Exhibit 3.2.2

Patrick Engineering 345 kV Transmission Line
Conceptual Design and Project Estimate

Taylorville 345kV Transmission Line

Conceptual Design & Project Estimate

Prepared For

TENASKA®

December 18, 2009

Prepared By
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Project # 20903.038

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INTRODUCTION

Patrick Energy Services (Patrick) conducted a preliminary engineering study to develop a conceptual design for the proposed route of a 345kV transmission line extending from the Taylorville Energy Center to a local transmission utility's existing Kincaid substation. This report includes a general description of the project, the assumptions made during engineering, and a detailed description of the preliminary design developed during this project. There is also an opinion of probable cost for the project included with this study which identifies specific subcontractor activities and the associated costs for each.

PROJECT DESCRIPTION

The purpose of this project is to develop a conceptual design and provide opinion of probable costs to Tenaska in order to prepare a project cost estimate. The proposed 345kV transmission line starts at the dead end structure of the Taylorville Energy Center to the fence of Kincaid Substation. The line will be designed to support two circuits but only one circuit will be installed for this study. The line will cross over privately owned properties as well as lakes and highways. The line will skirt the cities of Bulpitt, Tovey, and Taylorville, IL. Tenaska has requested Patrick to provide a +/- 30% cost estimate for the complete project.

The proposed line route was selected by Tenaska from a previous study performed by Patrick. The study is attached to this report in Appendix A. The line study performed evaluated various transmission line routes from the Taylorville Energy Center to the Kincaid substation. After studying the options, Patrick developed three proposed routes and an additional connection route. Tenaska selected a combination of the North and Direct routes connected by the Alternate route. Patrick and Tenaska agreed that the combined route impacted the least amount of residents. Appendix A includes a map of the various options along with a map of the final route.

ASSUMPTIONS

Some notable assumptions were made during the preliminary engineering of this line. Descriptions of these are listed here:

- Conceptual Design – The contents of this report are for conceptual and budgetary purposes only and are not intended to be used for final design purposes.
- Local transmission utility Standards – Structure type, conductor and shield wire types as well as stringing strength and ruling spans conform to local transmission utility standards.

- Land Acquisition – Land Acquisition was not included as part of this project. Tenaska will be providing land acquisition services for both permanent and construction services. A value of $332 per rod was supplied by Tenaska for 150ft wide right of way and multiplied by the 14 mile line to arrive at lump sum price located in the project cost summary.
- Wetland Delineation – Tenaska has already preformed some wetland studies in the region for other projects and will perform similar studies for transmission line activities.

CONCEPTUAL LINE DESIGN

Patrick performed the conceptual line design with Tenaska's direction. A picture of final line route can be seen in Appendix C. The proposed line utilizes local transmission utility standards. The standards referenced can be found in Appendix B. Patrick created plan and profile drawings which are located in Appendix C. Patrick designed single pole steel structures to support the double circuit line. The tangent structure used is Transmission Overhead Material specification number EM10561. Patrick used dead end specification number EM10566. Both of the specifications are located in Appendix B. At this time, not all the individual angle structures were modeled but this will be completed in a final design.

The structures were modeled in Power Line Systems' PLS Pole, a design software to design poles and attach equipment that can later be placed in a working model for ultimate design purposes. The poles were designed to a height of 115 feet from ground level to top of structure. They were then height adjusted as needed in the model. For the tangent structure the top arm has a length of 26 feet and secures the shield wire and top phase. The lower two arms are 16.5 feet in length, each supporting a single phase. For the dead end structure the top arm has a length of 30 feet and secures the shield wire. The lower three arms are 19 feet in length, each supporting a single phase.

Conductors were selected per local utility's standards Table III in EM10561. The conductor selected was a T2 BlueJay. The T2 conductor represents a twisted pair of standard BlueJay conductors. This conductor type reduces effects from galloping in the conductors. Galloping is an oscillation due to wind in the conductors that causes more stress on the transmission line and is prevalent in this area of the country. Patrick performed a three phase power equation to calculate the ampacity of the line to ensure it would be sufficient for Tenaska's needs. This calculation can be seen in Appendix C. The conductor information can be found in specification EM28061 which can be found in Appendix B. This appendix describes the physical attributes as well as the blowout characteristics of the conductor. As part of this study Patrick investigated the blowout of this conductor to determine the right of way width needed. The drawbacks of this conductor are increased cost for the construction company to string the conductor, increased material needs, and it has limited availability. This is due to the twisted multi conductor design.

The shield wire proposed is a 24 fiber optical ground wire. The shield wire attribute information can be found in specification EM28062. Patrick recommends the use of fiber optics in this situation due to increasing demands for communication on transmission lines.

The transmission line was modeled in PLS CADD. The model utilizes a basic digital elevation model purchased by Patrick. A more detailed model would be obtained by aerial survey which would be used to produce a final design. Elevation and global plane information was used to create a three dimensional map where the PLS pole structures are placed. The aerial maps were then viewed and structures were moved along the decided path to avoid existing obstacles.

Patrick traveled to Taylorville to verify preliminary structure locations and take pictures of areas of concern. After all the locations of the poles were confirmed, the conductors were placed into the model and poles were height adjusted to satisfy ground clearance requirements. In a final engineering model, new structures for each height will be placed in the model to obtain reactions to pass on to a material supplier for design and fabrication. Conductors were strung with maximum tensions found in Case A of Table III in the EM10561 specification. Ground clearance in the model is 27 feet from bottom phase to ground. This number was taken from the local transmission utility Design Clearances for Overhead Transmission Lines ESP 1.3.1.1 which can be found in Appendix B. Table 4.1.1 in ESP 1.3.1.1 states a minimum ground clearance of 24.6 feet which Patrick rounded up and added an additional two foot buffer per common industry practice. Both circuits were strung in the model to ensure that poles will be designed to support future expansion as requested by Tenaska.

After structures were modeled, a typical foundation size was calculated. Local transmission utility design standards require steel poles for 345kV lines are placed on caisson foundations. Different size structures have different size foundations. A structure check was performed inside the PLS CADD model to obtain base reactions on a typical tangent structure. These base reactions were inserted into PLS Caisson along with some conservative values for soil properties. The resulting output from PLS Caisson was a six foot diameter caisson with a length of 20 feet and is included in Appendix C. The size of dead end foundations will be larger. Both tangent and dead end foundations will need to be designed with specific soil properties obtained from a geotechnical study.

FINAL TRANSMISSION LINE ENGINEERING

The final transmission line engineering will be done in accordance with the local transmission utility standards and/or applicable codes such as NESC and ASCE. This work will expand on the conceptual design discussed above and develop the complete and final transmission line design. The design will include such items as:

- Route verification
- Survey coordination
- Structure placement
- Structure loading
- Foundation design
- Conductor stringing

- Material selection
- Permit coordination
- Construction coordination
- Project close out including as-builts

Engineering deliverables would include:

- Stringing charts
- Staking reports
- Specifications
    - Material procurement
    - Construction
    - Geotechnical
- Bill of materials
- Drawings
    - Structure load and design
    - Plan and profile
    - Hardware assemblies

Patrick has developed an estimate to complete this design. A spreadsheet outlining Patrick's anticipated hours to be spent on final engineering activities for this project can be found in Appendix C. This estimate incorporates all tasks and deliverables mentioned above. It also includes time and expenses for meeting attendance, phone conferences, site visits, and contacting and supporting other subcontractors. Anticipated site visits would include; initial route walk down, follow up review of areas that require special considerations, and verification of staking locations. The total project cost for this can be found in the cost summary of this document.

AERIAL SURVEY

Various companies were contacted to provide estimates for aerial survey and topographic mapping activities for the final engineering. An aerial survey company will provide color digital imagery of line area and data files for PLS model production. The current survey map used for PLS CADD model is accurate enough for proposals but the data is spread out and of a general variety. It is important when designing large expensive structures that the information used is as accurate as possible because small discrepancies can result in expensive redesign. Two different methods to produce this survey information are Photogrammetry and Lidar.

Photogrammetry is a method of obtaining topographic information using aerial photograph to develop terrain information. Lidar is a traditional method for collecting topographic information using a laser to scan the area to produce point coordinates. Both technologies have the ability to develop elevation contours in one foot intervals. They take the collected data and convert it into

a format that can be placed into a PLS CADD model. It also separates out the different ground points into various features such as vegetation, roads, ground features, and bodies of water.

There are many other features that can be collected by aerial survey companies which can be viewed in Appendix D. Some of these features include taking video of the route, taking still pictures of structures in the line area, converting data to a GIS format and many other services. Approximate price for aerial survey can be seen in the cost summary. The final number used was produced using the highest budgetary estimate to be conservative. We feel that the budgetary estimate submitted by the contractor is applicable to this work scope.

SITE SURVEY

Site survey is another necessary activity of design and construction of the final transmission line. Survey activities will include:

- Real-estate investigation
- Survey and determine property lines & owners
- New easement exhibits for the owners
- Verification of aerial obstacles
- Staking activities for the right of way as well as two occasions of construction staking

Various companies were contacted to provide budgetary estimates for site survey activities which can be seen in Appendix E. The approximate price for site survey can be seen in the cost summary. To be conservative the highest budgetary estimate was used.

GEOTECHNICAL SERVICES

Various companies were contacted to provide estimates for soil boring and soil lab activities. It is important to perform testing on soils in the location of each structure because soil conditions vary from location to location. Different locations will show different conditions over the 14 mile line and a foundation could be sufficient for one location and not for another. Standard practice is to obtain a general condition that works for a majority of the tangent structures and custom design the dead end foundations and other outliers.

To obtain estimates, contractors were asked to estimate costs of approximately 100 soil borings to a depth of 50 feet or refusal. The typical foundation depth will not be greater than 30 feet, but deeper foundations will be utilized at dead end locations. The contractors were asked to include all associated cost with producing a geotechnical report of the encountered conditions and provide foundation recommendations.

Subcontractors were informed that all locations would be staked, cleared and that access approvals would be provided to perform work. The estimates we received covered a wide range therefore a calculated cost was derived by averaging the highest two estimates to be conservative. Adjustments can be made to the scope of soil study such as soil borings can be taken at less frequent intervals to cut costs. The approximate price for geotechnical services is included in the cost summary.

MATERIAL SUPPLIERS

Various companies were contacted to provide estimates for total material cost. The materials included in these estimates are conductors, optical shield wire, poles, grounding, insulators, and other hardware. It is important to note that prices of these items will fluctuate, especially the steel poles. Materials also vary by when delivery is needed. Prices in this section reflect a projected value of steel for mid 2010 with an average delivery time, approximately 20 weeks. The most significant cost will be the steel poles.

The estimated cost is shown in the cost summary. This cost has been divided into two values due to the significance of the cost of the steel poles. The steel poles have been shown independently and other materials are combined into a material category. Some specific material details can be found in Appendix G. From the estimates we received, one contractor appeared to have the best understanding of the needs for this project. Therefore, their value was used for all hardware. For steel poles a cost was averaged from suppliers with similar estimates.

CONSTRUCTION SERVICES

Various companies were contacted to provide estimates for construction services. Construction activities are as follows:

- Unloading and storage of materials
- Constructing foundations
- Framing poles
- Setting poles
- Pull/string conductor
- Restoration of area

Included with construction costs is the clearing cost. Patrick contacted clearing subcontractors and obtained a cost of clearing from two different contractors. The right of way must be cleared for various reasons, one of the most important being electrical clearance. Trees represent hazards to the transmission line. Construction, surveying, and soil boring activities are all greatly impeded by non cleared locations.

Construction costs will differ depending on soil conditions and structure size. Poor soil conditions will result in larger foundations. Large structure sizes result in larger foundations as well as added difficulty in placement. Some contractors have broken up estimates for specific activities such as pole framing and pole setting while other contractors elected to submit an estimate as a cost per mile of construction. Approximate price for construction services can be seen on the cost summary. In determining the final budgetary estimate one contractor was abnormally low and was therefore not included in our determination. The remaining two contractors' numbers were similar and were averaged and combined with the clearing cost.

EPC PROJECT MANAGEMENT

Project management for this project consists of working with all parties communicating Tenaska's needs. The engineer will purchase required materials and contract the subcontractors. Project management would also develop and maintain a construction schedule. The estimated total time to complete this project is 24 to 30 months. One of the most critical tasks is ordering the materials. The lead time on steel poles alone is approximately 20 weeks. Other crucial tasks include aerial and site survey because they need to be completed before most of the engineering can be done. The anticipated construction schedule can be seen in Appendix J. The total cost of this activity is a percentage of the various project activities and can be viewed in the project cost summary.

PROJECT COST SUMMARY

	December 2009 Overnight Cost Estimate
Subcontractor Category	Total Price
Land Acquisition	$1,487,360
Engineering	$1,049,360
Lidar/Aerial Survey	$34,145
Site Survey	$169,940
Geotechnical Services	$150,000
Steel Poles	$6,124,980
Other Materials	$1,789,255
Construction	$10,800,000
EPC Project Management	$2,055,570
Total	$23,660,610

CONCLUSION

Patrick has concluded that the route proposed by Tenaska is a viable route. After conducting a conceptual study Patrick has developed a conceptual design that incorporates 98 structures over the 14 mile line. Utilizing local transmission utility standards, Patrick collected required information and distributed it to various subcontractors in an effort to achieve a budget estimate within 30% accuracy. The approximate cost for this project is estimated at $23,660,610.

The following pages contain the appendices referenced in this section. Any questions about this report or the line design should be directed to Patrick Engineering.

Patrick Engineering Inc.

Christopher P. Dietzler, P.E.
Vice President

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Appendix A

Tenaska Transmission Line Study

Tenaska Transmission Line Study

Patrick was charged with the task of performing a transmission line routing study into/from the Taylorville Energy Center. The project consisted of four tasks: propose routes, outline structure types, highlight constructability issues, and examine ROW requirements. These tasks are covered in this summary of findings.

Proposed Route Plans

- North Route – 13.26 miles. This plan starts to the north of the Kincaid Substation. It follows a line of existing Transmission Lines. The line follows apparent parcel lines and stays within the township border crossing through backyards. This path crosses two bodies of water and one highway. There are 4 major angles all less than 45 degrees.

- Direct Route – 12.21 miles. This route parallels the existing power lines running east to west. The route angles slightly north to avoid the towns of Bulpitt and Kincaid. The route then is located on the apparent parcel lines crossing the highway before terminating in the Taylorville Energy Center. This path crosses two bodies of water and one highway. There are 4 major angles all less than 45 degrees and smaller than the angles required for the North Route.

- South Route – 13.14 miles. This route is the least preferred but is provided in case there are rationale we are not aware of that Tenaska sees as advantages of the southern route. It starts south of the Kincaid Substation. This path weaves through fields and south of Tovey, Bulpitt, Kincaid and Jeisyville. The path crosses Springfield St. 104 southeast of Jeisyille and continues across apparent parcel lines before crossing a second highway. This path crosses two bodies of water and two highways. There are 6 major angles all less than 45 degrees.

- Alternate Route – This path is a connector. There are two existing lines that appear to be a large enough distance apart that a 345kV line could run in between the lines. This will have to be investigated further if Tenaska prefers this route. This route then could connect to any of the aforementioned routes.

Structure types

Tenaska requested both wood and steel pole supporting structures for the proposed double circuit 345kV line. The plan involves energizing one circuit and having a second circuit available for expansion. Since this line will be attaching to a [redacted] substation, and therefore should conform to [redacted] standards, it was determined that there are no standard [redacted] wood structures that would support a double circuit 345kV line. There are two options for steel monopole structures. Both structures utilize a 725-foot ruling span. One structure is a vertical design (EM10561) with a minimum height of 110 feet. The other structure (EM10431) utilizes a V-string support on the lower phase for an overall shorter structure minimum height of 85 feet.

Constructability issues

The terrain maps of the area show no significant elevation changes. The constructability issues ultimately hinge on the route selected. There are some water crossings and highway crossings that require attention. There are some areas that are classified as wetlands that all paths cross. The lines can be designed to span these areas and they should not affect the choice of route. Patrick recommends that proposed lines be field examined to determine if any other obstacles exist that are not apparent in aerial photos.

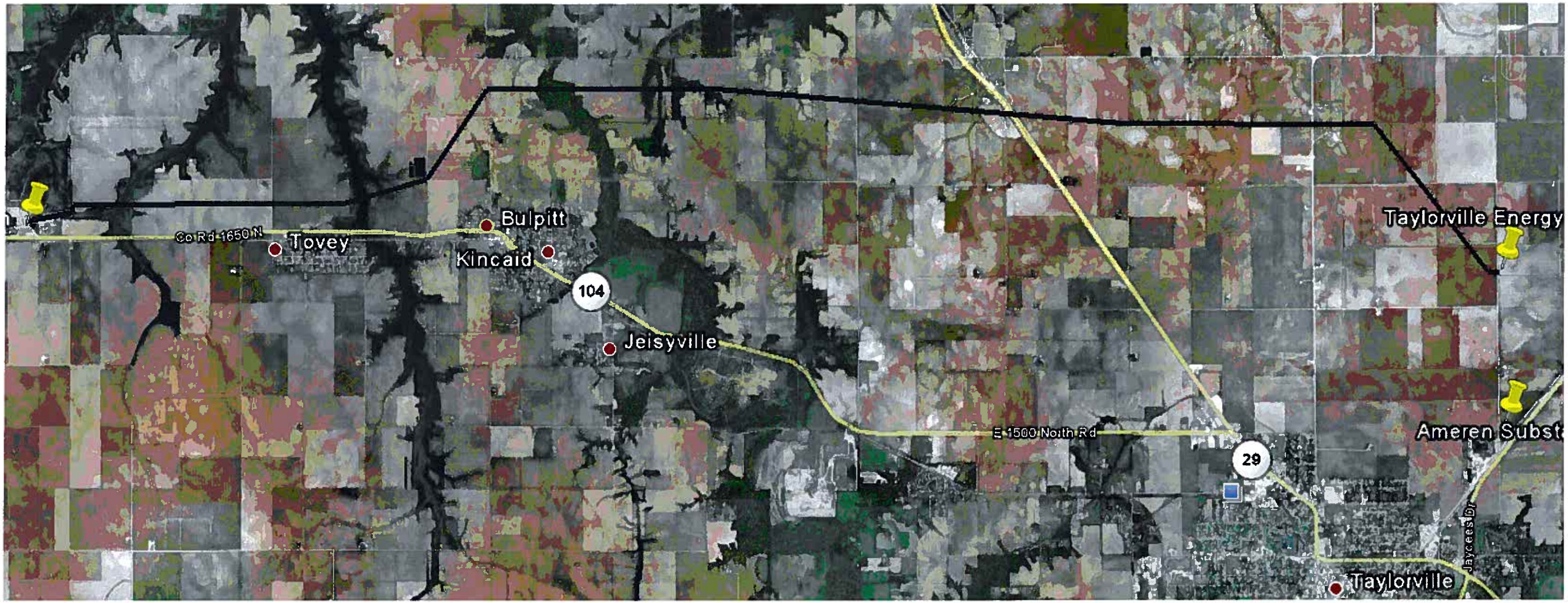
Right Of Way

Standards indicate that a 345kV double circuit single pole structure could require approximately 75 feet on each side of the line. The interaction between buildings, bridges, bodies of water, and electrical lines will need to be examined on a case by case basis. The calculated minimum design width is 113 feet but also requires that margins of safety be incorporated. Since there are unknowns along the pathway at this time, we recommend to plan on a 150-foot wide ROW.

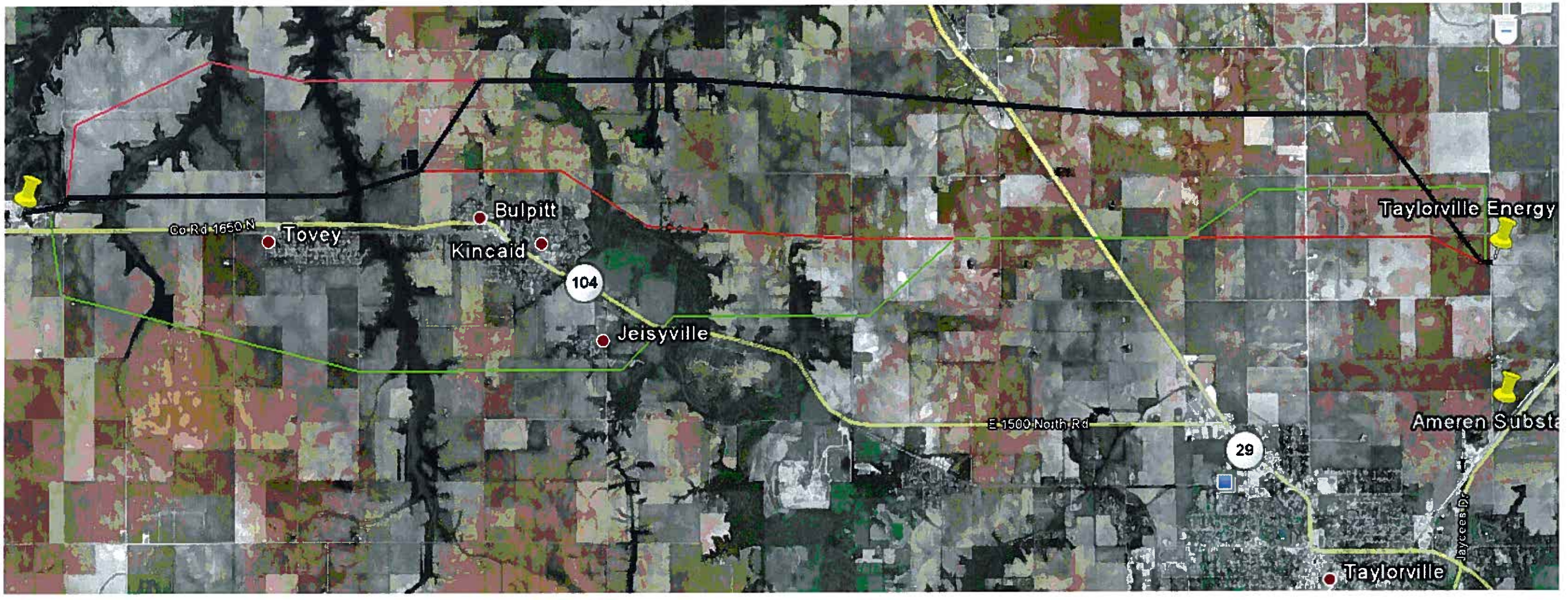
Summary

While all routes appear to be viable options, further study will be required to determine if obstructions exist in the field. The direct route is recommended. Patrick recommends that before final selection is made the proposed line should be examined in the field. All routes were prepared to avoid houses and other structures. The two pole styles that can be utilized for tangent structures are [redacted] standard structures EM10431 and EM10561. Constructability issues are not significantly different from route to route. Right of Way requirements for the line will likely be 150 feet in total width.

Selected Route



Route Options



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Appendix B

Local Transmission Utility Design Standards

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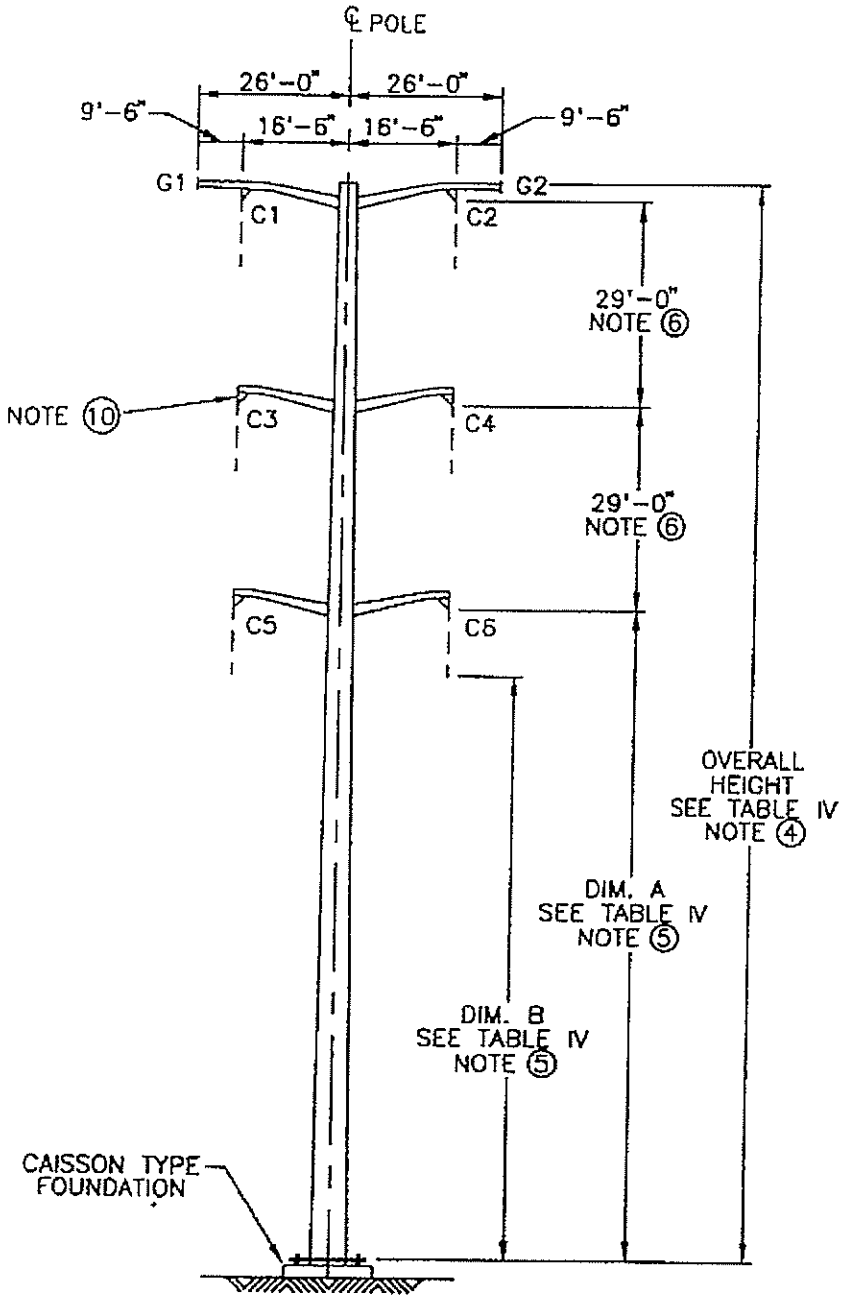
345KV DOUBLE CIRCUIT
0° – 2° SMALL ANGLE SUSPENSION STRUCTURE
WITH ORNAMENTAL ARMS
725' DESIGN RULING SPAN



ELEVATION

REV.	ENGINEER	REVIEWED	PROJECT	DATE	COMMENTS
0	N.F. KAUP	H.D. MURRAY	ADDED S.I. NO'S. FOR 150 TO 160 TOTAL HEIGHT POLES	3-17-00	
1	C.H. PRIEBE	N.F. KAUP	CHANGED EXTREME WIND LOADS FROM 21 PSF TO 24 PSF	4-18-01	

LINES ENGINEERING

[redacted] SYSTEM STANDARD

ACAD

TABLE I – ULTIMATE DESIGN LOADS						
CASE	LOADING COMBINATION	LOAD DIRECTION	OVERLOAD FACTORS USED IN WIRE LOADS	CONCENTRATED WIRE LOADS AT EACH POINT (KIPS)		DISTRIBUTED LOADS AND OVERLOAD FACTORS FOR STRUCTURES
				C1–C6	G1–G2	
A	NESC HEAVY: 1/2" ICE, 4# WIND, 0 DEG F., K=0.30 INITIAL TENSIONS	VERTICAL	1.50	7.44	2.40	DEAD WEIGHT x 1.50
		TRANSVERSE	3.00 WIND, 1.65 TENSION	3.47	1.51	0.004 KSF x AREA x 3.00
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE
B	HEAVY ICE: 1 1/2" ICE, 4# WIND, 32 DEG F. INITIAL TENSIONS	VERTICAL	1.00	10.10	4.79	DEAD WEIGHT x 1.00
		TRANSVERSE	1.00	2.28	1.28	0.004 KSF x AREA x 1.00
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE
C	EXTREME WIND (NOTE 07): NO ICE, 24# WIND, 0 DEG F. INITIAL TENSIONS	VERTICAL	1.10	3.67	1.03	DEAD WEIGHT x 1.10
		TRANSVERSE	1.10	4.21	1.13	0.035 KSF x AREA x 1.10
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE
D	BROKEN CONDUCTOR (NOTE 12): NO ICE, 4# WIND, 0 DEG F. INITIAL TENSIONS	VERTICAL	1.10	3.67	1.03	DEAD WEIGHT x 1.10
		TRANSVERSE	1.10	1.14	0.28	0.004 KSF x AREA x 1.10
		LONGITUDINAL	1.10	10.70	0.00	NOT APPLICABLE
E	BROKEN STATIC WIRE (NOTE 13): 1/2" ICE, 4# WIND, 0 DEG F., K=0.30 INITIAL TENSIONS	VERTICAL	1.10	5.46	1.76	DEAD WEIGHT x 1.10
		TRANSVERSE	1.10	1.62	0.56	0.004 KSF x AREA x 1.10
		LONGITUDINAL	1.10	0.00	6.44	NOT APPLICABLE
F	NORMAL, EVERYDAY CONDITION (NOTE 15): NO ICE, NO WIND, 50 DEG F. 1 DEG. LINE ANGLE, FINAL TENSIONS	VERTICAL	1.00	2.83	0.44	DEAD WEIGHT x 1.00
		TRANSVERSE	1.00	0.17	0.04	NOT APPLICABLE
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE
G	NORMAL, EVERYDAY CONDITION (NOTE 15): NO ICE, NO WIND, 50 DEG F. 2 DEG. LINE ANGLE, FINAL TENSIONS	VERTICAL	1.00	2.83	0.44	DEAD WEIGHT x 1.00
		TRANSVERSE	1.00	0.34	0.08	NOT APPLICABLE
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE

TABLE II – DESIGN SPANS AND LINE ANGLES	
DESIGN RULING SPAN (FT.)	725
MAX. DESIGN WIND SPAN (FT.)	750
MAX. DESIGN WEIGHT SPAN (FT.)	1,000
MIN. DESIGN LINE ANGLE (DEG.)	0
MAX. DESIGN LINE ANGLE (DEG.)	2

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TABLE III – DESIGN WIRE TYPES AND TENSIONS

CASE	LOADING COMBINATION	DESIGN TENSIONS (POUNDS) FOR EACH WIRE TYPE	
		345KV CONDUCTOR T-2 BLUEJAY 2● 1113 KCMIL, 45/7 ACSR (C1-C6)	7#6 ALUMOWELD OR 24-FIBER OPGW (NOTE (16)) STATIC WIRE (G1-G2)
A	NESC HEAVY: 1/2" ICE, 4# WIND, 0 DEG F., K=0.30 INITIAL TENSIONS	20,350	5,850
B	HEAVY ICE: 1 1/2" ICE, 4# WIND, 32 DEG F. INITIAL TENSIONS	29,176	11,013
C	EXTREME WIND: NO ICE, 24# WIND, 0 DEG F. INITIAL TENSIONS	20,910	4,891
D	BROKEN CONDUCTOR: NO ICE, 4# WIND, 0 DEG F. INITIAL TENSIONS	14,916	3,111
E	BROKEN STATIC WIRE: 1/2" ICE, 4# WIND, 0 DEG F., K=0.30 INITIAL TENSIONS	20,350	5,850
F & G	NORMAL, EVERYDAY CONDITION: NO ICE, NO WIND, 50 DEG F. FINAL TENSIONS	9,818	2,262

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TABLE IV – STRUCTURE HEIGHTS			
STORES ITEM NUMBERS	OVERALL HEIGHT (FEET)	APPROX. DIM. A (FEET)	APPROX. DIM. B (FEET)
386270	110	47.3	37.5
386271	115	52.3	42.5
386272	120	57.3	47.5
386273	125	62.3	52.5
386274	130	67.3	57.5
386275	135	72.3	62.5
386276	140	77.3	67.5
386277	145	82.3	72.5
388731	150	87.3	77.5
388732	155	92.3	82.5
388733	160	97.3	87.5

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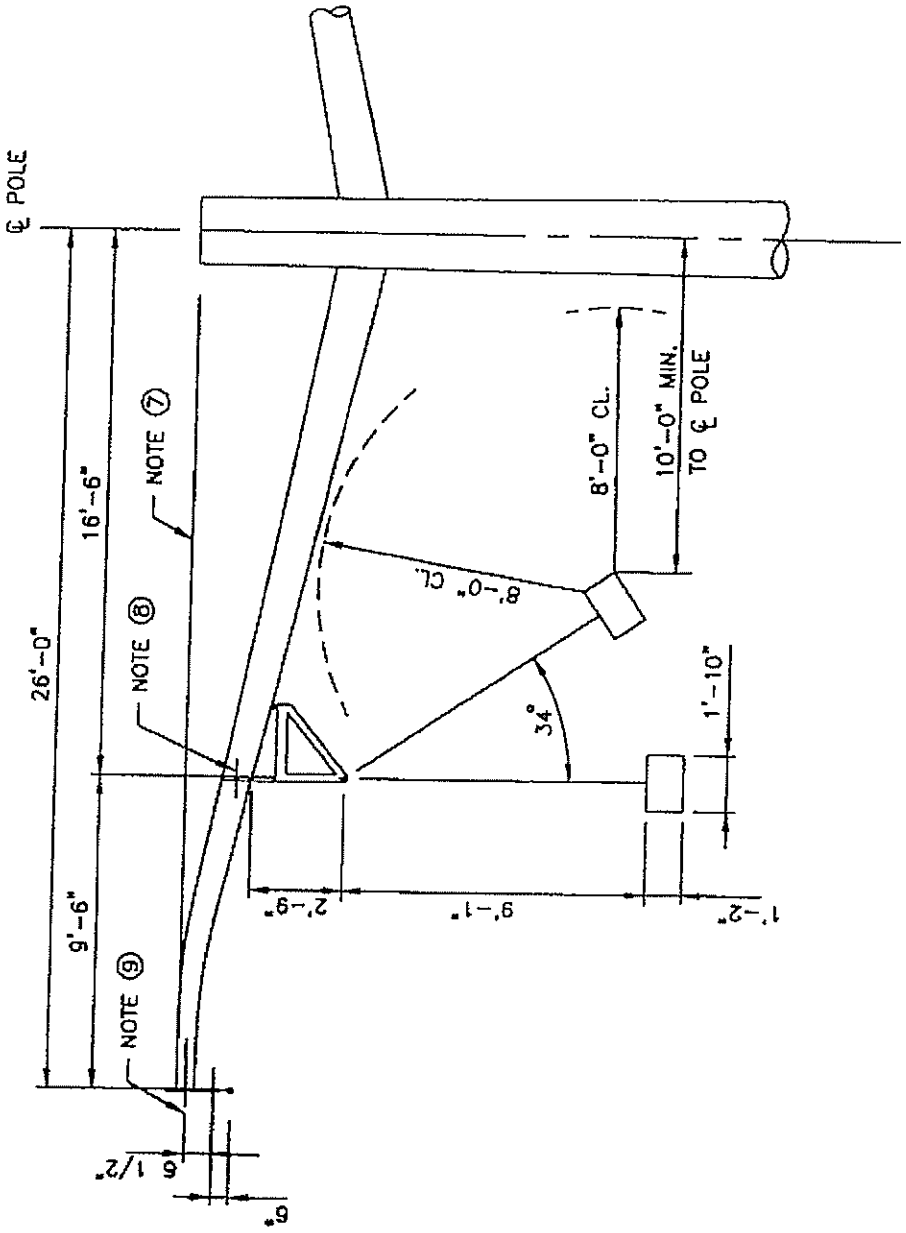

DETAIL 1
TYPICAL 345KV CLEARANCE REQUIREMENTS
(TOP CROSSARM)

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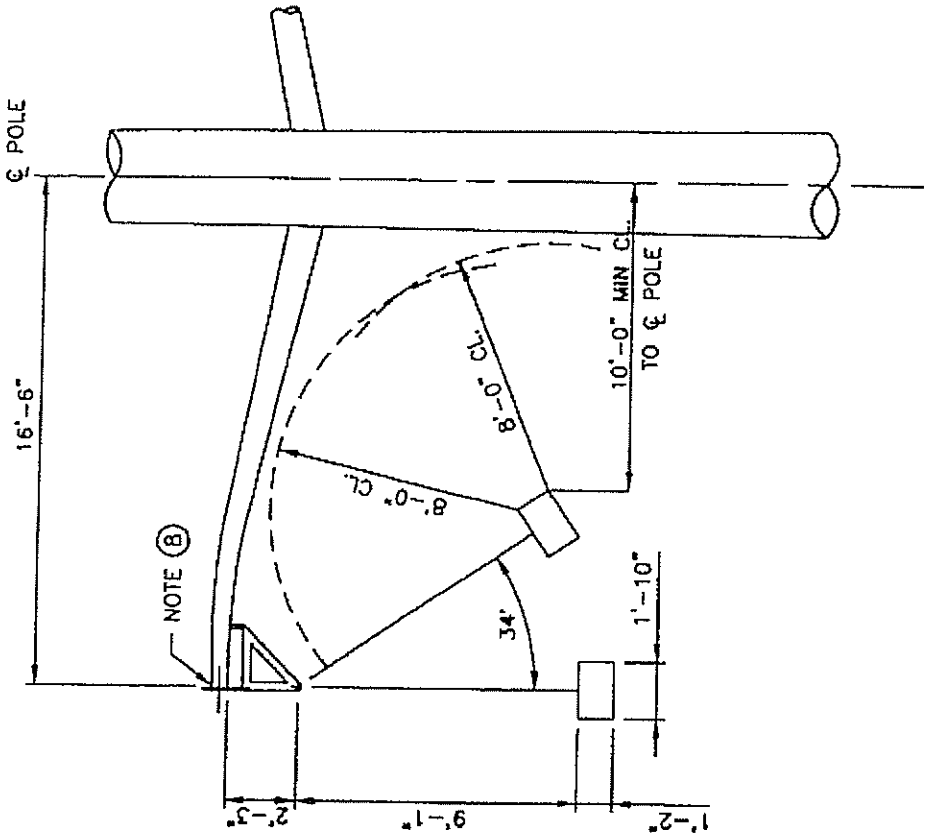

DETAIL 2
TYPICAL 345KV CLEARANCE REQUIREMENTS
(BOTTOM & MIDDLE CROSSARMS)

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NOTES:

1. THIS SPECIFICATION COVERS GEOMETRY AND LOADING REQUIREMENTS FOR DESIGN OF A TUBULAR STEEL POLE TRANSMISSION LINE STRUCTURE. IT SHALL BE USED IN CONJUNCTION WITH THE OWNER'S SPECIFICATION EM10361, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH EM10361, THE REQUIREMENTS OF THIS SPECIFICATION SHALL TAKE PRECEDENCE.

2. STRUCTURE HEIGHT SHALL BE AS INDICATED BY THE STORES ITEM NUMBER (SEE TABLE IV). UNLESS OTHERWISE STATED, STRUCTURE SHALL BE PAINTED THE FOLLOWING COLOR: SKY GRAY.

3. ALL CROSSARMS SHALL BE "ORNAMENTAL" ARMS WITH UPSWEEP ANGLE AND RADIUSED BEND. REFER TO EM10361 FOR TYPICAL "ORNAMENTAL" ARM GEOMETRY. UPSWEEP ANGLE OF ARMS SHALL BE 12 DEGREES.

(4) OVERALL HEIGHTS ARE FROM THE TOP OF BASEPLATE TO THE TOP OF POLE SHAFT. SEE TABLE IV.

(5) DIMENSION "A" IS FROM THE TOP OF BASEPLATE TO THE LOWEST ATTACHMENT HOLES ON THE BOTTOM CROSSARM. DIMENSION "B" IS FROM THE TOP OF BASEPLATE TO THE LOWEST CONDUCTOR SUSPENSION CLAMP. SEE TABLE IV FOR APPROXIMATE DIMENSIONS.

(6) THESE DIMENSIONS ARE BETWEEN HOLES FOR ATTACHMENT OF INSULATOR ASSEMBLIES, AS INDICATED.

(7) TOP OF POLE SHAFT SHALL BE (APPROXIMATELY) AT THE ELEVATION OF THE TOP OF THE UPPERMOST ARMS.

(8) FABRICATOR SHALL PROVIDE ATTACHMENT HOLES ON THE SIDES OF THE CROSSARMS DIRECTLY ABOVE EACH CONDUCTOR I-STRING HANGER BRACKET THESE HOLES ARE INTENDED AS WORKING HOLES OR FOR TEMPORARY DEAD-ENDING OF THE CONDUCTOR DURING CONSTRUCTION AND MAINTENANCE OPERATIONS. THE WORKING HOLE BRACKETS SHALL BE CAPABLE OF SUPPORTING ALL LOADS AS SHOWN FOR THE CONDUCTOR IN TABLE I.

(9) STATIC WIRE ATTACHMENT BRACKETS SHALL BE DESIGNED FOR BOTH SUSPENDING AND DEAD-ENDING THE STATIC WIRE. REFER TO EM10361 FOR TYPICAL DETAILS.

(10) ALL HANGER BRACKETS SHALL HAVE VERTICAL DIMENSIONS APPROXIMATELY AS SHOWN AND SHALL BE FREE TO SWING (UP TO 90 DEGREES FROM THE VERTICAL) IN THE LONGITUDINAL DIRECTIONS. REFER TO EM10361 FOR TYPICAL HANGER BRACKET DETAILS AND REQUIREMENTS.

11. NOT USED.

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NOTES: (CONT.)

(12) LONGITUDINAL UNBALANCE LOADS INDICATED FOR THE VARIOUS WIRE TYPES IN THE BROKEN WIRE LOADING COMBINATIONS IN TABLE I ARE TO BE APPLIED AT ANY ONE WIRE ATTACHMENT POINT (ANY ONE PHASE CONDUCTOR OR ANY ONE STATIC WIRE LOCATION BUT NOT TWO OR MORE LOCATIONS SIMULTANEOUSLY). ALL OTHER (INTACT) WIRE POSITIONS ON THE STRUCTURE SHALL HAVE THE VERTICAL AND TRANSVERSE FORCES SHOWN FOR THESE LOAD COMBINATIONS APPLIED WITH NO LONGITUDINAL UNBALANCE AT THOSE LOCATIONS.

13. STRUCTURE IS TO BE DESIGNED FOR INSTALLATION OF EITHER BOTH CIRCUITS OR FOR INSTALLATION OF ONLY ONE CIRCUIT ON ONE SIDE OF THE POLE SHAFT (FOR EXAMPLE, WIRES G2, C2, C4 AND C6 INSTALLED, WITH NO WIRES ON THE OPPOSITE SIDE OF THE POLE).

14. ALL VERTICAL WIRE LOADS (WITH THE EXCEPTION OF THE NORMAL, EVERYDAY CONDITION) INCLUDE A WORKING LOAD OF 500 POUNDS. ALL VERTICAL CONDUCTOR LOADS INCLUDE THE WEIGHT OF INSULATOR ASSEMBLIES USING PORCELAIN BALL & SOCKET INSULATORS. 345KV SUSPENSION ASSEMBLIES ARE ASSUMED TO HAVE 18 INSULATORS PER STRING. ASSUMED WEIGHTS OF INSULATORS ARE AS FOLLOWS.

CONDITION	ICED WEIGHT OF EACH INSULATOR
NO ICE	18 POUNDS
1/2" ICE	20 POUNDS
1 1/2" ICE	23 POUNDS

(15) THE NORMAL, EVERYDAY LOADING COMBINATIONS ARE INCLUDED FOR INFORMATION TO DETERMINE IF AND HOW MUCH THE STRUCTURE IS TO BE RAKED BY THE ERECTION CONTRACTOR.

(16) STATIC WIRE LOADS ARE BASED ON THE (LARGER) DIAMETER AND UNIT WEIGHT OF THE 24-FIBER OPTICAL GROUNDWIRE; HOWEVER, MOST OF THE DESIGN TENSIONS USED IN COMPUTING STATIC WIRE LOADS ARE BASED ON THE 7#6 ALUMOWELD (WHICH ARE SLIGHTLY HIGHER THAN THE OPTICAL GROUNDWIRE TENSIONS). THIS WAS DONE TO ENSURE THAT THE STRUCTURES WOULD ACCOMMODATE EITHER WIRE TYPE.

(17) DUE TO THE FACT THAT THE STRUCTURES COVERED BY THIS SPECIFICATION ARE NEARLY ALL GREATER THAN 110 FEET IN HEIGHT, THE EXTREME WIND LOADING COMBINATION WIRE LOADS AND DISTRIBUTED LOADS ON STRUCTURE HAVE BEEN COMPUTED BASED ON A WIND PRESSURE ON WIRES OF 24 PSF AND A WIND PRESSURE ON STRUCTURE OF 35 PSF (AS OPPOSED TO THE COMED STANDARDS OF 21 PSF AND 30 PSF, RESPECTIVELY).

18. TRANSVERSE LOADS ACT FROM LEFT TO RIGHT IN THE ELEVATION VIEW OF THE STRUCTURE, UNLESS OTHERWISE INDICATED.

19. NOTE FOR DESIGN ENGINEER-- WHEN PREPARING STRINGING CHARTS FOR STATIC WIRE USING 7#6 ALUMOWELD OR 12#9 ALUMOWELD 24-FIBER OPTICAL GROUNDWIRE, NESC HEAVY INITIAL TENSIONS SHALL BE BASED ON MAXIMUM 12% WIRE RATED TENSILE STRENGTH (RTS) FINAL TENSIONS UNDER 0 DEGREE, NO ICE AND NO WIND LOADING CONDITION. FOR EXAMPLE, FOR 725 FOOT DESIGN RULING SPAN, NESC HEAVY INITIAL TENSIONS FOR 7#6 ALUMOWELD AND 12#9 ALUMOWELD 24-FIBER OPTICAL GROUNDWIRE ARE 5850 LBS AND 5700 LBS RESPECTIVELY.

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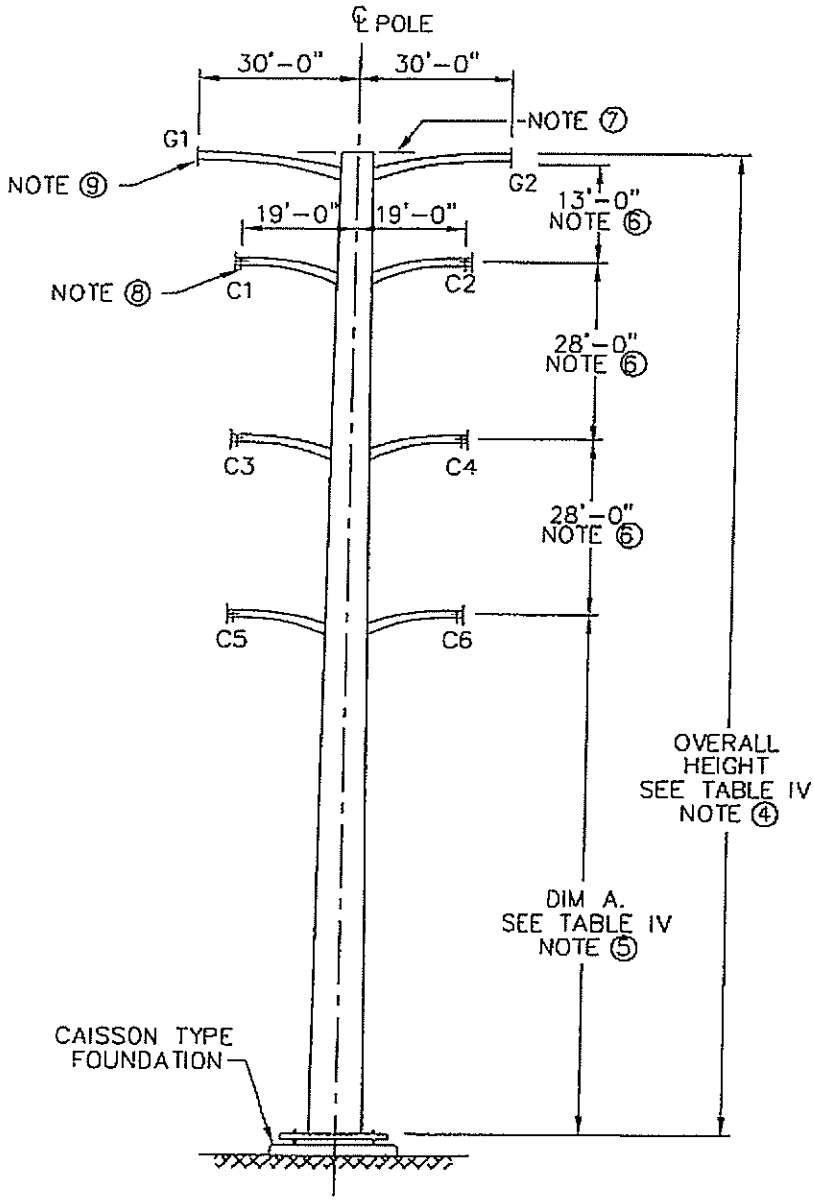
345KV DOUBLE CIRCUIT
60°-90° TERMINAL/HEAVY ANGLE STRUCTURE
WITH ORNAMENTAL ARMS
725' DESIGN RULING SPAN



ELEVATION

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TABLE I – ULTIMATE DESIGN LOADS

CASE	LOADING COMBINATION	LOAD DIRECTION	OVERLOAD FACTORS USED IN WIRE LOADS	CONCENTRATED WIRE LOADS AT EACH POINT (KIPS) C1–C6	CONCENTRATED WIRE LOADS AT EACH POINT (KIPS) G1–G2	DISTRIBUTED LOADS AND OVERLOAD FACTORS FOR STRUCTURES
A	NESC HEAVY, ALL WIRES INSTALLED: 1/2" ICE, 4# WIND, 0 DEG F., K=0.30 90 DEG. LINE ANGLE, INITIAL TENSIONS	VERTICAL	1.50	9.60	2.40	DEAD WEIGHT x 1.50
		TRANSVERSE	3.00 WIND, 1.65 TENSION	49.10	14.50	0.004 KSF x AREA x 3.00
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE
B	HEAVY ICE, ALL WIRES INSTALLED: 1 1/2" ICE, 4# WIND, 32 DEG F. 90 DEG. LINE ANGLE, INITIAL TENSIONS	VERTICAL	1.00	11.70	4.79	DEAD WEIGHT x 1.00
		TRANSVERSE	1.00	42.20	16.20	0.004 KSF x AREA x 1.00
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE
C	EXTREME WIND, ALL WIRES INSTALLED (NOTE (17)): NO ICE, 21# WIND, 0 DEG F. 90 DEG. LINE ANGLE, INITIAL TENSIONS	VERTICAL	1.10	5.09	1.03	DEAD WEIGHT x 1.10
		TRANSVERSE	1.10	33.00	7.79	0.030 KSF x AREA x 1.10
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE
D	NESC HEAVY, TANGENT DEAD-END: 1/2" ICE, 4# WIND, 0 DEG F., K=0.30 0 DEG. LINE ANGLE, INITIAL TENSIONS	VERTICAL	1.50	9.60	2.40	DEAD WEIGHT x 1.50
		TRANSVERSE	3.00 WIND, 1.65 TENSION	2.30	1.17	0.004 KSF x AREA x 3.00
		LONGITUDINAL	1.65	33.60	9.65	NOT APPLICABLE
E	NESC HEAVY, ANGLE DEAD-END: 1/2" ICE, 4# WIND, 0 DEG F., K=0.30 90 DEG. LINE ANGLE, INITIAL TENSIONS	VERTICAL	1.50	9.60	2.40	DEAD WEIGHT x 1.50
		TRANSVERSE	3.00 WIND, 1.65 TENSION	25.40	7.66	0.004 KSF x AREA x 3.00
		LONGITUDINAL	1.65	23.70	6.83	NOT APPLICABLE
F	HEAVY ICE, TANGENT DEAD-END: 1 1/2" ICE, 4# WIND, 32 DEG F. 0 DEG. LINE ANGLE, INITIAL TENSIONS	VERTICAL	1.00	11.70	4.79	DEAD WEIGHT x 1.00
		TRANSVERSE	1.00	1.27	0.89	0.004 KSF x AREA x 1.00
		LONGITUDINAL	1.00	29.20	11.00	NOT APPLICABLE
G	HEAVY ICE, ANGLE DEAD-END: 1 1/2" ICE, 4# WIND, 32 DEG F. 90 DEG. LINE ANGLE, INITIAL TENSIONS	VERTICAL	1.00	11.70	4.79	DEAD WEIGHT x 1.00
		TRANSVERSE	1.00	21.50	8.42	0.004 KSF x AREA x 1.00
		LONGITUDINAL	1.00	20.60	7.79	NOT APPLICABLE
H	NORMAL, EVERYDAY CONDITION (NOTE (15)): NO ICE, NO WIND, 50 DEG F. 75 DEG. LINE ANGLE, FINAL TENSIONS	VERTICAL	1.00	4.13	0.44	DEAD WEIGHT x 1.00
		TRANSVERSE	1.00	12.00	2.75	NOT APPLICABLE
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE
I	NORMAL, EVERYDAY CONDITION (NOTE (15)): NO ICE, NO WIND, 50 DEG F. 90 DEG. LINE ANGLE, FINAL TENSIONS	VERTICAL	1.00	4.13	0.44	DEAD WEIGHT x 1.00
		TRANSVERSE	1.00	13.90	3.20	NOT APPLICABLE
		LONGITUDINAL	NOT APPLICABLE	0.00	0.00	NOT APPLICABLE

TABLE II – DESIGN SPANS AND LINE ANGLES

DESIGN RULING SPAN (FT.)	725
MAX. DESIGN WIND SPAN (FT.)	750
MAX. DESIGN WEIGHT SPAN (FT.)	1,000
MIN. DESIGN LINE ANGLE (DEG.)	60
MAX. DESIGN LINE ANGLE (DEG.)	90

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TABLE III – DESIGN WIRE TYPES AND TENSIONS			
CASE	LOADING COMBINATION	DESIGN TENSIONS (POUNDS) FOR EACH WIRE TYPE	
		345KV CONDUCTOR T-2 BLUEJAY 2@ 1113 KCMIL, 45/7 ACSR (C1-C6)	7#6 ALUMOWELD OR 24-FIBER OPGW (NOTE (16)) STATIC WIRE (G1-G2)
A, D & E	NESC HEAVY: 1/2" ICE, 4# WIND, 0 DEG F., K=0.30 INITIAL TENSIONS	20,350	5,850
B, F & G	HEAVY ICE: 1 1/2" ICE, 4# WIND, 32 DEG F. INITIAL TENSIONS	29,176	11,013
C	EXTREME WIND: NO ICE, 21# WIND, 0 DEG F. INITIAL TENSIONS	19,840	4,636
H & I	NORMAL, EVERYDAY CONDITION: NO ICE, NO WIND, 50 DEG F. FINAL TENSIONS	9,818	2,262

TABLE IV – STRUCTURE HEIGHTS		
STORES ITEM NUMBERS	OVERALL HEIGHT (FEET)	DIM. A (FEET)
386478	110	39.8
386331	115	44.8
386332	120	49.8
386479	125	54.8
386334	130	59.8
386335	135	64.8
386336	140	69.8
386337	145	74.8
386338	150	79.8
386339	155	84.8

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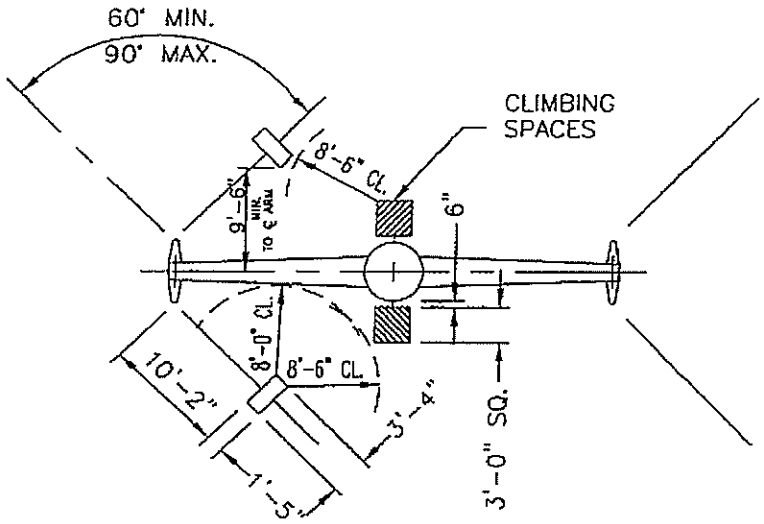

DETAIL 1

TYPICAL 345KV CLEARANCE REQUIREMENTS
(PLAN OF TOP, MIDDLE & BOTTOM CROSSARMS)

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NOTES:

1. THIS SPECIFICATION COVERS GEOMETRY AND LOADING REQUIREMENTS FOR DESIGN OF A TUBULAR STEEL POLE TRANSMISSION LINE STRUCTURE. IT SHALL BE USED IN CONJUNCTION WITH THE OWNER'S SPECIFICATION EM10361, WHICH COVERS GENERAL REQUIREMENTS AND DETAILS NOT SPECIFICALLY COVERED HEREIN. WHERE THIS SPECIFICATION IS IN CONFLICT WITH EM10361, THE REQUIREMENTS OF THIS SPECIFICATION SHALL TAKE PRECEDENCE.

2. STRUCTURE HEIGHT SHALL BE AS INDICATED BY THE STORES ITEM NUMBER (SEE TABLE IV). UNLESS OTHERWISE STATED, STRUCTURE SHALL BE PAINTED THE FOLLOWING COLOR: LIGHT GRAY.

3. ALL CROSSARMS SHALL BE "ORNAMENTAL" ARMS WITH UPSWEEP ANGLE AND RADIUSED BEND. REFER TO EM10361 FOR TYPICAL "ORNAMENTAL" ARM GEOMETRY. UPSWEEP ANGLE OF ARMS SHALL BE 12 DEGREES.

(4.) OVERALL HEIGHTS ARE FROM THE TOP OF BASEPLATE TO THE TOP OF POLE SHAFT (SEE TABLE IV).

(5.) DIMENSION "A" IS FROM THE TOP OF BASEPLATE TO THE LOWEST ATTACHMENT HOLES ON THE BOTTOM CROSSARMS. SEE TABLE IV FOR APPROXIMATE DIMENSIONS.

(6.) THESE DIMENSIONS ARE BETWEEN HOLES FOR ATTACHMENT OF STRAIN INSULATOR ASSEMBLIES.

(7.) TOP OF POLE SHAFT SHALL BE (APPROXIMATELY) AT THE ELEVATION OF THE TOP OF THE UPPERMOST ARMS.

(8.) FABRICATOR SHALL PROVIDE ATTACHMENT HOLES ON THE BOTTOMS OF THE CROSSARMS DIRECTLY BELOW EACH CONDUCTOR DEAD-END BRACKET. THESE HOLES ARE INTENDED FOR ATTACHMENT OF JUMPER SUPPORT INSULATOR ASSEMBLIES.

(9.) STATIC WIRE ATTACHMENT BRACKETS SHALL BE DESIGNED FOR BOTH SUSPENDING AND DEAD-ENDING THE STATIC WIRE. REFER TO EM10361 FOR TYPICAL DETAILS.

10. (NOT USED)

11. (NOT USED)

12. (NOT USED)

13. STRUCTURE IS TO BE DESIGNED FOR INSTALLATION OF EITHER BOTH CIRCUITS OR FOR INSTALLATION OF ONLY ONE CIRCUIT ON ONE SIDE OF THE POLE SHAFT (FOR EXAMPLE, WIRES G2, C2, C4, AND C6, INSTALLED, WITH NO WIRES ON THE OPPOSITE SIDE OF THE POLE).

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NOTES: (CONT.)

14. ALL VERTICAL WIRE LOADS (WITH THE EXCEPTION OF THE NORMAL, EVERYDAY CONDITION) INCLUDE A WORKING LOAD OF 500 POUNDS. ALL VERTICAL CONDUCTOR LOADS INCLUDE THE WEIGHT OF INSULATOR ASSEMBLIES USING PORCELAIN BALL & SOCKET INSULATORS. 345KV STRAIN ASSEMBLIES ARE ASSUMED TO HAVE 36 INSULATORS EACH. 345KV SUSPENSION JUMPER SUPPORT ASSEMBLIES ARE ASSUMED TO HAVE 18 INSULATORS PER STRING.
ASSUMED WEIGHTS OF INSULATORS ARE AS FOLLOWS:

CONDITION	ICED WEIGHT OF EACH INSULATOR
NO ICE	18 POUNDS
1/2" ICE	20 POUNDS
1 1/2" ICE	23 POUNDS

(15) THE NORMAL, EVERYDAY LOADING COMBINATIONS ARE INCLUDED FOR INFORMATION ON STRUCTURE DEFLECTION. DEPENDING ON THE ANTICIPATED USAGE OF A PARTICULAR STRUCTURE PURCHASED, THE OWNER MAY REQUIRE THAT THE FABRICATOR PRE-CAMBER THE POLE SHAFT TO OFFSET THE AMOUNT OF THE POLE TOP DEFLECTION UNDER THE NORMAL, EVERYDAY CONDITION FOR THE POLE IN QUESTION. UNLESS OTHERWISE DIRECTED, THE FABRICATOR IS TO ASSUME THAT POLES WHOSE TOP DEFLECTION EXCEEDS 1% OF OVERALL HEIGHT WILL BE CAMBERED. IF REQUIRED, THE OWNER WILL INFORM THE FABRICATOR OF THE PRECISE WIRE LOADS ON WHICH TO BASE THE ACTUAL PRE-CAMBER AFTER AWARD OF THE PURCHASE ORDER.

(16) STATIC WIRE LOADS ARE BASED ON THE (LARGER) DIAMETER AND UNIT WEIGHT OF THE 24-FIBER OPTICAL GROUNDWIRE; HOWEVER, MOST OF THE DESIGN TENSIONS USED IN COMPUTING STATIC WIRE LOADS ARE BASED ON THE 7#6 ALUMOWELD (WHICH ARE SLIGHTLY HIGHER THAN THE OPTICAL GROUNDWIRE TENSIONS). THIS WAS DONE TO ENSURE THAT THE STRUCTURES WOULD ACCOMMODATE EITHER WIRE TYPE.

17. (NOT USED)

18. TRANSVERSE LOADS ACT FROM LEFT TO RIGHT IN THE ELEVATION VIEW OF THE STRUCTURE, UNLESS OTHERWISE INDICATED.

19. NOTE FOR DESIGN ENGINEER-- WHEN PREPARING STRINGING CHARTS FOR STATIC WIRE USING 7#6 ALUMOWELD OR 12#9 ALUMOWELD 24-FIBER OPTICAL GROUNDWIRE, NESC HEAVY INITIAL TENSIONS SHALL BE BASED ON MAXIMUM 12% WIRE RATED TENSILE STRENGTH (RTS) FINAL TENSIONS UNDER 0 DEGREE, NO ICE AND NO WIND LOADING CONDITION. FOR EXAMPLE, FOR 725 FOOT DESIGN RULING SPAN, NESC HEAVY INITIAL TENSIONS FOR 7#6 ALUMOWELD AND 12#9 ALUMOWELD 24-FIBER OPTICAL GROUNDWIRE ARE 5850 LBS AND 5700 LBS RESPECTIVELY.

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CONDUCTOR LOAD AND BLOWOUT ANGLE CHARACTERISTICS

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CONDUCTOR SIZE, KCMIL	3000	2338	2335	(NOTE A) 2226	2156	1590
TYPE	ACSR/GA	ACAR	ACAR	T2-ACSR/GA	ACSR/GA	AA
STRANDING	84/19	42/19	63/28	2(45/7)	84/19	61
CODE NAME				T2-BLUEJAY	BLUEBIRD	COREOPSIS
COPPER EQUIVALENT, KCMIL	1903	1419	1418	1412	1368	1010
ASTM STANDARD	B 232	B 524	B 524	B 232	B 232	B 231
DIAMETER (INCHES)	2.079	1.762	1.762	2.061	1.762	1.454
ULTIMATE STRENGTH (LBS)	83,900	55,600	55,400	59,600	60,300	27,000
WEIGHT-BARE (LBS/FOOT)	3.495	2.19	2.213	2.51	2.511	1.493
WEIGHT-BARE (LBS/MILE)	18,450	11,560	11,680	13,252	13,258	7,883
0" ICE, 4# WIND----HORIZ	0.693	0.587	0.587	0.687	0.587	0.485
(LBS/FT) VERT	3.495	2.190	2.213	2.510	2.511	1.493
(LOW WIND) RESULTANT	3.563	2.267	2.290	2.602	2.579	1.570
ANGLE	11.22°	15.01°	14.86°	15.31°	13.17°	17.98°
0" ICE, 6# WIND---HORIZ	1.040	0.881	0.881	1.031	0.881	0.727
(LBS/FT) VERT	3.495	2.190	2.213	2.510	2.511	1.493
RESULTANT	3.646	2.361	2.382	2.713	2.661	1.661
ANGLE	16.56°	21.91°	21.71°	22.32°	19.33°	25.96°
0" ICE, 8# WIND---HORIZ	1.386	1.175	1.175	1.374	1.175	0.969
(LBS/FT) VERT	3.495	2.190	2.213	2.510	2.511	1.493
RESULTANT	3.760	2.485	2.505	2.861	2.772	1.780
ANGLE	21.63°	28.21°	27.96°	28.70°	25.07°	32.99°
0" ICE, 21# WIND---HORIZ	3.638	3.084	3.084	3.607	3.084	2.545
(LBS/FT) VERT	3.495	2.190	2.213	2.510	2.511	1.493
(HEAVY WIND) RESULTANT	5.045	3.782	3.795	4.394	3.977	2.950
ANGLE	46.15°	54.62°	54.33°	55.17°	50.84°	59.60°
0" ICE, 25# WIND---HORIZ	4.331	3.671	3.671	4.294	3.671	3.029
(LBS/FT) VERT	3.495	2.190	2.213	2.510	2.511	1.493
RESULTANT	5.565	4.274	4.286	4.974	4.447	3.377
ANGLE	51.10°	59.18°	58.92°	59.69°	55.63°	63.76°
1/2" ICE, 2.2# WIND,----HORIZ	0.564	0.506	0.506	0561	0.506	0.450
(LBS/FT) VERT	5.099	3.597	3.620	4.102	3.918	2.708
RESULTANT	5.130	3.632	3.655	4.141	3.951	2.746
ANGLE	6.32 °	8.01 °	7.96 °	7.79 °	7.36 °	9.43°
1/2" ICE, 4# WIND---HORIZ	1.026	0.921	0.921	1.020	0.921	0.818
(LBS/FT) (HORIZ-2 DIA.)	---	---	---	(1.173)	---	---
(NESC HEAVY) VERT	5.099	3.597	3.620	4.102	3.918	2.708
(VERT-2 DIA.)	---	---	---	(4.387)	---	---
RESULTANT	5.201	3.713	3.735	4.227	4.025	2.829
(RESULTANT + .30)	(5.501)	(4.013)	(4.035)	(4.527)	(4.325)	(3.129)
ANGLE	11.38°	14.36 °	14.27°	13.97°	13.22°	16.81°
1/2" ICE, 8# WIND---HORIZ.	2.053	1.841	1.841	2.041	1.841	1.636
(LBS/FT) VERT	5.099	3.597	3.620	4.102	3.918	2.708
RESULTANT	5.497	4.041	4.061	4.582	4.329	3.164
ANGLE	21.93°	27.11°	26.96°	26.45°	25.17°	31.13°
1 1/2" ICE, 4# WIND---HORIZ	1.693	1.587	1.587	1.687	1.587	1.485
(LBS/FT) VERT	10.173	8.277	8.300	9.155	8.598	7.005
(HEAVY ICE) RESULTANT	10.313	8.428	8.450	9.309	8.743	7.161
ANGLE	9.45 °	10.86 °	10.83°	10.44°	10.46°	11.97°

NOTE A:
VALUES FOR T-2 CONDUCTOR ARE BASED ON EQUIVALENT DIAMETER OF 1.637 TIMES THE DIAMETER OF ONE CONDUCTOR.
USE (HORIZ-2 DIA.) AND (VERT-2 DIA.) LOADS FOR T-2 NESC LOADS ON LOADING SCHEDULE WORK SHEETS.

X ~~T L S C G E~~
REVISION

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CONDUCTOR SIZE, KCMIL	5/16" *** SM	10#8AW	12#10AW	11#10AW	13#11AW	8#7AW
TYPE	GALVSTL	FOSW	FOSW	FOSW	FOSW	FOSW
STRANDING	7	24 FIBER	12 FIBER	12 FIBER	16 FIBER	16 FIBER
CODE NAME						
COPPER EQUIVALENT, KCMIL						
ASTM STANDARD	A 475	B 415	B 415	B 415	B 415	B 415
DIAMETER (INCHES)	0.312	0.5535	0.507	0.469	0.528	0.5236
ULTIMATE STRENGTH (LBS.)	5,350	18,450	17,200	16,010	15,000	11,620
WEIGHT - BARE (LBS/FOOT)	0.205	0.3971	0.352	0.317	0.336	0.3031
WEIGHT - BARE (LBS/MILE)	1,082	2,097	1,859	1,674	1,774	1,600
0" ICE, 4# WIND----HORIZ	0.104	0.185	0.169	0.156	0.176	0.175
(LBS./FT.) VERT	0.205	0.397	0.352	0.317	0.336	0.303
(LOW WIND) RESULTANT	0.230	0.438	0.390	0.353	0.379	0.350
ANGLE	26.90°	24.92°	25.65°	26.25°	27.65°	29.93°
0" ICE, 6# WIND----HORIZ	0.156	0.277	0.254	0.235	0.264	0.262
(LBS./FT.) VERT	0.205	0.397	0.352	0.317	0.336	0.303
(HORIZ CLEAR) RESULTANT	0.258	0.484	0.434	0.394	0.427	0.401
ANGLE	37.27°	34.87°	35.76°	36.49°	38.16°	40.82°
0" ICE, 8# WIND----HORIZ	0.208	0.369	0.338	0.313	0.352	0.349
(LBS./FT.) VERT	0.205	0.397	0.352	0.317	0.336	0.303
(SWING ANGLE) RESULTANT	0.292	0.542	0.488	0.445	0.487	0.462
ANGLE	45.42°	42.90°	43.84°	44.61°	46.33°	49.03°
0" ICE, 21# WIND----HORIZ	0.546	0.969	0.887	0.821	0.924	0.916
(LBS./FT.) VERT	0.205	0.397	0.352	0.317	0.336	0.303
(HIGH WIND) RESULTANT	0.583	1.047	0.955	0.880	0.983	0.965
ANGLE	69.42°	67.71°	68.36°	68.88°	70.02°	71.70°
0" ICE, 25# WIND----HORIZ	0.650	1.153	1.056	0.977	1.100	1.091
(LBS./FT.) VERT	0.205	0.397	0.352	0.317	0.336	0.303
RESULTANT	0.682	1.220	1.113	1.027	1.150	1.132
ANGLE	72.50°	71.00°	71.57°	72.03°	73.01°	74.47°
1/2" ICE, 2.2# WIND--HORIZ	0.241	0.285	0.276	0.269	0.280	0.279
(LBS./FT.) VERT	0.710	1.052	0.978	0.920	0.975	0.940
(WHIPPING) RESULTANT	0.750	1.090	1.017	0.958	1.015	0.980
ANGLE	18.71°	15.14°	15.77°	16.32°	16.02°	16.55°
1/2" ICE, 4# WIND--HORIZ	0.437	0.518	0.502	0.490	0.509	0.508
(LBS./FT.) VERT	0.710	1.052	0.978	0.920	0.975	0.940
(NESC HEAVY) RESULTANT	0.834	1.173	1.110	1.042	1.100	1.068
ANGLE	31.63°	26.20°	27.18°	28.03°	27.57°	28.39°
1/2" ICE, 8# WIND--HORIZ	0.875	1.036	1.005	0.979	1.019	1.016
(LBS./FT.) VERT	0.710	1.052	0.978	0.920	0.975	0.940
(SWING ANGLE) RESULTANT	1.127	1.477	1.402	1.343	1.410	1.384
ANGLE	50.93°	44.54°	45.76°	46.80°	46.24°	47.22°
1 1/2" ICE, 4# WIND--HORIZ	1.104	1.185	1.169	1.156	1.176	1.175
(LBS./FT.) VERT	3.586	4.229	4.097	3.991	4.120	4.079
(HEAVY ICE) RESULTANT	3.752	4.392	4.261	4.155	4.285	4.245
ANGLE	17.11°	15.65°	15.92°	16.16°	15.93°	16.06°

NOTE *** SM IS SIEMENS MARTIN GRADE
NOTE FOSW IS FIBER OPTIC STATIC WIRE, ALSO KNOWN AS OPGW (OPTICAL GROUND WIRE)

ACAD

- Rule 232, Vertical clearances of wires, conductors, cables, and equipment above ground, roadway, rail or water surfaces;
- Rule 233, Clearances between wires, conductors, and cables carried on different supporting structures;
- Rule 234, Clearances of wires, conductors, cables and equipment from buildings, bridges, rail cars, swimming pools, and other installations; and
- Rule 235, Clearances of wires, conductors, or cables carried on the same supporting structure.

4.1 Vertical Clearances Above Ground, Roads, Farmland, and Bodies of Water

Table 4.1.1 Vertical Clearances under Conditions at Maximum Sag (NESC Rule 232)

Surface Beneath Conductor	Conductor Nominal Line to Line Voltage		
	138kV (ft)	345kV (ft) +	765kV (ft)
Ground	20.6	24.6	31.0*
Roads, Streets, Alleys, Driveways	20.6	24.6*	31.0*
Farmland	20.6	24.6	31.0*
Spaces and ways, restricted to pedestrian traffic	16.6	20.6	27.0*
Water areas not suitable for sail boating	19.1	23.1	29.5
Water areas suitable for sail boating: Less than 20 acres	22.6	26.6	33.0
20 to 200 acres	30.6	34.6	41.0
200 to 2000 acres	36.6	40.6	47.0
Over 2000 acres	42.6	46.6	53.0

+ Clearance of 27 ft to be conservative

Table 4.1.2 Momentary Vertical Clearances (e.g. Under Galloping Conditions)

Surface Beneath	Ref. Ht. (ft)	Conductor Nominal Line to Line Voltage		
		138kV (ft)	345kV (ft)	765kV (ft)
Ground	14.0	15.0	16.5	19.5
Roads, Streets, Alleys, Driveways	14.0	15.0	16.5	19.5
Farmland	14.0	15.0	16.5	19.5
Spaces and ways restricted to pedestrian traffic	10.0	11.0	12.5	15.5
Water areas not suitable for sail boating	12.5	13.5	15.0	18.0
Water areas suitable for sail boating: Less than 20 acres	16.0	17.0	18.5	21.5
20 to 200 acres	24.0	25.0	26.5	29.5
200 to 2000 acres	30.0	31.0	32.5	35.5
Over 2000 acres	36.0	37.0	38.5	41.5

4.1.1 General Notes for Table 4.1.1 and Table 4.1.2

1. The minimum vertical clearances for conditions of maximum sag (Table 4.1.1) shall be maintained for the following conditions that result in the greatest sag:

   a) 32°F, no wind, 1/2 inch radial thickness of ice.

   b) 120°F, no wind

   c) Maximum conductor temperature at which the line is designed to operate (normally 275^{0}F for ACSR, 230^{0}F for ACAR, 248^{0}F for copper conductors), and at 32^{0}F, 1/2 inch ice, no wind.

2. In some cases, where indicated by * in Table 4.1.1, the electrostatic induction limitations at 120 ^{0}F final conductor sag condition may control minimum heights of 345kV and 765kV lines. A model shown in Figure 4.1.1 shall be used for the electrostatic induction calculations, and Table 4.1.3 shows the required minimum vertical clearance values under that condition.

3. Design engineer should add appropriate margins of safety as suitable for the project particulars. Suggested margins of safety for vertical clearances are shown in Table 3.2.1.

4. Refer to the latest publication of "Routine Procedures for the Procurement of Easements and Permits" issued by [redacted] Real Estate Department to determine if additional clearances are required at specific crossings of roads, railroads, or other utilities.

5. In public or private land and water areas specifically posted for rigging and launching sailboats, increase the clearances in the tables by 5 feet.

Table 3.2.2 Suggested Clearance Margins of Safety to be added to the Minimum Horizontal NESC Clearances Shown in this Standard Practice

Project Particulars	Construction Tolerance/ As-Built Factor (Inches)	Survey/Line Model Accuracy Factor (Inches)	Total Suggested Horizontal Clearance "Margin of Safety" (Feet)
Without As-built Data, Survey by Airborne (Remote Sensing) Methods (+/- 1 foot)	6"	24"	2.5
Without As-built Data, Survey by Ground Methods e.g. Total Station/GPS (+/- 3 inches)	6"	6"	1
With As-built Data, Survey by Airborne (Remote Sensing) Methods (+/- 1 foot)	0"	24"	2
With As-built Data, Survey by Ground Methods e.g. Total Station/GPS (+/- 3 inches)	0"	6"	0.5

3.2.2 General Notes for Table 3.2.2

1. **There is no sag factor considered in calculating horizontal design clearances since the effects of inaccuracies in predicting sags on horizontal clearance calculations are negligible.**

2. Construction tolerances are a factor in all new construction projects. At least 6 inches be added to the desired horizontal clearances for all new projects to account for "construction tolerances". When checking clearances on existing lines for which new survey (as-built) data is obtained (eliminating any uncertainties associated with construction tolerances) this 6-inch factor may be eliminated.

3. The survey/line model factor should be based on the accuracy of survey performed and the type of model used in computing clearances. If the survey is done using aerial methods and has an inherent horizontal accuracy of plus or minus 1 foot, then the engineer should include a 2 foot factor to account for

the possibility of up to a 2 foot error in the relative positions of the conductors and adjacent obstructions. If, on the other hand, the survey is accurate to within a few inches, a more appropriate factor for survey/line model inaccuracies might be 6 inches.

3.3 Vertical Clearances of Conductors under Galloping Conditions

For design of new lines, clearances between wires and from wires to ground or objects under the lines shall be checked using the method shown in the present TOG 1-1-1 on conductor galloping clearance criteria. The minimum momentary galloping clearances shall be based upon the following:

3.3.1 Electrical Component of Clearance Requirements

	138kV	345kV	765kV
Electrical Clearance (phase to ground)	1.0 ft	2.5 ft	5.5 ft
Electrical Clearance (phase to phase)	1.5 ft	3.5 ft	8.0 ft

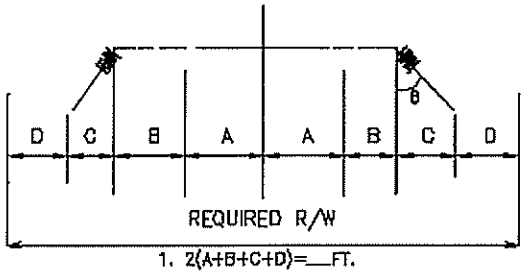
3.3.2 Object Heights

Object	Assumed Height
Ground	14 ft
Roads	14 ft
Railroads	22 ft
Distribution and Communication Wires	Assume a straight line between attachments on the supporting structures.

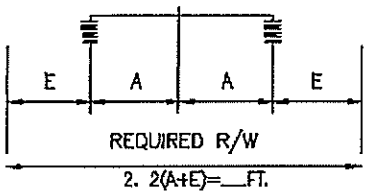
4.0 NESC Vertical and Horizontal Clearances for Transmission Lines

The applicable Rules of the NESC as they relate to vertical and horizontal clearances are listed below:

5.2 Right-of-Way Width Calculation



$2(32' + 0' + 11' + 11') = 108'$



(PG 5 EM10431 Detail 2)

A = Distance between end of arm conductor attachment and center of structure 32 ft.

B = Structure attachment deviation due to deflection 0 ft.

C = Blowout (Calculate for point of maximum blowout). Assume suspension insulator (if any) blowout at same angle as conductor.

(SAG 10)

a) Max. sag within R/W 15.4 ft. (@6 lb./ft.^{2} wind, 60°F final sag).*

(Detail 2)

b) Insulator String Length 9.1 ft. (suspension string only).

(SAG 10)

c) Vertical Force V = 1.255 lb/ft. (weight of conductor)

(SAG 10)

d) Horizontal force H = 6 lb./ft.^{2} x 1.259" 12 inch per foot (cond. dia.) = 0.6295 lb/ft.

e) Blowout angle θ = $\tan^{-1}$ H/V = 26.6 degree

f) Blowout, C = [(a) + (b)] sin θ = 11 ft.

D =Clearance requirement to building or objects with conductor displaced by wind per NESC Rule 234: 10.8ft.

E =Clearance requirement to buildings or objects with conductor at rest per NESC Rule 234: ___ft.

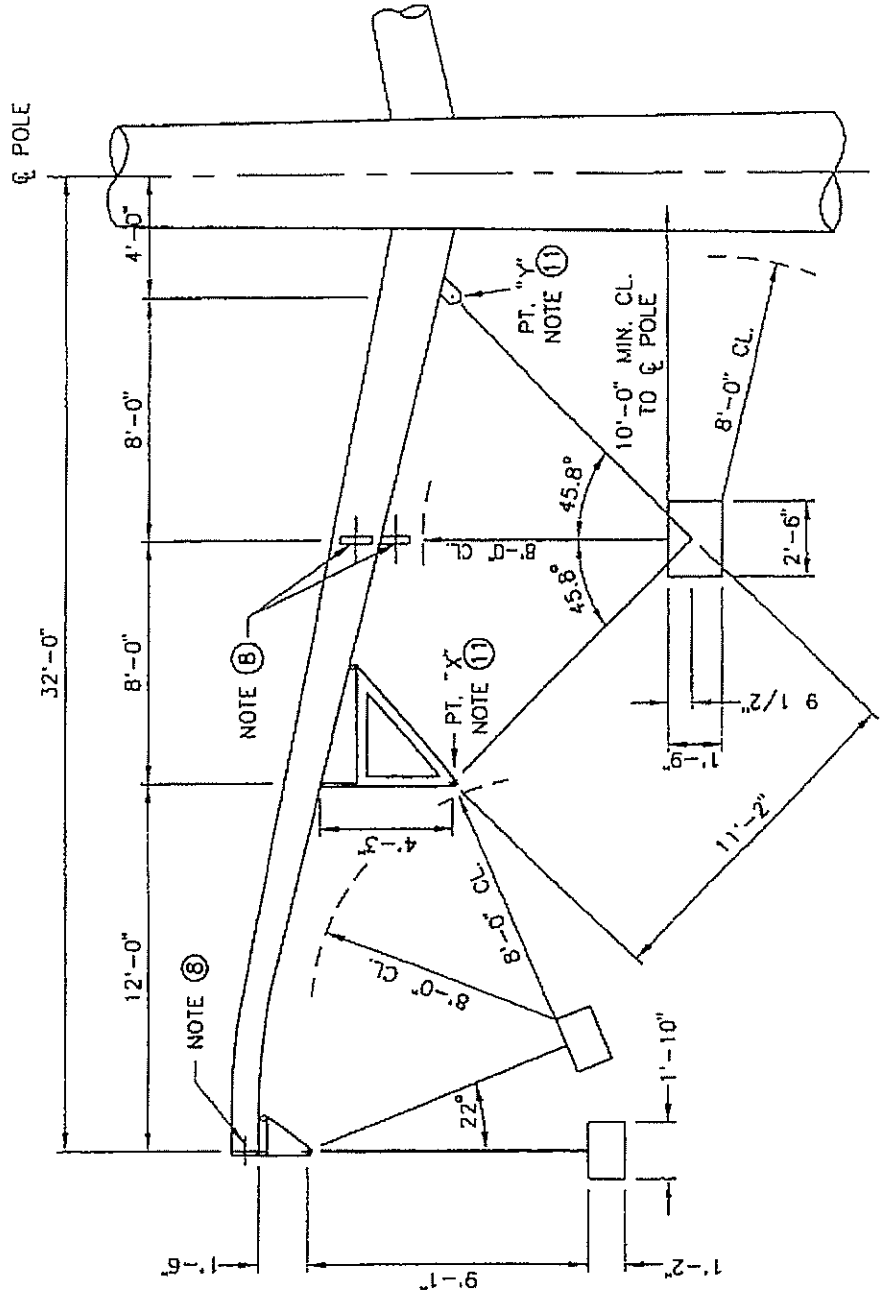
Table 5.2.1 Minimum Horizontal Separation

Conductor Nominal Line to Line Voltage	Min. Horizontal Separation (NESC)**	
	D (ft)	E (ft)
34kV	5.0	8.0
69kV	5.2	8.2
138kV	6.6	9.6
345kV	10.8	13.8
765kV	17.2	22.3

* The maximum sag within the Right-of-Way for an existing line or a known set of span lengths should reflect the greatest sag of all the known span lengths. For new construction, for which no structures have yet been spotted and span lengths have not been determined, a sag should be calculated based on a span length equal to the largest anticipated individual span length for the Right-of-Way. This is commonly estimated as the design ruling span times 1.30. 725'×1.3 = 943'

** Minimum horizontal separation shown as D is for conductor with wind displacement and minimum horizontal separation shown as E is for conductor at rest. Calculate required Right-of-Way width based on clearance requirements D and E and take larger of the two. Clearance values shown do not include any margins of safety. Refer to Table 3.2.2 for appropriate margins of safety.

9-25-95
EM10431
PAGE 5 OF 7



DETAIL 2
TYPICAL 345KV CLEARANCE REQUIREMENTS
(BOTTOM CROSSARM)

ACA CONDUCTOR ACCESSORIES, SAG AND TENSION DATA

Tensaka
ROW Calculation

Conductor BLUEJAY 1113.0 Kcmil 45/ 7 Stranding ACSR

Area= .9350 Sq. in Dia= 1.259 in Wt= 1.255 lb/ft RTS= 29800 lb
Data from Chart No. 1-957 d) c)
English Units
Using Exact Catenary Equations

Span= 943.0 feet Special Load Zone (EM1043I Case F Table III)
Creep is NOT CONSIDERED Rolled Rod

Design Points					Final		Initial	
Temp F	Ice in	Wind psf	K lb/ft	Weight lb/ft	Sag ft	Tension lb	Sag ft	Tension lb
60.	.00	6.00	.00	1.404	15.39	10150.*	15.39	10150.
0.	.00	.00	.00	1.255	10.71	13033.	10.71	13033.

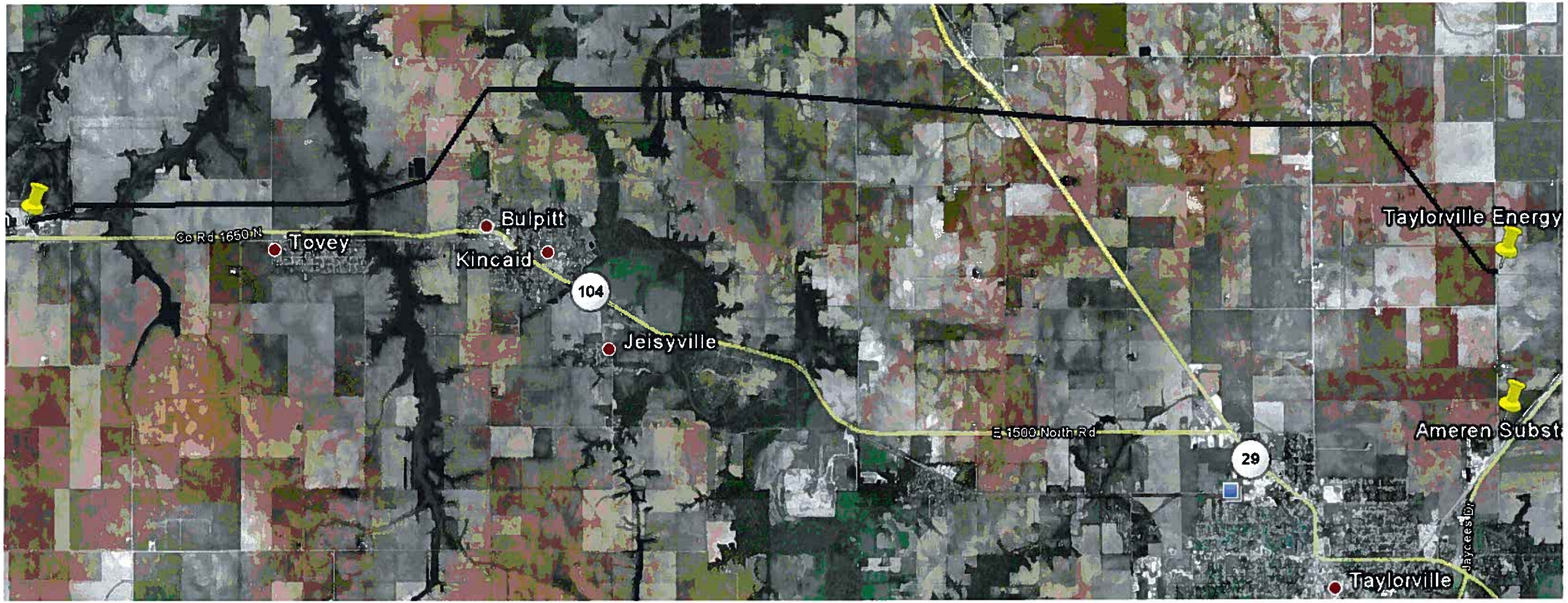
* Design Condition

0

PATRICK
ENGINEERING

Appendix C

Conceptual Line Design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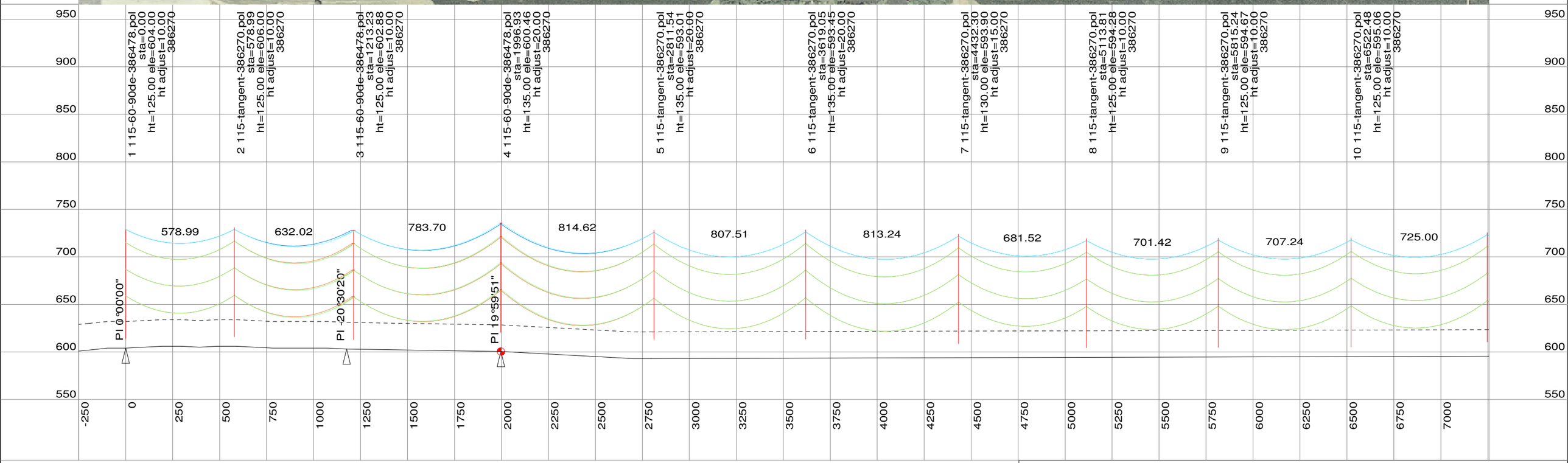
Tovey
Kincaid
104
Jeisyville
Taylorville Energy
E 1500 North Rd
29
Ameren Subst
Jaycees Dr
Taylorville

ADD Drawing



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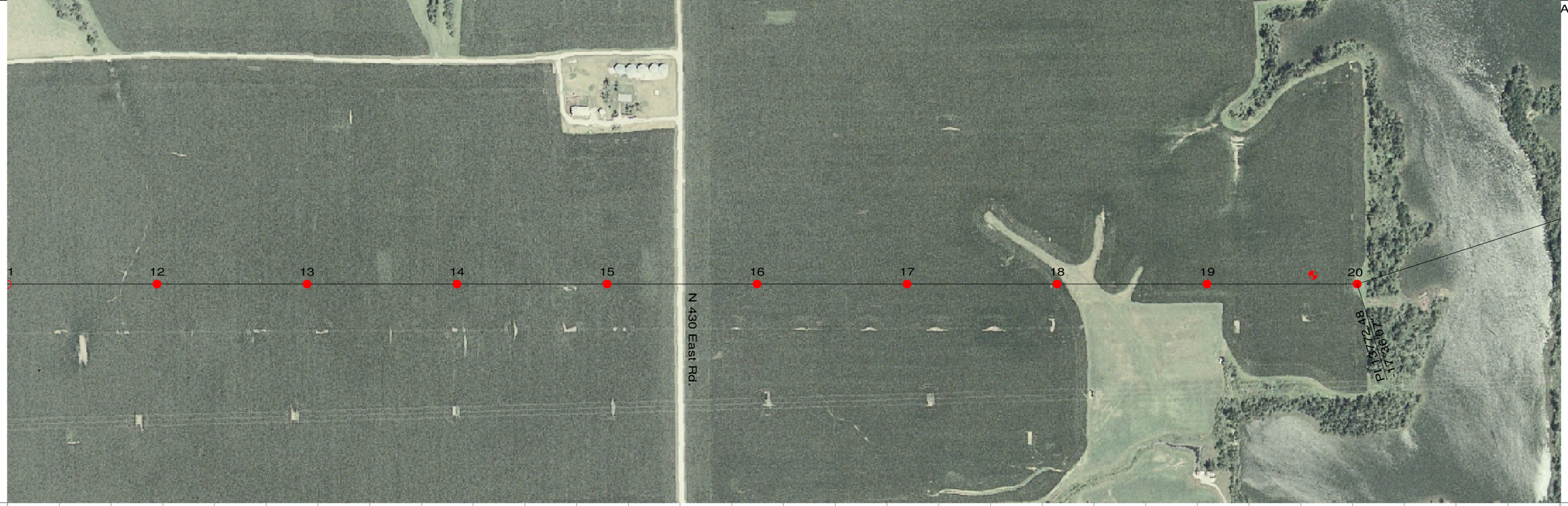
100.0 ft. Vert. Scale

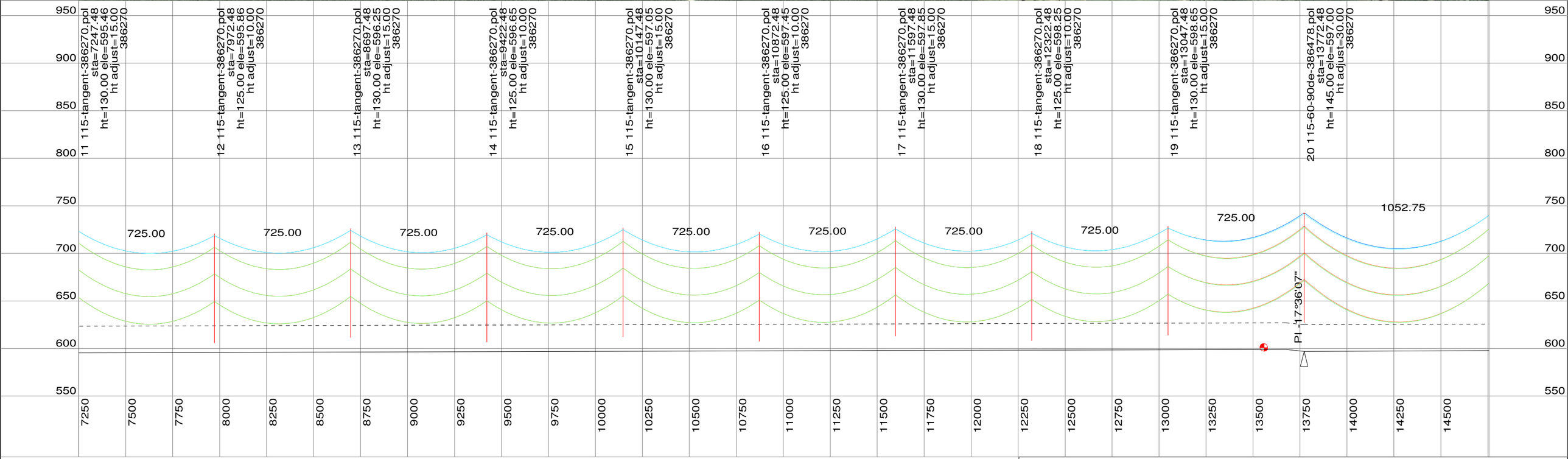
North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009

ADD Drawing





500.0 ft. Horiz. Scale

100.0 ft. Vert. Scale

North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009

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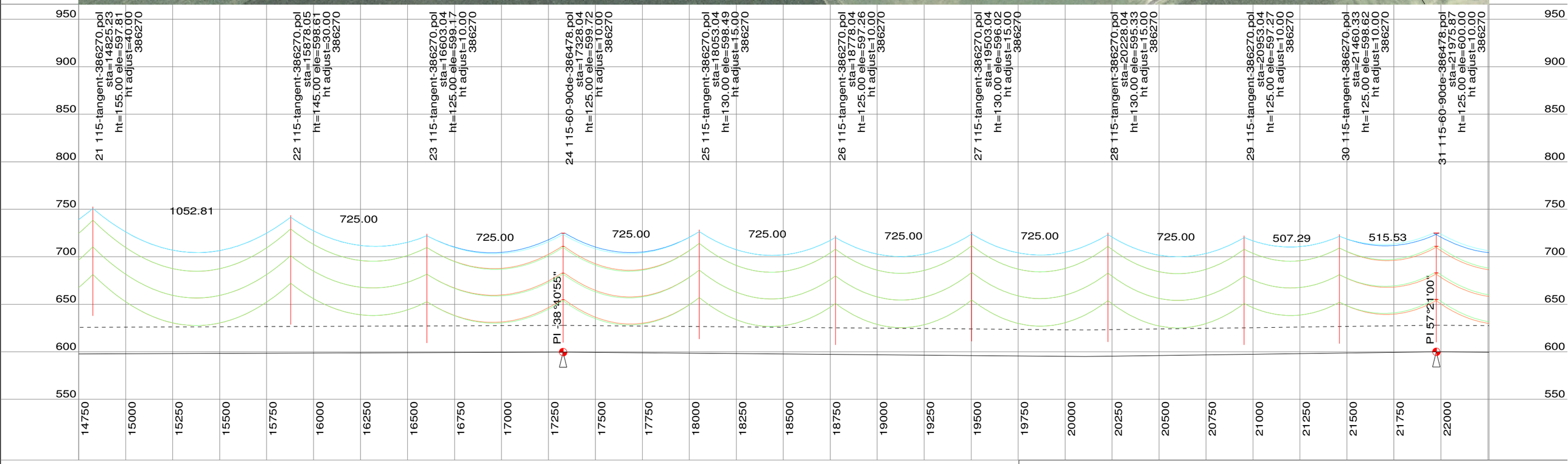

500.0 ft. Horiz. Scale

100.0 ft. Vert. Scale

North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009

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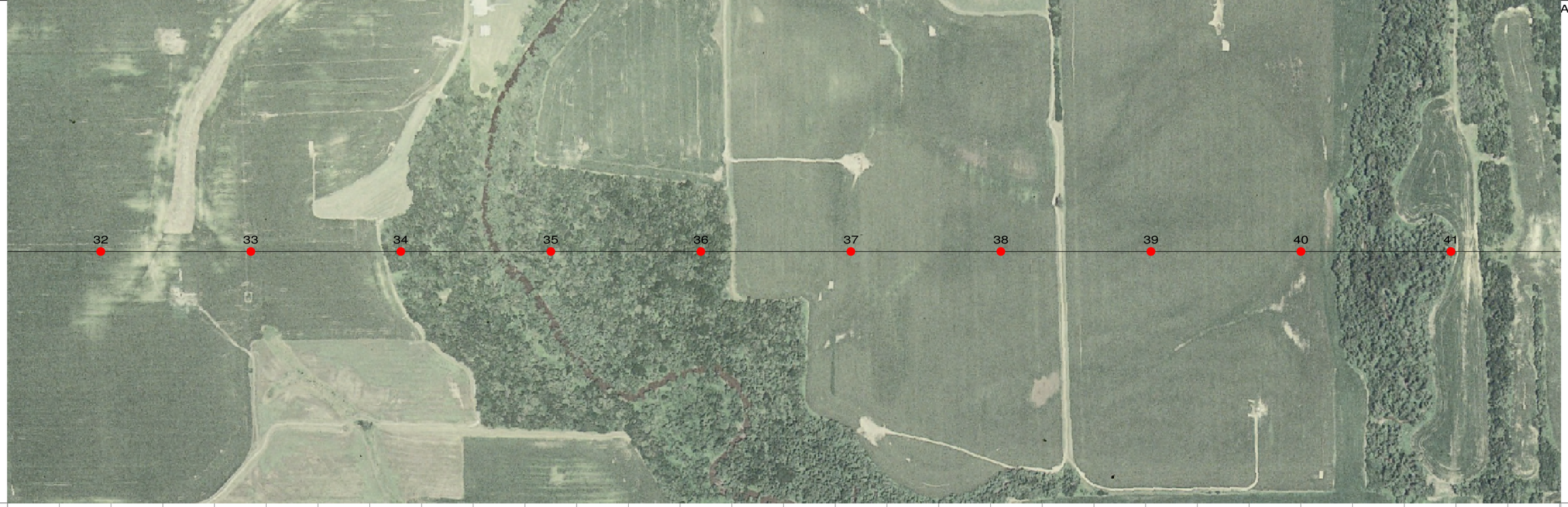

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500.0 ft. Horiz. Scale

100.0 ft. Vert. Scale

North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009

ADD Drawing

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725.00 541.09 416.44 812.07 725.00 725.00 725.00 725.00 725.00 725.00 725.00

PI 3°12'25"

29750 30000 30250 30500 30750 31000 31250 31500 31750 32000 32250 32500 32750 33000 33250 33500 33750 34000 34250 34500 34750 35000 35250 35500 35750 36000 36250 36500 36750 37000

500.0 ft. Horiz. Scale

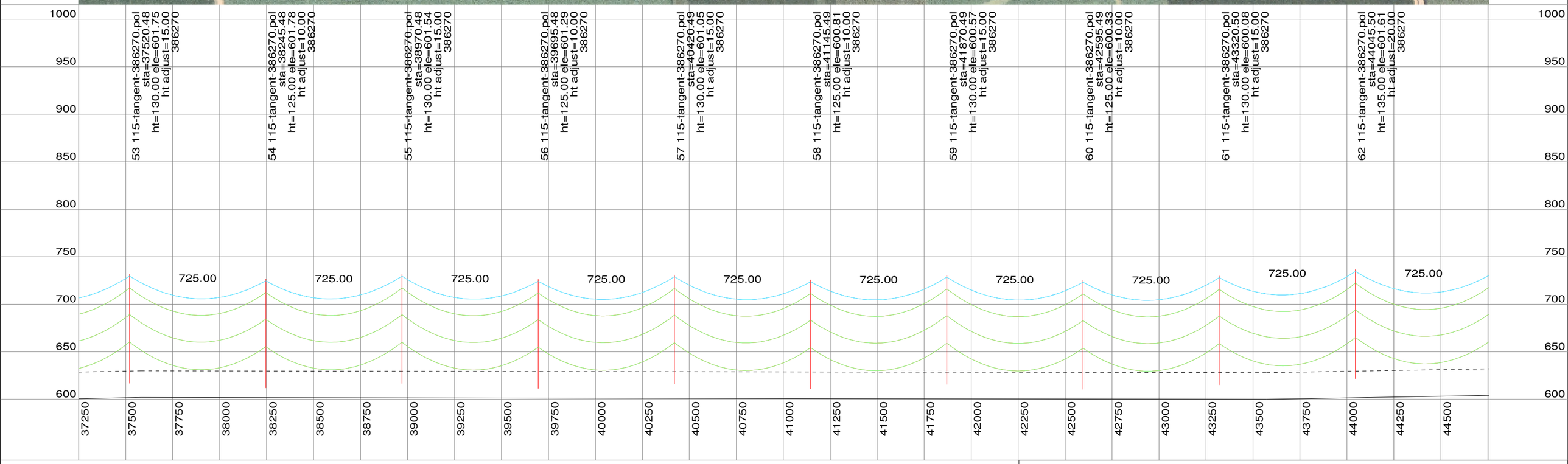
100.0 ft. Vert. Scale

North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009

ADD Drawing



500.0 ft. Horiz. Scale

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North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009

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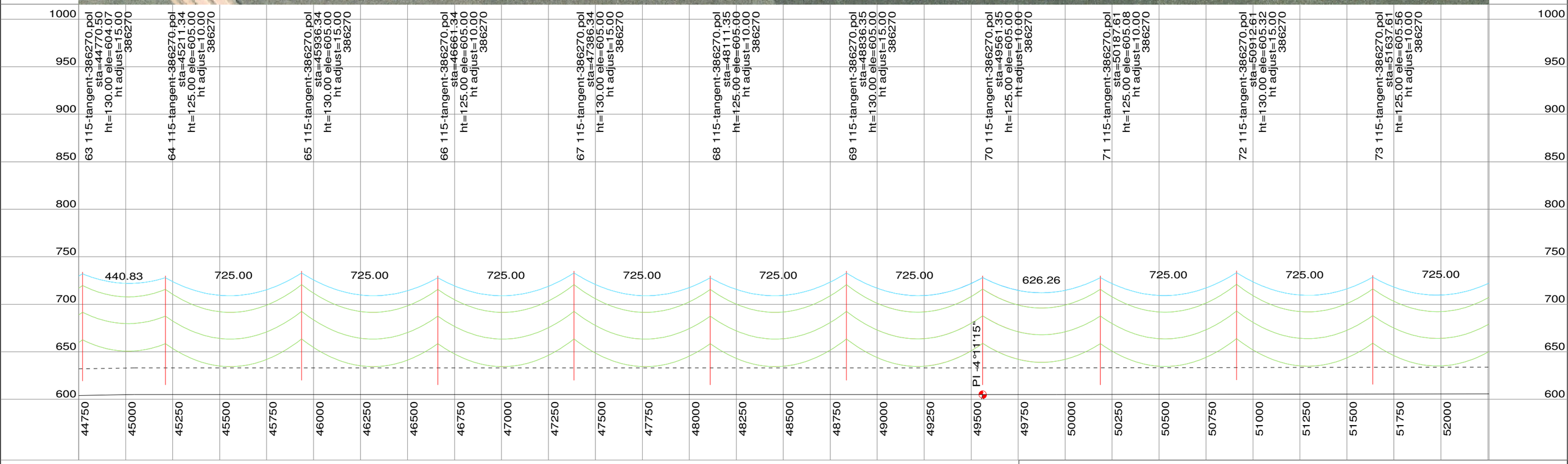

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100.0 ft. Vert. Scale

North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009

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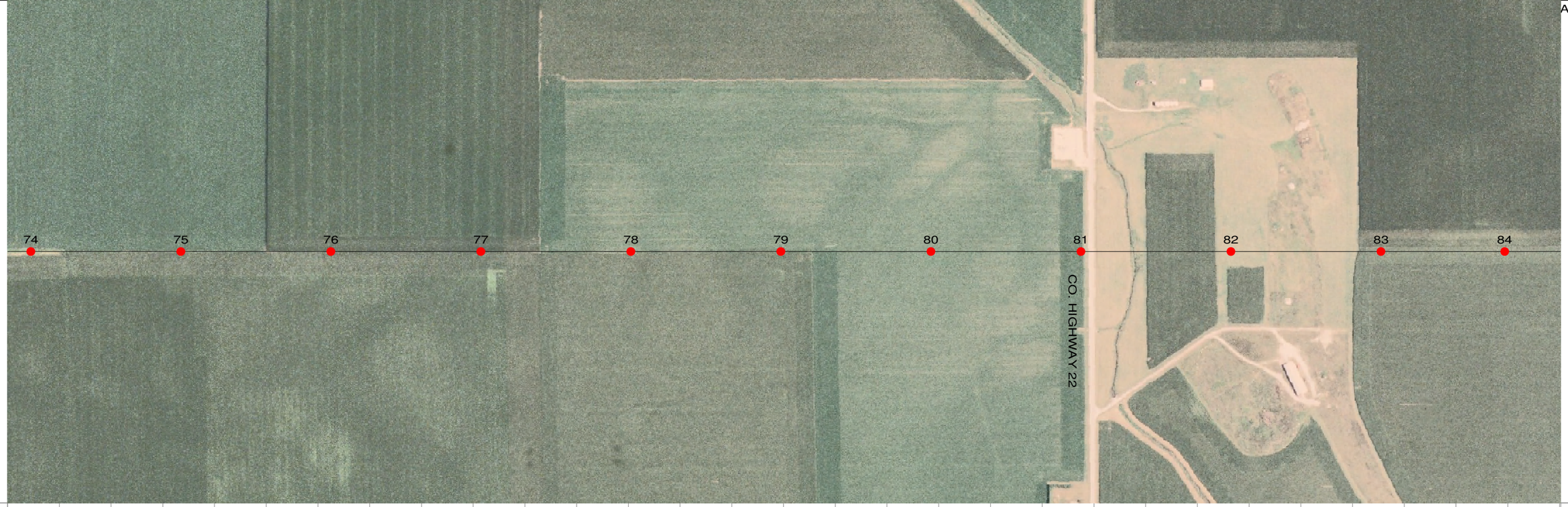

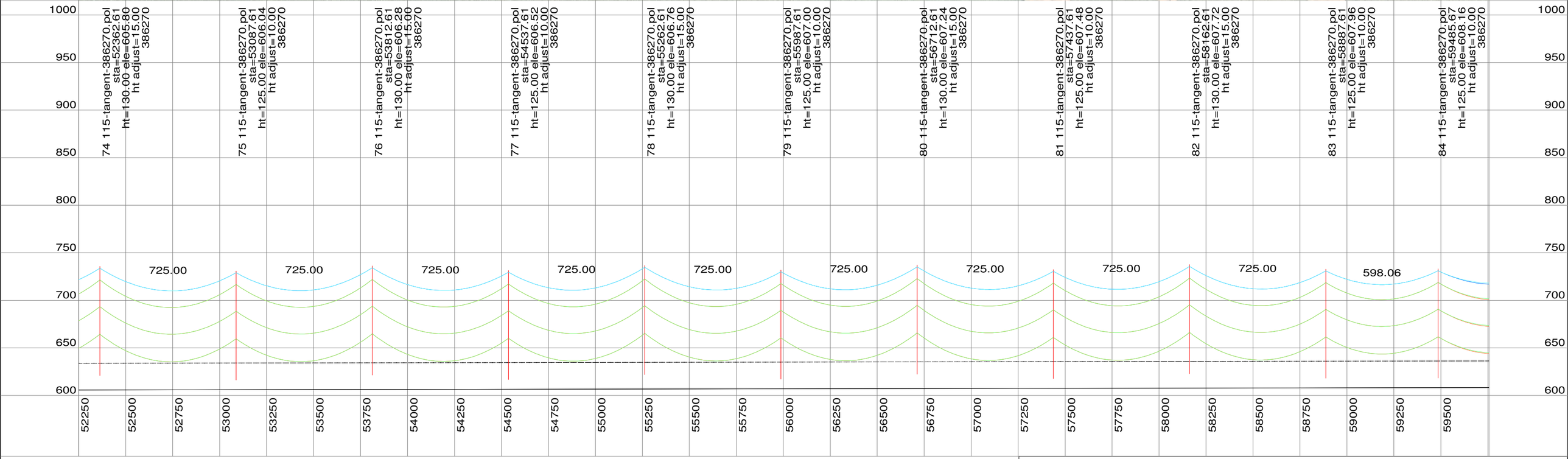

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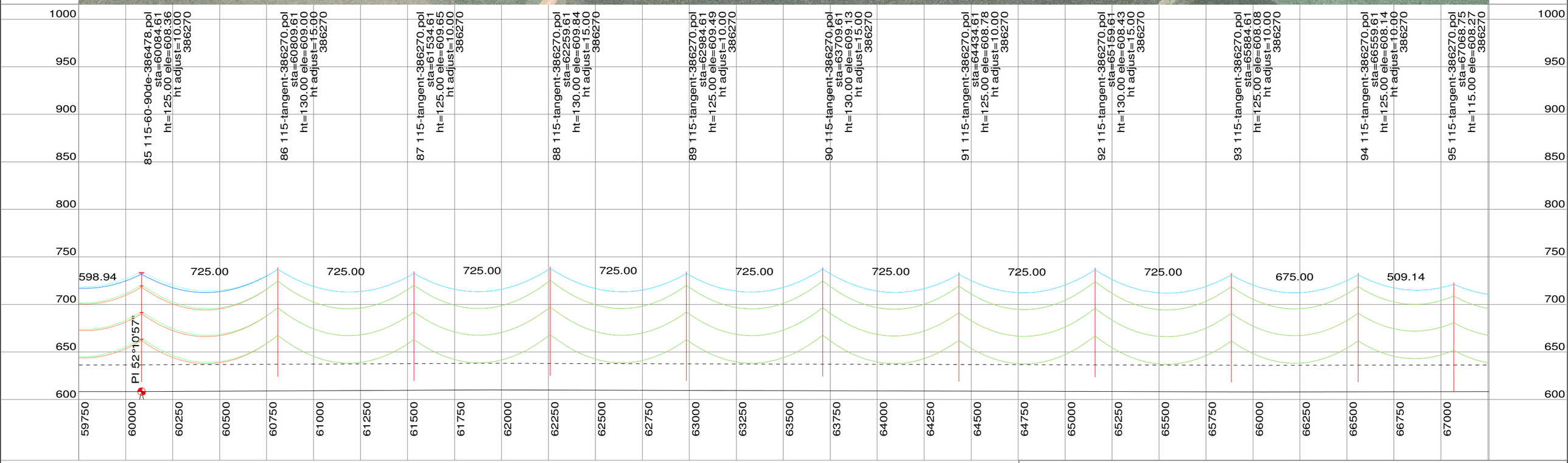
North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009

ADD Drawing



500.0 ft. Horiz. Scale

100.0 ft. Vert. Scale

North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009

PLS-CADD Drawing

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PI 0°00'00"

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850
800
750
700
650
600

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67500
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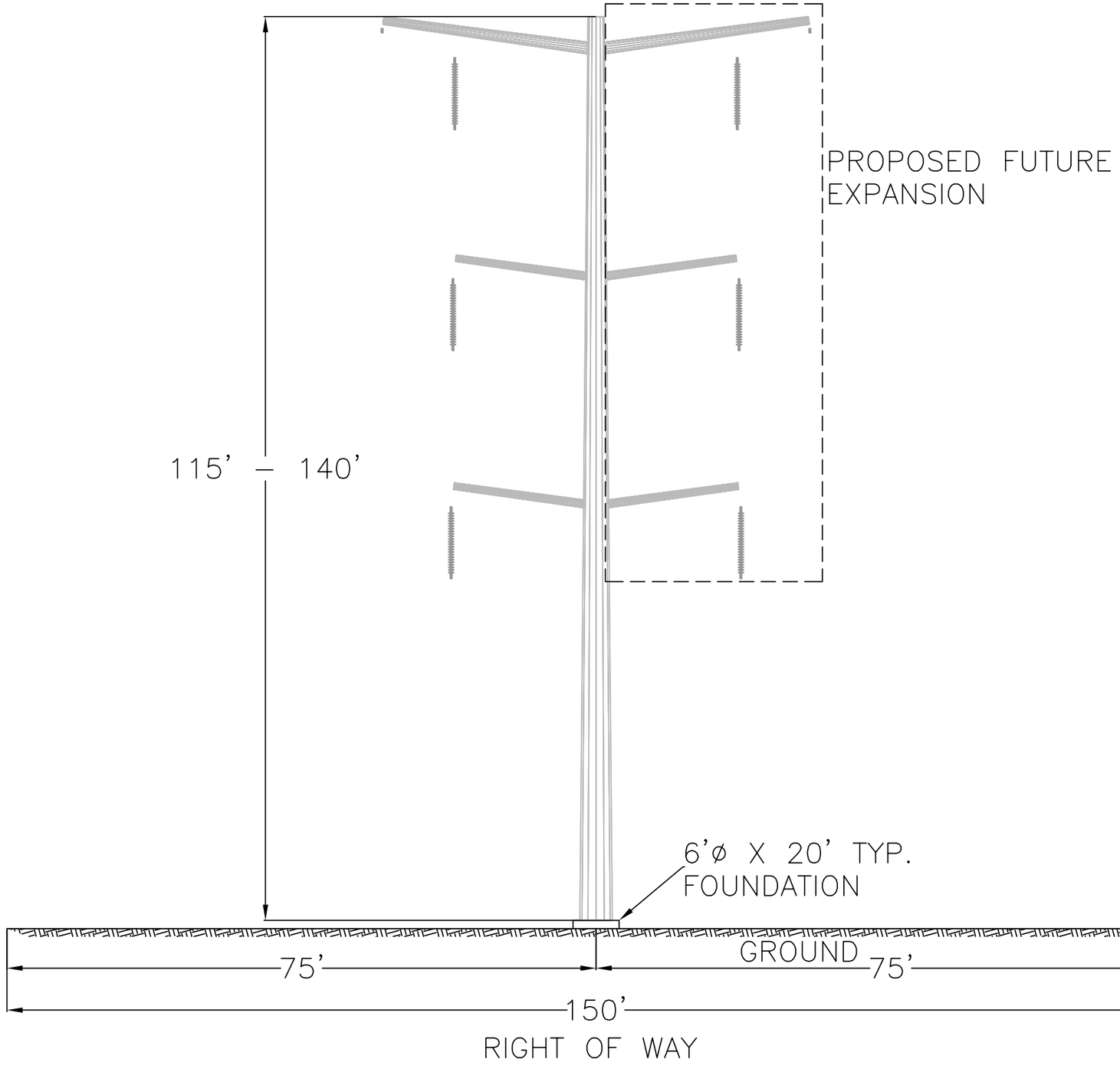
500.0 ft. Horiz. Scale

100.0 ft. Vert. Scale

North

Tenaska 345kV Transmission Line Preliminary Layout

10/27/2009



Rev. No.	Date	Description

PATRICK
ENERGY SERVICES
39500 Orchard Hill Place
Novi, Michigan 48375
TEL: (248) 319-0700
FAX: (248) 319-0701
http://www.patrickesi.com

Project: **TENASKA 345KV TRANSMISSION LINE SECTION VIEW**

Sheet Title:

Date: 10/27/2009

Designed: PES

Drawn: PES

Sheet 1 of 1

CAISSON Version 9.20 11:24:59 AM Wednesday, October 14, 2009
Patrick Energy Services

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**************************************************************************
*                                                                        *
*  PIER FOUNDATIONS ANALYSIS AND DESIGN - (C) 1995,2002 POWER LINE SYSTEMS, INC.*
*                                                                        *
**************************************************************************
```

*** ANALYSIS IDENTIFICATION : Tenaska 345kV Line
NOTES :

*** PIER PROPERTIES CONCRETE STRENGTH (ksi) = 4.00 STEEL STRENGTH (ksi) = 65.00

DIAMETER (ft) = 6.000 DISTANCE FROM TOP OF PIER TO GROUND LEVEL (ft) = 1.00

*** SOIL PROPERTIES

LAYER	TYPE	THICKNESS (ft)	DEPTH AT TOP OF LAYER (ft)	DENSITY (pcf)	CU (psf)	KP	PHI (degrees)
1	S	2.00	0.00	80.0		2.770	28.00
2	S	2.00	2.00	37.6		3.000	30.00
3	S	5.00	4.00	37.6		3.000	30.00
4	S	8.00	9.00	27.6		2.880	28.98
5	S	20.00	17.00	37.6		3.000	30.00

*** DESIGN (FACTORED) LOADS AT TOP OF PIER MOMENT (ft-k) = 1418.0 VERTICAL (k) = 29.5 SHEAR (k) = 16.6
ADDITIONAL SAFETY FACTOR AGAINST SOIL FAILURE = 1.00

*** CALCULATED PIER LENGTH (ft) = 20.000

*** CHECK OF SOILS PROPERTIES AND ULTIMATE RESISTING FORCES ALONG PIER

TYPE	TOP OF LAYER BELOW TOP OF PIER (ft)	THICKNESS (ft)	DENSITY (pcf)	CU (psf)	KP	FORCE (k)	ARM (ft)
S	1.00	2.00	80.0		2.770	7.98	2.33
S	3.00	2.00	37.6		3.000	21.34	4.06
S	5.00	5.00	37.6		3.000	88.88	7.74
S	10.00	3.92	27.6		2.880	97.04	12.04
S	13.92	4.08	27.6		2.880	-124.25	16.03
S	18.00	2.00	37.6		3.000	-73.61	19.02

*** SHEAR AND MOMENTS ALONG PIER

DISTANCE BELOW TOP OF PIER (ft)	WITH THE ADDITIONAL SAFETY FACTOR SHEAR (k)	WITH THE ADDITIONAL SAFETY FACTOR MOMENT (ft-k)	WITHOUT ADDITIONAL SAFETY FACTOR SHEAR (k)	WITHOUT ADDITIONAL SAFETY FACTOR MOMENT (ft-k)
0.00	17.4	1430.2	17.4	1430.2
2.00	15.4	1464.3	15.4	1464.3
4.00	-0.2	1481.8	-0.2	1481.8
6.00	-25.7	1457.2	-25.7	1457.2
8.00	-59.2	1373.8	-59.2	1373.8
10.00	-100.8	1215.1	-100.8	1215.1
12.00	-147.6	967.7	-147.6	967.7

14.00	-195.7	621.2	-195.7	621.2
16.00	-137.5	287.1	-137.5	287.1
18.00	-73.6	75.0	-73.6	75.0
20.00	0.0	-0.0	0.0	-0.0

*** TOTAL REINFORCEMENT PCT = 0.38 REINFORCEMENT AREA (in^2) = 15.47
*** USABLE AXIAL CAP. (k) = 29.5 USABLE MOMENT CAP. (ft-k) = 2273.1

*** US Standard Re-Bars (Select one of the following):

78	BARS #4	(AREA = 0.20 in^2	DIA = 0.500 in)	AT SPACING (in) =	2.50
50	BARS #5	(AREA = 0.31 in^2	DIA = 0.625 in)	AT SPACING (in) =	3.90
36	BARS #6	(AREA = 0.44 in^2	DIA = 0.750 in)	AT SPACING (in) =	5.41
26	BARS #7	(AREA = 0.60 in^2	DIA = 0.875 in)	AT SPACING (in) =	7.49
20	BARS #8	(AREA = 0.79 in^2	DIA = 1.000 in)	AT SPACING (in) =	9.74
16	BARS #9	(AREA = 1.00 in^2	DIA = 1.128 in)	AT SPACING (in) =	12.17
13	BARS #10	(AREA = 1.27 in^2	DIA = 1.270 in)	AT SPACING (in) =	14.98
10	BARS #11	(AREA = 1.56 in^2	DIA = 1.410 in)	AT SPACING (in) =	19.48
7	BARS #14	(AREA = 2.25 in^2	DIA = 1.693 in)	AT SPACING (in) =	27.83

*** WEIGHT OF CAISSON (kips) = 84.823
*** PRESSURE UNDER CAISSON DUE TO INPUT DESIGN AXIAL LOAD (psf) = 1043.4

PLS CADD OUTPU

Uplift,I NA+ 1	SWR Suspension	SWR	-0.000	0.022	0.472	0.473
Uplift,I NA+ 1	TOPL Suspension	TOPL	-0.000	-0.022	1.454	1.454
Uplift,I NA+ 1	TOPR Suspension	TOPR	-0.000	0.022	1.458	1.458
Uplift,I NA+ 1	MIDL Suspension	MIDL	-0.000	-0.023	1.453	1.453
Uplift,I NA+ 1	MIDR Suspension	MIDR	-0.000	0.023	1.456	1.457
Uplift,I NA+ 1	BOTL Suspension	BOTL	-0.000	-0.023	1.441	1.442
Uplift,I NA+ 1	BOTR Suspension	BOTR	-0.000	0.023	1.445	1.445

Overturning Moments For User Input Concentrated Loads:

TANGENT
STRUCTURE 21

Moments are static equivalents based on central axis of 0,0 (i.e. a single pole).

Load Case	Total Tran. Load (kips)	Total Long. Load (kips)	Total Vert. Load (kips)	Transverse Overturning Moment (ft-k)	Longitudinal Overturning Moment (ft-k)
RULE 250B NA+,I NA+	14.707	-0.000	26.821	1277.876	-0.042
RULE 250B NA-,I NA-	-14.709	-0.000	26.821	-1276.537	-0.042
RULE 250B Uplift NA+,I NA+	14.707	-0.000	17.881	1277.620	-0.042
RULE 250B Uplift NA-,I NA-	-14.709	-0.000	17.881	-1276.793	-0.042
RULE 250C NA+,I NA+	15.082	-0.000	10.617	1289.524	-0.034
RULE 250C NA-,I NA-	-15.083	-0.000	10.617	-1289.080	-0.035
RULE 250D NA+,I NA+	5.907	-0.000	26.485	524.277	-0.028
RULE 250D NA-,I NA-	-5.908	-0.000	26.485	-522.838	-0.028
RULE 277 Insulators NA+,I NA+	5.882	-0.000	17.881	511.335	-0.025
RULE 277 Insulators NA-,I NA-	-5.884	-0.000	17.881	-510.431	-0.025
Extreme Ice NA+,I NA+	-0.001	-0.000	19.656	0.508	-0.022
Extreme Ice NA-,I NA-	-0.001	-0.000	19.656	0.508	-0.022
Uplift,I NA+	-0.001	-0.000	9.650	0.182	-0.018
RULE 250B NA+,I NA+ 1	5.882	-0.000	17.881	511.335	-0.025
RULE 250B NA-,I NA- 1	-5.884	-0.000	17.881	-510.431	-0.025
RULE 250B Uplift NA+,I NA+ 1	5.882	-0.000	17.881	511.335	-0.025
RULE 250B Uplift NA-,I NA- 1	-5.884	-0.000	17.881	-510.431	-0.025
RULE 250C NA+,I NA+ 1	13.711	-0.000	9.652	1172.295	-0.031
RULE 250C NA-,I NA- 1	-13.712	-0.000	9.652	-1171.891	-0.032
RULE 250D NA+,I NA+ 1	5.370	-0.000	24.078	476.615	-0.025
RULE 250D NA-,I NA- 1	-5.371	-0.000	24.078	-475.307	-0.025
RULE 277 Insulators NA+,I NA+ 1	5.882	-0.000	17.881	511.335	-0.025
RULE 277 Insulators NA-,I NA- 1	-5.884	-0.000	17.881	-510.431	-0.025
Extreme Ice NA+,I NA+ 1	-0.001	-0.000	17.869	0.462	-0.020
Extreme Ice NA-,I NA- 1	-0.001	-0.000	17.869	0.462	-0.020
Uplift,I NA+ 1	-0.001	-0.000	9.650	0.182	-0.018

M 1289.08·1.1 = 1418 ft-k
Axial 26.8·1.1 = 29.9 K
Shear 15.083·1.1 = 16.6 K

Shear Vert M

*** Weight of structure (lbs):
Weight of Tubular Davit Arms: 3001.6
Weight of Steel Poles: 11444.9
Weight of Suspensions: 152.0

PATRICK

PROJECT NO
PROJECT Tenaska Transmission Line Study
CALCULATED BY CRK DATE 12/16/09
CHECKED BY DATE
SHEET 1 OF 1

TITLE Tenaska Transmission Lines – Current Calculation

Tenaska 138kV Transmission Line - Current Calculation

Equation:

$$I = \frac{P}{\sqrt{3} V \cos\theta}$$

Known Values:

$P = 15\ MW = 15 \times 10^6\ W$
$V = 138\ kV = 138 \times 10^3\ V$
$\cos\theta = pf = 0.9$

Calculated Current:

$$I = \frac{15 \times 10^6}{\sqrt{3}(138 \times 10^3)(0.9)} = 69.728\ A$$

ACSR Conductor Chosen: Hawk

Hawk Current Rating: 659 A

Tenaska 345kV Dual Circuit Transmission Line - Current Calculation

Equation:

$$I = \frac{P}{\sqrt{3} V \cos\theta}$$

Known Values (one circuit):

$P = 780\ MW = 780 \times 10^6\ W$
$V = 345\ kV = 345 \times 10^3\ V$
$\cos\theta = pf = 0.9$

Current Calculation:

$$I = \frac{780 \times 10^6}{\sqrt{3}(345 \times 10^3)(0.9)} = 1450.349\ A$$

ACSR Conductor Chosen: T2-Bluejay

T2-Bluejay Current Rating: 2184 A

TASK NO.	TASK DESCRIPTION	TOTAL HOURS
	PLS CADD	
	Line Design	680
	Structure Design	
	Tangent	56
	Tagent Deadend	56
	Light Angle	56
	Medium Angle DE	56
	Large Angle DE	56
	Special Structure	68
	Foundations	
	Caisson Design	376
	Engineering Documents	
	BOM / Hardware Fitup	432
	Structrue Drawings/Details	696
	L&D Drawings	664
	Foundation Drawings	136
	Staking Reports	76
	Work List	344
	Plan and Profile Drawings - Approx. 10 sheets	1,032
	Vendor Calc/Dwg Check	72
	As-Builts	184
	Project Management	
	Project Management	832
	Construction Support	320
	Vendor Support	128
	Bid Review	104
	Administration	360
	Meetings	
	At Tensaka Offices (Quarterly)	256
	Phone Conferrence (Weekly)	300
	Site Visits	
	Pre-design/Accessibility Walk Through	120
	Staking Review	80
	50% Design Review Meeting	96
	Construction Support/Review	64
	Final Walk Down/As-Built Walk Down	80
	Sub Contracted Work	
	Soil Borings	168
	Survey	168
	Permits	
	Road Crossing	344
	Environmental	216
	TOTAL HOURS/DRAWINGS	8,676
	TOTAL COST	$907,100

EXPENSE DEVELOPMENT

TRAVEL

Air fare	28	trips x	1,000	$/trip	=	$28,000
Hotel	71	night x	150	$/day	=	$10,650
Car rental	31	day x	65	$/day	=	$2,015
Parking fees	71	day x	25	$/day	=	$1,775
Meals	71	day x	50	$/day	=	$3,550
Gas	1,000	gallons	3	$/gal	=	$2,500
Mileage	1,100	miles	0.55	$/mile	=	$605
Subtotal - Travel						**$49,095**

TOTAL ENGINEERING COSTS

Employee labor cost (SPR)	$907,100
Contingency	10%
Labor Revenue	$997,810
Expenses	$49,095
Markup on Expenses	5%
Expense Revenue	$51,550
TOTAL COST	**$1,049,360**

PATRICK
ENGINEERING

Appendix D

Aerial Survey Estimates

12 October 2009

Mr Nicholas Link
PATRICK ENERGY SERVICES
39500 Orchard Hill Place - Suite 200
Novi MI 48375

Re: NEW TRANSMISSION LINE – PHOTOGRAMMETRY PROPOSAL
Taylorville, Christian County, IL

Dear Mr Link:

We are pleased to submit the following proposal for photogrammetric services covering the above-referenced project, as outlined on the map provided to us.

Aerial Photography:
New aerial photography will be flown as soon after your authorization to proceed as weather and ground conditions permit. The photography will be taken with black-and-white film at a 1"=330' negative scale suitable for mapping with 1' contours. On completion of the photography, the film will be processed, checked, and annotated; and one set of contact prints will be furnished for your files.

Ground Control:
It is our understanding that the ground control will be furnished to us. The approximately 47 control locations should be targeted prior to flight. The horizontal control required for the mapping should consist of a coordinate system (State Plane or assumed), and the vertical control should be established on NGVD-29 or NAVD-88 datums.

Analytical Triangulation:
Using the established horizontal and vertical control, analytical triangulation will be performed using the softcopy process to supplement the ground control.

In the softcopy analytical triangulation process, the aerial negatives are scanned and image correlation technology is used to perform passpoint selection, numbering and measurement as an automated process. The ground control locations and additional passpoint locations are measured interactively. A fully analytical bundle adjustment is performed using INPHO MATCH-AT software to produce final X Y Z coordinates for all points.

Topographic Mapping:
On completion of the analytical triangulation, planimetric detail and contours, (for a 150' wide corridor), will be collected in digital form at 1"=50' to cover the project consisting of approximately 14 miles. Mass points and breaklines will be collected in locations that will define the terrain in a manner that 1' contours can be accurately generated through terrain modeling software.

[redacted]

As the data is collected, it will be transferred to an interactive graphic station for editing and the enhancement of cartographic quality. The edited digital mapping will be furnished to you on CD-ROM in AutoCAD DWG format containing planimetric features, contours, and spot elevations. The point and breakline data used to generate the contours will also be furnished.

Standards:
All of the work will be performed in accordance with established practices and procedures of the profession, and in conformity with accepted mapping standards. Areas obscured by foliage, vegetation, or shadows will be defined to indicate that detail in these areas are approximated and may not be reliable. It is recommended that they be supplemented or checked with field surveys.

Our fees for these services will be:

Aerial Photography:	**$ 3,955.00**
Aerial Triangulation and Topographic Mapping:	**20,500.00**
Total:	**$ 24,455.00**

Thank you for the opportunity to submit this proposal. Should you have any questions, or require additional information, please feel free to contact us.

Sincerely,

[redacted]

Acceptance / Payment Terms:
If the above is satisfactory, please formalize your acceptance by signing in the space provided, and faxing the signed copy to us at [redacted]

[redacted] payment terms are Net 30 Days. Should *Patrick ESI* require a "pay when paid" project, and not be able to fulfill those terms, *Patrick ESI* shall pay to [redacted] the amounts agreed upon herein within 14 days of *Patrick ESI's* receipt of payment from its Client, or within 90 days of *Patrick ESI's* receipt of *Aerocon's* invoices, whichever comes first.

Any third-party billings are to be disclosed before work commences on the project.

Accepted by:

Signature	Title	Date

Project Limits

[redacted]

October 9, 2009

Mr. Nicholas Link
Patrick Energy Services
39500 Orchard Hill Place, Suite 200
Novi, MI 48375

Dear Nicholas

The following is [redacted] proposal for a) airborne LIDAR (laser-scan), b) airborne color digital imagery, c) airborne digital video, d) airborne "Happy Snap" digital still images of existing transmission line structures and substations, e) continuous overlapping oblique right-of-way imagery (if requested), f) continuous overlapping vertical right-of-way imagery (if requested), g) preparation of LIDAR intensity imagery (if requested), h) preparation of a PLS-CADD model, i) preparation of a digital terrain model, and j) preparation of plan/profile or planimetric drawings (if requested) for the approximately 14miles-long Tenaska 345KV Transmission Line near Taylorville, Illinois.

The transmission line mileage is approximate; therefore, total mileage and total price contained in this estimate will be adjusted for actual transmission line, right-of-way, or corridor mileage when actual mileage information becomes available. The unit prices per mile contained in this estimate are valid for increases or decreases in total transmission line mileage.

Certain information contained in this proposal is considered by [redacted] and its subcontractors to be proprietary and confidential. [redacted] requests that Patrick Energy Services treat this information as confidential, just as Patrick Energy Services treats its own confidential information.

[redacted] and its subcontractors understand the project scope to be defined as follows.

Project Scope:

Collect airborne LIDAR (laser-scan), digital video, weather, and airborne color digital imagery (digital aerial photography) data and prepare color imagery maps, LIDAR intensity imagery (if requested), digital video, digital "Happy Snap" still images of transmission line structures and substations, continuous overlapping oblique right-of-way imagery (if requested), continuous overlapping vertical right-of-way imagery (if requested), a digital terrain model, a PLS-CADD model, and plan/profile or planimetric drawings (if requested) of the transmission line listed above. All data capture work will be performed by [redacted] employees using [redacted]-owned aircraft and remote sensing equipment, unless otherwise

specified by [redacted] and agreed to by the customer or client. All data processing, engineering model preparation, and drawing preparation will be performed by [redacted] employees located in [redacted] Bessemer, Alabama office or [redacted] Picayune, Mississippi office, unless otherwise specified by [redacted] and agreed to by the customer or client. The work is described as follows:

1. Collect airborne LIDAR (laser-scan) and associated modeling data, using LIDAR remote sensing platform, that will provide the following:
   - Three-dimensional LIDAR (laser-scan) point coordinates
     - Horizontal point coordinates will be referenced to the appropriate State Plane Coordinate System-North American Datum 1983 (NAD83), and vertical point elevations will be referenced to the North American Vertical Datum of 1988 (NAVD88).
     - The units of measurement will be US survey feet.
     - Point data collected will be a) filtered, b) reduced in volume (to remove redundant and otherwise unnecessary points), and c) classified as
       - Ground,
       - Man-made structures, and
       - Vegetation and Other.
     - Data capture swath width for LIDAR (laser-scan) of the transmission line corridor or right-of-way will be at least 400 feet, as specified by Patrick Energy Services, to ensure complete coverage for a digital terrain model, features, and obstacles of the entire 300'-wide corridor or right-of-way. The laser-scan coverage will be uniform, consistent, and continuous over the land areas to be modeled.
     - The point accuracy of TopEye Mark II LIDAR System is the following:
       - Absolute positional accuracy at 95% confidence: (Horizontal: 5 cm; Vertical: 5 cm)
       - Relative (point-to-point) accuracy = (+/-) 2 cm
     - The point accuracy of [redacted] LIDAR data, taking into consideration features such as grass, brush, conductor attach points, atmospheric conditions, etc., is the following:
       - LIDAR vertical data accuracy is 0.50 feet:1000 feet ranging distance RMSE at 2 sigma (95% probability) or better for critical design points such as:
         - Conductor attachment points
         - Shield wire attachment points
         - Conductor and shield wire impingement points
         - Aerial obstacles and features
       - LIDAR vertical data accuracy is 0.25 feet:1000 feet ranging distance RMSE at 1 sigma (68% probability) or better for non-critical design points such as:
         - Ground obstacles
         - Vegetation
         - Ground features

- Up to four (4) coordinate points will be collected for each laser pulse, using multiple return signals from a single laser pulse. *This capability ensures that "ground" return signals are captured, even when penetrating vegetation.*
- The return signal strength (e.g., LIDAR intensity) will be captured for each coordinate point collected. LIDAR intensity is used to generate LIDAR intensity imagery, a LIDAR dot portrait of the geographic area, transmission line, features, and obstacles that are scanned by the LIDAR system. Signal intensity is also used as part of the classification/filtering process and the obstacle digitization process to identify objects in the laser-scan data.
- Laser scan-rate: Adjustable to 50 Hz; Laser scan-angle = (+/-) 20 degrees
- Laser pulses per second: Adjustable to 50,000
- Laser point density: 26-40/ sq. meter (Avg.), 15/sq. meter (Min.)
- Elliptical scan pattern (advantageous for capturing wire-crossings)
  - Forward scan angle = 20 degrees
  - Side-to-side scan angle = 20 degrees
  - Aft scan angle = 14 degrees
- Number data points captured per second (approximate): Up to 200,000

  Note: Laser-scan data (including the return signal intensity values) will be used to establish horizontal position and to determine height of obstacles and features identified using color digital imagery during the obstacle digitization process.
- FDA-certified **binocular eye-safe distance = 60 meters**, with automatic shutdown feature (**SAFETY REQUIREMENT**)

- Two full-motion, color, high-resolution digital videos (broadcast quality), if requested.
  - Orientations – vertical & oblique (45 degrees declination from horizontal)
  - Edited to remove extraneous aircraft flight path maneuvers
  - Geo-referenced to support playback using [redacted] PLS-CADD Image/Video Player software
  - Video cameras are NOT gyro-stabilized.
  - Delivered as **MPEG** or **AVI** file(s) on DVD or external hard disk drive.

- Continuous, overlapping, high resolution oblique right-of-way color digital imagery that operates in [redacted] PLS-CADD video player, if requested.

- Continuous, overlapping, high resolution vertical right-of-way color digital imagery that operates in [redacted] PLS-CADD video player, if requested.

[redacted]

- Color, geo-referenced, high-resolution (16 MPixel resolution) digital ("Happy Snap") images of transmission structures, major obstacles, and construction difficulties, if requested:
  - Camera orientation: **30 to 60 degrees** declination from horizontal, depending on structure spacing and aircraft altitude required by the LIDAR data capture operations
  - Photo format = **portrait**
  - Camera resolution = **12Mpixel**
  - **Entire structure** captured in photograph
  - Geo-referenced to support playback using [redacted] PLS-CADD Image/Video Player software (also provided as a MS/Excel spreadsheet with each photograph linked to spreadsheet by structure ID name/number)
  - Indexed to structure ID name/number - structure ID name/number to be supplied by Patrick Energy Services
  - Delivered as geo-referenced images (**jpg**) on DVD.

2. Capture and process airborne color, high-resolution (12 MPixel) digital imagery of the transmission line corridor or right-of-way. The color digital imagery will be suitable for the production of strip maps of the transmission line corridor or right-of-way, including:
   - Full color, geo-referenced, orthorectified high-resolution digital imagery (digital aerial photography) that has been edge-matched and color-balanced to produce a continuous geo-mosaic map of the entire transmission line corridor or right-of-way.
     - The swath width of the geo-mosaic imagery strip maps of transmission line corridor or right-of-way will be approximately 500 feet (e.g., approximately 250 feet on either side of the corridor or right-of-way centerlines), subject to image cropping requirements.
     - The imagery will have a ground-pixel size resolution of approximately 6 inches.
     - The imagery will be ortho-rectified using LIDAR digital elevation models for the width of the LIDAR data that is collected and will be ortho-rectified to a USGS digital elevation model outside the boundaries of the LIDAR data capture.

   - Full color geo-mosaic map sheets with digitized obstacles for use by ground obstacle verification personnel or crews to assist them in identifying obstacles and features that have not been digitized located and identified using laser-scan and color digital imagery.

   - Full color, digital, geo-referenced, orthorectified geo-mosaic imagery maps of the transmission line corridor or right-of-way in ECW compressed electronic format.

- Full color strip map backgrounds on transmission line plan/profile or planimetric drawings, if requested.

- Full color strip map backgrounds for the plan-view of the PLS-CADD model.

3. Capture and process survey control data and weather data for use in data processing and modeling.
   - Survey control monumentation associated with each ground control (GPS) reference point used in support of the airborne laser-scan activities. To provide GPS ground control for the LIDAR and color digital imagery (aerial photography) data capture and post processing, [redacted] typically sets up GPS recording stations on USGS monuments and records the GPS reference information for the entire duration of all data capture flights. Trimble R7 5700 GPS units are used for setup over USGS monuments.
     - [redacted] requires that airborne data collection flights occur within 15 miles of the (ground control) recording GPS units (ground reference stations) that are set up on stable, high-quality USGS monuments.
     - If there are no useable USGS monuments within 15 miles of all points along a data capture flight line, [redacted] will (with concurrence of the transmission facilities owner) either
       - Engage a licensed land surveyor to set new first-order quality survey ground control monuments (using available CORS stations) or
       - Baseline to a new ground control point in the vicinity of the data capture flight path. To accomplish the baseline operation, [redacted] would set up a recording GPS unit over a known USGS monument and then set up a second GPS station at the baseline point to be established. The GPS recording units record GPS data for a minimum of one hour for every 7 miles (straight-line distance) away from the occupied USGS monument that the baseline monument is located. This procedure is necessary to properly establish the location of the baseline GPS. Subsequently, the new baseline GPS location can be used successfully as a new ground control point.
   - To document the USGS monument that was used as the initial ground control, [redacted] does the following on site:
     - Makes a "pencil rub" of the inscribed lettering on the UGSG monument and
     - Takes pictures of the USGS monument and its surroundings.

- Weather conditions report, indicating wind speed, wind direction, ambient temperature, and sun conditions in 5-minute intervals at time of laser-scan data capture for the transmission line corridor or right-of-way. Weather data will be captured at multiple sites near the existing transmission line.

4. Prepare Basic Product Set that includes the following:
   - Transmission line plan/profile or planimetric drawings per Patrick Energy Services drawing specifications (ie. Patrick Energy Services drawing borders, title block, line widths, line colors, text sizes, text colors, etc.) in AutoCAD or Microstation format at data capture ambient conditions, if requested by Patrick Energy Services. The drawings will be prepared at a vertical scale of 1"=20' and at a horizontal scale of 1"=200', as applicable, or as otherwise specified by Patrick Energy Services, and will be delivered in electronic form on DVD and as hardcopy prints.

   - PLS-CADD model of transmission line, corridor, and/or right-of-way at data capture ambient conditions with features and obstacles that are located and identified by laser-scan and color digital imagery, with a digital terrain model of the corridor or right-of-way, and with color digital imagery as a background for the plan views.

   - LIDAR intensity imagery in PLS-CADD format, if requested. The LIDAR intensity imagery is composed of LIDAR points with location attributes and with the gray-scale color defined by the LIDAR reflection intensity generated by the object within the transmission line rights-of-way or corridors which produced the LIDAR reflection. Due to the accuracy of the LIDAR intensity imagery, it is extremely beneficial for lines routing and pole spotting along roadways and city streets.

   - Color digital imagery geo-mosaic map sheets with digitized features and obstacles that are located and identified by laser-scan and color digital imagery.

   - Color digital video at 45 degrees and 90 degrees in MPEG format.

   - Continuous, overlapping, high resolution oblique right-of-way color digital imagery that operates in [redacted] PLS-CADD video player, if requested.

   - Continuous, overlapping, high resolution vertical right-of-way color digital imagery that operates in [redacted] PLS-CADD video player, if requested.

   - Color "Happy Snap" still digital images of individual transmission structures and substations, if requested.

Project Planning/Coordination/Data Capture

Project planning, coordination, and data capture include the following:

1. Mission planning: [redacted] will initiate mission-planning activities immediately on completion of a contract or a work authorization document. Activities associated with the preparation of mission plans will include:
   - Acquisition of existing maps and information from Patrick Energy Services.
   - Acquisition of topographical feature codes or other identifiers from Patrick Energy Services for preparation of PLS-CADD model.
   - Identification by Patrick Energy Services of the exact start/end points and PI's (turn points) for the transmission line corridor or right-of-way.
   - Preparation of pilot navigation and instrument control data for project.
   - Identification of emergency services.
   - Identification and qualification of ground (GPS) control.
   - Preparation of mission plans (includes **Safety Plan**).
2. Data capture coordination: [redacted] will coordinate its data capture activities as follows to ensure successful and uneventful mission.
   - Coordination with local law enforcement, civil aviation, and emergency service providers, as required.
   - Coordination with Tenaska's Transmission Line Engineering Department for access to the transmission line corridor or right-of-way.
   - Coordination with Tenaska's "Control Center" for data-capture flights over the transmission line corridor or right-of-way.
   - Coordination with FAA and local airport authorities regarding permits, licenses, and access to controlled airspace.
   - Assignment of ground-air-ground radio frequencies to facilitate ground-based mission control of all airborne data capture activities. **This is a flight-safety requirement.**
3. Data capture:
   - Airborne data capture: The following equipment and crews may be used for airborne laser-scan and color digital imagery data capture for transmission lines, generating plants, and substations:

- Helicopter(s)/TopEye laser-scan instrument/color digital imagery equipment: The following primary and backup helicopters may be used for laser-scan and color digital imagery data capture:
  - Primary: N350BA, American Eurocopter AS350B/A helicopter (turbine engine, blue and white with gray trim), TopEye Mark II laser system, color digital still camera, vertical/oblique digital video, crew (flight operations manager, pilot, instrument operator, ground control station operator(s), geomatics engineer or technician).
- Fixed-wing aircraft/color digital imagery equipment: The following primary fixed-wing aircraft may be used for color digital imagery data capture:
  - Primary: N14XT, Partenavia high-wing airplane (twin reciprocal engines, white with blue and red trim), color high-resolution digital camera, crew (pilot and camera/ground reference station operator).

- Ground-based data capture: The following equipment and crews may be used for ground-based weather data capture and ground-based GPS data capture for land areas, transmission lines, generating plants, and substations:
  - Weather instruments: Multiple Davis Instruments Weather Wizard III portable weather stations with recording equipment in vinyl container (marked with [redacted] logo and telephone numbers) and with weather probes mounted on telescopic masts.
    - Temperature accuracy: +/- 1 degree F
    - Temperature range: -50 degrees F to 140 degrees F
    - Wind speed accuracy: +/- 5%
    - Wind speed range: 2 mph to 150 mph (2.9 ft/sec to 220 ft/sec)
    - Wind direction accuracy: +/- 7 degrees
  - Ground-based GPS instruments: Multiple Trimble 5700 survey grade GPS units that are set up at survey monuments and USGS monuments to collect GPS data for dual frequency, differential GPS coordinate calculations.

Project Deliverables

The following are the project deliverables:

1. Color digital imagery of transmission line, corridor, and right-of-way (GIS-compatible).
   - Full color digital imagery ground obstacle verification map sheets with digitized obstacles that are located and identified by laser-scan and color digital imagery for use by ground obstacle verification personnel or crews, if requested.

   - Full color, digital, geo-referenced, orthorectified geo-mosaic imagery maps of the transmission line corridor or right-of-way in ECW electronic format on DVD, accompanied by the appropriate ECW-viewer software.

- Full color strip map backgrounds for electronic transmission line plan/profile or planimetric drawings at a scale of 1"=200', if requested.

- Full color strip map backgrounds for plan-view of PLS-CADD model.

2. ASCII data files (GIS-compatible) of laser-scan coordinate point data (X, Y, Z, Intensity), if requested.

3. Survey monument information (documentation) for transmission line corridor or right-of-way.

4. Weather conditions data report for transmission line, corridor, and/or right-of-way, including:
   - Location of monitoring instruments
   - Recorded data at 5-minute intervals during laser-scan data capture
     - Date/time of data acquisition
     - Ambient temperature
     - Wind speed
     - Wind direction
     - Sun conditions

5. Full-motion vertical and oblique color digital video of corridor or right-of-way flown transferred to DVD, if requested.

6. LIDAR intensity imagery of transmission line right-of-way or corridor in PLS-CADD format, if requested.

7. Color digital imagery "Happy Snaps" of transmission line structures, obstacles, substations, and construction difficulties, if requested. "Happy Snap" imagery will be geo-referenced to support playback using [redacted] PLS-CADD Image/Video Player software and also will be provided as an MS/Excel spreadsheet with each photograph linked to spreadsheet by structure ID name/number.

8. Continuous, overlapping, high resolution oblique right-of-way color digital imagery that operates in [redacted] PLS-CADD video player, if requested.

9. Continuous, overlapping, high resolution vertical right-of-way color digital imagery that operates in [redacted] PLS-CADD video player, if requested.

10. PLS-CADD model and plan/profile (or planimetric) drawings of transmission line, corridor, and/or right-of-way.
    - PLS-CADD model of transmission line, corridor, and/or right-of-way at data capture ambient conditions, which include:

- Ground profiles with center, ___' left offset, and ___' right offset profiles, as specified by Patrick Energy Services.
- Digital terrain model.
- Existing transmission structure locations and numbers.
- Station numbers.
- Existing transmission overhead shieldwire 3D laser data points and attachment points for shieldwires that are located and identified by laser-scan and color digital imagery.
- Existing transmission conductor 3D attachment points.
- Existing transmission conductor 3D laser data points.
- Existing distribution poles that are located and identified by laser-scan and color digital imagery, with feature codes, locations, and heights.
- Existing distribution conductor 3D laser data points.
- Existing distribution conductor 3D attachment points on existing transmission structures.
- Existing communication poles that are located and identified by laser-scan and color digital imagery, with feature codes, locations, and heights.
- Existing communication cable 3D laser data points.
- Existing communication cable 3D attachment points on existing transmission structures.
- Utility line crossings that are located and identified by laser-scan and color digital imagery, with feature codes, locations, and heights.
- Support structures on each side of the transmission line centerline for all line crossings, with crossing conductor's attachment heights, for all line crossings.
- Obstacles and features, including other overhead utility structures and conductors, within the transmission line corridor or right-of-way, that are located and identified by laser-scan and color digital imagery, with feature codes, locations, and heights.
- Color digital imagery strip maps of transmission line corridor or right-of-way in the PLS-CADD plan view.
- Geo-referenced Happy Snap (close-up) digital photographs, if purchased by Patrick Energy Services.

- Plan/profile drawings or planimetric drawings of transmission line, corridor, and/or right-of-way in AutoCAD or Microstation format on DVD at a vertical scale of 1"=20' and at a horizontal scale of 1"=200', if requested. The plan/profile drawings will include the following or planimetric drawings will include applicable items from the following:
  - Ground profiles with center, ___' left offset, and ___' right offset profiles, or as otherwise specified by Patrick Energy Services.
  - Existing transmission structure locations and numbers.
  - Station numbers, per Patrick Energy Services specifications.

- Existing transmission overhead shieldwire laser data points and attachment points for shieldwires that are located and identified by laser-scan and color digital imagery.
- Existing upper transmission conductor laser data points.
- Existing lowest transmission conductor catenary.
- Existing transmission conductor attachment points.
- Existing distribution poles that are located and identified by laser-scan and color digital imagery, with feature codes, locations, and heights.
- Existing distribution conductor 3D laser data points.
- Existing distribution conductor 3D attachment points on transmission structures.
- Existing communication poles that are located and identified by laser-scan and color digital imagery, with feature codes, locations, and heights.
- Existing communication cable 3D laser data points.
- Existing communication cable 3D attachment points on transmission structures.
- Utility line crossings that are located and identified by laser-scan and color digital imagery, with feature codes, locations, and heights.
- Support structures on each side of the transmission line centerline for all line crossings, with crossing conductor's attachment heights, for all line crossings.
- Obstacles and features, including other overhead utility structures and conductors, within the transmission line corridor or right-of-way that are located and identified by laser-scan and color digital imagery, with feature codes, locations, and heights.
- Color digital imagery strip map of transmission line corridor or right-of-way to depict 500' of property, or more where specified (e.g., 250' on each side of the transmission line centerline).

Pricing

The pricing estimates for this transmission line are presented in the following table. The transmission line mileage is approximate. Actual pricing will be based on actual transmission line mileage.

Pricing Estimate: Patrick Energy Services

Item	Task Description	Units	Unit Price	Quantity	Price
1	Mobilization *				
	Helicopter/Crew	Flt. Hrs.	$850	9.50	$8,075
	Fixed-wing/Crew	Flt. Hrs.	$325		$0
	Ground Support Crew	Days	$450	2.50	$1,125
	Task Subtotal				$9,200

2	Tenaska 345KV T.L.				
	Color Orthophoto Imagery ** (400' Swath)				
	Data Capture	Miles	$165	14.00	$2,310
	Image Processing	Miles	$125	14.00	$1,750
	Color Imagery Plots (Est.)	Each	$45	13.00	$585
	Subtask Subtotal				$4,645
	LIDAR (Laser-scan 400' Swath)				
	Data Capture	Miles	$400	14.00	$5,600
	Filter & Format Ckt. 1	Miles	$300	14.00	$4,200
	Filter & Format Ckt. 2	Miles	$150		$0
	PLS-CADD Model Ckt. 1	Miles	$175	14.00	$2,450
	PLS-CADD Model Ckt. 2	Miles	$125		$0
	PLS-CADD Mth.1 Str.&Sag Cond. Ckt. 1	Miles	$100		$0
	PLS-CADD Mth.1 Str.&Sag Cond. Ckt. 2	Miles	$100		$0
	Overlapping Oblique R/W Imagery	Miles	$185	14.00	$2,590
	Overlapping Vertical R/W Imagery	Miles	$65		$0
	LIDAR Intensity Imagery	Miles	$55	14.00	$770
	Color Video of Right-of-Way	Miles	$50	14.00	$700
	Subtask Subtotal				$16,310
	Additional Tasks and Deliverables				
	Digital Terrain Model (ROW-width) (within right-of-way)	Miles	$85	14.00	$1,190
	Contour Map From DTM	Miles	$75		$0
	Digitize Topo. Features/Obstacles (Urban /suburban from laser/digital imagery)	Miles	$250		$0
	Digitize Topo. Features/Obstacles (Rural from laser/digital imagery)	Miles	$200	14.00	$2,800
	Happy Snap Imagery (Estimated) ***	Each	$15		$0
	Ground Obstacle Verification ****	Days	$1,900	16.00	$30,400
	LIDAR Accuracy Assessment Per Site	Each	$1,000		$0
	P/P or Planimetric Drawings Ckt. 1	Miles	$200	14.00	$2,800
	P/P or Planimetric Drawings Ckt. 2	Miles	$150		$0
	Thermal Rating Ckt. 1(with DTA)	Miles	$350		$0
	Thermal Rating Ckt. 2(with DTA)	Miles	$350		$0
	Vegetation Analysis (with Thermal Anal.)	Miles	$460		$0
	Subtask Subtotal				$37,190
	Task Subtotal				$58,145

Total Cost with Planimetric Dwgs. & With Ground Obstacle Verification	**$67,345**
Total Cost with Planimetric Dwgs. & w/o Ground Obstacle Verification	**$36,945**
Total Cost w/o Planimetric Dwgs. & w/o Ground Obstacle Verification	**$34,145**
Total Cost with Planimetric Dwgs. & w/o Video & Ground Obstacle Verification	**$36,245**
Total Cost w/o Planimetric Dwgs., Video, & Ground Obstacle Verification	**$33,445**
Total Cost w/o Plan. Dwgs., Video, Gnd. Obs. Ver, & LIDAR Intensity Imagery	**$32,675**

Pricing Notes:
* NTE: Invoiced at-cost but Not-to-Exceed. **If data collection for this project can be performed on the same mobilization as other projects in the same general area, the stated mobilization costs may be reduced.**

** Color digital imagery must be purchased for the project in order to digitize (locate and identify) obstacles and features from laser-scan and color digital imagery.

*** Optional color Happy Snaps for certain structures, obstacles, environmental hazards, construction difficulties, etc.

- The number of "Happy Snaps" in the pricing table above is estimated based on an anticipated number of structures per mile.
- If "Happy Snaps" are purchased by Patrick Energy Services, the actual price associated with this item will be computed to account for the actual number used, as based on the stated unit price.

Ground Obstacle Verification:

Although [redacted] TopEye Mark II LiDAR Systems detect most features and obstacles, some materials (e.g., particularly black polyethylene-covered CATV service drops, telephone wires that are not lashed to a messenger, and all-dielectric/self-supported fiber-optic cable) may not reflect enough laser light to be easily detected. Therefore, these and other obstacles with extremely low reflectivity may not be located and identified using laser-scan and color digital imagery. To ensure that all obstacles and features that may affect the operation of the transmission line are located and identified, a ground obstacle verification of the transmission line corridor or right-of-way is recommended by [redacted]

If requested by Patrick Energy Services, [redacted] will perform ground obstacle verification of the transmission line right-of-way or corridor that is mapped and/or modeled. The ground obstacle verification can be a right-of-way or corridor walk-through by qualified technicians or engineers, or it can be a ground obstacle verification survey by a small ground survey crew.

- If purchased by Patrick Energy Services, [redacted] personnel or an [redacted] sub-contractor ground obstacle verification survey crew will perform the ground obstacle verification with the aid of [redacted] digitized obstacles map product.
- Alternatively, Patrick Energy Services may elect to have its own ground survey crew or other personnel perform the ground obstacle verification, with or without the aid of [redacted] digitized obstacles map product.
- **A ground obstacle verification for the transmission line right-of-way or corridor is included as an option in the pricing estimate. The price for a**

ground obstacle verification of the transmission line right-of-way or corridor included in this proposal is $1900 per survey crew day, which has been added to the total Pricing Estimate Cost above. If Patrick Energy Services elects to have its own survey crews or its sub-contractor ground survey crew perform the ground obstacle verification of the transmission line right-of-way or corridor, the ground obstacle verification cost will not be included in the total project cost.

Invoice Schedule:

1. The mobilization price and the data collection price will be invoiced when the data capture activity is completed.
2. The price associated with the ground verification, if requested, will be invoiced when the ground verification is completed.
3. The price of the color digital imagery, plan/profile drawings (if requested), and PLS-CADD model of each transmission line corridor will be invoiced when final products are delivered for each line.
4. Payments are due 30 days after date of invoice. Invoices that are unpaid after 30 days after the date of the invoice are subject to a 1½% per month delinquent fee.

Project Schedule

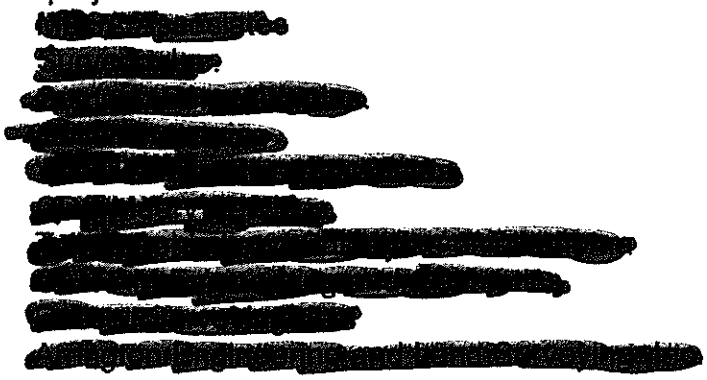
The schedule for this project will be as follows:

1. Color digital imagery and laser-scan data will be captured within two to three weeks (subject to acceptable weather conditions) or less after Patrick Energy Services
   - [redacted] the proposal,
   - Executes a contract or provides a work authorization for the work, and
   - Provides transmission line P.I. (Point-of-Intersection) information necessary for the preparation of the flight mission plans.
2. Color digital imagery maps with digitized features and obstacles for the transmission line to be used for the ground obstacle verification will be prepared by [redacted] within two weeks after the laser-scan and color digital imagery data capture flights have been completed for the line.
3. Ground obstacle verification work, if requested by Patrick Energy Services from [redacted], will be completed within two to three weeks (subject to acceptable weather conditions) after [redacted] conducts data capture operations and prepares color digital imagery maps with digitized obstacles that are located and identified by laser-scan and color digital imagery.
4. Color digital imagery maps, digital terrain model, PLS-CADD model, digital video, Happy Snaps, continuous overlapping vertical imagery, continuous overlapping oblique imagery, and plan/profile or planimetric drawings for the transmission line corridor or right-of-way will be delivered within two weeks after the ground obstacle verification has been completed, or before. Therefore, all deliverables for the transmission line should be provided to Patrick Energy Services within six weeks to seven weeks after the data capture flights have been completed, or within eight weeks to ten weeks after

Patrick Energy Services accepts the proposal and provides the necessary information for flight planning and data processing. If a ground obstacle verification is not required of [redacted] but will be provided by Patrick Energy Services' ground survey crew or other personnel, all deliverables for the transmission line will be delivered to Patrick Energy Services within six to seven weeks after Patrick Energy Services accepts the proposal and provides the necessary information for flight planning and data processing.

Subcontractors

[redacted] subcontractors who may perform ground obstacle verification work for this project are:



Insurance

[redacted] at its expense, shall procure and maintain in effect policies of insurance providing the coverages and limits specified below:

1. Worker's Compensation in statutory amounts and Employer's Liability with a minimum limit of $1,000,000 per person.
2. Commercial General Liability Insurance on an Occurrence Basis, with the following coverages and limits:

3. General Aggregate	$2,000,000
4. Products-Completed Operations-Aggregate	$2,000,000
5. Personal & Advertising Injury	$1,000,000
6. Each Occurrence	$2,000,000
7. Fire Damage (any one fire)	$ 50,000
8. Medical Expense (any one person)	$ 5,000

9. Business Automobile Liability, including owned, hired and non-owned automobiles, for Bodily Injury and Property Damage with a combined single limit of $1,000,000 per occurrence.
10. Excess Liability in Umbrella Form with a limit of $3,000,000 each Occurrence, $3,000,000 Aggregate.
11. Commercial Aviation Liability Insurance, including coverage for Bodily Injury and Property Damage, with a limit of $10,000,000 combined single limit including passengers, $1,000,000 each person.
12. [redacted] insurance shall be primary insurance with respect to the Work and insurance of Patrick Energy Services shall be in excess of [redacted] insurance and shall not contribute with it.

13. [redacted] insurance carrier will have an A. M. Best's Insurance Guide rating of A VIII or better.

[redacted]/Subcontractor Rates and Additional Charges for "Out-of-Scope" Work

1. [redacted] will provide additional electronic copies of LIDAR (laser-scan) data or PLS-CADD models for $25 per DVD plus the time required to compose the data at a rate of $75/hour.

2. [redacted] will provide additional electronic copies of the "Happy Snap" imagery for $25 per DVD plus the time required to compose the imagery to be stored to the DVD at a rate of $75/hour.

3. [redacted] will provide additional electronic copies of the color geo-mosaic map imagery, continuous overlapping oblique right-of-way imagery, continuous overlapping oblique right-of-way imagery, and/or digital vertical and oblique video for $25 per DVD plus the time required to compose the imagery to be stored to the DVD at a rate of $75/hour.

4. [redacted] will provide additional hardcopy plots of ground obstacle verification sheets, plan/profile drawings, or planimetric drawings at a rate of $45/drawing sheet.

Please call me at [redacted] or [redacted] with any questions or comments regarding this Proposal. Thank you for allowing us to offer this proposal.

Sincerely

[redacted]

[redacted]

Link, Nicholas

From: [redacted]
Sent: Thursday, October 15, 2009 2:58 PM
To: Link, Nicholas
Cc: LaRiviere, Randy; Bromley, Pat; Frank Taylor
Subject: RE: LiDAR Estimate Request.

Categories: Green Category

Nicholas,

Providing processed LiDAR data with Bare Earth classification for the below referenced project would be in the range of $15,000 to $18,000, and we could deliver final data within 30 days from LiDAR acquisition. Additionally, we will need as many as 8 ground control points – Patrick Engineering could collect these, or we could for an additional fee of $2500.

If you would like a more detailed and final quote/proposal from us, please just let us know and we can provide that. Feel free to call or email if you have any questions or comments. Thanks again for contacting us on this, and we look forward to hearing from you.

Regards,

[redacted]

new address

[redacted]

From: Link, Nicholas [mailto:nlink@patrickesi.com]
Sent: Thursday, October 08, 2009 3:15 PM
To: [redacted]
Cc: LaRiviere, Randy; Bromley, Pat
Subject: Lidar Estimate Request.

[redacted]

Patrick Energy Services is requesting an estimate to perform Lidar Survey for the approximately 14 mile route just north of Taylorville, Ill. We would like it to have elevation in foot increments (as we discussed on the phone). We would like a corridor width of 150 feet. I have attached a picture of our route which is the black line from the substation to our site. I also included a .kmz file per your request. We would like this estimate within 25% accuracy by Friday October 16th . If you have any questions or need more information please feel free to contact me.

Thank you,

Nicholas Link
Staff Civil Engineer

PATRICK
ENGINEERING

Appendix E

Site Survey Estimates

Link, Nicholas

From: [redacted]
Sent: Friday, October 16, 2009 4:27 PM
To: Link, Nicholas
Cc: LaRiviere, Randy; Bromley, Pat; [redacted]
Subject: RE: Ground Survey Request

Categories: Green Category

Nick,

I have a cost estimate. If you want a proposal, let me know, but I think this is for budgeting. Our estimated fee is on the order of $99,000.00 +/- 25%.

To summarize, the scope is the following:

- Real-estate investigation
- Survey and determine property lines & owners
- New easement exhibits for the owners
- Verification of aerial obstacles.
- Staking activities for the right of way as well as two occasions of construction staking.
- Staking out 100 poles.

Some assumptions are:

- 14 miles of corridor
- 30 property owners / parcels
- 5 significant rights of way to determine
- 16 Land Sections to survey and solve.

Let me know if you need this as a formal document from PEI.

Sincerely,

PATRICK [redacted]

[redacted]
[redacted]
Patrick Engineering, Inc.
4970 Varsity Drive
Lisle, IL 60532
(630) 795-7377 (office)
(630) 817-0371 (mobile)

From: Link, Nicholas
Sent: Friday, October 09, 2009 11:28 AM
To: [redacted]

Link, Nicholas

From: [redacted]
Sent: Monday, October 19, 2009 11:40 AM
To: Link, Nicholas
Subject: Taylorville

Categories: Green Category

Sorry for the delay with this. My weekend plan of having this ready first thing this morning didn't pan out. Regardless, I have numbers for you at this point. A rough number that you can run with at this point would be $136,000. This fee is assuming that we'd have 50 easements to prepare and 15 highway permit, railroad permit, or utility crossing type exhibits. I used the Posey County/Vectren project as my basis. Miscellaneous Surveying @ $1765 per day was not included in the above. I'm not sure how much of this type of service will be needed on the project and will look for your input. I'm going to head out to lunch but would like to talk to you once I get back.

[redacted]

nlink@patrickesi.com nlink@patrickesi.com

Link, Nicholas

From: [redacted]
Sent: Thursday, October 15, 2009 2:19 PM
To: Link, Nicholas
Subject: Ground Survey Quote - 345 KV line

Categories: Green Category

Nick:

Following is our quotation for the above referenced work:

Assumptions:

1) The line will be flown for topography and contours.
2) The number of easements for pricing purposes was based on 36. Included are courthouse research, corner tie-in, description, and plat of easement.
3) Staking for right-of-way and structures was figured. (one stake at centerline of structure)
4) A Route Survey Plat is included.

[redacted] proposes to furnish all labor, equipment, and supervision necessary to perform a ground survey on approximately fourteen miles of new 345kv transmission line North and West of Taylorville, IL.

The work shall include real estate investigation with any necessary property lines located; easement plat and description; and a route survey plat.

Overhead obstacles will be located with x, y & z coordinates.

Centerline control, staking of the right-of-way and two occasions of construction staking are included.

Our lump sum price for the above, based on the assumptions made, is $169,940.00.

If you have any questions, I'll be in the office in the morning after 9:00 A.M.

Sincerely,

[redacted]

PATRICK
ENGINEERING

Appendix F

Geotechnical Services

Link, Nicholas

From: [redacted]
Sent: Tuesday, October 20, 2009 6:58 AM
To: [redacted] Link, Nicholas
Subject: RE: Geotech Services for Tenaska 345kV Line

Categories: Green Category

Nicholas,

I have estimated a cost of approximately $100,000.00 for 100 test borings to a depth of 50 ft over the length of the 14 miles. This includes lab testing and geotechnical report based on the foundation type described below. This is based on the following assumptions as well:

The client will have a surveyor mark the test boring locations in the field
The client will arrange for right-of-entry onto private property
No traffic control will be required.
No rock coring will be required
All test borings locations are accessible to an ATV mounted drill rig without any clearing or bulldozer work.

Hopefully this will help the planning. If you have any questions or would like a formal proposal for the scope of work, please let me know.

Thanks so much,

[redacted]

From: [redacted]
Sent: Friday, October 16, 2009 12:22 PM
To: 'Link, Nicholas'
Cc: Tom Struewing
Subject: RE: Geotech Services for Tenaska 345kV Line

Thanks Nicholas

I will forward this info. on to [redacted] who will be the one to put together the overall costs, including the [redacted]

[redacted]

Link, Nicholas

From: [redacted]
Sent: Wednesday, October 14, 2009 3:45 PM
To: Link, Nicholas
Subject: FW: Tenaska 345kV Line near Bulpitt, IL

Categories: Green Category

Nicholas, somehow the email link came up as incorrect.
Resending my message.

From: [redacted]
Sent: Wednesday, October 14, 2009 2:40 PM
To: 'nlink@patrickengineering.com'
Cc: [redacted]
Subject: Tenaska 345kV Line near Bulpitt, IL

Nicholas,

Based on our conversation yesterday and the limited information available at present, our estimated cost for the scope of work requested is $200,000.

If the work will be scheduled for the winter months, December thru March, I suggest you increase that amount by about 20% to cover reduced drilling footage / production due to the weather.

This estimate includes: 100 borings to 50 feet deep, or to auger refusal, if shallower. (No rock coring.)
Split-spoon sampling at 2.5 feet intervals to 10 feet depth and at 5 feet intervals below that depth.

Routine lab testing for soil classification purposes.
Geotechnical report with recommended soil parameters for foundation design.

We understand that staking of the borings and permission to access the properties involved will be provided by Patrick.
No costs for tree clearing, building access roads, or repair of damage to crops / landscaping are included.

We trust this information will meet your current needs.
We also understand that once the project is authorized by your client, a formal RFP will be issued and the scope / budget may be revised as needed.

If you have any questions, or wish to discuss the project further, please contact us at your earliest convenience.

Thanks for your request.
We look forward to the opportunity to work with you.

[redacted]

PROJECT DESCRIPTION and OBJECTIVES

The proposed project includes the construction of a 345 kV transmission line to extend from Taylorsville, Illinois to about Sicily, Illinois. We understand that the proposed transmission line will be supported by one-hundred (100) mono-pole type structures, which will extend approximately 120 to 140 feet in height.

The objectives of this geotechnical engineering investigation will be to assess the subsurface conditions at each of the proposed mono-pole locations along the alignment of the proposed transmission line and to provide recommendations to aid in the design and construction of the proposed transmission line.

PROPOSED WORK PLAN

Per the Client's request, [redacted] will drill a total of one-hundred (100) soil borings, each to a depth of 50 feet; for a total of 5,000 lineal feet of drilling. We understand each of the proposed borings locations will be marked by a surveyor and will be referenced on a map or plan sheets; which will be provided to [redacted] prior to the start of our field activities. [redacted] will visit the project alignment prior to drilling to observe and note ground cover, existing structures, pavement, site access and topographic conditions. If site conditions require that borings be relocated from previous agreed-upon locations, the Client will be advised.

[redacted] understands that access to the proposed boring locations and coordination with any property owners will be the responsibility of the Client. Additionally, the "clearing of utilities" within and outside of the public domain shall be the responsibility of the Client and coordinated with [redacted] prior to the start of any subsurface exploration.

The typical drilling method will utilize hollow-stem augers to advance the borings to the required depths. Split-spoon samples and Standard Penetration Tests values (commonly referred to as the blow-count or N-value) will be obtained in advance of the augers at 2.5 foot intervals to a depth of 10 feet, and 5-foot intervals thereafter per ASTM Method D-1586.

Shelby tube samples may be obtained in cohesive soil strata-of-interest. Each boring will be monitored for the presence of groundwater during and immediately following the completion of the boring.

Upon completion of the borings, the boreholes will be backfilled with auger cuttings prior to demobilization for safety considerations. ***It should be noted that it is standard practice in drilling test borings to backfill with the auger cuttings. However, sometimes the backfill will settle after the borings have been completed, requiring a return trip to backfill again. If this takes place, an additional fee will be charged for the return trip. As an alternative, for an additional fee, the holes can be backfilled with bentonite or grout to reduce the potential settlement.***

After the fieldwork is completed, we will return samples to [redacted] soils laboratory to perform the appropriate laboratory testing. The laboratory testing may include unconfined compressive strengths, natural moisture contents, Atterberg Limits and grain size determinations and other tests as requested and applicable. All laboratory testing will be performed in accordance with applicable ASTM methods.

Based on the results of the fieldwork and laboratory testing, we will prepare a Geotechnical Engineering Report. The report will present all field, test boring logs and laboratory test data. The report will include recommendations for foundation design, as well as providing a discussion regarding any potential construction difficulties due to soil and groundwater conditions.

ESTIMATED PROJECT COST

Based upon the information provided and as outlined in our attached work plan, along with our experience with similar projects, we estimate the project cost to be ***$59,650.00.*** An itemized Cost Estimate is provided below. Work performed outside the Scope of Work discussed in this proposal will be performed at a unit rate basis for the actual work performed. Such work will be considered a change in scope. The *Client* will be provided with a budget for this work modification for approval and authorization prior to proceeding with the work.

Itemized Cost Estimate

1. Drilling Services Includes mobilization of two (2) drill rigs and the completion of one-hundred (100) test borings totaling 5,000 lineal feet of drilling.	$42,000.00
2. Engineering and Laboratory Services Includes engineering field services, laboratory soil analysis and preparation of the geotechnical investigation report.	$17,650.00
Estimated Total Cost	***$59,650.00***

SCOPE OF WORK LIMITATIONS

In preparation of this proposal, we have assumed that the alignment is accessible to ATV-mounted drilling rigs. If "clearing" or "grading" of the alignment is required (i.e. trees, brush, crops etc...), an additional charge will be assessed. Additionally, supplemental costs will also be incurred if obstructions are encountered in the borings requiring additional offset borings to be performed, rock coring to be completed, or if the subsurface conditions require the use of wash rotary or other methods to help prevent soils from heaving up into the augers.

If the borings reveal inconsistent and/or marginal soil conditions requiring additional borings, deeper borings, additional samples, or additional laboratory testing, the Client's Project Manager will be consulted immediately with regard to the possibility of modifying the proposed subsurface investigation program. Such a modification may be considered a change in scope of the Proposed Work Plan, thereby requiring a possible adjustment to the budget of this Geotechnical Engineering Investigation.

The subsurface investigation outlined in this proposal assumes that there are no hazardous materials in the soil or in the groundwater underlying the site. This investigation is not designed to detect or identify such materials. If it becomes apparent during the field investigation that hazardous materials are present, field operations will temporarily cease. The field investigation could be resumed only after the appropriate health and safety issues are addressed and the scope of our investigation modified to address this change in condition.

WORK SCHEDULE

[redacted] will initiate project activities upon receipt of the attached Proposal Acceptance Agreement, authorizing us to begin work. The field drilling work should take 12 to 15 days to complete, based on mobilizing two (2) drill rigs for completion of the field activities. We would expect to issue our engineering report within approximately 2 to 3 weeks of completing the fieldwork. However, verbal results can be provided shortly after the fieldwork is completed.

AUTHORIZATION TO PROCEED

As our formal authorization to proceed, please complete and sign the Proposal Acceptance Agreement form included with this proposal, indicating proper billing instructions, and return an executed copy of this acceptance agreement for our files. Also, please note the Terms and Conditions included with this proposal, which is an integral part of this proposal. Alternatively, this work may be authorized by a written purchase order or a letter instructing us to proceed, which provides for the Terms and Conditions herein.

ATTACHMENT A

Fee Schedule

	Unit	Unit Cost
PROFESSIONAL SERVICES		
Principal Engineer, P.E.	Hour	$170.00
Senior Project Engineer, P.E.	Hour	$125.00
Project Engineer, P.E.	Hour	$100.00
Senior Engineer/Geologist	Hour	$85.00
Geotechnical Engineer/Geologist	Hour	$75.00
Draftsperson/CAD Technician	Hour	$69.00
Senior Engineering Technician	Hour	$52.00
Word Processor	Hour	$58.00
LABORATORY TESTING		
Water Contents (oven dried)	Each	$4.85
Hand Penetrometer Test	Each	$9.25
Atterberg Limits (LL & PL)	Each	$62.00
Grain Size Distribution	Each	$108.00
Sieve Analysis only	Each	$51.00
Minus #200 Sieve only	Each	$32.00
Hydrometer only	Each	$59.00
Natural Density	Each	$26.00
Organic Content	Each	$31.00
pH Determination	Each	$26.00
Extrude & Log Shelby Tube Samples	Each	$25.00
Standard Proctor	Each	$130.00
Modified Proctor	Each	$150.00
CBR Test	Each / Point	$140.00
Unconfined Compressive Strength	Each	$52.00
Test for pH, organic matter, soluble salts	Each	$103.00
Triaxial Tests (CU - 3 circles)	Each	$900.00
Consolidation Test	Each	$410.00
Permeability Test (Cohesive Soils)	Each	$295.00
DRILLING SERVICES		
Mobilization of drill rig and crew (Local) ***plus $4.00 per mile over 60 miles from a Patriot office**	Lump Sum	$450.00
Minimum Charge for drill rig, crew and equipment	Lump Sum	$1,000.00
Drilling with 3.25" and 4.25" hollow stem augers with standard splitspoon sample intervals		
Under 50 feet depth and under 50 blows per foot	Foot	$9.50
50 to 75 feet depth and under 50 blows per foot	Foot	$11.00
Over 75 feet depth or over 50 blows per foot	Foot	$13.90
Additional splitspoon samples beyond standard intervals	Each	$13.25
ATV Drilling , Add	Foot	$1.45
Mud Drilling, Add	Foot	$2.05
Drilling without splitspoons	Foot	$8.30
Bulk Samples (50 lb. bag)	Each	$57.00
Rock Coring.	Foot	$31.00
Equipment, set-up for rock coring	Hole	$59.00
Shelby Tube Samples (3 in. O.D.)	Each	$46.50
Standby Time requested by Client or Hauling Water	Hour	$155.00
Rental of Dozer (to assist drill rig under adverse site conditions)	Cost + 15%	
Asphalt or Concrete Plug of Drill Holes	Hole	$26.00
Per Diem for Drill Crew per man	Per Day	$105.00
Grouting Holes	Foot	$7.75
Concrete Coring Through 6 to 8 inches of Floor Slab	Hole	$242.00
Monitoring Well Installation	Foot	$31.00
Monitoring Well Flush Manhole & Cover	Each	$237.00
GENERAL EXPENSES		
Transportation by Company or Personal Car	Mile	$0.59
Subcontractor Costs / Special Costs (i.e., film, FedEx, etc.)	Cost + 15%	
Additional Copies of Report (above 3 copies)***plus time**	Page	$0.42
Out-of-Town Living Expenses	Cost + 15%	

PATRICK
ENGINEERING

Appendix G

Material Supplier Estimates

[redacted]

Tenaska 345KV
Transmission Line Project

Patrick Engineering
Attn: Nicholas Link

QTY	UNIT	UNIT DESCRIPTION	DELIVERY	Unit Cost	Total
		Conductors			
211,700	ft	1113-T2 ACSR Bluejay (10,745' reels)	7-9 weeks	$6.96	$1,473,432.00
70,700	ft	DNO-XXXX 24 Fiber OPGW	12-14 weeks	$2.28	$161,196.00
		Structures			
86	EA	115' Anchor Based Steel StructureTangents Double Circuit (weight 27,670 lbs)	20-22 weeks	$39,007.00	$3,354,602.00
14	EA	115' Anchor Based Steel Structure Dead End Double Circuit (weight 79,439 lbs)	20-22 weeks	$91,800.00	$1,285,200.00
		Insulators & Hardware			
258	EA	345 KV Polymer Suspension Insulators 30Kip (Tangents and Angles)	8-10 weeks	$132.00	$34,056.00
84	EA	345 KV Polymer Suspension Insulators 50Kip (Dead Ends)	8-10 weeks	$185.00	$15,540.00
42	EA	345 KV Polymer Jumper Line Post	8-10 weeks	$522.00	$21,924.00
258	EA	CFS Suspension Clamps for 1113-T2 ACSR with socket	6-8 weeks	$87.00	$22,446.00
168	EA	HES-XXX Compresion Dead Ends for 1113-T2	6-8 weeks	$210.00	$35,280.00
84	EA	YPD-XX Yoke Plates for Dead End Assembly	8-10 weeks	$135.00	$11,340.00
42	EA	Hot Line Y- Ball Clevis for Jumper Post	8-10 weeks	$29.00	$1,218.00
86	EA	4301XXXX Fiberlign Suspension Assembly for OPGW Sheild	6-8 weeks	$57.00	$4,902.00
28	EA	289XXXX Fiberlign Dead End Assembly for OPGW Sheild	6-8 weeks	$115.00	$3,220.00
Advise	EA	5050XXXX OPGW Spiral Vibration Dampers	6-8 weeks	$8.00	$0.00
Advise	EA	1701-XXX 1113-T2 Stockbridge Type Dampers	6-8 weeks	$55.00	$0.00
		Grounding			
100	EA	3/4 x 10 Ground Rods Copper Clad with Clamps	2-4 weeks	$20.00	$2,000.00
1,000	Ft	#2 BCSD Ground Wire Stranded	2-4 weeks	$1.00	$1,000.00
100	EA	Connecting Hardware to Structrures	4-6 weeks	$17.00	$1,700.00
		Splicing			
Advise	EA	1113-T2 ACSR Bluejay Splices	2-4 weeks	$95.00	$0.00
Advise	EA	OPGW Splice Kits	2-4 weeks	$565.00	$0.00
			Total		**$6,429,056.00**

[redacted]

10/22/2009

Link, Nicholas

From: [redacted]
Sent: Thursday, October 22, 2009 3:46 PM
To: Link, Nicholas
Cc: [redacted]
Subject: Re: Tenaska 345kV steel pole estimate
Attachments: ATT121537.jpg

Categories: Green Category

Nicholas,

Structure weights and pricing are based on the following assumptions:

1. 345 kV double circuit single pole structures
2. Approximate height of 120-130'
3. Galvanized finish
4. Delivery mid-2010

345 kV Double Circuit Tangent Structure: 41,000 lbs. @ $1.65/lb = $67,650
345 kV Double Circuit Deadend (0-30) Structure: 75,000 lbs. @ $1.65/lb = $123,750
345 kV Double Circuit Deadend (30-60) Structure: 78,000 lbs. @ $1.65/lb = $128,700
345 kV Double Circuit Deadend (60-90) Structure: 109,000 lbs. @ $1.65/lb = $179,850

86 tangents @ $67,650 /ea = $5,817,900
14 deadends @ (see above) = $1,732,500-$2,517,900 (this is a range of all light angle deadends to all heavy angle deadends)
Total = $7,550,400-$8,335,800

Also, please keep in mind these are strictly budgetary estimates based upon a fairly recent project, and the final cost will be dependent upon final load trees and other factors. In addition, the price per pound is also is a budgetary estimate that can be higher or lower based upon the steel market at the time of RFQ and most importantly delivery of the structures. One potential way to minimize the cost of the deadend structures (especially with the foundation costs) would be to use a single deadend structure for each circuit. For instance, the bolt circle would be 108" for the 345 kV Double Circuit Deadend (60-90) Structure.

Let me know if you need anything else, and please keep [redacted] informed as/if this project comes to fruition. Thanks again.

[redacted]

Link, Nicholas

From: [redacted]
Sent: Tuesday, October 27, 2009 10:31 AM
To: Link, Nicholas
Cc: [redacted]
Subject: Tenaska Budgetary pricing

Categories: Green Category

Nick, based on the ground line moment you gave me of 1418 kip/ft I have estimated your 120 tangent will weight 10,375#. Current pricing per lb on this type of pole is approximately $1.30 per lb. I estimate a price per structure of $13,488. Pricing per lb for the large dead ends may be approximately 10 cents per lb cheaper.
I hope this quick estimate is what you are looking for. Thanks

Pole Calculator

Utility : Patrick Engineering
Project : Tenaska
Subject : 120' Tangents

File : 7700
Date : 10/27/2
Time : 9:15:05
Eng. : rms

Input Data:

Structure Height Above Ground:	**120**	ft
Embedment Length:	**0**	ft
Groundline Moment:	**1418**	ft-k

Estimated Output Data:

Estimated Pole + Base Plate Weight:	**10,375**	lbs
Estimated Anchor Bolt Weight:	**963**	lbs

Shaft Thickness:	**0.3125**	in
Shaft Base Diameter:	**32.82**	in
Anchor Bolt Circle:	**40.5**	in
# of Anchor Bolts:	**8**	
Shaft Deflection:	**137**	in.
Shaft Stress:	**62.7**	ksi

Notes:
1 Galvanized
2 Climbing Not Included
3 Camber Not Included
4 Deflection Limit Not

Accessories for AFL OPGW

Ref: ***EE09-23657*** *Specification Number:* ***DNO-5484***

Lead Time: 5 - 7 Weeks ARO

Quantity	Item Description	Part Number	Unit Price
44	**Deadend** Used at the terminal structures and structures with line angle changes over 30 degrees. The part number and price shown are for a single deadend (tension) located on one side of the structure.	**ODE12/62552G7**	$202.17
44	**10 inch Link Plate** For use with bolted deadend.	**ODELP10**	$19.10
44	**Anchor Shackle**	**ANSH30L**	$4.03
44	**Chain Link**	**CL-4**	$6.03
51	**Suspension** For structures with line angle changes up to and including 30 degrees	**SUME528/555**	$60.97
51	**Y-Clevis Eye 90 for Single Suspension**	**YC90E-750-1750**	$14.11
95	**Bonding Wire Assembly** Used for grounding deadends and suspensions to towers. 60" long, Two ½" terminals with hardware included for one side. Other variations are available. Contact AFL for additional information.	**BWAL50/50H-60**	$21.18
107	**Vibration Damper**	**OVD461/570**	$22.68
95	**1 Bolt Ground Clamp** Customer to specify diameter of grounding tap diameter ("YYY") in decimal inches.	**OBCF2YYY1**	$14.51
50	**Down Lead Clamp** Part number shown assumes the use of same size cable in both grooves. Different cable diameters can be used and will require a different part number.	**FDOA-B5B5**	$23.56
50	**Down Lead Clamp with Banding Adapter** Part number shown assumes the use of same size cable in both grooves. Different cable diameters can be used and will require a different part number.	**FDOA-B5B5A**	$23.54
50	**Down Lead Clamp with Lattice Web Adapter** (for web thicknesses up to 0.75") Part number shown assumes the use of same size cable in both grooves. Different cable diameters can be used and will require a different part number.	**FDOA-B5B5B**	$23.54
50	**Down Lead Clamp with Lattice Web Adapter** (for web thicknesses between 0.75" and 1.25") Part number shown assumes the use of same size cable in both grooves. Different cable diameters can be used and will require a different part number.	**FDOA-B5B5C**	$27.71
50	**Down Lead Clamp with Lag Bolt** Part number shown assumes the use of same size cable in both grooves. Different cable diameters can be used and will require a different part number.	**FDOA-B5B5D**	$18.22
18	**Splice Protector Sleeve - 60 mm length** Supplied in packages of ten (10).	**SPS60**	$11.80
6	**Splice Enclosure** Includes trays for up to 72 fibers	**SB01-72**	$565.46
10	**Connector Kit for OPT-GW Cable** Dielectric cable connector kits, if required in addition to OPT-GW connectors, to be ordered separately.	**OCK12/62552**	$47.93

Quantity	Item Description	Part Number	Unit Price
2	**Connector Kit for Loose Tube Cable** Specify diameter of loose tube cable ("XXX") in decimal inches, center strength member diameter ("YYY") in decimal inches.	**LCKXXXYYY**	$52.27
6	**Coil Bracket for SBO1 and Opti-Guard** OPT-GW and ADSS Storage bracket	**CB-44**	$189.00
6	**Comealong** Comealongs are not intended for use as deadends and are not recommended to hold conductors at sag and tension limits for longer than 6 hours. Maximum tension limit is 50% of the rated breaking strength of the OPT-GW ro 5,000 pounds, whichever is smaller.	**OCA550/559**	$391.04

Quantities are based on the following assumptions:

Total Quantity (feet)	70,700
Average Ruling Span (feet)	1,000
Average Reel Length (feet)	15,000
Average Tower Height (feet)	75

QUOTATION

REFERENCE: EE09-23657.0

WE ARE PLEASED TO SUBMIT THE FOLLOWING QUOTATION AT TODAY'S PRICES BASED ON THE QUANTITIES INDICATED BEING RELEASED FOR MANUFACTURE AND SHIPMENT AT ONE TIME, SUBJECT TO PARAGRAPH 1 OF THE TERMS AND CONDITIONS. FOR A COPY OF OF THESE TERMS AND CONDITIONS, PLEASE VISIT OUR WEBSITE AT [redacted]

PAYMENT TERMS: ***UNLESS OTHERWISE NOTED*** **NET CASH 30 DAYS FROM DATE OF INVOICE, SUBJECT TO THE APPROVAL OF AFL'S TREASURER.**

[redacted]

F O B	FOB Plant, PPD and ADD
SHIPMENT ESTIMATE	See Below
PACKING	

Line Number	Product Identification	Quantity	Unit Price (US Dollars)	Extended Price (US Dollars)
01	Item: DNO-5484 AC-12/62/552 OPT-GW Cable with 24 Single-mode fibers Wood reels with flex-wrap **Lead Time: 8-10 weeks ARO** Max length on wood reels: 6560 meters Max length on non-returnable steel reels: 7000 meters	21,550 meters 70,701 feet	6.234/m 1.900/ft 1,250 /reel	134,340.34
			TOTAL	134,340.34

PLEASE NOTE THE FOLLOWING:

Unless otherwise noted , the billable tolerance for OPT-GW items is -0%, +2%.

Ordered lengths should include a distribution of lengths. All reels cannot be ordered at the maximum nor all at the same length. A typical length distribution would be:
6000m – 7000m ~ 15%
4500m – 6000m ~ 55%
2500m – 4500m ~ 25%
<2500m ~ 5%

Lead times quoted are estimates only, and are based on receipt of a valid purchase order and drum lengths. Actual lead time may vary due to availability of raw materials or plant loading at time of order receipt.

For OPT-GW items, orders with shipping lengths less than 1 km are subject to an additional cutting charge of $200 per cut.

For [redacted] Loose Tube and OPT-GW items, prices shown are for the quantities quoted. Minimum order is 1km for manufactured items and 300 meters for inventory items.

[redacted] recommends purchasing steel reels for long-term storage. Please refer to [redacted]'s Reel Handling document available at [redacted] for additional handling and storage details.

QUOTATION

REFERENCE: EE09-23657.0

WE ARE PLEASED TO SUBMIT THE FOLLOWING QUOTATION AT TODAY'S PRICES BASED ON THE QUANTITIES INDICATED BEING RELEASED FOR MANUFACTURE AND SHIPMENT AT ONE TIME, SUBJECT TO PARAGRAPH 1 OF THE TERMS AND CONDITIONS FOR A COPY OF OF THESE TERMS AND CONDITIONS, PLEASE VISIT OUR WEBSITE AT [redacted] OR A COPY.

PAYMENT TERMS: ***UNLESS OTHERWISE NOTED*** **NET CASH 30 DAYS FROM DATE OF INVOICE, SUBJECT TO THE APPROVAL OF AFL'S TREASURER.**

[redacted]

F O B	FOB Plant, PPD and ADD
SHIPMENT ESTIMATE	See Below
PACKING	

Line Number	Product Identification	Quantity	Unit Price (US Dollars)	Extended Price (US Dollars)

NOTE. THIS QUOTATION IS NEITHER A CONTRACT NOR AN OFFER. ALL ORDERS ARE SUBJECT TO ACCEPTANCE BY [redacted] AT ITS PRINCIPAL OFFICE IN SPARTANBURG, SOUTH CAROLINA. ORDERS RESULTING FROM THIS QUOTATION WHICH ARE ACCEPTED WILL BE SUBJECT TO THE TERMS AND CONDITIONS OF THIS QUOTATION.

DATE
16-Oct-09

QUOTATION VALID THROUGH
18-Nov-09

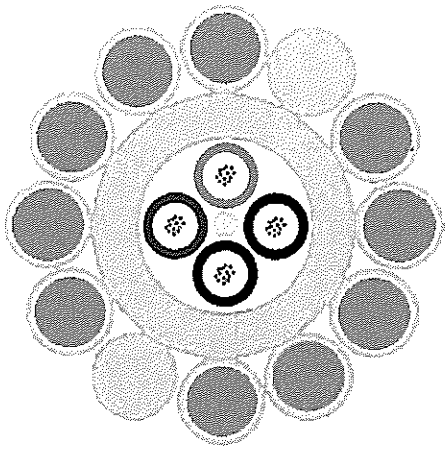
[redacted]

BY _____

[redacted]

Specification DNO-5484

AlumaCore Optical Ground Wire



AC-12/62/552

Component Details					
Component	**#**	**OD**		**Area**	
CENTER					
Aluminum Pipe	1	8.42 mm	0.3315 in	33.62 mm²	0.0521 in²
LAYER 1 - LEFT HAND LAY					
Aluminum Clad Steel (20.3% IACS)	10	2.80 mm	0.1102 in	61.58 mm²	0.0954 in²
Aluminum Alloy 6201	2	2.80 mm	0.1102 in	12.32 mm²	0.0191 in²

Standards	
Designed and Manufactured in accordance with the following:	
Cable	*IEEE 1138, IEC 60794-4*
Fiber	*IEC 60793, ITU-T G.65x Series*
Color Code	*ANSI/EIA 359-A, 598-A, IEC 60304*
Aluminum Pipes	*ASTM B483*
Aluminum Alloy Wires	*ASTM B398, IEC 60104*
Aluminum Clad Steel Wires	*ASTM B415*

Specification DNO-5484

Mechanical / Electrical Details		
Calculated Breaking Load	8,440 kg	18,606 lbs
Maximum Cable Design Tension	6,372 kg	14,049 lbs
Approximate Cable Diameter	14.02 mm	0.552 in
Total Cross-Sectional Area	107.51 mm^2	0.1666 in^2
Approximate Cable Weight	553 kg/km	1,962 lbs/mile
Modulus of Elasticity	11,893 kg/mm^2	16,915 kpsi
Coefficient of Linear Expansion	1.51E-05 1/°C	8.39E-06 1/°F
Sag10™ Chart Number	1-1166	1-1166
Calculated DC Resistance (20°C)	0.4516 Ohms/km	0.7268 Ohms/mile
Short Circuit Rating	87 $(kA)^2$•sec	87 $(kA)^2$•sec
Short Circuit Ambient Temperature	40 °C	104 °F
Short Circuit Duration 1 sec	9.3 kA	9.3 kA
Short Circuit Max Cable Temperature	210 °C	410 °F

Optical Details

Attenuation Characteristics for Single-mode Fiber

Max Individual

0.40 dB/km 1310 nm
0.30 dB/km 1550 nm

24 Fiber Loose Tube Design (4 - 6 fiber units)		
Unit	**Fiber Type**	**Fiber Count**
Blue	Single-mode	6
Orange	Single-mode	6
Green	Single-mode	6
Brown	Single-mode	6
	Total Fiber Count	24

Standard Fiber Color Code

Fiber	1	2	3	4	5	6	7	8	9	10	11	12
Color	Blue	Orange	Green	Brown	Slate	White	Red	Black	Yellow	Violet	Rose	Aqua

Designs with more than 12 fibers per tube will use the standard color code and binders for identification of the fibers.

Installation and Handling Recommendations

Installation and cable preparation procedures are outlined in the [redacted] documents listed below. Contact [redacted] to request copies.

Recommended Installation Procedures for Composite Optical Ground Wire

Installation Instructions for Installing Optical Ground Wire in an [redacted] Splice Enclosure

Fiber Optic Cable Receiving, Handling and Storage. Document ACS-WI-809

Specification DNO-5484

Quick Reference Installation Notes

Approximate Cable Diameter	14.02	mm	0.552	in
Maximum Stringing Tension (at tensioner)*	1,688	kg	3,721	lbs
Minimum Bull Wheel Diameter	99	cm	39	in
Stringing Sheave Diameter**	56	cm	22	in
Minimum Bending Radius				
Cable				
Static (No load)	21	cm	9	in
Dynamic (under tension)	28	cm	11	in
Fiber				
Static (No load)	3.8	cm	1.5	in
Buffer Tube				
Static (No load)	8.0	cm	3.0	in

* - The stringing tension is always measured at the tensioner side. In general the maximum stringing tension should be approximately half of the maximum sagging tension and should never exceed 20% RBS of the OPT-GW.

** - The value indicated is for the first and last structures of the pull and is based on 40 times the diameter of the OPT-GW. Smaller diameters can be used at tangent structures. Reference [redacted] installation instructions for more details.

Reference [redacted] "Recommended Installation Procedures for Composite Optical Ground Wire" for detailed installation instructions.

Shipping Reels

Reel Type	*FL*	*TR*	*DR*	*OW*	*Tare*	*FL*	*TR*	*DR*	*OW*	*Tare*	*Capacity*	
	(cm)				*(kgs)*	*(in)*				*(lbs)*	*(meters)*	*(feet)*
Wood	147	81	71	97	200	58	32	28	38	441	4,460	14,630
Wood	168	91	91	107	260	66	36	36	42	573	6,000	19,680
Wood	183	91	91	107	300	72	36	36	42	662	6,560	21,520
Wood	213	86	89	104	385	84	34	35	41	849	6,560	21,520
Steel	152	81	81	97	345	60	32	32	38	761	4,420	14,500
Steel	183	91	102	107	540	72	36	40	42	1,191	7,000	22,960
Steel	213	114	107	130	773	84	45	42	51	1,704	7,000	22,960

FL - Flange Diameter; TR - Inside Traverse Width; DR - Drum Diameter; OW - Outside Overall Width

Arbor Hole Diameter: Wood: 3-1/4in (7.9cm)
Steel: 3in (7.6cm)

Maximum lengths shown are the longest lengths that [redacted] offers. Longer lengths may be possible.

Ordered lengths should include a distribution of lengths, i.e., all reels cannot be ordered at the maximum. A typical reel length distribution is as follows:

6000m – 7000m ~ 15% of reels
4500m – 6000m ~ 55% of reels
2500m – 4500m ~ 25% of reels
<2500m ~ 5% of reels

Wood reels with flex-wrap covering are standard. Non-returnable steel reels and/or wood lagging are available upon request. Additional reel sizes may be available upon request.

Steel reels are recommended for long term storage. Reference [redacted] "Fiber Optic Cable Receiving, Handling and Storage" document for additional information.

Specification DNO-5484

Electrical Characteristics			
Composite DC Resistance	[20°C]	0.4516 Ohms/km	0.7268 Ohms/mile
Geometric Mean Radius		0.55 cm	0.0179 feet
Inductive Reactance	[60 Hz frequency]	0.3033 Ohms/km	0.4881 Ohms/mile
[one foot (0.3048 meter) spacing]			
	[50 Hz frequency]	0.2527 Ohms/km	0.4067 Ohms/mile
Capacitive Reactance	[60 Hz frequency]	0.1801 MOhms·km	0.1119 MOhms·mile
[one foot (0.3048 meter) spacing]			
	[50 Hz frequency]	0.2161 MOhms·km	0.1343 MOhms·mile

Composite Coefficient of Thermal Resistance 0.00366 (1/°C)

Temperature		DC Resistance		AC Resistance	
(°C)	(°F)	(Ohms/km)	(Ohms/mile)	(Ohms/km)	(Ohms/mile)
20	68	0.4516	0.7268	0.4606	0.7413
25	77	0.4599	0.7401	0.4691	0.7549
30	86	0.4681	0.7534	0.4775	0.7684
35	95	0.4764	0.7666	0.4859	0.7820
40	104	0.4846	0.7799	0.4943	0.7955
45	113	0.4929	0.7932	0.5027	0.8091
50	122	0.5011	0.8065	0.5112	0.8226
55	131	0.5094	0.8198	0.5196	0.8362
60	140	0.5177	0.8331	0.5280	0.8497
65	149	0.5259	0.8464	0.5364	0.8633
70	158	0.5342	0.8597	0.5449	0.8769
75	167	0.5424	0.8730	0.5533	0.8904
80	176	0.5507	0.8862	0.5617	0.9040
85	185	0.5589	0.8995	0.5701	0.9175
90	194	0.5672	0.9128	0.5785	0.9311
95	203	0.5755	0.9261	0.5870	0.9446
100	212	0.5837	0.9394	0.5954	0.9582
105	221	0.5920	0.9527	0.6038	0.9717
110	230	0.6002	0.9660	0.6122	0.9853
115	239	0.6085	0.9793	0.6207	0.9989
120	248	0.6167	0.9926	0.6291	1.0124
125	257	0.6250	1.0058	0.6375	1.0260
130	266	0.6333	1.0191	0.6459	1.0395
135	275	0.6415	1.0324	0.6543	1.0531
140	284	0.6498	1.0457	0.6628	1.0666
145	293	0.6580	1.0590	0.6712	1.0802
150	302	0.6663	1.0723	0.6796	1.0937

Specification DNO-5484

PLS-CADD Inputs

☐ Use simplified elastic cable model (no creep, no coefficient)

Name					
Description	[redacted] OPGW DNO-5484 AC-12/62/552				
Cross section area	(in^2) 0.1666	Unit weight	(lbs/ft) 0.372	Number of independent wires	1
Outside diameter	(in) 0.552	Ultimate tension	(lbs) 18,606	(above should be 1 unless cables are separated by spacers)	
Temperature at which strand data below obtained	(deg F) 70				

Outer Strands

Final Modulus of elasticity (psi/100) 22000

Thermal expansion coeff. (/100 deg) 0.001280

Polynomial coefficients (all strains in %)

	A0	A1	A2	A3	A4
Stress-strain	-77.1	27658.7	-30993.3	-36131	64018
Creep	-77.1	27658.7	-30993.3	-36131	64018

Core Strands (if different from outer strands)

Final Modulus of elasticity (psi/100) 160000

Thermal expansion coeff. (/100 deg) 0.000640

Polynomial coefficients (all strains in %)

	A0	A1	A2	A3	A4
Stress-strain	614.5	141862.3	91338.6	-298530	200314
Creep	3378	93505.4	256968.4	-488551	262053

Thermal Rating Properties

Resistance at two different temperatures

Resistance (Ohm/mile) 0.7401 at (deg F) 77

Resistance (Ohm/mile) 0.8730 at (deg F) 167

Emissivity coefficient 0.5

Solar absorption coefficient 0.5

✱ Outer strands heat capacity (Watt-s/ft-deg F)

✱ Core heat capacity (Watt-s/ft-deg F)

Generate Coefficients from points on stress-strain | OK | Cancel

✱ These two fields do not need to be entered for OPGW - intentionally left blank.

C.

Date	Page
Oct 19, 2009	1
Order Number	
QT009315	
Quote Valid To	
11/18/2009	

Quotation

Chicago, IL
USA

NAME

DELIVERY DATE 8-10 Weeks ARO

Reference	Delivery Terms	Payment Terms
Quote #kw1012	Delivered	NET 30 DAYS

Qty. Ord.	Item Number	Description	Unit Price	UOM	Extended Price
45	KL345HB7S776D	345 kV Sil Rub Trans Susp Ball/Socket Section Length 111.5" Leakage Distance 332.7"	308.00	ea	13,860.00

NOTATIONS:

Drawing included

Subtotal	13,860.00
Total sales tax	0.00
Total order	13,860.00
	USD $

K-LINE INSULATORS LIMITED

Per:_____

Distribution: Original - Customer **** Copy - File

PATRICK
ENGINEERING

Appendix H

Construction Estimates

October 16, 2009

Nicholas Link
Patrick Energy Services

Re: Labor Estimate for Tenaska 345kV Line

		QTY	Unit Price	Total
Foundations				
6' x 20'	Tangent	92	$ 13,000	$1,196,000
8' x 45'	Deadend	8	$ 60,000	$ 480,000
Pole Hauling	(Assuming one staging area)			
	Structures	100	$ 6,900	$ 690,000
Pole Framing				
	Structures	100	$ 4,875	$ 487,500
Pole Setting	(Assuming an average of 130' structures)			
	Structures	100	$ 40,000	$4,000,000
Wire Install				
14 Miles	Bluebird	14	$ 190,000	$2,660,000
14 Miles	Static	14	$ 20,000	$ 280,000
Deadend		42	$ 18,800	$ 789,600
			Total	$10,583,100

If you have any questions please feel free to contact me.

Thank you,

[redacted]

Link, Nicholas

From: [redacted]
Sent: Friday, October 23, 2009 2:31 PM
To: Link, Nicholas
Subject: RE: Tenaska Construction Estimate
Attachments: image001.jpg

Categories: Green Category

Nicholas

I forgot to send you the information. The pricing is for $825,000.00 per mile. This does not include any rock excavation or wet land construction or crossings.

[redacted]

From: Link, Nicholas [mailto:nlink@patrickesi.com]
Sent: Friday, October 23, 2009 1:53 PM
To: [redacted]
Subject: RE: Tenaska Construction Estimate

[redacted]

I didn't receive an attachment on this email. Did you intend to attach one?

Nicholas

From: [redacted]
Sent: Thursday, October 22, 2009 12:47 PM
To: Link, Nicholas
Subject: RE: Tenaska Construction Estimate

Nicholas

Sorry, I thought I had already sent this to you. I'll be back in the office later and will forward it to you.

[redacted]

From: Link, Nicholas [mailto:nlink@patrickesi.com]
Sent: Thursday, October 22, 2009 10:31 AM
To: [redacted]
Cc: [redacted]
Subject: Tenaska Construction Estimate

[redacted]
I'm pulling some documents together and was curious if you guys needed anything to complete the Tenaska estimate. When I should expect to see the estimate?
Thanks,

Nicholas Link

Staff Civil Engineer
PATRICK
ENERGY SERVICES
39500 Orchard Hill Place
Suite 200
Novi, MI 48375
Direct: (248) 319-0743
Main: (248) 319-0700
Fax: (248) 319-0701
nlink@patrickesi.com

From: Link, Nicholas
Sent: Thursday, October 15, 2009 9:46 AM
To: '[redacted]
Cc: LaRiviere, Randy; Bromley, Pat
Subject: RE: Construction Estimate

[redacted]

The conductor will be a single T2-BLUEJAY per phase. For the shield wire we are using a 24 Fiber OPGW (0.5535 in Dia, 0.3971 lbs/ft).

Nicholas

From: [redacted]
Sent: Wednesday, October 14, 2009 4:47 PM
To: Link, Nicholas; Hicks, Ted
Cc: LaRiviere, Randy; Bromley, Pat
Subject: RE: Construction Estimate

Nicolas

Is this single conductor or bundle?

Thanks
[redacted]

From: Link, Nicholas [mailto:nlink@patrickesi.com]
Sent: Monday, October 12, 2009 11:15 AM
To: [redacted]
Cc: LaRiviere, Randy; Bromley, Pat
Subject: Construction Estimate

[redacted]
Patrick Energy Services is requesting an estimate to perform construction services for a 345kV line approximately 14 miles in length. The line is located just north of Taylorville, Ill. Services would include constructing foundations, erecting and assembling poles, and installing cables and hardware. There will be approximately 100 monopole structures with heights ranging from 110 to 140. I have attached a picture of our route which is the black line from the substation to our site. We would like this estimate within 25% accuracy by Friday October 16th . If you have any questions or need more information please feel free to contact me.

CONSTRUCTION ESTIMATE

To: Patrick Engineering **October 16th, 2009**
Attn: Nicholas Link

Project: Tenaska 345kV Line
Labor Only Prices

As requested for budgetary purposes of +/- 25% on 14 miles of 345kV line that includes:

1. Installation of 100 foundations 6' diameter 20' depth to include labor and concrete. $16,000/each
   *Does not include procurement of any rebar or anchor bolt cage, more information required.

2. Installation of 100 steel poles varying in heights from 110' to 150' $9,100/each
   *Includes moving to pole location, framing and erecting on foundation.

3. Installation of single T2-Blue Jay per phase and 24 Fiber OPGW. $89,000/mile

4. Installation of Ground rods. Average 8 rods per structure. $46,480/total

Project Total $3,802,480.00

If we can be of any more assistance or service please do not hesitate to contact us.

Thank you,

[redacted]

[redacted] phone [redacted]

Link, Nicholas

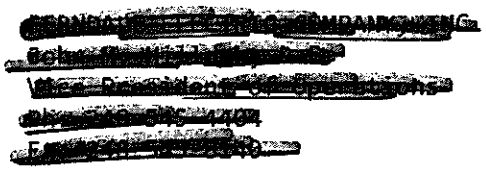
From: [redacted]
Sent: Wednesday, October 28, 2009 10:11 AM
To: Link, Nicholas
Cc: Kelley, David
Subject: RE: Tenaska 345kV line brush clearing

Categories: Green Category

Nicholas,

Our proposed budget for this project is $315,000.00. This amount includes clearing, grubbing, pull stumps, root rake disturbed areas, haul away all wood debris. We have developed this number based upon the
following:
1. As measured off Google Earth, the entire site route measured 12.60 miles.
2. As measured off Google Earth the sum of the individual pieces that required clearing equals 2.20 miles.
3. No restoration included.
4. No soil erosion devices included.

Thank you.



Link, Nicholas

From: [redacted]
Sent: Tuesday, October 27, 2009 10:11 AM
To: Link, Nicholas
Subject: RE: Tenaska 345kV line
Attachments: image001.jpg

Categories: Green Category

Nick,
It could run anywhere between $4000 to $8000 per acre (43560 sq ft) depending on what will be done with the wood, stumps, and debris. And is it Union or Non Union.
[redacted]

From: Link, Nicholas [mailto:nlink@patrickesi.com]
Sent: Tuesday, October 27, 2009 9:01 AM
To: [redacted]
Subject: RE: Tenaska 345kV line

[redacted]
I really can't wait till the end of the week. I only need a budgetary number but I'm out of my comfort zone when it comes to clearing activities. Do you have a ballpark for per square foot of clearing trees and shrubs that I can apply on my own?

From: [redacted]
Sent: Tuesday, October 27, 2009 8:49 AM
To: Link, Nicholas
Subject: RE: Tenaska 345kV line

Nick,
I have been working on some other bids this week. I will try to have a estimate for by the end of the week.
[redacted]

From: Link, Nicholas [mailto:nlink@patrickesi.com]
Sent: Tuesday, October 27, 2009 8:47 AM
To: [redacted]
Subject: RE: Tenaska 345kV line

[redacted]
I was curious what is the status of this?
Thanks

Nicholas Link
Staff Civil Engineer
PATRICK
ENERGY SERVICES
39500 Orchard Hill Place
Suite 200
Novi, MI 48375
Direct: (248) 319-0743
Main: (248) 319-0700

Fax: (248) 319-0701
nlink@patrickesi.com

From: Link, Nicholas
Sent: Friday, October 23, 2009 9:45 AM
To: [redacted]
Subject: RE: Tenaska 345kV line

[redacted]

I attached some close ups of the areas. Wooded area near E1800 North Rd and N800 East Rd. Wooded areas 2 &3 are the river crossings. We need about 75 feet on each side of the black line. I have also attached the Google earth route file (.kmz) If you open that inside of Google earth it will let you zoom in and out along the route as needed. I hope this helps.

Nicholas Link
Staff Civil Engineer
PATRICK
ENERGY SERVICES
39500 Orchard Hill Place
Suite 200
Novi, MI 48375
Direct: (248) 319-0743
Main: (248) 319-0700
Fax: (248) 319-0701
nlink@patrickesi.com

From: [redacted]
Sent: Friday, October 23, 2009 9:33 AM
To: Link, Nicholas
Subject: RE: Tenaska 345kV line

Nick,
There is not enough detail on this map to give an estimate.
[redacted]

From: Link, Nicholas [mailto:nlink@patrickesi.com]
Sent: Friday, October 23, 2009 9:09 AM
To: [redacted]
Subject: Tenaska 345kV line

[redacted]

Here is the aerial picture I spoke of. The site is just north of Taylorville, IL. We would like a estimate +/- 25% for budgetary purposes. Like I mentioned on the phone once Tenaska decides to go forward with the project we will send out formal requests for proposals. If you need any additional information let me know.

Thanks

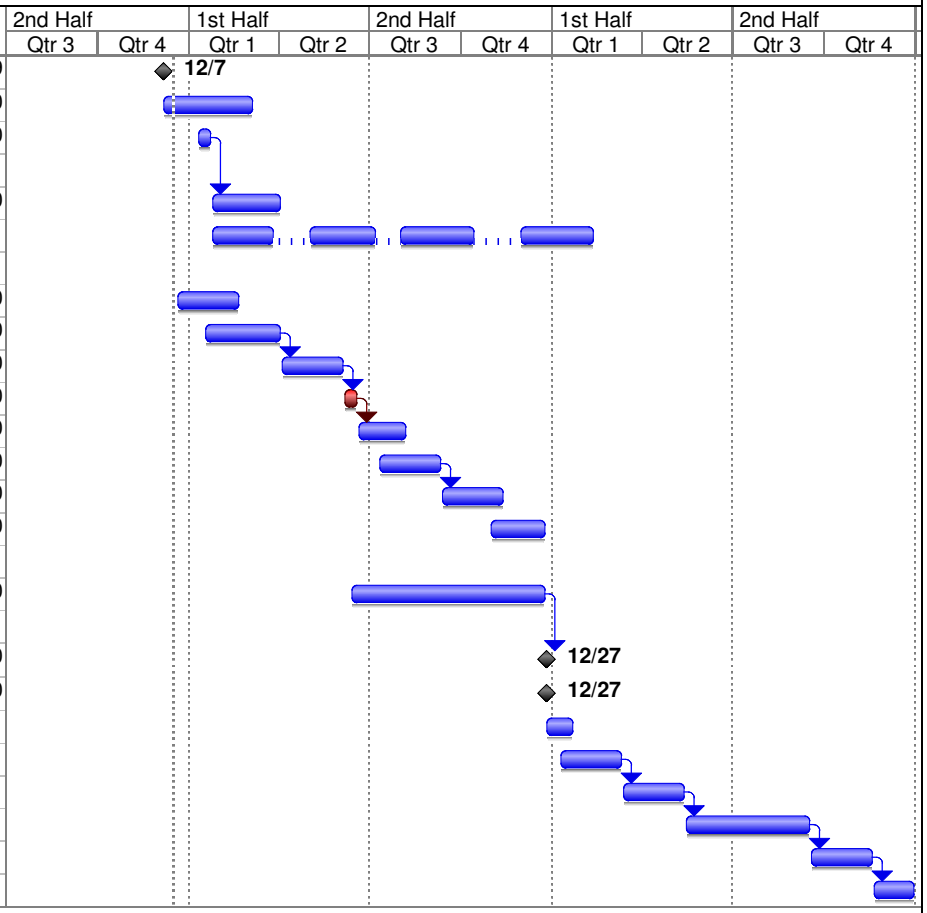
Nicholas Link
Staff Civil Engineer

Appendix J

EPC Project Management

PRELIMINARY CONSTRUCTION SCHEDULE
TENASKA 345kV TRANSMISSION LINE STUDY

ID	Task Name	Duration	Start	Finish
1	**Engineering**	0 days	Mon 12/7/09	Mon 12/7/09
2	Route Verification	65 days?	Mon 12/7/09	Fri 3/5/10
3	Survey Coordination	10 days?	Mon 1/11/10	Fri 1/22/10
4				
5	Aerial Survey	50 days?	Mon 1/25/10	Fri 4/2/10
6	Site Survey	199 days?	Mon 1/25/10	Fri 2/11/11
7				
8	Structures 50% Design	45 days?	Mon 12/21/09	Fri 2/19/10
9	Foundation 50% Design	55 days?	Mon 1/18/10	Fri 4/2/10
10	PLS-CADD Model 50% Design	45 days?	Mon 4/5/10	Fri 6/4/10
11	50% Client Review	10 days?	Mon 6/7/10	Fri 6/18/10
12	Structures 100% Design	35 days?	Mon 6/21/10	Fri 8/6/10
13	Foundation 100% Design	45 days?	Mon 7/12/10	Fri 9/10/10
14	PLS-CADD Model 100% Design	45 days?	Mon 9/13/10	Fri 11/12/10
15	Construction Coordination	40 days?	Mon 11/1/10	Fri 12/24/10
16				
17	Material Ordered	140 days?	Mon 6/14/10	Fri 12/24/10
18				
19	**Owners Acquisition of Right of Way**	0 days	Mon 12/27/10	Mon 12/27/10
20	**Construction**	0 days	Mon 12/27/10	Mon 12/27/10
21	Unloading and storage of materials	20 days?	Mon 12/27/10	Fri 1/21/11
22	Constructing foundations	45 days?	Mon 1/10/11	Fri 3/11/11
23	Framing poles	45 days?	Mon 3/14/11	Fri 5/13/11
24	Setting poles	90 days?	Mon 5/16/11	Fri 9/16/11
25	Pull/string conductor	45 days?	Mon 9/19/11	Fri 11/18/11
26	Restoration of area	30 days?	Mon 11/21/11	Fri 12/30/11



Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline