Span Length & Pole Height

Span length and pole height are two elements that PSE engineers examined when designing the proposed 230-kilovolt (kV) transmission line for the Eastside. Span length is the distance between each pole. This dimension is directly correlated with the number of poles that will be installed along a corridor. Additionally, topography and other obstacles can play an important role in determining span length. There is less design flexibility when it comes to these factors.

The greater the span length, the fewer number of poles; however, there are other factors that must be considered to ensure safe operation of the transmission line. For example, when the poles are spaced farther apart, they must be taller in order to ensure the wires are a safe distance from the ground. This is because the wires sag under their own weight between poles. Alternatively, taller poles can be used with shorter spans if the desired outcome is moving the wires farther away from the ground. The table below indicates the various relationships between design options and their tradeoffs are explained below.

Design Option	Long Spans 800 to 1,400 feet	Short Spans 350 to 800 feet	More Poles	Fewer Poles	Larger Pole Diameter	Smaller Pole Diameter	More Line (wire) Sag	Less Line Sag	Vegetation Height restriction	Vegetation Width restriction	Less Line Blow-out	More Line Blow-out
Taller Poles (100’ - 130')	✓	✓		✓	✓		✓			✓		✓
Shorter Poles (75’ - 100')		✓	✓			✓		✓	✓		✓	

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

Design options and tradeoffs

Span Length

Span length is the distance between poles. Generally, the length of a span between two poles correlates with the height of the poles. Here are a few design tradeoffs to consider for Energize Eastside.

- When replacing an existing line, span length is often kept the same to help minimize disturbance. Poles for the new line are typically replaced in the general location as where the old poles were removed.
- With longer spans, the wires sag more between poles, especially when the demand for electricity is high. To make sure the wires remain at a safe height, the poles need to be taller.
- To prevent outages, vegetation is kept away from the lines. Federal standards for 200 kV lines and above are strongly enforced. Longer spans have more wire sag and therefore a greater potential for the wires to move side to side due to wind, this is known as “blowout.” More blowout requires a wider area of vegetation clearing to prevent the lines from coming into contact with branches along the edges of the corridor.
- Longer spans may be used to cross ravines, valleys, interstates, critical areas, or in areas where residents or the local jurisdiction prefer fewer poles.
- Shorter spans typically keep pole height to a minimum.
- Shorter spans create a need for more poles.
- Blowout is reduced when span lengths are shorter; therefore, less trimming and clearing of vegetation may be required at the edge of the corridor.

Pole Height

In cases where taller poles are used, many of the tradeoffs are the same as those associated with longer spans. Design tradeoffs related to pole height can include:

- Increased pole diameter, ranging from three feet to five feet.
- A larger and possibly reinforced foundation. The pole foundation may either be directly embedded if soil conditions allow, or will be a reinforced with anchor bolts, rebar caging, and concrete.
- Shorter poles typically require shorter spans.
- Taller poles are often heavier then short poles and therefore, may need to be larger in diameter and require more robust foundations.
- Foundations of shorter poles are likely to be less robust than that of their taller counterparts. Shorter poles can often be directly embedded, which may require less construction time and working area than foundations that requires rebar cages and concrete.
- A corridor with a higher number of poles will require more points of access to maintain the poles, pole equipment and vegetation near the lines. As discussed previously, the lines will sag and blowout will be less, and therefore may require less clearing and trimming of vegetation at the edges of the corridor. In some years where there is a higher than usual growth rate of trees and other vegetation, more frequent visits to the corridor to maintain the area may be required.
- Shorter poles mean smaller diameter than taller poles, as the loading between pole structures will be reduced.

Additional design considerations

- Another factor of pole height is how the wires are attached on the poles. For example, a configuration with the wires stacked vertically will need to be taller than that with the wires arranged horizontally to maintain the minimum operational spacing between each of the wires. Where space in the right-of-way allows and height is of concern, a horizontal wire configuration would produce the shortest pole height. A structure with a horizontal design will have two poles connected by a cross-arm, like a bridge or an 'H.'
- Larger poles often require a reinforced foundation that contains anchor bolts, a rebar cage and concrete. These foundations will typically be larger in size, meaning a deeper and wider hole, and will require more working room and time to build during construction. To protect the structural integrity and reduce the risk of wear, anchor bolts are typically exposed at the pole's base and remain above finished grade.
- For directly embedded pole foundations, neither anchor bolts nor concrete are exposed at the base of the pole. The hole is drilled and the pole is placed directly in the ground with a structural backfill to hold it in place. A directly embedded foundation will typically have a drilled hole smaller in size when compared to a reinforced foundation.