

STAKE HOLDER CONSULTATION PROCESS OFFSHORE GRID NL	
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QUALITY CONTROL		
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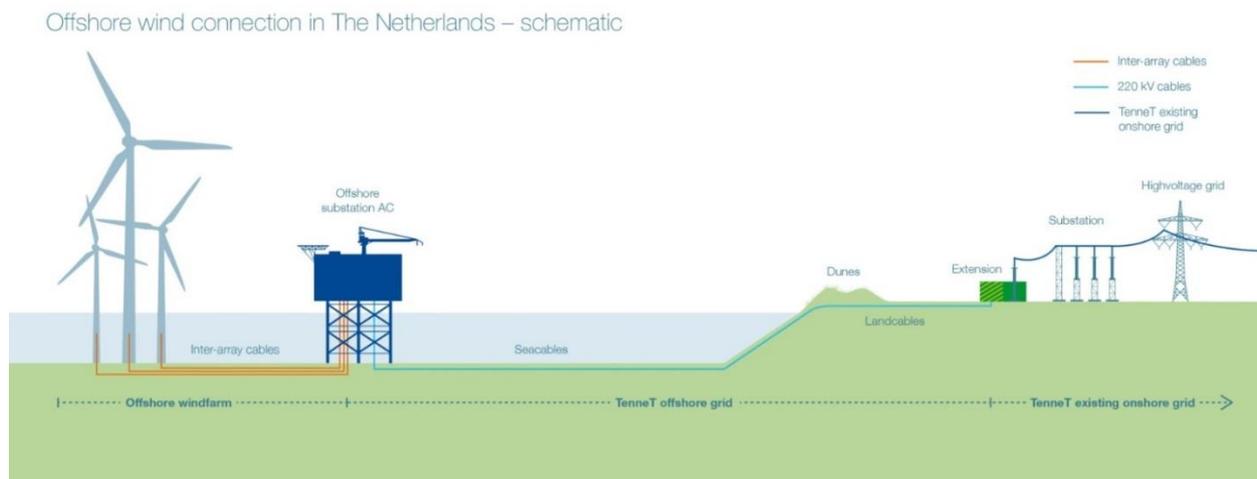
## 1. Background material

Literature used:

- N.A.

## 2. Scope and considerations

Figure 1 below shows a schematic cross-section of the connection of an offshore wind farm to the onshore electricity grid. Wind turbines are connected through “inter-array” cables (in orange) to the offshore Connection Point (CP)<sup>1</sup> at the offshore substation, from which electricity is transported to shore. TenneT is responsible for the grid connection up to, and including, the offshore substation and will take care for the supply and installation.



Schematic of the offshore electrical grid. Source: TenneT

The wind park, including the wind turbines and the inter-array cables, up to the offshore CP at the switchgear installation on the offshore substation of TenneT, is to be supplied and installed by the owner of the Power Park Module (PPM). TenneT intends to standardise the offshore substations as much as possible for all five wind areas to be realised in the coming years in line with the Energy Agreement. This position paper describes the position of TenneT on the planning principles for the platform and cable routes within the wind area are explained. These planning principles result in the location of the platform and offshore cable route.

<sup>1</sup> The connection point (CP) between the offshore power park module and TenneT is specified [TenneT position paper ONL 15-061 T.3 Point of Common Coupling] at the cable termination of the inter-array cables and the switchgear installation on the platform.

## General

The Energy Agreement requires a 40% cost reduction for offshore wind to be realised over the period 2014-2024. Realisation of this cost reduction is expected to require a combination of measures<sup>2</sup>, including - but not limited to - standardisation of the offshore electrical infrastructure and larger capacity wind turbines within larger wind farms. TenneT contributes to this overall cost reduction target, through a strategic long term vision on the development of the offshore grid, focussing on the initial investments, but certainly also on operational expenses during the lifetime of its grid connections. In other words, reduce the contribution of the grid infrastructure to the LCoE of offshore wind farms. In this respect, equipment that does not need to be located offshore could be prevented.

With this position paper the planning principles for the platform and cable routes within the wind area are explained. These planning principles result in the location of the platform and offshore cable route. In this paper the rationale behind the locations of the platforms is explained, as well as the exact coordinates of platform Alpha.

## TenneT assets in wind area

TenneT will realize in the wind area:

- Platform Alpha
- Platform Beta
- Two HVAC-cables to connect the platform Borssele Alpha to shore
- Two HVAC-cables to connect the platform Borssele Beta to shore
- One 66 kV redundancy cable from platform Alpha to platform Beta

## Planning principles for the platforms

TenneT consulted wind developers, the Ministries of Economic Affairs, Infrastructure and Environment and Rijkswaterstaat (RWS) regarding the platform locations. The proposed platform location is the result of studies carried out by TenneT and is based on several planning principles:

- General planning principles TenneT (accessibility, installation methods, bending radius of the cables)
- Spatial planning principles TenneT/RWS (safety zones, cables as much as possible parallel to existing cables/pipelines, distance to other infrastructure, obstacles, sand mining area)
- Specific Borssele requirements from the Ministry of Economic Affairs and Rijkswaterstaat (inter array cabling of one site not allowed in another site)
- Requirements of developers (lowest levelised costs of energy (LCoE), minimal number of cable crossings, short strings)

The general planning principles of TenneT are:

- The platform should be accessible by helicopter (no helicopter platform, only hoisting platform)

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<sup>2</sup> [http://tki-windopzee.nl/files/2015-01/20141124\\_TKI\\_Roadmap.2015-2020\\_EZU\\_F%20\(1\).pdf](http://tki-windopzee.nl/files/2015-01/20141124_TKI_Roadmap.2015-2020_EZU_F%20(1).pdf)

- The platform should be accessible by vessels
- Sufficient space for cable-routing and pull-in should be available which is defined to be a 1000m obstacle-free zone at one side of the platform
- Transformer replacement needs to be possible including adequate space for working-ships – therefore a cable-free area is defined
- Avoid the platform being an obstruction in shipping lanes

In the National Water Plan (NWP II) it has been decided to allocate special corridors for cables and pipelines through the (future) sand mining areas. This corridor starts at the eastern side of the wind area Borssele and lies just south of the existing cable corridor Farland North. This means that a logical location for both platforms is south of Farland North.

Because no routing of Infield cables of one Site (Kavel) through neighbouring Sites is allowed the platform shall lie between Sites. TenneT calculated all possible options to achieve the lowest LCOE. In these calculations not only the effect on the costs of the export cables has been taken into account, but also the effect of the location of the platform on the length of the infield cables is determined.

The lowest costs are achieved locating the platforms as proposed by EZ, RWS and wind developers at the "Werkatelier" of September 15: Platform Alpha in the upper left corner of Site II and platform Beta in the upper left corner of Site III.

### **Coordinates for the platform Alpha**

Location platform Alpha: 503919, 5727665 (in ETRS\_1989\_UTM\_Zone\_31N)

### **Planning principles for the cables**

To decide on the location of the export cables and the redundancy cable TenneT uses the following planning principles:

- With regards to combining the cables routes as much as possible the following principles have been applied
- Cables need to be bundled as much as possible and the spacing between cables should be at least 200m
- Cables need to be bundled as much as possible with existing cables and pipelines (e.g. through sand mining areas) and the spacing between cables and third party infrastructure should be at least 500m
- No cable bundling necessary within 500/1000 m zone around platform
- A cable free area for jack-up operations of 1000 x 1000 meters

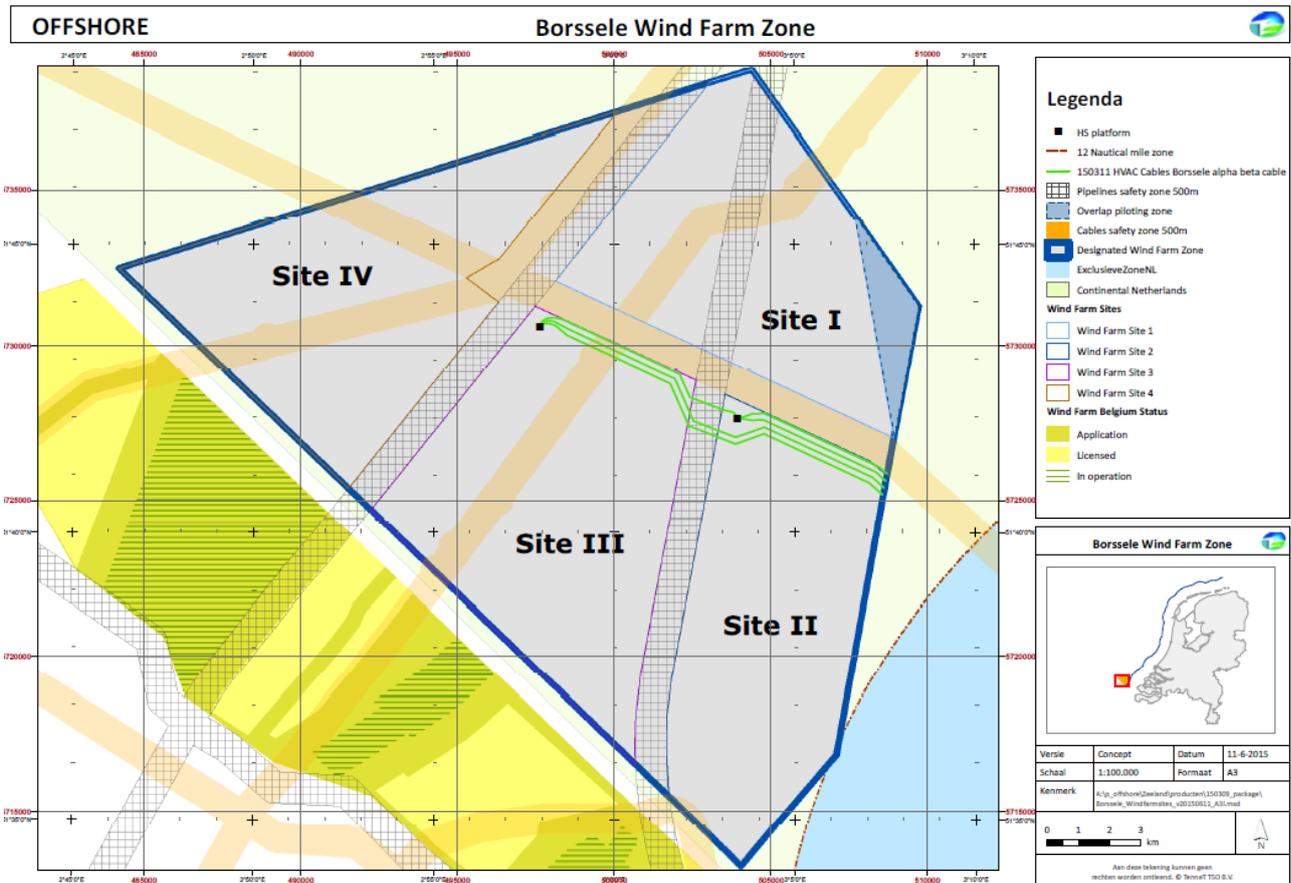


Figure 1 Platform locations

### Planning principles outside the wind area

With regards to the offshore cable route from both platforms to shore the following planning principles are adhered to:

- Cables should be held as short as possible
- Cable crossings should be avoided – in case a crossing is unavoidable the crossing should be close to perpendicular (minimum 45°)
- Pipeline crossings should be held close to perpendicular (minimum 80°)
- Cable bending radius has to be considered (tightest radius: 45° turn every 150 m (absolute minimum, better larger distance))
- Cable routes should be combined with other cable routes and/or infrastructure
- Known obstructions should be avoided (e.g. UXO-areas, dumping grounds, mining grounds, military practice areas, wreck-positions etc.)
- Cable-lengths in environmental-protection areas should be held as short as possible
- Crossings of shipping-lanes should be as short as possible and if possible these should be crossed perpendicular

This means that the distance between the export cables shall be 200 meters as indicated in the figure below.

The platform and its maintenance- and safety zones will be excluded from the wind farm site decision, as well as the cables. The cable corridor has a width of 1600 meter, partly overlapping with the existing safety zone of the Farland North cable. In practice, the reserved cable corridor will therefore be 1100 meters.

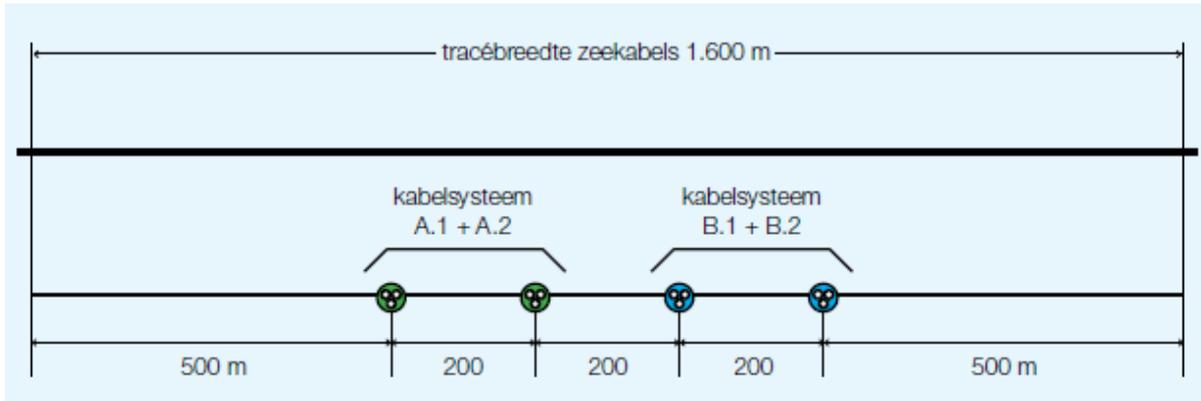


Figure 2 Cable corridor in wind area Borssele