Ebey Slough Case Study

Steel Monopoles Replace Deteriorating H-Frame Wood Poles in Historic Estuary

In the Ebey Slough basin of Snohomish County, Washington, nearly two miles of high-voltage transmission lines traversed decades-old, deteriorating wood poles, which jeopardized the safety and reliability of an essential part of the Puget Sound Energy (PSE) power grid. The H-frame structures were originally constructed on dry ground, but when the old diking district was dissolved in 2002 and the tide gates were no longer maintained, surface water began to accumulate in the basin. The structures, anchors and guy wires became unstable in this saturated environment and were further damaged by a windstorm that swept through the area in December, 2006.

To rebuild the line and enhance the area's natural habitat for a variety of wildlife and endangered fish species, PSE faced a unique combination of engineering and environmental challenges – to develop an innovative new system designed to withstand the wet conditions, constructed with minimal impact to the wetlands and residential views, in an extremely short time frame to avoid the storm season and disruption of salmon migration.

"This project was on an extremely fast track," said Ron Raczkowski, who acted as a consultant during the project design and construction. All construction had to be completed between May and November of 2008. "There were a number of complicating factors, including the fact that the project was not fully permitted nor the steel pole or foundation designs complete before PSE had to commit to a steel pole order. Additionally, with the construction time frames involved, we needed a dependable and responsive steel pole supplier. So the project team decided to award a sole-source contract based on our previous experience with the vendor. Our judgment for this project was that Thomas & Betts was the most capable of supplying a quality product in a timely manner."

PSE brought Trinity Meyer Utility Structures into the process early to help finalize the design and construction details. "Normally we have a design that is essentially complete," Raczkowski said. "This time we didn't have that, so we looked to [Trinity Meyer] for input into the design."

"[Trinity Meyer] worked with the design build team and with the client to provide an excellent product that was imperative for the long-term performance of the installation while meeting the environmental and aesthetic hurdles that had to be crossed in order to make the project feasible," said Dan Zacharda, transmission engineer for T&D Power Engineers. "The steel design was

chosen so that longer spans could be employed to minimize the impact to the wetlands and aesthetics while providing for a design that would require little to no maintenance over time."

To meet these objectives, the new system was designed to replace 84 H-frame wood poles with 15 weathering Meyer Steel Structures produced by Trinity Meyer, a pioneer in the use of weathering steel for over 30 years.

Since 1997, Trinity Meyer Utility Structures has actively monitored poles installed as far back as 1970 to study the long-term performance of weathering steel, which reacts to the wet and dry cycles of the atmosphere and forms a self-renewing, protective oxide layer, or "patina" barrier, that blends with the natural surroundings and requires minimum maintenance. The performance results are outstanding, especially for transmission structures in wet environments where the protective oxide growth is rapid and dense. Trinity Meyer's knowledge and experience allows them to design structures that eliminate pockets of trapped moisture and debris, preventing internal condensation often caused by damp conditions.

The new design was finalized, and construction began as planned in May, 2008. The steel monopoles were strung with 115 kilovolt (kV) and 230 kV lines, a significant enhancement to the two-structure design of the old H-frame system. In saturated areas of the basin, the poles would be mounted on environmentally-friendly, water-resistant micropile foundations and a concrete pile cap, which in some cases was 12 ft above grade. In more stable areas, conventional concrete foundations would be used.

To achieve minimal disruption to wetland soils and route systems, lightweight materials and equipment for the micropile foundations were brought to the sites on amphibious, tracked marsh buggies. The steel structures – averaging 20,000 pounds each and 105-120 feet tall – were flown to the completed foundation sites by an Erickson Skycrane, chosen for its ability to set the poles using an anti-rotation device that holds the pole steady in the air while positioning it over the foundation or pole slip zone. The quality and design of the Meyer structures helped make this impressive, airborne feat a success.

With innovative technologies and the successful collaboration of several permitting agencies, area residents, and a host of experienced designers, engineers and suppliers, the $15 million rebuild project was completed ahead of schedule in October, 2008. This significant accomplishment not only improved the stability of the region's entire electric transmission system but also paved the way for permanent restoration of over 230 acres of historic estuary for Snohomish County and the state of Washington.