

STAKE HOLDER CONSULTATION PROCESS OFFSHORE GRID NL	
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QUALITY CONTROL		
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Please note that the intention of this feedback report is to illustrate the overall discussion and results. The text should be placed in the greater context of transparency about TenneT 's consultation process. This text is not legally binding and could be modified during the stakeholder consultation process.

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1. Moments of feedback

Feedback	Abbreviation
Expert meeting 27.11.2014	EM01
Expert meeting 29.01.2015	EM02
Expert meeting 18.03.2015	EM03
Expert meeting 15&16.04.2015	EM04
Expert meeting 12&13.05.2015	EM05
Consultation website March	WS01
Consultation website April	WS02
Bi-lateral meetings	BL01

2. Feedback and action

Feedback	Feedback moment	Action
TenneT proposes a MV connection interface on 66kV. This has been challenged by the participants given the current planning and on the other hand has been recognized as a future step that would be beneficial to lower the costs for Offshore Wind. Enough competition from suppliers should be verified, including certainty on certifications for the necessary equipment. An interaction with the conditions for the tender by MinEZ for the "Kavels" is foreseen when this step is taken.	EM01	Incorporated in the position paper
Buying a WTG with 66kV end, means that manufacturers will have the responsibility to deliver the transformer and switchgear and therefore will have to qualify it as an 66kV WTG with increased market costs. DNV believes the OWF can have influence in these equipment without recertification and therefore keep transparency on added costs for a "66kV WTG". Participants are not sure whether this will be the case in practice.	EM02	Incorporated in the position paper
Infield cable price (Eur/m) is expected to increase going from 33kV to 66kV, by values up to 50%. TKI have stated a 15% increase, but it is not known if this is a total price increase, or only material cost. It is expected that certified wet design cables can be purchased end of 2016, probably from a limited number of suppliers.	EM02	Incorporated in the position paper
Good overview with regards to the 'maturity' of the supply chain is needed, especially if ordering is planned for beginning 2016 (including	EM02	Incorporated in the position paper

the associated cost risk). It is expected, that there will be cost increase for the first tender, which is not recognized at MinEA at this moment. Next to this, an increase in (perceived) risk due to the higher voltage is expected which could have an effect on bankability.		
Possibly distinctions should be made between the effect of stepping to 66kV as a current standard and as a future standard, including the supply chain.	EM02	Incorporated in the position paper
While there is a big need for a better cost insight, nobody is able to share the needed costs and it should be checked if there are possibilities to make these available.	EM02	Incorporated in the position paper
Certification of the wet design cable is seen by the OWF as critical for risk assessment of the tender. Issue also identified by Carbon Trust organisation; currently subsidising three manufacturers with the certification process.	EM02	Incorporated in the position paper
With respect to the reactive power compensation of the array cabling, a proposal was raised in the discussion to use a predesign of a specific "Kavel" at Borssele and verify the differences between 33kV and 66kV solutions.	EM02	Take into account in consultation topic reactive power
Shouldn't the WTG suppliers be more active involved in this position paper? Given the limited number this could be checked. And see if there will be a big restriction on available suppliers for mainly the first tender.	EM02	Incorporated in the position paper
We don't see certification of the wind turbine to be an issue. At least three wind turbine suppliers are capable of providing a bid with the 66kV application".	EM03	Acknowledged
We would like to express our worry about standardisation. We see other developments in the market: Dong for example makes smaller substations which decreases the costs. Standardisation could stop better solutions.	EM03	TenneT believes that current proposal leaves sufficient flexibility for innovation with the period of realisation
9 Months before bid closure all technical details should be ready: do we expect the supply chain at that point to be technically ready and able to provide a bid including binding price and sufficient guarantees?	EM03	Incorporated in position paper
With regards to costs, the present cost estimation of TenneT might be too optimistic and highlighting the advantages more than the challenges and risks in applying 66kV on the short term. The presented table with qualitative aspects as presented should be more elaborated in quantitative ranges.	EM03	Incorporated in position paper
With my lay-out I don't come to a 30% cable reduction based on their numbers. And not to 1.7% reduction in cost. Therefore this decision	EM03	Acknowledged

could drive up the price for development of wind farms.		
There could be technical issues during installation of a 66 kV cable: vessels with drums will also be a limiting factor. This may increase installation costs due to a limited market.	EM03	Incorporated in position paper
The implications of 66kV in terms of risks in installation and repair should be looked at in more detail.. Including the difference in installation due to a bigger bending radius, the need for different ships and their availability, both during installation and (unscheduled) repair.	EM03	Incorporated in position paper
The most critical aspect will be the availability of dedicated components (switchgear, turbines, cables, etc.) and equipment (e.g. vessels) and their certification. The timelines for all these components should be totally clear in advance. For this our advice is to work together with (turbine) manufacturers in order to make sure these timelines can be met. There should be no exclusion of the most important turbine manufacturers due to this choice. Rule of thumb is that for a good procurement process the competition of at least three to four parties is needed. Market limitation is likely to lead to a price increase, or lead to an unfeasible tender and, as such not in accordance with the goal of cost reduction.	WS01	Incorporated in position paper
With regards to costs, the present cost estimation of TenneT might be too optimistic and highlighting the advantages more than the challenges and risks in applying 66kV on the short term. The presented table with qualitative aspects as presented should be more elaborated in quantitative ranges. Potential cost-increases should be part of the cost calculations made by ECN for the ministry.	WS01	Incorporated in position paper / Noted
Developers appear to benefit from most of the 1% LCoE cost reduction suggested in the TenneT paper - but this is likely to be priced in the competitive tender bids for the site, thus leading to Society benefits. There should be a provision in the Dutch regulations to protect developers having to apply 'imposed' new 66kV technology in some way – i.e. if developers facilitate the cost saving to Society then there should be some protection against new technology risk. For example up to a certain amount of developer's lost energy costs reclaimable if failure in operation can be attributed to use of 66kV. To determine that amount we need a better measure or proposal, as is also quoted by DNV/GL in their report: "Common practice in developing any large electrical installation is to conduct electrical concept studies during the early stages of project development, including a risk assessment of the components". By undertaking such studies the benefits and drawbacks can be quantified clearly. Such studies are outside the scope of this document although such studies are expected to clarify the decision with confidence, the use or not of 66 kV as an array system. voltage.	WS01	Noted

<p>The documents state that there are/will be sufficient suppliers for 66 kV cables and 66 kV wind turbines which can deliver at acceptable prices . What's the base of this statement. Has it been checked with suppliers? And has the timeline for the first tender been checked with these suppliers?</p>	<p>WS01</p>	<p>Incorporated in position paper</p>
<p>The documents use 15% CAPEX reduction. Does this stand for the entire electrical infrastructure? Please specify which total investment was taken into account for cables, transformers and switchgear, in order to justify the 15% reduction with respect to all the different elements.</p>	<p>WS01</p>	<p>15% refers to 66 kV equipment cost. CAPEX quantitative numbers are confidential</p>
<p>If TenneT decides to go for standardized design employing 66kV for the complete portfolio of 3.5GW, it will be a significant signal to the market, which we know suppliers would welcome. We believe this will facilitate further development and optimisation as well as competition in the supply chain.</p>	<p>WS01</p>	<p>Acknowledged</p>
<p>We know that Nexans, JDR, Prysmian and NSW are all developing 66kV cables. These are already the main players for 33kV array cables, so in that sense there is no change. With a potential market of 3.5GW it is likely that NKT, ABB and others would find it interesting to focus more on array cables, and hence the situation could actually be that competition is increased.</p>	<p>WS01</p>	<p>Acknowledged</p>
<p>We acknowledge the fact that on the longer term 66kV cables are the way forward to reduce cost. On the short term however we see that there are side effects that may cause the cost of the wind farm to increase. These potential increases may not be reflected in the maximum bidding prices set by the Government.</p>	<p>WS01</p>	<p>Noted</p>
<p>The document states that cables will be on the market in 2015. In our view there is still considerable uncertainty around the timely availability of 66kV cables on the market. The on-going process of testing and certification (Offshore Wind Accelerator) does not provide any guarantees that cables are coming to the market against the anticipated terms & conditions. A small number of suppliers that can manufacture the 66kV cables may limit competition and not have the cost reduction effects that are projected.</p>	<p>WS01</p>	<p>Incorporated in position paper</p>
<p>The availability of wind turbines supporting 66kV may be limited or at least uncertain on the moment of selection of a wind turbine for the purpose of creating a bid for the tender. Besides the availability the cost and contractual terms and conditions are not clear. An early switch to 66kV may limit competition and therefore have cost effects.</p>	<p>WS01</p>	<p>Incorporated in position paper</p>
<p>The high level breakdown presented in the document list a number of qualitative impacts of the items above (certification, market, financial).</p>	<p>WS01</p>	<p>Incorporated in position paper</p>

These may easily exceed the estimated overall LCOE savings.		
Before making a final choice for 33kV or 66kV a short further investigation could be performed. Such an investigation can demonstrate the timely availability of components (cables, wind turbines) from a sufficient number of suppliers and possibly quantify the impacts mentioned in the consultation document. Given the urgency of making the choice, this investigation should start as soon as possible.	WS01	Incorporated in position paper
Our investigation shows that there are alternatives to a High Voltage Infield System in general. The High Voltage System is an opportunity, which might become a requirement if the Turbine Output further increases. Important is to have enough WTG suppliers to create a competitive tender situation. Here we have doubts. It could lead to higher capex with a negative impact to the cost of the energy production.	WS01	Noted
It has been confirmed to us that the main established WTG suppliers are ready for delivering a 66kV compatible WTG. Additionally that the main cable manufacturers are ready for delivery and are already delivering certified 66kV cables.	WS01	Acknowledged
We [OWF] will exhibit at the Hannover fair our compact 66kV switchgear especially for offshore installation (in the wind turbines). This component we enable the 66 kV connection between the OWT and the AC Platform. We currently do pilots with different WT manufactures.	WS01	Noted
A documented process should exist to outline how this decision shall be made, including a clear timeline. This should provide clarity on how TenneT shall seek and act on industry contribution, as the choice of array voltage level as significant implications for the OWF design.	BL01	Incorporated in position paper
As part of the decision making process TenneT should provide a detailed paper examining the merits and risks of all considered voltage levels (e.g. 33, 66kV) from both a TSO asset and OWF asset perspective.	BL01	Incorporated in position paper
The TenneT paper on array cable voltage level should be informed by engagement with industry (developers, suppliers, R&D organisations). Ideally a working group involving the developer community would jointly progress this topic.	BL01	Incorporated in position paper
This is the most important topic. Using 66 kV makes sense. When will this decision be made? Or what are the chances for one or the other?	BL01	Incorporated in position paper
Manufacturers say: we will deliver if there is a request. Cable manufacturers: certification is critical (three parties working on certification). 2016 design, 2017 production, 2018 installation. Risk is on bankability, not from technical side. The certification and financiability will be taken as an uncertainty / risk premium in the BC. This is important to discuss with EZ.	BL01	Incorporated in position paper
It will help if developer can quantify expected level of the risk premium.	BL01	Incorporated in

		position paper
For us (OWF) it is more important to have the decision, than which type of technology it is. The technology is not critical. It is the future.	BL01	Acknowledged
For us (OWF) management certainty with respect to grid connection is very important (ref. GE, BE). Compliments for how TenneT has organised the consultation process.	BL01	Acknowledged
We (OWF) expected that 33 kV would be the most logical choice if it was needed to make it now. We (OWF) stated that only cowboys will be able to win the EZ tender later this year if TenneT stipulates the 66kV technology due to the additional market risks that this implies. "TenneT determines who wins the tender."	BL01	TenneT disagrees (incorporated in position paper)
Position/starting point is that you can reduce the cable length. We don't see this decrease in cable length and therefore our LCOE doesn't decrease. It also has to do with redundancy and therefore we design the cable lay out at the safest layout. Our calcs show that 33kv and 66kv with configuration of loops show a cost neutral result for the cable (compared to each other). I think the 66 kv number are too high/positive.	EM04	Noted
Redundancy choice is based on cable cost and what you expect of cable failure rates. With our information and our number we don't have any reason to add redundancy to the design and will go for as many WTG as possible on one string.	EM04	Noted
I would like to confirm that all our numbers and calcs show that optimum case is as many on one string and radial system.	EM04	Noted
Our assessment is similar (as above) and with a radial system we see the same cost reductions.	EM04	Noted
Can cable and wtg deliver binding bids by the end of this year? Yes: wtg has been seen already and cable manufacturers have confirmed. Also including dates for certification.	EM04	Incorporated in position paper
Does this choice also effect the wtg types available with regards to size?	EM04	Incorporated in position paper
I think this is a hypothetical discussion because you are not going to offer 3 MW wind turbines in this bid. Based on the costs you will look at the larger wind turbines.	EM04	Noted
Do we say the risk of choosing 66kv are negligible with regards to regulatory framework with regards to SF6? Is the discussion about Banning SF6 or adjusting usage/reduce amount of leakage? TenneT: reduce the amount of leakage.	EM04	Focus is on reducing leakage and use SF6 free solutions if available
Cables are ready to deliver 66kV on time and with the same guarantees as 33kV. They even prefer to offer 66kV Wind turbine suppliers: 3/5 are ready on time and same guarantees and 2/5 are willing but at this	EM04	Noted

moment not ready yet.		
It would be very useful if we could see which assumptions are the base of these calculations. Could you therefore give more information on the assumptions used for the LCoE calculations?	EM04	See "ONL 15-058-T1_Voltage level_PP_v2", section 4".
TenneT: would you also state the same if you don't use loops? OWF: This we have to check internally and we will give you an answer afterwards. But we think that the assumption of adding as much as possible wind turbines on one string is an incorrect assumption. We would put less wind turbines on one string. With the discussion on the number of J-tubes this is even more of a risk – as soon as the number of J-tubes is fixed the amount of wind turbines per string is also fixed and the developer doesn't have a choice anymore.	EM04	Noted
Has the layout and therefore cable routes been optimised for existing cables and pipelines and other obstacles? Yes an initial layout has been made by an experienced layout and yield optimisation-consultant.	EM04	Yes
Our line of thought would be to add loops plus adding as many wind turbines per string.	EM04	Noted
In the case we want to use loops it must be clear where the point of common coupling is. The best benefit of a loop is if the strings are not going to the same bus bars and different transformers. This depends on power quality and short circuit conditions. Operation in an open loop is no problem. The coupling point doesn't change but the amount of energy going through changes but is no problem.	EM04	See "ONL15-061-T3_Connection Point_PP_v1"
In the original paper, written by DNV GL dated March 5, 2015 (Report Nr. 113799-UKBR-R02, rev.2), the following statement was made on page 33: "In total a CAPEX reduction of up to 15% can be achieved when using 66 kV inter-array solution compared to a 33 kV usual basic design of a 350 MW wind farm using a radial lay-out" Is this statement still valid? And how does this 15% CAPEX reduction relate to the -1,2% LCOE reduction mentioned in the last position paper?	WS02	15% refers to 66 kV equipment cost. CAPEX is only one one of the factors determining LCoE.
If the 15% cost reduction is related to the total cost of electrical infrastructure and the 1,2% to the total cost of offshore wind, this would mean that the cost of electrical infra is 8% of the total cost of an offshore windfarm. Is that correct?	WS02	Quantitative cost figures are confidential.
Attention point for the final paper & decision: Please confirm in your final paper that the suppliers of 66 kV cables and turbines are able to submit binding bids for their equipment before the end of this year (2015).	WS02	See "ONL 15-058-T1_Voltage level_PP_v2" section 3.2.1. Cable Supply".
Please find a brochure on the 8DM1 switch gear 66 kV voltage in the	WS02	Noted

attachment. The switch gear has been developed specifically for offshore wind. This new product has just been launched at the Hannover Messe 2015. The 66 kV solution is available for our offshore D6 / D7 platform. Please note that no fluorinated gases are used in this switch gear.		
The necessary amount of J-tube in case of 33kV will become a challenge for pull-in and cable lay operations.	WS02	Noted
The connection voltage level of the inter-array systems to the TenneT offshore transformer platform will be standardised at 66 kV for all five platforms to be realised by TenneT up to 2023.	EM05	Notification
Followed by a short discussion on request for reducing risk for OWF if cable certification is not ready yet. EZ is not planning on taking away or reducing this risk for the market.	EM05	Notification