FEEDBACK REPORT

SSTAKE 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
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Expert Meeting 18.03.2015	EM03
Expert Meeting 15&16.04.2015	EM04
Expert Meeting 12&13.05.2015	EM05
Expert Meeting 02.07.2015	EM06
Consultation website March	WS01
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2. Feedback and action

Feedback	Feedback moment	Response
TenneT requested if a number of J-tubes could be provided for a 33kV and a 66kV connection philosophy.	EM01	Not received from OWFs
A choice for six J-tubes as absolute minimum is suggested. However, some raise the issue for adding extra redundancy by creating loops and therefore might need more J-tubes. Comments were given that the parties would like to have TenneT show different OWF layouts. To substantiate the choices, TenneT is making in a broader context.	EM02	Noted. TenneT will hold to the 8 J-tubes per 350 MW wind farm principle. See "ONL 15-060-T2_ J tubes_ bays_PP_v3". Cable routing for Borssele platforms have been taken into account.
From experience it is better to have more J-tubes. The concept presented is the lowest possible amount of J-tubes. 12 strings with 5 wind turbines per string which gives optimum flexibility. In case switch gear fails then you can still power the wind turbines. Costs will be decreased. Smaller cables decrease costs more than adding J-tubes.	EM03	Noted

Suggestion to make a specific site layout for Borssele since you might need an additional J-tube when the layout doesn't allow specific connection at certain points of the platform – due to pipelines and cabling etc. Reserve one specific J-tube that can be used for quick repair of strings that could fail (including switch gear etc). Specific reservation for that wind farm for cable repair.	EM03	Noted. TenneT will hold to the 8 J-tubes per 350 MW wind farm principle. See PP v3.
What is the overload capability: upper side of what is currently available. This is the upper side/the maximum possible?	EM03	Question unclear in relation to # of J-tubes
What happens in the case of co-location. With other words: will this be connected to the spare J-tube? This would mean that in case of colocation there's no spare J-tube available anymore.	EM03	Innovativon/test area will use its own J-tube
We are talking about three parties: TenneT, developers with ring system, developers radial system. If the amount of J-tubes is fixed at a low amount than the lay out is mostly fixed (radial system). Why not add J-tubes (12 strings for 66kV) in order to keep availabilities open and therefore reducing risks?	EM04	If the number of 12 j-tubes is applied other elements will also increase. Discussed in expert meeting. Considerations on number of J-tubes included in PP.
We started this discussion with 6 J-tubes and are now at the number of 8. Is this enough and does this decrease the risk sufficiently? How far can we stretch this amount?	EM04	Discussed in expert meeting. Considerations on number of J-tubes included in PP.
8 is sufficient for how we now develop a WF but to lock this in for the future is quite stressing. How can we say that 8 j-tubes is still the best in the future (taking into account changes in costs etc). How fixed is this?	EM04	Fixed since we strive for standardisation
Is it a big challenge to have this many J-tubes on the platform? Suggestion would be to choose an amount that could be divided by 4. We can agree with 8 j-tubes. Is the spare tube necessary? If this is on the opposite site of the j-tube failure it could be possible that for connection to the spare j tube cables need to be crossed.	EM04	Noted
The testing roll out should be known before opening of the tender.	EM04	Noted
Based on 66 kV inter-array cables and 64 MW per cable - a standard platform shall be equipped with 18 J-tubes for the inter array system: • 2x 8 J-tubes for offshore PPM • 1 J-tube installed for possible test purposes	EM05	Noted

• 1 J-tube installed for the connection to the neighbouring platform.		
The advice for this topic is to first make a specific site layout and determine, based on that site specific layout, how many J-tubes are needed. Then added to that number there should be two redundant J-tube available, for design flexibility and a spare exclusively reserved for the wind farm in the event of an inter array cable fault. This J-tube plus equipment should be capable to reconnect every particular string.	WS01	Noted. TenneT will hold to the 8 J-tubes per 350 MW wind farm principle from point of view of standardisation. See PP v3
We call for more flexibility in the number of J-tubes per wind farm of 350 MW wind farm. Each wind farm should at least have access to one spare J-tube. This way different designs and layouts can be taken into account and gives room for "overplanting" up to 380 MW. On the one hand this leads to an increase in costs due to the higher number of J-tubes but on the other hand this also leads to a cost decrease since more yield can be expected from the wind farm.	WS01	Noted. TenneT will hold to the 8 J-tubes per 350 MW wind farm principle from point of view of standardisation. See PP v3
As general feed-back we agree with TenneT assessment on number of J-tubes.	WS01	Noted
Re: "For dimensioning of the J-tubes, the diameter of the 66 kV cable is estimated to be 160 mm. The inner diameter of the J-tube shall be at least 2,5 times the diameter of the cable, resulting in at least 400 mm." **For 33kV** we might see 630mm² cables with an outer diameter of 155mm + up to 6mm tolerance. J-tube inner dimensions should be minimum 2.5 x cable OD => ID ≤2.5 x (155+6) => ID ≤ 402.5mm. On top of that we might end up using 800mm², so I would advise that the 33kV j-tubes should have a minimum inner clearance of 402.5mm.	WS01	Noted
For 66kV we do not have an overview of cable sizes from a broad range of suppliers. We are however in correspondence with a likely supplier that offer a 800mm² with an outer diameter of 171mm + up to 3.5mm tolerance.	WS01	Final J-tube inner dimensions will be based on actual 66kV cable designs up to and including 1000mm^2 Al cables.
J-tube inner dimensions should be minimum 2.5 x cable OD => ID ≤2.5 x (171+3.5) => ID ≤ 436.25mm. On top of that we might end up using 800mm², so I would advise that the 66kV j-tubes should have a minimum inner clearance of 436.25mm.	WS01	Final J-tube inner dimensions will be based on actual 66kV cable designs up to and including 1000mm^2 Al cables.
Clearly the number of J-tubes in any case (33kV/66kV) should be sufficient and allow some freedom in design of the wind farm layout. A	WS01	Noted

spare J-tube is required for repairs or maintenance, as suggested by TenneT.		
With regards to the Borssele Substation Design we believe that it makes sense to provide 12 J-tubes per site. The scenario with 6 J-Tubes is under the possible solutions a design a) with a very low flexibility in all phases (Eng./Installation/Commissioning and Operation) of the project and b) has the highest risk profile.	WS01	TenneT foresees 8 J-tubes per WF (2 x 8 per platform) in case of 66kV. This will provide sufficient flexibility, but needs to be checked with park & IAC lay-out.
Will there be transformers for each cable? T: yes	EM06	Yes
This construction is business as usual for Medium voltage. Is TenneT sure this can also be applied to High voltage? We believe these cable current transformers are not sufficient for HV.	EM06	This has already been applied to HV and is possible/common practise
In the case of 2 strings attached to1 bay; there is a concern on the responsibility to decide which string is faulty. The OWF prefers TenneT to take this responsibility.	EM06	The responsibility of the OWF
Is it the intention of TenneT to install a 'fast event recorder' on the 66kV side?	EM06	Not per bay other than the fast event recorder as part of the protection/bay units
If you have two strings connected to one bay and there is one faulty string; there will also be a short circuit from the other string.	EM06	Full converters cannot inject currents higher than 1,1 In. DFIG can inject higher currents; they can be detected by applying directional overcurrent relays
This design takes away some of the advantages of a ring connection and therefore makes it less flexible.	EM06	Discussed in expert meeting. Considerations on number of J-tubes included in PP
90% of the layouts require 6 strings. Would it therefore be possible to make available 6 bays? All OWF agree on this.	EM06	Noted

Is 66 kV switch gear available on the market?	EM06	Yes it is and this will be mentioned in the updated position paper
The costs in case of a bay failure are high (in case of 2 strings per the loss of income alone amounts to ~5M euro/month). The chance that this will occur during the lifetime of the wind farm is perceived high. When put against the cost of a bay of ~200.000/bay, we recommend the application of 1 bay per string. During the expert meeting TenneT proposed to make a new position paper that takes into account 6 bays per wind farm, with 2 bays having 2 cable connection possibilities. We support this approach. Important in this approach is that these bays are available exclusively for the commercial wind farm, so any future test farm should be connected to a separate bay. A hard separation between the individual wind farms/test farm is needed to avoid complex, risky and costly interfaces that will outweigh the cost of an extra bay. Additionally we recommend to be prepared for the necessity of unexpected items to be installed, especially when designing a substation for all future wind farms. For that we recommend 1 additional space to install a bay per bus bar (so 4 in total, only the capability the bay can be installed later if needed). This bay can be used in unexpected circumstances for e.g: - Reactive power compensation - Harmonics - Test field - Connect an emergency power supply when it is deemed necessary	WS05	1. 6 bays per wind farm is noted (see "ONL 15-060-T2_ J tubes_ bays_PP_v3") 2. A test wind farm will have its own bay. 3. Spare space for one bay per section: this is not foreseen.
The footprint of the bays is expected to be 60cm to 1m per bay worst case dependent on the system used for each busbar. Furthermore we strongly recommend to reserve area's on the top size for 20/40foot containers for equipment that is needed unexpectedly. We would recommend at least 4 times 20 ft/ 2 times 40 ft. We have seen many times that unexpected events happen that require temporary or permanent installation of equipment on the platform, therefore it would be wise to be prepared for those events as it is a relatively small investment in order to have the optionality to solve problems that can result very large damages.	WS05	Topside will incorporate space for temporary (or permanent) containers on the top deck.
In continuation of the discussion at the expert meeting we confirm our belief that for 90% of layouts we will have 6 strings for 350MW. So it	WS05	Noted

doesn't make sense to add complexity and risk to the project to install specially designed switchgear in order save one 66kV bay.		
We agree to use 6 bays as standard and in case 7-8 strings needed, then they will be connected via 6 bays using the preferred solution. We suggest that there should be separate measurements for the two strings for fault indicators.	WS05	Accepted (see "ONL 15-060-T2_ J tubes_ bays_PP_v3")
We are against the reduction of bays. Every string should have its own switching bay. This is the most reliable scheme with the best availability	WS05	Noted
We need at least 6 switching bays. So if you decide to reduce the number of bays we prefer to have 6 bays. In this way there is also a better symmetrical load division between the windings of the transformers.	WS05	Accepted (see "ONL 15-060-T2_ J tubes_ bays_PP_v3")