Tehachapi Renewable Transmission Project: North America's first 500kV XLPE Cable System.

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ABSTRACT

The Tehachapi Renewable Transmission Project (TRTP) is a 250 mile 500-kV transmission line to deliver wind and solar renewable power to the Los Angeles and San Bernadino areas of California. The project consists of 11 segments that are overhead transmission, however a majority of segment 8 was placed underground.

The 500-kV underground XPLE cable system is the first duct and vault installation in the world and the first 500-kV XLPE in North America. Prior 500-kV XLPE installations were either located in tunnels or direct buried. The underground transmission line is 3.7 miles long and is ultimately planned for two circuits each with 3 cables per phase.

KEYWORDS

500kV extruded cable, restraint vault, extra high voltage (EHV).

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INTRODUCTION

The Southern California Edison (SCE) Tehachapi Renewable Transmission Project (TRTP) was approved as an overhead transmission line project by the California Public Utilities Commission (CPUC) in 2009 to deliver electricity generated at new wind farms in eastern Kern County to the Los Angeles Basin, more than 90 miles (145 km) away. Completion of the project would enable SCE to deliver up to 4500 MW of wind and other renewable energy — enough to power 3 million homes in Southern California.

In 2013 the project petition was modified by the CPUC to place the Segment 8 portion of the overhead line underground utilizing the existing 230-kV 150 foot (45.7 meter) wide overhead right-of-way in lieu of 200-foot (61 meter) tall overhead towers adjacent to homes.

Construction of the underground transmission line began in 2014 with the site grading and construction of access roads and vault cluster locations. Electrical construction began in late 2015 and the transmission line was commissioned in September 2016. The TRTP transmission line has been in service and under load since December 2016.

CABLE SYSTEM

The 500-kV XLPE cable system consist of one circuit with two cables per phase of 5000 kcmil (2500mm^2) copper conductor. The circuit is currently rated for 2300 amps with provisions to install a third cable per phase.

PROJECT ROUTE

The underground transmission line is installed in an existing overhead right-of-way which provides some unique challenges due to the steep terrain. The elevation drops 635 feet (198 meters) from west to east over the line length with 550 foot (168 meter) drop in the first 1.7 miles (2.7 km) of the line. Steep slopes, up to 35% grade and average of 15%, were encountered providing challenges to the cable installation and the clamping of the cable in splice vaults. In addition, restraint vaults were installed on the steepest slopes to prevent the cable from moving downhill. Figure 1 shows a profile of the elevation along the project route from west to east

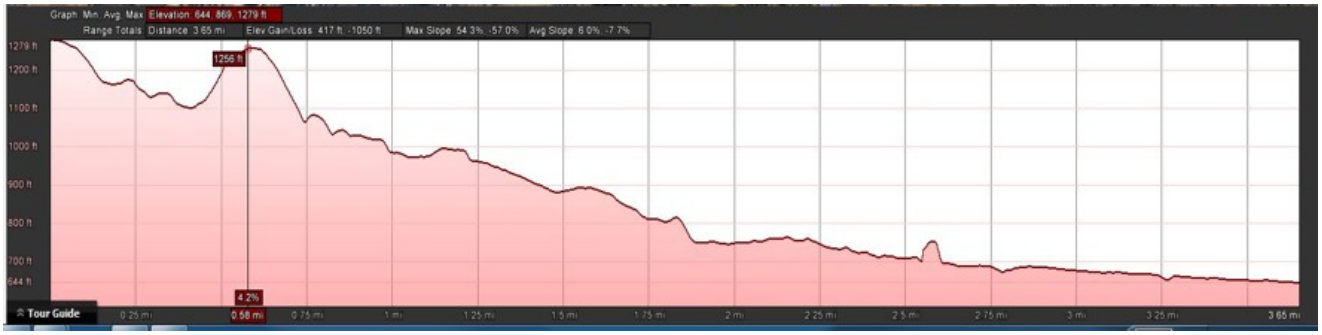

Fig. 1: Elevation Profile of Project Route

CIVIL CONSTRUCTION

The right-of-way was designed for an ultimate build out of two circuits, each with three cables per phase. Each splice vault location was designed to accommodate six splice vaults. Due to terrain and location constraints the vaults are arranged either adjacent to each other or in a staggered arrangement.

The duct bank consists of 12 8-inch schedule 40 PVC conduits, three power ducts and spare duct per phase. In addition, the duct bank includes various 2-inch and 4-inch ducts for fiber-optic cables and ground continuity conductors. Figure 2 below shows a detail of the duct bank and Figure 3 shows a picture of the duct bank prior to concrete encasement.