**MVDC-ERS Newsletter No.2 (April 2020)**

1. **Completed a literature review of converters suitable for Medium Voltage DC (MVDC) railway electrification**

This literature review compares the conventional railway electrification systems with the proposed MVDC system to define the differences and requirements of the MVDC system. In addition, it investigates high-power MVDC converters, and explains about the most important issues in MVDC networks such as protection and control. At last, it reviews potential benefits of using Wide Band-Gap (WBG) semiconductors in MVDC converters. Check the details on the published deliverable D1.1.

1. **Sizing and Loss analysis for different topologies**

We sized and compared three different AC-DC converter topologies, i.e., anti-paralleled thyristor rectifier and inverter, two-level voltage source converter, and modular multilevel converter with full-bridge submodules for the MVDC traction substation. In addition, we estimated efficiency of these converters using analytical approach. The comparisons show that the modular multilevel converter with bipolar submodules is a promising solution to be used in the MVDC system. This topology facilitates the controllability of the system, can limit the DC side short circuit current and has fair efficiency. In addition, this topology does not need the semiconductor switches to be connected in series, and there is no need to use voltage divider circuits in the converter. These analyses have been summarised in a conference paper, which is ready to be presented. The target conference is to be confirmed after COVID-19 pandemic.

1. **Software model of MVDC substation under development**

We have started modelling a MVDC substation using Simulink/Power systems, taking power from a 33 kV AC distribution network and supplying a 25 kV DC railway line. The converter is based on a modular multilevel converter with full-bridge submodules. The main features of the model are the regulation of the DC-bus voltage irrespectively of the rail load and the balancing of capacitor voltages.

1. **Completed a literature review of converters suitable for MVDC railway traction transformers**

This literature survey reviews the principles and historical evolution of the railway traction systems and Power Electronic Traction Transformers (PETTs). Considering the differences and requirements of the MVDC traction system, it evaluates the state of the art PETTs topologies to define the optimal topologies and configuration for PETT. Moreover, the survey compares the conventional railway traction systems with new traction systems which have been proposed and developed in the last decade, and are also suitable for the MVDC railway electrification concept presented in this project. At last, it reviews the impact of WBG semiconductor technologies on the PETT design, and investigates the use of on-board storages. Check the details on the published deliverable D2.1.

1. **Software model for DC based power transformers**

Based on the supply line’s specifications defined in D1.1, we have developed a software model of a PETT module using Simulink/Power systems, with an input voltage of 25kV DC. The traction transformer is based on a multi modular DC-DC converter with Dual Active Bridge (DAB) topology as bidirectional sub-modules. This configuration is an ideal candidate for flexible control and power flow, Zero Voltage Switching (ZVS) and high power density. At this phase a single module is simulated, however the software model is under continuous development to be able to simulate the multi-modular structure too. In addition, a design sheet was also developed for the sizing of the DAB module.

1. **Publishing a literature survey of the converters suitable for MVDC railway electrification**

We are preparing a review paper which is based on the literature review done for the substation’s converter and the rolling stock’s converter (PETTs). This paper will be submitted to a scientific journal and further news about it will be provided in the next newsletter.