HumeLink Community Consultation Group (CCG) Representatives for:

Snowy Valleys CCG

Wagga Wagga, Cootamundra, Gundagai CCG

Upper Lachlan, Yass Valley CCG

24 August 2022

Mr Brian Elton
Independent Chair
HumeLink Undergrounding Steering Committee

By email: brianelton1952@outlook.com

RE: CCG Representatives' Position on HumeLink Undergrounding Study Report

Dear Mr Elton,

This letter summarises the position of the Community Consultative Groups representatives on the HumeLink Undergrounding Steering Committee (CCGSC) following the review of the final GHD report "Concept Design and Cost Estimate HumeLink Project – Underground" Revision 3, dated 22 August 2022.

There are many aspects, outcomes and conclusions presented in this report that the CCGSC do not agree with and therefore the CCGSC do not endorse the report.

Since the release of the draft report to the CCGSC on 27 May 2022, the CCGSC have submitted a total of 100 comments to be addressed by the consultant. As of the date of release of this final report, only 48 of those original comments have been resolved to the satisfaction of the CCGSC, with 52 remaining unresolved.

1 Key Topics of Concern

Over 50% of the unresolved comments can be summarised by the following key topics of concern. It should be noted that these topics cover only a subset of the outstanding issues which have been provided to the consultant.

1.1 Report is Unbalanced

It is the CCGSC view that the report is unbalanced and favours an approach of focusing on the negative aspects of the use of underground cables, while downplaying the positive aspects of selecting underground high voltage cables over AC overhead lines. The lack of balance is further worsened in the report by the downplaying of significant negative impacts of overhead lines and lacking the same level of detail and explanation of negatives of overhead lines as is given to underground cables.

The CCGSC were involved in the drafting of the Request for Quotation (RFQ) of this study, and the RFQ was specifically developed to provide a balanced approach to comparing underground and overhead transmission.

There were two main parts to comparing options in the study:

1. Construction and operation costs; and
2. Non-market benefits.

At the outset of the study, it was understood undergrounding would cost more to construct. Therefore, an important part of the study was to assess the non-market benefits of undergrounding relative to overhead lines, so an informed decision could be made about the benefits of the additional undergrounding construction cost.

For this purpose, the scope required that the selected undergrounding options be compared with the current AC overhead line scope against a set of criteria which was carefully selected by the CCGSC to provide a balanced comparison. In the CCGSC's view, this part of the scope was of equal importance as the construction cost in the report.

The comparison tables in the body of the report as well as the executive summary are considered by the CCGSC to be unbalanced and do not cover all of the criteria required by the RFQ.

1.2 Unit Costs for Underground High Voltage Underground Cables too High

While the CCGSC understand that the cost of high voltage cables and their installation has increased significantly over the past 12 months, the CCGSC are of the view that the cost estimates for the underground cable components are significantly higher than (in some cases almost double) values expected according to various sources (including the AEMO Transmission Cost Database, which was also developed by GHD) and Australian based high voltage cable experts.

The CCGSC are concerned that a bottom-up approach to develop these costs has not been undertaken by the consultant and that the methodology applied has resulted in this higher value. The methodology that has been applied is confusing and seems to be based on high level ballpark pricing derived from a small sample size of other projects. We understand that the major point of difference is in the estimated cost of the cable installation and we understand that was determined using the above approach from overseas. It is the CCGSC's opinion that the cost of installation should have been developed using a bottom-up approach and using rates and indices from Australian sources and cost guides and handbooks.

The report also assumes no cost reduction when installing two trenches and two sets of bipole cables (three cables) side by side. The unit cost per kilometre for the three cables installed in a single trench has been doubled, with no allowance for economies of scale that should be expected when installing two trenches and six cables instead of one trench and three cables. As a minimum, there should be cost efficiencies in aspects such as mobilisation, demobilisation, overheads, use of labour and procurement of longer lengths of cable. The CCGSC are of the view that failure to apply such cost efficiencies has contributed to a higher than expected underground cable cost component.

1.3 Cost Benchmarks for HVDC Cables not Appropriate

Related to the CCGSC's concerns described in section 1.2, the report states that the underground cable cost estimates were "*based on reference to recent bids received by Stantec for EuroAsia and Harmony link HVDC projects as well as information received from equipment suppliers*".

We note that the EuroAsia and Harmony HVDC links are projects where the proportion of land cable components are relatively short (public references indicate 26km and 40km respectively) compared to the more expensive subsea cable components. The consultant to the CCGSC, Amplitude Consultants, has advised that the unit cost of underground cables, both in terms of the cost of the cable and the installation costs, would be expected to reduce as the total amount of cable purchased and total length of cable installed increases. In the case of the HumeLink project, there will be 679 km of total circuit length and over 2,000 km of underground cables procured and installed. The costing benchmarks selected by the consultant will not have accounted for economies from the procurement and installation of these significantly longer lengths.

It is the CCGSC's view that the consultant should have benchmarked their unit costs against other projects under construction of similar scope to the HumeLink undergrounding options, such as SuedLink (Germany, 2GW, double symmetric monopole, 750km), SuedOstLink (Germany, 2GW, double symmetric monopole, 275km) and SOO Green (USA, 2GW, symmetric monopole, 563km).

1.4 No Information on Scaling of Costs to 2022

The report states that the cost estimates developed are in 2022 costs, and often refers to recent and dramatic increases in cost for HVDC equipment and high voltage underground cables. Section 4.1.1 refers to "Factors that may affect the cost estimates" which include commodity price fluctuations, suppliers' manufacturing plant loading and labour rates along with others.

Given the methodology applied to develop the cost estimates, particularly for the underground cables, the CCGSC have repeatedly asked the consultant to advise how these factors have been applied in the development of the cost estimates. The responses the representatives have received include statements such as *"our engineering judgement based on our experience and understanding of the HVDC market to prepare the cost estimates"*, *"the present market conditions were considered in the development of the estimate"* and *"the estimate is based on today's market conditions"*. Given that actual values have been produced, there has been no satisfactory response from the consultant to this request.

The CCGSC are aware of certain indices that are available for high voltage equipment, cables and conductor manufacture, both in Europe and Australia that do show an increase in costs in these areas particularly over the past 6 to 12 months. However, the fact that the consultant cannot state specifically how they have adjusted historical values to account for these market changes raises concern over the accuracy of the estimates provided.

1.5 Comparison of Underground Costs in 2022 to AC Overhead Costs in 2020/21

The "Options" section of the executive summary of the report provides a summary comparison of the AC overhead option against the various underground options. On the first page of the table, there are CAPEX and OPEX cost comparisons where the cost estimates for the underground options, stated within the report to be to present market conditions and therefore considered to be mid-2022 cost values, and compared with the 2020/21 CAPEX and OPEX costs of the AC overhead option.[1]

[1] The CCGs note that the costs have been updated to indicate that the costs are 2021 costs however, from the overhead line modelling included with the PACR it is understood that 2020 HumeLink costs have been escalated simply using a CPI of 1.57% and not using an index more relevant to the plant, materials, equipment, and delivery of AC overhead transmission projects.

The report goes to great lengths to describe the cost impacts that have affected pricing under current market conditions (see section 4.1.1 of the report). It is the CCGSC's view that a number of the factors listed in the report, including commodity price fluctuations, suppliers' manufacturing plant loading and labour rates and in addition the supply chain issues being experienced from countries where overhead towers and conductors are typically sourced, such as China and India, are likely to also affect the estimate of CAPEX and OPEX of the AC overhead option.

It is the CCGSC's view that report unfairly compares costs based on current market conditions for the underground cable options against previously developed 2020/21 estimates for the AC overhead option, especially given the sudden and dramatic increase in costs over the past 12 months. In our view, the AC overhead option cost should be reassessed to present market conditions (i.e. 2022), and applying the same basis, methodology, and other applicable input assumptions as the underground cable estimates to allow a fair and reasonable comparison of CAPEX and OPEX costs.

1.6 Comparison of Losses in OPEX Costs

In the executive summary, the report provides a comparison of operating costs against a value reported for the AC overhead option. It is stated that the AC overhead option value includes losses, which are also included in the OPEX estimates for the underground options.

However, the CCGSC have requested from the consultant to provide the actual MW and MWh values used to derive the cost of losses in the report. By virtue of the technologies being compared and the distances involved, the total electrical losses of the underground HVDC options should be less than (and in some cases, significantly less than) the AC overhead loss values – this is one of the major reasons why HVDC underground transmission is selected over AC overhead transmission at these distances. The costs presented and compared indicate that the consultant has determined equal losses for the underground options as the AC overhead line option, and the CCGSC have not had the opportunity to check these values and how they have been derived.

The CCGSC are of the view that the OPEX costs presented in the executive summary should not be compared between the underground options and the AC overhead options until the calculation of losses used to determine the OPEX costs for both the underground and AC overhead options have been presented and checked.

1.7 Route Assessment

The report presents various route options, primarily for the purpose of determining circuit lengths and cost assumptions. The CCGSC have raised a number of concerns regarding this route assessment.

Firstly, the RFQ required that the consultant "*For all Options, develop and provide, based on a desktop assessment, an expected route for all underground cable sections. These routes shall consider the "best available" route for the underground cables. The selected routes will not necessarily be inside or follow the study corridor presently being considered for the overhead transmission line route i.e. more direct routes or routes following road reserves or other features and minimising disturbance to private landholders would likely be preferable considering differences in overhead and underground construction*."

In our view, this was not done. The consultant has produced only one underground specific route (the Hume Highway route), which was only applied to one set of options. This was not done for "all options" as required in the RFQ which was jointly developed in consultation with the CCGSC. Furthermore, the Hume Highway route was more than 70 km longer than the Option 2C route from

the Project Assessment Conclusions Report (PACR) that followed the same topography, Maragle – Gugaa – Bannaby. Reducing the route length of the options assessed with the Hume Highway route, by 70+ km can be certainly expected to reduce the cost of these options.

Secondly, the consultant ranked the routes considered using a multi-criteria assessment tool "InDeGO". InDeGO purports to evaluate enviro-social constraints, with the route with the lowest InDeGO score being regarded as the route with the least environmental and social impact – the preferred route subject to the least constraints.

In the CCGSC's view, it is questionable whether all the factors listed in the report are constraints for an undergrounding route. The consultant argues that during the short construction phase (relative to the overall asset life), these factors are constraints. The assertion that an inconvenience for a short period during construction, should dictate the location of an infrastructure project that will operate for decades, is not compelling.

The CCGSC are of the view that dwellings within a kilometre of the easement, unlicenced airstrips and bushfire prone land shouldn't be regarded as constraints for an underground route.

Further it became evident during the course of the study that the InDeGO database is missing significant numbers of "constraints", with numerous dwellings not identified in the mapping and bushfire prone land not consistent with RFS mapping (see Section 1.8 of this letter Identification of Bushfire Prone Areas). The CCGSC therefore believe that the majority of the routes identified for the underground options were done so using previous study information that was used for exploration of overhead routes using public and private land. The CCGSC are of the view that different input information is relevant for overhead and underground solutions such that underground solutions could be developed more directly, and could present differently to what would otherwise be used for development of an overhead solution based on the input information. Even if the methodology was considered robust, the problems with the database and input information makes the scores reported unreliable.

Based on the above, the CCGSC are of the view that the ranking of routes using this method cannot be relied upon for the decision about the location of the HumeLink transmission project, for both the AC overhead and underground options.

1.8 Identification of Bushfire Prone Areas

The CCGSC have identified major inconsistencies with what the NSW Rural Fire Service (RFS) defines as bushfire prone, and what Transgrid defines as bushfire prone. Some properties in the area have not been designated as bushfire prone by Transgrid but are shown as bushfire prone according to the RFS maps[2].

The consultant maintains that the RFS has certified the Bushfire Prone Land Maps that have been used to map HumeLink, in the GHD *HumeLink Route Options Assessment (March 2022)*, and this undergrounding study. The question is then why are the RFS online maps of bushfire prone land and the consultant's maps of bushfire prone land so vastly different? The maps used by Transgrid and the consultant have established bushfire prone land as heavy vegetation/forested areas, yet the RFS maps

[2] https://www.rfs.nsw.gov.au/plan-and-prepare/building-in-a-bush-fire-area/planning-for-bush-fire-protection/bush-fire-prone-land/check-bfpl

available to the public show bushfire prone land to be more widespread and encompassing large areas of agricultural land.

1.9 Technical Accuracy of Various Aspects of AC and HVDC Underground Cable Installation and Operation

The CCGSC have flagged a number of concerns of technical accuracy presented in the reported. Some of these concerns are related to the issue of highlighting negative aspects as described in Section 1.1 of this letter.

One example is how the topic of energisation of the AC cables has been presented in section 3.3.2 of the report. Under the heading of "installation considerations", the report states "*the energisation of the AC cables will require a significant amount of time, estimated to be 48 to 72 hours per 20 to 40 km segment of cable. This introduces operability issues for configurations with AC cables. By reducing the length of AC cables, the operability of the system is improved*".

This statement is misleading. The 48 to 72 hours is only required as a "soak test" of the cables on completion of installation and segments can be soak tested simultaneously, which is common for such long-distance AC underground cables.

Another example of highlighting the negative, under the same topic, is in section 3.1.2 of the report under "Installation conditions" where the report correctly refers to the "soak test" but then goes on to state *"Initial cable commissioning tests will require setup of specialised equipment."*. It is the view of the CCGSC's consultant that for such long distance cables, it is likely that only a "soak test" would be applied and that the paragraph presented here unnecessarily paints a negative picture of AC underground cables.

It is also clear in the report that the design and installation assumptions applied to these long-distance AC and HVDC cables are based on the Transgrid EHV Cable Design and Installation Manual (section 3.1.2 of the report) and that the consultant has applied techniques for installation of relatively shorter distances of AC underground cables in built-up areas, to the installation of long distance AC and HVDC cables in rural and non-built up areas. This includes the inclusion of thermally stabilised backfill (TSB) in their design assumptions. The CCGSC are aware that TSB was not used in the two long distance HVDC underground cable projects built in Australia (Directlink and Murraylink) and that in both cases, more time and cost-efficient methods of installation were applied to improve the efficiency of the installation process. TSB can be very expensive and at the lengths considered in this project, it is highly likely that a choice to space the cables a little wider or to select a slightly larger cable may prove more cost effective than assuming TSB. It is noted that in section 4.1.1 it is stated that *"TSB has not been included in the cost estimate"* however in our view applying these types of assumptions for shorter AC underground cable systems to long-distance cable systems would contribute to the higher unit cost of cable installation as discussed in Section 1.2 of this letter.

1.10 Project Schedule

The CCGSC continue to have concerns over the project schedules presented in the report, particularly for the HVDC options. In the comparison of options, and in the light of current concerns over power supply and transmission, a comparison of the project schedules is likely to be a focus when comparing underground and overhead options.

Section 5 of the report shows the various HVDC options requiring between just over 6 years and just under 7 years.

The CCGSC's consultant agrees that current worldwide demand for HVDC and underground cables are likely to result in longer project delivery times (which in itself speaks to the popularity of HVDC underground transmission over other alternatives) but have flagged a concern that the schedule assumes 8+ months for commissioning that has not been addressed by the consultant. Representatives of the CCGSC's consultant headed up the development of the CIGRE technical brochure TB697 "Testing and Commissioning of VSC HVDC Systems" and has held the roles of commissioning manager or commissioning engineer for two out of three HVDC systems currently in service in Australia and one in the USA. The CCGSC's consultant is of the view that the commissioning schedule in the report is excessive and should be no more than two-to-three months maximum – which will bring the schedule for some options below 6 years and therefore closer to that of the AC overhead line.

2 Conclusions that can be Drawn from the Report

Even though the CCGSC cannot endorse the report as presented, the CCGSC can draw the following conclusions from the study.

2.1 Technical Underground Solutions Presented are Reasonable

It is the view of the CCGSC that the technical solutions and options presented for the AC underground, HVDC underground and various hybrid combinations are technically feasible and reasonable. The consultant has done a good job in identifying the scope of the various options and in determining the technical parameters and requirements for these options. In developing such technical options, this provides a useful reference for the development and consideration of underground options both further for the HumeLink project, and as alternatives for other proposed transmission projects in Australia.

2.2 Undergrounding is not "10 Times" the Cost of Overhead Transmission

The comments presented in Section 1 of this letter highlight a number of concerns with the cost estimates presented. Overall, these comments show that it is the CCGSC's view that the cost of undergrounding will be lower than those presented in report (in 2022 values) and that the comparison to the AC overhead line in 2022 values should be higher than the $3.3 billion presented in the report.

Notwithstanding the above, even with the disputed values presented in the report, there are a number of underground options or hybrid underground / overhead options with N-1 reliability that are between 2.9 and 3.5 times the estimated cost of the current AC overhead option. Of course, based on our comments in Section 1 of this letter, we expect this ratio to be substantially smaller, but even so hopefully the outcomes of this report will debunk the often-repeated myth that undergrounding is "ten times the cost".

3 CCGs Conclusion

As discussed above, we, the CCGSC, do not have confidence that the undergrounding study fairly compares overhead and underground options for the following reasons:

1. The unbalanced assessment of the non-market benefits;
2. The non-market benefits not being quantified;
3. The unit cost for underground high voltage underground cables is too high;
4. The cost benchmarks for HVDC cables not being appropriate;
5. No information on scaling of costs to 2022 dollars;

6. The comparison of underground costs in 2022 to AC overhead costs in 2020/21;
7. Comparison of losses in OPEX costs is not substantiated;
8. Validity of inputs into the route assessment process;
9. Failure to accurately identify bushfire prone areas;
10. Technical accuracy of various aspects of AC and HVDC underground cable installation and operation; and
11. Excessive project schedule for undergrounding.

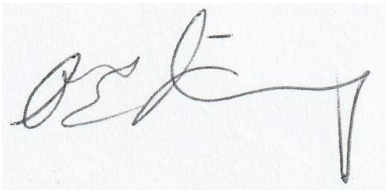
We therefore believe that this study has not met the intent or objectives of the original scope of the study and should be read with the knowledge that there are many unaddressed questions and comments, and disputed costs in the report, and that it is considered that the analysis of the non-market benefits of underground cables and overhead lines is presented in a biased manner.

As such, this study should not be relied upon for making decisions about whether overhead lines or underground cables are the preferred option for HumeLink.

A full and comprehensive expert review of the HumeLink undergrounding study is urgently needed to address problem areas of the report, so that informed decisions can be made about undergrounding of the HumeLink project going forward.

Yours sincerely,

The HumeLink Community Consultation Groups representatives on the Steering Committee:



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