

Multi-Terminal DC system performance evaluation using interconnected RTDS and OPAL RT System

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Abstract— Recently, multi-terminal DC (MTDC) system has received more attention in the power transmission areas. Development of modular structured power converter topologies has now enabled the power converter technology to attain high voltage high power ratings. State of the art HVDC systems are mainly back to back HVDC links where power is transmitted from a remote end to main land using similar converter technologies at the both ends. But keeping in mind the economic viability of the HVDC systems it is expected that soon these point to point terminals will be replaced by multi-terminal DC systems. Considering the fact that there might be several vendors to build a whole MTDC system, it is quite reasonable to say that the individual terminals in a MTDC system will never be using same technology. Therefore, the system level analysis of MTDC system consisting of terminals with different converter topologies is of particular interest. In this particular configuration, the MTDC system consists of four terminals namely two advanced modular cascaded H-bridge converter with high frequency isolation, one MMC with half bridge sub modules and the fourth terminal is modular DC-DC converter stage which integrates PV with the DC grid directly. Another benefit of this kind of DC grid system is that the renewable energy sources like solar energy can be integrated to the DC grid in a single stage power conversion (DC to DC) unlike the AC grid system where two stage power conversion (first DC to DC then, DC to AC) has to be implemented to push power into the AC grid. This increases the overall system efficiency and enables to get more clean energy with minimum wastage. This abstract presents a system level real time simulation study of a hybrid MTDC System. The system behavior is evaluated in a unique real time platform combining RTDS and OPAL RT systems connected together. In order to implement the whole MTDC network the RTDS and OPAL RT platforms are interconnected and they are synchronized. The real time simulation results proves that this kind of synchronized simulation platforms may be used to implement a complex interconnected grid system. (*Abstract*)

I. KEY FIGURES

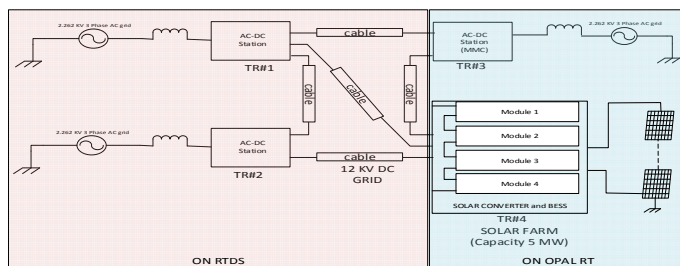


Figure 1: 4-Terminal 12 KV MTDC network

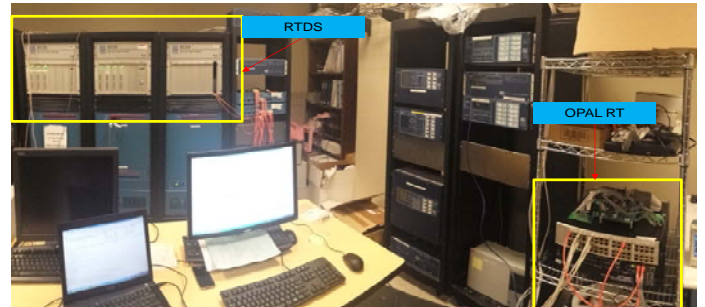


Figure 2: RTDS and OPAL RT interconnected system set up

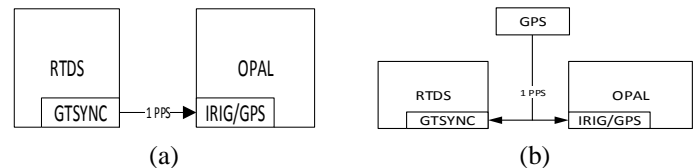


Figure 3: Synchronization techniques (a) direct syn, (b) global syn using GPS

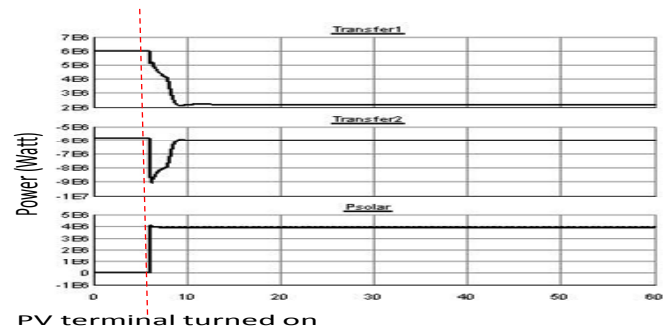


Figure 4: Power dynamics between terminals when PV start injecting power into the DC grid

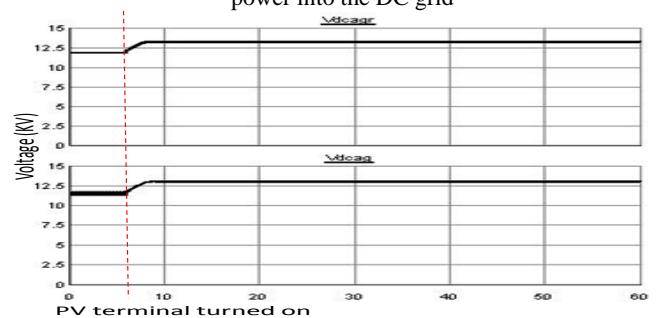


Figure 5: Terminal Voltages during power transients