European Network of
Transmission System Operators
for Electricity

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ENTSO-E response to CEDEC on Interpretation of article 15 in NC DCC

External Project Team / WG CNC

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2. Questions received

Title: Interpretation of article 15 in NC DCC – Belgian DSOs

Topic: correct understanding of article 15.1 (f) and 15.2 of the NC DCC

Date: 2016-09-09

Relevant articles from the NC DCC:

Article 15.1

(...)

(e) the reactive power range requirement values shall be met at the connection point;

(f) by way of derogation from point (e), where a connection point is shared between a power generating module and a demand facility, equivalent requirements shall be met at the point defined in relevant agreements or national law.

Article 15.2

The relevant TSO may require that transmission-connected distribution systems have the capability at the connection point to not export reactive power (at reference 1 pu voltage) at an active power flow of less than 25 % of the maximum import capability. Where applicable, Member States may require the relevant TSO to justify its request through a joint analysis with the transmission-connected distribution system operator. If this requirement is not justified based on the joint analysis, the relevant TSO and the transmission-connected distribution system operator shall agree on necessary requirements according to the outcomes of a joint analysis.

Questions:

For article 15.1.f:

Is this text applicable to DSOs?

The connection point between a distribution grid and a transmission grid (typically a transformer station) will most probably always be a 'mixed' connection point. Power generating modules and demand facilities will be connected at the same connection point, not necessarily directly, but at least indirectly via the distribution lines connected to that connection point.

So, one could argue that article 15.1.f would be applicable to (almost) all connection points between the distribution and the transmission grid...

... but since the exact phrasing is not mentioned in plural but in singular (power generating module and demand facility) we conclude that the paragraph will not be applicable to the DSOs' connections points to the transmission grid.

Can this latter statement be confirmed ?

For article 15.2:

The article is clearly applicable to the DSOs if the relevant TSO requires to have this capability.

We could 'translate' this article (and article 15.1 (b)) in the following figure (see next page).

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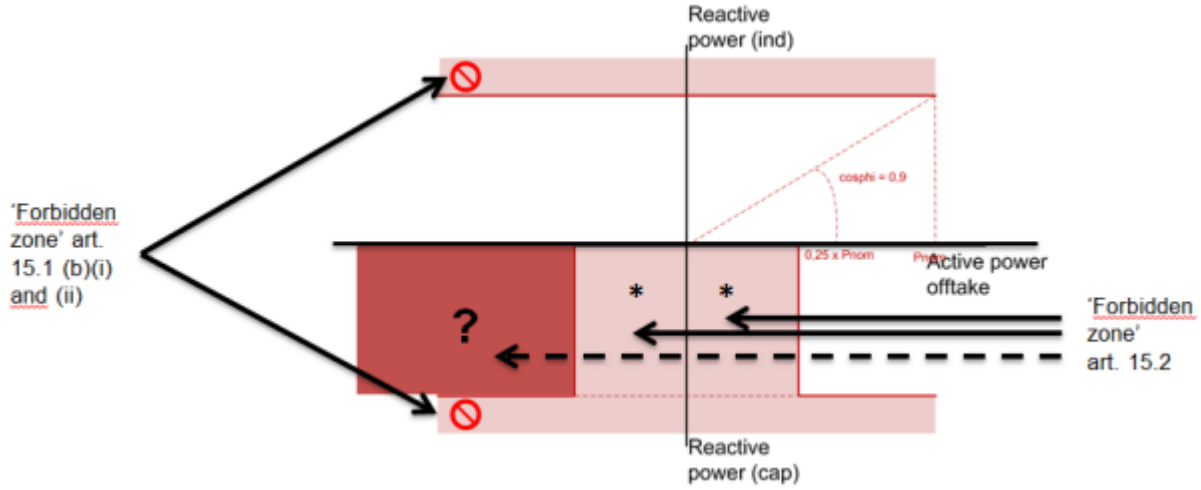

Is it correct to state that in relation to article 15.2 the 'forbidden zone' (= not export reactive power) is limited to the light red zones (*) as indicated above and does not concern the dark red zone.

Can this statement be confirmed ?

Note regarding the dark red zone:

If there is a power flow from the DSO to the TSO (export power to the TSO), one could mathematically state, since the power flow has a negative sign, that the dark red zone represents a power flow of less than 25% of the maximum import power (e.g. – 75% < 25%).

3. Position on CEDEC question re DCC Article 15(1)(f)

Due to the removal of a generic statement in the ENTSO-E version of DCC (Article 1 of 21/12/12 version) during comitology process, that the requirements were to apply net of generation, Article 15(1)(f) was introduced to specifically address this issue for this requirement.

As it is conceivable that the TSO/DSO interface, typically within a station, could also contain a PGM at the same connection point, the objective of Article 15(1)(f) is to clarify that the equivalent requirements to Article 15 would be required, i.e. net of the PGM.

The definition of the connection agreement and the connection point in the Network Code RfG are very explicit. Given these definitions it seems to be clear the Article refers to the situation as described above and not to all embedded generation (i.e. those beyond the connection point) within the DSOs network.

> *NC RfG Definition –*
>
> *'connection agreement' means a contract between the relevant system operator and either the power-generating facility owner, demand facility owner, distribution system operator or HVDC system owner, which includes the relevant site and specific technical requirements for the power-generating facility, demand facility, distribution system, distribution system connection or HVDC system;*
>
> *'connection point' means the interface at which the power-generating module, demand facility, distribution system or HVDC system is connected to a transmission system, offshore network,*

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distribution system, including closed distribution systems, or HVDC system, as identified in the connection agreement;

In the event of a generator application to the DSO that generator will connected to the distribution network and thus become part of the distribution system, i.e. the network and the users connected to it. This system will be connected to the TSO network at the connection point via a connection agreement and therefore the generator will have a connection point to the Distribution system (and not the Transmission System). However the Distribution system will have a connection point to the Transmission system, and it will be required to ensure its system (network and users in totality) complies with the requirements at the connection point.

4. Position on CEDEC question re DCC Article 15(2)

Objective

The objective of the document is to provide clarity about the original intention of Article 15.2 of the Demand Connection Code regulation. The purpose of this proposal is to remove misinterpretation of the requirement and its application following feedback and comments to the CNC ESC from stakeholders.

Function of requirement

The development (and redevelopment) of distribution systems has and continues to make greater use of an increasing range of technologies.

These technologies have a range of technical characteristics that must be factored in when considering the ongoing requirements placed on Distribution System Operators when they seek connection or modernisation of their existing connections to the transmission system.

Most significant are changed load flow patterns in distribution networks due to significant amounts of embedded generation, and a greater share of cables within the system, both having impact on the reactive power exchange between transmission and distribution networks.

The most problematic operating conditions in a distribution network with regard to reactive power exchange between TSO and DSO are likely to occur during the lowest net demand[1] periods. A low net demand situation will occur in either low gross demand periods or in periods where gross demand and embedded generation are quite balanced in that distribution network. In this situation, the reactive power generated in the distribution system, notably from cables but also from low loaded overhead lines[2], is likely to exceed the reactive power utilised by the demand users. The excess reactive power is then exported from the distribution system into the transmission system where it must be managed. Such an export of reactive power is likely to cause a significant challenge to the TSO to keep transmission level voltages in the admissible operating range.

[1] Net demand of a distribution network is the difference between the instantaneous active power demand of demand facilities or other distribution networks connected to that distribution network (gross demand) and the instantaneous embedded generation in that distribution network (neglecting active power losses in that distribution network). It equals to the active power accumulated over all interfaces between a transmission network and the distribution network connected to it. In case of an instantaneous generation surplus, net demand becomes negative.

[2] If the low net demand situation results from a balance of gross demand and embedded generation the phenomenon of low loaded lines depends on the local distribution of load and embedded generation.

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In particular this is challenging during low net demand periods when a considerable amount of transmission-connected generation is not running and hence a source of reactive power provision is missing.

This also means that there is a limited capability to absorb excess reactive power generated from the network by either generation or demand. In order to do so would require additional mitigation measures for example running additional out of merit generation. Even utilising latent on-line grid users' capabilities to manage reactive power has a cost implication to those users. This must be accounted for in selecting the most appropriate management approach in this situation.

Cost benefit analysis was completed as part of the development of the Demand Connection Code. This supported the universal recognised principle that reactive power is most efficiently supplied when the distance between production and demand is minimised. The analysis concluded that in order to develop the most efficient solutions to users and an overall equitable approach, transmission and distribution system operators should seek to balance reactive power (reactive power compensation) in their respective networks.

Therefore to ensure that the principle of reactive power compensation is cost effectively applied the requirement of Article 15.2 was included in the code.

Typically as the absolute value of net demand increases, the excess of reactive power that could flow from the distribution to transmission network reduces. To minimise the level of reactive compensation capacity that a distribution system operator would be required to install, the requirement for capability of reactive power compensation shall cover the worst case realistic network condition of minimum demand.

Following discussion with the 4 DSO European associations a figure of an active power flow from transmission to distribution of 25% of the maximum import capability at each transmission to distribution interface was selected to represent the minimum demand level to be used. The use of a single minimum demand provides a common and equitable approach across Europe in the application of this requirement.

Although lower demand or even active power export conditions will occur the overall operating time in these conditions was not considered adequate to justify the investments necessary.

In order to ensure security of supply, voltage stability and cost effective network development, the range of generation availability and dispatch patterns need to be assessed. Therefore in assessing the reactive compensation from embedded sources within the distribution system, their availability to meet the requirement needs to be justified and shown.

As a functional connection requirement for distribution network connections, only the capability is specified to ensure that on-going system operation is possible. It does not prescribe the operational use of this capability at the 25% or at any other demand level.

Conclusion

Following feedback from stakeholders on their interpretation of the requirements in the code it is clear that the existing text can be misconceived. The confusion is centred on, is it required to install capability that is sufficient to be compliant with the requirement at a single operational point at or below 25% of the maximum import capability, or for every operational point at or below 25%.

To resolve this issue a revised wording of Article 15.2 could deliver certainty with regard to the originally intended purpose of the requirement as discussed and agreed with stakeholders in the consultation and development of the code, mostly notably the four DSO associations.

Original Article 15.2

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'The relevant TSO may require that transmission-connected distribution systems have the capability at the connection point to not export reactive power (at reference 1 pu voltage) at an active power flow of less than 25 % of the maximum import capability. Where applicable, Member States may require the relevant TSO to justify its request through a joint analysis with the transmission-connected distribution system operator. If this requirement is not justified based on the joint analysis, the relevant TSO and the transmission-connected distribution system operator shall agree on necessary requirements according to the outcomes of a joint analysis.' 18.8.2016 L 223/22 Official Journal of the European Union EN

Revised wording for Article 15.2

'The relevant TSO may require that transmission-connected distribution systems have the capability at the connection point to not export reactive power (at reference 1 pu voltage) over the normal range of output of generating resources within the distribution system in combination with either,

- *an active power flow into the distribution system of 25 % of the maximum import capability or,*
- *a defined active power flow from transmission to the distribution system from zero up to 25% of the maximum import capability, if the latter leads to are more cost-efficient solution.*

Where applicable, Member States may require the relevant TSO to justify its request through a joint analysis with the transmission-connected distribution system operator. If this requirement is not justified based on the joint analysis, the relevant TSO and the transmission-connected distribution system operator shall agree on necessary requirements according to the outcomes of a joint analysis.'

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