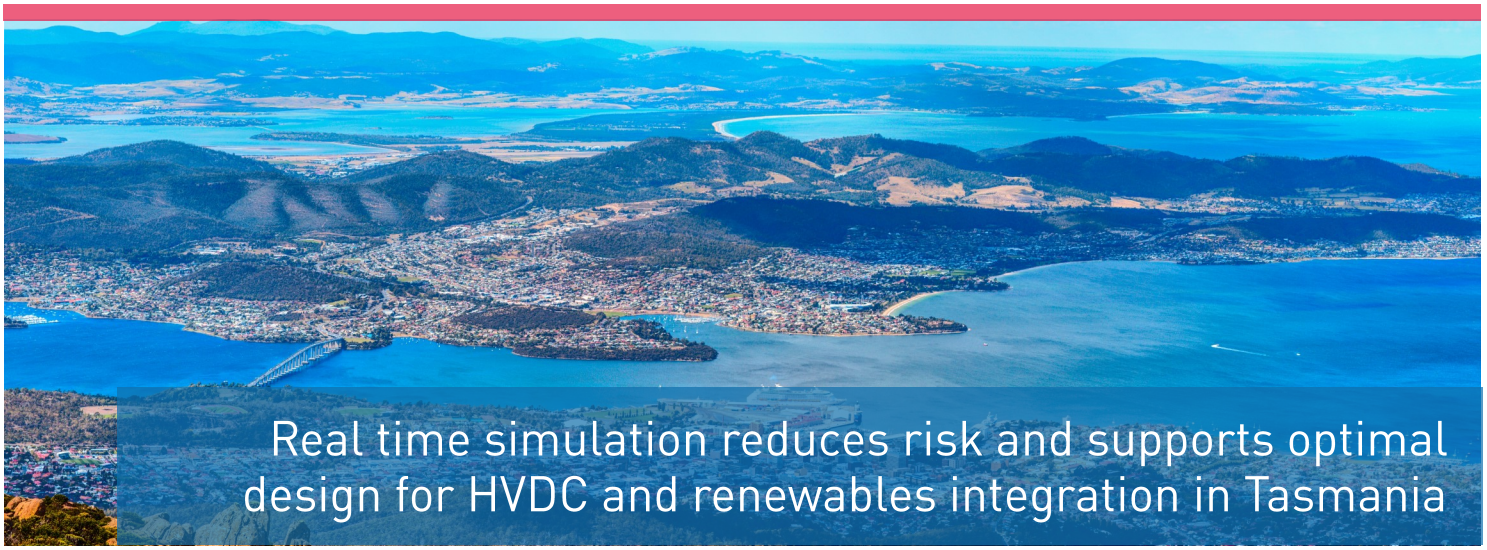
Case Study

Large scale simulation



Real time simulation reduces risk and supports optimal design for HVDC and renewables integration in Tasmania

User profile: Tasmania's transmission and distribution network operator

TasNetworks owns, operates, and maintains the transmission and distribution network in Tasmania—Australia's island state. A single 500 MW HVDC link, based on LCC technology, currently connects Tasmania to the Australian mainland power system.

To replace over 12 GW of coal retiring from the Australian grid by 2035, over 40 GW of variable renewable energy sources and 8 GW of "dispatchable" energy sources (e.g. hydro and pumped hydro storage) will be required. Tasmania, with 25% higher energy output winds than mainland Australia and the ability to deploy pumped hydro systems at 30% lower cost, will be a huge part of this energy transition.

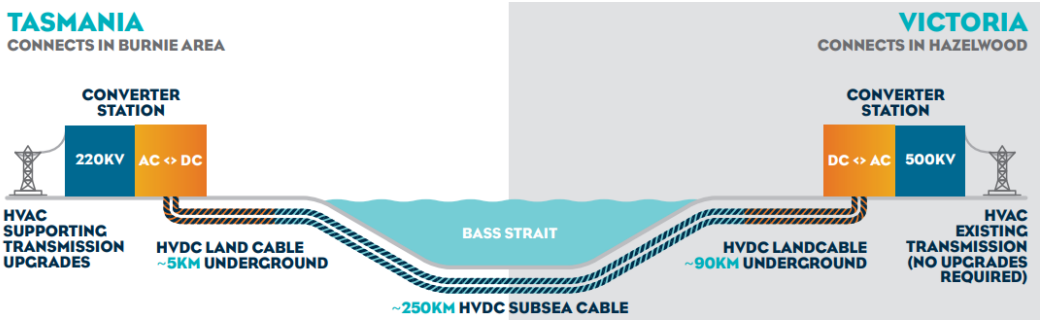
The integration of large-scale inverter-connected energy sources and loads and a new VSC-HVDC interconnection to the mainland present significant technical challenges to the Tasmanian grid. Real time simulation is among the tools that will support TasNetworks as they ensure the security and reliability of Tasmania's power while contributing significantly to a changing National Electricity Market.

Potential hydro and wind energy sites in Tasmania — Image courtesy of AEMO

Project focus: Ensuring successful integration of renewables and HVDC

The Marinus Link, a groundbreaking proposed VSC-HVDC project consisting of two 750 MW interconnections, would allow the Australian power system to take full advantage of Tasmania's world-class renewable resources.

The link, based on modular multi-level converter (MMC) technology, will support continuous power provision during power flow reversals, substantial reactive power support, continuous provision of frequency control, and black start capability. VSC-based technology will also ensure stable operation when connecting the weak Tasmanian network to Victoria (southeast Australia).



Connecting Marinus would enable the potential supply of all Tasmanian load via mainland Australia—a world first for a power system of this size.

Image courtesy of TasNetworks

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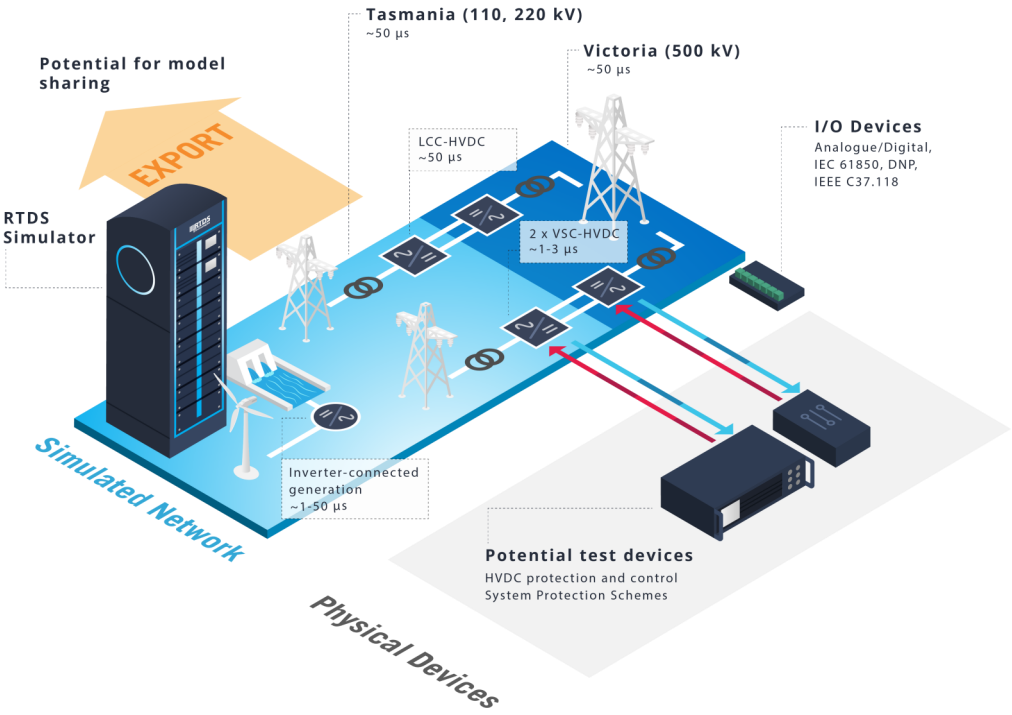
The tool: A multi-purpose closed-loop testbed for Tasmania's future grid



A real time simulator at TasNetworks will provide multiple capabilities and benefits:

- EMT simulations represent the interaction between HVDC systems and renewable generation in close proximity
- Highly detailed system models can run much more efficiently compared to other tools
- Sharing the network model with HVDC manufacturers has the potential to yield a more optimal, cost-effective design
- Existing and new protection and control schemes can be "hardware-in-the-loop" tested to consider events not feasible during commissioning
- Builds knowledge base and skills for utility staff

TasNetworks' RTDS Simulator is powerful despite its small footprint; scalability is achieved via core licensing

All of the 110 and 220 kV lines in Tasmania are currently modelled on TasNetworks' RTDS Simulator. Because TasNetworks hopes to anticipate complex interactions and instabilities due to the HVDC interconnectors, a simple infinite bus representation of the Australian mainland network is not sufficient. Instead, all 500 kV lines on the Victoria side have been modelled in full EMT detail. This impressive large-scale network model also includes:

- 1 LCC-based HVDC link
- 59 synchronous generators
- 12 converter-based generators
- 136 transmission lines
- 2 MMC-based HVDC links
- 37 capacitor banks
- 55 substation loads
- Over 20,000 controls components

Looking ahead: Battery of the nation

As Tasmania journeys toward a status of "battery of the nation" for Australia, the ability to integrate high levels of power electronics-based generation into the grid without compromising security or reliability will become critical. From running many operating conditions and contingencies in very high detail to testing protection and control schemes in a closed loop, TasNetworks is leveraging their power system knowledge and modelling skills alongside real time simulation technology to create a world-class simulation laboratory and testbed for their future grid.

Learn more about real time simulation at www.rtds.com

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