

Demonstration of HVDC Grid Protection System Overview

Work Package 9

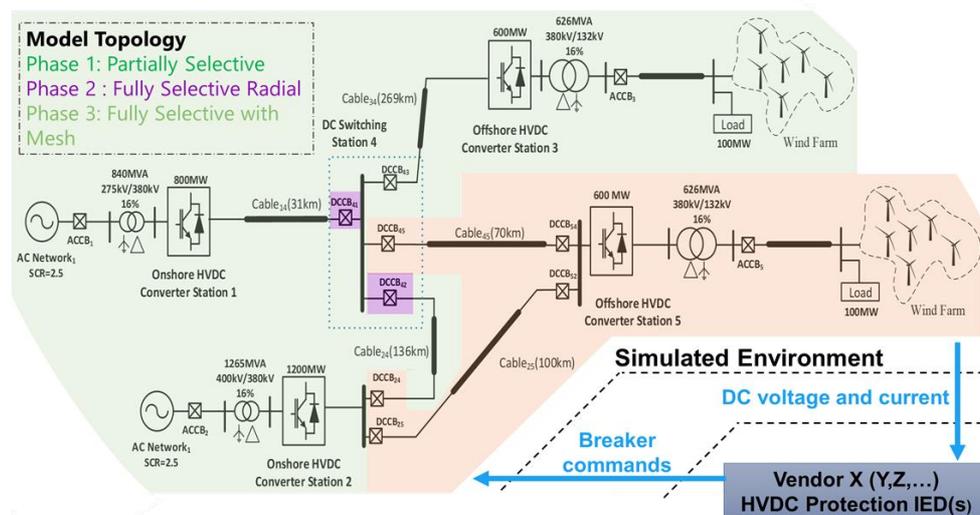
Work Package 9 represents the culmination and integration of a number of other work packages. A range of grid protection strategies and implementations have been taken from Work Package 4, where they have previously been verified using off-line simulation. The use of hardware in the loop techniques allows an opportunity to verify and increase Technology Readiness Level (TRL) of the overall protection system

Intelligent Electronic Device (IED)

As part of PROMOTiON Work Package 9, two hardware devices are being used as test objects during the demonstrations (one university led and one industrial). Details of are given overleaf. Intelligent Electronic Devices allow a broader range of functions than traditional relays, and can be used to provide a number of protection functions within one hardware unit.

Hardware In the Loop (HIL) Testing

HIL testing is commonly used to verify the correct operation of control and protection equipment within HVDC systems. A simulation model emulates the target HVDC network and physical hardware is used to synthesise the measurement output which is fed into the hardware test object. The test object then sends and outputs signals (e.g. trip signals) back to the simulation system, thus closing the hardware/software 'loop'. In this way, as far as the test object is concerned it is connected to a 'real' system. To accomplish this real-time simulation methods and hardware are required.



Within Work Package 9 a range of system configurations have been investigated, including interoperability of protection IEDs. A number of these configurations will be demonstrated during the event.



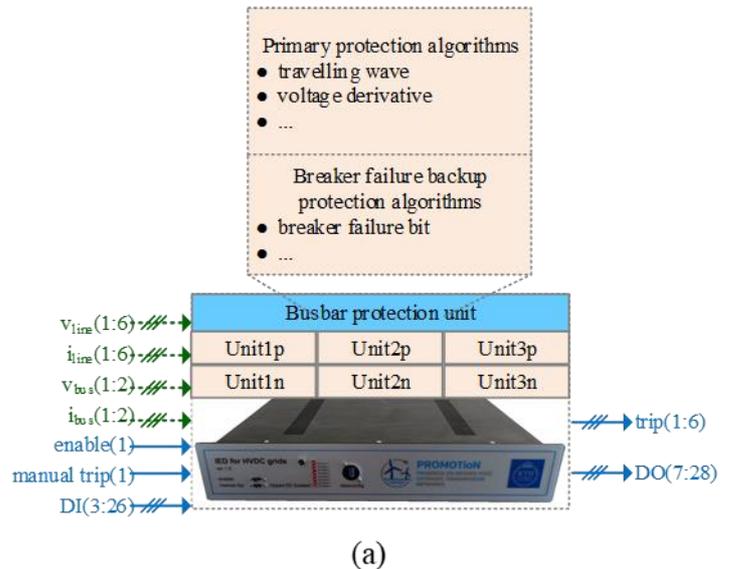
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PROMOTiON – Progress on Meshed HVDC Offshore Transmission Networks

PROMOTiON IED

The PROMOTiON IED has been developed at KTH through the PROMOTiON project.

- Off-the-shelf System-on-Chip development platform (Zedboard)
- Six independent function unit
- Inputs: line voltage(1) and current (1)
- Outputs: trip out
- Implemented protection functions:
 - Primary protection: travelling wave, du/dt..
 - Breaker failure backup: breaker failure bit
 - Busbar protection



Mitsubishi Electric IED

The Mitsubishi Electric IED features HVDC Diamond™ hardware, tailored for high-speed protection. The industrial-grade design has been developed for high reliability and operation in a range of environments. It features a large number of grid-side measurement inputs and a number of flexible number of high-speed outputs, making it suitable for a range of network topologies. The industrial grade, redundant design ensures reliability when it's most critical.

Key Features:

- State-of-the-art, industrial-grade hardware
- High-speed input measurement sampling and computation
- Outputs: flexible applicable in variety of network topologies
- Software customisable protection functions, including breaker failure detection.

