DEVELOPMENT AND DEMONSTRATION OF A LONG LENGTH TRANSMISSION VOLTAGE COLD DIELECTRIC SUPERCONDUCTING CABLE TO OPERATE IN THE LONG ISLAND POWER AUTHORITY GRID

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ABSTRACT

The US Department of Energy is funding the world's first cold dielectric superconducting power cable demonstration project at transmission level voltage, to be installed at the Long Island Power Authority (LIPA) grid in 2007. The cable is designed to carry 574 MVA at a voltage of 138 kV. It will remain installed as a permanent part of the LIPA grid. The project team is comprised of American Superconductor, Nexans, Air Liquide and LIPA. This paper will give an overview of the technical goals of this project as well as the project status. It will describe the cable design and development process, the refrigeration system and the site installation status. An overview will be given about some system-specific operational characteristics influencing the cable system design such as fault currents.

KEYWORDS

Superconducting cable, Superconductor, high voltage

INTRODUCTION

High-capacity, underground HTS power cable has long been considered an enabling technology for power transmission. Power cables using HTS wires have been developed to increase the power capacity in utility power networks while maintaining a relatively small footprint. Over the past decade, several HTS cable designs have been developed and demonstrated [1]-[4]. All HTS cables have a much higher power density than copper-based cables. Moreover, because they are actively cooled and thermally independent of the surrounding environment, they can fit to much more compact installations than conventional copper cables, without concern for spacing or special thermal backfill materials to assure dissipation of heat. The Lipa HTS cable project is funded by the US Department of Energy. The project goal is to design, develop and demonstrate the first long length, transmission level voltage, cold dielectric, high temperature superconducting power cable. The cable is designed for permanent installation in the Long Island Power Authority (LIPA) grid and will be able to carry 574 MVA at a voltage of 138 KV. This paper gives a project overview and discusses aspects of the cable design, refrigeration system and site design.

PROJECT DESCRIPTION

The project is a Superconductivity Partnership Initiative (SPI) between the United States Department of Energy (DOE) and industry to develop a long length transmission voltage high temperature superconductor power cable. American Superconductor Corporation is the prime contractor as well as the manufacturer of the high temperature superconducting wires. Nexans is providing the design, the development and manufacturing of the cable, terminations and cryostat and Air Liquide is providing the cryogenic refrigeration expertise. The host utility, LIPA, is providing the site, civil work, controls and protection, transmission planning and the operation of the HTS cable. The cable system will be integrated into the LIPA grid and ready for energization in 2007.

CABLE SYSTEM DESIGN

Specification

The cable system to be installed in the Long Island Power Authority grid is the worlds first to operate at the transmission level voltage of 138 kV. This cable is designed to carry 2400 A rated current resulting in 574 MVA of total power carrying capacity. The 600 meter long system is able to withstand 51 kA rms fault currents for 12 line cycles. In addition to that the system is designed to withstand lower level through faults while staying in operation.
The system will be installed in the Holbrook Substation area of the LIPA grid heading north for a distance of 600 meters where a new switching station is installed. This new station will house the cryogenic refrigerator, the HTS cable terminations, liquid nitrogen storage and the necessary controls for operation and control of the cable system, The power for this line will be taken from an existing 138 KV overhead circuit which will remain in parallel as a backup.

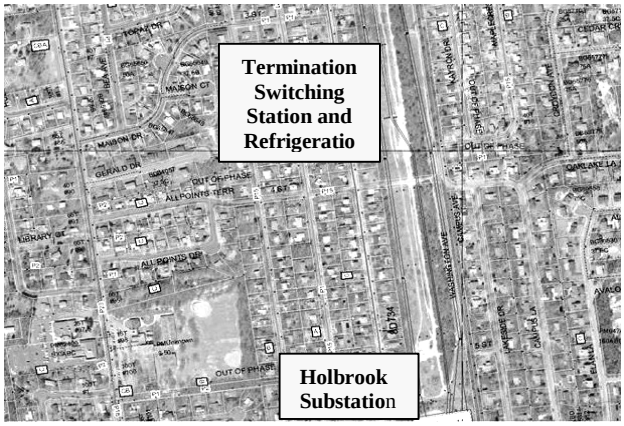

Fig. 1. Aerial view of the cable route