Integrated System Plan Consultation Submission

March 2018

16 March 2018

Mr Eli Pack
Manager National Planning
Australian Energy Market Operator

Dear Mr Pack

Submission to the AEMO Integrated System Plan Consultation

Smart Wires are pleased to make this submission to AEMO's Integrated System Plan Consultation (ISPC). As the leading provider of modular power flow control solutions, we believe we have a unique and valuable perspective on the optimisation and development of new and existing transmission network assets, and welcome the opportunity to contribute to the discussion surrounding AEMO's development of an Integrated System Plan (ISP) for the National Electricity Market (NEM).

The development of a holistic long term strategic infrastructure development plan for the NEM at a time where rapid and uncertain change is occurring on both the supply and demand sides, and when reduction of electricity prices is a national priority, is an important activity that will prospectively provide significant long term benefits to the community. The judicious consideration and integration of flexible modular power flow control within such a plan has potential to deliver a number of key benefits, producing optimal and adaptable outcomes that improve network utilisation and reliability, reduce, defer or eliminate major capital expenditure, and enable increased connection of renewable sources of generation, resulting in a reduction in the overall cost of electricity supplied to consumers.

We are glad to see that the ISPC paper recognises the potential for new technologies to improve the efficiency of the provision of network services through the ability to control and operate the power system in a way that increases utilisation of transmission assets, however we found that details of the proposed transmission developments presented in Chapter 4 of the ISPC were somewhat prescriptive in nature in some areas, particularly where equipment required to control power flow was concerned. Therefore we would like to provide information regarding the practical application of modular power flow devices to promote enhanced appreciation of their characteristics so that the technology can be more carefully considered and the benefits better exploited where possible.

Characteristics of modular power flow control

Modular power flow control offers a number of unique benefits that allow greater scope in both the use of existing network assets and the development of network augmentations. The utilisation of existing lines can be increased by improving the sharing of load between lines according to their respective ratings, removing constraints to increase the total transfer capability of a transmission corridor. Improvements of tens, or even hundreds, of megawatts are practically achievable in many cases, often with a much higher MW/$ benefit to cost ratio versus building new infrastructure. When new lines are required to be built and operated in conjunction with existing lines, power flow control allows higher capacity lines to be considered, removing constraints that would otherwise be present from operating lines of highly differing capacity in parallel with one another and thereby enabling the full utilisation of the new capacity.

Modular power flow control can be delivered in a short time scale, typically less than a year, and is therefore useful in enabling connection of renewable generation projects, or new loads, where construction of new lines to facilitate the connections would take several years. The modular nature of the power flow control solution allows its size to be readily changed to meet the needs of the network. This allows lower cost incremental installations that can be augmented as system conditions change over time. Most importantly, the solutions can be deployed quickly, with greater visibility to need, and also redeployed should the underlying need fundamentally change, reducing the risk typically associated with long-lived, fixed investments. This inherent modularity creates investment flexibility and optionality when managing networks under considerable and increasing uncertainty.

Beyond investment flexibility, modular power flow control also offers greater operational flexibility than many traditional solutions, with the ability to both push and pull power enabling the operator to manage loading conditions under a variety of outage scenarios and operational paradigms that can occur in highly meshed networks.

Comparison of Smart Wires with traditional bulk power flow control solutions

When compared with traditional solutions for bulk power flow control, such as phase shifting transformers (PST), series reactors, and series capacitors, modular power flow control has a number of distinct advantages:

- Solutions are scalable and transportable – traditional equipment is often fixed in size and designed for a particular application, and not readily scalable or redeployable as conditions change or the patterns of need shift to a different location on the network.
- Low maintenance – no tap changers, oil, insulation, or bushings to monitor or maintain.
- No sub-synchronous resonance risks – unlike series capacitors, the impedance compensation only exists at 50 Hz, so there is no interaction with generator turbine resonant modes.
- Inherent redundancy – due to the modular nature of the solution, failure of any single device results in only an incremental loss of performance, and replacement lead time is relatively short, especially if spare units are kept onsite. And in comparison to PSTs or series reactors, spare units can economically be kept onsite or rapidly procured.
- Smaller applications are compact and cost effective – in comparison to other traditional flow control equipment that typically have large fixed costs and overheads, and that do not scale down in size.
- Low impact on protection schemes – in many cases little or no changes are required to be made to existing protection schemes, especially in comparison to the needs of some series capacitor installations.
- Low environmental impact risk – compared to PSTs that require allowances for oil handling and spillage, as well as management of noise in many instances. And because the latest Smart Wires products are based purely on power electronics and contain no magnetics, there are no concerns around the generation of electromagnetic fields.

Alignment with the Integrated System Plan objectives

The characteristics of a modular power flow control solution align with many of the expressed needs and objectives of the ISP, including the following:

- A “least regret” investment, due to the ability to incrementally adjust the solution as required, or even to resize for redeployment elsewhere at a later date.

- A solution that is robust, controllable and adaptable, suited to the variation in generation patterns that are likely to emerge from diversity in solar and wind generation resources.
- Ability to respond quickly to unexpected and sudden generation or load developments, with lead times that are considerably shorter than those typically associated with the construction of new lines.

Modular power flow control offers a practical and attractive solution that support the key forecast needs and proposed developments described in Chapter 4 of the ISPC. A number of power flow control projects are presently being considered, or are already underway, that directly address specific development options described in the ISPC, including:

Improvement of interconnection capacity between New South Wales and Victoria – A proposed project to provide series compensation on the Jindera-Wodonga 330 kV line will increase the capability for New South Wales to export power to Victoria. This project directly addresses the proposal to provide series compensation and a PST along this line route and can readily be expanded in the future to provide additional transfer capability across the New South Wales to Victoria interface.

Relieving congestion on the Snowy to Canberra/Yass transmission corridor – A project to provide series compensation on the Upper Tumut-Yass 330 kV line is under development and seeks to improve the transfer capability from the Snowy region to Canberra/Yass. This project provides a cost-effective increase in the amount of renewable and hydro generation that can be exported toward New South Wales and the Canberra and Sydney load centers. It is estimated that an additional 200 MW of transfer capability can readily be developed by maximising modular power flow control deployments on Upper Tumut-Yass 330 kV and the parallel Upper Tumut-Canberra 330 kV circuit.

Enable connection of renewable resources – A project in South Australia is being developed that reduces curtailment of wind generation in the state. This project displaces expensive marginal cost gas generation, leading to substantial wholesale market savings. The deployment is also readily scalable to release additional wind resources onto the South Australian network.

Beyond projects already under development that represent potential future expansion opportunities, we see numerous additional examples where modular flow control could be leveraged as a complementary solution to a number of the ISPC initiatives, including:

Development of high capacity lines in Western Victoria – Power flow control on proposed higher rating 220 kV lines in Western Victoria would allow them to be built and operated in parallel with existing lower rated lines without the lower rated lines prematurely constraining the new build, while also providing vital improvement to voltage stability on the corridor.

Upgrade of Victoria to New South Wales and South Australia to Victoria interconnections – Modular flow control is capable of supporting a number of the proposed upgrades by reducing constraints and improving line utilisation and transfer capability across the Victoria to New South Wales and South Australia to Victoria interconnections. In the case of the latter, latent capacity of the Murraylink interconnector can be readily captured by balancing flows between existing 132 kV lines in the South Australian Riverland network.

Optimal investment to accommodate Snowy 2.0 project – Modular power flow control enables maximum utilisation of the existing and prospective new line builds. In particular, solutions that leverage the push-pull capability of modular power flow equipment to manage line loading under a variety of outage conditions have been identified as highly cost-effective. This technology may enable greater utilisation of existing network capability and therefore reduce the total augmentation required to integrate the Snowy 2.0 project.

Support of future ISP considerations and AEMO initiatives

In sum, we believe that Smart Wires' modular power flow control solutions represent a strategic tool as AEMO seeks to manage the current and impending energy transition. We hope that this document provides context for the inherent advantages of Smart Wires' modular approach versus traditional bulk power flow control, and sheds light on how these solutions align with and complement AEMO's various strategic initiatives and objectives. We look forward to working with AEMO, and the various network service providers within the NEM to assist in identifying applications that can leverage the technology to provide lowest cost reliable supply to Australian electricity consumers.

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