Submission
No 107

INQUIRY INTO FEASIBILITY OF UNDERGROUNDING THE TRANSMISSION INFRASTRUCTURE FOR RENEWABLE ENERGY PROJECTS

Organisation: Australian Energy Infrastructure Commissioner

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Standing Committee on State Development
Legislative Council
Parliament of New South Wales
via email to: state.development@parliament.nsw.gov.au

Dear Sir/Madam

Re: Inquiry into the feasibility of undergrounding the transmission infrastructure for renewable energy projects

The Australian Energy Infrastructure Commissioner (**AEIC**) welcomes the opportunity to make a submission in response to the Inquiry into the feasibility of undergrounding the transmission infrastructure for renewable energy projects (**Inquiry**).

The AEIC fulfils a national, independent role in Australia's energy sector and our responsibilities include:

- facilitating the handling of complaints from concerned community residents about planned and operating wind farms, solar farms, energy storage facilities and new large-scale transmission projects,
- identifying and promoting best practices for industry, government and related agencies to adopt with regard to the planning, operation and governance of such projects, and
- improving information access and transparency about proposed and operating projects, and relevant government and industry information more broadly.

The efficient delivery of large-scale transmission projects that enable the significant energy transition in Australia to occur, whilst ensuring that the potential impacts of such projects to landholders and communities are appropriately managed, is likely to be our collective highest priority for this decade.

It is essential that the community, government and industry are appropriately informed about the undergrounding of transmission infrastructure and we are delighted that the NSW Legislative Council Standing Committee on State Development (**Committee**) is contributing to this important work through its Inquiry.

Types of transmission infrastructure

At the outset, it is necessary to distinguish the different infrastructure roles within the transmission network.

High voltage transmission infrastructure describes infrastructure that transmits electricity from generation assets (e.g. hydro, coal, gas, wind energy, solar energy, stored energy etc.) to major substations at high voltages, typically in the range of 66 kV up to 500 kV AC.

Electricity distribution infrastructure (often described as “poles and wires”) is then used to deliver electricity from substations to homes and businesses.

Often, private transmission lines need to be built to connect an electricity generation asset to the existing transmission network. These are typically developed, constructed, operated and maintained by an experienced transmission company under an arrangement with the generation asset developer.

Those developers usually enter into commercial agreements with landholders who provide the easement for the connecting transmission line route. Depending on the circumstances, those same landholders may host some or all of the project’s generation assets. Developers will try to minimise the distance of the connecting transmission line to the existing transmission network through site selection and design/location of the internal point of connection at the site.

Infrastructure that comprises the broader transmission network is operated and maintained by a transmission network service provider (**TNSP**). In New South Wales, the largest TNSP is TransGrid.

Determining whether undergrounding of transmission infrastructure is the best option for a project will depend on careful analysis of the actual current and future requirements, route topography, landholder considerations, agricultural and environmental considerations, technology options, projected costs, benefits and impacts for that project with reference to the context and purpose of the infrastructure.

Transmission infrastructure projects in NSW

New South Wales is a member of the National Electricity Market (**NEM**) along with the Australian Capital Territory, Queensland, South Australia, Victoria and Tasmania. The Australian Energy Market Operator (**AEMO**) is responsible for producing the Integrated System Plan (**ISP**) which outlines a whole of system plan to supply energy across the NEM.

In the ISP, AEMO identifies the optimal development path and the network investment required to ensure the efficient connection and operation of electricity resources across the NEM.

Major transmission projects in NSW currently under consideration or development include, the Queensland-New South Wales Interconnector, VNI-West, Central West Orana REZ Transmission Link, Project Energy Connect, HumeLink, Sydney Ring and New England REZ Transmission Link.

The purpose of these projects will be to transmit electricity generated by new, often yet to be built, large scale power stations to major substations. A key objective of these projects is to provide new transmission that will allow the development and deployment of new renewable electricity generation assets where currently insufficient, or no grid exists. Some projects are providing new interconnections between States, such as VNI-West and Project Energy Connect.

It is essential that this transmission infrastructure is developed to unlock existing, constrained generation capacity and/or unlock new geographic areas to develop additional generation capacity. New transmission infrastructure unlocks capacity when it increases the amount of electricity that the network is capable of transmitting. It unlocks geography when it provides opportunities for generation assets in new geographies to connect to the transmission network.

Technical considerations

Electricity can be transmitted using either direct current (DC) or alternating current (AC). Each method provides different opportunities and constraints. When transmitting electricity over long distances, the most efficient approach is to transmit at high voltages using either HVDC or HVAC, hence the ongoing need for a well-planned transmission network.

In Australia, aboveground HVAC is the standard approach to transmitting electricity over long distances. The high voltage electricity is stepped down to lower voltages at substations prior to entering the distribution network which allows the electricity to be transmitted to homes and businesses.

A key advantage of AC transmission and distribution is that the voltage can be efficiently and cost-effectively stepped up (increased) or stepped down (decreased) using transformers and substations. In contrast, DC transmission requires conversion to AC before it can be stepped up or down.

Underground HVAC produces significantly more reactive power than aboveground HVAC. To attain voltage control in underground HVAC cables, reactive compensators are required to compensate for the reactive power produced. Depending on the length of the underground HVAC transmission line, substations can be enlarged to accommodate reactive compensator requirements at each end of the line. However, longer AC underground transmission lines may require reactive compensators to be installed aboveground at intervals along the route.

The interval at which reactive compensation is required is dependent on a combination of the length and voltage of the transmission infrastructure. If reactive compensation is required at intervals along the route, the cost of the infrastructure may increase substantially and there may be impacts for landholders who are required to host the compensators.

In its 2023 Draft Transmission Expansion Options Report, AEMO opined that generally, HVAC underground cable is suited to lengths below approximately 50 km.[1] In its submission in response to AEMO's 2023 Draft Transmission Expansion Options Report, Star of the South stated that the assumed transmission distance cut off for HVAC underground transmission should vary with the transmission voltage selected. It provided examples of cut off lengths of 20 km for 500 kV, 50 km for 330 kV, 75 km for 275 kV and 100 km for 220 kV.[2]

Due to limitations on the length of HVAC underground transmission infrastructure, it is generally accepted that HVDC is the preferred option for long distance underground transmission.

To connect an HVDC underground transmission line to an HVAC aboveground transmission line, requires a significant converter station, with size and cost correlated to the transmission voltage. These are large, complex conversion stations and are very expensive relative to other project costs.

If an HVDC underground system is used to transmit electricity directly from one point to another, a converter station is required at each end point. However, if the purpose of the transmission line is not only to transmit electricity from point to point – but to also allow new electricity generation stations to be located along and connect to the DC transmission line, then a converter station will be required at each new connection point.

The magnitude of costs and impacts arising from installing converter stations at each existing and potential future connection point are unlikely to be feasible or even possible. Consequently, underground HVDC is unlikely to meet the fundamental requirements of these projects, even regardless of cost considerations.

Other impacts

When evaluating whether underground transmission infrastructure is appropriate for a particular project, attention should be given to a range of other potential impacts including route selection and design considerations, construction and operational impacts on landholders and land use (e.g. recreation, forestry, agriculture/horticulture), environmental considerations, supply chain and critical materials availability.

[1] AEMO, Draft 2023 Transmission Expansion Options Report, May 2023, accessed at: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/2023-teor/draft-2023-transmission-expansion-options-report.pdf?la=en.

[2] Star of the South, Submission: 2023 Draft Transmission Expansion Options Report, 31 May 2023, accessed at: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/2023-teor/submission/14-star-of-the-south-2023-draft-teor-submission.pdf?la=en.

Our Office has heard from many landholders, neighbours and communities who have expressed views that underground transmission infrastructure is the solution to the impacts of aboveground infrastructure.

We have also heard from landholders, with first-hand experience from being directly located on the proposed route for an HVDC underground transmission line, who are particularly concerned about the invasive impacts and destruction arising from the trenching and drilling required to place and locate the transmission cables underground. Concerns also include the ability to maintain and ensure compliance with bio-security requirements, the inability to deep-rip in vicinity of the easement and how landholders are compensated for the impost.

To install underground HVDC infrastructure requires multiple trenches along the length of the transmission line that may cause significant disturbance to the land and the farming operation. The construction easement required is typically double the actual long-term easement, once completed. As a result, the disruption to the land and land use during the construction and rehabilitation period is likely to be much more impactful than the impacts from construction of aboveground infrastructure.

Both aboveground and underground transmission infrastructure – and the technology selection – can have a range of impacts. These impacts, constraints and opportunities require careful consideration when assessing options for transmission projects.

Conclusion

Thank you for the opportunity to make a submission on this important consultation. We would be delighted to discuss these matters with you and your colleagues in further detail and expand on the background to our various observations and recommendations.

In the meantime, should you have any queries about this submission or require additional information, please do not hesitate to contact us by telephone on 1800 656 395 or by email at aeic@aeic.gov.au.

Sincerely

Andrew Dyer
Australian Energy Infrastructure Commissioner