Submission No 55

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

Organisation: DNV

Date Received: 14 November 2023

NSW Parliament
Select Committee on the Feasibility of Undergrounding the Transmission Infrastructure for Renewable Energy Projects.
Attn. Ms. Cate Faehrmann MLC – Committee Chair
Parliament House
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Sydney NSW 2000

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Date:	**Our reference**:	**Your reference**:
13 November 2023	23-3254	Email dated 20 October 2023

Subject: The Feasibility of Undergrounding the Transmission Infrastructure for Renewable Energy Projects

Dear Ms. Cate Faehrmann,

By email message on 20 October 2023, you have invited me to make a submission to an inquiry into the feasibility of undergrounding the transmission infrastructure for renewable energy projects. I thank you for your invitation and I am happy to provide a submission with this letter. Please understand this submission as a submission from my company, DNV Netherlands B.V.

In this submission, I would like to inform you about the following:

- Introduction to my company and myself as respondent to your invitation
- Experience with UGC solutions for connecting renewables
- Relevant topics that are good to consider before making a decision between UGC and OHL
- A proposal for an independent study
- Conclusions.

Introduction

First I will introduce myself followed by an introduction to DNV Netherlands B.V, the company I am working in. I will make this submission on behalf of my company. Frankly, it was unclear if you invited me as my personal self, or as my company representative, so I have considered both. I believe that answering as company representative is more valuable than answering as a person, the more as I am no inhabitant of Australia nor have any Australian affiliation.

My name is Frank de Wild, born on 9th of December 1970 in the city of Gouda in The Netherlands. I am a master of science in Applied Physics, and have since my studies developed a career in underground and submarine power cables. My career started in the company KEMA, who were acquired by the company DNV I currently work for. In both these companies, I myself have been focusing on underground and submarine power cables as an expert. I have worked worldwide on many larger, more special power cable systems. My contributions always have been in the form of a consultancy or technical authority role, either providing guidance or providing opinions on challenging aspects of power cable systems. One of my experiences in Australia has been about the Basslink Interconnector, where I represented Hydro Tasmania in an arbitration case. This experience ended with the arbitrator in favor of Hydro Tasmania in the disputes in 2021. At the moment I have spend just over 25 years in the power cable industry in the role of independent third party or independent technical authority, working globally and having a limited experience in

Australia. To end this introduction to me as a person, my current role in the company DNV is Business Director and Senior Principal Consultant in Power Cables.

DNV is a commercial company headquartered in Norway. The company DNV is fully owned by Stiftelsen Det Norske Veritas, which is a foundation with the primary purpose to 'safeguard life, property and the environment'. The foundation works to fulfil this purpose by the conduct of the commercial company DNV. DNV employs ~12.000 highly educated persons in offices worldwide, focusing primarily on the maritime, business assurance and energy industries. DNV Netherlands is a 100% subsidiary of DNV located in The Netherlands. In this part of the company, the service area 'power grids' is housed which is a part of the energy business unit of DNV.

DNV has no stakeholders other than the foundation Det Norske Veritas, and is therefore ideally positioned as an independent company. Given this position, we typically provide services as certification, verification, qualification, evaluations, assurance, decision support and guidance (for example by issuing recommended practices and standards) to anyone in and out of the industry.

Our main centre of expertise in underground and submarine power cables worldwide is within DNV Netherlands B.V, and I myself function as the business director of this group. Key services we provide are:

- Design services, in which we provide independent feasibility studies, conceptual design studies or basic design studies, or in which we help to overcome complex design challenges
- Third party authority services, in which we provide our opinion, statements or evaluations as third party to provide decision support. Think about support in decisions between AC and DC, decisions between technologies, bid evaluations, company or product qualifications, matters of compliance, queries of regulators or arbitration and court case expert support
- Niche services, where we have particularly strong technical competence, for example in the dynamic rating of power cable systems, in the performance of cable systems to floating structures or in probabilistic engineering approaches in which we take into considerations the many unknowns of the design basis
- Specification and verification services, where we help study, develop and draft employer requirements and technical specifications for projects, after which we help ensure that these requirements are demonstrably met by suppliers. In the latter, DNV can support in a quality and risk management role ensuring that cable systems reach their intended level of quality before they are commissioned to perform their task.

These services are provided to a multitude of customer types as utilities, project developers, manufacturers, installation contractors, insurance companies, regulators, governments, juridical entities, financers and more.

Specific to the subject of your inquiry, we have more often supported in the decision process for either overhead or underground connections, and we have more often supported in a wide range of conceptual design and feasibility studies. Furthermore, we have experience with fully undergrounded and fully overhead networks and with the (possible) role of new power cable systems within them.

As a last aspect of this company introduction, I would like to inform that we also have DNV offices in Australia. We work with our Australian colleagues where this makes sense to do so. Nonetheless, I have replied to you, and provide you this submission from DNV Netherlands B.V., for two main reasons as follows:

- The main group of power cable and overhead line expertise in DNV is situated in this entity in The Netherlands
- We have an outsider position to the topics of your inquiry.

Experience with UGC solutions for connecting renewables

In recent times, increasing amounts of renewable energy sources (RES) are established and connected to the electricity grids in many countries worldwide. Very regularly such RES are connected by underground or submarine power cables. Larger RES like offshore wind farms are often positioned such that only connections with submarine or underground cables is feasible, while smaller RES like PV plants are often situation in urbanized areas where undergrounding offers various interesting advantages. RES can also be connected with overhead lines to the electricity grid, for example in on-shore windfarm in specific locations.

It must also be noted that the electricity grid itself can be build using OHL and UGC or submarine solutions. The vast majority of the EHV electricity grids in the world is build with overhead line solutions, though increasingly, underground cable solutions are adopted in parts of the network and multiple submarine interconnector links are being integrated.

Typical sizes of RES can be in the order of 10s of MW for smaller scale developments (local PV plants or a few local wind or wave energy generators), up to 1-3 GW scale for very large developments (for example consisting of a small number of offshore windfarms grouped together). Power cables for both AC and DC transmission are available to transmit such amounts of energy.

Relevant topics to consider before deciding between UGC and OHL

When it comes to deciding whether to transmit energy via overhead lines or underground cables, many topics are of importance to study. Below, I have listed a number of these topics for your information. The different topics are at a different level of importance, which is significantly influenced by the location dependent regulations and social acceptance of the infrastructure. Connecting a RES to the electricity grid via an overhead line or an underground cable, effectively means that one has to make decisions on what topics are more important than other topics, and how within a topic the OHL and UGC solutions compare. This can result either in a decision for an overhead line or for an underground or submarine power cable, which both exist and are applied in the World as mature options for energy transmission.

TOPIC	SHORT DESCRIPTION
FOOTPRINT	The land required for an OHL or UGC is quite different, and the possible land usage of the land under an OHL is very different from the possible land usage over an UGC. In case of HVDC alternatives (either OHL or UGC) also the footprint of the substation (converter station) is important to consider due to their significant size, though this is a difference between HVAC and HVDC than between OHL and UGC.
SCALABILITY	Later uprating or refurbishing such that the infrastructure can be scaled to the future needs works different for OHL and UGC, and if this is of importance, the scalability must be considered to ensure choosing for the best overall option.
MAXIMUM TECHNICAL ROUTE LENGTH	Both OHL and UGC can be used in long transmission systems, especially when choosing for HVDC, but there are limitations and particularities that must be understood. Some of these require substations to compensate effects after certain distances (as in HVAC cables), and these requirements must be clearly understood when choosing for a particular option.
MAXIMUM TRANSMISSION CAPACITY	Both OHL and UGC can be designed to carry a large amount of electric power, typically more than enough to connect a RES to the grid. Both OHL and UGC are

	also used in the transmission backbones of countries, where typical transmission capacities are a few Giga Watt. Though OHL have the larger capacities, the transmission capacity offered by UGC are typically large enough to function in transmission backbones. HVDC systems carry even more power over longer distances as compared to HVAC systems.
SECURITY AND PROTECTION	This is an increasingly important topic and comprises security of supply considerations when evaluating possible effects of third party damage (accidental or on purpose), effects of extreme weather, earthquakes, fires, solar flares and so on. The protection against such threats is very different between OHL and UGC and is increasingly important given increasing likelihoods on weather extremities and increasing populations. The UGC has some obvious advantages due to its already sheltered installation.
SAFETY AND HEALTH	There are various safety considerations for the OHL and UGC infrastructure that must be considered and controlled. The impact of the OHL and UGC on their environment is different, also in terms of electrical fields, magnetic fields and noise. Furthermore, the performance during, and results of short circuits, lightning strikes and more are different between OHL and UGC leading to differences in safety and health aspects. Safety and health aspects can encompass many topics and can lead to public concerns that will require addressing. A clear and complete view of these safety and health aspects therefore is important to make the best choice between OHL and UGC.
RECYCLABILITY AND ENVIRONMENTAL LIFE CYCLE ANALYSES	OHL and UGC also differ in their options for recyclability and the overall life cycle environmental impact. This is an important topic especially considering the application in this case to connect renewable energy. Material usage is very different between OHL and UGC leading to also significant differences between the environmental impact and recyclability of the two options.
PLANNING AND CONSENTS	I have no experience myself when developing infrastructure in New South Wales, but there will be differences in the consenting between overhead and underground constructions. In Europe for example, such differences cause permitting and achieving the necessary consents to be on a different timescale for OHL in comparison to UGC. Such differences are material and must play their part in an evaluation.
RELIABILITY, AVAILABILITY AND MAINTAINABILITY	There are differences in the reliability of OHL versus UGC and there are differences in the impact of internal failures or external hazards. It must be ensured that the overall availability between OHL or UGC solution is over a certain limitation to ensure 'apples' are compared against 'apples'. Subsequently, understanding the additional availability offered by OHL and UGC, and the maintenance and repair needs to ensure the availability, are to be considered in an evaluation between OHL and UGC.

ENVIRONMENTAL IMPACT DURING CONSTRUCTION AND OPERATION	The environmental impact of an OHL and an UGC is very different, both during construction and during operation. During construction the work is completely different between building OHL or UGC infrastructure, and during operation the environmental impact is on different topics. Horizon pollution and impact on birds for example are aspects of importance with OHL, while for UGC it is more about the vegetation clearance on top of the UGC and the temperature increase of the soil directly surrounding the cables.
COMMUNITY IMPACT	Depending on the placement of the OHL or UGC, the community impact can be evaluated. As the OHL and UGC are quite different technologies, the disturbance to the community is quite different both during construction and during operation. Disturbances during construction will be present and are of different nature and duration, while during operation with the different impact on the environment the impact on the community will also differ. Aspects like visibility, noise, EM fields, but also simply the presence of the infrastructure are all different between OHL and UGC. The community impact is therefore different which may lead to differences in acceptance of the transmission solution. The acceptance is again very important for the security and protection aspects discussed above as well as for the acceptance of further OHL / UGC projects in New South Wales.
COST	Costs are also different between OHL and UGC. Both CAPEX and OPEX will be different between OHL and UGC. Lifetime costing will therefore also be different. Furthermore, not all costs are equally visible or payable by stakeholders (think about societal costs for consenting, appeals etc, the costs of the delays in connecting RES, land value changes, costs of more repairs due to vandalism) and it can therefore be important to evaluate the overall cost for society between OHL and UGC.

In all of the above aspects, it will be important to make a well-founded evaluation between transmission options. This helps decision making and social acceptance.

Proposal

DNV Netherlands B.V. proposes to support the New South Wales government by making an independent and unbiased evaluation of the topics that differentiate OHL and UGC solutions. Such a study can be used as a sound basis for agreement on the pros and cons of the various options. This itself may lead to clarity in many discussions now and in the future, regardless of the choice that is made.

DNV Netherlands B.V. cannot opine on the relative importance to the Australian society of the different topics that should be comprised in such a study. There, the New South Wales government will need to make decisions. However, DNV can provide information on typical practices or best practices in many cases.

As I already explained, DNV is a fully independent third party. We are often seen as an authority in the field of energy and we therefore believe we can provide relevant support to the decision making process. This was also the reason to answer your invitation as DNV Netherlands B.V., outside of Australia, though DNV has local presence as explained.

Conclusions

I hope this submission is useful to you. To be clear, we do not favour an OHL or UGC solution. Both are mature possibilities and which one should be favoured, depends on a multitude of aspects. I have tried to inform you about various of such aspects which range between technical, environmental, financial, societal, and more.

We can understand a need to have clarity in the many discussions before, during and after decision making between OHL and UGC options. We can also understand a need to evaluate both current and future situations, where RES becomes increasingly important and where all kind of other changes may happen while society will increasingly depend on the energy sources that will be connected to the grid with the infrastructure that is now decided upon.

For that reason, I have proposed to support the New South Wales government by performing a study to all aspects in which OHL and UGC differ, from our position as unbiased and independent third-party authority in the field of energy transmission.

I thank you for your attention to making a well-founded decision for New South Wales in the matter of connecting renewable energy projects to the grid, and for your efforts to invite me to make this submission.

Yours sincerely,
for DNV Netherlands B.V.

Frank de Vvild
Business Director and Senior Principal Consultant - Power Cables