



## NEW 345 KV UNDERGROUND EXTRUDED CABLE SYSTEM PROJECT IN CONNECTICUT



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### ABSTRACT

*The Connecticut Light & Power Company (CL&P, which is part of the Northeast Utilities System) energized a new 345-kilovolt (kV) electric transmission line in Connecticut in October, 2006. This project includes the first long-distance, 345-kV extruded cable installed in the United States. This paper describes the project route, the cable system employed, and unique aspects of the project, including a verification of the ampacity after installation, and use of a manhole cover restraint system for the unlikely event of an explosion in the vault.*

*As a result of this project, CL&P learned the importance of working closely with its Planning Department to provide accurate cable characteristics (e.g., capacitance, impedance) which are necessary and critical when a substantial amount of cable is installed on a power system with a source impedance that is relatively high compared to most power systems.*

### KEYWORDS

345 kV, solid dielectric, extruded dielectric, extra high voltage (EHV), tether, restraint system, ampacity verification, hybrid, siphon.

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### INTRODUCTION

The Connecticut Light & Power Company (CL&P) energized a new 345-kilovolt (kV) electric transmission line between Bethel and Norwalk, Connecticut on October 12, 2006. This hybrid overhead/underground transmission line allows an additional 600 megawatts of electricity to be delivered to Southwest Connecticut and the region. This project was approved in the 2002 Regional Transmission Expansion Plan and is commonly referred to as the Bethel-to-Norwalk (B-N) Southwest Connecticut 345 kV Expansion Project.

This project is one of the world's largest 345-kV projects. It is also the first time that a long-distance, 345-kV extruded cable was installed in the United States. Most of the circuit route is comprised of overhead wire and traditional fluid-filled, pipe-type cable (also known as HPFF cable). However, for a 3.4-circuit kilometer segment of the cable system, the utility used extruded-dielectric technology.

The construction of this 345-kV connection is the first step towards enhancing the existing 345-kV grid comprising already 644 kilometers of overhead transmission lines. Other projects are currently in progress.

This paper focuses on the 3.4-circuit kilometer, extruded-dielectric cable portion of the B-N 345-kV Southwest Connecticut Expansion Project.

### DESCRIPTION OF OVERALL PROJECT

#### History

Over the past several decades, electricity usage in Connecticut has increased significantly as a result of population increases, economic growth, and the expanded use of air conditioners and electronic devices such as computers. This growth in electricity usage is particularly evident in Southwest Connecticut, which encompasses 54 municipalities, including the metropolitan centers of New Haven, Waterbury, Danbury, Bridgeport, Norwalk, Stamford, and all of lower Fairfield County.

Southwest Connecticut was served by an electric transmission system of 115-kV lines and substations. It was the only major load pocket in New England that was not connected to the 345-kV backbone transmission system. Many of the lines in the region were installed more than 40 years ago and were never intended to support the present level of electric demand. Despite numerous upgrades and reinforcements that CL&P implemented over the last few decades, the 115-kV transmission system was no longer adequate to supply the area's continuing growth in electricity usage without extensive modification.

The urgency of this need has been highlighted by a series of recent events:

- In June 2000, the local area 115-kV system experienced a prolonged voltage depression following a contingency event that disconnected local customer loads. This event did not lead to cascading losses of transmission system elements or to a wide-area blackout, but it forewarned of this danger.