Specification SP-061709-102145
Steel Transmission Poles

Luther Forest Transmission Lines and Substation Take-Off Structures
115 kV AMD Global Foundries Line #222
115 kV Rotterdam-Luther Forest #1
115 kV Spier-Luther Forest #302
115 kV AMD Global Foundries Line #111
115 kV Luther Forest-Turner Road #308
115 kV Mohican-Luther Forest #3

Towns of Malta and Stillwater, NY

Luther Forest Economic Development Corporation (LFTCEDC)

July 6, 2009

PREPARED BY:

TRC Power Delivery Engineering

APPROVED BY:

Date

Date

Date
TABLE OF CONTENTS

S1. SUPPLEMENTAL SPECIFICATION – PROJECT SPECIFIC REQUIREMENTS ........ 2
   1. PROJECT TITLE ....................................................................................................................... 2
   2. PROJECT SCOPE .................................................................................................................... 2
   3. STEEL STRUCTURE FINISHES ........................................................................................... 2
   4. STRUCTURE DESIGN REQUIREMENTS ............................................................................. 2
      A. CHARPY REQUIREMENTS ................................................................................................ 2
      B. CLIMBING ATTACHMENTS ........................................................................................... 3
      C. FALL PROTECTION ATTACHMENTS ............................................................................ 3
      D. WORKING ATTACHMENTS ............................................................................................ 3
      E. STRUCTURE SIGNAGE ..................................................................................................... 3
      F. DAVIT ARMS .................................................................................................................. 3
      G. GROUNDING ATTACHMENTS ....................................................................................... 4
      H. POLE TESTING ............................................................................................................... 4
      I. MULTI-SECTION POLE STRUCTURES ........................................................................... 4
      J. DEFLECTION CRITERIA .................................................................................................... 4
      K. SPECIAL STRUCTURE ATTACHMENTS ......................................................................... 5
      L. DESIGN CALCULATIONS ............................................................................................... 5
      M. MISCELLANEOUS ............................................................................................................ 5
   5. DELIVERY LOCATION AND NOTIFICATION INSTRUCTIONS ........................................ 6
   6. PROJECT ENGINEER .......................................................................................................... 6
   7. SCHEDULE AND DELIVERY REQUIREMENTS .................................................................. 6
   8. STRUCTURE SUMMARY LIST ............................................................................................ 7
   9. STRUCTURE DESIGN INFORMATION REQUIRED WITH BID ........................................ 9
  10. STRUCTURE WEIGHT AND COST INFORMATION REQUIRED WITH BID ............ 11

APPENDIX A. STEEL POLE SPECIFICATION
APPENDIX B. REFERENCE DRAWINGS
S1. SUPPLEMENTAL SPECIFICATION – PROJECT SPECIFIC REQUIREMENTS

This Supplemental Specification shall serve to supplement the General Specification entitled “Steel Pole Transmission Structures, Document # SP.06.01.407, Version 1.2, 03/06/2009” as provided in Appendix A of this Specification. In all cases the information specified in Section S1 shall supersede the requirements of the General Specification. In all cases where a conflict occurs, the more stringent requirement shall govern.

1. PROJECT TITLE

This specification shall be used to define the Vendor requirements for Steel Transmission Poles for the following project:

LFTCEDC
Luther Forest Transmission Lines and Substation Take-off Structures
115 kV AMDGF Line #111
115 kV Rotterdam-Luther Forest #1
115 kV Spier-Luther Forest #302
115 kV AMDGF Line #222
115 kV Luther Forest-North Troy #308
115 kV Mohican-Luther Forest #3

2. PROJECT SCOPE

This specification defines the requirements for the design, fabrication and F.O.B. delivery of twenty-eight (28) galvanized Steel Transmission Pole Structures, complete with anchor bolts and all accessories as shown on the contract drawings and in accordance with these specifications for the subject transmission line project. Anchor bolt clusters shall be designed and provided as an assembled cluster by the Vendor. Seven (7) Steel Pole Structures are multi-pole structures and require bolted flange connections. Twenty-one (21) Steel Pole Structures are single-pole structures and require mated slip-joint connections.

3. STEEL STRUCTURE FINISHES

All structures and associated appurtenances shall be galvanized in accordance with the requirements of this Specification.

4. STRUCTURE DESIGN REQUIREMENTS

A. CHARPY REQUIREMETS

All steel from the mill used in the structure fabrication shall be guaranteed to have a minimum energy impact value of 15 foot-pounds for full size specimens (10mm x 10mm) at -20 def F as measured by a Charpy V-notch test performed in accordance with ASTM A370 and A673. Frequency “P” testing shall be supplied. Plate test specimens shall be taken after rolling and finishing operations.
B. CLIMBING ATTACHMENTS

Climbing attachments shall be provided for all single pole structures in accordance with General Specification SP.06.01.407.

Climbing attachments shall not be provided for multi-pole substation take-off structures.

C. FALL PROTECTION ATTACHMENTS

Fall protection attachments shall be provided for all single pole structures in accordance with General Specification SP.06.01.407.

Fall protection attachments shall not be provided for multi-pole substation take-off structures.

D. WORKING ATTACHMENTS

Working attachments shall be provided for removable bail steps as shown in General Specification SP.06.01.407 for all single pole structures. One removable bail step shall be supplied for each bail step attachment.

Working attachments and associated removable bail steps shall not be provided for multi-pole substation take-off structures.

Cross arm ladder attachments are not required for any structures as part of this Specification.

E. STRUCTURE SIGNAGE

Structure signage brackets shall be provided for all single-pole structures in accordance with the General Specification SP.06.01.407.

Structure signage brackets are not be provided for multi-pole substation take-off structures.

F. DAVIT ARMS

All davit arms and appropriate attachment hardware are to be provided by the steel pole vendor.

All arms must be capable of being mounted and removed independently without affecting each other in any manner.

All conductor-to-structure (phase-to-ground) clearances as defined in this Specification and on associated drawings shall be maintained for each arm design.

Arms shall be designed so the end of the arm is at the specified height under a loading of initial conductor tension, 60-deg F, no wind, no overload factors. Arms shall not deflect
vertically more than 6-inches for the National Grid Heavy Ice Load Case. Arm deflection for all load cases shall not compromise the required phase-to-ground clearances as designated on the structure detail drawings.

Arm end-plates shall allow both suspension and strain insulator configurations, unless otherwise specified on the structure detail drawings.

G. GROUNDING ATTACHMENTS

Grounding nuts shall be provided on the pole cap unless indicated otherwise on the structure detail drawings. The grounding nut shall be a 1/2" stainless steel heavy hex nut welded over a 9/16” diameter hole.

At other locations, stainless steel grounding attachment plates, as shown on the structure detail drawings, shall be used. Grounding attachment plates shall be installed on one longitudinal face of the pole centered at each of the following locations:

1. 18 inches above the theoretical groundline
2. 12 inches below the conductor attachment elevation (not at arm attachment point)

H. POLE TESTING

Pole testing is not a requirement of this Specification.

I. MULTI-SECTION POLE STRUCTURES

Multi-section pole shafts for substation take-off structures shall have bolted flange joints.

Multi-section pole shafts for single-pole transmission structures shall have bolted flange joints.

J. DEFLECTION CRITERIA

The following table defines the deflection criteria for each respective substation take-off steel pole structure. The Maximum Allowable Recoverable Deflection should be verified for all load cases defined on the contract drawings.

<table>
<thead>
<tr>
<th>Structure Number</th>
<th>Maximum Allowable Recoverable Deflection (inches)</th>
<th>Top of 12-sided Tubular Pole Shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBR T.O.</td>
<td>0.25</td>
<td>Provide rake offset if deflection ≥ 6</td>
</tr>
<tr>
<td>1 T.O.</td>
<td>Not applicable</td>
<td>Provide rake offset if deflection ≥ 6</td>
</tr>
<tr>
<td>314 T.O.</td>
<td>Not applicable</td>
<td>Provide rake offset if deflection ≥ 6</td>
</tr>
<tr>
<td>313 T.O.</td>
<td>Not applicable</td>
<td>Provide rake offset if deflection ≥ 6</td>
</tr>
<tr>
<td>2 T.O.</td>
<td>Not applicable</td>
<td>Provide rake offset if deflection ≥ 6</td>
</tr>
<tr>
<td>302 T.O.</td>
<td>Not applicable</td>
<td>Provide rake offset if deflection ≥ 6</td>
</tr>
<tr>
<td>3 T.O.</td>
<td>Not applicable</td>
<td>Provide rake offset if deflection ≥ 6</td>
</tr>
</tbody>
</table>

1 Applies for ALL load cases on structure detail drawing
2 Applies for Camber Load Case, only

All take-off structure crossarms shall be designed to meet the respective deflection criteria defined on the structure detail drawings.

All transmission line steel pole structures shall meet the deflection criteria of Section 2.1.2 of General Specification SP.06.01.407.

K. SPECIAL STRUCTURE ATTACHMENTS

1. SBR T.O. Switch Attachment

The steel pole vendor shall design the Stonebreak Road Take-Off structure to accommodate the loads from the proposed 115 kV USCO Type AVR-11520 switches. The Vendor shall apply the appropriate dead and live loads to the structure for each separate load case to accommodate the design loads applied by the proposed switches.

2. Substation Post Insulators

When applicable, all substation take-off structures shall be designed to accommodate the appropriate dead and live loads imposed on the structure from all substation post insulators.

L. DESIGN CALCULATIONS

In addition to the submittal requirements for steel pole design calculations defined in the General Specification, the Vendor shall provide PLS-POLE files in a *.BAK file format for each proposed steel pole design for review by the Owner’s Representative. The *.BAK file shall contain all component libraries and load case files used for the design of each respective structure.

M. MISCELLANEOUS

In the design of connections for vangs, brackets, or stiffeners attached to the pole shaft, care shall be taken to distribute the loads sufficiently to protect the wall of the pole from local buckling.

All poles shafts shall be 12-sided polygonal shapes. All 12 flats shall be of equivalent geometries.
5. DELIVERY LOCATION AND NOTIFICATION INSTRUCTIONS

The structures covered under this specification shall be delivered FOB to the following location:

Wright Malta Site
40 Hermes Road
Malta, NY 12020

Delivery shall be made to the site between the hours of 9:00 AM and 2:00 PM Monday thru Friday. The Vendor shall notify the TRC 15-days in advance of the proposed shipment date. A confirmed notification of delivery must be made to TRC at least 48 hours before delivery is made.

6. PROJECT ENGINEER

For technical questions and submittal of technical documents, please contact:

Joseph Procopio, P.E.
TRC Project Manager
315-671-1604
jprocopio@trcsolutions.com

7. SCHEDULE AND DELIVERY REQUIREMENTS

The project associated with the steel structures covered under this specification has a schedule containing little or no slack time. Preference will be given to the proposals which reflect quick delivery timeframes for a complete structure.

Completed structure delivery shall be no later than November 18, 2009.
# 8. STRUCTURE SUMMARY LIST

<table>
<thead>
<tr>
<th>Str. No.</th>
<th>Structure Type</th>
<th>Structure Style</th>
<th>Foundation Type</th>
<th>Line Angle</th>
<th>Structure Total Height “H” (ft)</th>
<th>Reference Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBR T.O.</td>
<td>3-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td>CAISSON</td>
<td>0º</td>
<td>60’-0”</td>
<td>SK-100LFW</td>
</tr>
<tr>
<td>12</td>
<td>D1394</td>
<td>0-30º DEAD-END</td>
<td>CAISSON</td>
<td>9º-43’</td>
<td>95’-0”</td>
<td>SK-106LFW</td>
</tr>
<tr>
<td>13</td>
<td>D1393</td>
<td>0-15º R. A. RIGHT</td>
<td>CAISSON</td>
<td>11º-18’</td>
<td>95’-0”</td>
<td>SK-104LFW</td>
</tr>
<tr>
<td>14</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td>CAISSON</td>
<td>0º</td>
<td>95’-0”</td>
<td>SK-103LFW</td>
</tr>
<tr>
<td>15</td>
<td>D1395</td>
<td>0-50º DEAD-END</td>
<td>CAISSON</td>
<td>-40º-32’</td>
<td>95’-0”</td>
<td>SK-107LFW</td>
</tr>
<tr>
<td>16</td>
<td>D1393</td>
<td>0-15º R. A. LEFT</td>
<td>CAISSON</td>
<td>-7º-51’</td>
<td>90’-0”</td>
<td>SK-104LFW</td>
</tr>
<tr>
<td>17</td>
<td>D1393</td>
<td>15-25º R. A. LEFT</td>
<td>CAISSON</td>
<td>-23º-51’</td>
<td>95’-0”</td>
<td>SK-105LFW</td>
</tr>
<tr>
<td>18</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td>CAISSON</td>
<td>0º</td>
<td>95’-0”</td>
<td>SK-103LFW</td>
</tr>
<tr>
<td>19</td>
<td>D1393</td>
<td>15-25º R. A. LEFT</td>
<td>CAISSON</td>
<td>-21º-52’</td>
<td>90’-0”</td>
<td>SK-105LFW</td>
</tr>
<tr>
<td>20</td>
<td>D1393</td>
<td>15-25º R.A. RIGHT</td>
<td>CAISSON</td>
<td>16º-39’</td>
<td>90’-0”</td>
<td>SK-105LFW</td>
</tr>
<tr>
<td>21</td>
<td>D1393</td>
<td>15-25º R.A. RIGHT</td>
<td>CAISSON</td>
<td>21º-25’</td>
<td>90’-0”</td>
<td>SK-105LFW</td>
</tr>
<tr>
<td>22</td>
<td>D1394</td>
<td>0-30º DEAD-END</td>
<td>CAISSON</td>
<td>-29º-24’</td>
<td>95’-0”</td>
<td>SK-106LFW</td>
</tr>
<tr>
<td>23</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td>CAISSON</td>
<td>2º-1’</td>
<td>95’-0”</td>
<td>SK-103LFW</td>
</tr>
<tr>
<td>24</td>
<td>D1396</td>
<td>0-70º DEAD-END</td>
<td>CAISSON</td>
<td>66º-44’</td>
<td>90’-0”</td>
<td>SK-108LFW</td>
</tr>
<tr>
<td>25</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td>CAISSON</td>
<td>0º</td>
<td>90’-0”</td>
<td>SK-103LFW</td>
</tr>
<tr>
<td>26</td>
<td>D1394</td>
<td>0-30º DEAD-END</td>
<td>CAISSON</td>
<td>-27º-18’</td>
<td>85’-0”</td>
<td>SK-106LFW</td>
</tr>
<tr>
<td>27</td>
<td>D1393</td>
<td>15-25º R.A. RIGHT</td>
<td>CAISSON</td>
<td>16º-43’</td>
<td>95’-0”</td>
<td>SK-105LFW</td>
</tr>
<tr>
<td>28</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td>CAISSON</td>
<td>0º</td>
<td>95’-0”</td>
<td>SK-103LFW</td>
</tr>
<tr>
<td>29</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td>CAISSON</td>
<td>0º</td>
<td>95’-0”</td>
<td>SK-103LFW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>D1394</td>
<td>0-30º DEAD-END</td>
<td>CAISSON</td>
<td>-2º-50'</td>
<td>80'-0&quot;</td>
<td>SK-106LFW</td>
</tr>
<tr>
<td>31A</td>
<td>D1304M</td>
<td>S.C. VERT. DEAD-END</td>
<td>CAISSON</td>
<td>-4º-39'</td>
<td>95'-0&quot;</td>
<td>SK-109LFW</td>
</tr>
<tr>
<td>31B</td>
<td>D1304M</td>
<td>S.C. VERT. DEAD-END</td>
<td>CAISSON</td>
<td>-11º-12'</td>
<td>95'-0&quot;</td>
<td>SK-109LFW</td>
</tr>
<tr>
<td>222 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td>CAISSON</td>
<td>0º</td>
<td>60'-0&quot;</td>
<td>D-36098-E</td>
</tr>
<tr>
<td>1 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td>CAISSON</td>
<td>0º</td>
<td>66'-0&quot;</td>
<td>D-36098-E</td>
</tr>
<tr>
<td>302 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td>CAISSON</td>
<td>0º</td>
<td>66'-0&quot;</td>
<td>D-36098-E</td>
</tr>
<tr>
<td>111 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td>CAISSON</td>
<td>0º</td>
<td>60'-0&quot;</td>
<td>D-36098-E</td>
</tr>
<tr>
<td>308 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td>CAISSON</td>
<td>0º</td>
<td>61'-0&quot;</td>
<td>D-36099-E</td>
</tr>
<tr>
<td>3 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td>CAISSON</td>
<td>0º</td>
<td>61'-0&quot;</td>
<td>D-36099-E</td>
</tr>
</tbody>
</table>
9. STRUCTURE DESIGN INFORMATION REQUIRED WITH BID

<table>
<thead>
<tr>
<th>Str. No.</th>
<th>Total Pole Length (ft)</th>
<th>Top Diameter (in.)</th>
<th>Bottom Diameter (in.)</th>
<th>Taper (in/ft)</th>
<th>Min. Wall Thickness (in.)</th>
<th>Max. Pole Top Deflection (in.)</th>
<th>Maximum Design Pole Ground Line Reactions at “Point of Fixity”</th>
<th>Maximum Vertical Arm Tip Deflection for 1.5-IN. Heavy Ice Loading (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Camber</td>
<td>Maximum</td>
<td></td>
<td></td>
<td>Axial (kips)</td>
<td>Shear (kips)</td>
<td>Moment (ft-kips)</td>
</tr>
<tr>
<td>SBR T.O.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>222 T.O.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 T.O.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>302 T.O.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111 T.O.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>308 T.O.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 T.O.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 10. STRUCTURE WEIGHT AND COST INFORMATION REQUIRED WITH BID

<table>
<thead>
<tr>
<th>Str. No.</th>
<th>Structure Type</th>
<th>Structure Style</th>
<th>Structure Weight (lbs.)</th>
<th>Anchor Bolt Cage Weight (lbs.)</th>
<th>Structure Cost ($) *</th>
<th>Anchor Bolt Cage Cost ($) *</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBR T.O.</td>
<td>3-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>D1394</td>
<td>0-30º DEAD-END</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>D1393</td>
<td>0-15º</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>D1395</td>
<td>0-50º DEAD-END</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>D1393</td>
<td>0-15º</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>D1393</td>
<td>15-25º</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>D1393</td>
<td>15-25º</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>D1393</td>
<td>15-25º</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>D1393</td>
<td>15-25º</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>D1394</td>
<td>0-30º DEAD-END</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>D1396</td>
<td>0-70º DEAD-END</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>D1394</td>
<td>0-30º DEAD-END</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>D1393</td>
<td>15-25º</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>D1392</td>
<td>0-5º SUSPENSION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>D1394</td>
<td>0-30º DEAD-END</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>-------</td>
<td>----------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31A</td>
<td>D1304M</td>
<td>S.C. VERT. DEAD-END</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31B</td>
<td>D1304M</td>
<td>S.C. VERT. DEAD-END</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>222 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>302 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>308 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 T.O.</td>
<td>2-POLE H-FRAME</td>
<td>0-15º TERMINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTALS:**

*The cost above shall include transportation and delivery of all materials FOB.*
BIDDING COMPANY’S PROPOSED SCHEDULE:

Delivery of approval drawings: ______ weeks after bid award

Delivery of Anchor Bolt Assemblies: ______ weeks after bid award

Delivery of Steel Pole Structures: ______ weeks after approval drawings

 Proposed start of project after issuance of Purchase Order: ______ days

 Expected duration of work: ______ days

BIDDING COMPANY’S NAME: ____________________________________________

PERSON TO CONTACT WITH QUESTIONS CONCERNING BID:

NAME: ____________________________________________

TITLE: ____________________________________________

DATE: ____________________________________________

TELEPHONE: ____________________________________________

FACSIMILE: ____________________________________________

E-MAIL: ____________________________________________
APPENDIX A. STEEL POLE SPECIFICATION
Steel Pole Transmission Structures
<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Modification</th>
<th>Author</th>
<th>Reviewer</th>
<th>Approver</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>04/10/07</td>
<td>Added drawing LS-6544 and LS-6545 in section 1.4, replaced ‘Section 5’ with ‘project specific requirements’ in section 2.1.11</td>
<td>Lisa Sasur</td>
<td></td>
<td>Mark Browne</td>
</tr>
<tr>
<td>1.2</td>
<td>03/06/09</td>
<td>Removed requirement for A354 Grade BD bolts</td>
<td>Jeremy Cote</td>
<td>Amit Urs</td>
<td>Mark Browne</td>
</tr>
</tbody>
</table>
Table of Contents

1. GENERAL .................................................................................................................................. 4
   1.1 SCOPE .................................................................................................................................. 4
   1.2 DEFINITIONS .......................................................................................................................... 4
   1.3 REFERENCES ........................................................................................................................ 4
   1.4 STANDARD DETAIL DRAWINGS ....................................................................................... 5
   1.5 CALCULATIONS ...................................................................................................................... 6
   1.6 DRAWINGS ............................................................................................................................ 6
   1.7 QUALITY CONTROL DOCUMENTATION ........................................................................... 6
   1.8 DELIVERY ............................................................................................................................. 7
   1.9 CONFLICTS .......................................................................................................................... 7

2. DESIGN ..................................................................................................................................... 8
   2.1 GENERAL - ALL POLE STRUCTURES ................................................................................. 8
   2.2 POLE STRUCTURES FOR DIRECT EMBEDMENT ............................................................... 11
   2.3 POLES STRUCTURES FOR FOUNDATIONS ...................................................................... 11
   2.4 PAINTED POLE STRUCTURES ......................................................................................... 12
   2.5 GALVANIZED POLE STRUCTURES .................................................................................. 12
   2.6 WEATHERING STEEL POLE STRUCTURES ................................................................. 12

3. MATERIALS .............................................................................................................................. 14
   3.1 PAINTED POLES .................................................................................................................. 14
   3.2 GALVANIZED POLES ......................................................................................................... 15
   3.3 WEATHERING STEEL POLES .......................................................................................... 15
   3.4 GROUNDING PLATES ........................................................................................................ 16
   3.5 MASTIC COATING ............................................................................................................... 16
   3.6 ANCHOR BOLTS ................................................................................................................. 16

4. FABRICATION ............................................................................................................................. 16
   4.1 TOLERANCES ....................................................................................................................... 17
   4.2 APPEARANCE AND BURRS ............................................................................................. 17
   4.3 WELDING ............................................................................................................................ 17
   4.4 PAINTED POLES .................................................................................................................. 18
   4.5 GALVANIZED POLES ....................................................................................................... 19
   4.6 WEATHERING STEEL POLES ......................................................................................... 19
   4.7 ANCHOR BOLTS .................................................................................................................. 19
1. GENERAL

1.1 SCOPE

This specification covers the design, drawings, materials, fabrication, finishing, and delivery of tubular steel pole transmission structures. This includes all design calculations, detailing, arms, attachments, attachment bolts, anchor bolts, climbing attachments, and grounding attachments.

1.2 DEFINITIONS

Certain terms and abbreviations used throughout this specification are defined as follows:

- ACI - American Concrete Institute.
- ASCE - American Society of Civil Engineers.
- AWS - American Welding Society.
- Company - The purchaser of the tubular steel pole structures.
- Engineer - The National Grid Project Engineer.
- NG - National Grid.
- SSPC - Steel Structures Painting Council.
- Standard Detail Drawing - National Grid drawing which details certain aspects of the steel transmission pole structure.
- Supplier - Designer and fabricator of the steel pole structures.
- Weathering Steel - Atmospheric corrosion resistant steel per ASTM A871/A871M.

1.3 REFERENCES

References to industry standards are made throughout this specification. The following specifications and codes, in their latest revisions, are incorporated as part of this specification:

- ACI Standard 318, "Building Code Requirements for Reinforced Concrete."
- ANSI/AWS D1.1, "Structural Welding Code - Steel."
- ASCE "Design of Steel Transmission Pole Structures."
ASTM A143, "Recommended Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement."


ASTM A325, "Specification for High-Strength Bolts for Structural Steel Joints."

ASTM A354, "Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners."

ASTM A370, "Standard Test Methods and Definitions for Mechanical Testing of Steel Products."

ASTM A384, "Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies."

ASTM A435, "Specification for Straight-Beam Ultrasonic Examination of Steel Plates for Pressure Vessels."

ASTM A490, "Specification for Heat-Treated, Steel Structural Bolts, 150 ksi (1035 MPa) Tensile Strength."

ASTM A572, "Specification for High-Strength Low-Alloy Columbium-Vanadium Steel of Structural Quality."

ASTM A615, "Specification for Deformed and Plain-Billet Steel Bars for Concrete Reinforcement."


ASTM A871/A871M, "Specification for High-Strength Low-Alloy Structural Steel Plate With Atmospheric Corrosion Resistance."

SSPC-SP-6, "Commercial Blast Cleaning."

1.4 STANDARD DETAIL DRAWINGS

References to Standard Detail Drawings are made throughout this specification. The following Standard Detail Drawings are incorporated as part of this specification:

Drawing LS-5658, “Grounding Attachment Plate”


Drawing LS-5660-1, “Step Bolt Arrangement and Requirements for Steel Poles”

Drawing LS-5661, “Jacking Block Detail”
1.5 CALCULATIONS

The Supplier shall submit preliminary calculations, drawings, and data to NG with the quotations. These shall include general dimensions of all component parts of the structures, and calculated values as specified in Section 2.1.1.

The Supplier shall submit to NG one set of final calculations, and data with the approval drawings. These shall include general dimensions of all component parts of the structures, and calculated values as specified in Section 2.1.1.

1.6 DRAWINGS

The Supplier shall submit three sets of design, detail, and erection drawings to NG for approval. This approval must be obtained before fabrication is begun. The Supplier shall be responsible for the correctness of design, dimensions, and details on the drawings. The approval of these drawings by NG shall not relieve the Supplier of this responsibility.

The Supplier shall provide an electronic file for each final approved design, detail, and erection drawing before shipping the structure(s). All electronic drawing files shall be in AutoCad version 2006 format using standard AutoCAD fonts for the Transmission line poles and Micro Station Version 8 XM for the Station Take Off structures.

The Supplier shall provide one set of reproducible drawings of the final approved design, detail, and erection drawings to NG before shipping the structure(s). These drawings shall be reproductions on 0.004" film Dupont Cronaflex, Order Code 2 CWO-4 or approved equivalent. Reproduction shall be direct reading, image on front, water erasable, and matte surface on two sides.

1.7 QUALITY CONTROL DOCUMENTATION

The Supplier shall submit the following items to NG:

- one copy of the certified mill test report for all steel, including anchor bolts and base plates,
- one copy of the ultrasonic test report for each base plate,
- evidence of the ability of the steel to meet the required impact properties.

The following records shall be kept by the Supplier and shall be available for review by NG:
welding procedures,

welding operator test results,

welding inspection reports.

The Company reserves the right to make inspection and tests at either the Supplier's plant or at the destination. Inspection and tests or the waiving of inspection and tests shall not relieve the Supplier of the responsibility to provide structures conforming to these specifications and to the Supplier's design.

1.8 DELIVERY

The Supplier shall be responsible for delivery of the structures to the designated delivery location. The Supplier shall notify NG of delivery at least 48 hours before delivery is made.

Each shipment, unless otherwise specified, shall be composed of parts to assemble complete structures. Each invoice shall be accompanied by a list of all parts, including bolts, identified by structure type and number. Bolts, nuts, palnuts, and the parts list, shall be bagged or boxed, and attached to each structure. Anchor bolts shall be delivered as assembled clusters.

The Supplier shall be responsible for the cost of repairing any damage to the structures caused by improper shipping or handling until the poles are accepted by NG. This includes, but is not limited to, touching up any damage to surface finishes.

1.9 CONFLICTS

When a conflict exists between two referenced industry standards, the more stringent requirement shall govern.

When a conflict exists between a referenced industry standard and this specification, the more stringent requirement shall govern.

When a conflict exists between project specific requirements and any other section of this specification, the project specific requirements shall govern.
2. DESIGN

2.1 GENERAL - ALL POLE STRUCTURES

2.1.1 CALCULATIONS

Calculated design values shall be provided for each of the loadings given on the structure outline drawings. The wind loads shall be considered as uniform pressures acting on the full projected area of the structure. Calculated values shall include: diameter, thickness, area, moment of inertia, shear and axial reactions, moments, deflections, and maximum combined stresses. These values shall be calculated at the base of the pole, each splice, all attachment points, and at least every five feet. Total pole design weights shall also be provided.

Structures for direct embedment shall be assumed to be rigidly supported two feet below the defined groundline. Structures for mounting on foundations shall be assumed to be rigidly supported at the base plate.

For these design calculations, structures shall be rotated 1° for all design loadings, except camber design loadings. This rotation shall be about the assumed support point of the structures. Secondary moments due to structure deflection and rotation about the assumed support point shall be included in the design calculations.

Structures shall be designed to withstand the loadings given on the structure outline drawings without exceeding the recommended and/or required allowable stresses in Section 2.2 of ASCE "Design of Steel Transmission Pole Structures".

2.1.2 CAMBER AND RAKE

Camber and rake shall be based on the camber design loadings given on the structure outline drawings. The structures shall be cambered if the deflection at the top of the structure, for this case, is two percent of the total structure height above ground or greater. If the deflection at the top of the structure, for this case, is six inches or greater, and camber is not required, a rake offset distance shall be furnished with the final design drawings.

2.1.3 MULTI-SECTION POLE STRUCTURES

Pole shafts longer than 60 feet shall be designed in sections. No individual pole shaft section shall be more than 60 feet long. Pole shafts 40 feet long or shorter shall be provided in one piece.

In general, either slip joint or flange connections may be used. However, slip joint connections are not acceptable:

for painted pole structures,

when the axial compressive force at the joint, for any of the design loadings, is less than 1,000 pounds or is more than the jacking force required for assembly of the slip joint.
When slip joints are used, jacking blocks shall be furnished at each slip joint. Standard Detail Drawing LS-5661 shows these jacking blocks. These jacking blocks will be used for pulling the pole shaft sections together.

2.1.4 MINIMUM TOP DIAMETER

The pole shaft top diameter shall not be less than nine inches.

2.1.5 MINIMUM THICKNESS

The steel used in fabricating any member shall not be less than 0.25 inches thick.

2.1.6 UNIFORM TAPER

The pole shaft shall have a uniform continuous taper for its entire length.

2.1.7 MARKING & IDENTIFICATION

Each separate part of the structure, including crossarms, shall be distinctly, and permanently marked with letters and numbers at least 1/2 inch high to identify the piece by structure number and the position of the piece in the structure.

For multi-section pole shafts, a match mark shall be placed on each section at the connection to indicate proper orientation. These match marks shall be in line for all sections of the same pole shaft.

For slip joints, a hole in the female section of the slip joint shall be placed to identify the point of minimum engagement of the slip joint. A horizontal weld bead, three inches long, on the male section of each slip joint shall be placed to identify the point of maximum slip joint engagement.

2.1.8 CONNECTIONS

Arm connections shall not use bolts through the pole shaft. Each arm shall be removable without affecting any other member.

2.1.9 TOP COVER

The pole tops shall be capped.

2.1.10 GROUNDING ATTACHMENTS

For the grounding of shield wires attached to a pole, a 1/2" stainless steel heavy hex nut shall be welded over a 9/16" diameter hole in the pole cap as detailed on the structure outline drawings. For the grounding of shield wires attached to an arm, a 1/2" stainless steel heavy hex nut shall be welded over a 9/16" diameter hole in the arm end plate as detailed on the structure outline drawings.
At other locations, stainless steel grounding attachment plates, as shown in Detail Drawing LS-5658, shall be used. Grounding attachment plates shall be installed on one longitudinal face of the pole centered at each of the following locations:

- 18 inches above the base plate or groundline corrosion collar,
- 12 inches below each conductor attachment elevation.

### 2.1.11 CLIMBING ATTACHMENTS

Climbing attachments shall be provided for removable double nutted 3/4" diameter step bolts as shown in Standard Detail Drawing LS-5660-1. Step bolt attachments shall be installed on the longitudinal face opposite the grounding attachments. Step bolt attachments shall be staggered with 18" maximum vertical separation of steps on each side. Climbing attachments shall be installed from the top of the pole structures to 12 feet above the defined groundline or base plate. Unless otherwise noted in the project specific requirements, one step bolt shall be supplied for each step bolt attachment.

### 2.1.12 FALL PROTECTION ATTACHMENTS

Fall Protection attachments shall be Buckingham Manufacturing Co., Inc. “Model 30" and “Model 30L" Flanges. Unless otherwise noted in the project specific requirements, the Supplier shall provide these Fall Protection Flanges at one-third of all step bolt positions on all steel pole structures comprising the total order, as specified on Detail Drawings LS-5660-1 and LS-6515-1.

### 2.1.13 WORKING ATTACHMENTS

Working attachments shall be provided for removable bail steps as shown in Detail Drawing LS-5659. Working attachments shall be installed on both transverse faces and on the longitudinal face opposite the climbing attachments. Working attachments shall be installed with 15" maximum vertical separation. Working attachments shall be installed from 7' below the lowest wire attachment level to the top of the pole structures. No working attachments shall be installed within 12' of the defined groundline or base plate. Unless otherwise noted in the project specific requirements, one bail step shall be supplied for each bail step attachment.

Unless otherwise noted in the project specific requirements, ladder attachments shall be located and fabricated as shown on the structure Reference Drawing or, if so noted on the structure Reference Drawing, as shown on Detail Drawings LS-6544 and LS-6545. Crossarm ladder attachments shall be provided based on the use of standard fiber glass ladder lengths of 6', 8', and 10'. The fiberglass ladders are not included as part of this specification.
2.1.14 SIGNAGE BRACKETS

Unless otherwise noted in the project specific requirements, brackets for the attachment of structure signage shall be provided as shown in Detail Drawing LS-5672.

For single-shaft structures, brackets shall be provided on both longitudinal faces of the steel pole. For multi-pole structures, signage brackets shall be provided on the front longitudinal face of one pole and the back longitudinal face of another pole. For pole structures for foundations, the signage brackets shall be located at 8'-0" above the base plate as detailed. For direct embedment structures, the signage brackets shall be located at 8'-0" above theoretical groundline.

2.2 POLE STRUCTURES FOR DIRECT EMBEDMENT

The following requirements shall apply to pole structures designed for direct embedment:

2.2.1 BEARING PLATE

Pole shafts shall have a bottom bearing plate. The bearing plate shall have a minimum thickness of 0.25 inches. The bearing plate shall not extend beyond a circle three inches larger than the nominal diameter of the pole shaft.

2.2.2 CORROSION COLLAR

Pole shafts shall have a groundline corrosion collar. The corrosion collar shall have a minimum thickness of 0.25 inches. The corrosion collar shall be four feet long and extend from 30 inches below to 18 inches above the defined groundline.

2.2.3 MASTIC COATING

Pole shafts shall have a mastic coating meeting the requirements of Section 3.5 from six inches below the top of the corrosion collar to the base of the pole.

2.3 POLES STRUCTURES FOR FOUNDATIONS

The following requirements shall apply to pole structures designed for mounting on a foundation:

2.3.1 ANCHOR BOLTS

The bond stresses for the design of anchor bolts in concrete shall be in accordance with ACI Standard 318, using a 28 day compressive strength of 3,000 psi for the concrete.

Anchor bolts shall be designed to withstand the loadings given in the project specific requirements, when the base plate is two inches plus the length of one nut above the top of concrete, without exceeding the recommended and/or required allowable stresses in Section 2.2 of ASCE "Design of Steel Transmission Pole Structures". This is to provide for the adjustment of leveling nuts and the tightening of top nuts.
Anchor bolts shall be double nutted with the length of thread nominally seven inches greater than the base plate thickness.

The largest outside dimension of the anchor bolt spacers shall not be greater than six inches larger than the anchor bolt circle diameter.

Clustered anchor bolts shall have an unobstructed opening through the center to permit the use of a tremie for placing concrete. This opening shall be as large as possible, but shall not be smaller than 16 inches in diameter.

No welding shall be permitted above the bottom three inches of the anchor bolts.

2.4 PAINTED POLE STRUCTURES

The following requirements shall apply to painted pole structures:

2.4.1 HERMETICALLY SEALED

All tube sections, for any part of the structure, shall be hermetically sealed.

2.5 GALVANIZED POLE STRUCTURES

The following requirements shall apply to galvanized pole structures:

2.5.1 GALVANIZING

All tube sections, for any part of the structure, shall be open to allow galvanizing of both the interior and the exterior surfaces of the tube section.

2.5.2 DRAINAGE

All tube sections, for any part of the structure, shall have weep holes that are located to prevent any water from becoming trapped in the tube section.

2.6 WEATHERING STEEL POLE STRUCTURES

The following requirements shall apply to weathering steel pole structures:

2.6.1 CONNECTIONS

All connections shall be designed to prevent any water from becoming trapped against the steel of the structures. This is to allow the proper formation of the protective oxide layer on the steel.

2.6.2 ABOVE GROUND SECTIONS

All tube sections that will be entirely above ground, shall be hermetically sealed or vented and designed to drain to prevent any water from becoming trapped in the tube section.
2.6.3 BELOW GROUND SECTIONS

All tube sections that will be partially or entirely below ground, shall be hermetically sealed.
3. MATERIALS

3.1 PAINTED POLES

The following requirements shall apply to painted pole structures:

3.1.1 STEEL

All steel pole structure components, except grounding plates and anchor bolts, shall be fabricated from weathering steel meeting the requirements of ASTM A871/A871M.

All steel from the mill shall be guaranteed to have a minimum energy impact value of 15 pounds for full size specimens (10 mm x 10 mm) at -20 F as measured by a Charpy V-notch test performed in accordance with ASTM A370 and A673. Frequency “P” testing shall be supplied. Plate test specimens shall be taken after rolling and finishing operations.

3.1.2 BASE PLATES

Base plates shall meet the material requirements for steel of Section 3.1.1. All base plates shall be subjected to ultrasonic testing in the longitudinal direction in accordance with ASTM A435. Testing shall be done on a plate tested basis.

3.1.3 WELD ELECTRODES

All weld electrodes shall meet an impact property of 15 pounds at -20 F during a Charpy V-notch test and shall have physical and corrosion resistance properties at least equal to the physical and corrosion resistance properties of the steel being welded.

3.1.4 BOLTS

All bolts, nuts, and palnuts shall be galvanized. All bolts and nuts, up to 1-1/2” in diameter, shall conform to ASTM A325, A490, or A354 with hex heads and hex nuts. Galvanized nuts shall be tapped 1/32” over-size. All bolts, except anchor bolts, shall have galvanized palnuts. A354 Grade BD bolts, if used, shall not be hot-dip galvanized.

3.1.5 PAINT

One of the paint systems listed below shall be used. The paint shall be applied in accordance with the manufacturer's recommendations.

3.1.5.1 PAINT SYSTEM 1 - Keeler & Long

Primer shall be Keeler & Long Number 6000 Tri-Polar Primer.

Finish paint shall be Keeler & Long Number 4401 Anodic Self-Priming Green Gray Paint.

3.1.5.2 PAINT SYSTEM 2 - Carboline
Primer shall be Carboline Carbozinc 859

Finish paint shall be Carboline Number 7317 Silver Green Grid Guard Carbocoat 2901 Paint.

3.2 GALVANIZED POLES

The following requirements shall apply to galvanized pole structures:

3.2.1 STEEL

All steel pole structure components, except grounding plates and anchor bolts, shall be fabricated from steel meeting the requirements of ASTM A572.

All steel from the mill shall be guaranteed to have a minimum energy impact value of 15 pounds for full size specimens (10 mm x 10 mm) at -20 F as measured by a Charpy V-notch test performed in accordance with ASTM A370 and A673. Frequency "P" testing shall be supplied. Plate test specimens shall be taken after rolling and finishing operations.

3.2.2 BASE PLATES

Base plates shall meet the material requirements for steel of Section 3.2.1. All base plates shall be subjected to ultrasonic testing in the longitudinal direction in accordance with ASTM A435. Testing shall be done on a plate tested basis.

3.2.3 WELD ELECTRODES

All weld electrodes shall meet an impact property of 15 pounds at -20 F during a Charpy V-notch test and shall have physical properties at least equal to the physical properties of the steel being welded.

3.2.4 BOLTS

All bolts, nuts, and palnuts shall be galvanized. All bolts and nuts, up to 1-1/2" in diameter, shall conform to ASTM A325, A490, or A354 with hex heads and hex nuts. Galvanized nuts shall be tapped 1/32" over-size. All bolts, except anchor bolts, shall have galvanized palnuts. A 354 Grade BD bolts, if used, shall not be hot-dip galvanized.

3.3 WEATHERING STEEL POLES

The following requirements shall apply to weathering steel pole structures:

3.3.1 STEEL

All steel pole structure components, except grounding plates and anchor bolts, shall be fabricated from weathering steel meeting the requirements of ASTM A871/A871M.
All steel from the mill shall be guaranteed to have a minimum energy impact value of 15 pounds for full size specimens (10 mm x 10 mm) at -20 F as measured by a Charpy V-notch test performed in accordance with ASTM A370 and A673. Frequency "P" testing shall be supplied. Plate test specimens shall be taken after rolling and finishing operations.

3.3.2 BASE PLATES

Base plates shall meet the material requirements for steel of Section 3.3.1. All base plates shall be subjected to ultrasonic testing in the longitudinal direction in accordance with ASTM A435. Testing shall be done on a plate tested basis.

3.3.3 WELD ELECTRODES

All weld electrodes shall meet an impact property of 15 pounds at -20 F during a Charpy V-notch test and shall have physical and corrosion resistance properties at least equal to the physical and corrosion resistance properties of the steel being welded.

3.3.4 BOLTS

All bolts and nuts, up to 1-1/2" in diameter, shall conform to ASTM A325, A490, or A354 with hex heads and hex nuts. Galvanized nuts shall be tapped 1/32" over-size. All bolts, except anchor bolts, shall have palnuts. All bolts, nuts, and palnuts shall have corrosion resistance properties at least equal to the corrosion resistance properties of the steel used in fabricating the pole structures. A354 Grade BD bolts, if used, shall not be hot-dip galvanized.

3.4 GROUNDING PLATES

Grounding plates shall be stainless steel meeting the requirements of ASTM A276 Type 316.

3.5 MASTIC COATING

The mastic coating system described below and distributed by Keeler & Long shall be used. The system shall be applied in accordance with the manufacturer's recommendations except that the minimum ambient air temperature during application and curing shall be 40 F. The Supplier may request approval from the Engineer to use an equivalent mastic coating system. The request must be accompanied by appropriate supporting documentation.

Primer shall be one coat Wasser MC-Zinc at two to four mils dry film thickness (DFT).

Top coat shall be two coats Wasser MC-Tar. Each top coat shall be four to seven mils DFT.

3.6 ANCHOR BOLTS

Anchor bolts shall be fabricated from #18S steel rebar meeting the requirements of ASTM A615 Grade 60 or Grade 75 modified.

4. FABRICATION
4.1 TOLERANCES

The following tolerance limits shall be met:

Overall Structure Length: -3", +9".

Diameter or Major Axis Dimension of Tubes: -1/8", +1/4".

Straightness: ± 1/8" per 10' of Overall Structure Length.

Camber: ± 5% of Design Camber.

Location of Attachments Relative to Top of Structure:

At End of Arm: ± 3".
On Pole Shaft: ± 3/4".

Size of Holes:

Base Plate: -0", + 1/8".
All Others: -0", + 1/16".

Spacing Between Holes:

Base Plate: ± 1/8".
Same Connection: ± 1/16".

Any Angles Shown on Drawing: ± 3°.

4.2 APPEARANCE AND BURRS

Steel pole structures shall be generally uniform in color. Sharp edges, burrs, and slag shall be removed from all surfaces of the steel pole structures.

4.3 WELDING

4.3.1 GENERAL REQUIREMENTS

Welding shall be performed by qualified operators using qualified procedures in accordance with ANSI/AWS D1.1, latest revision, American Welding Society's "Structural Welding Code - Steel."

Records of welding procedure and welding operator test results shall be kept by the supplier and shall be available for review by NG.

4.3.2 CIRCUMFERENTIAL WELDS

All circumferential welds shall be full penetration welds.
4.3.3 LONGITUDINAL WELDS

Longitudinal welds shall have 60% minimum weld penetration for plates up to 3/8" thick, and 80% minimum weld penetration for plates over 3/8" thick. Longitudinal welds within six inches of a circumferential or butt weld shall be full penetration welds.

4.3.4 LONGITUDINAL WELDS AT SLIP JOINTS

Longitudinal seam welds, in both the male and female sections of a slip joint and at least one foot beyond the maximum joint overlap, shall be full penetration welds.

4.3.5 BUTT WELDS

Pole shaft to base plate welds, pole shaft to flange plate welds, and arm to arm bracket welds are typically butt welds. All butt welds shall be full penetration welds.

4.3.6 QUALITY CONTROL

Weld quality shall conform to Section 9 of ANSI/AWS D1.1, latest revision, American Welding Society's "Structural Welding Code - Steel."

The supplier may use any combination of inspection methods to verify that weld quality requirements have been met. As a minimum, ultrasonic inspection, conforming to Section 6 of ANSI/AWS D1.1, latest revision, American Welding Society's "Structural Welding Code - Steel", shall be made of all full penetration welds.

4.4 PAINTED POLES

The following requirements shall apply to painted steel pole structures:

4.4.1 GENERAL REQUIREMENTS

The steel shall be cleaned to SSPC-SP-6 immediately prior to painting.

Touch up paint shall be provided in one gallon cans. At least one gallon of the primer and one gallon of the finish paint shall be provided for every four structures ordered.

The mastic coating for pole structures for direct embedment shall be applied prior to painting. The mastic coating shall meet the requirements of Section 3.5.
4.4.2 PAINT SYSTEM 1 - Keeler & Long

The primer coat shall be applied to a dry film thickness of 2.0 to 3.0 mils following Keeler & Long's application instructions.

The finish coat shall be applied to a dry film thickness of 6.0 to 10.0 mils following Keeler & Long's application instructions.

4.4.3 PAINT SYSTEM 2 - Carboline

The primer coat shall be applied to a dry film thickness of 3.0 to 4.0 mils following Carboline's application instructions.

The finish coat shall be applied to a dry film thickness of 2.0 to 4.0 mils following Carboline's application instructions.

4.5 GALVANIZED POLES

The following requirements shall apply to galvanized steel pole structures:

The steel pole structures shall be hot dip galvanized in accordance with ASTM A123, latest revision, after all fabrication is completed.

The galvanized coating shall be uniform in appearance.

Precautions shall be taken against embrittlement, warping, and distortion, in accordance with ASTM A143 and ASTM A384.

The base plate to pole shaft weld shall be ultrasonically inspected after galvanizing.

The mastic coating for pole structures for direct embedment shall be applied after galvanizing. The coating shall meet the requirements of Section 3.5 except that no MC-Zinc shall be applied. Treatment of the galvanized surface prior to application of MC-Tar shall be in accordance with the manufacturer's recommendations.

4.6 WEATHERING STEEL POLES

The following requirements shall apply to weathering steel pole structures:

The steel shall be cleaned to SSPC-SP-6 (Commercial Blast Cleaning) after fabrication is completed.

The mastic coating for pole structures for direct embedment shall meet the requirements of Section 3.5.

4.7 ANCHOR BOLTS

Anchor bolt nuts and the top 18 inches of anchor bolts shall be hot-dip galvanized in accordance with ASTM A123.
Anchor bolts shall be delivered in assembled clusters.
BAIL STEP ASSEMBLY

LUG FOR BAIL STEP ATTACHMENT

"GO – GAGE"

TWO SECTIONS OF 13/16" O.D. ROUND MECHANICAL TUBING CARBON STEEL WELDED OR BRAZED TOGETHER. THICKNESS OF TUBING SUFFICIENT FOR WELDING OR BRAZING. SUPPLIER SHALL USE "GO–GAGE" TO CHECK ALL BAIL STEP LUGS.

3/4" ROD (A–36) BAIL STEP – GALVANIZED

5/16" DIA. HOLE THROUGH ROD

3/16" X 3" LG. S.S. COTTER KEY

1"

POLE SHAFT

DE–BURR INSIDE AND OUTSIDE (TYP.)

4"

5 DEG.

1–1/16"

9/16" R

2–1/8"
STEP BOLT ARRANGEMENT AND REQUIREMENTS FOR STEEL POLES

LS-5660-1
R:\ACADDR\HS_BVP\POLE

FOR WEATHERING STEEL POLES

<table>
<thead>
<tr>
<th></th>
<th>Weathering Steel Step Bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/3 of Step Bolts</td>
<td>3/4&quot; x 6 3/4&quot; with 11/16&quot; Thread</td>
</tr>
<tr>
<td>1/3 of Step Bolts</td>
<td>3/4&quot; x 6 3/4&quot; Modified with 1 3/4&quot; Thread, Provided with One Weathering Steel 3/4&quot; Hex Nut (See LS-6515)</td>
</tr>
</tbody>
</table>

FOR PAINTED POLES

<table>
<thead>
<tr>
<th></th>
<th>Galvanized Steel Step Bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/3 of Step Bolts</td>
<td>3/4&quot; x 6 3/4&quot; with 11/16&quot; Thread</td>
</tr>
<tr>
<td>1/3 of Step Bolts</td>
<td>3/4&quot; x 6 3/4&quot; Modified with 1 3/4&quot; Thread, Supplied with One Galvanized Steel 3/4&quot; Hex Nut (See LS-6515)</td>
</tr>
</tbody>
</table>

FOR GALVANIZED STEEL POLES

<table>
<thead>
<tr>
<th>All Step Bolts</th>
<th>Galvanized Steel Step Bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4&quot; x 7 1/2&quot; with 2&quot; Thread Supplied with Two 3/4&quot; Heavy Hex Nuts (See LS-6515)</td>
</tr>
</tbody>
</table>
JACKING BLOCK DETAILS

1. BLOCKS AND NUTS TO BE WELDED TO POLE

2. EACH BLOCK SHALL BE DESIGNED FOR A
MINIMUM LOAD OF 100 KIPS APPLIED 3/4"
ABOVE THE BASE OF THE BLOCK.

3. THE 20 DEGREE BEVEL ON THE SHORT
DIMENSION OF THE BLOCK SHALL BE
MAINTAINED ACROSS THE WELD.
TWO 5/16" DIAMETER HOLES 1/4" PLATE TYPICAL

8'-0" TO BASEPLATE

3" MIN. CLEAR TYPICAL
Requirements for Fall Protection Flanges for Steel Poles

Elevation

GALVANIZED POLES

3/4" Hex Nut Welded to Face of Pole

Face of Pole

FOR RIGHT SIDE STEP BOLTS

FOR LEFT SIDE STEP BOLTS

WRENCH HOLD

FOR WEATHERING POLES

FOR PAINTED POLES

NOTE:

Steel pole manufacturer shall supply a quantity of Buckingham Model 30 and 30L fall protection flanges for installation on 1/3 of all step bolt positions. See material list below and additional information shown on drawing LS-5660-1.

MATERIAL LIST

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Galvanized 3/4&quot; x 7 1/2&quot; Step Bolt W/2&quot; of Thread</td>
</tr>
<tr>
<td>2</td>
<td>Galvanized 3/4&quot; Standard Hex Nut</td>
</tr>
<tr>
<td>3</td>
<td>Galvanized Buckingham Model 30 Flange, (RIGHT HAND)</td>
</tr>
<tr>
<td>4</td>
<td>Galvanized Buckingham Model 30L Flange, (LEFT HAND)</td>
</tr>
<tr>
<td>5</td>
<td>Weathering Steel 3/4&quot; x 6 3/4&quot; Step Bolt W/1.75&quot; of Thread</td>
</tr>
<tr>
<td>6</td>
<td>Weathering Steel 3/4&quot; Standard Hex Nut</td>
</tr>
<tr>
<td>7</td>
<td>Galvanized 3/4&quot; x 6 3/4&quot; Step Bolt W/1.75&quot; of Thread</td>
</tr>
</tbody>
</table>
Typical Crossarm Ladder Arrangements

1. The structure contractor shall provide all crossarm ladders. Ladders based on use of standards may be purchased by others.

2. See drawing LS-6544 for lengths.

SEE NOT 1)
LS–6545

SECTION 1–1

SECTION 2–2 & 2’–2’

SECTION 3–3

SECTION A–A

NOTES:
1) SEE DRAWING LS–6544 FOR TYPICAL CROSSARM LADDER ARRANGEMENTS
## APPENDIX B. REFERENCE DRAWINGS

<table>
<thead>
<tr>
<th>Reference Drawing</th>
<th>Drawing Description</th>
<th>Structure Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>SK-100LFW (Sheets 1 &amp; 2)</td>
<td>Stonebreak Road Substation Terminal H-Frame Take-Off Structure Structure Load Drawing Lines 1 &amp; 302</td>
<td>SBR T.O.</td>
</tr>
<tr>
<td>D-36099-E (Sheets 1 &amp; 2)</td>
<td>Luther Forest Substation Terminal H-Frame Take-Off Structure Structure Load Drawing Lines 3 &amp; 308</td>
<td>3 T.O.  308 T.O.</td>
</tr>
<tr>
<td>SK-103LFW</td>
<td>115KV Double Circuit 0-5º Suspension</td>
<td>14, 18, 23, 25, 28, 29</td>
</tr>
<tr>
<td>SK-104LFW</td>
<td>115KV Double Circuit 0-15º Running Angle</td>
<td>13, 16</td>
</tr>
<tr>
<td>SK-105LFW</td>
<td>115KV Double Circuit 15-25º Running Angle</td>
<td>17, 19, 20, 21, 27</td>
</tr>
<tr>
<td>SK-106LFW (Sheets 1 &amp; 2)</td>
<td>115KV Double Circuit 0-30º Dead-End</td>
<td>12, 22, 26, 30</td>
</tr>
<tr>
<td>SK-107LFW</td>
<td>115KV Double Circuit 0-50º Dead-End</td>
<td>15</td>
</tr>
<tr>
<td>SK-108LFW</td>
<td>115KV Double Circuit 0-70º Dead-End</td>
<td>24</td>
</tr>
<tr>
<td>SK-109LFW</td>
<td>115KV Single Circuit Dead-End</td>
<td>31A, 31B</td>
</tr>
<tr>
<td>115873</td>
<td>PPC Insulator 550 HU TR 287</td>
<td>SBR T.O.</td>
</tr>
</tbody>
</table>