

STAKE HOLDER CONSULTATION PROCESS OFFSHORE GRID NL	
Type:	Position paper
Work stream	Technical
Topic:	T.17 – Compliance testing
Filename	ONL-TTB-03069 T17_Compliance testing_PP_V1
Version	1 - Public
Pages	8

QUALITY CONTROL		
Prepared:	TenneT team	
Reviewed:	M. Müller	08.10.2015
Approved:	F. Wester	08.10.2015
Release	Public	

Table of Contents

1. BACKGROUND MATERIAL.....	2
2. SCOPE AND CONSIDERATIONS.....	2
<i>General</i>	3
<i>Technical</i>	3
3. POSITION TENNET ON COMPLIANCE ACTIVITIES	8
4. TOPIC CONSULTATION.....	8

1. Background material

Literature used:

- Draft Regulation establishing a Network code on Requirements for Grid Connection of Generators (version sent to electricity cross-border committee 10/04/2015: <https://ec.europa.eu/energy/en/topics/wholesale-market/electricity-network-codes>)
- TenneT, SO-SOC 13-141 version 3.0 January 2014, "Compliance activities"

2. Scope and considerations

Figure 1 shows the connection of an offshore wind farm to the onshore electricity grid. TenneT will supply and install the grid connection up to, and including, the offshore substation. The wind park, including the wind turbines and the array cables, up to the offshore Connection Point (CP)¹ at the switchgear installation on the offshore substation of TenneT, is to be supplied and installed by the owner of the Power Park Module (PPM²).

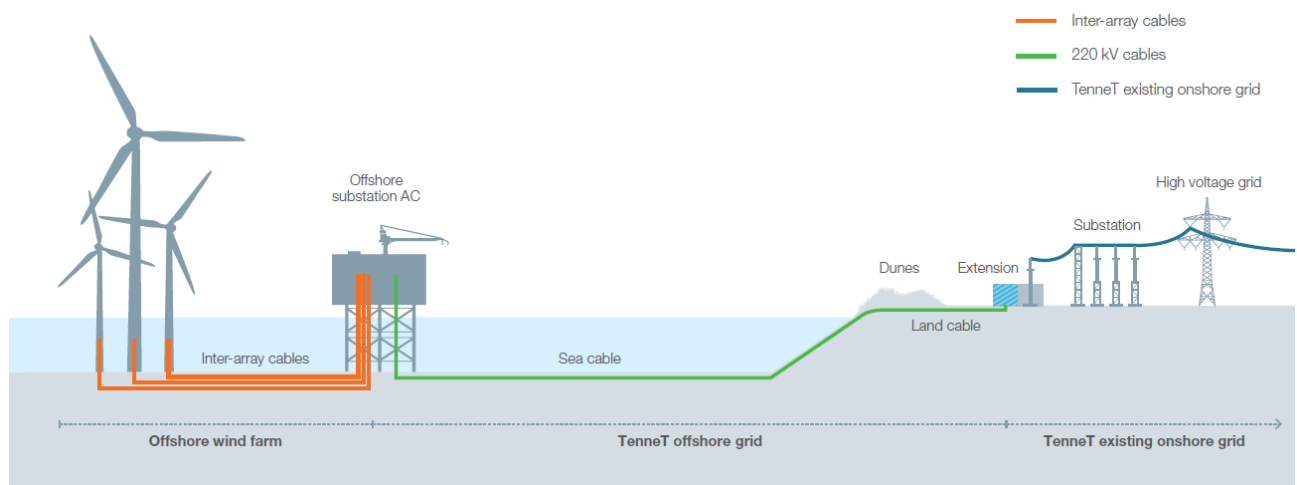


Figure 1 - Schematic overview of the offshore electrical grid. Source: TenneT

Each inter array cable string connects a number of turbines of a PPM to the offshore substation. 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 paper describes the commissioning process for connected Power Park Modules connected to TenneT offshore grid.

¹ The connection point (CP) between the offshore power park module (PPM) and TenneT is specified [Ref: position paper T3] at the cable termination of the inter-array cables and the switchgear installation on the platform.
² Ref: position paper T3

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 measures³, 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.

Technical

The commissioning can be divided into two main consecutive activities. First the Site Acceptance Test (SAT) activities, followed by the compliance testing activities.

The SAT activities focus on the prove of the technical quality of the installed installation. Although these activities are the responsibility of the OWFs, the OWFs shall mitigate any risk that the energisation of their installation jeopardises the TenneT offshore grid. Therefore the SAT program, regarding the Offshore PPM connection to the TenneT platform, of the OWF shall be approved by TenneT and scheduled in cooperation with TenneT.

The compliance testing activities are necessary to prove that the connection of the Offshore PPM of the OWF to the TenneT offshore substation is compliant with the connection requirements for offshore PPMs as defined in the RfG, and further detailed in annex 6 of the Realisation Agreement (REA). Furthermore compliancy with the harmonic emission limits will be assessed.

The compliance tests are described in the (draft) RfG, chapter 4 of Title IV "Compliance testing for offshore power park modules", which has been further detailed in the TenneT document "Compliance activities" with reference SO-SOC 13-141, version 3.0 January 2014. These two documents, with the following additions to the document SO-SOC 13-141, are applicable for the compliance activities:

Chapter 1 Scope

The activities shall be based on the requirements described in document RfG, further detailed in annex 6 of the REA. The requirements are to be called 'TenneT Requirements' (TR). Document "Wind farm Connection Requirements version 5.7" is not applicable.

Clause 3.2.2.2 bullet 4 and 5

- Test reports for short and long term operation during over and under frequency according to Article 24 of the RfG;
- Test reports for short and long term operation during over and under voltage according to Article 25 of the RfG;

³ [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)

Clause 3.2.2.2

The section "All in this section mentioned measurements and tests shall be performed and witnessed by an independent party" is not applicable.

Clause 4.2

The reference to section 2.2 of the TR must be replaced by the reference to Article 25 of the RfG.

Clause 4.3

The reference to section 2.3 of the TR must be replaced by the reference to Article 25 of the RfG.

Clause 4.4

The reference to section 2.4 of the TR must be replaced by the reference to Article 25 of the RfG.

Clause 4.5

The reference to section 2.5 of the TR must be replaced by the reference to Article 25 of the RfG.

Clause 4.6

The reference to section 2.6 of the TR must be replaced by the reference to Article 26 of the RfG.

Clause 4.7

The reference to section 3.1 of the TR must be replaced by the reference to Article 24 of the RfG.

Clause 4.8

The reference to section 3.2 of the TR must be replaced by the reference to Article 24 of the RfG.

Clause 5.1.1

The reference to section 2.5 and 2.6 of the TR must be replaced by the reference to Articles 25 and 26 of the RfG.

Clause 5.2

Figure 1 shall be replaced by the applicable figures 'c' and 'd' of annex 6 of the REA.

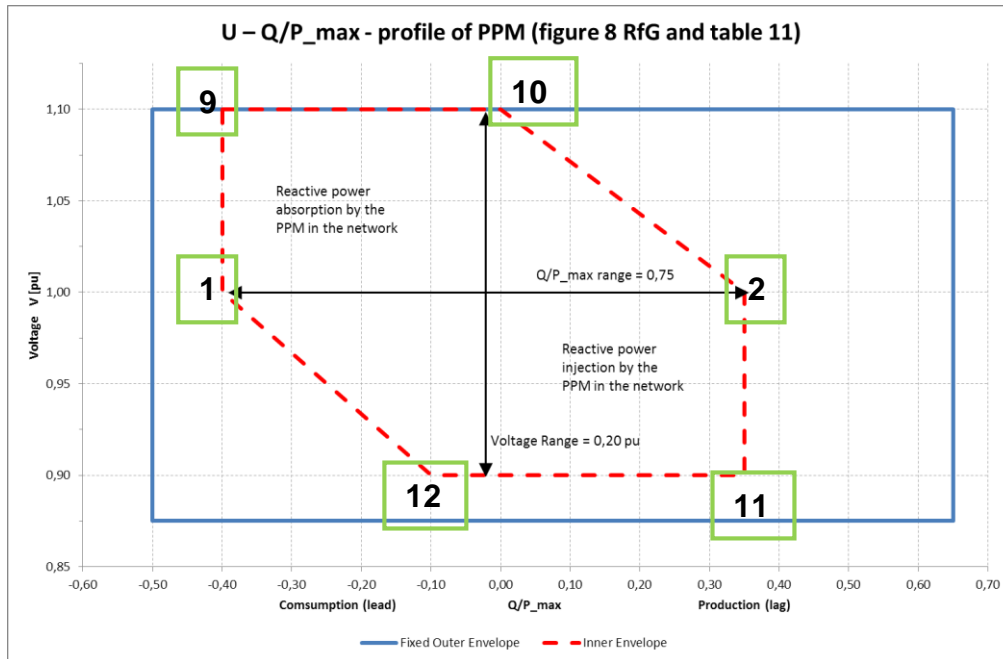


Figure 'c'

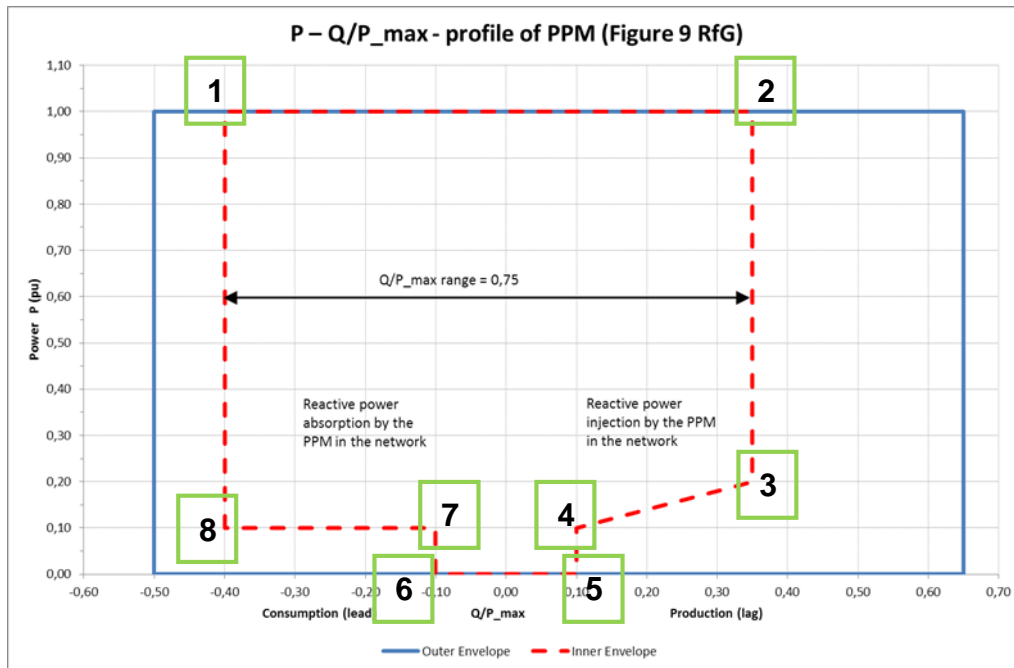


Figure 'd'.

First bullet "**Procedure**"

Text shall be replaced by:

- Load flow calculations shall reproduce the in Table 2 mentioned scenarios at the Connection Point

considering the reactive power capability of the wind turbines. Table 2 visualizes this calculations cases referring to P - Q/Pmax profile and V - Q/Pmax according to Article 25 of the RfG.

Table 2 shall be replaced by:

Calculation case	U	P	Q	Reference
1	100%	100% Pmax	Q/Pmax=-0.4	Article 25 (P - Q/Pmax profile)
2	100%	100% Pmax	Q/Pmax=0.35	Article 25 (P - Q/Pmax profile)
3	100%	20% Pmax	Q/Pmax=0.35	Article 25 (P - Q/Pmax profile)
4	100%	10% Pmax	Q/Pmax=0.10	Article 25 (P - Q/Pmax profile)
5	100%	0	Q/Pmax=0.10	Article 25 (P - Q/Pmax profile)
6	100%	0	Q/Pmax=-0.10	Article 25 (P - Q/Pmax profile)
7	100%	10% Pmax	Q/Pmax=-0.10	Article 25 (P - Q/Pmax profile)
8	100%	10% Pmax	Q/Pmax=-0.10	Article 25 (P - Q/Pmax profile)
9	110%	100% Pmax	Q/Pmax=-0.40	Article 25 (V - Q/Pmax profile)
10	110%	100% Pmax	Q/Pmax=0	Article 25 (V - Q/Pmax profile)
11	90%	100% Pmax	Q/Pmax=0,35	Article 25 (V - Q/Pmax profile)
12	90%	100% Pmax	Q/Pmax=-0,10	Article 25 (V - Q/Pmax profile)
13	80%	100% Pmax	open	Article 24
14	115 %	100% Pmax	open	Article 24

First bullet "**Evaluation Criteria**"

Text shall be replaced by:

- Requirements as specified in Article 50 of the RfG including the following issues:

Clause 5.3

Text "section 2.5 of the TR" shall be replaced by "Article 25 of the RfG"

Text "section 2.6 of the TR" shall be replaced by "Article 26 of the RfG"

Clause 5.4"Procedure"

Text shall be replaced by

- Starting point for the following 4 tests is normal operation. This means the unit is in steady state operation with a power factor at the Connection Point as determined with TenneT.
- The set-point of reactive power control mode may be adjusted locally in the park-controller in case no remote control available.
- While executing the tests the active power output of the wind park shall be more than 20 % Pmax.
- Tests shall be executed by step-changing the set-point in both directions in full range until one of the following restrictions applies.
 - min. or max. set-point position is reached
 - max. absorbed or injected reactive power is reached according to P - Q/Pmax and V - Q/Pmax profiles in Articles 24 and 25 of the RfG.
 - one of the operational limits of the TenneT network is reached. This restriction needs to be determined in advance and real time by TenneT. Usually an operated voltage range of 95-105% of rated voltage applies.
- Max. and min. reached set-point shall be maintained for at least 10 minutes.
- Voltage control mode
 - Voltage set point shall be step-wise changed by 1% steps in both directions until one of above mentioned restrictions applies
 - Q_{ref} set point be step-wise changed by 1% steps in both directions until one of above mentioned restrictions applies
- Power factor control mode
 - Power factor set point shall be step-wise changed by 0.01 steps in both directions until one of above mentioned restrictions applies.
- Reactive power control mode
 - Reactive power set point shall be step-wise changed by 10% steps in both directions until one of above mentioned restrictions applies.

"Evaluation Criteria"

Text "section 2.4 of the TR" shall be replaced by "Article 25 of the RfG"

Clause 5.4First bullet "Procedure"

Text "reactive power injection" shall be replaced by "park in Voltage Control Mode, Qref = 0 Mvar"

Because the Offshore PPM installation will consist of several physical cable connections, which might be commissioned separately, a further detailed commissioning planning will be agreed upon. The SAT and commissioning might then be done per connected string of turbines, where the requirements will be assessed proportionally in respect with the technical capabilities per connected string.

It shall be acknowledged by all parties that necessary information for compliance testing activities shall be made available and shared without restrictions.

3. Position TenneT on Compliance activities

Above considerations lead TenneT to the following position:

With respect to the SAT activities of the Offshore PPM connection to the TenneT platform, the OWF shall submit their SAT program to TenneT for approval.

Furthermore, it is the responsibility of each connected OWF party that its Offshore PPM has the required capabilities according to the TenneT requirements. TenneT requires the OWF to perform all compliance activities. The planning of all activities shall be agreed with TenneT. Once all compliance tests of the entire connection are performed successfully, the OWF realisation phase is considered to be finalised.

4. Topic consultation

The expert meeting of October 21st 2015 gives TenneT the opportunity to get feedback from developers on their position regarding "Compliance activities".