Ampacity and Other Design Considerations for Medium Voltage Cables Used in Renewable Energy Applications

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ABSTRACT

The paper provides an overview of medium voltage cable system design and compares typical utility practice in terms of selecting and applying medium voltage (distribution voltage) cables and system implications to applications of medium voltage cables to renewable energy projects. Topics discussed include ratings, loading patterns, operating characteristics, and economic factors driving the cable selection process. The paper concludes with discussions on approaches to medium voltage cable system design to enhance long-term reliable operation for renewable projects.

KEYWORDS

Renewable Energy, Cable Ratings, Ampacity, Distribution, Underground, Power, Solar, Wind, Design Considerations

INTRODUCTION

Renewable energy systems often include underground distribution-class cables to connect solar panels or wind turbines to collector stations where there is a step up in voltage for transmission to the nearest utility system. The general approach is to utilize medium voltage distribution cables (see Fig. 1); 35kV cables are common. Many of these systems are designed and installed by developers that are seeking to minimize the project cost so that the payback period of the systems can be realized sooner, making the economics of these systems more attractive to regulators, utilities and other entities. Efficiency, in terms of minimizing losses, is sometimes a secondary consideration.

There have been many instances of these cable systems failing after being placed in service due to issues related to thermal overload. The cause of these problems is based on applying traditional utility distribution cable system practices to the environments and operating scenarios associated with many of the renewable energy sites that have alternate characteristics.

The paper summarizes the factors that affect cable system design on renewable systems and discusses how these factors should be evaluated when specifying and installing cables for renewable energy projects. While the science for engineering utility underground distribution circuits and renewable energy underground cable collection systems is identical, utility-based experience applied to renewables can affect the success of these systems. By carefully evaluating the various factors, reliable cable systems for renewable projects can be implemented with similar success as for utility systems.

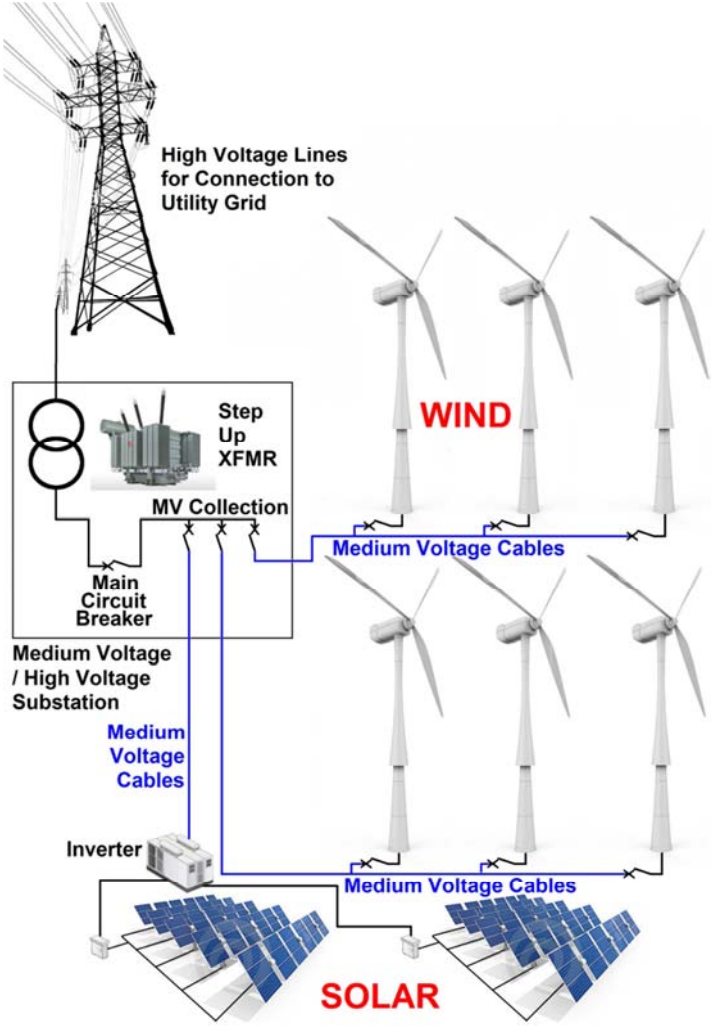

Fig. 1: Conceptual Renewable Energy System with Medium Voltage Cables for Collecting Power

TRADITIONAL UTILITY DISTRIBUTION CIRCUIT DESIGN AND OPERATION

Individual distribution circuits at most utilities are designed with minimal consideration for optimization and with relatively low (as compared to transmission cables) technical evaluation. Rather, the overall underground distribution system standards are designed to provide maximum flexibility for future growth as well as the necessary redundancy for good customer reliability. In North America, utility distribution circuits are more often installed in conduits with concrete encasement; while not optimized, the presence of the conduit and concrete encasement reduces the possibility of soil drying immediately near the cables, affecting soil thermal