Submission: 2023 Draft Transmission Expansion Options Report

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Star of the South welcomes the opportunity to make a submission in response to AEMO's Draft 2023 Transmission Expansion Options Report **(Options Report)**.

About Star of the South

Star of the South is Australia's most advanced offshore wind project, with the potential to power nearly 20 per cent of Victoria's electricity needs while creating thousands of jobs and investing billions in the Gippsland region.

The Star of the South offshore wind project has been developed under a Commonwealth Exploration Licence since 2019 and is currently in the advanced stages of feasibility and environmental assessment, targeting approvals around the middle of the decade and first power before 2030. Star of the South is backed by Copenhagen Infrastructure Partners (CIP), one of the world's largest clean energy investors, and Cbus Super, a leading Australian Industry Super fund.

Introduction

Star of the South has been developing a 2.2 GW capacity, high voltage, underground transmission system. Based on this experience and work with local landholders, communities, and other stakeholders, Star of the South offers the following inputs to the **Options Report.**

Economic, social and environmental costs and benefits

Transmission considerations

Reducing community, land use, environmental and visual impacts are typically the main drivers for choosing underground transmission. In Australia, most new transmission projects are High Voltage Alternating Current (HVAC) overhead, with a few notable exceptions. While we acknowledge that HVAC overhead transmission will continue to form the backbone of Australia's power supply, however underground transmission will have an increasing role in managing impacts and risks associated with the rapid and large-scale transition underway.

Different transmission technologies have varying advantages and disadvantages which need to be considered and balanced for each specific project. In addition to cost, consideration of community and visual impacts, land use and landholder impacts, soil disturbance, electrical system resilience, grid support, construction and maintenance are all important factors for sound decision making.

When seeking to secure multiple transmission corridors in one region, it is critical to consider the combined impacts of these factors and increased social licence risk.

Social licence is a critical factor to enable the timely delivery of significant transmission required for Australia's energy transition. Star of the South welcomes an increased focus from AEMO on this need.

Recommendation: That evaluation of transmission technology options includes multi-criteria analysis that includes environmental, social and land use considerations alongside cost and technical factors.

Underground Transmission Costs

Many of the proposed Renewable Energy Zones (REZs), major transmission projects and augmentation projects proposed are situated in rural areas. In such environments, the most common method of installation for underground cables is direct burial or conduit installation, such as for the Gippsland Desalination Plant cable and Murray Link interconnector. Depending on topography and existing infrastructure crossings, trenchless installation techniques may also be required in limited locations.

While installing cables in conduit incurs additional costs compared to direct burial, it offers additional benefits. Civil work can be conducted ahead of cable manufacturing, reducing the risk of project delays during execution. Additionally, it allows for future planning by incorporating spare conduits (if planned for), avoiding the need for further excavation at a later date to add more capacity which minimises land and landholder impacts.

Figure 7 in the **Options Report** provides an average comparison between overhead transmission, direct burial, and cable tunnel installation. However, it is important to note that costs are highly site-specific and need to be assessed on a case-by-case basis.

The 'Tunnel installed cable' installation method is primarily applicable to urban areas, which may create the false perception that an underground cable solution is an order of magnitude more expensive than overhead transmission, particularly for rural projects. A more appropriate comparison would be to include unit costs for 'overhead lines', 'direct buried cables' and 'conduit buried cables'. This would reflect a more realistic unit multiplier for underground cables.

Recommendation: Clearly label or update Figure 7 to make it clearer that direct buried or installed in conduit transmission is most relevant for rural areas and tunnel installation is most relevant for urban areas or very specific situations. We also propose that this difference is carried through to the costing tool.

HVAC transmission distance assumptions

The **Options Report** states that HVAC underground cables are suitable for lengths below approximately 50 km and beyond this distance, AC cables at high voltage levels will experience significant charging currents, necessitating reactive compensation and design considerations.

It should be noted that this guideline does not apply universally to all transmission voltages considered by developers.

As an example, Star of the South has developed an underground cable concept design for voltages of 220kV and 275kV, covering distances of up to 90 km onshore. In this design, reactive compensation is implemented at each end of the system, eliminating the need for additional mid-point reactive compensation stations. However, for concepts involving voltages of 330kV or 500kV, one or several intermediary reactive stations would be required[1].

Reactive power management is not limited to underground cables and is also a consideration with overhead lines.

Recommendation: The assumed transmission distance cut off in the costing tool for HVAC underground transmission should vary with the transmission voltage selected. For example, 20km for 500kV, 50km for 330kV and 75km for 275kV and 100km for 220kV.

Cost comparison assumptions

Figure 7 in the **Options Report** illustrates a comparison between overhead transmission and underground cables based on thermal ampacity, assuming identical voltage. However, this comparison does not provide an equal assessment of the two options.

The figure states that a 500kV overhead double circuit has the thermal capacity to carry up to 3500MW. However, when considering AEMO's network operating constraints, the actual capacity is significantly lower. AEMO operations do not favour double circuit lines for generation radially connected, as they pose a potential network security risk in the event of non-credible contingencies like tower collapse or the loss of both circuits in a single event. The preference is for two single circuit designs, which require a wider easement (100m width) and twice the number of towers, impacting cost estimates.

If a double circuit structure is used, the transfer capacity of the line may be constrained well below the thermal capacity mentioned in the report. For instance, in Victoria, loading on a double circuit 500kV line is limited to 1500MW. However, it is worth noting that AEMO has managed to increase this value to 2000MW in the case of SEVIC 1 as shown on page 132 of the DRAFT document under review.

Recommendation: The network operating constraints should be integrated into the assessment of the various transmission options in the ISP.

Figure 7 also compares a 500kV overhead line to a 500kV underground system, which might be a fair comparison for shorter distances. However, for longer distances, it would be more appropriate to use a lower voltage for the underground system.

1 Note that the specific requirements and considerations may vary depending on the project and the chosen transmission voltage

For example, the longest operating HVAC 500kV underground system in the world spans less than 20km [1]. For larger distances, such as SEVIC1 (65km), a lower voltage would be employed for the underground system. A capacity of 1500MW could be achieved with three 275kV underground circuits, while four 275kV circuits could deliver 2000MW. This cost comparison would provide a more meaningful evaluation[2].

Recommendation: The overhead vs underground transmission option comparisons should be made based on the systems' comparable transfer capacity. This may involve evaluating solutions of different voltages.

Transmission project lead time

The **Options Report** proposes an update for the development timeframe of transmission projects, providing estimates that are aligned with recent market experience.

We welcome the proposed update for the development timeframe of transmission projects in Section 3.8 as these are more aligned with recent market experience. It is important to consider that securing an overhead line transmission corridor vs an underground corridor may have significant differences in development timeframes and risks to time and cost. This should be taken into account when planning the overall delivery of a transmission project, as it may influence the selection of technology, dependent on project drivers which may include a need to deliver new capacity or meet emissions reduction target within certain timeframes.

Recommendation: Development timeframes should be differentiated for specific technology options.

System strength considerations

The use of standard synchronous condensing sizing for consenting as a first estimate seems appropriate. However, the framework should be flexible enough to be technology agnostic to open the door to more innovative solutions such as grid forming inverters which may be able to operate in weaker grids (SCR<3) and may have a lower remediation cost.

Conclusion

Thankyou for the opportunity to contribute to the development of the 2024 ISP through the 2023 Transmission Expansion Options Report consultation process. We would be pleased to discuss this feedback and look forward to further consultation with AEMO.

2 Note that the specific technical requirements and considerations may vary depending on the project and the chosen transmission parameters