BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

APPLICATION OF PENNSYLVANIA ELECTRIC COMPANY FOR APPROVAL TO LOCATE AND CONSTRUCT THE BEDFORD NORTH-CENTRAL CITY WEST 115 KILOVOLT TRANSMISSION LINE PROJECT IN CENTRAL CITY BOROUGH AND SHADE TOWNSHIP, SOMERSET COUNTY, AND NAPIER, EAST ST. CLAIR, AND BEDFORD TOWNSHIPS, BEDFORD COUNTY, PENNSYLVANIA	**:**	**Docket No.**

DIRECT TESTIMONY OF

LAWRENCE P. MATTEI

ON BEHALF OF

PENNSYLVANIA ELECTRIC COMPANY

STATEMENT NO. 4

Re: The Design, Engineering, Construction, Operation and Maintenance of the Project

Dated: September 1, 2016

I. INTRODUCTION AND PURPOSE OF TESTIMONY

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Lawrence P. Mattei. My business address is FirstEnergy Service Company, 800 Cabin Hill Drive, Greensburg, PA. 15601.

Q. By whom are you employed and in what capacity?

A. I am employed by FirstEnergy Service Company as a transmission design engineer.

Q. Please describe your educational background and professional experience.

A. I am a 1980 graduate of the University of Pittsburgh with a Bachelor of Science degree in Civil Engineering. I am a registered Professional Engineer in Pennsylvania. After graduation from the University of Pittsburgh I worked for the Municipal Authority of Westmoreland County, Pennsylvania, designing public water supply projects. In 1981 I began employment with Allegheny Power Service Corporation in the Surveys and Rights-of-Way Section. My primary responsibilities included engineering support for right-of-way acquisition of Company transmission lines. I also teamed with environmental specialists to establish new transmission line routes and obtain approval of regulators at the local, state, and federal levels. In 1995, I was assigned to the Allegheny Power's Transmission Engineering Department. My responsibility was to design new transmission lines as issued by Company planners and to re-design existing transmission lines for planned upgrades. I also was responsible for civil

engineering design activities associated with new substations and the expansion of existing substations. With the 2011 merger of Allegheny Energy, Inc., with FirstEnergy Corp., I was assigned to the FirstEnergy Service Company Transmission Design Department and keeping the same job responsibilities. In July 2015 I was assigned to the Company's External Design Engineering Department. My current responsibilities focus on the oversight of the Company's external transmission engineering consultants.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to describe the design and construction methodology of Pennsylvania Electric Company ("Penelec") for the proposed Bedford North-Central City West 115 kV HV Transmission Line Project. Penelec is a FirstEnergy company. I will also provide information on the operations and maintenance of this line.

Q. Briefly outline your testimony.

A. My testimony will cover the following aspects of the proposed 115 kV line:

- Proposed transmission line configuration
- Right-of-way requirements
- Design criteria
- Construction activities
- Maintenance activities

Q. Does your testimony address the filing requirements of 52 Pa. Code § 57.1 and §§ 57.1 – 57.77 concerning the siting and construction of high voltage ("HV") transmission lines?

A. Yes. My direct testimony, together with the siting Application filed by Penelec provides information to respond to the requirements of 52 Pa. Code § 57.72(c)(6) (safety considerations to be incorporated into the design, construction and maintenance of the proposed HV line); (c)(13)(ii) (an engineering and design-based description of the proposed line); and (c)(13)(iii) (a simple drawing of a cross section of the proposed right-of-way of the HV line showing the placement of supporting structures at typical locations, with structure sizes, right-of-way widths, and the lateral distances between the conductors and the edge of the right-of-way indicated).

II. EXHIBITS

Q. Please identify and describe the exhibits that you will refer to in your testimony.

A. I am sponsoring exhibits 6A, 6B, 10A, 10B, 10C, 10D, 10E, 10F, 10G, 10H, 10I, 10J, 11A, 11B, 11C, and 20.

I will refer to the exhibits that accompanied Penelec's Application. The exhibits were developed by me or under my supervision. Exhibits 6A and 6B show the minor relocation of the Central City West – Statler Hill 115 kV Line at Central City Substation. Exhibit Nos. 10A through Exhibit No. 10J to Penelec's Application show the types of structures that will be used in the project. Exhibit 11A through 11C to the Application depict typical right-of-way widths for the transmission line. Exhibit No. 20 is a copy of the Company's Tree Trimming and Comprehensive Vegetation Management Plan.

III. LINE CONFIGURATION

Q. Has a general description of the project been provided?

A. Yes, a description of the proposed transmission line project has been provided in Penelec's Application. Additionally, other Penelec witnesses will provide a general description of the need for the line, the proposed route and other basic information about this project. My discussion of the engineering, construction, and maintenance of the project which follows is consistent with those descriptions.

Q. Please describe the general transmission line configuration planned for the project.

A. The project calls for a double circuit 115 kV Line to be constructed between Bedford North Substation and Central City West Substation. The line length is

approximately 17.5 miles. Based on preliminary engineering the Project requires installation of approximately 144 structures ranging from 50 feet to 145 feet in height above ground level. The average span length is approximately 650 feet. It will share a common right of way with the existing Bedford North-New Baltimore 115 kV Line on the westerly side of the line corridor for approximately 7.2 miles. This project will also require that the existing Central City West-Statler Hill 115 kV Line be relocated where it enters Central City Substation. This relocation is about 1,000 feet. The Bedford North-Central City West 115 kV Line will then occupy the existing Central City West-Statler Hill 115 kV Line termination structure at Central City Substation. The Central City West-Statler Hill 115 kV Line will use an open termination at Central City West Substation. Reasons for this will be further discussed below. Also, this line termination change is depicted on exhibits 6A and 6B.

There are numerous structure designs under consideration to best fit topography, land use, and constructability constraints for this project. As such, we anticipate single and double pole structures using both wood and steel. Initially only one circuit will be installed. The proposed transmission line conductors will be installed on one side of the structure in a vertical configuration for all structures except the substation termination structures which will be configured horizontally. The other side of the structure will be used for future transmission line conductors with similar geometry. Some structures are actually two independent single circuit structures installed adjacent to each other for a double circuit configuration. In

these situations, only the Bedford North-Central City West 115 kV circuit will be constructed. The other structure will be constructed when the second circuit is needed. However, a section of this new line will rebuild the existing Bedford North-New Baltimore 115 kV Line for about 7.2 miles. As such, both circuits will be installed on this section of the line. Refer to Exhibit Nos. 10A through 10J of Penelec's Application, which depict the various types of structures that will be used on the project. Exhibit No. 10A shows a typical double circuit tangent wood pole structure. This structure will be used on straight line sections. Exhibit 10B shows a typical double circuit light angle wood pole structure. This structure requires guying to stabilize unbalance loads due to line direction changes. Exhibit 10C shows a typical double circuit angle dead end wood pole structure. This structure requires in-line guying to stabilize unbalance loads due to line direction changes also. Exhibit 10D shows a typical double circuit steel tangent structure. These structures could be used where wood poles are structurally inadequate to support the line. Also, there are locations where the line route will overbuild sections of Penelec's distribution lines. At these locations, the existing distribution lines will be attached below the transmission line as needed. These structures are typically direct imbedded into the ground or can be supported on concrete foundations if soil conditions require it. Exhibit 10E shows a typical double circuit steel dead end or tangent structure. The difference between the two is primarily on the insulator assembly attachment to the pole. Dead end structures are typically used where line direction changes occur and tangent structures are

typically used where there are no line angles. This structure will use concrete foundations and are typical where structure loads are high and require increased foundation support. Exhibit 10F shows another typical double circuit dead end structure on a concrete foundation. This type of structure will be used on shorter spans that could require distribution underbuild. As mentioned, there are some sections of the proposed route where we will combine the existing distribution lines with the Bedford North-Central City West 115 kV Line. This joint use occupancy of transmission and distribution lines is in the Central City area where it's advantageous to share existing right-of-way to minimize land use by this proposed project. Exhibit 10G shows a typical substation termination structure. These will only be used at the Bedford North Substation and Central City West Substation. They will be inside the substation fences. Exhibit 10H shows a typical single circuit angle dead end steel pole structure. This structure will be used to re-route the existing Central City West-Statler Hill 115 kV Line in and around Central City West Substation. It is used as direct embedded when the supporting soil conditions warrant. Otherwise, it could be installed on concrete foundations. As mentioned in the Siting Application and above, this existing line will move its termination location to accommodate the Bedford North-Central City West 115 kV Line termination. This will keep the line exits at Central City Substation from immediately crossing each other and increase reliability of both lines. Exhibit 10I also shows a typical single circuit angle dead end structure. This structure will be used to re-route the existing Central City West-Statler Hill 115 kV Line in and

around Central City West Substation. It will be used on concrete foundations when the supporting soil conditions cannot support the structure. Exhibit 10J shows a typical single circuit wood light angle structure with guying. This structure will be used where wood poles are structurally adequate on the existing Central City West-Statler Hill 115 kV Line. This structure could also be used where the two circuits separate to enter the Bedford North Substation. As shown on the exhibits, structure heights will vary between 50 feet and 145 feet above ground level.

Q. Do you anticipate the need for any other types of structures for the project?

A. No. We do not anticipate the need for any other types of structures other than those shown in Exhibit Nos. 10A through 10J to Penelec's Application. However, if the situation arises where the wood pole structures shown on Exhibits 10A, 10B, 10C, and 10J are not structurally adequate we would use steel pole versions of similar dimensions as the wood poles for needed strength requirements**.**

Q. What width of right-of-way is planned for the project?

A. As shown in Exhibits 11A, 11B, and 11C of the Application the project will be constructed on varying right-of-way of 100 feet and 130 feet. However, if during detailed design engineering, it becomes necessary to develop longer span lengths, for example, to span environmentally sensitive areas, the Company would require wider right-of-way to accommodate the greater side-to-side conductor movement with longer span lengths. Additionally, in areas where the proposed line would

parallel, and be located just outside of a public road's right-of-way, a narrower transmission line right-of-way can be used in combination with the road right-of-way.

Q Will the proposed transmission line overlap any existing transmission line right-of-way?

A. Yes. The proposed transmission line will use the centerline of the existing Bedford North-New Baltimore 115 kV Line 115 kV transmission line for about 40 percent of its length. In this overlap section the existing right-of-way is 100 feet in width in some places and 120 feet in width in other places. These right-of-way widths are shown on exhibits 11A and 11B. No new right-of-way is anticipated for this section of the line.

Q. Will the existing Bedford North-New Baltimore 115 kV transmission line remain in service following the completion of the proposed project?

A. Yes. The Bedford North-New Baltimore 115 kV line will be re-energized and share the same structures as described above.

Q. Will the supporting structures carry any wires other than transmission conductors?

A. Yes. The structures will have two static wires that will be located above the transmission conductors. The purpose of the static wire is to protect the

conductors from lighting strikes. One of these static wires will also serve as communications via fiber optics.

Q. Does the project meet FirstEnergy's existing engineering and design standards?

A. Yes, the structures depicted in Exhibits Nos. 10A through 10J of the Application are based upon and meet FirstEnergy's applicable existing engineering and design standards for 115 kV transmission lines.

IV. DESIGN CRITERIA

Q. Please describe the "vertical configuration" of the three conductor phases shown on Exhibit Nos. 10A through10J and explain why this configuration was selected.

A. The vertical configuration is FirstEnergy's typical configuration for a 115 kV double circuit transmission line. The configuration minimizes the width of the right-of-way.

Q. Please describe the voltage, temperature and other electrical parameters at which the conductors will operate and how these parameters will conform to the National Electric Safety Code ("NESC").

A. The 115 kV transmission line will be designed to operate at a maximum design temperature of 212 degree Fahrenheit. The line will meet all requirements of the current NESC under all operating conditions.

Q. Please describe the minimum conductor-to-ground clearances under maximum operating conditions the design will meet.

A. The transmission line will be designed to meet or exceed the NESC minimum requirements of 21 feet (rounded up to nearest foot) under all operating conditions.

Q. Please describe the type and size of conductor planned for the conductors and shield wire.

A. The three (3) conductors are 795 thousand circular mills ("kcmil") 26/7 aluminum conductor, steel reinforced ("ACSR"). The 26/7 designation indicates the stranding of the conductor, with the 26 representing the outer 26 aluminum wires and the 7 representing the inner 7 steel wires. The shield wires will be one 7#8 alumoweld and one fiber optic.

Q. Please describe the relationship of the proposed right-of-way width to the design and NESC requirements for the project.

A. The right-of-way width was selected to provide necessary conductor clearances when considering structure type, span length between supporting structures, conductor motion, line voltage, and NESC defined weather conditions.

V. CONSTRUCTION ACTIVITIES

Q. Please describe, in general terms, the construction process.

A. The project will be constructed according to a well-defined procedure that utilizes standard construction practices to perform all work safely and in compliance with the Occupational Safety and Health Administration ("OSHA") Rules and Regulations, while keeping environmental impact to a minimum. Project activities will include the installation and maintenance of soil erosion and sedimentation control measures, temporary access route construction, right-of-way clearing, foundation, structure and wire installations, and the rehabilitation of all areas disturbed during construction.

Q. Will a construction project contractor and/or manager be utilized?

A. Penelec plans to construct the line with contractor construction labor and supervision, with FirstEnergy Service Company personnel oversight.

Q. How will Penelec oversee and monitor the construction cost and progress of the project?

A. Penelec uses the services of FirstEnergy Service Company, a FirstEnergy affiliate, for oversight of engineering, construction, and other services. FirstEnergy Service Company will assign a project manager to monitor and oversee the project construction activities.

Q. What is the estimated cost to site and construct the project?

A. The cost of the project is currently estimated to be $48 million.

Q. When will the project be constructed?

A. Pending approval for the Project from the Pennsylvania Public Utility Commission, construction is scheduled to occur from February 2018 thru December 2018.

Q. What steps are planned for minimizing the effects of construction on areas within and outside of the right-of-way, including such things as traffic and other local community issues?

A. Physical work on the Project will not begin until the necessary permits for work have been issued. All work will be conducted in accordance with state, local, and federal permits, property releases, and approved special conditions. Penelec will, at all times, minimize to the greatest extent practical the impacts of construction activities on local communities.

VI. RIGHT-OF-WAY CLEARING AND PREPARATION

Q. What methods will be used to clear and prepare the right-of-way for construction?

A. The construction specifications adopted for the project are designed to keep environmental impact to a minimum. In addition to the implementation of best management practices for erosion control ("BMPs"), Penelec's efforts to minimize environmental impact during the right-of-way preparation phase of construction will include the following:

1. A copy of the Soil Erosion and Sedimentation Control Plan, along with the appropriate permit forms, will be submitted to the Pennsylvania Department of Environmental Protection and, as necessary, the County Conservation District for approval.

2. BMP for soil erosion measures and sedimentation control will be put in place prior to any earth disturbance.

3. Construction access routes will be installed in accordance with the Soil Erosion and Sedimentation Control Plan. Existing roads, private farm lanes, private forest roads and other similar existing access will be utilized to the extent practical. Where new access routes are needed for vegetation removal and/or construction, it is preferred that the access remain for future maintenance activities. Any new access roads that are to remain

will be stabilized by seeding and installation of water diversion measures. Where it is necessary to remove new access roads after construction, the roads will be re-graded to pre-construction contours and re-vegetated with an appropriate seed mix.

4. Disturbed work areas will be re-vegetated in accordance with the approved Soil Erosion and Sediment Control Plan.

5. Penelec will clear the corridor to the specific width in accordance with the FirstEnergy Initial Clearing of Transmission Lines Specification and the FirstEnergy Detailed Property and Provision List. Trees located outside the ROW that are deemed Priority Trees shall be removed. Priority Trees are defined as trees located adjacent to transmission corridors that are dead, dying, diseased, structurally defective, leaning or significantly encroaching, where the transmission conductor would be a target when a tree fails and will fall or be within close proximity of the transmission conductor to potentially flash-over, strike or grow into the conductor. In order to remove trees and vegetation both on and off ROW, Penelec will first obtain the necessary rights from the applicable property owners.

When required, Penelec's standard specifications will be modified and/or amended for construction of the project to comply with all terms of the governing permits required and applicable to construct the project.

Q. What steps will be taken to upgrade, seed, or otherwise restore disturbed right-of-way once construction is complete?

A. After construction is completed, the transmission line right-of-way will be restored to conditions as good as or better than what existed prior to construction. Such work includes restoring drainage ditches, fencing, and field drainage tiles. Non-cultivated areas that are disturbed by construction activities will be fertilized, seeded, and mulched. Temporary soil erosion and sedimentation control measures will be removed after vegetative cover has been established.

Q. Please describe the steps that will be taken to control erosion and the siltation of streams where the ground is disturbed during construction activities along the right-of-way.

A. FirstEnergy will follow all applicable guidelines from the Commonwealth of Pennsylvania, Department of Environmental Protection Office of Water Management's Erosion and Sediment Pollution Control Program Manual (Chapter 102).

VII. RIGHT-OF-WAY MAINTENANCE

Q. Please describe the procedures that will be employed to maintain the right-of-way free of incompatible vegetation following the completion of construction and the commencement of operations.

A. The approach that Penelec employs is the control or removal of all incompatible vegetation that has the potential to interfere with the safe and efficient operation of the transmission system. This is accomplished through either removal by mechanical means or the application of herbicides. The goal is to promote a low growing plant community of grasses, herbs, and low growing compatibles. Along the transmission corridor, where the transmission conductor is a target, priority trees that are dead, dying, diseased, structurally defective, leaning or significantly encroaching are identified and removed. Work activities are performed under established cycles considering the inter-relations between vegetation growth rates, vegetation control methods and inspection frequency. These cycles have been developed based on consideration of vegetation conditions and species, movement of line conductors under their rating and all rated electrical operating conditions, as well as terrain, state regulatory requirements, easement restrictions and environmental concerns.

Q. Describe the general parameters under which Penelec will maintain the project right-of-way?

A. Penelec's methods used to manage and control vegetation include manual control methods using hand-operated tools, mechanical control using aerial and equipment-mounted saws, mowers or other devices, and various herbicide application techniques

such as, selective basal, stem foliage and cut stubble. Exhibit 20 provides additional information on Penelec's vegetation management program.

Penelec will maintain the Project in accordance with best management practices and the Company's Transmission Vegetation Management Program.

The objective of the Penelec transmission vegetation management program is to ensure the continued and safe operation of transmission circuits through the removal and control of all incompatible vegetation that has the potential to interfere with the safe and efficient operation of the transmission system. Penelec's vegetation management practices are designed to prevent vegetation related outages by creating and sustaining a stable and compatible vegetated community within and along the transmission corridor using integrated vegetation management techniques. Penelec's overarching goal is to prevent all vegetation-caused service interruptions at the lowest possible cost by removing potentially threatening vegetation at the most advantageous time.

Q. Will Penelec's vegetation control procedures observe specific legal or regulatory standards?

A. Yes. The vegetation management procedures described above are designed to ensure that Penelec complies with all required federal, state, and local vegetation management standards. For example, the North American Electric Reliability Service Company ("NERC") Reliability Standard FAC-003-3 contains, the following requirements among others:

- Standard R3 requires Penelec to have documented maintenance strategies or procedures or process or specifications it uses to prevent the encroachment of vegetation into the Minimum Vegetation Clearance Distances (MVCD) provided in FAC-003-3 Table 2.

- Standard R1 and R2 requires Penelec to manage vegetation to prevent encroachments into the MVCD. Penelec's Transmission Vegetation Management Strategies and Procedures are designed to maintain a reliable electric transmission system by using a defense-in-depth strategy to manage vegetation located on and adjacent to transmission rights-of-way (ROW). The objective of these strategies and procedures is to ensure that vegetation with the potential to encroach into Penelec's vegetation clearances is identified and mitigated and that vegetation clearances are achieved at the time of maintenance to prevent encroachments into the MVCD and to ensure safe and reliable operation of the electric transmission system.

- Standard R6 and R7 requires Penelec to perform and complete vegetation inspections. Maintenance inspections are scheduled annually for those corridors that are scheduled for vegetation maintenance based on their established vegetation management cycle. Aerial and/or associated ground inspections are scheduled on 100% of FirstEnergy applicable transmission

lines Aerial and/or ground inspections generally are performed at least once per calendar year and with no more than 18 calendar months between inspections on the same ROW

- Standard R7 requires Penelec to complete 100% of its annual vegetation work plan of applicable lines to ensure no vegetation encroachments occur within the MVCD. The purpose of creating and implementing the annual work plan for vegetation management work is to ensure no vegetation encroachments occur within the MVCD. The creation of the work plan involves scheduling transmission corridors every year for vegetation management based on the next cycle date. The work plan is flexible enough to adjust to changing conditions, taking into consideration anticipated growth of vegetation, and all other environmental factors that may impact the reliability of the transmission system.

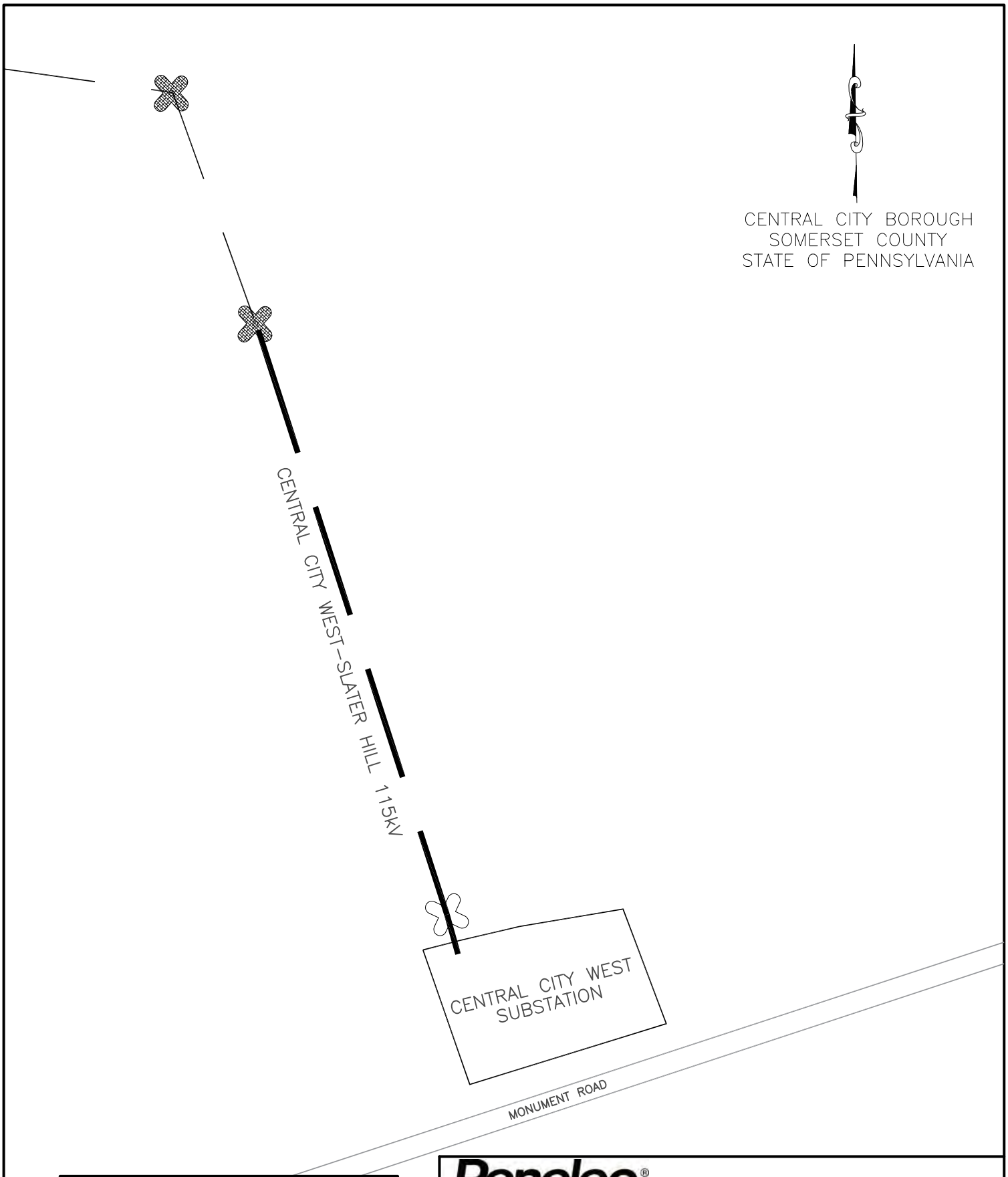
Q. Please describe the expected right-of-way maintenance cycle for this project.

A. The FirstEnergy transmission vegetation management program within the Penelec service territory is currently on a five-year maintenance schedule for all transmission voltages.

Q. Does this conclude your direct testimony?

A. Yes, it does. However, I would like to reserve the right to file such additional testimony or exhibits as may be necessary or appropriate.

EXHIBIT 6 – CENTRAL CITY WEST SUBSTATION LAYOUT



LEGEND

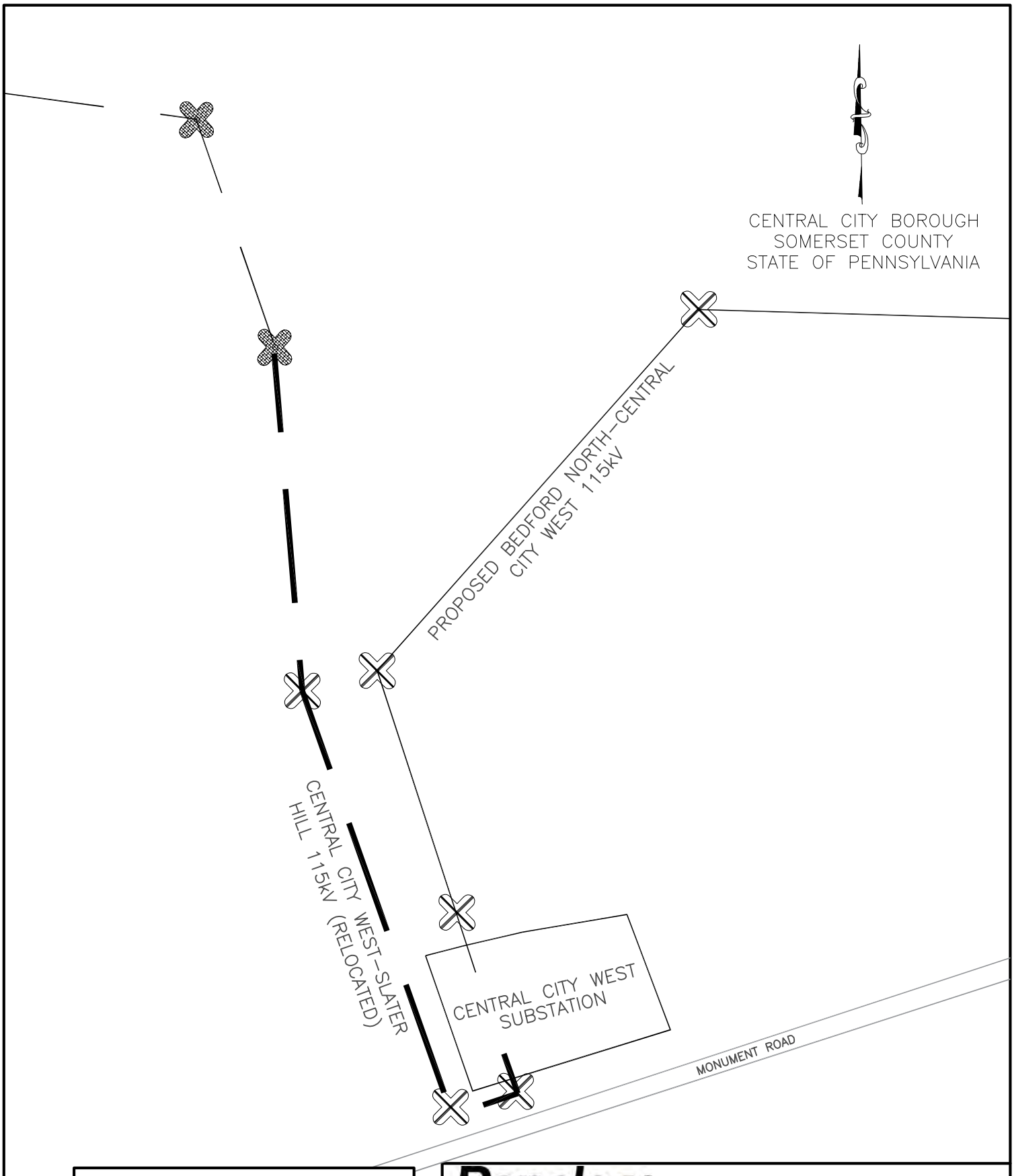
- EXISTING STRUCTURE TO REMAIN
- EXISTING STRUCTURE TO BE REPLACED
- EXISTING TRANSMISSION LINE
- PORTION OF THE EXISTING TRANSMISSION LINE TO BE RELOCATED

Penelec®
A FirstEnergy Company

BEDFORD NORTH–CENTRAL CITY WEST 115kV TRANSMISSION LINE

EXISTING LAYOUT AT THE CENTRAL CITY WEST SUBSTATION

EXHIBIT 6A



LEGEND

- EXISTING STRUCTURE TO REMAIN
- PROPOSED STRUCTURE
- EXISTING TRANSMISSION LINE
- PORTION OF THE EXISTING TRANSMISSION LINE TO BE RELOCATED
- PROPOSED TRANSMISSION LINE

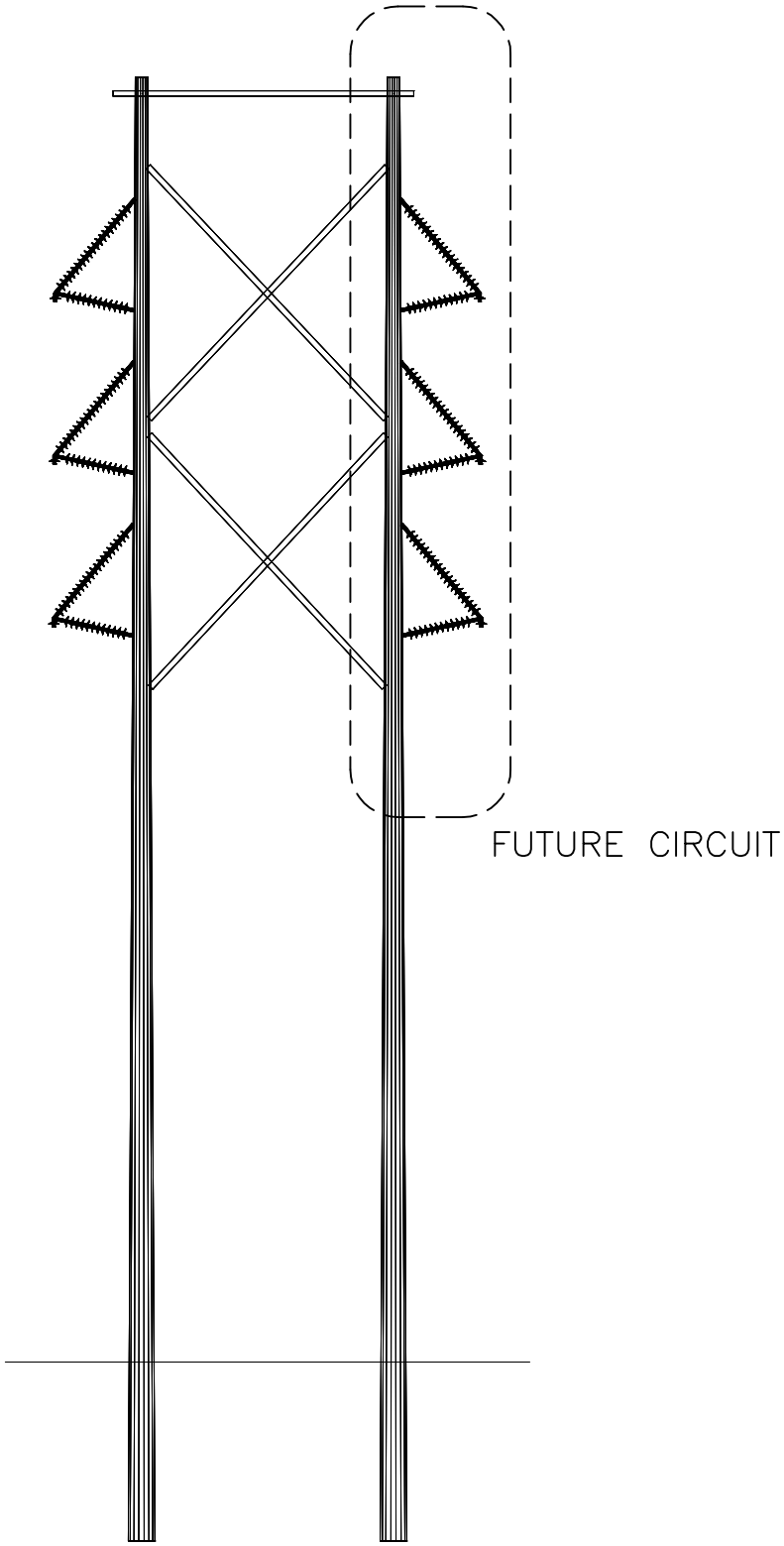
Penelec®
A FirstEnergy Company

BEDFORD NORTH–CENTRAL CITY WEST 115kV TRANSMISSION LINE

PROPOSED LAYOUT AT THE CENTRAL CITY WEST SUBSTATION

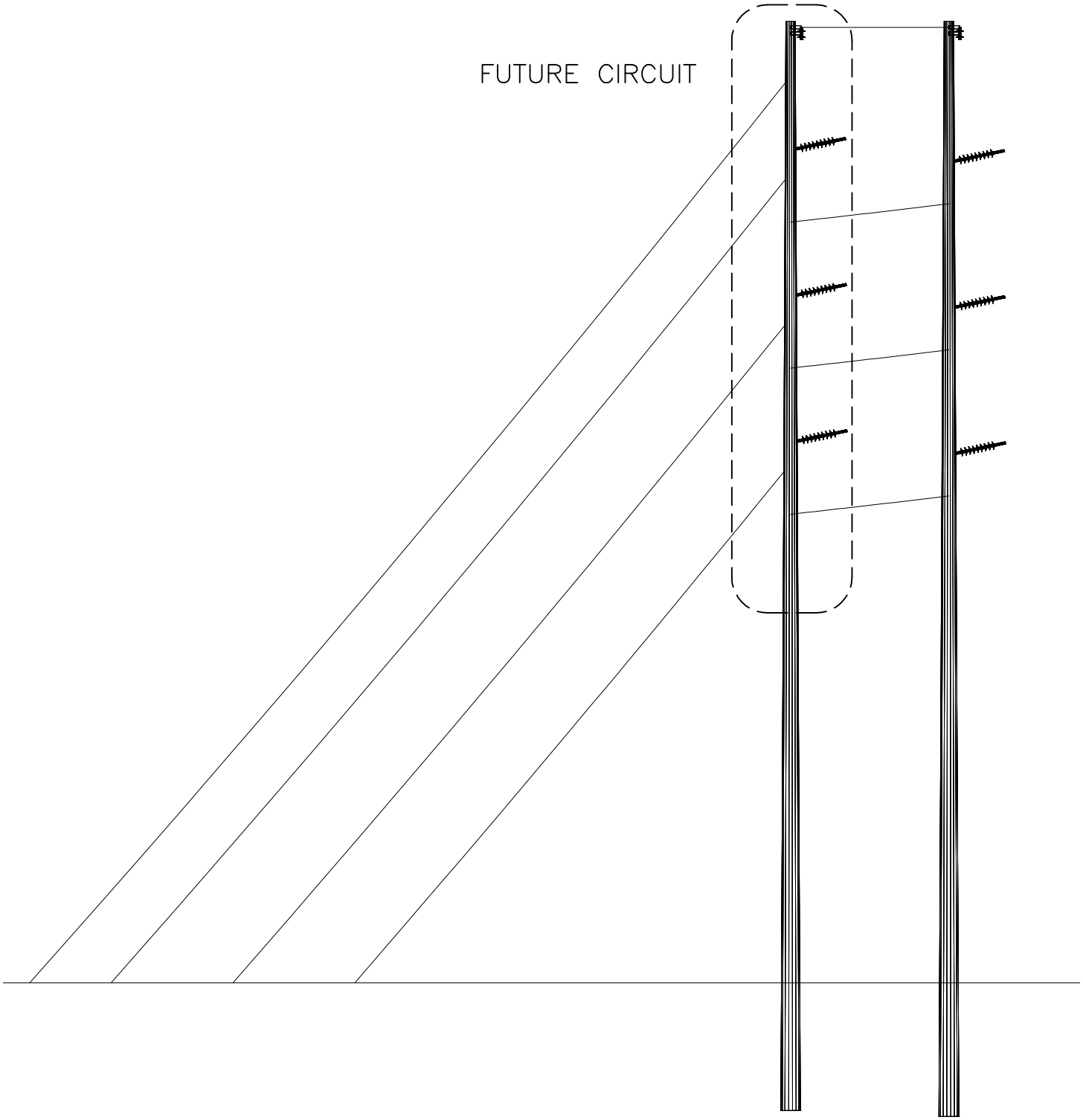
EXHIBIT 6B

EXHIBIT 10 – TRANSMISSION STRUCTURE TYPES



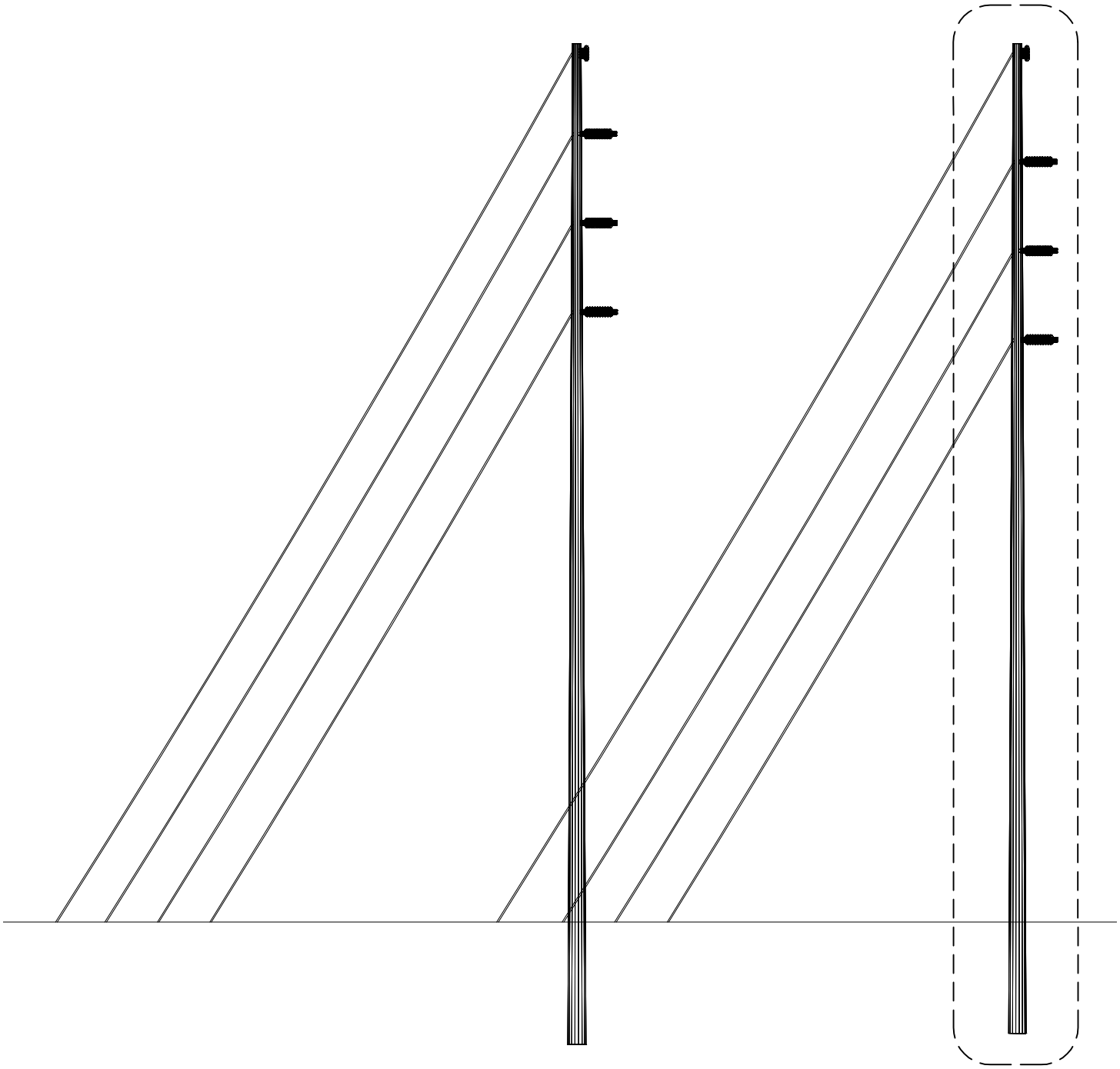
WOOD DOUBLE CIRCUIT
TANGENT STRUCTURE –
HEIGHT RANGE: 79' TO 103'

ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14-102-PN	BEDFORD NORTH–CENTRAL CITY WEST 115kV STRUCTURE EXAMPLE DOUBLE CIRCUIT TANGENT STRUCTURE				
	CHK.	ORDER NO. 14209469					
	INS.	WBS PW-004714 R/W	FirstEnergy Transmission Design	OPERATING CO. PENELEC	DWG NO. EXHIBIT 10A	SHEET	REV.
	APP.	SCALE N.T.S.					



WOOD DOUBLE CIRCUIT
LIGHT ANGLE STRUCTURE –
HEIGHT RANGE: 79' TO 93'
(BASED ON FE STD 18–555)

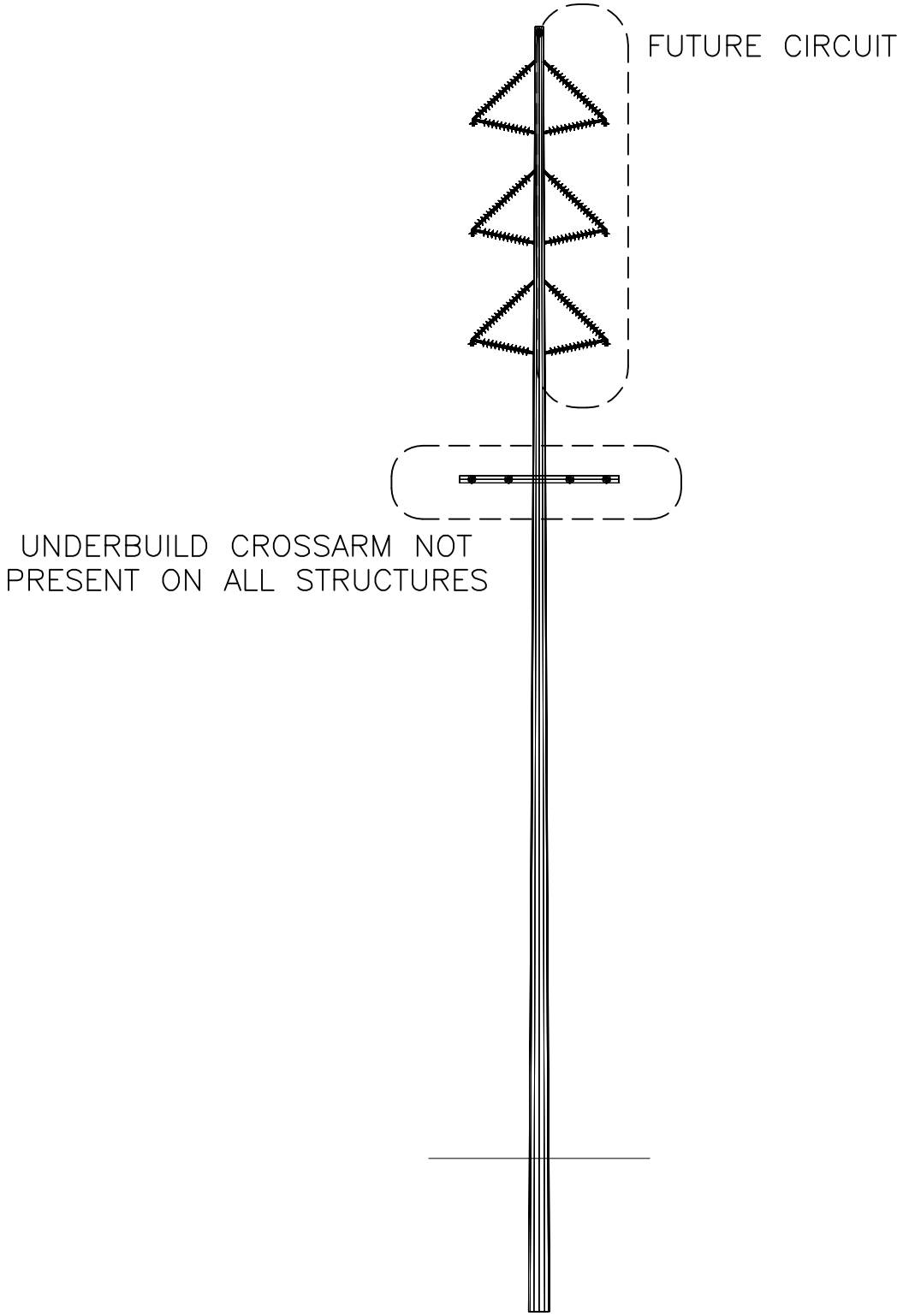
ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14–102–PN	BEDFORD NORTH–CENTRAL CITY WEST 115kV STRUCTURE EXAMPLE DOUBLE CIRCUIT LIGHT ANGLE STRUCTURE			
	CHK.	ORDER NO. 14209469				
	INS.	WBS PW–004714 R/W				
	APP.	SCALE N.T.S.	FirstEnergy. Transmission Design	OPERATING CO. PENELEC	DWG NO. EXHIBIT 10B	SHEET REV.



WOOD DOUBLE CIRCUIT
ANGLE DEAD-END STRUCTURE -
HEIGHT RANGE: 79' TO 103'
(BASED ON FE STD 18-560)

ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14-102-PN	BEDFORD NORTH-CENTRAL CITY WEST 115kV STRUCTURE EXAMPLE DOUBLE CIRCUIT ANGLE DEAD-END
	CHK.	ORDER NO. 14209469	
	INS.	WBS PW-004714 R/W	
	APP.	SCALE N.T.S.	

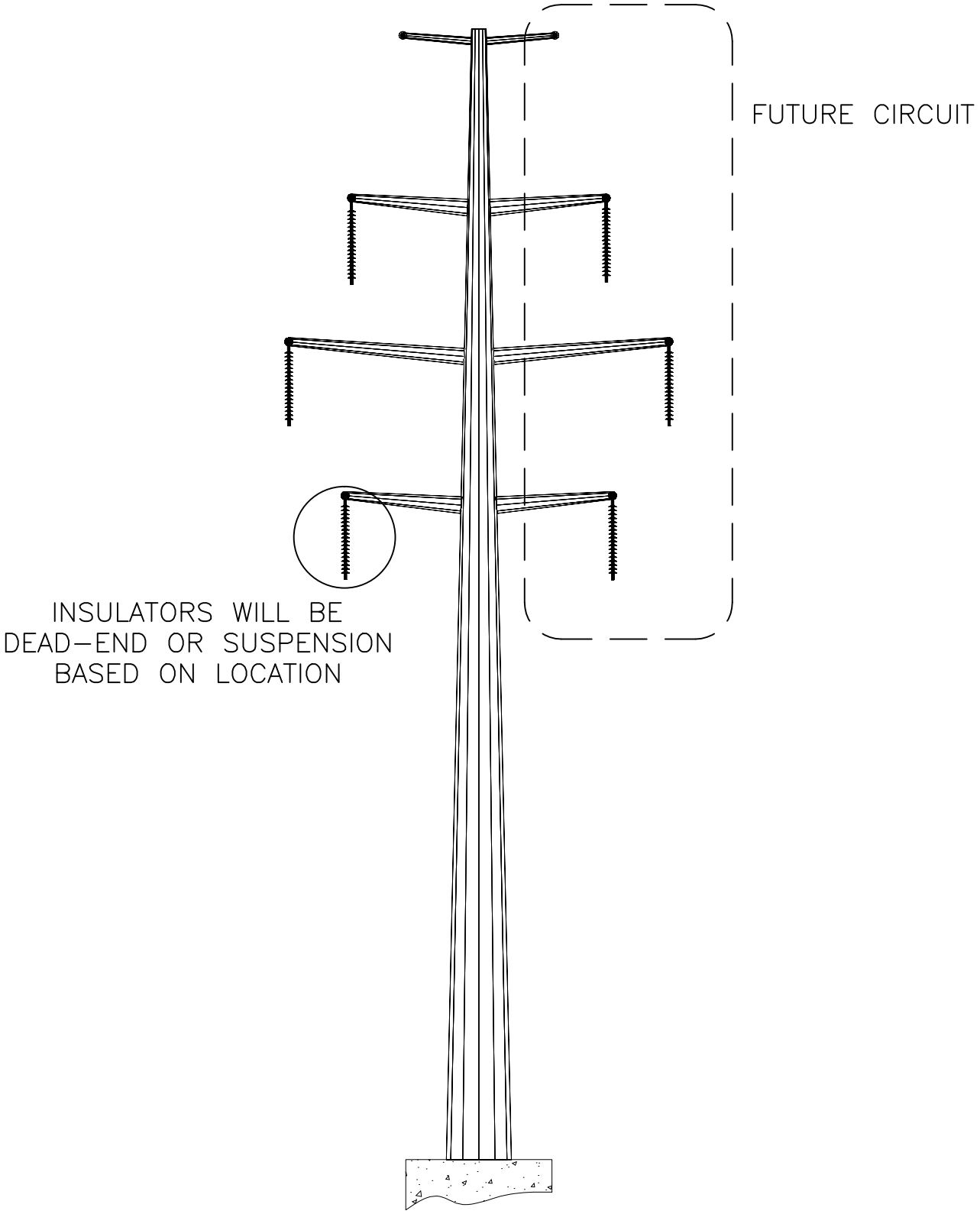
FirstEnergy Transmission Design	OPERATING CO.	DWG NO.	SHEET	REV.
	PENELEC	EXHIBIT 10C		



DIRECT BURY STEEL DOUBLE CIRCUIT
TANGENT STRUCTURE –
HEIGHT RANGE: 105'
(BASED ON FE STD 18–550)

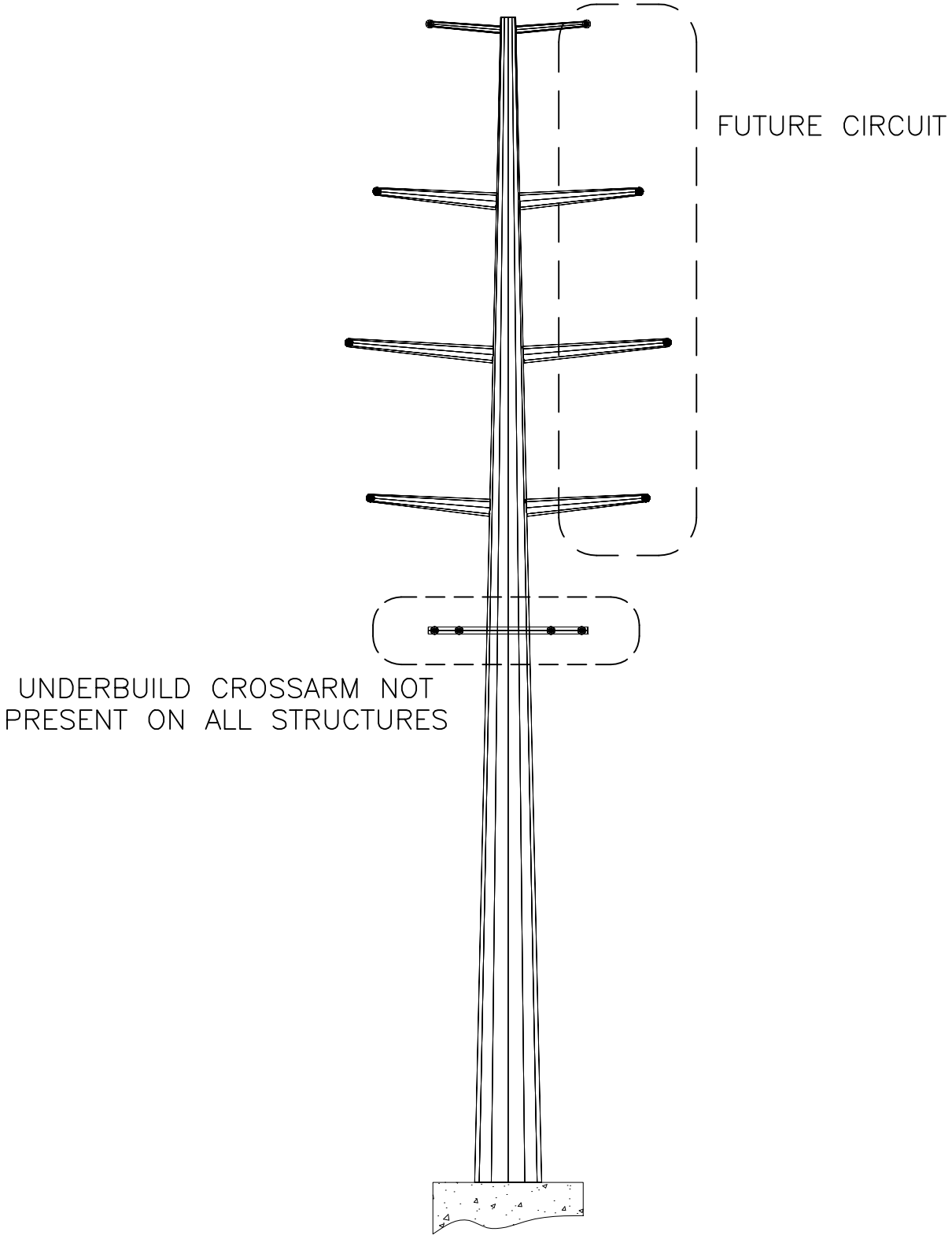
ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14–102–PN	BEDFORD NORTH–CENTRAL CITY WEST 115kV STRUCTURE EXAMPLE STEEL DOUBLE CIRCUIT TANGENT
	CHK.	ORDER NO. 14209469	
	INS.	WBS PW–004714 R/W	
	APP.	SCALE N.T.S.	

FirstEnergy Transmission Design	OPERATING CO.	DWG NO.	SHEET	REV.
	PENELEC	EXHIBIT 10D		



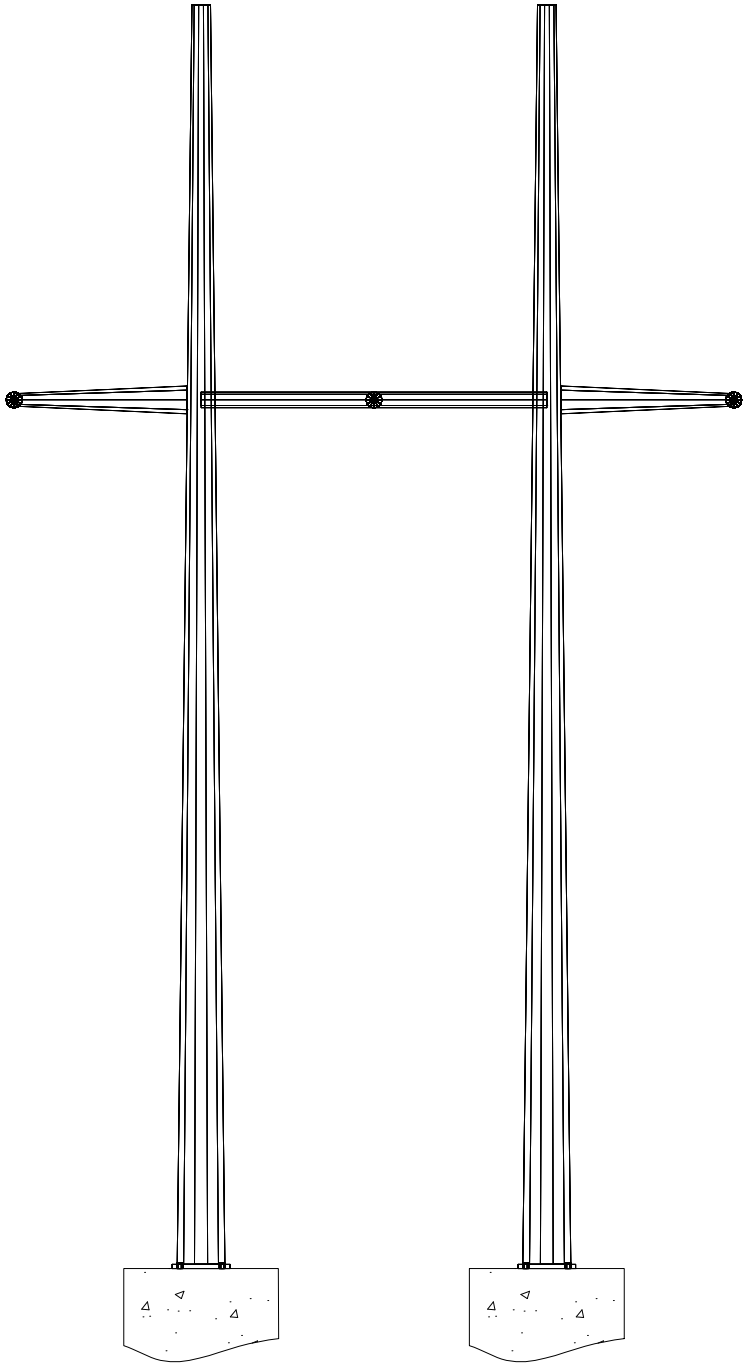
ENGINEERED STEEL ON FOUNDATION
(APPALACHIAN RIDGE AREA)
DOUBLE CIRCUIT TANGENT/DEAD-END STRUCTURE –
HEIGHT RANGE: 95' TO 145'

ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14-102-PN	BEDFORD NORTH-CENTRAL CITY WEST 115kV STRUCTURE EXAMPLE STEEL DOUBLE CIRCUIT TANGENT/DEAD-END			
	CHK.	ORDER NO. 14209469				
	INS.	WBS PW-004714 R/W	FirstEnergy Transmission Design	OPERATING CO. PENELEC	DWG NO. EXHIBIT 10E	SHEET / REV.
	APP.	SCALE N.T.S.				



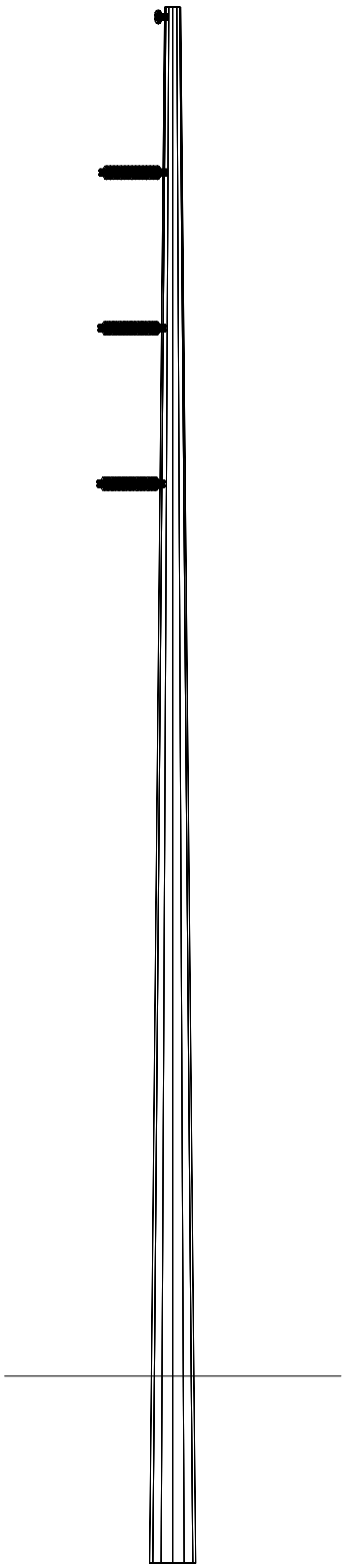
ENGINEERED STEEL ON FOUNDATION
DOUBLE CIRCUIT DEAD-END STRUCTURE -
HEIGHT RANGE: 90' to 95'

ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14-102-PN	BEDFORD NORTH-CENTRAL CITY WEST 115kV STRUCTURE EXAMPLE STEEL DOUBLE CIRCUIT DEAD-END				
	CHK.	ORDER NO. 14209469					
	INS.	WBS PW-004714 R/W	FirstEnergy Transmission Design	OPERATING CO. PENELEC	DWG NO. EXHIBIT 10F	SHEET	REV.
	APP.	SCALE N.T.S.					



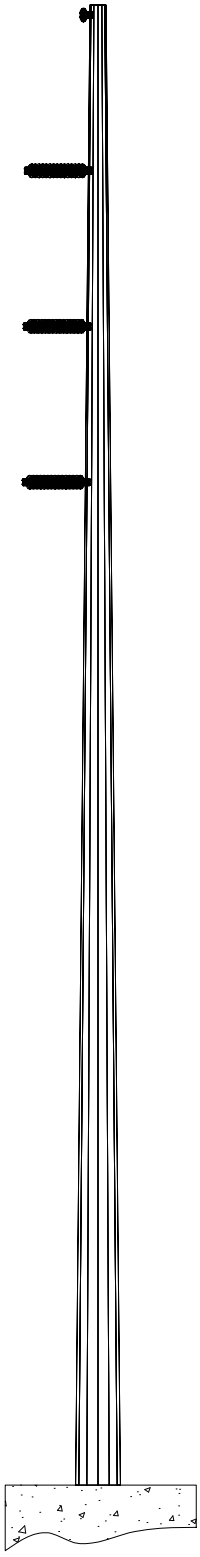
ENGINEERED STEEL ON FOUNDATION
SUBSTATION TERMINATION STRUCTURE –
HEIGHT RANGE: 50' to 65'

ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14-102-PN	BEDFORD NORTH–CENTRAL CITY WEST 115kV STRUCTURE EXAMPLE STEEL TERMINATION STRUCTURE			
	CHK.	ORDER NO. 14209469				
	INS.	WBS PW-004714 R/W	FirstEnergy. Transmission Design	OPERATING CO. PENELEC	DWG NO. EXHIBIT 10G	SHEET / REV.
	APP.	SCALE N.T.S.				



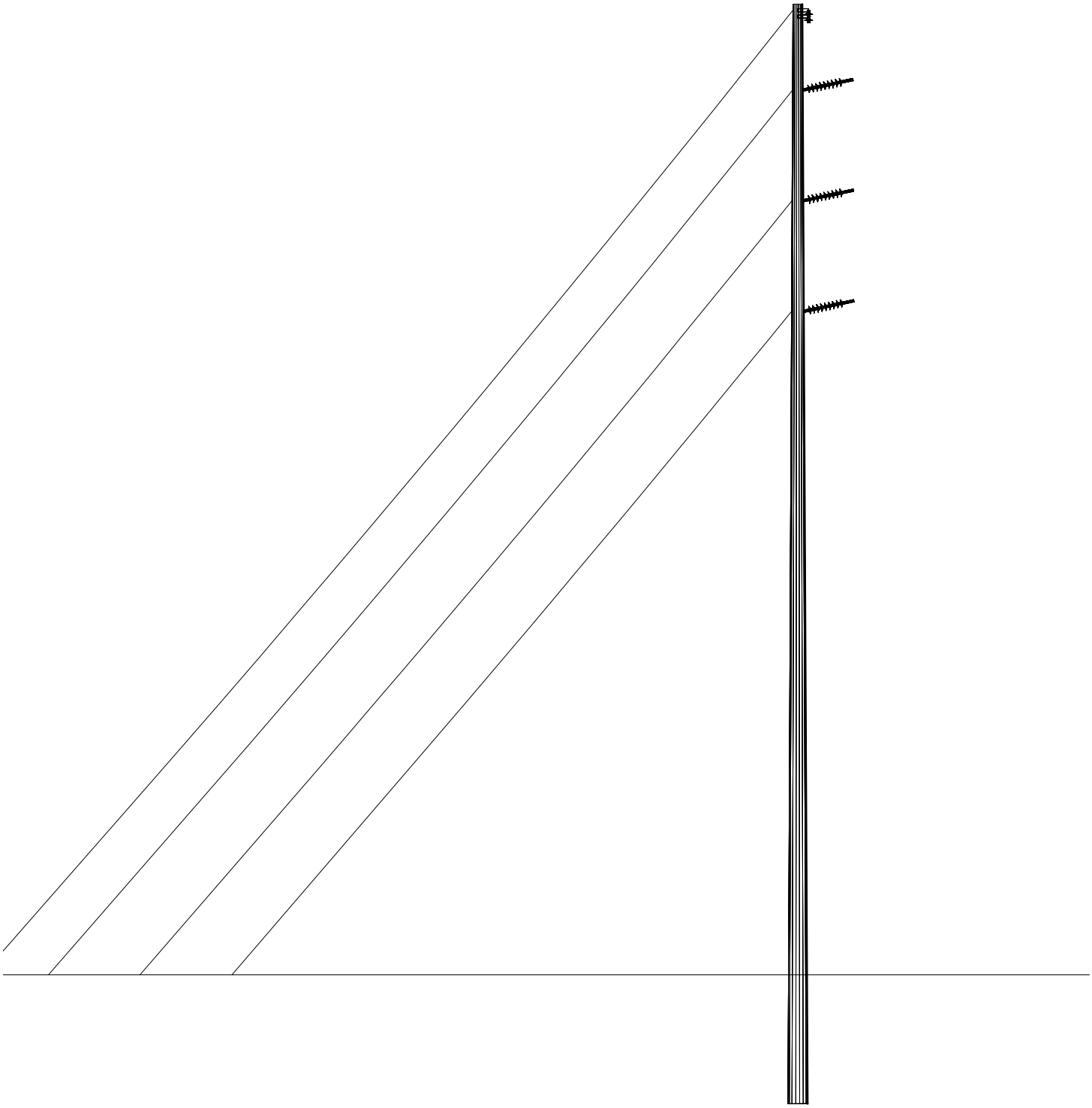
DIRECT BURY STEEL SINGLE CIRCUIT
ANGLE DEAD-END STRUCTURE -
HEIGHT RANGE: 90'

ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14-102-PN	CENTRAL CITY WEST-STATLER HILL 115kV STRUCTURE EXAMPLE STEEL SINGLE CIRCUIT ANGLE DEAD-END				
	CHK.	ORDER NO. 14209469					
	INS.	WBS PW-004714 R/W					
	APP.	SCALE N.T.S.	FirstEnergy. Transmission Design	OPERATING CO. PENELEC	DWG NO. EXHIBIT 10H	SHEET	REV.



ENGINEERED STEEL ON FOUNDATION
SINGLE CIRCUIT ANGLE DEAD-END STRUCTURE -
HEIGHT RANGE: 90' to 110'

ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14-102-PN	CENTRAL CITY WEST-STATLER HILL 115kV STRUCTURE EXAMPLE STEEL SINGLE CIRCUIT ANGLE DEAD-END				
	CHK.	ORDER NO. 14209469					
	INS.	WBS PW-004714 R/W	FirstEnergy Transmission Design	OPERATING CO. PENELEC	DWG NO. EXHIBIT 101	SHEET	REV.
	APP.	SCALE N.T.S.					

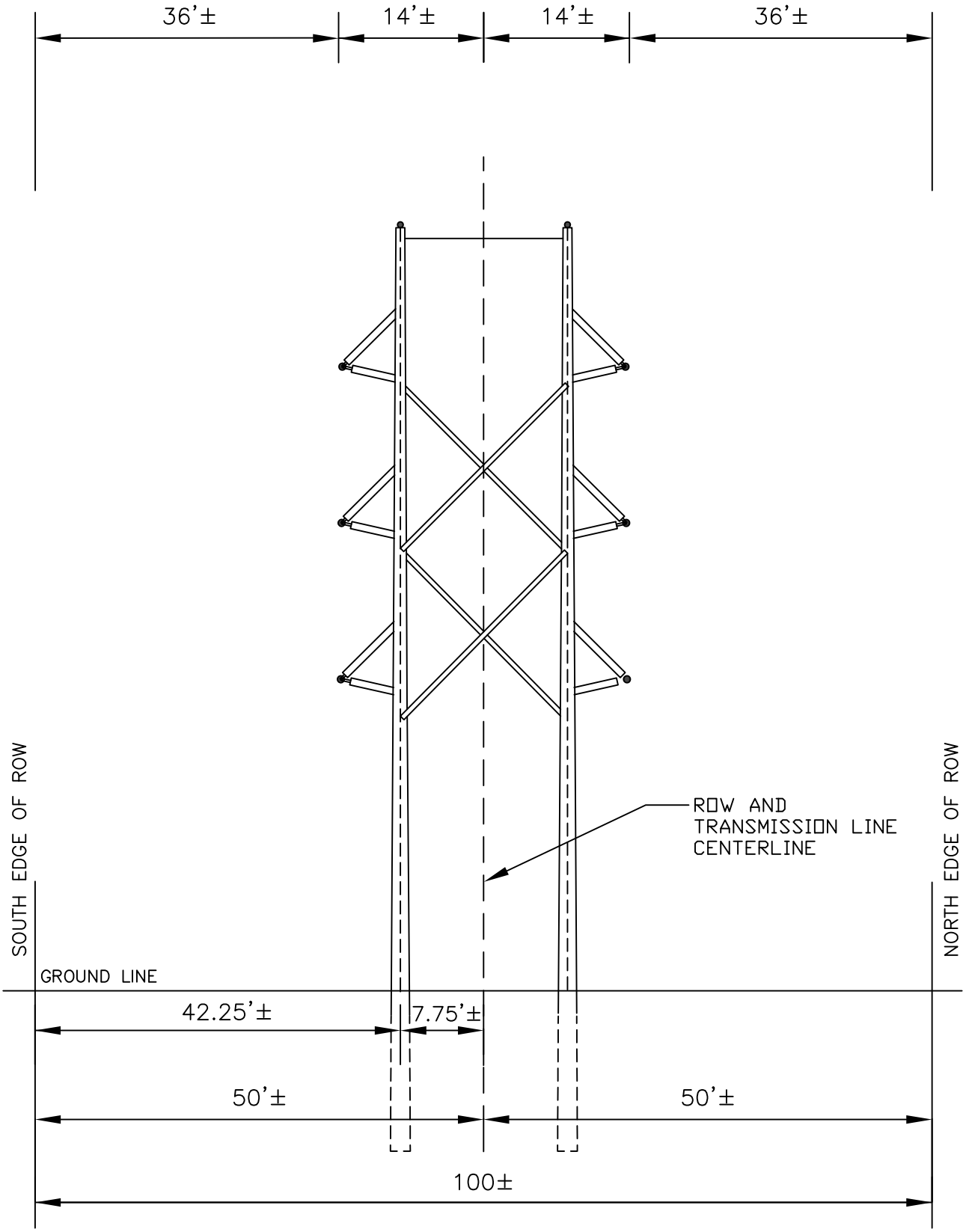


WOOD SINGLE CIRCUIT
LIGHT ANGLE STRUCTURE –
HEIGHT RANGE: 85' TO 105'
(BASED ON FE STD 18–555)

ISSUE DATE: ☐ CONSTRUCTION ☐ AS BUILT ☐ RECORD	DR. WRB/RUE 8/16	C.E. 14–102–PN	CENTRAL CITY WEST–STATLER HILL 115kV STRUCTURE EXAMPLE SINGLE CIRCUIT LIGHT ANGLE STRUCTURE
	CHK.	ORDER NO. 14209469	
	INS.	WBS PW–004714 R/W	
	APP.	SCALE N.T.S.	

FirstEnergy Transmission Design	OPERATING CO.	DWG NO.	SHEET	REV.
	PENELEC	EXHIBIT 10J		

EXHIBIT 11 – TYPICAL RIGHT-OF-WAY CROSS SECTIONS



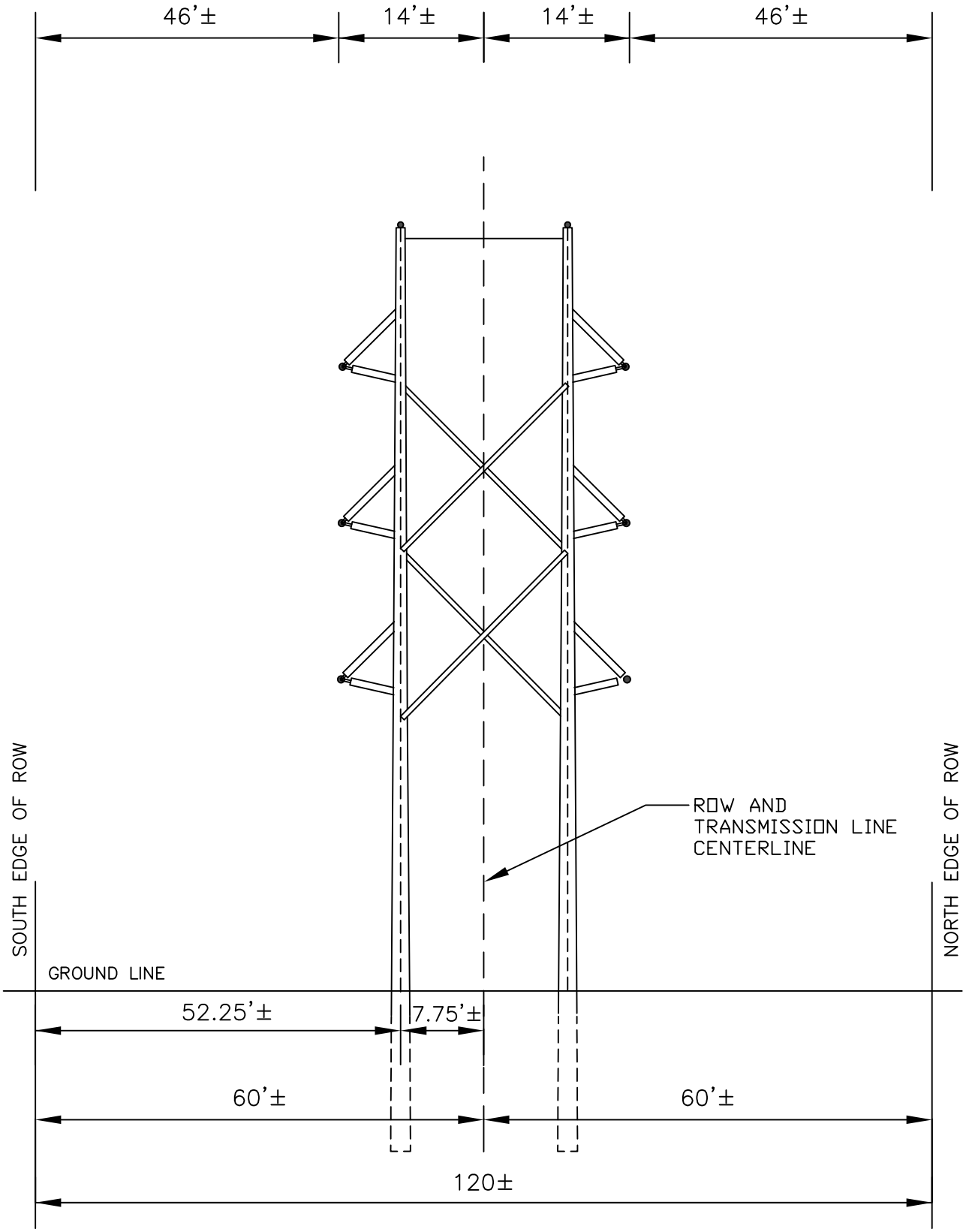
**NOT TO SCALE

Penelec®
A FirstEnergy Company

BEDFORD NORTH–CENTRAL CITY
WEST 115 kV TRANSMISSION LINE
PROJECT

TYPICAL RIGHT OF WAY CROSS SECTION FOR
THE 11.7 MILE, 100 FOOT WIDE RIGHT OF WAY

EXHIBIT 11A



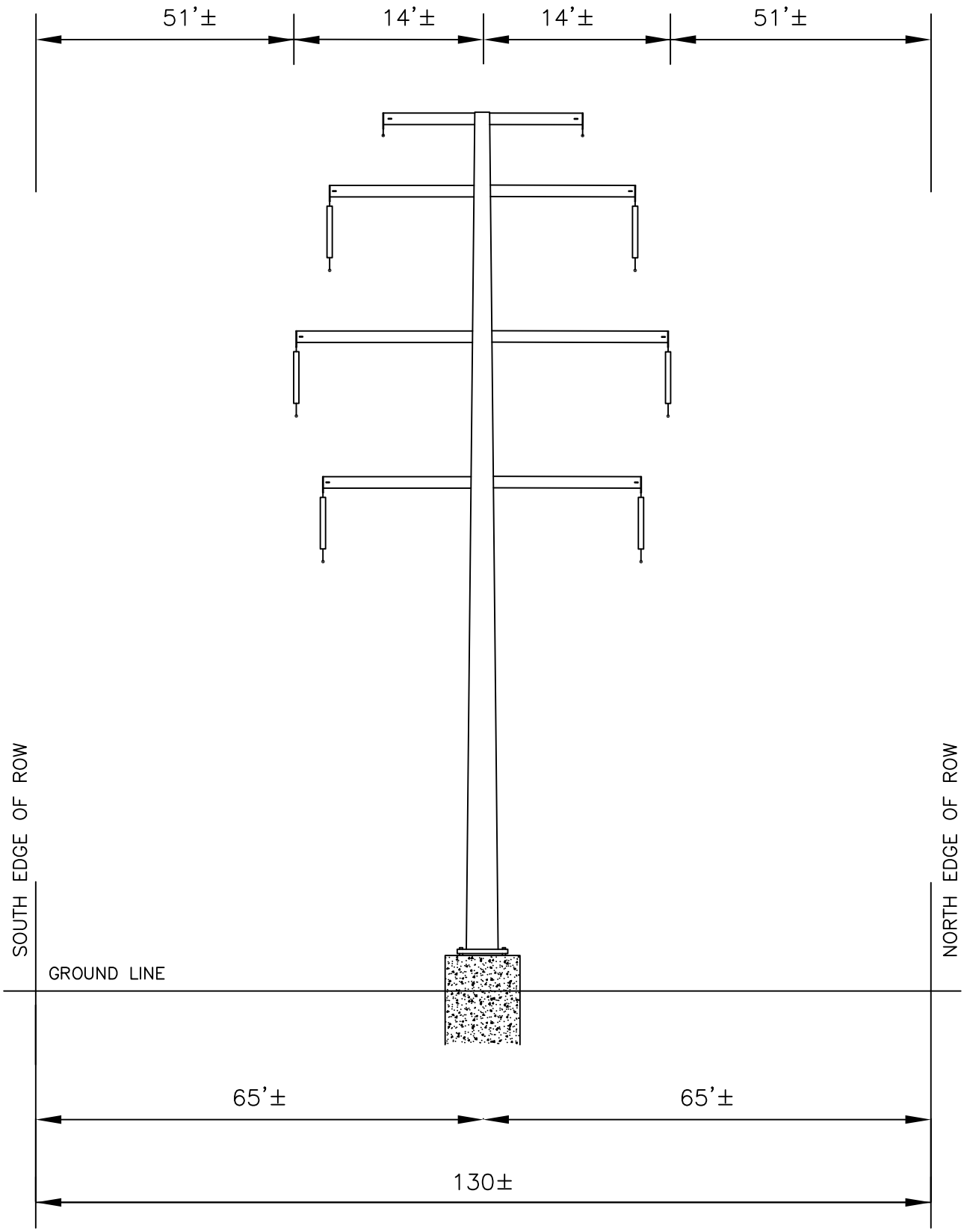
**NOT TO SCALE

Penelec®
A FirstEnergy Company

BEDFORD NORTH–CENTRAL CITY
WEST 115 kV TRANSMISSION LINE
PROJECT

TYPICAL RIGHT OF WAY CROSS SECTION FOR
THE 5.6 MILE, 120 FOOT WIDE RIGHT OF WAY

EXHIBIT 11B



**NOT TO SCALE

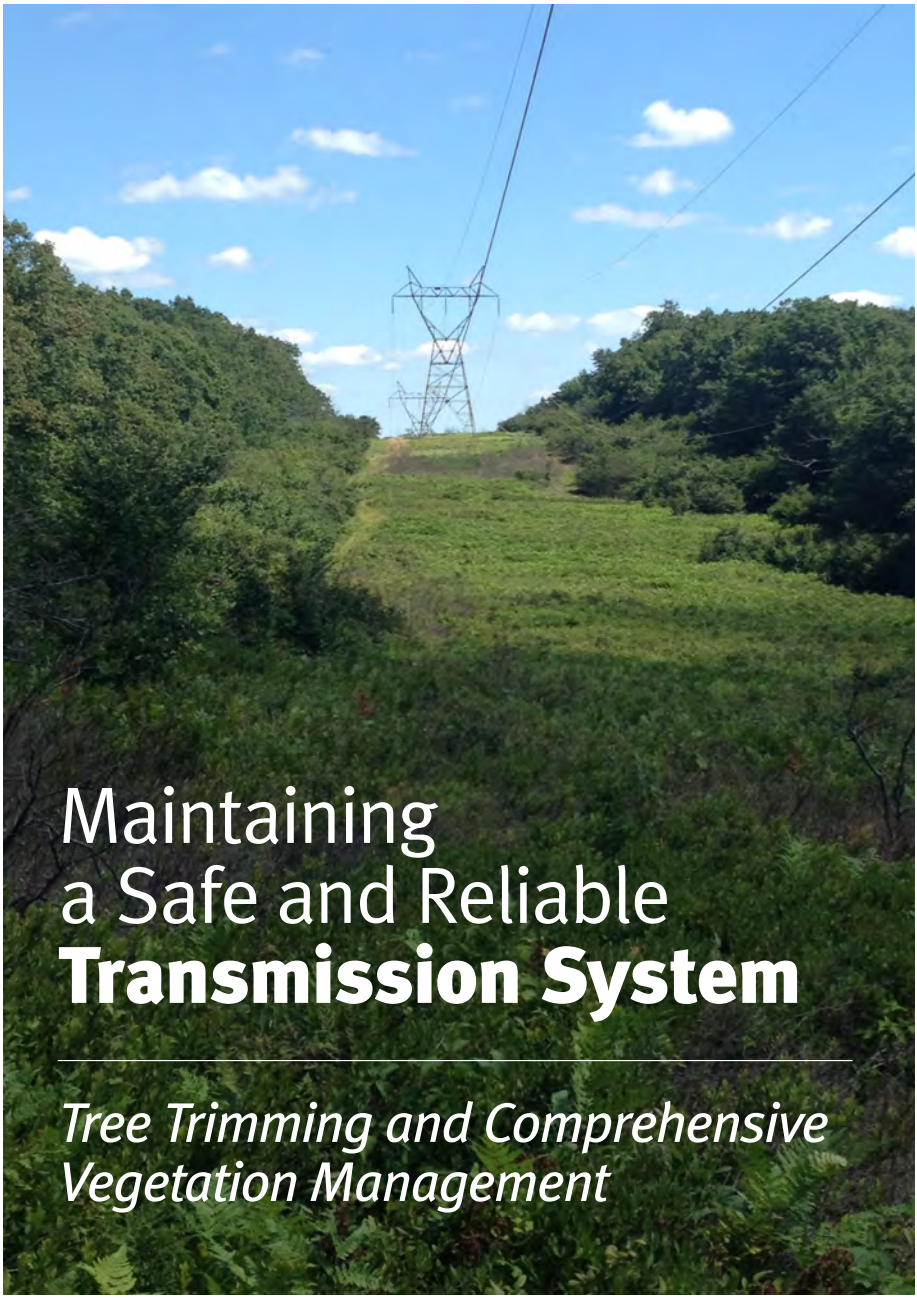
Penelec®
A FirstEnergy Company

BEDFORD NORTH–CENTRAL CITY WEST 115 kV TRANSMISSION LINE PROJECT

TYPICAL RIGHT OF WAY CROSS SECTION FOR THE 0.3 MILE, 130 FOOT WIDE RIGHT OF WAY

EXHIBIT 11C

EXHIBIT 20 – TRANSMISSION VEGETATION MANAGEMENT BROCHURE



Maintaining a Safe and Reliable **Transmission System**

Tree Trimming and Comprehensive Vegetation Management

FirstEnergy®

Managing Vegetation Along FirstEnergy's Transmission System

Transmission lines are considered the "super highway" of the electric grid, allowing large amounts of electricity to be moved across the country from power plants to end-use customers.

As part of its ongoing efforts to enhance service reliability, FirstEnergy has a comprehensive, year-round program to remove and trim trees and manage vegetation along more than 13,000 miles of transmission line corridors in six states.

FirstEnergy's transmission system includes lines ranging in size from 69,000 to 500,000 volts. The width of transmission line rights-of-way (ROW) vary according to the voltage of the lines and the easement rights that were negotiated with the property owner prior to the lines being constructed.

Easements give FirstEnergy the right to build, operate and maintain transmission lines, which includes removing trees and managing vegetation. While many easements were negotiated by previous property owners, the terms of the agreement remain in place even if the property is transferred or sold.

Unless properly maintained by FirstEnergy, trees have the potential to come in contact with power lines and other electric facilities and can be a major cause of power outages, especially during severe weather.

As utilities look to enhance reliability and safety, it is important that existing vegetation management easement rights are enforced. The removal of trees under high-voltage lines rather than pruning serves to minimize the chance of any vegetation contact.

FirstEnergy is aware that this can be an emotional issue for property owners – but the work must be done to remain in compliance with reliability mandates established on the federal level by the Federal Energy Regulatory Commission (FERC) and the North American Electric Reliability Council (NERC), and by state public utility commissions.

Proper vegetation management does not always involve removal of all vegetation. Compatible shrubs that do not have the potential to interfere with electric facilities typically are not disturbed.

Ultimately, transmission line corridors should include a diverse mixture of grasses, low growing shrubs and other ground cover preferred by birds, deer and small animals to promote a thriving wildlife habitat. In this way, a well-managed ROW provides food and cover wildlife need to survive, and the reliability electric customers require.

Ensuring **Service Reliability**

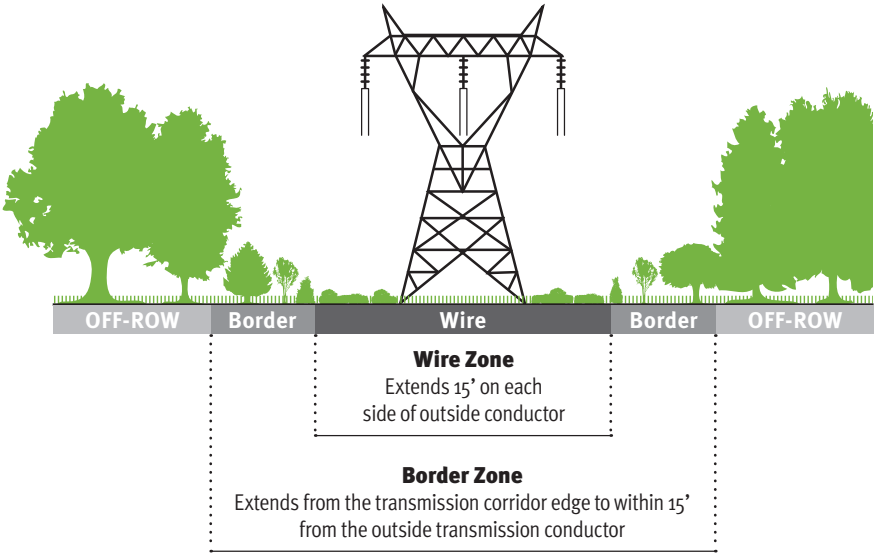
FirstEnergy has a comprehensive vegetation management program designed to maintain its transmission ROW. As part of this program, all safety precautions are utilized by FirstEnergy employees and forestry contractors. We are committed to managing vegetation in ways that will have a minimal impact on our environment.

Creating and sustaining a compatible, stable and low-growing plant community on the ROW is a key component to a successful vegetation management program.

FirstEnergy's policy regarding transmission lines includes the removal of all trees, regardless of height, to the edge of the ROW. This could include removing trees where pruning was done in the past.

In order to perform vegetation maintenance, FirstEnergy also requires a clear path for trucks and other heavy equipment to access the ROW and transmission structures. As a result, we focus on removing or controlling vegetation that may impede access and affect our ability to inspect transmission equipment for maintenance work.

When site conditions permit, FirstEnergy utilizes the "wire zone-border zone" approach for maintaining most of its higher voltage



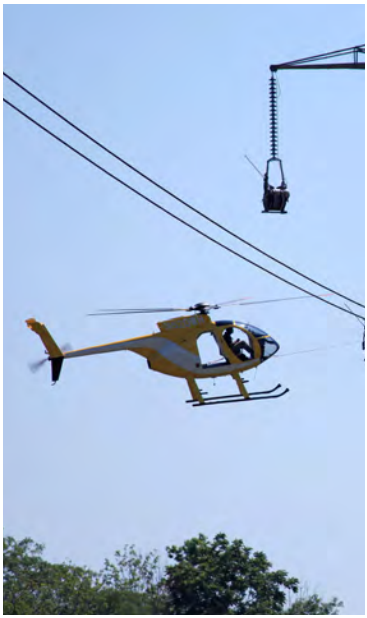
transmission line corridors, typically those that are more than 100 feet wide. All trees and incompatible vegetation are removed and controlled in both zones. In the "wire zone," which extends about 15 feet beyond each side of where the wires are attached to tower or structure, efforts are made to encourage low growing grasses and shrubs that mature at less than five feet tall. In the "border zone," which extends beyond the wires to the edge of the ROW, taller shrubs and plants that mature at 15 feet or less are allowed to grow.

If the ROW is 100 feet or less, all incompatible vegetation will be controlled from edge to edge.

We also inspect the areas beyond the ROW. Trees that are leaning, dead or diseased may be removed if they are determined to pose a danger of falling into the transmission line.

Inspecting the **Corridors**

Inspections are a key component of FirstEnergy's comprehensive vegetation management program.



Twice a year, helicopters fly low over our transmission line corridors to inspect the condition of the electrical equipment and monitor any ROW encroachments from trees, shrubs or other vegetation.

In addition to the inspections, for most company transmission corridors, the vegetation is maintained on a five-year cycle, based on expected growth rates. In New Jersey and certain areas of Pennsylvania, the vegetation maintenance work is done every four years.

However, if a mid-cycle inspection uncovers an issue with a leaning tree or fast growing vegetation, the problem will be addressed immediately rather than waiting until the next regularly scheduled vegetation management cycle.

Multiple Options Can Be Used to Control Trees and Vegetation

FirstEnergy's policy is to make every reasonable effort to notify property owners prior to vegetation management work taking place along the transmission ROW. However, in the event of storms or other emergencies, advance notice may not always be possible.

FirstEnergy utilizes integrated vegetation management (IVM) techniques, which involve evaluating the transmission ROW to identify incompatible vegetation, the timeframe for control, and evaluation and selection of control options. These options include manual, mechanical and chemical methods that are used to prevent encroachments from vegetation located on and adjacent to transmission corridors. Site characteristics, environmental impact and worker/public safety are analyzed to determine the most effective control options. The goal of using IVM techniques is to create and sustain stable and compatible vegetation within and along the transmission corridor.

Depending on the location and the voltage of the transmission line, FirstEnergy and its tree contractors can utilize specific control methods – manual saws, aerial saws or herbicides – or a combination of methods, to safely and effectively remove and control vegetation.

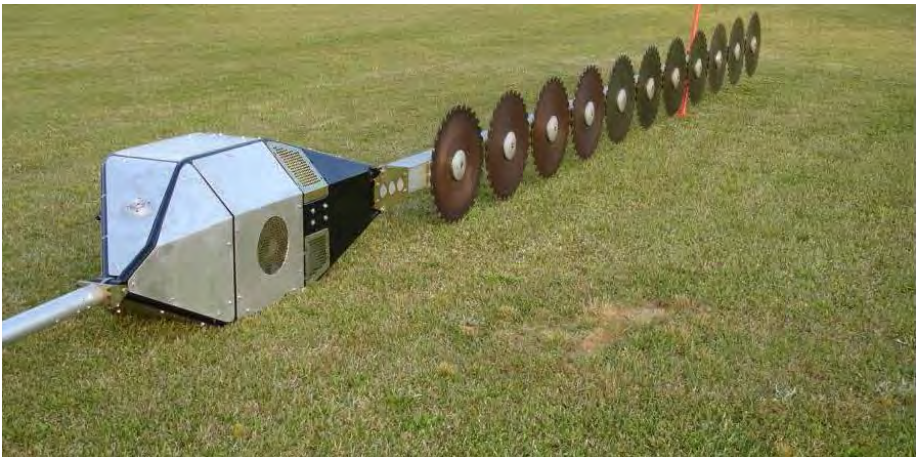
Manual Trimming

For as long as there have been power lines, forestry personnel have used manual saws and bucket trucks to remove trees and limbs. However, using this method is very labor intensive and some transmission lines are not easily accessible by foot or in a vehicle.

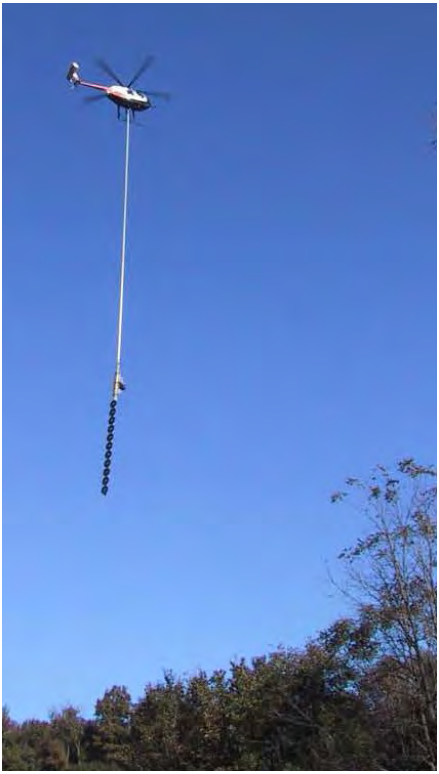
Manual tree trimming also is limited by the reach of the bucket truck or ladder, which can make trimming the very top of the tree a challenge.

Aerial Saw

Another way to trim along the edge of a ROW is using helicopters equipped with aerial saws. The saw attachment consisting of multiple 24-inch rotary blades powered by a motor suspended on a vertical



boom beneath the helicopter. The company has been safely using aerial tree-trimming since 1988 and aerial saws are in accordance with American National Standards Institute (ANSI) A300 tree pruning standards.



As the helicopter flies slowly along the ROW, the aerial saw cuts and trims trees and other vegetation rapidly and cleanly. Tree limbs 8 to 10 inches are neatly cut without tearing, and typically fall straight down, assisted by the air blasts from the rotors of the helicopter.

Benefits

The aerial saw eliminates the risk of injury to workers using bucket trucks or climbing trees near energized lines. The aerial saw can be used in remote areas or places inaccessible to a vehicle. In addition, this method helps protects private land and roads from damage by heavy equipment making repeated trips during the course of the work schedule.

The aerial saw can perform work quickly, side-trimming both sides of a 10-to-12 mile right-of-way in one week. It also is an effective tool to use in environmentally sensitive areas since it is not necessary to take equipment in to perform the work.

Clean Up

Brush that has fallen onto access roads, maintained yards, agricultural fields or in streams will be moved to adjacent wooded areas by a ground crew shortly after the aerial saw has been used. The ground crew also will identify and remove individual dead trees found along the ROW that potentially threaten the transmission line.

The aerial saw is not a replacement for conventional tree-trimming methods, but it is very effective on hard-to-reach transmission and sub-transmission lines. This method is not used to trim trees in residential areas unless safety buffers are utilized.

Using an aerial saw allows subsequent maintenance work to focus on the removal of "priority" trees off the ROW. By using the aerial saw, we expect to extend the length of our tree-trimming cycle in rural areas.

EPA-Approved Herbicide Application

Once the ROW is cleared of trees, it is important to take steps to prevent future growth of incompatible vegetation. U.S. Environmental Protection Agency (EPA)- approved herbicides for use on utility ROW provide the most effective means of controlling unwanted trees, shrubs and other incompatible plants.

Safe and Effective

The EPA approves such products for use only after determining that they will not adversely affect people, animals or the environment when properly applied. Nearly 60 years of university and industry research also has shown that herbicide use on ROWs can help create optimum plant and wildlife habitats.

These products have undergone significant testing. In fact, some of the materials our contractors use are the same as those commonly used by homeowners to control weeds and other vegetation.

Herbicide application is the preferred method to control immature trees or brush. Herbicide control options are determined by terrain, brush height, and density and are designed to control only incompatible vegetation.

Multiple Options Can Be Used to Control Trees and Vegetation (continued)

While mechanical methods such as cutting and mowing might appear to be less harmful compared to herbicides, these methods have many disadvantages. For example, cutting and mowing vegetation have the undesired effect of causing vegetation to grow back thicker and fuller, requiring repeated and often more frequent trimming.

Less Needed Over Time

In subsequent years, once the preferred low-growing shrub/herb community becomes dominant, less herbicide will be needed for future maintenance as incompatible species are brought under control.

Ultimately, herbicides eliminate the need for much more frequent mechanical treatments, like tree trimming and mowing — meaning you'll see our crews much less often.

Professional Application

All herbicides used on ROWs are applied by state-certified applicators or under the supervision of a certified applicator. FirstEnergy vegetation managers and its contractors are trained and certified in the use of herbicides.

Herbicides can be applied using several methods:

1.) Aerial applications using a helicopter are used in less populated areas where terrain and accessibility make it difficult and dangerous for ground-based crews to safely apply herbicides.

2.) Trucks or ATVs with spray tanks can be used in areas with accessible ROW.

3.) Backpack sprayers can be used in populated areas, as well as near parks, ponds and other sensitive areas.

Herbicides are important vegetation management tools to stop the spread of invasive plant species. Using herbicides helps control these weeds and other nuisance plants from overtaking ROWs, and will stop the spread to adjacent areas, including your property.

Guidelines for Planting Near Rights-of-Way

If you are considering planting shrubs or other plants on any transmission ROW, please contact a member of FirstEnergy's transmission forestry staff using the customer service numbers listed on the following page. You also can consult your local arborist, nursery professional or cooperative extension agent for more information regarding compatible plant species.

It is important to select the right plant for the right place.

Planting proper vegetation in and around transmission ROW can help provide a sustainable and compatible plant community. However, the vegetation must be limited to low-growing plants – such as grasses, herbs and shrubs – that are less than five feet high at mature height. Plus, vegetation must be planted at least 10 feet away from any pole, tower or guy wire and should not hinder access to the transmission line.

FirstEnergy **Customer Service** Phone Numbers

The Illuminating Company	1-800-589-3101
JCP&L	1-800-662-3115
Met-Ed	1-800-545-7741
Mon Power	1-800-686-0022
Ohio Edison	1-800-633-4766
Penelec	1-800-545-7741
Penn Power	1-800-720-3600
Potomac Edison	1-800-686-0011
Toledo Edison	1-800-447-3333
West Penn Power	1-800-686-0021

Information about FirstEnergy's transmission tree trimming and vegetation management are available online at www.firstenergycorp.com/help/brochures.html.

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