

DATE November 4~~30~~, 2015
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Disclaimer: the content of this draft is disclosed for information ~~and discussion~~ purposes only. In no way does this draft constitute rights for (potential) connected parties, or bind TenneT legally.

Annexes to Realisation Agreement

- Annex 1** Details of ~~{Name of Connected Party}~~ [and TenneT](#)
- Annex 2** Description and technical specifications of the Connection, including drawings
- Annex 3** Technical terms and conditions for the Platform
- Annex 4** Technical requirements applicable for the connection of ~~O~~offshore ~~P~~power ~~P~~park ~~M~~modules
- Annex 5** Operational arrangements and exchange of information

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Annex 1 Details of ~~Name of Connected Party~~ and [TenneT](#)

General note

In this Annex the Parties capture data in good cooperation. This will take place in the bilateral consultations after the offshore wind subsidy tender (prior to concluding the Realisation Agreement).

General details

Connected Party

Correspondence address

Postcode + city/town

Chamber of Commerce registration number _____

Invoice address

Order number / reference for invoicing purposes

Relation managers

Organisation: _____ Name of Connected Party _____

Department:

Contact person:

Correspondence address

Postal code + city/town

Telephone:

Fax: _____

E-mail:

Organisation: TenneT TSO B.V.

Department:

Contact person: _____ Name of relations manager

Correspondence address

Postal code + city/town

Telephone:

Fax:

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E-mail:

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TenneT TSO B.V.

[Connected Party]

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Management during Realisation

Organisation: _____ Name of Connected Party _____

Department:

Contact person: _____ Name of project leader _____

Correspondence address

Postal code + city/town

Telephone:

Fax:

E-mail: _____

Organization: TenneT TSO B.V.

Department:

Contact person: _____ Name of project leader _____

Correspondence address

Postcode + city/town

Telephone:

Fax:

E-mail: _____

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[Connected Party]

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Annex 2 Description and technical specifications of the Connection, including [drawings](#)
~~drawings~~

General note

In this Annex the Parties capture data in good cooperation. This will take place in the bilateral consultations after the offshore wind subsidy tender (prior to concluding the Realisation Agreement).

Connection details

Connection capacity _____ MVA ~~W~~ ~~cos phi~~

Physically connected to platform

Physically connected voltage level 66 kV

Bay name(s) _____ (TenneT will specify all bay names to be used by the Connected Party and TenneT before concluding the Realisation Agreement _____)

Substation (name and coordinates) _____ (TenneT will specify before concluding the Realisation Agreement) _____

Description of the Connection

(One or more 66kV bays, to be specified before concluding the Realisation Agreement)

Description of the Connection Points

Primary Connection Point The primary Connection Point between the Installation (Offshore Power Module) and TenneT is specified at the 66kV cable termination of the 66kV inter-array cables in the 66kV switchgear installation on the Platform.

Secondary Connection Point(s) The secondary Connection Point(s) are defined at the terminals of the interface cabinet and it concerns all communication and control related interfaces.

Tertiary Connection Point(s) The tertiary Connection Points concern all spatial boundaries at the Platform [and onshore](#), where ownership and management transfer to the Parties.

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Explanation of Secondary Connection Points

Current transformer and voltage transformer measurements

The current and voltage measurements ~~will~~shall be provided by TenneT ~~and take place via the cabling on the Platform to~~at the terminals of the interface cabinet located in the Connected Party's room on the platform. The interface cabinet is property of TenneT. ~~At~~From the terminals of the interface cabinet ~~the transition of ownership is made from TenneT to~~onward, the Connected Party is responsible for connecting these measurements to its equipment, including the measurements for the accountable metering equipment of the Acknowledged Metering Responsible Party. The metering equipment ~~will~~shall be according to the Metering Code.

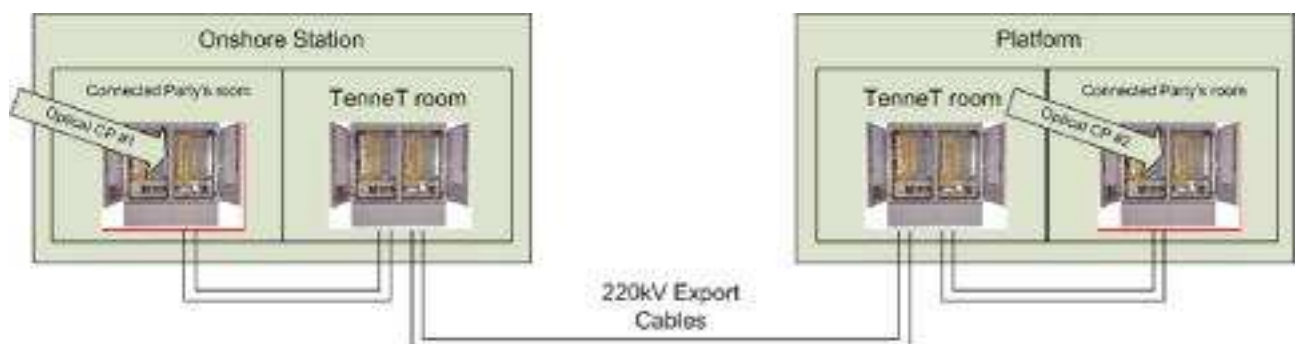
Explanation of fibre optic cable connection points (Optical CP) as Secondary Connection Points

TenneT shall install two 220kV export cables from the onshore substation to the Platform (offshore). Fibre optic cables will be included in these cables. All of these fibre optic cables will end in a fibre optic patch panel in TenneT rooms, both on the onshore station as well as on the Platform.

From the TenneT room designated fibre optic cables will be installed and connected to a second patch panel in the designated room for the Connected Party ("Connected Party's room" in the figure below). The optic fibres designated to be used by the Connected Party will be 1:1 patched in the TenneT rooms and therefore create a "dark fibre" path from the Connected Party's room onshore to the Connected Party's room offshore (on the Platform).

TenneT shall install the patch panel in the designated room of the Connected Party offshore. The patch panel placed in the Connected Party's room will be the Optical CP, meaning that the patch cable itself that will be plugged into the patch panel of the equipment will owned by the Connected Party.

The above design is depicted in the figure below:



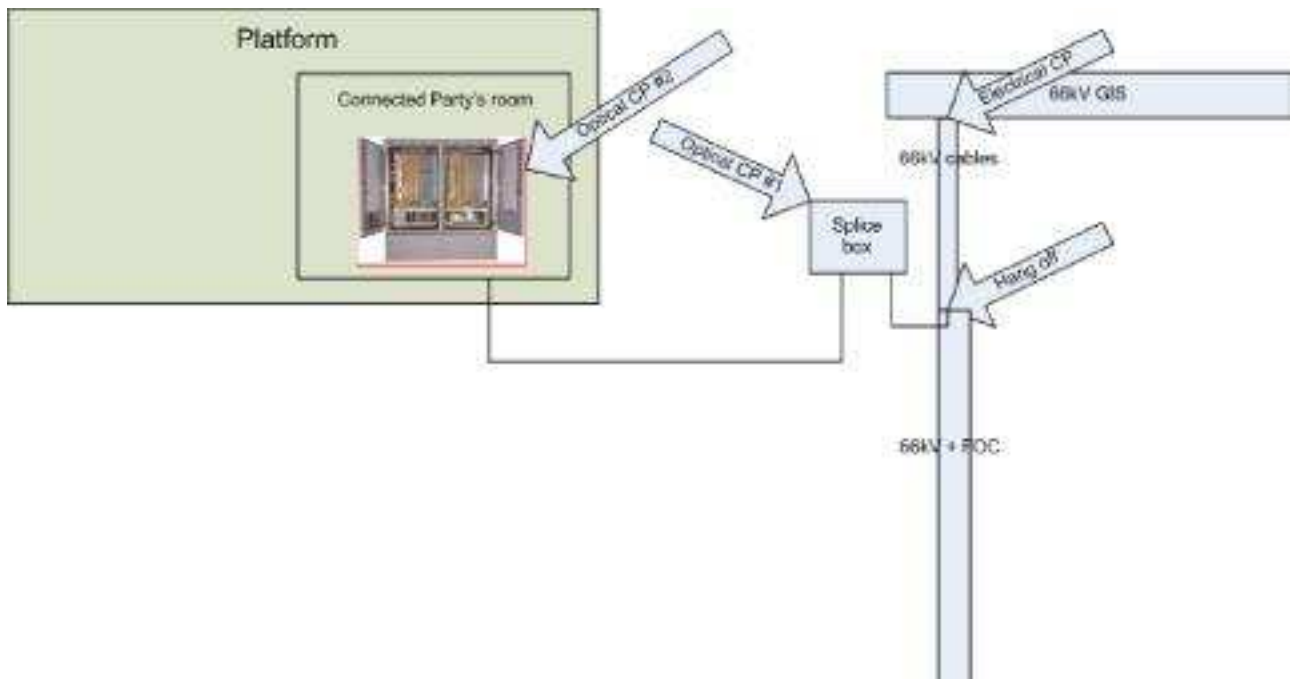
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Optical Connection Point #	Equipment	Installed by	Spliced by	Patched by
1	Patch panel in Connected Party's room	TenneT	TenneT	Connected Party
2	Patch panel in Connected Party's room	TenneT	TenneT	Connected Party

At the cable hang off on the cable deck (or such other location as may be agreed upon between TenneT and the Connected Party), an optical cable splice box shall be installed by TenneT for each 66 kV cable.

From this splice box an Fibre Optic Cable (FOC) shall be installed by TenneT towards the fibre optic patch panel placed in the [designated room for the Connected Party](#) ("Connected Party's room"). The fibre optic cores of the FOC will end in the fibre optic patch panel owned by TenneT. The other side will end in the splice box on the cable deck, the optical fibres shall be spliced by the Connected Party.



Optical Connection Point #	Equipment	Installed by	Spliced by	Patched by
1	Splice box at cable deck	TenneT	Connected Party	-
2	Patch panel in Connected Party's room	TenneT	TenneT	Connected Party

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Also the relevant tertiary connection point (e.g. power supply) is defined at the interface panel in the Connected Party's room.

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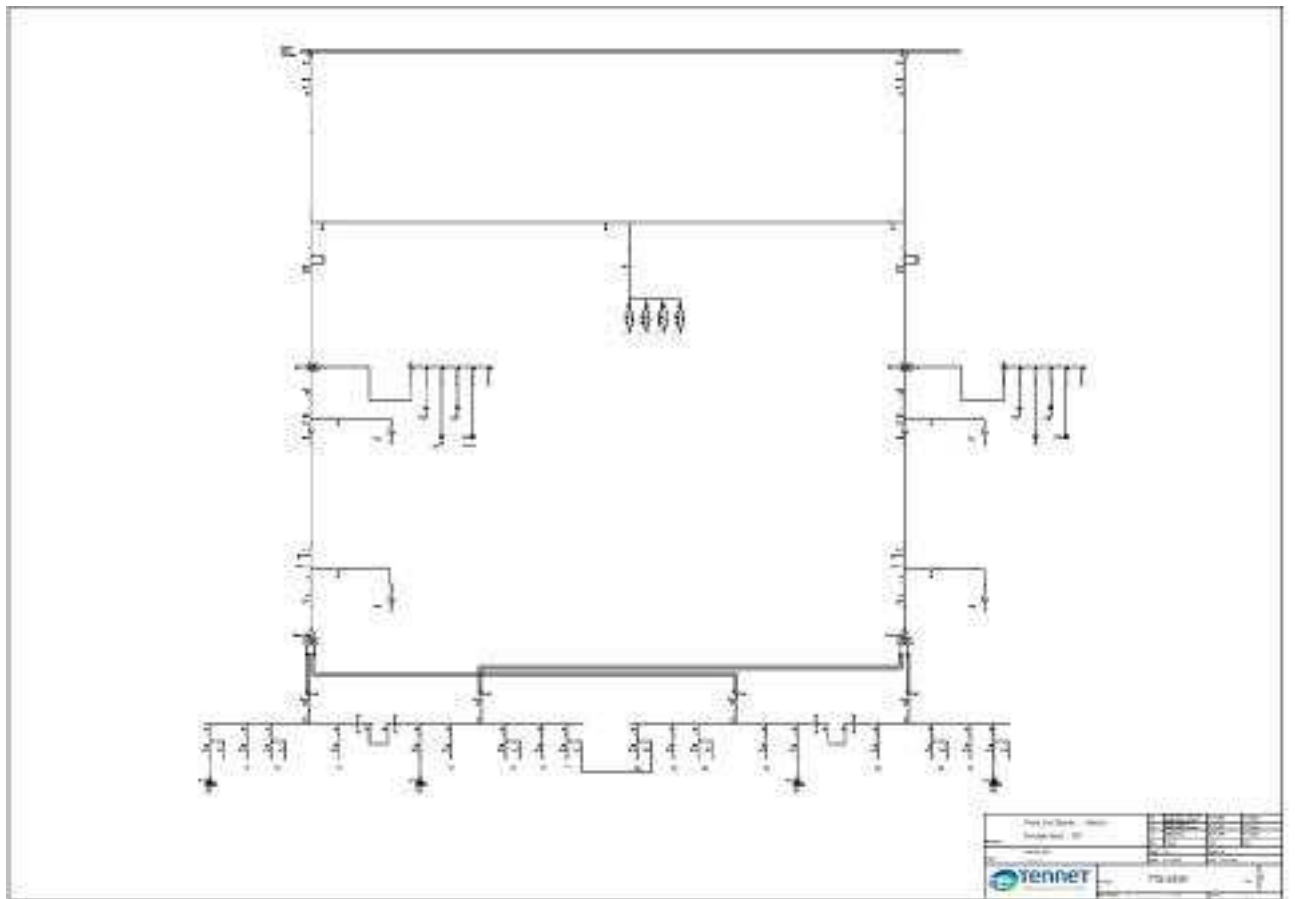
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Single line diagram and other drawings and/or photographs, including the connection- and metering point(s), bay codes, etc.

[Drafting note: these drawings/photographs will be updated/completed before concluding the Agreement.]

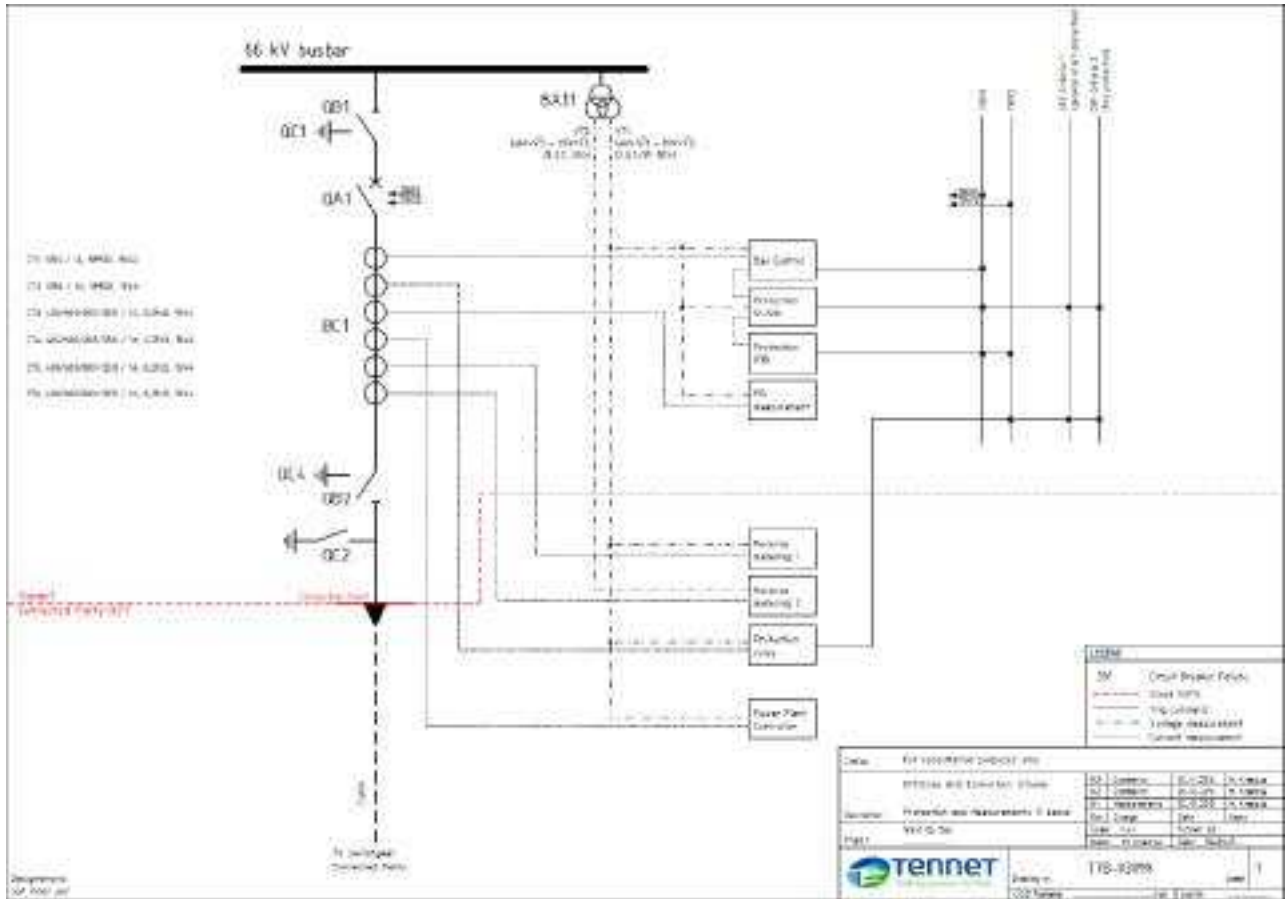
The drawings below are realistic drafts ~~for consultation purposes~~, not final drawings. These draft drawings are also uploaded as separate document for quality reasons.]

Draft:



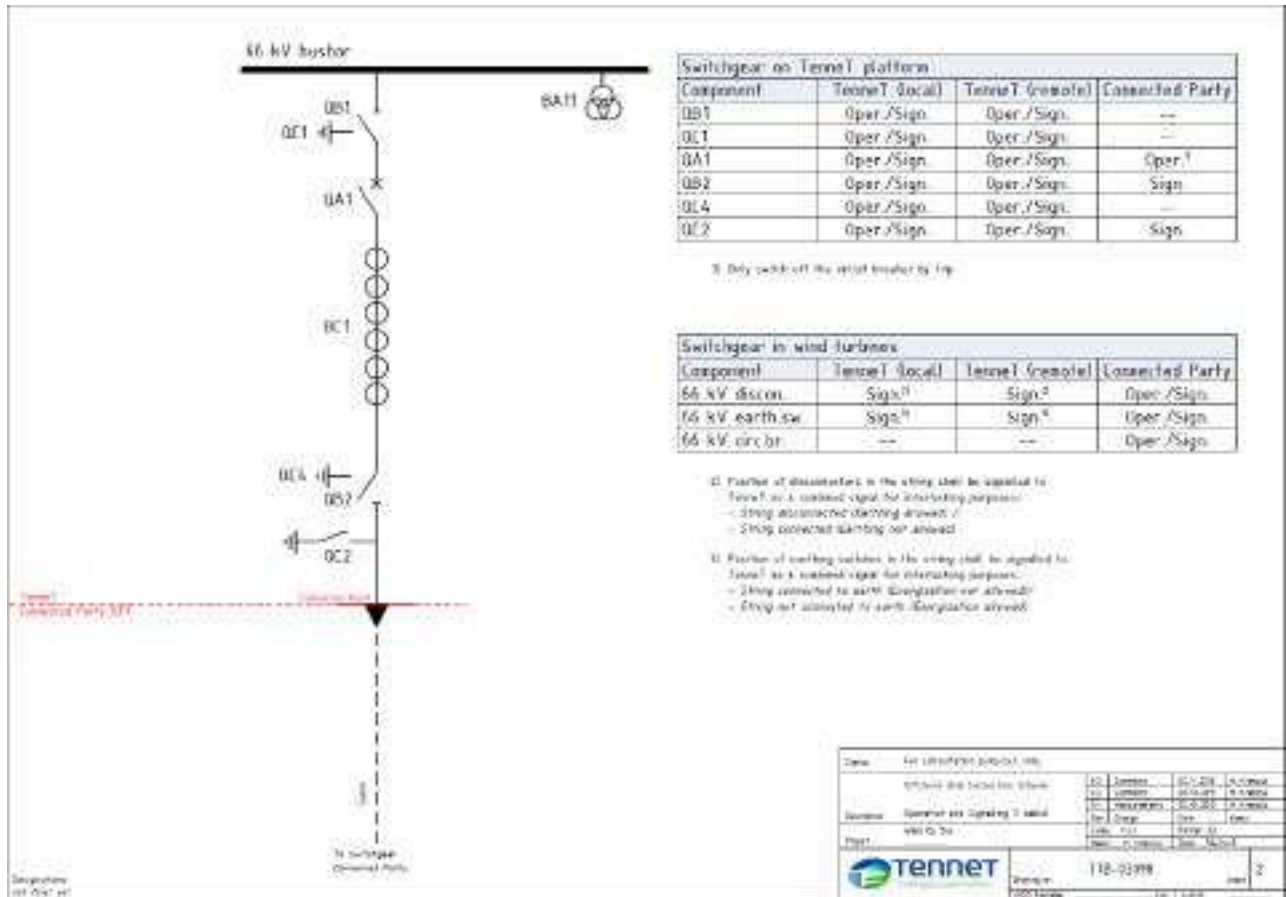
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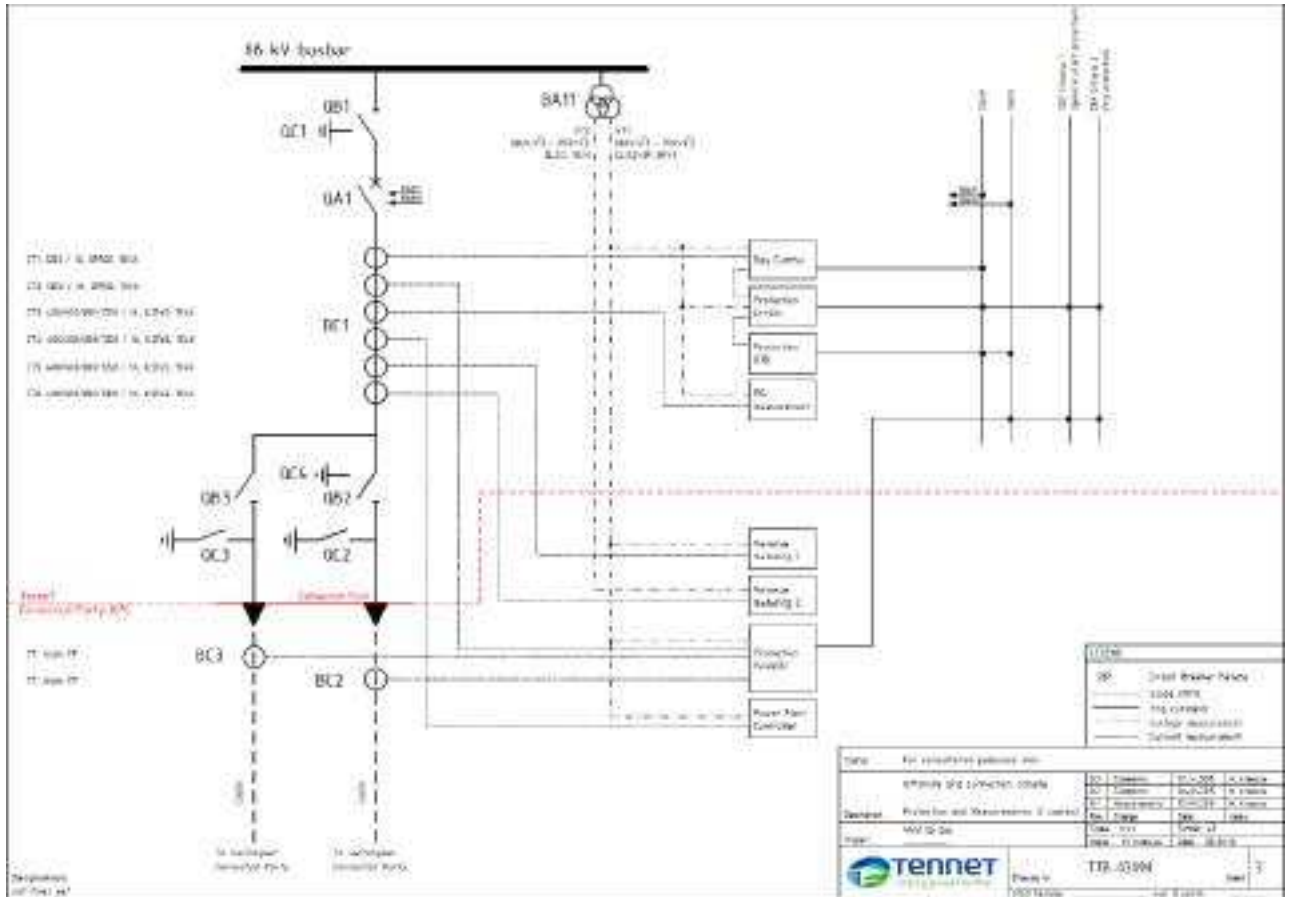
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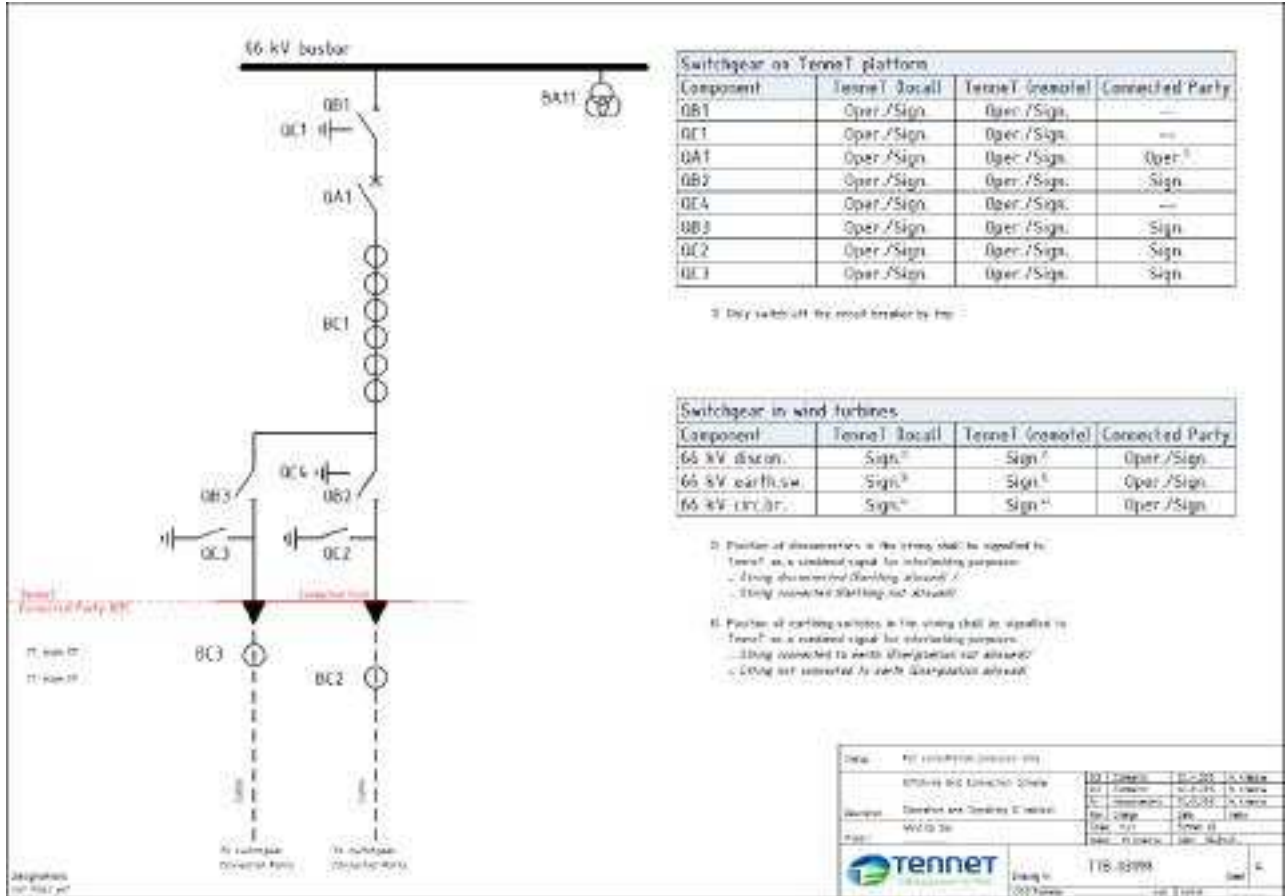
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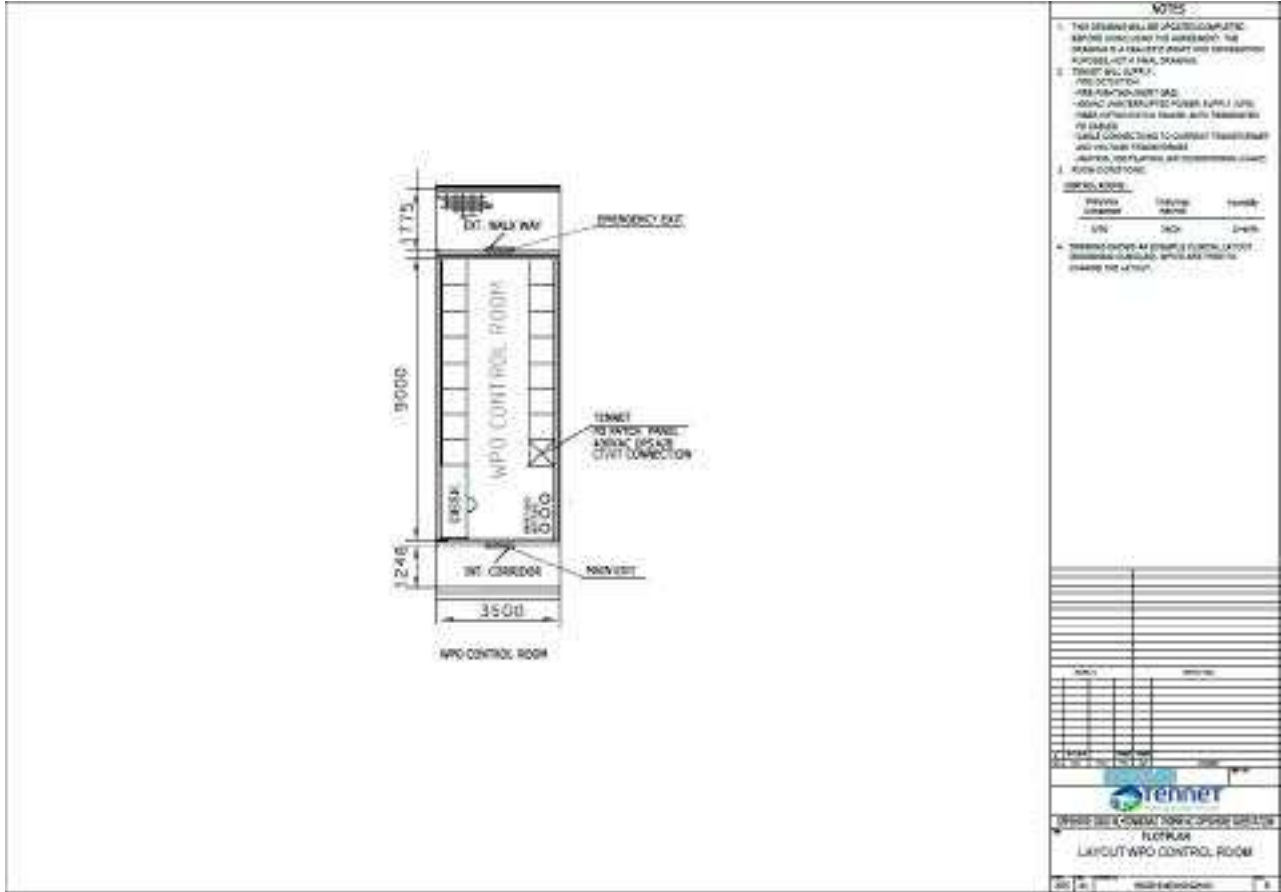
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Annex 3 Technical terms and conditions for the Platform

Drafting General note: At the time of publication, certain design parameters of the 66 kV equipment in this Annex ~~are~~were still subject to

investigation and can be amended in the final version of the model Realisation Agreement that will be offered to the Connected Party.

1. General system specifications

Nominal frequency: 50 Hz
 Nominal voltage: 66 kV +/- 10%
 Maximum system voltage: 72,5 kV
 Impedance earthed grid with

- Short circuit withstand capability of 66 kV 31,5 kA
- Maximum contribution from system: 16 kA
- Single phase short circuit current: approx. 8 kA (max. 0,6 s)
- Earth fault factor (c): 1,4 (according to IEC $1 < c < 1,73$)

- ~~three phase short circuit current~~ 25kA
- ~~single phase short circuit current~~ 1015kA (max. 0,6s)
- ~~earth fault factor c:~~ 1,2 (according to IEC $1 < c < 1,73$)

Operating voltage: 66 kV +/- 1%

2. Number of J-tubes and bays

The Platform will accommodate up to 8 (eight) J-tubes (inner diameter 450 mm) for use by the Connected Party. Each connection of a J-tube will be facilitated with a Primary Connection Point. Six 66 kV bays will be available per Power Park Module (i.e. the Installation of the Connected Party and any other Power Park Module connected to the Platform). This results in four bays "one string – one bay" and two bays "two strings – one bay". In the case of two strings – one bay, this will be done with two separate cable disconnectors.

- per Power Park Module (350 MW) Minimum number of 66kV cables 4
- per Power Park Module (350 MW) Minimum number of 66kV cables 8
- Maximum number of 66 kV GIS bays available per Power Park Module (350 MW) 6
- bay Minimum current (I) per 66kV/GS 120A

TenneT will define the final layout of the 66 kV switchgear installation and cable routing on the Platform in order to ensure a balanced distribution of power per switchgear section. It shall be possible to group all 66kV cables of the Connected Party into two sections. The maximum active power (P) for each section shall be less than 210 MW.

3. Secondary Connection Point

- The Secondary Connection Point is defined and explained in Annex 2;

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- ~~Besides a~~A metering system is to be provided by the Acknowledged Metering Responsible Party under responsibility of the Connected Party;
- Besides a metering system, power quality components will be installed by TenneT to measure and verify

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~~and verify~~ that the energy supplied is in accordance with RfG requirements;

- A patch panel in the designated room for the Connected Party will be provided by TenneT facilitating the fibre optic cable interface which is explained in detail in Annex 2;
- An interface cabinet for secondary equipment in the designated room for the Connected Party will be

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provided by TenneT in order to facilitate the other secondary Connection Points including a telecom interface (other than fibre optics) and other shared services (such as a weather station, CCTV, etc.).

4. Tertiary Connection Points

- The tertiary Connection Points are defined in Annex 2.
- The interface cabinet for secondary equipment in the designated room for the Connected Party shall also facilitate the 230 VAC (max 16 kW) power supply.

5. Operation of bays

TenneT will standardise the operation of bays for the Platform. TenneT (NCC) shall make the standardised

procedure for operation of bays available for the Connected Party and ~~the other~~ Offshore PPMs. The switchgear

installation with connections to the Installation or (the) other Offshore PPM(s) connected to the Platform is

~~installation with connections to the Installation or the other Offshore PPM is~~ fully operated by TenneT (owner

of the switchgear). According to this procedure TenneT will contact the

person responsible for the Installation of the Connected Party (see contact details in Annex 6) for all

operation activities.

6. Protection

TenneT will standardise the protection equipment of the 66 kV cables that is situated on the Platform. TenneT will own, operate and maintain the protection system. TenneT will align on details of the protection system with the Connected Party and the other Offshore PPM(~~on details of the protection system~~s) connected to the Platform.

The following guidelines will apply to the protection system of the 66 kV cables on the Platform:

- ~~the TenneT's~~ protection system will be based on a primary protection by ~~two~~one protection relays (max. I-t, ANSI Code 51) in the outgoing feeder bays ~~which each have either a different measuring principle or a different manufacturer~~; the protection system and its settings will be aligned with the Connected Party and the other Offshore PPM(s) connected to the Platform;
- The TenneT protection panel of each 66 kV cable allows for additional protection relays of the Connected Party, if desired. In such a case TenneT facilitates 2 slots for 19" racks and the Parties shall review the complete protection design. The additional protection system, if added by the Connected Party, will be owned and maintained by the Connected Party;
- ~~in~~ case two 66 kV cables are connected to one 66 kV bay, TenneT cannot distinct which of the two 66 kV cables is healthy or faulty if the protection trips. The Connected Party may install additional equipment to distinguish between the healthy and faulty 66kV cables, after cable installation;
- ~~u~~Underneath the Gas Insulated Switchgear (GIS) cable termination box there will be enough space left for the Connected Party to install equipment to distinct the healthy 66 kV cable from the faulty 66 kV cable

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(e.g. current transformers or short circuit indicators). For practical reasons this equipment will be

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installed after cable termination (e.g. use of split core current transformers);

- ~~the TenneT protection panel of each 66 kV cable allows for additional protection relays of the Connected Party, if desired. In such a case TenneT facilitates 2 slots for 19" racks and the Parties shall review the complete protection design;~~
- ~~if~~ the Connected Party desires an emergency "button" for tripping a particular 66 kV cable, TenneT facilitates such by connecting the "tripping contacts" to the tripping coil;
- ~~F~~ault ride through capability for any fault in the Offshore Transmission System (on 66 kV switchgear, in other 66 kV cables and in the step-up transformer and the Offshore Transmission System for electricity) shall be respected; reference is made to Annex 4;

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- ~~shall be according to curve as presented Annex 4;~~
• ~~the~~The 66 kV system that is part of the Offshore Transmission System is impedance earthed by an earthing transformer; the protection system shall be aligned with this earthing method by providing earth fault current protection ($I_0 >$).

7. Reactive power compensation

During operation the Connected Party shall absorb or inject reactive power on demand of TenneT between -0,1 pu and +0,1 pu (1 pu is full active power in MW independent of the numbers of WTG in operation, applicable from 100 MW installed power) at the Primary Connection Point, without any right of financial compensation.

If the reactive power capabilities of a specific WTG cannot comply at very low active power (below 0,1 pu), then TenneT ~~ef~~will adjust the component set-up (reactors, capacitors) accordingly.

The full reactive power capabilities of the Connected Party to absorb or inject reactive power on demand of TenneT are between -0,4 pu (absorption) and +0,35 pu (injection) at the Primary Connection Point (1 pu is full active power in MW dependent of the numbers of WTG in operation).

8. SCADA, communication interface and data links

TenneT shall make available to the Connected Party:

- at the Platform: a room designated for the Connected Party of ~20m² to install cabinets owned by the Connected Party. Following services are supplied by TenneT: ~~sufficient~~ CT/VT connections, Heating, Ventilation, Air Conditioning (HVAC); a redundant and uninterruptable power supply, fire detection and extinguishing;
- ~~at~~At the onshore substation: a room of ~48m² (~6m x ~8m) with following services supplied by TenneT: Heating, Ventilation, Air Conditioning (HVAC); a redundant and uninterruptable power supply, fire detection (no fire extinguishing);
- ~~a~~A patch panel at the Platform in the Connected Party's room for the optical fibres of all 66 kV cables ~~strings~~. The ~~maximum~~ amount is to be agreed upon by TenneT and the Connected Party. The Patch panel capacity will be sufficient for 24 optical fibres per ~~string~~cable as a maximum;
- The principle of the amount of CT/VT connections is depicted in single line diagrams. The following connections will be provided by TenneT to the Connected Party:
 - 1 (one) CT for a protection relay;
 - 2 (two) CT's for the Acknowledged Metering Responsible Party's measurement system;
 - 1 (one) CT for wind farm power plant control;
 - 1 (one) VT connection for the above;
 - 1 (one) additional VT connection for the Acknowledged Metering Responsible Party's

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measurement system.

In case the Connected Party requires additional CT's, it should arrange for ringcore CT's themselves. TenneT will reserve space for these ringcore CT's.

- ~~sufficient~~ Optical fibre pairs in both 220 kV export cables which will be made available in the (one) patch panels in the Connected Party's rooms both at the Platform and in the onshore substation, respectively. For each Connected Party, each 220 kV export cable will contain a ~~M~~ maximum amount of 24 optical fibres. Therefore, in total each ~~export cable~~ Connected Party will have a maximum amount of 48 optical fibres at its disposal.
- ~~e~~ Only in case of a firm and significant delay in realisation of such communication through the 220 kV export cable fibres ~~will~~ TenneT ~~be bound to~~ will install a wireless communication interface (emergency facility) between the Platform and the onshore substation.

9. Shared data

TenneT aims to share systems with the Connected Party where possible in order to save on space, weight and power consumption. The currently identified possibilities of data acquisition systems are summarized in table below. Final decisions about shared systems shall be elaborated with the Connected Party.

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Sensor	Owner	Shared
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Shared sensors by Rijkswaterstaat (RWS)

<u>Meteo</u> <ul style="list-style-type: none"> • <u>Wind speed & direction</u> • <u>Ceilometer (Cloud height)</u> • <u>Temperature and Humidity</u> • <u>Visibility</u> • <u>Atmospheric pressure</u> • <u>Rain Gauge</u> • <u>LIDAR</u> 	<u>RWS</u>	<u>S</u> <u>h</u> <u>a</u> <u>r</u> <u>e</u> <u>d</u>
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<u>Hydro</u> <ul style="list-style-type: none"> • <u>Temperature</u> • <u>Wave height</u> 	<u>RWS</u>
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Shared

Meteo <u>Radio</u> <ul style="list-style-type: none"> • Wind speed & direction • Ceilometer (Cloud height)<u>AIS (Bacon,</u> 	RWS	Shared
Hydro <ul style="list-style-type: none"> • Temperature • Wave height 	RWS	Shared
Radio <ul style="list-style-type: none"> • AIS (Bacon, Sender, Receiver) • VHF (Radio over IP) 	RWS	Shared
Bird Radar	RWS	Shared
Nautical Radar	RWS	Shared
Bat detection (if required)	RWS	Shared
CCTV	RWS/TenneT	Shared
Hydro, Current (speed and direction)	RWS	Shared
4G	RWS/TenneT/Telecom Provider	Shared

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4G

RWS/TenneT/Telecom Provider

Shared

The Connected Party may install its own LIDAR and CCTV, including connection cables, on the Platform. For systems listed above that are decided not to be shared, TenneT will make available the provisions required for installation and operation of these systems, including mounting facilities, auxiliary services and telecommunication systems.

It is required that communication interface(s) of the shared systems mentioned are able to share the data with all parties involved (including the other Offshore PPM(s) [connected to the Platform](#)).

Costs regarding the procurement of shared data shall be born proportionally by each party that takes part in the sharing. Unless agreed otherwise, TenneT shall invoice the Connected Party, taking into account sufficient transparency, for its part in the shared data costs.

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Annex 4 Technical requirements applicable for the connection of Offshore Power Park Modules

General drafting note:

This annex is based on the RfG version ~~June 10~~, as been submitted for scrutiny of the European Council and the European Parliament in November 2015. The latest version of the RfG can be found at the EU website: <https://ec.europa.eu/energy/en/topics/wholesale-market/electricity-network-codes>

1. Introduction

RfG, the Act, and relevant clauses of the current Electricity Grid Code and the Electricity System Code apply

accordingly, unless indicated otherwise in this Annex.

The Electricity Grid Code (*Netcode Elektriciteit*) applies accordingly to the Offshore Transmission System, except for the following provisions:

Article 2.1.1.1 — 2.1.2.6

Article 2.2.1.1 — 2.2.5.3

Article 2.4.1.1 — 2.4.5.3

Article 2.5.4.1

Article 2.5.4.2

Article 2.5.4.6

Article 2.7.1 — 2.9.10

Article 4.1.3.1

Article 4.1.4.1 — 4.1.4.10

Article 4.2.3.1 — 4.2.5.18

Article 5.4.1 — 7.3.12

The Electricity System Code (*Systeemcode Elektriciteit*) applies accordingly to the Offshore Transmission System, provided that for "*netbeheerder van het landelijk hoogspanningsnet*" should be read: "TenneT" and except for the following provisions:

Article 2.1.3

Article 2.4.1.7

2. Applicability

With respect to RfG, the Connected Party is considered an Offshore PPM, which results in the applicability of:

- Chapter 4 of title II: "Requirements for Offshore Power Park Modules",
- Chapter 4 of title IV: "Compliance testing for offshore power park modules", and
- Chapter 7 of title IV: "Compliance simulations for offshore power park modules".

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RfG specifies the general required capabilities of Offshore PPM. Proceedings regarding compliance testing and compliance simulations related to the RfG requirements will be part of the Connection and Transmission Agreement (Annex on Compliance Activities; applicable testing requirements).

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3. Explanatory Notes to RfG

1) Article 2: Definitions

Definition 2. The Offshore Transmission System is connected to the synchronous area of Continental Europe.

2) Article 2: Definitions

Definition 3. The nominal voltage of the Connection Point is 66 kV.

3) Article 5: Determination of significance

The Offshore PPM connected to the Platform with a rated power > 75 MW is of type D, independent of the voltage level.

4) Article 13: Frequency requirements

Table 2 of RfG for the Synchronous Area Continental Europe shall be replaced by table A below:

Table A: Minimum time periods for which an Offshore PPM has to be capable of operating on different frequencies, deviating from the nominal value, without disconnecting from the Offshore Transmission System.

Synchronous area	Frequency range	Time period for operation
Continental Europe	47.5 Hz — 48.5 Hz	30 minutes
	48.5 Hz — 49.0 Hz	30 minutes
	49.0 Hz — 51.0 Hz	Unlimited
	51.0 Hz — 51.5 Hz	30 minutes

5) Article 25: Voltage ranges

Table 10 of RfG for the Synchronous Area Continental Europe shall be replaced by table B below:

Table B: The table shows the minimum period during which an AC-connected Offshore PPM must be capable of operating over different voltage ranges deviating from a nominal value without disconnecting.

Synchronous area	Voltage range	Time period for operation for
Continental Europe	0.85 pu — 0.90 pu	60 minutes
	0.9 pu — 1.118 pu	Unlimited
	1.118 pu — 1.15 pu	60 minutes

~~6) Article 25 referring to Article 20: Voltage stability — fast fault current injection~~

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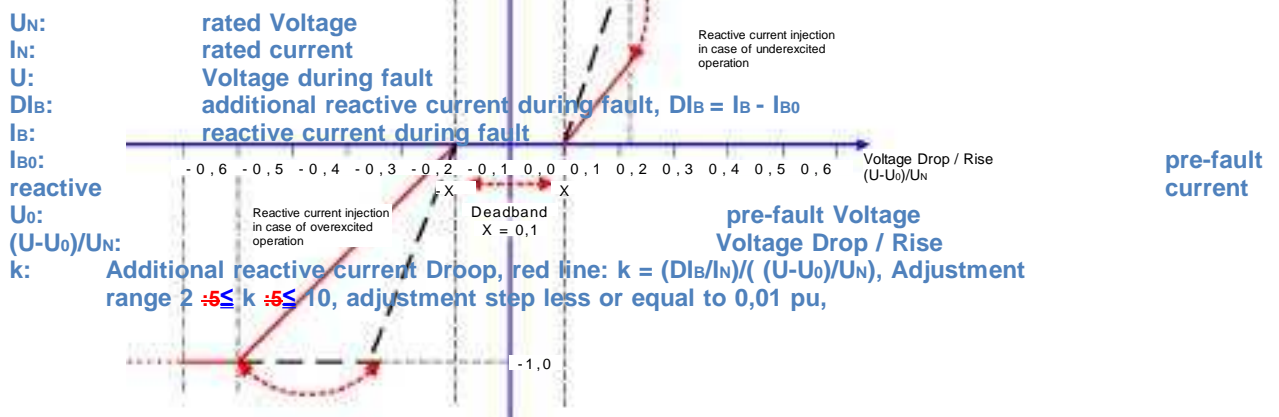
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6) Article 25 referring to Article 20: Voltage stability – fast fault current injection

The requirements of Article 20(2)(b) RfG are further detailed to:

- i. Additional reactive current injection shall be activated in the event of a voltage deviation of more than 10% of the effective value at the Connection Point of the Offshore PPM. This 10% voltage deviation is called the dead band. The voltage control shall ensure the supply of additional reactive current, originating from the Offshore PPM, of minimum 2% and maximum 10% of the rated current per percent of the voltage deviation, see Figure a. The full required reactive current must be available after $t_p = 40$ ms after the fault inception into the grid, with a rise time (t_r) less than 30 ms, see Figure b.
- ii. Additional reactive current injection shall be supplied up to a voltage limit of minimal 120% rated Offshore PPM voltage.
- iii. After fault clearance stable operation must be pursued.

Figure a: Principle of voltage support by fast reactive current injection during faults. The red line represents the required minimum additional reactive current, expressed by the ratio of the additional reactive current and the rated current in per unit, against the voltage drop, expressed by the ratio of the actual voltage value and its pre-fault value in per unit at the Connection Point.



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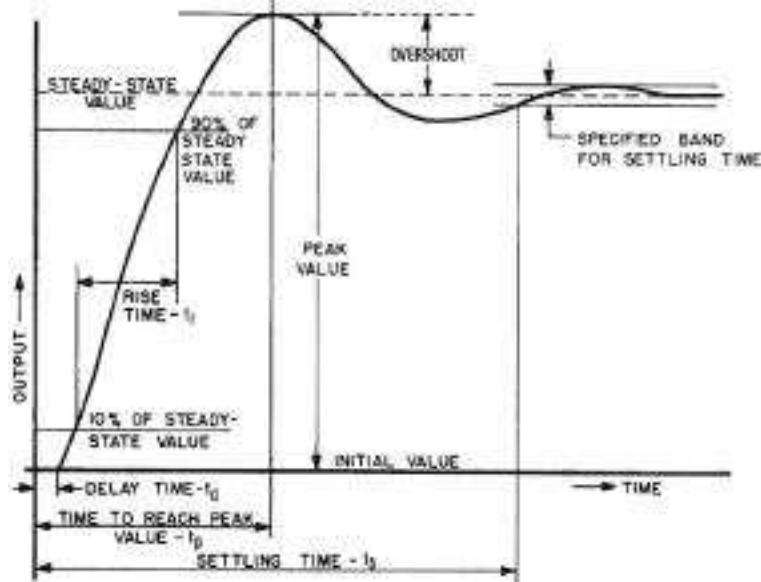


Figure b: Typical transient response of a feedback control system to a step change in input

7) Article 25 referring to Article 21: Reactive power capability and voltage stability requirements

The requirements of this Article apply to the steady state condition of the power system only, and do not apply to transient stability.

The inner profile of Figure 8 of RfG is further specified by the red dashed line in Figure c below, while respecting the figures of Table 11.

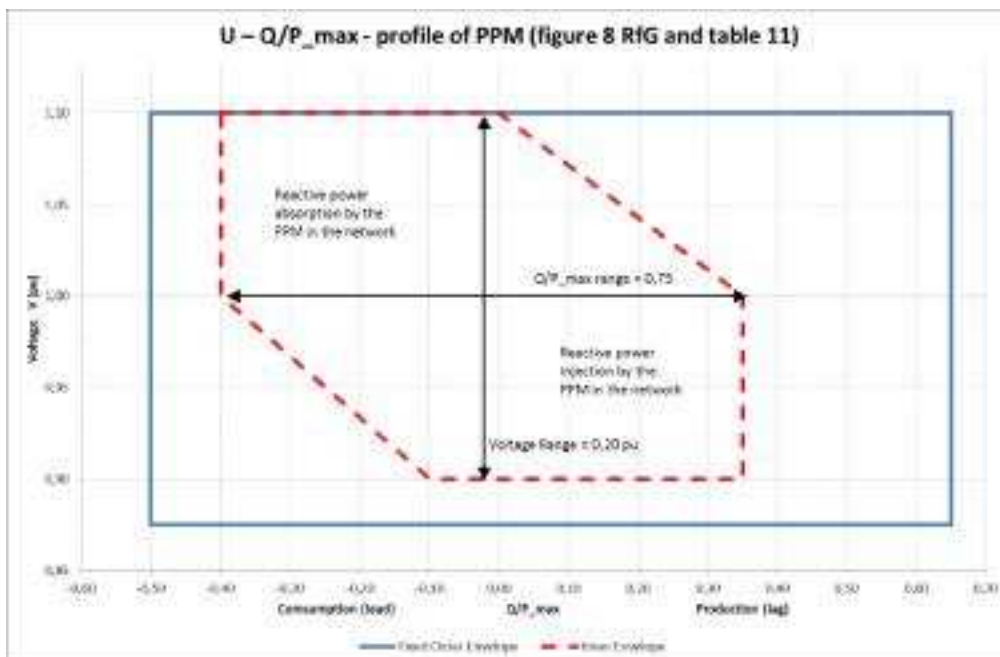


Figure c: The required U-Q/P_{max}-profile of an Offshore PPM at the Connection Point by the voltage

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The coordinates of the vertices of the red dashed profile of Figure c are:

Reactive power Q/P_{max} [pu]	Voltage V [pu]
-0,40	1,10
-0,40	1,00
-0,10	0,90
0,35	0,90
0,35	1,00
0,00	1,10

If an Offshore PPM has a reactive power capability beyond the minimum requirements, the capability shall not be deliberately limited.

The Offshore PPM shall be capable of providing reactive power automatically by either voltage control mode, reactive power control mode or power factor control mode.

The set points and slope (voltage droop) must be adjustable, during normal operation.

Set point values relate to the Connection Point of the Offshore PPM to the Offshore Transmission System.

The parameters of the control speed of the reactive power controller, will be mutually agreed by TenneT and the Connected Party at least 6 months prior to energisation, taking into account the actual local grid characteristics.

The reactive power control mode Voltage must result in a stable and damped behaviour of the voltage at the Connection Point of the Offshore PPM. If the reactive power control mode is Voltage, adjustment of the operating point of the slope must be possible within 15 minutes, to adjust the reactive power exchange at the Connection Point.

In case the reactive power control mode is Reactive Power, adjustment of the set point must be within the frequency and accuracy definition of the Onshore Voltage Controller (which determines the Reactive Power Set point for the Offshore PPM at its Connection Point).

8) Article 25 referring to Article 21: Reactive Power Capability

The requirements of this Article apply to the steady state condition of the power system only, and do not apply to transient stability.

The inner profile of Figure 9 of RfG is further specified by the red dashed line in Figure d below, while respecting the figures of Table 11:

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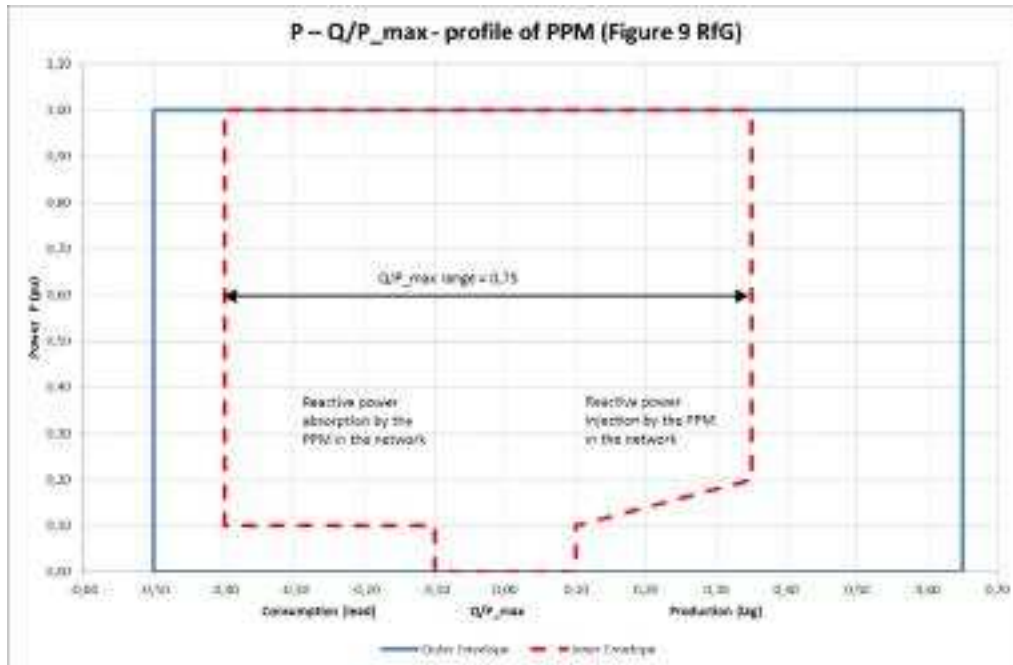


Figure d: The required P-Q/P_{max}-profile of an Offshore PPM at the Connection Point by the active power. The coordinates of the vertices of the red dashed profile of Figure d are:

Reactive power Q/P_{max} [pu]	Power P [pu]
-0,40	1,00
-0,40	0,10
-0,10	0,10
-0,10	0,00
0,10	0,00
0,10	0,10
0,35	0,20
0,35	1,00

In case a Offshore PPM has a reactive power capability beyond the voltage range specified the capability shall not be deliberately limited.

Limitation of reactive power capability based on the number of generating units in service may not influence the behaviour of the reactive power controller within these limited capabilities.

9) Article 26 referring to Article 16: Fault ride through capability

The fault ride through capability as laid down in Figure 3 and Table 3.2 of RfG is further detailed in Figure e

below:

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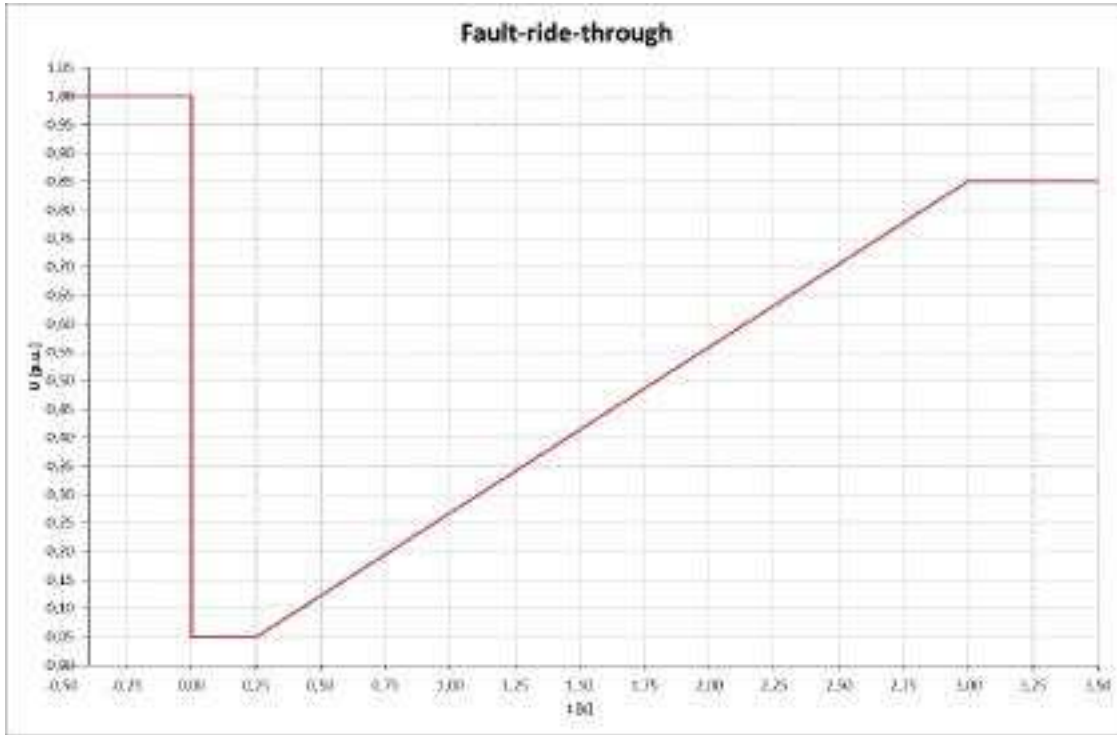


Figure e: The fault-ride through capability of Power Park Module

The coordinates of the vertices of the curve of Figure e are:

Time t [s]	Voltage V [pu]
0,00	1,00
0,00	0,05
0,25	0,05
3,00	0,85

10) Article 27 referring to Article 15: System restoration

Black start capability is not required ~~off~~from Offshore PPMs.

4. Harmonic emission limits

The Connected Party is responsible for the fulfilment of the requirements with respect to the total harmonic

distortion and the emission limits. TenneT shall specify the maximum allowed harmonic distortion at the 66 kV Primary Connection Point. If more than one Offshore PPM is connected to one single 66 kV bus bar, the

emission planning level will be distributed proportional to the rated power of each Offshore PPM.

The Connected Party is responsible for taking necessary measures in order to fulfil the requirements with respect to the harmonic distortion, at its own cost.

TenneT shall define the planning levels of the harmonic emission limits at 66 kV level, which shall be

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| further

allocated to the individual Offshore PPMs based on the capacity according to the Wind Farm Permit and the

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equivalent permit of the other Offshore PPM. All Offshore PPMs shall plan for and take measures to fulfil the requirements, and be accountable for the fulfilment of its requirements at its own costs.

At 66 kV level, the defined offshore compatibility and planning levels of the Total Harmonic Distortion (THD) are:

- Compatibility level:
 - o THD < 5% for 95% of the ten minutes average measurements of one week;
 - o THD < 6% for 99,9% of the ten minutes average measurements of one week.
- Planning level:
 - o THD < 3%, for 95% of the ten minutes average measurements of one week;
 - o THD < 3,6%, for 99,9% of the ten minutes average measurements of one week.

1. The Connected Party and other Offshore PPM shall not exceed the harmonic emission limits as specified by TenneT.

Since, without detailed information of the Offshore Transmission System, it is not possible yet to define concrete and complete requirements with respect to the harmonic emission limits, the following approach on the definition of these requirements will be followed:

- a. TenneT specifies the maximum contribution of individual harmonic voltages to the THD of each 66 kV cable with turbines; TenneT will provide later the root loci of the applicable Offshore Transmission System's grid impedance at the Platform.
- b. The Connected Party shall deliver their offshore grid specifications and the contribution of the injected individual harmonic currents at the Connection Point as a percentage of the current of the connected rated power per 66 kV cable (95% and 99,9% percentile values). The Connected Party shall prove through calculation that its Installation complies with the requirements where summation per section is allowed. The Connected Party shall consult TenneT if compliance cannot be achieved without the installation of filter equipment. As part of this consultation the Connected Party shall specify the root loci for which compliance can be achieved without filters.
- c. An independent third party, to be assigned by TenneT, will perform an overall harmonic study to verify that the planning levels at the Platform are not exceeded. This study will investigate the harmonic behaviour of the grid including all connected Offshore PPMs to the Platform (including the Connected Party). All parties shall make the necessary information for these studies available and share it with the independent third party without restrictions, although based on a non-disclosure agreement. ~~The study will be part of the compliance verification process~~
- d. After realisation of the Connection, as part of the compliance activities, the amplitude of the harmonic current injected by the WTG's at the Connection Point will be measured. Compliance shall be assessed by comparison of measured currents against the values guaranteed by the Connected

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Party during the design stage.

2. Regarding the responsibility for maintaining power quality:

- TenneT is responsible for undoing, at the onshore connection of the Platform to the onshore transmission system, the impact of the total Offshore Transmission System (export cabling and 66 kV cables) to the onshore transmission system for electricity with respect to the harmonic amplification;
- The design criteria for the Connected Party and the other Offshore PPM shall be based on the compliancy and planning levels of the THD at the 66 kV busbar.

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Annex 5 Operational arrangements and exchange of information

General note

In this Annex the Parties capture data in good cooperation. This will take place in the bilateral consultations after the tender and prior to concluding the ~~Realisation~~ Agreement.

1. Scope

This Annex 7⁵ describes the operational arrangements agreed between Connected Party and TenneT. The following details are specified:

- a. The contact persons of the two Parties
- b. The content of the operational arrangements
- c. The procedure for resolving failures, and
- d. The exchange of information

2. Contact details

2.1 Contact details for operational matters

Operations

Operations at Connected Party will be performed by*: _____

Organisation:

Location: _____

Person responsible: _____

Telephone:

Fax:

E-mail:

Operations at TenneT will be performed by the following National Control Centre (NCC):

Arnhem for voltages of 380/220 kV

Telephone: +31 26 373 12 41; fax: +31 26 445 26 97; e-mail:@tennet.eu

* If the Connected Party outsources operational management to a third party, this third party will act as the contact person on behalf of the Connected Party.

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2.2 Contact details for planning the availability of the TenneT transmission grid

Planned Unavailability

On working days, [Name of Connected Party]'s contact person for matters concerning Planned [Unavailability](#)

~~Unavailability~~ within the meaning of Article 6 of the General Terms and Conditions will be: _____

Organisation: _____

Location: _____

Person responsible: _____

Telephone: _____

Fax: _____

E-mail: _____

On working days, TenneT's Operational Support department (Planned Unavailability group) can be reached in the following ways:

Telephone: +31 26 373 17 61

Fax: +31 26 373 24 53

E-mail: groepvnb@tennet.eu

2.3 Changes to contact details

~~[Name of The~~ Connected Party] shall ensure that changes to contact details are notified to TenneT by: _____

Organisation: _____

Location: _____

Person responsible: _____

Telephone: _____

Fax: _____

E-mail: _____

Correspondence address: _____

The TenneT Customer Relationship Manager will be responsible for changing the contact details:

Name: _____

Telephone: +31 26 373

E-mail: ...@tennet.eu

Correspondence address: _____

TenneT TSO B.V.

Signed for approval: _____

Commencement date: _____

Customers & Markets department
Postbus 718
NL-6800 AS Arnhem

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3. Content of arrangements

3.1 Access to the Platform

~~Boat landing and Walk to Work (W2W) solutions are the standard access method. The Platform will be equipped with a hoisting facility. In case of emergency response and if allowed by authorities, helicopter hoisting will be used.~~

TenneT will allow access for the Connected Party representative(s) to the Platform without accompaniment. ~~Only specific rooms (general room and the equipment room of the Connected Party) will be accessible.~~ This will be done under safety and operational regulations and requirements, as determined by TenneT. All persons requesting access to the Platform minimally need to be qualified for accessing high voltage premises as well as standard marine certification (offshore safety directive).

A shelter on the cable deck with all required equipment for emergency stay is required by native standards and will be accessible without any restrictions.

A general day crew room with necessary basic facilities - including emergency accommodation - will be accessible to all parties on the Platform.

As a design principle, equipment owned by TenneT or the Connected Parties of a platform will be installed in separate rooms, having separate entrance doors. Under normal circumstances a room will only be accessible to the owner of the equipment inside this room. At the Platform, one room will be designated for use by the Connected Party.

In case the Connected Party requires access to ~~other~~ areas (other than described above; e.g. to switchgear rooms where 66 kV cables are connected, own equipment installed elsewhere on the Platform or shared services devices); accompaniment by (a) TenneT representative(s) is required. TenneT and the Connected Party shall make operational agreements regarding response time of accompanying staff. TenneT estimates a response time for TenneT of two (2) hours.

~~Boat landing and Walk to Work (W2W) solutions are the standard access method. The Platform will be equipped with a hoisting facility. In case of emergency response and if allowed by authorities, helicopter hoisting will be used.~~

3.2 Installation Interface Management

TenneT will manage interfaces by involving the selected Connected Party as early in the project as possible

and to define clear roles for major interfaces. The following main technical interfaces have been identified:

1. 66 kV cable route starting at the entry of the platform safety zone (500 m) up to the 66 kV switchgear;
2. 66 kV switchgear at the Platform;
3. ~~†~~Telecommunication and fibre optic infrastructure;
4. Connected Party's equipment located on TenneT infrastructure (offshore and onshore).

Each technical interface and the associated sub interfaces are defined in the next paragraphs. For each

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| sub interface a functional role is assigned to TenneT and to the Connected Party. One of the parties (mainly

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TenneT will have the responsible (R) and accountable (A) role whereas the other party (Connected Party) will have either a supportive (S), consulting (C) or informative (I) role. The responsible Party may transfer the 'responsible' part of the interface (execution) to a third party (contractor). Further details of these interfaces shall be determined in mutual agreement between the Connected Party and TenneT.

3.2.1 66 kV cable route from platform safety zone up to the 66 kV switchgear

In the table below, high level interfaces for the 66 kV cable route from entry of the platform safety zone (500 m) up to the 66 kV switchgear are listed with for each interface the role of the two main stakeholders.

High level interfaces on 66 kV cable route from platform safety zone up to the 66 kV switchgear

Interface

Design: Cable field layout in the direct vicinity of the platform (< 500 m)

Design: Cable approach from burial to J-tube including scour protection and cable protection system

Design: Scour protection of the jacket (if applicable)

Design: J-tube with a bell mouth

Design: Cable hang-offs

Design: Cable route from hang-off to 66 kV switchgear

Design: Cable pull-in methodology (basic design/philosophy)

Design: Cable pull-in method (detailed design)

Construction & installation of the platform

Procurement of HV Cable trays

Procurement of Cable specific items (terminals, cable termination, etc.)

Installation: 66kV Cable pull-in and routing works

Installation: 66kV Cable termination and connection works

Cable testing

Energising of cable

TenneT	CP
A ⁽¹⁾	R
C	R / A
R / A	C
R / A	C
C	R / A
R / A	C
R / A	C
C	R / A
R / A	I
R / A	I
-	R / A
S	R / A
S	R / A
C	R / A
R	A ⁽²⁾

¹ The cable field layout shall be approved by TenneT.

² Accountable here means: the Connected Party will give clearance to TenneT to energise the cable.

Design

Design of the cable pulling methodology (basic design/philosophy) will take into account the following

factors:

- Dimensioning and load restrictions (e.g. J-tubes);
- Locations for winches;

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- Temporary storage area + facilities (scaffolding) on the cable deck in case the cables are stored before the topside is installed on top;
- Working area on the cable deck for cable works;
- Pull-in and routing of cables up to the 66 kV switchgear without joints or junction boxes on the cable deck.

Based on the generic cable pulling methodology, the Connected Party shall consult TenneT on detailed design for the cable pulling and installation method. With respect to the J-tubes, they have a fixed position on

the

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jacket which is determined in the basic design. The angle of the J-tube may however be (slightly) adapted as long as there are no conflicts with neighbouring cables or J-tubes. TenneT has to be consulted in this design process and has to approve the method. [TenneT will organise regular design meetings with the Connected Parties to the Platform.](#)

Procurement for items of the 66kV Cable route

TenneT will, after detailed design by the Connected Party, procure the cable trays for the main cable route. All components ~~which that~~ are cable specific (~~eg: such as~~ terminals, ~~wall penetrations, etc~~ [and cable termination](#)) will be procured by the Connected Party.

Installation of 66 kV Cables

The Connected Party is responsible for installation of cable protection (if applicable), the actual cable pull-in, cable storage (if any), J-Tube pigging (adjustment of the J-tube bell mouth angle will be very limited), cable routing, cable fastening and termination works making use of equipment such as pulling winch, hang-offs, pull-in wire, etc.

TenneT will facilitate these activities of the Connected Party with regards to the Platform structure itself. The Connected Party will get the possibility to install pull-in equipment on the Platform while it is under construction onshore.

[Before installation and after installation of the 66 kV cables on the Platform by the Connected Party and at such other moments as the Parties may agree on, joint inspections will be held to assess and log possible damages caused by one Party to property of the other Party.](#)

Testing and commissioning of 66 kV cables

After installation, the Connected Party shall be responsible for testing of the 66 kV cables, including HV

tests, phase checks, sheath testing and [optical time-domain reflectometer \(OTDR\)](#) tests on optical fibres.

For commissioning of the 66 kV cables, TenneT will be responsible for energising of the 66 kV cables and

TenneT will execute actual switching operation, after clearance is given by the Connected Party.

For the testing and commissioning phase agreements shall be made between TenneT and the Connected

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Party including agreements on installation responsibility (nominated person¹) and LOTO (Lock-out, Tag-out) principles.

Depending on the testing equipment needed, the equipment may be placed in vicinity of the [Gas Insulated Switchgear \(GIS\)](#) equipment or on the top deck of the Platform. The Connected Party may need HV cables and terminations to connect the test equipment to the 66 kV cable bay.

3.2.2 66 kV switchgear (feeder bays for 66 kV cables of the Connected Party)

In the table below, high level interfaces for the 66 kV switchgear (feeder bays for 66 kV cables of the Connected Party) are listed with for each interface the role of the two main stakeholders.

~~¹ Nominated person: the person responsible for the electrical safety of an electrical system. In Dutch: "installatieverantwoordelijke".~~

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High level interfaces on 66 kV switchgear (feeder bays for 66 kV cables of the Connected Party)

Interface	TenneT	CP
<u>Interface</u>	<u>TenneT</u>	<u>CP</u>
Design: 66kV GIS	R / A	I
Design: switchgear control	R / A	I
Design: protection of 66 kV feeder bays	R / A	C
Installation of switchgear on platform (+ P&C cabinets)		-

Design / installation on to the platform

TenneT intends to include the following cable termination in the 66 kV switchgear (only GIS part) which is designed according to IEC 62271-209: *Pfisterer HV-CONNEX, Size 4*.

The Connected Party shall align the accessories and (type) testing of its 66 kV cables on these specifications. Aspects on which the Connected Party will be consulted during the design phase of the 66 kV switchgear protection system are:

- Type of protection relay(s) for the 66 kV feeder bays;
- Protection relay settings for the 66 kV feeder bays¹.

Testing and commissioning

For testing and commissioning of the 66 kV cables is referred to Annex 5 [to the CTA – Compliance activities;](#)
[applicable testing requirements.](#)

¹ Nominated person: the person responsible for the electrical safety of an electrical system. In Dutch: "installatieverantwoordelijke".

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3.2.3 Telecommunication and fibre optic infrastructure

In the table below, high level interfaces for the telecommunication and fibre optic infrastructure (for use of the Connected Party) are listed with for each interface the role of the two main stakeholders.

High level interfaces on the telecommunication and fibre optic infrastructure (for use of the Connected Party)

Interface	TenneT	CP
Design & installation: Fibre optic infrastructure of the grid connection system	R / A	C
Design & installation: routing and termination of inter-array FO cable in splice box	C	R / A
Design & installation: Interface to other equipment of TenneT	R / A	I

Fibre optic infrastructure design and installation

In the design phase, TenneT will define requirements, location of patch panels and fibre optic cabling within the Platform.

The Connected Party shall provide all necessary design input including number and specification of fibre

optic cables from 66 kV cables of the Connected Party. Special attention shall be given to the location of the first splice boxes where fibre optic cables from 66 KV cables of the Connected Party will be terminated and connected to fibre optic platform cables.

During the design phase, agreements shall be made on interface management of the installation phase (checks by the Connected Party) and testing phase.

3.2.4 Connected Party's equipment located on TenneT infrastructure (offshore and onshore)

The Connected Party can freely design the equipment to be installed in the designated rooms [for the Connected Party](#) as long as general requirements and boundary conditions applicable to ~~these~~[the](#) rooms are followed (weight / size limits, climate conditions, power supply, etc.).

In the case equipment of the Connected Party is to be placed outside of the designated room (including connection from this equipment to the designated room), the Connected Party shall inform TenneT on these requirements in the early design stage and agreements on this equipment shall be made between TenneT and the Connected Party.

With regards to installation of equipment in the designated rooms, agreements shall be made on starting date and (ultimate) date of completion of the Connected Party's installation works.

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Designated room for the Connected Party in onshore station

In the table below, high level interfaces for the equipment of the Connected Party in the designated room in

the onshore substation are listed with for each interface the role of the two main stakeholders.

High level interfaces on the Connected Party's equipment in the designated room on the onshore substation

Interface	TenneT	Connected Party
Design: TenneT auxiliary services for the designated room	R/A	C / I
Design: Connected Party's equipment inside designated room	I	R / A
Construction: TenneT auxiliary services for the designated room	R/A	I
Construction: installation of Connected Party's equipment in the designated room	S	R / A

Designated room for the Connected Party at the Platform

In the table below, high level interfaces for the equipment of the Connected Party in the designated room [on at](#)

the Platform are listed with for each interface the role of the two main stakeholders.

High level interfaces on the Connected Party's equipment in the designated room on the platform

<u>Interface</u>	<u>TenneT</u>	<u>CP</u>
Interface	TenneT	CP
Design: TenneT auxiliary services for the designated room	R/A	C / I
Design: Connected Party's equipment inside designated room	I R / A	R / A
Construction: TenneT auxiliary services for the designated room	S	C / I R / A
Construction: installation of Connected Party's equipment in the designated room		
Construction: installation of Connected Party's equipment on other locations	S	R / A

All permanent equipment of the Connected Party for the designated room on the Platform must be installed when the Platform is in the construction yard, i.e. before load out. Configuration / programming works, interface tests and inspections by the Connected Party shall be done in the construction yard as far as possible. The construction yard may be located outside of Europe.

If installation works need to be planned after offshore installation of the topside, the Connected Party shall inform TenneT as soon as possible.

Commissioning

The Connected Party shall be responsible and accountable for all testing and commissioning activities related to the Connected Party's equipment on TenneT's infrastructure.

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TenneT will support the Connected Party during testing and commissioning with regards to the services provided by TenneT (66 kV GIS switching actions, auxiliary services to designated rooms, shared data acquisition systems, optical fibres).

3.2.5 Coordination during offshore works

TenneT will be responsible (R) and accountable (A) for the Platform and therefore for planning, coordination and safety rules, where the Connected Party will be supportive (S). To manage planning, coordination and safety properly, TenneT will provide work permits for offshore works within the safety zone (500 m) of the Platform and for all works on the Platform.

The Connected Party will support TenneT with this coordination by correct and on-time application for work permits and by participating in all planning, interface and progress meetings to be scheduled for this purpose.

TenneT will define the method for (emergency) communication within the project site (platform safety zone and the Platform itself).

Further agreements between TenneT and the Connected Party on marine coordination and coordination of works on the Platform shall be made in a later phase.

3.2.6 Document management

Exchange of documents and formal communication between the Parties shall be through a single document management system, to be selected by TenneT.

4. Exchange of information

The Parties shall provide each other with the information that by reasonable standards may be relevant to the operation of the Offshore Transmission System (including the Connection and the Platform) and the onshore transmission system and the operation of the Installation of the Connected Party.

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Summary report:	
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Style name: De Brauw Default Style	
Intelligent Table Comparison: Active	
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Modified filename: 20151201 FINAL DRAFT Annexes to REA_Offshore_UK.PDF	
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Delete	190
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Move To	7
Table Insert	48
Table Delete	46
Table moves to	0
Table moves from	0
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Embedded Excel	0
Format changes	0
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