

Jacksonville Electric Authority (JEA)
JEA Church Street 69KV UG Relocation Project
Underground Transmission Construction Specifications
Jacksonville, Florida

Project Number 190016
UG Duct Bank and Cable Installation
Issued for Construction – April 03rd, 2026

Underground Transmission Line Specification Index

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GENERAL SPECIFICATIONS

SECTION 01 11 01 – SUMMARY OF WORK

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section summarizes the Work covered in detail in the complete Contract Documents.

1.02 DEFINITIONS:

- A. Owner: Jacksonville Electric Authority (JEA)
- B. Engineer: Burns & McDonnell Engineering Company, Inc.
- C. Contractor: To Be Determined
- D. UG Cable Supplier: Marmon Utility, LLC

1.03 PROJECT DESCRIPTION:

- A. The proposed JEA Church Street 69-kV Relocation Project consists of the relocation of the underground (UG) segment of existing 69-kV transmission line, Circuit 601, due to anticipated Florida Department of Transportation (FDOT) improvements to Interstate 95. The relocated UG transmission line will connect Church Street substation to an existing concrete cable riser pole at the intersection of Church Street and Eaverson Street in Jacksonville, Florida. The UG transmission line will be approximately 1,560 feet (0.29 miles) long and will consist of a single circuit, concrete encased duct bank installed via open cut trench..

1.04 SCOPE OF WORK BY CONTRACTOR UNDER THESE SPECIFICATIONS:

- A. These contract documents include the Work associated with the complete installation of the proposed 69-kV underground duct bank and cable system accessories for the Project as listed below. All work shall be in accordance with associated drawings and specifications listed as attachments to this document.
- B. The proposed 69-kV UG cable system will be installed within concrete encased duct bank.
- C. The work shall include the following items
 - 1. Removals, Demolitions, and Abandonments
 - a. Removal of existing 69-kV UG direct-bury cable and protective concrete slab for Owner's Circuit 601 where in conflict with proposed installation or in conflict with FDOT's proposed improvements
 - b. Removal of existing 69-kV UG cable terminations and lightning arresters for Owner's Circuit 601
 - c. Removal of abandoned, JEA-owned 6" water line where in conflict with proposed installation in Church Street
 - (1) Contractor to coordinate with Owner and City of Jacksonville for any requirements for work on abandoned water lines prior to start of work.
 - d. Contractor to coordinate outage with Owner for all removal work for existing circuit
 - (1) Contractor to request hold tags from Owner for Circuit 601. In order for the contractor to request a hold tag on the Owner's system, the individual request the hold tag must be an *Authorized Person* as determined by the Owner. The Contractor will be required to have a knowledgeable employee, preferably a foreman, take an successfully pass the Owner's course "Principles of Hold Tags and Grounding for Contractors". The course will be provided at JEA's Westside Service Center, and will take one (1) full day to complete. The prerequisite for the course is "JEA's Substation Entry Training." Both courses will be administered by Scott Nordeng (contact information below). The

SECTION 01 11 01 – SUMMARY OF WORK: continued

contractor must have their employees sign up for the course(s) by contacting the Owner's project manager upon winning the bid

(a) Scott Nordeng: nordsc@jea.com Office: 904-665-6728 Cell: 904-591-5232

- e. Coordinate with Owner for recycling and disposal of all removed materials
- 2. Construction and Installation
 - a. Installation of concrete encased duct bank
 - b. Installation of marker balls above spare conduit stub out and tie in point
 - c. Installation of the Owner-provided 69-kV 2,000 kcmil EPR cables
 - d. Installation of Owner-provided 69-kV underground cable AIS terminations and lightning arresters, including mounting hardware, onto existing baseplates at the UG cable riser pole
 - i. Contractor to reuse existing termination and lightning arrester baseplate and adjust as necessary to fit the new terminations
 - e. Installation of cable clamping on termination structure inside Church Street substation and the cable riser pole
 - f. Installation of Owner-provided ground continuity conductor (GCC)
 - g. Installation of bonding cable between link boxes and terminations
 - h. Installation of bonding cable between link boxes and ground
 - i. Installation of Owner-provided three-phase ground/earth link box at the existing cable riser pole as well as its mounting hardware
 - j. Installation of Owner-provided three-phase SVL link box at the existing substation termination structure as well as its mounting hardware
 - k. Installation of all cable clamps and Kellem grips
 - l. Procurement and installation of galvanized steel cable guard at cable riser pole
 - m. Restoration of any areas disturbed during the performance of Contractor's work per the Contract Drawings or applicable authority standards
 - n. Contractor's work shall be in accordance with the Engineer's Project Quality Assurance/Quality Control (QA/QC) Plan. Contractor shall submit a project/site specific QA/QC plan for Owner and Engineer's review before the Work begins.
 - o. Contractor's work shall be in accordance with the Owner's Project Safety Plan. Contractor shall submit a safety plan and associated deliverables for Owner and Engineer's review before the Work begins.
 - (1) Contractor shall develop a project/site specific Health and Safety Plan (HASP) for the Work specified.
- 3. The Services, Equipment, and Materials to be furnished shall include but not necessarily be limited to the following major items
 - a. Contractor shall perform the following Services:
 - (1) All labor, supervision, administration, and management required to perform the Work
 - (2) Attend and participate in weekly status meetings held by Owner for the duration of the Contractor's scope of work
 - (3) Provide site representation for duct bank installation Contractor final conduit proofing for acceptance by Owner.
 - (4) Provide site representation to comply with cable Supplier's warranty requirements
 - (5) Receive, unload, and store equipment and materials in a secure yard provided by the Contractor. Storage shall be per the Supplier's recommendation and requirements.

SECTION 01 11 01 – SUMMARY OF WORK: continued

- (6) Provide security of all Equipment and materials under Contractor's care, custody, and control
- (7) Soil erosion and sediment controls in accordance with project requirements and City of Jacksonville requirements
- (8) Dewatering plan as required for project site conditions
- (9) Traffic controls in accordance with project requirements, including traffic signage, materials, and equipment
- (10) Compliance with applicable permits, laws, or other governmental authority and safety training as designated by Owner
- (11) Inspecting and proofing of the duct bank system, including mandrelling and all required testing of conduits to verify acceptance prior to starting the cable installation
- (12) Locating and securing laydown areas necessary to store required equipment and materials for the proposed underground transmission system cable installation
- (13) Delivery of UG cable and its accessories to project site from Owner's secure yard
 - (a) Contractor to coordinate with Owner prior to start of construction for address of Owner's secure yard for all Owner-provided materials.
- (14) Perform all pre-construction and construction testing required for the duct bank system
- (15) Perform all installation and commissioning testing of HV cable system
 - (a) Contractor to provide site support for Owner's final soak test
- (16) Provide technical submittals as indicated in the Contract Documents
- (17) Provide testing, construction records, and as-built records
- (18) Support of all existing utilities adjacent to or across duct bank excavation for duration of excavation.
 - (a) Support of existing utilities to be designed and performed by Contractor and approved by utility owners prior to start of construction
- (19) Support of existing UG cable riser pole and existing substation termination structure for the duration of excavation.
 - (a) Temporary support of existing structures to be designed and performed by Contractor and approved by Owner prior to start of construction
- b. Contractor shall furnish the following Equipment:
 - (1) All construction Equipment necessary to perform the Work in accordance with the Specifications, Plan Drawings, and other Contract Documents, except as specifically excluded
- c. Contractor shall furnish the following Materials:
 - (1) Concrete encased duct bank materials, including but not limited to conduit, concrete, backfill, spacers, and all materials needed for restoration
 - (2) Cable clamps and mounting hardware as required for mounting cable to existing UG cable riser pole
 - (3) Earth link box mounting materials
 - (4) SVL link box mounting materials
 - (5) Galvanized steel cable guards
 - (6) Grounding and bonding connection materials
 - (7) 3M EMS Ball Marker 1402-XR Stock Number: 80611161144
 - (8) All other materials required to complete the Work not specifically identified as furnished by Owner

SECTION 01 11 01 – SUMMARY OF WORK: continued

1.05 WORK BY OTHERS:

- A. Florida Department of Transportation
 - 1. Improvements to I-95 bridge

1.06 OWNER-FURNISHED EQUIPMENT AND MATERIALS

- A. 69-kV transmission cable
- B. 69-kV open air terminations
- C. Other Cable System Accessories
 - 1. All link boxes, including surge voltage limiters (SVL)
 - a. Link boxes shall be 3-phase
 - b. Substation termination structure shall use SVL link boxes
 - c. Cable riser pole shall use earth link boxes
 - 2. Basket type / Kellem grips to secure cable below terminations
 - 3. 4/0 AWG copper bonding cable
 - 4. Mounting plate adaptors for the AIS terminations
 - 5. Cable heat shrinks
 - 6. Lightning Arresters
 - 7. 4/0 AWG Cu Ground Continuity Conductor
 - 8. Phasing Tags

1.07 WORK BY OWNER

- A. Owner's commissioning testing
- B. Existing Circuit 601 outage

1.08 WORK SEQUENCE:

- A. General: Sequence of Work shall be determined by Contractor and submitted to Engineer and Owner for approval.

1.09 ADMINISTRATIVE REQUIREMENTS:

- A. Preinstallation Conference: Conduct conference at Project Site in Jacksonville, FL

1.10 LIST OF DRAWINGS:

- A. Contract Drawings:
 - 1. Each sheet of the Contract Drawings bears the following general title:
 - a. Church Street 69kv UG Relocation.
 - 2. Individual sheet numbers and titles are as stated on index sheet under "Contract Drawings".
- B. Reference Drawings:
 - 1. Appendix A – Circuit 601 UG As-Built
 - 2. Reference Drawings included with the set of Contract Drawings are as stated on index sheet under "Contract Drawings."

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 01 11 01

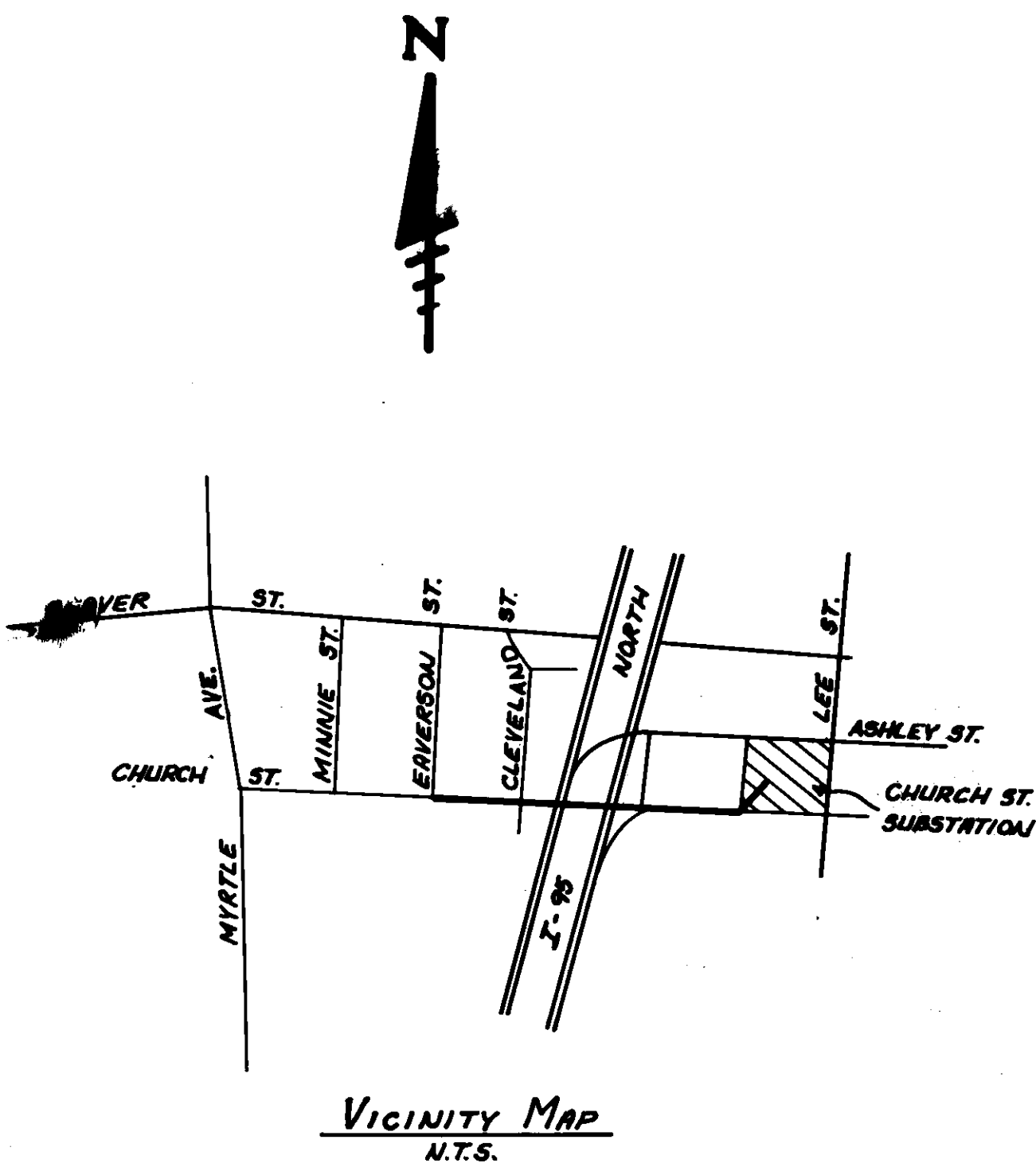
01 11 01A - CIRCUIT 601 UG AS-BUILTS

CONSTRUCTION DRAWINGS

FOR

69KV BROOKLYN TO CHURCH

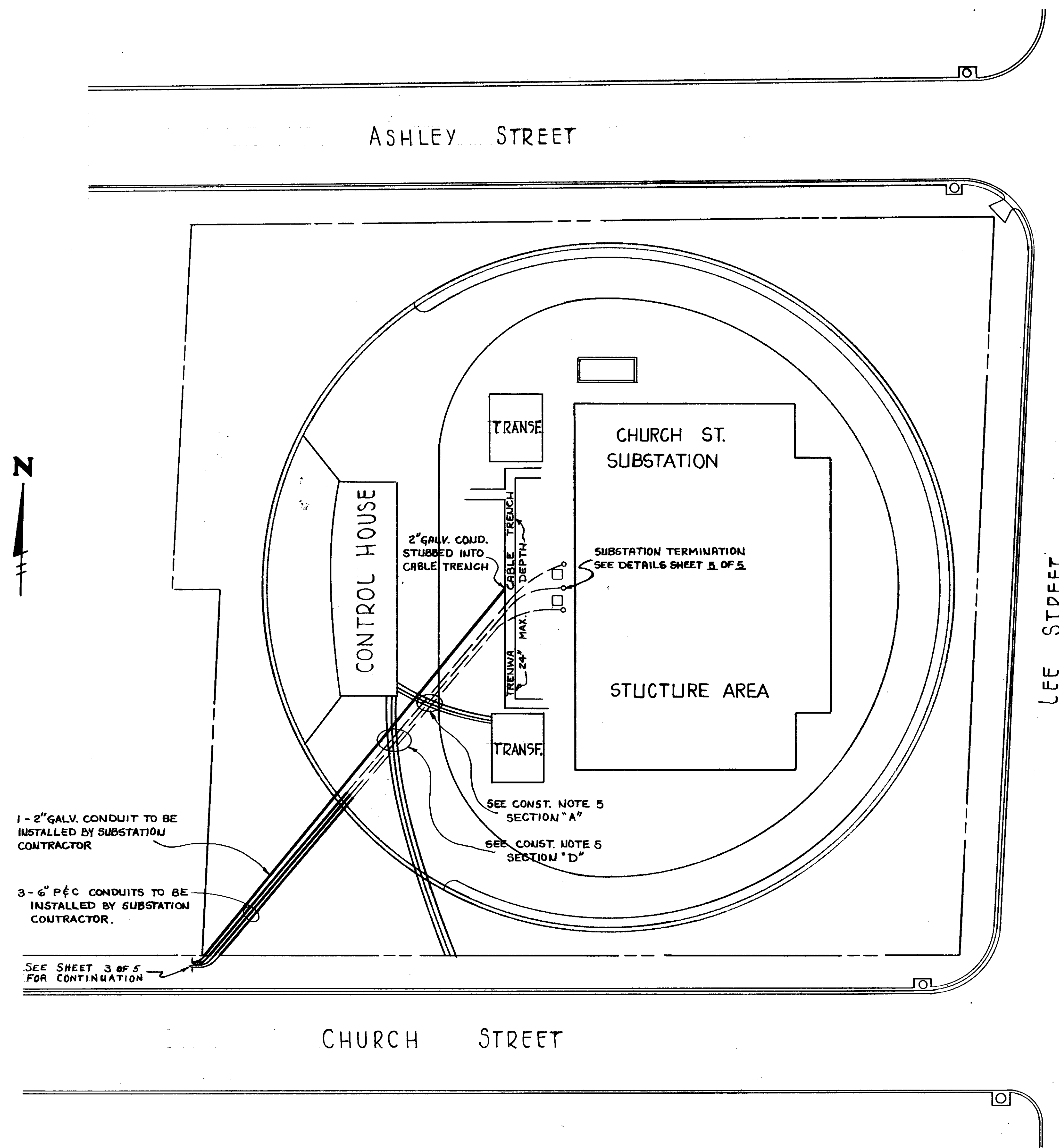
U.G. TRANSMISSION LINE



INDEX TO DRAWINGS	
TITLE	SHEET
COVER SHEET AND VICINITY MAP	1
SUBSTATION DETAILS & CONSTRUCTION NOTES	2
PLAN AND PROFILE DRAWING	3
CABLE RISER POLE DETAILS	4
SUBSTATION TERMINATION DETAILS	5

TRANSMISSION & SUBSTATION ENGINEERING DIVISION

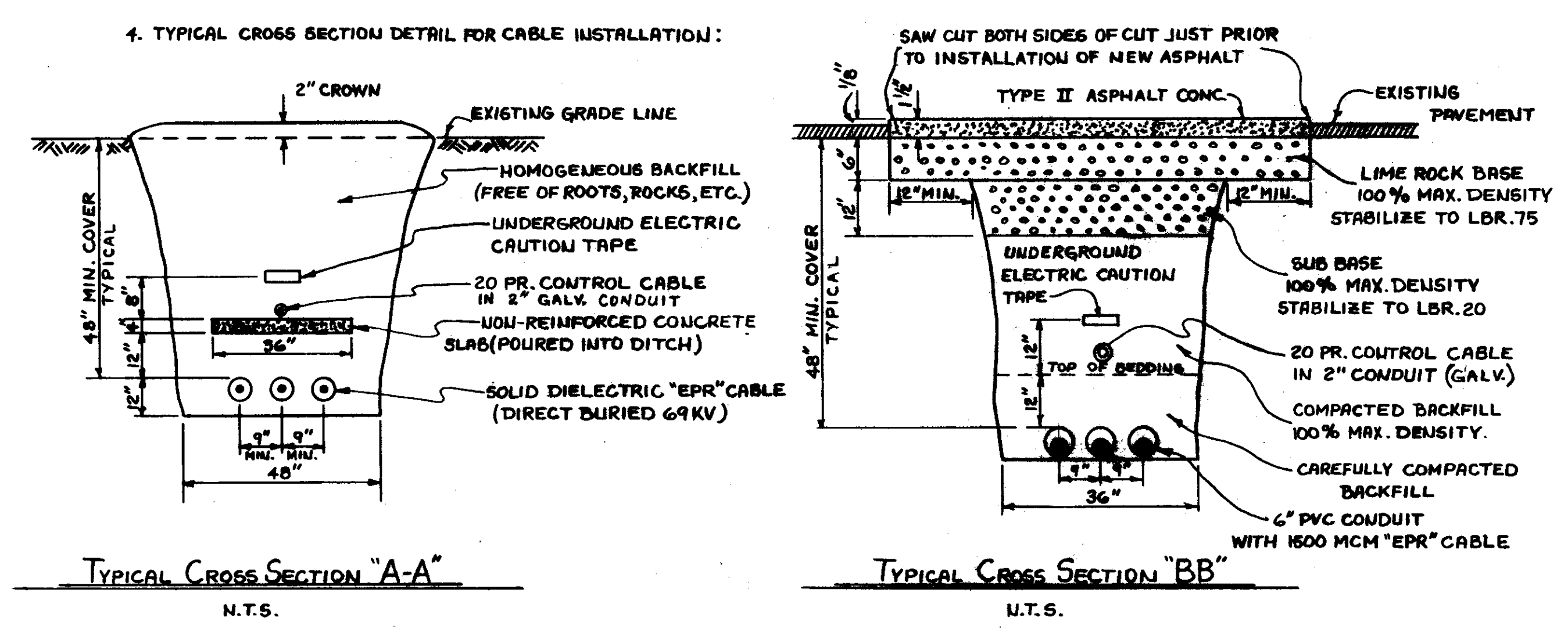
JACKSONVILLE ELECTRIC AUTHORITY



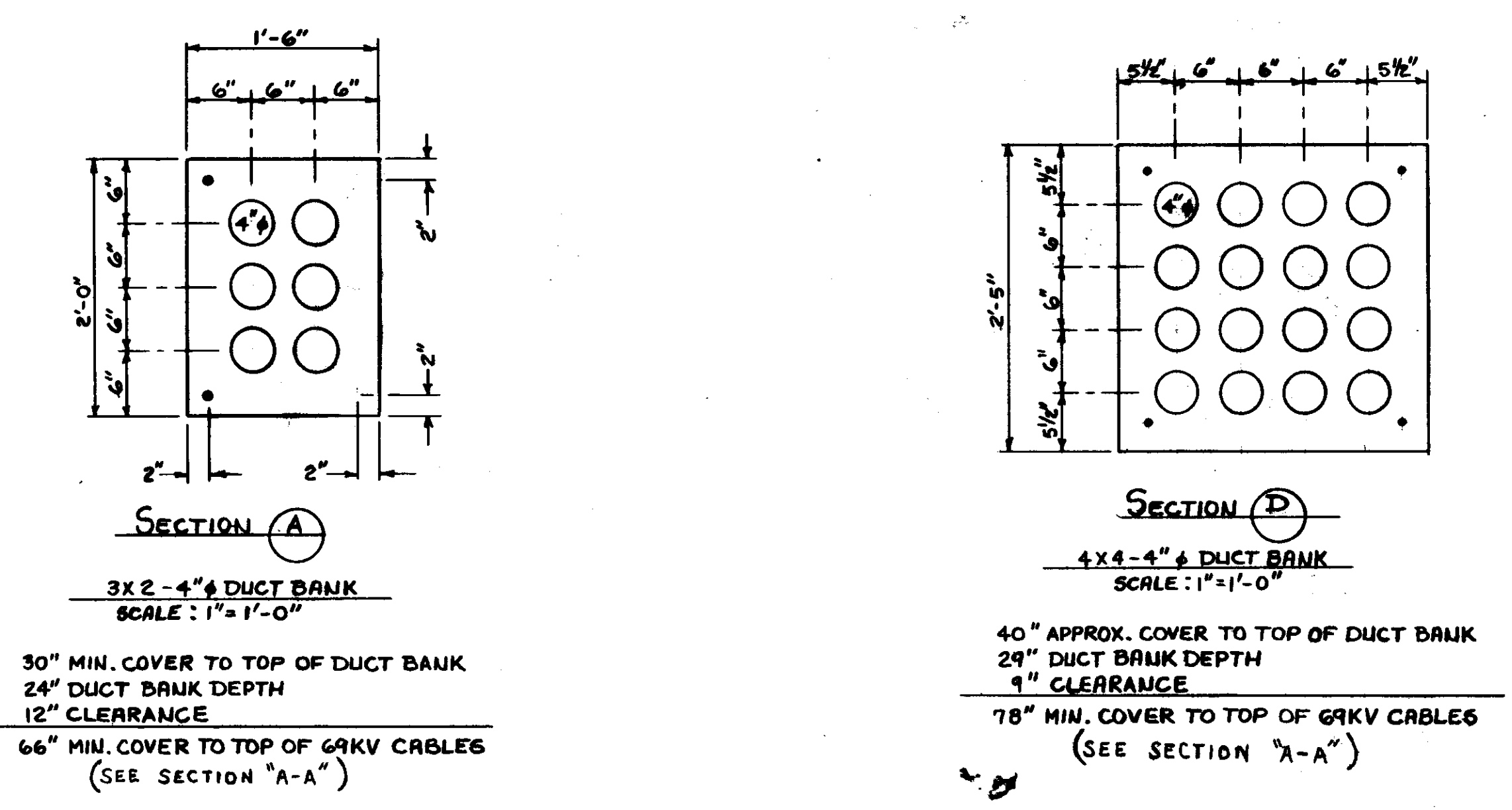
- CONSTRUCTION NOTES:**
1. SURVEY LINE TO BE ESTABLISHED ACCORDING TO THE FOLLOWING:
 - STA 0+00 = CENTERLINE INTERSECTION OF EAVERTON & CHURCH ST. RIGHT OF WAYS, THEN CONTINUE EASTERLY ON CHURCH ST. A STRAIGHT LINE PROJECTION TO STA 0+82.
 - STA 13+85 = INTERSECTION OF CHURCH ST. RIGHT OF WAY CENTERLINE AND THE WESTERLY CHURCH ST. SUBSTATION PROPERTY LINE, THEN CONTINUE WESTERLY ON CHURCH ST. A STRAIGHT LINE PROJECTION TO STA. 10+86.
 - PROJECT A STRAIGHT LINE BETWEEN STA. 0+82 & STA. 10+86 WHEN ESTABLISHED AS DESCRIBED ABOVE.
 2. THE 69KV BROOKLYN TO CHURCH UNDERGROUND SOLID DIELECTRIC CABLES TO BE INSTALLED AT 22.5' NORTHERLY FROM AND PARALLEL TO THE SURVEY LINE AS ESTABLISHED ABOVE. ANY DEVIATIONS IN THIS PROPOSED LINE ROUTE SHALL BE RECORDED ON THE "AS BUILT" DRAWINGS BY THE CONSTRUCTION PERSONNEL.
 3. UNDERGROUND CABLE INSTALLATION:

DIRECT BURY OR INSTALL	QUANTITY	LOCATION		LENGTH OF TRENCH	SUBST. TERM. STR. AND/OR CABLE RISER POLE	TOTAL REQ'D CABLE LENGTH	CABLE REEL NO. AND LENGTH
		FROM	TO				
1500 KCM "EPR" CABLE	3	SUBSTATION TERMINATION STRUCTURE	SPLICE PIT	100'	25'	795'	C ₁ =810', C ₂ =810', C ₃ =808'
1500 KCM "EPR" CABLE	3	SPLICE PIT	"CABLE RISER" POLE	170'	75'	845'	B ₁ =1010', B ₂ =1010', B ₃ =1020'
20 PAIR CONTROL CABLE	1	TRENWA CABLE TRENCH	"CABLE RISER" POLE	SAME TRENCH	* 130'	1750'	

* LEAVE ENOUGH CONTROL CABLE IN TRENWA CABLE TRENCH TO REACH CONTROL PANELS WITH NO SPLICES



5. TRANSFORMER DUCT BANK (SECTION A) & DISTRIBUTION DUCT BANK (SECTION D) CROSS SECTIONS



NO.	REVISION	DATE	BY	CH'D	APP'D	PRINT RECORD				DRAWING STATUS		ENGINEERING RECORD			W.D. NO.
										ISSUED	DATE	DRAWN	BY	DATE	
										PRELIMINARY		DRAWN			D112-77
										FOR COMMENTS AND/OR APPROVAL		TRACED			DRAWING NO.
										APPROVED FOR CONSTRUCTION		DESIGNED	B.R.M.	1-6-80	TR1143A
										REVISED AND APPROVED FOR CONSTRUCTION		CHECKED			SHEET NO.
										NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED BY THE ENGINEER AND PRINTED EARLIER DATE AND/OR REVISION DATE		APPROVED	JAD	2-5-81	
												APPROVED			

69KV BROOKLYN TO CHURCH ST. U.G. TRANSMISSION LINE

SUBSTATION DETAIL & CONSTRUCTION NOTES

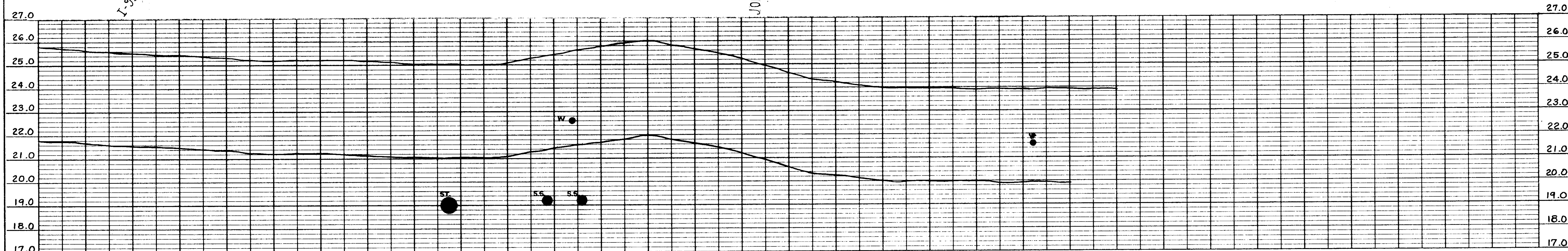
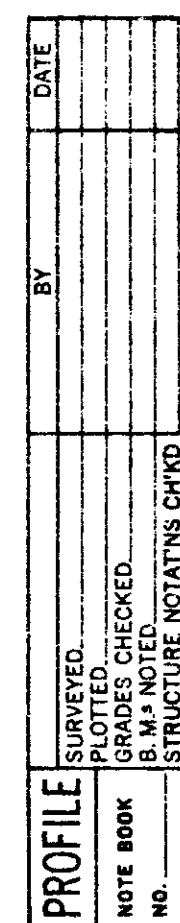
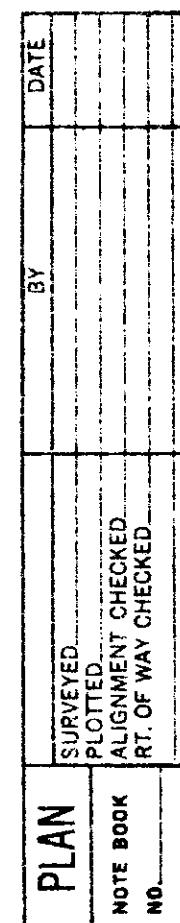
JACKSONVILLE ELECTRIC AUTHORITY
 JACKSONVILLE, FLORIDA

DISTRIBUTION ENGINEERING DIVISION

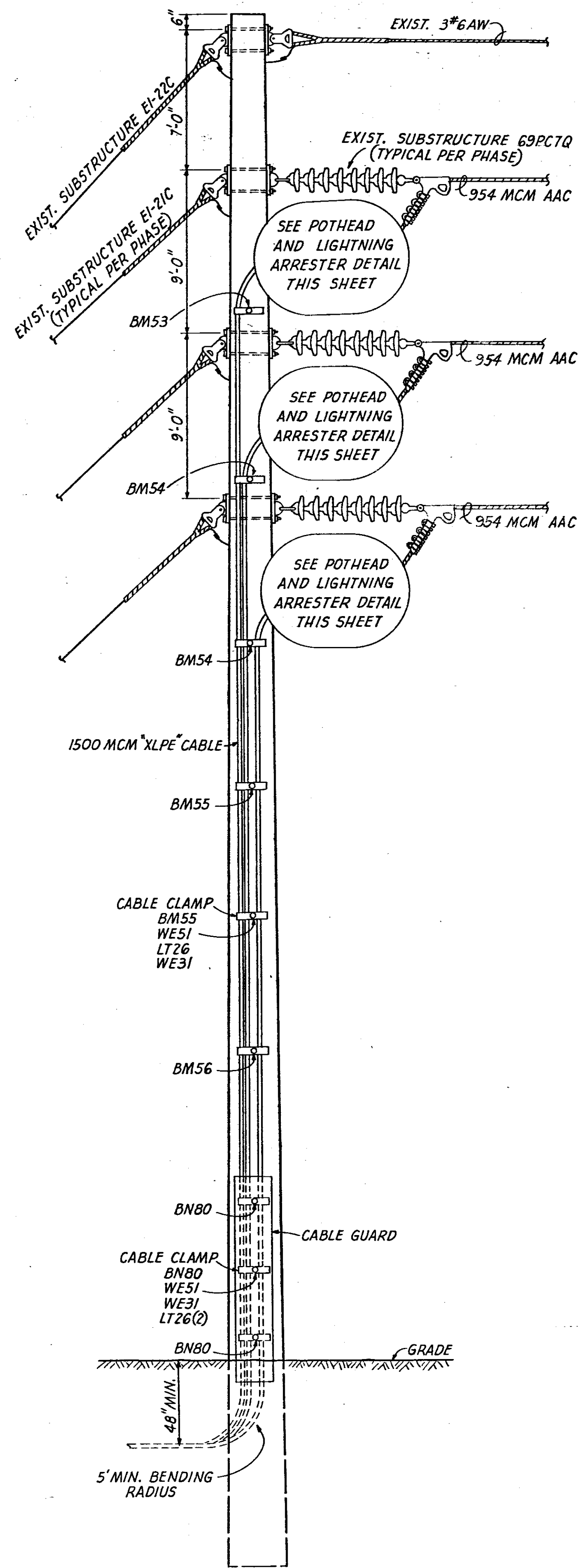
SCALE: 1" = 20'-0"

SPEC. NO.

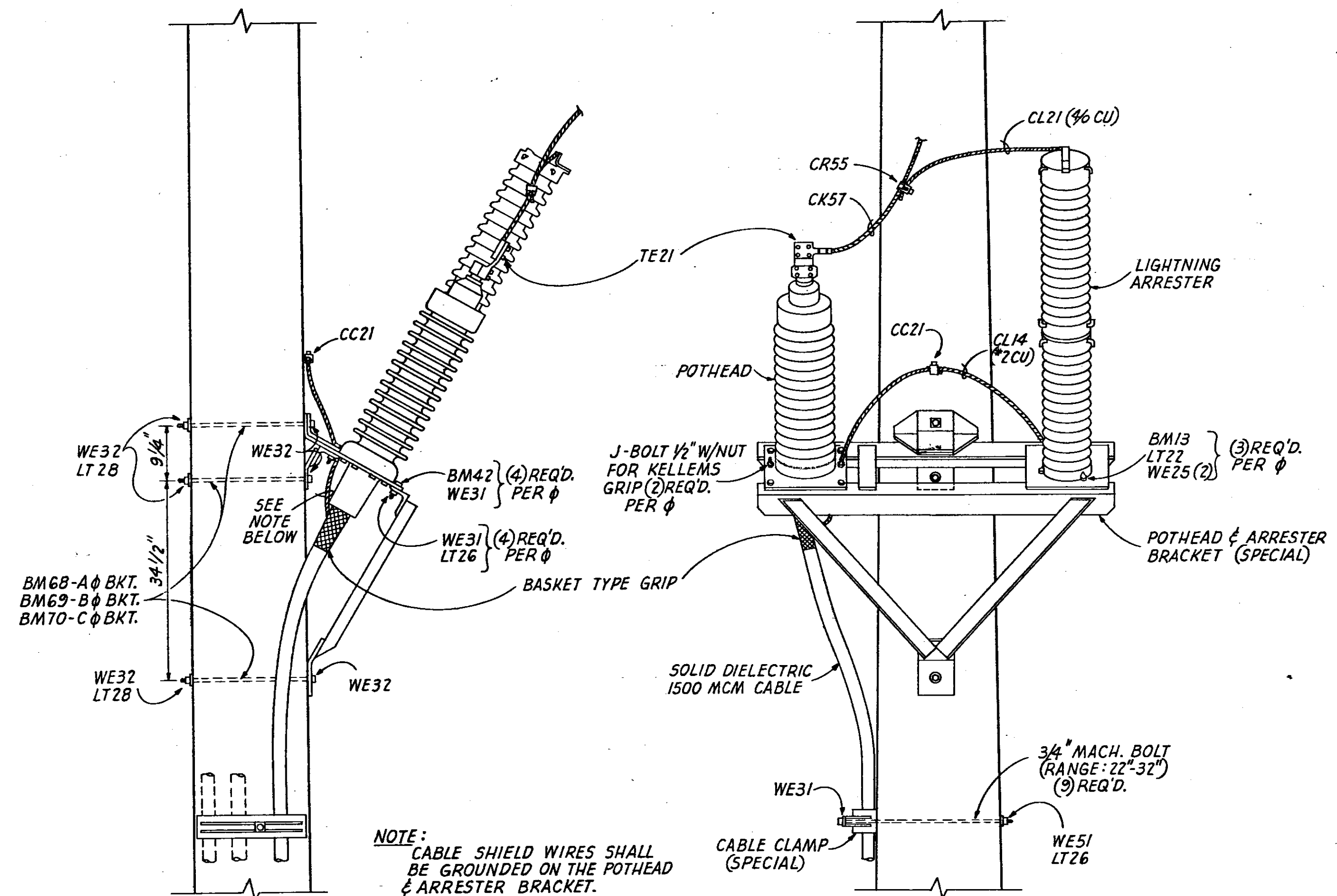
2 OF 5



NO.		REVISION		DATE	BY	CH'D	APP'D	PRINT RECORD										DRAWING STATUS		ENGINEERING RECORD		69KV BROOKLYN TO CHURCH U.G. TRANSMISSION LINE		WO NO			
																				D112-77							
																		ISSUED		DATE	BY		DATE	PLAN & PROFILE DRAWING		DRAWING NO.	
																		PRELIMINARY			DRAWN					TR1143A	
																		KRS COMMENTS AND/OR APPROVAL			TRACED						
																		APPROVED FOR CONSTRUCTION		2/81	DESIGNED		B.R.U.	1-6-81	JACKSONVILLE ELECTRIC AUTHORITY		
																		REVISED AND APPROVED FOR CONSTRUCTION			CHECKED			JACKSONVILLE, FLORIDA		SHEET NO	
																		APPROVED		JAD	APPROVED		2-5-81	SCALE 1"=50' HORIZ. AS SHOWN VERT.		TRANSMISSION & SUBSTATION ENGINEERING DIVISION	SPEC. NO.
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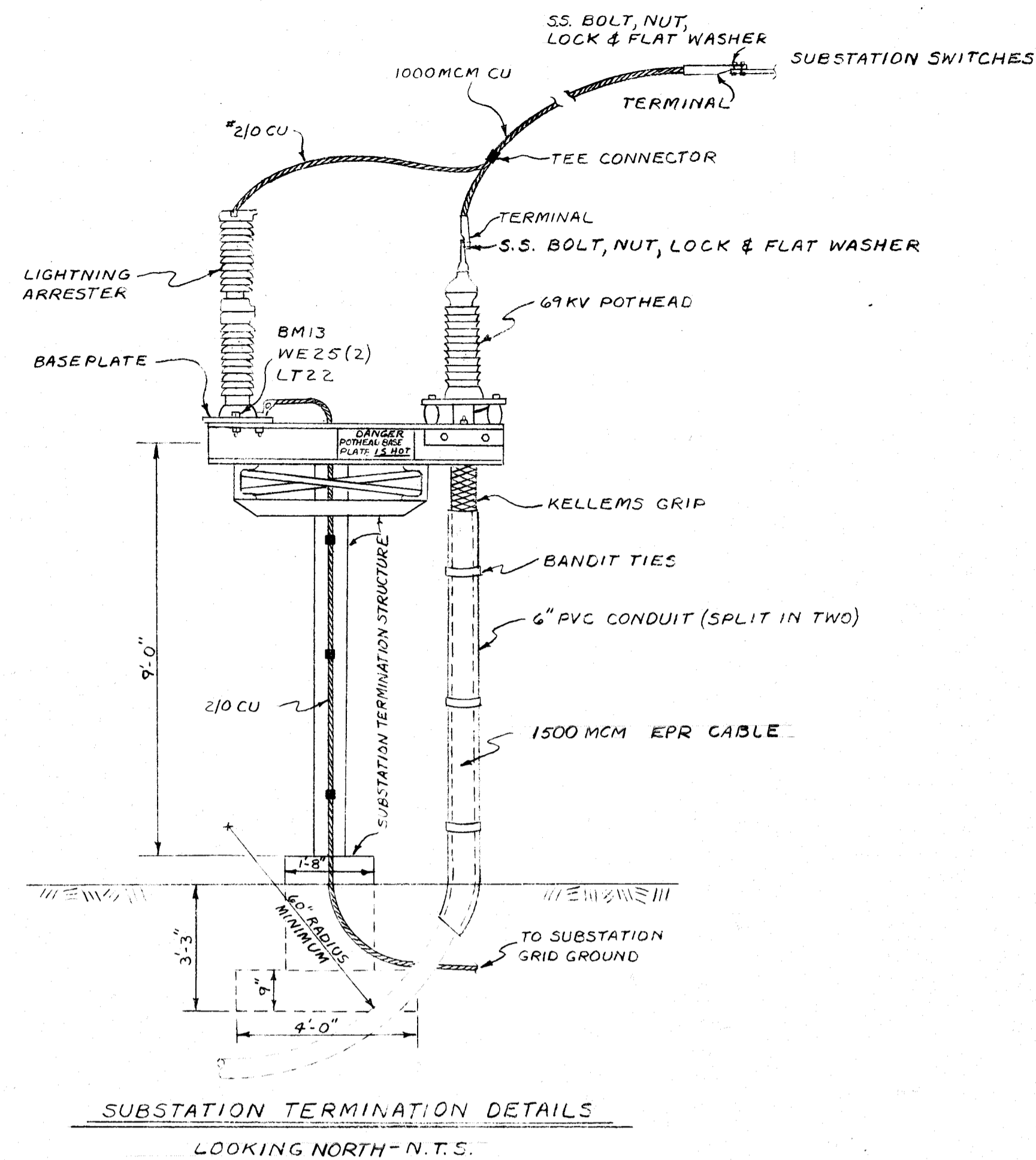
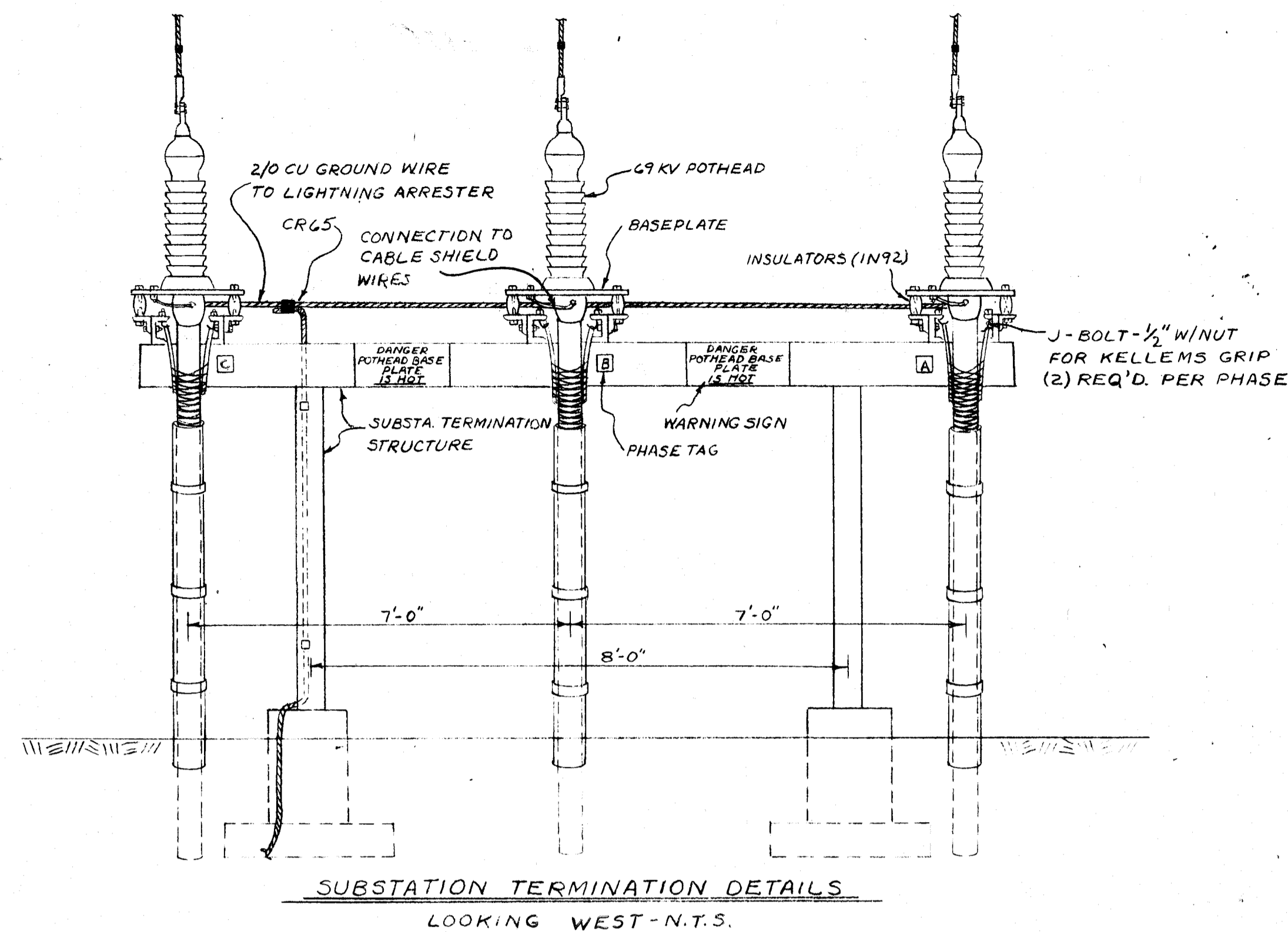
"CABLE RISER" POLE DETAIL
LOOKING SOUTH



POTHEAD AND LIGHTNING ARRESTER DETAILS

MATERIAL LIST FOR "CABLE RISER" POLE			
QUANTITY	ITEM CODE	STOCK NUMBER	DESCRIPTION
9			CABLE CLAMP
1			CABLE GUARD
12	BM42	2101203M	BOLT, MACH. - 3/4" x 3"
1	BM53	2101224	BOLT, MACH. - 3/4" x 24"
2	BM54	2101226	BOLT, MACH. - 3/4" x 26"
2	BM55	2101228	BOLT, MACH. - 3/4" x 28"
1	BM56	210123M	BOLT, MACH. - 3/4" x 32"
3	BN80	2111236	BOLT, D.A. - 3/4" x 38"
24	LT26	2162006	LOCKNUT, SQ. - 3/4"
33	WE31	2270006	WASHER, ROUND - 3/4"
12	WE51	2270035	WASHER, SQ. - 3/4"
3			POTHEADS, UG. CABLE TERM. (JOSLYN)
3			LIGHTNING ARRESTER, INTERMEDIATE
3			POTHEAD & ARRESTER BRACKET
3			POTHEAD & ARRESTER ACCESSORY KITS
3	TE21	1265472	TERMINAL, LUG-AL.
3	CR55		CONNECTOR, BRONZE - 2 BOLT - BURNDY KV544A
15'	CL21	1873411	CONDUCTOR, 40 CU
3	CC21	3003020	CONNECTOR, GROUND
15'	CL14	1890212	CONDUCTOR, * 2 CU
3	BM68	2101418M	BOLT, MACH. - 7/8" x 18"
3	BM69	2101420M	BOLT, MACH. - 7/8" x 20"
3	BM70	2101422C	BOLT, MACH. - 7/8" x 22"
9	LT28	21620075	LOCKNUT, SQ. - 7/8"
9	WE32	22700075	WASHER, ROUND - 7/8"
9	WE52	22700405	WASHER, SQ. - 7/8"
9	BM13		BOLT, MACH. - 1/2" x 3"
9	LT22	2162004	LOCKNUT, SQ. 1/2"
18	WE25	2270004	WASHER, ROUND - 1/2"
6			J-BOLT, SPECIAL-USE U-BOLT

	NO.	REVISION	DATE	BY	CH'D	APP'D	PRINT RECORD				DRAWING STATUS		ENGINEERING RECORD			69KV BROOKLYN TO CHURCH-UG. TRANSMISSION LINE "CABLE RISER" POLE-DETAILS JACKSONVILLE ELECTRIC AUTHORITY JACKSONVILLE, FLORIDA TRANSMISSION & SUBSTATION ENGINEERING DIVISION	SHEET NO. 4 OF 5
											ISSUED	DATE	DRAWN	BY	DATE		
													TRACED	A.H.G.	1-9-81		
													DESIGNED	B.R.N.	1-6-81		
													CHECKED				
											APPROVED FOR CONSTRUCTION	2/81					
											REVISED AND APPROVED						
											NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED BY THE ENGINEER OR HIS AUTHORIZED REPRESENTATIVE						



MATERIALS LIST FOR SUBSTATION TERMINATION DETAIL				
QUANTITY	ITEM CODE	STOCK NUMBER	DESCRIPTION	
3	---	---	POTHEADS (CABLE TERMINATORS)	
3	---	---	LIGHTNING ARRESTERS (INTERMEDIATE)	
12	1N92	15210805	POTHEAD INSULATORS WITH (24) 1/2\"	
3	---	---	POTHEAD BASEPLATE	
3	---	---	KELLEMS GRIPS	
6	---	---	J-BOLT-1/2\"	
30'	---	---	6\"	
9	---	---	BANDIT TIES	
9	EM13	2100803	BOLT, MACHINE 1/2\"	
18	WE25	2270004	WASHER, 1/2\"	
9	LT22	2162004	LOCKNUT, 1/2\"	
20'	CL17	1883211	CONDUCTOR, 2/0 CU	
1	CR65	1264540	CONNECTOR, VICE TYPE	
4	---	---	WARNING SIGNS	
3	---	---	PHASE TAGS	
30'	---	---	CONDUCTOR - 2/0 CU, BARE, MHD	
225'	---	---	CONDUCTOR - 1000 MCM CU, BARE, MHD	
12	---	---	TERMINAL-1000MCM CU TO 4-HOLE NEMA PAD	
6	---	---	TEE-1000 MCM CU TO 2/0 CU	
48	---	---	S.S. BOLT, NUT, LOCK & FLAT WASHER, 1/2\"	

* DENOTES MATERIALS TO BE FURNISHED BY SUBSTATION CONTRACTOR

CONSTRUCTION NOTES

1. THE CONSTRUCTION AND INSTALLATION OF THE TERMINAL STRUCTURE, POTHEADS, SPLICES, AND CABLE TESTING WILL BE THE RESPONSIBILITY OF J.E.A. FORCES.
2. GROUNDING OF SOLID DIELECTRIC TERMINATION
 - A. ALL LIGHTNING ARRESTERS ARE TO HAVE AN EXTERNAL GROUND.
 - B. POTHEAD GROUNDING:
 1. "CABLE RISER POLE" POTHEAD MUST HAVE AN EXTERNAL GROUND.
 2. "SUBSTATION STRUCTURE" POTHEAD SHALL "ONLY" BE GROUND TO THE CABLE SHIELD WIRES.
3. FOUR "WARNING SIGNS" SHALL BE CONSTRUCTED TO BE PLACED ON EACH SIDE OF THE SUBSTATION TERMINATION STRUCTURE, THE SIGNS SHALL READ: DANGER POTHEAD BASEPLATES ARE "HOT."

NO.	REVISION	DATE	BY	CH'D	APP'D	PRINT RECORD	DRAWING STATUS	ENGINEERING RECORD	69KV BROOKLYN TO CHURCH U.G. TRANSMISSION LINE		W.D. NO.
							ISSUED	DATE	BY	DATE	D112-77
							PRELIMINARY		DRAWN	ARB	
							FOR COMMENTS AND/OR APPROVAL		TRACED		
							APPROVED FOR CONSTRUCTION	2/01	DESIGNED	BRN	1-6-81
							REVISOR AND APPROVED	REV.	CHECKED		
							NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED DESTROY ALL PRINTS BEARING EARLIER DATE AND/OR REVISION DATE		APPROVED	JAD	2-5-81
									SCALE	N.T.S.	SPEC. NO.
									TRANSMISSION & SUBSTATION ENGINEERING DIVISION		5 OF 5

JACKSONVILLE ELECTRIC AUTHORITY
JACKSONVILLE, FLORIDA

SECTION 01 55 26 – TRAFFIC CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract apply to this Section.

1.02 DEFINITIONS

- A. Owner: Jacksonville Electric Authority (JEA)
- B. Engineer: Burns & McDonnell Engineering Company, Inc.
- C. Contractor: To Be Determined

1.03 SUMMARY:

- A. Section includes furnishing, installing, relocating and removing all temporary traffic control devices including but not limited to: construction signs, barricades, cones, drums, flaggers, variable message signs, flashing arrow boards, traffic control truck with mounted crash cushion, temporary pavement markings, uniformed Police officers, and temporary crash cushion inertial barrier systems.
- B. The Contractor shall implement the traffic control plans provided by Owner for the proposed Church Street UG Relocation Project, following the City of Jacksonville and FDOT requirements. Most of the proposed UG cable system is within Church Street. Any change or deviations from the traffic control plans shall be presented to the Owner for approval.

1.04 RELATED REQUIREMENTS:

- A. Section 01 11 01 – Summary of Work
- B. Section 33 05 90 – Underground Cable System Installation
- C. Section 31 23 24 – Cable System Excavation & Fill

1.05 REFERENCE STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. Name of Referenced Standard:
 - 1. City of Jacksonville.
 - 2. Manual on Uniform Traffic Control Devices (MUTCD)
 - 3. American National Standards Institute (ANSI)

1.06 PERFORMANCE/DESIGN CRITERIA:

- A. All devices shall be furnished, installed, relocated and removed by the Contractor conforming to the requirements of the City of Jacksonville and FDOT.

1.07 SUBMITTALS:

- A. Shall be approved by Owner and reviewed by Engineer.
- B. Include, but are not limited to, product data, catalog cut sheets, and Shop Drawings of the following:
 - 1. Breakaway barricade
 - 2. Drum
 - 3. Traffic cone
 - 4. Flashing arrow board
 - 5. Portable Variable Message Sign

SECTION 01 55 26 – TRAFFIC CONTROL: continued

- 6. Temporary Crash Cushion, Inertial Barrier System
 - 7. Truck Mounted Crash Cushion
 - C. Name and contact information of on-site Traffic Control Coordinator (TCC) per Section 2.04
- 1.08 PROJECT SITE CONDITIONS:
- A. Environmental requirements, limitations.
 - 1. Maintain I-95 access ramps per Maintenance of Traffic (MOT) drawings.

PART 2 - EXECUTION

- 2.01 ERECTION, INSTALLATION, APPLICATION:
- A. Contractor shall schedule and perform the work so that successive construction operations and lane or roadway openings follow preceding operations as closely as possible. Confine construction operations adjacent to traffic to one side of the roadway at a time unless otherwise specified. Where the work is performed in stages adjacent to traffic, ensure that the road opened to traffic adequately accommodates traffic. Do not interfere with existing traffic access, except when required to perform the Work.
 - B. Where work interferes with existing pedestrian access, provide temporary pedestrian access as directed. Where necessary, install and maintain temporary sidewalks and curb ramps. Remove temporary access measures when no longer required.
 - C. Provide temporary approaches to maintain traffic access to private and public property as directed. When the Work will interfere with property owners' normal passage, provide written notice to Engineer and Owner at least 14 Days before beginning work.
- 2.02 CHANGES TO THE TRAFFIC CONTROL PLANS (TCP)
- A. Submit requests for changes to the traffic control plans (TCP), including hours of operation, for approval at least 30 days before the change is needed. Contractor shall include a written description of the requested TCP change and detailed plan sheets signed and sealed by a Professional Engineer, if requested.
- 2.03 NIGHT OPERATIONS
- A. Night operations are not allowed unless approved by Authority Having Jurisdiction (AHJ).
 - B. Night operations comprises work performed from 30 minutes before sunset to 30 minutes after sunrise. Before beginning night operations, meet the specified illuminance levels and visibility requirements for workers and equipment for each planned operation.
 - 1. Lighting Requirements and Illuminance Levels. Maintain the minimum illuminance level throughout the required lighting area as specified in the following table. Provide lighting for all areas of the Work.

Minimum Illuminance Levels for Night Operations		
Work Description	Minimum Level (Foot Candles)	Minimum Lighting Area
Embankment Excavation Landscaping (seeding and sodding) Mechanical sweeping and	5	General lighting throughout area of operation

SECTION 01 55 26 – TRAFFIC CONTROL: continued

cleaning Subgrade		
Traffic Control setup and removal (excluding barrier curb)	5	Lighting on task
Traffic Director	5	Lighting on task plus minimum of 15 m (50 feet) ahead and 15 m (50 feet) behind employee
Milling ¹ HMA paving operation ¹ HMA roller operation ¹	10	Lighting on task and around equipment plus minimum of 7.6 m (25 feet) ahead and 7.6 m (25 feet) behind equipment plus 3.05 m (10 feet) to each side of equipment
Crack Sealing Sawcutting and Sealing Joints Electrical work	20	Lighting on task
All work not listed in this table ¹	10	Lighting on task

¹ Provide 5 foot-candles for the indicated lighting area outside the limits for
10 foot-candles to a minimum of 30.5 m (100 ft) ahead and 30.5 m (100 ft) behind equipment

2.04 TRAFFIC CONTROL COORDINATOR

- A. Before starting Work, submit to the Engineer and Owner the name and contact information of an employee assigned as the on-site Traffic Control Coordinator (TCC). The TCC shall have the responsibility for and authority to implement and maintain all traffic operations for the Project on behalf of the Owner. The TCC's responsibilities and duties shall include the following:
1. Communicate TCP or changes to the TCP with the City of Jacksonville and FDOT.
 2. Overseeing traffic control operations, including those performed by Contractor.
 3. Coordinating traffic control with subcontractors or other contractors.
 4. Ensuring that set-up and removal is performed according to the Contract.
 5. Performing daily traffic control inspections and providing written reports documenting the inspections, including detailed findings and corrections made.
 6. Performing inspections at night and on weekends to ensure compliance with the TCP.
 7. Ensuring that traffic control devices are correctly positioned and spaced.
 8. Ensuring that signs are properly covered or uncovered.
 9. Maintaining or replacing traffic control devices to ensure traffic control devices are in an acceptable condition and good working order. Maintenance also includes replacing lights bulbs and electrical components and refueling, recharging, or replacing batteries.
 10. Ensuring that excavations and lateral drop-offs greater than 50 mm (2 in) in depth are eliminated or protected by barrier or emergency escape ramps during non-working periods.
 11. Ensuring that construction operations do not create flooding or icing conditions for lanes open to traffic.
 12. Identifying and correcting traffic control deficiencies immediately.
 13. Ensuring that Engineer, Owner and Contractor vehicles for material delivery enter or exit the traveled way in a safe manner.

SECTION 01 55 26 – TRAFFIC CONTROL: continued

2.05 TRAFFIC CONTROL DEVICES

- A. Erect traffic control devices before beginning construction operations. Trim vegetation that obscures the sight distance to traffic control devices. Keep the traffic control devices clean and maintain in acceptable condition until no longer required. Relocate and remove traffic devices as required.
 - 1. Construction Signs. If construction signs are required for less than 3 days, the Contractor may place construction signs on portable sign stands instead of signposts. When construction signs or existing signs do not reflect work zone traffic conditions, cover the signs with black polyethylene sheeting. Ensure that the cover is opaque under all lighting conditions and completely conceals the entire front of the sign panel. Securely attach the cover to the back side of the sign without damaging the reflective sheeting. Do not alter the face of a sign with revised messages. Remove construction signs when no longer required and restore the post hole to match the surrounding conditions.
 - 2. Portable Variable Message Sign (PVMS). Place the PVMS as required. Ensure that a designated representative familiar with the operation and programming of the unit is available for the Project. Messages shall be as approved by the Owner.
 - 3. Temporary Crash Cushion. Install inertial barrier systems as required. The units shall be on the Qualified Products list. Immediately repair or replace crash cushions that become damaged or become inoperable. Keep the areas in front, atop, and around the crash cushions clear of snow accumulation of more than 100 mm (4 in) in depth.
 - 4. Traffic Control Truck with Mounted Crash Cushions. Position the traffic control truck to ensure that there is adequate stopping distance after impact and to prevent errant vehicles from traveling around the truck and endangering workers. When used in a fixed position, place manual transmission vehicles in second gear and place automatic transmission vehicles in park. Ensure that the parking brake is set, and the wheels are turned to avoid rolling into active traffic lanes. Do not use traffic control trucks in place of other temporary impact attenuators for more than 24 hours. Relocate the traffic control truck as directed. Do not use the truck to carry additional equipment, materials, or debris.
 - 5. Flashing Arrow Board. Provide a flashing arrow board as required.

2.06 REMOVABLE BLACK LINE MASKING TAPE

- A. Apply black line masking tape over existing traffic stripes, where shown on the plans, or as directed, according to the manufacturer's recommendations and when the weather is favorable. Ensure that the black line masking tape completely covers existing stripes. Replace black line masking tape that becomes loose after placement within 2 hours. When black line masking tape is no longer required, carefully and completely remove without using heat, solvents, grinding, sanding, or water.

2.07 TEMPORARY PAVEMENT MARKERS

- A. Temporary markers may be used on milled surfaces and areas where existing markings have been obliterated by construction for no longer than 48 hours. Apply temporary pavement markers with butyl adhesive pads to clean, dry pavement surfaces free of cracking, checking, or spalling. If the layout locates a marker at a joint or defect, relocate the marker longitudinally at least 50 mm (2 in) beyond the joint or defect. Replace lost or damaged temporary pavement markers.
- B. Only remove temporary pavement markers that will be replaced by striping in the same day.

SECTION 01 55 26 – TRAFFIC CONTROL: continued

2.08 TEMPORARY PAVEMENT MARKING TAPE

- A. Install tape according to the manufacturer's recommendations when the weather is favorable. Immediately before marking the pavement surface, clean the surface of dirt, oil, grease, and foreign material, including curing compound on new concrete. Clean the surface 50 mm (2 in) beyond the perimeter of the marking to be placed.
- B. Install tape on dry surfaces having a surface temperature between 10°C (50 °F) and 65.6°C (150 °F), when the ambient temperature is at least 10°C (50 °F) and rising. When splicing is required, install the tape using butt splices. Do not overlap the tape.
- C. Tamp the tape for initial adhesion and then apply pressure by driving a truck slowly over the tape several times. Maintain tape by replacing loose or damaged tape within 2 hours. Remove tape when no longer required.

2.09 TEMPORARY TRAFFIC STRIPES AND TEMPORARY TRAFFIC MARKINGS

- A. Install temporary traffic stripes and markings when required or as directed on temporary surfaces. Apply temporary traffic stripes and markings when the ambient and surface temperatures are at least 7.2°C (45 °F) and rising and the surface temperature is no more than 60°C (140 °F). Apply the traffic paint in a wet film thickness of 6 ± 1 mil. Apply glass beads of the correct gradation to the wet paint in a uniform pattern and at the rate of 1.4 kilograms per liter (12 pounds per gallon) of paint.

2.10 TRAFFIC DIRECTION

- A. **Flagger.** Provide flaggers that have received formal training in flagging operations and the proper use of the STOP/SLOW paddle. The flagger must meet MUTCD qualifications and, when requested, demonstrate competency. Ensure that flaggers wear a 360° high-visibility retroreflective orange safety garment meeting ANSI Class 3, Level 2 standards. Ensure that the flagger is equipped with a STOP/SLOW paddle and follows MUTCD flagging procedures.
- B. **Police.** Activities requiring uniformed Police services include:
 - 1. Traffic direction on all FDOT roads
 - 2. Signalized and complex unsignalized intersections
 - 3. In front of schools when in session and work is underway
 - 4. Night Operations
 - 5. As otherwise Determined by Local Authorities

END OF SECTION 01 55 26

SECTION 01 57 25 – AS-BUILT SURVEY

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. This section covers As-Built Survey work required by the Contractor.

1.02 DEFINITIONS:

- A. Definition
 - 1. Owner: Jacksonville Electric Authority (JEA)
 - 2. Engineer: Burns & McDonnell Engineering Company, Inc. (BMcD)
 - 3. Contractor: To Be Determined

1.03 SUBMITTALS

- A. As-Built Drawings and records.
- B. All required submittals as specified in the project specifications.

1.04 RELATED REQUIREMENTS

- A. Section 01 11 01 – Summary of Work

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 AS-BUILT SURVEY

- A. During the course of installation, Contractor shall survey as-constructed horizontal and vertical underground (UG) cable system alignment, structure locations, foundation location, and installation configurations.
- B. Horizontal and vertical locations shall be surveyed at a maximum of 25-foot intervals for straight sections, and at the following reduced intervals and additional locations:
 - 1. At a maximum of 5-foot intervals through horizontal curves.
 - 2. At a maximum of 5-foot intervals through areas of vertical deflection where factory- and/or field-bend pipe/conduit pieces are used to generate the vertical curvature.
 - 3. At all locations where an existing utility is crossed over or under. At these locations a horizontal and vertical location shall be surveyed at the point of crossing (plan-view intersection point).
 - a. Top and bottom survey points for existing utilities shall be provided alongside top of duct bank in order to accurately reflect crossing on conformed to construction record drawings
 - 4. Additional survey points as necessary to properly document installed conditions.
 - 5. Vertical position to be measured from top of both duct bank conduit, concrete, and backfill
- C. Contractor shall survey at a maximum of 3-foot intervals while within Church Street Substation to support record-keeping within Owner property.
- D. Contractor shall note installed radii of both horizontal and vertical curves on the as-built drawings.
 - 1. Contractor shall take sufficient survey points to determine actual radius of installed horizontal and/or vertical bends
 - 2. As-built survey to include points of intersection (PI), points of tangency (PT), and points of curvature (PC) of installed horizontal and vertical curvature.

SECTION 01 57 25 – AS-BUILT SURVEY: continued

- E. Contractor shall specifically record all deviations from Contract Drawings including, but not limited to, the following:
 - 1. Termination structure and handhole location deviations of greater than or equal to six inches from Contract Drawings.
 - 2. Horizontal or vertical alignment deviations greater than or equal to four inches from Contract Drawings.
 - 3. Any changes in the size, type, location or existence of existing utilities exposed during excavation work from that shown in Contract Drawings.
 - 4. Any changes in configuration from that shown in Contract Drawings.
 - 5. Any other details not on Contract Drawings.
- F. Horizontal location data shall be surveyed into same coordinate system as Contract Drawings.
- G. Vertical location data shall be surveyed into same datum as Contract Drawings.
- H. Relative dimensions to existing features shall not be acceptable to document as-built locations.
- I. Contractor shall maintain a clean set of up-to-date mark-ups available for off-hours emergencies.

END OF SECTION 01 57 25

ELECTRICAL SPECIFICATIONS

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION

PART 1 - GENERAL

1.01 SUMMARY:

- A. This specification includes criteria & requirements related to the installation of the cable system.

1.02 RELATED REQUIREMENTS:

- A. Section 01 11 01 – Summary of Work
- B. Section 33 05 05.44 – Proofing Log
- C. Section 33 08 70.10 – Underground HV Cable Testing

1.03 REFERENCED STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. Design, construct, assemble and test material furnished to conform with, but not limited to, the latest editions at time of contract award of all applicable standards of the following:
 - 1. American Institute of Steel Construction (AISC):
 - a. M015L - Manual of Steel Construction Load & Resistance Factor Design.
 - b. M016 - Manual of Steel Construction Allowable Stress Design.
 - c. S323 - Quality Criteria and Inspection Standards.
 - 2. American National Standards Institute/American Welding Society (ANSI/AWS):
 - a. D1.2 – Structural Welding Code – Aluminum.
 - 3. Association of Edison Illuminating Companies (AEIC).
 - a. CG4 – Guide for Installation of Extruded Dielectric Insulated Power Cable Systems Rated 69kV Through 138kV.
 - b. CG5 – Underground Extruded Power Cable Pulling Guide.
 - c. CS9 – Specification for Extruded Insulation Power Cables and Their Accessories Rated Above 46 kV Through 500-kV.
 - 4. Council on Large Electric Systems (CIGRE)
 - a. TB 889 – Installation of underground HV cable systems
 - 5. Insulated Cable Engineers Association (ICEA).
 - a. S-108-720 – Standard for Extruded Insulation Power Cables Rated Above 46kV Through 500kV.
 - 6. Institute of Electrical and Electronic Engineers (IEEE).
 - a. C2 - National Electrical Safety Code.
 - b. C62.92.5 – Neutral Grounding – Transmission Systems.
 - c. 48 – Requirements for High Voltage AC Cable Terminations.
 - d. 400 – Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.
 - e. 404 – Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2,500 – 500,000V.
 - f. 575 – IEEE Guide for the Application of Sheath-Bonding Methods for Single-Conductor Cables and the Calculation of Induced Voltages and Currents in Cable Sheaths.
 - g. 635 – Selection and Design of Aluminum Sheaths of Power Cables.
 - 7. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.
 - 8. Steel Structures Painting Council (SSPC)

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

- a. SP 3 - Surface Preparation Specification No. 3 Power Tool Cleaning.
- b. National Electric Manufacturer's Association (NEMA).
- c. WC 26 – Wire and Cable Packaging.

1.04 DEFINITIONS:

- A. Owner: Jacksonville Electric Authority (JEA)
- B. Engineer: Burns & McDonnell Engineering Company, Inc.
- C. Contractor: To Be Determined
- D. Supplier: Marmon Utility, LLC.

1.05 SUBMITTALS:

- A. Shall be approved by Owner and reviewed by Engineer.
- B. Installation Plan including, at a minimum, the following:
 - 1. For information:
 - a. Proposed equipment to be used
 - b. Equipment setup / layout
 - c. Crew size and roles
 - d. Pulling records for each pull
 - e. Mandrel data
 - f. Termination records
 - g. Cable pulling lubricant
 - h. Cable clamp
 - i. Cable clamp mounting hardware
 - j. Link box mounting hardware
 - 2. Required prior to Work
 - a. Splicer certifications
 - b. Pulling procedure
 - c. Pulling calculations including maximum tension, direction of pull, and sidewall pressure for each pull.
 - d. Anticipated schedule of activities
- C. Material Certificates: For each of the following:
 - 1. Contractor shall submit MSDS sheets for pulling lubricants, cleaners, solvents, etc. that are used for the cable system installation prior to the commencement of work.
- D. Field Quality Control
 - 1. Conduit proofing logs
 - 2. Cable pulling logs
 - 3. Termination installation QA/QC checklist

1.06 QUALITY ASSURANCE:

- A. Splicer Qualifications:
 - 1. Contractor shall submit current splicer certifications from the Supplier for all personnel that will perform cable terminating activities. If Supplier does not provide certifications, then Contractor shall submit splicer resumes for all personnel that will perform cable terminating activities.
 - a. Splicers will not be allowed to perform work without current certifications or resumes.

1.07 RECEIVING AND STORAGE OF MATERIALS:

- A. General:
 - 1. Receipt of Materials:

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

- a. Unload all equipment promptly when delivered.
 - b. Inspect all equipment and material for damage and check against shipping receipts for any missing parts. Inform Engineer and Owner of any shortages or damaged materials at the time of delivery. Report obvious shipping damage immediately to Owner. Note the damage on the shipping company's forms before accepting shipment.
 - c. Prepare "Material Receipts" for each shipment received, on electronic forms furnished by Owner. Receipts shall be distributed to Engineer and Owner as well as the Supplier's file and shall list in detail all items received noting any items damaged or missing as listed on Supplier's shipping list. "Material Receipts" shall have attached to Owner's copy the shipping list taken from the equipment received. Material receiving reports shall be filled out, signed, dated, and delivered to Engineer and Owner within 24 hours of receiving the materials.
 - d. The Contractor shall be responsible for any damage or missing items of stored equipment and material while in their custody.
 - e. The Contractor shall pay all deposits for shipping containers such as gas bottles, cable reels, etc.; be responsible for the containers while on site; and arrange for their pickup when the contents of the containers have been expended.
 2. Inventory of Crates and Boxes:
 - a. All accessory parts received in cartons shall be inventoried item by item with any damage or shortages noted.
 - b. All materials received in crates shall be uncrated to the extent that a complete and thorough inventory may be made. Upon the completion of the inventory, the equipment shall be reboxed, packaged, and stored to the satisfaction of Owner.
- B. Heavy Equipment Hauling:
1. Provide the services of a heavy hauling subcontractor experienced in moving and handling equipment of this size, weight, and type (unless evidence can be shown that the Contractor possesses the proper equipment and skilled personnel equal to that of such a heavy hauling subcontractor).
 - a. The heavy hauling subcontractor shall be licensed, if required by the local regulatory agency, for the area in which the work is to be done.
 - b. The heavy hauling subcontractor shall own his equipment or have a bona fide lease for the use of such equipment.
 - c. The subcontractor shall issue a surety bond with the local regulatory agency adequate to cover all possible damage to roads, highways, bridges, etc., as determined by said agency. This bond shall be in addition to the bond required for equipment protection on this contract.
 - d. The subcontractor shall have insurance in minimum amounts as required by the local regulatory agency for Personnel Injury Liability and for Property Damage Liability.
 2. Work must be done under the supervision of an experienced rigger approved by Owner if requested.
 3. Extreme care must be used in moving this equipment for personnel safety and prevent damage to the equipment. A written Work Plan of the methods, materials, and operations must be reviewed by the Owner before work is started.
 4. Roadways, bridges, and other areas over which equipment is to be moved shall be planked and braced, if necessary, for their protection.
 5. Contractor shall secure all permits and make all other necessary arrangements with local street and highway authorities and police as required to obtain use of right-of-way, crossing rights, and traffic control for moving equipment from the points of unloading to

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

- points of installation. All stipulations for the issuance of permits shall be strictly followed. Copies of these permits shall be provided to Engineer and Owner.
6. Contractor shall be responsible for raising or having raised all power cables, telephone cables, service drops, etc., to provide sufficient overhead clearances for equipment. Replace or restore to original condition all items damaged because of heavy equipment hauling.
 7. The subcontractor shall familiarize themselves with the design loading of all equipment and structures and shall not overload. Use all lifting lugs provided.
 8. Replace or restore to original condition any equipment or material missing or damaged while under the responsibility of this contract.
 9. Equipment shall be moved to its permanent location as soon as possible. If temporarily stored, the equipment shall be blocked on the ground as low as possible with the approval of Owner.
- C. Medium-Weight Equipment Receiving:
1. Use cranes or fork lifts of sufficient size to prevent overloading of lifting equipment. Do not load rigging in excess of its recommended safe working load. When fork lifts are used, line the forks so that equipment finishes will not be marred.
 2. Rigging equipment shall be inspected prior to use and during its use for safety. If found defective, the rigging equipment shall be replaced.
 3. Use lifting hooks, eyes, etc., if provided on the equipment for lifting.
 4. Use rope or synthetic webbing for slinging steel structures.
- D. Material Storage:
1. Equipment and materials shall be placed in storage areas as designated.
 2. Materials shall be stored such that materials being used first will not have to be lifted over materials which will be used later.
 3. As much as possible, all parts for a particular piece of equipment shall be stored in one location.
 4. Deliver all spare or extra parts to the Owner's warehouse and store as directed at the end of the job.
- E. Material Inventory Control:
1. The Contractor shall be responsible for the safe storage of all materials at the Contractor's staging and storage facilities/areas.
 2. Material inventory shall be started in conjunction with "Material Receipts" prepared for receiving materials.
 3. Materials shall be listed in accordance with the manner of storage.
 4. Materials which are a portion of some other item shall be listed as such.
 5. Material inventory control reports shall be made weekly or as directed by Owner. This report may be compiled by numerical addition or subtraction of items received or used and include, but not be limited to, the following:
 - a. New materials received.
 - b. Materials incorporated into the project.
 - c. Materials missing.
 - d. General comments concerning the condition of materials.
 6. An inventory, item-by-item count, shall be made of all materials on hand monthly or as directed by Owner.
- F. Material Protection: All equipment while under the responsibility of this Contract whether furnished and installed, or furnished by the Supplier and installed under this Contract, shall be adequately protected. Provide protection as specified in following:
1. Equipment shall be stored outdoors unless designed for permanent indoor installation and must be stored indoors.

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

2. Where stored out of doors, equipment shall be properly blocked up 6 inches off the ground on timbers.
 3. Equipment requiring indoor storage must be stored in the control house or warehouse space provided by the Contractor which shall be heated by this contract when required by weather conditions to prevent condensation and shall be locked or supervised to prevent the entrance of unauthorized persons. Temporary buildings and trailers shall be in locations acceptable to Owner and will be removed when the work is complete.
 4. Provide adequate protection during storage, installation, and up to the time of final acceptance, from the following:
 - a. Rain and all other weather conditions.
 - b. Dust, dirt, sand, and concrete splatter.
 - c. Excessive heat, freezing, and condensation.
 - d. Welding operations, falling objects, and construction work in general.
 5. Provide protection in a manner meeting the approval of Owner and Supplier's representatives by the application of the following:
 - a. Tarpaulins.
 - b. Properly controlled electric heaters, heating lamps and fans.
 - c. Temporary guards, protective awnings, barricades, etc.
 6. Particular care shall be exercised in protecting equipment from moisture and damage to the finish. Equipment with damaged finish shall be touched up or completely repainted to equal the original finish as directed by Owner.
 7. All work, material, and equipment furnished or installed by the Contractor shall be kept in a clean condition during the construction period of the project as required by Owner.
 8. Store equipment and materials in accordance with instructions of the Supplier's representatives when storage at the site is required.
 9. Owner shall be informed of any arrangements made for storage of materials or equipment in a place other than the Owner's site.
 10. Contractor shall assume responsibility for and protect all equipment and materials during the storage period in accordance with the Supplier's recommendations including the following:
 - a. Protection of equipment and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter.
 - b. Protection of exposed machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds.
 11. Materials and equipment shall not show any pitting, rust, decay or other deleterious effects of storage prior to final acceptance of the work.
- G. Acceptance at site.
1. Prior to acceptance at site, cable reels shall undergo successful jacket integrity test (JIT) according to Section 33 08 70.10 – Underground HV Cable Testing.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Contractor shall furnish all miscellaneous materials and tools as required to complete the work. Any materials not specified as being furnished by others, but which are required for a complete installation, shall be furnished by Contractor.

2.02 EQUIPMENT & MATERIALS:

- A. Provide all equipment required for the installation of equipment and materials including, but not limited to, the following:

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

1. Aluminum heliarc welding equipment and wire.
2. Cranes and forklifts.
3. Jacking equipment.
4. Miscellaneous hand and power tools.
5. Heavy hauling equipment and materials.
 - a. Multiwheeled lowboys (size as required).
 - b. Hauling tractor (size as required).
 - c. Tractor, capable of pushing, backing, or anchoring on grades, 5 percent or greater.
 - d. Heavy cribbing, blocks, planks, or rails.
 - e. Chains, equipment tie down and safety.
 - f. Winch or cranes.
 - g. Hydraulic lifting jacks with a common control for simultaneous lifting and lowering.
6. Cable pulling lubricant
7. Cable clamps and mounting hardware
 - a. Cable clamp shall be Ellis Cable VRT+08TFM10-4 or Owner-approved equivalent (see Appendix 33 05 90B)
8. Other miscellaneous equipment as required.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS:

- A. It is the sole responsibility of the Contractor to monitor the Safety & Health procedures for the field conditions to be encountered on the job site and comply with Owner's safety procedures and policies during the project.
- B. Contractor's responsibilities shall include but not limited to the items listed below. Contractor shall assume all responsibility for his methods of construction and the costs of any damage caused by them. The Contractor shall be solely responsible for personnel engaged in underground cable system construction throughout the duration of the work.
 1. Provide personnel, arbor bar, spreader bar, lifting slings, and crane to unload the reels of transmission cable and accessories at the construction site.
 2. Supply all installation equipment, labor, and qualified construction supervision personnel to install all cable, cable terminations and accessories in accordance with the cable Supplier's recommendations, requirements in this document, and AEIC Guide CG5 titled "Underground Extruded Power Cable Pulling Guide". Contractor's construction supervisor shall be the same construction supervisor as identified in Contractor proposal unless a qualified replacement construction supervisor is specifically approved in writing by Owner.
 3. Supply and erect temporary structures necessary to facilitate installation of the cable and cable terminations. Remove any temporary structures after the work is complete.
 4. Test and clean all conduits in the duct banks, per 3.03 below, to determine if they are suitable for cable installation.
 5. Install the ground continuity conductors between the substation termination structures and the existing cable riser pole.
 6. Install bonding cable between terminations and link boxes.
 7. Mount and connect the link boxes on the termination structure in the substation and cable riser pole.
 8. Prepare and maintain an up-to-date construction schedule for the Project. An up-to-date construction schedule shall be sent to Engineer and Owner upon request.

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

9. Maintain compliance with all federal, state, and local regulations concerning safety and environmental control practices.
10. Remove and dispose of spoil and scrap material from the construction site to locations as specified.
11. Restore the surface of the cable route to be reasonably similar to conditions prior to construction.
12. Dispose of the non-returnable cable reels and other packing material for the transmission cable and accessories.
13. Contractor shall be responsible for the storage and security of all material delivered to the construction site.
14. Assist Owner with the phasing and testing of the transmission cables prior to commissioning.

3.02 CLEANING:

- A. The following shall be performed for each duct run that is to be used for current or future installation of power cables, or is of a size equivalent the ducts to be used for power cables.
1. Prior to cable pulling, each duct shall be swabbed, and mandreled.
 2. Mule tape installed by duct bank installer is intended for use in pulling of the required winch line or rope to complete subsequent activities. Mule tape is not intended for pulling of mandrel or cable.
 3. Swabbing:
 - a. The swab shall consist of a ball of cotton rags, sized to fit snugly within the duct.
 - b. If moisture and/or foreign materials are evident on the swab after being pulled through the pipe, additional swabbing must be performed until swab appears dry per the Owner's discretion.
 - c. If ripping is evident on the swab, swabbing must be carefully repeated and inspected to confirm pipe or weld defects do not exist. If any defects exist, they must be reported to Engineer and Owner and further direction will be provided.
 4. Mandreling:
 - a. Mandrel shall be constructed of maple wood or approved substitute.
 - b. Mandrel shall be painted first with a red coat and finished with a white coat to indicate any scratches upon pulling through.
 - c. Mandrel shall have a diameter of one-half inch (1/2") less than the inside diameter of the duct and shall be tapered at each end. The overall length of the mandrel, and the length of the full-diameter portion shall be in accordance with the following table:

Nominal Conduit Diameter	Overall Length	Full Diameter Length	Taper Length (each end)
6"	16"	10"	3"

- d. Mandrel shall be approved by the Owner, in writing, prior to use.
- e. Mandrel shall be equipped with a backup cord, for use in the event it cannot pass through the duct line.
- f. If a scratch is found deeper than 1/32", the Engineer and Owner shall be notified and the source of the scratch shall be investigated and, if necessary, corrected. Owner shall determine when the mandrel shall be re-run. Contractor shall remove such burrs and/or obstructions after which the mandrel is passed through again. The process will be repeated until a satisfactory result is obtained.

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

- B. As the ducts are being tested, Contractor shall record exact conduit length on the Proofing Log found in Section 33 05 05.44 – Proofing Log. This information shall be provided to Engineer and Owner immediately.
- C. Following successful testing of the ducts;
 - 1. Contractor shall install in each duct run a mule tape pull line of at least 6,000 lbs. minimum break tension and at least 1” width or equivalent.
 - 2. Pull lines shall be secured to the conduit plugs or tied to structures.
 - 3. Seal both ends of each duct with plastic plugs until cable pulling commences.
- D. An inspection report shall be provided to Engineer and Owner along with the executed Proofing Log for final acceptance.

3.03 CABLE INSTALLATION:

- A. Contractor shall comply with the following requirements during cable installation:
 - 1. Prior to setting up equipment and material for any cable pull, the conduits shall be thoroughly cleaned of all fine sand, dirt, or dried concrete residue, and then dried.
 - 2. All leader lines blown through the ducts shall be clean and dry.
 - 3. Cables shall be pulled in the directions indicated on the drawings.
 - 4. Contractor shall maintain reliable radio and/or telephone connections between the cable reel trailer and the winch.
 - 5. In addition to that normally required, the following equipment shall be utilized for all cable pulling operations.
 - a. A variable speed pulling winch capable of at least 150% of the maximum expected pulling tension.
 - b. An accurately calibrated dynamometer, which will indicate and record tension up to 200% of the cable Supplier’s maximum allowable pulling tension, with a means for chart recording of pulling tension with respect to length pulled.
 - c. The pulling apparatus shall include an accurate indication of footage pulled.
 - 6. The pulling tension records for all cable pulls shall be submitted to the Engineer and Owner upon completion of each cable pull.
 - 7. The pulling record submitted to the Engineer and Owner shall include the dynamometer pulling record along with a sheet containing the following data for each cable.
 - a. Circuit number.
 - b. Start and end points of the cable pull.
 - c. Cable type and size.
 - d. Cable reel identification number.
 - e. Cable sequential foot markings at each end of the cable.
 - f. Date and time circuit installation was started and completed.
 - g. Foreman of pulling crew.
 - h. Maximum pulling tension.
 - i. Speed(s) of pulling.
 - 8. Pulling lines shall be of rated working load compatible with the pulling winch and of a size and construction to minimize any abrasive action on the internal duct wall. Fishing, duct proofing, and leader lines shall be designed and utilized as to not damage the ducts.
 - 9. Pulling lines and leader lines shall be clean and dry when installed in the duct.
 - 10. A reliable nonfreezing type of swivel, or swivel connection, shall be inserted between the pulling rope and the cable pulling eye, grip, or loop to prevent twisting under strain.
 - 11. Contractor shall provide all guide reels and rollers, and feed tubes necessary to guide the cable into the ducts and to limit all feed and take-ups and bends to a radius not less than 20 times cable outside diameter, or as recommended by the cable Supplier.

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

12. Contractor shall install the cable in such a manner that at no time is the cable bent to a radius less than twenty (20) times the cable diameter except during permanent positioning within the vaults or at termination structures.
13. Cable rollers and guides shall be placed along the cable pull as required to support cable during cable pulling. The cable shall not be allowed to rest or scrape on timbers, rock or any sharp or hard object that could damage the cable.
14. Only lubricants recommended by the cable Supplier and acceptable to Owner shall be used. The duct shall be pre-lubricated and lubricants shall be applied liberally and continuously during the entire pull.
 - a. Pulling lubricant shall be Polywater NN or Owner-approved equivalent.
15. A thorough continual visual inspection for flaws, breaks, or abrasions of the exterior of each cable shall be made as it leaves the reel. Each inspector shall be equipped with direct communication with the pulling winch operator. Pulling operations shall be immediately stopped upon detection of any irregularities. Engineer and Owner shall be immediately informed of these irregularities.
 - a. The pulling speed shall be slow enough to allow for this inspection.
 - b. In the event that damage should occur to the cable jacket during cable installation, cable installation shall be halted and Engineer and Owner notified of the damage. Repair of the cable jacket shall be made subject to the approval of Owner.
16. The pulling tension of any cable shall not exceed the maximum tension recommended by the cable Supplier. Pulling mechanisms of both the manual and power types used by Contractor shall have the rated capacity in tons clearly marked on the mechanism.
 - a. A recording dynamometer shall be used to show the tension on the cable and the indicator shall be constantly watched. If any excessive strain develops, the pulling operation shall be stopped at once and the difficulty determined and corrected.
17. The area of the cable covered by the pulling eye or seal plus 6 inches shall be cut off and discarded when the pull is completed.
18. After the cable is pulled into place, the pulling eyes or cable grips shall be removed and any cable which was sealed prior to the pull shall be resealed.
19. The cable shall be allowed a minimum of 24 hours of resting in the ducts after pulling before any terminating activities.
20. Contractor shall perform a jacket integrity test on each cable section in accordance with Section 33 08 70.10 – Underground HV Cable Testing.

3.04 TERMINATION INSTALLATION:

- A. Contractor shall comply with the following requirements during cable termination:
 1. Supplier and Contractor shall supply current training certificates or resumes for all terminating personnel.
 - a. Only personnel with current training certificates or Owner-approved resumes shall be allowed to perform the termination work.
 2. A Supplier representative shall be present at all times during the termination activities as required for warranty.
 3. Contractor shall install the cable termination system in strict accordance with the Supplier's recommendations and instructions.
 4. Contractor shall inspect the end of each of the transmission cables for the presence of moisture when the cables are cut for terminating. If moisture is noted then Contractor shall:
 - a. Immediately notify Engineer and Owner.
 - b. Take pictures of the cable at the cut, the pulling eye and the free end sealing cap.

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

- c. Discontinue terminating of the cable until the moisture ingress problem is resolved.
5. The terminations shall be installed in a clean and controlled environment per the cable Supplier's specifications. If the weather conditions are unfavorable and Contractor is conducting termination work, proper measures shall be taken to maintain an appropriate environment.
6. If termination of a cable cannot be completed during a given work day, then any exposed cable insulation or high voltage conductor shall be effectively sealed to preclude ingress of moisture until the termination can be completed.
7. Contractor is responsible for all scaffolding, bucket trucks or temporary platforms required to make terminations in a professional and safe manner.
8. Contractor is responsible for all miscellaneous materials and supplies required for the installation.
9. Contractor shall afford Engineer and Owner, at Owner's option, the opportunity to have its employees or representatives observe all phases of cable termination.
10. Smoking is not permitted during cable terminator installation.
11. Contractor shall record the following data for each termination. The termination records shall be submitted to Engineer and Owner after completion of the termination.
 - a. Circuit Number
 - b. Termination location
 - c. Termination start and completion dates
 - d. Name of electrician(s) who terminated the circuit
 - e. Completed QA/QC checklists provided by Supplier
 - f. Photos of the work

3.05 MISCELLANEOUS MATERIAL INSTALLATION:

- A. Cable Clamps and Supports:
 1. All cable supports and clamps shall be installed to provide adequate support and restraint without damaging any part of the cable.
 2. Cable supports shall be provided at no more than five feet of separation and shall be secured to a permanent wall using precast or drilled-in concrete anchors.
 3. Contractor is responsible for furnishing and installing drilled-in concrete anchors and supports as necessary.
 4. Contractor shall clamp cable on termination structures and existing riser pole utilizing the mounting points provided. Contractor shall not modify the termination structures or clamps without Owner approval.
- B. Link Box Installation:
 1. Contractor shall install the Owner-furnished link boxes and bonding connections.
 2. Contractor shall furnish all miscellaneous materials not specified as being within the scope of the Owner but required for a complete installation of the link boxes at cable terminations as indicated on the drawings and/or as required for a complete installation.
 3. Special care shall be taken to proper placement of link boxes with SVLs versus those without SVLs. The Plan Drawings will show all bonding connections.
 4. All installation activities shall be in strict accordance with the written instructions of the Supplier.
 5. Grounding of the cable sheath shall allow easy disconnection and reconnection of the grounds to facilitate periodic cable jacket integrity testing.
 6. Contractor shall install a complete bonding system, including all necessary stainless-steel link boxes, sheath voltage limiters as well as a complete racking system.
- C. Contractor shall install all cable bonding materials and grounding system materials as indicated on the drawings and recommended by the Supplier.

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

1. Contractor shall furnish and install all materials not provided by the equipment Supplier, as required to attach, support or connect the cable bonding materials.
- D. Contractor shall install the ground continuity conductor (GCC) as indicated on the drawings.
 1. The ground continuity conductor shall be installed in a similar procedure to the high voltage cable.
 2. Contractor shall proof the ducts for the GCC utilizing a clearance mandrel no more than 1/2" smaller than the duct inside diameter.
 3. The GCC shall be installed utilizing pulling lubricant, a cable winch and an acceptable pulling line. The pulling method shall be designed to minimize pulling surges and conduit damage or burn-through.
- E. Contractor shall furnish and install bonding, grounding conductors and miscellaneous attachment hardware to connect the cable bonding and cable accessories to the termination structure as indicated on the drawings or as recommended by the Supplier.
 1. Utilizing the termination structure steel as the sole ground path is not acceptable.

3.06 BOLTED CONNECTIONS:

- A. Galvanized Surface Coatings:
 1. All galvanized surfaces on which the galvanizing is removed by cutting, drilling or by any other operation shall be re-galvanized with "Galvanizing Powder M-321" as manufactured by the American Solder and Flux Company of Philadelphia, Pennsylvania; with "Zincilate 810" as manufactured by Industrial Metal Protectives, Inc., of Dayton, Ohio; with "Zinc Rich" coating as manufactured by ZRC Chemical Products Company, Quincy, Massachusetts; or acceptable equal. Contractor shall furnish this protective material and shall apply it in the field to any surface where the galvanized coating is broken or removed either intentionally or unintentionally.
- B. Location Tolerances:
 1. Material shall be located within 1/8 inch of the dimensional location indicated on the Plan Drawings unless otherwise permitted by Owner.
- C. Bolted Electrical Connections:
 1. Where bolted connections are made to aluminum, the aluminum surface shall be thoroughly cleaned with a wire brush, then coated with joint compound and thoroughly brushed again through the compound. Additional compound shall then be added and the joint bolted together. Joint compound shall be Alcoa No. 2.
 2. Where bolted connections are made between copper or brass surfaces, the metal surfaces shall be thoroughly cleaned and coated with Penetrox A as manufactured by Burndy Corp. or No-Ox-Id A compound as manufactured by Sanchem Inc.
 3. Where bolted connections are made between aluminum and copper, brass transition plates shall be used.
 4. The tightness of each bolt in each factory-made bolted electrical connection shall be checked during installation and connection of the equipment.
 5. It shall be Contractor's responsibility to verify that the tightness of each bolt in all bolted electrical connections, factory or field, is in accordance with the Supplier's recommendations.
 6. Bolted electrical connections shall be tightened with manual torque wrenches. Torque wrenches shall be so constructed that they will visually or audibly indicate when the proper torque is reached. The accuracy of each torque wrench shall be calibrated by a testing laboratory acceptable to Owner immediately prior to its use on equipment erected under these Technical Specifications. Torque values shall be as recommended by the equipment Supplier's installation instructions.
- D. Connection Bolt Tightness Check:

SECTION 33 05 90 – UNDERGROUND CABLE SYSTEM INSTALLATION: continued

1. The tightened bolts in electrical connections shall be checked by and in the presence of the Owner or their representative. Contractor shall provide calibrated hand torque wrenches and the necessary platforms, equipment and personnel for the check.
2. Contractor shall be responsible for coordinating the checking of bolt tightness so that minimum interference with equipment installation and connection will be experienced. Removal of covers and similar dismantling of equipment to permit Owner to witness the testing of bolt tightness of enclosed connections shall be part of the work included under these Technical Specifications.
3. Checking of tightness of electrical connections in the presence of Owner is intended to assist Contractor in avoiding the expense of repairing costly connection failures. This check shall not relieve Contractor of complete responsibility for the integrity of the electrical connections.

3.07 FIELD QUALITY CONTROL:

- A. Tests.
- B. Inspection.
- C. Repairs.
- D. Suppliers field services.

3.08 REPAIRS:

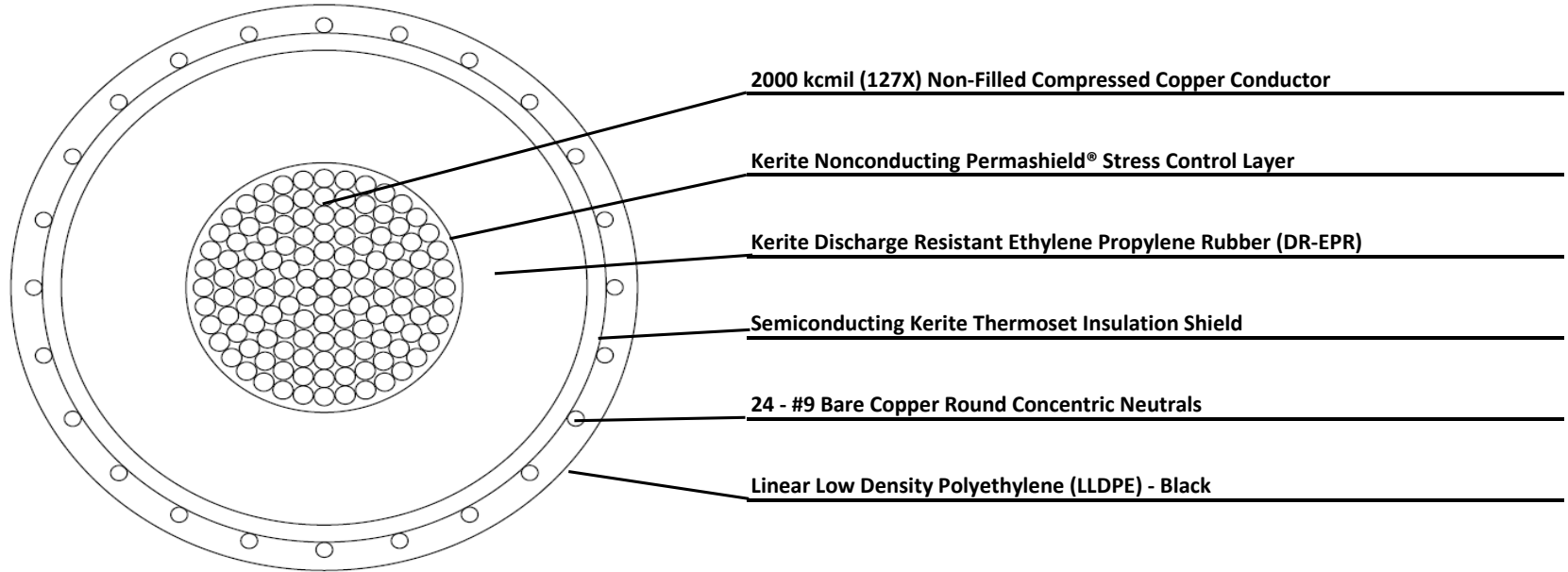
- A. If any significant damage occurs to the cable jacket during installation, Engineer and Owner must be notified immediately. Significant cable damage is defined as any damage that penetrates the jacket by 50 mils or greater. If cable damage exceeds 30% of the thickness of the cable jacket but does not penetrate the metallic sheath, then the jacket damage must be repaired using the procedure recommended by the cable Supplier.
 1. If the cable damage penetrates the metallic sheath but does not penetrate insulation semi-conducting shield, then the cable repair procedure must be approved by Owner and the cable Supplier.
 2. If the cable damage penetrates the insulation semi-conducting shield, then the cable must be removed and replaced.
 3. Any cable repair costs shall be to the account of the Contractor.

3.09 ADJUSTING, CLEANING:

- A. The work included under these Technical Specifications shall include removal of all foreign materials from the Site, repair of all damage, and restoration of the Site to as good or better condition than when the work was commenced by the Contractor.
- B. The Contractor shall clean up construction debris, packing materials, cleaning materials and excess materials on a daily basis. Debris will be placed into suitable containers provided by the Contractor and disposed of as containers become full.
- C. At the conclusion of each day's work, the Contractor shall thoroughly clean all foreign materials caused by the construction operations from all streets and roads.
- D. Completion of the work shall be followed immediately by clean-up of the work site. The Contractor shall remove from the vicinity of the work all Equipment/Materials and Parts brought onto site for purposes of construction.

END OF SECTION 33 05 90

Marmon Utility - Kerite Part No: 199C69-J2100001



COMPONENT	DESCRIPTION	Min Dia (in)	Nom Dia (in)	Max Dia (in)	Additional Notes	
Conductor	2000 kcmil (127X) Non-Filled Compressed Copper	-	1.583	-	Cable Weight (1/C):	11.305 (lbs/ft)
Conductor Shield	24 mil min pt Kerite Nonconducting Permashield®	-	1.645	-	Cu Weight:	7.190 (lbs/ft)
Insulation	620 mil min pt Kerite DR-EPR	2.870	2.995	3.005	Al Weight:	0.000 (lbs/ft)
Insulation Shield	55 mil min pt Semiconducting Thermoset	2.980	3.115	3.155	Industry Standards: ICEA: S-108-720	
Metallic Shield	24 - #9 Bare Copper Round Concentric Neutrals	-	3.340	-		
Jacket	125 mil min pt LLDPE Jacket - Black	-	3.650	-		



CABLE DESCRIPTION:

1/C Single - 2000 kcmil (127X) Non-Filled Compressed Copper Conductor, Kerite Nonconducting Permashield®, 69 kV 100% (650mil) Kerite DR-EPR Insulation, Semiconducting Thermoset Insulation Shield, 24 - #9 Bare Copper Round Concentric Neutrals, 140 mil Encapsulating LLDPE Jacket - Black

DRAWING:

199C69-J2100001
 SCALE: None
 BY: M Kubikowski
 DATE: May 22, 2025

IMPORTANT NOTICE:

This drawing is only an illustration of the product and is for information purposes only.
 Marmon Utility LLC does not accept any liability for errors or omissions or misuse of the information provided.

ELLIS

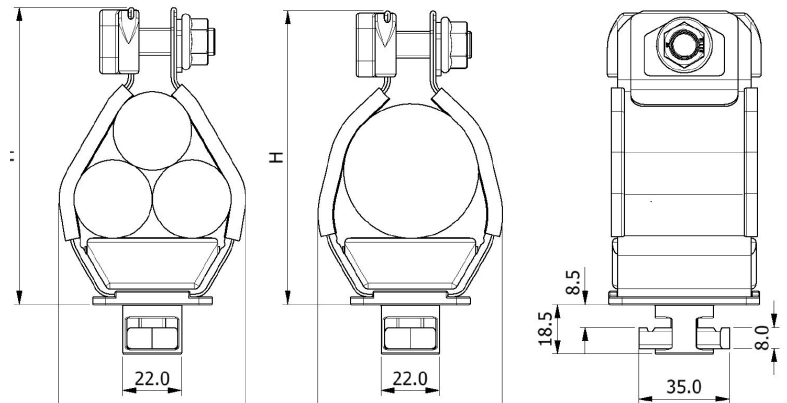
Holding Power

DATA SHEET

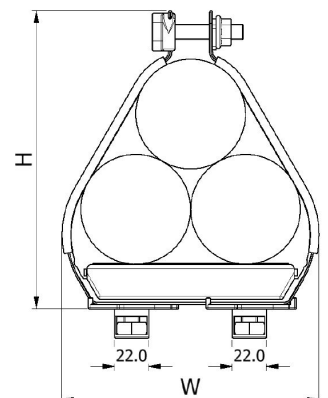
TWIST FOOT VULCAN+ (VRT)

Patent No. UK Patent GB 255 7257, UK Patent GB 258 5846

- BASE FIXING KIT DESIGNED FOR FAST INSTALL ON 41X41 AND 41X21 UNISTRUT CHANNEL/LADDER
- CLEAT COMES WITH ALL FIXINGS IN PLACE READY FOR INSTALL, NO EXTRA FIXINGS ARE REQUIRED ON SITE
- FIXING KIT CAN BE SUPPLIED IN A4 STAINLESS STEEL, GALVANISED STEEL OR ZINC PLATED STEEL
- SHORT CIRCUIT AND MECHANICALLY TESTED TO IEC 61914 – REFER TO VRT+ DATA SHEET



PART NO.	CABLE RANGE TREFOIL		CABLE RANGE SINGLE		DIMENSIONS (mm)			WEIGHT (g)
	MIN Ø (mm)	MAX Ø (mm)	MIN Ø (mm)	MAX Ø (mm)	W	H	D	
VRT+00BTFM10-X	-	-	18	28	64	96	54	330
VRT+00ATFM10-X	15	18	26	30	64	96	54	337
VRT+00TFM10-X	19	24	30	42	60	96	54	301
VRT+01TFM10-X	23	28	38	50	63	102	54	308
VRT+02TFM10-X	27	32	43	58	72	109	54	319
VRT+03TFM10-X	30	35	49	64	79	115	54	329
VRT+04TFM10-X	33	38	55	70	85	121	54	334
VRT+05TFM10-X	36	42	58	75	96	128	54	369
VRT+06TFM10-X	40	46	63	84	105	137	54	381
VRT+07TFM10-X	44	50	73	90	112	143	54	441
VRT+08TFM10-X	48	55	83	100	121	152	54	455
VRT+09TFM10-X	51	58	86	104	126	158	54	461
VRT+10TFM10-X	55	62	88	110	134	166	54	492
VRT+11TFM10-X	59	66	90	115	143	174	54	503
VRT+12TFM10-X	63	70	100	125	152	181	54	510
VRT+13TFM10-X	67	74	107	132	161	188	70	574
VRT+14TFM10-X	71	78	120	145	169	195	70	586
VRT+15TFM10-X	74	82	125	150	176	199	70	592
VRT+16TFM10-X	77	85	132	153	183	208	70	594
VRT+17TFM10-X	81	89	136	156	190	219	70	668
VRT+18TFM10-X	85	93	139	159	200	228	70	678
VRT+19TFM10-X	89	97	142	162	200	238	70	687
VRT+20TFM10-X	93	101	160	170	215	243	70	696



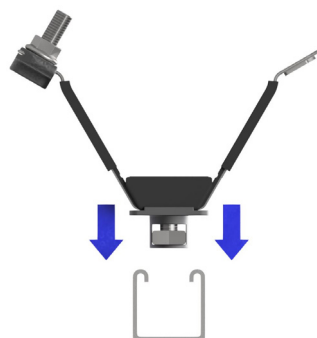
TWIN FIX TWIST FOOT: VRT+13 TO VRT+20

'X' DENOTES FIXING MATERIAL, OPTIONS ARE AS FOLLOWS:
 4 = A4 STAINLESS STEEL
 G = GALVANISED STEEL
 Z = ZINC PLATED STEEL

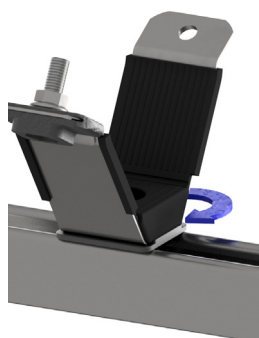
E.G A VRT+04 WITH STAINLESS STEEL TWIST FOOT FIXINGS BECOMES: VRT+04TFM10-4

INSTALLATION OVERVIEW

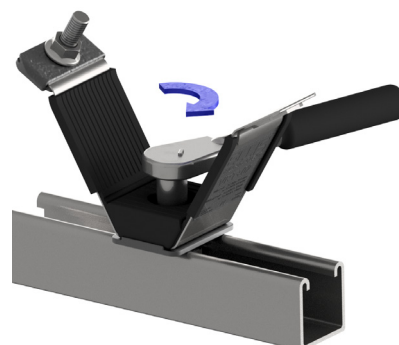
SINGLE FIX TWIST FOOT: VRT+00 TO VRT+12



1) Lower the cleat through the gap in the channel.



2) Once lowered twist the cleat 90°.



3) Tighten the M10 bolt in the base of the cleat.



4) As the bolt is tightened the channel nut will move up the twist foot base and grip onto the channel.



5) The cleat is now securely fastened to the structure and is ready to accept the cables.

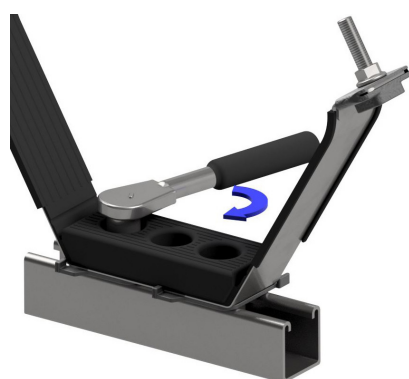
TWIN FIX TWIST FOOT: VRT+13 TO VRT+20



1) Lower the cleat through the gap in the channel.



2) Rotate both twist foot bases through 90° into the locking position.



3) Tighten both bolts in the base of the cleat to the same torque value.



4) As the bolts are tightened the channel nuts will move up the twist foot base and grip onto the channel.



5) The cleat is now securely fastened to the structure and is ready to accept the cables.

This data sheet is subject to change without notice. The information provided has been generated in laboratory conditions, as such results in use may vary.

SECTION 33 08 70.10 – UNDERGROUND HV CABLE TESTING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This specification includes criteria & requirements related to the testing of the cable system.

1.02 RELATED REQUIREMENTS:

- A. Section 01 11 01 – Summary of Work
- B. Section 33 05 90 – Underground Cable System Installation

1.03 REFERENCED STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. Design, construct, assemble and test material furnished to conform with, but not limited to, the latest editions at time of contract award of all applicable standards of the following:
 - 1. Association of Edison Illuminating Companies (AEIC).
 - a. CS9, Specification for Extruded Insulation Power Cables and Their Accessories Rated Above 46 kV Through 500-kV.
 - 2. Council on Large Electric Systems (CIGRE)
 - a. TB 502 – High-Voltage On-Site Testing with Partial Discharge Measurement.
 - b. TB 728 – On site Partial Discharges Assessment of HV and EHV cable systems
 - c. TB 841 – After laying tests on AC and DC cable systems with new technologies.
 - 3. Insulated Cable Engineers Association (ICEA).
 - a. S-108-720, Standard for Extruded Insulation Power Cables Rated Above 46kV Through 500kV.
 - b. T-24-380, Partial Discharge Test Procedure.
 - 4. International Electrotechnical Commission (IEC).
 - a. 60060-1 – High-voltage test techniques - Part 1: General definitions and test requirements
 - b. 60060-2 – High-voltage test techniques - Part 2: Measuring systems
 - c. 60060-3 – High-voltage test techniques - Part 3: Definitions and requirements for on-site testing
 - d. 60885-2 – Electrical test methods for electric cables. Part 2: Partial discharge tests.
 - e. 60885-3 – Electrical test methods for electric cables - Part 3: Test methods for partial discharge measurements on lengths of extruded power cables.
 - f. 60840 – Power Cables With Extruded Insulation and their Accessories for Rated Voltages Above 30kV up to 150kV – Test Methods and Requirements.
 - 5. Institute of Electrical and Electronic Engineers (IEEE).
 - a. 4 - Standard Techniques for High Voltage Testing.
 - b. 400 – Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.
 - c. 400.2 – Guide for Field Testing of Shielded Power Cable Using Very Low Frequency (VLF)
 - d. 400.3 – Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment.

1.04 DEFINITIONS:

- A. Definition:
 - 1. Engineer: Burns & McDonnell Engineering Company, Inc.

SECTION 33 08 70.10– UNDERGROUND HV CABLE TESTING: continued

2. Contractor: To Be Determined
 3. Owner: Jacksonville Electric Authority (JEA)
 4. Supplier: Marmon Utility, LLC.
- 1.05 PERFORMANCE REQUIREMENTS:
- A. The cable system shall be PD free.
- 1.06 SUBMITTALS:
- A. Submittals shall be approved by Owner and reviewed by Engineer
 - B. Include, but are not limited to the following:
 1. Pre-install, post-install, and final commissioning recommendations.
 2. Detailed test plan(s) for Engineer and Owner approval prior to commencement of any Acceptance Tests.
 - a. Test plan shall include the following;
 - (1) Block diagram of test set up
 - (2) Schematic of test circuit
 - (3) Bonding / grounding set up for each test
 - (4) Graph showing the voltage vs time graph
 - (5) PD sensor description and data
 - (6) Test schedule
 - C. Certificates: For each of the following:
 1. Certification and calibration for each piece of test equipment.
 - D. Field quality-control reports.
- 1.07 QUALITY ASSURANCE:
- A. Testing Agency Qualifications

PART 2 - PRODUCTS

- 2.01 TESTING REQUIREMENTS
- A. Contractor shall provide a Test Plan providing an overview of means, methods and schedule.
 - B. Field Acceptance Tests
 1. The Contractor will perform a jacket integrity test of 150 V/mil (6 kV/mm) of average jacket thickness to a maximum of 25 kV DC for one minute on each reel of cable prior to removing cable from the reels. Supplier's representative shall be present while the jacket integrity tests are performed as required for Supplier warranty. If any reel of cable fails to pass the jacket integrity test, then Supplier shall replace the reel of cable or make jacket repairs, approved by Engineer and Owner, at no cost to Engineer and Owner.
 2. The Contractor will perform a jacket integrity test of 150 V/mil (6 kV/mm) of average jacket thickness to a maximum of 25 kV DC for one minute after pulling in the cables but prior to splicing/terminating. Supplier's representative shall be present while the jacket integrity tests are performed as required for Supplier warranty.
 3. The Contractor will perform a jacket integrity test of 150 V/mil (6 kV/mm) of average jacket thickness to a maximum of 25 kV DC for one minute on the complete cable system after the installation of the underground transmission line is complete. Supplier's representative shall be present while the jacket integrity tests are performed as required for Supplier warranty.
 4. Final commissioning test(s) consisting of:

SECTION 33 08 70.10– UNDERGROUND HV CABLE TESTING: continued

- a. AC Withstand Test – Contractor shall perform AC Hi-Pot test at $3.0 U_0$ for a duration of 15 minutes per CIGRE TB 841 Table 5 for EPR commissioning testing.
- b. Partial Discharge (PD) Test – Contractor shall perform offline PD tests during the AC withstand test on all joints and terminations. The cable system shall be PD free per CIGRE TB 841 Table 5 for EPR commissioning testing.
- C. A copy of the approved field test report(s) shall be included in each instruction manual.
- D. A representative of the Engineer, Owner, and Supplier shall be present as witness to all testing required in the field.

2.02 EQUIPMENT:

- A. Voltage source for the AC Withstand shall be continuous AC or VLF equipment, DAC equipment is not allowed as a withstand voltage source.
- B. DAC voltage sources shall not be used on EPR insulation systems.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify conditions. Contractor shall examine the existing site conditions and coordinate with Engineer and Owner to confirm that conditions are acceptable.

3.02 ERECTION, INSTALLATION, APPLICATION:

- A. Contractor is responsible for the test setup including all miscellaneous materials, equipment and labor.
- B. Contractor shall coordinate with the Owner for site access.
- C. Contractor shall coordinate any station switching or space requirements with the Owner.

3.03 FIELD QUALITY CONTROL:

- A. The Contractor shall provide a qualified field service technician to perform the following:
 - 1. Qualifications and references of proposed commissioning test provider.
 - 2. Jacket Integrity Tests.
 - 3. Final commissioning tests.

END OF SECTION 33 08 70.10

CIVIL SPECIFICATIONS

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes duct bank thermal concrete and related items.

1.02 RELATED REQUIREMENTS:

- A. Section 01 11 01 – Summary of Work
- B. Section 31 23 23.13 - Thermally Controlled Low Strength Material
- C. Section 31 23 34 - Underground Cable System Excavation and Fill
- D. Section 33 71 19.23 - Trenched Electrical Underground Ducts & Duct Banks

1.03 REFERENCE STANDARDS:

- A. Comply with the provisions of the following codes, specifications, and standards, except as otherwise indicated.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. American Concrete Institute (ACI):
 - a. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - b. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - c. ACI 305R – Guide to Hot Weather Concreting.
 - d. ACI 306R – Guide to Cold Weather Concreting.
 - e. ACI 308.1 - Specification for Curing Concrete.
 - f. ACI 309R - Guide for Consolidation of Concrete.
 - g. ACI 318 - Building Code Requirements for Structural Concrete.
 - 2. ASTM International (ASTM):
 - a. ASTM A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - b. ASTM C31/C31M REV A – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - c. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
 - d. ASTM C39/C39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - e. ASTM C40/C40M – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - f. ASTM C42/C42M – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - g. ASTM C88 – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - h. ASTM C94/C94M – Standard Specification for Ready-Mixed Concrete.
 - i. ASTM C114/C114M – Standard Test Methods for Chemical Analysis of Hydraulic Cement
 - j. ASTM C117/C117M – Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
 - k. ASTM C136/C136M – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - l. ASTM C142/C142M – Standard Test Method for Clay Lumps and Friable Particles in Aggregates

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

- m. ASTM C143/C143M REV A – Standard Test Method for Slump of Hydraulic Cement Concrete.
 - n. ASTM C150/C150M – Standard Specification for Portland Cement.
 - o. ASTM C172/C172M REV A – Standard Practice for Sampling Freshly Mixed Concrete.
 - p. ASTM C192/C192M – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
 - q. ASTM C231/C231M – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - r. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - s. ASTM C430 – Standard Test Method for Fineness of Hydraulic Cement by the 45- μ m (No. 325) Sieve
 - t. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 - u. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements.
 - v. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - w. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - x. ASTM C1193 – Standard Guide for Use of Joint Sealants.
 - 3. Concrete Plant Manufacturers Bureau (CPMB):
 - a. 100 - Concrete Plant Standards.
 - b. 102 - Recommended Guide Specifications for Batching Equipment and Control Systems in Concrete Batch Plants.
 - 4. Plant Mixer Manufacturers Division (PMMD):
 - a. 100 - Concrete Plant Mixer Standards.
 - 5. Federal Specification (FS):
 - a. SS-S-200 - Sealants, Joint: Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement.
 - b. TT-S-227 - Sealing Compound: Elastomeric Type, Multi-Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
 - 6. National Bureau of Standards (NBS) Specifications for Scales.
 - 7. Truck Mixer Manufacturers Bureau (TMMB):
 - a. Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards.
 - 8. Institute of Electrical & Electronic Engineers (IEEE):
 - a. 442 – Guide for Soil Thermal Resistivity Measurements
- 1.04 DEFINITIONS:
- A. Owner: Jacksonville Electric Authority (JEA)
 - B. Engineer: Burns & McDonnell Engineering Company, Inc.
 - C. Contractor: To Be Determined
- 1.05 SUBMITTALS:
- A. Shall be approved by Owner and reviewed by Engineer
 - B. Include, but not limited to, product data and Shop Drawings of the following:
 - 1. Grouts
 - 2. Admixtures
 - 3. Bonding Agents
 - 4. Curing Agents

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

- C. Mill Certificates:
 - 1. Submit to Owner and Engineer a minimum of one copy for each cement shipment.
- D. Concrete Mix Design Proportions:
 - 1. Submit as specified in PART 2, Paragraph 2.01.E. - Mix Proportions, this Section.
 - 2. Submit for each mix design
 - a. Aggregate gradation data.
 - b. Aggregate quarry information.
 - c. Slump.
 - d. Test results for compressive strength and thermal resistivity.
 - e. Admixtures, if required.
 - 3. Resubmit for any change in each mix design.
- E. Production Test Reports: Submit as specified in PART 2, Paragraph 2.01E. - Measurement of Materials, this Section during construction.
 - 1. Contractor shall furnish certified test reports of all tests within ten (10) Business Days of test laboratory receiving samples.
 - 2. Test results for compressive strength and thermal resistivity.
- F. Laboratory Test Reports: Submit as specified in PART 3, Paragraph 3.08C – Laboratory Testing of Aggregates and Concrete During Construction, this Section.
- G. Field control testing plan for samples gathered in field

1.06 QUALITY ASSURANCE:

- A. Field Testing: Shall be performed by an ACI Concrete Field Testing Technician Grade 1.

PART 2 - PRODUCTS

2.01 CONCRETE:

- A. Thermal Resistivity:
 - 1. Concrete for duct bank shall be thermally tested prior to placement as noted in these Technical Specifications. The test results shall be verified by Owner and Engineer and the duct bank concrete mixture approved by Owner in writing one month prior to construction. Each concrete truck shall provide a batch mixture ticket prior to concrete placement. If the truck driver does not have a batch mixture ticket, the truck may be rejected.
 - 2. The maximum thermal resistivity shall be 65° C-cm/watt at two percent (2%) moisture content and 100° C-cm/watt at zero percent (0%) moisture.
- B. Materials:
 - 1. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - a. Portland cement: ASTM C150, Type I or II
 - (1) Fly ash: ASTM C618, Class F or C.
 - b. The maximum amount retained on the No. 325 sieve shall be 10% as determined in accordance with ASTM C430.
 - c. The maximum amount of alkalis (Na₂O + 0.658 K₂O) shall be 0.60% determined in accordance with ASTM C114. A running average of three Samples shall not exceed a maximum of 0.50%.
 - 2. Aggregate:
 - a. The maximum aggregate size for use in concrete for duct lines shall be 3/8 inch.
 - b. Fine Aggregate:
 - (1) Conform to ASTM C33.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

- (2) Maintain fine aggregate free of ice and frozen lumps.
 - c. Coarse Aggregate:
 - (1) Conform to ASTM C33.
 - (2) Maintain coarse aggregate free of ice and frozen lumps.
 - (3) Blast furnace slag will not be permitted.
 - (4) Grading requirements:
 - (a) From 1-inch to No. 4 for all concrete unless otherwise specified.
 - 3. Mixing Water:
 - a. Only potable water will be acceptable. Expense of testing water shall be paid by Contractor
 - 4. Admixtures:
 - a. Water-Reducing Type:
 - (1) Conform to ASTM C494, Type A.
 - (2) Conform to manufacturer's recommendations for use.
 - (3) Technical assistance of the manufacturer's field representative shall be furnished upon request.
 - b. Other Admixtures: Use only with Owner's written concurrence.
 - (1) Water-Reducing, Retarding Type: Conform to ASTM C494, Type D.
 - c. Admixtures shall not contain any chloride ions.
 - d. Storage: Admixtures shall be stored in such a manner as to avoid contamination, evaporation, freezing, temperature changes, settling, or any damage which would adversely affect their characteristics.
- C. Laboratory Testing of Materials for Use in Concrete:
 - 1. An approved independent testing laboratory shall be selected and paid by Contractor to perform all required laboratory tests of materials proposed for use in the production of concrete and to determine mix proportions when laboratory trial batches are required.
 - 2. Geotherm, Inc. has proven to be the industry leader in thermal resistivity testing and reporting. Geotherm shall provide all thermal resistivity testing and can assist with concrete mix design(s) should the Contractor elect to utilize this service.
 - 3. All cylinders shall be tested conforming to ASTM C39. Age of cylinders at test shall be 28 days unless an earlier age is authorized.
 - 4. The laboratory shall electronically report the results of the testing and mix designs as follows:
 - a. Engineer, Kansas City Office (copies as required).
 - b. Owner, Jacksonville Florida Office (copies as required).
 - c. Resident Project Representative, Field Office (copies as required).
 - d. Contractor (copies as required).
 - e. Concrete Supplier (copies as required).
 - 5. The laboratory test results shall be part of the design mix submittal specified in this PART 2, Paragraph 2.01D. - Mix Proportions.
- D. Concrete Qualities Required:

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

Concrete Application	28 Day Strength	Max Aggregate Size	Max. Slump	Total Air Content	Maximum Thermal Resistivity
Thermal Concrete (Duct Bank Encasement)	3,000 psi	3/8"	6" +/- 1"	Naturally Entrained Only (1.5%-3%)	65° C-cm/W at 2% moisture 100° C-cm/W at 0% moisture

1. Compressive Strength:
 - a. Minimum 28-day compressive strength = 3,000 psi (20685 kPa) for all construction unless otherwise indicated.
 - b. Compressive-strength determinations shall be made from 6-inch diameter by 12-inch long concrete cylinders tested in accordance with ASTM C39.
 2. Slump:
 - a. Concrete shall be between 5 inches and 7 inches.
 - b. Testing shall be in accordance with ASTM C143.
 3. Air Content:
 - a. Naturally entrained air only (1.5% to 3.0%) for concrete.
 - b. Testing shall be in accordance with ASTM C231.
- E. Mix Proportions:
1. Concrete shall be homogeneous, readily placeable, uniformly workable, finishable, and proportioned to conform to ACI 211.1.
 2. Mix proportions for all concrete, unless otherwise specified, shall be selected preferably on the basis of field experience; but in the case where sufficient or suitable strength test data is not available, concrete shall be proportioned on the basis of laboratory trial mix design.
 - a. Field experience using test results within the preceding year, with the materials and plant to be employed may be the basis of mix proportioning, provided that not less than 30 consecutive satisfactory compressive-strength tests on concrete using the proposed materials with a similar mix are available. A compressive-strength test is defined as the average 28-day compressive strength of two companion cylinders made conforming to ASTM C172 and ASTM C31 and tested conforming to ASTM C39.
 - (1) The standard deviation of compressive-strength tests shall be computed as a basis for design of the mix. The design average compressive strength shall exceed the specified strength by at least:
 - (a) 400 psi (2760 kPa) if standard deviation is less than 300 psi (2070 kPa).
 - (b) 550 psi (3800 kPa) if standard deviation is 300 to 400 psi (2070 to 2760 kPa).
 - (c) 700 psi (4830 kPa) if standard deviation is 400 to 500 psi (2760 to 3450 kPa).
 - (d) 900 psi (6200 kPa) if standard deviation is 500 to 600 psi (3450 to 4140 kPa).
 - (e) 1,200 psi (8275 kPa) if standard deviation is greater than 600 psi (4140 kPa).
 - b. Laboratory Trial Batch: When laboratory trial batches are used as a basis for determining mix proportions, all such Work shall be performed by the laboratory as specified in PART 2, Paragraph 2.01B.C. - Laboratory Testing of Materials for Use in Concrete, this Section.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

- (1) Laboratory trial batches shall be used to establish a water-cement ratio, compression-strength curve with at least three points, each representing the strength of a separate trial batch. At least one point shall be above and one below the strength required. Each point on the curve shall represent the average of at least three cylinders tested at 28 days or an earlier age when approved by Owner. The slump and air content shall be at the maximum limits specified in PART 2, Paragraph 2.01C.D. - Concrete Qualities Required, this Section.
 - (2) A point on the water-cement ratio, compressive-strength curve shall be selected that will provide an average compressive strength at least 1,200 psi (8275 kPa) greater than the specified minimum strength.
 - (3) Submit the following test data to Owner for approval prior to placing concrete.
 - (a) Fine Aggregate:
 - 1). ASTM C33.
 - 2). ASTM C40.
 - 3). ASTM C88.
 - 4). ASTM C117.
 - 5). ASTM C136.
 - 6). ASTM C142.
 - 7). Fineness modulus.
- F. Measurement of Materials:
1. General Requirements:
 - a. Conform to ACI 304R.
 - b. Beam or springless dial-type scale conforming with NBS - "Specifications for Scales."
 - c. Volumetric measurement of water shall be performed with an approved automatic valve.
 2. Concrete Plant Scale Accuracy and Calibration Frequency:
 - a. The concrete plant scales shall be accurate to $\pm 0.4\%$ of the capacity of the scale.
 - b. The scales shall be calibrated at intervals as specified in PART 3, Article 3.09-Testing, this Section.
 3. Individual Batch Accuracy:
 - a. Cement: $\pm 1.0\%$.
 - b. Water: $\pm 1.0\%$ by volume or weight.
 - c. Aggregates: $\pm 2.0\%$.
 - d. Admixtures: $\pm 3.0\%$ by volume or weight.
- G. Mixing and Delivery:
1. Conform to ACI 304R.
 2. Cement temperature, when added to mix, shall not exceed 170°F (77°C).
 3. Adjust the amount of mix water to compensate for the moisture content of the aggregates.
 4. Concrete Plant:
 - a. Conform to "Concrete Plant Mixer Standards" of the Plant Mixer Manufacturers Division, Concrete Plant Manufacturers Bureau, and "Concrete Plant Standards" of the Concrete Plant Manufacturers Bureau.
 - b. Charge with 5% to 10% of the mixing water both in advance and after the addition of aggregates and cement.
 - c. Charge with remaining water uniformly with the other materials.
 - d. Avoid charging in excess of manufacturer's rating.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

- e. Discharge mixed concrete completely prior to recharging.
- f. Mixing Time:
 - (1) Start immediately when all ingredients, except the last of the water, are in the mixer.
 - (2) Minimum mixing time shall conform with mixer manufacturer's instructions, but not be less than the following:

Capacity of Mixer Cubic Yards	Minimum Time of Mixing
1 or less.....	1 minute
2.....	1 minute, 15 seconds
3.....	1 minute, 30 seconds
4.....	1 minute, 45 seconds
5.....	2 minutes
6.....	2 minutes, 15 seconds

Add 15 seconds' mixing time for each additional cubic yard of concrete.

- 5. Mixing of Concrete at Plant Off Jobsite:
 - a. Mix concrete in central mixer or truck mixer. Transport in truck mixer turning at agitation speeds only.
 - b. Water added to concrete having a slump below the specified minimum shall be at Contractor's risk. If the water added produces a slump greater than the specified maximum, the concrete will be rejected. If water is added, the concrete shall be remixed for a minimum of 25 revolutions. Water shall not be added after the truck mixer has begun to discharge concrete.
 - c. Truck mixer shall conform to "Truck Mixer, Agitator, and Front Discharge Concrete Carrier Standards" of the Truck Mixer Manufacturers Bureau.
 - d. Ready-mixed concrete shall be produced and delivered conforming to ASTM C94 as applicable.
 - e. Contractor shall furnish Owner with a concrete delivery ticket for each load of concrete. The ticket shall have the following information recorded:
 - (1) Serial number of ticket.
 - (2) Time batched.
 - (3) Time arrived on jobsite.
 - (4) Amount of concrete (by volume).
 - (5) Mix number.
 - (6) Amount of all water added at jobsite by Contractor.
 - (7) Name of ready-mix batch plant.
 - (8) Date.
 - (9) Truck number.
 - (10) Name of purchaser.
 - (11) Slump
- 6. Plant and truck mixer uniformity shall be tested according to ASTM C94. Frequency of tests shall be as specified in PART 3, this Section.

2.02 BONDING AGENT:

- A. Provide moisture-insensitive, epoxy-resin bonding agent conforming to ASTM C881, Type V.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

2.03 CURING AGENT:

- A. Apply to all concrete surfaces unless otherwise indicated or specified.
- B. Curing agent shall conform as follows:
 - 1. ASTM C309, Type 1: Use where concrete surface is not exposed to direct sunlight after placement.
 - 2. ASTM C309, Type 1-D: Use where slabs are exposed to direct sunlight for a period of seven days minimum after placement. Curing and sealing agent with fugitive dye shall be readily distinguishable upon the concrete surface for at least four hours after application but shall be inconspicuous within seven days after application.
 - 3. ASTM C309, Type 2: Use as specified in PART 3, Article 3.05 - Hot Weather Concreting, this Section.
- C. Curing compound shall be VOC compliant with a maximum VOC content of 2.9 lbs./gal (350 g/L), or less where Project location regulations are more stringent.

PART 3 - EXECUTION

3.01 PREPARATION FOR CONCRETE PLACEMENT:

- A. Openings Through Concrete: Provide openings through concrete as indicated and for the proper installation of all equipment, piping, wiring, ductwork and similar items, installed under this Contract.
- B. Installation of Embedded Items:
 - 1. Provide for accurate installation of embedded items installed under this Contract.
 - 2. Securely fix floor drains in place to prevent flotation while placing concrete. Uniformly and accurately slope finish floor slab toward the drains.
 - 3. Embedded items shall be as indicated or specified, or as selected by Contractor and approved by Owner.
 - 4. During cold weather, protect pipe sleeves, shear pockets, and blockouts from moisture which may freeze, expand, and crack the sleeve, pocket or blockout and concrete structure.
 - 5. Grease or tape anchor bolt threads to protect from concrete splatter.
- C. Installation of Joints:
 - 1. Contraction Joints: As specified in Contract Drawings.
- D. Cutting and Bonding to Existing Concrete:
 - 1. Cutting Existing Concrete:
 - a. Use methods and equipment that will avoid damage to adjacent parts of the structure from heavy blows or vibration.
 - b. Cut existing concrete with power concrete saw where possible to prevent spalling and chipping and to form neat, straight edge. Only cut existing concrete after full cable removal.
 - c. Remove all loose or cracked concrete resulting from cutting existing concrete, leaving only sound, undamaged concrete adjacent to new Work.
 - d. Leave cut edges with a clean grout surface to the opening size indicated.
 - e. Cut reinforcing steel with sufficient length remaining (approximately 38 bar diameters) for bending and lapping into new construction.
 - 2. Bonding to Existing Concrete:
 - a. Roughen concrete to 1/4-inch (6-mm) amplitude by use of a pneumatic chipping hammer or other approved means.
 - b. Thoroughly clean the concrete surface and apply the bonding agent in accordance with manufacturer's written instructions.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

3.02 PLACING OF CONCRETE:

A. Conventional Placing:

1. General Requirements:

- a. Conform to ACI 304R.
- b. Bonding surfaces, including reinforcement, shall be clean, free of laitance and foreign materials.
- c. Face horizontal bonding surfaces with 1-inch (25-mm) thick coat of fresh "grout for bonding." Wet all other surfaces.
- d. Place concrete on properly prepared and unfrozen subgrade and only in dewatered excavation and forms.
- e. Use neat earth formed for all concrete where indicated or specified. Footings entirely below grade may be earth formed.
- f. Do not place concrete that has partially hardened or has been contaminated by foreign materials.
- g. Prevent mud or foreign materials from entering the concrete or forms during placement operations.

2. Conveying:

- a. Convey concrete from the mixer and deposit in place by methods which will prevent the segregation or loss of materials.
- b. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to provide a practically continuous flow of concrete at the delivery end.
- c. Aluminum conveying equipment shall not be used.

3. Depositing:

- a. Place concrete in continuous horizontal lifts not to exceed 18 inches, and place concrete against bulkheads and keyways at vertical joints.
- b. Maximum free drop of concrete and grout for bonding shall be 5 feet, in walls 10 inches or less in thickness, with 1-foot additional drop allowed for each inch of wall thickness over 10 inches, with a maximum drop of 10 feet.
- c. When vapor barrier is used, keep lapped joints closed and take precautions to avoid puncturing the barrier.

4. Consolidation of Concrete:

- a. Consolidate concrete in conformance with ACI 309R. Characteristics and application of concrete vibrators shall be as set forth in Table 5.1.5.
- b. Vibrator shall not come in contact with ducts.
- c. Provide an adequate number of vibrators of sufficient capacity to keep up with the maximum rate of concrete placement. Keep on hand adequate standby equipment in good operating condition.
- d. Vibrate concrete only until the concrete is thoroughly consolidated and the voids filled, as evidenced by the leveled appearance of the concrete at the exposed surface and the embedment of the surface aggregate.
- e. Insert internal vibrators vertically to the full depth of the layer being placed and into the previous layer. Do not drag vibrators through the concrete. Insert and withdraw vibrator slowly with the vibrator running continuously so that no hole will be left in the concrete. Do not flow concrete from one location to another by use of a vibrator.
- f. Consolidate concrete layer to full depth when using a surface vibrator. Use thinner layers or a more powerful vibrator if necessary to achieve complete consolidation.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

- g. Use form vibrators only where sections are too thin or where sections are inaccessible for internal vibrators.
 - 5. Time Requirements:
 - a. Place concrete at a sufficient rate to assure that lifts below have not taken initial set before fresh concrete is deposited.
 - b. Place concrete within 30 minutes after mixing. This period may be extended to 1 hour and 30 minutes provided that the combined air temperature, relative humidity, and wind velocity are such that the plasticity of the fresh concrete is satisfactory for placement and consolidation, and that the specified mixing water is not exceeded. Concrete which has partially set shall not be retempered but shall be discarded.
 - B. Placing Concrete at Joints:
 - 1. Bed horizontal joints with 1 inch (25 mm) of grout for bonding.
 - 2. Take precautions to ensure tight, well-bonded construction joints with no air pockets or voids.
 - 3. Take special precautions to avoid bending or displacing waterstop while placing concrete around it.
 - 4. Delay construction at a joint a minimum of 16 hours where placement is continued past joint, except where otherwise indicated.
- 3.03 FINISHING:
 - A. Unformed Surfaces:
 - 1. Broomed Finish:
 - a. Use as final finish on all duct banks.
 - b. Draw a stiff bristle broom across the surface making uniform corrugations, perpendicular to the direction of the duct bank, not more than 1/16 inch (1.6 mm) deep.
 - B. Repair of Defective Surfaces:
 - 1. Defined as any concrete surface showing misalignment, rock pockets, poor joints, holes from ties, voids, honeycomb, or any other defective area.
 - 2. Repairing:
 - a. Repair as soon as forms have been removed.
 - b. Chip surface back to minimum depth of 1/2 inch (13 mm), chip edges perpendicular to surface, prewet depression and brush with neat cement immediately before patching.
 - c. Patch surfaces using stiff mortar with same sand-cement ratio as original concrete and with minimum water for placing. Blend with white cement to match concrete color.
 - d. Compact mortar into depressions so that after curing, hole is filled, and mortar is flush with surface. Use hammer and ramming rod for compacting the holes.
 - e. Moist-cure for 3 days or use curing compound.
 - f. Owner and Engineer shall be notified of areas containing defects or where reinforcing steel is exposed, prior to determination of repair method.
- 3.04 CURING:
 - A. Cure concrete by one of the following methods in accordance with ACI 308.1:
 - 1. Leaving in forms for a minimum of 7 days. Keep formwork wet to prevent drying of concrete surfaces.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

2. Using one coat of a liquid membrane forming compound as specified. Apply immediately after removal of forms (which have been continuously wet); or in case of a slab, after the concrete has been finished and is hardened sufficiently to walk on.
3. Curing of concrete during hot or cold weather shall conform to PART 3 - Hot Weather Concreting and Cold Weather Concreting, this Section.

3.05 HOT WEATHER CONCRETING:

- A. Follow the recommendations of ACI 305R if any of the following conditions occur:
 1. When the temperature is 90°F (32°C) or above.
 2. When the temperature is likely to rise above 90°F (32°C) within the 24-hour period after concrete placement.
 3. When there is any combination of high air temperature, low relative humidity, and wind velocity which would impair either concrete strength or quality.
- B. Concrete shall have a maximum temperature of 85°F (29°C) during placement.
- C. Dampen subgrade and forms with cool water immediately prior to placement of concrete.
- D. Protect freshly placed concrete immediately after placement so that the rate of evaporation as determined by ACI 305R (Figure 4.2) does not exceed 0.2 pound per square foot (1.0 kg per square meter) per hour.
- E. Protect concrete with suitable insulation if rapidly decreasing nighttime temperatures occur, which would cause thermal shock to concrete placed during warm daytime temperatures.
- F. Protect the concrete with temporary wet covering during any appreciable delay between placement and finishing.
- G. Begin curing unformed surfaces immediately after finishing and continue for 24 hours. Curing shall consist of application and maintenance of water-saturated material to all exposed surfaces; horizontal, vertical, and otherwise. After the 24-hour interval, continue curing using one of the following methods:
 1. Moist curing for 6 days.
 2. Application of one coat of curing compound as specified.
 3. Application and maintenance of curing paper or heat-reflecting plastic sheets for 6 more days.
- H. Begin curing formed concrete immediately after placing. Curing shall consist of keeping forms continuously wet for 24 hours. Thereafter, continue curing using one of the following methods:
 1. Loosen forms and position soaker hose so that water runs down along concrete surfaces. Continue for 6 days.
 2. Strip forms and apply curing compound as specified. Do not allow concrete surfaces to dry prior to application of curing compound.

3.06 COLD WEATHER CONCRETING:

- A. When the temperature is 40°F (4.4°C) or is likely to fall below 40°F (4.4°C) during the 24-hour period after concrete placement, follow the recommendations of ACI 306R to prevent loss of concrete strength or quality.
- B. Minimum temperature for concrete as mixed shall be as indicated on lines 2, 3, and 4 of Table 5.1 of ACI 306R. Maximum temperature for concrete as mixed shall be 10°F (5.6°C) greater than the corresponding minimum temperature.
- C. Place and maintain concrete so that its temperature is never less than the temperature indicated on line 1 of Table 5.1 of ACI 306R. Maintain the required temperature for the time duration indicated on Tables 5.1 and 7.1 of ACI 306R.
- D. Monitor temperature of concrete in place at corners or edges of formwork as applicable.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

- E. Air Heaters:
 - 1. Do not expose concrete to carbon monoxide or carbon dioxide fumes from heaters or engines.
 - 2. Oil- or coke-burning salamanders will not be permitted.
 - 3. Heaters shall be ultramatic portable heaters made by the Union Chill Mat Company or Owner approved equal.
 - 4. Personnel shall be present at all times to maintain safe, continuous operation of heating system.
- F. Control temperature and humidity of protected concrete so that excessive drying of concrete surfaces does not occur.
- G. Calcium chloride will not be permitted as a concrete accelerator or to thaw frozen subgrade prior to concrete placement.
- H. The maximum allowable temperature drop during the first 24-hour period after protection is discontinued shall be as indicated on line 1 of Table 5.1 of ACI 306R.
- I. Cure the concrete in accordance with Chapter 10 of ACI 306R.

3.07 LOW-STRENGTH CONCRETE:

- A. Low-Strength Concrete:
 - 1. Defined as either:
 - a. Concrete whose average, of any sets of three consecutive 28-day compressive strength tests, is below the required 28-day strength.
 - b. Concrete whose individual 28-day strength test (average of two cylinders) is more than 500 psi (3450 kPa) below the required 28-day strength.
 - 2. Should concrete meet either definition of low-strength concrete as a minimum, the Contractor shall take the following steps:
 - a. Increase the cement content. The increase shall be based on a statistical evaluation of the strength data, the design water-cement ratio, compressive-strength curve, and acceptable mix-design literature as follows:
 - (1) If sufficient concrete has been furnished to accumulate 30 tests, these should be used to establish a new target average strength in accordance with ACI 318, Section 5.3.
 - (2) If less than 30 tests have been made, the new target average strength should be at least as great as the average strength used in the initial selection of the mix proportions. Increase the target average strength based on a statistical evaluation of the available strength data, the design water-cement ratio, compressive-strength curve, and acceptable mix-design literature. If the statistical average equals or exceeds the initial mix-design level, a further increase in the average level is required.
 - b. Remove and replace with acceptable concrete when the quality and location of the low-strength concrete is such that Owner or Engineer considers the strength or durability of the structure is impaired and so orders.
 - 3. Low-strength concrete shall be considered defective Work as defined in General Conditions.
- B. Potentially Low-Strength Concrete: Defined as concrete whose 7-day test (average of two cylinders) is less than 70% of the specified minimum 28-day compressive strength.
- C. Construction delays caused by low-strength or potentially low-strength concrete shall not relieve Contractor from responsibility for late completion even though extensions of time may be granted.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

3.08 TESTING:

A. Field Testing of Concrete Plant and Mixing Trucks:

1. The concrete plant shall be inspected and tested to ensure conformance with ACI 304R and the "Concrete Plant Standards of the Concrete Plant Manufacturers Bureau." The scales shall be calibrated at the initial setup and at 3-month intervals thereafter.
2. Mixing trucks shall be inspected and tested to ensure conformance with ACI 304R and "Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau" of the National Ready-Mix Concrete Association. Tests shall be done at initial setup and every 3 months thereafter.
3. Submit test reports as required.
4. Make the following concrete test cylinders for laboratory testing:

Test	Codes	Samples	Cylinder Size	Frequency	Test Sample ID
Compressive Testing	ASTM C31	4 Cylinders	6" by 12"	1 set (4 cylinders) every 50 cubic yards	Material Date of Sample Location (Station Number) Copy of Batch Ticket
Thermal Resistivity Testing	ASTM C31 IEEE 442	2 Cylinders	3" by 6"	1 set (2 cylinders) every 50 cubic yards	Material Date of Sample Location (Station Number) Copy of Batch Ticket

5. Contractor shall keep a record of the sample numbers and the corresponding station locations (beginning and end) where the concrete mixture associated with each sample was installed

B. Field Testing of Concrete and Making of Concrete Test Cylinders:

1. Contractor shall furnish test equipment, test cylinder molds, and certified personnel to perform all required field tests, make the required concrete test cylinders, and deliver test cylinders to the testing laboratory. The prescribed tests shall be made in the presence of or with the concurrence of Owner.
2. Concrete sampling for tests and cylinder making shall be done conforming to ASTM C172. Samples shall be taken at random and at the point of truck discharge.
3. Perform the following tests:
 - a. Prepare test cylinders conforming to ASTM C31, with not less than one set of cylinders (four cylinders) from each day's placement for each 50 cubic yards or fraction thereof.
 - b. Slump test conforming to ASTM C143. Perform tests on the first batch produced each day, for every 50 cubic yards or fraction thereafter, and with every set of test cylinders.
 - (1) Slump shall be tested more frequently if the consistency of the concrete appears to vary or whenever there are temperature extremes that make concrete delivery temperature more restrictive.
 - c. Air content test conforming to ASTM C231. Perform for first batch of day and with each set of test cylinders.
 - d. The batch of concrete being tested for slump or air content shall not be placed until acceptable results are obtained.
 - e. Discard concrete used for slump and air tests.

SECTION 03 30 11 – DUCT BANK THERMAL CONCRETE: continued

- f. Perform concrete and air temperature tests for first batch of day and with each set of test cylinders. Additional readings shall be taken when directed by Owner.
 - g. Any batch of concrete with slump or air content not in conformance with Specifications shall be rejected.
 - h. Furnish slump, air content, and temperature test results to the testing laboratory for inclusion in the cylinder test reports.
 - 4. Thermal Tests:
 - a. Contractor shall send the set of samples to Geotherm, Inc. to be thermally tested. Tests shall include thermal dryout characterization (thermal resistivity as a function of moisture content), density, and moisture content measurement on each set. Test results shall be provided to Owner and Engineer within ten (10) Business Days after the day the samples are received by test laboratory.
 - b. Laboratory will cure and test concrete cylinders conforming to ASTM C192 and C39, testing one cylinder at 28 days of age. The remaining cylinder will be held to verify test results, if needed.
 - c. Laboratory will hold and maintain the spare thermal test samples for the duration of the project should further testing be needed.
 - d. If the thermal test results of the concrete samples do not meet the requirements of these Technical Specifications, Contractor shall have thermal tests performed on nearby native soil samples, as directed by Owner. Owner shall then have ampacity calculations performed showing the combined effect of the substandard concrete and the native soil on cable ratings. If the combined effect results in a cable rating lower than acceptable to the Owner, Contractor shall take the corrective actions necessary to achieve acceptable ampacity. Contractor shall be responsible for all costs associated with this testing, calculations and any required corrective actions.
 - C. Laboratory Testing of Aggregates and Concrete During Construction:
 - 1. An independent testing laboratory shall be selected and paid by Contractor to perform the required laboratory tests and statistical evaluations of aggregates and concrete being used in the Work.
 - a. Laboratory shall cure and test concrete cylinders conforming to ASTM C192 and C39, testing two cylinders at 7 days of age and two at 28 days of age.
 - b. Owner shall have the right to observe all phases of concrete cylinder curing and testing.
 - c. Should the test results indicate low strength concrete as defined in PART 3, Article 3.07 - Low-Strength Concrete, this Section, Contractor shall take immediate corrective action.
 - d. Should the material tests taken during construction indicate nonconformance with the Specifications, Contractor shall take immediate corrective action.
- 3.09 REPAIR, REPLACEMENT, AND FIELD MODIFICATIONS:
- A. Embedded items and concrete that are misplaced or damaged during construction shall not be repaired, replaced, or field-modified without approval of Owner.

END OF SECTION 03 30 11



21239 FM529 Road, Bldg F
Cypress, Texas 77433
Tel: 281-985-9344
Fax: 832-427-1752
info@geothermusa.com
<http://www.geothermusa.com>

Sampling and Shipment of Soil/Backfill Samples for Thermal Analysis

Undisturbed Tube Samples and Bulk Samples

- If cohesive soils (clayey or silty) are encountered, samples should be taken in nominal 3" diameter Shelby tubes or large diameter California sampler with brass liners (no rings), otherwise, standard split spoon samples or auger cuttings should be taken (see bulk soil section below).
- Please do not extrude sample from Shelby tube. Cut the bottom 6" section (+/- 1/2") of the tube, seal both ends with plastic caps and tape it to prevent any moisture loss.
- Identify the samples with Project Name, Location, Bore Hole, Depth, Date samples taken, etc
- The samples should be representative of the soil at the cable (or ductbank) burial depth. If the soil above this elevation is different, it should be sampled as well.
- Please include a copy of the borehole logs.
- Email the details of the shipment - courier name, tracking number, etc. to info@geothermusa.com and lab@geothermusa.com
- If **bedrock** is encountered, take core samples (minimum 2" diameter by 5" long) or block samples of about 5" cube of irregular shape.

Bulk Soil or Backfill Samples

- Send ~10 pounds of each sample, contained in double heavy-duty plastic (Ziploc) bags, identified with Project Name, Sample Location, Bore Hole, Depth, Date samples taken, etc...
- Email the details of the shipment - courier name, tracking number, etc. to info@geothermusa.com and lab@geothermusa.com
- For all foreign shipments
 - declare a value of \$10 for the entire package and send it via **FedEx or UPS** overnight service (or 2nd day air service).
 - Mark the package "**Aggregate samples for laboratory testing only**".
 - Request import permit instructions to info@geothermusa.com
- Provide the Proctor (Standard or Modified) density, starting moisture content and percent compaction effort.

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Purpose for testing (in-situ vs. construction phase), the following apply:

For thermal resistivity measurements to determine in-situ values

- For soils that are cohesive
 - Undisturbed tube samples
 - bottom 6-inches of Shelby tube or
 - brass/stainless steel liner (minimum diameter of 2-inches)
 - must be continuous and NOT ring samplers
 - Disturbed samples
 - Provide us a Proctor Density Curve (Standard or Modified)
 - Provide percent (%) compaction (i.e. 95%, 90% or 85%)
 - Provide starting moisture content (i.e. in-situ, optimum or %)

For thermal resistivity measurements to determine construction phase (materials to be used around cables)

- Disturbed samples
 - Provide us a Proctor Density Curve (Standard or Modified)
 - Provide percent (%) compaction (i.e. 95%, 90% or 85%)
 - Provide starting moisture content (i.e. in-situ, optimum or %)
1. Provide soil descriptions or borehole logs, a business card or contact information with the samples in a separate Ziploc bag.
 2. Please issue a PO or a charge to number with the samples
 3. Email the tracking number to info@geothermusa.com and lab@geothermusa.com
 4. Turnaround time is about 10 days after we receive all the necessary information

Ship all samples to:

**GEO THERM USA
ATTN: Lab Manager
21239 FM529 Road, Bldg F
Cypress, Texas 77433
Tel: 281-985-9344**



Chain of Custody Form

Please include this form in a Ziploc bag for each sample submitted:

Company Name: _____

Contact Name: _____ Contact Number _____

Project Name: _____

Project Location: _____

Company to Invoice: _____ PO Number: _____

Report Submittal email: _____

Sample Location/ID: _____

Sample Collection Date: _____ Sample Depth: _____

Soil Description: _____

Is this a bulk sample that requires Recomaction?

____ Yes (continue below) **OR** ____ No (tube sample test "as is")

If the sample requires Recomaction please complete items below:

- a. What is the Proctor Maximum Dry Density (lb/ft³)? _____
- b. Is this a Standard or Modified Proctor: _____
- c. Specify compaction effort(s)? (i.e. 85%, 90 or 95%): _____

2. What is the starting test moisture content?

____ As Received/In-situ? **OR** ____ Optimum?

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract apply to this Section.

1.02 SUMMARY:

- A. This Section includes thermally controlled low strength material and related items.

1.03 DEFINITION:

- A. Thermally Controlled Low Strength Material (TCLSM) is a free flowing, controlled density fill, consisting of stone aggregate, sand, cement, and a fluidizing agent, specifically engineered to meet thermal resistivity and stability criteria.

1.04 RELATED REQUIREMENTS:

- A. Section 01 11 01 – Summary of Work
- B. Section 03 30 11 - Duct Bank Thermal Concrete
- C. Section 31 23 34 - Underground Cable System Excavation and Fill
- D. Section 33 71 19.23 - Trenched Electrical Underground Ducts & Duct Banks

1.05 REFERENCE STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. Comply with the provisions of the following codes, specifications, and standards, except as otherwise indicated.
 - 1. American Concrete Institute (ACI):
 - a. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - b. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - c. ACI 305R – Guide to Hot Weather Concreting.
 - d. ACI 306R – Guide to Cold Weather Concreting.
 - e. ACI 308.1 - Specification for Curing Concrete.
 - f. ACI 309R - Guide for Consolidation of Concrete.
 - g. ACI 318 - Building Code Requirements for Structural Concrete.
 - 2. ASTM International (ASTM):
 - a. ASTM A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - b. ASTM C31/C31M REV A – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - c. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
 - d. ASTM C39/C39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - e. ASTM C40/C40M – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - f. ASTM C42/C42M – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - g. ASTM C88 – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - h. ASTM C94/C94M – Standard Specification for Ready-Mixed Concrete.
 - i. ASTM C117/C117M – Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

- j. ASTM C136/C136M – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - k. ASTM C142/C142M – Standard Test Method for Clay Lumps and Friable Particles in Aggregates
 - l. ASTM C143/C143M REV A – Standard Test Method for Slump of Hydraulic Cement Concrete.
 - m. ASTM C150/C150M – Standard Specification for Portland Cement.
 - n. ASTM C172/C172M REV A – Standard Practice for Sampling Freshly Mixed Concrete.
 - o. ASTM C192/C192M – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
 - p. ASTM C231/C231M – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - q. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - r. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 - s. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements.
 - t. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - u. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - v. ASTM C1193 – Standard Guide for Use of Joint Sealants.
 - 3. Concrete Plant Manufacturers Bureau (CPMB):
 - a. 100 - Concrete Plant Standards.
 - b. 102 - Recommended Guide Specifications for Batching Equipment and Control Systems in Concrete Batch Plants.
 - 4. Plant Mixer Manufacturers Division (PMMD):
 - a. 100 - Concrete Plant Mixer Standards.
 - 5. Federal Specification (FS):
 - a. SS-S-200 - Sealants, Joint: Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement.
 - b. TT-S-227 - Sealing Compound: Elastomeric Type, Multi-Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
 - 6. National Bureau of Standards (NBS) Specifications for Scales.
 - 7. Truck Mixer Manufacturers Bureau (TMMB):
 - a. Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards.
 - 8. Institute of Electrical and Electronic Engineers (IEEE):
 - a. 442 - Guide for Soil Thermal Resistivity Measurements.
- 1.06 QUALITY ASSURANCE:
- A. Field testing: Shall be performed by an ACI Concrete Field Testing Technician Grade 1.
- 1.07 SUBMITTALS:
- A. Shall be approved by Owner and reviewed by Engineer.
 - B. Include, but not limited to, product data and Shop Drawings of the following:
 - 1. Admixtures.
 - 2. Bonding Agents.
 - 3. Curing Agents.
 - C. Concrete Mix Design
 - 1. Submit as specified in PART 2, paragraph 2.01– Thermally Controlled Low Strength Material, this SECTION 31 23 23.34

2. Submit for each unique mix design with the following information:
 - a. Slump.
 - b. Aggregate Gradation Data.
 - c. Aggregate Quarry Information.
 - d. Test Results for Compressive Strength and Thermal Resistivity.
 3. Resubmit for any change in each mix design.
 4. Contractor shall furnish to Engineer and Owner certified reports of all tests within ten (10) days of receipt the samples.
- D. Field Placement Test Reports
1. Submit as specified in PART 3, paragraph 3.02B– Laboratory Testing of Thermal Backfill During Construction, this SECTION 31 23 23.34.

1.08 ATTACHMENTS

- A. See Appendix A for Geotherm Sampling and Shipping Instructions

PART 2 - PRODUCTS

2.01 THERMALLY CONTROLLED LOW STRENGTH MATERIAL:

- A. Materials:
1. The approved material must be thermally tested prior to placement and must meet the thermal requirements of these Technical Specifications.
 2. Contractor shall utilize thermally controlled low strength material as backfill material above concrete duct bank.
- B. Thermal Resistivity:
1. Thermal backfill for duct bank must be thermally tested prior to placement as noted in these Technical Specifications. The test results must be verified by Engineer and Owner and the duct bank thermal backfill mixture approved by the Owner in writing one month prior to construction. Each concrete truck shall provide a batch mixture ticket prior to thermal backfill placement. If the truck driver does not have a batch mixture ticket, the truck may be rejected.
 2. The maximum thermal resistivity shall be 70°C-cm/watt at two percent (2%) moisture content and 100°C-cm/watt at zero percent (0%) moisture.
- C. Laboratory Testing of Materials for Use in Concrete:
1. An approved independent testing laboratory shall be selected and paid by Contractor to perform all required laboratory testing of materials proposed for use in the production of thermal backfill and to determine mix proportions when laboratory trial batches are required.
 2. Contractor shall deliver representative samples of all proposed concrete materials to the laboratory for the following testing:
 - a. Fine Aggregate:
 - (1) ASTM C33.
 - (2) ASTM C40.
 - (3) ASTM C88.
 - b. Coarse Aggregate:
 - (1) ASTM C33.
 - (2) ASTM C88.
 - c. Mixing water, if other than potable water is proposed for use and in the opinion of the Owner there is reason to suspect its acceptability:
 - (1) With the design mix the laboratory shall make two concrete test cylinders using proposed water and two concrete test cylinders using potable water conforming to ASTM C192.

- d. All cylinders shall be tested conforming to ASTM C39. Age of cylinders at test shall be 28 days unless an earlier age is authorized.
- D. Thermal Backfill Qualities Required:
1. Thermal backfill shall have a maximum compressive strength of 300 psi after 28 days.
 2. Slump of concrete shall be 9 inches unless noted otherwise.

Concrete Application	28 Day Strength	Max Aggregate Size	Max. Slump	Total Air Content	Maximum Thermal Resistivity
Thermally Controlled Backfill	300 psi	3/8"	9" +/- 1"	Naturally Entrained Only (1.5% to 3.0%)	70° C-cm/W at 2% moisture 100° C-cm/W at 0% moisture

- E. Mix Proportions:
1. Material mixtures shall be determined and approved by Geotherm, Inc. All thermal testing shall be performed in accordance with IEEE 442 guidelines. In general, with the guidance of the laboratory, mix samples will be selected and sent to the laboratory for testing. The laboratory shall inform Contractor which mixture is suitable. The approved mixture shall be provided to Engineer and Owner for written verification of the delivered product.
- F. Measurement of Materials:
1. General Requirements:
 - a. Conform to ACI 304.
 - b. Measure materials within one percent by weight for aggregates and cement, and within 1-1/2 percent by volume or weight for water.
 2. Apparatus:
 - a. Beam or springless dial-type scale conforming with NBS - "Specifications for Scales."
 - b. Volumetric measurement of water shall be performed with an approved automatic valve.

PART 3 - EXECUTION

3.01 PLACING OF THERMAL BACKFILL:

- A. Backfill as specified in SECTION 31 23 34 of these Technical Specifications.

3.02 FIELD TESTING:

- A. Field Testing of Thermal Backfill and Making of Thermal Backfill Test Cylinders:
1. Contractor shall furnish test equipment, test cylinder molds, and trained personnel to perform all required field tests, make the required thermal backfill test cylinders and deliver test cylinders to the testing laboratory. The prescribed tests shall be made in the presence of or with the concurrence of Owner.
 2. Thermal backfill sampling for tests and cylinder making shall be done conforming to ASTM C172.
 3. Perform the following tests:
 - a. Slump Test conforming to ASTM C143.
 - b. Air Content Test conforming to ASTM C231.
 - c. Slump and Air Content Test results shall be furnished to the Testing Laboratory for inclusion in the Cylinder Test Reports.
 - d. Discard thermal backfill used for slump and air tests.

4. Make the following concrete test cylinders for laboratory testing:
 - a. Prepare test cylinders conforming to ASTM C31, with not less than one set of cylinders (four cylinders) from each day's placement for each 50 cubic yards or fraction thereof for Compressive Testing. Test samples shall be identified with the type of material, date of the sample, location (station number) of the sample, and a copy of the batch ticket. Contractor shall keep a record of the sample numbers and the corresponding station locations (beginning and end) where the concrete mixture associated with each sample was installed.
 - b. Prepare test cylinders conforming to ASTM C31, with not less than one set of cylinders (two cylinders) from each day's placement for each 50 cubic yards or fraction thereof for Thermal Resistivity Test conforming to IEEE 442. Test samples shall be cast in three-inch (3") by six-inch (6") and identified with the type of material, date of the sample, location (station number) of the sample, and a copy of the batch ticket. Contractor shall keep a record of the sample numbers and the corresponding station locations (beginning and end) where the concrete mixture associated with each sample was installed.
- B. Laboratory Testing of Thermal Backfill During Construction:
 1. Compressive Tests:
 - a. An independent testing laboratory will be selected and paid by Contractor to perform the required laboratory tests and statistical evaluations of thermal backfill being used in the Work.
 - b. Laboratory will cure and test thermal backfill cylinders conforming to ASTM C192 and C39, testing one cylinder at seven, 28 and 56 days of age. The 56 day cylinder can be held in reserve and can be broken if needed. The remaining cylinder will be held to verify test results, if needed.
 - c. Laboratory will hold and maintain the spare compressive test samples for the duration of the project should further testing be needed.
 - d. Contractor shall have the right to observe all phases of thermal backfill cylinder curing and testing. Should Contractor observe any deviations from the prescribed testing procedures that it considers detrimental to thermal backfill strength test results, it shall immediately notify Engineer and Owner in writing.
 - e. Contractor shall make arrangements with the testing laboratory to receive copies of test reports. The cost of providing a maximum of two copies of each report will be paid by Contractor.
 - f. Should the statistical data indicate an unacceptable combination of average strength and standard deviation, Contractor shall take immediate corrective action.
 - g. If 28-day test is more than the anticipated 28-day strength, Engineer and Owner shall be notified immediately for corrective action, if any.
 - h. Should the statistical data indicate an excessive margin of safety, the concrete mix may be modified subject to Owner's approval.
 - i. Thermal Tests:
 - (1) Contractor shall send the set of samples to Geotherm, Inc. to be thermally tested. Tests shall include thermal dryout characterization (thermal resistivity as a function of moisture content), density, and moisture content measurement on each set. Test results shall be provided to Engineer and Owner within ten (10) Business Days after the day the samples are received by Geotherm.
 - (2) Laboratory will cure and test concrete cylinders conforming to ASTM C192 and C39, testing one cylinder at 28 days of age. The remaining cylinder will be held to verify test results, if needed.
 - (3) Laboratory will hold and maintain the spare thermal test samples for the duration of the project should further testing be needed.

- (4) If the thermal test results of the concrete samples do not meet the requirements of these Technical Specifications, Contractor shall have thermal tests performed on nearby native soil samples, as directed by Owner. Contractor shall then have ampacity calculations performed showing the combined effect of the substandard concrete and the native soil on cable ratings. If the combined effect results in a cable rating lower than acceptable to the Owner, Contractor shall take the corrective actions necessary to achieve acceptable ampacity. Calculations shall be performed by Engineer. Contractor shall be responsible for all costs associated with this testing, calculations and any required corrective actions.

END OF SECTION 31 23 23.34



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Cypress, Texas 77433
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Sampling and Shipment of Soil/Backfill Samples for Thermal Analysis

Undisturbed Tube Samples and Bulk Samples

- If cohesive soils (clayey or silty) are encountered, samples should be taken in nominal 3" diameter Shelby tubes or large diameter California sampler with brass liners (no rings), otherwise, standard split spoon samples or auger cuttings should be taken (see bulk soil section below).
- Please do not extrude sample from Shelby tube. Cut the bottom 6" section (+/- 1/2") of the tube, seal both ends with plastic caps and tape it to prevent any moisture loss.
- Identify the samples with Project Name, Location, Bore Hole, Depth, Date samples taken, etc
- The samples should be representative of the soil at the cable (or ductbank) burial depth. If the soil above this elevation is different, it should be sampled as well.
- Please include a copy of the borehole logs.
- Email the details of the shipment - courier name, tracking number, etc. to info@geothermusa.com and lab@geothermusa.com
- If **bedrock** is encountered, take core samples (minimum 2" diameter by 5" long) or block samples of about 5" cube of irregular shape.

Bulk Soil or Backfill Samples

- Send ~10 pounds of each sample, contained in double heavy-duty plastic (Ziploc) bags, identified with Project Name, Sample Location, Bore Hole, Depth, Date samples taken, etc...
- Email the details of the shipment - courier name, tracking number, etc. to info@geothermusa.com and lab@geothermusa.com
- For all foreign shipments
 - declare a value of \$10 for the entire package and send it via **FedEx or UPS** overnight service (or 2nd day air service).
 - Mark the package "**Aggregate samples for laboratory testing only**".
 - Request import permit instructions to info@geothermusa.com
- Provide the Proctor (Standard or Modified) density, starting moisture content and percent compaction effort.

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Purpose for testing (in-situ vs. construction phase), the following apply:

For thermal resistivity measurements to determine in-situ values

- For soils that are cohesive
 - Undisturbed tube samples
 - bottom 6-inches of Shelby tube or
 - brass/stainless steel liner (minimum diameter of 2-inches)
 - must be continuous and NOT ring samplers
 - Disturbed samples
 - Provide us a Proctor Density Curve (Standard or Modified)
 - Provide percent (%) compaction (i.e. 95%, 90% or 85%)
 - Provide starting moisture content (i.e. in-situ, optimum or %)

For thermal resistivity measurements to determine construction phase (materials to be used around cables)

- Disturbed samples
 - Provide us a Proctor Density Curve (Standard or Modified)
 - Provide percent (%) compaction (i.e. 95%, 90% or 85%)
 - Provide starting moisture content (i.e. in-situ, optimum or %)
1. **Provide soil descriptions or borehole logs, a business card or contact information with the samples in a separate Ziploc bag.**
 2. **Please issue a PO or a charge to number with the samples**
 3. **Email the tracking number to info@geothermusa.com and lab@geothermusa.com**
 4. **Turnaround time is about 10 days after we receive all the necessary information**

Ship all samples to:

**GEO THERM USA
ATTN: Lab Manager
21239 FM529 Road, Bldg F
Cypress, Texas 77433
Tel: 281-985-9344**



Chain of Custody Form

Please include this form in a Ziploc bag for each sample submitted:

Company Name: _____

Contact Name: _____ Contact Number _____

Project Name: _____

Project Location: _____

Company to Invoice: _____ PO Number: _____

Report Submittal email: _____

Sample Location/ID: _____

Sample Collection Date: _____ Sample Depth: _____

Soil Description: _____

Is this a bulk sample that requires Recomaction?

____ Yes (continue below) **OR** ____ No (tube sample test "as is")

If the sample requires Recomaction please complete items below:

- a. What is the Proctor Maximum Dry Density (lb/ft³)? _____
- b. Is this a Standard or Modified Proctor: _____
- c. Specify compaction effort(s)? (i.e. 85%, 90 or 95%): _____

2. What is the starting test moisture content?

____ As Received/In-situ? **OR** ____ Optimum?

SECTION 31 23 34 – UNDERGROUND CABLE SYSTEM EXCAVATION AND FILL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract apply to this Section.

1.02 SUMMARY:

- A. This Section includes earthwork activities related to Site preparation and installation of structures, drainage pipes, and underground electric utilities, including:
 - 1. Clearing and Grubbing.
 - 2. Disposal of Waste Materials.
 - 3. Stripping.
 - 4. Excavation and Trenching.
 - 5. Stockpiling.
 - 6. Embankment.
 - 7. Site Grading.
 - 8. Subgrade Preparation.
 - 9. Backfilling.
 - 10. Borrow.
 - 11. Granular Fill.
 - 12. Soil Sterilant.
 - 13. Topsoiling.
 - 14. Riprap.
 - 15. Measurement.
 - 16. Maintenance and Repair.
 - 17. Temporary Plating.
 - 18. Rock.

1.03 RELATED REQUIREMENTS:

- A. Section 01 11 01 – Summary of Work
- B. Section 01 55 26 – Traffic Control.
- C. Section 03 30 11 – Duct Bank Thermal Concrete.
- D. Section 31 23 23.34 – Thermally Controlled Low Strength Material
- E. Section 32 01 12 – Pavement Restoration.

1.04 REFERENCE STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. Applicable Standards:
 - 1. ASTM International (ASTM):
 - a. C33 - Standard Specification for Concrete Aggregates.
 - b. C88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - c. C94/C94M – Ready-Mixed Concrete.
 - d. C131 - Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - e. C144 – Aggregate for Masonry Mortar.
 - f. C150 – Portland Cement.

SECTION 31 23 34 – UNDERGROUND CABLE SYSTEM EXCAVATION AND FILL: continued

- g. C173/C173M – Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- h. C231 – Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- i. C403/C403M – Test Method for Time Setting of Concrete Mixtures by Penetration Resistance.
- j. C422 – Test Methods for Particle-Size Analysis of Soils.
- k. C618 – Coal Fly Ash and Raw or Natural Pozzolan for Use as a Mineral Admixture in Concrete.
- l. C939 – Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
- m. C940 – Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
- n. D75 – Practice for Sampling Aggregates.
- o. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
- p. D1140 – Test Methods for Amount of Material in Soils Finer than No. 200 μm Sieve.
- q. D1241 – Materials for Soil-Aggregate Subbase, Base, and Surface Courses.
- r. D1556 - Density and Unit Weight of Soil In-Place by Sand Cone Method.
- s. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
- t. D2167 - Test for Density and Unit Weight of Soil In-Place by the Rubber Balloon Method.
- u. D2487 – Classification of Soils for Engineering Purposes (Unified Soils Classification System).
- v. D3017 - Test Method for Moisture Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth).
- w. D3776 – Test Methods for Mass per Unit Area (Weight) of Fabric.
- x. D4253 - Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
- y. D4254 - Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
- z. D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- aa. D4546 - One-Dimensional Swell/Settlement Potential of Cohesive Soils.
- bb. D4632 – Test Method for Grab Breaking Load and Elongation of Geotextiles.
- cc. D4751 – Test Method for Determining the Apparent Opening Size of a Geotextile.
- dd. D4832 – Test Method for Preparation and Testing of Controlled Low Strength material (CLSM) Test Cylinders.
- ee. D4833 – Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
- ff. D5084 – Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using A Flexible Wall Permeameter.
- gg. D5239 – Practice for Characterizing Fly Ash for use in Soil Stabilization.
- hh. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- 2. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR Part 1926 – Safety and Health Regulations for Construction.

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3. Institute of Electrical & Electronic Engineers (IEEE):
 - a. 442 - Guide for Soil Thermal Resistivity Measurements.
4. All applicable State of Florida Standards, Requirements and Specifications for Highway and Bridge Construction.
 - a. All applicable Jacksonville Florida standards and requirements.

1.05 DEFINITIONS:

- A. Stakeholder Definitions
 1. Owner: Jacksonville Electric Authority (JEA)
 2. Engineer: Burns & McDonnell Engineering Company, Inc
 3. Contractor: To Be Determined
- B. Backfilling: Material placed in an excavation for a structure or in a trench for underground utilities.
- C. Borrow: Earth materials obtained from sources other than excavations or stockpiles within the area to be graded by Contractor.
- D. Clearing: The removal of trees, shrubs, and other vegetation above the existing grade surface.
- E. Demolition: The removal of improvements without regard to class and type of construction or material.
- F. Excavation: Material removed (cut) below the elevation of the stripped ground surface, or material removed for trenching or structure foundations.
- G. Embankment: Material placed above the elevation of the original (existing) ground surface after stripping.
- H. Grubbing: The removal of roots, shrubs, and other vegetation to a depth below the ground surface.
- I. Stabilize: Placement of sod, seed, riprap, or crushed rock in order to prevent the erosion of soil.
- J. Stripping: Excavation of an overlying layer of material to expose material of a different type, use, or class.
- K. Subgrade: The surface layer of earth on which structures, pavements, rock surfacing, or other surfacing materials, except topsoil, are to be placed.
- L. Topsoil: The final surface layer of earth material intended to support vegetation.
- M. Rock: See PART 3, Paragraph 3.04

1.06 SUBMITTALS:

- A. Shall be approved by Owner and reviewed by Engineer.
- B. Includes, but not limited to the following:
 1. Test results from laboratory testing of proposed borrow material.
 2. Test results from thermal resistivity laboratory testing of previously uncharacterized soils.
 3. Test results for field density of backfill lifts.
 4. Erosion control plan.
 5. Dewatering Plan.
 6. Sheet piling and Shoring Excavation Plan.
 7. Soil Disposal Plan
 8. Material Storage Plan
- C. Where selecting an option for excavation, trenching, and shoring in compliance with local, state, or federal safety regulations such as OSHA 29 CFR Part 1926 or successor regulations, which require design by a registered professional engineer, submit (for information only and not for Owner and Engineer approval) the following:

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1. Copies of design calculations and notes for sloping, benching, support systems, shield systems, and other protective systems prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project is located.
2. Documents provided with evidence of registered professional engineer's seal, signature, and date in accordance with appropriate state licensing requirements.

1.07 QUALITY ASSURANCE

- A. Sampling and Testing:
1. Tests to determine conformance with all requirements of this Specification for quality and properties of all Contractor-secured materials, including borrow materials (both on or off Site) proposed for use, shall be performed by an independent, commercial laboratory retained and compensated by the Contractor, and approved by Owner.
 2. Copies of reports and certificates regarding tests and inspection of equipment, materials and completed work shall be distributed per Owner requirements . Furnish specific schedule for sampling to provide Owner and Engineer with the opportunity to observe sampling.

1.08 JOB CONDITIONS:

- A. Lines and grades shall be as indicated. Owner will furnish bench marks and property monuments as indicated. Contractor shall use these benchmarks and reference points and any other points that Contractor may have to establish the layout and construct the Work properly.
- B. Carefully maintain all bench marks and monuments and replace as directed if disturbed or destroyed at no additional cost to Owner and Engineer.
- C. Disposition of Existing Facilities, Structures, and Property:
1. Existing underground utilities are shown on Contract Drawings using the best information available at the time of Drawing preparation. Contractor shall identify, locate, and protect all underground utilities which may be affected by construction under this Contract before starting excavation or other Site construction activities which could damage existing utilities.
 2. It shall be Contractor's responsibility to have existing underground utilities located and verified prior to excavation and earth moving activities.
 3. Adequately protect from damage all existing utilities, structures, and property.
 4. Remove or relocate only as indicated, specified, or directed. Provide a minimum 48 hours' notice to Owner and Engineer and receive written notice to proceed before interrupting any utility service.
 5. Report inactive and abandoned utilities encountered in excavating and grading operations. Remove, plug, or cap as directed.
- D. Environmental Protection:
1. It is mandatory that the Contractor employ construction methods and techniques that will result in the least detrimental impact upon the environment. Actions taken by the Contractor shall include, but are not limited to the following:
 - a. Erosion and Sediment Control plans shall be implemented as indicated on plan Drawings.
 - b. Contractor shall furnish, install, construct, and maintain temporary erosion and sediment control measures to control erosion and minimize the siltation of intermittent streams and the pollution of private properties. Temporary erosion and sediment control measures shall be constructed in substantial compliance with

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local, state, federal, and jurisdictional agencies regulation and shall be maintained until completion of Contract.

- c. During dry and windy weather conditions, watering trucks shall be used to lessen wind erosion and dusting problems on areas not surfaced with turf or crushed rock that are subject to wind erosion.
- d. Contractor shall repair ruts before leaving the area. At the conclusion of each working day the Site shall be left in a condition to prevent soil erosion due to a possible rainfall event.
- e. Areas that are damaged by construction activities shall be regraded to their original condition and resurfaced as specified or as directed.
- f. Care should be taken to avoid oil or fuel spills and other pollution. Areas polluted shall be cleaned and restored to their original condition.
- g. If items or areas of possible archaeological interest are uncovered during construction, Contractor shall notify Owner and Engineer immediately.
- h. The removal of trees and other vegetation on the Site shall be limited to that required by the new installation as indicated.

1.09 ATTACHMENTS

- A. See Appendix A for Geotherm Sampling and Shipping Instructions

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Definitions and classifications of materials used in this Part are stated in PART 3: EXECUTION below.

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING:

- A. Clear and grub all areas where earthwork is to be performed, including borrow areas, and any other areas beyond the earthwork limits where indicated.
- B. Clearing:
 - 1. Clearing includes felling and disposal of trees, brush, and all other vegetation found on or above the existing ground surface inside the clearing limits.
 - 2. Remove existing fence within the limits of clearing. Store fence materials for reinstallation as indicated.
 - 3. Conduct Work in a manner to prevent damage to property and to provide for the safety of employees and others.
 - 4. Keep operations within construction limits indicated.
- C. Grubbing:
 - 1. Grubbing includes the removal and disposal of all tree stumps and roots where embankment is to be placed and when the excavated material is to be used as embankment. Removal and disposal of tree stumps and roots larger than 3 inches in diameter will be required at all other locations.
 - 2. Backfill all excavated depressions with approved material and grade to drain.
- D. Disposal of Debris:
 - 1. Dispose of debris from clearing and grubbing at a location off the Site, as arranged for by Contractor.

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2. Contractor may claim and salvage any timber or other debris which he may consider of value but shall not delay in any manner either this Contract or other work with salvaging operations.
- 3.02 DISPOSAL OF WASTE MATERIALS:
- A. Waste Materials:
 1. Waste material includes all excess suitable materials and materials unsuitable for use in the Work.
 - a. Unsuitable materials include all material that contains debris, roots, organic matter, frozen matter, rock (with any dimension greater than one-half the loose layer thickness), or other materials that are determined by the Owner as too wet or otherwise unsuitable for providing an acceptable fill or subgrade for roads and structures or that do not meet the thermal resistivity values for backfill as stated in this Section.
 2. Remove unsuitable materials from work area as excavated.
 3. Dispose of waste materials off the Site, at a location arranged for by the Contractor.
- 3.03 STRIPPING:
- A. Stripping shall consist of scraping areas clean of all brush, grass, weeds, roots, and other materials.
 - B. Remove topsoil from areas within limits of excavation, trenching, borrow, and areas designated to receive embankment.
 - C. Strip to a minimum depth of six (6) inches, but to a sufficient depth to remove excessive roots in heavy vegetation, unsuitable material, or brush areas and as required to remove all soil containing organic material or segregate topsoil.
 - D. Stockpile topsoil off site, at a location arranged for by Contractor.
 - E. Dispose of waste at a location off the Site, as arranged for by the Contractor or on Site at locations approved by Owner.
- 3.04 ROCK:
- A. Rock, which is defined as boulders of 1/2-cubic yard or more in volume for trench or pit excavation that cannot be removed without systematic drilling, ram hammering, ripping, or blasting (when permitted) such as material in beds, ledges, unstratified masses, or aggregate conglomerate deposits that are so firmly cemented as to possess the characteristics of solid rock. Hard and compacted materials such as cemented gravel, glacial till, and relatively soft or disintegrated rock that can be removed without continuous and systematic drilling and blasting will not be considered as rock. Material will not be considered as "rock" because of intermittent drilling and blasting that is performed merely to increase production.
 - B. When layers of rock and soil are encountered, the excavated soil between the layers of rock will be considered as rock excavation if the thickness of the soil layer does not exceed six (6) inches.
 - C. Rock excavation includes the removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of underground cable system.
- 3.05 EXCAVATION AND TRENCHING:
- A. General:
 1. No more trench shall be opened in advance of duct bank construction than is necessary to expedite the Work. All Applicable Laws shall be strictly followed by Contractor.
 2. Excavate all materials found within the limits for excavation.

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3. Perform excavation by any recognized method of good practice to complete the job in the most expeditious manner in conformance with specified requirements.
 4. Take appropriate precautions so no damage is caused to existing facilities or equipment, or other work.
 5. Blasting will not be allowed.
 6. All trenching shall comply with OSHA regulations 29 CFR.
 7. Unsuitable trench excavated materials shall be stockpiled separate from suitable excavated materials authorized for use as backfill. This unsuitable material shall be disposed of and not used as trench backfill.
 8. All excavated material deemed unacceptable for use as fill material shall be hauled away and disposed of in accordance with this Section.
 9. Each time a new type of soil is encountered that has not been previously characterized Contractor shall take samples at two locations. At each location samples shall be taken at a depth of five (5) feet and ten (10) feet.
 - a. Test samples shall be obtained in accordance with the requirements of Geotherm, Inc. and identified with the type of material, date of the sample, and location (station number) of the sample, and depth of the sample. Contractor shall send the set of samples to Geotherm, Inc. or an equivalent test laboratory approved by Owner in writing to be thermally tested. Tests shall include thermal dryout characterization (thermal resistivity as a function of moisture content), density, and moisture content measurement on each set. Test results shall be provided to Owner and Engineer within ten (10) Business Days after the date the samples are taken. Contractor shall be responsible for all costs associated with this testing.
- B. Trenching:
1. Trench Side Walls:
 - a. Make vertical or slope within specified trench width limitations below a horizontal plane 12 inches above top of facility.
 - b. Make vertical or sloped (stepped) as required for stability, above a horizontal plane 12 inches above top of facility.
 - c. Excavate without undercutting.
 2. Trench Depth:
 - a. Electrical Conduits:
 - (1) Remove material required for alignment and elevation, or minimum depth of installation.
 3. Trench Bottom:
 - a. Protect and maintain when suitable natural materials are encountered.
 - b. Use clean stone to stabilize trench bottom when adverse trench bottom conditions exist.
 - c. Remove rock fragments and materials disturbed during excavation or dislodged from trench walls.
 4. Trench Width:
 - a. Excavate trench to a width which will permit satisfactory work clearances and thorough tamping of the bedding.
 - b. Maximum trench width limitations shall apply beginning three (3) feet from manhole or structure walls.
 - c. Maximum width shall be as near the minimum specified as can be controlled by construction equipment and methods utilized.
 - d. Correct when over excavated.
 - (1) Restore over excavation with thermal backfill.

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- (2) Obtain approval of Owner before proceeding.
- C. Trenching in Embankment Areas: Perform after compacted embankment has reached an elevation of not less than one foot above the top of the facility.
- D. Thermal Resistivity Testing
1. Contractor shall perform soil thermal resistivity and soil ambient temperature testing during the trenching activities every time a new type of soil is encountered that has not been previously characterized and for backfilling material furnished by Contractor. In addition to the soil thermal resistivity measurements, Contractor shall take a sample for dryout curves every time a new type of soil is encountered that has not been previously characterized. Contractor shall record the results of this testing, correlate the results to the Plan Drawings, and submit a report of such testing to Owner and Engineer after completion.
 - a. Contractor shall perform soil thermal resistivity testing in accordance with IEEE Standard 442.
- E. Sheeting and Bracing
1. Design, furnish, place, maintain, and subsequently remove, to extent required, a system of temporary supports for cut and cover, open cut, or trench excavations, including bracing, dewatering, and associated items to support sides and ends of excavations where excavation slopes might endanger in-place or proposed improvements, extend beyond construction right-of-ways, or as otherwise specified or indicated.
 2. Provide all materials on Site prior to start of excavation in each section and make such adjustments as are required to meet unexpected conditions.
 3. Space and arrange sheeting and bracing as required to exclude adjacent material and according to stability of excavation slopes.
 4. Assess existing conditions including adjacent property and possible effects of proposed temporary works and construction methods; and select and design such support systems, methods, and details as will assure safety to the public, adjacent property, and the completed Work.
 5. Modify or relocate underground facilities, only with prior approval, if existing underground facilities interfere with Contractor's proposed method of support.
 6. Use caution in areas of underground facilities, which shall be exposed by hand or other excavation methods acceptable to Contractor.
 7. Perform sheeting, shoring, and bracing for trench excavation, for underground facilities, and for other purposes in accordance with safety and protection requirements of the Contract Documents.
 8. Provide sheeting, shoring, and bracing for trench excavation in subgrade of excavation when required to prevent movement of the main excavation support system.
 9. Provide shoring, sheeting, and bracing as indicated or as needed to meet the following requirements:
 - a. Prevent undermining and damage to all structures, buildings, underground facilities, pavements, and slabs.
 - b. Perform excavations with vertical banks where necessary for construction activities or as indicated, and also within all limits of excavation noted on Drawings.
 - c. Design excavation support system and components to support lateral earth pressures, unrelieved hydrostatic pressures, utility loads, traffic and construction loads, and building and other surcharge loads to allow safe and expeditious construction of permanent structures without movement or settlement of the ground, and to prevent damage to or movement of adjacent buildings, structures, underground facilities, and other improvements. Design shall account for staged

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- removal of bracing to suit the sequence of concrete placement for permanent structures and backfill.
- d. Except as otherwise specified herein, shoring and sheeting materials may be extracted and reused at Contractor's option; however, Contractor shall remove and replace any existing structure or underground facility damaged during shoring and sheeting. Remove sheeting and bracing as backfill progresses. Fill voids left after withdrawal with sand or other material approved by Owner.
 - e. Where shoring and sheeting materials must be left in-place in the completed Work to prevent settlements to or damage within adjacent structures or as directed by Owner, backfill the excavation to three (3) feet (1 meter) below finished grade and remove the remaining exposed portion of shoring before completing backfill. If soldier piles and wood lagging are used for shoring, remove wood lagging to within three (3) feet (1 meter) of finished grade in incremental steps of approximately six (6) inches (150 mm) as backfill is placed, or to Contractor's design if more stringent. Location of all shoring and sheeting left in-place shall be documented on Contractor-furnished construction record drawings and provided to Owner and Engineer.
10. Contractor shall be solely responsible for proper design, installation, operation, maintenance, and any failure of any component of the system. Review by Owner and Engineer of drawings and data submitted by Contractor shall not in any way be considered to relieve Contractor from full responsibility for errors therein or from the entire responsibility for complete and adequate design and performance of the sheeting and shoring system.
11. Provision for Contingencies:
- a. Performance of components of the support system shall be monitored for both vertical and horizontal movement daily.
 - b. Provide a contingency plan or alternative procedure for implementation, if system does not adequately perform.
 - c. The materials and equipment necessary to implement the contingency plan shall be kept readily available.
12. Damages:
- a. Document all existing damage to adjacent facilities and submit information to Engineer prior to performing any excavation. Documentation shall include a written description, diagrams, measurements, and appropriate photographs.
 - b. Repair all damage resulting from Contractor's excavation and remove and replace all undermined pavements with Owner-approved equal, either concrete or asphalt.

3.06 DEWATERING

A. General:

1. Contractor shall design and provide the dewatering system using accepted and professional methods of design and engineering consistent with the best current practice to eliminate water entering the excavation under hydrostatic head from the bottom and/or sides. The system shall be designed to prevent differential hydrostatic head which may occur from rising water levels from adjoining or nearby bodies or water, proximity of excavation to phreatic groundwater level, or surface runoff, and which would result in floating out soil particles in a manner termed as a "quick" or "boiling" condition. System shall not be dependent solely upon sumps and/or pumping water from within the excavation where differential head would result in a "quick" condition, which would continue to worsen the integrity of the excavation's stability.

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2. Provide dewatering system of a sufficient size and capacity as required to control ground and surface water flow into the excavation and to allow all Work to be installed in a dry condition, including the obtaining of a licensed well-driller, where required.
 3. Control, by any acceptable means, all water regardless of source and be fully responsible for the disposal of water.
 4. Confine all discharge piping and/or ditches to the available easement or to additional easement obtained by Contractor. Provide all necessary means for disposal of the water, including the obtaining of all necessary permits and of additional easement.
 5. Control groundwater in a manner that preserves the strength of the foundation soils, does not cause instability or raveling of the excavation slopes, and does not result in damage to existing structures. Where necessary to these purposes, lower the water level in advance of excavation, using wells, wellpoints, jet eductors, or similar positive methods. The water level as measured in piezometers shall be maintained a minimum of 1 meter (3 feet) below the prevailing excavation level.
 6. Commence dewatering with means to provide positive dewatering of all water sources prior to any appearance of water in excavation and continue until Work is complete to the extent that no damage results from hydrostatic pressure, flotation, or other causes.
 7. Open pumping with sumps and ditches shall be allowed, provided it does not result in boils, loss of fines, softening of the ground, or instability of the slopes.
 8. Install wells and/or wellpoints, if required, with suitable screens and filters, so that continuous pumping of fines does not occur. Arrange the discharge to facilitate collection of samples by Owner, Engineer or Owner's Representative. During normal pumping, and upon development of well(s), levels of fine sand or silt in the discharge water shall not exceed five (5) ppm. Install a sand tester on the discharge of each pump during testing to verify that levels are not exceeded.
 9. Install, operate, and maintain the dewatering system required to control surface and/or groundwater.
 10. Control grading around excavations to prevent surface water from flowing into excavation areas.
 11. Drain or pump as required to continually maintain all excavations and trenches free of water or mud from any source, and discharge to approved drains or channels. Commence when water first appears and continue until Work is complete to the extent that no damage will result from hydrostatic pressure, flotation, or other causes.
 12. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head.
 13. In preparing the dewatering plan, Contractor shall consider all available information, together with Site constraints, excavation/sheeting requirements, and construction schedule. Other potential problems may require specific reference and amplification within the dewatering plan.
 14. After completion of the dewatering installation and prior to commencement of excavation, Contractor shall submit for review a detailed plan of the dewatering system as constructed, together with test data and computations demonstrating that the system is capable of achieving the specified results.
 15. Contractor shall be responsible for the accuracy of the drawings, design data, and operation records required by this Section.
- B. Design
1. Contractor shall designate and obtain the services of a qualified dewatering specialist or expert to provide a dewatering plan as may be necessary to complete the Work.

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Contractor shall provide dewatering plan at the time of Bid submission. Items to be provided shall include, but not be limited to the following:

- a. Drawings indicating the general location and size of berms, dikes, ditches, all deep wells, observation piezometer wells, wellpoints, jet eductors, sumps and discharge lines, including their relation to water disposal ditches.
 - b. Make, model and capacities of pumps, prime movers, power generators, and standby equipment.
 - c. Design calculations, including any computer modeling, to show adequacy of system and selected equipment, estimated flow rate of water to be discharged, and estimated duration for groundwater to be drawn down to elevations required for excavation.
 - d. Detailed description of dewatering procedure and maintenance method.
 - e. Description of emergency plan to protect in-place construction in the event of an unanticipated rise in groundwater due to loss of power or other unexpected conditions or inundation from surface water.
 - f. Additional details, as requested by Owner or Engineer.
 - g. Specific items to be included addressing dewatering operations using wells, wellpoints, or jet eductors shall consist of the following:
 - (1) Diameter of hole drilled.
 - (2) Type of equipment and method of well installation.
 - (3) Diameter and material type of well casing inserted.
 - (4) Elevation of top of each well.
 - (5) Screen opening sizes.
 - (6) Screened interval or elevations of segments in well that are screened.
 - (7) Backfill gravel pack zone elevations.
 - (8) Gravel pack gradation.
 - (9) Size of pumps (watts)(horsepower).
 - (10) Anticipated pumping capacity (L/s)(gpm).
 - (11) Drawdown in well with time during pumping.
 - (12) Number and location of wells.
 - (13) Number and location of piezometers.
 - (14) Wellpoint details.
 - (15) Certification license of well-driller, where required.
2. In preparing the dewatering plan, Contractor shall consider all available information, together with Site constraints, excavation/sheeting requirements, and construction schedule. Other potential problems may require specific reference and amplification within the dewatering plan.
 3. After completion of the dewatering installation and prior to commencement of excavation, Contractor shall submit for review a detailed plan of the dewatering system as constructed, together with test data and computations demonstrating that the system is capable of achieving the specified results.
 4. Contractor shall be solely responsible for proper installation, operation, maintenance, and any failure of any component of the system. Notice to Proceed issued by Owner or submittal of the dewatering plans and data by Contractor shall not relieve Contractor from full responsibility for errors therein or for complete and adequate design and performance of the system in controlling the water level in the excavated areas and for control of the hydrostatic pressures to the depth specified.
 5. Contractor shall be responsible for the accuracy of the drawings, design data, and operation records required by this Section.

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6. Piezometers and Groundwater Monitoring:
 - a. Contractor shall install as a minimum number of piezometers per qualified dewatering specialist, in addition to any required by regulating agencies having jurisdiction, at locations prior to excavation below the groundwater level, for the purpose of monitoring groundwater elevations in the vicinity of the excavation. The design and location of the piezometers will be subject to approval by Owner.
 - b. Observe and record twice daily the elevation of the groundwater at all of the piezometers on a daily basis 7 days a week, and furnish a daily written summary of the observations to Owner and Engineer. Record groundwater elevations to the nearest 30 mm (0.1 foot), with observations conducted throughout the duration of any dewatering, and until dewatering is no longer required.
 - c. Monitor upstream and downstream river/stream levels to anticipated rising groundwater levels.
 - d. Repair or replace within 24 hours piezometers that become inactive, damaged, or destroyed. If required, suspend excavation and construction activities in areas where piezometers are not functioning properly until reliable observations can be made. Add or remove water from piezometer risers and demonstrate that observation wells are functioning properly.
 - e. Remove and grout piezometers when dewatering is completed and in accordance with requirements of jurisdictional agencies.
- C. Damages:
 1. Contractor shall be responsible for and shall repair without cost to Owner and Engineer any damage to work in place, other Contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, and the excavation, including, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.
 2. Remove subgrade materials rendered unsuitable by excessive wetting and replace with approved backfill material at no additional cost to Owner and Engineer.
- D. Maintaining Excavation in Dewatered Condition:
 1. Dewatering shall be a continuous operation. Interruptions due to power outages, or any other reason shall not be permitted.
 2. Continuously maintain excavation in dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction and/or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance.
 3. Provide standby equipment on site, installed, wired, and available, for immediate operation if required to maintain dewatering on a continuous basis in event any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequate or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner and Engineer.
 4. Subsequent to completion of excavation and during the installation of all Work in the excavated area, Contractor shall maintain the excavation in a dewatered condition.
 5. System maintenance shall include but not be limited to 24-hour supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain the excavation in a dewatered condition.

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- E. System removal:
 - 1. Contractor shall remove all dewatering equipment from the Site, including related temporary electrical service.
 - 2. All wells shall be removed or cut off a minimum of three (3) feet (1 meter) below the final ground surface, capped, and abandoned in accordance with the regulations by agencies having jurisdiction.
 - 3. Removal work under this paragraph does not include any of the Site cleanup work as required elsewhere in these Specifications.

3.07 TEMPORARY PLATING:

- A. Contractor shall maintain traffic and access to driveways, parking facilities, sidewalks, walkways, and similar facilities. Maintenance of access shall be in accordance with local requirements. Temporary skid-resistant steel plates or other local governing authority-approved alternative plating shall be utilized to maintain access. Contractor shall visit the Site and determine the necessary footage of temporary plating required to meet all local requirements. Contractor is responsible for the cost of plating, as required by Owner and Engineer and/or any governmental authorities.
- B. Plating shall be furnished and placed in accordance with the applicable local governing authority requirements.

3.08 STOCKPILING:

- A. Stockpile in amounts sufficient for and in a manner to segregate materials suitable for the following:
 - 1. Topsoiling.
 - 2. Constructing embankments.
 - 3. Waste only.
- B. Do not obstruct or prevent access to the following:
 - 1. Roads and driveways.
 - 2. Utility control devices.
 - 3. Ditches or natural drainage channels.
 - 4. Material storage (lay-down) areas.
 - 5. Indicated utility lines and poles.
 - 6. Waste and borrow areas.
- C. Perform in a manner to avoid endangering the Work, stability of banks or structures, or health of trees and shrubs to be saved.
- D. Maintain safe distance between toe of stockpile and edge of excavation or trench.
- E. Stockpile in other areas or off -site when adjacent structures, easement limitations, or other restrictions prohibit sufficient storage adjacent to the Work. Off-site areas shall be arranged for by Contractor.

3.09 EMBANKMENT:

- A. General:
 - 1. The construction of embankment shall consist of obtaining suitable materials and placing these materials in compacted lifts.
 - 2. Suitable embankment materials include material from excavations and borrow areas that is free of debris, roots, organic matter, refuse, ashes, cinders, frozen earth, and which is free of rock with any dimension greater than one-half the specified loose layer thickness.

SECTION 31 23 34 – UNDERGROUND CABLE SYSTEM EXCAVATION AND FILL: continued

3. Unsuitable embankment materials include material that does not conform to the above or other materials that are determined by Owner as too wet or otherwise unsuitable for providing a stable earth structure.
 4. That portion of material passing the No. 40 sieve shall have a liquid limit not exceeding 40 and a plastic index not exceeding 25 when tested in accordance with ASTM D4318.
 5. Place fill material only on ground surfaces which conform to the following:
 - a. Scarified to 6 inches deep prior to placement of first lift.
 - b. Compacted prior to placement of second or succeeding lifts.
 - c. Wetted or dried as required to obtain correct moisture content.
 - d. Approved by Owner .
 6. All slopes on fills shall be constructed 1 foot wider than indicated and then dressed to the final grade.
- B. Earthen (Cohesive) Embankment:
1. Material shall be friable sandy or silty clay containing sufficient fine material to provide a dense mass free of voids when compacted. When impact compacted, these materials will produce a well-defined moisture-density relationship curve.
 2. Material shall not contain more than ten percent (10%) by volume of rock and gravel and not contain particles with maximum dimension greater than one-half the depth of the layer to be compacted.
- C. Sand and Gravel (Cohesionless) Embankment:
1. Include gravels, gravel-sand mixtures, sands and gravelly sands exclusive of clayey and silty components. These materials have the following properties:
 - a. Free-draining.
 - b. Impact compaction will not produce a well-defined moisture-density relationship curve.
 - c. The maximum density by impact methods will generally be less than by vibratory methods.
- D. Placement:
1. Place to the contours and elevations indicated.
 2. Place embankment material in eight (8)-inch maximum layers (uncompacted depth).
 3. Obtain materials for embankment construction in the following order of priority:
 - a. From on-site excavation.
 - b. From borrow areas secured by the Contractor.
 4. If the slope bounding the embankment area is steeper than six (6) horizontal to one (1) vertical, step existing grade prior to placing material.
 5. Perform wetting or drying of embankment material as required to obtain specified density. The moisture content at time of placement shall be within the following specified range:

Lower Limit: two percent (2%) below optimum moisture content.
Upper Limit: three percent (3%) above optimum moisture content.
Moisture content shall be determined by ASTM D6938.
 6. Do not place snow, ice, or frozen earth in embankment and do not place embankment on a frozen surface.
 7. Prior to constructing embankment, the ground surface shall be proof rolled with a medium weight roller or other suitable equipment. Contractor shall identify the location of soft or yielding materials.
 8. Place embankment material only on ground surfaces which conforms to the following:
 - a. Scarified to six (6) inches deep prior to placement of first lift.
 - b. Compacted prior to placement of second or succeeding lifts.

SECTION 31 23 34 – UNDERGROUND CABLE SYSTEM EXCAVATION AND FILL: continued

- c. Wetted or dried as required to obtain correct moisture content.
 - d. Soft spots over excavated and compacted as specified.
 - e. Approved by Owner
 - 9. All slopes and embankments shall be constructed one (1) foot wider than indicated and then dressed to final grade.
 - E. Compaction:
 - 1. Cohesive material and cohesionless material smaller than the No. 4 sieve in embankment shall be compacted to 95% of the maximum dry density as determined by ASTM D698.
 - 2. Cohesionless material in embankment shall be compacted to 85% of relative density as determined by ASTM D4253 and D4254.
 - 3. Obtain compaction specified by normal methods and equipment.
 - 4. Embankment failing to meet specified densities shall be removed or scarified and recompacted to meet specified densities.
 - 5. Exercise caution in the use of heavy equipment in areas adjacent to existing structures.
 - 6. The method of in-place compaction testing shall be in accordance with ASTM D2167, D6938 or D3017 at Owner's option.
 - 7. Frequency of compaction (density and moisture content) testing shall be as follows:
 - a. At least one test for every lift or 1,000 cubic yards, whichever occurs first, of material placed in a mass embankment.
 - b. At least one test every 100 feet per lift along access road.
 - c. At least one test for every 200 cubic yards of material placed in trenches or around structures.
 - d. At least one (1) test for every shift of compaction operation on a mass embankment.
 - e. At least one (1) test when Owner and Engineer suspects the quality of moisture control or effectiveness of compaction.
- 3.10 SITE GRADING:
- A. Excavate, construct embankments, and rough grade to bring Project area to subgrades as follows:
 - 1. To underside of respective surfacing or base course for surfaced areas as indicated.
 - 2. As indicated on grading sections for seeded areas, ditches, and slopes.
 - B. Finish Grading:
 - 1. Grade and compact all areas within the Project, including excavated and filled sections, and adjacent transition areas reasonably smooth and free from irregular surface changes.
 - 2. Degree of finish shall be that ordinarily obtained from blade grader or scraper operations, except as otherwise specified.
 - 3. Finished subgrades for roads and surfaced areas shall not be lower than indicated, nor higher than 0.1 foot above that indicated.
 - 4. Finish all ditches and swales to drain readily.
 - 5. Provide roundings at top and bottom of banks and at other breaks in grade.
- 3.11 SUBGRADE PREPARATION:
- A. General:
 - 1. Excavate or construct embankment as specified and as required to construct subgrades to the elevations and grades indicated.
 - 2. Remove all unsuitable material and replace with approved embankment material, and perform all wetting, drying, shaping, and compacting required to prepare a suitable subgrade. Unsuitable material is defined under Paragraph "Embankment," this Section.

SECTION 31 23 34 – UNDERGROUND CABLE SYSTEM EXCAVATION AND FILL: continued

- B. Subgrade for Slab Foundations, Roadways, Drives, Parking Areas, and Areas to be Surfaced with Crushed Rock:
 - 1. Extend subgrade the full width of the surfaced area plus, where possible, one foot outside the edges of the overlying course to be placed.
 - 2. Perform wetting or drying of subgrade material as required to obtain specified density. The moisture content at time of placement shall be within the following specified range:
 - Lower Limit: 2% below optimum moisture content.
 - Upper Limit: 3% above optimum moisture content.
 - Moisture content shall be determined by ASTM D698.
 - 3. Compact subgrade as follows:
 - a. Cohesive material and cohesionless material smaller than the No. 4 sieve shall be compacted to 95% of maximum dry density as determined by ASTM D698.
 - b. Cohesionless material shall be compacted to 85% of relative density as determined by ASTM D4253 and D4254.
 - c. The method of in place compaction testing shall be in accordance with ASTM D2167, D6938, or D3017 at Owner's option.
 - d. Frequency of compaction (density and moisture content) testing shall be as follows:
 - (1) At least one (1) test for every 2,500 square feet in substation yard.
 - (2) At least one (1) test every 100 feet along access road.
 - (3) At least one (1) test when Engineer suspects the quality of moisture control or effectiveness of compaction.

3.12 BACKFILLING:

- A. Refers to material used in the backfilling of trenches for duct banks and around structures, including the backfilling of any over-excavation that occurs, regardless of the cause of the over-excavation.
- B. Backfill of trenches for duct bank
 - 1. Trench-excavated material shall not be used as backfill. Backfill shall be in accordance with Section 31 23 23.34 Thermally Controlled Low Strength Material.
- C. Placement
 - 1. Trenches:
 - a. Place backfill to the elevations indicated in lifts no greater than eight (8)-inches (uncompacted depth).
 - b. Do not place on frozen earth.
 - c. Obtain compaction specified by normal methods and equipment without flooding.
 - d. Complete promptly after approval to proceed.
 - e. Backfill failing to meet specified densities shall be removed or scarified and recompact to meet specified densities.
 - 2. Structures: Perform as specified for "Trenches" and as follows:
 - a. Backfill only after concrete has attained 70 percent of its design strength.
 - b. Backfill adjacent to structure(s) only after, in the opinion of the Engineer, a sufficient portion of the structure has been completed to resist the imposed load.
 - c. Remove all forms and debris from excavation prior to placing backfill.
 - d. Backfill within one foot of structure to be free of gravel, rock or shale particles larger than two (2) inches.
 - e. Perform backfilling simultaneously on all sides of structure.
 - f. Exercise caution in the use of heavy equipment in areas adjacent to structure.
- D. Compaction:

SECTION 31 23 34 – UNDERGROUND CABLE SYSTEM EXCAVATION AND FILL: continued

1. Subgrades for structures and the bottom of trenches shall be firm, dense, free from mud, thoroughly compacted, and sufficiently stable to remain firm and intact. Compaction shall be to at least 90 percent of the maximum dry density at optimum moisture content as determined by ASTM D1557 or to meet local codes.
 2. Trench subgrades that run beneath roads or pass through structural backfill shall be compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557 and/or local code. The moisture content shall be within two percent of optimum.
- E. Compaction Testing:
1. The method of in-place compaction testing including density and moisture content shall be as follows:
 - a. Density – Cohesive materials: ASTM D6938.
 - b. Density – Cohesionless materials: ASTM D6938.
 - c. Moisture Content: ASTM D6938.
 2. The minimum frequency of in-place compaction testing including density and moisture content will be as follows:
 - a. At least one (1) test for every 300 feet per lift.
 - b. At least one (1) test per each crew's day's Work.
 - c. At least one test when Engineer suspects the quality of moisture control or effectiveness of compaction.
 - d. Tests as required or directed by owning entity of roadway or right of way in which the Work is occurring (Florida Department of Transportation, municipality, property owner, other).
 3. Backfill failing to meet required densities shall be removed or scarified and recompacted as necessary to achieve specified results.
 4. Removal of in-place material and replacement with approved new material will be required if scarifying and re-compaction do not produce the required densities.
- F. Equipment
1. Compaction equipment shall conform to the following requirements and be subject to the approval of Owner.
 - a. Tamping Rollers:
 - (1) May be towed or self-propelled.
 - (2) Have staggered uniformly spaced knobs or feet. When fully loaded, they shall exert at least 250 psi on combined area of tamping feet in contact with ground.
 - (3) Be equipped with cleaning fingers maintained at full length to prevent accumulation of material between feet.
 - b. Pneumatic Rollers:
 - (1) Have two (2) axles, not less than nine (9) wheels with pneumatic tires of equal size, diameter, and ply rating, a rigid steel frame, and a body suitable for ballast loading. Tracking wheels shall overlap by a minimum of 1/4-inch.
 - (2) Tires shall be uniformly inflated at all times.
 - (3) Self-propelled or towed.
 - c. Vibratory Rollers:
 - (1) Have either one (1) or two (2) smooth-surfaced steel drums with a minimum diameter of 42 inches.
 - (2) Have a minimum vibrating force of 300 pounds per cycle per inch of drum width.
 - (3) Have a minimum vibrating frequency of 1,200 cycles per minute with a means of adjusting the resonance of the dynamic force.

SECTION 31 23 34 – UNDERGROUND CABLE SYSTEM EXCAVATION AND FILL: continued

- (4) May be self-propelled or towed.
 - d. Power tampers shall be used for compaction of material in areas where it is impractical or unsafe to use heavy equipment, and as recommended by Owner.
 - e. Vibratory plate compactor may be used for compaction of sand and/or gravel material in areas where it is impractical or unsafe to use heavy equipment, and as recommended by Owner.
 - 2. All equipment shall be maintained in good repair.
- 3.13 BORROW:
- A. Borrow materials refers to all embankment materials and topsoil obtained from approved locations either on or off the Site.
 - B. Borrow shall include all clearing, grubbing, excavating, handling, and final disposal of materials as specified. Borrow, if required, to bring embankment areas to the lines and grades indicated, shall be furnished by the Contractor, as specified, without additional compensation.
 - C. Borrow areas shall be:
 - 1. Arranged for by Contractor.
 - 2. Subject to approval by Owner.
 - D. Material removed from borrow areas shall be as approved by Owner. Excavate borrow material in uniform lifts not greater than two (2) feet in thickness.
- 3.14 SOIL STERILANT:
- A. Sterilant shall be Non-Selective Herbicide #1 as manufactured by Athea Laboratories, Inc., or a comparable product meeting requirements of State Environmental Protection Laws and the Environmental Protection Agency (EPA).
 - B. Application:
 - 1. Subgrade will be approved by Owner prior to placing soil sterilant.
 - 2. Apply to all areas of the substation indicated to receive crushed rock surfacing and crushed rock base course.
 - 3. Apply prior to placing crushed rock.
 - 4. Apply according to manufacturer's recommendations.
- 3.15 SURFACE RESTORATION:
- A. See Section 32 01 12 Pavement Restoration
- 3.16 TOPSOILING:
- A. Shall be material excavated from within the upper 6 inches to 1 foot; and be obtained from Site areas having healthy plant growth prior to stripping.
 - B. Contractor may furnish topsoil from off-site borrow areas at Contractor's option and without additional charge to Owner and Engineer provided these materials are:
 - 1. From that portion of the soil profile defined as the "A" horizon by the Soil Science Society of America.
 - 2. Fertile, friable, and loamy soil of uniform quality without admixture of subsoil materials, gravel, hardpan, debris, or other similar impurities.
 - 3. Demonstrate healthy plant growth prior to stripping.
 - 4. From areas from which topsoil has not been previously removed by erosion or mechanical methods.
 - C. Place topsoil on all areas indicated.
 - D. Treatment of Subgrade Prior to Topsoil Placement:

SECTION 31 23 34 – UNDERGROUND CABLE SYSTEM EXCAVATION AND FILL: continued

1. Clear Site of vegetation heavy enough to interfere with proper grading and tillage operations.
 2. Clear surfaces of all stones or other objects larger than 3 inches in thickness or diameter, all roots, brush, wire, grade stakes, or other objectionable material.
 3. Loosen subgrade by discing or scarifying to a depth of 2 inches wherever compacted by traffic or other causes to permit bonding of the topsoil to the subgrade.
- E. Placement:
1. Clear Site of vegetation heavy enough to interfere with proper grading and tillage operations.
 2. Clear surfaces of all stones or other objects larger than three (3) inches in thickness or diameter, all roots, brush, wire, grade stakes, or other objectionable material.
 3. Loosen subgrade by discing or scarifying to a depth of two (2) inches wherever compacted by traffic or other causes to permit bonding of the topsoil to the subgrade.
 4. Distribute topsoil over required areas without compaction other than that obtained with spreading equipment.
 5. Place material within following limits:
 - a. Not less than four (4) inches in depth.
 - b. Do not exceed six (6) inches in depth.
 6. Shape cuts, fills, and embankments to contours indicated.
 7. Grade to match contours of adjacent areas and permit proper natural drainage.
 8. Grade a gentle mound over trenches.
- F. After spreading topsoil, clear surface of stones or other objects larger than two (2) inches in thickness or diameter and of objects that might interfere with planting and maintenance operations.
- G. Protect areas from the elements until grass is established. Repair eroded areas as required.
- H. Keep paved areas clean.

3.17 RIPRAP MATERIAL:

- A. Stone shall be durable and of suitable quality to maintain permanence of the structure.
- B. Boulders or quarried rock may be used in the following gradation:

<u>Weight in Pounds Per Stone or Size</u>	<u>Percent of Total Weight Lighter Than or Passing</u>
300	100
150	55-75
50	25-45
2-inch Screen	5-15

- C. Quantity of rock with an elongation greater than 3:1 shall not exceed 20% of the mass. No stone shall have an elongation greater than 4:1.
- D. Material shall be free from cracks, seams, or other defects that would tend to increase its deterioration and shall not have a loss of more than 12% after five (5) cycles when tested for soundness with sodium sulfate as described in ASTM C88.
- E. Objectionable quantities of dirt, sand, clay, and rock fines will not be permitted.
- F. Place on the prepared base as indicated in such a manner as to produce a reasonably well graded mass of rock with a minimum practicable percentage of voids.
- G. Place to its full course thickness in one operation and in a manner to avoid displacing the base material.

SECTION 31 23 34 – UNDERGROUND CABLE SYSTEM EXCAVATION AND FILL: continued

- H. Finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Hand place only if necessary to secure the desired results.
- I. A tolerance of \pm four (4) inches from the slope lines and grades will be allowed to the extremes that such a tolerance shall not be continuous over an area greater than 200 square feet.
- J. Maintain the riprap protection until accepted and replace any material.

3.18 MAINTENANCE AND REPAIR:

- A. Maintenance:
 - 1. Protect newly graded areas from actions of the elements.
 - 2. Settling or erosion shall be filled, repaired, and grades reestablished to elevations and slopes indicated.
- B. Correction of Settlement:
 - 1. Contractor is responsible for correcting any excessive settlement as determined by Owner for the specific areas of embankments or backfill and damages created thereby within one year after acceptance of the Work.
 - 2. Make repairs within ten (10) days from and after due notification by Owner of embankment or backfill settlement and resulting damage.
 - 3. Make own arrangements for access to the Site for purposes of repair.

3.19 TEMPORARY ACCESS ROADS AND MOVEMENT ON THE OVERHEAD TRANSMISSION LINE RIGHT-OF-WAY:

- A. The following requirements apply for instances where the Contractor must access the overhead transmission line right-of-way for construction purposes:
 - 1. Contractor's bid prices shall include all costs incurred for gaining access to the Work except as specified elsewhere including construction of roads, construction permits, right-of-way agreements and environmental protection.
 - 2. Development of temporary access roads shall be held to a minimum. Contractor shall make maximum use of existing roads and trails. Temporary access roads shall be routed so that the least amount of vegetation is disturbed (and as indicated). Once established, the same path shall be used throughout construction.
 - 3. Vehicular traffic shall be limited to the established access roads. Any damages to crops or ground cover caused by Contractor's activities off of the established access roads will be the responsibility of Contractor.
 - 4. Temporary access roads shall not run in a straight line of sight but shall meander so that visual impact of the roads is held to a minimum.
 - 5. Temporary access roads are not allowed on unstable slopes. Bulldozing or other machine cutting is not allowed on slopes which exceed 35 percent.
 - 6. Unstable slopes resulting from installation of temporary access roads shall be made stable.
 - 7. Permanent access road grading is not allowed unless specifically called for on contract drawings or approved by the Owner or the property owner.
 - 8. During extremely dry and windy weather, watering trucks may be required by the Owner to combat wind erosion and dusting problems on areas traveled by construction equipment

END OF SECTION 31 23 34



21239 FM529 Road, Bldg F
Cypress, Texas 77433
Tel: 281-985-9344
Fax: 832-427-1752
info@geothermusa.com
<http://www.geothermusa.com>

Sampling and Shipment of Soil/Backfill Samples for Thermal Analysis

Undisturbed Tube Samples and Bulk Samples

- If cohesive soils (clayey or silty) are encountered, samples should be taken in nominal 3" diameter Shelby tubes or large diameter California sampler with brass liners (no rings), otherwise, standard split spoon samples or auger cuttings should be taken (see bulk soil section below).
- Please do not extrude sample from Shelby tube. Cut the bottom 6" section (+/- 1/2") of the tube, seal both ends with plastic caps and tape it to prevent any moisture loss.
- Identify the samples with Project Name, Location, Bore Hole, Depth, Date samples taken, etc
- The samples should be representative of the soil at the cable (or ductbank) burial depth. If the soil above this elevation is different, it should be sampled as well.
- Please include a copy of the borehole logs.
- Email the details of the shipment - courier name, tracking number, etc. to info@geothermusa.com and lab@geothermusa.com
- If **bedrock** is encountered, take core samples (minimum 2" diameter by 5" long) or block samples of about 5" cube of irregular shape.

Bulk Soil or Backfill Samples

- Send ~10 pounds of each sample, contained in double heavy-duty plastic (Ziploc) bags, identified with Project Name, Sample Location, Bore Hole, Depth, Date samples taken, etc...
- Email the details of the shipment - courier name, tracking number, etc. to info@geothermusa.com and lab@geothermusa.com
- For all foreign shipments
 - declare a value of \$10 for the entire package and send it via **FedEx or UPS** overnight service (or 2nd day air service).
 - Mark the package "**Aggregate samples for laboratory testing only**".
 - Request import permit instructions to info@geothermusa.com
- Provide the Proctor (Standard or Modified) density, starting moisture content and percent compaction effort.

COOL SOLUTIONS FOR UNDERGROUND POWER CABLES
THERMAL SURVEYS, CORRECTIVE BACKFILLS & INSTRUMENTATION

Serving the electric power industry since 1978



Purpose for testing (in-situ vs. construction phase), the following apply:

For thermal resistivity measurements to determine in-situ values

- For soils that are cohesive
 - Undisturbed tube samples
 - bottom 6-inches of Shelby tube or
 - brass/stainless steel liner (minimum diameter of 2-inches)
 - must be continuous and NOT ring samplers
 - Disturbed samples
 - Provide us a Proctor Density Curve (Standard or Modified)
 - Provide percent (%) compaction (i.e. 95%, 90% or 85%)
 - Provide starting moisture content (i.e. in-situ, optimum or %)

For thermal resistivity measurements to determine construction phase (materials to be used around cables)

- Disturbed samples
 - Provide us a Proctor Density Curve (Standard or Modified)
 - Provide percent (%) compaction (i.e. 95%, 90% or 85%)
 - Provide starting moisture content (i.e. in-situ, optimum or %)
1. Provide soil descriptions or borehole logs, a business card or contact information with the samples in a separate Ziploc bag.
 2. Please issue a PO or a charge to number with the samples
 3. Email the tracking number to info@geothermusa.com and lab@geothermusa.com
 4. Turnaround time is about 10 days after we receive all the necessary information

Ship all samples to:

**GEO THERM USA
ATTN: Lab Manager
21239 FM529 Road, Bldg F
Cypress, Texas 77433
Tel: 281-985-9344**



Chain of Custody Form

Please include this form in a Ziploc bag for each sample submitted:

Company Name: _____

Contact Name: _____ Contact Number _____

Project Name: _____

Project Location: _____

Company to Invoice: _____ PO Number: _____

Report Submittal email: _____

Sample Location/ID: _____

Sample Collection Date: _____ Sample Depth: _____

Soil Description: _____

Is this a bulk sample that requires Recompaction?

____ Yes (continue below) **OR** ____ No (tube sample test "as is")

If the sample requires Recompaction please complete items below:

- a. What is the Proctor Maximum Dry Density (lb/ft³)? _____
- b. Is this a Standard or Modified Proctor: _____
- c. Specify compaction effort(s)? (i.e. 85%, 90 or 95%): _____

2. What is the starting test moisture content?

____ As Received/In-situ? **OR** ____ Optimum?

SECTION 32 01 12 – PAVEMENT RESTORATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract apply to this Section.

1.02 SUMMARY:

- A. This Section includes all work associated with the restoration and/or replacement of pavement, sidewalks, and curbing.

1.03 RELATED REQUIREMENTS:

- A. Section 01 11 01 – Summary of Work
- B. Section 31 23 34 – Underground Cable System Excavation and Fill.
- C. Section 33 71 19.23 – Trenched Electrical Underground Ducts and Duct Banks.

1.04 REFERENCE STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated. Shall be latest revisions, supplements, and amendments to the following:
 - 1. City of Jacksonville Specifications, Standards, and Requirements.
 - a. Land Development Procedures Manual, Volume 3
 - 2. ASTM International (ASTM):
 - a. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
 - b. D5249 – Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.
 - c. D5893 – Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
 - d. D6690 – Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.05 SUBMITTALS:

- A. Shall be approved by Owner and reviewed by Engineer.
- B. Include, but not limited to, product data for the following:
 - 1. Sub-base.
 - 2. Dense-Graded Aggregate Base Course (DGA).
 - 3. Concrete Base Course.
 - 4. Tack Coat.
 - 5. Hot Mix Asphalt.
 - 6. Expansion Joint Assembly.
 - 7. Class A Concrete.
 - 8. Concrete and Granite Curbing
 - 9. Americans with Disabilities Act (ADA) Compliant Detectable Warning Panels

SECTION 32 01 12 – PAVEMENT RESTORATION: continued

PART 2 - PRODUCTS

2.01 PERFORMANCE/DESIGN CRITERIA:

- A. Products used shall be in accordance with City of Jacksonville and Owner specifications, standards, and requirements. In the event of a conflict between City of Jacksonville and Owner requirements, the more stringent shall apply. Contractor shall submit any questions concerning any conflicts within the specifications to the Engineer and Owner for resolution prior to work proceeding.

PART 3 - EXECUTION

3.01 BASE AND SUBBASE

- A. Subbase shall be in accordance with City of Jacksonville specifications, standards, and requirements.
- B. Base shall be in accordance with City of Jacksonville specifications, standards, and requirements.
- C. Subgrades that run beneath roads or pass through structural backfill shall be compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557 and/or local code. The moisture content shall be within two percent of optimum.

3.02 FULL DEPTH PAVEMENT REPLACEMENT

- A. Full-depth pavement replacement shall be in accordance with City of Jacksonville specifications, standards, and requirements.
- B. Full-depth pavement replacement shall be no less than one foot on each side of the trench excavation.
- C. The joint of any street opening patch shall not fall within approximately two feet plus or minus of a painted lane marking.
- D. All pavement joints shall be neatly saw cut to a vertical edge.
- E. When possible, street openings in high traffic areas are to be same day paved. When same day paving is not possible, the street opening is to be properly maintained on a daily basis or more frequently, if needed, during inclement weather. In cases where same day paving is not possible and permanent pavement cannot be placed within two days, the governing authority may require installation of temporary pavement. For any street openings that are not same day paved, the Contractor shall be responsible for any claims of damage or injury resulting from the work.
- F. The Contractor shall replace any street markings damaged or destroyed during the project.

3.03 MILL-AND-OVERLAY

- A. Contractor shall perform additional mill-and-overlay from curb to curb for the length of the installation as required by the City of Jacksonville to repair areas that have been damaged due to Contractor's activities as determined by Owner.

3.04 CURB AND GUTTER REPLACEMENT

- A. Curb and gutter replacement shall be in accordance with City of Jacksonville specifications, standards, and requirements.
- B. Contractor shall perform additional curb and gutter replacements as required by Owner and City of Jacksonville to repair areas that have been damaged due to Contractor's activities.

SECTION 32 01 12 – PAVEMENT RESTORATION: continued

3.05 SIDEWALK REPLACEMENT

- A. Sidewalk replacement shall be in accordance with City of Jacksonville specifications, standards, and requirements.
- B. Contractor shall perform additional sidewalk replacements as required by Engineer and Owner and/or City of Jacksonville to repair areas that have been damaged due to Contractor's activities.
- C. Sidewalk ramps shall be in accordance with ADA requirements.

END OF SECTION 32 01 12

Burns & McDonnell Engineering Company, Inc.

Underground Conduit Proofing Log/Acceptance

JE A CHURCH STREET 69KV UG RELOCATION

Foreman: _____ Crew Size: _____ Start Station: _____

Date: _____ End Station: _____

Weather Conditions:

Temp: _____ Visibility: _____

From Riser/Manhole Location: _____

To Riser/Manhole Location: _____

<u>Duct</u>	<u>Size</u>	<u>Pass/Fail</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

<u>Duct</u>	<u>Size</u>	<u>Pass/Fail</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

<u>Duct</u>	<u>Size</u>	<u>Pass/Fail</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Mandrel Sizes
2" _____
6" _____

Pull String Left in Place: Yes No

Duct Type Information: _____

Mandrelled With Pull Direction: Yes No

Measured Conduit Length: _____

Fault or Comments:

Owner: _____ Signed: _____
Duct Bank Installer: _____

Cable Installer: _____

All parties signed above confirm that the duct bank condition is acceptable and ownership of the duct bank may be transferred from duct bank installer to cable installer.

SECTION 33 05 31.29 – PVC ELECTRICAL DUCT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract apply to this Section.

1.02 SUMMARY:

- A. Section includes requirements for the PVC conduits utilized in underground transmission duct banks.
- B. The terms "conduit" and "duct" mean the same thing and may be used interchangeably.
- C. This Section includes furnishing and installing of all conduits, fittings, and accessories as specified or indicated.
- D. The Plan Drawings define the size and type of each conduit. These Technical Specifications define the type of all conduits.

1.03 RELATED REQUIREMENTS:

- A. Section 01 11 01 – Summary of Work
- B. Section 03 30 11 – Duct Bank Thermal Concrete.
- C. Section 31 23 34 – Underground Cable System Excavation and Fill.
- D. Section 33 71 19.23 – Trenched Electrical Underground Ducts and Duct Banks.

1.04 REFERENCE STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. Standards:
 - 1. ASTM International (ASTM):
 - a. F512 - Smooth-Wall Polyvinyl Chloride (PVC) Conduit and Fittings for Underground Installation.
 - b. F1668 - Guide for Construction Procedures for Buried Plastic Pipe.
 - 2. Federal Specifications:
 - a. W-C-1094A - Conduit and Conduit Fittings, Plastic, Rigid.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - b. TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - c. TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation.
 - d. TC 8 - Extra-strength PVC Plastic Utilities Duct for Underground Installations.
 - e. TC 9 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
 - 4. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.
 - 5. Underwriters Laboratory (UL):
 - a. 467 - Grounding and Bonding Equipment.
 - b. 651 - Schedule 40 and 80 Rigid PVC Conduit.
 - c. 651A - Type EB and A Rigid PVC Conduit and HDPE Conduit.

1.05 DEFINITIONS:

- A. Owner: Jacksonville Electric Authority (JEA)
- B. Engineer: Burns & McDonnell Engineering Company, Inc.

SECTION 33 05 31.29 – PVC ELECTRICAL DUCT: continued

C. Contractor: To Be Determined

1.06 SUBMITTALS:

- A. Shall be approved by Owner and reviewed by Engineer.
- B. Product Data: For each type of product including but are not limited to, product data, catalog cut-sheets, and Shop Drawings of the following:
 - 1. Conduit.
 - 2. Conduit Elbows.
 - 3. Conduit Fittings.
 - 4. Conduit Couplings.
 - 5. Conduit Caps.
 - 6. Solvent Cement.
 - 7. Penetration Sealant.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Contractor shall cover with weatherproof covering any conduit that is to be stored outdoors for more than fourteen (14) days. Contractor shall cap ends of conduit for storage.
- B. Contractor shall provide support for the full length of the conduit when transporting or storing long lengths (20'). Contractor shall not permit unsupported overhang.
- C. Packing and shipping.
- D. Acceptance at site.
 - 1. Contractor shall verify continuity and ovality prior to installation and use.
- E. Storage and protection.
 - 1. Prior to assembly, Contractor shall expose all PVC conduit and fittings to the same temperature conditions for a period of time long enough for conduits to reach ambient temperature.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. ACCEPTABLE MANUFACTURERS:
 - 1. Electrical Plastic Tubing (EPT) and Conduit (EPC-40):
 - a. Carlon Division, Lamson & Session Company.
 - b. CertainTeed Corp.
 - c. Condux International, Inc.
 - d. Cantex Inc.
 - e. JM Eagle
 - f. Others approved by Owner.

2.02 MATERIALS:

- A. CONDUIT:
 - 1. Shall have one integral belled end per length for use in bell and spigot conduit joints.
 - 2. Fabricated from self-extinguishing high impact polyvinyl chloride designed for aboveground and underground installations.
 - 3. Fittings and accessories fabricated from same material as conduit unless otherwise specified.
 - 4. Inside diameter no less than that of rigid steel conduit.
 - 5. Dielectric strength a minimum of 400 volts per mil.
 - 6. Rated and labeled for use with 90°C rated conductors.

SECTION 33 05 31.29 – PVC ELECTRICAL DUCT: continued

7. Type EB conduit will not be acceptable.
8. Type EPC schedule 40 heavy-wall rigid conduit to conform to NEMA W-C-1094A Type II.
9. All conduits shall be electrical grade rated for 90°C.
- B. SOLVENT CEMENT
 1. Solvent cement type joints as recommended by manufacturer.
- C. PENETRATION SEALANT:
 1. Raychem Rayflate Duct Sealing System (RDSS).
 2. Polywater FST Foam Duct Sealant.
 3. Owner-approved equivalent.

2.03 ACCESSORIES:

- A. Fitting and Couplings.
 1. Fabricated from self-extinguishing high-impact polyvinyl chloride designed for aboveground and underground installations.
 2. Fittings and accessories fabricated from same material as conduit unless otherwise specified.
 3. Solvent cement type joints as recommended by manufacturer.
 4. Inside diameter no less than that of rigid steel conduit.
 5. Dielectric strength a minimum of 400 volts per mil.
 6. Rated and labeled for use with 90°C rated conductors.
 7. Type EB conduit will not be acceptable.
 8. Type EPC schedule 40 heavy-wall rigid conduit to conform to NEMA W-C-1094A Type II.
 9. All conduit fitting and couplings shall be electrical grade.
 10. Offset couplings are not allowed.

PART 3 - EXECUTION

3.01 APPLICATION:

- A. GENERAL REQUIREMENTS:
 1. Furnish conduit in sizes indicated on contract drawings.
 2. Install ducts per SECTION 33 71 19.23 Trenched Electrical Underground Ducts and Duct Banks, of these Technical Specifications.
- B. CONDUIT FITTINGS: Install as specified, indicated, or necessary.

END OF SECTION 33 05 31.29

SECTION 33 71 19.23 – TRENCHED ELECTRICAL UNDERGROUND DUCTS AND DUCTBANKS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- 1.02 SUMMARY:
- A. Section includes Underground duct systems consisting of banks of non-metallic ducts encased in concrete and installed via open-trench construction.
- 1.03 RELATED REQUIREMENTS:
- A. SECTION 01 11 01 – Summary of Work
 - B. SECTION 03 30 11 – Duct Bank Thermal Concrete.
 - C. SECTION 31 23 34 –Underground Cable System Excavation & Fill.
 - D. SECTION 33 05 05.44 – Underground Conduit Proofing Log.
- 1.04 REFERENCE STANDARDS:
- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - B. CIGRE:
 - 1. TB 194 – Construction, Laying and Installation Techniques for Extruded and Self-Contained Fluid Filled Cable Systems.
 - C. Association of Edison Illuminating Companies (AEIC)
 - 1. CG4 – Guide for Installation of Extruded Dielectric Insulated Power Cable Systems Rated 69kV and Above
 - 2. CG5 – Underground Extruded Power Cable Pulling Guide
- 1.05 DEFINITIONS:
- A. Owner: Jacksonville Electric Authority (JEA)
 - B. Engineer: Burns & McDonnell Engineering Company, Inc.
 - C. Contractor: To Be Determined
- 1.06 SUBMITTALS:
- A. Shall be approved by Owner and reviewed by Engineer
 - B. Include, but are not limited to, product data, catalog cut-sheets, and Shop Drawings of the following:
 - 1. Duct Spacers
 - 2. Mule Tape
 - 3. Mandrel
 - C. Procedures:
 - 1. Submit procedures prior to performing the following activities:
 - a. Field-Bending.
 - b. Cleaning and Testing.
 - c. Proofing.
 - D. Documentation:
 - 1. Submit photo confirmation as specified in PART 3, paragraph 3.02 – Documentation, of this Section for the following:

SECTION 33 71 19.23 – TRENCHED ELECTRICAL UNDERGROUND DUCTS AND DUCTBANKS:
continued

- a. Rounded Conduit Ends (must be submitted and approved prior to initial placement of conduit).
 - b. Utility Crossings.
 - c. Installed Conduit Bundle.
- E. Field quality-control reports.
 - 1. Proof Logs and Inspection Reports: Submit as specified in PART 3, paragraph 3.08 – Cleaning and Testing, of this Section

1.07 QUALITY ASSURANCE:

- A. Installer Qualifications: Contractor to provide installer qualifications for proposed work.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Duct Spacers:
 - 1. Underground Devices
 - 2. Carlon Electrical Products
 - 3. Formex
 - 4. Approved Equivalent
- B. Mule Tape Pull Line:
 - 1. Neptco.
 - 2. Approved Equivalent

2.02 DUCTS:

- A. As specified in SECTION 33 05 31.29 of these Technical Specifications.
- B. Provide with all necessary end bells, couplings, offset couplings, elbows, plugs, and other fittings.
- C. All ducts shall be sized as indicated on Plan Drawings.
- D. Provide prefabricated, interlocking, plastic duct spacers and caps for duct spacing as specified or indicated on Plan Drawings.

2.03 CONCRETE:

- A. Concrete shall be furnished as specified in SECTION 03 30 11 of these Technical Specifications and as indicated elsewhere in the Contract Documents.

2.04 THERMAL BACKFILL:

- A. As specified in SECTION 31 23 23.34 of these Technical Specifications.

2.05 WARNING TAPE

- A. Warning Tape as shown on drawings shall be furnished and installed.

PART 3 - EXECUTION

3.01 EXCAVATION:

- A. Perform excavations as specified in SECTION 31 23 34 of these Technical Specifications.
- B. Unless otherwise shown on drawings, clearance requirements to edge of concrete duct bank to nearest existing utilities shall be as follows:
 - 1. 2-foot vertical clearance above or below existing utilities

SECTION 33 71 19.23 – TRENCHED ELECTRICAL UNDERGROUND DUCTS AND DUCTBANKS:
continued

2. 2-foot horizontal clearance from parallel utilities

3.02 DOCUMENTATION

- A. All photograph documentation shall be completed with a digital camera.
- B. Before installation of the conduits every utility crossing exposed shall be photographed.
- C. At least one photograph shall be taken as evidence of proper rounding of conduits ends prior to initial placement.
- D. Prior to duct bank concrete encasement at least one photograph shall be taken of the fully-assembled conduit package at the following frequency, whichever is less:
 1. After each 100' of conduit package installation is complete since last photograph
 2. Prior to concrete encasement of conduit package installed since last photograph
- E. All photographs shall be cataloged in a file for future audit/review. All photographs shall be named with project initials, date and location of the photo/conduits. Do not use the default numbers assigned by the camera for the name.
- F. All photos and catalog of them (or a copy of each) shall be kept together at the site office and may be reviewed by Owner or Engineer at any time.
- G. Photos and catalog will be provided to Owner and Engineer upon completion of the project:

3.03 ERECTION, INSTALLATION, APPLICATION:

- A. Ducts:
 1. Assemble as follows:
 - a. The inside of all male ends of the ducts shall be rounded with a router equipped with a round-over bit to allow cable pulling to proceed in either direction.
 - b. If it is necessary to field-cut ducts, Contractor shall make a square cut and remove all ridges and burrs. Contractor shall round inside the inside edge of cut end with a router equipped with a round-over bit to allow cable pulling to proceed in either direction.
 - c. All rounded male ends shall be confirmed to be clean any ridges or burrs that could damage the power cable jacket, fiber optic, or ground continuity conductor. If any ridges or burrs exist, Contractor shall sand or otherwise remove them.
 - d. All ducts shall be installed with the bell-ends facing the direction stated on the Contract Drawings.
 - e. Contractor shall wipe all foreign matter off the sockets of the fittings and the edges of the conduit with clean cloth.
 - f. Contractor shall restrain the duct bank to prevent floating or movement during concrete placement. Contractor shall not encircle any individual conduit with ferrous material to prevent floating or movement during concrete placement. Contractor shall provide method to prevent floating or movement prior to start of construction.
 - g. Field bending of ducts shall be done with a conduit heating and bending process approved by the Owner in writing and only with craftsman experienced at bending two-inch (2") or greater Schedule 40 PVC conduit into short radius bends. The minimum radius allowed, are shown on the plans unless otherwise approved in writing by Owner.
 - (1) The conduit bends shall be mandreled in accordance with Section 3.06 prior to installation to verify the conduit has not deformed. If the mandrel does not pass through the conduit properly that bend shall be discarded.

SECTION 33 71 19.23 – TRENCHED ELECTRICAL UNDERGROUND DUCTS AND DUCTBANKS:
continued

- h. Use spacers to maintain horizontal and vertical separation as indicated on the Contract Drawings. Maximum longitudinal distance between spacers for PVC duct shall be five feet and shall be a minimum of 15" and maximum 21" from any joints or couplings.
 - i. Stagger joints in adjacent ducts.
 - j. Make all joints watertight by application of joint sealer compound furnished by duct manufacturer.
 - k. Reinforcing steel or other ferrous materials shall not be placed around individual ducts.
2. Conduit solvent-cemented joints:
- a. Contractor shall join all joints per manufacturer's recommendations. The PVC cement shall be obtained from the conduit manufacturer. Thinners are not acceptable.
 - b. Contractor shall apply a liberal and uniform coat of cement to the conduit for a length equal to the depth of the socket. Also, Contractor shall apply sufficient cement to wet the socket of the fitting. Contractor shall avoid excess cement on the fitting, as it is wiped into the joint and tends to weaken the conduit. Contractor shall not use plastic bristle brushes.
 - c. Contractor shall slip conduit into the socket of the fitting with a slight twist until it bottoms. Contractor shall hold the joint for fifteen (15) seconds so the conduit does not push out of the fitting. Contractor shall not twist or drive the conduit after the insertion is complete.
 - d. Contractor shall cure the joined members for at least five (5) minutes before disturbing or applying stress to the joint. After this initial cure, care must be exercised in handling to prevent twisting or pulling the joint. In damp weather, Contractor shall increase this interval to allow for slower evaporation of the solvent. Where possible, Contractor shall assemble all conduit above ground and allow it to lay undisturbed while curing before lowering it into the trench.
 - (1) Contractor shall wipe off the excess cement left on the outer shoulder of the fitting.
 - (2) Another fitting or section of conduit may be added to the opposite end within two (2) or three (3) minutes, if care is exercised in handling so that the strain is not placed on the previous assembly.
 - (3) Contractor shall assemble above ground, any joint included in a section of conduit to be bent in the trench and allow it to lay undisturbed for at least two (2) hours before installation. In cases where a plastic connection is made with the union under stress due to misalignment or other factors, Contractor shall secure such work with stakes to relieve stress on the joint until the conduit is backfilled or encased.
 - (4) To minimize accidental mechanical damage, the conduit in an open trench shall be exposed for a period no longer than is absolutely necessary and for maximum on one (1) day unless otherwise approved in writing by Owner.
 - e. Contractor shall securely tie overall at five-foot intervals with non-ferrous banding (i.e. nylon) or approved equivalent.
 - f. After assembly, align ducts so that they do not vary from the drawings more than four inches in the horizontal or vertical plane. Owner and Engineer shall be notified of any deviations in excess of 4" from the drawings.

SECTION 33 71 19.23 – TRENCHED ELECTRICAL UNDERGROUND DUCTS AND DUCTBANKS:
continued

- g. Seal all exposed ends watertight with an expansion-type plug at the end of each day's work, when work has to be interrupted, when duct might be submerged in water, and in stub-outs. Plugs shall be watertight, expansion type plugs that fit inside the ends of the duct and that cannot be easily dislodged due to weather, handling, concrete and thermal backfill placement, or submergence in water
 - h. Plug ducts installed and not terminated for future cable and leave ready for said cable. Plug shall be equivalent to those used for exposed ends as described above.
 - i. Provide all duct bank terminations with end bells installed flush with face of concrete.
 - j. Conduit Temperature:
 - (1) Contractor shall expose all PVC conduit and fittings to the same temperature conditions for a reasonable length of time before assembly.
 - (2) Precaution - due to expansion and contraction of the PVC conduit of one and one-half inches (1-1/2") per one hundred feet (100') for every 20°F change in the temperature, Contractor shall include unglued slip couplings every 100' to allow for conduit movement due to temperature changes.
- B. Concrete:
 - 1. Place duct bank concrete following inspection and approval of ducts and reinforcing installation by the Owner.
 - 2. Concrete for duct bank must be thermally tested prior to placement.
 - 3. Place concrete as indicated per SECTION 03 30 11 of these Technical Specifications.
- C. Conduit Identification:
 - 1. Identify conduit designation on each conduit at time of installation.
 - a. An acceptable method is the use of a broad-tipped permanent ink marker.

3.04 FIELD QUALITY CONTROL:

- A. Submit Proof Logs and Inspection Reports.
- B. Proofing Logs shall be in accordance with SECTION 33 05 05.44 of these Technical Specifications.

3.05 CLEANING & TESTING:

- A. The completed duct lines shall be cleaned and field-tested and pulling lines and plugs installed before final duct bank acceptance. Contractor shall notify Engineer and Owner a minimum of forty-eight (48) hours before starting this Work. Owner shall have the right to be present at all times until the cleaning, and testing are completed and pulling lines and plugs are installed to its satisfaction.
- B. The following shall be performed for each duct run that is to be used for current or future installation of power cables or is of a size equivalent the ducts to be used for power cables. Contractor shall confirm with Engineer which duct runs are applicable to these requirements as described under 3.06.B. Refer to 3.06.C. for cleaning and testing procedures for non-power cable duct runs.
 - 1. Upon completion, each duct shall be brushed, swabbed, and mandreled.
 - 2. Brushing:
 - a. The brush for cleaning the duct shall be a standard duct brush and the diameter shall be the same as the inside diameter of the ducts to be cleaned.
 - 3. Swabbing:
 - a. The swab shall consist of a ball of cotton rags, sized to fit snugly within the duct.

SECTION 33 71 19.23 – TRENCHED ELECTRICAL UNDERGROUND DUCTS AND DUCTBANKS:
continued

- b. If moisture and/or foreign materials are evident on the swab after being pulled through the pipe, additional swabbing must be performed until swab appears dry per the Owner's discretion.
 - c. If ripping is evident on the swab, swabbing must be carefully repeated and inspected to verify pipe or weld defects do not exist. If any defects exist, they must be reported to Engineer and Owner and further direction will be provided.
 - 4. Mandreling:
 - a. Mandrel shall be constructed of maple wood or approved substitute.
 - b. Mandrel shall be painted first with a red coat and finished with a white coat to indicate any scratches upon pulling through.
 - c. Mandrel shall have a diameter of one-half inch (1/2") less than the inside diameter of the duct and shall be tapered at each end. The overall length of the mandrel, and the length of the full-diameter portion shall be in accordance with the following table:

Nominal Conduit Diameter	Overall Length	Full Diameter Length	Taper Length (each end)
6"	13"	7"	3"
 - d. Mandrel shall be approved by the Owner, in writing, prior to use.
 - e. Mandrel shall be equipped with a backup cord, for use in the event it cannot pass through the duct line.
 - f. If a scratch is found deeper than 1/32", the Owner and Engineer shall be notified and the source of the scratch shall be investigated and, if necessary, corrected. Owner shall determine when the mandrel shall be re-run. Contractor shall remove such burrs and/or obstructions after which the mandrel is passed through again. The process will be repeated until a satisfactory result is obtained.
- C. Cleaning and Testing Procedure for duct that will not be utilized for installation of power cables
 - 1. Upon completion a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct; and to verify continuity.
 - 2. The mandrel shall have a diameter no less than 1/2" less than the inside diameter of the duct.
 - 3. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.
- D. As the ducts are being tested, Contractor shall record exact conduit length on the Proofing Log found in Section 33 05 05.44 of these Technical Specifications. This information shall be provided to Owner and Engineer immediately.
- E. Following successful testing of the ducts, Contractor shall install in each duct run a mule tape pull line (Neptco 6,000 lbs., 1" width) or equivalent and seal both ends of each duct with plastic plugs until cable pulling commences. Mule tape is intended for tag line use only and mule tape shall not be used for cable installation.
- F. The following parties must witness a successful mandreling procedure for duct bank to be accepted:
 - 1. Duct Bank Installer
 - 2. Cable Installer
 - 3. Owner (and/or Owner and Engineer's Representative)The above parties shall attend no more than one instance of final mandreling at their own cost. Any additional occurrences shall be responsibility of Contractor. Contractor shall perform any

SECTION 33 71 19.23 – TRENCHED ELECTRICAL UNDERGROUND DUCTS AND DUCTBANKS:
continued

- and all necessary preliminary mandreling in advance of witnessed final mandreling as described in this section.
- G. After successful completion of the mandreling process the witness for each party shall sign off on the Proofing Log provided as Section 33 05 05.44 of these Specifications. By signing this log all parties acknowledge that the duct bank system is acceptable to receive cable and that all parties agree on the transfer of ownership of the duct bank to the cable installer for cable installation operations.
 - H. An inspection report shall be provided to Owner and Engineer along with the executed Proofing Log for Final Acceptance.
 - I. Contractor shall video proof installed conduits, catalog, and maintain video in the same manner as photos in PART 3, paragraph 3.02 – Documentation, of this Section.

3.06 BACKFILLING:

- A. Backfilling and compaction may commence only after the duct bank concrete has cured sufficiently to avoid compromise of the installation as determined by Owner before motor traffic is allowed to pass over it.
- B. Contractor shall take all steps necessary to stabilize the duct bank to verify no movement will occur such that the cable will experience shear forces.
- C. Backfill as specified in Section 31 23 34 and Section 31 23 23.34 of these Technical Specifications.

END OF SECTION 33 71 19.23