



January 2, 2009

VIA ELECTRONIC FILING

Dr. Burl W. Haar
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101

RE: Plan and Profile, Pequot Lakes Substation to Pine River Substation and Pine River Substation to Badoura Substation portions of the Badoura 115 kV Project
Docket ET2, E015/TL-07-76

Dear Dr. Haar:

Minnesota Power respectfully submits (via eFiling) the specifications and drawings for right-of-way preparation, construction, cleanup, and restoration, and the plan and profile of the right-of-way for Segment 1 (Pequot Lakes Substation to Pine River Substation – 147L) and Segment 2 (Pine River Substation to Badoura Substation – 142L) of Minnesota Power's portions of the Badoura 115 kV project for the Commission's review as per Permit Condition IVA.

Great River Energy previously submitted a plan and profile for Segment 5 and will be submitting the same for Segments 3 and 4, scheduled to begin construction in late 2009 or 2010.

Please feel free to give me a call at the number listed below if you have any questions regarding this filing.

Yours truly,

David R. Moeller

kl
Attachments

c: Bill Storm, Department of Commerce, OES (letter only)
Carole Schmidt, Great River Energy (letter only)
Craig Kvale, Minnesota Power (letter only)
Jim Atkinson, Minnesota Power (letter only)

**MINNESOTA POWER
STANDARD SPECIFICATIONS
FOR
OVERHEAD LINE CONSTRUCTION
TRANSMISSION**

DETAILED CONSTRUCTION SPECIFICATIONS

**115 kV BADOURA – PINE RIVER LINE NO. 142
115 kV PINE RIVER – PEQUOT LAKES LINE NO. 147**

MINNESOTA POWER
DETAILED CONSTRUCTION SPECIFICATIONS
FOR
115 kV BADOURA – PINE RIVER LINE NO. 142
115 kV PINE RIVER – PEQUOT LAKES LINE NO. 147

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MINNESOTA POWER
DETAILED CONSTRUCTION SPECIFICATIONS
FOR
115 kV BADOURA – PINE RIVER LINE NO. 142
115 kV PINE RIVER – PEQUOT LAKES LINE NO. 147

1. SCOPE OF WORK

These specifications cover the principal details of construction necessary to install approximately 30.1 miles of 115 kV transmission line between Badoura 115 kV Substation, Pine River 115 kV Substation, and Pequot Lakes 115 kV substation. The project is located in Hubbard, Cass, and Crow Wing counties in north central Minnesota.

The Contractor shall furnish all labor, supervision, tools and equipment as required for completing the overhead line construction as specified in the contract documents and as detailed on the drawings. Should any discrepancies or ambiguities be found, the Engineer shall be notified at once to obtain clarification of the same.

1.1 115 kV Badoura – Pine River Line No. 142

Construct 20.3 miles of single circuit 115 kV transmission on wood H-frame with 636 kcmil ACSR (24/7) “Rook” conductors, one 3/8” H.S. 7-strand steel shield wire, and one 64mm²/528 OPGW (24-fiber) shield wire. Construct 0.75 miles of double circuit 115 kV transmission on self-supporting steel pole structures on caisson foundations with 636 kcmil ACSR (24/7) “Rook” conductors, one 3/8” H.S. 7-strand steel shield wire, and one 64mm²/528 OPGW (24-fiber) shield wire.

1.2 115 kV Pine River – Pequot Lakes Line No. 147

Construct 8.3 miles of single circuit 115 kV transmission on wood H-frame with 636 kcmil ACSR (24/7) “Rook” conductors, one 3/8” H.S. 7-strand steel shield wire, and one 64mm²/528 OPGW (24-fiber) shield wire. Construct 0.75 miles of 115 kV transmission on Line No. 142 double circuit with 636 kcmil ACSR (24/7) “Rook” conductors.

2. COORDINATION, CONSTRUCTION SCHEDULE, AND REPORTS

2.1 Coordination

Contractor shall be responsible for all coordination with local, state, and federal authorities, or with any other groups who have rights to intervene in the Project. He shall also coordinate the activities of all subcontractors, suppliers, and other involved entities, with the Engineer's consent.

Contractor shall be required to attend a pre-construction conference with the Owner, Engineer, and any other party involved with the Project. The Contractor's superintendent (field person-in-charge) shall also attend the conference. If the Contractor's superintendent is not present, the conference shall be rescheduled. At the conference the Contractor shall present a construction plan including but not limited to the following:

- Construction sequence, methods, and equipment to be used in all phases.
- Tentative access and right of way roads.
- Location(s) of staging area(s).
- Construction schedule showing all activities for the entire Project. The activities shall correspond to the construction units in the Bid Schedule. Contractor shall update schedule weekly for the duration of the Project.

Contractor shall provide a field office for his personnel. Phone service shall be provided to the field office. A facsimile machine and copy machine shall be supplied by the Contractor and should be made available to the Engineer. Contractor shall pay for all utility costs related to their field office.

Contractor shall furnish job-site office space for use by the Engineer. Prior to any job-site work, the Contractor shall furnish 100 square feet (minimum) of office space adjacent to the location of his own field office for the use of the Engineer. Contractor shall also provide furniture for the office consisting of one (1) desk, one (1) reference table, three (3) chairs, one (1) filing cabinet, one (1) telephone, and one (1) drawing rack. The Contractor shall make all arrangements and pay all costs for providing lighting, heating, cooling, and telephone service. The office shall have a heating and cooling unit sized to provide adequate heating and cooling in temperatures ranging from -40°F to 120°F. Adequate lighting and 110-volt electrical outlets shall be provided. The Contractor shall make arrangements to provide one telephone line for use by the Engineer.

2.2 Construction Schedule

The work shall commence as soon as possible after award of contract but no earlier than January 19, 2009. The date at which the Contractor shall begin shall be as listed in the Proposal Form. The Contractor shall appropriately man and equip the job to insure completion on or before July 31, 2009. The Owner may exclude a portion of 147 Line (str's 11-18) from the project to the winter of 2010, dependant on the easement acquisition. Steel pole erection and foundation installation will be completed under the labor, equipment, and material rates included as part of this contract. The construction schedule will be established and agreed to at the time of the award.

Within ten (10) working days after Notice of Award, the Contractor shall furnish the Engineer a Construction Plan showing in detail how the Contractor will provide for the orderly performance of the work in accordance with these Specifications.

The Construction Plan shall as a minimum show the following:

- Sequence of operations, construction methods and equipment.

- A detailed Construction Schedule including dates for commencing and completing material spotting, structure assembly, structure erection, wire stringing, right-of-way restoration activities.
- Detailed access plan including off right-of-way access.
- Estimated payment schedule based on bid units.
- Date and length of time for any line outages.

The Construction Plan and Construction Schedule shall be supported by a CPM (Critical Path Method) or similar network analysis scheduling program such as MS Project or Primavera. The CPM schedule shall as minimum show start dates, end dates, manpower per unit, tasks on the critical path and float.

The Construction Schedule shall be continuously updated and, if necessary, redrawn on the first working day of each month or upon issuance of any Change Order which substantially affects the scheduling. Schedule slippage shall be accompanied by a recovery plan, subject to the Engineer's acceptance, showing how the Project will be brought back on schedule. Schedule recovery, including additional personnel and/or equipment, double shifts, or overtime shall be at no additional cost to the Owner. Failure to promptly provide revised schedules may result in delayed progress payments.

2.3 Reports

Weekly progress reports shall be prepared by the Contractor. These reports shall be signed by both the Contractor and the Owners representative. Delinquency in signing weekly reports may result in delayed progress payments. If disagreements occur, the Contractor's representative shall circle, note, initial, and date those items in dispute.

3. OUTAGE REQUIREMENTS

The contractor shall familiarize himself with the outage requirements for the project and with all the existing structure locations, physical clearances, electrical clearances, line voltages, grounding requirements, and any additional physical or electrical conditions under which the work will be performed. All special outage requirements shall be reviewed and shall be mutually acceptable to both the Contractor and the Owner prior to commencement of work.

Contractor shall be responsible for contacting all involved utility companies prior to starting any underground work to determine the location of any underground facilities. The Contractor shall repair any damaged underground equipment without additional cost to the Owner.

Engineer and the Contractor shall jointly prepare an outage plan for all scheduled interruptions of electrical power that affect third parties. This plan shall be signed by the Contractor, Engineer, Owner, and the affected utilities at least two (2) weeks prior to the outage. Prior to requesting signatures, all materials required for the scheduled outage shall be at the site.

The Contractor shall be aware that breaks in the construction sequence will occur from completion of line transfers and line switching. All transmission switching will be the responsibility of the Owner.

All costs for delays in construction, remobilization throughout the job site to accommodate line outages, or any special requirements needed to complete the work shall be assumed incidental and should be included in the Contractor's base mobilization price.

The majority of the project will be on a 100 foot parallel with energized 230 kV Riverton - Badoura Line No. 91. Both, 115 kV Lines No. 142 and 147 will cross underneath 230 kV Line No. 91. Minnesota Power crews will be responsible to modify 91 Line to accommodate the future crossings. Outage restraints on 91 Line will delay the line raises to the spring of 2009, no outage schedule has been determined to date.

4. ENVIRONMENTAL PROTECTION

Contractor shall exercise care to preserve the natural landscape in the construction area, as well as areas outside the right of way. Construction operations shall be conducted to prevent any unnecessary scarring or defacing of the natural vegetation and surroundings in the vicinity of the work. All land-disturbing activities shall be planned and designed to be compatible with the natural land forms and not detract from them. Construction methods shall be designed to limit, so far as reasonable, erosion or subsidence. The Contractor shall take such soil and resource conservation and protection measures that the Engineer determines necessary. The Contractor shall adhere to and comply with all permit conditions, which have been secured by the Owner. Permits include the Minnesota Public Utilities Commission Route Permit PUC Docket No. ET-2, ET015/TL-07-76, MnDNR License to Cross Protected Waters License No. 144-065-7006, MnDNR License to Cross State Lands License No. 144-065-5295, and US Army Corp of Engineers preconstruction notification Corps RPG-003-MN.

Contractor shall conduct all construction activities in a manner that will avoid or minimize degradation of air, land, and water quality. Toxic material shall not be released into any lake or water drainage. All construction work and subsequent use of the job-site must be consistent with applicable federal, state, and local standards relating to safety, environmental quality, and public health. Mobile ground equipment shall be kept out of the waters of lakes, streams, and rivers.

Contractor shall obtain permits and comply with the requirements of state and local air-pollution control and fire authorities. If permitted, open burning shall only be allowed in approved locations and during appropriate weather conditions. If weather conditions rapidly change (such as wind direction or velocity), the Contractor's burning operation may be temporarily halted by the Engineer. Burn piles shall be kept as clean and dry as possible and burned in such a manner as to reduce smoke.

Construction activities shall be conducted to minimize the creation of dust. This may require the limitation of types of equipment, vehicle speeds, and routes utilized. Water, straw, wood chips, dust oil, dust reducer, gravel, combinations of these, or similar control measures may be required by the Engineer.

Disturbed areas are to be restored and seeded in accordance with the Section on Restoration.

Crankcase oil or other petroleum products shall be containerized. No drainage onto the ground or into streams shall be allowed. A totally enclosed cage or other containment shall be provided for all trash. All garbage, debris, and foreign matter shall be removed to an established sanitary landfill or other recognized disposal facility.

In all its operations under this Contract, the Contractor shall comply with all applicable federal, state, and local laws and regulations concerning the use storage, transportation and disposal of hazardous materials. These substances include but are not limited to insecticides, herbicides, fungicides, rodenticides, petroleum products, wood preservatives and solvents.

Contractor shall take such measures as are necessary to ensure unrestricted passage and movement of fish and wildlife. No artificial structure or stream channel change that causes a permanent blockage to movement of fish shall be constructed.

Contractor shall do everything reasonably within its power, both independently and on request of any duly-authorized representative of the United States, to prevent and suppress fires on or near the job-site, including making available such construction personnel and equipment as may be reasonably obtainable for the suppression of such fires.

5. HYGIENE, FIRST AID, AND SAFETY

Contractor agrees to comply with all safety provisions for the Project, including all requirements and regulations of OSHA and state requirements for health and safety on construction projects. Daily tailboard safety meetings as well as more formal weekly safety meetings shall be performed by the Contractor.

In the event of the occurrence of a situation wherein life and/or valuable property is in apparent imminent danger, the Contractor is hereby authorized without further special instructions from the Owner to act at its own discretion to prevent injury to persons or damage to property.

Contractor shall provide all required toilet facilities for its employees.

Contractor shall furnish to the Owner detailed written reports of all injuries occurring on the job.

Contractor bears sole responsibility under the law for the safety of its own personnel and for persons entering the work site as agents or visitors of the Contractor.

6. ACCESS

The Contractor shall conduct all of his operations, on public or privately owned land, in accordance with the conditions imposed by the Minnesota Power's Transmission Lines General Specification. It will be the Contractor's responsibility to make certain that all of his employees are fully aware of, and comply at all times with, the conditions of these specifications. Also attached as appendices to these Detailed Specifications are MP's Right-of-Way Acquisition Summary Report for 115 kV Line No. 142 & 147.

6.1 Access Roads

The Contractor shall visit all sites to familiarize himself with conditions under which the work will be done.

Access to all sites shall be the responsibility of the Contractor.

All costs involved in site access shall be assumed incidental and should be included in the Contractor's base bid.

The Contractor at his own expense will be required to construct or maintain existing roads in a condition equal to or better than that prior to construction. The Contractor will be responsible to observe all applicable road limit restrictions and other applicable laws and regulations in this connection.

The Contractor shall consult with Minnesota Power as to means of access and the method to be used in bringing the materials and equipment onto the respective sites. Only the Contractor's equipment will be allowed access to the sites.

All culverts and mats required by local units of government for access off public roads or along the Right-of-Way will be furnished by the Contractor and installed by the Contractor. Mats used for this purpose shall be billed at the unit price included in the Contractor's base bid. Culverts used for this purpose shall be assumed incidental and should be included in the Contractor's base bid.

No plea of ignorance of existing or foreseeable conditions which will create difficulties or hindrances in the execution of the work will be accepted as an excuse for any failure on the part of the Contractor to fulfill in every detail all of the requirements of the Specification and/or Drawings. Furthermore, a plea of ignorance will not be accepted as a basis for any claim whatsoever for additional or extra compensation, or for delay in the work.

Contractor shall indemnify and hold the Owner harmless for any and all claims arising out of or connected with any road damage on this project. If the Contractor fails to promptly maintain and repair access roads, Owner may do so, and all costs incurred by the Owner shall be set off and deducted from the contract price. The Contractor states that he consents to such set off from the contract price.

6.2 Off Right-of-Way Traffic

If it is necessary for the Contractor to go outside of the Right-of-Way, he must obtain approval from Minnesota Power and the landowner. If damages occur from this off Right-of-Way traffic, the Contractor will be held responsible for promptly restoring the land to its former state at his own expense.

6.3 Right-of-Way Restoration

Contractor shall restore all transmission line Right-of-Way as described in the General Specification. The Contractor shall restore all transmission line Right-of-Way areas by discing and/or blading where determined necessary by the Owner. Right-of-Way restoration shall be assumed incidental and should be included in the Contractor's base bid.

Seeding and mulching requirements will be completed by others where determined necessary by the Owner.

6.4 Stream and Road Crossings

The Contractor shall review with the Owner, prior to construction, all road crossings as to whether or not equipment crossings are permitted. The contractor shall review all state and county road crossing permits and adhere to all special requirements for construction

The Contractor shall consider all streams encountered during construction as Environmental Protection Zones, not to be used as equipment crossings. The Contractor shall make every effort to maintain existing vegetation within 100 feet of established streambeds in as undisturbed condition as possible. The Contractor shall adhere to and implement all requirements addressed in the crossing permits as discussed in the Environmental Protection section of this specification.

The Contractor shall adhere to and comply with all permit conditions, which have been secured by the Owner.

7. MATERIAL STORAGE

All material will be stored at the following sites:

Minnesota Power
Little Falls Service Center
1201 11th St. NE
Little Falls, MN 56345

grounding material, insulators,
hardware, OPGW (6 reels), shield wire
(20 reels), guy wire, anchors

Minnesota Power

conductor (33 reels), OPGW (7reels)

Pine River Service Center
426 Park Avenue
Pine River, MN 56474

Minnesota Power (69 poles, structure assemblies)
Badoura 230 kV Substation
(9 miles South of Akeley on Highway 64 and 1/4 mile East)
Akeley, MN

Minnesota Landscape and Habitat (431 poles)
2458 40th Ave. SW
Pine River, MN 56474

The Owner will unload all material arriving prior to the date of starting work. Materials arriving after the date of starting work will be unloaded by the Contractor at the time the materials are received, regardless of whether or not those materials are immediately required for the project. The Contractor will be required to sign a receipt for all material received from or for the Owner. Upon receipt of material by the Contractor, he shall become solely responsible for its care and protection. Material delivery from the afore mentioned storage yards to the construction site shall be assumed incidental and should be included in the Contractor's base bid.

8. STRUCTURE TYPES

The location and type of each structure will be shown on the Plan & Profile drawings. In addition, the Structure List identifies the assembly drawing and materials required for each structure.

For special conditions, some of the standard structures may require modification. Drawings will be supplied showing the necessary changes.

Drawings will be furnished, as necessary, for certain angles showing the pole offsets, guys and locations for insulator fastenings for maintaining straight conductor alignment.

9. WOOD POLES

New poles consist of "Penta" treated douglas fir and western red cedar and will be pre-drilled by the supplier. Poles will vary in length from 50 to 95 feet, and in ANSI classes from 3 to H-5. Gaining of poles will not be permitted without specific approval of the Owner's representative. With this exception, the pole handling, framing, and setting shall be in strict accord with the applicable drawings and the provisions of Part E of these Specifications.

9.1 Pole Wrap

An effort will be made to minimize damage to poles by woodpeckers by installing ½” hardware cloth on all wood poles per MP Drawing MA-30019. Use 1-1/2” to 2” long galvanized slash point staples or 1-1/2” long air gun staples with a 1” crown, cost to be included in the Contractor’s unit price for woodpecker wrap.

9.2 Numbering

The structure ground and aerial patrol numbers shall be installed in accordance with the applicable drawings. Ground patrol numbers shall be installed on each structure and aerial patrol numbers on every fifth structure. The numbering of the lines will be the final structure numbers shown on the Structure List.

10. CROSSARMS

The new crossarms will be laminated Douglas Fir “Penta” treated. Arms will be delivered with hardware assembled per the manufacture's drawings.

11. HARDWARE

All hardware will be galvanized and shall be installed with bolts of proper length and all nuts drawn up snug against the washers.

12. GUYS AND ANCHORS

12.1 Material and Installation

All guys will be 7/16” (7-wire) utilities grade galvanized steel strand. When more strength is required than can be obtained by one guy, double 7/16” guys shall be installed instead of changing to a larger strand.

Preformed guy grips will terminate the guy strand on the pole end. Strandvises will terminate the guys on the anchor end. In general, twin (10” & 11-5/16”) helix power installed screw anchors similar to Chance Co.’s type SS anchor and 5’-0” rod extensions will be used. When ground conditions will not permit the installation of the above anchors, alternate anchors of an approved type may be used.

12.2 Location

Guys and anchors shall be installed where shown on the structure assembly drawing or staking sheets. In general, anchors will be installed so as to make a one-to-one slope of the guy wire. Exceptions to this slope may be necessary to meet certain Right-of-Way conditions and will be indicated on the staking drawings.

Guy wire protectors shall be installed at each new anchor location.

13. POLE GROUND WIRE

A pole ground wire shall be installed where indicated on structure assembly drawings.

The pole ground wire will be Dead Soft Annealed #2 Copperweld wire stapled every 18 inches down the pole to the bottom. About 8 feet of the wire shall be coiled and securely stapled on the base of the pole.

Ground resistance readings shall be made at each structure after the poles are set and backfilled and before the shield wire or conductor is strung, and as specified on Minnesota power specification MA-27695. The ground resistance readings shall be recorded on Form No. 2097 which will be provided by the Owner. The readings shall be recorded so that the resistance for each ground can be readily identified as to structure number and location.

In the event that three adjacent structures each have a ground resistance greater than 50 ohms, one of the structures will have its ground resistance reduced to 50 ohms or less by installing an additional ground rod or ground counterpoise system.

The cost of making the ground resistance readings shall be included in the Unit Price for installing the grounds.

14. INSULATORS

The conductor insulators on the project will be of the fiberglass-polymer type as indicated on the structure drawings.

Installation of electrical insulators shall consist of handling and hauling to the job site, unpacking, assembling and installing the electrical insulators on the structures, in accordance with the Data Sheets and/or Drawings.

Insulators shall be carefully handled while being transported, assembled, and placed. All insulators shall be inspected for damage and be thoroughly cleaned of all foreign materials immediately before being installed on the structures. Under no circumstances shall climbing on, walking on, or hanging ladders from insulator surfaces be allowed.

Temporary storage of insulators shall be in areas free of standing water. Direct contact with transformer oil, hydraulic oil, or similar petroleum derivatives shall be avoided.

Items that carry cotter key fastenings shall be installed so that the key is visible from the structure. All cotter keys in each insulator string shall face the nearest climbing space. All cotter keys shall be spread after installation.

Care shall be exercised when handling, lifting, and installing polymer insulators on the structures, so as not to damage the weathersheds, sheaths, or fiberglass rods. Unpacking, lifting and hand transportation from the shipping container to the structure shall be in accordance with manufacturer's recommendations. The polymer insulator unit shall be lifted to the crossarm, or structure attachment point, only by the end fitting of the unit and shall not be subjected to compression, torsion or vibration, or any bending other than natural bending due to its own weight before installation.

When erecting the structures by crane, the polymer insulator units may be attached to the crossarms after the structure has been raised sufficiently to allow the units to hang vertically and precautions have been taken to prevent the ends of the insulators from striking the ground. Before final lifting of the structure, the free ends of the insulator units shall be temporarily secured to the structure so as to prevent unrestrained swinging and collision damage to the insulator and to the structure.

Snubbing the polymer insulator unit to the crossarm will not be allowed since damage to the insulator unit may result.

Under no circumstances shall polymer suspension insulator units be installed on the structures and left unrestrained in a vertical position without conductor.

In general, polymer insulators may be packaged and shipped from the factory in sealed containers, individual tubes, or in crates and should not require cleaning prior to installation. If any washing or cleaning is required, it shall be done only in strict accordance with manufacturer's recommendations.

14.1 Fiberglass – Polymer Insulators

The following types of fiberglass-polymer insulators will be used for the Project.

Type I	Ohio Brass Quadri*sil #S025040S2010 Y-clevis Ball / Length 52.7" / 25k lbs. / (7-Bell Equivalent)
Type II	Ohio Brass Quadri*sil #S025047S2010 Y-clevis Ball / Length 59.2" / 25k lbs. / (8-Bell Equivalent)
Type III	Ohio Brass Quadri*sil #S030053S2010 Y-clevis Ball / Length 65.7" / 30k lbs. / (9-Bell Equivalent)
Type IV	Ohio Brass Quadri*sil #S030060S2010 Y-clevis Ball / Length 72.1" / 30k lbs. / (10-Bell Equivalent)

15. CONDUCTOR

The conductor on the Project is 636 kcmil ACSR (24/7), code word “Rook” with a diameter of 0.977 in. and weight of 0.819 lbs./ft. Conductor has a standard steel core and a rated breaking strength of 22,600 lbs.

15.1 Clearances and Separation

Suitable structure types and proper length poles for the spans shown on the Plan & Profile have designed the necessary clearance and separation into the line. However, any clearance less than that given in the following tabulation shall be reported to the Owner.

MINIMUM VERTICAL CLEARANCE (Ft.)

Over Railways	35
Over Roads	27
Over Cultivated Land	25
Over Pedestrian Spaces	22
Along Urban Streets or Alleys	27
Along Rural Roads	25
Over Communication Wires	11
Over Power Wires	9
Over Guy Wires	9
Over Open Water	36

*MINIMUM CLEARANCE AT SUPPORTS (in.)

Clearance of line conductor from:

Span guys attached to same pole	49
Down guys attached to same pole	34
Surface of crossarms	27
Surface of poles	27

*These clearances must be maintained when suspension insulators, which are free to move, are swung 30 degrees from the vertical.

15.2 Stringing

Stringing equipment shall be set up in such locations as to avoid overloading structures by imposing excessive vertical loads on poles or crossarms.

The conductor shall be pulled in by controlled tension stringing. The equipment and methods used for stringing shall be subject to the approval of the Owner and to the recommendations of the conductor manufacturer.

The conductors shall be sagged in accordance with the stringing tables furnished by the Owner.

15.3 Reel Lengths

The 636 kcmil ACSR (24/7) conductor will be supplied on 33 nominal 12,000 foot lengths on RMT 90x45 reels.

15.4 Compression Accessories

See the Transmission General Specifications for restrictions regarding splices. The following Alcoa alloy tube compression fittings shall be used as indicated:

Compression Dead-ends	VES115	(Die - CD11)
Compression Splice	CJ115	
Jumper Terminal	TF11	

15.5 Suspension Clamps

Single armor grip suspension clamps (Dulmison #HSU2445-SE) will be used on all insulator strings in a suspension position and at angles up to a 30 degree. Double armor grip suspension clamps (Dulmison #DHSU2445) will be used on all insulator strings with angles between 30 and 60 degrees. No armor rods will be installed.

Suspension assemblies shall be placed to hang vertically or to split angles evenly.

All idler string suspension clamps at dead-end structures will be of the conventional style (Anderson #HAS-139S)

15.6 Vibration Dampers

Vibration dampers similar to the Stockbridge Type (Fargo # 607051012-0), shall be attached to the conductor as specified on the application drawing. The dampers shall be fastened securely to the torque specified by the manufacturer and so they will hang in a vertical plan. The contractor shall make sure that the drain holes are open after the vibration dampers are installed. One damper per span shall be installed per the Manufacturers recommendation.

16. OVERHEAD SHIELD WIRES

16.1 3/8" HS (7-Strand) Steel

One 3/8" HS (7-strand) galvanized steel shield wire shall be strung on the east side of the structures on both 142 and 147 lines. The 3/8" HS (7-strand) galvanized steel shield wire will be supplied in nominal 8,200 foot lengths on 20 NR reels.

Stringing equipment shall be set up in such locations as to avoid overloading structures by imposing excessive vertical loads on poles or crossarms. The shield wire

shall be pulled in by controlled tension stringing. The equipment and methods used for stringing shall be subject to the approval of the Owner and to the recommendations of the conductor manufacturer. The shield wires shall be sagged in accordance with the stringing tables furnished by the Owner.

Suspension clamps (MPS #FS46) without armor rods will be used where the shield wire is not dead-ended. Dead-ends and splices in the shield wires shall be made with preformed dead-ends (Helical # HG210-3/8) and preformed splices (Dulmison #SGS0915) installed in accordance with the manufacturers instructions. Be sure the splice or dead-end is properly “set” on the strand before leaving.

Preformed Line Product Company’s “Spiral Vibration Damper” (PLP#5050104) shall be installed on the shield wire as specified on the applicable drawings.

16.2 Fiber Optic Shield Wire

One fiber optic shield wire (AFL Telecommunications OPT-GW AC 64mm²/528) shall be strung on the west side of the structures on both 142 and 147 lines. The 64mm²/528 OPT-GW will be supplied in specified lengths on 13 NR reels.

The Contractor shall inspect each reel upon receipt to determine if visible damage has occurred to the OPGW during transit and storage. Prior to acceptance of the cable by the Contractor, the cable Supplier will have tested each fiber of each reel using an Optical Time Domain Reflectometer (OTDR) to validate the working condition of the cable prior to shipment.

Prior to installation of the OPGW, the Contractor shall verify, by use of an OTDR, that the OPGW has not been damaged during shipment. Readings obtained from the OTDR shall be furnished to Engineer for review and approval fifteen working days before commencement of installation. The Contractor is responsible for the working condition of the cable throughout the installation process.

Identification tags and markers provided by the manufacturer or the Owner shall be retained on the reels. The Contractor shall record for future reference the structure numbers in the line where the OPGW from each reel was installed.

Reels shall be handled in such a manner as to prevent smashing, nicking, cutting or otherwise damaging the OPGW. When unloading reels from trucks, the reels shall not be dropped to the ground or allowed to roll freely down ramps. Cranes or other equipment of adequate capacity shall be used when unloading the OPGW. Reels shall be picked up with a shaft in the center of the reel using a spreader bar to prevent crushing of the OPGW and reel.

After removing lagging or other protective covering from reels, the Contractor shall examine the outside layer of each reel to be sure that the OPGW is undamaged and that no nails, staples, or other sharp objects, which would damage the OPGW during unreeling, protrude on the inside of the reel heads. If damage is found upon removal of

the protective covering, the Contractor shall notify the Engineer and obtain Engineer's approval before using the OPGW.

All OPGW shall be strung by the controlled-tension method using double bullwheel-design tension-stringing equipment or approved equivalent. This shall consist of a single-cable tensioner used in combination with a cable puller and single pulling line. The Contractor shall comply with the requirements contained in AFL Telecommunications Specification DNO-5651 meeting all sheave and bull wheel diameters, stringing tensions and, bending radii. The Contractor shall also acquire and reference AFL's "Recommended Installation Procedures for Composite Optical Ground Wire" for detailed installation instructions. The use of double swivels, anti-rotational devices (two 6 foot or three 4 foot), and AFL come-along for OPT-GW (Pocket Book Grip) will be required for pulling and tensioning the fiber optic shield wire.

The fiber optic cable shall be sagged in accordance with the stringing tables furnished by the Owner. The contractor shall terminate the OPGW on the designated structures and attach all down lead cushions to the pole base.

Single suspension clamps (Alcoa #SUME 528/555) will be used on all suspension positions and at angles up to a 30 degree. Double suspension clamps (Alcoa #ODSME 528/555) will be used on all angles between 30 and 60 degrees.

The fiber optic cable will be terminated with Preformed Line Product's Fiberlign Dead-End Assembly (PLP # 2801308) at all splice locations and deadend structures.

Vibration dampers similar to the Stockbridge Type (Fargo # 607051011-0), shall be attached to the fiber optic cable as specified on the application drawing. The dampers shall be fastened securely to the torque specified by the manufacturer and so they will hang in a vertical plan. The contractor shall make sure that the drain holes are open after the vibration dampers are installed. One damper per span shall be installed per the Manufacturers recommendation.

At all splice structures, the Contractor shall neatly coil the excess OPGW and securely attach it to the structure near the splice box as indicated on the drawings. The diameter of the coils shall be five feet (5') minimum. The amount of excess OPGW required at each splice location shall be the height of the splice box above ground plus fifty feet (50'). If additional length is required, due to limited access for splicing vehicles, it shall be included, as required and with the approval of the Engineer. Attachment of the splice box enclosure will be done by the Contractor and OPGW splicing will be done by others.

17. CLEANUP

17.1 Cleanup During Construction

The right of way and staging area(s) shall be kept in a neat and orderly condition, as stipulated below. The Engineer or Owner may at any time during construction order a general cleanup of the site as a part of the work under this section. Such cleanup shall not result in any additional cost to the Owner. At the time they become scrap, all wire clippings, bundle ties, nails, breakaway bolt heads and nuts, and other metallic scrap are to be picked up.

All garbage, lunch wraps, equipment parts, oil filters, petroleum products, and light packaging material such as plastic, paper, and cardboard are to be removed on a daily basis.

At the completion of each type of work all assembly, erection, and stringing remnants and debris are to be removed from each work-site.

After completion of construction, all survey debris - stakes, lath, flagging, etc. shall be removed by the Contractor.

The Contractor shall dispose of waste, trash, and debris in a manner acceptable to the Engineer.

17.2 Final Cleanup

Final cleanup of facilities prior to final inspection by the Engineer and after all construction work is essentially complete; the Contractor shall thoroughly clean up all facilities.

Items to be cleaned up include but are not limited to all work staging areas, material storage areas, structures and facilities, access areas, and all other sites and facilities within or incidental to the construction.

18. FINAL INSPECTION

18.1 Requirements Preparatory to Final Inspection

Contractor shall notify the Engineer to perform a preliminary final inspection for the purpose of determining the state of completion of the Project. Contractor shall notify the Engineer at least seven (7) days in advance of the time this inspection is to be performed. From the information gathered from this inspection the Engineer shall prepare a punch list of work to be performed, corrected, or completed before the Project will be accepted. All work on the punch list shall be completed by the Contractor prior to final inspection.

All temporary facilities shall be removed from the job-site, except those required for the performance of work expected to appear on the punch list.

The job-site, including all storage areas, shall be cleaned up.

18.2 Final Inspection

After all requirements preparatory to the final inspection have been completed as specified above, the Contractor shall notify the Engineer to perform the final inspection. Notice shall be given at least seven (7) days in advance of the time the final inspection is to be performed.

Contractor shall accompany the Engineer and Owner on the final inspection tour, along with any principal subcontractors the Engineer or Owner may request to be present.

If the work has been completed in accordance with the Specifications Document and no further corrective measures are required, the Engineer shall issue a Certificate of Completion and the Owner shall accept the Project.

If the work has been substantially completed in accordance with the Specifications Document and only minor corrective measures are required, the Owner may conditionally accept the Project and may issue a Certificate of Completion based upon the Contractor's assurance that the corrective measures will be completed within the shortest practical time period. A Certificate of Completion will not be issued if an electrical shutdown is required to complete the Project.

If the work has not been substantially completed in accordance with the Specifications Document and numerous or substantial corrective measures are still required, the Engineer will not issue a Certificate of Completion. Instead, a new punch list will be prepared based on the information gathered from the final inspection, and the Contractor shall be required to complete this work and then call for another final inspection following the procedure outlined above.

Upon acceptance of the Project by the Owner, the Contractor shall submit his request for the final payment.

19. RECORD DRAWINGS

Upon completion of the work the Contractor shall provide the Engineer with one (1) marked up copy of the construction drawings and the structure list. All changes made during construction shall be shown.

Contractor's progress payment retention will not be released until the Engineer receives the marked up construction drawings.

20. CONTACT PEOPLE

The Contractor shall familiarize himself and review all aspects of the project prior to commencement of work with the following Owner's representatives:

Minnesota Power
30 West Superior Street
Duluth, MN 55802

Purchasing & Contracts	Bob D. Peters	218-722-5642 Ext. 3972
Project Engineer / Construction Manager	David A. Johnson	218-355-2625 Cell 218-591-9984
Construction Inspector	Paul Liane	Cell 218-232-0428
Stormwater Supervisor / SWPPP / MP	Craig Kvale	218- 355-2408 Cell 218-428-5549
Erosion Control Supervisor / Contractor		
Clearance Coordinator	Pat Schnobrich	218-355-2672 Cell 218-269-4754
System Operators		218-720-2750 218-720-2755

**MINNESOTA POWER
TRANSMISSION LINES
GENERAL SPECIFICATIONS**

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MINNESOTA POWER
TRANSMISSION LINES
GENERAL SPECIFICATIONS

1. SCOPE

These specifications cover the general types of material and methods of construction for overhead transmission lines to carry three-phase circuits of 46,000 volts and over.

2. RIGHT-OF-WAY

In general, transmission line construction activities will be conducted on right-of-way obtained by the Purchaser on property owned by others.

In the event that the Contractor encounters property owners who object to the performance of the Work, Contractor shall immediately contact Purchaser's Representative.

Contractor shall not commence work on the right-of-way until authorized in writing by the Purchaser.

3. ACCESS TO AND RESTORATION OF THE RIGHT-OF-WAY

Access to the right-of-way for construction purposes will be from intersecting or adjacent public roads and thence along the right-of-way.

The Contractor shall observe all applicable road limit restrictions and shall indemnify and hold the Purchaser harmless for any and all claims arising out of or connected with any damage to public or private roadways.

The Contractor shall consider all streams encountered during performance of the Work as "Environmental Protection Zones". Equipment shall not be allowed to cross streams unless specifically authorized in writing by the Purchaser. Contractor shall not disturb vegetation within 50 feet of established stream beds.

The Contractor shall consult with the occupant of private property regarding best means of access to the site of work. In the event that access via the existing right-of-way is not viable, and additional compensation to affected landowners is required to obtain reasonable access, the Contractor shall notify the Purchaser's Representative immediately.

Should the Contractor use public or private roads or cross public or private property for access to the site of work, he shall be solely responsible, and the roads or other access route shall be suitably maintained by him at all times, and upon completion of the

contract be left in good condition. The Contractor shall provide traffic control in accordance with the requirements of the Minnesota Department of Transportation Manual on Uniform Traffic Control Devices. The Contractor shall prepare additional roads or other means of access if required to complete the Work. The cost of obtaining access to the right of way and construction of temporary roads or trails shall be borne by the Contractor.

Contractor shall conduct operations to minimize disturbance of the existing right-of-way. The Contractor shall take special care to prevent unnecessary disturbance of livestock, damage to crops, orchards, etc. The Contractor shall restore the right of way and other disturbed areas to conditions equal to or better than those conditions existing prior to commencing the Work, and shall provide compensation to the satisfaction of the affected landowners for irreparable damage to crops, roads and trails, fences or other property. Access to all work locations is the responsibility of the Contractor. The cost of obtaining access to the right of way, construction of temporary roads or trails, restoration of damaged areas, or monetary compensation for damages occurring within or outside of the limits of the established right-of-way shall be incidental to the Work.

The Contractor shall be responsible for any and all damages resulting from Contractor's operations occurring within or outside the limits of the established right-of-way.

In the event that the Contractor encounters property owners unwilling to settle damages at a reasonable amount, Contractor shall contact Purchaser's Representative.

4. FENCES

The Contractor may find it necessary to open or cross fences either on or adjacent to the construction right-of-way, in order to complete the Work. The Contractor shall contact the affected property owner to discuss the need to breach the fence and to obtain property owner's consent to install gates to match the existing fence. These gates shall be constructed with material equal to or better in quality than the existing fence. The cost of these gates shall be borne by the Contractor. Contractor shall remove these gates at Contractor's expense in the event that property owner wants the gates removed after completion of construction activities.

All gates utilized during the performance of the Work shall be maintained to prevent the possible escape or straying of livestock from or onto adjacent lands. Contractor shall provide property owners adequate notice to allow relocation of livestock prior to commencing construction activities in affected areas.

5. SURVEYS AND STAKING

The Purchaser will make the necessary surveys and will stake all structures and locations. The Contractor shall request the Purchaser, well in advance of the requirements, to place

the necessary stakes. All stakes established by the Purchaser shall be preserved by the Contractor, and in case of destruction or removal by the Contractor's forces, they shall be replaced at the Contractor's expense. Work installed in error by the Contractor without proper staking shall be subject to relocation or replacement at the Contractor's expense.

6. OTHER LINES & CROSSINGS

The Contractor shall make such provisions as may be necessary or required to protect all parallel, converging, or intersecting electrical or communication lines all in a manner satisfactory to the owners or operators thereof and to the Purchaser. The Contractor shall give reasonable notice to the Purchaser and operators of other lines to arrange for any switching required, and shall give notice that he will be working near their lines. Contractor shall notify railroad and highway authorities as required prior to performing construction activities over these crossings. Contractor shall provide all watchmen, signals, guards, temporary structures, traffic control barricades, etc., indemnification or other bonds if required, and all or any other materials, equipment, labor or services required to safely perform line construction activities over existing electrical, communications, rail, highway or other crossings.

7. WORKMANSHIP

The drawings and these specifications describe the general requirements for the Work. It is not the intent of the drawings and specifications to show all details or list all steps the Contractor must take to complete the Work. The intent of the drawings and specifications is that the Work shall be of high quality and complete in all respects. All work shall be performed and completed in accordance with the best modern construction practices and subject to the inspection and approval of the Purchaser, who shall have access to the work at all times. All work shall be performed by craftsmen trained and highly skilled in the construction of overhead electrical transmission lines.

8. MATERIALS FURNISHED

Purchaser will furnish all materials to be incorporated in the finished Work. Materials furnished by the Purchaser will be made available to Contractor at Purchaser's designated warehouse. Contractor shall at his own expense obtain and deliver all such materials to the job site or sites and return the excess materials as provided herein.

Contractor's authorized representative shall receive and sign for materials issued by Purchaser. Contractor shall not co-mingle materials furnished by the Purchaser with other materials. The Contractor shall be responsible for the materials safety and protection from loss or damage of any nature until the finished Work and/or surplus materials are accounted for and accepted by Purchaser. Contractor shall return to Purchaser's designated warehouse any materials furnished in excess of the requirements of the Work and any materials removed from the line and designated for salvage in the course of such construction.

9. STEEL TOWERS & POLES

The steel towers and poles will be furnished unassembled by the supplier. Bolts, nuts and locknuts will be shipped in separate packages at the same time. Structural steel parts will be plainly marked so as to be readily identified with the particular tower they will compose.

All towers and poles shall be assembled as shown on the drawings. All bolts shall be finally drawn up tight but taking care not to impair the strength of the bolts. After the bolts and nuts have been installed and tightened, the locknuts shall be installed. Under no circumstances may the bolt nut and locknut be run up in one operation of the socket wrench.

A reasonable amount of drifting shall be anticipated in assembly. Holes shall not be reamed. Contractor shall provide Purchaser with written documentation of any and all claims for shop errors at the time they occur. In case of shop errors, the Purchaser will decide on the corrective procedure.

After each tower or pole is completed, the vertical axis through the center of the tower shall not be out of plumb by more than one inch (1") for every 40 feet of height. The Purchaser reserves the right to check alignment with a transit prior to allowing wire stringing.

All towers and poles shall be transported and handled with care to avoid bending or damage to the galvanizing or other coating system. Pieces bent in handling may be used only if, in the opinion of the Purchaser, they can be straightened without injury to the galvanizing or other coating system. Damaged coatings shall be repaired at the Contractor's expense. Material on which galvanizing has been damaged shall be re-dipped at the Contractor's expense unless, in the opinion of the Purchaser, the damage is very limited in extent and can be repaired by applying Galv-Weld (or equivalent) in accordance with the manufacturer's directions.

Step bolts, aerial numbers, structure numbers, warning signs and other appurtenances shall be attached to the structure as shown on the drawings.

10. WOOD STRUCTURES

The designs of the various types of structures for tangents, dead ends and angles are shown on the drawings. All structures shall be constructed in a workmanlike manner and in accordance with the details shown on the drawings. Wherever practicable, structures shall be completely assembled on the ground. Aerial numbers, structure numbers, and warning signs shall be attached to the structure as shown on the drawings.

10.1. Pole Material

Poles shall be of Western Red Cedar, or Douglas Fir, depending upon availability, and shall conform to ANSI specifications for the respective wood.

10.2 Pole Framing

The Contractor shall roof and bore the poles for all crossarms and crossarm braces where required. "Pole Toppers" shall be installed on all roofed poles. All gains, cuts and holes shall be impregnated with pentachlorophenol.

10.3 Pole Handling

Poles, cross-arms, and braces shall be handled with care to avoid damage to the wood or the preservative treatment. The use of chisel point tongs or hooks will not be permitted. Cant hooks or other sharp tools shall not be used in the area of the poles extending from a point two feet above the butt to a point two feet above the setting depth and also in the area extending from the top of the pole to a point three feet below the top of pole. Poles shall not be dragged along the ground. Contractor shall, at his own expense, shave and preservative treat damaged areas or replaces excessively damaged components as determined by the Purchaser.

Poles stored after delivery, shall be arranged with care and shall be placed so that no pole will come in contact with water or the ground. Poles shall be sorted, those with larger diameter top being used at points of greater strain, or where additional safety is required. Poles for individual X-braced structures shall be matched for common dimensions as closely as possible.

10.4 Pole Setting

Poles shall be set in the ground to a depth shown on Drawing MA-18618. The depth may be changed by the Purchaser when in his judgment such change is necessary, but in no case shall the depth be less.

Where the pole is set in a sloping bank, the depth shall be measured from the lowest side of the opening. Where the slope of the bank is greater than forty-five degrees, or where the bank is so soft that the pole is liable to kick out, the pole shall be set one-half foot deeper than specified above.

When a pole is to be set in quicksand or soft soil where the digging is difficult and the setting insecure, it may be set in a steel culvert or casing worked into the hole to the required depth. After raising the pole, the culvert or casing shall be filled with competent granular backfill. In poor soils, bog shoes, guys, or braces shall be added. A split casing may be removed and re-used in the event that this type of pole setting is frequently required.

All holes shall be dug large enough to admit "air tamping" all around the pole and shall not have a larger diameter at the top than at the bottom, if the ground

condition does not make this impossible. When extremely heavy poles are to be set with pikes, or poles are to be set through existing lines, or in any difficult situation where there is danger of the pole getting away, the hole shall be trenched on one side in such a position that the pole may be lifted into place without striking the obstacles. The distances that the trench shall extend from the hole and the depth of the trench shall be left to Judgment of the foreman in charge of the work.

Poles with a bend or sweep shall be placed in the line so that the defect is least noticeable. In general, this will be accomplished by turning the bend or sweep in the direction of the line.

Poles shall be set to stand perpendicularly, within a tolerance of 1% of the pole length, and in exact alignment, within a tolerance of +/- 1 foot, when the line is completed, unless otherwise called for on the particular type of construction used.

After the pole is in position, only one shovel shall be used for filling the hole while three hand tampers or one mechanical tamper continually tamp the earth until the hole is filled. Small rock may be used for filling, care being taken that there be no voids in the earth. After the hole is filled, earth shall be banked up and firmly packed around the pole.

Backfill shall be inspected after the first rainstorm and after the earth has thawed, if the poles were erected when the ground was frozen. Any settlement that may have occurred shall be filled.

On single crossarm lines, poles shall, in general, be set with the crossarms alternately toward and away from one end of the line. In the case of crossing obstacles, long spans, etc., crossarms on each side of such special construction shall be faced toward the special construction. At line terminals the crossarms of the last two poles shall face towards the terminal.

On single pole corners the crossarm shall face away from the longer straight section on either side of the pole and the crossarms on the first pole on either aide of the corner pole shall face toward the corner pole.

At road crossings, the crossarms shall be faced towards the center of the road when conditions do not warrant the use of double arm structures.

10.5 Pole Ground Wire

Contractor shall install No. 6A copper ground wire on all new poles. Pole ground wires shall be fastened from a designated point near the pole top and shall be stapled every 18 inches down the pole to the bottom. A minimum of 8 feet of ground wire shall be coiled, and securely stapled to the butt of the pole as shown on Detail GS-5 Drawing MD-18550.

10.6 Crossarms

The crossarms covered by these specifications are of the type as shown on the drawings and should preferably be installed on the poles before the poles are erected to avoid excessive "spurring" of the poles. Crossarms chipped or otherwise damaged during construction shall be shaved and treated.

10.7 X-Braces

X-braces for structures shall be attached where required. The poles shall be bored, and the X-braces shall be assembled and attached by the Contractor in accordance with the details shown on the drawings. All nuts shall be tightened adequately.

10.8 Miscellaneous Hardware

Bolts and lag screws shall not be driven into place with a sledge or other metal objects which may destroy the galvanizing on the bolt or lag screw or rupture the wood fibers of the pole or other wood members.

10.9 Hardware Cloth Bird Wrap

Hardware cloth bird wrap shall be installed on all new poles in accordance with Drawing MA-30019.

11. GUYS AND ANCHORS

Install anchors and guys as indicated in the listing of work by structure and as indicated on the drawings. Guys shall be installed before conductors or overhead shield wires are strung.

Anchors shall be the twin (10" & 11-5/16") helix power installed screw anchors A.B. Chance Co. type SS anchor with 5'-0" extension (see Drawing MD-25413). Where soil conditions do not permit installation of the screw type anchors, a cross-plate type A.B. Chance Co.'s No. X-24 1" x 10'-0" twin eye anchor rod shall be installed as shown on Drawing MA-16910. When ground conditions will not permit the installation of a standard earth anchor, swamp or rock anchors of a type approved by the Purchaser may be installed.

Where excavations for cross-plate type anchors are required, backfill shall be compacted to a minimum of 95% of Standard Proctor Density. Earth anchor holes shall be inspected after the first rainstorm and after the earth has thawed, if the anchors were installed in the frozen earth. Any settlement that may have occurred shall be filled.

Guys and anchors shall be installed at a one-to-one slope (unless noted otherwise) in

locations designated. Anchor rods shall be in line with the strain and so installed that approximately 6 inches of the rod shall remain out of the ground. Under no circumstances shall an anchor rod be driven into position or the eye of a rod to be covered. Holes shall be back filled and tamped in the same manner as for pole holes. Guys shall be 7/16", 7-wire Utilities Grade galvanized steel strand attached to poles at the points shown on the drawings and tightened to remove all slack with no rake in the poles. Guys shall be attached to poles in such a manner as to interfere as little as possible with linemen climbing or working on the poles.

Preformed guy grips will terminate the guy strand on the pole end. Strandvises will terminate the guys on the anchor end.

Guy guards shall be installed on all new guys.

After the conductors have been strung and sagged, the guys shall be inspected and all loose guys shall be pulled up.

Vertical clearance of guys over roadways shall not be less than 18 feet and over pedestrian ways not less than 15 feet.

12. INSULATORS

All insulators are to be installed in accordance with instructions shown on the drawings. When strings of suspension insulators are installed on a crossarm prior to the erection of the structure, the strings of insulators shall be lashed to the crossarm in a manner so as not to add excessive strain on the individual insulators within the string. This shall be accomplished by supporting the insulator string with the proper insulator fitting on the crossarm and securing the free end of the string of insulators to the crossarm by means of a sling placed between the second and third insulator from the suspension clamp.

All cotter keys must be properly and adequately spread before the strings of insulators are installed. Insulators cracked or chipped or otherwise damaged must be replaced with sound units before the line is finally accepted.

13. CONDUCTORS

13.1 Stringing - General

Unless otherwise shown on the drawings or directed by the Purchaser, all clearances, shall conform to the requirements of the latest edition of the National Electrical Safety Code, as adopted by the State of Minnesota. The equipment and methods used for stringing the conductors shall be subject to the approval of the Purchaser and shall be such that the conductors or structures will not be damaged

or injured. Particular care shall be taken at all times to insure that the conductors do not become kinked, twisted, or abraded in any manner. If the conductors are damaged, the Contractor shall repair or replace the damaged sections in a manner satisfactory to the Purchaser and at no additional cost to the Purchaser. All sections of the conductors damaged by the application of gripping attachments shall be repaired or removed before the conductors are finally sagged in place.

The conductor shall not be dragged over the ground, rock, fence wires or any object that may damage the conductor. Guards or suitable material over which the conductor may pass without injury shall be placed at such locations to provide the required protection to the conductor. Temporary guard structures shall be installed adjacent to all existing overhead facilities, (such as power, communication lines, etc.) highways and railroads at their intersection with the line as required to provide adequate protection. The design and location of the guard structures shall be subject to the approval of the Purchaser.

Reel stands shall be heavily constructed and equipped with provisions for adequate braking. Lead or pulling lines shall be of suitable strength and characteristics to properly perform the intended function and shall be connected to the conductor with swivel connectors and stocking-type gripe. These lines shall be of sufficient length to avoid applying undue strain to the insulators and structures.

The design, size, material and condition of the stringing sheaves shall be subject to the approval of the Purchaser. Sheaves shall be equipped with high quality ball or roller bearings to reduce friction to a minimum. The grooves shall be lined with neoprene or other approved material. Sheaves shall be designed and used so that the pulling line does not damage the sheaves or deposit foreign matter in the liner, which may damage the conductor or cause foreign matter to be deposited on the conductor.

The sheave diameter at the bottom of the groove shall be not less than twelve (12) times the conductor diameter for 954 kcmil ACSR and smaller conductors and not less than thirteen (13) times the conductor diameter for larger conductors.

The Contractor shall replace or restore to proper operation and condition any sheave found by the Purchaser to be operating improperly or in such condition that damage to the conductor may result from continued use of the sheave.

The conductors shall be transposed at the locations shown on the lists of structures, and in accordance with the details shown on the drawings.

The Contractor shall establish a reel set-up schedule, prior to the start of the stringing operation, designed to minimize the number of part reels and scrap conductor at the completion of the operation. (All conductors in lengths of less than 1000 feet are considered scrap.) The Contractor shall be held responsible to the Purchaser for excessive scrap conductor. A copy of the reel set-up schedule

showing reel lengths and serial numbers and where "set-ups" will be made shall be given to the Purchaser for approval. Approval must be obtained in writing and schedule revised, before any deviation from the authorized stringing schedule will be permitted.

13.2 Controlled Tension Stringing

On specific instructions of the Purchaser, the conductors shall be strung by the controlled tension method using double bull wheel type tension stringing equipment. The Contractor may, at his option, use this method of stringing conductors on any given project.

The minimum diameter of the bull wheels over which the conductor phases on the tensioning device shall be twenty-five (25) times the conductor diameter for 954 kcmil ACSR and smaller conductors, and not less than twenty-seven (27) times the conductor diameter for larger conductors. The areas of the bull wheels which are contacted by the conductor shall be surfaced to protect the conductor and to provide the friction required to prevent slippage of the conductor. The brake design shall be such that when the desired tension is obtained the same constant tension will be maintained so long as the brakes are left at the established setting. The equipment shall be so designed that there can be no conduction of heat generated by the braking action of the bull wheels. Slight mechanical braking on the reel stands shall be provided to prevent loose conductor between the reels and the tensioning device.

The pulling and tensioning equipment shall be capable of maintaining the desired continuous tension for the stringing operation. All associated stringing equipment shall be of a design and in good condition so as to adequately provide for the requirements of the project.

When stringing conductor by the controlled tension method, the sag of each conductor shall be maintained at least 20 percent greater than the sag specified in the stringing sag tables, prior to final adjustment of the sag before clipping in the conductors. Maximum sag of the conductors during the stringing operation shall be such that the conductors will not come in contact with the ground or obstacles which may damage the conductor.

The conductors shall at no time be allowed to contact the ground. Contractor shall provide sufficient racks, horses or similar devices for this purpose. Special care shall be given to eliminate all possible sources of nicks and scratches. In all cases where minor nicks and scratches are observed the conductor shall be wiped with emery cloth. Major conductor abrasions and damage shall be repaired in accordance with the provisions of Section 14 of these Specifications.

Every reasonable effort shall be made to pull out all three phases from each setup within approximately 4 hours. In any event, each phase shall have been in the

stringing sheaves for approximately the same length of time when sagged.

When pulling more than one (1) reel of conductor (per phase) from one (1) set-up, the conductors shall be connected with swivel connectors and stocking-type grips.

The length of conductor which may be pulled from any one set-up will depend upon the size and type of conductor, the reel lengths furnished, etc.

13.3 Sagging

The conductors shall be allowed to hang freely in the stringing blocks for at least two hours before being sagged to permit the conductor and air temperatures to equalize. The total time which the conductor is allowed to remain in the stringing blocks before being clipped in shall not exceed 72 hours without written permission from the Purchaser. The conductors will not be pre-stretched and shall be sagged in accordance with sag tables furnished by the Purchaser. The tension in the conductor during the Stringing operations shall not exceed 35 percent of the ultimate strength of the conductor. The length of conductor sagged in one operation shall be limited to the length that can be sagged satisfactorily, but shall not exceed 20,000 ft.

The Purchaser shall select spans at which sag will be checked.

In sagging one reel length, the sag of two spans shall be checked. In sagging lengths of more than one reel, the sag of three or more spans, near each end and the middle of the length being sagged shall be checked. The length of the spans used for checking shall be approximately equal to the ruling span. The sag of all spans more than twice the ruling span in length shall be checked. At sharp vertical angles, the sag shall be checked on both sides of the angle. The sag of span on both sides of all horizontal angles of more than 10 degrees shall be checked.

After the conductors have been pulled to the required sag, intermediate spans shall be inspected to determine whether the sags are uniform and correct. Sagging operations shall not be carried on when, in the opinion of the Purchaser, wind prevents satisfactory sagging. A tolerance of plus one-half inch of sag per hundred feet of span length, but not to exceed six inches in any one span, will be permitted PROVIDED that all conductors in the span assume the same sag and the necessary ground clearance is obtained; and PROVIDED FURTHER that the conductor tension between successive sagging operations is equalized so that the suspension insulator assemblies will assume the proper position when the conductor is clipped in.

The recommended method for measuring and checking sag is described as follows:

Attach a target consisting of a lath or other wood strip to the poles at each end of

the span so that the distance between the upper edge of the target and the conductor attachment point is equal to the required sag. The conductor is properly sagged when the low point of the conductor is in line with the top of the targets when sighting from one target to the other.

When using this method, spans with adjacent supports at approximately the same elevation shall be selected.

Contractor may elect to utilize an alternate method requiring a transit to measure and check sag.

The air temperature at the time and place of stringing shall be determined by a certified etched-glass thermometer. The temperature at which the conductor is sagged, the sag, and the spans in which sags are measured shall be recorded and provided to the Purchaser's representative within 2 working days of completing the sag measurement.

The Contractor shall furnish the necessary supervision, labor, material, and equipment, for measuring temperature, determining appropriate sag from the charts provided, attaching targets, signaling, and providing written records of sag measurements.

13.4 Attachment

At all suspension or tension structures, the conductors shall be attached to the insulator assemblies as shown on the drawings. Suspension or strain clamp nuts shall be tightened in accordance with the manufacturer's instructions.

14. COMPRESSION JOINTS, SPLICES, REPAIR SLEEVES AND DEAD ENDS

All joints or splices, repair sleeves and dead ends shall be applied to the conductor in accordance with the installation instructions of the supplier of such devices and as approved by the Purchaser. The Contractor shall furnish all necessary tools, including compressors, required for applying compression joints or splices, repair sleeves and compression type dead ends. All joints or splices should be located at least 50 feet away from the structures. Splices or joints should be avoided in crossings and adjacent spans. In no case shall more than one splice be installed in a given span and no conductor splice shall be installed in a dead end span. At all dead end and large angle structures, the conductor may be run through without cutting. During stringing operations, if the conductor is cut at a dead end or heavy angle structure, the conductor remaining on the reels will be used on the spans adjacent to the dead end or angle structures or wherever practicable on the line.

If the conductor is cut, the jumper connections shall be made with parallel groove connectors or suitable compression type Jumper connectors. Where compression type dead ends are used, the jumper connections shall be made with compression type Jumper

terminals which shall be bolted to the compression type dead ends. Compression or preformed type repair sleeves may be used to repair minor damage to the conductor provided that:

- (1) At the location of the damage on the conductor to be repaired, not more than 1/3 of the outer strands are damaged over a length of not more than four inches.
- 2) Not more than two strands in the outer layer are broken, and the cross-sectional area of any other of the damaged strands is not reduced by more than 25 percent.
- (3) Repair sleeves or splices will be limited to one per conductor, per span. The repair sleeves shall be suitable for the size and type of conductor with which they are to be used.

In splicing, connecting or repairing conductor, it is essential that the connection between the metal surfaces be made clean and bright and that all foreign material be removed from between the strands with a wire scratch brush or emery cloth or both preparatory to making the compression repair or joint. An approved filler compound is to be used in all compression Joints or splices, repair sleeves, and dead ends. An approved joint compound is to be used on the bolted connections of compression type jumper terminals and in parallel groove clamps. All excess joint compound shall be removed to the satisfaction of the Purchaser. All compression splices and dead ends shall be made on a portable table or on the clean flat bed of a truck, in the presence of the Purchaser's representative. Fittings unduly curved or distorted will not be accepted. Straightening by hammering of any kind will not be permitted. Any compression device installed without the Purchaser's representative being present shall be removed and a new one installed in Purchaser's presence. All costs associated with such reinstallation shall be borne by the Contractor.

15. ARMOR RODS FOR ALUMINUM CONDUCTOR

Unless otherwise specified, where aluminum conductor is used, aluminum armor rod shall be attached in accordance with the recommendations of the manufacturer at each suspension insulator assembly on the transmission line in accordance with the drawings. If it becomes necessary to change the point of attachment by more than two and one-half inches either way from the mid-point of the armor rods after the armor rods are attached, a new set of armor rods shall be furnished and attached by the Contractor without cost to the Purchaser.

16. CONDUCTOR TIES

All ties to pin or post type insulators shall be made in accordance with the detailed instructions as given in the specifications for the particular line. All ties shall be made with soft drawn wire, thoroughly annealed, so that when applied they will hold tight and

not spring loose.

NO TIE WIRE SHALL BE USED A SECOND TIME.

17. CHANGE OF CONDUCTOR SIZE

Where a change is made in the size of a conductor the larger and smaller wires shall be securely dead-ended on the crossarms or poles and facilities provided for guying the unbalanced strain where this is sufficient to distort the line.

18. POLE WIRING

All tape and connecting wires passing from one level to another on a pole shall, so far as possible, be made vertical. All tape and connecting wires crossing from one side of a pole to another shall be made horizontal. Such wires shall not interfere with the working or climbing space.

All bends in wire shall be as near right angles as possible, allowing an eight inch radius when making a corner so as not to unduly kink or bend the conductor.

When strung in position, all wire shall be free from kinks and crooks and shall not hang loosely from or between supports. Loosely hung or kinked wires are unsightly and indicative of poor workmanship and shall be deemed as sufficient cause for replacement or repair by the Contractor at his own expense.

19. OVERHEAD SHIELD WIRES

The overhead shield wires shall be connected to the structures as shown on the drawings. The Contractor shall furnish all tools and equipment for stringing, splicing and installing the overhead shield wires. The equipment, methods and limitations for stringing overhead shield wires shall be the same as those for stringing conductor as described in Section 13 of these Specifications. Particular care shall be taken at all times to insure that the overhead shield wires do not become kinked, twisted or abraded in any manner. If the wires are damaged, the Contractor shall replace the damaged sections in a manner satisfactory to the Purchaser and at no additional cost to the Purchaser. All sections of the overhead shield wires damaged by the application of gripping attachments shall be removed before the wires are finally sagged in place. Joints or splices in overhead shield wires shall be made in accordance with the recommendations of the supplier and as approved by the Purchaser. The overhead shield wires shall be sagged in accordance with sag tables furnished by the Purchaser. The procedure of checking the sag of conductors, as outlined in Section 13 of these Specifications, shall be followed for the overhead shield wires. Before stringing is started, the Contractor shall furnish a schedule or plan showing reel lengths and serial numbers, and where "set-ups will be made to the Purchaser for approval.

20. POLE STEPS

Unless otherwise specified, no pole steps shall be used on transmission lines.

21. WARNING SIGNS

Warning signs shall be installed not less than four feet or more than six feet from the ground on structures designated as follows:

- (1) All switch structures;
- (2) All poles within one hundred feet of school grounds or inhabited buildings;
- (3) All poles within the corporate limits of a village, town or city;
- (4) One pole on each side of a railroad or highway crossing;
- (5) Every fifth pole along a railroad or highway right-of-way or within the limits of a cultivated field.

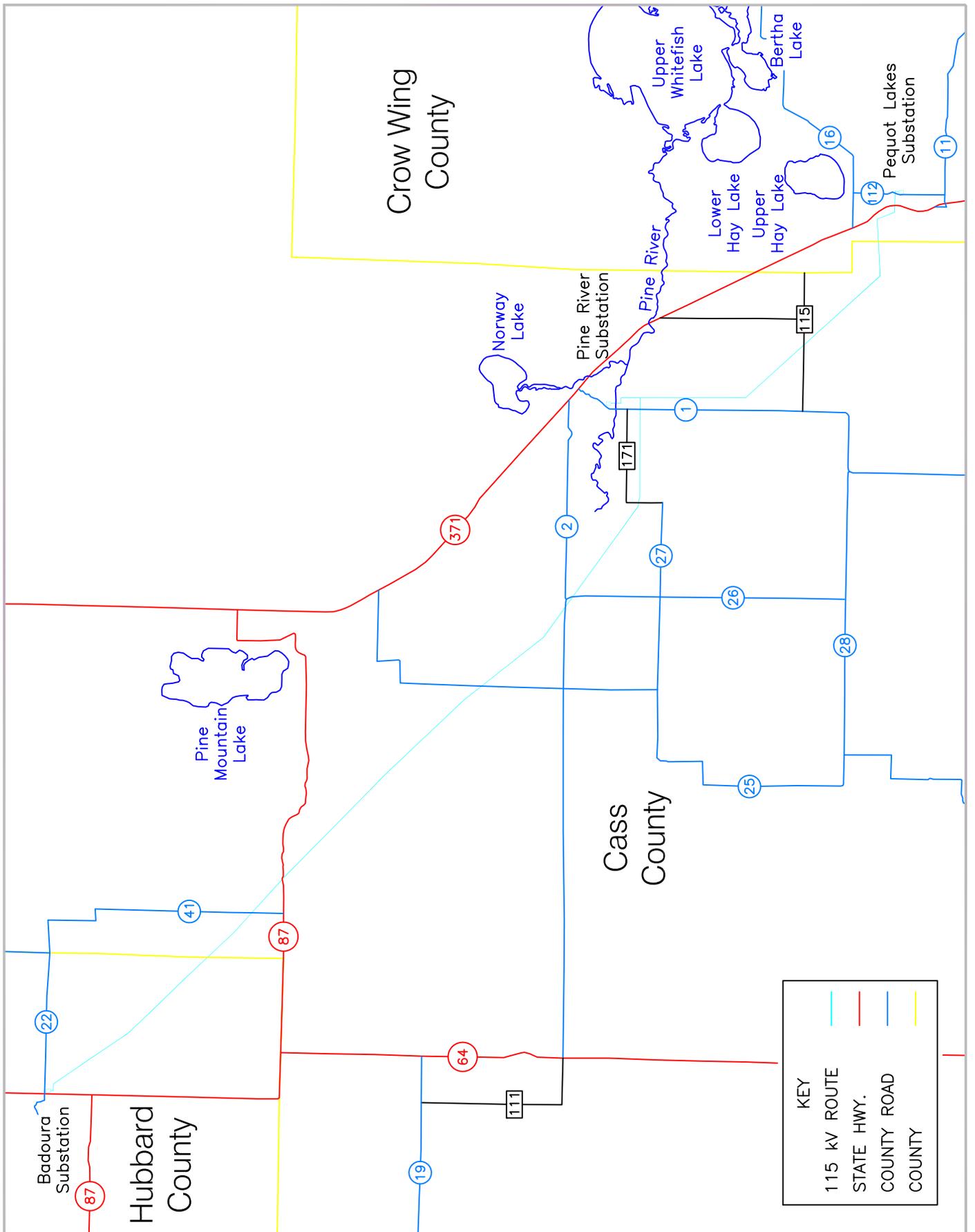
22. COMMUNICATION WITH PURCHASER

Contractor shall equip field supervision personnel with cellular phones or other mobile communication system for reliable communication with Purchaser's Representative and Purchaser's System Operations Department.

23. MINIMUM CLEARANCES

Contractor shall verify that all Work performed meets the clearance requirements set forth in Section 202 Table of Minimum Clearances.

In the event that the required clearances are not achieved, the Contractor shall immediately notify the Purchaser's Representative.



Drawn: ARH
 Checked: _____
 Approved: _____
 Rev. 1 Date: 07-016-08



115 kV Lines No. 142 & 147
 Badoura - Pine River - Pequot Lakes