Composite Based EHV AC Overhead Transmission Lines

Overhead lines at transmission level are the backbone of any national power grid today. New overhead line projects however are at the same time subject to ever greater public resistance due to the lines environmental impact. As full undergrounding of transmission lines at extra high voltage (EHV) levels are still not seen as possibility, the future expansion of transmission grids are dependent on new solutions with lessened environment impact, especially with regard to the visual impact. In the present Thesis, composite materials and composite based overhead line components are presented and analysed with regard to the possibilities, limitations and risks widespread application of composite materials on EHV AC overhead transmission lines may present. To form the basis for evaluation of the useability of composite materials, different overhead line projects aimed at reducing the environmental impact are analysed with regard to their visual impact reducing design steps. These are used to form the basis for overhead line system design ideas, which are analysed with regard to application of composite materials and components. Composite materials and components, when applied in EHV systems, are exposed to electrical, mechanical, thermal and environmental ageing mechanisms. Experiences and tests examining the effect of the ageing mechanisms are reviewed and discussed in the Thesis. Standards and guidelines for dimensioning of overhead line systems are presented and composite based high voltage components are examined with respect to current loadability and required dimensions due to voltages and mechanical loads. The Thesis is concluded with a discussion on composite materials’ influence on electrical line parameters when introduced into EHV overhead lines. Furthermore general conclusions on the possibilities, limitations and risks of application of composite materials and composite components are outlined. The main conclusions of the Thesis are; that composite materials based components are today available for the EHV range on a commercial basis with some limitations on Towers and post insulators, that the use of composite materials alone only introduces small impacts with regard to improving the environmental impact of overhead lines; and that composite based components offer several advantages compared to components conventionally applied in overhead line systems.

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