STANDING COMMITTEE ON STATE DEVELOPMENT

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

Supplementary questions: Professor Bartlett, Mr Brand and Mr Barber

Answers are to be returned to the Committee secretariat by 8 August 2023

1. Has TransGrid already signed up a contractor to build HumeLink, as is rumoured to be the case?
2. What commitments beyond the $633 million for early works have been made?
3. Should all expenditure on HumeLink be paused till the Inquiry has concluded and the government made a decision on future undergrounding of transmission?
4. Are there any proposals for additional connections along the route of HumeLink?
    a. If so:
        - why weren't they included in the PACR, and its benefit-cost analysis?
        - how much spare capacity does HumeLink have when Snowy 2.0 is operating?
5. What consideration was given to upgrading existing AC lines or replacing with/adding DC circuits for proposed new transmission in NSW?
6. What consideration has been given to locating underground cables within, or near, existing overhead line easements?
7. What are the requirements for HumeLink to be 'a collector line'?
8. What is the basis for claiming that HumeLink would be delayed up to five years if undergrounded?
9. What renewable energy will not be able to be connected if HumeLink is not completed by 2026?
10. What new interstate connections will not be able to be connected if HumeLink is not completed by 2026, noting that VNI West will not be completed till well after that date?
11. Is it realistic to expect that HumeLink could be built by 2026?
12. Could an underground HumeLink be completed by the time Snowy 2.0 is completed (2029+)?
    There are now at least five qualified cable suppliers of HV DC cable in the ASEAN region and the companies that are contracting to install the OHL for TransGrid could be used to install these cables.
13. TransGrid has said that the delay in Snowy 2.0 is a 'potential delay'. Is it potential or actual?
14. How does HumeLink improve 'access to stored energy from across the entire Snowy scheme' as HumeLink does not connect into the existing Snowy Scheme 330kV network (except the UTSS to LTSS line)?
15. What new interstate connections will not be able to be connected if HumeLink is not completed by 2026, noting that VNI-West will not be completed till well after that date and Project Energy Connect will be connected to the existing 330kV network at multiple locations?
16. How is HumeLink expected to transmit 3,200 MW of South West REZ generation when its capacity is almost fully taken up when Snowy 2.0 is operating?

17. What is the amount of renewable generation planned to be added in the South West REZ prior to 2030?
18. What additional power is estimated to be transmitted to Sydney by HumeLink over the next decade, in addition to Snowy 2.0?
19. Is there any reason why priority should not be given for undergrounding transmission lines in NSW, as is the case in many overseas countries?
20. Are underground cables designed to cope with the heat generated? If so, how?
    HV AC underground cables operate with a maximum conductor temperature of 90 deg C. and HV DC underground cables usually operate at a maximum conductor temperature of 70 deg. C.
    The heat generated is dissipated in the ground and with suitable backfill. Finite element analysis shows that the change in temperature of the ground above these cables is barely noticeable, so normal agriculatural practices of cropping or grazing can occur.
21. Are fibre optic monitoring cables installed to prevent overheating? If so, how?
    These days most HV cables either have optical fibre cables included in the cable or Optical Fibre cable units are placed close to the cable. These are connected to equipment at the substation to provide an alarm if the cables are overheating due to some external effects. (As an example, on a project in New Zealand many years ago we were able to locate a gas leak which was causing bugs in the soil to heat the ground above the cable!)
    a) Can examples be provided where this has not been the case and hence why it has been highlighted in TransGrid's submission?
    Optical Fibre temperature sensing has been used on circuits in NSW since 1988. The new 330 kV AC cable circuits that TransGrid have installed are fitted with these systems.
22. Can't underground cables be designed to equal the capacity of overhead lines?
    Yes of course, but since there is some time delay in the heating of underground cables, if there is a requirement for a short time peak load then this is a real advantage of underground cables compared with overhead lines.
23. In what ways is maintaining underground lines more challenging than overhead lines?
    TransGrid have experience with underground cables they are aware of the problems with the very old, HV pressurised oil filled cables, but today new HV XLPE cables are much more reliable.
24. What 'regular inspection and maintenance' is required for underground cables other than occasional 'driving or droning of the route' to ensure no building activities?
    The DTS and DAS monitoring systems which TransGrid now use make real time monitoring very effective, however as with overhead lines some regular inspection by drones is also valuable.
25. Aren't monitoring systems installed with underground cables, providing real-time information on cable conditions and warnings of potential problems?
    See above comments.
26. Doesn't modern fault detection technology usually locate underground faults within hours?
    Yes, see above comments.
27. What is the typical fault history of underground cables – it is understood to be far superior to overhead lines?
    Yes, there are far less faults on Underground cables because they are not exposed to the elements, and this will be more so due to climate changes.

28. Are underground cables designed to withstand moisture seepage (e.g., subsea cables)? Explain.
All HV cables have welded or extruded metallic protection, it is only the Medium and low voltage cables which are affected by moisture.

29. What is the prevalence of this 'moisture seepage problem'? Can examples be provided where this has not been the case and hence why it has been highlighted in TransGrid's submission?
The only HV cables that are affected by moisture are corrosion on of some of the 60+ year old, Oil filled cables in Sydney.

30. How is it that underground cables require 'increased ongoing maintenance expenses' when they are not subject to weather impacts (lightning, wind, ice, heat etc) and are considerably more reliable than overhead lines?
We need examples this from TransGrid. As mentioned, the only known problems with HV underground cables in Sydney are with Oil Leakage on the old, pressurised Oil filled cables that should have been replaced years ago.

31. What is the difference between overhead and underground easements with respect to being 'kept clear of certain types of vegetation' and sterilisation for other productive purposes?
In the case of Overhead line easements these must be kept clear of any vegetation that might act as a funnel for bush fires. This means slashing and spraying to kill weeds and native vegetation. Nowadays it is very difficult to carry out normal cropping operations under or near OHL easements because of the size and height of modern agricultural machinery.
For underground cables normal farming operations of cropping and grazing can done without any major restrictions.

32. Aren't there substantial restrictions on farming activities for overhead lines (tall machinery, cropping planes, drones, interference of GPS machinery etc)?
Yes, particularly with the new low frequency devices which are being used for monitoring livestock etc.

33. Do the much wider easements for overhead lines result in greater biosecurity risks?
Mainly the problems with bush fire control, these long straight easements funnel the bush fire and make bushfire protection impossible.

34. Where are there examples of a 50 metre wide trench being required?
    - what is the width of trenches for underground cables in Australia and overseas?

There is no experience of 50 m wide easements. The GDH report suggests two 5.5 m trenches in which there would be six 500 kV AC cables (2 circuits). These are separated by 4m. and there is 5 m each side making a total easement of 25m.
From the Nexans Catalogue if, 2500mm S En copper conductors were used for a 500kV AC cable, and the soil TR was <1.2 and Soil temperature 30 deg C, then the ratings for one circuit of three cables would be 1275 MVA. This confirms that it is possible to transfer 5000 MVA with 4 circuits in a 25m easement.

    - the GHD report, commissioned by TransGrid, shows trenches 2.1 metres wide, spaced 3 metres apart (7.2 metres combined width) for the largest HVDC option.

HV DC is more efficient, so it is possible to the transfer more power in a narrower easement.

35. Where are there examples of trenches a 'minimum two metres deep, typically more'?
In Australia most HV cables are laid in trenches with are 1.2 m deep and there is at least 900mm from the top of the cable to the surface?

36. Can underground cables be routed to avoid land that is unsuitable or of particular construction difficulty or having high economic/environmental value?
Yes, unlike overhead construction which must follow straight lines, when designing an underground link, we can make may changes in route to avoid obstructions and select a route with minimum inconvenience to the landowners.

37. Can underground cables be routed to be beside existing roads, tracks, fences, fire breaks etc to minimise the impact and the need for additional access tracks or 'sterilisation'?
Yes, when designing and underground cable circuit then one try's to make use of existing roads , road easements, existing farm tracks, fire tracks, and there is no need for 'sterilisation',

38. In some circumstances can't farmers reorient paddocks to 'fit' with the underground trench location (e.g., beside new fence lines and under new fire breaks)?
With consultation with landowners the route can be selected to suit farming and overcome community concerns.

39. Can most forms of farming be continued on an underground easement (cropping, pastures etc)?
Most farming applications, e.g., cropping & grazing, but not orchards or vineyards where posts or soil disturbance greater than 500-600mm is required.

40. Do access roads (tracks) for overhead lines usually extend along the entire line?
Not normally

41. Is an access track always required along underground cables?
During construction it may be required to install a track by the side of, or between the trenches. This is required for the transportation of construction personnel, materials, tools, conduits, special backfill and especially security and safety. This track will only be required to carry a load of up to 18 tons and can left in place or removed after construction at the choice of the landowner.

42. Is the identification of aboriginal heritage essential for both overhead lines and underground cables?
    a) Can underground cables be routed to avoid such sites, even when discovered during construction?
    If they are found during the survey, then the route can be changed.
    Note:-This is not possible if they are found whist digging foundations for an overhead line