public Utilities		
Bobby Sweat	Brunswick County Public Utilities	910-253-1825	bobby.sweat@brunswickcountync.gov
Mitch Dillahay	Brunswick County Public Utilities	910-523-4729	mitch.dillahay@brunswickcountync.com
Peter Heuschneider	Brunswick County Public Utilities	910-664-8451	peter.heuschneider@brunswickcountync.gov
Bob Tweedy	Brunswick County Public Utilities	910-880-5827	bob.tweedy@brunswickcountync.gov
Joseph Conroy	King Construction Service, Inc.	203-297-1185	jconroy@kingcsinc.com
Josh Quinn	Falconer Construction	910-388-7206	jquinn@falconerconstruction.com
John Dodd	Falconer Construction	919-398-3312	jdodd@falconerconstruction.com
Adam Collins	T.A. Loving	919-223-3833	acollins@taloving.com
Paula Bruce	R.H. Moore Company, Inc	843-213-8264	pulbruce@rhmoorecompany.com
Patrick Seay	Xylem Dewatering	910-237-7135	Patrick.Seay@xylem.com
Andy Underseth	Islan Automation	910-358-7545	andyu@islandautomation.com
Ted Summerlin	Capital Electric Supply	910-520-4439	Ted.summerlin@capitalelectricsupply.com

2. Project Description:

- A. The work on this project shall include, without limitation, extension of the County's wastewater collection system to serve previously unserved residents in the vicinity of Longwood Road with the construction of approximately 51,200 LF of 12-inch force main, 85,000 LF of low pressure sewer pipe, 1,200 LF of 8-inch gravity sewer, and sewer connections with grinder pumps and associated appurtenances, as well as an anchor lift station at Waccamaw School.
- B. The Work is bid as a Formal Bid.
- C. Contract Times:
  - i. 420 calendar days to Substantial Completion / 450 days to Final Completion from Notice to Proceed
  - ii. Liquidated Damages: \$1,000/day.
- D. All bids shall be lump sum with provisions for unit prices as indicated in the Form of Proposal. Bid Alternates also included. Ms. Quintos-Pascual emphasized that Contractors should pay careful attention to Pay Items listed in the proposal and price appropriately.
- E. Bid Security/Bond, Payment Bond and Performance Bonds are required.
- F. Project is funded by NCDWI State Reserve ARPA Funds. State funding requirements apply. Project does include Davis Bacon Wage Rate requirements, included in Bidding Documents.
- G. Note the insurance requirements as outlined in the General Conditions.
- H. Bid Requirements:
  - i. Form of Proposal
  - ii. Bid Bond or Bid Security
  - iii. Socioeconomic Contracting Affidavit
  - iv. MBE/WBE Forms – Good Faith Efforts Form, Table A, Table B and applicable information
  - v. Contractor's License information

3. Additional Items

- A. Review Construction Sequence on G-002.
  - B. Note NCDOT Requirements on G-002.
  - C. Note Horizontal Directional Drills throughout the project (summary on G-002) and Bore and Jack under Whiteville Rd and Longwood Rd, dual pipe encasement detail on C-520.
  - D. Note trenching detail for proposed force main and low pressure along Waccamaw School Road and Longwood Road on C-521.
  - E. Proposed Lift Station site plan is shown on sheet C-401, C-516, and E-102.
  - F. Coordination with County and Waccamaw School for existing construction of gravity sewer on and adjacent to school property, and for abandonment of existing wastewater treatment equipment.
  - G. Service Connections Installation and Septic Tank Abandonment. Refer to Spec Section TS 021 for measurement and payment details related to individual bid items.
  - H. Service taps, lateral, and valve box are shown for every property adjacent to the project. The County has estimated that approximately 200 full connections will be made (as indicated in the Unit Price table in Form of Proposal), which includes grinder pump assembly, electrical, and all work to connect existing residence to proposed low pressure.
  - I. Where existing private wells were noted during design, the low pressure has been shown on the plans to be constructed a minimum of 25' from the existing well.
  - J. Brunswick County Approved Products List is included in Bidding Documents.
  - K. Brunswick County standard details and specifications are being utilized on this project.
  - L. Note bid alternates as described in the Bid Documents and described on G-005:
    - i. Alternate Bid No. 1 – Low Pressure Line Group A
    - ii. Alternate Bid No. 2 – Low Pressure Line Group B
    - iii. Alternate Bid No. 3 – Low Pressure Line Group C
  - M. Subsurface Geotechnical reports included in Bidding Documents.
  - N. Site visit: Linework portions of the project are in the road right-of-way and are accessible. For a site visit of the Waccamaw School Site, please coordinate through Bobby Sweat, (910) 253-1825.
4. Submit any questions to [matthew.jones@mcgillassociates.com](mailto:matthew.jones@mcgillassociates.com). **The deadline for bidder questions and/or clarification will be on Thursday, April 24th at 5:00 p.m.**

Longwood Road Sewer  
Pre-Bid Meeting MINUTES  
Page 4 of 4

5. Questions and Answers

- A. How will material price increases due to potential tariffs be handled?
  - i. The County will respond to this question via separate addendum.
- B. Is there an engineer's estimate for the project?
  - i. Approximately \$20,000,000.

**ADDENDUM NUMBER TWO  
LONGWOOD ROAD SEWER PROJECT  
DWI PROJECT NO. SRP-W-ARP-0297  
BRUNSWICK COUNTY PUBLIC UTILITIES  
BRUNSWICK COUNTY, NORTH CAROLINA**

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This Addendum Number Two is issued this 29th day of April 2025, to all parties who hold a set of Bid Documents for the project entitled "LONGWOOD ROAD SEWER PROJECT, DWI PROJECT NO. SRP-W-ARP-0297." This Addendum Number Two shall become part of the Contract Documents, and its receipt acknowledged on the Bid Documents at the time of bidding.

The following changes and clarifications shall be made to the Contract Documents:

**General**

1. **BID DATE CHANGE:** Sealed bids will be received at the Brunswick County Public Utilities Operations Center, located at 250 Grey Water Road NE, Supply, North Carolina, until **2:00 p.m. on May 13, 2025**, and will then be publicly opened and read aloud. Bidder inquiries will be received until 5:00 p.m. on May 6, 2025.
2. In accordance with the prequalification requirements contained in the Bidding Documents, the following brand has been prequalified for this project for the item specified, in addition to the brands already included in the Approved Products List within the Bidding Documents:
  - a. Submersible Solids-handling Sewer Pumps: KSB

**Form of Proposal**

1. Clarification: The unit price schedule on page F-5 requires the Bidder to provide indicated pricing for items that shall be included in the lump sum Base Bid. These unit prices will be utilized as needed to revise the contract amount based on actual installed quantities during construction.
2. Pay Item No. 17 has been added to the unit price schedule. Page F-5 has been updated accordingly and is attached to this addendum. Bidders shall utilize this revised page with the bid submittal.

**Plans**

1. Sheet C-118 – The two extra service taps shown off of the service lateral for 2067 Longwood Road are shown incorrectly, only one service lateral and box should be installed for each property in the project.

2. Sheet C-132: Plan notes on this sheet that call for a 4" ARV, 4" plug valve, and 4" horizontal directional drill should read 6" for all, rather than 4".
3. Sheet C-133: The 12" and 6" plug valves are correctly shown on both plan and profile but are only labeled on the profile view.
4. Sheet C-102: A 12" plug valve and cleanouts has been added to the north side of the bore of Whiteville Road. This sheet is re-issued with this addendum.
5. Sheets C-144 and C-145: Service lateral and valve boxes were not previously shown to all properties on Robin Circle. All properties throughout the project, regardless of existing residence or not, shall receive a service lateral connected to the proposed low pressure line and a valve box installed inside of the ROW, according to the detail shown on sheet C-506 and notes on sheet G-003. For clarification, Sheets C-144 and C-145 are being re-issued to show the proposed service boxes intended for the properties on Robin Circle.
6. Sheet C-145: The plug valve at Sta. 26+00 should be a 2.5" valve. Following the two bends on this sheet, the proposed line reduces from 2.5" PVC to 2." PVC. Sheet C-145 is re-issued with this addendum.

### **Specifications**

1. Section TS-021, Under section 1.1, add the following as (g): Low Pressure Service Tap, Lateral, and Valve Box (Pay Item No. 17) – This line item shall be paid on a unit cost (each/EA) basis. The quantity in the bid documents is an estimated quantity. The Contractor shall be paid for the actual number of service taps, laterals, and valve boxes installed complete per unit price at bid. The unit price shall include all costs for service tap, service lateral piping by bore or open cut, and valve box installed inside of right-of-way according to drawings and details.

### **Questions**

1. What method should be used for septic tank abandonment?  
RESPONSE: The scope for this item is described in specification section TS-021, section 1.1 (f).
2. Is the Contractor responsible for installing grinder pumps for service connections?  
RESPONSE: Per Project Specific Note 3 on sheet G-003, the project includes full sewer service connection to certain properties. A quantity of 200 grinder pump connections is estimated and included in the unit price schedule within the Form of Proposal. Actual installed quantity may vary based on sign-ups, and therefore a unit price is requested for this and associated work items. A full list of addresses to receive full sewer connection will be provided to the Contractor prior to construction.
3. With regards the grinder station electrical services/hookups – if the electrical service/existing panel or service must be brought up to current electrical code, how is that to be handled or is the assumption that all houses are up to code?

RESPONSE: The Contractor is not responsible for bringing existing houses up to code. Pay Item No. 10 is provided in the event that the existing house electrical panel does not have space to add the grinder service. The scope for this item is described in specification section TS-021, section 1.1 (d).

4. Confirm that the SCADA/RTU is just a marshalling/termination point with no active components? If otherwise, please advise.

RESPONSE: SCADA/RTU will control the pumps at the pump station.

5. Is it the control panel supplier's responsibility for programming of the PLC and touchscreen in the RTU/PUMP Control Panel or will BCPU be responsible for programming?

RESPONSE: BCPU will be responsible for programming the PLC and the touchscreen.

6. Is it the control panel supplier responsibility to program and/or configure the radio in the RTU/PUMP Control Panel or will BCPU configure the radio?

RESPONSE: BCPU will be responsible for programming the radio.

7. Is seeding acceptable in ROWs/easements/public areas? Seeding is specifically mentioned in lawns/private areas but it is unclear whether that is acceptable for the ROWs, etc.

RESPONSE: Yes, seeding is allowed. All disturbed areas shall be repaired to equal or better condition than original site.

8. If clearing is needed in any capacity for this project, is clearing and mulching acceptable?

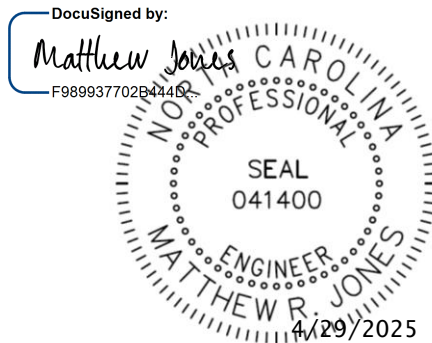
RESPONSE: Clearing and grubbing wastes shall be removed from site and property disposed of by Contractor at his expense.

This Addendum Number Two is issued this 29th day of April 2025.

**Matthew R. Jones, P.E.**



**712 Village Rd SW, Suite 103  
Shallotte, North Carolina 28470**



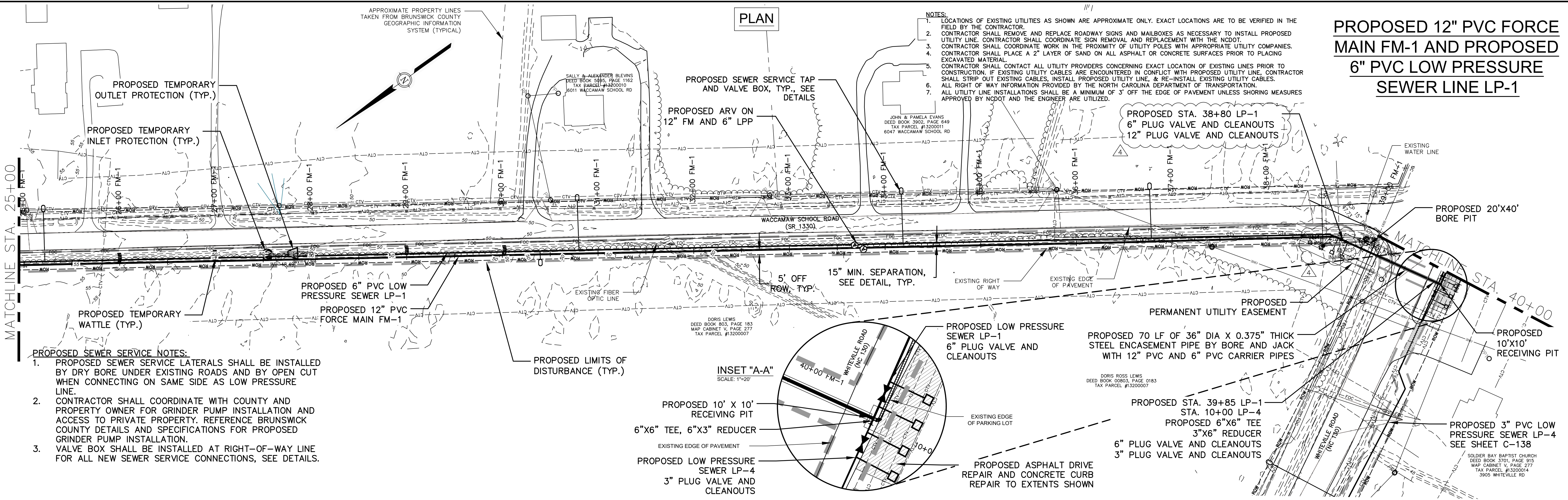
UNIT PRICES – SINGLE PRIME

**NOTE TO CONTRACTOR:**

All items included below shall be included in the lump sum Base Bid. These unit prices will be utilized as needed to revise quantities during construction.

Pay Item	Spec. Section	Pay Item Description	Unit	Estimated Quantity	Unit Price
1	GC 30	Testing Allowance (soils, geotechnical testing)	LS	1	\$ 40,000.00
2	TS 022	12” FM from South Russtown Rd to Connection at US-17 <sup>1</sup>	LS	1	
3	TS 013	Removal of Unsuitable Soil (as directed by Engineer)	CY	500	
4	TS 013	Additional Stone (as directed by Engineer)	TN	700	
5	TS 013	Select Backfill (as directed by Engineer)	CY	1,000	
6	TS 014	Removal and Disposal of Contaminated Soil	CY	200	
7	TS 021	Grinder Package Install	EA	200	
8	TS 021	Grinder Electrical Connection (to the building/house)	EA	200	
9	TS 021	Additional Electrical wiring between grinder panel and structure panel	LF	100	
10	TS 021	Supplemental structure electrical panel	EA	10	
11	TS 021	Septic Disconnection & Grinder Tank Connection to building drain	EA	200	
12	TS 021	Septic Tank Abandonment	EA	200	
13	TS 021	Petroleum Resistant Pipe Gaskets	EA	10	
14	TS 021	CTS/HDPE pipe	LF	400	
15	TS 016	Concrete Driveway Repair / Removal and Replacement	LF	600	
16	TS 017	Asphalt Removal and Replacement	LF	600	
17	TS 021	Low Pressure Service Tap, Lateral, and Valve Box	EA	760	

<sup>1</sup>Note: The full length of force main is intended to be installed with this project. Scope for pricing this item shall include 12” force main and appurtenances from South Russtown Road up to and including the completed connection with existing Brunswick County force main.

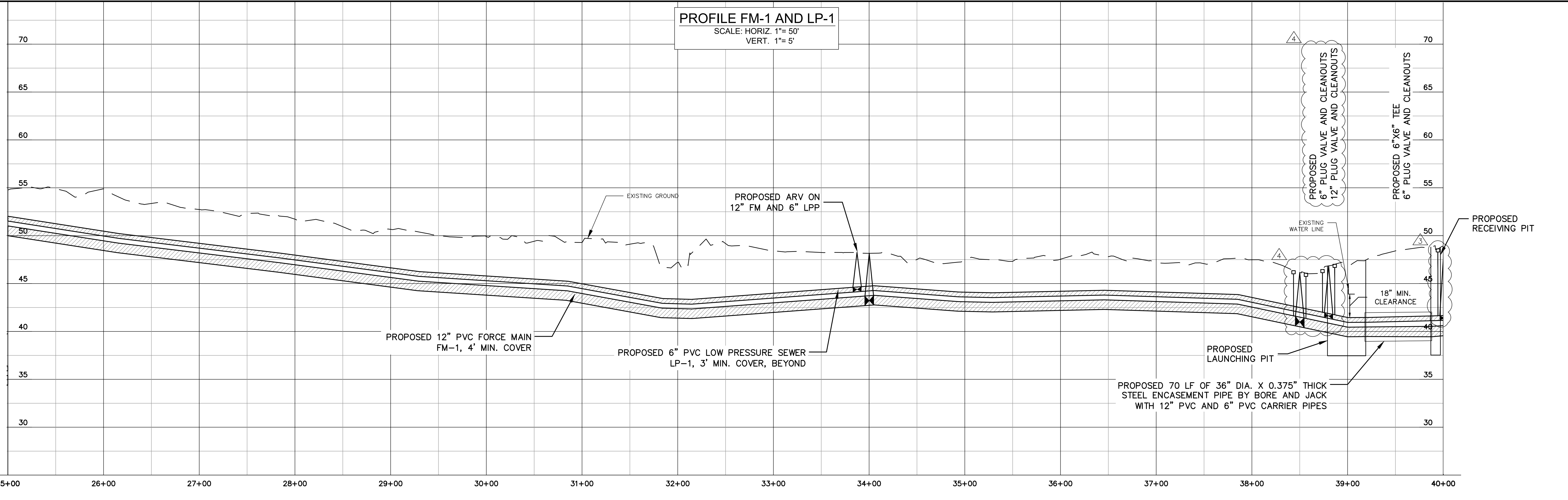


**PROPOSED 12" PVC FORCE MAIN FM-1 AND PROPOSED 6" PVC LOW PRESSURE SEWER LINE LP-1**

- NOTES:**
1. LOCATIONS OF EXISTING UTILITIES AS SHOWN ARE APPROXIMATE ONLY. EXACT LOCATIONS ARE TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR.
  2. CONTRACTOR SHALL REMOVE AND REPLACE ROADWAY SIGNS AND MAILBOXES AS NECESSARY TO INSTALL PROPOSED UTILITY LINE. CONTRACTOR SHALL COORDINATE SIGN REMOVAL AND REPLACEMENT WITH THE NCDOT.
  3. CONTRACTOR SHALL COORDINATE WORK IN THE PROXIMITY OF UTILITY POLES WITH APPROPRIATE UTILITY COMPANIES.
  4. CONTRACTOR SHALL PLACE A 2" LAYER OF SAND ON ALL ASPHALT OR CONCRETE SURFACES PRIOR TO PLACING EXCAVATED MATERIAL.
  5. CONTRACTOR SHALL CONTACT ALL UTILITY PROVIDERS CONCERNING EXACT LOCATION OF EXISTING LINES PRIOR TO CONSTRUCTION. IF EXISTING UTILITY CABLES ARE ENCOUNTERED IN CONFLICT WITH PROPOSED UTILITY LINE, CONTRACTOR SHALL STRIP OUT EXISTING CABLES, INSTALL PROPOSED UTILITY LINE, & RE-INSTALL EXISTING UTILITY CABLES.
  6. ALL RIGHT OF WAY INFORMATION PROVIDED BY THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION.
  7. ALL UTILITY LINE INSTALLATIONS SHALL BE A MINIMUM OF 3' OFF THE EDGE OF PAVEMENT UNLESS SHORING MEASURES APPROVED BY NCDOT AND THE ENGINEER ARE UTILIZED.

- PROPOSED SEWER SERVICE NOTES:**
1. PROPOSED SEWER SERVICE LATERALS SHALL BE INSTALLED BY DRY BORE UNDER EXISTING ROADS AND BY OPEN CUT WHEN CONNECTING ON SAME SIDE AS LOW PRESSURE LINE.
  2. CONTRACTOR SHALL COORDINATE WITH COUNTY AND PROPERTY OWNER FOR GRINDER PUMP INSTALLATION AND ACCESS TO PRIVATE PROPERTY. REFERENCE BRUNSWICK COUNTY DETAILS AND SPECIFICATIONS FOR PROPOSED GRINDER PUMP INSTALLATION.
  3. VALVE BOX SHALL BE INSTALLED AT RIGHT-OF-WAY LINE FOR ALL NEW SEWER SERVICE CONNECTIONS, SEE DETAILS.

**PROFILE FM-1 AND LP-1**  
SCALE: HORIZ. 1" = 50'  
VERT. 1" = 5'



P:\2023\23.07095-BRUNSWICK-COUNTY-PUBLIC UTILITIES-PLAN AND PROFILE FM-1 AND LP-1 STA. 25+00 TO STA. 40+00

712 Village Road SW  
Suite 103  
Shallotte, NC 28470  
910.755.5872  
NC Firm License # C-0459  
mcgillassociates.com

Designed by:  
*Matthew Jones*  
Professional Engineer  
SEAL 041400  
MATTIE W. R. JONES  
4/29/2025

CALL IT BEFORE YOU DIG  
SAFE DIGGING PARTNER

NO.	DATE	BY	DESCRIPTION
4	04/29/25	MRJ	ADDENDUM 2 REVISIONS
3	01/21/25	MRJ	FINAL DESIGN REVISIONS

LONGWOOD ROAD SEWER PROJECT  
SRP-W-ARP-0297

**BRUNSWICK COUNTY PUBLIC UTILITIES**

BRUNSWICK COUNTY, NORTH CAROLINA

50 0 25 50 100  
GRAPHIC SCALE DIVISION VALUE = 50 FEET

OFFICE MANAGER	DESIGNER
M. NORTON	K. SCOTT
PROJECT MANAGER	REVIEWER
M. JONES	M. JONES

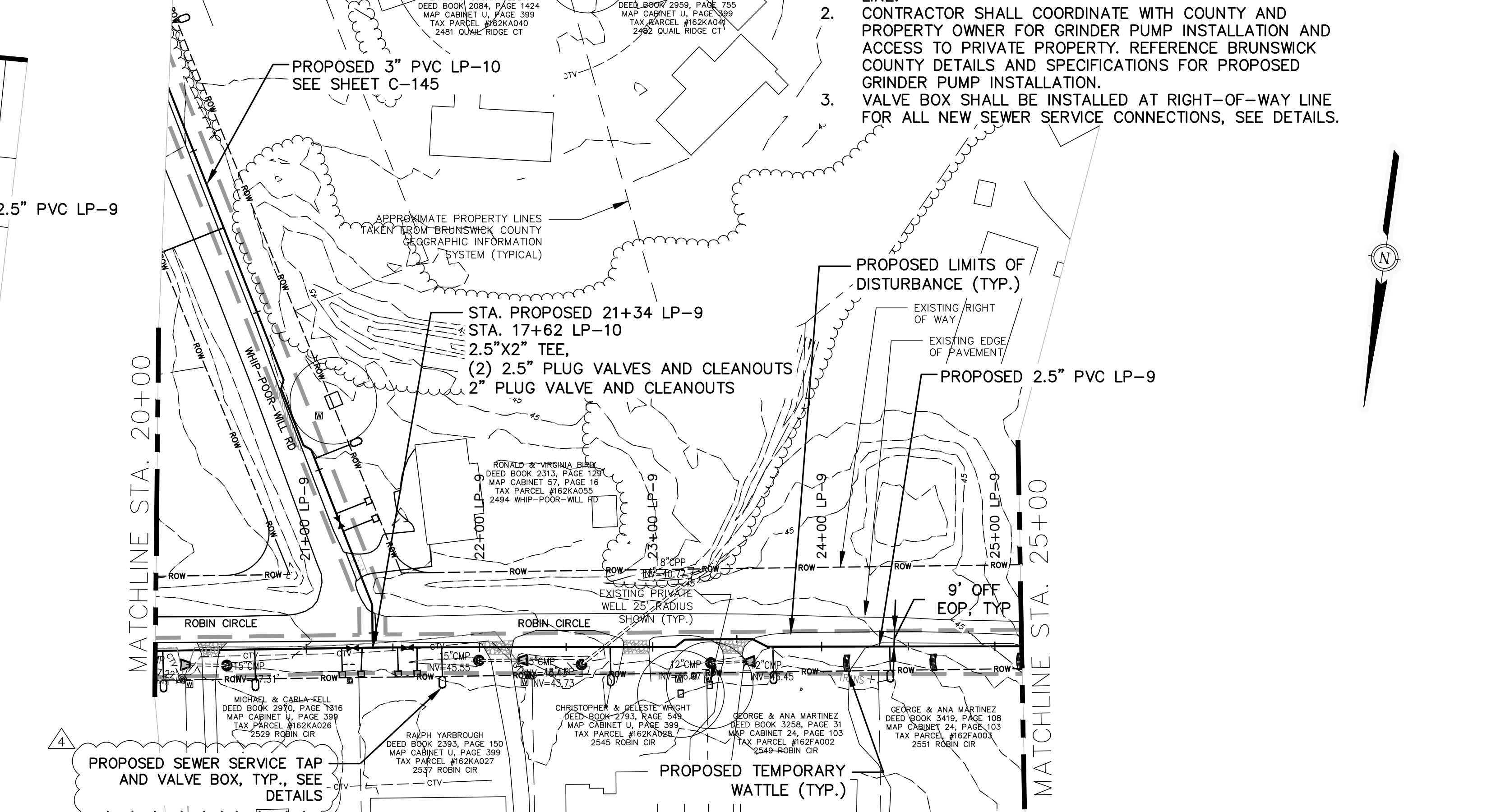
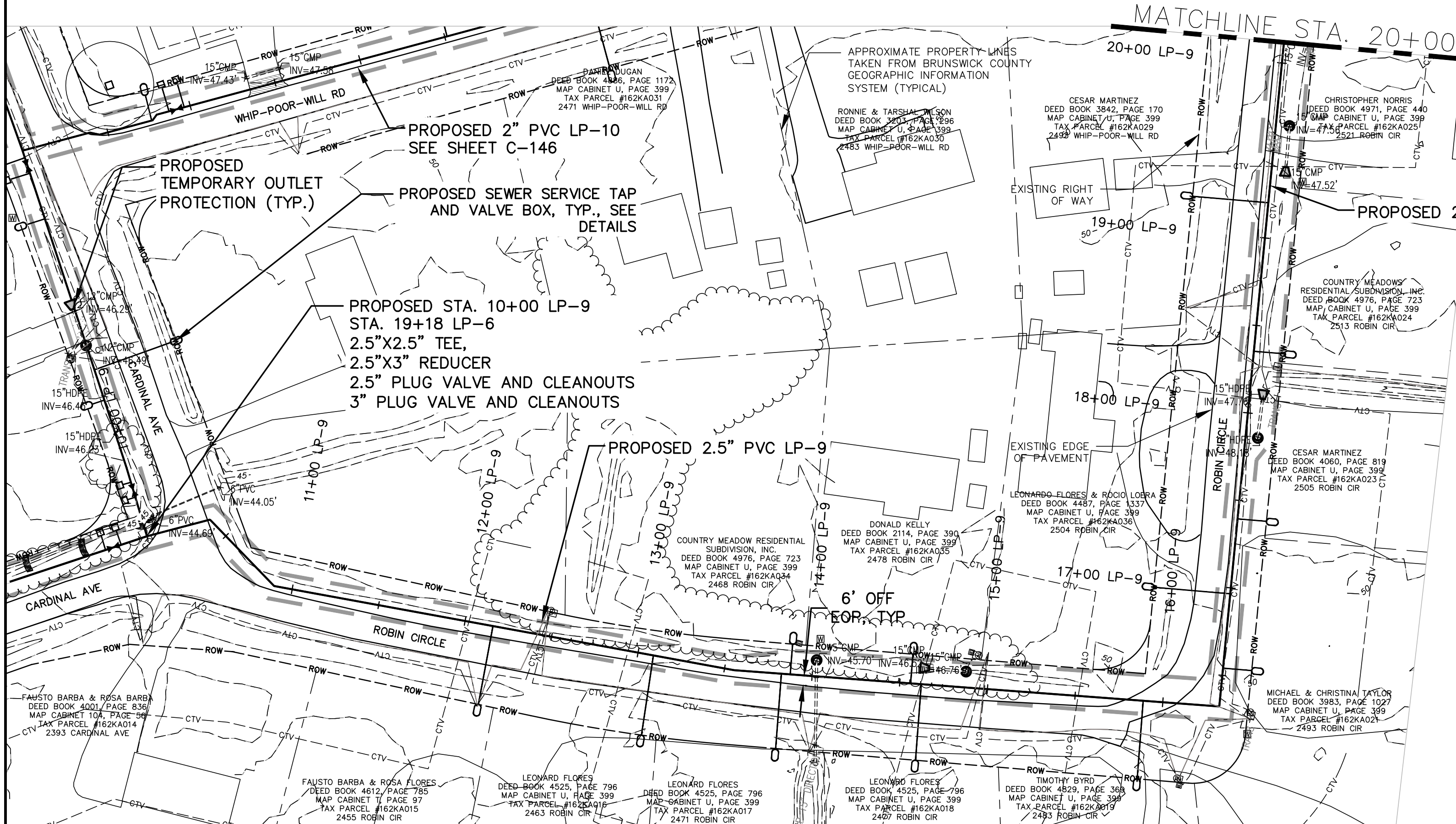
PLAN AND PROFILE FM-1 AND LP-1 STA. 25+00 TO STA. 40+00

DATE	PROJECT #	FUNDING #
OCT 2024	23.07095	SRP-W-ARP-0297

SHEET  
**C-102**

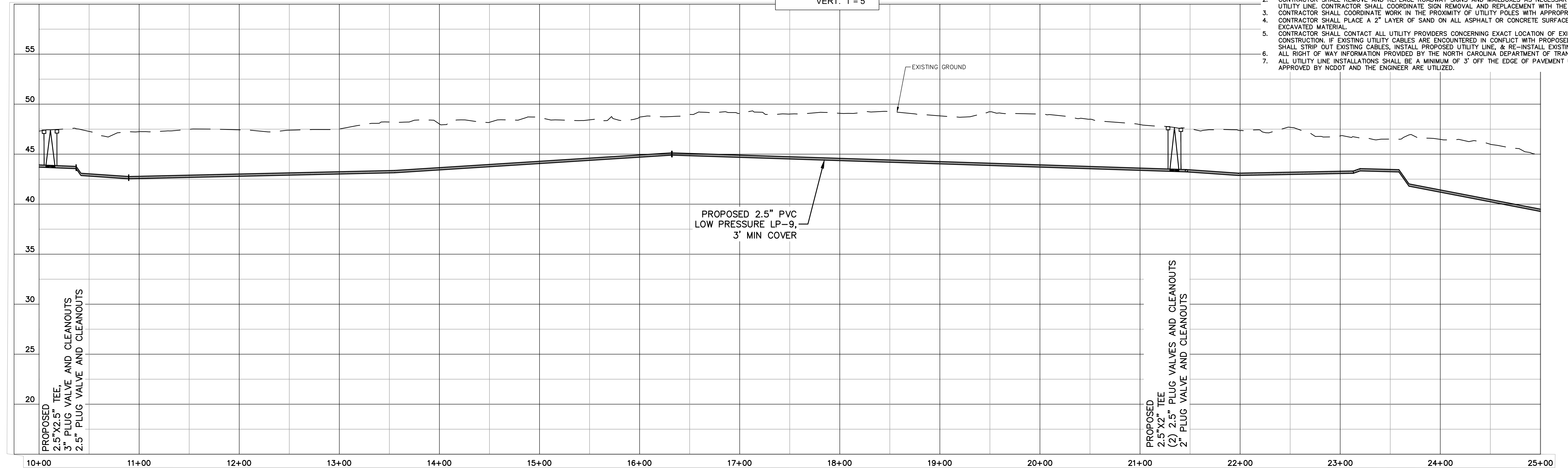
# PROPOSED 2.5" PVC LOW PRESSURE SEWER LINE LP-9

PLAN



- PROPOSED SEWER SERVICE NOTES:**
1. PROPOSED SEWER SERVICE LATERALS SHALL BE INSTALLED BY DRY BORE UNDER EXISTING ROADS AND BY OPEN CUT WHEN CONNECTING ON SAME SIDE AS LOW PRESSURE LINE.
  2. CONTRACTOR SHALL COORDINATE WITH COUNTY AND PROPERTY OWNER FOR GRINDER PUMP INSTALLATION AND ACCESS TO PRIVATE PROPERTY. REFERENCE BRUNSWICK COUNTY DETAILS AND SPECIFICATIONS FOR PROPOSED GRINDER PUMP INSTALLATION.
  3. VALVE BOX SHALL BE INSTALLED AT RIGHT-OF-WAY LINE FOR ALL NEW SEWER SERVICE CONNECTIONS, SEE DETAILS.

**PROFILE LP-9**  
SCALE: HORIZ. 1"= 50'  
VERT. 1"= 5'



- NOTES:**
1. LOCATIONS OF EXISTING UTILITIES AS SHOWN ARE APPROXIMATE ONLY. EXACT LOCATIONS ARE TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR.
  2. CONTRACTOR SHALL REMOVE AND REPLACE ROADWAY SIGNS AND MAILBOXES AS NECESSARY TO INSTALL PROPOSED UTILITY LINE. CONTRACTOR SHALL COORDINATE SIGN REMOVAL AND REPLACEMENT WITH THE NCDOT.
  3. CONTRACTOR SHALL COORDINATE WORK IN THE PROXIMITY OF UTILITY POLES WITH APPROPRIATE UTILITY COMPANIES.
  4. CONTRACTOR SHALL PLACE A 2" LAYER OF SAND ON ALL ASPHALT OR CONCRETE SURFACES PRIOR TO PLACING EXCAVATED MATERIAL.
  5. CONTRACTOR SHALL CONTACT ALL UTILITY PROVIDERS CONCERNING EXACT LOCATION OF EXISTING LINES PRIOR TO CONSTRUCTION. IF EXISTING UTILITY CABLES ARE ENCOUNTERED IN CONFLICT WITH PROPOSED UTILITY LINE, CONTRACTOR SHALL STRIP OUT EXISTING CABLES, INSTALL PROPOSED UTILITY LINE, & RE-INSTALL EXISTING UTILITY CABLES.
  6. ALL RIGHT OF WAY INFORMATION PROVIDED BY THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION.
  7. ALL UTILITY LINE INSTALLATIONS SHALL BE A MINIMUM OF 3' OFF THE EDGE OF PAVEMENT UNLESS SHORING MEASURES APPROVED BY NCDOT AND THE ENGINEER ARE UTILIZED.

P:\2023\23.07095-BRUNSWICK\LONGWOOD ROAD SEWER RE-DRAWING\SEWER\AREA\_E\_C196C144.DWG PLOT DATE: 4/29/2025 1:47 PM CLAY BORNHORST

712 Village Road SW  
Suite 103  
Shallotte, NC 28470  
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NC Firm License # C-0459  
mcgillassociates.com

Designed by:  
*Matthew Jones*  
Professional Engineer  
SEAL 041400  
MATTHEW R. JONES  
4/29/2025

CALL IT BEFORE YOU DIG  
SAFE DIGGING PARTNER

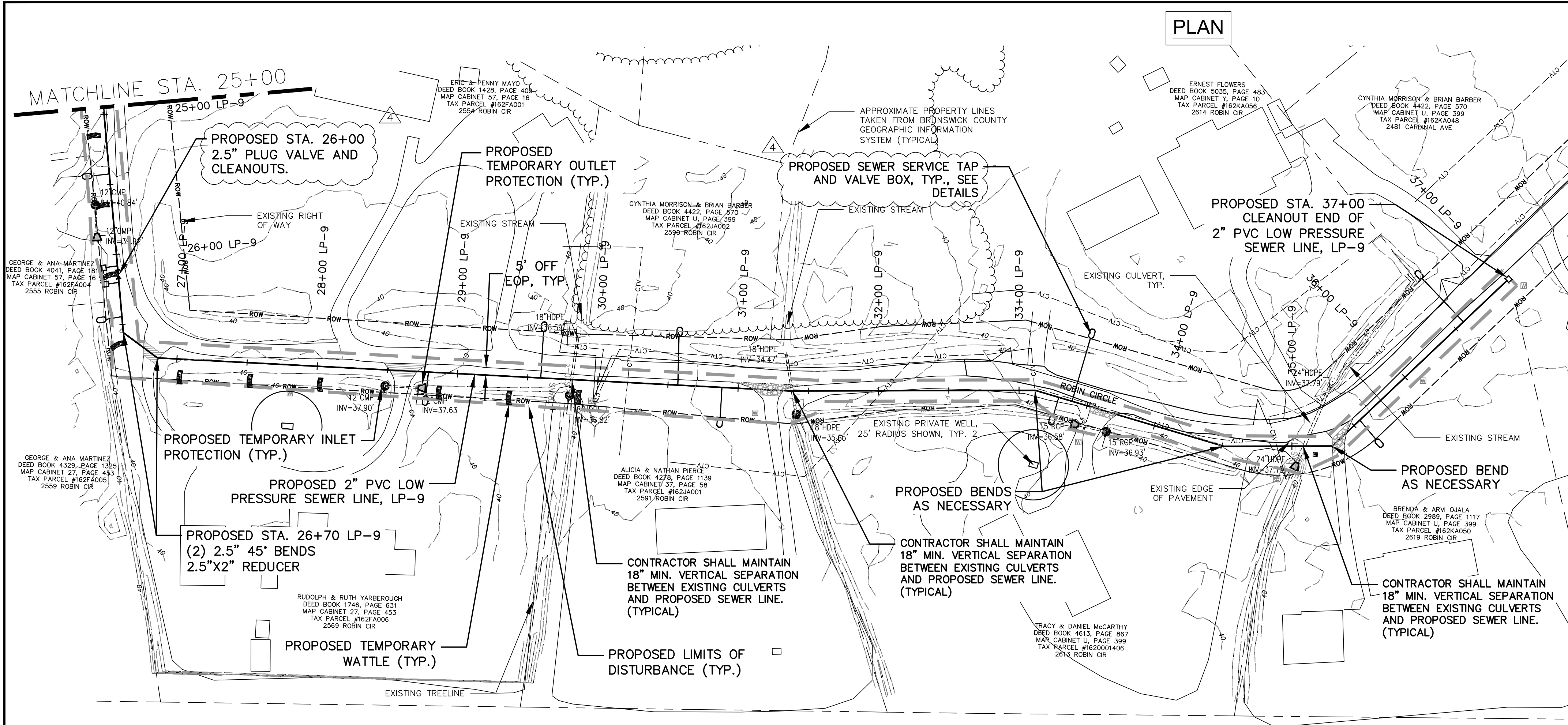
NO.	DATE	BY	DESCRIPTION
4	04/29/25	MRJ	ADDENDUM 2 REVISIONS

LONGWOOD ROAD SEWER PROJECT  
SRP-W-ARP-0297  
**BRUNSWICK COUNTY PUBLIC UTILITIES**  
BRUNSWICK COUNTY, NORTH CAROLINA

OFFICE MANAGER M. NORTON	DESIGNER K. SCOTT
PROJECT MANAGER M. JONES	REVIEWER M. JONES

DATE OCT 2024	PROJECT # 23.07095	FUNDING # SRP-W-ARP-0297
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SHEET  
**C-144**

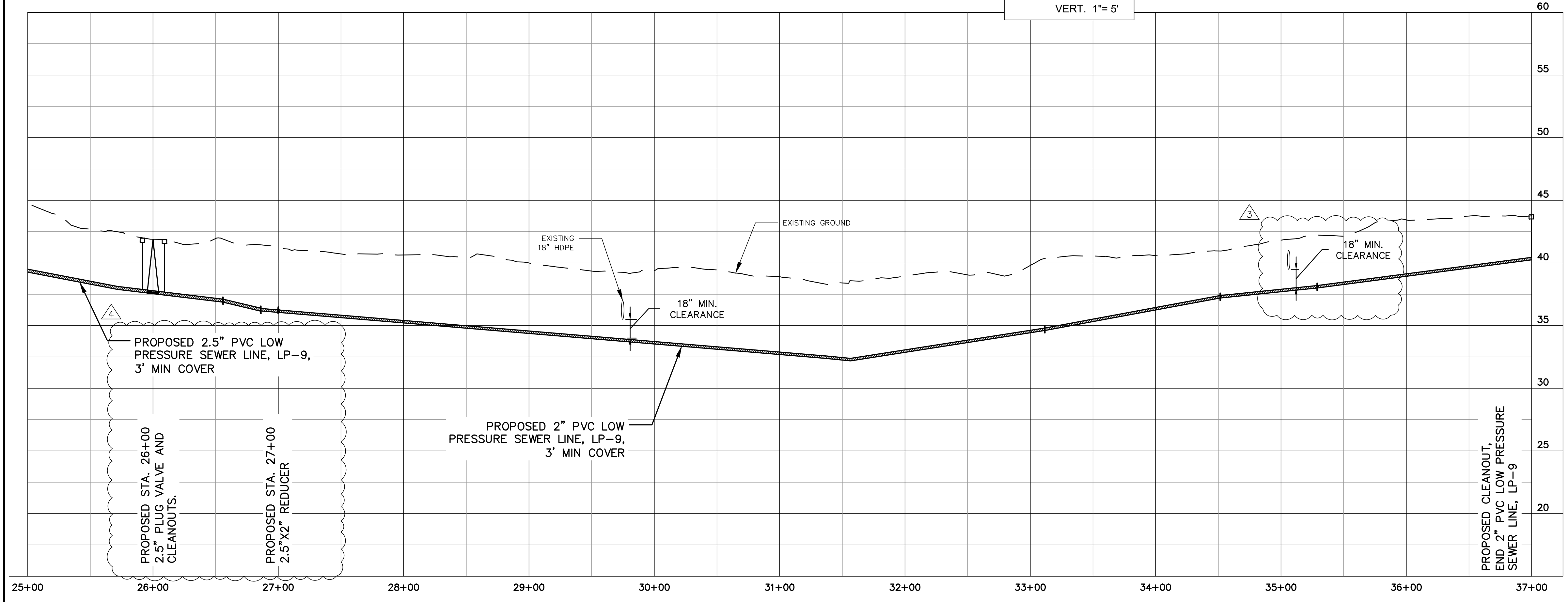


**PROPOSED 2.5" AND 2" PVC LOW PRESSURE SEWER LINE LP-9**

- NOTES:**
1. LOCATIONS OF EXISTING UTILITIES AS SHOWN ARE APPROXIMATE ONLY. EXACT LOCATIONS ARE TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR.
  2. CONTRACTOR SHALL REMOVE AND REPLACE ROADWAY SIGNS AND MAILBOXES AS NECESSARY TO INSTALL PROPOSED UTILITY LINE. CONTRACTOR SHALL COORDINATE SIGN REMOVAL AND REPLACEMENT WITH THE NCDOT.
  3. CONTRACTOR SHALL COORDINATE WORK IN THE PROXIMITY OF UTILITY POLES WITH APPROPRIATE UTILITY COMPANIES.
  4. CONTRACTOR SHALL PLACE A 2" LAYER OF SAND ON ALL ASPHALT OR CONCRETE SURFACES PRIOR TO PLACING EXCAVATED MATERIAL.
  5. CONTRACTOR SHALL CONTACT ALL UTILITY PROVIDERS CONCERNING EXACT LOCATION OF EXISTING LINES PRIOR TO CONSTRUCTION. IF EXISTING UTILITY CABLES ARE ENCOUNTERED IN CONFLICT WITH PROPOSED UTILITY LINE, CONTRACTOR SHALL STRIP OUT EXISTING CABLES, INSTALL PROPOSED UTILITY LINE, & RE-INSTALL EXISTING UTILITY CABLES.
  6. ALL RIGHT OF WAY INFORMATION PROVIDED BY THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION.
  7. ALL UTILITY LINE INSTALLATIONS SHALL BE A MINIMUM OF 3' OFF THE EDGE OF PAVEMENT UNLESS SHORING MEASURES APPROVED BY NCDOT AND THE ENGINEER ARE UTILIZED.

- PROPOSED SEWER SERVICE NOTES:**
1. PROPOSED SEWER SERVICE LATERALS SHALL BE INSTALLED BY DRY BORE UNDER EXISTING ROADS AND BY OPEN CUT WHEN CONNECTING ON SAME SIDE AS LOW PRESSURE LINE.
  2. CONTRACTOR SHALL COORDINATE WITH COUNTY AND PROPERTY OWNER FOR GRINDER PUMP INSTALLATION AND ACCESS TO PRIVATE PROPERTY. REFERENCE BRUNSWICK COUNTY DETAILS AND SPECIFICATIONS FOR PROPOSED GRINDER PUMP INSTALLATION.
  3. VALVE BOX SHALL BE INSTALLED AT RIGHT-OF-WAY LINE FOR ALL NEW SEWER SERVICE CONNECTIONS, SEE DETAILS.

**PROFILE LP-9**  
SCALE: HORIZ. 1"= 50'  
VERT. 1"= 5'



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DocuSigned by:  
*Matthew R. Jones*  
Professional Engineer  
SEAL 041400  
MATTIE W. R. JONES  
4/29/2025

CALL 811 BEFORE YOU DIG  
SAFE DIGGING PARTNER

NO.	DATE	BY	DESCRIPTION
4	04/29/25	MRJ	ADDENDUM 2 REVISIONS
3	01/21/25	MRJ	FINAL DESIGN REVISIONS

LONGWOOD ROAD SEWER PROJECT  
SRP-W-ARP-0297  
**BRUNSWICK COUNTY PUBLIC UTILITIES**  
BRUNSWICK COUNTY, NORTH CAROLINA

50 0 25 50 100 GRAPHIC SCALE DIVISION VALUE = 50 FEET	
OFFICE MANAGER M. NORTON	DESIGNER K. SCOTT
PROJECT MANAGER M. JONES	REVIEWER M. JONES

PLAN AND PROFILE LP-9 STA. 25+00 TO 37+00		
DATE OCT 2024	PROJECT # 23.07095	FUNDING # SRP-W-ARP-0297

SHEET  
**C-145**

**ADDENDUM NUMBER THREE  
LONGWOOD ROAD SEWER PROJECT  
DWI PROJECT NO. SRP-W-ARP-0297  
BRUNSWICK COUNTY PUBLIC UTILITIES  
BRUNSWICK COUNTY, NORTH CAROLINA**

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This Addendum Number Three is issued this 9th day of May 2025, to all parties who hold a set of Bid Documents for the project entitled "LONGWOOD ROAD SEWER PROJECT, DWI PROJECT NO. SRP-W-ARP-0297." This Addendum Number Three shall become part of the Contract Documents, and its receipt acknowledged on the Bid Documents at the time of bidding.

The following changes and clarifications shall be made to the Contract Documents:

**General**

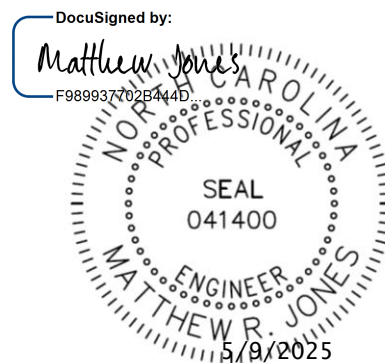
1. **BID DATE CHANGE:** Sealed bids will be received at the Brunswick County Public Utilities Operations Center, located at 250 Grey Water Road NE, Supply, North Carolina, until **2:00 p.m. on May 16, 2025**, and will then be publicly opened and read aloud.

This Addendum Number Three is issued this 9th day of May 2025.

**Matthew R. Jones, P.E.**



**712 Village Rd SW, Suite 103  
Shallotte, North Carolina 28470**



**ADDENDUM NUMBER FOUR  
LONGWOOD ROAD SEWER PROJECT  
DWI PROJECT NO. SRP-W-ARP-0297  
BRUNSWICK COUNTY PUBLIC UTILITIES  
BRUNSWICK COUNTY, NORTH CAROLINA**

---

This Addendum Number Four is issued this 13th day of May 2025, to all parties who hold a set of Bid Documents for the project entitled “LONGWOOD ROAD SEWER PROJECT, DWI PROJECT NO. SRP-W-ARP-0297.” This Addendum Number Four shall become part of the Contract Documents, and its receipt acknowledged on the Bid Documents at the time of bidding.

The following changes and clarifications shall be made to the Contract Documents:

**General**

1. **BID DATE REMINDER:** Sealed bids will be received at the Brunswick County Public Utilities Operations Center, located at 250 Grey Water Road NE, Supply, North Carolina, until **2:00 p.m. on May 16, 2025**, and will then be publicly opened and read aloud.
2. **Clarification:** In the event that tariffs are imposed after the bids are received or the contract has been executed, the Contractor shall maintain detailed records substantiating any cost increases directly attributable to such tariffs. Any claims for additional compensation due to tariff-related cost increases must be submitted in writing to the County for review and consideration in accordance with the Contract’s change order provisions. The Contractor shall keep records of increased pricing after the contract is signed that are due to tariffs and submit any claims to the County for review.

**Form of Proposal**

1. **Clarification:** Unit price Pay Item #2 (12” Force Main from Russtown Road to Connection at US-17) shall be prioritized in the Construction Sequence such that the force main from Russtown Road to US-17 is installed, tested, certified and ready to be put into service within 9 months of the Notice to Proceed date.

**Plans**

1. Sheet C-129: A 12-inch plug valve and cleanouts shall be added to alignment FM-1 at approximately Sta. 441+00 FM-1.
2. Sheet E-201: General Note 1 is replaced with the following: Refer to Specification Section 133400 for interior and exterior finishes for precast electrical building.

## **Specifications**

1. Section TS-023, section 4.0, part c.1, Remove vendors currently listed under d) and e), and replace with d) Piedmont Automation, Inc. and e) Industrial Control Panels, Inc.
2. The following Supplemental Specification Sections that pertain to the Waccamaw Lift Station are hereby incorporated into the Bidding Documents, as attached to this Addendum:
  - a. 133400 Precast Concrete Structures
  - b. 230000 Mechanical General Requirements
  - c. 230001 Closeout Documentation and Procedures
  - d. 230503 Electrical Requirements of Mechanical Systems
  - e. 230548 Seismic Restraints and Wind Restraints
  - f. 238113.13 Packaged Terminal Air Conditioners, Outdoor, Wall-Mounted Units
  - g. 260523 Control-Voltage Electrical Power Cables
  - h. 260529 Hangers and Supports for Electrical Systems
  - i. 260533 Raceways and Boxes for Electrical Systems
  - j. 260548.16 Seismic Controls for Electrical Systems
  - k. 262213 Low-Voltage Distribution Transformers
  - l. 262416 Panelboards
  - m. 262816 Enclosed Switches and Circuit Breakers
  - n. 265119 LED Interior Lighting
  - o. 265619 LED Exterior Lighting

## **Questions**

1. Is the odor control unit required at the proposed lift station?  
RESPONSE: Yes, it is required. Note 16 on sheet C-516 describes the odor control unit requirements.
2. Is builder's risk and/or pollution insurance required by the Owner?  
RESPONSE: Yes, builder's risk insurance is required, as described in Article 57, Section B.1 of the General Conditions. Pollution Liability insurance is required, as stated on page F-17 under "Brunswick County Minimum Insurance Coverage Requirements."
3. Are the low-pressure sewer services connected to the 200 grinder pumps included in the 760 services, laterals, and valve boxes for bid item #17?  
RESPONSE: Yes. Of the 760 service laterals included in Pay Item 17, the estimate is that 200 of those will be fully connected as covered under the Grinder Package Pay Item 7.
4. Please clarify the diameter for the ARV manholes.  
RESPONSE: See sheet C-509 for details: Air Release Valve boxes for NCDOT ROW shall be 2'x3'x4', reference detail WS-1. Air Release Valve manholes for non-NCDOT ROW shall be 5-ft precast manhole.

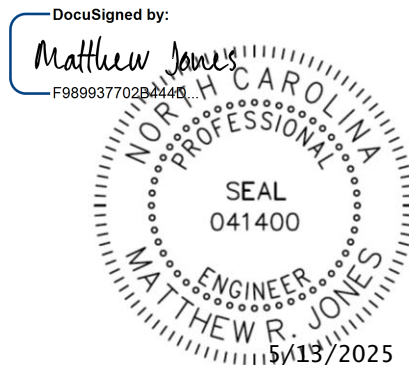
5. Bid item #17 describes a valve box but the detail shows an 18"x30" meter box possible as well. Do we need primarily valve or meter boxes for the services?  
RESPONSE: The 18"x30" rectangular cast iron valve box, as shown and described on detail S-12 on sheet C-506, is the only box required at the right-of-way for service connections on this project. Pay Item 17 includes everything up to and including the shut-off valve.
6. Is testing for the low pressure main pipeline required before making low pressure main service connections?  
RESPONSE: Pressure testing on low pressure lines may be performed prior to installation of service taps
7. What building type is preferred for the electrical building at the pump station?  
RESPONSE: The electrical building shall be a precast structure with brick veneer exterior and concrete interior walls. Reference specifications added to Bidding Documents with this Addendum for requirements associated with the Waccamaw Lift Station.
8. If Pay Item #11 requires existing plumbing to be changed and rerouted from under house (i.e. from out front to out back, or from back to out front), will this be a change?  
RESPONSE: Because existing houses currently connect to septic tanks by gravity, it is not anticipated that rerouting of sewer will be needed from the tie-in point to the proposed grinder pump locations. Should this be necessary during construction, Contractor shall contact County and Engineer for review as needed. For clarification, Pay Item 11 shall include up to 10 LF of gravity piping needed for connection from existing sewer to proposed grinder pump between existing house and septic tank.

This Addendum Number Four is issued this 13th day of May 2025.

**Matthew R. Jones, P.E.**



**712 Village Rd SW, Suite 103  
Shallotte, North Carolina 28470**



# **SECTION 133400                    FABRICATED PRE-ENGINEERED PRECAST** **CONCRETE STRUCTURES**

## **PART 1 – GENERAL**

### **1.1 WORK INCLUDED**

Contractor shall furnish a precast concrete transportable building to be delivered and placed on owner-prepared crushed stone foundation in accordance with manufacturer's recommendations. Building shall be provided by manufacturer with all necessary openings as specified by contractor in conformance with manufacturer's structural requirements.

### **1.2 REFERENCES**

- A. ACI-318-11: Building Code Requirements for Structural Concrete and Commentary
- B. ASCE/SEI 7-10: Minimum Design Loads for Buildings and Other Structures
- C. IBC 2012: International Building Code
- D. PCI Design Handbook, 7th Edition
- E. Concrete Reinforcing Institute, Manual of Standard Practice
- F. UL-752 (Test Method level 5) for bullet resistance certified by a military approved laboratory.

### **1.3 BUILDING DESCRIPTION**

#### **DESIGN REQUIREMENTS**

#### **A. Building Dimensions:**

Exterior: 13' x 18' x 8'-8"

Interior: 12'-6" x 17'-6" x 8'-0"

#### **CASE 2: Heavy**

#### **B. Design Loads:**

1. Seismic Design Category 'D', Risk Design Category III

2. Roof Live Load (Snow) – 30 PSF
  3. Floor Live Load – 250 PSF
  4. Wind Loading\* – 165 MPH
- C. Roof: Roof panel shall have a peak in the center of 12-foot direction and shall slope  $\frac{1}{2}$ " to each side. The roof shall extend a minimum of 2  $\frac{1}{2}$ " beyond the wall panel on each side and have a turndown design which extends  $\frac{1}{2}$ " below the top edge of the wall panels to prevent water migration into the building along top of wall panels. Roof shall also have an integral architectural ribbed edge.
- D. Roof, floor, and wall panels must each be produced as single component monolithic panels. No roof, floor, or vertical wall joints will be allowed, except at corners and along perimeter. Wall panels shall be set on top of floor panel.
- E. Floor panel must have  $\frac{1}{2}$ " step-down around the entire perimeter to prevent water migration into the building along the bottom of wall panels.

#### **1.4 SUBMITTALS**

- A. Engineering calculations that are designed and sealed by a professional engineer, licensed to practice in the state where the project is located, shall be submitted for approval.
- B. Manufacturers' product literature shall be provided for any plumbing, electrical, and miscellaneous installed fixtures demonstrating compliance with these specifications.

#### **1.5 QUALITY ASSURANCE**

- A. The precast concrete building producer shall be a plant-certified member of either the National Precast Concrete Association (NPCA), The Precast/Prestressed Concrete Institute (PCI), or equal.
- B. The precast concrete building producer shall demonstrate product knowledge and must have a minimum of 5 years experience manufacturing and setting precast concrete.

## **PART 2 – PRODUCTS**

### **2.1 MATERIALS**

- A. Concrete: Steel-reinforced, 5000 PSI minimum 28-day compressive strength, air-entrained (ASTM C260).
- B. Reinforcing Steel: ASTM A615, grade 60 unless otherwise specified.  
Welded Wire Fabric: ASTM 185, Grade 65
- C. Post-tensioning Strand: 41K Polystrand CP50, ½” 270 KSI Seven-Wire strand, enclosed within a greased plastic sheath (ASTM A416). Roof and floor each shall be post-tensioned by a proprietary, second generation design using a single, continuous tendon. Said tendon is placed in the concrete slab to form a perimeter loop starting from one corner of the slab to a point where the cable entered the slab. The tendon then turns 90 degrees and follows the cable member(s) in the periphery to a point midway along the “X” axis of the concrete building panel and then turns 90 degrees along the “Y” axis of the concrete building panel. This bisects the concrete building panel and crosses the opposite parallel portion of the cable member and exits from an adjacent side of the concrete building panel. This creates a cable pattern with no less than 2.5 parallel cables in any direction. To ensure a watertight design, no alternate methods shall be substituted for the post-tensioning.
- D. Sealant: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be DOW CORNING 790 silicone sealant or equal. Exterior caulk reveal to be 3/8”x 3/4” deep so that sides of the joint are parallel for proper caulk adhesion. Back of the joint to be taped with bond breaking tape to ensure adhesion of caulk to parallel sides of joint and not the back.
- E. Vents: Two screened aluminum vents to be cast in rear wall. Vents shall be SUNVENT INDUSTRIES Model FL-164 or equal.
- F. Panel Connections: All panels shall be securely fastened together with 3/8” thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A36 and hot dipped galvanized after fabrication. All fasteners to be ½” diameter bolts complying with ASTM A325 for carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior F-63 coil inserts, or equal. All inserts for corner connections must be secured directly to form before casting panels. No floating-in of connection inserts shall be allowed.

### **2.2 ACCESSORIES**

- A. Doors and Frames: Shall comply with Steel Door Institute “Recommended Specifications for Standard Steel Doors and Frames” (SDI-100) and as herein specified. All door and frame galvanizing shall be in accordance with ASTM A924 and A653, A60 minimum coating thickness.

1. The buildings shall be equipped with double 3'-0" x 6'-8" x 1-3/4" thick insulated, 18 gauge, metal doors with 16-gauge frames (to meet wall thickness). Doors to have flush top cap. 12 gauge flat astragals shall be applied to the active leaf to protect against the elements or forced opening. Doors and frames shall be factory bonderized and painted with one coat of rust inhibitive primer and one finish coat of enamel paint; color to be BOLT BROWN unless specified otherwise.
2. Doors and frames shall meet SDI standard Level 2, 1<sup>3</sup>/<sub>4</sub>" heavy duty.  
Approved manufacturers: Republic, Steelcraft, Ceco, Black Mountain, Pioneer, Curries, Mesker, MPI, Door components or equal

B. Door Hardware:

1. Pull Handle: Shall meet requirements of ANSI A156.2. Shall be thru bolt attached and constructed of a minimum <sup>3</sup>/<sub>4</sub>" diameter stainless pull handle sized 8" center to center with a stainless backer plate, minimum 0.053" on both sides.

Approved manufacturers: Design Hardware, Don-Jo, or equal

2. Hinges: Shall comply with ANSI A156.1 and be of the ball bearing, non-removable pin type (3 per door minimum). Hinges shall be 4 1/2" x 4 1/2" US26D (652) brushed chrome finish. Manufacturer shall provide a lifetime limited warranty.

Approved manufacturers: Design Hardware, or equal

3. Deadbolt: Commercial Grade Deadbolt conforming to ANSI 156.5 furnished with a 2 1/4" face plate and a 1" projecting deadbolt with hardened steel pins. Dead bolts shall be UL and ADA approved. Finish shall be US26D (626) brushed chrome finish. Manufacturer shall provide a lifetime limited warranty.

Approved manufacturers: Design Hardware, Dorma, or equal

4. Surface Bolt: 8" Surface bolt UL listed. Finish US26D (626) brushed chrome finish. (2 per inactive leaf)

Approved manufacturers: Don-Jo, Design Hardware, or equal

6. Threshold: Bumper Seal type threshold with a maximum 1" rise to prevent water intrusion. Thresholds shall be approved for UL 10B suitable for use with fire doors rated up to three hours.

Approved manufacturers: National Guard Products or equal

7. Overhead Door Holder: Heavy duty surface mounted hold open device with hold open/stop angle of 85 to 110 degrees. Construction shall be stainless steel. Finish US32D (630) satin stainless steel finish.

Approved manufacturers: ABH, Rockwood, or equal

8. Drip Cap: Aluminum drip cap with minimum projection of 2 1/2" shall be furnished.

Approved Manufacturers: Design Hardware, National Guard Products, or equal

9. Door Stop: ANSI 156.16 approved wall mounted door stop with keeper constructed of a corrosion resistant cast brass material. Finish US26D (626) brushed chrome finish.

Approved manufacturers: Don-Jo, Rockwood, or equal

## **2.3 FINISHES**

- A. Interior of Building: Smooth form finish on all interior panel surfaces unless exterior finish is produced using a form liner, then smooth hand-troweled finish.
- B. Exterior of Building: Architectural precast concrete brick finish: Finish must be imprinted in top face of panel while in form using an open grid impression tool similar to EASI-BRICK®. Finished brick size shall be 2 3/8" x 7 5/8" with vertical steel float or light broom finish. Joints between each brick must be 3/8" wide x 3/8" deep. Back of joint shall be concave to simulate a hand-tooled joint. Each brick face shall be coated with the following water-based acrylic, water repellent penetrating concrete stain: 1) Canyon Tone stain by United Coatings, 2) Sherwin Williams (H&C concrete stain) or equal. Stain shall be applied per manufacturer's recommendation. Joints shall be kept substantially free of stain to maintain a gray concrete color. Stain color shall be BRICK RED unless specified otherwise.

## **PART 3 – EXECUTION**

### **3.1 SITE PREPARATION**

- A. Building shall be placed on a concrete slab, substrate below slab must have a vertical soil capacity of 1,500 pounds per square foot. Ensure bearing surface for building is flat and level. As required, place adequate material (stone or sand) to 1" above highest point of area where building will be placed and at least 1'-0" wide all around the building footprint. Retain stone or sand with a perimeter form to prevent the material from washing out. Provide a turned down reinforced concrete slab foundation design for this building with a stamp from a registered engineer in the State of North Carolina.
- B. Provide positive drainage for the fill, pad or slab as required.

### **3.2 SITE ACCESS**

Provide a level, unobstructed area large enough for a crane and a tractor-trailer to park adjacent to the pad. Crane must be able to place outriggers within 5'-0" of edge of pad; truck and crane must be able to get side by side under their own power. No overhead lines may be within 75' radius of center of pad. Firm roadbed with turns that allow 65' lowbed tractor-trailer must be provided directly to site. No building shall be placed closer than 2'-0" to an existing structure unless specifically permitted.

**PART 1 - GENERAL****1.1 DESCRIPTION OF WORK:**

- A. General: This section specifies several categories of provisions of mechanical work, including: 1) Certain adaptive expansions of requirements specified in Division 1, as uniquely applicable to mechanical work, 2) General performance requirements within the mechanical work as a whole and 3) General work to be performed as mechanical work, because of its close association with mechanical work. This section applies to all subsequent Division 23 sections.
- B. Heating, Ventilating, Air Conditioning and Refrigeration work shall include all material and labor to furnish and install all the HVAC systems as indicated on the M-series drawings and the mechanical specifications.
- C. Contractor - The person or organization awarded the contract for construction services. In the case of a construction project administered as a multiple-prime contract, the term shall be further defined as the Contractor holding a prime contract for Mechanical construction work. Any reference to "contractor" or "subcontractor" shall be superseded by the actual contractual arrangement used on the project.
- D. The term "Mechanical Contractor" is used interchangeably with the term "Contractor".
- E. All start-up and testing and balancing shall be complete. Coordination between the TAB and mechanical contractors will be mandatory and the responsibility of each.
- F. All bidders shall visit the site prior to submitting a bid. Any existing condition which should be obvious to an experienced bidder shall be deemed to be included in the bid. Failure of any bidder to visit the site shall not relieve them of this responsibility.

**1.2 QUALITY ASSURANCE:**

- A. Workers shall be thoroughly experienced and fully capable of installing assigned work. Work shall be in accordance with the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to Owner.
- B. Provide complete operational mechanical systems with facilities and services to requirements described, in accordance with applicable codes and statutes.
- C. Drawings are diagrammatic and approximately to scale. The contract documents establish scope, material and quality, and are not detailed installation instructions. The Contractor shall be responsible to prepare all necessary coordination and shop drawings to completely and correctly install systems and/or make field

modifications necessary resulting from a failure to do so, at no additional cost to the contract.

- D. Provide labor and materials required to install, test and place into operation the mechanical systems. Provide additional labor and materials for modifications required to correct job conflicts resulting from a failure to coordinate between trades, at no additional cost to contract.
- E. Certain terms such as "shall, provide, install, complete, start-up" are occasionally not used in some parts of these specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.
- F. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage prior to final inspections, the Contractor shall repair or replace damaged items as determined by the Architect or Engineer, at no cost to the Owner.
- G. Install all equipment and appurtenances in strict accordance with the manufacturer's requirements and recommendations.
- H. Working pressure of piping, fittings, valves, equipment and accessories in piping systems shall be of a pressure rating equal to or greater than the maximum working pressure of the system and/or the test pressure to which it will be subjected.
- I. All welders shall be certified by the Welding Bureau of the Mechanical Contractors Association of America for the appropriate service, and shall perform all welding in accordance with Welding Bureau's procedures and the ASA Code for pipe welding.

### **1.3 DEFINITIONS:**

- A. By other Trades: Shall mean by persons or parties who are not anticipated to be the contractor for this trade working together with the Prime Contractor. In this context the words "by other trades" shall not be interpreted to mean not included in the overall contract, unless specifically noted as not in contract (NIC).
- B. Concealed: Embedded in masonry or other construction, installed behind wall furring, above ceilings, in crawl spaces, in shafts or otherwise not visible.
- C. Contractor: As used in this Division of the specification refers to the Mechanical Contractor unless specifically noted otherwise.
- D. Ductwork: All air distribution, recirculation and exhaust ducts, whether of sheet metal or other material, and includes all connections, hanger, supports, damper controls, insulation, accessories, fire and smoke control devices, and appurtenances necessary for and incidental to a complete system.
- E. Exposed: Not concealed.

- F. Furnish: Purchase and deliver to the project site complete with every necessary appurtenance and for installation.
- G. Install: Unload at the delivery point and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.
- H. Piping: Pipe, fittings, flanges, valves, controls, hangers, supports, traps, drains, gauges, insulation, vents and items customarily required in connection with the transfer of fluids.
- I. Provide: Furnish and install complete ready for use.

#### **1.4 INTERPRETATION OF CONTRACT DOCUMENTS:**

- A. This section of the specifications and related drawings describe general provisions applicable to every section of Division 23.
- B. Attention is directed to Instructions to Bidders and General Conditions, which are binding in their entirety on this portion of the work and in particular to paragraphs concerning materials, workmanship and substitutions.
- C. Provide all materials called for in these specifications and accompanying drawings and provide the apparatus complete in every respect. Anything called for in the specifications and not shown on the drawings, or shown on the drawings and not called for in the specifications must be provided.
- D. Mention in these specifications, indications and reasonable implications on drawings, whereby articles, materials, operation or methods related to execution of the mechanical work are noted, specified, drawn or described, thereby requires execution of each such item of work and provision of all labor, materials, equipment and appurtenances required for execution thereof.
- E. Particular attention is directed to the drawings and other contract documents for information pertaining to required items or work which are related to and usually associated with the work of this Division of the specifications, but which are to be provided as part of the work of other Divisions of the specifications.
- F. Drawings show arrangements of system desired and shall be followed as closely as practical. Because of the small scale of the drawings not all offsets and bends can be shown and these shall be provided as required, to fully complete the intent of plans. Verify and check all measurements in the field. Should conditions and substitutions of equipment necessitate a rearrangement, prepare and submit for review, scaled drawings of such rearrangement before beginning work.
- G. No exclusions from, or limitations in, the language used in the drawings or specifications shall be interpreted as meaning that the appurtenance or accessories necessary to complete any required system or item of equipment are to be omitted.

- H. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded. When abbreviations appear on the drawings or specification in lower case letter with or without periods, their meanings shall be the same as stated above.
- I. Certain details appear on the drawings that are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not make unnecessary the field coordination for the indicated work.
- J. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
- K. The use of words in the singular shall be considered as limited where other indications denote that more than one item is referred to.
- L. Submission of a proposal and ultimate acceptance of an agreement or contract for execution of this section of work will be construed as evidence that the Prime Contractor, Subcontractor and Vendor has carefully read and accepts all conditions set forth in each Division under specification Divisions titled "Instruction to Bidders" and Division 1, "General Condition", insofar as such conditions may affect both the bidding for and execution of this section or work.

#### **1.5 DELINEATION OF WORK:**

- A. The "Division of Work:" as shown on the drawings, is a recommended division of work as an aid to Contractors and Subcontractors for bidding and performance of the overall prime contract. This or any other reference to the Mechanical Contractor or any Subcontractor shall in no way be intended to interfere with or relieve the Prime Contractor as to his overall responsibility.
- B. Division 23 contractors are required to supply all necessary supervision and coordination of information to any others who are performing work to accommodate Division 23 installations. Where the Division 23 contractors are required to install items which they do not purchase, they shall include for such items:
  - 1. The coordination of their delivery.
  - 2. Their unloading from delivery trucks driven in to any designated point on the property line at grade level.
  - 3. Their safe handling and field storage up to the time of permanent placement in the project.
  - 4. The correction of any damage, defacement or corrosion to which they may have been subjected.
  - 5. Their field assembly and internal connection as may be necessary for their

- proper operation.
6. Their mounting in place including the purchase and installation of all dunnage, supporting members, fastenings necessary to adapt them to architectural and structural conditions.
  7. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
- C. Items that are to be installed but not purchased as part of the work of Division 23 shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the work will be considered only if presented in writing within one week of the date of delivery of the project of the items in question. The work under Division 23 shall include all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

## **1.6 MECHANICAL CODES, STANDARDS & REGULATIONS:**

- A. General: All work shall comply with the current governing codes, ordinances and regulations of all National, State and Local authorities having jurisdiction. The requirements of the following governing bodies, codes and standards are included by reference and shall have the same force and affect as if printed here in full (in addition to specific applications specified by individual work sections of these specifications):
1. ADA: Air Diffusion Council.
  2. AMCA: Air Moving and Conditioning Association, Inc.
  3. ANSI: American National Standards Institute
  4. ANSI Pressure Piping Standards (B31-Series).
  5. ARI: American Refrigeration Institute
  6. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers
  7. ASHRAE 15, Safety Code for Mech. Refrig. (ANSI B9.1).
  8. ASME: American Society of Mechanical Engineers
  9. ASME Boiler and Pressure Vessel Code
  10. ASTM: American Society of Testing and Materials
  11. AWS Standards for Welding.
  12. IBR: Institute of Boiler and Radiator Manufacturers
  13. MSS: Manufacturers Standardization Society
  14. North Carolina Department of Labor
    - a. The Uniform Boiler and Pressure Vessel Act – current edition
  15. North Carolina State Building Code.
    - a. General Construction
    - b. Plumbing
    - c. Mechanical
    - d. Energy
    - e. Fire Code
  16. NEMA: National Electrical Manufacturer's Association

17. NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals
18. NFPA 70 National Electrical Code.
19. OSHA: Occupational Safety and Health Administration
20. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.

- B. Include all items of labor and materials required to comply with such standards and codes. Where quantity, sizes or other requirements indicated on the drawings or herein specified are in excess of the standard or code requirements, the specifications or drawings, respectively, shall govern.
- C. Should contractor become aware of any change in plans or specifications required to comply with governing regulations, the Contractor is to notify the Professional at least 10 days prior to the bid date.

#### **1.7 PERMITS AND FEES:**

- A. The contractor shall arrange for, obtain and pay for all permits, certificates, tests, inspections, agency approvals, etc. and pay all fees levied by the authorities and having jurisdiction over the work performed under this contract. Provide copies of all required permits, certificates, inspections and agency approvals to the owner. Contractor shall submit to the appropriate Regulatory Agencies all items necessary to obtain all required permits and to perform all tests and inspections.
- B. Contractor shall pay royalties or fees required in connection with the use of any patented devices and systems.

#### **1.8 VERIFICATION OF DIMENSIONS AND LOCATIONS:**

- A. The Contractor shall visit the premises and thoroughly familiarize themselves with all details of the work, working conditions, verify all dimensions in the field, advise the Architect/Engineer of any discrepancy, and submit shop drawings of any significant changes affecting other work he proposes to make, in quadruplicate for approval, before starting the work.
- B. The location of duct, pipe, fixture, equipment and appurtenances for existing facilities are shown on plans to indicate the extent of work required. Exact condition shall be field verified.

#### **1.9 PRODUCT SUBMITTALS:**

- A. General: Refer to the Division 1 sections for general requirements concerning work-related submittals. In addition to those general requirements, the following are required for Division 23 submittals. Failure to comply with these requirements may result in rejection without further review.
  1. Manufacturer or Vendor terms and conditions of sale are strictly between Vendor and Contractor. Approval of submittal data shall not be construed as approval of terms and conditions.

By providing submittals to the contractor to be forwarded to the engineer for review, the equipment vendor is acknowledging review of the contract documents and installation details, and that the submitted product is suitable for application in the manner indicated in the contract documents. Upon request, and at no additional charge, the equipment vendor will provide to the engineer a letter from the manufacturer stating the product has been applied in accordance with manufacturer's recommendations.

- B. Product Data, Shop Drawings and Samples: After checking and verifying all field measurements, the Contractor shall submit to the Engineer for review, in accordance with the accepted schedule of shop drawings submissions, copies of all product data, shop drawings and samples, which shall have been checked by and stamped with the approval of the Contractor and identified as the Engineer may require. The data shown on the shop drawings will be complete with respect to dimensions, design criteria, materials of construction and the like to enable the Engineer to review the information as required.
1. The Contractor shall review each submittal in detail. The work described in shop drawing submission shall be carefully checked for clearances (including those required or recommended for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with other trades on the job. If it is determined to be correct, the Contractor shall place an approval stamp on each copy; approval stamp shall be filed in with the date on which the items is checked and the checker's name. The Contractor's approval stamp certifies that submittals and related job conditions have been checked and that conflicts do not exist. Any job conflicts arising from the contractor's failure to fully complete these responsibilities shall be corrected as directed by the Professional at no additional cost to the contract. Drawings which the Contractor finds are incomplete or incorrect shall be returned to the source without being forwarded to the Professional. Drawings which do not contain the signed Contractor's stamp may be returned unchecked to the Contractor. Return of unchecked submittals and any delays in construction it may cause, will not be considered cause for any extensions or delays in construction by the Contractor.
  2. Shop drawings shall be submitted well in advance of field requirements to allow ample time for checking. Submittals shall be complete and contain required detailed information. Shop drawings with multiple parts shall be submitted as a package.
  3. Include with each submittal a permanent cover sheet for identification. Provide the following information on the cover sheet for proper processing and recording of action taken. A sample cover sheet can be made available by the Engineer for reproduction and use for each submittal.
    - a. Project name;
    - b. name and address of Professional;
    - c. name and address of Contractor;
    - d. name and address of supplier;
    - e. Sequential submittal number (e.g. FP-1, M-1, P-1, P-2, P-3, etc.); resubmittals shall be designated with the same submittal number but noted as a resubmittal (e.g. FP-1R, M-1R, P-1R, P-2R, P-3R, etc.);

- f. name of manufacturer;
  - g. number and title of appropriate specification section, drawing number identifying symbol, and detail references, as appropriate.
  - h. similar definitive information as necessary.
  - i. space for the Contractor's review and approval markings
  - j. space for the Professional "Action" marking
4. Submit materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalogue material. Do not assume applicable catalogues are available in the Professional's office. Maintenance and operating manuals are not suitable substitutes for shop drawings.
  5. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features such as special tank linings, pump seals, materials or painting.
  6. Include dimensional data for roughing in and installation, technical data sufficient to verify that equipment meets requirements of drawings and specifications. Include wiring, piping and service connection data, motor sizes complete with voltage ratings and schedules.
  7. Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Professional.
  8. Furnish all submittals for the items used in this project as listed in their related sections.
  9. The Contractor shall also submit to the Engineer for review, with such promptness as to cause no delay in work, all samples required by the Contract Documents. All samples shall have been checked by and stamped with the approval of the Contractor, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.
  10. At the time of each submission, the Contractor shall in writing call the Engineer's attention to any deviations that the shop drawings or sample may have from the requirements of the Contract Documents. Make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.
  11. The Engineer shall review with reasonable promptness shop drawings and samples, but their review shall be only for conformance with the design concept of the project and for compliance with the information given in the Contract documents.
  12. No work requiring a shop drawing or sample submission shall be commenced until the submission has been reviewed by the Engineer. A copy of each shop drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer and other authorities having jurisdiction.
  13. The Engineer's review and acceptance of submitted data or shop drawings for material equipment apparatus, devices, arrangement and layout shall not relieve Contractor from responsibility of furnishing the proper dimensions and weight, capacities, sizes, quantity, quality and installation details to efficiently perform the requirements and intent of the Contract. Approval shall not relieve the Contractor from responsibility for errors, omissions or

inadequacies of submitted data or shop drawings.

14. Upon final approval of shop drawings, the Contractor shall submit manufacturer's installation instructions to the Local Building Authority for all equipment and appliances at their request.
15. Upon final approval of shop drawings, the Contractor shall submit a record copy of all applicable items to the Balancing Agency.
16. If any components for which shop drawings have been approved is later found to not comply with those shop drawings contractor shall be responsible for all costs to address this, including but not limited to charges from the owner, engineer and other contractors.

#### **1.10 SUBSTITUTIONS:**

- A. Follow requirements listed in the general provisions of the contract.
- B. Submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name or by catalog reference, Contractor shall select for use any of those so specified.
  1. Should Contractor desire to substitute another manufacturer's equipment for one specified by name, the Contractor shall apply to the Engineer in writing no later than 10 days prior to bid opening for such permission. They shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article or process required under the contract unless approved by the Engineer.
- C. Contract documents are based on materials and equipment specified. Approval by Professional of equipment submitted by the mechanical trade as equal to that specified does not relieve the mechanical trade of any responsibility.
- D. Revisions required to adapt alternative shall be included in such proposals. No increase in the contract price will be considered to accommodate the use of the equipment other than that specified.
- E. Wherever operating results such as quantity delivered, pressure obtained, or similar results are specified, or a definite manufacturer and size of apparatus is specified, for which such quantities are readily determinable, the manufacturer and size of apparatus that the Contractor has proposed using must conform substantially (in regard to the operating results) to the quantities specified or implied. This requirement shall also apply to important dimensions relating to operation of apparatus in coordination with the rest of the system, and to properly locating the apparatus in available space conditions.
- F. Acceptance of substitutions for equipment specified shall be given only after receipt of complete and satisfactory performance data covering the complete range of operating conditions in tabular and graphical form. Furnish complete and satisfactory information relative to equipment dimensions, weight, etc. Acceptance of equipment specified or shown on the Drawings, or substitutions submitted for that specified or shown on the drawings, will be granted if such equipment, in the opinion of the Professional, conforms to the performance requirements, space conditions, weight requirements and quality requirements. Acceptance by the Professional as "equivalent" does not relieve the contractor(s) of any responsibility. Any additional construction and design costs incurred as a result of any accepted

substitution shall be borne by the Contractor.

**1.11 REQUESTS FOR INFORMATION:**

- A. During the course of construction, the Contractors may find it necessary to request additional information. The Professional encourages written requests for information (RFI's) to clearly document the request. The response issued by the design Professional is an attempt to assist in the progress of construction. With a response, the design Professional is not conceding any deficiency of the design and is not assuming responsibility for means and methods. RFI's may not be used and asserted as an excuse for late submittal of shop drawings. The Contractor bears the responsibility to prioritize RFI's in the order in which it desires the professional to respond.

**1.12 ALTERNATES:**

- A. Refer to Division 1 for Schedule of Alternates, if any.
- B. Alternate amounts quoted on bid forms shall include any and all costs to coordinate related work among all disciplines and modify surrounding work as required to obtain complete and operational systems.

**1.13 PROJECT/SITE CONDITIONS:**

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. If conflicts arise, prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Professional before proceeding.

**1.14 FUTURE PROVISIONS:**

- A. Where indicated on the Contract Documents there may be provisions for future work. Contractor shall carefully coordinate any associated work that could affect that future work. Future equipment space and working clearances shall be maintained by avoiding routing current mechanical systems through those areas. Where indications of "Capped For Future" are indicated, provide capped isolation valves in piping and for duct work provide dampers with capped ends, sealed with removable sealant.

**1.15 OWNER FURNISHED PRODUCTS:**

- A. Certain products may be furnished to the site and paid for by Owner: Rough-ins and final connections shall be provided by the HVAC subcontract as required. Contractor shall fully coordinate requirements with Owner and/or Owner's vendor.

## **1.16 INTERRUPTION OF SERVICES:**

- A. Occupancy: The work is to be performed in and around existing facilities that are occupied by the public as a place of business. The work shall be coordinated and scheduled with the Owner and/or Owner's representatives to minimize any disruption to normal functions and occupancy of the facility.
- B. The Contractor shall schedule their work to avoid any major interruption of any utility services.
- C. Existing utilities serving facilities occupied and used by the Owner or others shall not be interrupted except when such interruptions have been authorized in writing by the Owner or the Professional. Interruptions shall occur only after an acceptable temporary utility services have been provided. The Contractor shall provide a minimum of ten (10) working days notice to the owner and receive notice to proceed before interrupting any utility.

## **PART 2 - PRODUCTS**

### **2.1 MECHANICAL PRODUCT REQUIREMENTS:**

- A. Under the Base Bid, the specified equipment shall be used as the basis of the proposal.
- B. Standard Products: Provide not less quality than manufacturer's standard products, as specified by their published product data. Notwithstanding the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf conditions of a product comply with the requirements; as an example, a specific finish or color may be required. Where the specifications do list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.
- C. Unencumbered Purchases: Wherever possible, avoid the purchase and use of products which are encumbered with questionable title transfers, patent rights, trade union restrictions, code compliance, non-listing as "approved products" for compliance with governing regulations, duties due, embargoes and similar possible encumbrances, claims, or seller's interest.
- D. Purchasing: Do not purchase specific mechanical materials and equipment for the project until completion of submittals that might affect the purchase.
- E. Conditions of Products: Unless noted otherwise, all equipment and materials required for installation under these specifications shall be new and without blemish or defect. Applicable equipment and materials to be listed by Underwriter's Laboratories and manufactured in accordance with ASME, AWWA, or ANSI standards, and as approved by local authorities having jurisdiction. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service. Where no specific indication as to the

type or quality of material or equipment is indicated, a first-class standard article shall be furnished. All manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacturers of said equipment a minimum of three (3) years and, if so directed by the Engineer, be able to furnish proof of their ability to delivery this equipment by submitting affidavits supporting their claim. Comply with Division 1 requirements for exposure or visual display limitations against trademarks and manufacturer's names. Provide each product complete with trim, accessories, finish, guards, safety devices and similar components specified or recognized as integral parts of the product, or required by governing regulations.

- F. Uniformity: Where multiple units of a generic product are required for the mechanical work (as specified in Division 23), provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated.
- G. Limitations: Product/manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanges and grooved type), insulation, sheet metal, wire, steel bar stock, welding rods, solder, paint, fasteners, motors for unlike equipment units, and similar items used in the work, and except as otherwise indicated.
- H. Product Compatibility Options: Where more than one product selection is specified, either generically, or proprietarily, selection is Purchaser's or Installer's option, except do not provide products which are not compatible with previously purchased or installed products which must interface with the adjacent selections. Provide mechanical adaptations as needed for the interfacing of selected products in the work.
- I. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated mechanical equipment, indicating the manufacturer's name and address, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data. Locate nameplates in easily-read locations; except where product is visually exposed in occupied areas of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel. UL or other label, or other data that is die-stamped into the surface of the equipment shall be stamped in a location easily visible. The generic nameplate of a distributing agent will not be acceptable.
- J. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, clearances, cleaning, testing, charging, lubrication, adjustment, start-up test operation, and shut-down of operating equipment. Provide a copy of such instructions at the equipment during work on the equipment. Consult with manufacturer's technical representatives, who are recognized as the technical experts, for specific instructions on unique project conditions and unforeseen problems.

- K. Statically and dynamically balance rotating equipment for minimum vibration and low operating noise level after installation is complete.
- L. Pressure vessels and relief valves shall be selected, built and labeled in accordance with ASME. Obtain a certificate from the Inspector having jurisdiction showing such acceptance, and mount this certificate in a black frame under glass or laminated plastic adjacent to each pressure vessel and relief valves.
- M. Where factory testing of equipment is required to ascertain performance and attendance by the Owner's representative is required to witness such test, associated travel costs and subsistence shall be borne by the Contractor.
- N. No product containing any amount of any form of asbestos shall be installed on this project. Asbestos includes but is not limited to asbestiform varieties of chrysotile, crocidolite, anthophyllite, tremolite or actinolite. The contractor shall furnish a letter to the Owner certifying that this requirement has been complied with prior to final payment.

## **PART 3 - EXECUTION**

### **3.1 COORDINATION OF MECHANICAL WORK:**

- A. The HVAC contractor shall coordinate the HVAC work with the work of other trades to avoid installation conflicts. Conflicts arising from failure to coordinate shall be rectified by the contractors at no additional cost to the contract.
- B. The mechanical drawings show the general arrangement of equipment, ductwork, piping and appurtenances. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide offsets, fittings, and accessories that may be required but not shown on the drawings. Investigate the site, structural and finish ground conditions affecting the work, and arrange the work accordingly. Provide such work and accessories as may be required to meet such conditions.
- C. Examine and compare the contract drawings and specifications with the drawings and specifications of other trades and work furnished by others not in contract (NIC), and report any discrepancies between them to the Professional and obtain from Professional written instructions for changes necessary in the mechanical work. Install and coordinate the mechanical work in cooperation with other related trades and work furnished by others (NIC). Before installation, make proper provisions to avoid interference.
- D. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale similar to that of the design drawings, prepared on medium of the same size as contract drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work shall be clearly identified on the drawings as to the area to which it applies. Submit these drawings to the Professional for approval. At completion include a set of such drawings with each set of as-built drawings.

- E. Certain materials will be provided by other trades. Coordinate the affected work with other trades. Examine the Contract Documents to ascertain these requirements. Consult with other trades regarding equipment so that, wherever possible, motors, motor controls, pumps and valves are of the same manufacturer.
- F. Wherever work interconnects with work of other trades, coordinate with other trades to insure that they have the information necessary so that they may properly install the necessary connections and equipment. Identify items (valves, dampers, coils, etc.) requiring access in order that the ceiling trade will know where to install access doors and panels.
- G. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface requirements has been checked and satisfactorily established.
- H. Chases and Holes: Unless otherwise indicated, all piping and ductwork shall be run in concealed spaces between floor and ceilings or in chases. Ductwork and piping areas without ceilings shall be installed exposed and as high as practical. This Contractor shall be responsible for the location and size of holes required for pipe, ducts and other equipment and shall advise of chase spaces and holes required as building progresses. Failure to do so shall require this Contractor to provide or cut same.
- I. Carefully check space requirements with other trades prior to installation to insure that material can be installed in the spaces allotted including finished suspended ceilings.
- J. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members, except with the Architect's or Engineer's written authorization. Authorization will be granted only where there is not another reasonable method of completing the mechanical work, and where the proposed cutting clearly does not materially weaken the structure. Provide required supports and hangers for ductwork, piping and equipment, designed so as not to exceed allowable loading of structures.
- K. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs shall be provided by the various trades in their respective materials. Contractor shall properly locate such openings and be responsible for cutting and patching caused by the failure to do so.
- L. All cutting and patching required for installation of Division 23 work shall be the responsibility of the associated Contractor(s), performed in accordance with all requirements indicated in Division 1.
  - 1. Cutting Concrete: Where authorized, cut openings through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer driven chisel or drill, unless receiving special permission for specific cases.
  - 2. Other Work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the

- proposed cutting with the Installer of the work to be cut, and comply with their recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.
3. Patching: Where patching is required to restore other work, because of either cutting or damage inflicted during the installation of mechanical work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Architect/Engineer and Owner.
- M. Furnish and set sleeves for passage of pipes, ducts and conduits through structural masonry and concrete walls and floors and elsewhere as required for the proper protection of each pipe and duct passing through building surfaces. Coordinate locations of sleeves with General Contractor for proper scheduling and installation.
- N. Install mechanical work to permit removal (without damage to other parts) of coils, heat exchanger plates and tube bundles, fan shafts and wheels, filters, belt guards, sheaves and drives, and other parts requiring periodic replacement or maintenance. Arrange pipes, ducts, and equipment to permit access to valves, gauges, starters, motors, and control components, and to clear the opening of swinging doors and access panels.
- O. Sequence, coordinate and integrate the various elements of mechanical work so that the mechanical plant will perform as indicated and be in harmony with other work of the building. The Architect/Engineer will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:
1. Install piping, ductwork and similar services straight and true, aligned with other work, close to walls and overhead structure (allowing for insulation), concealed where possible in occupied spaces, and out-of-the-way with maximum passageway and headroom remaining in each space.
  2. Arrange work to facilitate maintenance and repair or replacement of equipment without removal of relatively fixed building elements or other equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
  3. Locate operating and control equipment and devices for easy access. Install access panels where units are concealed by finishes and similar work.
  4. Integrate mechanical work with light fixtures and other work, so that required performances of each will be achieved.
  5. Adjust location of pipes, ducts, panels, equipment, etc., to accommodate the work to prevent interference, both anticipated and encountered. Determine the exact route and location of each pipe and duct prior to fabrication
  6. Right-of-Way: Piping systems that pitch have the right-of-way over those which do not pitch (e.g. drainage systems normally have right-of-way). Service lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
  7. Make offsets, transitions and changes in direction in pipes and ducts as required to maintain proper head room and pitch on sloping lines. Furnish

and install air vents, drains, etc., as required to affect these offsets, transitions and changes in direction.

8. Obtain from Others furnishing products, materials or services not in contract, all necessary catalog cut sheets, rough-in requirements or any other such information as required to fully coordinate the services to support all such work by others. Costs that arise from not performing this coordination shall be borne by the Contractor.
- P. Protective Drip Pans: Where indicated, and where mechanical work piping carrying liquids pass over electrical or electronic equipment which might be damaged by dripping liquids (leakage or condensation), install drip pans 2" deep, 16 gauge galvanized steel with rolled edges of adequate width and length to protect the electrical equipment. Pipe drainage from pan to nearest floor drain or similar suitable point of discharge, and terminate pipe as an open-sight drainage connection. Provide permanent support and anchorage to prevent displacement of drip pans. Drains shall be 3/4" copper unless noted otherwise. Locate drip pans as close to underside of piping as possible. Extend edges not less than 6" each side of piping and extend ends not less than 18": beyond equipment being protected.
- Q. Electrical Work: Coordinate the mechanical work with electrical work, and interface properly with electrical service to mechanical equipment. In general, and except as otherwise indicated, install mechanical equipment ready for electrical connection.
1. Refer to Division 26 sections for electrical power connection of mechanical equipment, including disconnect switches.
  2. Power Characteristics: Refer to the appropriate sections of Division 26 and the electrical drawings for the power characteristics available for the operation of each power driven item of mechanical equipment. Coordinate purchases to ensure uniform interface with electrical work.
- R. Utility Coordination: Coordinate the connection of mechanical systems with exterior underground and overhead utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. It is the construction contractor's responsibility to mark and trace the lines using appropriate/suitable devices; i.e., metal detectors, pipe locators, etc.; or by having the appropriate utility company stake the lines. The contractor shall repair all utility systems he damages at no charge to the Owner. All repairs shall be performed to Owner's or the affected utilities' satisfaction. The contractor is responsible for all utility hook ups, disconnects and coordination with the appropriate agencies.
- S. Seasonal Requirements: Adjust and coordinate the timing of mechanical system start-ups with seasonal variations, so that demonstration and testing of specified performance can be observed and recorded. Exercise proper care in off-season start-ups, to ensure that systems and equipment will not be damaged by the operation.
- T. The HVAC Contractor shall be responsible for ensuring that the HVAC systems, wiring, and controls are complete and operational and for providing written documentation as such to the Professional and the TAB prior to TAB being

performed. The HVAC Contractor shall be responsible for any costs associated with additional services required to reschedule and/or redo TAB and punch list inspections resulting from the failure to perform said completed services.

### **3.2 CUTTING & PATCHING:**

- A. See Division 1 for Cutting and Patching requirements.
- B. This Contractor must have an experienced Mechanic on the job before concrete floors, concrete or masonry walls are set in place, whose duty it shall be to locate the exact position of any and all sleeves and holes for the future installation of his pipe or duct work. This Contractor shall locate and size all openings required for his equipment in time to not delay the building construction.
- C. If it becomes necessary to cut holes in concrete floors or concrete or other masonry walls, each subcontractor shall contact the Prime Contractor or their superintendent of Construction, and inform them of the position and size of the hole or other opening to be provided and the Prime Contractor shall determine how this will be done. Under no condition shall this Contractor make any cuts without permission from the Prime Contractor, nor shall he cut any green floors or walls.
- D. This Contractor shall arrange proper openings in the building to admit their equipment. If it becomes necessary to cut any portion of the building to admit any equipment or install mechanical systems, this Contractor shall be responsible for cutting and patching. The portions cut must be restored to their former condition by this Contractor.
- E. All cutting of structure shall be done using best method to minimize noise and cracking of structure. The method of cutting shall be approved by the Prime Contractor before work if started.
- F. All drilled holes required for equipment or supports shall be done by this Contractor. Holes for piping shall be core drilled only.

### **3.3 ACCESS PANELS:**

- A. The Contractor shall furnish access doors to the General Contractor for installation in ceilings, walls, partitions and floors for access to valves, dampers, equipment, etc. and all appurtenances.
- B. Access panels shall be of sufficient size to permit removal or access to equipment, except that the minimum size shall be 12-inches by 16-inches.
- C. Access door locations shall be as determined by field conditions for optimum access to equipment, and shall be reviewed by the Professional before final installation, and shall be subject to the following:
  - 1. Bottom of access doors shall not be lower than the top of the partition base, or a minimum of 6 inches above floor.

2. Tops and/or sides of access panels shall be a minimum of 6-inches from the ceiling or opening or from the edge of a wall return.
3. Access doors shall be suitable for installation in the finish material of the ceilings, walls, partitions and floors.
4. Frame and panel access doors in restrooms, kitchens and as indicated shall be stainless steel.
5. Access doors with UL Listing shall be provided in rated construction assemblies. Access doors shall be "B-Label" and shall have a UL one and one-half (1-1/2) hour rating at 250 degrees F rating for both door and frame. Maximum size shall be 20" x 20" or 400 square inches in area. Frame shall be sixteen (16) gauge minimum steel, panel shall be twenty (20) gauge minimum steel. Access doors shall be provided with a baked-on enamel finish (prime coat), continuous type hinge on one side, flush-face type lock with key operation and self-latching cylinder locks.
6. Access doors without UL label shall be provided in all non-rated construction assemblies: Frame shall be sixteen (16) gauge minimum steel, panel shall be fourteen (14) gauge minimum steel. Access doors shall be provided with a baked-on enamel finish (prime coat), concealed spring type hinges and flush-face type lock with key operation and self-latching cylinder locks. Door shall open 175 degrees (minimum).
7. All access doors shall be keyed alike.

### **3.4 STORAGE AND INSTALLATION OF EQUIPMENT AND MATERIALS:**

- A. Move and store products and materials in a manner that will protect them from damage, weather and entry of debris. The Contractor shall fully protect finished parts of the materials and equipment against damage from whatever cause during the progress of the work until final acceptance. Materials and equipment in storage and during construction shall be stored on elevated supports and covered on all sides with securely fastened protective rigid or flexible waterproof coverings in such a manner that nothing will be damaged or marred, and kept clean and dry. If items are damaged, do not install, but take immediate steps to obtain replacement or repair at no cost to Owner.
- B. Piping shall be protected by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation in the piping.
- C. During construction cap all ductwork openings that could be exposed to dust, dirt and debris. Cap all piping installed vertically.
- D. Periodically during construction and prior to Owner acceptance of the building, Contractor shall remove from the premises and dispose of all packing material and debris. All adjacent occupied areas shall be cleaned daily to remove dirt and debris resulting from this work.

- E. If products and materials are specified or indicated on the drawings for a specific item or system, the Contractor shall use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, subject to approval of shop drawings.
- F. Install materials and equipment with qualified trades people. Install all equipment and appurtenances in strict accordance with the manufacturer's instructions and recommendations.
- G. Replace materials less than specified quality or as designated by Professional and relocate work incorrectly installed as determined by Professional.
- H. All parts of the HVAC system shall be protected from entry of dust and other contaminants until all activities producing these contaminants are complete and all dust and debris has been removed. HVAC Contractor shall bear the responsibility to thoroughly clean all air handling equipment, interior surfaces of ductwork, terminal devices, air distribution devices and any other related mechanical equipment if any of these systems are contaminated due to inadequate protection during construction.
- I. Do not use the HVAC system for temporary heat or cooling until all dust and other contaminant producing activities are complete and all dust and debris have been removed. Once all dust and other contaminant producing activities are complete and all dust and debris has been removed HVAC system may be used for temporary heating or cooling. Do not operate air systems until ductwork is complete, temporary filters are in place. At a minimum provide one-inch thick fiberglass filter media across the face of each return air opening prior to start of each air system during temporary system operation. HVAC Contractor shall bear the responsibility to thoroughly clean all air handling equipment, interior surfaces of ductwork, terminal devices, air distribution devices and any other related mechanical equipment if any of these systems are contaminated due to use as for temporary heat.
- J. Do not operate water systems until piping has been cleaned and startup strainers are in place.
- K. Secure equipment with bolts, washers and locknuts of ample size to support equipment. Embedded anchor bolts shall have bottom plate and pipe sleeves. Grout all machinery set in concrete under the entire bearing surface. After grout has set, remove all wedges, shims and jack bolts and fill space with grout.
- L. Valves, dampers operators, and access doors, shall be easily accessible, either in mechanical spaces or through access panels specified.
- M. All equipment shall be thoroughly cleaned. All excess materials and all debris shall be removed from the site.

### **3.5 REVIEW OF WORK PROGRESS:**

- A. Prior to performing work, the Contractor shall carefully review and assess the installed Work of all other Trades and verify that all such Work is complete to the point where their installation may properly commence.
- B. Verify that all equipment may be installed in accordance with all pertinent codes and regulations, the original design and the referenced standards. Schedule and obtain inspections of the AHJ, and contact Professional for site observations at appropriate times.
- C. In the event of discrepancy, immediately notify the Architect/Engineer.
- D. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

### **3.6 WELDING:**

- A. All welded piping shall be installed by Contractor using NCPWB or ASME Certified Welding Procedures. Welding shall comply with ANSI/ASME B31.1 and Section IX of the ASME Boiler and Pressure Code.
- B. All welded piping shall be hydrostatically tested for pressure of 1-1/2 times the working pressure of the line, but not less than 150 psig. This hydrostatic test shall be witnessed by the Engineer.
- C. Ten days before any welded work is to start, the Contractor shall furnish the Engineer copies of the welding procedures approved for the Contractor.
- D. Before any welder is put to work in welding any piping for this job, the Engineer shall be furnished with duplicate copies of the certification of each welder. If, in the opinion of the Engineer, the welding is not done properly, a coupon shall be cut from field welds for inspection and/or the welder may be required to pass a recertification test. Costs of cutting the coupon shall be the responsibility of the Contractor. Also all welds shall be subject to non-destructive x-ray examination by Owner. In the event that defective work is found the Contractor will be responsible for all costs of non-destructive x-ray examination, including all remedial repair work and retesting of welding that is determined to be unsatisfactory.
- E. No welding is to be covered with insulation or concealed until the welding has been approved by the Engineer as outlined above.
- F. All welding operations shall be approved by the Engineer prior to beginning work. Extreme care shall be exercised to prevent damage to the existing buildings or building or surrounding contents during welding operations.
- G. During welding of all piping, contractor shall use fire resistant or equal pad protection to prevent scorching or burning of existing floor and wall finishes, etc. Also, care shall be taken to eliminate sparks from dropping on existing furniture,

equipment and flooring material. All damages created by welding flame or sparks shall be repaired to owner's satisfaction at contractor's expense.

### **3.7 PAINING REQUIREMENTS:**

- A. Work buried in soil or encased in concrete or insulation need not be painted (except for protective coatings specified with the piping system).
- B. Painting of work in finished areas will be done by others. However, this Contractor shall leave their work in proper condition and ready for painting by removing all dirt, grease, pipe dope and scale or other foreign material by wire-brushing or as required.
- C. Except as indicated specifically otherwise herein, paint material shall be selected from materials for work under the Architectural Specifications.
- D. Painting on all pipe and pipe insulation in equipment rooms shall be done by the Mechanical Contractor. Colors shall be selected from the Industry Standard for colors or those approved by the owner.
- E. All equipment having factory applied finish shall have its surface restored to its original condition if the finish is marred during installation.

### **3.8 MANUALS, REPORTS AND FORMS SUBMITTAL:**

- A. Submit specified number of operating and maintenance manuals, reports and forms to the A/E for review. Submittals shall be in strict compliance with specifications.
- B. Submittals not approved or not submitted in proper format may be rejected and returned to Contractor. Contractor shall make necessary changes and resubmit until approved.
- C. Submittals shall include all reports, forms and manuals referenced in these specifications.

### **3.9 GENERAL COMPLETION AND DEMONSTRATION:**

- A. All aspects of the work shall be completed and demonstrated to be operating correctly before project will be considered complete. The following results are expected:
  - 1. All systems and controls shall be complete, tested and operational.
  - 2. All start-up and testing and balancing shall be complete.
  - 3. All equipment shall be thoroughly cleaned. All excess materials and all debris shall be removed from the site.

4. All walls, floors, ceilings and other surfaces marred or otherwise damaged as a result of execution of this contract shall be cleaned and repaired to the satisfaction of the Architect/Engineer and Owner.

**3.10 MAINTENANCE OF LOCAL SERVICE ORGANIZATION:**

- A. The Contractor shall maintain sufficient forces to respond promptly to any system problems that occur during construction and during the warranty period. The Contractor shall provide the Owner and the Engineer with reliable and prompt means of contacting the Contractor. In the event that after an attempt to contact the Contractor, the Contractor does not respond appropriately to any problem, the Owner and/or Engineer will without further notice address the problem. All costs associated with addressing the problem will be borne by the Contractor including all costs of the engineer and owner and including all risk of damage to equipment except that caused by gross negligence of others.

**END OF SECTION 230000**

## **SECTION 230001 CLOSEOUT DOCUMENTATION & PROCEDURES**

### **PART 1 - GENERAL REQUIREMENTS**

#### **1.1 SCOPE OF WORK:**

- A. Refer to Division 1 Specifications for documentation and close-out requirements. When conflicts exist; the more stringent shall apply.

### **PART 2 PRODUCTS**

#### **2.1 RECORD DOCUMENT SUBMITTALS:**

- A. General: Specific requirements for record documents are indicated in the individual sections of these specifications. Other requirements are indicated in the General Conditions.
  - 1. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Professional's reference during normal working hours.
- B. Record Drawings: Maintain a record set of blue or black line white-prints of contract drawings and shop drawings in a clean, undamaged condition for concurrent mark-up of actual installations which vary substantially from the work as shown. Mark whichever drawing is most capable of showing the actual "field" condition fully and accurately; however, where shop drawings are used for mark-up, record cross-reference at the corresponding location on the working drawings.
  - 1. Mark with red ink, and where feasible use multiple colors to aid in the distinction between work of separate mechanical systems. Give particular attention to concealed work that would be difficult to measure and record at a later date. In general, record every installation of mechanical work which previously is either not shown or shown inaccurately, but in any case record the following:
    - a. Mark-up new information which is known to be important to the Owner, but for some reason was not shown on either contract drawings or shop drawings. Record drawings shall identify location of fire dampers, major control lines, access doors, tagged valves, systems concealed in walls or ceilings.
    - b. Work concealed behind or within other work, in a non-accessible arrangement. All such work shall be identified with field measured dimensions to locate in the future and shall be inspected by Owner's representative prior to completing enclosure.
    - c. Mains and branches of piping systems, with valves and control devices located and numbered, with concealed unions located, and with items requiring maintenance located (traps, strainers, expansion

- d. compensators, tanks, etc.).
  - d. Note related change-order and numbers where applicable. When construction clarification or change order sketches are issued by the Professional and approved to be used for construction, a copy of each sketch shall be securely taped to the back of the preceding sheet and properly referenced on the original drawing.
  - e. Ductwork layouts, including locations of coils, dampers, filters, boxes, and similar units.
  - f. Concealed control system devices and sensors.
  - g. Cross out work that has been moved or changed.
  - h. Qualified drafters shall perform this task.
2. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set. Upon completion of the work, submit record drawings to the Professional for review.
  3. Once drawings are approved by the Professional, the Contractor shall obtain a minimum of 3 full size reproduced sets (2) for Owner's use and (1) is the Architect's/Engineer's records.
- C. Record Specifications: Maintain one complete copy of the Project Manual, including specifications and addenda, and one copy of other written construction documents such as change orders and similar modifications issued in printed form during construction. Mark these documents to show substantial variations in the actual work performed in comparison with the text of the specifications and modifications as issued. Give particular attention to substitutions, selection of options and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note related record drawing information and product data, where applicable.
1. Upon completion of the Work, submit record specifications to the Professional for the Owner's records.
- D. Record Product Data: Maintain one copy of each product data submittal. Mark these documents to show significant variations in the actual Work performed in comparison with the submitted information. Include both variations in the products as delivered to the site, and variations from the manufacturer's instructions and recommendations for installation. Give particular attention to concealed products and portions of the Work which cannot otherwise be readily discerned at a later date by direct observation. Note related change orders and mark-up of record drawings and specifications.
1. Upon completion of mark-up, submit complete set of record product data as part of the Operation and Maintenance Manuals.
- E. Miscellaneous Record Submittals: Refer to other sections of these specifications for requirements of miscellaneous record-keeping and submittals in connection with the actual performance of the Work. Immediately prior to the date or dates of substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Professional for the Owner's records.

## 2.2 OPERATING AND MAINTENANCE MANUALS:

- A. General: The Contractor shall develop or acquire the necessary documents describing the operation and maintenance of equipment, assembled in the form of an instructional manual for use by Owner's personnel. In addition to the general requirements listed in Division 1, comply with the following requirements. Failure to comply with this organizational format and/or content will result in rejection of manual until conditions are met.
- B. Number and Format: **Submit one hard copy and one electronic copy (PDF Format, not copy protected)**
- C. Binders: Organize and bind operating and maintenance data into fully identified and indexed binder sets of manageable size. Binders shall be heavy-duty 3-inch maximum, 3-ring vinyl type sized to handle 8.5"x11" paper. Each binder shall include clear plastic sleeves on front and spine to insert labels.
1. Identify each binder on the front and spine, with the typed or printed title "OPERATING AND MAINTENANCE MANUAL", project title or name, and subject matter covered. Indicate the volume number for multiple volumes.
  2. Dividers: The binders shall be divided according to the format described under "Manual Content".
    - a. Tabbed Dividers: 3-hole, reinforced, punched, heavy paper dividers with plastic tabs and typewritten inserts. Provide a typed description of the product(s) included in the subdivision on each divider. Clear plastic tabs shall be minimum 2-inches and inserts shall be assembled to prevent them from falling out.
  3. Text Material: Where written material is required as part of the manual, use the manufacturer's standard printed material. If it is not available, specially prepared data, neatly typewritten, on 8.5"x11", 20 pound white bond paper.
  4. Drawings: Where drawings or diagrams are required as part of the manual, insert them in top-loading plastic sheet protectors and bind in with the text.
    - a. Where oversize drawings are necessary, fold the drawings to the same size as the text pages and insert into large capacity sheet protectors. Insert a cover sheet to describe the contents of the drawing(s).
- D. Manual Content: Organize each manual according to the outline listed below. Manuals that are submitted incomplete or not in accordance with the following format will not be acceptable.
1. Title Page: Provide a title page in a transparent plastic sheet protector as the first sheet of each manual. Provide the following information:
    - a. Construction Specification Division covered by the manual.
    - b. Name and address of the Project.
    - c. Date of submittal.
    - d. Name, address, and telephone number of the Contractor.
    - e. Name and address of the Professional.
  2. Table of Contents: Provide a typewritten table of contents for each volume in a transparent plastic sheet protector.
    - a. Where more than one volume is required, provide a comprehensive

- table of contents in each volume of the set.
3. List of Products and Suppliers: Provide a list of products and suppliers in transparent plastic sheet protectors. List each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the Subcontractor or installer, and the local vendor. Clearly delineate the extent of responsibility of each of these entities.
  4. Product and System Information: Provide all pertinent information to properly locate, identify, operate and maintain each product or system. Assemble the submittal information required by the individual specification section and the requirements listed below. Organize information in the same sequence as the specification sections listed in the Project Manual Table of Contents. Identify each divider tab with the specification number and name.
    - a. General Description: Provide a complete description of each product or system and related equipment parts including the specification section listed in the Project Manual Table of Contents. Identify each divider tab with specification section number and name:
      - (1) Name, identification tag (where applicable), location and function of product or system.
      - (2) Final record copies of Shop Drawings and Product Data, including Professional's comments and approval stamp.
      - (3) All engineering data including Performance Curves: For fans, pumps, balance valves and similar equipment at the operating conditions, certifications, and test reports for all products or systems required by the specifications, professional or the authorities having jurisdiction.
    - b. Manufacturer's Information: Provide manufacturer's standard printed data for equipment. May be standard instruction booklets but shall be clearly marked to indicate applicable equipment and characteristics. Mark each sheet to identify each part or product included in the installation. Where more than one item in a tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information that is not applicable. In general, the manufacturer's information shall include:
      - (1) Printed operating and maintenance instructions.
      - (2) Inspection and test procedures.
      - (3) Alignment, adjusting, lubrication and checking procedures.
      - (4) Assembly drawings and diagrams including complete nomenclature and number of replacement parts, and instruction for disassembly, repair and reassembly.
      - (5) Trouble-shooting guide.
      - (6) Safety precautions.
      - (7) Copies of warranties, bonds and service contracts.
    - c. Supplemental Information: Where manufacturer's standard printed data is not available, and information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement data

included in the manual, prepare written text to provide necessary information. Organize the text in a consistent format under separate headings for different procedure. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Also, provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems, or to provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation. Do not use original Project Record Documents as part of the Operating and Maintenance Manuals.

- d. System Operating Instructions: Provide typewritten instructions to assist the owner in proper building systems operation. These instructions shall include the following.
  - (1) Start-up procedure.
  - (2) Equipment or system break-in.
  - (3) Routine operating instructions or systems, special valves, dampers or controls.
  - (4) Lubrication Schedule: Indicating type and frequency of lubrication required.
  - (5) Shut-down and emergency instructions.
  - (6) Summer and winter operating and change over instructions.
  - (7) Any other special operating or maintenance instructions.
  - (8) List of items recommended to stocked as spare parts.
- e. Servicing Schedule: Provide a summary schedule of routine servicing and lubrication requirements.
- f. Filter schedule: Identifying filter type, size efficiency, manufacturer and equipment number
- g. Valve Charts: Provide copies of charts of valve tag numbers, with the location and function of each valve. Coordinate valve tags and charts with existing numbers and provide updated valve charts including all new and existing to remain valves.
- h. Ceiling marker schedule.
- i. Material Safety Data Sheets: Where applicable, include standard safety data sheets for hazardous or toxic materials such as refrigerants and water treatment chemicals. These sheets shall clearly indicate the level of hazard or toxicity, the proper use, storage and disposal of such material and what to do in case of an emergency as well as any other information listed by the material manufacturer.
- j. Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.
- k. Automatic Controls: Diagrams and functional descriptions. The following diagrams, schematics and lists shall be framed under glass and hung adjacent to equipment, in mechanical room.
  - (1) Automatic control diagram and points list.
  - (2) Sequence of operation.
- l. Test and Balance Reports.
- m. Certifications of welders and brazers.
- n. Certificate of Completion: Provide standardized form sheets for each

- sub contractors own final review, punchlist and sign-off that work is complete,
5. Submit a draft copy of operating and maintenance manual for review and approval prior to final issuance and at least one month prior to turnover seminar.
  6. Once draft copy is approved by the Professional, **submit paper copies in binders and one electronic copy on a CD, PDF format, not copy protected**, divided into tabs and sections.

## **PART 3 EXECUTION**

### **3.1 SUBSTANTIAL COMPLETION AND FINAL INSPECTIONS**

- A. Prior to substantial completion inspection, confirm in writing, that the following work is completed. The Professional will not perform substantial completion inspection without this confirmation.
  1. Heating, ventilation and air conditioning systems are capable of operation with alarm conditions functional and automatic controls in operation generally, but not finally calibrated.
  2. Tests performed on equipment including those required by authorities and approval certificates obtained.
  3. Rough balance of air and water systems are complete and draft copy of report issued to Engineer.
  4. Valve tagging is complete, equipment is identified and escutcheons installed. Equipment and piping is painted.
  5. Equipment is lubricated per manufacturer's instructions.
  6. Systems are chemically cleaned, flushed, strainers are cleaned and water treatment initiated. Obtain report from manufacturer's representative to confirm acceptability of treatment
  7. Sample of Operating/Maintenance Manuals submitted. Arrange Operating and Maintenance Instruction Seminar and submit schedule for approval provided.
  8. Ensure access doors are suitably located and equipment accessible.
  9. Noise and vibration control devices including flexible connections inspected by manufacturer's representative and written report submitted.
  10. Equipment aligned by qualified millwright is complete.
  11. Ensure electrical connections to mechanical equipment are complete.
  12. Air handling units and fan plenums cleaned, permanent filters installed.
- B. Prior to substantial completion inspection, the contractor shall provide complete punch list of items which are not finished or deficient at the time of the scheduled inspection.
- C. Prior to final inspection, provide declaration in writing that previously identified deficiencies and the following items have been completed.
  1. Equipment cleaned inside, outside and lubricated.

2. Final balancing completed and balance reports submitted.
3. Final calibration of controls completed and control system report submitted.

### **3.2 CLOSEOUT PROCEDURES:**

- A. General Coordination: Refer to Division 1 sections and the 23-Series sections for coordination of mechanical closeout work with seasonal heating and cooling loads on mechanical system. Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.
- B. Basic Requirements: Contractor shall be sure to perform all basic functions to ensure proper system functions, including but not necessarily limited to:
  1. Fill and vent water systems.
  2. Check rotation on each motor.
  3. Have representatives of each manufacturer present when hereinafter specified, so that equipment will be started up by manufacturer.
- C. Cleaning and Lubrication: After final performance test run of each mechanical system, clean system both externally and internally. Clean dirt and debris from air handling systems and clean or replace dirty filters. Flush piping systems by operating drains and similar means, and clean strainers and traps. Remove any start up screens in strainers and suction diffusers at pumps. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as mechanical work; refinish work where damage is noticeable.
- D. System Performance: Test Run: Following Testing, Adjusting and Balancing Work, at the time of mechanical work closeout, check each item in each system to determine that it is set for proper operation. With Owner's Representative, Equipment Manufacturers' Representatives, and Architect/Engineer present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of systems to refine and improve performances wherever possible, including noise and vibration reduction, elimination of hazards, best response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Architect's/Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible.
- E. Construction Equipment Removal: After completion of performance testing and Owner's operating instructions and demonstrations, remove installers' tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not incorporated in the work.

### **3.3 GENERAL OPERATIONAL AND MAINTENANCE INSTRUCTION:**

- A. General Operating Instructions: In addition to specific training of Owner operating personnel specified in individual Division 23 work sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified in 23-Series sections and elsewhere in these specifications, provide general operating instructions for total mechanical plant. Conduct a walk-through explanation and demonstration for orientation and education to Owner's personnel to be involved in continued operation of building and its mechanical plant. Make arrangements to record this seminar on videotape and turnover the completed tapes to the owner at the conclusion of the project.
1. After all final tests and adjustments have been complete, a competent employee of the Contractor, and equipment vendor if necessary, shall be provided to instruct the Owner's Representative in all details of operation and maintenance for equipment installed. Supply qualified personnel to operate equipment for sufficient length of time after instructions to assure that Owner's Representative is qualified to take over operation and maintenance procedures. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive.
  2. Instruction period shall be performed during the 12 months following substantial completion at time periods as requested by Owner. Fifty percent of instruction shall be in a formal classroom setting. Use the Product and System Information division of the final operation and maintenance manual as the basis of instruction.
  3. Describe each basic mechanical system and how its control system functions, including flow diagrams, signals, alarms, intercom system (if any), and similar audiovisual provisions of the work.
  4. Describe basic sequencing requirements and interlock provisions for system start-up, phasing, coast-down, shut-down, seasonal operations, and emergency procedures.
  5. Emphasize emergency procedures and safety provisions for protection of plant and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances, and describe system limitations and precautions including weather adjustments.
  6. Outline basic maintenance procedures and major equipment turnaround requirements.
  7. Point out operational security provisions, safety, unavoidable hazards and similar operator limitations.
  8. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, spare parts inventory, storage of extra materials and similar service items.
- B. Submit agenda schedule and list of representatives to the Professional for approval thirty (20) days prior to seminar. Confirm attendance of seminar by written notification to participants.
- C. Submit a written record of the seminar, complete with an attendance list to the Professional.

### **3.4 CONTROLS OPERATION AND MAINTENANCE INSTRUCTIONS**

- A. Upon completion of Operation and Maintenance instructions, competent employees of the Control Contractor shall be provided to instruct the Owner's representative in all details of operation and maintenance for the controls installed. Supply qualified personnel to operate system for sufficient length of time after instructions to assure the Owner's Representative is qualified to take over operation and maintenance procedures.
- B. Controls Operation and Maintenance Instruction shall include the entire control system including control sequences that are inherent to equipment provided by the Equipment Manufacturer including economizer cycles, low ambient operation, freezestats and similar sequences. Contractor shall provide sufficient personnel equipment walkie-talkies, gauges, and other accessories for this work.

**END OF SECTION 230001**



# **SECTION 230503      ELECTRICAL REQUIREMENTS OF MECHANICAL SYSTEMS**

## **PART 1      GENERAL REQUIREMENTS**

### **1.1      SECTION INCLUDES**

- A. General: The contents of this section describe the division of work and product requirements for work normally recognized as electrical but required for mechanical work including, but not necessarily limited to:
  - 1. Motors
  - 2. Motor Starters
  - 3. Power and Control Wiring
  - 4. Emergency Stop Switches (ESS).

### **1.2      DIVISION OF WORK**

- A. This section delineates the division of electrical work between Division 23 and 26.
  - 1. The HVAC Contractor shall furnish and install all motors, starters, pushbuttons for local and remote control, controllers, pressure switches, aquastats or similar items together with all appurtenances, accessories and control wiring required to operate the equipment furnished under their respective sections of the contract, which is necessary to perform the operating functions as specified, shown on the drawings or as otherwise required.
    - a) Exceptions:
      - 1) Motor starters for mechanical equipment provided in motor control centers shall be furnished under Division 26.
      - 2) Duct smoke detectors shall be furnished and wired by Division 28, installed by Division 23. Fire alarm AHU shut down circuits shall be wired from the fire alarm control panel to a termination point, adjacent to the AHU control, under Division 28. AHU control wiring from the termination point to the equipment shall be under Division 23.
  - 2. Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter or disconnect switch. Under Division 26, line side terminations shall be provided. Wiring from the termination point to the mechanical equipment, including final connections and proper rotation, shall be provided under Division 23.
  - 3. The HVAC contractor shall confirm all electrical characteristics of HVAC equipment with the Electrical Contractor prior to ordering. If procurement requirements necessitate a change in the electrical characteristics of any motor or equipment being furnished under the HVAC Contract, the respective contractor shall first obtain approval of such changes from the

Professional. This same Contractor shall also be responsible for all necessary arrangements and shall pay all costs, if any, for all required changes to the Electrical Contract.

B. Temperature Control Wiring:

1. All 120V and low voltage interconnecting control wiring in connection with the temperature control system for all heating and air conditioning systems shall be furnished, installed and connected under the HVAC Contract by the ATC vendor. The ATC vendor shall also provide power wiring from spare circuits in electric panels dedicated to mechanical equipment powered control components requiring line voltage such as actuators and timeclocks.
2. All relays; actuators; timers; timeclocks; alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches; aquastats; freezestats; line and low voltage thermostats; thermals; remote selector switches; remote push-button stations; emergency break-glass stations; interlocking; disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 23 shall be furnished, installed and wired under Division 23.
3. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 23.

C. Electrical Work for Roof Ventilators and/or Exhaust Fans:

1. For single-phase units, a motor starting-disconnecting type snap switch shall be furnished as an integral part of the roof ventilator or exhaust fan.
2. Roof exhaust fans with built-in disconnects provided under Division 23 shall be wired under Division 26 to the line side of the disconnect switch. A disconnect switch shall be provided under Division 26 if the fan is not provided with a built-in disconnect switch. In this case, the wiring from the switch to the fan shall be under Division 23.

D. Electrical Equipment by Others:

1. All electrical equipment furnished and installed under contracts other than the Electrical Contract shall be furnished with full complement of control equipment, control wiring, conduit and all other items necessary for satisfactory operation.

### **1.3 QUALITY ASSURANCE**

- A. Coordination with Electrical Work: Wherever possible, match manufacturers and types of electrical devices required under mechanical work with similar elements of electrical work specified in Division-26 sections. Comply with applicable requirements of Division-26 sections for electrical work of this section which is not otherwise specified. Refer to Section 23 05 00 on requirements for product uniformity.
- B. Standards: For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology herein.

Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data for each type of separate motor, starters, and other electrical devices required for mechanical work. Include electrical characteristics, ratings, list of application and general locations.
- B. Wiring Diagrams: After the contractor has placed orders for all materials and equipment, he shall prepare complete wiring and control diagrams for all equipment included in this contract.
  - 1. Identity of terminals shall agree with those used by manufacturer of equipment.
  - 2. A minimum number of copies of these wiring diagrams as required by respective contractors shall be submitted to the Professional for approval. One (1) copy shall be retained by Architect and one (1) by Engineer for record purposes.
  - 3. In approving diagrams, the Professional assumes no responsibility for correctness of terminal identification.
- C. Maintenance Data: Submit operation and maintenance data for each type of electrical device. Include this data in Maintenance Manual in accordance with requirements of Section 23 05 00.

### **PART 2 PRODUCTS**

#### **2.1 MOTORS**

- A. General: Provide electric motors for driving the mechanical equipment. Motors shall be of proper power, construction and speed to suit the specified makes of equipment. If other makes of equipment are accepted, the proper adjustment of motor speed and power must be included without additional cost. Submit drawings for review before the equipment is purchased.
- B. Motor Characteristics: Except where more stringent requirements are indicated, and except where mechanical equipment cannot be obtained with fully complying motor, comply with the following requirements for motors of mechanical work.
- C. Temperature Rating: Rated for 40°C environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation). Where normal operating temperature will exceed this rating, provide Class B, F or H insulation as required.

- D. Starting Capability: Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hours for manually controlled motors.
1. Fan motors shall be capable of accelerating their respective fans from 0 revolutions per minute to design or synchronous revolutions per minute within a maximum of 10 seconds. Submit to the Engineer for review curves which plot time versus revolutions per minute for the particular motor and fan combination.
- E. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 1/2 hp and larger, and provide capacitor-start single-phase motors for 1/3 hp and smaller, except 1/6 hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division-26 sections, and with individual equipment requirements specified in other Division-23 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.
1. Coordinate the NEMA type of each motor with the torque and inertia load of the equipment served, and the inrush characteristics of the motor with the starter selection, so that all items furnished constitute a properly related package. No motor shall operate in the service factor range.
- G. Motor Construction: Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque motors and accessories shall comply with NEMA Standards.
1. Frames NEMA No. 48
  2. Bearings: Ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is normally inaccessible for regular maintenance.
    - a. Where belt drives and other drives produce lateral and axial thrust, in motor, provide bearings designed to resist thrust loading. Refer to individual sections of Division 23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
  3. Enclosure Type: Except as otherwise indicated, provide TEFC motors. Provide totally enclosed fan cooled (TEFC) weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 23 for other enclosure requirements.
  4. Overload Protection: Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
  5. Noise Rating: Provide "Quiet" rating on motors, guaranteed to fulfil the specified requirements without producing any objectionable sound audible outside of machine rooms and which prohibits maintaining room NC levels as specified.

6. Efficiency: In accordance with IEEE Standard 112, test method B and NEMA Standards Publication MG1-2006.
  - a. Motors of less than 1 horsepower shall be industry “standard” efficiency motors.
  - b. Motors 1 horsepower or greater shall be “Premium Efficiency” as defined by energy efficiency levels mandated by the Energy Policy Act of 1992 in accordance with NEMA Publication MG 1-2006, Table 12-12, Full Load Efficiency for NEMA Premium Efficiency Motors.
    - 1) Motor nameplates shall be labeled with a Department of Energy approved code including the motor manufacturer’s specific compliance number issued by DOE. Each motor nameplate shall also display the NEMA nominal efficiency.
  - c. All motors supplied with variable speed drives shall be inverter duty rated.
- H. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
- I. Acceptable Manufacturer: Subject to compliance with requirements provide motors for mechanical equipment by one of the following: Except where item of mechanical equipment (which otherwise complies with requirements) must be integrally equipped with motor produced by another manufacturer:
  1. Baldor Electric Co.
  2. Eaton Corp.
  3. General Electrical Co.
  4. Lincoln Electric Co.
  5. Magne Tek
  6. Marathon Electric Mfg. Corp.
  7. Reliance Electric Co.
  8. Westinghouse Electric Corp.

## **2.2 ELECTRICAL DEVICES AND WIRING**

- A. Motor Connections: Provide flexible-conduit motor connections except where plug-in electrical cords are specifically indicated. Comply with applicable provisions of Division-26 sections for wiring materials and wiring devices. Refer to individual equipment sections for special high-voltage (600 volts and over) and star-delta connected motor requirements.

## **2.3 MOTOR STARTERS AND SAFETY DISCONNECT SWITCHES**

- A. All motor starters and safety switches provided by Mechanical Contractor shall be in accordance with all requirements of Division 26. Provide NEMA-type enclosure consistent with environment in which starters will be mounted. Provide size of starter recommended by motor and/or equipment manufacturer for applicable

protection and start-up condition; refer to equipment schedules for basic load requirements. Provide Hand/Off/Auto switch.

1. Manual Switches: Provide molded plastic manual switch with pilot light for motors ½ hp and smaller, except where interlock or automatic operation is indicated. Include overload trip assembly, one per phase.
2. Combination Magnetic Starters: Provide combination magnetic starters with circuit breaker disconnect for motors ¾ hp and larger, and for smaller motors where interlock or automatic operations is indicated.
3. Magnetic motor starters: Same as above without circuit breaker disconnect where disconnecting means is provided by others.
4. Safety Disconnect Switches: Where motor starters are part of the HVAC packaged equipment and a separate safety disconnect is required, furnish in accordance with the requirements of Division 26.

## **2.4 EMERGENCY STOP SWITCHES (ESS)**

- A. GENERAL: Where indicated, provide emergency stop switches in accordance with the following:
  1. 1-3/8" diameter red mushroom push button, twist to reset, single gang coverplate. Contacts as required.
  2. Hinged clear acrylic protective cover.
  3. Engraved nameplate fastened to wall above switch. Refer to drawings for nameplate nomenclature.

## **2.5 EQUIPMENT FABRICATION**

- A. General: Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives, arranged for lubrication and similar running-maintenance without removal of guards, in accordance with OSHA Standards.

## **2.6 CONTROL WIRING**

- A. Digital signal wiring shall be NEC class 2. Analog signal wiring shall be #18 copper wire or control cable. All control wiring shall be plenum rated regardless of whether it is in a plenum or in conduit.
- B. All control conductors shall be color-coded. Where conductors pass through a junction box or connect to a device, the conductor and box shall be tagged to indicate the circuit and terminal number as designated on the controls shop drawings.

- C. There shall be no splices in the control system other than at terminal boxes. Wire nuts and crimps are not permitted.
- D. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Each motor shall be factory wired to a junction box mounted on the motor or on the driven piece of equipment to facilitate single point field power connection under Division 26.
- C. The Mechanical Contractor shall install starters and wiring devices at locations indicated, securely supported and anchored, and in accordance with manufacturer's installation instructions and the National Electric Code. Locate for proper operational access, including for visibility and safety.
- D. Check overload relay heaters with motor nameplate full load current. Change heaters per manufacturer's recommendation if not correctly rated at no cost to Institution.
- E. Investigate and correct cause of motors operating above full load rating instead of increasing overload relay trip setting.

### **3.2 COORDINATION**

- A. After the contractor receives the engineer's approval, they shall then deliver the required minimum number of copies of the approved wiring diagram to the electrical contractor.
- B. The contractor shall render whatever assistance is required by the electrical contractor in making connections to control devices furnished by the contractor.

**END OF SECTION 230523**



**PART 1 - GENERAL****1.1 SCOPE**

- A. Mechanical equipment and system components in this project require seismic restraint per section 1613, Volume 1, North Carolina Building Code.
- B. Wind restraint is required for all rooftop components per Section 1609, Volume 1, North Carolina Building Code.
- C. The scope of this specification encompasses the necessary product specifications for seismic and wind restraints.

**1.2 REQUIREMENTS**

- A. Responsibilities
  - 1. The Contractor shall cause all wind and seismic restraint systems to be designed by a Manufacturer experienced in this type of work. This provision, however, shall not be construed as relieving the Contractor of his overall responsibility for the work.
  - 2. The Contractor shall provide to the manufacturer of wind and seismic restraint systems a listing of all mechanical equipment and components to be restrained, including areas, total weight, center-of-gravity and all other data required by them.
- B. Design – Seismic Restraint Systems
  - Seismic Performance Category C.
- C. Design – Wind Restraint Systems
  - 1. The wind requirements for mechanical equipment and components for this project for all components and systems shall comply with section 1609 of the North Carolina Building Code.

**1.3 SCOPE**

- A. The following requires wind restraints:
  - 1. All exterior mounted equipment.

**1.4 SEISMIC CERTIFICATION**

- A. Seismic Certification and Analysis:

1. Seismic restraint requirements, calculations and Design shall be provided for all Mechanical components. Calculations shall be performed registered professional engineer in the State of North Carolina.
2. Calculations to support seismic restraint designs must be stamped by a registered professional engineer in the State of North Carolina.
3. A seismic design Errors and Omissions insurance certificate must accompany submittals prepared by a licensed independent Consulting Engineer in the state of North Carolina.
4. The licensed professional engineer responsible for the design of the restraints shall review the seismic restraint installation, and a sealed certificate of compliance shall be issued.

## **1.5 WIND CERTIFICATION**

### **A. Wind Certification and Analysis:**

1. Wind restraint requirements, calculations and Design shall be provided for all Mechanical equipment and components. Calculations shall be performed registered professional engineer in the State of North Carolina.
2. Calculations to support wind restraint designs must be stamped by a registered professional engineer in the State of North Carolina.
3. A wind design Errors and Omissions insurance certificate must accompany submittals prepared by a licensed independent Consulting Engineer in the state of North Carolina.
4. The licensed professional engineer responsible for the design of the restraints shall review the restraint installation, and a sealed certificate of compliance shall be issued.

## **1.6 CODE AND STANDARDS REQUIREMENTS**

### **A. Applicable Codes**

1. International Building Code as adopted by the state of North Carolina with Amendments.
2. SMACNA Guidelines for wind restraint of HVAC systems.
3. SMACNA guidelines for seismic restraint of HVAC systems.

**B.** Where conflicts between these documents exist, the more stringent requirement shall apply.

## **1.7 MANUFACTURER'S RESPONSIBILITY**

### **A. Manufacturer of restraint equipment shall have the following responsibilities:**

1. Determine restraint sizes and locations.

2. Provide equipment and component restraints as scheduled or specified.
3. Provide installation instructions, drawings and field supervision to the contractor to insure proper installation and performance of systems.

## **1.8 RELATED WORK**

- A. Housekeeping Pads:
  1. Anchoring of and attachment of pads.
- B. Attachments:
  1. Restraint attachment plates cast into housekeeping pads, concrete inserts, beam clamps, etc. are required to be certified under this section.

## **PART 2 - PRODUCTS**

### **2.1 DESCRIPTION**

- A. All seismic restraint devices described in this section shall be products of a single manufacturer.
- B. All wind restraint devices described in this section shall be products of a single manufacturer.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. All restraint systems must be installed in strict accordance with the manufacturers written instructions.
- B. Installation of restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration control integrity.
- D. The contractor shall not install any rotating equipment which makes rigid connection to the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

- F. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
  
- G. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval.

**END OF SECTION 230548**

## **SECTION 238113.13      PACKAGED TERMINAL AIR-CONDITIONERS, OUTDOOR, WALL-MOUNTED UNITS**

### **PART 1 - GENERAL**

#### **1.01      SUMMARY**

- A. Section Includes: Packaged, terminal air-conditioners, outdoor, wall-mounted units.

#### **1.02      ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For packaged, terminal air conditioners.
  - 1. Include plans, elevations, sections, details for wall penetrations, seismic bracing, and attachments to other work.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
- C. Color Samples: For unit cabinet, discharge grille, and exterior louver, and for each color and texture specified.

#### **1.03      INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: For packaged, terminal air conditioners, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

#### **1.04      CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For packaged, terminal air conditioners to include in emergency, operation, and maintenance manuals.

## 1.05 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, terminal air conditioners that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and labor.
  - 2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than five years from date of Substantial Completion, including only components and excluding labor.
  - 3. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 PACKAGED TERMINAL AIR-CONDITIONERS, OUTDOOR, WALL-MOUNTED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bard Manufacturing Company.
  - 2. Compu-Aire, Inc.
  - 3. Liebert; Vertiv Holdings Co.
  - 4. Marvair.
- B. Description: Factory-assembled and -tested, self-contained, packaged, terminal air conditioner with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with hardwired chassis and circuit breaker.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- F. ASHRAE Thermal Comfort: Applicable requirements in ASHRAE 55.
- G. ASHRAE ERV Testing: Applicable requirements in ASHRAE 84.
- H. AHRI Rating: Applicable requirements in AHRI 1060.
- I. UL listed and ETL performance certified.

## 2.02 CHASSIS

- A. Cabinet: Sloped top, 0.052-inch-thick steel with removable front panel with concealed latches.
  - 1. Mounting: On exterior wall.
  - 2. Discharge Grille: Extruded-aluminum discharge grille.
  - 3. Return Grille: Extruded-aluminum grille.
  - 4. Louvers: Extruded aluminum with enamel finish.
  - 5. Finish: Epoxy coating.
  - 6. Access Door: Hinged door in top of cabinet for access to controls.
  - 7. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.
  - 8. Insulation: Cooling and heating sections fully insulated with 1-inch-thick fiberglass insulation.
  - 9. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  - 10. Wall Sleeves: Galvanized steel with polyester finish.
  
- B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor and hermetically sealed, soft-start scroll compressor with crankcase heater, liquid line filter dryer, externally equalized expansion valve, high-pressure switch, low-pressure switch, low-pressure bypass timer, fan cycle, control, common alarm, vibration isolation, and overload protection.
  - 1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins with capillary tube distributor on indoor coil.
  - 2. Charge: R-410A.
  
- C. Indoor Fan: Forward curved, centrifugal; with constant-speed motor(s) and positive-pressure ventilation damper with concealed manual operator.
  
- D. Filters: 2-inch, pleated, disposable MERV 8, serviceable from front of the unit.
  
- E. Condensate Drain: Coated galvanized-steel drain pan to direct condensate to outdoor coil for re-evaporation.
  - 1. Comply with ASHRAE 62.1 for drain pan construction and connections.
  
- F. Outdoor Fan: Forward curved, centrifugal, or propeller type with separate motor.
  - 1. Indoor and Outdoor Fan Motors: Two speed; comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 00 00 "Mechanical General Requirements."
    - a. Fan Motors: Permanently lubricated split capacitor.
    - b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
    - c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

### **2.03**     **HEATING**

- A.     Electric-Resistance Heating Coil: Nickel-chromium-wire, electric-resistance heating elements with contactor and high-temperature-limit switch.

### **2.04**     **CONTROLS**

- A.     Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation. Include the following features:
  - 1.     Low-Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg F outdoor air temperature.
  - 2.     Temperature-Limit Control: Prevents occupant from exceeding preset setup temperature.
  - 3.     Building Automation System Interface: Allows remote on-off control with setback temperature control.
  - 4.     Reverse-Cycle Defrost: Solid-state sensor monitors frost buildup on coil and reverses unit to melt frost.
- B.     Remote Control: Standard unit-mounted controls with remote-mounted, low-voltage, adjustable thermostat with heat anticipator; heat-off-cool-auto switch; and on-auto fan switch.
- C.     Outdoor Air:
  - 1.     Motorized intake damper. Open intake when unit indoor-air fan runs.
- D.     Economizer Operation: Motorized intake-air damper controlled by an enthalpy sensor and a mixed-air sensor to provide natural cooling when the outdoor air temperature is favorable.
- E.     Three-Phase Power Rotation Monitor: Three-phase monitoring to protect compressor from reverse rotation and to protect the unit from phase failure. Monitor manually reset.

### **2.05**     **CAPACITIES AND CHARACTERISTICS**

- A.     Refer to schedule on drawings.

### **2.06**     **SOURCE QUALITY CONTROL**

- A.     Sound-Power Level Ratings: Factory test to comply with AHRI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."
- B.     Unit Performance Ratings: Factory test to comply with AHRI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install wall sleeves in finished wall assembly; seal and weatherproof.
- C. Install and anchor wall sleeves to withstand, without damage to equipment and structure, seismic forces required by building code.

### **3.02 CONNECTIONS**

- A. Install piping adjacent to machine to allow service and maintenance.

### **3.03 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
  - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 2. After installing packaged, terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Unit is level on base and is flashed in exterior wall.
  - 4. Unit casing has no visible damage.
  - 5. Compressor, air-cooled condenser coil, and fans have no visible damage.
  - 6. Labels are clearly visible.
  - 7. Controls are connected and operable.
  - 8. Shipping bolts, blocks, and tie-down straps are removed.
  - 9. Filters are installed and clean.
  - 10. Drain pan and drain line are installed correctly.
  - 11. Electrical wiring installation complies with manufacturer's submittal and installation requirements in electrical Sections.
  - 12. Installation: Perform startup checks according to manufacturer's written instructions, including the following:
    - a. Lubricate bearings on fan.
    - b. Check fan-wheel rotation for correct direction without vibration and binding.
  - 13. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 14. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. After performance test, change filters.

- D. Packaged, terminal air conditioners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

**3.04 ADJUSTING**

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

**3.05 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain packaged, terminal air conditioners.

**END OF SECTION**

## **SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Brunswick County Technical Specification 028 "General Electrical Information"

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Backboards.
  - 2. Category 6 balanced twisted pair cable.
  - 3. Balanced twisted pair cabling hardware.
  - 4. RS-485 cabling.
  - 5. Low-voltage control cabling.
  - 6. Control-circuit conductors.
  - 7. Identification products.

#### **1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- D. RCDD: Registered Communications Distribution Designer.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency, RCDD, layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

## **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
- D. RoHS compliant.

### **2.2 BACKBOARDS**

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.
- B. Painting: Paint plywood on all sides and edges with black latex paint. Comply with requirements in Section 099000 "Interior Painting."

### **2.3 CATEGORY 6 BALANCED TWISTED PAIR CABLE**

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

- B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Shielded twisted pairs (FTP) Screened twisted pairs (F/UTP) Screened and shielded twisted pairs (F/FTP).
- E. Cable Rating: Plenum.
- F. Jacket: Gray thermoplastic.

## 2.4 **BALANCED TWISTED PAIR CABLE HARDWARE**

- A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.
- B. General Requirements for Balanced Twisted Pair Cable Hardware:
  - 1. Comply with the performance requirements of Category 6a.
  - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  - 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain balanced twisted pair cable hardware from same manufacturer as balanced twisted pair cable, from single source.
- D. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
  - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
  - 1. Features:
    - a. Universal T568A and T568B wiring labels.
    - b. Labeling areas adjacent to conductors.
    - c. Replaceable connectors.
    - d. 24 or 48 ports.
  - 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
  - 3. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
- H. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
  2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
- I. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
  2. Designed to snap-in to a patch panel or faceplate.
  3. Standards:
    - a. Category 5e, unshielded balanced twisted pair cable shall comply with IEC 60603-7-2.
    - b. Category 5e, shielded balanced twisted pair cable shall comply with IEC 60603-7-3.
    - c. Category 6, unshielded balanced twisted pair cable shall comply with IEC 60603-7-4.
    - d. Category 6, shielded balanced twisted pair cable shall comply with IEC 60603-7.5.
    - e. Category 6a, unshielded balanced twisted pair cable shall comply with IEC 60603-7-41.
    - f. Category 6a, shielded balanced twisted pair cable shall comply with IEC 60603-7.51.
- J. Faceplate:
1. Four port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
  2. Eight port, vertical double-gang faceplates designed to mount to double-gang wall boxes.
  3. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
  4. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
  5. For use with snap-in jacks accommodating any combination of balanced twisted pair, optical fiber, and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

## 2.5 **RS-485 CABLE**

A. Standard Cable: NFPA 70, Type CMG.

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

## 2.6 **LOW-VOLTAGE CONTROL CABLE**

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. Multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

## 2.7 **CONTROL-CIRCUIT CONDUCTORS**

- A. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- B. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- D. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

## **2.8 SOURCE QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Test cables on receipt at Project site.
  1. Test each pair of twisted pair cable for open and short circuits.

### **3.2 INSTALLATION OF RACEWAYS AND BOXES**

- A. Comply with requirements in Brunswick County Technical Specification 028 "General Electrical Information" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
  1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
  2. Outlet boxes for cables shall be no smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
  3. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
  1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
  2. Install cable trays to route cables if conduits cannot be located in these positions.
  3. Secure conduits to backboard if entering the room from overhead.
  4. Extend conduits 3 inches above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
1. Comply with TIA-568-C Series of standards.
  2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
  3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
  5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
  6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
  8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
  9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
  10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
  11. Support: Do not allow cables to lie on removable ceiling tiles.
  12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
  13. Provide strain relief.
  14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
  15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
- C. Balanced Twisted Pair Cable Installation:
1. Comply with TIA-568-C.2.

2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.
3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inches of cable in a coil not less than 12 inches in diameter.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.

- b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.
- 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
- 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

### **3.4 REMOVAL OF CONDUCTORS AND CABLES**

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

### **3.5 CONTROL-CIRCUIT CONDUCTORS**

- A. Minimum Conductor Sizes:
  - 1. Class 1 remote-control and signal circuits; No 14 AWG.
  - 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
  - 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

### **3.6 FIRESTOPPING**

- A. Comply with TIA-569-D, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping" Chapter.

### **3.7 GROUNDING**

- A. For low-voltage control wiring and cabling, comply with requirements in Brunswick County Technical Specification 030 "Grounding and Bonding."

### **3.8 IDENTIFICATION**

- A. Comply with requirements for identification specified in Brunswick County Technical Specification 028 "General Electrical Information."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

### **3.9 FIELD QUALITY CONTROL**

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
  - 1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**END OF SECTION**

## **SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Steel slotted support systems.
  - 2. Conduit and cable support devices.
  - 3. Support for conductors in vertical conduit.
  - 4. Structural steel for fabricated supports and restraints.
  - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
  - 6. Fabricated metal equipment support assemblies.
- B. Related Requirements:
  - 1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Slotted support systems, hardware, and accessories.
    - b. Clamps.
    - c. Hangers.
    - d. Sockets.
    - e. Eye nuts.
    - f. Fasteners.
    - g. Anchors.
    - h. Saddles.
    - i. Brackets.
  - 2. Include rated capacities and furnished specialties and accessories.

- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
  - 1. Hangers. Include product data for components.
  - 2. Slotted support systems.
  - 3. Equipment supports.
  - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Ductwork, piping, fittings, and supports.
  - 3. Structural members to which hangers and supports will be attached.
  - 4. Size and location of initial access modules for acoustical tile.
  - 5. Items penetrating finished ceiling, including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Projectors.
- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 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.
- C. Welding certificates.

#### **1.5 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M.
  - 2. AWS D1.2/D1.2M.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.0.

### **2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 304.
  - 3. Channel Width: Selected for applicable load criteria.
  - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Stainless-steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Toggle Bolts: Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

### **2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Miscellaneous Metals" for steel shapes and plates.

## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA 1.
  2. NECA 101
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.

### **3.2 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.

- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
  - 6. To Light Steel: Sheet metal screws.
  - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

### **3.4 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### **3.5 PAINING**

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099000 "Painting and Coating" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

**END OF SECTION**

## **SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Brunswick County Technical Specification 028 "General Electrical Information"

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal conduits and fittings.
  - 2. Nonmetallic conduits and fittings.
  - 3. Metal wireways and auxiliary gutters.
  - 4. Nonmetal wireways and auxiliary gutters.
  - 5. Surface raceways.
  - 6. Boxes, enclosures, and cabinets.
  - 7. Underground duct accessories.
  - 8. Duct Sealing for underground ducts and duct banks.

#### **1.3 DEFINITIONS**

- A. GRC: Galvanized rigid steel conduit.
- B. RTRC: Reinforced thermosetting resin conduit (Fiberglass).

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Sustainable Design Submittals:
- C. Shop Drawings:
  - 1. For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
  - 2. Factory-Fabricated Manholes, Handholes, and Boxes:

- a. Include plans, elevations, sections, and details, including attachments to other work.
- b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
- c. Include reinforcement details.
- d. Include frame and cover design and manhole chimneys.
- e. Include ladder or step details.
- f. Include grounding details.
- g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, sumps, and other accessories.
- h. Include joint details.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  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.
  4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- B. Source quality-control reports.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUITS AND FITTINGS**

- A. Metal Conduit:
  1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. GRC: Comply with ANSI C80.1 and UL 6.
  3. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
    - a. Comply with NEMA RN 1.
    - b. Coating Thickness: 0.040 inch, minimum.
  4. FMC: Comply with UL 1; zinc-coated steel.
  5. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
  2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. Fittings, General: Listed and labeled for type of conduit, location, and use.
  4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  5. Expansion Fittings: Fiberglass, PVC, or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  6. Rigid and intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## **2.2 NONMETALLIC CONDUITS AND FITTINGS**

- A. PVC Conduit per Brunswick County Technical Specification 028:
1. Schedule 80, complying with NEMA TC 2 and UL 651.
- B. Liquid-Tight Flexible Non-Metallic Conduit
1. LFNC: Comply with UL 1660.
  2. Fittings: Comply with UL 514B and NEMA FB 2.20.

## **2.3 METAL WIREWAYS AND AUXILIARY GUTTERS**

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Flanged-and-gasketed type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

## **2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS**

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- D. Solvents and Adhesives: As recommended by conduit manufacturer.

## **2.5 SURFACE RACEWAYS**

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. Tele-Power Poles:
  - 1. Material: Galvanized steel with ivory baked-enamel finish.
  - 2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

## **2.6 BOXES, ENCLOSURES, AND CABINETS**

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- J. Gangable boxes are prohibited.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Plastic.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
  - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## **2.7 UNDERGROUND DUCT ACCESSORIES**

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

## **2.8 DUCT SEALING**

- A. Duct Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Compound must be capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials,

and common metals. Duct sealing compound must be removable without damaging ducts or cables.

## **PART 3 - EXECUTION**

### **3.1 RACEWAY APPLICATION**

- A. General: Contractor shall attend a certified training for fiberglass conduit installation or produce a certificate indicating successful completion of previous training.
- B. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Aboveground Conduit: GRC.
  - 2. Underground Conduit: PVC schedule 80, concrete encased under pavement, direct buried for runs not under pavement.
  - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4x SS unless otherwise stated on drawings.
- C. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed: GRC unless otherwise indicated on drawings.
  - 2. Concealed in Ceilings and Interior Walls and Partitions: Fiberglass (RTRC) or PVC schedule 80.
  - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 4. Damp or Wet Locations: GRC.
  - 5. Boxes and Enclosures: NEMA 250, Type 12 stainless steel unless otherwise indicated on drawings.
- D. Minimum Raceway Size: 3/4-inch trade size for above ground applications, 1-inch trade size for below ground applications.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass-through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

### **3.2 INTERIOR RACEWAY INSTALLATION**

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for

aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Field Bends: Field bends should be performed when manufactured bends are not available. Field bends shall be performed according to NEC 355.26 and pursuant to manufacturer instructions.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads with a corrosion-preventing conductive compound prior to assembly.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

- P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- S. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- T. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
  2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- U. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- V. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Conduit extending from interior to exterior of building.
  4. Conduit extending into pressurized duct and equipment.
  5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  6. Where otherwise required by NFPA 70.
- W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- X. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semi recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

- FF. Set metal floor boxes level and flush with finished floor surface.
- GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### **3.3 EXTERIOR DUCT AND DUCT BANK INSTALLATION**

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Engineer if there is conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Engineer.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain in accordance with Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 311000 "Site Clearing".
- D. Restore area after construction vehicle traffic in immediate area is complete. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
- E. Cut and Patch existing pavement in path of underground duct, duct bank, and underground structures. Patched pavement shall be of substantially similar material and workmanship as original pavement.
- F. Complete duct bank installation before starting conductor installation.
- G. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to manhole or handhole.
- H. Install expansion fitting near center of straight line duct with calculated expansion of more than 3/4 inch.
  - 1. Curves and Bends:
  - 2. Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with minimum radius of 48 inch, both horizontally and vertically, at other locations unless otherwise indicated.
  - 3. Field bending must be in accordance with NFPA 70 minimum radii requirements, except bends over 45 degrees must be made with minimum radius of 48 inch.

Use only equipment specifically designed for material and size involved. Use PVC heating bender for bending PVC conduit.

4. Duct must have maximum of 180 degrees of bends between pull points.
- I. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.
  1. Install insulated grounding bushings on steel raceway terminations that are less than 12 inch below grade or floor level and do not terminate in hubs.
- J. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inch o.c. for 5 inch duct, and vary proportionately for other duct sizes.
  1. Begin change from regular spacing to end-bell spacing 10 ft from end bell, without reducing duct slope and without forming trap in line.
  2. Grout end bells into structure walls from both sides to provide watertight entrances.
- K. Building Wall Penetrations: Make transition from underground duct to steel raceway at least 10 ft outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to steel raceway type installed. Install steel raceway penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling".
- L. Install manufactured steel raceway elbows for stub-ups at poles unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
  1. Couple steel elbows to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.
- M. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15 psig hydrostatic pressure.
- N. Pulling Cord: Install 200 lbf test nylon cord in empty ducts.
- O. Direct Buried Ducts and Duct Bank:
  1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inch in nominal diameter.
  2. Width: Excavate trench 3 inch wider than duct on each side.
  3. Depth: Install top of duct at least 36 inch below finished grade unless otherwise indicated.
  4. Set elevation of top of duct bank below frost line.

5. Place minimum 3 inch of sand as bed for duct. Place sand to minimum of 6 inch above top level of duct.
  6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 ft of duct. Place spacers within 24 inch of duct ends. Stagger spacers approximately 6 inch between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  8. Install manufactured duct elbows at changes of direction in duct direction unless otherwise indicated.
  9. Install manufactured steel elbows for stub-ups, and at building entrances.
    - a. Couple RNC or RTRC duct to steel raceway with adapters designed for this purpose.
    - b. Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of base. Install insulated grounding bushings on terminations at equipment.
      - 1) Stub-ups must be minimum 4 inch above finished base and minimum 3 inch from conduit side to edge of base.
    - c. Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally on exterior of wall minimum of 60 inch from edge of wall. Install insulated grounding bushings on terminations at equipment.
    - d. Stub-ups through interior floors must be minimum 4 inch above finished floor and no less than 3 inch from conduit side to edge of equipment pad or floor slab.
  10. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inch over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
- P. Underground-line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inch above concrete-encased duct and duct banks and approximately 12 inch below grade. Align tape parallel to and within 3 inch of centerline of duct bank. Provide additional warning tape for each 12 inch increment of duct-bank width over nominal 18 inch. Space additional tapes 12 inch apart, horizontally across width of ducts.
- Q. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems".

### **3.4 PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

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## **SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Restraint channel bracings.
  - 2. Restraint cables.
  - 3. Seismic-restraint accessories.
  - 4. Mechanical anchor bolts.
  - 5. Adhesive anchor bolts.
- B. Related Requirements:
  - 1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Field quality-control reports.

#### **1.5 QUALITY ASSURANCE**

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

### **2.2 RESTRAINT CHANNEL BRACINGS**

- A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

### **2.3 RESTRAINT CABLES**

- A. Restraint Cables: ASTM A492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

### **2.4 SEISMIC-RESTRAINT ACCESSORIES**

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## **2.5 MECHANICAL ANCHOR BOLTS**

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

## **2.6 ADHESIVE ANCHOR BOLTS**

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 APPLICATIONS**

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### **3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION**

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

- B. Equipment and Hanger Restraints:
  - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### **3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION**

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### **3.5 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2. Schedule test with Owner, through Engineer, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
  - 3. Obtain Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 5. Test to 90 percent of rated proof load of device.
- B. Seismic controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.6 ADJUSTING**

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

**END OF SECTION**

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## **SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
  - 3. Include diagrams for power, signal, and control wiring.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for transformers, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 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.
  4. Certification: Indicate that equipment meets equipment seismic requirements.
- C. Source quality-control reports.
- D. Field quality-control reports.

## **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

## **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Accredited by NETA.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
  2. Eaton.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; Schneider Electric USA.
- B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

## **2.2 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the transformer will remain in place without separation of any parts when subjected to the seismic forces specified and the transformer will be fully operational after the seismic event."

## **2.3 GENERAL TRANSFORMER REQUIREMENTS**

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:
1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
  2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

## **2.4 DISTRIBUTION TRANSFORMERS**

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
1. One leg per phase.
  2. Grounded to enclosure.

- D. Coils: Continuous windings without splices except for taps.
  - 1. Coil Material: Aluminum.
  - 2. Internal Coil Connections: Brazed or pressure type.
  - 3. Terminal Connections: Bolted Welded.
- E. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- F. Enclosure: Totally enclosed, nonventilated.
  - 1. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound using a vacuum-pressure impregnation process to seal out moisture and air.
  - 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
  - 3. Wiring Compartment: Sized for conduit entry and wiring installation.
  - 4. Finish: Comply with NEMA 250.
    - a. Finish Color: ANSI 49 gray weather-resistant enamel.
- G. Taps for Transformers 3 kVA and Smaller: None.
- H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- J. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- K. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- L. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- M. K-Factor Rating: 1.
  - 1. Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.
  - 2. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding the indicated insulation class in a 40 deg C maximum ambient and a 24-hour average ambient of 30 deg C.
  - 3. Indicate value of K-factor on transformer nameplate.
  - 4. Unit shall comply with requirements of DOE 2016 efficiency levels when tested according to NEMA TP 2 with a K-factor equal to one.

- N. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
  - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
  - 2. Include special terminal for grounding the shield.
- O. Neutral: Rated 200 percent of full load current for K-factor-rated transformers.
- P. Wall Brackets: Manufacturer's standard brackets.

## **2.5 IDENTIFICATION**

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Brunswick County Technical Specification 028 "General Electrical Information."

## **2.6 SOURCE QUALITY CONTROL**

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
  - 1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
  - 2. Ratio tests at rated voltage connections and at all tap connections.
  - 3. Phase relation and polarity tests at rated voltage connections.
  - 4. No load losses, and excitation current and rated voltage at rated voltage connections.
  - 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
  - 6. Applied and induced tensile tests.
  - 7. Regulation and efficiency at rated load and voltage.
  - 8. Insulation-Resistance Tests:
    - a. High-voltage to ground.
    - b. Low-voltage to ground.
    - c. High-voltage to low-voltage.
  - 9. Temperature tests.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
  - 2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
  - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

### **3.3 CONNECTIONS**

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection.
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
    - g. Verify the presence of surge arresters and that their ratings are as specified.
  - 2. Electrical Tests:
    - a. Measure resistance at each winding, tap, and bolted connection.
    - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
    - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
    - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.

- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### **3.5 ADJUSTING**

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### **3.6 CLEANING**

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**END OF SECTION**

## **SECTION 262416 - PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Brunswick County Technical Specification 028 "General Electrical Information"

#### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Power panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### **1.03 DEFINITIONS**

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

#### **1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
  - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
  - 4. Detail bus configuration, current, and voltage ratings.
  - 5. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 7. Include wiring diagrams for power, signal, and control wiring.
  - 8. Key interlock scheme drawing and sequence of operations.

#### **1.05 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards.

#### **1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "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 that allows adjustments.

#### **1.07 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Two spares for each type of panelboard cabinet lock.
  - 2. Circuit Breakers: Spares as indicated in drawings schedules.

## **1.08 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

## **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

## **1.10 FIELD CONDITIONS**

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Owner's written permission.
  - 3. Comply with NFPA 70E.

## **1.11 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS**

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Panelboards, load centers, and mini power zones must be UL listed.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Panelboards located indoors, Type 12.
    - b. Panelboards located outdoors, Type 4X SS.
  - 2. Height: 84 inches maximum.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Same finish as panels and trim.
- G. Incoming Mains:
  - 1. Location: Convertible between top and bottom.
  - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
  - 1. Material: Hard-drawn copper, 98 percent conductivity.

- a. Plating shall run entire length of bus.
  - b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
    1. Material: Hard-drawn copper, 98 percent conductivity.
    2. Terminations shall allow use of 75 deg C rated conductors without derating.
    3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
    4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
    5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
  - J. Panelboard Short-Circuit Current Rating: Assembly listed by an NRTL for 100 percent interrupting capacity.
    1. Panelboards and overcurrent protective devices shall have short-circuit ratings as shown on Drawings.

## **2.02 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. 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."

## **2.03 POWER PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ABB (Electrification Products Division).
  2. Eaton.

3. Schneider Electric USA (Square D).
  4. Siemens Industry, Inc., Energy Management Division.
- B. Power Panelboards designated on drawings with prefix PP.
  - C. Panelboards: NEMA PB 1, distribution type.
  - D. Electrical Rating: See panel schedule on drawings.
  - E. Voltage Configuration: See panel schedule on drawings.
  - F. Mains: See panel schedule on drawings.
  - G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
  - H. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
  - I. Main Circuit Breakers: Main circuit breakers rated greater than 200A shall be 100% rated with adjustable long, short, and instantaneous trip settings.

#### **2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ABB (Electrification Products Division).
  2. Eaton.
  3. Schneider Electric USA (Square D).
  4. Siemens Industry, Inc., Energy Management Division.
- B. Branch Circuit Panelboards designated on drawings with prefix LP.
- C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- D. Electrical Rating: See panel schedule on drawings.
- E. Voltage Configuration: See panel schedule on drawings.
- F. Mains: See panel schedule on drawings.
- G. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- H. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## **2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB (Electrification Products Division).
  2. Eaton.
  3. Schneider Electric USA (Square D).
  4. Siemens Industry, Inc., Energy Management Division.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
  4. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

- e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
- f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
- h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount panelboards so that operating handle of top-most switch or circuit breaker, in on position, is not higher than 75 inches AFF.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Install overcurrent protective devices not already factory installed.
  1. Set field-adjustable, circuit-breaker trip ranges.
  2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- K. Install filler plates in unused spaces.

### **3.03 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Brunswick County Technical Specification 028 "General Electrical Information."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Brunswick County Technical Specification 028 "General Electrical Information."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Brunswick County Technical Specification 028 "General Electrical Information."

### **3.04 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

**3.05 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.

**3.06 PROTECTION**

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION**

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# **SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

## **PART 1 - GENERAL**

### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Nonfusible switches.
  - 2. Molded-case circuit breakers (MCCBs).
  - 3. Enclosures.

### **1.03 DEFINITIONS**

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

### **1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include wiring diagrams for power, signal, and control wiring.

## **1.05 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 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.
- C. Field quality-control reports.

## **1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

## **1.07 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Fuse Pullers: Two for each size and type.

## **1.08 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

## **1.09 FIELD CONDITIONS**

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.

## **1.10 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two year(s) from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. 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."

### **2.02 GENERAL REQUIREMENTS**

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

### **2.03 NONFUSIBLE SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB, Electrification Products Division.
  - 2. Eaton.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; Schneider Electric USA.
  
- B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
  
- C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
  
- D. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
  - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper neutral conductors.
  - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
  - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
  - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
  - 8. Service-Rated Switches: Labeled for use as service equipment.

### **2.04 MOLDED-CASE CIRCUIT BREAKERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the:
  - 1. ABB, Electrification Products Division.
  - 2. Eaton.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; Schneider Electric USA.

- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.
- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Lugs shall be suitable for 167 deg F rated wire.
- G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- L. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

## **2.05 ENCLOSURES**

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts.
- D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

### **3.02 PREPARATION**

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Owner's written permission.
  - 4. Comply with NFPA 70E.

### **3.03 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS**

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 4X, stainless steel.
  - 3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
  - 4. Locations subject to incidental chemical gas or liquid contact: NEMA 250, Type 4X, stainless steel..
  - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

### **3.04 INSTALLATION**

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

### **3.05 IDENTIFICATION**

- A. Comply with requirements in Brunswick County Technical Specification 028 "General Electrical Information."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### **3.06 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.

- f. Verify that each fuse has adequate mechanical support and contact integrity.
  - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter.
      - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
      - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
  - i. Verify correct phase barrier installation.
  - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Measure contact resistance across each switchblade fuse-holder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
  - 1. Test procedures used.
  - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

### **3.07 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

**END OF SECTION**

## **SECTION 265119 - LED INTERIOR LIGHTING**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Brunswick County Technical Specification 028 "General Electrical Information"

#### **1.02 SUMMARY**

- A. Section includes the following types of LED luminaires:
  - 1. Indoor LED Fixtures.

#### **1.03 DEFINITIONS**

- A. Fixture: See "Luminaire."
- B. LED: Light-emitting diode.
- C. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### **1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include emergency lighting units, including batteries and chargers.
  - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  - 6. Photometric data and adjustment factors based on laboratory tests.
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### **1.05 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 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.
- C. Product Certificates: For each type of luminaire.
- D. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Sample warranty.

#### **1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### **1.07 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

## **1.08 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.

## **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

## **1.10 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
  - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."
- C. Ambient Temperature: 41 to 104 deg F.
  - 1. Relative Humidity: Zero to 95 percent.
- D. Altitude: Sea level to 1000 feet.

## **2.02 LUMINAIRE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage, and coating.
    - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.

## **2.03 INDOOR LED FIXTURES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. See Luminaire Schedule on drawings for basis of design.
  - 2. Equal model that is approved by the Engineer.
- B. Nominal Operating Voltage: As shown on drawings.
- C. Lamp:
  - 1. Dimmable from 100 percent to 0 percent of maximum light output.
  - 2. Internal driver.
  - 3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Diffusers and Globes: As shown on Luminaire Schedule.
- F. With integral mounting provisions.
- G. Standards:
  - 1. ENERGY STAR certified.

2. RoHS compliant.
3. UL Listing: Listed for damp location for all fixtures mounted outdoors or in non-climate controlled areas.

## **2.04 MATERIALS**

### A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

### B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

### C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/240M.

### D. Galvanized Steel: ASTM A653/A653M.

### E. Aluminum: ASTM B209.

## **2.05 METAL FINISHES**

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## **2.06 LUMINAIRE SUPPORT**

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 TEMPORARY LIGHTING**

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

### **3.03 INSTALLATION**

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
  - 1. Secured to outlet box.

2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to a minimum 20 gauge backing plate attached to wall structural members.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:

- a. Two 5/32-inch-diameter aircraft cable supports adjustable to 10 feet in length.
- b. Pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 10 feet in length.
- c. Hook mount.

2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

### **3.04 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Brunswick County Technical Specification 028 "General Electrical Information."

### **3.05 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

### **3.06 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
  - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 3. Adjust the aim of luminaires in the presence of the Architect.

**END OF SECTION**

# **SECTION 265619 - LED EXTERIOR LIGHTING**

## **PART 1 - GENERAL**

### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Brunswick County Technical Specification 028 "General Electrical Information"

### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Luminaire-mounted photoelectric relays.
  - 2. Luminaire types.
  - 3. Materials.
  - 4. Finishes.
  - 5. Luminaire support components.

### **1.03 DEFINITIONS**

- A. Fixture: See "Luminaire."
- B. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

### **1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of luminaire.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaire.
  - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  - 5. Photometric data and adjustment factors based on laboratory tests, complying with.
    - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

6. Wiring diagrams for power, control, and signal wiring.
  7. Photoelectric relays.
  8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### **1.05 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  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.
- C. Product Certificates: For each type of the following:
1. Luminaire.
  2. Photoelectric relay.
- D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Source quality-control reports.
- F. Sample warranty.

#### **1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
  2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

## **1.07 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: Furnish at least one of each type.
  - 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: Furnish at least one of each type.
  - 3. Diffusers and Lenses: Furnish at least one of each type.
  - 4. Globes and Guards: Furnish at least one of each type.

## **1.08 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
  - 1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

## **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

## **1.10 FIELD CONDITIONS**

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

## **1.11 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.

- b. Faulty operation of luminaires and accessories.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 1 year from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURER AND MODEL**

- A. Exterior fixtures shall be provided as follows:
- 1. Manufacturer and model shown on the Luminaire Schedule on the drawings.
  - 2. Equal model approved by the Engineer.

### **2.02 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance:
- 1. Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 2. Luminaires and lamps shall be labeled vibration and shock resistant.
  - 3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

### **2.03 LUMINAIRE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61.
- F. Bulb shape complying with ANSI C79.1.
- G. L70 lamp life of 50,000 hours.

- H. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- I. Internal driver.
- J. Nominal Operating Voltage: As shown on drawings.
- K. In-line Fusing: On the primary for each luminaire.
- L. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- M. Source Limitations:
  - 1. Obtain luminaires from single source from a single manufacturer.
  - 2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

#### **2.04 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS**

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
  - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
  - 2. Adjustable window slide for adjusting on-off set points.

#### **2.05 LUMINAIRE TYPES**

- A. Area and Site:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. See Luminaire Schedule on drawings.
  - 2. Mounting: Pole with stainless-steel arm, 11 inches in length.
  - 3. Luminaire-Mounting Height: As shown on drawings.

#### **2.06 MATERIALS**

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Stainless steel. Form and support to prevent warping and sagging.

- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
  - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
  - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage and coating.
    - c. CCT and CRI for all luminaires.

## 2.07 **FINISHES**

- A. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
  - a. Color:
    - 1) As selected from manufacturer's standard catalog of colors.

## **2.08 LUMINAIRE SUPPORT COMPONENTS**

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 TEMPORARY LIGHTING**

- A. If approved by the Engineer, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

### **3.03 GENERAL INSTALLATION REQUIREMENTS**

- A. Comply with NECA 1.

- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Support luminaires without causing deflection of finished surface.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires at height and aiming angle as indicated on Drawings.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Adjust luminaires that require field adjustment or aiming.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

### **3.04 CORROSION PREVENTION**

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### **3.05 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Brunswick County Technical Specification 028 "General Electrical Information."

### **3.06 FIELD QUALITY CONTROL**

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### **3.07 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
  - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 3. Adjust the aim of luminaires in the presence of the Architect.

**END OF SECTION**

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