SPECIFICATIONS FOR CONSTRUCTION FOR UNDERGROUND SYSTEMS

1. General

These specifications provide for the construction of underground distribution power facilities by the direct burial of cables, using trenching, as specified.

All construction work shall be done in a thorough and workmanlike manner in accordance with the plans and specifications, construction drawings.

The most current version of the National Electrical Safety Code (ANSI C2-1984) adopted by the State of Alaska shall be followed for installations for the utility.

2. Storage of Material and Equipment

All material and equipment to be used in construction shall be new and stored so as to be protected from deteriorating effects of the elements. If outdoor storage cannot be avoided, the material and equipment shall be stacked on supports well above the ground line and protected from the elements as appropriate, and with due regard to public safety.

3. Handling of Cable

Cable shall be handled carefully at all times to avoid damage, and shall not be dragged across the ground, fences or sharp projections. Care shall be exercised to avoid excessive bending of the cable. The ends of the cable shall be sealed at all times against moisture with suitable end caps. Where it is necessary to cut the cable, the ends shall be terminated or sealed immediately after the cutting operation.

4. Plowing (NOT USED)

6. Trenching

All trenching depths are minimum as measured from the final grade to the top surface of the conduit. The routing shall be as shown on the plans and specifications unless conditions encountered are such that changes are necessary to accomplish the work. In such event, the owner shall be notified promptly. If rock or other difficult digging is involved, the contractor shall determine the nature and extent of the difficulty, and the owner will determine whether rerouting, rock trenching, plowing or other changes are necessary. Loose soil or crumbly rock will not be considered as "difficult digging." The trench widths specified are minimum and should be increased as necessary to obtain the required depths in loose soils.

Where trenches are intended for more than one cable or conduit, particular care must be taken to provide for extra depth and width to allow for soil falling into the trench during the laying of the first cables or conduits.

Care shall be exercised to minimize the likelihood of waterflow since this may cause trench damage and reduction in trench depth. When this occurs, the trench must be cleared to the specified depth before installing the cable.

All trenches shall follow straight lines between staked points as far as possible. Secondary and service trenches shall extend in a straight line from takeoff points wherever possible. The trenches shall be dug so that the bottom has a smooth grade. Large rocks, stones and gravel in excess of one inch shall be removed from the bottom of the trench. Where this cannot be done, a two-inch bed of sand or clean soil shall be placed in the bottom of the trench.

Construction shall be arranged so that trenches will be left open for the shortest practical time to avoid creating a hazard to the public and to minimize the likelihood of trench collapse due to other construction activity, rain, accumulation of water in the trench, etc.

7. Installing Cable (SEE SECTION 10 FOR INSTALLING CABLE IN CONDUIT)

The contractor shall inspect the cable carefully as it is removed from the reel in laying operations to be certain that it is free from visible defects. The owner shall decide upon corrective action when defects are discovered.

Sufficient slack and in no case less than 24 inches shall be left at all risers, transformer pads, pedestals and terminal points so that movements of cable after backfilling will not cause damaging strain on the cable or terminals. The cable trench shall be mechanically compacted 3'0" minimum from all riser poles, pads, pedestals and terminal points. All risers shall be sealed with an approved waterproof sealant.

When a hole contains equipment with a metal tank, the concentric neutral cable shall be dressed carefully as shown in the drawings. It shall not be coiled at the bottom of the hole. The coiling of a concentric neutral cable around a metal equipment tank provides an undesirable electrical shield, which prevents proper cathodic protection of the tank. Further, the concentric neutral cable shall be so positioned that it neither lies on nor rubs against the equipment tank.

The ends of all secondary cable terminated below ground shall be long enough to reach at least 12 inches above the top of the underground enclosure.

8. Minimum Bending radius of Cable

The minimum bending radius of primary cable is 12 times the overall diameter of the cable. The minimum bending radius of secondary and service cable is six times the overall diameter of the cable. In all cases the minimum radius specified is measured to the surface of the cable on the inside of the bend. No cable bends shall be made within 6-inches of a cable terminal base.

9. Conduit

The conduit shall be placed in the trench as soon after the trenching operation as feasible. Wherever possible, coiled conduit shall be payed out from the reel mounted on a moving vehicle or trailer. The conduit shall be carefully placed on a uniform base to minimize minor deflections in the conduit. All conduit placement shall be done under constant supervision to be certain that no damage to the conduit occurs.

Primary and secondary conduit trench depths are to be 30" minimum in road crossings and 18" minimum otherwise.

All exposed ends of conduit shall be plugged during construction to prevent the entrance of foreign matter and moisture into the conduit. Burrs or sharp projections which might injure the cable shall be removed. All PVC conduit must be glued securely with PVC cement. All RSC conduit must be securely screwed at all couplings. Primary and secondary risers shall be sealed at the top with a suitable moisture resistant sealant to prevent water from accumulating in the riser. Riser conduit shall extend at least 1.0 foot below grade at all riser poles. ALL METAL RISERS SHALL BE GROUNDED. The minimum size of riser conduit, with equivalent usable area, is as follows:

Primary Cables, 15kV Polyethylene Concentric Neutral

Size AWG or MCM	# of Cables	Conduit Dia. (inches)
2, 1, 1/0, 2/0, 3/0, 4/0	1	2
2, 1, 1/0, 2/0	3	4

Secondary Cables, 600V

Size AWG or MCM	# of Cables	Conduit Dia. (inches)
2, through 2/0	3 or 4	2
Except 2/0	4	3
3/0 through 350	3 or 4	3
Except 350	4	3.5
400 and 500	3	3.5
400 and 500	4	4

10. Installation in Conduit or Duct

Where cable must be pulled through conduit or duct, the operation shall be performed in such a way that the cable will not be damaged from strain or dragging. The cable shall be lubricated with a suitable lubricant prior to pulling into conduit or duct.

In placing primary cables, the stress applied while pulling into ducts or during other pulling operations shall not exceed the least of the following:

a. Where a pulling eye is attached to the conductor, the maximum pulling strain in pounds shall not exceed 0.006 times the circular mill area for aluminum or 0.008 times the circular mill area for copper.

b. Where a basket grip is placed over the cable, the pulling strain shall not exceed the lesser of (1) that calculated in "a." above or (2) 1,000 pounds. The cable under the cable grip and 1-foot preceding it shall be severed and discarded after the pulling operation.

c. In no case shall the maximum pulling tension exceed that recommended by the specific cable manufacturer.

d. At bends the maximum sidewall pressure recommended by the cable manufacturer shall not be exceeded.

11. Tagging of Cables at Termination Points

As the cables are laid they shall be identified and tagged. The identification shall be of a permanent type, such as that done with permanent marker on plastic or corrosion resistant metal tags. The tag shall be securely attached to the cable, tape as required. Paper or cloth tags are not acceptable. Writing on plastic tags shall be done in neat, large block letters. Cable terminations at riser poles shall also be tagged properly. Tags inside enclosures shall be oriented so they can be read without having to touch them.

12. Splices

Cable splices are NOT permitted without prior approval or as shown on the drawings. Splices shall be of the prefabricated type, of the correct voltage rating and shall be made in accordance with the splice manufacturer's instructions. Splices that depend solely on tape for a moisture barrier shall not be used.

Not more than one splice shall be permitted for each 2,000 feet of cable installed unless authorized by the owner. No bends shall be permitted within 12 inches of the ends of the splice. The cable or circuit numbers and the exact location of all splices shall be noted on the (as built). A 5/8"x 8' Copperweld ground rod shall be driven at all primary splice locations.

ALL PRIMARY AND SECONDARY SPLICES SHALL HAVE PRIOR APPROVAL. A UM12 WARNING POST WILL BE PLACED BY ALL SPLICES.

13. Primary Cable Termination (SD)

All cable terminations shall be made with 200A, 15 KV, load break elbows with capacitive test point for attachment of fault indicator. The load break elbows shall be installed in accordance with the manufacturer's instructions at all primary cable

terminals. The termination shall be suitable for the size and type of cable that they are used with. Any indication of misfit, such as a loose or exceptionally tight fit, shall be called to the owner's attention. The outer conductive surface of the termination shall be bonded to the system neutral.

14. Special Precautions for Cable Splices and Termination's

A portable covering or shelter shall be available for use when splices or terminations are being prepared and when prefabricated terminations are being switched. The shelter shall be used as necessary to keep rain, snow and windblown dust off the insulating surfaces of the devices. Since cleanliness is essential in the preparation and installation of primary cable fittings, care shall be exercised to prevent the transfer of conduction particles from the hands to insulating surfaces. Mating surfaces shall be wiped with a solvent such as denatured alcohol to remove any possible accumulation of dirt, moisture or other conducting materials. A silicone grease should be applied afterwards in accordance with the manufacturer's recommendations. Whenever prefabricated cable devices are opened, the unenergized mating surfaces shall be lubricated with silicone grease before the fittings are reconnected.

15. Secondary and Service Connections (SD)

A suitable inhibiting compound shall be used with all secondary and service connections.

All secondary cable connections located below grade or in secondary pedestals shall be made with preinsulated secondary connector blocks. Diving bells with open terminals, insulating boots or moisture barriers that depend solely on tape are not acceptable.

All transformer secondary terminal connections shall be completely insulated. If the secondary terminals are threaded studs, the connection shall be made with a preinsulated secondary transformer connection blocks. If the transformer secondary terminals are insulated cable leads, connection shall be made with a preinsulated secondary connector block or with a secondary prefabricated splice when the transformer leads continue directly to the service.

If a transformer is so large that it must have a secondary spades, the spades shall be taped or otherwise insulated. Boots used for insulation shall be taped so that they cannot be readily slipped off.

Secondary connections to terminals of pole-mounted transformers shall be made so that moisture can not get inside the cable insulation. This may be accomplished by covering the terminals and bare conductor ends with an appropriate moisture sealant.

The secondary connections and insulation shall have accommodations for all future and existing services as shown on the plans and specifications.

16. Pedestals (NOT USED)

17. Inspection and Inventory of Buried Units

Before any backfilling operations are begun, the contractor and owner shall jointly inspect all trenches, cable placement, risers, pedestal stakes, and other construction not accessible after backfilling, and an inventory of units shall be taken. If corrections are required, a second inspection shall be made after completion of the changes.

18. Backfilling

The first six inches of trench backfill shall be free from rock, gravel, or other material, which might damage the cable jacket. Contractor shall place a two-inch bed of clean sand or soil under the cable and four inches of clean soil above the cable. Cleaned soil backfill when used shall contain no soil materials larger than one inch.

Backfilling shall be completed in such a manner that voids will be minimized. Excess soil shall be piled on top and shall be well tamped. All rock and debris shall be removed from the site, and any damage to the premises repaired immediately.

Pieces of scrap cable shall not be buried in the trench as a means of disposal.

A. Road Crossing Backfill

Compaction to minimum +95% maximum proctor density to be accomplished full depth in maximum 8" lifts, with each lift compacted using a vibratory mechanical compactor. The use of a backhoe bucket for compaction is insufficient.

19. Equipment Plastic Pad Box

Equipment shall be placed on undisturbed earth adjacent to trench. The site shall be cleared of all debris and excavated to the specified depth. Gravel, sand or other acceptable self-draining material shall be added to the site and thoroughly vibratory compacted in lifts. The pad shall be installed at the specified elevation. Plastic box pads shall be used for transformers, as approved by the owner. Plastic cabinets shall be used for sectionalizing cabinets, as approved by the owner. See Details on Sheet E-4

20. Transformers (SD)

Transformers shall be handled carefully to avoid damage to the finish and shall be positioned in accordance with the plans and specifications. Only qualified and experienced personnel shall be allowed to make connections and cable terminations. Lock rings must be installed in addition to penta nut being tight.

Transformers shall be loop feed, as approved by the owner. See Details on Sheet E-4

21. Equipment Enclosures (SD)

Excavations for transformer hole liners, junction cabinets and other below-grade enclosures shall be made so as to disturb the surrounding earth as little as practical. Enclosures shall be installed with sidewalls plumb. Backfilling should be done with covers in place and with careful tamping so as to avoid distortion of the enclosure. When installation is complete, the cover of the enclosure shall not be lower than and not more than two inches higher than the grade specified by the owner. Soil in the immediate vicinity shall be tamped and sloped away from the enclosure. At the owners option the excess soil shall be removed from the site or spread evenly over the surface of the ground to the satisfaction of the owner.

Pieces of scrap cable and other refuse shall not be discarded in equipment enclosures.

22. Warning Signs

Each equipment enclosure shall display a warning sigh placed so that it is visible to anyone attempting entry to the enclosure.

23. Submersible Type and Direct-Buried Type Equipment with Tank Coatings, Not used

24. Sacrificial Anodes, Not used

25. Grounding

All neutral conductors, ground electrodes and groundable parts of equipment shall be interconnected. All interconnections shall be made as shown on the construction drawings. A copperweld ground rod with minimum dimensions of 5/8" by 8.0' shall be installed at all equipment locations as shown in the construction drawings and at all cable splices and taps. A complete ground loop shall be trained neatly around equipment opening and shall include the ground rod in the loop. The size of the ground wire to be equal to or larger than the neutral conductor, i.e. use #2 cu for #1/0 full concentric.

26. Cable Location Markers

Permanent cable markers shall be installed at 1000-foot intervals along alignment. Marker tape shall be located above all buried cable and conduit. The tape shall be marked “high voltage electric cable buried below”, and shall be located one foot below grade.

27. Cable Acceptance Tests (SD test records)

a. Continuity: After installation of the cable and prior to the high potential test specified below, the contractor and the owner shall jointly perform a continuity test on the system. This can easily be accomplished by grounding the conductor at the source and checking for continuity from the end of each tap with an ohm meter or with a battery and ammeter

b. High Potential: After successful continuity tests, the contractor and the owner jointly shall perform high potential tests on each length of cable in the system, with termination's in place but disconnected from the system.

The installation shall withstand for a minimum of five minutes a dc test potential as follows:

Primary URD Cable
XLPE and HMW Poly

Rated Voltage	Insulation Thickness (inches)	Field dc Acceptance Test Voltage
15 kV	0.220	52.8 kV

The voltage may either be increased continuously or in steps to the maximum test value.

(1) If increased continuously, the rate of increase of test voltage should be approximately uniform and increasing to maximum voltage in not less than 10 seconds and in not more than approximately 60 seconds.

(2) If applied in steps, the rate of increase of test voltage from one step to the next should be approximately uniform. The duration at each step shall be long enough for the absorption current to attain reasonable stabilization (one minute minimum). Current and voltage readings should be taken at the end of each step duration. The number of steps should be from five to eight.

WARNING:

A hazardous voltage may still exist on the cable after the above testing has been completed. Therefore, before handling the cable, the conductor shall be grounded to permit any charge to drain to earth.

28. Meters (SD)

QUALITY ASSURANCE

A. Watt-hour Meter: Factory certified. Tested in accordance with State of Alaska, Department of Weights and Measures' regulations. Submit test results to Engineer for approval.

B. Current Transformers: Factory tested. Submit certificate of test to State of Alaska, Department of Weights and Measures, and to Engineer for approval.

PRODUCTS

SINGLE PHASE 100 AMP SERVICE (NOT USED)

SINGLE PHASE 200 AMP SERVICE (NOT USED)

THREE PHASE SERVICE, 200 AMPS (NOT USED)

THREE PHASE SERVICE, LARGER THAN 200 AMPS (NOT USED)

EXECUTION

CONNECTIONS

A. All connections in strict accordance with manufacturer's recommendations.

B. Post copy of wiring diagram on inside of current transformer enclosure.

29. Shop Drawings

The contractor shall submit shop drawings, properly identified for all items marked in this specification with the prefix “(SD)” located next to the title.

CONDUCTOR							PRIMARY ASSEMBLY		TRANSFORMER		SERVICE		MISC.		TRENCH		07/09/10
SECONDARY			PRIMARY			LOCATION ROAD STA.											Legend: ( ) existing, (*) remove,
NO	SZ	BACK SPAN	NO	SZ	BACK SPAN												REMARKS
TYPE		FT	TYPE		FT		NO	UNITS	NO	UNITS	NO	UNITS	NO	UNITS	NO	UNITS	
					Existing												EXISTING TRANSFORMER
					XFMR												
					Existing												EXISTING PRIMARY FROM ATKA PRIDE
					Plant Feed												SEAFOODS DIESEL PLANT
						FSC	(1)	UM 33									EXISTING FUSED CABINET AT
					STA 4+50		3	UM 3-1									PROPERTY CORNER. INSTALL NEW
																	LOAD BREAK ELBOWS.
			3	2	908	SC-1	1	UM 33					4	UM 3	1,000	UR 2	ADJUST SC AS REQUIRED TO ALLOW
					STA 14+50		3	UM 3-3					3	UM 40-1			FOR PULLING OF CONDUCTOR IN
							6	UM 3-1					1	UM 12-2			CONDUIT
													1	UM 6-6			
						ROAD									20	UR 3	ROAD CROSSING
					CROSSING												
					STA 20+06												
			3	2	944	JB-1	1	VAULT					2	UM 1	944	UR 2	ADJUST JB LOCATION AS REQD TO
					STA 23+94		3	UM 45-4									ALLOW FOR PULLINIG OF CONDUCTOR
													1	UM 6-6			IN CONDUIT
			3	2	495	JB-2	1	VAULT					2	UM 1	495	UR 2	ADJUST JB LOCATION AS REQD TO
							3	UM 45-4									ALLOW FOR PULLINIG OF CONDUCTOR
													1	UM 6-6			IN CONDUIT
			3	2	504	Hydro			1	UG 17-2			4	UM 3	504	UR 2	TRANSFORMER AT CHUNIISAX
						T-1			3	UM 3-1			3	UM 4	80	UR 2	CREEK HYDROELECTRIC PLANT
									4	UJ 2-2			1	UM 12-2			CONNECT TO EXISTING SECONDARY
									1	UM 1-4			1	UM 6-6			CONDUIT INTO BUILDING
3	600	40				SG											SWITCHGEAR IN PLANT
																	SEE SWITCHGEAR SUPPLY
1	1/0	40															SPECIFICATIONS
Cu Ins Grd																	
		120			8,553		21		9		0		24		3,043		PAGE TOTAL

NO.	DATE	REVISION	BY

ENG. | APP. | DATE

POLARCONSULT ALASKA, INC.
1503 WEST 33RD AVE. – SUITE 310 – ANCH., ALASKA 99503
FAX (907) 258-2419 TELEPHONE (907) 258-2420

CHUNIISAX HYDROELECTRIC PRIMARY CONNECTION

ATKA ALASKA

Materials List 9-Jul-10

Unit	Entire Project Qty.		Description
Prim. Cable	9,000	Ft.	#2 AL. 1/C JCN, 15kV, 175 mil Insulation, 2,500 feet spool
Sec. Cable	130	Ft.	600 mcm CU, URD 600 V Insulation
Sec. Cable		Ft.	or 750 mcm CU, URD 600 V Insulation. Single run
Triplex	0	Ft.	#2/0 Cu., URD 600 V Insulation, 1,000 feet spool (GROUND)
UG 7	1	Ea.	Single Phase Pad-Mounted Transformer, 7.2kV/120/240v, loop feed, 25 kva
UG 17-2	4	Ea.	Three Phase Pad-Mounted Transformer 7.2/12.47kV/277/480v, Loop Feed, 300 kva
UG 23	0	Ea.	Cable Tagging Spec. for 1 Ph. Underground Line
UG 23-3	1	Ea.	Cable Tagging Spec. for 3 Ph. Underground Line
UJ 2-2	9	Ea.	Transformer connector Blocks, with cover
UK 5	3	Ea.	Secondary Pedestal Assembly
UM 1-4	4	Ea.	Plastic Box and Pad Assemblies
UM 3-1	3	Ea.	Load Break Elbow Terminations with Voltage Test Point, 200a/15 kV
UM 3-3	3	Ea.	Feed thru bushing
UM 6-6	0	Ea.	Ground Assembly, 5/8" x 8' Ground Rod, Clamp, 10' Wire Copper Weld
UM 6-7	0	Ea.	Blank Parking Stand Bushing, 15 kV
UM 6-11	0	Ea.	Grounded Bushing Cover, 15 kV
UM 8	4	Ea.	Meter Installation, Underground Source, 120/240v, 1 Ph, 3w w/2P-100a bkr.
UM 8-3	1	Ea.	Meter Installation, Underground Source, 277/480v, 3 Ph, 4w w/3P-200a bkr.
UM 12	12	Ea.	Warning Sign & Post
UM 12-2	0	Ea.	Warning Sign, Sticker
UM 32	0	Ea.	Equipment Protective Posts
UM 40-1	0	Ea.	TPR Automatic reset fault indicators (for UM 3-1 connection)
UM 45-3	1	Ea.	Secondary Splice Assembly
UM 45-4	2,943	Ea.	Primary Splice Assembly
UM 47	80	Ea.	Conduit Marker
UM 33	20	Ea.	Three Phase Sectionalizing Assembly, 200 Amps Max., 2 Pt Connector.
VAULT	2	Ea.	Buried Pull Vault with cover (3'x1.5' Min)
UR 2-1	0	Ft.	Trench, Primary 4" HDPE SDR17 Conduit
UR 2-3	0	Ft.	Trench, Secondary
UR 3	0	Ft.	Road Crossing Trench, 6" Core Flow Conduit

Contractor to verify all quantities.

NO.	DATE	REVISION	BY	ENG.		DATE	POLARCONSULT ALASKA, INC.	CHUNIISAX HYDROELECTRIC PRIMARY CONNECTION
				APP.			1503 WEST 33RD AVE. - SUITE 310 - ANCH., ALASKA 99503 FAX (907) 258-2419 TELEPHONE (907) 258-2420	ATKA ALASKA