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BC Hydro's experience with a novel on-line monitoring system used on a 242 kV PPLP insulated cable system

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Abstract:

BC Hydro recently commissioned two new 242 kV_{rms}, 440MVA, PPLP-insulated, corrugated aluminum sheathed cable systems. These circuits are approximately 3.3km in length with a section of approximately 200meters in a tunnel 15meters below a Highway crossing. Each circuit required two hydraulic sections due to the large elevation difference along the route. In order to monitor the condition of the hydraulic system, parameters such as fluid pressures, remaining fluid volume in the tanks, fluid flow rates, a microprocessor based Signal Processing Panel with data acquisition and control features was developed. This system was also designed to monitor the cables' sheath currents. This paper describes BC Hydro's experience with the integration of the monitoring system into BC Hydro Supervisory Control and Data Acquisition System (SCADA) using fiber optic links. It also describes some of the problems experienced during the design stage, as well as during the site commissioning tests, and how the data is currently being used by System operators to operate these brand new transmission cable systems in the BC Hydro network.

Keywords: 230kV SCFF cables, cable monitoring systems, oil-filled cables

1. Introduction

As a replacement for two 43 year old cable circuits BC Hydro recently commissioned two new 242 kV_{rms}, 440MVA (i.e., 1050 Amps continuous with an emergency rating of 1350Amps), PPLP-insulated, corrugated aluminum sheathed cable systems. These cables connect the Newell Substation (NEL) to Hill Avenue Terminal Station (HLT) located in Burnaby, British Columbia. These circuits are each approximately 3.3km in length. They cross the Trans Canada Highway in a tunnel at a depth of approximately 15meters below grade for over a length of approximately 200 meters. Further, the termination at Hill Avenue Terminal (HLT) is in an environmentally sensitive area (near a fresh water lake) so extensive precautionary measures were applied during design, construction, and operation stages of this project. The cables were placed for most of the run in previously existing ducts except for ends at the two terminal stations. The ducts used at HLT end were seismic resistant to comply with BC Hydro's seismic requirements. Each circuit required two hydraulic sections due to the large elevation difference along the route.

Due to the environmentally sensitive nature of this project coupled with the selection of a self-contained fluid-filled (SCFF) cable system, a decision was made to have a truly sophisticated hydraulic monitoring and alarm system. Due to requirements of detecting and monitoring fluid leaks and leak rates in the event of a leak and enable intelligent decision making during emergency conditions a requirement for a monitoring system to compute the available (active) fluid volume was considered paramount. This would enable one to establish the quantity of fluid available at any time. This together with oil flow rate will help Field Services to establish level of emergency once the leak is detected. It was also determined that an extra quantity of insulating fluid not less than 200 liters would be available in each hydraulic section under the most unfavorable loading and ambient temperature conditions, to assist in maintaining pressure in case of an fluid leak in the system.

A cursory review of the available systems determined that there were some commercial systems in the market [1] but none of them had these specific desired features.

This hydraulic monitoring and alarm system was intended to function as SCFF cable condition monitor

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