Implementation of a Real-Time Scaled in Hardware 1.3kW Back-to-Back VSC-HVDC Transmission System

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Introduction

- A Point to Point HVDC converter system allows precise real and reactive power control between two asynchronous systems (Fig 1)
- A scaled back-to-back converter has been simulated, constructed and tested with a 520 V_{DC} Bus voltage and 1.3kW power capability (Fig 2)[1]

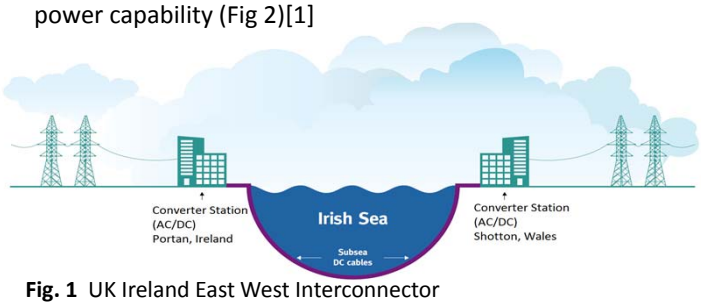


Fig. 1 UK Ireland East West Interconnector

Motivation

- Demonstration of OPAL-RT equipment in a relevant application (Point to Point Power transmission)
- It can be used as a stepping stone to Multi-Terminal HVDC work

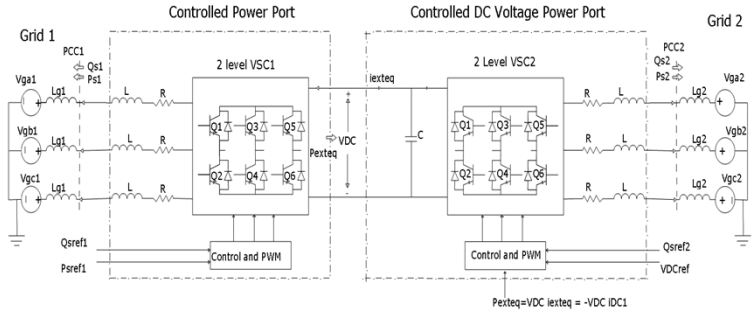


Fig. 2 Back-to-Back HVDC System [1]

Operation

- The Controlled Voltage Power port (RHS fig 2) ensures that the DC bus voltage is kept at the set-point using the outer controller
- The Controlled Power Port's (LHS fig 2) purpose is to transfer power through the system

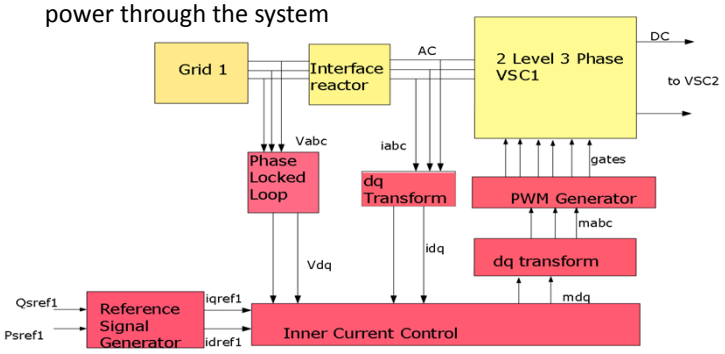


Fig. 3 Controlled Power Port [1]

- Fig 3 shows the Controlled Power port in more detail
- Set-points received (Qsref1, Psref1) translate to idref1, iqref1. PI Inner current control, dq transform simplifies control.
- Phase Locked Loop (PLL) gives instantaneous grid phase allowing dq transform

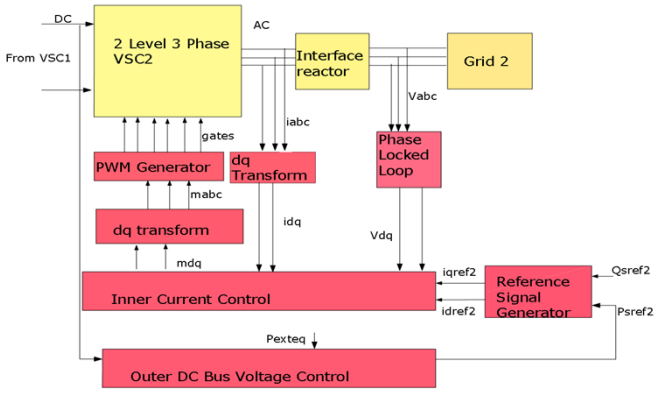


Fig. 4 Controlled Voltage Power Port

- Fig 4 shows the Controlled Voltage Power Port in more detail. Inner Power /current control identical to Controlled Power Port
- Power balance based outer voltage control
- System Power throughput (Pexteq) feed forward enables improved DC Bus Voltage control

Implementation and Results

- OPAL-RT OP5600 Real time implementation. OP8600 used for sensor inputs and outputs (current, voltage, inverter drives). Lab-Volt inverters (8857-15) used to model HVDC converters (Fig 5)
- Fig 6 shows output for sample inputs. Voltage excursions from 520v to 480v to 600v and back to 520v, real power excursions from 0 to 1300W (Grid 2 to 1) and 1300W (Grid 1 to 2) and back to zero.

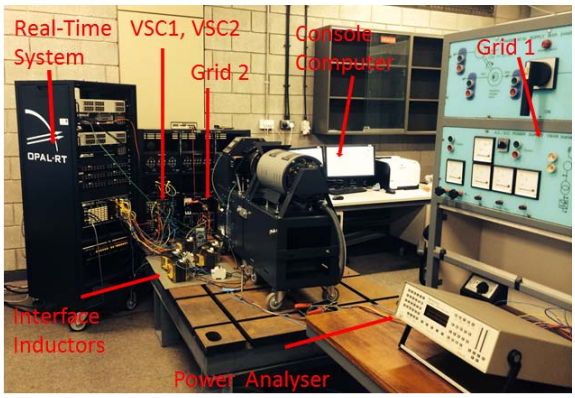
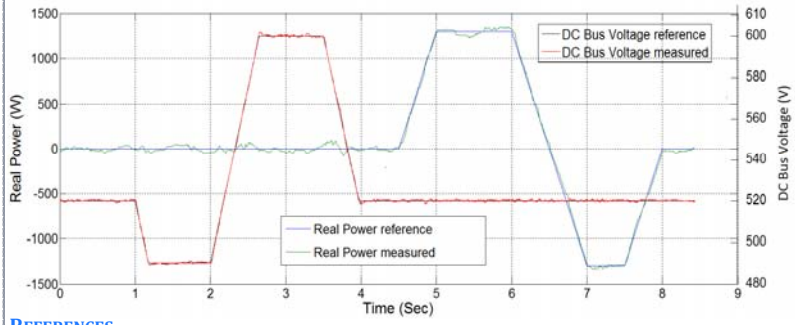


Fig. 5 Hardware implementation. **Fig. 6** DC Bus Voltage and Real Power throughput



References

[1] Amirnaser Yazdani, Reza Iravani *"Voltage-Sourced Converters in Power Systems; Modeling, Control and Applications"*, IEEE Press, Wiley, 2010.

Acknowledgement

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