Reactive power requirements

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entsoe
Reliable Sustainable Connected

Reactive Power Requirements – General principles

Fundamental

- Availability of reactive power capability is a **key need** for system performance and security.
- With **higher levels of RES penetration** many synchronous generators are displaced, as they are not in merit to provide active power and hence unable to provide reactive power, at the times of high RES production. This **removes a key source of reactive power**.
- The development of **underground cables** mainly in the distribution grid and the development of embedded generation in distribution networks have an increasing impact on the reactive power flows at the interface between transmission and distribution.

Challenges

The above leaves the transmission system with less reactive resources to

- be able to compensate the reactive demand of distribution networks;
- cope with the transmission connected reactive demand itself.

Reactive Power Requirements – General principles

How to cope with these Challenges?

- ENTSO-E believes that voltage stability of the system should be supported by all network operators and grid users, especially in the context of increasing RES/embedded generation and large transit flows.

- Some requirements exist already in some countries, for generators and/or for customers and for distribution system operators. There is a need for improvement and harmonization to some extent across Europe in order to cope with these new challenges.

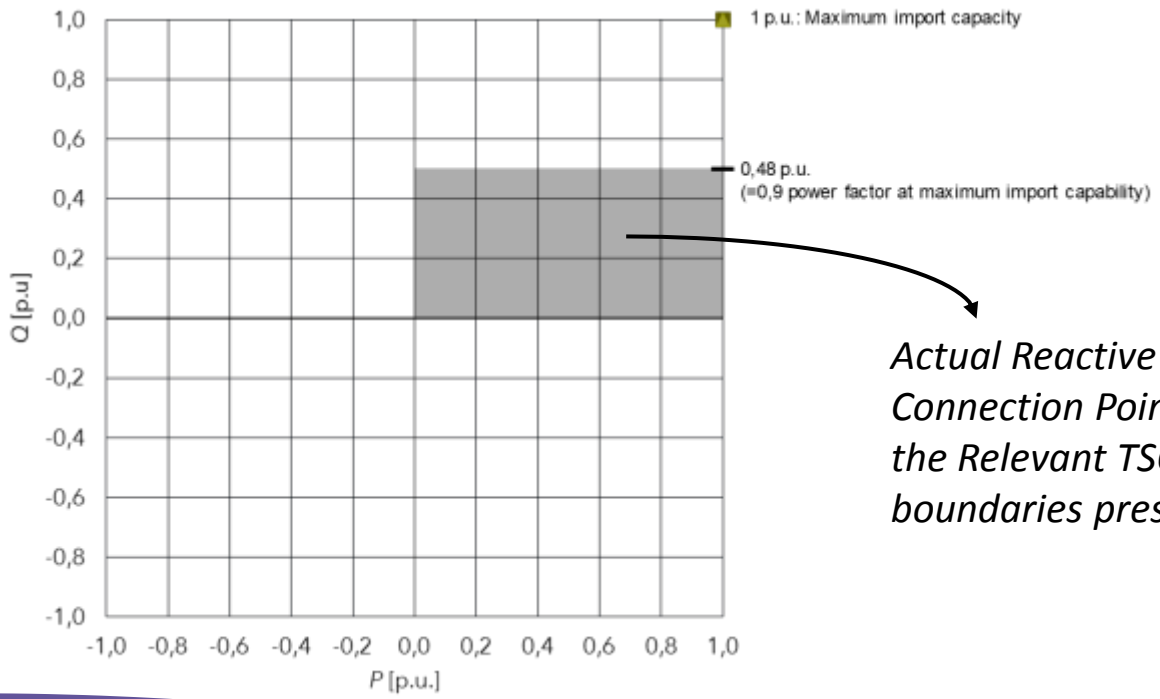
- Cost Benefit Analyses carried out in several diverse systems (see FAQs) have shown that from a socio-economic viewpoint the total cost to meet the need for reactive power is lower if the reactive compensation is undertaken closer to the demand than if undertaken at the TSO EHV level.

- Reactive power needs and potential is also determined by local conditions. A correct balance is to be found in the DCC to allow exceptional and alternative solutions if justified.

General Reactive Power Requirements

a) Reactive Power capability ranges. Transmission Connected Distribution Networks and Transmission Connected Demand Facilities shall be capable to maintain their steady-state operation at their Connection Point in a Reactive Power range:

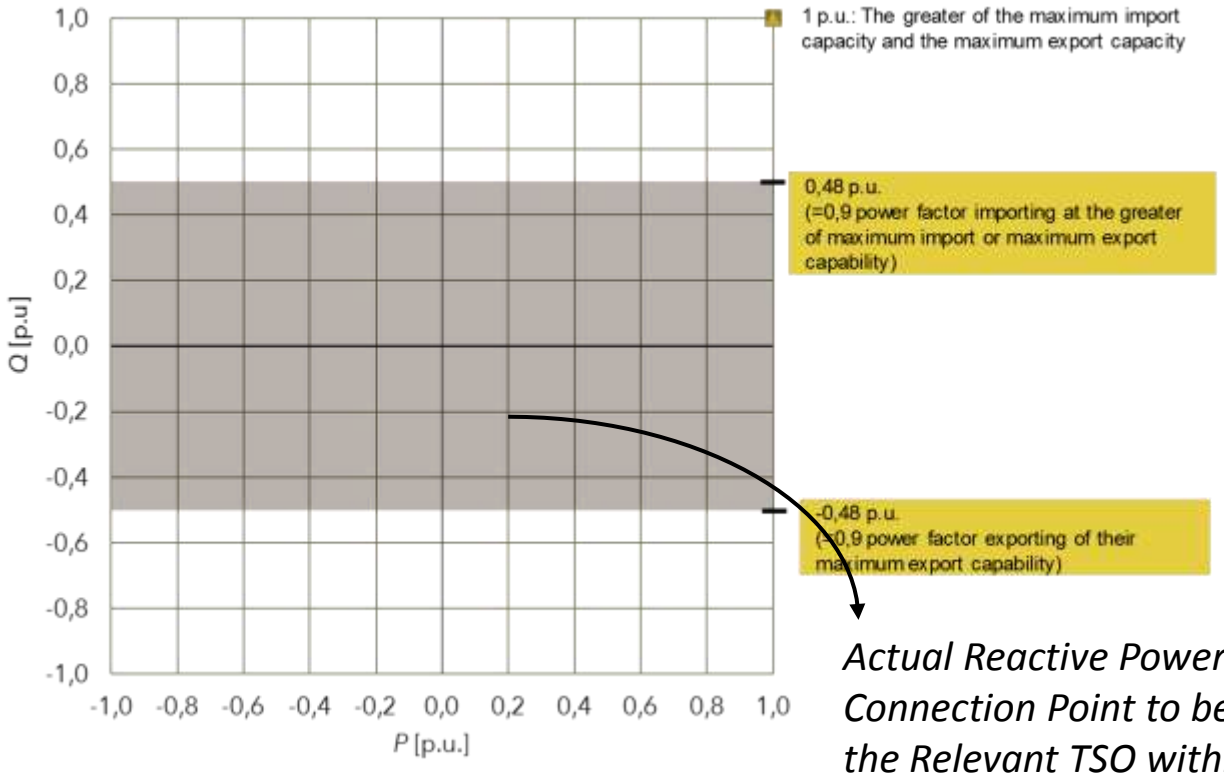
- **Maximum Reactive Power exchange of a Transmission Connected Demand Facility without onsite generation:**



Actual Reactive Power range at the Connection Point to be specified by the Relevant TSO within the boundaries prescribed by DCC

General Reactive Power Requirements

- **Maximum Reactive Power exchange of a Transmission Connected Demand Facility with onsite generation or a Transmission Connected Distribution Network**



Actual Reactive Power range at the Connection Point to be specified by the Relevant TSO within the boundaries prescribed by DCC

General Reactive Power Requirements

- **Transmission Connected Distribution Networks shall have the capability at the Connection Point to not export Reactive Power (at nominal Voltage) at an Active Power flow of less than 25% of the Maximum Import Capability, except in situations where either technical or financial system benefits are demonstrated by the Relevant TSO and the Distribution Network Operator through joint analyse, while respecting the provisions of Article 9(3).**

Principles

- Compensation of reactive power spilling in the higher voltage network during low load
- Compensation close to the production of reactive power – same CBA justification as for the preceding requirements
- Design requirement – only tested by simulation, not in real operation
- Reference point of 25% as low load indicator discussed with the DSO TEG
- Alternative solutions allowed as exception if justified.

General Reactive Power Requirements

b) The Relevant TSO shall have the right to require, while respecting the provisions of Article 9(3), the ability of the Transmission Connected Distribution Network to actively control the exchange of Reactive Power at the Connection Point as part of a wider common concept for management of Reactive Power capabilities for the benefit of the entire Network The method of this control shall be agreed between the Relevant TSO and the Distribution Network Operator to ensure the justified level of security of supply for both parties. The justification shall include a roadmap in which the steps and the timeline for fulfilling the requirement are specified.

c) The DSO shall have the right to apply to the Relevant TSO to be considered for reactive power management set out in Paragraph b, whilst respecting the provisions of Article 9(3).

Changes since the public consultation on reactive power requirements

June 2012

1. Transmission Connected Demand Facilities and Transmission Connected Distribution Networks shall fulfill the following requirements referring to Reactive Power exchange and control:

a) With regard to Reactive Power capability ranges:

1) All Transmission Connected Distribution Networks and Demand Facilities will be capable to maintain their operation at their Connection Point as follows:

- For Demand Facilities without onsite generation, the actual Reactive Power range specified by the Relevant Network Operator will not be wider than 0.90 importing to unity power factor of their Maximum Import Capability, except in situations where either technical or financial system benefits (in particular through contractual arrangements) are demonstrated and accepted by the Relevant Network Operator in agreement with the Relevant TSO, while respecting the provisions of Article 4 (3);

1. All Transmission Connected Demand Facilities and all Transmission Connected Distribution Networks, deemed significant pursuant to the provisions of this Network Code, shall fulfil the following requirements referring to Reactive Power exchange and control:

a) With regard to Reactive Power ranges:

i. Transmission Connected Distribution Networks and Transmission Connected Demand Facilities shall be capable to maintain their steady-state operation at their Connection Point in a Reactive Power range specified by the Relevant TSO, while respecting the provisions of Article 9(3) and the following conditions:

- For Transmission Connected Demand Facilities without onsite generation, the actual Reactive Power range specified by the Relevant TSO for importing reactive power shall not be wider than 0.9 to 1 Power Factor of their Maximum Import Capability, except in situations where either technical or financial system benefits are demonstrated and accepted by the Relevant TSO, while respecting the provisions of Article 9(3);

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Changes since the public consultation on reactive power requirements

June 2012

- For Demand Facilities with onsite generation, the actual Reactive Power range specified by the Relevant Network Operator will not be wider than 0.9 importing power factor of the larger of their Maximum Import Capability or Maximum Export Capability to 0.9 exporting power factor of their Maximum Export Capability, except in situations where either technical or financial system benefits (in particular through contractual arrangements) are demonstrated and accepted by the Relevant Network Operator in agreement with the TSO, while respecting the provisions of Article 4(3);

- For Transmission Connected Distribution Networks, the actual Reactive Power range specified by the Relevant Network Operator will not be wider than 0.9 importing power factor of the larger of their Maximum Import Capability or Maximum Export Capability to 0.9 exporting power factor of their Maximum Export Capability;

- For Transmission Connected Demand Facilities with onsite generation, the actual Reactive Power range specified by the Relevant TSO shall not be wider than 0.9 Power Factor of the larger of their Maximum Import Capability or Maximum Export Capability in import to 0.9 Power Factor of their Maximum Export Capability in export, except in situations where either technical or financial system benefits are demonstrated and accepted by the Relevant TSO, while respecting the provisions of Article 9(3);

- For Transmission Connected Distribution Networks, the actual Reactive Power range specified by the Relevant Network Operator shall not be wider than 0.9 Power Factor of the larger of their Maximum Import Capability or Maximum Export Capability in import to 0.9 Power Factor of their Maximum Export Capability in export, except in situations where either technical or financial system benefits are demonstrated by the Relevant TSO and the DNO through joint analyse.

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b) Transmission Connected Distribution Networks shall have the capability at the Connection Point to maintain 0Mvar exchange at nominal Voltage (with a deadband of 5% of Active Power of Maximum Import Capability) for a load exchange of no higher than 25% of the Maximum Import Capacity.

Transmission Connected Distribution Networks shall have the capability at the Connection Point to not export Reactive Power (at nominal Voltage) at an Active Power flow of less than 25% of the Maximum Import Capability, except in situations where either technical or financial system benefits are demonstrated by the Relevant TSO and the DNO through joint analyse, while respecting the provisions of Article 9(3).

This scope of the analysis will be agreed between the Relevant TSO and DNO and will consider the possible solutions and determine the optimal solution for reactive power exchange between their networks taking adequately in consideration the specific network characteristics, variable structure of power exchange, bidirectional flows and the reactive capabilities in the distribution grid, while respecting the provisions of Article 9(3);

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c) The TSO shall have the right where justified to require … while respecting the provisions of Article 4 (3). The method of this control should be agreed between the TSO and the Distribution Network to ensure …

b) The Relevant TSO shall have the right to require, while respecting the provisions of Article 9(3), …… The method of this control shall be agreed between the Relevant TSO and the Distribution Network Operator to ensure …

c) The DSO shall have the right to apply to the Relevant TSO to be considered for reactive power management set out in Paragraph b, whilst respecting the provisions of Article 9(3).

d) The applicability of the provisions of paragraph 1 c) to the Transmission Connected Distribution Network shall exclude the applicability of paragraph 1 a) to this Network.

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➢ Reactive power range requirements

Thank you all for your attention.

Questions?