A guide for rating calculations of insulated power cables

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ABSTRACT

CIGRÉ SC B1 set up Working Group B1-35 to consider the subject of cable rating. The working group was formed to prepare a guide for calculating the current rating of a power cable system in any occurring situation. This article is one of the first deliverables of the working group and provides a summary of the work of the group including insights and important considerations for the user in the quest to understand the current rating of insulated power cables in unique and varied situations.

KEYWORDS

Power Cables, Current rating, Ampacity, Methods, DTS, DRS

INTRODUCTION

The topic of cable rating ("cable current rating", "ampere capacity" or "ampacity") refers to the amount of current a cable system can carry without exceeding design limitations, particularly insulation temperature limitations, of the cable system at any position along the circuit; the allowable line-to-ground voltage and cable rating combine to give the power transmission capacity of the cable.

The current rating cannot be sufficiently assessed without considering the physical construction of the cable, the installation conditions and expected loading patterns.

The Technical Brochure to be published soon by CIGRÉ WG B1.35 supports the user in that important task by providing guidance to anyone trying to calculate or better understand the current rating of a power cable.

As one of the basic requirements of a power cable system, the topic of cable ratings is important to utilities, developers, manufacturers, consultants, universities and others, mainly during the following phases of a cable's life:

1. **The procurement phase**, in which a power cable having a certain capability to transport current is bought by an operator / user. Although this contractual phase is before detailed design and engineering takes place, the current rating of the power cable is often calculated using assumed worst case parameters to allow evaluation of the bids from suppliers.
2. **The design and engineering phase**, where the cable rating is usually confirmed with measured site parameters and has to correspond with a certain requirement (either constant or dynamic) set by the user. This theoretical exercise is often the only means of obtaining the cable current rating as testing or verifying the current rating is seldom performed.
3. **The operation phase**, where cables may become increasingly loaded or where initial design assumptions prove inaccurate or inadequate. It is not easy to forecast the expected current rating requirements for the 30 – 50 year design life due to load growth from increasing demands of electric energy generation, transmission and distribution. Existing power cables may see loading grow to the maximum allowable according to the original engineering calculations (also see [1]. Careful evaluation is important to understand the exact limitations regarding the cable rating, in order to prevent severe overloading, and to appropriately plan investment in new transmission facilities.

This leads to the need to establish an accurate cable rating for each power cable system regardless of its situation or age. There are, however, difficulties with this, as the variety in cable designs and installation situations differs significantly compared to the breadth of the calculation options available in existing standards. For this reason, CIGRÉ considered the rating of insulated power cables, including common buried, submarine and in-air installations in detail, while addressing problems with establishing the ampacity of the cable circuit in unusual configurations and installation conditions.