

BID PACKAGE FOR:
Latouche Earthquake Repair
W.O. E2020059
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**Chugach Electric Association, Inc.
INVITATION TO BID**

April 6, 2021

TO: Chugach Electric Association, Inc., 2019-2020 Outside Electrical Line Construction Contract Contractors/Via Fax Line

You are invited to submit a proposal for Chugach Work Order E2020059 – Latouche Substation Earthquake Repairs.

The November 2018 earthquake caused the west side of the T1 transformer foundation and containment pit to settle about 6". This settlement brought the long-term integrity of the foundation into question. Conduits connecting the transformer to the switchgear enclosure were pulled apart, stress was placed on the transformer bushings by the bus work, and the transformers ability to cool itself are all negative byproducts of the settled foundation and containment pit.

This project includes the removal of two MV steel cable risers, MV cables and conduits, LV control cables and conduits, a transformer foundation a containment pit and two riser structure foundations.

New foundations for the transformer, riser structures, and blast wall suitable for the soil conditions will be installed. A new concrete transformer foundation with oil containment pit will be installed and connected to the existing oil-water sump system. Bus work, conduits and wiring will be replaced based on current industry standard.

A blast wall between the transformer and the switchgear enclosure will be added to bring the repair work up to current standards.

Major project activities include construction of a temporary transformer foundation, demolition, foundation construction, transformer, blast wall and riser structure placement onto new foundations, and installation of conduit and cabling. Chugach will be responsible for moving the transformer to and from the temporary foundation, and for setting the blast wall.

This project is not subject to the union signatory sections of Chugach's Outside or Generation Agreements contained in Exhibit N of the 2019-2020 Outside Electrical Line Construction Contract.

Contractors are not required to be signatory to a current collective bargaining agreement with IBEW Local 1547 in order to bid on the project. The signatory requirement only becomes applicable to the successful bidder once a contract is awarded. The successful bidder can comply by either establishing that; 1) it is signatory to a current collective bargaining agreement with IBEW Local 1547; 2) by executing a collective bargaining agreement with IBEW Local 1547, or; 3) by executing an agreement with IBEW Local 1547 to comply with the terms and conditions set forth in the most current agreement between IBEW Local 1547 and the Alaska Chapter National



Electrical Contractors Association, Inc. If the successful bidder elects the third option, the agreement will be limited to the scope of the work and duration of the project.

Please base your bids on the following conditions:

- All Contractor bids must be valid for at least 60 calendar days after the bid due date.
- After that time, the Contractor shall have the option of retracting its bid. Projects awarded as late as and including the last day the Contractor's bids are valid, are not subject to contractor claim for delay of award.
- Completion period: Based on a May 11, 2021 notice to proceed, Substantial completion of all work and equipment energized shall be completed no later than August 27, 2021. Final completion, clean-up, punch list, as-built drawings and close out no later than September 24, 2021.
- Liquidated damages in the amount of \$790.00 shall apply if the Contractor fails to meet the required completion date.
- Bid bond is required. A bid bond in the amount of 10% of the bid shall be provided with the Bid documents. A certified check made payable to Chugach Electric Association, Inc. may be substituted for the Bid Bond.

A Pre-Bid Conference is scheduled for 2:00 PM Anchorage time, on April 13, 2021. Due to the ongoing issues surrounding the COVID-19 restrictions the Pre-Bid Conference will be conducted via Microsoft Teams.

All bids delivered in person or submitted by fax to (907) 762-4699 must be received prior to 2:00 P.M. Anchorage time, April 27, 2021 at Chugach's Headquarters Building, first floor Purchasing Office, 5601 Electron Drive, Anchorage, Alaska.

A Notice-to-proceed shall not be issued until Chugach has received: 1) all bonds required by this ITB in the required amounts and forms, and properly executed by the appropriate individuals; and, 2) a certificate of insurance establishing builders all risk coverage as required by this ITB and specifications. 3) a site specific HSE plan. The contract time allowed for completion of this contract shall not be extended or suspended by any delay by Contractor in providing these documents necessary for notice to proceed to be issued.

No work shall begin until the successful bidder has been issued a written Notice-to-Proceed (NTP). The Contractor should not expect that NTP will be issued at the time of Notice of Intent to Award.

A Pre-Construction Conference will be required, and subsequent weekly construction meetings.

All work shall be performed in compliance with all applicable local, state, and federal ordinances, orders, statutes, rules and regulations.



Project material required for the project, which is not so indicated on Chugach's List of Owner Furnished Material, shall be furnished by the Contractor. All Contractor-furnished material must be approved by Chugach prior to installation.

The Contractor shall secure locates and assume responsibility for damage to any and all overhead and underground facilities. Contractor's workmanship shall be warranted for two (2) years following Chugach acceptance of project completion documentation.

Unit bids shall reflect all work noted on the drawings and staking sheets even if not assigned a separate unit description.

The Contractor will not energize new or existing primary facilities in the absence of the Chugach Site Representative unless advanced written approval is secured from Chugach.

Payment for contractor work is accomplished through use of a Completed Construction Report prepared by the Chugach Site Representative and signed off by the Contractor's representative. Total payment is made on actual units completed, not on estimated units stated in the bid documents unless otherwise stated in writing. Chugach has no obligation to subsequently reconcile or assist in reconciling the Contractor's billing records.

Chugach reserves the right to define and waive irregularities, to accept or reject any or all proposals/bids, in whole or in part, and to reissue, withdraw or cancel the solicitation/project in its entirety for any reason, including its subsequent determination to perform the Work in-house, without liability of any type to bidder/proposer, including but not limited to any costs associated with proposal/bid preparations and submittal.

All questions regarding the bid documents are to be directed to the Project Engineer, Bruce Aspray, at (907) 762-4505. The Project Engineer will either address them or refer them to the most knowledgeable individual associated with the project.

If you do not currently maintain a Contractor mailbox at Chugach's Operations Building "C", you must request a bid package by submitting a fax request to (907) 762-7633 or by calling the Project Engineer, at (907) 762-4505. Chugach will initiate return of a bid package within three (3) Chugach workdays of the request, by Federal Express, UPS, DHL or U.S. Express Mail as determined by Chugach. Contractors not regularly participating in bid solicitations may be subject to a mailing charge. There is no charge for the bid package.

CHUGACH ELECTRIC ASSOCIATION, INC.

A handwritten signature in blue ink, appearing to read "S. Wendling", is written over the typed name of Shawn Wendling.

Shawn Wendling MSPM, PMP
Senior Manager, PROJECTS

cc: Manager, Administrative Services
W.O. E2020059



Bid Sheet

WORK ORDER NUMBER: E2020059

LOCATION: Latouche Substation

CONTRACTOR: _____ DATE: _____

BIDS ARE DUE PRIOR TO 2:00 P.M.: April 27, 2021

This bid is submitted subject to the terms of the 2019-2020 Outside Electrical Line Construction Contract between Chugach Electric Association, Inc. and the undersigned for the above project as set out in the Invitation to Bid.

Project Bid Quotation: E2020059 \$ _____

Contractor's Alaska License No.: _____

Insurance Expires: _____

Worker's Compensation: _____

Liability: _____

Automobile: _____

Contractor Sell Rate: _____

Contractor Labor Man-Hours: _____

EXCEPTIONS AND QUALIFICATIONS

Exceptions or qualifications taken by the Bidder to any of the documents furnished with this Invitation to Bid or clarifications to the Proposal shall be stated below and, if none, Bidder shall state "NONE".

SUBCONTRACTORS

The Bidder shall indicate below the Work intended to be subcontracted to others.

Dated: _____ By Contractor: _____

BID ACCEPTED SUBJECT TO TERMS AND CONDITIONS OF THE OUTSIDE ELECTRICAL LINE CONSTRUCTION CONTRACT

Dated: _____ By Chugach Electric Association, Inc: _____

**LATOUCHE EARTHQUAKE REPAIR
BID SCHEDULE SUMMARY
W.O. E2020059**

NEW CONSTRUCTION

GROUP A: STRUCTURES

GROUP C: CIRCUITS & BUS WORK

GROUP F: FOUNDATIONS

GROUP G: TRANSFORMERS

GROUP K: CABLE AND CONDUIT

GROUP M: SITE WORK

GROUP O: GROUNDING

TOTAL NEW CONSTRUCTION

RETIREMENT

GROUP I: RETIREMENT

TOTAL RETIREMENT

TOTAL BID

**LATOUCHE EARTHQUAKE REPAIR
 BID SCHEDULE
 WO E2020059**

BID UNIT	DESCRIPTION	TAKEOFF QTY.	UNIT	UNIT LABOR & EQUIPMENT	UNIT MATERIAL	UNIT LABOR & MATERIAL	EXTENDED COST
GROUP A: STRUCTURES							
A1	INSTALLATION OF STEEL STRUCTURE, 34.5KV TERMINATION	1	ea.			\$ -	
A2	INSTALLATION OF STEEL STRUCTURE, 12.5KV TERMINATION	1	ea.			\$ -	
Total Group A:							\$ -
GROUP C: CIRCUITS AND BUSWORK							
C1	BUSWORK, RIGID AND FLEXIBLE	1	lot			\$ -	
Total Group C:							\$ -
GROUP F: FOUNDATIONS							
F1	FOUNDATION, TRANSFORMER T1 WITH OIL CONTAINMENT	1	ea.			\$ -	
F2	FOUNDATION, TERMINATION STRUCTURES	2	ea.			\$ -	
F3	FOUNDATION, FIREWALL	1	ea.			\$ -	
F4	INSTALLATION OF PRECAST FIREWALL	1	ea.			\$ -	
F5	INSTALLATION OF PILES, 10.75" DIA. X 45' LONG STEEL PIPE PILES	36	ea.			\$ -	
Total Group F:							\$ -
GROUP G: TRANSFORMERS							
G1	RELOCATE POWER TRANSFORMER. 34.5KV/12.47KV, 14MVA (CURRENT TO TEMPORARY)	1	ea.		\$ -	\$ -	
G2	RELOCATE POWER TRANSFORMER. 34.5KV/12.47KV, 14MVA (TEMPORARY TO FINAL)	1	ea.		\$ -	\$ -	
Total Group G:							\$ -
GROUP K: CABLE AND CONDUIT							
K1	CONDUIT, 1" HDPE	30	lf			\$ -	
K2	CONDUIT, 2" HDPE	280	lf			\$ -	
K3	CONDUIT, 4" HDPE	160	lf			\$ -	
K4	CONDUIT, 6" HDPE	80	lf			\$ -	
K5	CONDUIT, 1" FIBERGLASS	40	lf			\$ -	
K6	CONDUIT, 2" FIBERGLASS	40	lf			\$ -	
K7	CONDUIT, 4" FIBERGLASS	40	lf			\$ -	
K8	CONDUIT, 6" FIBERGLASS	40	lf			\$ -	
K9	CONDUIT, 1" RGS	20	lf			\$ -	
K10	CONDUIT, 2" RGS	80	lf			\$ -	
K11	CABLE AND RACEWAY, MEDIUM VOLTAGE, 1000MCM CU	350	lf			\$ -	
K12	CABLE AND RACEWAY, MEDIUM VOLTAGE, 750MCM AL	700	ea.			\$ -	
K13	CABLE, POWER AND CONTROL, 4C#10 XHHW	400	lf			\$ -	

**LATOUCHE EARTHQUAKE REPAIR
 BID SCHEDULE
 WO E2020059**

K14	CABLE, POWER AND CONTROL, 20C#16 TFFN	200	lf			\$	-		
K15	CABLE, POWER AND CONTROL, 2C#18 TFFN	160	lf			\$	-		
K16	CABLE, POWER AND CONTROL, 2C#10 XHHW	100	lf			\$	-		
K17	CABLE, POWER AND CONTROL, 12C#12 XHHW	150	lf			\$	-		
K18	MANHOOR	1	ea.			\$	-		
Total Group K:							\$	-	
GROUP M: SITE WORK									
M1	CRUSHED ROCK SURFACE COURSE	1	lot			\$	-		
M2	FINAL GRADE/ CLEANUP	1	lot			\$	-		
M3	XFMR SUMP MATERIALS	1	lot			\$	-		
M4	OIL CONTAINMENT STONE	1	lot			\$	-		
Total Group M:							\$	-	
GROUP O: GROUNDING									
O1	GROUNDING, SUBSTATION	1	lot			\$	-		
Total Group O:							\$	-	
GROUP I: RETIREMENT									
I-A1	RETIREMENT, STRUCTURES	2	ea.			\$	-		
I-C1	RETIREMENT, BUSWORK, RIGID AND FLEXIBLE	1	lot			\$	-		
I-F1	RETIREMENT, TRANSFORMER FOUNDATION AND OIL CONTAINMENT	1	ea.			\$	-		
I-F2	RETIREMENT, BUS SUPPORT FOUNDATIONS	2	ea.			\$	-		
I-K1	RETIREMENT, CONDUITS, 1" RGS	30	ft			\$	-		
I-K2	RETIREMENT, CONDUITS, 2" RGS	280	ft			\$	-		
I-K3	RETIREMENT, CONDUITS, 4" PVC	160	ft			\$	-		
I-K4	RETIREMENT, CONDUITS, 6" PVC	40	ft			\$	-		
I-K5	RETIREMENT, CABLE AND RACEWAY, MEDIUM VOLTAGE UNDERGROUND	1	lot			\$	-		
I-K6	RETIREMENT, POWER AND CONTROL	1	lot			\$	-		
Total Group I:							\$	-	

BID BOND

KNOW ALL MEN BY THESE PRESENT, That we, _____

of _____

_____ as Principal, and _____

_____ a corporation organized under the laws of _____

_____ and authorized to transact surety business in the State of Alaska, of _____

as Surety, are held and firmly bound unto Chugach Electric

Association, Inc., as Obligee in the full and just sum of

(\$ _____) dollars, lawful money of the UNITED STATES, for the

payment of which sum, well and truly to be made, we bind ourselves,

our heirs, executors, administrators, successors and assigns, jointly

and severally, firmly by these presents.

WHEREAS, the said Principal is herewith submitting its proposal for

The condition of this obligation is such that if the aforesaid Principal will, within the time required, enter into a formal contract and give a good and sufficient bond to secure the performance of the terms and conditions of the contract, then this Obligation to be void; otherwise the Principal and Surety will pay unto the Obligee the amount stated above.

Signed, sealed, and delivered _____, 20__.

WITNESS AS TO PRINCIPAL:

Signature:

Print Name:

Principal

By: _____

Title: _____

Corporate Surety (Seal)

Business Address

By: _____
Attorney-in-Fact

CONTRACTOR'S BOND

Bond Number: _____

1. Know all men that we, _____, as Principal, and _____, as Surety, are held and firmly bound unto CHUGACH ELECTRIC ASSOCIATION, INC. (hereinafter "Chugach") and unto all persons, firms and corporations who or which may furnish materials for or perform labor on the Work for the Project known as awarded to Principal by Chugach under the Outside Electrical Line Construction Contract (OELCC) executed by the parties on _____, 20____ and to its successors in the penal amount of _____ dollars (\$_____), as hereinafter set forth and for the payment of which sum well and truly to be made, we bind ourselves, our executors, administrators, successors and assigns jointly and severally by these present.
2. The condition of this obligation is such that if the Principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of the OELCC and any Projects thereunder and any amendments thereto, whether such amendments are for additions, decreases, or changes in materials, their quantity, kind of price, labor costs, mileage, routing or any other purpose whatsoever, and whether such amendments are made without notice to the Surety, and shall fully indemnify and hold harmless Chugach from all costs and damages which it shall suffer or incur by reason or any failure so to do, and shall fully reimburse and repay Chugach for all outlay and expense which Chugach shall incur in making good any such failure or performance on the part of the Principal and shall promptly make payment to all persons working on or supplying labor or materials for use in the construction of the Projects hereunder, in respect of such labor or materials furnished and used therein, to the full extent thereof, and in respect of such labor or materials furnished but not so used, the extent of the quantities estimated in the Projects to be required for the construction of the Projects, and shall well and truly reimburse Chugach for any excess in cost of construction of said Projects over the cost of such construction as provided in the Projects, occasioned by a default of the Principal under the Projects, then this obligation shall be null and void but otherwise shall remain in full force effect.
3. It is expressly agreed that this bond shall be deemed automatically and immediately amended, without formal and separate amendments hereto, upon any amendment to this Contract or the Projects hereunder so as to bind the Principal and the Surety to the full and faithful performance of the Projects as so amended provided only that the total amount of all increases in the costs of construction shall not exceed twenty percent (20%) of the amount of maximum price set forth in the construction contract. The terms "Amendment" wherever used in this bond and whether referring to this bond or the Projects shall include any alternation, addition, extension, modification, amendment, rescission, waiver, release or annulment, or any character whatsoever.
4. It is expressly agreed that any amendment which may be made by agreement between the Principal and Chugach in the terms, provisions, and conditions of a Project, or to the terms, provisions, and conditions of this Contract shall not in any way release the Principal and the Surety, or either of them or their respective executors, administrators, successors or assigns, from liability hereunder. The Surety hereby acknowledges receipt of notice of any amendment, indulgence or forbearance, made, granted or permitted.0.0.

5. This bond is made for the benefit of all persons, firms and corporations who or which may furnish any materials or perform any labor for or on account of the construction to be performed on any projects, and they, and each of them, are hereby made obliges hereunder with the same force and effect as if their names were written herein as such, and they and each of them may sue hereon.

IN WITNESS WHEREOF, the undersigned have caused this instrument to be executed and their respective corporate seals to be affixed and attested by their duly authorized representative this day of _____, 20_____.

Principal
By: _____

Attest: _____ Its: _____

Secretary

Surety
By: _____

Attest: _____ Its: _____

Address of Surety's Home Office

By: _____
Resident Agent of Surety
(For service of process)

Signatures

The Contractor's Bond must be signed with the full name of the Contractor. If the Contractor is a partnership, a partner must sign the Contractor's bond in the partnership name. If the Contractor is a corporation, the Contractor's bond must be signed in the corporate name by a duly authorized officer and the corporate seal affixed and attested by the Secretary of the corporation. A typewritten copy of all such names and signatures shall be appended.

Power of Attorney

The Contractor's Bond must be accompanied by a power of attorney authorizing execution on behalf of the Surety by a duly authorized Alaska resident agent of the Surety.

**LATOUCHE EARTHQUAKE REPAIR
BID UNIT DESCRIPTIONS
W.O. 2020059**

BID UNIT	DESCRIPTION
NOTES	GENERAL NOTES APPLICABLE TO ALL BID UNITS
	1. Cost for loading, transporting to construction site and offloading of Chugach furnished material is incidental to the cost of the affected Bid Unit. No additional compensation will be paid for loading, transporting to construction site and offloading of Chugach furnished material. Reference List Of Owner Furnished Material for materials furnished by Chugach and Bid Units affected by the material.
	2. Chugach will only furnish materials identified on the List Of Owner Furnished Material. All other materials required to complete the Work are to be furnished by the Contractor.
	3. Cost of dewatering is incidental to cost of affected Bid Unit. No additional compensation will be paid for dewatering.
	4. Cost of surveying is incidental to cost of affected Bid Unit. No additional compensation will be paid for surveying or surveying related expenses.
	5. Cost of excavations including but not limited to those excavations provided for general excavation of the substation site, foundations, conduits, etc. shall include removal, from site, of excess excavated materials. Cost of this work is incidental to the cost of the Contract. No additional compensation shall be paid for removal of excess or unusable excavation.
	6. Excavation in substation areas with existing conduit to remain in tact outside the limits of construction shall be done using a vac-truck. A vac-truck shall be provided by the Contractor on this project for excavation of the conduit containing low voltage control cable and medium voltage cable leading to the transformer T-1, and the cost of this equipment shall be considered incidental to the cost of the Contract.
A1	INSTALLATION OF STEEL STRUCTURE, 34.5kV TERMINATION - This unit includes furnishing all labor, miscellaneous materials, and equipment required for the complete installation of one Chugach furnished structure. The unit includes placement and adjustment in accordance with specifications, drawings, and manufacturer's instructions.
A2	INSTALLATION OF STEEL STRUCTURE, 12.5kV TERMINATION - This unit includes furnishing all labor, miscellaneous materials, and equipment required for the complete installation of one Chugach furnished structure. The unit includes placement and adjustment in accordance with specifications, drawings, and manufacturer's instructions.
C1	BUSWORK, RIGID AND FLEXIBLE - This unit includes installing owner furnished buswork, connectors, clamps, and fittings required for rigid and flexible bus. This unit includes installing all jumpers for connecting all equipment to rigid and flexible buswork. This unit includes furnishing and installation of all filler compounds, fasteners, on flexible and rigid bus and all miscellaneous labor and materials to provide a complete bus system for all transformer and termination structure connections, and other connections required to make a complete and functional bus.
F1	FOUNDATION, TRANSFORMER T1 WITH OIL CONTAINMENT - This unit includes all labor and miscellaneous materials to install one cast-in-place transformer foundation with oil containment as per the drawings and specifications. This unit includes all required excavating, compaction; furnishing backfill and miscellaneous materials required for a complete foundation.
F2	FOUNDATION, TERMINATION STRUCTURES - This unit includes all labor and miscellaneous materials to install two cast-in-place termination structure foundations as per the drawings and specifications. This unit includes all required excavating, compaction; furnishing backfill and miscellaneous materials required for a complete foundation.
F3	FOUNDATION, FIREWALL - This unit includes all labor and miscellaneous materials to install one cast-in-place firewall foundation as per the drawings and specifications. This unit includes all required excavating, compaction; furnishing backfill and miscellaneous materials required for a complete foundation.
F4	INSTALLATION OF PRECAST FIREWALL - This unit includes all labor, equipment and miscellaneous materials to install owner furnished precast firewall as per the drawings and specifications. This unit includes all required rigging, lifting, placement, attachment, and other effort and miscellaneous materials required for a complete installation.

**LATOUCHE EARTHQUAKE REPAIR
 BID UNIT DESCRIPTIONS
 W.O. 2020059**

BID UNIT	DESCRIPTION
F5	INSTALLATION OF PILES, 10.75" DIA, X 45' LONG STEEL PIPE PILES - This unit includes all labor, equipment and miscellaneous materials to install owner furnished steel pipe piles as per the drawings and specifications. This unit includes all required driving, concrete fill, grounding, other effort and miscellaneous materials required for a complete installation.
G1	RELOCATE POWER TRANSFORMER, 34.5/12.47 kV, 14 MVA (CURRENT TO TEMPORARY)- This unit includes assistance to relocate one 34.5kV/12.47 14 MVA power transformer from the current foundation to a temporary foundation in the substation yard. The unit does not include the crane for the relocation. This unit includes all material and labor to construct a temporary 8"x8"x16' timber foundation. This unit includes all labor to disconnect the MV buswork, conduits, MV and LV cables from the transformer prior to the move. This unit includes disconnecting the transformer from the foundation per Chugach's Transformer move plan.
G2	RELOCATE POWER TRANSFORMER, 34.5/12.47 kV, 14 MVA (TEMPORARY TO FINAL)- This unit includes the relocation of one 34.5kV/12.47 14 MVA power transformer from the temporary foundation in the substation yard to the new transformer foundation. The unit includes placement of the transformer and welding the transformer to the foundation in accordance with specifications, drawings, and manufacturer's instructions.
K1	CONDUIT, 1" HDPE - This unit includes furnishing and installing all 1" HDPE conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings for risers from GRS conduits to equipment cabinets and provision of entrance hole in equipment cabinets. This unit includes all miscellaneous labor and material for a complete conduit system.
K2	CONDUIT, 2" HDPE - This unit includes furnishing and installing all 2" HDPE conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings for risers from GRS conduits to equipment cabinets and provision of entrance hole in equipment cabinets. This unit includes all miscellaneous labor and material for a complete conduit system.
K3	CONDUIT, 4" HDPE - This unit includes furnishing and installing all 4" HDPE conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings for risers from GRS conduits to equipment cabinets and provision of entrance hole in equipment cabinets. This unit includes all miscellaneous labor and material for a complete conduit system.
K4	CONDUIT, 6" HDPE - This unit includes furnishing and installing all 6" HDPE conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings for risers from GRS conduits to equipment cabinets and provision of entrance hole in equipment cabinets. This unit includes all miscellaneous labor and material for a complete conduit system.

**LATOUCHE EARTHQUAKE REPAIR
 BID UNIT DESCRIPTIONS
 W.O. 2020059**

BID UNIT	DESCRIPTION
K5	CONDUIT, 1" Fiberglass - This unit includes furnishing and installing all 1" Fiberglass conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings. This unit includes all miscellaneous labor and material for a complete conduit system.
K6	CONDUIT, 2" Fiberglass - This unit includes furnishing and installing all 2" Fiberglass conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings. This unit includes all miscellaneous labor and material for a complete conduit system.
K7	CONDUIT, 4" Fiberglass - This unit includes furnishing and installing all 4" Fiberglass conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings. This unit includes all miscellaneous labor and material for a complete conduit system.
K8	CONDUIT, 6" Fiberglass - This unit includes furnishing and installing all 6" Fiberglass conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings. This unit includes all miscellaneous labor and material for a complete conduit system.
K9	CONDUIT, 1" RGS - This unit includes furnishing and installing all 1" RGS conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings. This unit includes all miscellaneous labor and material for a complete conduit system.
K10	CONDUIT, 2" RGS - This unit includes furnishing and installing all 2" RGS conduits as shown on drawings and in conduit schedules. The unit includes furnishing and installing all couplings, fittings, elbows, bending, grounding hardware, trenching, core drilling, grouting, bedding sand, trench backfill, compaction and testing, and wall penetrations. This unit includes providing and installing conduit sealing bushings for spare conduits, and providing and installing pull ropes in all conduits. This unit includes all flexible liquid tight conduits and fittings. This unit includes all miscellaneous labor and material for a complete conduit system.
K11	CABLE AND RACEWAY, MEDIUM VOLTAGE, 1000MCM CU - This unit includes all labor and equipment to install Chugach provided 1000MCM CU medium voltage cable, as shown on drawings and in cable schedules. This unit includes cable installation at the risers and terminating the cable in the switchgear and outdoors at the termination structure. This unit includes installing cables into conduit, providing and installing cable tags, cable ties, conduit sealing materials, cable testing and all miscellaneous labor and materials to provide a complete cable installation.

**LATOUCHE EARTHQUAKE REPAIR
 BID UNIT DESCRIPTIONS
 W.O. 2020059**

BID UNIT	DESCRIPTION
K12	CABLE AND RACEWAY, MEDIUM VOLTAGE, 750MCM AL- This unit includes all labor and equipment to install Chugach provided 750 MCM AL medium voltage cable, as shown on drawings and in cable schedules. This unit includes cable installation at the risers and terminating the cable in the switchgear and outdoors at the termination structure. This unit includes installing cables into conduit, providing and installing cable tags, cable ties, conduit sealing materials, testing and all miscellaneous labor and materials to provide a complete cable installation.
K13	CABLE, POWER and CONTROL, 4C#10 XHHW - This unit includes installation of all 4C#10 XHHW control cables as shown on drawings and in cable schedules. This unit includes installing cables, providing and installing cable tags, cable ties, conduit sealing materials, testing and all miscellaneous labor and materials to provide a complete cable installation. Chugach will terminate power and control cables.
K14	CABLE, POWER and CONTROL, 20C#16 TFFN - This unit includes installation of all 20C#16 TFFN control cables as shown on drawings and in cable schedules. This unit includes installing cables, providing and installing cable tags, cable ties, conduit sealing materials, testing and all miscellaneous labor and materials to provide a complete cable installation. Chugach will terminate power and control cables.
K15	CABLE, POWER and CONTROL, 2C#18 TFFN - This unit includes installation of all 2C#18 TFFN XHHW control cables as shown on drawings and in cable schedules. This unit includes installing cables, providing and installing cable tags, cable ties, conduit sealing materials, testing and all miscellaneous labor and materials to provide a complete cable installation. Chugach will terminate power and control cables.
K16	CABLE, POWER and CONTROL, 2C#10 XHHW - This unit includes installation of all 2C#10 XHHW control cables as shown on drawings and in cable schedules. This unit includes installing cables, providing and installing cable tags, cable ties, conduit sealing materials, testing and all miscellaneous labor and materials to provide a complete cable installation. Chugach will terminate power and control cables.
K17	CABLE, POWER and CONTROL, 12C#12 XHHW - This unit includes installation of all 12C#12 XHHW control cables as shown on drawings and in cable schedules. This unit includes installing cables, providing and installing cable tags, cable ties, conduit sealing materials, testing and all miscellaneous labor and materials to provide a complete cable installation. Chugach will terminate power and control cables.
K18	MANHOUR - This unit includes all labor and miscellaneous support tools required to perform one hour of Chugach -directed work.
M1	CRUSHED ROCK SURFACE COURSE - This unit includes all labor and materials to provide geotech fabric and 6" of crushed rock surface course to restore the disturbed areas of the site to the the pre-construction condition to the satisfaction of the owner.
M2	FINAL GRADE/ CLEANUP - This unit includes the final grading and compaction of the substation pad, prior to placement of the surface course. This unit also includes removal from the substation site and disposal of excess excavated materials, trash and debris that are not utilized for final grading of the substation.
M3	XFMR SUMP MATERIALS - This unit includes all labor, equipment, and material required for the installation of the transformer sump system, as shown on the drawings.
M4	OIL CONTAINMENT STONE - This unit includes all labor, equipment and material required for the installation of the stone in the transformer containment pit, as shown on the drawings.
O1	GROUNDING, SUBSTATION - This unit includes furnishing and installation of all copper ground conductor for ground grid, jumpers and structure mounted ground bus as shown and specified on the drawings. This unit includes furnishing and installation of all ground rods, copper connectors, clamps, and fittings. This unit includes all labor, equipment, materials required to install the grounding system, including equipment, structure, and pile grounds, in accordance with plans, specifications and manufacturer's instructions.
I-A1	RETIREMENT, STRUCTURES - This unit includes all labor, equipment and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of specified steel structures shown on the drawings.
I-C1	RETIREMENT, BUSWORK, RIGID AND FLEXIBLE - This unit includes all labor, equipment and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of specified rigid and flexible buswork shown on the drawings.

**LATOUCHE EARTHQUAKE REPAIR
 BID UNIT DESCRIPTIONS
 W.O. 2020059**

BID UNIT	DESCRIPTION
I-F1	RETIREMENT, TRANSFORMER FOUNDATION AND OIL CONTAINMENT - This unit includes all labor, equipment and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of the specified foundations shown on the drawings.
I-F2	RETIREMENT, BUS SUPPORT FOUNDATIONS - This unit includes all labor, equipment and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of the specified foundations shown on the drawings.
I-K1	RETIREMENT, CONDUITS, 1" RGS - This unit includes all labor, equipment, and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of the 1" RGS conduit shown on the drawings.
I-K2	RETIREMENT, CONDUITS, 2" RGS - This unit includes all labor, equipment, and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of the 2" RGS conduit shown on the drawings.
I-K3	RETIREMENT, CONDUITS, 4" PVC - This unit includes all labor, equipment, and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of the 4" PVC conduit shown on the drawings.
I-K4	RETIREMENT, CONDUITS, 6" PVC - This unit includes all labor, equipment, and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of the 6" PVC conduit shown on the drawings.
I-K5	RETIREMENT, CABLE AND RACEWAY, MEDIUM VOLTAGE UNDERGROUND - This unit includes all labor, equipment, and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of the 1000MCM CU cable shown on the drawings.
I-K6	RETIREMENT, POWER AND CONTROL - This unit includes all labor, equipment, and material necessary for the removal and disposal of all miscellaneous materials necessary for complete removal of the control and power cable shown on the drawings.

**LATOUCHE EARTHQUAKE REPAIR
OWNER FURNISHED MATERIALS LIST
WO E2020059**

Reference Drawing	Drawing Item #	Description	Required	Qty Ordered	Rcv'd	Issued to Contractor	Manufacturer Description	CEA CAT#	MR	Vendor	Purchase Order	ETA / Status	Cost per	Total Cost	
LASS-EL-0010_1	1	15KV STATION POST INSULATOR, 110KV BIL, 10" TALL, 3" B.C.	EA	6	7	--	NO	NEWELL PORCELAIN CAT. NO. 231002		41707	ANIXTER	PO 93848	APR. 30	\$ 53.00	\$ 371.00
LASS-EL-0010_1	2	35KV STATION POST INSULATOR, 200KV BIL, 18" TALL, 3" B.C.	EA	6	7	--	NO	NEWELL PORCELAIN CAT. NO. 231004		41707	POTELCOM	PO 93849	DELIVERED	\$ 110.00	\$ 770.00
LASS-EL-0010_1	3	15KV HIGH VOLTAGE CABLE TERMINATOR, OUTDOOR, 400-1000 KCMIL	EA	12	12	--	NO	RAYCHEM #HVT-Z-153-SG		41703	POTELCOM	PO 93849	DELIVERED	\$ 142.00	\$ 1,704.00
LASS-EL-0010_1	4	35KV HIGH VOLTAGE CABLE TERMINATOR, OUTDOOR, 600-1000 KCMIL	EA	6	6	--	NO	RAYCHEM #HVT-Z-254/354-SG	14507	41703	POTELCOM	PO 93808	DELIVERED	\$ 385.00	\$ 2,310.00
LASS-EL-0010_1	5	15KV CABLE CLAMP	EA	6	7	--	NO	TE CC38-50-FM-M12		41707	POTELCOM	PO 93849	DELIVERED	\$ 46.00	\$ 322.00
LASS-EL-0010_1	6	35KV CABLE CLAMP	EA	3	4	--	NO	TE CC60-70-FM-M12	15860	41707	POTELCOM	PO 93808	DELIVERED	\$ 63.00	\$ 252.00
LASS-EL-0010_1	7	CABLE, 15KV, 750 MCM AL, EPR INSULATED	FT	700	700	--	NO	GENERAL CABLE	354				IN STOCK	\$ 7.42	\$ 5,194.00
LASS-EL-0010_1	8	CABLE, 35KV, 1000MCM CU	FT	350	350	--	NO	GENERAL CABLE	346				IN STOCK	\$ 25.60	\$ 8,960.00
LASS-EL-0010_1	9	250 MCM AAC CONDUCTOR, 19 STR, "VALERIAN", 0.574 O.D.	FT	220	500	--	NO			41707	ANIXTER	PO 93848	APR. 30	\$ 1.45	\$ 725.00
LASS-EL-0010_1	10	ALUMINUM SINGLE CABLE SWAGE TERMINAL, 250 MCM TO 2-HOLE PAD	EA	18	21	--	NO	DMC POWER #CPLK9202D02500S		41707	POTELCOM	PO 93849	DELIVERED	\$ 27.00	\$ 567.00
LASS-EL-0010_1	11	ALUMINUM SINGLE CABLE SWAGE TERMINAL, 250 MCM TO 4-HOLE PAD	EA	18	21	--	NO	DMC POWER #CPLK9442D02500S		41707	POTELCOM	PO 93849	DELIVERED	\$ 32.00	\$ 672.00
LASS-EL-0010_1	12	GROUND STIRRUP ASSEMBLY, 3", ALUMINUM	EA	6	7	--	NO	DMC PART #PLK1161D48		41707	ANIXTER	PO 93848	APR. 30	\$ 125.12	\$ 875.84
LASS-EL-0010_1	13	ALUMINUM DOUBLE CABLE SWAGE TERMINAL, 2-250 MCM TO 4-HOLE PAD	EA	6	7	--	NO	DMC POWER #CPLK9642D02500-4S		41707	POTELCOM	PO 93849	DELIVERED	\$ 60.00	\$ 420.00
LASS-EL-0010_1	14	SWAGE TEE, BUS TO 2-HOLE PAD, ALUM	EA	9	11	--	NO	DMC POWER #PLK1200D48E1		41707	ANIXTER	PO 93848	APR. 30	\$ 94.73	\$ 1,042.03
LASS-EL-0010_1	15	3" IPS SEAMLESS ALUMINUM BUS PIPE, 6063-T6 ALLOY-TEMPER, SCHEDULE 40	FT	120	120	--	NO			41707	ANIXTER	PO 93848	APR. 30	\$ 13.83	\$ 1,659.60
LASS-EL-0010_1	16	ALUMINUM SWAGE CENTER FORMED TERMINAL, 3" IPS TUBE TO 4 HOLE FLAT	EA	6	7	--	NO	DMC POWER #PLK1850D48B		41707	POTELCOM	PO 93849	DELIVERED	\$ 112.00	\$ 784.00
LASS-EL-0010_1	17	ALUMINUM WELDMENT END BELL, 3" IPS TUBE	EA	6	7	--	NO	DMC POWER #PLK1360		41707	POTELCOM	PO 93849	DELIVERED	\$ 76.75	\$ 537.25
LASS-EL-0010_1	18	BUS SUPPORT, 3" IPS SLIP OR FIXED, 3" B.C., ALUMINUM	EA	12	14	--	NO	DMC POWER #PLK2230D48E1		41707	ANIXTER	PO 93848	APR. 30	\$ 90.17	\$ 1,262.38
LASS-EL-0010_1	19	ANGLE BUS DOUBLE COVER	EA	12	12	--	NO	RAYCHEM PART # BCIC-7.5D/18-3		41707	POTELCOM	PO 93849	DELIVERED	\$ 180.00	\$ 2,160.00
LASS-EL-0010_1	20	SURGE ARRESTOR COVER	EA	6	6	--	NO	RAYCHEM PART # BCIC-13/13HD		41707	POTELCOM	PO 93849	DELIVERED	\$ 200.00	\$ 1,200.00
LASS-EL-0010_1	21	BUSHING COVER	EA	4	6	--	NO	RAYCHEM PART # BCIC-5.5D/16H1		41707	POTELCOM	PO 93849	DELIVERED	\$ 94.50	\$ 567.00
LASS-EL-0010_1	22	BUSHING COVER	EA	3	3	--	NO	RAYCHEM PART # BCIC-8D/15HO		41707	POTELCOM	PO 93849	DELIVERED	\$ 107.50	\$ 322.50
LASS-EL-0010_1	38	MEDIUM VOLTAGE CONDUCTOR COVER	FT	200	200	--	NO	RAYCHEM #MVCC-19/.75(B50)		41707	POTELCOM	PO 93849	DELIVERED	\$ 6.60	\$ 1,320.00
		15KV BRACKET	EA	6	7	--	NO			41707	CASH MACHINE	PO 93809	DELIVERED	\$ 155.00	\$ 1,085.00
		35KV BRACKET	EA	3	4	--	NO		18949	41703	CASH MACHINE	PO 93809	DELIVERED	\$ 118.00	\$ 472.00
		35KV 4-HOLE PADDLE, 1000 MCM	EA	6	10	--	NO	ABB L-1000-4-N		42106	WESCO	PO 94273	TBD	\$ 237.31	\$ 2,373.10
		15 KV 4-HOLE PADDLE, 750 MCM	EA	12	20	--	NO	ABB L-750-4-N		42106	WESCO	PO 94273	TBD	\$ 186.76	\$ 3,735.20
LASS-SS-0012_1		STEEL STRUCTURE, 34.5KV TERMINATION	EA	1	1	--	NO	GREER TANK		N/A	GREER TANK	PO 94121	JUN. 14	\$ 21,684.00	\$ 21,684.00
LASS-SS-0012_1		STEEL STRUCTURE, 12.5KV TERMINATION	EA	1	1	--	NO	GREER TANK		N/A	GREER TANK	PO 94121	JUN. 14	\$ 21,684.00	\$ 21,684.00
		PRECAST FIREWALL	EA	1	1	--	NO	AGGPRO		N/A	AGGPRO	PO 94124	JUN. 1	\$ 48,310.00	\$ 48,310.00
		STEEL PIPE PILES	EA	36	40	--	NO	PIPE AND PILING SUPPLY		N/A	P&P SUPPLY	CONTRACT 54450	MAY 14	\$ 2,555.00	\$ 102,200.00

TOTAL	\$ 235,540.90
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PART 1
SPECIAL PROVISIONS FOR
LATOUCHE EARTHQUAKE REPAIR
W.O. E2020059
April 6, 2021

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SPECIAL PROVISIONS

These special provisions supplement the provisions of the 2019-2020 Chugach Electric Association, Inc. Outside Electrical Line Construction Contract (OELCC) and the Technical Specifications.

SECTION 1 SUMMARY OF WORK

1.1 SECTION INCLUDES

- Description of the Project
- Work
- Contractor use of Premises
- Permits and Licenses
- Supplementary Instructions to Contractors

1.2 DESCRIPTION OF THE PROJECT

The November 2018 earthquake caused the west side of the T1 transformer foundation and containment pit to settle about 6". This settlement brought the long-term integrity of the foundation into question. Conduits connecting the transformer to the switchgear enclosure were pulled apart, stress was placed on the transformer bushings by the bus work, and the transformers ability to cool itself are all negative byproducts of the settled foundation and containment pit.

This project includes the removal of two MV steel cable risers, MV cables and conduits, LV control cables and conduits, a transformer foundation a containment pit and two riser structure foundations.

New foundations for the transformer, riser structure, and blast wall suitable for the soil conditions will be installed. A new concrete transformer foundation with oil containment pit will be installed and connected to the existing oil-water sump system. Bus work, conduits and wiring will be replaced based on current industry standard.

A blast wall between the transformer and the switchgear enclosure will be added to bring the repair work up to current standards.

Major project activities include construction of a temporary transformer foundation, demolition, foundation construction, transformer, blast wall and riser structure placement onto new foundations, and installation of conduit and cabling. Chugach will be responsible for moving the transformer to and from the temporary foundation, and for setting the blast wall.

Assume construction at LASS will be performed in and around an energized substation. The substation and T2 transformer will remain energized for the duration of this project, except during pile driving activities.

No temporary station service will be available at LaTouche Substation for the Contractor's use during construction. The Contractor shall provide all miscellaneous power required for planned construction needs. The cost of any Contractor provided power will be considered incidental to the cost of the project and no further compensation will be provided.

If during the course of construction, the Contractor chooses to remove any portion of the substation fence to provide construction access, the Contractor shall maintain security during construction activities and secure the fence opening while not in attendance. Temporary fence removal must be coordinated in advance with Chugach.

1.3 WORK

The Work consists of all obligations, duties and responsibilities necessary to the successful completion of the Contract assigned to or undertaken by the Contractor under the Contract Documents, including all labor, materials, equipment, and other incidental operations to provide a complete facility and the furnishing thereof.

1.4 CONTRACTOR USE OF PREMISES

The Contractor shall:

- A. Limit the use of the premises to Work, storage of project materials and equipment, and access.
- B. Coordinate use of premises under direction of Chugach.
- C. Assume full responsibility for protection and safekeeping of products under this Contract.
- D. Obtain and pay for use of additional storage and Work areas needed for operations under this Contract. No additional compensation will be made for costs associated with storage or work areas.
- E. No sanitary facilities or utilities are available at the site. Contractor shall furnish all temporary utilities and sanitary facilities at the site for construction purposes and comply with all local, state, and federal codes, regulations, and laws. No additional compensation will be made for costs associated with the forgoing.
- F. The Contractor shall maintain all best management practices (BMPs) required in the Contract Documents, in all areas affected by any construction activity. Cost of providing all measures required in the Contract Documents are considered incidental to the cost of the affected unit. No additional compensation will be paid for these measures.

1.5 PERMITS AND LICENSES

- A. Except as otherwise provided in the Contract Documents, the Contractor shall procure all permits and licenses, pay all charges and fees and give all notices necessary and incident to the due and lawful prosecution of the Work. Copies of all permit-related correspondence as well as the permits are to be transmitted to Chugach.

1.6 CONTAMINATED SOILS AND CONTRACTORS DISCHARGE RESPONSE PLAN

- A. Latouche Substation (LASS) is an older substation that may contain areas of contaminated soil located within the project area. If contaminated soils are encountered, contractor shall contact Chugach for further direction. It is anticipated that Chugach will coordinate, testing and removal of any contaminated soils in such a way as to mitigate the impact on the Work.

1.7 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

- A. Substitutions and Product Options:

1. At time of bidding, unless otherwise specified in the Specifications, Contractor may, on an "approved equal" or substitution-basis, propose other equipment which he considers comparable with or superior to the specified items. In the absence of a listing of such equipment, it will be assumed that the Contractor intends to furnish the items as specified.
 2. Contractor shall provide sufficient information and data necessary for a full evaluation of any equipment proposed on an "approved equal" or substitution-basis. At a minimum, information shall include complete description, physical dimensions, manufacturer's name and model number, price, time for delivery, and a specific listing of any characteristics which differ from those specified and could require engineering changes to equipment, buildings, structures, and services. Failure to supply adequate or accurate information may result in rejection of Contractor's proposal.
 3. The determination of the suitability of "approved equals" or substitutions for the service intended, and final acceptance thereof, shall be by Chugach. The successful Contractor shall be liable for the cost of any subsequent engineering changes which are clearly attributable to negligence on the part of the Contractor to furnish proper information with his proposal.
 4. If any revisions to Drawings or Specifications are required to conform equipment, materials, or work to national, state, and local laws, codes, ordinances, and regulations, Contractor shall give notice when submitting its bid and include a statement listing the additions to or deductions from the bid price required by the revisions.
 5. If Contractor fails to give notice, Contractor shall provide the equipment, materials, and Work as intended by the above without extra cost to Chugach.
- B. Surveys:
1. All surveys shall be performed as specified in Section 3 of these Special Provisions.
- C. All Contractor personnel shall be qualified to work in an energized substation or shall be accompanied by a qualified lineman provided by the contractor.

END OF SECTION

**SECTION 2
MEASUREMENT AND PAYMENT**

2.1 SECTION INCLUDES

- Measurement Methods
- Measurement by Weight
- Lump-Sum Measurement

2.2 MEASUREMENT METHODS

- A. Measurement methods specified in the Bid Schedule of the Contract shall govern if they differ from methods specified in this Section.
- B. The Contractor shall compute all quantities and submit calculations for approval by Chugach. Where necessary, such computations shall be based upon surveys performed by the Contractor as specified by the Special Provisions in Section 3, 3.4 Field Engineering.
- C. Payment will be full compensation for furnishing all labor, materials, tools, equipment, transportation, services, and incidentals, as specified and for performing all work necessary for completing the erection or installation of the item or work classification.
- D. Full compensation for all expense involved in conforming to the requirements for measuring materials shall be considered as included in the prices paid for the materials being measured, and no additional compensation will be made therefore.
- E. All costs in connection with the Work specified herein will be considered to be included with the related item of Work in the Bid Schedule, or incidental to the Project.
- F. Measurement Standards: All Work to be paid for at a Contract price per unit of measurement shall be measured by Chugach in accordance with United States Standard Measures.

2.3 MEASUREMENT BY WEIGH

- A. Material to be measured and paid for by weight and not measured by handbook weights, shall be weighed on accurate, State of Alaska approved scales, furnished by and at the expense of the Contractor. A ton is defined as 2,000 pounds avoirdupois.

2.4 LUMP SUM MEASUREMENT

- A. Lump-sum measurement shall be for the entire item, unit of Work, structure, or combination thereof, as listed in the Bid Schedule.
- B. If the Contractor requests progress payments for lump-sum items or amounts in the Bid Schedule, such progress payments shall only be allowed if approved by Chugach in writing. Progress payments will be made in accordance with a well-balanced, detailed program of payment-apportioning, prepared by the Contractor and submitted to Chugach for approval.
- C. Such program for each applicable lump-sum item shall show estimated quantities and unit prices therefore as allocated by the Contractor to the different features of the Work and major subdivisions thereof. The summation of extensions of quantities and unit prices and related costs shall total, in each case, the exact amount to be paid under the lump-sum Contract Price for the item.

- D. Such programs will be used for computing progress payments as provided herein, but will not be used to determine the amount of the final payment for the Work of this Contract. Final Payment will be based on actual percentage of Work completed by the Contractor.

END OF SECTION

**SECTION 3
COORDINATION AND FIELD ENGINEERING**

3.1 SECTION INCLUDES

- Coordination
- Outages
- Field Engineering
- Project Documents

3.2 COORDINATION

- A. Contractor shall coordinate scheduling, submittals, and Work for the various activities with Chugach to assure efficient and orderly sequence of installation of interdependent construction elements.
- B. The disposition of surplus, non-contaminated soils will be the responsibility of the contractor.
- C. Chugach's system operation will require other crafts to perform work at or near this project. Contractor shall coordinate activities with Chugach's site representative to avoid delays and interference. Chugach substation and relay protection technicians will be onsite during the project to perform various project related tasks. The crane operator and his rigger will be onsite for the transformer and blast wall moves.
- D. After Chugach occupancy of premises, coordinate access to site with Chugach for correction of defective Work and Work not in accordance with Contract documents.
- E. Contractor is responsible for coordinating with other entities for locates.

3.3 OUTAGES

- A. All work around and near energized 12.5kV and 34.5kV facilities shall be coordinated with CEA's Power Dispatch (Dee Fultz, Supervisor @ 762-4622.) The contractor shall take all required measures to ensure safety of personnel and existing facilities.
- B. Outages must be scheduled a minimum of five (5) Chugach working days in advance of the outage and be approved by Chugach. Outage requests shall be entered through the computerized "Dispatch Outage Application (DOA)".
- C. The Contractor shall indicate all outages in its construction schedule.
 - 1. One planned full substation outage is planned for driving pile. The Contractor is to estimate the duration and schedule for pile driving in the project schedule.
 - 2. All other activities are planned with the substation in service. The T2 transformer bus and switchgear will be energized throughout the project with the exception of pile driving.

3.4 FIELD ENGINEERING

- A. The Contractor shall use a Land Survey registered in the State of Alaska to do survey work which includes establishing elevations, lines, and levels, utilizing recognized engineering survey practices.

- B. Contractor shall furnish all labor, equipment, materials, and services to perform all surveying and staking for the construction survey for the project. The Contractor is responsible for orientation and alignment.
- C. The Contractor shall locate and protect survey control and reference points.
- D. All survey work shall be performed under the supervision of a Land Surveyor registered in the State of Alaska and acceptable to Chugach.
- E. Activities of the Surveyor are to be restricted to within the Chugach property boundary or public right-of-way. Obtain written permission for ingress or egress to Chugach property or public right-of-way where access to Chugach property or public right-of-way is across private property. Obtain written permission for use of private property by the Surveyor for parking or other work performed by the Surveyor that is not completely within the Chugach property or public right-of-way. Permission must be granted in a written agreement between the property owner and the Surveyor. Chugach Electric Association, Inc. shall be held harmless from any act of the Surveyor. See Appendix F for Permission To Enter Property form.
- F. Copies of all field notes produced by the Surveyor, shall be provided to Chugach.
- G. In addition to a signed, stamped paper copy of the as-built drawing, an electronic file containing of the drawings in AutoCAD Map 3D 2019 is required. Details of the Chugach drawing standards and data formats can be found in Appendix D. All spatial data should be submitted in compliance with the standards defined in Appendix C. The files shall be accompanied by the layer naming convention and other information as necessary to allow Chugach to utilize the files. The files shall also contain a listing of all surveyed points with coordinate positions listed by point number and again by like items.
- H. A Geotechnical report was done by the engineering contractor. Further Geotechnical investigations can be performed by the Contractor if so desired with proper coordination. No additional compensation shall be made for such investigations.

3.5 PROJECT RECORD DOCUMENTS

- A. As-Built Drawings, Field Notes and Surveyor's Certificate
 - 1. Maintain on the Site two separate sets of marked-up full-scale Contract Drawings indicating as-built conditions. These drawings shall be maintained in a current condition at all times until completion of the Work and shall be available for review by Chugach at all times. All variations from the Contract Drawings, for whatever reason, including those occasioned by modifications, optional materials, and the required coordination between trades shall be indicated. These variations shall be shown in the same general detail utilized in the Contract Drawings. Upon completion of the Work, the marked-up drawings shall be furnished to Chugach.
 - 2. Store Record Documents separate from documents used for construction.
 - 3. Record information concurrent with construction progress.
 - 4. Record Documents and Shop Drawings shall be legibly marked to record actual construction including:
 - a. Measured depths of foundations in relation to finish floor datum.

- b. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - c. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - d. Field changes of dimension and detail.
 - e. Details not on original Contract Drawings.
5. Submit as-built drawings, field notes and Surveyor's certified as built not later than twenty (20) days after completion of construction.

B. Test and Inspection Reports

Submit test and inspection reports per the following schedule and as specified elsewhere in the Technical Specifications

- 1. Compaction test reports – Submit the day after test is completed.
- 2. LV and MV cable high pot test data 5 days after testing.
- 3. LV and MV cable continuity testing 7 days after testing.
- 4. Piling steel inspection reports 14 days after material delivery.
- 5. Pile driving data 7 days after pile driving.
- 6. Concrete tests, within 7 days of the test.

END OF SECTION

SECTION 4 SUBMITTALS

4.1 SECTION INCLUDES

- Submittal Procedures
- Construction Progress Schedules
- Shop Drawings
- Product Data
- Samples
- Manufacturers' Instructions
- Manufacturers' Certificates

4.2 SUBMITTAL PROCEDURES

The Contractor shall submit pertinent data as required in other parts of these Contract Documents for Chugach's approval:

- A. Transmit each submittal with Chugach accepted form.
- B. Sequentially number the transmittal forms. Resubmittals are to have the original submittal number with an alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or Supplier; pertinent drawing sheet and detail number(s), and Specification section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Submittals will not be reviewed by Chugach until they have been reviewed by the Contractor.
- E. Schedule submittals to expedite the Project and deliver to Chugach. Coordinate submission of related items. Allow seven (7) calendar days for Chugach's review.
- F. If substitutions become necessary after Contract award and initial approval of Contractor furnished materials, the Contractor shall submit all information as required in the bid and include a detailed explanation as to causes for the substitution.
- G. Provide space on submittals for Contractor's and Chugach's review stamps.
- H. Revise and resubmit submittals as required; identify all changes made since previous submittal.
- I. Distribute copies of approved submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- J. No material and/or procedure requiring Chugach's approval shall be used or implemented until such approval has been given.

4.3 CONSTRUCTION PROGRESS SCHEDULES

- A. A schedule shall be submitted with the bid and include the planned duration of the following major construction groups:

1. Mobilization
2. Install Temporary Foundation
3. Transformer Testing
4. Transformer Move
5. Demolition
6. Install Piling
7. Install New Foundations
8. Transformer Move
9. Install Riser Structures
10. Install Blast Wall
11. Install New MV Cable/Conductors
12. Transformer Test and Commission
13. De-Mobilization

The schedule shall note manpower loading and cash flow. The schedule shall be submitted using a Microsoft Project format. The schedule shall be saved to a base line and submitted electronically.

- B. Within five (5) working days of award, the Contractor shall submit one (1) hard copy and one (1) electronic copy of an updated construction schedule for approval by Chugach. The construction schedule shall be updated to include cashflow on a weekly basis for each individual bid unit and planned percent complete by task and overall project.
- C. The construction schedule shall be updated with actual percent complete by task and manpower and one electronic copy submitted with all invoices.
- D. The basic construction schedule (data on planned performance) shall not be changed without Chugach's concurrence.

4.4 SHOP DRAWINGS

The Contractor shall:

- A. Submit three paper copies and one electronic copy of shop drawings.
- B. After review by Contractor, distribute in accordance with Submittal Procedures above and upon completion of Project, provide copies for Record Documents described in Special Provisions, Section 8 - Contractor Closeout.

4.5 PRODUCT DATA

The Contractor shall:

- A. Submit the number of product data copies which the Contractor requires, plus three (3) copies which will be retained by Chugach.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to the Project.
- C. After review, distribute in accordance with Submittal Procedures above and provide copies for Record Documents described in Special Provisions, Section 8 - Contractor Closeout.

4.6 SAMPLES

The Contractor shall:

- A. Submit samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing Work.
- B. Include identification on each sample with full product information.
- C. Submit the number or samples specified in individual Specification sections; one of which will be retained by Chugach. Reviewed samples which may be used in the Work are indicated in individual Specification sections.

4.7 MANUFACTURERS INSTRUCTIONS

The Contractor shall:

- A. When specified in individual Specification sections, submit manufacturers printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for product data.
- B. Identify conflicts between manufacturers' instructions and Contract Documents. Notify Chugach in a timely manner to allow resolution of the conflicts without impact on the project completion.

4.8 MANUFACTURERS CERTIFICATES

The Contractor shall:

- A. When noted in individual Specification Sections, submit manufacturers certificate in quantities specified for product data.
- B. Indicate material or product as it conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to Chugach.

END OF SECTION

**SECTION 5
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**

5.1 SECTION INCLUDES

- Temporary Utilities
- Temporary Controls
- Construction Facilities
- Staging Area

5.2 TEMPORARY UTILITIES

The Contractor shall:

- A. Supply all temporary electric power required for construction of the project.
- B. Provide and maintain adequate lighting for construction operations at all times.
- C. Obtain potable water as needed for the Work.
- D. Provide sanitary facilities at the site as required by law or regulation.

5.3 TEMPORARY CONTROLS

A. Water Control

- 1. No Storm Water Pollution Prevention Plan (SWPPP) has been prepared for this project. The Contractor shall comply with all municipal, state and federal laws governing storm water pollution control. The Contractor shall provide all temporary erosion and sedimentation control measures during the draining of hydro-test water that are specified in the project Documents.
- 2. The Contractor shall maintain excavations free of water. Provide, operate and maintain pumping equipment as required. Costs for dewatering and disposal of water removed from all excavations is incidental to the cost of the affected unit. No additional compensation will be paid for dewatering any excavation.
- 3. The Contractor shall protect site from puddling or running water.

B. Traffic Control

- 1. Any traffic control plan is required for this project is the responsibility of the Contractor and needs to be approved by Chugach 14 calendar days in advance.

C. Dust and Mud Control

- 1. Dirt and mud shall be controlled on 56th Avenue.

5.4 CONSTRUCTION FACILITIES

A. Protection of Installed Work

The Contractor shall:

- 1. Protect installed Work and provide special protection where specified in individual specification sections.

2. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.

B. Barriers

The Contractor shall:

1. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.
2. Protect stored materials, site, and structures from damage.

C. Security

1. Provide security and facilities to protect Work, from unauthorized entry, vandalism, or theft.
2. Temporary fencing must be secure and of the same height as the existing substation fence.

D. Parking

1. All parking shall be on Chugach property or in areas that the Contractor has obtained approval to park.

E. Cleaning

1. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in a clean and orderly condition.
2. Remove waste materials, debris, and rubbish from site weekly and dispose off-site in compliance with all local, State and Federal regulations.

F. Removal of Utilities, Facilities and Controls

1. Remove temporary above grade or buried utilities, equipment, facilities, materials prior to final inspection.
2. Clean and repair damage caused by installation or use of temporary Work.

END OF SECTION

**SECTION 6
MATERIAL AND EQUIPMENT**

6.1 SECTION INCLUDES

- Material and equipment quantities.
- Products.
- Transportation and Handling.
- Storage and Protection.
- Owner Furnished Material

6.2 MATERIAL AND EQUIPMENT QUANTITIES

- A. Material and equipment quantities shown on drawings are the Engineer's best estimate and shall be verified by the Contractor. Discrepancies shall be brought to Chugach's attention and conflicts resolved in a timely manner so to not interfere with scheduled completion of the work.

6.3 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Product does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components authorized for reuse.
- B. The Contractor shall not reuse materials except as specifically permitted by the Contract Documents.

6.4 TRANSPORTATION AND HANDLING

The Contractor shall:

- A. Furnish the necessary labor and equipment to load, haul to the jobsite, and offload all materials for the project.
- B. Exercise due care in the handling of all materials. Transport and handle products in accordance with manufacturer's instructions.
- C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

6.5 STORAGE AND PROTECTION

The Contractor shall:

- A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
- B. For exterior storage of products, place on sloped supports, above ground.
- C. Provide off-site storage and protection when Site does not permit on-site storage or protection.
- D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

- E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- G. Arrange storage of products to permit access for inspection. Periodically inspect to ensure products are undamaged and are maintained under specified conditions.

6.6 OWNER FURNISHED MATERIAL

Material on the owner furnished material (OFM) list will be the ONLY material furnished by Chugach.

END OF SECTION

**SECTION 7
CHUGACH-FURNISHED MATERIAL**

7.1 SECTION INCLUDES

- Chugach-Furnished Material
- Transfer of Material
- Damage to Chugach-Furnished Material
- Installation of Chugach-Furnished Material
- Manufacturer's Representative

7.2 CHUGACH FURNISHED MATERIAL

- A. All Chugach furnished material is listed in the "List of Owner-Furnished Materials." If material does not appear on this list, the Contractor shall provide it.
- B. The costs associated with the Chugach-furnished material listed represent original costs to Chugach and may or may not be replacement costs.
- C. The Contractor shall include the Chugach-furnished materials for this project in his insurance posted for the work.

7.3 TRANSFER OF MATERIAL

- A. Coordinate with Chugach for transfer and transportation of Chugach-furnished materials and equipment. Chugach furnished materials and equipment shall be located at Chugach's Operations Warehouse at 5601 Electron Drive, Anchorage, Alaska.
- B. Chugach-furnished materials and equipment may have been previously unpackaged for inspection. The Contractor shall repackage the material and equipment as necessary for transport and storage subject to the approval of Chugach.
- C. After the acceptance of Chugach-furnished items, the Contractor shall place them at the point of installation or in areas as approved by Chugach. Chugach may direct that certain items be stored in heated storage buildings. The Contractor is responsible for transporting Chugach-furnished material from the specified storage location to the jobsite. The Contractor is responsible for loading all Chugach furnished materials at their storage location and offloading Chugach-furnished material at the jobsite
- D. After acceptance, Chugach-furnished items are the Contractor's responsibility. The Contractor shall appropriately store and protect all Chugach-furnished items upon acceptance.
- E. Spare Parts and Special Tools: Place spare parts and special tools together with any unused materials and equipment in storage at the Jobsite upon completion of the Work as directed by Chugach.

7.4 DAMAGE TO CHUGACH-FURNISHED MATERIAL

- A. The Contractor shall repair or replace any Chugach-furnished items damaged by the Contractor's handling and storage at no additional cost to Chugach.

7.5 INSTALLATION OF CHUGACH-FURNISHED MATERIAL

- A. Except as otherwise specified, installation Work shall be the responsibility of the Contractor and all mistakes in installation and damage shall be corrected by the Contractor at no cost to Chugach.
- B. The Contractor will not be held liable for faulty manufacture of Chugach-furnished items or for mistakes in the manufacturer's drawings.
- C. Supply and fix all ancillary conduit, bolts, anchors, cabling, supports, and line required to place all Chugach-furnished items in operation.

7.6 MANUFACTURER'S DRAWINGS

- A. Drawings approved by Chugach will be given to the Contractor for all equipment furnished by other contracts that is to be installed and connected by this contract. These drawings shall be used for construction and are provided as reference drawings for the project.
- B. Drawings and specifications for equipment furnished by Chugach under other contracts for installation under this contract will be available in the office of Chugach for inspection before bidding.

7.7 MANUFACTURER'S REPRESENTATIVE

None Required.

END OF SECTION

**SECTION 8
CONTRACT CLOSEOUT**

8.1 SECTION INCLUDES

- Closeout Procedures
- Closeout Documents
- Final Cleanup

8.2 CLOSEOUT PROCEDURES

- A. Notify Chugach to perform a preliminary inspection for the purpose of determining the state of completion of the Work. Contractor shall notify Chugach at least seven (7) days in advance of the time this inspection is to be performed. From the information gathered from this inspection, Chugach will prepare a punch list of Work to be performed, corrected, or completed before the project will be accepted. The Contractor, prior to final inspection shall complete all Work on the punch list.
- B. Contractor shall accompany Chugach and their representatives on the final inspection tour as well as any principal subcontractors that Chugach may request to be present.
- C. If the Work has been completed in accordance with the Contract Documents and no further corrective measures are required, Chugach will issue a Certificate of Completion and will accept the project.

8.2 DOCUMENTS

- A. The following documents in addition to those specified in the OELCC shall be completed and signed by authorized representatives of Chugach and/or Contractor before final payment is made:
 - 1. Certified as-built drawings including shop drawings and other product information (1 set).
 - 2. Post-Construction As-Built Survey deliverables.

8.3 FINAL CLEANUP

- A. The Contractor shall maintain the site in a clean and orderly condition. All equipment, packaging materials, temporary facilities, etc., shall be removed within ten (10) working days of construction completion.

END OF SECTION

PART 2
TECHNICAL SPECIFICATION FOR
LATOUCHE EARTHQUAKE REPAIR

W.O. E2020059

April 6, 2021

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**SECTION 024155
MISCELLANEOUS DEMOLITION**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. The Contractor shall supply all labor, materials, equipment, tools and supervision necessary to complete miscellaneous demolition at existing substation site including removing and disposing of structures and debris and site restoration.
- B. Items of demolition work associated with this section include the following:
 - 1 Remove designated and dispose of items as shown on drawings.

1.3 CERTIFICATION REQUIREMENTS

- A. Conform to applicable local, State and Federal requirements.
- B. Conform to applicable requirements for hauling and disposal of debris to contractor-furnished disposal site.

1.4 COORDINATION REQUIREMENTS

- A. Traffic: Conduct demolition operations to ensure minimum interference with roads, streets, bike paths, walks and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, bike paths or other occupied or used facilities without prior written permission from authorities having jurisdiction.
- B. The Contractor and its subcontractors shall minimize tracking soil onto adjacent sidewalks, trails, and streets. All tracked soil material shall be cleaned up at the end of each workday.
- C. Locate and protect all utilities.
- D. Coordinate all work with utility.

2 PRODUCTS - unused

3 EXECUTION

3.1 PREPARATION

- A. Remove improvements, or obstructions, as required, to the extent necessary for the execution of the work.

3.2 PROTECTION

- A. Protect existing shrubs and vegetation adjacent to and outside of construction limits of work.
- B. Locate, identify, and protect all existing facilities from damage.
- C. Protect survey benchmarks, property corners, existing structures and improvements to remain from damage or displacement.

- D. Provide continuous vehicle access and egress.

3.3 DEMOLITION

- A. Demolish and remove existing construction only to the extent required by new construction and as indicated.
- B. Verify all existing utilities, site conditions, information, and dimensions.
- C. Provide, erect, and maintain temporary barriers, security devices, and temporary support structures as necessary to protect and support existing items which are not indicated to be removed.
- D. Notify the Chugach's Representative immediately in the event that hazardous or contaminated material are encountered or suspected. Conform to procedures applicable to local, State and Federal regulations when handling, transporting, and disposing of hazardous or contaminated materials.
- E. Identify and indicate all utility locations on Project Record Documents.
- F. Remove materials to be re-installed or returned to Chugach in a manner to prevent damage.
- G. Remove demolished materials, rubbish, and debris from site as work progresses. Upon completion of work, leave areas of work in clean condition. Local, State and Federal regulations regarding hauling and disposal shall apply.
- H. Anchors to be retired shall be completely removed. Cutoff anchor rods will not be acceptable.
- I. Poles to be retired are to be completely removed and disposed of as required by law.
- J. Do not burn or bury materials on site.
- K. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.4 DISPOSAL OF WASTE MATERIAL

- A. Remove waste materials and excess excavated material to a contractor-furnished disposal site in compliance with all applicable local, State and Federal requirements.

3.5 SALVAGED MATERIAL

- A. All material and equipment designated for removal, not designated to be reused or relocated in other Sections or on the Drawings, will become the property of the Contractor on the date that it is removed.

3.6 REMOVED AND REINSTALLED ITEMS

- A. Clean and repair items to functional condition adequate for intended reuse.
- B. Pack or crate items after cleaning and repairing. Identify contents of containers.
- C. Protect items from damage during transport and storage.
- D. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.7 EXISTING ITEMS TO REMAIN

- A. Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Chugach, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.8 USE OF EXPLOSIVES

- A. Use of explosives will not be permitted.

END OF SECTION 024155

**SECTION 260500
COMMON WORK RESULTS FOR ELECTRICAL**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1 Electrical equipment coordination and installation.
 - 2 Sleeves for raceways and cables.
 - 3 Sleeve seals.
 - 4 Common electrical installation requirements.

1.3 DEFINITIONS

- A. ATS Acceptance Testing Specifications.

1.4 REFERENCES

- A. The latest and applicable sections of the following standards shall be used in the performance of the work:
 - 1 NESC - National Electric Safety Code
 - 2 NEC - National Electric Code
 - 3 IEEE - Institute of Electrical and Electronics Engineers
 - 4 RUS Bul. 1724E-300 (Design Guide for Rural Substations)
 - 5 RUS Pub. 202-1 (List of Materials)
 - 6 AEIC - Association of Edison Illuminating Companies
 - 7 NEMA - National Electrical Manufacturer's Association
 - 8 NECA - National Electrical Contractor's Association
 - 9 NETA - InterNational Electrical Testing Association

1.5 SUBMITTALS

- A. As required by Special Provisions and as outlined here.
- B. Shop drawings and product data for all Contractor furnished equipment and materials.
- C. Manufacturers' test reports.

- D. Equipment manuals and installation manuals.
- E. Approval of submittals required when materials substitutions are made.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain accurate information of all installations on drawings, product information, test reports and instruction manuals and as required by Special Provisions.

1.7 QUALITY ASSURANCE

- A. Use qualified crafts, trained in the specific task(s) to be performed. Certify special qualifications where required.
- B. Follow recommendations and instructions of equipment manufacturer in addition to requirements of drawings and specifications in handling and erection of equipment.

1.8 FIELD MEASUREMENTS

- A. Verify that all field measurements are as indicated on the drawings.
- B. Determine required location, arrangement and quantities of equipment and materials from drawings.

1.9 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1 To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2 To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3 To allow for piping and conduit installed at required slope.
 - 4 So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, walls, and other structural components as they are constructed.
- C. Coordinate timing of installations with other trades and Chugach's personnel working on other projects in the station.
- D. Coordinate installations of Chugach-furnished materials with Chugach personnel.

2 PRODUCTS

2.1 CONTRACTOR-FURNISHED EQUIPMENT AND MATERIALS

- A. Unless otherwise specified, the Contractor shall furnish all fittings, hangers, conduit, anchors, junction boxes, mounting brackets, cable supports, terminal board jumper wires, wire terminals, solderless lugs, connectors, identification tags, identification signs, insulating tape, insulating compounds, grounding system hardware, and all other electrical accessories, hardware, or materials required to satisfactorily install and place into service all equipment and material specified or shown on the drawings, or supplied by Chugach.

3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive the work.
- B. Beginning of the installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Before assembly and erection thoroughly clean equipment of all protective coatings and foreign materials.
- B. Verify all equipment elevations prior to placement.
- C. Schedule testing services and other inspections in a timely manner.

3.3 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. All electrical installations shall be in accordance with the applicable standards, manufacturer's instructions specified herein and any requirements of the local regulatory or code enforcing agencies, unless otherwise specified herein. The Contractor shall place the equipment accurately in position, level the equipment, assemble all equipment which requires such, including wire connections where required. Also the Contractor shall remove, modify and reinstall equipment where required and adjust and make ready for service the electrical equipment and material required by these Specifications or as shown on the drawings. After the installation is complete, the Contractor shall clean each piece of equipment. All work shall be done in an orderly and skillful manner and shall present a neat appearance when completed.
- B. Construction installation quality and workmanship shall comply with NECA 1.
- C. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete walls, or fire-rated floor and wall assemblies.
- B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

- F. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- G. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- H. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- I. Above ground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- J. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install and seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 TESTS

- A. All materials and equipment installed and/or connected by the Contractor shall be thoroughly checked, tested and made completely ready for in-service commercial operation. Refer to specifications Section 260550, Field Testing, for test requirements.

3.7 PROTECTION

- A. Maintain safe clearances from all existing installations not part of this project.
- B. Safeguard all existing facilities.

END OF SECTION 260500

**SECTION 260513
CONDUCTORS AND CABLES**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. This section covers the furnishing and installation of all wire and cable, required to complete the installation of equipment as shown on the Drawings, and as specified herein with terminations and connections required to provide functioning power and control systems as required.
- B. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
- C. This section also includes high voltage cable installation, cable terminations, splices and wiring connectors and connections.
- D. This section covers the termination and installation requirements for relaying, control and indication cables in the field equipment and control enclosure.

1.3 REFERENCES

- A. References listed in Section 260500 shall apply in conjunction with the following:
 - 1 NEMA WC7 - Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and distribution of Electrical Energy.
 - 2 IEEE Standard 400 - IEEE Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.

1.4 SUBMITTALS

- A. Product Data: For each type of product supplied.
- B. Approval of submittals required when materials substitutions are made.

1.5 QUALIFICATIONS

- A. Manufacturer: As approved by Chugach.
- B. Construction Personnel: Foreman responsible for termination and installation of all cables in the station equipment and control building shall have completed such work in the past for an electric utility, inspected and reviewed with Chugach personnel similar Chugach installations for workmanship requirements, and be acceptable to Chugach.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit As-built Drawings as specified in the Special Provisions.
- B. Accurately record actual sizes and locations of direct buried cables on the drawings.
- C. Accurately record any deviation from project drawings.

1.7 QUALITY ASSURANCE

- A. Handle wire and cable in accordance with the manufacturer's instructions.
- B. Do not exceed minimum bending radii for cables and wires or exceed pulling tensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.

1.8 FIELD MEASUREMENTS

- A. Cable lengths shown on the cable schedule are estimates only. Contractor is responsible for verification of the exact lengths necessary.
- B. Determine required separation between cables and other work.
- C. Determine cable routing to avoid interference with other work.

1.9 COORDINATION

- A. Schedule cable and wire installation in conjunction with equipment and raceway placement.

2 PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements and approved by Chugach.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for type XHHW-2.
- D. Overhead and Underground conductors: See Owner furnished material list for Chugach supplied conductors. Contractor to supply all other Conductors and Cables.
- E. General Purpose Wiring:
 - 1 General purpose wiring circuits shall be 600V UL type XHHW-LS 90°C, with low-smoke zero halogen (LS-ZH) insulation, flexible strand, with copper conductor. An example of acceptable wire would be Houston Wire and Cable type HW010. The Contractor shall submit wire types to be used for Chugach approval.
- F. Switchboard Wiring
 - 1 All switchboard wire shall be 600V UL type SIS 90°C, with gray XLP VW-1 insulation, flexible strand, with tinned copper conductor. An example of acceptable switchboard wire would be Houston Wire and Cable type HW052. The Contractor shall submit wire types to be used for Chugach approval.
 - 2 Intra-panel current transformer circuits shall be #10 SIS wire. Intra-panel potential transformer circuits shall be #12 SIS wire. All other wire shall be #14 SIS except where specified.
- G. Instrumentation Cable

- 1 Instrumentation cable/wiring installed in trays or raceways shall be indoor/outdoor low-smoke zero halogen (LS-ZH) jacketed non-PVC flame retardant 600V UL type TC (tray cable) color coded by ICEA method 9 or Chugach approved equivalent. An example of an acceptable instrumentation cable would be Houston Wire and Cable type HW120. The Contractor shall submit cable types to be used for Chugach approval.

H. Power Cable

- 1 Power cable/wiring installed in trays or raceways shall be indoor/outdoor low-smoke zero halogen (LS-ZH) jacketed non-PVC flame retardant 600V UL type TC (tray cable) color coded by ICEA method E-1 or Chugach approved equivalent. An example of an acceptable power cable would be Houston Wire and Cable type HW170 or HW172. The Contractor shall submit cable types to be used for Chugach approval.

2.2 CONNECTORS

- A. Solderless pressure connectors.
- B. Compression connectors: Ring-type lugs
- C. Description: Factory-fabricated connectors of size, ampacity rating, material, type, and class for application and service indicated.
- D. All terminals for #10 wire and smaller shall be made with the terminals shown in Table I or as specified on the drawings. All terminals for wire larger than #10 shall be made with terminals shown on Drawings. Burndy terminations shall be double crimped with a Burndy MR8-9Q tool. No substitutions will be permitted.

Wire Range (AWG)	Stud Range	Terminal Mfgr./Model
10 – 12	8 – 10	Burndy / YAV10-H
14 – 20	8 – 10	Burndy / YAV14-H
18 – 22	8 – 10	Burndy / YAV18-H

Table 1: Wire Terminals

- E. Contractor shall provide the correct Burndy YAV type terminals with the proper hole size for the specified screw size. Drilled out terminals are not acceptable.

2.3 TERMINATIONS (1000 V AND ABOVE)

- A. Modular terminators suitable for cables described under 2.1 of this section. Manufacturer: As specified on drawings.
- B. Connectors, NEMA 2 and 4 hole pads, as specified on drawings.

3 EXECUTION

3.1 EXAMINATION

- A. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 CONDUCTOR AND INSULATION APPLICATIONS

- A. As indicated on the drawings.

3.4 INSTALLATION

- A. Install cable and accessories in accordance with manufacturer's instructions.
- B. Avoid abrasion and other damage to cables during installation.
- C. Do not exceed cable pulling tensions, sidewall pressures or bending radius limitations. For Chugach supplied conductors information on these limitations will be furnished by Chugach at the time of construction.
- D. Ground cable shield only at switchgear enclosure end termination.
- E. Neatly train and lace wiring inside boxes, equipment, panelboards, and cable trays.
- F. Clean conductor surfaces before installing lugs and connectors.
- G. Make terminations which are rated to carry the full ampacity of conductors with negligible temperature rise.
- H. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- I. Use pulling lubricants where necessary.
 - 1 Use only lubricants approved for use with cable types specified that do not leave flammable residue or support flame propagation.
 - 2 Pulling lubricants shall not deteriorate conductor or insulation.
 - 3 Soap/wax based lubricants shall not be used.
 - 4 Use Polywater J or equivalent where compatible with cable types installed as specified by the lubricant manufacturer.
 - 5 Use Polywater LZ or equivalent for Low Smoke Zero Halogen (LSZH) cables.
- J. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- K. Support cables according to Section 260500 "Common Work Results for Electrical."
- L. For low-voltage cable, after the cable jacket has been stripped back to the appropriate length, each cable shall have a minimum 2-inch piece of heat shrink tubing with internal hot melt sealing compound installed. The heat shrink tubing shall be long enough and positioned so that approximately 1-inch of heat shrink tubing is positioned over the cable jacket and 1-inch of heat shrink tubing is positioned over the conductors. Heat shrink tubing shall be Thomas & Betts HS-series, heavy-wall heat-shrinkable tubing, black in color.
- M. Identify and color-code conductors and cables according to Section 260553 "Electrical Identification."
- N. Ensure that all control, communication, status or relaying cables and conductors have sufficient length to be re-terminated at any location within the cabinet or rack. Jacket shall be stripped and the uncovered conductors secured at no more than 6" intervals.

- O. For spare conductors of multiconductor cables, sufficient length shall be secured to terminate the conductor at any location within the cabinet or rack. Ends of spare conductors shall be heat shrunk with Thomas & Betts CPO-series, thin-wall heat-shrinkable tubing that is black in color.
- P. Where cable trench is used, leave a loop of minimum 3 feet of cable in the cable trench where the cable transitions to conduit.
- Q. Wiring at Outlets: Install conductor at each outlet per NEC. Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Splicing
 - 1 No splicing allowed.

3.6 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1 After installing conductors and cables and before electrical circuitry has been energized, test conductors as specified in Section 260550, Field Testing and as specified in this section.
 - 2 Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
 - 3 Inspect wire and cable for physical damage and proper connection.
 - 4 Inspect shield grounding, cable supports, and terminations for proper installation.

END OF SECTION 260513

**SECTION 260526
GROUNDING AND BONDING**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. This section covers:
 - 1 Connectors
 - 2 Conductors

1.3 REFERENCES

- A. ANSI/IEEE C2 - National Electric Safety Code
- B. ANSI/NFPA 70 National Electric Code
- C. IEEE 80 - Guide for Safety in AC Substation Grounding
- D. IEEE 142 - Grounding of Industrial and Commercial Power Systems
- E. Motorola R56 - Standards and Guidelines for Communication Sites

1.4 SUBMITTALS

- A. As required by Special Provisions and as outlined here.
- B. Product Data: For each type of product indicated.
- C. Approval required when materials substitutions are made.
- D. Product Data: For the following:
 - 1 Grounding connectors
 - 2 Ground wire
- E. Approval of submittals required when materials substitutions are made.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit As-built Drawings as specified in Special Provisions.
- B. Accurately record actual locations of electrodes and connections.

1.6 QUALITY ASSURANCE

- A. Follow manufacturer's instructions in transporting, handling, assembling and installing the equipment.
- B. Employ only qualified crafts for and adequate means of handling of the installation of the equipment.

1.7 COORDINATION

- A. Coordinate work with site excavating, foundation installation, backfilling and final grading.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Materials as shown on the drawings or as approved by Chugach.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section 260513 "Conductors and Cables."
- B. Material: Copper.
- C. Equipment Grounding Conductors (low-voltage): Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded soft-drawn copper cable.
- F. Underground Conductors: Bare, stranded, soft-drawn copper unless otherwise indicated.
- G. Copper Bonding Conductor: As follows:
 - 1 Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch (6.4 mm) in diameter.
 - 2 Bonding Conductor: No. 4 or No. 10 AWG, stranded copper conductor.
 - 3 Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
 - 4 Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- H. Grounding Bus: Bare, annealed copper bars of rectangular cross section (with insulators at required locations).

2.3 CONNECTOR PRODUCTS

- A. Provide swaged connections as shown on the drawings.
- B. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- C. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- D. Welded Connectors: Not used, unless specifically approved by Chugach. Contractor shall submit written request for use.

2.4 CONNECTORS

- A. Material: Bronze or copper.
- B. Below Grade: Swaged.
- C. Above Grade: Mechanical, Compression, or Swaged as specified on the drawings.

2.5 WIRE

- A. Material: Stranded copper.
- B. Horizontal electrodes: #4/0 AWG copper, minimum.
- C. Grounding conductors for equipment shall be soft drawn copper and shall be sized no smaller than the following:
 - 1 Steel Structures #4/0
 - 2 Power Transformer #4/0
 - 3 Gas Circuit Breaker #4/0
 - 4 Ground Grid #4/0
 - 5 Conduit Grounds #2
 - 6 All other grounds that may be necessary shall be size in accordance with NFPA 70.

3 EXECUTION

3.1 EXAMINATION

- A. Verify site is acceptable for installation of grounding system.
- B. Commencement of work signifies acceptance of conditions.

3.2 APPLICATION

- A. In raceways, use insulated equipment grounding conductors.
- B. Exothermic-Welded Connections: Not allowed, unless specifically approved by Chugach.
- C. Equipment Grounding Conductor Terminations: Use bolted pressure connections to attach to equipment.

D. Underground connections shall be swaged type.

1 Bolted connectors shall not be utilized in below grade applications.

3.3 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of control house equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated on the drawings.

B. Install equipment grounding conductors in all feeder and branch circuits.

3.4 INSTALLATION

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

B. All electrical equipment enclosures, equipment, and all metallic parts of the installation, including structures, pipe, conduit, wireways, frames, and metalwork, shall be grounded and connected to the nearest ground cable, even if such connection is not shown on Drawings.

C. The electrical continuity of wireways, pipes, rails and enclosures shall be maintained by bonding. Bonding of electrical raceway and enclosures shall assure electrical continuity and the capacity to conduct safely any fault current that could be imposed. Bonding shall comply fully with Article 250 of NFPA 70.

D. Paint, scale, rust, corrosion, or other foreign matter shall be removed from the points of contact on metal surfaces before ground connections are made.

E. Precautions shall be taken to assure that no damage is done to grounding conductors or connections during construction. All existing grounding conductors damaged during construction work shall be replaced or repaired to comply with this section.

F. Exposed grounding conductors shall be supported on surfaces of the structures and on equipment with non-corrosive hardware, such as Everdur or equal, at not less than four foot intervals. Ground grid risers shall be visible for inspection.

G. Make ground tap connections to equipment at the points provided on the equipment for grounding in accordance with the equipment manufacturer's recommendations. Connections from ground conductors to the ground buses of switchgear, and/or panel boards shall be made by means of an acceptable swaged fitting.

H. All other electrical power equipment shall be provided with a grounded, identified grounding conductor. Power and control circuits will contain a grounding conductor.

3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1 Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2 Make connections with clean, bare metal at points of contact.

3 Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

- B. Exothermic-Welded Connections: Not allowed, unless specifically approved by Chugach.
- C. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values.
- D. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- E. Connections shall not be painted.

3.6 FIELD QUALITY CONTROL

- A. Inspect all connections for tightness.

END OF SECTION 260526

**SECTION 260533
RACEWAYS AND BOXES**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. FMC Flexible Metal Conduit.
- B. LFMC Liquidtight Flexible Metal Conduit.
- C. LFNC Liquidtight Flexible Nonmetallic Conduit.
- D. RNC Rigid Nonmetallic Conduit.
- E. HDPE High Density Polyethylene Conduit.
- F. RGS or GRSC Rigid Galvanized Steel Conduit.

1.4 SUBMITTALS

- A. Submit the following in accordance with Special Provisions:
 - 1 Product Data: For raceways and fittings, enclosures, and cabinets.
- B. Approval of submittals is required when materials substitutions are made.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit As-built Drawings as specified in Special Provisions.
- B. Accurately record actual sizes, locations, and depths of conduits on the drawings.
- C. Accurately record any deviation from project drawings.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Comply with NECA 1.

1.7 COORDINATION

- A. Coordinate layout and installation of surface mount raceways, boxes, enclosures, cabinets, and suspension systems with other construction.

- B. Coordinate layout and installation of underground conduits as shown on the drawings and to avoid intersection with other conduits and underground structures while maintaining specified conduit clearances and burial depths.

2 PRODUCTS

2.1 MANUFACTURERS

- A. As specified on the drawings and as approved by Chugach.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit, Zinc Coated (RGS): ANSI C80.1.
- B. LFMC Flexible steel conduit with PVC jacket.
- C. FMC Zinc-coated steel or aluminum.
- D. Fittings for Conduit (Including all Types and Flexible and Liquidtight): NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. RNC
 - 1 PVC NEMA TC 2.
 - 2 PVC fittings: NEMA TC 3.
 - 3 FIBERGLASS NEMA TC 14.
 - 4 HDPE NEMA TC 7.

2.4 CONDUIT ADHESIVES

- A. Bonduit by American Polywater Corporation.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1. Cast aluminum with factory finish and gasketed covers.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- E. Hinged-Cover and clamp cover Enclosures: Types and sizes and accessories as shown on drawings.
 - 1 Interior Dry Locations: NEMA 250, Type 1, galvanized steel box with factory finish.
 - 2 Exterior Cabinets: NEMA 250, Type 4 stainless steel.
- F. Cabinets: Types and sizes and accessories as shown on drawings.
 - 1 Interior Dry Locations: NEMA 250, Type 1, galvanized steel box with factory finish.

2 Exterior Cabinets: NEMA 250, Type 4 stainless steel.

1.1 FACTORY FINISHES

- G. Finish: Enclosure or cabinet components, except for stainless, shall be finished with the manufacturer's standard gray standard rust proof enamel applied to factory-assembled enclosures, and cabinets before shipping.

2.6 ACCESSORIES

- A. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
- B. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
- C. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35°F. Capable of withstanding temperature of 300°F without slump and shall not have any permanent property changes when exposed to temperatures below 35°F, recovering original workability characteristics above 35°F. Compound shall adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

3 EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors where conduits are not specified on the conduit schedule:
 - 1 Exposed: RGS.
 - 2 Concealed: RGS.
 - 3 Underground: RGS. HDPE schedule 40 shall be used for all conduits 4" diameter and greater unless otherwise noted on the drawings.
 - 4 Connection to Vibrating or Moving Equipment (Including Transformers, circuit breakers and all outdoor equipment subject to seismic and/or frost jacking movements): LFMC.
 - 5 Boxes and Enclosures: NEMA 250, Type 4 stainless steel.
- B. Indoors where conduits are not specified on the conduit schedule:
 - 1 Exposed, Concealed, Dry, Damp or Wet Locations: RGS.
 - 2 Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
 - 3 Boxes and Enclosures: NEMA 250, Type 1, except as follows: a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
- C. Minimum Raceway Size: 3/4-inch trade size (DN 21).
- D. Where conduits sizes are not specified, conform to requirements of NFPA 70 for conduits sizing.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.

- F. Conduit Elbows:
 - 1 Underground elbows for 2" diameter conduits or larger shall be fiberglass with factory installed couplers.
 - 2 Elbow radius for underground conduits 4" diameter or larger shall be 3' or greater for vertical bends and 3' or greater for horizontal bends.
 - 3 Rigid galvanized steel Conduit: Use threaded rigid galvanized steel conduit fittings and factory elbows unless otherwise indicated.

3.2 INSTALLATION

- A. Complete raceway installation before starting conductor installation.
- B. Seal and bond conduits with approved adhesives.
- C. Support raceways as specified and in conformance with NFPA 70.
- D. Install temporary closures to prevent foreign matter from entering raceways.
- E. Protect stub-ups from damage where conduits rise through floor slabs and in the field.
- F. Install conduits so curved portions of bends are not visible above the finished slab or outdoor grade.
- G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated. Each riser from the ground level to an outdoor piece of equipment shall include an offset equal to the diameter of the raceway between the end of the RGS conduit and the LFMC conduit.
- H. Underground Conduits:
 - 1 Provide trenching and backfill as specified in section 312000 Earthwork.
 - 2 Provide conduit depths, trench preparation, and backfill as shown on the drawings.
 - 3 Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line as shown in trench details. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
 - 4 Where connected to Vibrating or Moving Equipment (Including Transformers, circuit breakers and all outdoor equipment subject to seismic and/or frost jacking movements) the rigid section of conduit shall be physically anchored to the device foundation prior to transition to flexible conduit.
- I. Raceways Embedded in Slabs: As indicated on the drawings.
- J. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1 Run parallel or banked raceways together on common supports.
 - 2 Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- K. Join raceways with fittings designed and approved for that purpose and make joints tight.

1 Use insulating bushings to protect conductors.

L. Terminations:

1 Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.

2 Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

M. Install and leave pull cords in all raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

N. Stub-up Connections: Extend conduits through concrete floor and outdoor pad for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

O. Flexible Connections: Use maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

P. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1 "Devcon" or equivalent zinc rich paint, or approved equal, shall be used to touch up damaged galvanizing and applied to exposed threads at all galvanized conduit couplings and connectors. Touch up may be done by either a spray or brush application.

2 Repair damage to paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 260533

**SECTION 260550
FIELD TESTING**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. This specification covers the field testing of the substation equipment and electrical systems installed or constructed by the Contractor. It is the intent of this specification that field testing be extensive and complete, as specified, to provide positive assurance of correct installation and operation of equipment. The Contractor shall subcontract the services of a QUALIFIED testing firm or INDIVIDUALS, hereafter referred to as the "Testing Subcontractor" to perform all electrical testing specified herein.
- B. This specification includes, but is not limited to, the following:
- 1 Testing of all wire, cable, electrical equipment and systems installed or connected by the Contractor to assure proper installation, adjustment, setting, connection, and functioning in accordance with the drawings, these specifications and the manufacturer's recommendations.
 - 2 Furnishing of qualified personnel and labor required for, and incidental to testing.
 - 3 Furnishing all test equipment required to perform all tests, including special equipment as required, and qualified operators for testing equipment.
 - 4 This specification includes all testing required during installation and prior to energization of substation equipment and electrical systems installed or constructed by the Contractor. The scope of work does not include testing of equipment or systems off-site. The Contractor shall cooperate with and coordinate with Chugach for testing of systems and equipment that interface with Chugach's facilities that may be required to confirm phasing, rotation or other electrical characteristics.

1.3 DEFINITIONS

- A. ATS Acceptance Testing Specifications.

1.4 REFERENCES

- A. The latest and applicable sections of the following standards are to be used in the performance of the work:
- 1 NESC - National Electric Safety Code
 - 2 NEC - National Electric Code
 - 3 IEEE - Institute of Electrical and Electronics Engineers
 - 4 REA Bul. 1724E-300 (Design Guide for Rural Substations)
 - 5 REA Pub. 202-1 (List of Materials)
 - 6 AEIC - Association of Edison Illuminating Companies

- 7 NEMA - National Electrical Manufacturer's Association
- 8 NECA - National Electrical Contractor's Association
- 9 NETA - International Electrical Testing Association
- 10 ANSI - American National Standards Institute

1.5 SUBMITTALS

- A. Testing Subcontractor qualifications.
- B. Testing plan and schedule for all conductors and equipment.
- C. Certified test equipment calibration reports.
- D. Test Reports:
 - 1 The Testing Subcontractor shall submit reports for all tests performed.
 - 2 The Testing Subcontractor shall maintain a written and electronic record of all tests showing date, personnel making test, equipment or material tests performed, and results. A copy of these reports shall be submitted to Chugach on a weekly basis.
 - 3 Submit two written copies and one electronic copy of the final test reports, as specified.
 - 4 The Testing Subcontractor may use his standard report forms subject to the approval of Chugach.
 - 5 Electronic documents shall be submitted in Word/Excel 2003, or earlier format, or in searchable unsecured PDF.

1.6 QUALITY ASSURANCE

- A. The Testing Subcontractor shall furnish the services of a testing supervisor who is a graduate electrical engineer or an approved technician, thoroughly familiar with substation relaying and controls who shall perform the following:
 - 1 Be personally present on the jobsite during the testing of all wiring, controls, and systems furnished, installed, or connected by the Contractor and until they are all in complete and satisfactory operation, and the substation is ready for Chugach's personnel.
 - 2 Conduct and direct the complete program of testing specified herein.
 - 3 Check all wiring installed by the Contractor for proper connection according to the diagrams shown in the plans, connection diagrams, and the manufacturer's shop drawings.
- B. The Contractor shall submit to Chugach a proposed testing plan. This plan will detail at a minimum the following:
 - 1 Specific tests to be performed on each piece of equipment, cable, or system.
 - 2 Testing procedures to be followed for each type of test.
 - 3 List references and standards which require a specified test.
 - 4 Provide a list of the manufacturers recommended tests and procedures.

- 5 List of testing equipment to be used and calibration certificates for proposed testing equipment.
 - 6 List of personnel responsible for performing tests and their qualifications. Provide certifications and proof of training applicable to the tests and equipment to be provided under this contract. Provide resumes which show testing and commissioning experience.
 - 7 Testing schedule based on the project schedules.
- C. Follow recommendations and instructions of equipment manufacturer and NETA ATS in addition to requirements of drawings and specifications in testing of equipment.

1.7 COORDINATION

- A. Coordinate tests with completion of equipment or system installation and with the completion of auxiliary or related equipment that may be affected by tests. Schedule testing and provide notification of testing to Chugach so as not to delay construction or system energization.
- B. Notify Chugach two weeks prior to commencement of all testing.

1.8 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to be tested.

1.9 TESTS

- A. The types of tests to be performed under this specification shall include, but are not limited to, the following:
 - 1 Power and control cable: All power and control cables installed by the Contractor shall receive a Megger test. Megger all 600 volt power and control cable with a 1000 volt Megger for one minute. Values at the end of one minute must be as follows:

Conductor Capacity Amps	Minimum Resistance Ohms
0 - 24	1,000,000
25 - 50	250,000
51 - 100	100,000
101 - 200	50,000
201 - 400	25,000
501 - 800	12,000
Over 800	5,000

Table 2: Acceptable Megger Test Results

- 2 Instrument cable: All instrument cables installed by contractor shall be Megger tested. Megger at 500 volts for one minute each conductor of a multi-conductor cable to all other conductors and the shield. Devices that can be damaged by Megger testing shall be removed from the circuit prior to testing. Megger wire and cable after installation and termination, not on the cable reel.
- 3 Instrument Transformer Tests: No Tests are required.
- 4 Continuity Tests: All power and control cables shall be tested for continuity between each termination point.

- 5 Phase Relationships tests: Connections to all equipment shall be checked and verified by the Contractor. Any device which could be damaged by the application of a voltage of reversed phase shall be disconnected prior to the check. Contractor shall be responsible for maintaining the phasing as shown on the Drawings.
- 6 High Potential Tests: High potential tests shall be performed in accordance with the following: Observe all precautions to ensure the safety of all personnel associated with and near the area of the test. Perform a visual inspection of equipment to be tested prior to the commencement of the test for dirt and moisture accumulation and to assure work is complete. Record air temperature, barometric pressure, and humidity prior to the test. Perform megger test prior to high potential test. The high potential test form can be found in Appendix F.
- 7 Power Cable: Medium voltage power cable for a new installation shall be performed as an acceptance test and shall be tested in accordance with IEEE Std. 400. In no case shall the cable manufacturer's maximum recommended test voltage be exceeded. Test Cable for 15 minutes with a dc test set only, from conductor to shield or armor with shield or armor grounded. Perform test with cable installed in permanent location, properly terminated, disconnected from equipment. Direct-buried cable shall be tested when the cable has a minimum 1 foot compacted permanent cover over the cable.

1.10 TESTING EQUIPMENT

- A. The Contractor shall provide all testing equipment required to perform tests.
- B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.11 PERFORMANCE OF TESTS

- A. Testing requirements shall include all tests recommended by the equipment manufacturer for the lighting, high and low voltage power cable and instrumentation cable unless specifically waived by Chugach.
- B. Additional tests shall be performed, as deemed necessary by Chugach, because of field conditions or to determine that equipment material and systems meet the requirements of the contract documents. The Contractor shall be responsible for all damage to equipment or material due to improper test procedures or test apparatus handling.
- C. After completing testing and checkout of equipment, wiring, control schemes, and other items associated with individual systems, and believing a system to be ready for operation, the Contractor shall notify Chugach, who may elect to witness a final operational test of each individual system.
- D. Test procedures, equipment, temporary circuits, etc., shall be designed and utilized to minimize danger to testing technicians and surrounding personnel; Furnish and use safety devices such as rubber gloves and blankets, provide protective screens and barriers, yellow tape, and danger signs, to adequately protect and warn all personnel in the vicinity of the tests.

1.12 EQUIPMENT TESTS

- A. Equipment tests shall be performed in accordance with the following.
- B. Miscellaneous Equipment.
 - 1 Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

2 The Contractor shall perform tests on all equipment and systems installed by the Contractor. This shall include, but not be limited to, the following:

- a. Wiring Devices: After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

C. Auxiliary System Energization. The auxiliary systems shall include the substation ac service power and the dc control power. Chugach shall be advised two weeks prior to the energization of this equipment. This equipment may be energized from a backup or emergency source upon the concurrence of Chugach. The Contractor will be required to have concluded all testing and checkout of equipment prior to energization. Preliminary test reports are required to be submitted to Chugach prior to the energization of the equipment.

1 The following procedure shall be followed when placing an auxiliary system in-service:

- a. Check all circuit connections and phase relationships immediately prior to energization.
- b. Megger all circuits phase-to-phase, phase-to-ground, wire-to-wire or wire-to-ground immediately preceding energization to assure temporary grounds have been removed.
- c. Disconnect all solid state equipment and ground fault circuit interrupters before making cable tests. Contractor responsible for damage to any such equipment caused by cable tests.
- d. Energize equipment one stage, section, circuit, or piece at a time to minimize damage upon equipment failure and to aid in locating trouble areas.
- e. The Contractor shall be responsible for implementing the tagging procedure upon energization of equipment. He shall also verify that proper voltage levels, current levels, phasing and rotation have been achieved after each energization step. If necessary, corrections shall be made beforeproceeding to the next step.
- f. All measurements and tests shall be recorded. All cables tested and installed by the Contractor shall be noted on a set of Contractor mark-ups. The mark-ups shall clearly note the cables and conductors the Contractor has tested for continuity and Megger. The date and testing person shall be clearly recorded on the mark-ups.

D. Power Cable Tests. The following tests and checks shall be performed on all 15 kV power cables installed under this contract.

1 Hi-Pot and Insulation Resistance test

END OF SECTION 260550

**SECTION 260553
ELECTRICAL IDENTIFICATION**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1 Identification for conductors and communication and control cable.
 - 2 Underground-line warning tape.
 - 3 Warning labels and signs.
 - 4 Instruction signs.
 - 5 Equipment identification labels.
 - 6 Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- D. Approval of submittals required when materials substitutions are made.

1.2 QUALITY ASSURANCE

- E. Comply with ANSI A13.1 and ANSI C2.
- F. Comply with NFPA 70.
- G. Comply with NESC.
- H. Comply with 29 CFR 1910.145.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.

1.3 QUALITY ASSURANCE

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NFPA 70.
- F. Comply with NECA 1.

1.5 COORDINATION

- A. Coordinate layout and installation of surface mount raceways, boxes, enclosures, cabinets, and suspension systems with other construction.
- B. Coordinate layout and installation of underground conduits as shown on the drawings and to avoid intersection with other conduits and underground structures while maintaining specified conduit clearances and burial depths.

2 PRODUCTS

1.4 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Heat Shrink Wire Markers: Provide polyolefin heat shrink tubing makers. Printing shall be by thermal transfer with black characters/lettering on a white background. Heat shrink tubing shall be compatible with printing device used. Provide heat shrink labels from the following manufacturers:
 - 1 Brady B-342 permaleeve markers.
 - 2 Kroy Shrink Tubing.
 - 3 Substitutions will be permitted at Chugach's discretion. Contractor shall provide a written request for wire label substitution. Chugach may request physical samples be submitted to approve a wire label substitution.
- C. Cable Tags:
 - 1 Provide Brady type B-145 polyethylene tag material with a grey background and black printed lettering.
 - 2 Substitutions for this tag type will be permitted at Chugach's discretion. Contractor shall provide a written request for cable tag substitution. Chugach may request physical samples be submitted to approve a cable tag substitution.

2.2 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1 Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
 - 2 Compounded for permanent direct-burial service.
 - 3 Embedded continuous metallic strip or core.
 - 4 Printed legend shall indicate type of underground line.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1 Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2 Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
 - 1 Engraved legend with black letters on white face.
 - 2 Punched or drilled for mechanical fasteners.
 - 3 Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.
- B. Stenciled Legend: In non-fading, waterproof, black ink or paint. Minimum letter height shall be 2 inch (25 mm).

1.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- C. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1 Minimum Width: 3/16 inch (5 mm).
 - 2 Tensile Strength: 50 lb (22.6 kg), minimum.
 - 3 Temperature Range: Minus 40°F to plus 185°F (Minus 40°C to plus 85°C).
 - 4 Color: Black, except where used for color-coding.
- D. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

3 EXECUTION

3.1 APPLICATION

- A. All wires and cables installed by the contractor be labeled at their terminations as shown on the drawings and as approved by Chugach.
- B. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use heat shrink markers. Identify each ungrounded conductor according to source and circuit number.
- C. Wiring Devices: write panel and circuit number in inside on back side of cover-plate with indelible marker. Identify each ungrounded conductor according to source and circuit number with heat shrink markers.
- D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1 Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2 Use system of cable tags and heat shrink markers that is uniform and consistent with drawings or the system used by manufacturer for factory-installed connections.
 - 3 Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway or conduit systems. Install warning tape as shown on drawings under ground conduit details.
- F. Equipment Identification Labels: On each unit of equipment, install unique designation label as shown on the nameplate drawings or provide label consistent with equipment designations on drawings or wiring schematics.
 - 1 Labeling Instructions:
 - a. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 2 Equipment to Be Labeled:
 - a. Enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Circuit Switchers.
 - d. Power Fuses.
 - e. Phasing on Medium Voltage Circuits.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Heat shrink wire markers: Markers shall be heat shrunk onto the wires so that the lettering is visible in the as-left condition.
- D. Apply identification devices to surfaces that require finish after completing finish work.
- E. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- F. Retain paragraph below for non-adhesive signs or labels.
- G. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- H. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side.
- I. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

END OF SECTION 260553

**SECTION 261200
TRANSFORMERS**

1 GENERAL

1.1 SECTION INCLUDES

- A. Existing Power Transformer.
- B. Auxiliary Equipment and Interconnections.

1.2 DESCRIPTION OF THE WORK

- A. This section covers the removal and re-installing the Power Transformer. Work also includes making all connections necessary to other equipment to provide a functioning electrical installation. Major equipment to be installed under this section includes:
- B. 14 MVA 34.5/12.47 kV Power Transformer.

1.3 SUBMITTALS

- A. Welder's certificate of fitness and welding procedures.

1.4 PROJECT RECORD DOCUMENTS

- A. As-built Drawings as specified in Special Provisions.

1.5 QUALITY ASSURANCE

- A. Follow manufacturer's instructions in transporting, handling and installing the equipment.
- B. Employ only qualified crafts.
- C. Provide adequate means of handling of the installation of the equipment.
- D. Verify that field conditions are acceptable and are ready to receive equipment.
- E. Begin installation only after examination is complete and site is in all respects, ready for equipment installation to proceed.
- F. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 COORDINATION

- A. Coordinate all equipment transfer and installation activities with Chugach. Chugach to commission all equipment. Coordinate with Chugach for commissioning of installed equipment.
- B. Power Transformer bushings shall be installed and commissioned by Chugach personnel. Coordinate all activities through Chugach's Site Representative.

2 PRODUCTS

- A. Power Transformer listed under description of work are Chugach-furnished. Product information is included on the project Drawings.
- B. Contractor shall supply and install all additional materials for complete installation of Power Transformer.

3 EXECUTION

3.1 EXAMINATION

- A. Visually inspect equipment for physical damage.
- B. Verify dimensions as shown on the Drawings.
- C. Assure work of other trades is complete and site is ready to receive the equipment.
- D. Field cutting, drilling, punching, or burning is not permitted. Any parts which do not fit or are misaligned will be rejected.

3.2 PREPARATION

- A. Clean placement surfaces of debris.
- B. Clean all insulators.
- C. Contractor shall verify allowed angle from vertical for oil filled devices. Contractor shall not exceed allowed angles during transport and placement of oil filled devices.

3.3 INSTALLATION

A. 14 MVA Power Transformer

- 1 This section covers installation of an existing Chugach-furnished Power Transformer.
 - a. The Power Transformer will be removed and set on the temporary pad by the Contractor. The Contractor shall ensure the Power Transformer is set on the pad in the correct location.
 - b. The Contractor shall direct the placement of the Power Transformer onto the correct position on the new pad, secure the Power Transformer to the pad, and install ground and conduit connections.
 - c. Welding shall be performed by qualified personnel in accordance with AWS D1.1 and D1.8. Provide welded attachment to foundation embedded steel. The Contractor shall provide welder qualifications for Chugach review.
 - d. Provide temporary dunnage to store the existing Power Transformer, surge arrestors, bushings, and other equipment near Power Transformer location, in the south east corner of the switchyard. Provide labor and equipment to off load surge arrestors, bushings, and equipment. Power Transformer, bushings, and other equipment associated with the Power Transformer shall be the Contractors responsibility until the transformer is tested and re-energized by Chugach. If any of the above equipment is damaged during this time period the contractor shall replace it with no additional compensation.
 - e. Install all power, control and grounding connections as shown on drawings.
 - f. Lightning arresters shall be removed and replaced by the contractor.
 - g. Bushings will be removed and replaced by Chugach.
 - h. Final installation of all medium and high-voltage jumpers shall be coordinated with Chugach.

3.4 TOLERANCES

- A. Alignment 1/16 inches horizontal, 1/16 inches vertical.

3.5 TESTS

- A. Chugach to test and commission equipment. No tests required.

3.6 PROTECTION

- A. Assure adequate protection from the environment until all covers, valves etc. are installed and functioning.

END OF SECTION 261200

**SECTION 261220
BUSWORK, CONDUCTORS AND FITTINGS**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. This specification includes, but is not limited to, the following:

- 1 Rigid bus
- 2 Flexible bus
- 3 Swaged, Bolted, and Compression Connections

1.3 DESCRIPTION OF THE WORK

- A. This Section covers the material and installation of all buswork including rigid buses, flexible jumper buses, cable jumpers, fittings and all hardware required to form a complete system of current carrying paths connecting the equipment as shown on the Drawings.

1.4 SUBMITTALS

- A. Shop Drawings and product data for all Contractor furnished equipment and materials.

1.5 PROJECT RECORD DOCUMENTS

- A. Maintain accurate information of all installations on Drawings, product information, test reports and instruction manuals in accordance with the Special Provisions.

1.6 QUALITY ASSURANCE

- A. Use qualified crafts, trained in the specific task(s) to be performed.
- B. Provide complete details of swaged procedures.
- C. Operate swaged connection press in accordance with manufacturer's instructions.

1.7 FIELD MEASUREMENTS

- A. Verify that all field measurements are as indicated on the Drawings.
- B. Determine required location, arrangement and quantities of materials from the Drawings.

1.8 COORDINATION

- A. Coordinate timing of installations with other trades.

1.9 TOOLS

- A. Contractor shall provide a swaged press for use to construct bus for this project.

2 PRODUCTS

2.1 MATERIALS

- A. Tubular Bus: Extruded aluminum seamless pipe made of 6063-T6 alloy, schedule 40 as indicated on the Drawings. Tubular bus shall be manufactured and supplied in conformance with ASTM B-241.

2.2 CONNECTIONS

- A. Bolted Connectors: As indicated on the drawings or approved equal.
- B. Compression Connectors:
 - 1 As indicated on the drawings or approved equal.
 - 2 Swaged for tubular and flexible jumper bus conductors.
- C. Fasteners: All bolts, washers, and lock washers for bus connections shall be Grade 8 Cad Plated or Stainless Steel (300 series CRES) and provided by Contractor. All nuts shall be silicone bronze. Aluminum is not acceptable. All conductors at joints and fittings shall be clean and free of foreign matter. Excluding DMC Power swaged connections, an oxide-inhibiting compound (Burndy "Penatrox A" or an approved equal) shall be used at all connections involving aluminum conductor and fittings.
- D. 34.5kV and 12.47kV Bus: Swaged compression type as shown on Drawings.

3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive the work.
- B. Verify all dimensions prior to cutting bus section.

3.2 PREPARATION

- A. When aluminum bus is prepared for shipment by wrapping in paper or packaging in cardboard cartons, the bus finish may be damaged if such materials are allowed to become wet and remain on the bus. The Contractor shall unpack, clean, and check aluminum bus immediately upon receipt from the carrier. Contractor shall remove all materials which might damage the bus finish and store the bus in such a manner that the finish will be protected.
- B. Before assembly and erection thoroughly clean equipment of all protective coatings and foreign materials.
- C. Aluminum to aluminum connections shall be prepared by covering the contact surfaces with "Penetrox A". Then the surface shall be thoroughly cleaned with fine steel wool and bolted together without removing the compound from the contact surfaces. When making aluminum-copper connections place the aluminum above the copper.
- D. Aluminum to aluminum connections made with DMC Power swaged connectors do not require contact surfaces to be prepared with any compounds. Follow manufacturer's instructions for surface preparation.

- E. Copper to copper connections shall be prepared by rubbing the tinned contact surfaces lightly with fine steel wool, covering them with "Penetrox A" and bolting together without removing the compound from the contact surfaces. If the copper terminals are not tinned, surfaces shall be prepared by cleaning with emery cloth down to bright metal and tinning before applying "Penetrox A".

3.3 INSTALLATION

- A. Install buses, damping conductors, cable jumpers, fittings, and all connectors in complete conformance with manufacturers' recommendations.

- B. Tubular Bus

- 1 All bus shall be field cut and trimmed to the required configurations. Bus supports shall be adjusted so that the centerline of the bus is uniform, in alignment, and fits snugly in its saddle. Placement of shims may be necessary. Skewing will not be permitted, and there shall be no offsets where joints are made. Vertical bus or risers shall be perpendicular to, and in alignment with, lower bus. Bus to equipment shall be carefully formed prior to installation by field cutting and bending so as to eliminate any strain on the porcelain equipment bushings from "forced" connection.
- 2 Where possible, the Contractor shall install bus conductor such that runs between fittings and terminal connectors shall be one continuous run without joints.
- 3 Care shall be exercised in handling bus to prevent damage to the surface such as nicks and abrasions. Sharp edges and protrusions shall be ground smooth in order to prevent corona discharge from the bus.
- 4 The Contractor shall drill weep holes in all bus risers, bends, A-frames, and horizontal runs at the lowest practical point to drain moisture accumulation. Unless otherwise noted on the Drawings, the size of weep holes shall be 3/16-inch diameter for bus 3-inch IPS and 4-inch IPS. All holes shall be reamed to remove sharp edges.
- 5 All tube cutting shall be done with an approved pipe cutter. Flame cutting will not be permitted.
- 6 Use extreme care not to scratch or mar aluminum surfaces. Contractor shall replace all damaged buswork and fittings without additional compensation.
- 7 Expansion joints will be shipped unassembled and shall be installed to the configuration as shown on the Drawings.
- 8 All tubular bus connectors shall be DMC Power swage fittings. Bus couplers shall be installed as specified on the Drawings within the first quarter span either side of a bus support. Bus couplers outside of the first quarter span are not approved.

- C. Swaged and Compression Connections

- 1 Install per manufacturer's recommendations.
- 2 Minimum distance between two swaged fittings is 6 inches.

- D. Bolted Connections

- 1 Use corrosion inhibiting compound (Penetrox-A) for all connections, except where using DMC Power swaged connectors.

- 2 Use torque wrenches in accordance with manufacturer's recommendations for bolt installations.
- 3 Remove excess compound.
- 4 All bolts, washers, and lock washers for bus connections shall be Grade 8 Cad Plated or Stainless Steel (300 series CRES) and provided by Contractor. All nuts shall be silicone bronze. Aluminum is not acceptable. All conductors at joints and fittings shall be clean and free of foreign matter. Excluding DMC Power swaged connections, an oxide-inhibiting compound (Burndy "Penatrox A" or an approved equal) shall be used at all connections involving aluminum conductor and fittings.
- 5 Bolts installed vertically shall have the bolt head oriented gravitationally down (nut on top).
- 6 No more than three and no less than one thread shall be showing when the nut is attached and tightened to the correct torque value.

E. Compression Connections for Flexible Conductors

- 1 Install connectors with properly sized dies in accordance with the manufacturer's instructions. All required dies and equipment is to be furnished by the Contractor.
- 2 Apply oxide inhibiting compound compatible with the connections and surface conditions involved.
- 3 Where inverted connections are required provide swaged connections with weep hole. Inverted compression type connectors are not acceptable.

F. Jumper Loops and Strings

- 1 Flexible jumpers and flexible vertical cable taps shall be installed of such length and form as to maintain maximum clearance for surrounding objects and to give assurance that such contour will be stable. Cable for the jumper buses shall be the type and size shown on the Drawings. Jumper buses shall be smoothly formed, and adjacent runs shall be similarly and symmetrically shaped to provide a uniform and aesthetically pleasing appearance throughout.
- 2 Stranded conductor shall be installed without twists, kinks, or "bird-caging" and shall be handled to avoid abrasions or other damage. No splices shall be allowed in overhead strain buses.

3.4 TOLERANCES

- A. Horizontal Bus: 1/8 inches per 10 Feet length.
- B. Vertical Bus: 1/8 inches per 10 Feet length.

3.5 FIELD QUALITY CONTROL

- A. Chugach's Representative may inspect all swaged, compression, and bolted connections. Contractor shall assist by providing equipment and operators to access locations.
- B. Radiographic and/or infrared tests may be performed by Chugach. Contractor shall provide assistance in performing such tests.

3.6 PROTECTION

- A. Maintain safe clearances from all existing installations not part of this project.
- B. Safeguard all existing facilities.

END OF SECTION 261220

**SECTION 261225
INSULATORS**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. This specification includes, but is not limited to, the following:

- 1 Station Post Insulators
- 2 Auxiliary Equipment and Interconnections

1.3 DESCRIPTION OF THE WORK

- A. This section covers receiving and installing insulators and their mounting and all connections necessary to other equipment to provide a functioning electrical installation.

1.4 SUBMITTALS

- A. Shop Drawings and product data for all Contractor furnished equipment and materials.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit As-built Drawings as specified in Special Provisions.

1.6 QUALITY ASSURANCE

- A. Follow manufacturer's instructions in transporting, handling, and installing the equipment.
- B. Employ only qualified crafts for and adequate means of handling of the installation of the equipment.

1.7 COORDINATION

- A. Coordinate all activities through Chugach's Site Representative.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: As specified on the drawings or approved by Chugach.

3 EXECUTION

3.1 EXAMINATION

- A. Visually inspect equipment for physical damage.
- B. Verify dimensions as shown on the Drawings.
- C. Assure work of other trades is complete and site is ready to receive the equipment.

3.2 PREPARATION

- A. Clean placement surfaces of debris.
- B. Remove protective coverings.
- C. Clean Insulators.

3.3 INSTALLATION

A. Station Post Insulators

- 1 Install on support structures as shown on the Drawings.
- 2 Contractor to provide all required auxiliary equipment and materials required for mounting and interconnections.
- 3 Torque bolts to the manufacturer's instructions.
- 4 Make electrical connections in accordance with the Drawings.

3.4 TOLERANCES

- A. Station post insulator alignment: 1/4 inches horizontal, 1/4 inches vertical.

END OF SECTION 261225

**SECTION 312000
EARTHWORK**

1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1 Classified Fill.
- 2 Crushed Rock Surface Course.
- 3 AASHTO #57 Coarse Aggregate
- 4 Bedding Sand.
- 5 Separation Geotextile.
- 6 Final Grading.
- 7 Excavating, backfilling, and compacting for foundations, pads, and other underground structures.

1.3 DEFINITIONS

- A. Crushed Rock Surface Course: Crushed gravel or rock placed above subgrade on substation site. Shown as 'Crushed Rock' on drawings.
- B. AASHTO #57 Coarse Aggregate: Open-graded, self-compacting aggregate blend of size 5, 6, & 7 stone placed as part of the transformer oil secondary containment system.
- C. Excavation: Removal of material encountered below subgrade.
- D. Backfill: Soil material used to fill an excavation.
- E. Subgrade: Final surface or elevation after completing cut, or top surface of a fill or backfill that will be directly below topsoil, crushed rock surface, or leveling course.
- F. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Product Data for the following:

- 1 Geotextile.

- B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

- 1 Particle Size Analysis according to ASTM D 422 for Classified Fill, AASHTO #57 Coarse Aggregate, and Crushed Rock.

2 Laboratory density according to ASTM D 1557 for Classified Fill.

C. Compaction density testing program and test equipment calibration certificate.

1.5 QUALITY CONTROL/QUALITY ASSURANCE

A. Contractor shall provide his own quality control program for field density testing, as further specified in Section 3 of this Specification. Chugach may, at their option, provide additional field density testing for quality assurance.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities unless permitted in writing by Chugach and then only after arranging to provide temporary utility services according to requirements indicated.

1 Notify Chugach not less than two days in advance of proposed utility interruptions.

2 Do not proceed with utility interruptions without Chugach's written permission.

2 PRODUCTS

2.1 SOIL MATERIALS

A. Classified Fill

1 Classified Fill shall consist of sand and gravel material free from lumps, frozen material, balls of clay, organic matter, or other objectionable matter, durable and sound conforming to the quality requirements of AASHTO M-147 and shall meet the following washed sieve gradation. Municipality of Anchorage, Type II-A material qualifies as a Classified Fill.

Classified Fill	
Sieve Size	% Passing by Weight
3 inch	100
3/4 inch	50-100
#4	25-60
#10	15-50
#40	4-30
#200	0-6

Table 3: Classified Fill

B. Crushed Rock

1 Crushed Rock shall consist of hard, angular crushed, washed natural stone uniform in density and quality, and free from thin and elongated pieces, friable materials and debris, dirt, and other objectionable material. At least fifty (50) percent of the coarse aggregate particles shall have two or more mechanically fractured faces. The aggregate shall meet the following washed sieve gradation as follows:

Crushed Rock	
Sieve Size	% Passing by Weight
3 inch	100
2 inch	90-100
1 1/2 inch	80-95
1 inch	30-60
3/4 inch	0-10
3/8 inch	0-3

Table 4: Crushed Rock

C. AASHTO #57 Coarse Aggregate

- 1 AASHTO #57 stone as defined by quarries, state agencies, etc. is an open-graded, self-compacting aggregate blend of size 5, 6, & 7 stone. The aggregate shall meet the following washed sieve gradation as follows:

AASHTO #57 Coarse Aggregate	
Sieve Size	% Passing by Weight
1 1/2 inch	100
1 inch	95-100
1/2 inch	25-80
#4	0-10
#8	0-5

Table 5: AASHTO #57 Coarse Aggregate

D. Bedding Sand

- 1 Bedding Sand shall consist of clean, sound, durable particles of sand, stone, or gravel and shall be free from ice, frozen material, organic matter, excess coatings of clay, silt, and other deleterious material and shall contain no clay balls. Anchorage Sand & Gravel product 13206B Class E Bedding Material qualifies as Bedding Sand. Bedding sand shall be graded within the design range indicated as follows:

Bedding Sand	
Sieve Size	% Passing by Weight
1/2 inch	100
3/8 inch	80-100
#4	20-75
#8	12-60
#30	2-30
#200	0-6

Table 6: Bedding Sand

E. Geotextile

- 1 Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
- 2 Tensile Strength: 180 x 180 lb; ASTM D-4632.

- 3 Elongation: 15%; ASTM D-4632.
- 4 CBR Puncture: 550 psi; ASTM D-6241.
- 5 Trapezoidal Tear: 70 x 70 lb; ASTM D-4533.
- 6 UV Resistance (500 hours): 70%; ASTM D-4355.
- 7 Apparent Opening Size (AOS): No. 40 sieve maximum; ASTM D-4751.
- 8 Permittivity: 0.05 per second, minimum; ASTM D-4491.
- 9 Water Flow Rate: 4 gpm/sq. ft., minimum; ASTM D-4491.

2.2 STOCKPILE MATERIAL

- A. Stock Piled Material: None

3 EXECUTION

3.1 PREPARATION

- A. Preparation of subgrade is not applicable as this substation is existing.

3.2 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.3 EXCAVATION AND INSPECTION

- A. Undeveloped areas to be graded shall be excavated minimum 12 inches below existing ground surface. Excavate additionally as required to expose planned subgrade, to remove frost susceptible (silty) soils within 30 inches of the depth below planned subgrade, or to completely remove organics, obstructions, and debris.
- B. Prior to filling or covering notify Chugach when excavations have reached required depth.
- C. If Chugach determines that unsatisfactory soil is present, continue excavation as directed.
- D. Where frost susceptible (silty) soils are encountered in structural areas, place geotextile between the silty soils and backfill regardless of the depth to subgrade.
- E. Where native soils are left at the subgrade surface in structural areas, subsurface shall be scarified to 6 inches depth and compacted to not less than 95% of maximum dry unit weight according to ASTM D1557.
- F. Reconstruct subgrade damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Chugach.
- G. This project takes place in a historical substation where contaminated soils may exist. Should contaminated soils be encountered in the course of excavation, the Contractor shall cease excavation activities and notify Chugach.

3.4 FOUNDATION EXCAVATION

- A. Foundations shall be over-excavated if silty, soft, or loose soils are encountered or as noted on the Drawings.

- B. Bottom of excavation for other foundations shall be scarified to a depth of 6 inches and compacted to not less than 95% of maximum dry unit weight according to ASTM D 1557.

3.5 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation with compacted Classified Fill material.

3.6 STORAGE OF SOIL MATERIALS

- A. Stockpile excavated backfill materials and excavated soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Stockpile soil materials away from edge of excavations.

3.7 FILL AND BACKFILL

- A. Place and compact backfill in excavations promptly.
- B. Classified Fill
 - 1 Place fill and backfill in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers. Compact Classified Fill materials to not less than 95% of maximum dry unit weight according to ASTM D 1557.
 - 2 Uniformly moisten or aerate fill layer before compaction to within 2 percent of optimum moisture content. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.8 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to contours indicated on the drawings.
- B. Provide a smooth transition between adjacent existing grades and new grades surrounding all foundations and work areas.
- C. Site Grading: Establish slope grades to pre-construction grades.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will perform field quality control testing. Chugach may, at their option, engage a qualified independent geotechnical engineering testing agency to perform field quality-assurance testing.
- B. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed on each lift of material at the following frequency:
 - 1 Footings – One test per every 200 square feet of concrete footing, minimum of one test per concrete footing.
 - 2 Site Utility Trenches – One test every 200 feet of trench.
- C. When soils have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; re-compact and retest until specified compaction is obtained.

3.10 GEOTEXTILE

- A. A. Separation Geotextile: Lay geotextile parallel to the slope at surface of subgrade. Stretch geotextile to remove any creases or wrinkles. Join edges by sewing a double-thread chain stitch or overlap a minimum of 3 feet. Sew or overlay areas torn or punctured.

3.11 CRUSHED ROCK

- A. Place crushed rock surface course over separation geotextile.
- B. Shape to required elevations.
- C. Compact with a minimum of 6 passes of a 15-ton roller or other Chugach-approved vibrating equipment.

3.12 AASHTO #57 COARSE AGGREGATE

- A. Place AASHTO #57 Coarse Aggregate as specified on the Drawings.
 - A. This material cannot be compacted in a true sense, but can be properly oriented with compaction equipment. Compaction testing of #57 stone with a nuclear gauge or other device is not possible. So rather than compaction tests, #57 stone should have its individual stone facets properly oriented using a plate compactor, jumping jack, or other Chugach-approved vibratory compaction devices. Using compaction equipment, #57 stone will typically compact about one inch in vertical height, which is equivalent to about 8% settlement. This can be visually observed and verified.
 - B. Shape to required elevations.

3.13 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions. Reshape and re-compact as directed by Chugach.

3.14 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus excavated material from the substation site.
- B. The Contractor shall remove contaminated soils from the excavation as directed by Chugach. Contaminated soils will be disposed of by Chugach.

END OF SECTION 312000

**SECTION 03 10 00
CONCRETE FORMWORK**

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION:

- A. This Section includes formwork for cast-in-place concrete.

1.3 RELATED REQUIREMENTS

- A. Section 03 20 00 – Concrete Reinforcement.
B. Section 03 30 00 – Concrete.

1.4 REFERENCES

- A. IBC 2012– International Builders Code
- 1 Publication dates for listed standards shall comply with standards referenced within 2012 International Building Code or those that are in effect as of the date of the Contract Documents if not referenced within 2012 International Building Code or noted otherwise.
- B. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.
- C. ACI 301 - Specifications for Structural Concrete.
- D. ACI 318 - Building Code Requirements for Structural Concrete.
- E. ACI 347 - Guide to Formwork for Concrete.
- F. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- G. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- H. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.

2 PRODUCTS

2.1 MATERIALS FOR FACING

- A. Where concrete will be exposed to view after construction:
- 1 Smooth finish exterior grade plywood at least 5/8 inch thick.
- 2 Steel.
- 3 Do not use form-facing materials with raised grain, torn surfaces, worn edges, dents, or other defects that will impair the texture of concrete surfaces.
- B. Where concrete will not be exposed to view after construction:

- 1 Exterior grade plywood at least 5/8 inch thick.
 - 2 Steel.
 - 3 Wood fiberboard.
 - 4 Dressed lumber free of loose knots.
- C. Treat forms with commercially available form releasing agents that will not bond with, stain, or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion, nor shall it impede the wetting of surfaces to be cured with water or curing compounds. Form releasing agents shall be VOC compliant with a maximum VOC content of 3.8 lbs./gal. (450 g/L), or less where area restrictions are more stringent.
- D. Clean forms of sawdust, dust, dirt, and other foreign materials.

2.2 FORM TIES

- A. Break-back, coil, or screw type, except where otherwise specified.
- B. Water seal coil type in walls below grade and walls of water-bearing structures. Removable through-wall tapered ties shall not be used.
- C. Coil type shall leave conical depression in concrete.
- D. Space as required against pressure of fresh concrete.
- E. The portion of the form tie remaining in place shall provide for a clearance of two times the minimum dimension of the tie, but not less than 3/4 inch, from the formed surface.

2.3 CHAMFER STRIPS

- A. 3/4-inch chamfer except where otherwise indicated.
- B. Place in all forms to provide chamfer where concrete will have exposed projecting corners.

3 EXECUTION

3.1 FORM CONSTRUCTION

- A. Conform to ACI 301, 318, and 347, except shop drawings for formwork, shoring, and re-shoring shall not be submitted for approval.
- B. Adequately brace, stiffen, and support forms to prevent perceptible deflection or settlement, and to hold plumb, level, and true to line.
- C. Construct and maintain forms to the tolerances given in ACI 117.
- D. Construct sufficiently tight to prevent mortar leakage.
- E. Avoid offsets between adjacent forms and construct so that shores, braces, and stiffening members are in line with those below.
- F. Space studs and stringers as required to support facing against concrete pressure but not more than 12 inches for 5/8-inch plywood or 16 inches for 3/4-inch plywood. Maximum deflection of facing materials reflected on concrete surfaces exposed to view shall be 1/240 of the span between structural members of the formwork.

- G. Use wales, strongbacks, shores, and bracing as required.
- H. Form all necessary openings or chases for piping, ductwork, and similar items where indicated or as required for the Work.
- I. Construct forms to be removable in sections without marring concrete surface.
- J. Surface of forms shall provide smooth, dense, plane surface to finished concrete where exposed to view.
- K. Contractor shall be responsible for structural adequacy, design, engineering, and construction of the formwork.
- L. Stay-in-place metal forms shall not be used.

3.2 TIME-IN-PLACE FOR FORMS

- A. It is the responsibility of Contractor to consider all applicable factors and leave the formwork in place until it is safe to remove them.
- B. All removal shall be performed in a manner which will prevent damage to the concrete and ensure the complete safety of the structure, with particular care for corners and edges.
- C. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements.
- D. Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C31 and ASTM C39 at the expense of Contractor by an independent laboratory that complies with ASTM C107. Control cylinders shall be tested within 4 hours after removal from the Site.
- E. Forms shall not be removed unless the minimum time or minimum compressive strength requirements below are met.
 - 1 Formwork Not Supporting Weight of Concrete:
 - a. Formwork for walls, columns, sides of beams, gravity structures, slabs-on-ground, and other vertical type formwork not supporting the weight of concrete shall remain in place 24 hours minimum after concrete placement is completed.
 - 2 Formwork Supporting Weight of Concrete:
 - a. Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, no forms or shoring shall be loosened or removed until control concrete test cylinders indicate the concrete has attained the following compressive strengths for the respective structural members:

Concrete Compressive Strength Percentage	
Structural Member	Percent of Design Compressive Strength
Unshored slab and beam forms or forms which can be removed without disturbing shores	70
Slab or beam shoring	85

Table 7: Concrete Strength for Form Removal

END OF SECTION 03 10 00

**SECTION 03 20 00
CONCRETE REINFORCEMENT**

1 GENERAL

1.1 DESCRIPTION

- A. This Section includes steel reinforcement bars, ties, welded wire fabric, bolsters, chairs supports and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 10 00 – Concrete Formwork
B. Section 03 30 00 – Concrete
C. Section 03 42 00 – Precast Separation & Fire Walls

1.3 REFERENCES

- A. IBC 2012– International Building Code
- I Publication dates for listed standards shall comply with standards referenced within 2012 International Building Code or those that are in effect as of the date of the Contract Documents if not referenced within 2012 International Building Code or noted otherwise.
- B. ASTM A146 - Standard Specification for Molybdenum Oxide Products.
- C. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- E. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
- F. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
- G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- H. ACI SP-66 - ACI Detailing Manual.
- I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
- J. AWS D1.4/D1.4M - Structural Welding Code: Reinforcing Steel.
- K. AWS B2.1/B2.1M AMD1 - Specification for Welding Procedure and Performance Qualification.

1.4 SUBMITTALS

- A. Submit as specified in Division 01.
- B. Include, but not limited to, the following:
- I Complete bar schedule, bar details and erection drawings to conform to ACI SP-66.

- 2 Drawing with each group of like bars labeled with a mark number.
- 3 Erection drawings shall be clear, easily legible and to a minimum scale of:
 - a. 1/4-inch = 1 foot.
 - b. 1/8-inch = 1 foot if bars in each face are shown in separate views.
- 4 Size and location of all openings.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store steel reinforcement blocked up off the ground and in orderly stacks.
- B. Store only bars with the same identifying label in the same stack.

1.6 TESTING

- A. Perform at the mill for each heat.
- B. Submit certified test results to Engineer upon request.

2 PRODUCTS

2.1 REINFORCEMENT BARS, TIES AND STIRRUPS

A. Materials:

- 1 Conform to ASTM A615/A615M, Grade 60 except as otherwise specified.
- 2 Drilled shaft ties and stirrups of any size shall conform to ASTM A615/A615M, Grade 60 unless otherwise indicated.

B. Fabrication of Bars:

- 1 Fabricate with cold bends conforming to the recommended dimensions shown in ACI 318.
- 2 Field fabrication will be allowed only if Contractor has equipment to properly fabricate steel and must be approved by the Engineer/Owner.
- 3 Attach metal or plastic tags with identifying mark corresponding to mark number on drawing.
- 4 Contractor may, at his option, continue steel reinforcement through openings in walls and slabs, then field-cut the opening.

2.2 WELDED WIRE FABRIC

- A. Conform to ASTM A146 using bright basic wire conforming to ASTM A1064/A1064M.
- B. Wire gauges No. 11 and smaller shall be galvanized.

2.3 BOLSTERS, CHAIRS AND ACCESSORIES

- A. Conform to ACI SP-66 and the Manual of Standard Practices of the Concrete Reinforcing Steel Institute.

- B. Provide all spacers, bolsters, chairs, ties, and other devices necessary to properly space, place, support and fasten steel reinforcement in place during the concrete placement.
- C. Metal accessories shall be galvanized or plastic coated where legs will be exposed in finished concrete surfaces.
- D. Do not use rocks, broken bricks, wood blocks, or concrete fragments for support of steel reinforcement.

2.4 PRECAST CONCRETE BLOCK BAR SUPPORTS

- A. May be used only for bar supports in slabs on ground.
- B. Blocks shall be made with a minimum of nine sacks of cement per cubic yard and have a compressive strength of 6,000 psi in seven days.
- C. Each block shall have a minimum of 9 square inches of bearing area. Space as required by the particular condition of weight, bearing surface and rigidity of the steel reinforcement.

3 EXECUTION

3.1 PLACEMENT OF STEEL REINFORCEMENT

- A. Place in accordance with ACI 318 and the Manual of Standard Practice of the Concrete Reinforcing Steel Institute.
- B. Tie securely with 16-gauge or larger annealed iron wire.
- C. Place to maintain concrete cover to conform to ACI 318 unless otherwise indicated.
- D. Splice steel to conform to ACI 318.
 - 1 Unless otherwise indicated, the minimum length of lap for tension lap splices shall be as required for Class B splices as defined by ACI 318.
- E. Lap welded wire fabric not less than the length of one mesh plus 2 inches unless otherwise indicated.

END OF SECTION 03 20 00

SECTION 03 30 00
CONCRETE

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

- A. This Section includes concrete and related items.

1.3 RELATED REQUIREMENTS

- A. Section 03 10 00 – Concrete Formwork.
- B. Section 03 20 00 – Concrete Reinforcement.
- C. Section 07 21 00 – Thermal Insulation.

1.4 REFERENCES

- A. IBC 2012– International Builders Code
 - 1 Publication dates for listed standards shall comply with standards referenced within 2012 International Building Code or those that are in effect as of the date of the Contract Documents if not referenced within 2012 International Building Code or noted otherwise.
- B. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM A615 - Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- E. ASTM C31 - Making and Curing Concrete Test Specimens in the Field.
- F. ASTM C33 - Concrete Aggregates.
- G. ASTM C39 - Compressive Strength of Cylindrical Concrete Specimens.
- H. ASTM C40 - Organic Impurities in Fine Aggregates for Concrete.
- I. ASTM C42 - Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- J. ASTM C88 - Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- K. ASTM C94 - Ready-Mixed Concrete.
- L. ASTM C143 - Slump of Hydraulic Cement Concrete.
- M. ASTM C150 - Portland Cement.
- N. ASTM C172 - Sampling Freshly Mixed Concrete.
- O. ASTM C192 - Making and Curing Concrete Test Specimens in the Laboratory.

- P. ASTM C231 - Air Content of Freshly Mixed Concrete by the Pressure Method.
- Q. ASTM C233 --Testing Air-Entraining Admixtures for Concrete.
- R. ASTM C260 - Air-Entraining Admixtures for Concrete.
- S. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- T. ASTM C494 - Chemical Admixtures for Concrete.
- U. ASTM C618 - Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- V. ASTM D1752 - Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- W. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.
- X. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- Y. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- Z. ACI 305 - Hot Weather Concreting.
- AA. ACI 306 - Cold Weather Concreting.
- BB. ACI 309 - Guide for Consolidation of Concrete.
- CC. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.
- DD. ANSI B18.2.1 - Square and Hex Bolts and Screws - Inch Series.
- EE. ANSI B18.2.2 - Square and Hex Nuts (Inch Series).
- FF. National Bureau of Standards (NBS) Specifications for Scales.
- GG. National Ready-Mix Concrete Association, "Truck Mixer, and Agitator Standards of the Truck Mixer Manufacturers' Bureau.", TMMB 100-05 - Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards.
- HH. Corps of Engineers, CRD-C 620-10 - Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture, and Aggregate (Accelerated Mortar-Bar Method).

1.5 SUBMITTALS

- A. Submit as specified in Division 01.
- B. Include, but not limited to, the following:
 - 1 Nonshrinking grouts.
 - 2 Admixtures.
 - 3 Bonding agents.
 - 4 Curing agents.

5 Expansion joint materials.

6 Sealants.

7 Waterstops.

C. Concrete Mix Design Proportions:

1 Submit as specified in Division 01 and PART 2.

2 Submit for each mix design, including aggregate gradation data.

3 Resubmit for any change in each mix design.

2 PRODUCTS

2.1 CONCRETE

A. Materials:

1 Portland Cement Type I:

a. Shall conform to ASTM C150.

b. Pozzolan shall conform to ASTM C595.

c. Fly ash shall be permitted to be used as the pozzolan and be interground with the clinker in the manufacture of the cement. Fly ash shall conform to ASTM C618, Class F with less than 15% CaO. Class C fly ash is not allowed. Fly ash may be added by Supplier as a separate ingredient provided the Supplier has scales for dispensing fly ash that meet the requirements of this PART, Paragraph "Measurement of Materials".

d. The maximum amount retained on the No. 325 sieve shall be 10% as determined in accordance with ASTM C430.

e. The maximum amount of alkalis ($\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$) shall be 0.60% determined in accordance with ASTM C114. A running average of three Samples shall not exceed a maximum of 0.50%. Total alkali contribution from the cement shall not exceed 4 pounds of alkali per cubic yard.

f. Use one brand of cement throughout the Project unless otherwise approved by the Engineer.

2 Fine Aggregate:

a. Conform to ASTM C33.

b. Fineness modulus shall be between 2.3 and 3.1.

c. Maintain fine aggregate free of ice, frozen lumps, and deleterious substances.

3 Coarse Aggregate:

a. Conform to ASTM C33.

b. Blast furnace slag will not be permitted.

- c. Maintain coarse aggregate free of ice, frozen lumps, and deleterious substances.
- d. Gradating Requirements:
 - (1) From 3/4 inch to No. 4 for all concrete unless otherwise specified.

4 Mixing Water:

- a. Only potable water will be acceptable without testing. Expense of testing water shall be paid by Contractor.
- b. Nonpotable water may be used if it produces concrete with at least 95% of the strength of similar specimens of the same mix design made with potable water, subject to approval of qualitative analysis.

5 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. Air-Entraining Type:

- (1) Conform to ASTM C260.
- (2) Conform to manufacturer's recommendations for use.
- (3) Technical assistance of the manufacturer's field representative shall be furnished upon request.
- (4) Testing of air-entraining admixtures shall conform to ASTM C233.

c. Other Admixtures: Used only with Owner's written concurrence.

- (1) Water Reducing, Retarding Type: Conform to ASTM C494, Type D.

d. Admixtures shall not contain any chloride ions.

e. 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.

B. 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 Contractor shall deliver representative samples of all proposed concrete materials to the laboratory for the following testing:

- a. Fine Aggregate:
 - (1) ASTM C33 as amended by PART 2, Paragraph 2.01.A.
 - (2) ASTM C40.
 - (3) ASTM C88.
 - (4) ASTM C177.
 - (5) ASTM C136.
 - (6) ASTM C142.
 - (7) Fineness modulus.
 - (8) ASTM C295 and ASTM C289 or approved service records.
 - b. Coarse Aggregate:
 - (1) ASTM C33 as amended by PART 2, Paragraph 2.01.A.
 - (2) ASTM C88.
 - (3) ASTM C136.
 - (4) ASTM C142.
 - (5) ASTM C295 and ASTM C289 or approved service records.
 - c. Mixing water; if other than potable water is proposed for use and in the opinion of Engineer 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.
 - (2) All cylinders shall be tested conforming to ASTM C39. Age of cylinders at test shall be 28 days unless an earlier age is authorized.
 - (3) Concrete made with nonpotable water shall attain at least 95% of the compressive strength of similar specimens of the same mix design made with potable water.
 - d. Air-entraining admixture shall be tested conforming to ASTM C233.
- 3 The laboratory test results shall be part of the design mix submittal specified in this PART 2, Paragraph 2.01.D, "Mix Proportions."

C. Concrete Qualities Required:

- 1 Compressive Strength:

- a. Minimum 28-day strength = 4,000 psi for all construction unless otherwise indicated.
- 2 Slump of concrete shall be 3 inches \pm 1 inch unless noted otherwise. Concrete slump for drilled shafts shall be as indicated for each method of construction:
 - a. Dry and Uncased Excavation: 5 inches \pm 1 inch.
 - b. Cased Excavation with Casing Withdrawn: 7 inches \pm 1 inch.
 - c. Slurry Construction (Underwater Placement): 8 inches \pm 1 inch.
 - 3 Air Content: 6% \pm 1-1/2%.
 - a. For Compressive Strength greater than 5,000 psi, Air Content can be reduced by 1.0%.

D. Mix Proportions:

- 1 Concrete shall be homogeneous, readily placeable, and uniformly workable; 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 90 days 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. The standard deviation of such tests shall be computed as a basis for design of the mix. The design average strength shall exceed the specified strength in accordance with the following formulae:
 - (1) When standard deviation is less than 500 psi, Design Average Strength = Specified Minimum Strength + 1.343 x Standard Deviation.
 - (2) When standard deviation is greater than 500 psi, Design Average Strength = Specified Minimum Strength - 500 + 2.326 x Standard Deviation.
 - (3) Submit previous test data, calculated standard deviation, and the proposed mix proportions to Engineer for approval prior to placing concrete.
 - b. 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 this PART, Paragraph "Laboratory Testing of Materials for Use in Concrete."

- (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 specimens tested at 28 days or an earlier age when approved by Engineer. The slump and air content shall be at the maximum limits specified in this PART, Paragraph "Concrete Qualities Required."
- (2) A point on the water-cement ratio compressive strength curve shall be selected that will provide an average strength at least 1,200 psi greater than the specified minimum strength.
- (3) Laboratory reports establishing mix proportions shall be sent to Engineer and his approval obtained prior to placing all concrete.

3 Mix Proportions for Concrete for Underwater Placing (Special Requirements):

- a. Fine aggregate - Not less than 40% natural sand.
- b. Coarse aggregate - 3/4-inch maximum size natural gravel.
- c. Cement - 7 sacks minimum per cubic yard.
- d. Water - Minimum required for slump between 7 and 9 inches.
- e. Water reducing retarder - Conform to ASTM C494 Type D and use in sufficient amount to delay the setting time to not less than six hours.
- f. Air entrainment - Conform to ASTM C260 and use in sufficient amount to entrain 4% air \pm 1%.
- g. 28-day compressive strength:
 - (1) Not less than 4,000 psi when tested conforming to ASTM C31 and ASTM C39.

4 Prior to placing any concrete, the laboratory selected by the Contractor shall report the results of the testing and mix designs as follows:

- a. Engineer (1 copy).
- b. Resident Project Representative, Field Office (1 copy).
- c. Contractor (copies as required).
- d. Concrete Supplier (copies as required).

E. Measurement of Materials:

1 General Requirements:

- a. Conform to ACI 304.

- b. Measure materials within 1% by weight for aggregates and cement, and within 1-1/2% 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.

F. Mixing and Delivery:

1 Conform to ACI 304.

2 Cement temperature when added to mix shall not exceed 170°F.

3 Batch Plant Mixer:

- a. Charge with 5% to 10% of the mixing water both in advance and after the addition of aggregates and cement.
- b. Charge with remaining water uniformly with the other materials.
- c. Avoid charging in excess of manufacturer's rating.
- d. Discharge mixed concrete completely prior to recharging.

e. 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:

Minimum Concrete Mixing Times	
Capacity of Mixer, Cubic Yards	Minimum Time of Mixing, Minutes
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

Table 8: Minimum Concrete Mixing Times

- (3) For quantities above 6 yards, add 15 seconds of extra mixing time for each additional cubic yard of concrete.

4 Mixing of Concrete at Plant Off Job Site:

- 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.
- c. Truck mixer shall conform to TMMB 100-05 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) Ticket number.
 - (2) Time batched.
 - (3) Time arrived on Job Site.
 - (4) Amount of concrete (by volume).
 - (5) Mix number.
 - (6) Amount of all water added at Job Site by Contractor.
 - (7) Number of revolutions on the truck's revolution counter before batching and after placement is completed.
 - (8) Truck number.
 - (9) Truck driver's name.
 - (10) Types and quantities of admixtures added to the batch.
 - (11) Slump of concrete.

2.2 GROUT:

A. Plain Grout:

- 1 1 part Portland cement to 2 parts sand by volume.
- 2 Keep water to a minimum as required for placing by the dry packing method.
- 3 Place after the mixed grout has been allowed to stand for two hours.
- 4 The sand and cement shall be as specified for concrete.

B. Nonshrinking Grout:

- 1 Required for setting sleeved anchor bolts, for setting equipment recommended by the manufacturer to be set with nonshrinking grout, and in other places indicated.

2 Grout shall be nonmetallic, as manufactured by one of the following:

- a. Crystex, L and M Construction Chemicals, Inc.
- b. Five Star Grout, U. S. Grout Corporation.
- c. Masterflow 713 Grout, Master Builder's Company.
- d. Sauereisen F-100, Sauereisen Cements Company.
- e. Supreme Grout, Gifford-Hill & Company.

3 Prepare and place conforming to manufacturer's printed instructions.

C. Grout for Bonding:

1 1 part cement to 1-1/2 parts sand by weight.

2 Keep water to a minimum.

2.3 CONCRETE ACCESSORIES

A. Water Stops:

1 Serrated polyvinyl chloride equal to one of the following.

- a. Servicized/Durajoint Type 13, W. R. Grace Company.
- b. 6-inch heavy-duty Flextrip, Water Seals, Inc.
- c. Vulco VP 8044 Heavy, Vulcan Metal Products Company.
- d. Envirostop TPER, Profile 618 or 555, Westec Corp.

B. Expansion Joints:

1 Expansion Joint Filler: Premolded cork of thickness indicated and conforming to ASTM D1752, Type II, cork or Type III, self-expanding cork.

2 Bond Breaker: Polyethylene strip.

3 Joint Sealant: Two component polysulfide system as manufactured by one of the following:

- a. Hornflex L, A. C. Horn, Inc.
- b. Synthacalk GC-2, Pecora, Inc.

C. Igas Joint: Single component mastic waterstop, Sika Chemical Corporation.

2.4 CURING AGENT

A. Liquid membrane-forming compound conforming to ASTM C309, Type 1. ASTM C309, Type 2 shall be used as specified in PART 3, Paragraph "Hot Weather Concreting."

B. Curing compound used on floors to be painted, tiled, or covered with resilient floor covering shall be guaranteed not to interfere with application of paint, tile mortar, or tile adhesive after a 28-day curing period.

2.5 MISCELLANEOUS ITEMS

A. Anchor Bolts:

- 1 Provide all anchor bolts required for complete installation as indicated.
- 2 Anchor bolts and accessories shall conform to ASTM F1554 Grade 55 as a minimum unless otherwise specified. 2-1/4-inch diameter anchor bolts shall conform to ASTM A615, Grade 60 as a minimum. These 2-1/4-inch anchor bolts shall be made from deformed rebar.
- 3 Use hexagonal bolts and nuts conforming to ANSI B18.2.1 and B18.2.2.
- 4 All exposed area of anchor bolts and nuts plus a minimum of 6 inches of embedded length shall be hot-dip galvanized in accordance with ASTM A123.
- 5 Set to elevations and alignment indicated, or as required for proper anchorage, with template and other devices to align and hold bolts in place top and bottom during placement of concrete.
- 6 Washers:
 - a. For ASTM F1554: Conform to F436.
- 7 Galvanize all anchor bolts, nuts, and washers.

B. Moisture Barrier:

- 1 Provide Kraft Paper - Polyethylene Sheet:
 - a. Water-resistant barrier consisting of heavy Kraft paper and asphalt, glass fiber reinforcement, and polyethylene film. Layers shall be laminated under heat and pressure. Perm rating of 0.15 or less per ASTM E96, Procedure A.
 - b. Manufacturers:
 - (1) Fortifiber Corporation, Moistop I.
 - (2) Glas-Kraft Inc., Plybar Plus II.
- 2 Provide adhesive or tape as recommended by moisture barrier manufacturer.

C. Structural Metals:

- 1 Steel:
 - a. Steel shall conform to ASTM A36 unless otherwise specified.
 - b. Fabricate to conform to American Institute of Steel Construction (AISC) specifications, codes, and standards.
 - c. Galvanize to conform to ASTM A123 and ASTM A153 after all drilling, bending, welding, or other forms of fabrication have been completed.

D. Perimeter and Under-Slab Insulation: (Rigid Board.)

- 1 See SECTION 07 21 00 for insulation.

- E. Concrete Floor Hardener: Concrete floor hardener shall be Lapidolith as manufactured by Sonneborn Building Products, Minneapolis, Minnesota or Engineer-approved equal.

3 EXECUTION

3.1 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 floatation 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 Engineer.
 - 4 Protect pipe sleeves from moisture during cold weather.
 - 5 Grease anchor bolt threads to protect from concrete splatter.
- C. Installation of Joints:
 - 1 Construction Joints:
 - a. Location:
 - (1) Locate joints, which are not indicated or specified, in conformance with ACI 318.
 - (2) Obtain Engineer's approval of joints located by Contractor prior to preparation of reinforcing steel drawings.
 - b. Preparation and Installation:
 - (1) Clean and break laitance or other foreign material from bonding surface.
 - (2) Tighten forms remaining in place (where applicable) to prevent seepage between forms and hardened concrete.
 - (3) Provide water stops and shear keys as indicated or specified and as required in any new construction joint requested by Contractor.
 - c. Waterstops:
 - (1) Install in all construction joints where indicated.
 - (2) Install conforming to manufacturer's printed instructions.
 - (3) All joints and splices of PVC waterstop shall be 100% fused.

- (4) Metal waterstops shall be welded with a continuous watertight weld or bolted with a minimum contact lap of 12 inches.

2 Expansion Joints:

- a. Install as indicated.
- b. Completely cover the top surface of the joint filler with a polyethylene strip bond breaker prior to sealing joint.
- c. Seal top of expansion joint with joint sealant applied conforming to manufacturer's instructions. Depth of sealant shall be 1/2 the joint width unless otherwise indicated. During cold weather protect joint from moisture prior to installation of joint sealant.

3 Contraction Joints: As specified in this PART, Paragraph "Finishing."

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.
- c. Remove all loose or cracked pieces resulting from cutting existing concrete, leaving only sound, undamaged concrete adjacent to new work.
- d. Leave access opening edges with a neat, true grout surface to the opening size indicated.
- e. Cut reinforcing steel with sufficient length remaining (approximately 30 bar diameters) for bending and lapping into new construction.

2 Bonding to Existing Concrete:

- a. Roughen concrete by use of a pneumatic chipping hammer or other approved means.
- b. Thoroughly clean the concrete surface and apply the Weldcrete bonding agent or approved equal. Place the fresh concrete after the bonding agent becomes tacky.

3.2 PLACING OF CONCRETE

A. Conventional Placing:

1 General Requirements:

- a. Conform to ACI 304.
- b. Bonding surfaces shall be clean, free of laitance and foreign materials.
- c. Face horizontal bonding surfaces with 1-inch 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 forms for all concrete except where otherwise indicated or specified.
 - 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 2 feet, and place concrete against bulkheads and keyways at vertical joints.
 - b. Maximum free drop of concrete 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 ft.-0 inches.
 - c. When moisture 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 309. Characteristics and application of concrete vibrators shall be as set forth in Table 5.1.4.
 - b. 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.
 - c. 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.
 - d. 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.
 - e. Consolidate concrete layer to full depth when using a surface vibrator. Use thinner layers or more powerful vibrator if necessary to achieve complete consolidation.
 - f. Vibrate the top 10 feet of drilled shaft foundations.

- 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 45 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.

6 Placing Concrete at Joints:

- a. Bed horizontal joints with 1 inch of grout for bonding.
- b. Take precautions to ensure tight, well-bonded construction joints with no air pockets or voids.
- c. Take special precautions to avoid bending or displacing waterstop while placing concrete around it.
- d. Delay construction at a joint a minimum of 16 hours where placement is continued past joint except where otherwise indicated.

B. Underwater Placing of Concrete:

1 General Requirements:

- a. Do not place concrete under water except where indicated or authorized in writing by Engineer.
- b. Do not place concrete under water which has a temperature below 40°F or when there is a flow of water in or out of the form or excavation. Dewatering shall be prohibited for a minimum of 24 hours after completion of concrete placement.
- c. Use concrete mix as specified under PART 2, Paragraph 2.01.D.3 "Mix Proportions for Concrete for Underwater Placing."
- d. Design formwork for increased pressure due to the use of retarding admixture. Clean inside of forms with water jets where necessary to remove mud or debris from the bottom of sides.

2 Depositing: As specified in Section 03500 - Drilled Shaft Foundations.

C. Mass Concrete:

1 General Requirements:

- a. Mass concrete shall comply with requirements of this Specification, unless otherwise specified in this Section or in Contract Documents.
- b. Unless otherwise specified, the following criteria shall apply for mass concrete placements:

- (1) The maximum temperature in concrete after placement shall not exceed 155°F; and
- (2) The maximum temperature difference between center and surface of placement shall not exceed 35°F.

c. Mass concrete is defined as follows:

- (1) A placement of structural concrete with a minimum dimension equal to or greater than 4 ft.
- (2) Concrete placements that contain Type III cement, accelerating admixtures, or cementitious materials in excess of 660 lbs./yd.³ of concrete.
- (3) Placements that trap heat.

d. Submittals - Comply with above specification and, unless otherwise specified, submit a thermal control plan for each mass concrete placement. The adiabatic temperature rise (ATR) of concrete and temperature differences may be predicted using simple methods or specifically-designed software. Unless otherwise specified or permitted, the thermal control plan shall include following items:

- (1) Concrete mixture proportions;
- (2) Calculated or measured adiabatic temperature rise of concrete;
- (3) Upper limit for concrete temperature at time of placement;
- (4) Description of specific measures and equipment that will be used to ensure maximum temperature in placement will not exceed specified maximum temperature limit;
- (5) Calculated maximum temperature in placement based on expected conditions at time of placement and use of proposed measures to control temperatures;
- (6) Description of specific measures and equipment that will be used to ensure temperature difference will not exceed specified temperature difference limit;
- (7) Calculated maximum temperature difference in placement based on expected conditions at time of placement and use of proposed measures to control temperature differences;
- (8) Method used to predict ATR and temperature differential and to which mass concrete it applies;
- (9) If simple methods are used to predict ATR and temperature differential, provide copies of all calculations and copies of all graphs and charts used;
- (10) If specifically designed software is used to predict ATR and temperature differential, provide all assumptions and all program inputs used;

- (11) Description of curing procedures, including materials and methods, and curing duration; and
 - (12) Description of formwork removal procedures to ensure temperature difference at temporarily exposed surface will not exceed temperature difference limit, and how curing will be maintained.
- e. If concrete design mixture is changed, thermal control plan must be updated.

2 Execution:

- a. Unless otherwise specified, cure and protect concrete in accordance with Paragraph 3.04 for a minimum of 7 days.
- b. Unless otherwise specified or permitted, preserve moisture by maintaining forms in place. For surfaces not in contact with forms, apply one of the procedures specified in Paragraph 3.04. Unless otherwise specified, do not use water curing.
- c. Control of Concrete Temperature - Unless otherwise specified, control concrete temperature and temperature difference within concrete from time the concrete is placed until time internal temperature has cooled from its maximum so the difference between average daily ambient and internal temperatures at time of protection removal is less than specified temperature difference limit.

3.3 FINISHING

A. Unformed Surfaces:

1 Screed Finish:

- a. Use as first stage for all concrete finishes.
- b. Use as final finish on surfaces that will be covered by additional concrete, grout placement, mortar setting bed except as otherwise specified, or earth backfill.
- c. Immediately after screeding, use a wood float, darby, or bullfloat to eliminate high and low spots and to embed large aggregate. This shall be done in a manner to produce even, uniform surfaces so that surface irregularities do not exceed 3/8 inch in 10 feet when used as final finish.

2 Floated Finish:

- a. Use as second stage of broomed, troweled, or magnesium-troweled finish.
- b. Float with mechanical float. Hand floating will be permitted only in areas inaccessible to mechanical float.
- c. On surfaces not to receive troweled or magnesium-troweled finish, finish with wood or cork float after mechanical floating to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet, except at floor drains.

3 Broomed Finish:

- a. Use as final finish on all outdoor slabs including door stoops and equipment pads.

- b. After floated finish draw a stiff bristle broom across the surface making uniform corrugations, perpendicular to the direction of traffic, not more than 1/16 inch deep.
- 4 Troweled Finish:
- a. Use as final finish on inside floors and on all other unformed surface not otherwise indicated or specified.
 - b. Trowel with steel trowel, mechanical or hand, to obtain a smooth, dense finish. The final troweling shall be done after the concrete has become hard enough so that no mortar adheres to the edge of trowel and a ringing sound is produced as the trowel passes over the surface.
 - c. Do not trowel before surface water has evaporated or been removed with a squeegee.
 - d. Finish to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet, except at floor drains.
 - e. Do not add sand or cement to the floor surface.
- 5 Magnesium-Troweled Finish:
- a. Perform as specified for "Troweled Finish" except use a magnesium trowel by hand instead of a steel trowel to obtain a dense, but not slick, finish.
 - b. Use where floor will receive protective coating after curing.
- 6 Concrete Floor Hardener:
- a. Furnish and install concrete floor hardener where indicated.
 - b. Contractor shall apply in strict accordance with the manufacturer's written recommendations.
 - c. Apply Lapidolith in three (3) applications. Coverage shall be 100 square feet per gallon.
 - d. Contractor shall apply the hardener as soon as possible after placement of concrete to prevent concrete damage during construction.
- 7 Stair-Tread Finish:
- a. Apply to all interior and exterior concrete stair treads and landings that do not have abrasive nosings.
 - b. Spread fine abrasive aggregate uniformly on concrete before it has set, in the amount not less than 1/4 pound of aggregate per square foot, and steel trowel into surface of concrete.
 - c. Expose abrasive aggregate slightly by rubbing with an abrasive brush after concrete finish has set and cured.
 - d. Aggregate and application shall conform to Specification "A" of the Norton Company.

8 Contraction Joints:

- a. Locate as indicated.
- b. Maintain true alignment with straightedge.
- c. Joints shall be grooved except where sawed joints or preformed joints are indicated.
- d. Grooved Joints:
 - (1) Perform during the finishing process.
 - (2) Width of groove shall not exceed 1/4 inch.
 - (3) Depth of groove shall be at least 1 inch.
- e. Sawed Joints:
 - (1) Cut joints with power blade as soon as concrete surface is firm enough to resist tearing or damage by the blade and before random shrinkage cracks can occur. (Usually required 4 to 12 hours after finishing.)
 - (2) Make joints approximately 1/8 inch wide with depth as indicated.
 - (3) Seal with the same type sealant specified for expansion joint sealant.
- f. Install preformed joints as recommended by manufacturer.

B. Formed Surfaces:

- 1 Repair surface defects as specified in this PART, Paragraph "Repair of Defective Surfaces," except for surfaces against which fill material or concrete is to be placed.
- 2 Stoned Finish:
 - a. Use as a final finish on all formed surfaces that will be exposed to view after all work has been completed.
 - b. To obtain surface finish, patch defective surfaces immediately upon removal of forms with mortar as specified in this PART, Paragraph "Repair of Defective Surfaces."
 - c. Immediately before starting this work, keep concrete thoroughly saturated with water for a minimum period of three hours.
 - d. Rub surfaces to be finished with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in proportions used in the concrete being finished. Continue rubbing until all form marks, projections, and irregularities have been removed, all voids filled, and a uniform surface has been obtained. Leave paste produced by this rubbing in place at this time.

- e. After all concrete above the surface being treated has been cast, obtain final finish by rubbing with a fine carborundum stone and water. Continue rubbing until the entire surface is of a smooth texture and uniform color.
- f. After the final rubbing is completed and the surface has dried, rub with burlap to remove loose powder and unsound patches, paste, and objectionable marks.
- g. Cure as specified in this PART, Paragraph "Curing."

C. 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, 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 three days or use curing compound.
 - f. Engineer shall be notified of areas containing major defects or where reinforcing steel is exposed prior to determination of repair method.

3.4 CURING

A. Cure all concrete by one of the following methods:

- 1 Leaving in forms for a minimum of seven days. Keep formwork wet to prevent drying of concrete surfaces.
- 2 Use of saturated bats, soaker hoses, or sprinkler for a minimum of seven days. Keep concrete continuously wet.
- 3 Using one coat of a liquid membrane-forming compound conforming to ASTM C309, Type 1. 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.
- 4 Using polyethylene sheets applied in full contact with surfaces.
- 5 Curing of concrete during hot or cold weather shall conform to this PART, Paragraphs "Hot Weather Concreting" and "Cold Weather Concreting."

3.5 HOT WEATHER CONCRETING

- A. When the temperature is 90°F or above, or is likely to rise above 90°F within the 24-hour period after concrete placement; or when there is any combination of high air temperature, low relative humidity, and wind velocity which would impair concrete strength or quality, follow the recommendations of ACI 305.
- B. Concrete shall have a maximum temperature of 90°F 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 305 (Figure 2.1.5) does not exceed 0.2 pound per square foot 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 six days.
 - 2 Application of one coat of curing compound conforming to ASTM C309, Type 2.
 - 3 Application and maintenance of curing paper or heat-reflecting plastic sheets for six 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 six days.
 - 2 Strip forms and apply curing compound conforming to ASTM C309, Type 2. Do not allow concrete surfaces to dry prior to application of curing compound.

3.6 COLD WEATHER CONCRETING

- A. When the temperature is 40°F or is likely to fall below 40°F during the 24-hour period after concrete placement, follow the recommendations of ACI 306 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 1.4.1 of ACI 306. Maximum temperature for concrete as mixed shall be 10°F 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 1.4.1 of ACI 306. Maintain the required temperature for the time duration indicated on Table 1.4.2 of ACI 306.
- D. Monitor temperature of concrete in place at corners or edges of formwork as applicable.

- E. Do not expose concrete to carbon monoxide or carbon dioxide fumes from heaters or engines. Oil or coke burning salamanders will not be permitted. 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 5 of Table 1.4.1 of ACI 306.

3.7 LOW-STRENGTH CONCRETE

- A. Low-Strength Concrete:
 - 1 Defined as concrete whose 28-day test (average of two cylinder breaks) is less than the minimum 28-day strength required.
 - 2 Remove and replace with acceptable concrete when the quality and location of the low-strength concrete is such that Engineer considers the strength or durability of the structure is impaired and so orders.
- B. Potentially Low-Strength Concrete: Defined as concrete whose 7-day test 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.

3.8 TESTING

- A. Field Testing of Concrete and Making of Concrete Test Cylinders:
 - 1 Field testing shall be performed by an ACI Concrete Field Testing Technician Grade 1.
 - 2 Contractor shall furnish test equipment, test cylinder molds, and trained 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 the Owner.
 - 3 Concrete sampling for tests and cylinder making shall be done conforming to ASTM C172.
 - 4 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.
 - c. Air Content Test conforming to ASTM C231.
 - d. Discard concrete used for slump and air tests.
 - e. Slump and Air Test results shall be furnished to the Testing Laboratory for inclusion in the Cylinder Test Reports.

B. Laboratory Testing of Concrete During Construction:

- 1 An independent testing laboratory will be selected and paid by the Contractor to perform the required laboratory tests and statistical evaluations of concrete being used in the Work.
- 2 Laboratory will cure and test concrete cylinders conforming to ASTM C192 and C39, testing one cylinder at seven days of age and two at 28 days of age. The remaining cylinder will be held to verify test results, if needed.
- 3 Contractor shall have the right to observe all phases of concrete cylinder curing and testing. Should Contractor observe any deviations from the prescribed testing procedures that he considers detrimental to concrete strength test results, he shall immediately notify Owner in writing.
- 4 The 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 the Contractor.
- 5 The Contractor shall provide all laboratory test results to both the Owner and Engineer for acceptance.
- 6 Should the statistical data indicate an unacceptable combination of average strength and standard deviation, Contractor shall take immediate corrective action.
- 7 Should the statistical data indicate an excessive margin of safety, the concrete mix may be modified subject to Owner's approval.

END OF SECTION 03 30 00

**SECTION 05 05 13
GALVANIZING**

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

- A. This Section includes hot-dip galvanizing of structural steel members, assemblies, and metal fabrications.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05 12 00 - Steel.

1.4 DEFINITIONS

- A. Hot-Dip Galvanizing: The dipping of steel members and assemblies into molten zinc for lasting, long-term corrosion protection. The resultant zinc coating fuses permanently with the base steel material.
- B. Electro galvanizing: Electrodepositing or electroplating with zinc by electrolysis for limited corrosion protection.
- C. Passivating: The chemical treatment of freshly galvanized steel materials to prevent humid storage stain (white rust or white corrosion). This treatment (passivation) consists of quenching freshly galvanized steel in water to which a chromate or a chromic-acid solution, or other proprietary solution, has been added.

1.5 REFERENCES:

- A. IBC 2012– International Building Code
 - I Publication dates for listed standards shall comply with standards referenced within 2012 International Building Code or those that are in effect as of the date of the Contract Documents if not referenced within 2012 International Building Code or noted otherwise.
- B. AGA T-IPAF - Inspection of Products Hot-Dip Galvanized After Fabrication.
- C. AGA D-PGAF - The Design of Products to be Hot-Dip Galvanized after Fabrication.
- D. AGA D-RDS - Recommended Details for Galvanizing Structures.
- E. AGA Quality Assurance Manual.
- F. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- G. ASTM A143 - Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- H. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- I. ASTM A325 - High Strength Bolts for Structural Steel Joints.

- J. ASTM A384 - Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- K. ASTM A385 - Providing High Quality Zinc Coatings (Hot-Dip).
- L. ASTM A563 - Carbon and Alloy Steel Nuts.
- M. ASTM A767 - Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
- N. ASTM A780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- O. ASTM B6 - Zinc (Slab Zinc).
- P. ASTM D2092 - Guide for Treatment of Zinc-Coated (Galvanized) Steel Surfaces for Painting.
- Q. ASTM D6386 - Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
- R. ASTM E376 - Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods.
- S. AWS D19.0 - Welding Zinc-Coated Steel.
- T. Research Council on Structural Connections of the Engineering Foundation, Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- U. SSPC SP1 - Solvent Cleaning: Removes oil, grease, soil, drawing and cutting compounds, and other soluble contaminants.
- V. SSPC SP6 - Commercial Blast Cleaning: Two-thirds of every 9 square inches free of visible residues; remainder only slight discoloration.
- W. SSPC SP11 - Power Tool Cleaning to Bare Metal.

1.6 SUBMITTALS

- A. Submit as specified in Division 01:
 - 1 Certification: Furnish notarized Certificates of Compliance with AGA, ASTM Specifications and Standards specified herein. Each certificate shall be signed by Contractor and galvanizer certifying that steel materials, bolts, nuts, washers, and items of iron and steel hardware conform with specified requirements. Certificate shall contain a detailed description of material processed and shall indicate the ASTM standard used for coating.
 - 2 Name and location of coating applicator. Applicator shall certify that applicator specializes in hot-dip galvanizing and follows the procedures in the AGA Quality Assurance Manual.
 - 3 Contractor shall review all details and submit modified details and/or recommended modified details to Owner and Engineer which comply with AGA guidelines.
 - 4 Submit coating data sheets and applicator's recommendations.

1.7 QUALITY ASSURANCE

- A. Inspections and Tests: Inspections, tests, and samples shall conform with ASTM Specifications and Standards. Inspection rights and privileges, procedures, and acceptance or rejection of galvanized steel materials shall conform with ASTM A123 or A153, as applicable. Inspections and tests include the following:
 - 1 Visual examination of samples and finished products.
 - 2 Tests to determine weight or mass of zinc coating per square foot of metal surface.
 - 3 Tests to determine distribution and uniformity of zinc coating.
- B. Owner and Engineer shall be provided access to galvanizer's facilities during normal working hours for the purpose of obtaining information on the status and for visual inspection of materials being fabricated.
- C. Delivery of any material shall in no way relieve Contractor of any responsibility for meeting all of the requirements of the Specifications, and it shall not prevent subsequent rejection if such material is later found to be defective.
- D. Galvanizing plant shall review all design drawings for compatibility with galvanizing plant limitations and fabrication details. Any redesign, due to galvanizing limitations, shall be responsibility of Contractor.
- E. All steel shall be marked with metal tags that will remain in place during normal handling and galvanizing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Of type to prevent damage to galvanized surfaces and distortion of steel materials and components.
- B. Handling and Storage: Handle and protect galvanized materials from damage to zinc coating. Store galvanized material above ground and separate material with strip spacers. Do not allow galvanized material to rest on cinders, clinkers, or on wet soil or decaying vegetation. Store in a manner to promote continuous drainage.

2 PRODUCTS

2.1 STEEL

- A. Material for galvanizing shall be geometrically suitable for galvanizing as specified in ASTM A384 and A385. Steel materials suitable for galvanizing include structural shapes, pipe, sheet, fabrications, and assemblies.
- B. Material shall be chemically suitable for galvanizing. Steel fabricator shall provide galvanizing shop mill orders (or any information required), such that galvanizer can determine that the supplied steel is chemically suited for galvanizing.

2.2 IRON AND STEEL HARDWARE

- A. Bolts, nuts, washers, and items of iron and steel hardware furnished for galvanizing shall be suitable for hot-dip galvanizing.
- B. Inspect iron and steel hardware before galvanizing and ascertain whether suitable for galvanizing. Replace items which are not suitable for galvanizing.

2.3 SURFACE PREPARATION

- A. Prepare all steel to be galvanized by removing paint markings, welding slag, and burrs. Preclean in an alkaline cleaner and acid pickle, and flux. Alternatively, steel shall be blast cleaned and fluxed.

2.4 ZINC FOR GALVANIZING

- A. Conform to ASTM B6, as specified in ASTM A123.

2.5 GALVANIZING

- A. Galvanize steel members, fabrications, and assemblies after fabrication, by hot-dip process in accordance with ASTM A123 or A153, as applicable. Weight of zinc coating shall conform with paragraph 6.1 of ASTM A123 or Table 1 of ASTM A153, as applicable.
- B. Safeguard against steel embrittlement conforming to ASTM A143.
- C. Safeguard against warpage or distortion of steel members conforming to ASTM A384. Notify Owner and Engineer of potential warpage problems which may require modification in design, before proceeding with steel fabrications.
- D. Finish and uniformity of zinc coating and adherence of coating shall conform with ASTM A123 or A153, as applicable.
- E. Galvanize bolts, nuts, and washers, and iron and steel hardware components in accordance with ASTM A153. Weight of zinc coating shall conform to requirements specified under "Weight of Coating" in ASTM A153. Nuts shall be tapped after galvanizing to minimum diametral amounts specified in ASTM A563. Coat nuts with waterproof lubricant, clean and dry to touch. High strength bolts for structural steel joints shall be galvanized in accordance with ASTM A325.
- F. Comply with AGA's "Recommended Details for Galvanized Structure."
- G. Galvanize reinforcing steel in conformance with ASTM A767.

2.6 POST-GALVANIZING TREATMENTS

- A. Galvanized materials subject to extended periods of storage in open, exterior locations shall be given passivating treatment or light oiling to prevent humid storage stain. Treatment, solution and process shall be subject to review and acceptance by Engineer. Chromate passivation should not be used on items galvanized after fabrication and to be painted after erection.
- B. Do not treat freshly galvanized or passivated surfaces with oils, grease, or chemicals which might interfere with adhesion of subsequent paint primers and coatings.
- C. Where slip factors are required to enable friction grip bolting, these shall be obtained after galvanizing by suitable treatment of the faying surfaces in accordance with the latest edition of the "Specification for Structural Joints" using ASTM A325 or A490. Bolts shall be as approved by the Research Council on Structural Connections of the Engineering Foundation. Slip critical connections will be used for steel to steel connections.

2.7 COATING OF STEEL WHICH CANNOT BE HOT-DIP GALVANIZED

- A. Coat as outlined below. Engineer approval is required prior to coating any steel as outlined below.
- B. Surface Preparation: If grease or oils are present, SSPC-SP1 cleaning shall precede any other method specified.

- C. Prepare surface in accordance with SSPC SP6 methods and 1.0- to 1.5-mils profile depth.
- D. Shop Coat: Inorganic zinc rich primer (ethyl silicate base) with minimum 80% zinc in dry film, by weight. Apply at 3-mils dry film thickness.
 - 1 Ameron - Dimetecote 9HS.
 - 2 Carboline - Carbozinc 11HS.
 - 3 ICI Devoe - Catha-Coat 304 Series.
 - 4 International - Interzinc 22HS.
 - 5 Tnemec - Tnemezinc 90E-92.

3 EXECUTION

3.1 INSTALLATION OF STEEL MATERIALS

- A. Steel materials, fabrications, and assemblies are specified to be installed in various other sections and under Section 05 12 00 - Steel.

3.2 FIELD INSPECTION

- A. Inspect installed galvanized materials, fabrications, and assemblies to conform with applicable requirements of AGA "Inspection Manual for Hot-Dip Galvanized Products," consisting of visual inspection.

3.3 REPAIR (TOUCH-UP) OF DAMAGED COATING

- A. Repair areas damaged by welding, flame cutting, or during handling, transport, or erection by the approved method (as outlined below), and in accordance with ASTM A780 for any noticeably damaged galvanizing.
- B. Surface Preparation: If grease or oils are present, SSPC-SP1 cleaning shall precede any other method specified.
- C. Prepare galvanized surfaces in accordance with SSPC-SP11 methods. Surface preparation shall extend into the undamaged galvanized coating by a minimum of 1 inch. For welds, remove all flux and weld splatter. Apply organic zinc-rich primer containing a minimum of 93% zinc in the dry film, by weight. Apply multiple coats, 2 coats minimum, (allowing proper recoating time as recommended by coating manufacturer) to achieve 4-mils dry film thickness. Color shall approximately match color of galvanizing, but if primer color cannot match galvanizing, apply a finish coat of aluminum paint over galvanizing compound. Approved coatings are as follows:
 - 1 Subox, Division of Carboline - Galvanox Type I.
 - 2 Crown North American Professional Products, Inc. - Cold Galvanizing Compound.
 - 3 ZRC Worldwide - Cold Galvanizing Compound.
 - 4 Duncan - Zirp.
 - 5 Brite Products - Brite Zinc.

- D. Prepare inorganic zinc coated surfaces in accordance with SSPC-SP11 methods. Surface preparation shall extend into the undamaged zinc coating by a minimum of 1 inch. For welds, remove all flux and weld splatter. Apply organic zinc-rich primer containing a minimum of 50% zinc in the dry film, by weight. Apply 1 coat minimum to achieve 3-mils dry film thickness. Color shall approximate match color of shop coating. Approved coatings are as follows:
- 1 Ameron-Amercoat 68HS.
 - 2 Carboline - Carbozinc 859.
 - 3 ICI Devoe - Catha-Coat 303H.
 - 4 International - Interzinc 52HS.
 - 5 Tnemec - Tnemezinc 90-97.
- E. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
- F. Repair of damaged surfaces shall be a continuous activity and shall occur as the coating is damaged and shall take place prior to rust bloom starting.

3.4 WELDING

- A. Where galvanized steel is to be welded, provide adequate ventilation.
- B. Perform welding in accordance with the American Welding Society D19.0. Welders and welding operators shall be trained in the hazards of welding galvanized steel prior to performing any welding on Site.
- C. Touch up all welded areas as specified.

3.5 WET STORAGE STAIN

- A. Remove any wet storage stain prior to installation as follows:
- 1 Arrange steel so that surfaces dry rapidly.
 - 2 Light stain deposits are to be removed by means of a stiff bristle (not wire) brush. Remove heavier deposits by brushing with a 5% solution of sodium or potassium dichromate with the addition of 0.1% by volume of concentrated sulfuric acid. Apply with a stiff bristle brush and leave for about 30 seconds before thoroughly rinsing and drying. Alternatively, a proprietary product such as Oakite Highlite, or approved equal, which is intended for this purpose may be used according to manufacturer's recommendations. Dispose of rinse water in an approved manner and in accordance with state, local, and federal Laws and Regulations.
 - 3 A coating thickness check shall be made in the affected areas to ensure that zinc coating remaining after the removal of wet storage stain is sufficient to meet or exceed requirements of the Specification.

3.6 REPAIRS

- A. Repair material showing evidence of damage to zinc coating. If not repairable, material with damaged coating will be subject to rejection.

END OF SECTION 05 05 13

SECTION 05 12 00
STEEL

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

- A. This Section includes hot-dip galvanizing of structural steel members, assemblies, and metal fabrications.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05 12 00 - Steel.

1.4 DEFINITIONS

- A. **Hot-Dip Galvanizing:** The dipping of steel members and assemblies into molten zinc for lasting, long-term corrosion protection. The resultant zinc coating fuses permanently with the base steel material.
- B. **Electro galvanizing:** Electrodepositing or electroplating with zinc by electrolysis for limited corrosion protection.
- C. **Passivating:** The chemical treatment of freshly galvanized steel materials to prevent humid storage stain (white rust or white corrosion). This treatment (passivation) consists of quenching freshly galvanized steel in water to which a chromate or a chromic-acid solution, or other proprietary solution, has been added.

1.5 REFERENCES

- A. IBC 2012- International Building Code
 - 1 Publication dates for listed standards shall comply with standards referenced within 2012 International Building Code or those that are in effect as of the date of the Contract Documents if not referenced within 2012 International Building Code or noted otherwise.
- B. AGA T-IPAF - Inspection of Products Hot-Dip Galvanized After Fabrication.
- C. AGA D-PGAF - The Design of Products to be Hot-Dip Galvanized after Fabrication.
- D. AGA D-RDS - Recommended Details for Galvanizing Structures.
- E. AGA Quality Assurance Manual.
- F. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- G. ASTM A143 - Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- H. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- I. ASTM A325 - High Strength Bolts for Structural Steel Joints.

- J. ASTM A384 - Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- K. ASTM A385 - Providing High Quality Zinc Coatings (Hot-Dip).
- L. ASTM A563 - Carbon and Alloy Steel Nuts.
- M. ASTM A767 - Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
- N. ASTM A780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- O. ASTM B6 - Zinc (Slab Zinc).
- P. ASTM D2092 - Guide for Treatment of Zinc-Coated (Galvanized) Steel Surfaces for Painting.
- Q. ASTM D6386 - Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
- R. ASTM E376 - Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods.
- S. AWS D19.0 - Welding Zinc-Coated Steel.
- T. Research Council on Structural Connections of the Engineering Foundation:
 - 1 Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- U. SSPC SP1 - Solvent Cleaning: Removes oil, grease, soil, drawing and cutting compounds, and other soluble contaminants.
- V. SSPC SP6 - Commercial Blast Cleaning: Two-thirds of every 9 square inches free of visible residues; remainder only slight discoloration.
- W. SSPC SP11 - Power Tool Cleaning to Bare Metal.

1.6 SUBMITTALS

- A. Submit as specified in Division 01:
 - 1 Certification: Furnish notarized Certificates of Compliance with AGA, ASTM Specifications and Standards specified herein. Each certificate shall be signed by Contractor and galvanizer certifying that steel materials, bolts, nuts, washers, and items of iron and steel hardware conform with specified requirements. Certificate shall contain a detailed description of material processed and shall indicate the ASTM standard used for coating.
 - 2 Name and location of coating applicator. Applicator shall certify that applicator specializes in hot-dip galvanizing and follows the procedures in the AGA Quality Assurance Manual.
 - 3 Contractor shall review all details and submit modified details and/or recommended modified details to Owner and Engineer which comply with AGA guidelines.
 - 4 Submit coating data sheets and applicator's recommendations.

1.7 QUALITY ASSURANCE

- A. Inspections and Tests: Inspections, tests, and samples shall conform with ASTM Specifications and Standards. Inspection rights and privileges, procedures, and acceptance or rejection of galvanized steel materials shall conform with ASTM A123 or A153, as applicable. Inspections and tests include the following:
 - 1 Visual examination of samples and finished products.
 - 2 Tests to determine weight or mass of zinc coating per square foot of metal surface.
 - 3 Tests to determine distribution and uniformity of zinc coating.
- B. Owner and Engineer shall be provided access to galvanizer's facilities during normal working hours for the purpose of obtaining information on the status and for visual inspection of materials being fabricated.
- C. Delivery of any material shall in no way relieve Contractor of any responsibility for meeting all of the requirements of the Specifications, and it shall not prevent subsequent rejection if such material is later found to be defective.
- D. Galvanizing plant shall review all design drawings for compatibility with galvanizing plant limitations and fabrication details. Any redesign, due to galvanizing limitations, shall be responsibility of Contractor.
- E. All steel shall be marked with metal tags that will remain in place during normal handling and galvanizing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Of type to prevent damage to galvanized surfaces and distortion of steel materials and components.
- B. Handling and Storage: Handle and protect galvanized materials from damage to zinc coating. Store galvanized material above ground and separate material with strip spacers. Do not allow galvanized material to rest on cinders, clinkers, or on wet soil or decaying vegetation. Store in a manner to promote continuous drainage.

2 PRODUCTS

2.1 STEEL

- A. Material for galvanizing shall be geometrically suitable for galvanizing as specified in ASTM A384 and A385. Steel materials suitable for galvanizing include structural shapes, pipe, sheet, fabrications, and assemblies.
- B. Material shall be chemically suitable for galvanizing. Steel fabricator shall provide galvanizing shop mill orders (or any information required), such that galvanizer can determine that the supplied steel is chemically suited for galvanizing.

2.2 IRON AND STEEL HARDWARE

- A. Bolts, nuts, washers, and items of iron and steel hardware furnished for galvanizing shall be suitable for hot-dip galvanizing.
- B. Inspect iron and steel hardware before galvanizing and ascertain whether suitable for galvanizing. Replace items which are not suitable for galvanizing.

2.3 SURFACE PREPARATION

- A. Prepare all steel to be galvanized by removing paint markings, welding slag, and burrs. Preclean in an alkaline cleaner and acid pickle, and flux. Alternatively, steel shall be blast cleaned and fluxed.

2.4 ZINC FOR GALVANIZING

- A. Conform to ASTM B6, as specified in ASTM A123.

2.5 GALVANIZING

- A. Galvanize steel members, fabrications, and assemblies after fabrication, by hot-dip process in accordance with ASTM A123 or A153, as applicable. Weight of zinc coating shall conform with paragraph 6.1 of ASTM A123 or Table 1 of ASTM A153, as applicable.
- B. Safeguard against steel embrittlement conforming to ASTM A143.
- C. Safeguard against warpage or distortion of steel members conforming to ASTM A384. Notify Owner and Engineer of potential warpage problems which may require modification in design, before proceeding with steel fabrications.
- D. Finish and uniformity of zinc coating and adherence of coating shall conform with ASTM A123 or A153, as applicable.
- E. Galvanize bolts, nuts, and washers, and iron and steel hardware components in accordance with ASTM A153. Weight of zinc coating shall conform to requirements specified under "Weight of Coating" in ASTM A153. Nuts shall be tapped after galvanizing to minimum diametral amounts specified in ASTM A563. Coat nuts with waterproof lubricant, clean and dry to touch. High strength bolts for structural steel joints shall be galvanized in accordance with ASTM A325.
- F. Comply with AGA's "Recommended Details for Galvanized Structure."
- G. Galvanize reinforcing steel in conformance with ASTM A767.

2.6 POST-GALVANIZING TREATMENTS

- A. Galvanized materials subject to extended periods of storage in open, exterior locations shall be given passivating treatment or light oiling to prevent humid storage stain. Treatment, solution and process shall be subject to review and acceptance by Engineer. Chromate passivation should not be used on items galvanized after fabrication and to be painted after erection.
- B. Do not treat freshly galvanized or passivated surfaces with oils, grease, or chemicals which might interfere with adhesion of subsequent paint primers and coatings.
- C. Where slip factors are required to enable friction grip bolting, these shall be obtained after galvanizing by suitable treatment of the faying surfaces in accordance with the latest edition of the "Specification for Structural Joints" using ASTM A325 or A490. Bolts shall be as approved by the Research Council on Structural Connections of the Engineering Foundation. Slip critical connections will be used for steel to steel connections.

2.7 COATING OF STEEL WHICH CANNOT BE HOT-DIP GALVANIZED

- A. Coat as outlined below. Engineer approval is required prior to coating any steel as outlined below.
- B. Surface Preparation: If grease or oils are present, SSPC-SP1 cleaning shall precede any other method specified.

- C. Prepare surface in accordance with SSPC SP6 methods and 1.0- to 1.5-mils profile depth.
- D. Shop Coat: Inorganic zinc rich primer (ethyl silicate base) with minimum 80% zinc in dry film, by weight. Apply at 3-mils dry film thickness.
 - 1 Ameron - Dimetcote 9HS.
 - 2 Carboline - Carbozinc 11HS.
 - 3 ICI Devoe - Catha-Coat 304 Series.
 - 4 International - Interzinc 22HS.
 - 5 Tnemec - Tnemezinc 90E-92.

3 EXECUTION

3.1 INSTALLATION OF STEEL MATERIALS

- A. Steel materials, fabrications, and assemblies are specified to be installed in various other sections and under Section 05 12 00 - Steel.

3.2 FIELD INSPECTION

- A. Inspect installed galvanized materials, fabrications, and assemblies to conform with applicable requirements of AGA "Inspection Manual for Hot-Dip Galvanized Products," consisting of visual inspection.

3.3 REPAIR (TOUCH-UP) OF DAMAGED COATING

- A. Repair areas damaged by welding, flame cutting, or during handling, transport, or erection by the approved method (as outlined below), and in accordance with ASTM A780 for any noticeably damaged galvanizing.
- B. Surface Preparation: If grease or oils are present, SSPC-SP1 cleaning shall precede any other method specified.
- C. Prepare galvanized surfaces in accordance with SSPC-SP11 methods. Surface preparation shall extend into the undamaged galvanized coating by a minimum of 1 inch. For welds, remove all flux and weld splatter. Apply organic zinc-rich primer containing a minimum of 93% zinc in the dry film, by weight. Apply multiple coats, 2 coats minimum, (allowing proper recoating time as recommended by coating manufacturer) to achieve 4-mils dry film thickness. Color shall approximately match color of galvanizing, but if primer color cannot match galvanizing, apply a finish coat of aluminum paint over galvanizing compound. Approved coatings are as follows:
 - 1 Subox, Division of Carboline - Galvanox Type I.
 - 2 Crown North American Professional Products, Inc. - Cold Galvanizing Compound.
 - 3 ZRC Worldwide - Cold Galvanizing Compound.
 - 4 Duncan - Zirp.
 - 5 Brite Products - Brite Zinc.

- D. Prepare inorganic zinc coated surfaces in accordance with SSPC-SP11 methods. Surface preparation shall extend into the undamaged zinc coating by a minimum of 1 inch. For welds, remove all flux and weld splatter. Apply organic zinc-rich primer containing a minimum of 50% zinc in the dry film, by weight. Apply 1 coat minimum to achieve 3-mils dry film thickness. Color shall approximate match color of shop coating. Approved coatings are as follows:
- 1 Ameron-Amercoat 68HS.
 - 2 Carboline - Carbozinc 859.
 - 3 ICI Devoe - Catha-Coat 303H.
 - 4 International - Interzinc 52HS.
 - 5 Tnemec - Tnemezinc 90-97.
- E. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
- F. Repair of damaged surfaces shall be a continuous activity and shall occur as the coating is damaged and shall take place prior to rust bloom starting.

3.4 WELDING

- A. Where galvanized steel is to be welded, provide adequate ventilation.
- B. Perform welding in accordance with the American Welding Society D19.0. Welders and welding operators shall be trained in the hazards of welding galvanized steel prior to performing any welding on Site.
- C. Touch up all welded areas as specified.

3.5 WET STORAGE STAIN

- A. Remove any wet storage stain prior to installation as follows:
- 1 Arrange steel so that surfaces dry rapidly.
 - 2 Light stain deposits are to be removed by means of a stiff bristle (not wire) brush. Remove heavier deposits by brushing with a 5% solution of sodium or potassium dichromate with the addition of 0.1% by volume of concentrated sulfuric acid. Apply with a stiff bristle brush and leave for about 30 seconds before thoroughly rinsing and drying. Alternatively, a proprietary product such as Oakite Highlite, or approved equal, which is intended for this purpose may be used according to manufacturer's recommendations. Dispose of rinse water in an approved manner and in accordance with state, local, and federal Laws and Regulations.
 - 3 A coating thickness check shall be made in the affected areas to ensure that zinc coating remaining after the removal of wet storage stain is sufficient to meet or exceed requirements of the Specification.

3.6 REPAIRS

- A. Repair material showing evidence of damage to zinc coating. If not repairable, material with damaged coating will be subject to rejection.

END OF SECTION 05 12 00

**SECTION 07 21 00
THERMAL INSULATION**

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes:
 - 1 Extruded polystyrene foam-plastic board.
 - 2 Expanded polystyrene foam-plastic board.

1.3 RELATED REQUIREMENTS

- A. Section 03 30 00 – Concrete
- B. Section 31 20 00 – Site Preparation and Earthwork

1.4 REFERENCES

- A. ASTM C578: Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- B. ASTM C1029: Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.
- C. ASTM C1289: Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- D. ASTM D4397: Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
- E. ASTM E84: Test Method for Surface Burning Characteristics of Building Materials.
- F. NFPA 285: Method of Test for the Evaluation of Fire Propagation Characteristics of Exterior, Nonload-Bearing Wall Assemblies Containing Combustible Components.

1.5 SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1 Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2 Protect against ignition at all times. Do not deliver foam-plastic board materials to Project Site until just before installation time.

- 3 Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.
- 4 Polystyrene insulation shall not be exposed to petroleum-based products.

2 PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

- 1 Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

- B. Extruded Polystyrene Board, Type IV: ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

- 1 Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

- C. Extruded Polystyrene Board, Type VI: ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

- D. Extruded Polystyrene Board, Type VII: ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

- E. Extruded Polystyrene Board, Type V: ASTM C578, Type V, 100-psi (690-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

2.2 Expanded POLYSTYRENE FOAM-PLASTIC BOARD

- A. Expanded Polystyrene Board, Type IX: ASTM C578, Type IX, 25-psi (173-kPa) minimum compressive strength.

3 EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF FOUNDATION INSULATION

- A. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

- 1 If not otherwise indicated, extend insulation a minimum of 24 inches outside the edge of foundation.

END OF SECTION 07 21 00

**SECTION 33 41 00
STORM DRAINAGE SYSTEM**

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

- A. This Section includes storm drainage pipe and appurtenances, manholes, and inlet and outlet structures.

1.3 RELATED REQUIREMENTS

- A. Section 03 20 00 – Concrete Reinforcement
- B. Section 03 30 00 - Concrete
- C. Section 31 20 00 - Site Preparation and Earthwork

1.4 REFERENCES

- A. IBC 2012– International Building Code
 - 1 Publication dates for listed standards shall comply with standards referenced within 2012 International Building Code or those that are in effect as of the date of the Contract Documents if not referenced within 2012 International Building Code or noted otherwise.
- B. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- C. AASHTO M36 - Corrugated Steel Pipes, Metallic-Coated, for Sewers and Drains.
- D. AASHTO M252 - Plastic and Polyethylene Corrugated Drainage Pipe or Tubing.

1.5 SUBMITTALS

- A. Tests to determine conformance with all requirements of this Specification for quality and properties of all Contractor-secured materials, shall be performed by an independent commercial laboratory retained and compensated by the Contractor, and approved by the Engineer.
- B. When incorporating materials into the Project, quality control testing will be performed during construction by a testing laboratory retained and compensated by the Owner.
- C. Copies of reports and certificates regarding tests and inspection of equipment, materials, and completed work shall be distributed as specified in Division 01. Furnish specific schedule for sampling to provide Owner and Engineer with the opportunity to observe sampling.

2 PRODUCTS

2.1 GENERAL

- A. Lay all pipe carefully, true to lines and grades indicated. Any pipe which is not in true alignment or which shows undue settlement after laying shall be taken up and re-laid at the Contractor's expense.
- B. Trenching and Filling: Perform as specified in Section 31 20 00.

2.2 CORRUGATED POLYETHYLENE PIPE

A. Materials:

- 1 Pipe and fittings shall conform to AASHTO M252 for 4 inch diameter pipe and AASHTO M294 for 36 inch diameter pipe except as modified herein.
- 2 Pipe and fittings shall not be made from reprocessed material.

B. Installation:

- 1 Coupling bands shall be as per the manufacturer's recommendation to produce a watertight joint.
- 2 Install to conform to manufacturer's recommendations.
- 3 All cracked pipe shall be rejected.

2.3 CLEAN-UP

- A. Upon completion of the storm drainage system, flush out and clean all storm drainage pipes and structures.

3 EXECUTION - unused

END OF SECTION 33 41 00

SECTION 31 62 18
FOUNDATION PILING (STEEL PIPE PILES)

1 PART 1 - GENERAL

1.1 SUMMARY

- A. Work under this Section consists of furnishing all labor, equipment, and materials necessary to install all foundation piling for the structures as indicated for the LaTouche (56th Street) Substation Transformer.
- B. Minimum pile capacity shall be as indicated on Drawings.
- C. Dynamic pile load testing shall be performed on select piles as described herein, and in the applicable Pile Load Testing Section(s) as referenced in ARTICLE 1.02.B of this SECTION. The ultimate capacity of each pile tested shall confirm the following minimum safety factor values:
 - 1 2.5 times the design compression capacity.
 - 2 3.0 times the design tension capacity.
- D. Contractor and/or Subcontractor shall visit the Site prior to bidding to observe and review specific Site conditions and requirements for equipment, methods, and costs to install piling. Contractor shall become familiar with conditions present at the Site prior to bidding; specifically should there be limited access dimensions, headroom clearances, or other conditions which restrict the use of particular driving equipment and thereby affect the associated minimum final driving resistance. Limited horizontal access due to a switch building located near the proposed transformer shall be reviewed and considered by Contractor.
- E. Contractor shall verify the location of all underground conduits, piping, duct banks, and utilities prior to pile driving.

1.2 RELATED REQUIREMENTS

- A. Section 31 08 17 - Dynamic Pile Testing.
- B. Section 03 30 00 – Concrete.

1.3 REFERENCES

- A. General - Standards listed by reference, including revisions by issuing authority, form a part of this Section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation. Where specifications and reference documents conflict, the specification shall govern. Unless otherwise noted, the latest revision of the following references shall apply to this Section.
- B. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- C. ACI 305.1-06 – Hot Weather Concreting.
- D. ACI 306.1-90 – Cold Weather Concreting.
- E. ASTM A252 – Welded and Seamless Steel Pipe Piles.
- F. ASTM A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

- G. AWS D1.1 - Structural Welding Code.
- H. AWS Qualify all welders, welding processes and procedures in accordance with AWS"Code for Welding in Building Construction."
- I. IBC 2012– International Building Code
 - 1 Publication dates for listed standards shall comply with standards referenced within 2012 International Building Code or those that are in effect as of the date of the Contract Documents if not referenced within 2012 International Building Code or noted otherwise.

1.4 EXPERIENCE QUALIFICATIONS

- A. The Contractor or Subcontractor to perform work shall have a minimum of five years'experience installing the type of piles on which he bids.
- B. The name of proposed Subcontractor along with his experience statement of past work shall be submitted at time of Bid and will be considered in the evaluation of Bids.
- C. All other guidelines for submitting Subcontractor information shall be followed in accordancewith that specified elsewhere.

1.5 SUBMITTALS

- A. Design and Pre-Construction Submittals:
 - 1 Submit details of pipe pile section; including outside diameter, minimum wall thickness, yield strength, concrete fill material, bearing plate, and anchorage steel, if used.
 - 2 Submit details of proposed pile driving equipment to Owner at least two weeks prior to driving piling. The information shall include:
 - a. Make and model of pile driving hammer and mandrel, if used, ram weight, stroke and proposed fuel setting, if applicable.
 - b. Weight, stiffness, and coefficient of restitution of capblock assembly, cushion dimensions, type of cushion material, and cushion stiffness.
 - c. Weights and dimensions of mandrels for steel pipe piles along with location and type of splices, if present.
 - 3 Proposed location and type of splices, if present.
 - 4 Detailed description of Vibration Monitoring Program.
 - 5 Pile Driving Layout and Sequence Plan.
 - 6 Details of proposed Test Pile Program, as specified herein and in the applicable Pile Load Testing Section(s).
- B. Construction and Closeout Submittals:
 - 1 During pile driving, submit a record of each driven pile to the Resident Project Representative to include:
 - a. Name of structure.

- b. Pile cap number.
- c. Pile number.
- d. Driven pile length.
- e. Pile length after cutoff.
- f. Elevation of pile tip and cutoff.
- g. Ground surface elevation during driving.
- h. Date and time of day pile is driven.
- i. Continuous driving resistance and pressure gauge readings or hammer stroke.
- j. Hammer speed.
- k. Location and type of splice, if present.
- l. Final driving resistance and pressure gauge readings or hammer stroke.
- m. Driving time.
- n. Predrilling diameters and depths.
- o. Heaving records.
- p. Redriving data.
- q. Details of concrete placement and concrete strength test results.
- r. Remarks concerning installation of pipe.

2 As-Built Pile Location and Elevation Data.

- a. Submit to Owner's Resident Project Representative prior to final payment.

3 Vibration Monitoring Records.

- a. Submit to Resident Project Representative within 24 hours of testing.

4 Records from Test Pile Program.

- a. Submit to Resident Project Representative within 24 hours of testing.

1.6 FIELD MARKING AND ELEVATIONS

- A. Provide elevation reference and mark each pile along its entire length at 1-foot intervals and along at least the last foot of driving at 1-inch increments, so as to permit determination of the pile tip elevation and corresponding driving resistances during driving.

2 PRODUCTS

2.1 DRIVEN STEEL PIPE PILES

- A. Piles shall be top-driven, concrete-filled steel pipe conforming to A252, Grade 2.

- 1 Minimum outside diameter shall be 10.75 inches.
 - 2 Minimum wall thickness shall be 0.5-inch.
- B. The tip shall be closed with a 3/4-inch-thick flat steel plate installed flush with the outside diameter of the pile, or other approved devices, continuously welded to the outside of the pipe and capable of withstanding all driving forces and earth pressures without separation. Weld shall be watertight.
- C. Store on platforms, skids, or other supports at the Site and support to prevent excessive deflection.
- D. The pile assembly shall be watertight after driving.

2.2 CONCRETE FOR INTERIOR OF STEEL PIPE PILES

- A. Fill piling with concrete of minimum compressive strength at 28 days of 4,000 psi as specified in SECTION 03 30 00 - CONCRETE except as follows:
- 1 The slump of the concrete shall not be less than 4 inches or more than 6 inches.
 - 2 One set of six test cylinders for not less than one day's concrete placement or each 25 cubic yards of concrete or fraction thereof or as directed by Owner's Resident Project Representative will be prepared by the testing laboratory retained by the Owner. Test cylinders will be tested for compressive strength.
 - 3 Concrete placement shall conform to ACI 304R, 305.1 and 306.1.

2.3 ANCHORAGE STEEL FOR UPLIFT:

- A. Attach anchorage steel to steel pipe pile as indicated.
- B. Anchorage steel shall comply with amount, lengths, and connection methods as noted on the Drawings.

2.4 PILE DRIVING EQUIPMENT:

- A. Pile Driving Hammer:
- 1 Piles shall be driven with an approved single, partial double-acting or double-acting air, diesel or hydraulic hammer with minimum driving energy and ram weight as required to install the pile to the required penetration depth and ultimate capacity without overstressing the pile.
 - 2 Contractor shall submit details of the pile hammer to Owner for approval at least two weeks prior to the driving of any piles.
 - 3 Should a change in hammer or driving equipment be necessitated by Contractor, the Contractor shall submit these revised details to Owner for approval at least two weeks prior to driving piles with revised equipment.
 - 4 The pile driving hammer shall be operated at all times at speeds and conditions recommended by the hammer manufacturer.
 - 5 The compressor capacities for air-operated hammers shall be sufficient to operate the hammer continuously at the full-rated speed and energy.
 - 6 For air-operated pile hammers, Contractor shall provide a pressure gauge to be located on the hammer airline in such position that it can be clearly read by the pile driver operator.

- 7 For all partial double-acting and double-acting hammer types, the Contractor shall provide the applicable pressure gauge(s) to be located in a position such that it can be clearly read by the pile driver operator and Resident Project Representative to permit determination of the chamber pressure.
- 8 For all single-acting hammer types, the Contractor shall mark the ram such that it can be clearly read by the pile driver operator and Resident Project Representative to permit determination of the stroke.
- 9 Unless otherwise approved by Owner in writing, the pile driver shall be equipped with fixed leads and/or template, secured to the pile driving rig with rigid bracing, and extending to the lowest point which the hammer must reach to drive the piles.

B. Capblock and Cushion:

- 1 Piles shall be protected during driving by a capblock-and-cushion assembly of approved design.
- 2 The capblock or cushion materials shall be replaced during driving if it has been damaged, highly compressed, charred, burned, or has become spongy or deteriorated in any manner.
- 3 Continuous or frequent introduction or addition of cushion materials shall not be permitted.
- 4 The driving helmet or capblock shall fit flush with the plane of the pile end so that a uniform impact force is applied to the pile during driving.
- 5 The cushion shall be fabricated from durable materials with referenced elastic and stiffness value properties. The cushion stiffness shall be determined as:

$$S = (AE) / L$$

where:
S = Cushion stiffness (kip/in)
A = Cushion area (in²)
E = Secant modulus of elasticity of cushion material (ksi)
L = Length or height of cushion (in)
- 6 The coefficient of restitution of the capblock-and-cushion assembly shall not be less than 0.8.
- 7 Contractor shall submit to Owner, for approval, details concerning the stiffness of the cushion assembly, the coefficient of restitution, and the weight of the capblock-and-cushion assembly at least two weeks prior to driving piles.
- 8 Capblock and cushion materials used for installation of production piles shall be the same material and condition as that used for installation of the indicator piles, unless otherwise approved by Owner.

3 EXECUTION

3.1 EQUIPMENT FOR DRIVING STEEL PIPE PILES

- A. All pile driving equipment shall be subject to Resident Project Representative's approval after inspection at the Site.
- B. At any time during the progress of the Work, equipment that, in the Resident Project Representative's opinion, is unsuitable or in poor operating condition, will not be approved for pile driving.

3.2 DRIVING PROCEDURE

- A. Piles shall not be driven until inspected and approved for driving.
- B. Each pile shall be driven continuously and without voluntary interruption until the specified penetration length and driving resistance have been obtained.
- C. Piles shall be driven in contact with surrounding soil and left permanently in place.
- D. Piles shall be driven in a sequential operation which will minimize heaving of adjacent piles.
- E. Pile driving operations shall be suspended if impact shock results in problems to any adjacent structures or equipment until corrective measures can be taken.
- F. No pile shall be driven within 10 feet of any previously driven pile where concrete has been placed less than 8 hours prior.
- G. No method requiring force to correct the position or line of any pile shall be permitted during driving.
- H. Special precautions shall be taken to avoid oil spatter from pile driving equipment when working in the vicinity of existing structures, vehicles, and other permanent fixtures.
- I. After completion of driving each pile, the pile shall be kept covered continuously to prevent debris and foreign materials from falling into the pile prior to the placement of concrete.
- J. Pile driving areas shall be kept free from water at all times.

3.3 VIBRATION MONITORING

- A. Perform vibration monitoring on adjacent structures or other facilities subject to damage from pile driving, as directed.
- B. A separate, certified firm shall be provided to:
 - 1 Determine locations to set up seismographs, or where to position during various stages of pile driving activities.
 - 2 Measure background vibration response and air response noise prior to commencing driving.
 - 3 Perform background monitoring during construction at times corresponding to those times of proposed driving operations.
 - 4 Monitor driving operations at necessary locations throughout all driving operations.
 - 5 Provide a permanent record from each seismograph, referencing location of seismographs and distance away from driving operation.
 - 6 Use a minimum of two seismographs capable of detecting peak particle velocities in three mutually perpendicular components, otherwise known as the x, y, and z axes.
 - 7 Use a minimum of two seismographs capable of recording amplitude (peak particle velocity) and frequency (hertz). Displacement shall be developed, if needed for frequencies as required, from empirical computer relationships.
 - 8 Peak particle velocities and/or displacements at adjacent structures, equipment, exposed or buried, pipelines and conduits shall not exceed the level of criteria as determined by

9 U.S. Department of Interior, Bureau of Mines in Appendix Figure B-1 from Report of Investigations 8507 by D.E. Siskind, et al.

- C. Contractor shall take appropriate corrective actions to prevent damage to adjacent structures, pavement, utilities, and other improvements.

3.4 PREDRILLING AND JETTING

- A. When necessary to assist in attaining indicated penetration length without exceeding maximum driving resistance and damaging piles, predrilling will be permitted upon prior written approval by Owner of Contractor's proposed method.
- B. Where required, perform predrilling in advance of driving with a continuous flight auger to a depth not below the proposed final tip elevation.
- C. Unless otherwise approved by Owner, do not drill hole larger than the 75% of the pile's depth and diameter.
- D. Remove waste from drilling operations at an off-site location or as directed by Owner.
- E. Jetting will not be permitted.

3.5 PENETRATION AND DRIVING RESISTANCE

- A. Piles shall be driven to a pile length of 45 feet into the underlying stiff clays below final subgrade elevation and then to the specified and minimum driving resistance.
- B. The minimum final driving resistance will be determined by Contractor using the U.S. Department of Transportation, Federal Highway Administration Wave Equation Analysis of Pile Driving (WEAP) for the pile hammer and associated capblock-cushion materials and properties, as to be submitted and utilized for pile driving by Contractor and as determined in conjunction with the Indicator Test Pile Program.
- C. Chugach's Engineer will be on site to assist and approve driven pile installations.

3.6 SPLICING

- A. Splice pile assembly before driving to produce a length adequate for anticipated penetration.
- B. If the length of a pile assembly is insufficient to achieve the specified penetration and driving resistance, extend the driven assembly by splicing an assembly of the same cross section.
- C. Welding shall not be performed when the temperature of the base metal is lower than 0° F. At temperatures between 32° F and 0° F, the surface of all areas within 3 inches of the area where the weld is to be performed shall be heated uniformly to a temperature at least warm to the hand before any welding is done.
- D. Splices shall be accurately aligned, watertight, and welded as follows:
 - 1 Shielded arc, fusion welded in conformance with "Standard Code for Arc and Gas Welding in Building Construction" by the AWS D1.1.
 - 2 Executed by welders presently qualified by passing tests prescribed by the AWS "Standard Qualification Procedure."
 - 3 100% butt welded using a 45° single-bevel weld backed up on the far side.

- 4 Using mild steel electrodes conforming to AWS specification E70 series.
- E. Prefabricated Drive-On Pipe Pile Splicer, S-20000 WF, or approved equal may be used as follows:
 - 1 Prepare, attach, and weld splicer in accordance with manufacturer's requirements.
 - 2 All welds shall be adequate to handle driving stresses, compressive, uplift and shear ultimate loads, as indicated.
 - 3 Drive on splices are not to be allowed on the piles supporting foundation F-2.
- F. After welding, permit sufficient time for weld to cool to touch prior to continuation of pile driving.
- G. After splicing, piles shall be driven to the specified penetration and driving resistance.
- H. Only one splice per pile shall be permitted.
- I. Splices are not allowed in the upper 25 feet from the top of final pile indicated elevation.

3.7 HEAVING

- A. Heaving shall be checked on a selected reference pile within each pile group or cluster.
- B. The reference pile shall be checked by comparison of elevations before and after driving of all adjacent piles within a group or cluster.
- C. Heaving shall be considered as occurring to all piles within a group or cluster when the reference pile head elevation changes in excess of 0.025-foot.
- D. Piles within a group or cluster shall be redriven when the reference pile heaves in excess of 0.025-foot.

3.8 REDRIVING

- A. A pile selected by Owner's Resident Project Representative from within the initial pile group or cluster driven shall be redriven not less than 4 hours and preferably 24 hours after completion of initial driving in order to check for relaxation or freeze. Relaxation is indicated by a lesser number of blows per inch required to mobilize the pile than was attained at completion of its original final driving resistance.
- B. Pile shall be driven not less than the same number of blows originally applied to the pile, after the hammer has warmed up. Driving resistance shall be noted for each inch of pile penetration. If redriving indicates relaxation, Owner shall be notified. All piles within a pile group or cluster which has indicated relaxation shall be redriven until the driving resistance for the last inch indicates that specified pile capacities have been attained.
- C. Redrive all piles within a group or cluster that have indicated heave of the reference pile.

3.9 CUTOFF

- A. Piles shall be cut off perpendicular to the vertical axis of the pile and to within 1-inch of the cutoff elevation indicated.
- B. Piles shall be cut off by methods which will not damage reinforcing steel and/or concrete of the pile left in place. Where applicable, cut off steel pipe pile before installation of reinforcing steel and concrete.

- C. Portions of pile which are battered, split, warped, buckled, damaged, or imperfect within the upper reaches of the top shall be cut off. This does not apply to piles that have been rejected.
- D. If excavation around the piles is required to achieve pile cut off, the excavated material shall be removed and disposed of as directed by Owner's Resident Project Representative.
- E. Remove waste steel pipe, reinforcing steel, concrete, and dispose of off-site or as otherwise directed by Owner's Resident Project Representative.

3.10 INSTALLATION TOLERANCES

- A. Piles shall not exceed a variation from the vertical axis of the pile of more than 1/4-inch per foot of pile length.
- B. Piles shall not exceed a sweep in which one side of the pile tip is not visible from the ground surface, unless otherwise approved in writing by Owner.
- C. The center of the pile head shall not vary from plan location at cutoff by more than 3 inches.
- D. Piles shall be cut off and concrete placed to within 1-inch of the cutoff elevation indicated.

3.11 ANCHORAGE STEEL PLACEMENT

- A. Remove all foreign matter from pile prior to attaching anchorage steel.
- B. Anchor for uplift as indicated.
- C. Anchorage steel shall not be attached to piles until after initial inspection by Resident Project Representative. Anchorage steel shall not be attached to rejected piles.

3.12 CONCRETE PLACEMENT

- A. Remove all foreign materials, including water, sand, mud, or debris from the pile prior to concrete placement. Concrete shall be placed only in piles without water, unless pumping or other placement methods are approved in writing by Owner.
- B. Do not place concrete within the pile until pile is inspected by Resident Project Representative using a light suitable for inspection of the entire length of the pile. Light, tape, and plumb weight shall be provided by Contractor.
- C. Concrete shall be placed in the pile as soon as possible after driving, consistent with Contractor's operations. Water and/or foreign materials shall not be allowed to accumulate in the pile.
- D. Do not place concrete into any pile within an area indicated as heaved until redriving has been performed.
- E. Place concrete by methods and equipment which will prevent segregation, arching, or formation of voids in the concrete.
- F. Place concrete continuously in each pile from pile tip to pile cutoff elevation without interruption.
- G. Vibrate or rod concrete within the upper 15 feet of the pile to promote complete consolidation of concrete.
- H. Concrete shall be placed in accordance with SECTION 03 30 00 - CONCRETE.

3.13 NON-CONFORMING WORK

- A. Contractor shall be solely responsible for full compliance with the Contract Documents regardless of if and when discrepancies are brought to their attention. Contractor shall be responsible for all re-work necessary to achieve full compliance with the Contract Documents. Repairs or replacement shall be at the sole expense of the Contractor, including the costs to redesign, as required.
- B. Owner may employ one or more of their representatives to provide observation and testing services.
- C. Owner or Resident Project Representative may reject any piles which, in their opinion, do not conform to the Contract Documents.
- D. As directed by Owner, perform the following for rejected piles at no additional cost to Owner:
 - 1 Leave piles in place, cut off as directed, and install one or more replacement piles in designated location(s).
 - 2 Withdraw the pile and install a new pile in the same location. Any holes which result from pile withdrawal shall be packed with sand, gravel, or other approved material prior to installation of the replacement pile.
 - 3 Other remediation work, as directed.

3.14 REJECTED PILES

- A. The Resident Project Representative will determine the acceptability of all piles driven and may, at his option, reject those piles which do not conform to the Drawings and Specifications.
- B. As directed by Resident Project Representative, Contractor shall perform one of the following for rejected piles:
 - 1 Leave piles in place, cut off as directed, and drive one or more new piles in locations designed by Resident Project Representative to replace the rejected pile and maintain symmetry of the pile group or cluster.
 - 2 Withdraw the pile and drive a new pile. Any holes which result from pile withdrawal shall be packed with sand, gravel, or other approved nonplastic (noncohesive) soil before re-driving of the replacement pile.

3.15 TEST PILE PROGRAM

- A. Indicator Piles:
 - 1 Indicator piles shall be driven to an ultimate pile capacity and corresponding driving resistance as determined by Contractor based upon the preliminary driving resistance indicated by wave equation results. Adjustments to the preliminary driving criteria shall be made by Contractor based upon the dynamic testing results of both initial driving and strike tests.
 - 2 The Contractor shall install a minimum of one indicator pile at locations to be determined by the Owner or Contractor.
 - 3 Indicator piles may be installed at production pile locations.

- 4 The installation equipment (hammer, cushion, cap-block, follower) and methods during the driving of the indicator piles shall be the same (including speeds, fuel/energy settings, and conditions) as that used for production pile driving. Each additional hammer and equipment setup including one of identical make and model shall require performance evaluation (including Pile Driving Analyzer) and Owner's subsequent approval.
- 5 Indicator piles shall be installed in accordance with procedures required for production piles and Contractor shall submit to Resident Project Representative a record of each indicator pile placed including all information required for production piles.
- 6 Remaining production piles shall not be driven until evaluation of indicator piles has been completed by the Owner or Contractor's Dynamic Consultant.

B. Dynamic Pile Testing:

- 1 Dynamic pile load testing shall be performed in accordance with the requirements outlined in Section 31 08 17 and as described herein.
- 2 Contractor shall secure the services of a Dynamic Testing Consultant.
- 3 Dynamic pile testing shall be conducted on all indicator piles during the entire duration of initial driving and during restrike driving operations.
- 4 If Indicator Pile testing shows piles have sufficient capacity, additional production pile dynamic tests are not required, however, if the Indicator Pile testing indicates that additional pile length or modification to driving is required to obtain the required geotechnical capacity, dynamic pile testing shall be conducted on additional production piles to account for a minimum of 10% of remaining production piles. Dynamic monitoring of production piles shall be performed over the entire length during initial driving, or as otherwise directed by Contractor's Dynamic Testing Consultant. The monitoring of production piles with PDA shall be performed throughout the duration of the project to obtain a representative cross-section of conditions present.
- 5 The restrike shall be performed with a warmed up hammer and shall consist of striking the piles for 50 blows or until the pile penetrates an additional three inches, whichever occurs first. In the event the pile movement is less than 1/2 inch during the restrike, the restrike may be terminated after 20 blows.
- 6 Restrike driving shall be performed a minimum of 72 hours following completion of initial pile installation and prior to placing concrete in the piles.
- 7 The Contractor shall maintain sufficient pile head exposure at the end of initial driving on production piles to permit the attachment of the dynamic testing sensors. This may be accomplished with either additional pile length or small excavations to expose the pile head.
- 8 CAPWAP analysis of the dynamic pile testing data shall be performed on data obtained from the end of initial driving and the beginning of restrike driving for the Indicator Piles.
- 9 CAPWAP analysis shall be performed on all production piles monitored with dynamic pile testing, as selected by the Contractor's Dynamic Testing Consultant.
- 10 Dynamic pile load testing shall be performed only in the presence of the Owner.

END OF SECTION 31 62 18

**SECTION 31 08 17
DYNAMIC PILE TESTING**

1 GENERAL

1.1 SUMMARY

- A. This Section specifies requirements for dynamic testing of driven foundation piling.
- B. Dynamic testing requires attaching two strain transducers and two accelerometers to the pile usually 1.5 to 3 pile diameters below the pile head during initial driving or at a convenient location during restrike testing. A cable connects the sensors on the pile with the Pile Driving Analyzer® (available from Pile Dynamics, Inc., 30725 Aurora Road, Cleveland, OH 44139, USA; www.pile.com/pdi; email: sales@pile.com; phone: +1 216-831-6131; fax +1 216-831- 0916) or equivalent, located at ground level a safe distance away from the pile.
- C. Dynamic testing shall be performed on all indicator piles as indicated to assess the performance of the hammer, confirm the set, capacity, allowable driving stresses and observed driving resistance with depth of the piles. Dynamic testing of indicator piles shall be performed at locations as designated by Contractor's Dynamic Consultant and approved by Owner during the entire length of initial driving and during restrike driving.
- D. A percentage of additional production piles shall have dynamic testing performed throughout production driving at locations as specified in the applicable Foundation Piling Section.
- E. The minimum duration between initial driving and restrike driving shall be as specified in the applicable Foundation Piling Section.
- F. Dynamic testing shall be performed to verify that piling is being driven sufficiently to achieve their required design compression and design tension capacities with the specified safety factor value(s) as summarized in the applicable Foundation Piling Section.

1.2 REFERENCES

- A. ASTM D4945 - Standard Test Method for High-Strain Dynamic Testing of Deep Foundations.
- B. Hannigan, P.J. et al, 2006. Workshop Manual on Design and Construction of Driven Pile Foundations, U.S. Department of Transportation, Federal Highway Administration, Report No. FHWA-HI-96-033, Washington, D.C., pp. 11-3 to 11-9.
- C. American Association of State and Highway Transportation Officials (AASHTO):
- D. AASHTO LRFD Bridge Design Specifications, Sixth Edition, 2012.

1.3 SUBMITTALS

- A. Bid Submittals:
 - 1 Experience and qualifications of Dynamic Testing Consultant.
- B. Pre-Construction Submittals:
 - 1 Pile Driving Equipment Data:

- a. Submit detailed information regarding make and model of pile hammer and driving equipment two weeks prior to commencement of indicator pile driving activities. Submit details of driving helmets, cap-blocks, pile cushions, follower, and driving heads. Include weight, dimensions, stiffness and coefficient of restitution of cap block assembly (helmet, hammer cushion materials, and driving head); dimensions, stiffness, coefficient of restitution and type of material(s) of cushion (pile cushion).
- b. Do not commence pile driving activities until complete pile hammer and driving equipment submittals have been received and accepted by Owner.

2 Pile driving layout and sequence plan:

- a. Show the location, identification, order and orientation in which piles will be driven, and describe how the sequence will minimize piles from being displaced laterally when driving subsequent piles.
- b. Unless otherwise noted in the applicable Piling Section, it is intended that all indicator piles be installed at final production pile locations, uniformly distributed across the site, driven in a sequential manner to minimize their impact to production pile installation at the Site and so as to permit ease of access to subsequent production piles.
- c. The location of the indicator piles is subject to review and approval by the Owner.

C. Construction Submittals:

- 1 New or modified pile driving system or installation procedures, as applicable.
- 2 Dynamic Testing Consultant shall provide preliminary dynamic testing reports and datafiles within 24-hours of completion of each test.
- 3 Dynamic Testing Consultant shall provide summary report of all finalized data from all piles tested prior to final payment.

2 PRODUCTS

2.1 EQUIPMENT

- A. Dynamic monitoring shall be performed using a Pile Driving Analyzer. All equipment necessary for the dynamic monitoring such as sensors, cables, etc., shall be furnished by Dynamic Testing Consultant. The equipment shall conform to the requirements of ASTM D4945.
- B. Provide power capable of operating an electric drill to install sensor attachment holes in the test piles. Provide a 12 to 24 volt D.C. power source (e.g. car battery) for operating the Pile Driving Analyzer.

3 EXECUTION

3.1 CONSTRUCTION ACCESS

- A. Prior to lifting the pile to be dynamically tested, provide a minimum of 3 feet of clear access to 180 degree opposite faces of the pile for pile preparation. Dynamic Testing Consultant or Piling Subcontractor's personnel shall then drill and prepare holes in the pile for attachment of sensors.

- B. Dynamic Testing Consultant or Piling Subcontractor's personnel will attach the sensors to the pile prior to initial driving. Driving shall then continue using routine pile installation procedures. When the sensors approach the ground surface, water surface, or a pile template, driving shall be halted to remove the sensors from the pile to prevent damage to the sensors. If additional driving is required, the pile shall be spliced and the sensors shall be reattached to the next pile segment prior to continuing driving.

3.2 TESTING PROCEDURES

A. Preconstruction Wave Equation Analyses:

- 1 Contractor's Dynamic Consultant will use Pile Driving Equipment Data to perform a wave equation analysis. The wave equation analysis performed by the Contractor's Dynamic Consultant will be used to confirm the ability of the Piling Subcontractor's proposed driving system to install the pile to the required capacity and desired penetration depth within the allowable driving stresses.
- 2 Approval of the proposed driving system by Owner shall be based upon the wave equation analysis indicating that the proposed driving system can develop the ultimate pile capacities as identified by the Owner at an acceptable driving resistance not greater than 10 to 20 blows per inch within allowable driving stress limits.
- 3 A new pile driving system, modifications to existing system, or new pile installation procedures shall be proposed by Piling Subcontractor if the pile installation stresses predicted by wave equation analysis or calculated by the Pile Driving Analyzer exceed the following maximum values:
 - a. DEFINITIONS
 - (1) F_y : Yield stress of section
 - (2) ϕ : LRFD resistance factor (AASHTO, 2012).
 - b. Steel Pile Sections:
 - (1) Compressive Stress: $0.9 \times F_y$
 - (2) Tensile Stress: $0.9 \times F_y$

B. Dynamic Monitoring:

- 1 Dynamic monitoring shall be performed during driving in accordance with ASTM D4945, and as directed by Engineer. Dynamic testing data shall be recorded on every blow throughout monitoring for all piles monitored at the site.
- 2 An experienced civil/structural/geotechnical engineer provided by Dynamic Testing Consultant shall operate the Pile Driving Analyzer in the field and be certified at a minimum level of BASIC (second of four levels) on the PDI/PDCA Dynamic Measurement and Analysis Proficiency Test or the Foundation QA High Strain Dynamic Pile Testing Examination to perform all monitoring and reporting activities.
- 3 Dynamic Testing Consultant shall take measures to ensure that the location of strain gage placement does not impact the accuracy of the ultimate compression capacity of the piling per Pile Driving Analyzer and CAPWAP analyses (check proportionality values).

- 4 Installation of indicator piles is typical of normal pile installation except Dynamic Testing Consultant may frequently stop driving to request changes in the hammer fuel setting, recommend changes to cushion material and/or thicknesses, or to check the PDAgages and equipment. If requested, provide Dynamic Testing Consultant access to the head of the pile to check the gauge and cable attachments, change gauges, or perform similar work. Provide a qualified member of the pile driving crew to assist the DynamicTesting Consultant with such work as directed.
- 5 Cushions and hammer fuel settings: Owner may request combinations of hammer cushions and thicknesses, and hammer fuel settings be investigated during the testing. Piling Subcontractor shall cooperate with the Resident Project Representative by installing the indicator piles using combinations of cushion material and thicknesses, andhammer fuel settings selected by Contractor's Dynamic Consultant. Change cushions, orchange hammer fuel settings when requested by Resident Project Representative.

3.3 DYNAMIC TESTING REPORTS

- A. The Dynamic Testing Consultant shall prepare a written report of the dynamic testing operations. This report shall include a discussion of the pile capacity results obtained from thedynamic testing. The report shall also discuss hammer and driving system performance, driving stress levels, and pile integrity. The report data shall be provided to Owner's ResidentProject Representative for review immediately upon completion of each dynamic pile testing operation, and prior to installation of further production piling. Dynamic Testing Consultant shall provide Owner with electronic copies of the W01/X01 data files generated during the dynamic testing immediately upon completion of each dynamic pile testing operation.
- B. CAPWAP analyses of the dynamic pile testing data shall be performed on data obtained from the end of initial driving and the beginning of restrike as specified in the applicable FoundationPiling Section.
- C. If a portion of the remaining production piles are to be monitored with dynamic pile testing,they shall also have CAPWAP analysis performed as selected by the Owner. The required percentage shall be as specified in the applicable Foundation Piling Section.
- D. Resident Project Representative may request additional CAPWAP analyses at selected pilepenetration depths to investigate potential alternate bearing layers or time dependent soil strength changes.
- E. Owner may request that Dynamic Testing Consultant perform a refined wave equation analysisor analyses based upon the variations in the subsurface conditions and/or drive system performance observed during dynamic pile testing.
- F. Owner will perform evaluation of all dynamic testing reports for the development ofappropriate driving resistance criteria for the project.

END OF SECTION 31 08 17