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1.0 DESCRIPTION OF THE PROPOSED 500 kV LINE AND STRUCTURES

As explained in **Attachment 1**, PPL Electric Utilities Corporation ("PPL Electric") is seeking approval from the Pennsylvania Public Utility Commission ("PUC" or the "Commission") to rebuild the existing single-circuit Breinigsville-Alburtis 500 kV Transmission Line to a double-circuit configuration (the "Project"). A detailed map of the proposed double-circuit Breinigsville-Alburtis 500 kV Transmission Line is provided in **Figure 3-1** to **Attachment 3**. Upon completion, the new double-circuit 500 kV line will be designated as the Breinigsville-Alburtis #1 & #2 500 kV Transmission Line.

The Breinigsville-Alburtis 500 kV Transmission Line extends approximately 6 miles from the Breinigsville 500-138-69 kV substation ("Breinigsville substation") to the Alburtis 500-230 kV substation ("Alburtis substation"). The existing 500 kV circuit will be removed and replaced with a new double circuit 500 kV transmission line . The final three spans into the Breinigsville substation will consist of parallel single circuit 500 kV transmission lines as described below:

Section	Section Length	Conductor	OHGW
Alburtis substation to Structure 1	~ 400 feet	Double bundle 2493 kcmil[1] 54/37 ACAR[2]	Two 0.572", 19#9 Alumoweld OHGW
Structure 1 to Structure 2	~ 0.1	Triple bundle 1590 kcmil 54/19 "Falcon" ACSR[3]	Two 0.572", 19#9 Alumoweld OHGWs
Structure 2 to Structure 27	5.8 miles	Triple bundle 1590 kcmil 54/19 "Falcon"	Two 0.791"144-Fiber optical ground wires

[1] kcmil stands for thousand circular mils. Kcmil wire size is the equivalent cross sectional area in thousands of circular mils. A circular mil is the area of a circle with a diameter of on thousandth (0.001) of an inch.
[2] ACAR stands for aluminum conductor aluminum alloy reinforced.
[3] ACSR stands for aluminum conductor steel reinforced.

		ACSR[4]	("OPGW")
Structure 27 to the Breinigsville substation (parallel single circuit lines)	~2,200 feet	Double bundle 2493 kcmil[5] 54/37 ACAR[6] per circuit.	One 0.572", 19#9 Alumoweld OHGW and one 0.791", 144-Fiber OPGW per circuit

The configuration of conductor and overhead ground wire (OHGW) varies along the circuits due to audible noise constraints and the varying fiber path taken along each circuit. From the Alburtis substation to Structure 1 (approximately 400 feet), the new 500 kV conductors will consist of double bundle 2493 kcmil[7] 54/37 ACAR[8] with two 0.572", 19#9 Alumoweld overhead ground wires ("OHGW"). From Structure 1 to Structure 27 (approximately 5.8 miles), the new 500 kV conductors will consist of triple bundle 1590 kcmil 54/19 "Falcon" ACSR[9] with two 0.572", 19 #9 Alumoweld OHGWs from Structure 1 to Structure 2 and two 0.791", 144-Fiber optical ground wires ("OPGW") from Structure 2 to Structure 27. From Structure 27 to the Breinigsville substation (approximately 2,200 feet), the new 500 kV conductors will consist of double bundle 2493 kcmil 54/37 ACAR with. A second 144-Fiber OPGW will be strung to replace the existing OHGW along the outside of the existing single-circuit H-frame dead-end structures between Structure 27 and the Breinigsville substation. The double-circuit double bundle design between the Alburtis substation and Structure 1 and between Structure 27 and the Breinigsville substation will utilize six (6) conductors that make up three (3) double bundle phases and two (2) OHGW per circuit for a total of twelve (12) conductors and four (4) OHGWs. The double-circuit triple bundle design between Structure 1 and Structure 27 will utilize nine (9)

[5] kcmil stands for thousand circular mils. Kcmil wire size is the equivalent cross sectional area in thousands of circular mils. A circular mil is the area of a circle with a diameter of on thousandth (0.001) of an inch.
[6] ACAR stands for aluminum conductor aluminum alloy reinforced.
[3] ACSR stands for aluminum conductor steel reinforced.
[7] kcmil stands for thousand circular mils. Kcmil wire size is the equivalent cross sectional area in thousands of circular mils. A circular mil is the area of a circle with a diameter of on thousandth (0.001) of an inch.
[8] ACAR stands for aluminum conductor aluminum alloy reinforced.
[3] ACSR stands for aluminum conductor steel reinforced.

conductors that make up three (3) triple bundle phases and one (1) OPGW per circuit for a total of eighteen (18) conductors and two (2) OPGWs. The conductors will be strung to PPL Electric wire tension limits that will meet or exceed National Electrical Safety Code ("NESC") standards and maintain safe operating conditions. The OHGWs and OPGWs will be strung so they are no greater than 80% of the conductor sag with both at the 60˚F, no wind, no ice, final (creep) condition.

The existing Breinigsville-Alburtis 500 kV Transmission Line currently utilizes a total of 29 structures:

- 23 double-circuit H-frame structures with an average height of 145 feet;
- 3 angle structures with a two-pole design and average height of 125 feet;
- 2 single-circuit H-frame structures (Structures 28 and 28A) at the Breinigsville substation with an average height of 115 feet (these will not be replaced); and
- 1 monopole structure (Structure 1) at the Alburtis substation with a height of 185 feet.

The location of these 29 structures is shown in **Figure 3-1** to **Attachment 3**.

To rebuild the existing Breinigsville-Alburtis 500 kV Transmission Line, PPL Electric will:

- Replace 21 existing H-frame structures with 21 new H-frame structures;
- Replace 2 H-frame structures with new two-pole structures;
- Install 2 new H-frame structures at the Breinigsville substation;
- Replace 3 two-pole structures with 3 new two-pole structures; and
- Replace 1 monopole at the Alburtis substation with a new two-pole structure.

In total, the Project will require the replacement of 23 existing structures within the ROW. It will also require the replacement of 4 existing structures and the installation of 2 new structures on substation properties as further described below.

The existing 21 H-frame structures currently support one circuit and will need to be replaced with 21 new double-circuit H-frame structures to accommodate the addition of the second 500 kV circuit (**Figure 2-1**). In addition, 2 new single-circuit H-frame structures (Structures 28B and 28C in **Figure 3-1** to **Attachment 3**) will be installed at the Breinigsville substation to support connection of the new 500 kV circuit to the substation (**Figure 2-2**). The new double-circuit H-frame structures will consist of two parallel tubular steel poles with outboard davit arms connected by two tubular steel cross arms. The new single-circuit H-frame structures will consist of two parallel tubular steel poles with outboard davit arms connected by one tubular steel cross arm. These structures will be installed on concrete caisson foundations. The new single-circuit H-frame structures will have an average height of approximately 115 feet and the new double-circuit H-frame structures will have an average height of approximately 160 feet. Each of these structure types will meet all NESC and PPL Electric clearance requirements.

Two existing H-frame structures (Structures 9 and 11 in **Figure 3-1** to **Attachment 3**) will be replaced with 2 new two-pole structures (**Figure 2-3**) to accommodate the addition of the second 500 kV circuit. Three existing angle structures with a two-pole design (Structures 23, 25 and 27 in **Figure 3-1** to **Attachment 3**) will be replaced with 3 new two-pole angle structures (**Figure 2-4** and **Figure 2-5**) to accommodate the addition of the second 500 kV circuit. The two-pole structures will consist of self-weathering tubular steel structures equipped with straight arms, installed on concrete caisson foundations. The two-pole structures will have an average height of approximately 190 feet and will meet all NESC and PPL Electric clearance requirements.

Finally, 1 existing monopole structure (Structure 1 in **Figure 3-1** to **Attachment 3**) at the Alburtis substation will be replaced with a new two-pole structure. The new two-pole structure is needed to provide the clearance between facilities, required by PPL Electric's transmission design criteria, and to interconnect the new 500 kV circuit with the substation. The new two-pole structure will consist of self-weathering tubular steel structures equipped with straight arms, installed on concrete caisson foundations. The new two-pole structure will have an average

height of approximately 195 feet and will meet all NESC and PPL Electric clearance requirements (**Figure 2-6**).

All new structures will be located entirely:

- Within the existing right-of-way, placed in generally the same location as the existing structures (within approximately 20 feet) and on the same property as the existing structure, or
- On PPL Electric-owned properties for the Breinigsville substation or Alburtis 500-230 kV substation. A detailed description of the location of the new and replaced structures is provided in **Attachment 3** and **Figure 3-1**.

The proposed 500 kV transmission line will not substantially alter the right of way for the following reasons:

1. The new transmission line will be constructed within the existing right of way corridor,
2. The proposed structures will be placed in the same general location as the existing structures.
3. No structures will be placed on properties that don't presently have structures.
4. The proposed structures will only be 14% taller than the existing structures (the average height of the proposed structures is approximately 161 feet while the average height of the existing structures is approximately 142 feet).

The new Breinigsville-Alburtis #1 & #2 500 kV Transmission Line will be designed to meet, and generally exceed, NESC minimum standards. Design specifications and safety rules practiced by PPL Electric are included in **Attachment 4**. The designed minimum conductor clearances and conductor thermal ratings are set forth in **Table 2-1**, **Table 2-2**, and **Table 2-3** below.

TABLE 2-1: DESIGN MINIMUM CONDUCTOR CLEARANCES*

Condition	Design Clearance-to-Ground
Normal load; average weather (16°C ambient temperature)	45.0 feet
Predicted extreme thermal load (125°C conductor temperature)	40.0 feet
Predicted extreme wind load (90 mph, 16°C)	50.5 feet
Predicted extreme weather conditions (1.0" Ice, 0 mph, 32°C)	44.5 feet
*Clearances based on a maximum tension of 16,500 pounds at .5 inch ice, 0º F, 4# wind and a ruling span of 982 feet (Span from STR #2 to STR #3).	

*Based on1590 kcmil 54/19 stranding ACSR "Falcon"

TABLE 2-2: ACSR CONDUCTOR THERMAL RATING*

Condition	Ambient Temperature °C	Wind Speed ft/sec	Rating (Amps)
Summer Normal	35	0	5013
Winter Normal	10	0	5775
Summer Emergency	35	2.533	6189
Winter Emergency	10	2.533	6969

***Based on triple bundle 1590 kcmil 54/19 stranding ACSR "Falcon" (257°F) 125°C Maximum Conductor

TABLE 2-3: ACAR CONDUCTOR THERMAL RATING**

Condition	Ambient Temperature °C	Wind Speed ft/sec	Rating (Amps)
Summer Normal	35	0	3394
Winter Normal	10	0	4178
Summer Emergency	35	2.533	4310
Winter Emergency	10	2.533	5108

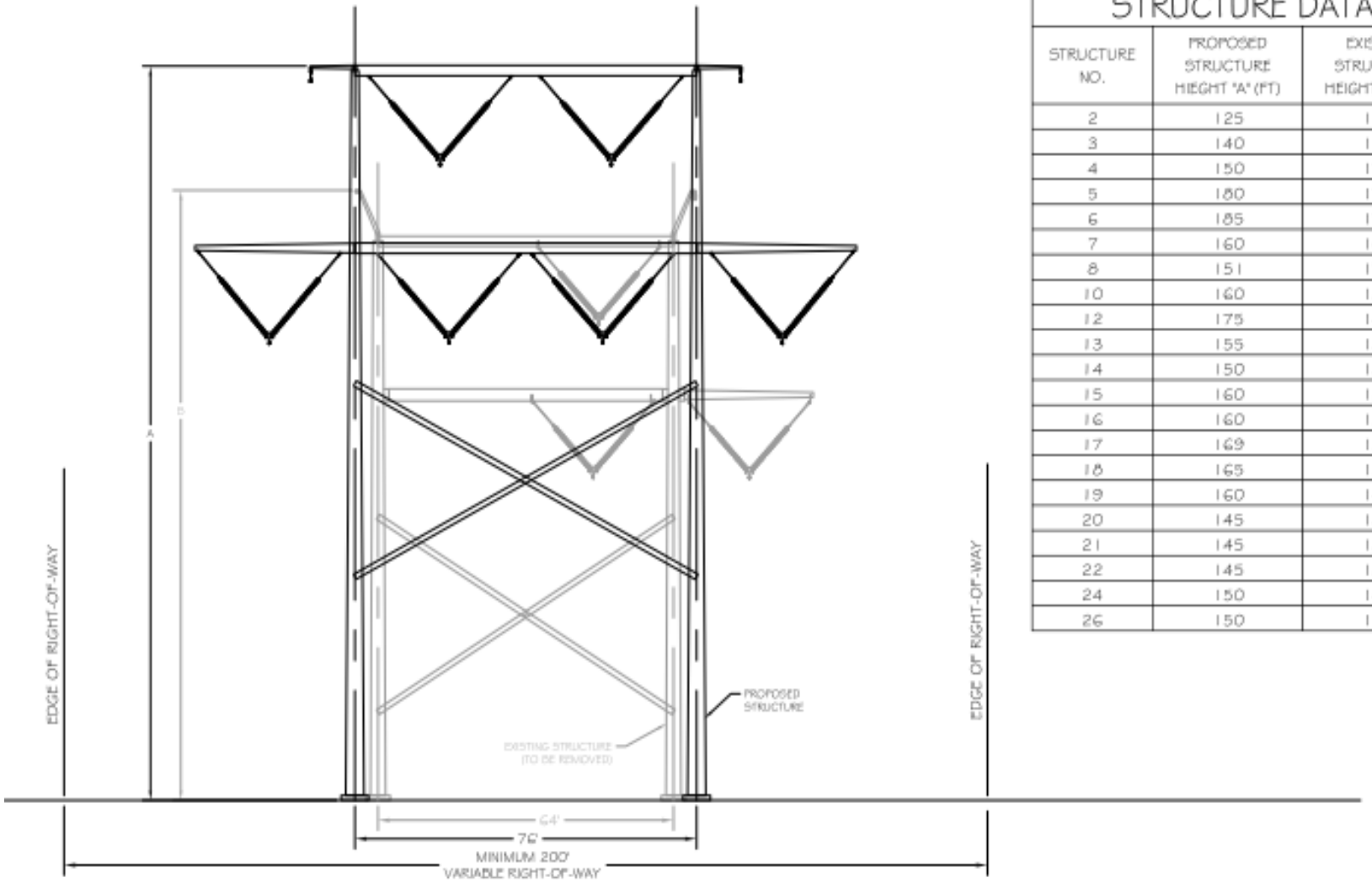
****Based on double bundle 2493 kcmil 54/37 Stranding ACAR (212°F) 100°C Maximum Conductor

2.0 MAGNETIC FIELD MANAGEMENT

PPL Electric's Magnetic Field Management Program is applied to new and reconstructed transmission line projects. The Company does not believe that current scientific evidence demonstrates that magnetic fields cause any adverse health effects or pose a health or safety danger to the public. Nevertheless, PPL Electric has determined, as a matter of policy, to design its new and rebuilt transmission lines to reduce magnetic fields when consistent with functional requirements. The program generally prescribes the use of a line design with ground clearance that exceeds NESC standards by a minimum of five feet and reverse phasing of new double-circuit lines when feasible and can be implemented at low or no additional cost.

The Project will be designed with structures that have a ground clearance that is eleven feet higher than NESC standards to minimize electro-magnetic fields at ground level. In addition, the rebuilt 500 kV transmission line will be double-circuit configuration and will use phasing specifically designed to minimize electro-magnetic fields at ground level as well as at the right-of-way edge.

Figure 2-1: Typical Double-Circuit H-frame ROW Cross-Section



STRUCTURE DATA		
STRUCTURE NO.	PROPOSED STRUCTURE HIEGHT "A" (FT)	EXISTING STRUCTURE HEIGHT "B" (FT)
2	125	125
3	140	120
4	150	175
5	180	175
6	185	170
7	160	165
8	151	175
10	160	135
12	175	145
13	155	135
14	150	135
15	160	150
16	160	150
17	169	150
18	165	155
19	160	145
20	145	135
21	145	130
22	145	135
24	150	140
26	150	120

Figure 2-2: Typical Single-Circuit H-Frame Dead-end ROW Cross-Section

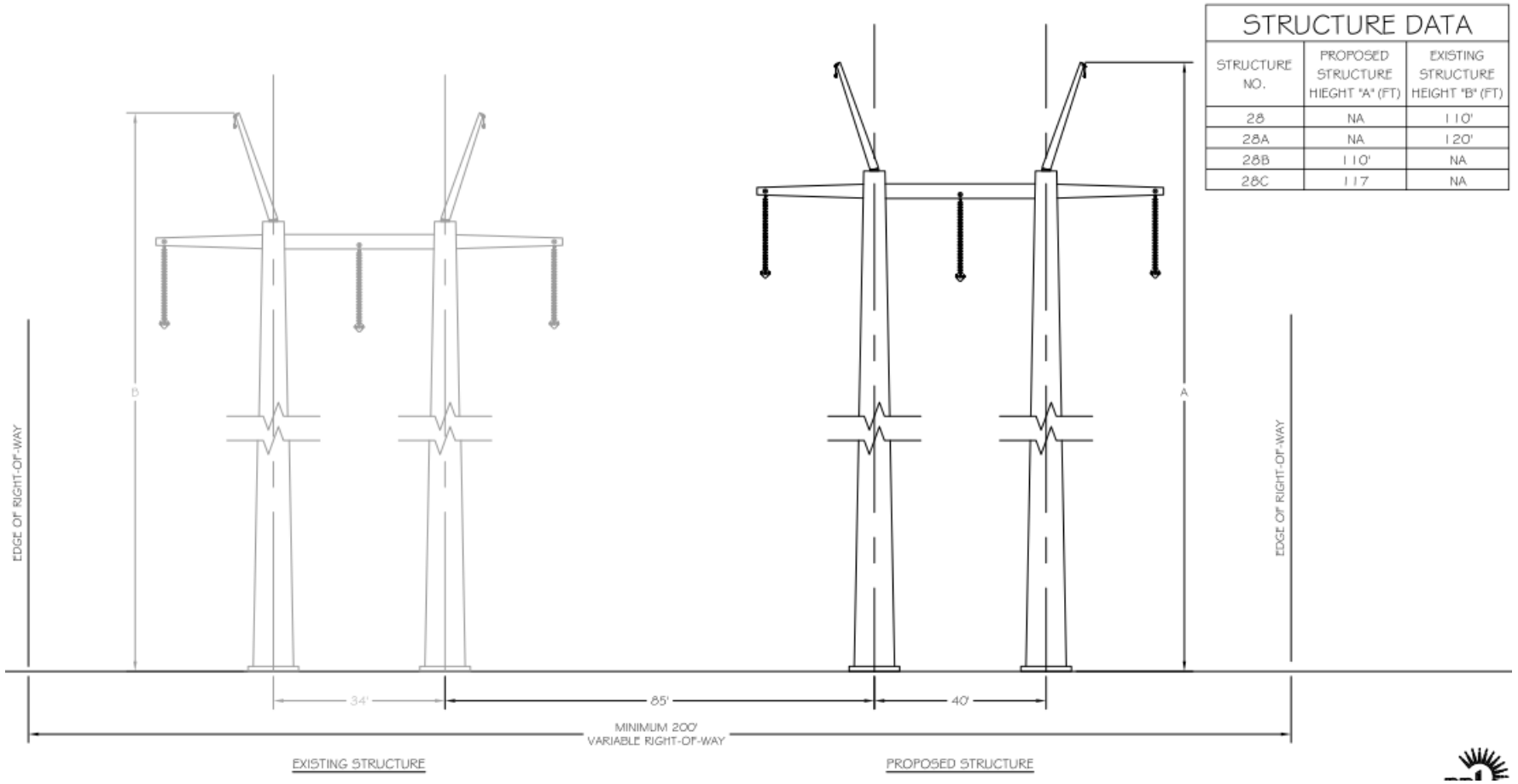


Figure 2-3: Typical Double-Circuit 2-Pole Dead-end Angled Structure ROW Cross Section

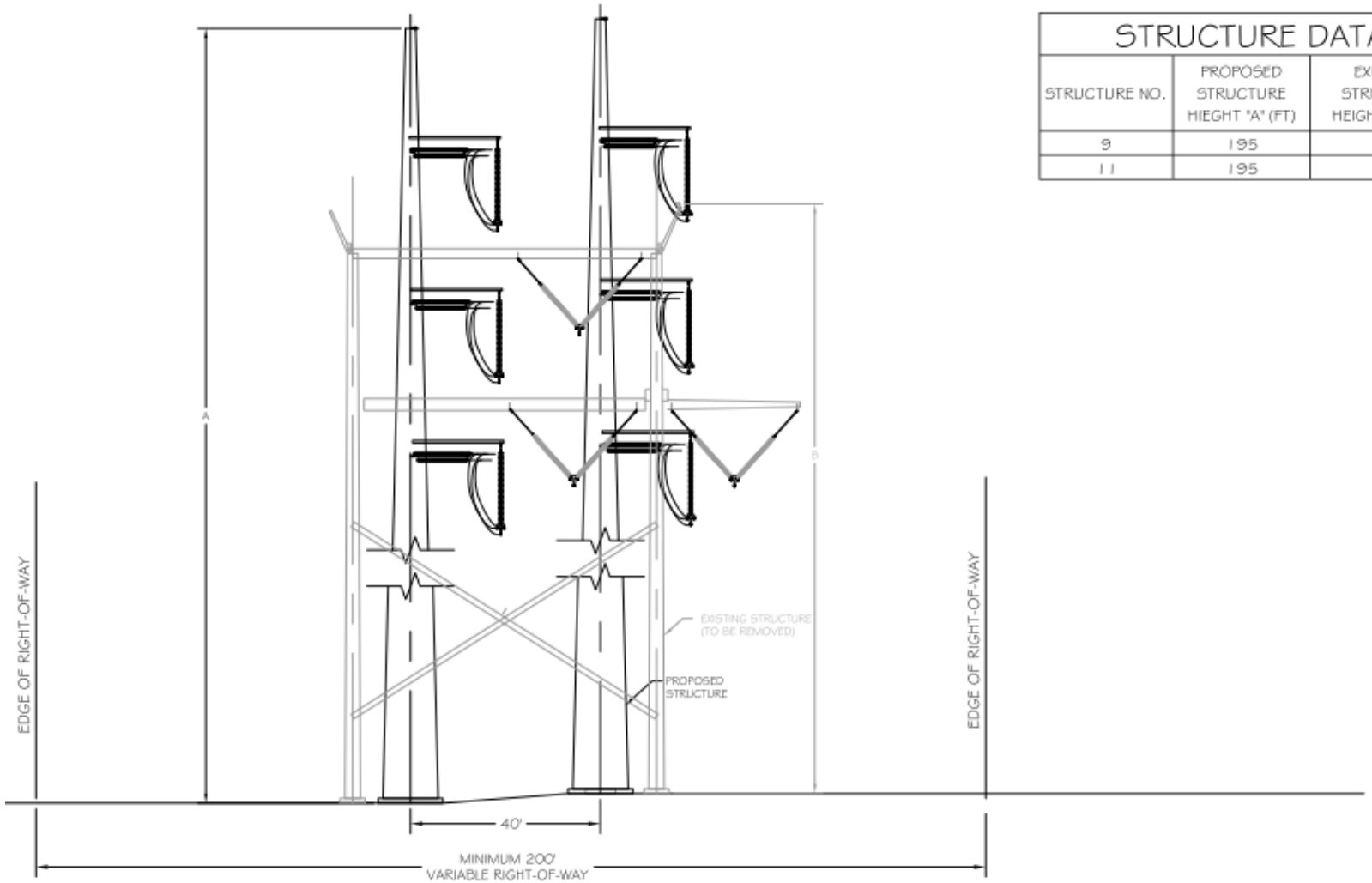


Figure 2-4: Typical Double-Circuit 2-Pole Dead-end Structure ROW Cross Section

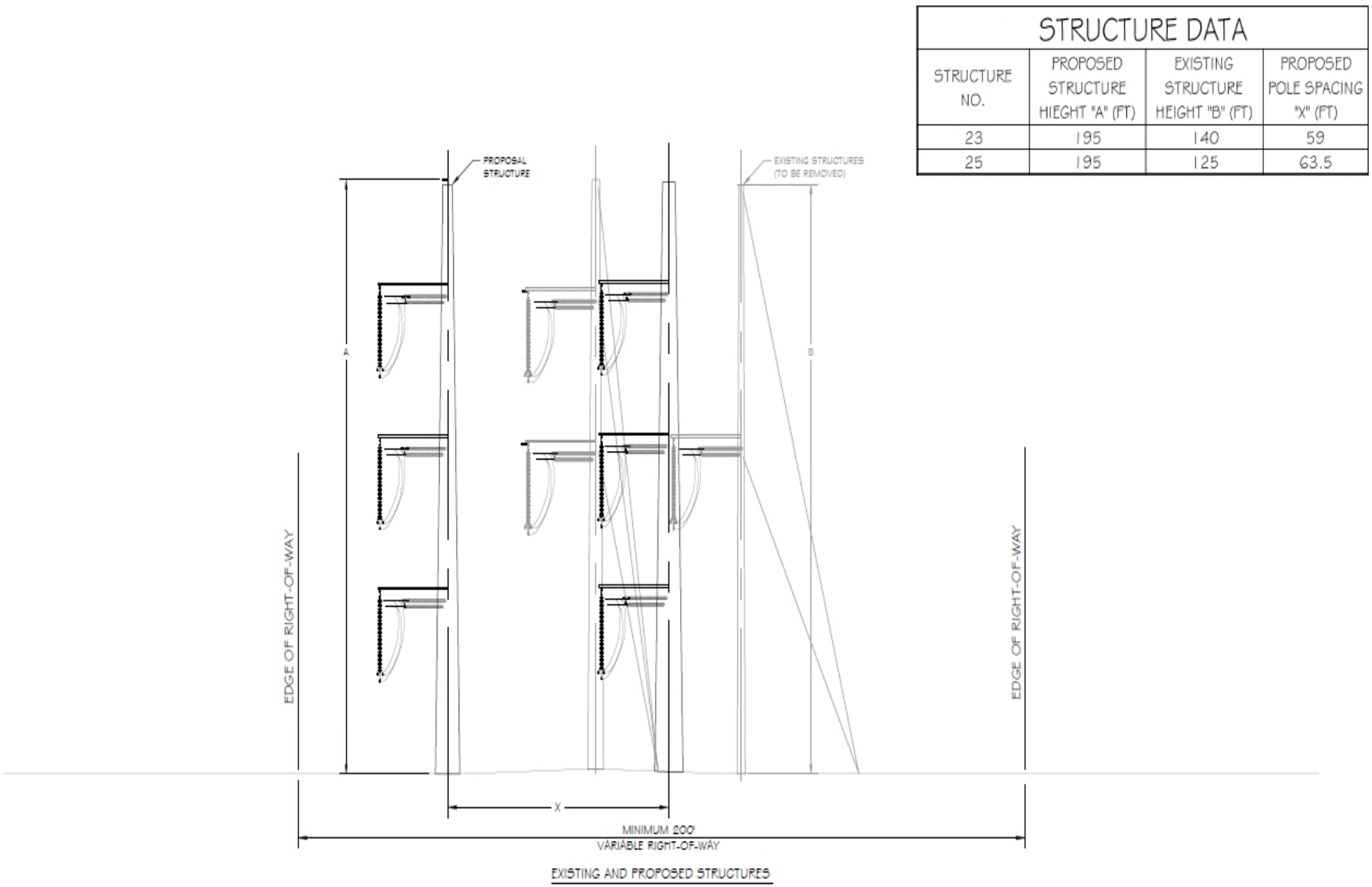


Figure 2-5: Typical Double-Circuit 2-Pole Dead-end Angled Structure ROW Cross Section

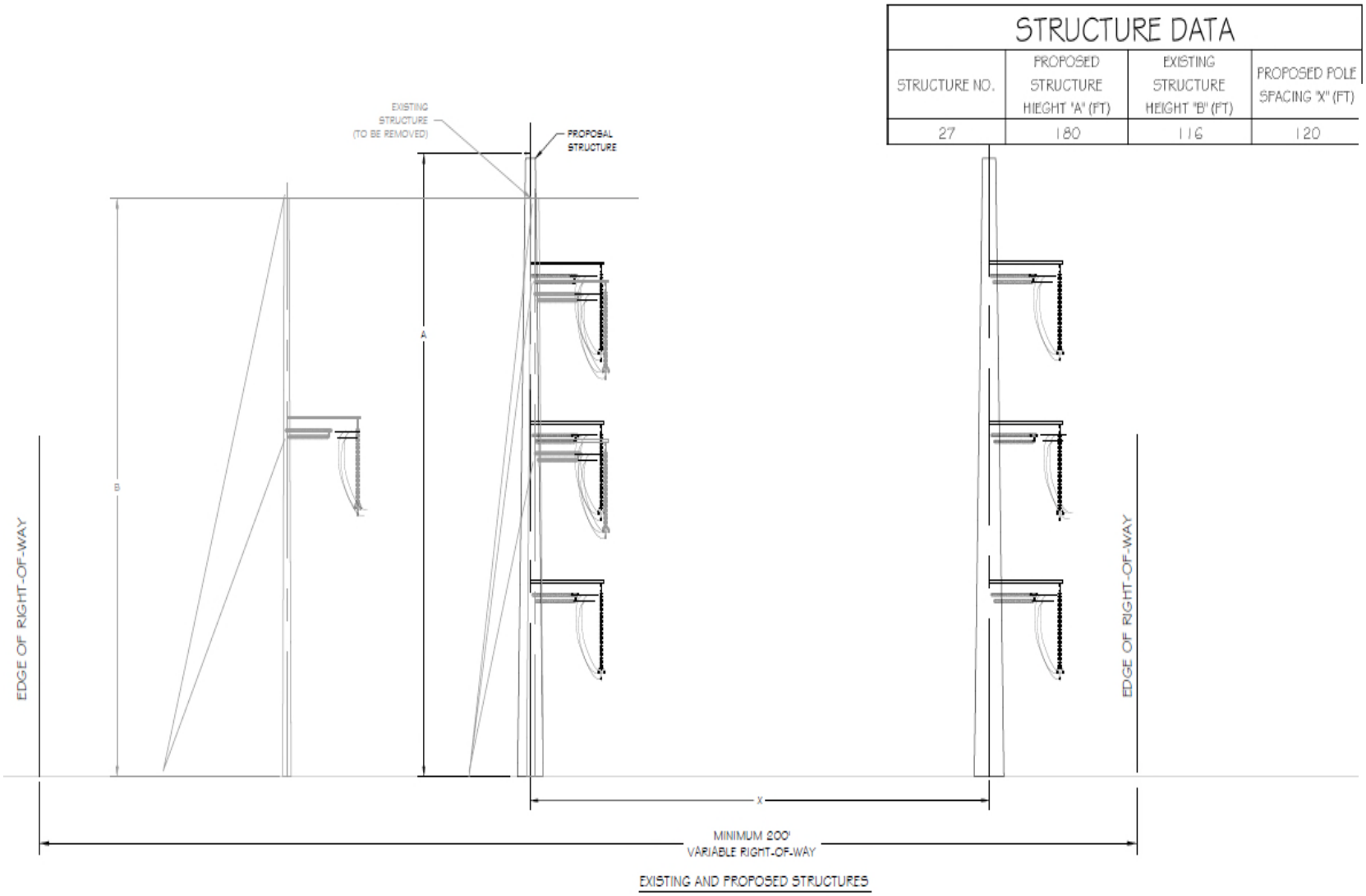


Figure 2-6: Typical Double-Circuit 2-Pole Dead-end Structure ROW Cross Section