energizeEASTSIDE

PUGET SOUND ENERGY

Pole Types

A variety of design options exist for electric transmission poles- variations range from style to material and finish. The type of poles selected for a transmission line is dependent upon many factors – including corridor width, other utilities within the corridor, topography, span length, pole height, line voltage, line type and soil characteristics. Although the vast majority of the poles are oriented in a straight line, or tangent to each other, under certain situations, such as when the line changes direction, larger poles need to be used.

Multiple design options are being considered within the Energize Eastside project area, including double and single-circuit monopoles, as well as H-frame designs. A circuit is composed of three electrical wires or conductors, so a double-circuit pole would have six electrical conductors attached, whereas a single-circuit pole would have three conductors. The characteristics and trade-offs of the design options are below.

Design Tradeoffs	Double-circuit Monopole	Two Single-circuit Monopoles	Single H-Frame Pole
Taller Poles	✓	✓	
Shorter Poles		✓	✓
Longer Spans	✓	✓	
Shorter Spans		✓	✓
More Poles		✓	✓
Fewer Poles	✓		
Larger Pole Diameter	✓		
Smaller Pole Diameter		✓	✓
Higher Cost		✓	✓
Lower Cost	✓		

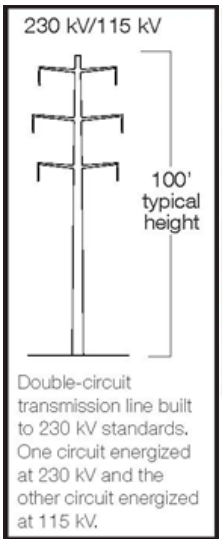
Note: *In some scenarios, pole type is limited due to conditions and/or circumstances that do not allow for design flexibility.*

Design options and tradeoffs

Double-circuit Monopole

A double-circuit monopole is a single pole carrying two circuits. The characteristics of using a double-circuit monopole in transmission design include:

- Pole height – Double-circuit monopoles are typically taller than single-circuit or H-frame poles. This is because the poles must accommodate enough space for a vertically “stacked” wire configuration on each side of the pole.
- Number of poles – Since a double-circuit monopole means both sets of lines can be placed on one pole, fewer poles would be needed in the existing utility corridor. The poles in the corridor today are H-frame construction and by replacing the existing structures with double-circuit monopoles, there is the potential to reduce the number of poles in the ground at the existing structures from four to one.



Above: Photo simulation representing double-circuit monopole structure in Bridle Trails (Bellevue).

Left: Pole schematic representing double-circuit monopole structure. Note: Graphics are for discussion purposes only and may change.

- Pole Diameter – To accommodate the weight of two transmission line circuits, the diameter of the double-circuit monopole would be greater than that of a single-circuit pole.
- Cost – The cost to manufacture poles is primarily based on the weight of the steel. A double-circuited monopole typically weighs less than the combined weight of two single-circuit monopoles, and would therefore cost less to build and construct.

Two Single-Circuit Monopoles

Two single-circuit monopoles provide more flexibility when designing a route. While this is the only pole design option that will work in some areas of the project (*e.g.,* where the Olympic Pipeline is located in the middle of the corridor), it can be used for others if desired. Here are the implications of using two single-circuit monopoles:

Above: Photo simulation and pole schematic representing two single-circuit monopole structures in Newcastle. Note: Graphics are for discussion purposes only and may change.

- Pole height – Pole height is variable with two single-circuit poles, although they can be made shorter than a double-circuit pole due to wire configuration flexibility; however, they cannot be as short as an H-frame structure.
- Number of poles – At any location where a double-circuit monopole is feasible, changing to a two single-circuit monopoles configuration adds an additional pole. This could add to the length of construction at each pole location.
- Pole Diameter – Because each pole carries one circuit, the poles do not need to support as much weight as a double-circuit monopole and therefore can be smaller in diameter.

Single H-Frame structure

Single H-frame structures are similar in design to the existing structures in the transmission line corridor today. They have two poles with a cross-arm. The H-Frame structures proposed for Energize Eastside are steel instead of wood and meet 230 kV design standards (height, conductor spacing). Here are some design characteristics for consideration:

Above: Photo simulation and pole schematic representing single H-frame structure in Somerset (Bellevue). Note: Graphics are for discussion purposes only and may change.

- Pole height – The H-frame design allows for shorter poles, as the wires are attached in a horizontal configuration to the structure, rather than vertically. When compared to the double-circuit monopole and the single-circuit monopole, the H-frame structure is the shortest option.
- Pole Diameter – Compared to a double-circuit monopole, the pole diameter and foundations can be smaller, as the number of wires and total weight is distributed on two poles per circuit rather than two circuits per pole.
- Cost – the cost of building an H-frame structure is similar to the cost of constructing two single-circuit monopoles, which is more than a double-circuit monopole.

Other Considerations

Under certain conditions, it is necessary to use larger poles or structures, specifically when the line changes direction (turning structures) or where the wires terminate or need to be under higher tension to reduce the amount of sag (*e.g.,* highway crossings). These termination poles are referred to as dead-ends. Under these conditions, the poles are subject to a heavier load from the wires; therefore they are usually made of thicker steel and placed on more robust foundations. Tangent poles are typically 2 to 4 feet in diameter, whereas turning and dead-end poles are can be between 3 and 6 feet in diameter. Turning and dead-end poles are not as prevalent as tangent poles.