
Overview of Implementation Guidance Documents

- Connection Network Codes -

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1. Introduction

Overview of connection codes

The European Connection Network Codes - [Requirements for Generators \(RfG\)](#), [Demand Connection Codes \(DCC\)](#) and [High Voltage Direct Current Connections \(HVDC\)](#) – have been developed in accordance with Regulation (EU) 714/2009 and are cornerstones to fulfil the third energy package.

The first connection network code, which entered into force on 17 May 2016, is the Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (RfG). Regulation (EU) 2016/1447 of 26 August 2016 establishing a network code on requirements for grid connection of high voltage direct current systems (HVDC), and The Regulation establishing a network code on demand connection (DCC) entered into force on 7 September 2016.

In order to support the implementation of network codes at national level, as required by the codes, ENTSO-E has produced non-binding guidance on implementation. This guidance is provided through so-called Implementation Guidance Documents (IGDs).

Legal background for IGDs

Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators, in chapter 8, article 58 – Non-binding guidance on implementation, stipulates:

1. *No later than six months after the entry into force of this Regulation, the ENTSO for Electricity shall prepare and thereafter every two years provide non-binding written guidance to its members and other system operators concerning the elements of this Regulation requiring national decisions. The ENTSO for Electricity shall publish this guidance on its website.*
2. *ENTSO for Electricity shall consult stakeholders when providing non-binding guidance.*
3. *The non-binding guidance shall explain the technical issues, conditions and interdependencies which need to be considered when complying with the requirements of this Regulation at national level.*

The same requirements are defined in DCC (Article 56) and HVDC (Article 75).

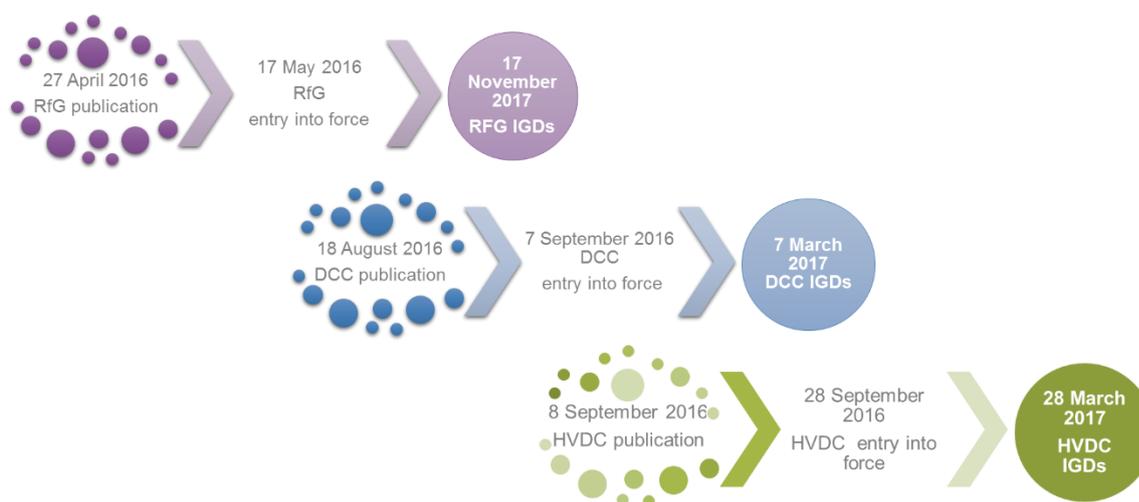


Figure 1: Timeline of adoption of connection network codes and deadlines for publishing different sets of IGDs.

2. Scopes of IGDs

Target audiences

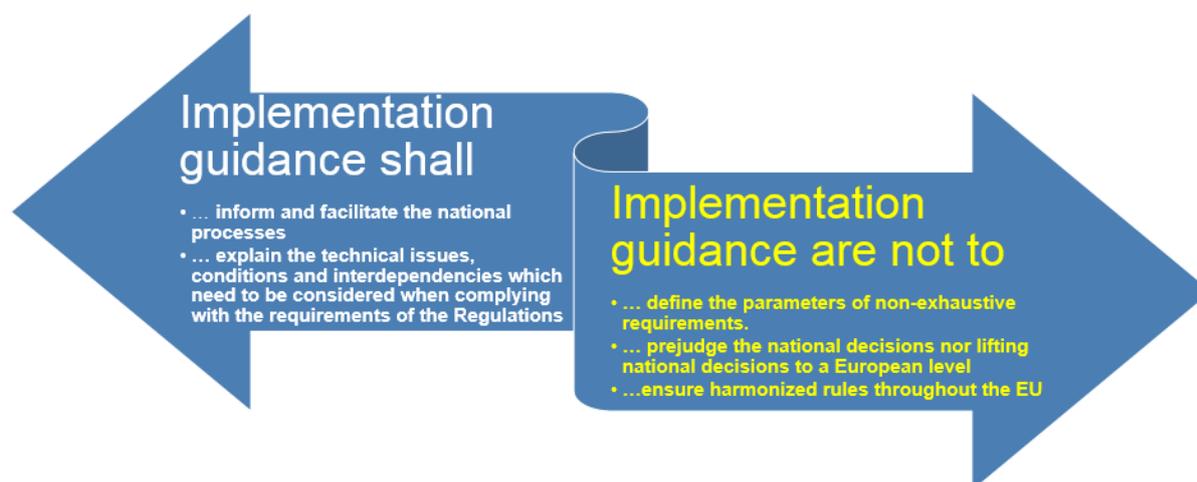
The implementation guidance is to support ENTSO-E members and other system operators in the process of determination on national level of non – exhaustive requirements during the national implementation. Besides studying the codes, readers are recommended to read the supporting documents of the connection network codes, which are available on a dedicate mini-website of ENTSO-E for all network codes¹.

Objectives of IGDs

The objectives of the implementation guidance documents are:

- to facilitate a common understanding of technical issues specified in the connection network codes, in context of new technologies and new requirements (e.g. synthetic inertia)
- to deliver broader explanations and background information and to illustrate interactions between requirements,
- to recommend coordination/collaboration between network operators (TSO) where either explicitly required by the connection codes or reasonably exercised from a system engineering perspective,
- to give guidance to national specifications for non-exhaustive requirements,
- to give guidance on stakeholder involvement during the network code implementation, and
- to express the need of further harmonisation beyond what is requested by the CNCs when reasonable from a system engineering perspective.

Figure 2: Scopes of IGDs



Roles of ENTSO-E and member states

| ENTSO-E supports implementation | Member states prerogatives |
|-------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Implementation guidance documents • Overview of the national processes | <ul style="list-style-type: none"> • Defining the implementation process including the stakeholders information and interactions • Specifying the parameters of non-exhaustive requirements |

3. Methodology and Structure of IGDs

¹ <https://www.entsoe.eu/major-projects/network-code-development/updates-milestones/Pages/default.aspx>

Rationales of identifying IGDs

The network codes have been designed to help realise Europe's triple energy policy objective of developing a reliable, sustainable and competitive electricity sector. The network codes will now become one of the starting points of the Energy Union. For this to happen, they need to be implemented and complied with across Europe.

This represents an important challenge for the sector with each network code requiring a series of steps to be taken, before being considered as fully implemented. This process will include, amongst other things, cross-national and national decisions, the conclusion of regional agreements, the creation of European-level common detailed methodologies and their actual (coordinated) application.

2016 is the year when all three Connection Network Codes have become European regulations. The allocated 2 years for their implementation is posing already significant challenges to all the member states. In order to support this activity ENTSO-E is drafting the legally requested implementation guidance documents in respect of the three connection codes.

The network codes consist of both exhaustive and non-exhaustive requirements, which need to be further specified at national level. The focus of IGDs is on those non-exhaustive aspects. The IGDs are to explain the technical issues, conditions and interdependencies which need to be considered when developing the non-exhaustive proposals at national level. They shall be provided no later than six months after the entry into force of each regulation and thereafter every two years, and shall include stakeholder consultation.

The IGDs support, but do not replace the MSs decisions in their CNC implementation.

How have IGDs been drafted?

ENTSO-E has prepared IGDs in a transparent and open manner. When drafting the IGDs, the expectations of the relevant stakeholders have been taken into consideration initially by means of a stakeholder survey and a subsequent workshop to select the topics and later consultation and a further workshop focused on draft IGDs. In line with this strategy, the next two years of national implementation shall be accompanied by continuous stakeholder interaction primarily at national level, but supplemented through the European connection codes Stakeholder Committee, and by updated and further IGDs and other means of stakeholder interaction (e.g. further workshops) where necessary.

The IGDs were drafted by ENTSO-E experts taking account of the input received from stakeholders during the process as follows:

- [23 September 2015 workshop](#) - stakeholders were informed of the intent to draft IGDs and gave their initial views on how they saw this being accomplished. They wished to be strongly involved in the process. Consequently ENTSO-E organised ahead of the entry into force of the codes:
- A [survey on Stakeholders' priority](#) issues for IGDs. This survey took place between 25 December 2015 and 22 January 2016. As a result ENTSO-E has taken on board further topics for IGDs. The outcomes of the survey were presented in the workshop on 29 February.
- A [public stakeholder workshop on 29 February](#) with the objective of defining the content of IGDs to address each of the priority issues previously identified. The outcomes can be accessed on the event site.
- 1 July – 15 August 2016 – ENTSO-E publishes draft IGDs for consultation from the RfG perspective. The comments received have supported the update of the IGDs which ENTSO-E now publishes according to the RfG regulation no later than 17 November 2016.

- ENTSO-E will consult again these IGDs from the DCC and HVDC perspective. Based on the outcomes of this second consultation ENTSO-E will further enhance the IGDs and will publish them within the 6 month deadlines defined by the DCC and HVDC regulations.
- Regular input and updates from stakeholders on their expectations for the IGDs and regular updates on the next steps within the European [Connection codes Stakeholder committee](#).

The IGDs were drafted from a topic perspective and therefore most of them cover more than one connection code simultaneously.

Structure of IGDs

Development of the IGDs has been aimed at making them easy to read and in a short format (around 10 pages) and focus on the most relevant information for each topic. Taking account of comments received, the IGDs have been moved towards more uniformity guided by the following:

| Heading | Expected content |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Codes(s) & Articles | CNCs covered Article references |
| Introduction | Replace previous title “Objective” Briefly about the intended guidance and if useful what the requirement is for. |
| NC frame | Main body of guidance, key considerations. Process & methodology |
| Further info | Other sources of relevant information. References and where effective extracts. IGDs by name External refs in full or to “other documents” |
| Interdependencies Between the CNCs With other NCs | Identify interaction of guidance to aspects in other Network Codes. |
| System characteristics | Consideration affecting the guidance, e.g. network characteristics And expected changes |
| Technology characteristics | Considerations affecting the guidance, e.g. technical limitations |
| Collaboration TSO-TSO TSO-DSO RNO – Grid User | Aspects of collaboration between key parties |
| Example(s) | Examples of existing practices, e.g. high or low values already in operation / proven. References to work done already in countries in the lead on this topic |
| <i>Exceptions from use of headings above</i> | <i>For non-technical / process IGDs e.g. CBA, choosing other headings may be preferable.</i> |

4. List of Implementation Guidance Documents

Table 1: list of IGDs

| No | Titles of IGD | Short descriptions |
|----|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a | Compliance tests and simulations | Objective is to give guidance on the compliance of equipment connected to the system with the technical requirements forming part of the Connection Network Codes and as detailed within these. |
| b | Cost-benefit analysis | The purpose of this IGD is to collate the main considerations when preparing national processes for implementing CBAs, including the benefit of input from third parties. |
| c | Fault current contribution from PPMs & HVDC converters | Its objective is to give guidance on the purpose of these requirements and on how to design these specific requirements for power park modules or HVDC systems connected to distribution or transmission networks to deliver an adequate reactive current injection during short circuits and after fault clearing when the voltage has not recovered. |
| d | Harmonisation | Its objective is to give a general overview on both opportunities and constraints related to further harmonisation beyond what is justified to facilitate market integration. Reflecting the constraint that cross border considerations have been the main focus, with a system engineering view and associated collaboration. Could standards help to create desired further harmonisation? |
| e | Instrumentation, simulation models and protection | Its objective is to give guidance on considerations for how to add practical details at national level on these aspects / processes. |
| f | Making non-mandatory requirements at European level mandatory in a country | Its objective is to give guidance on how to proceed, when deciding if a non-mandatory requirement should be made mandatory in a specific country where the need for this requirement can be demonstrated. |
| g | Need for synthetic inertia for frequency regulation | The purpose of this IGD is to define under what system circumstances synthetic inertia should be considered including considerations of forward needs, what are the alternatives, how could the functional requirements be defined and what is the readiness of technologies. |
| h | Parameters of non-exhaustive requirements | Its objective is to give a general overview on the non-exhaustive parameters of the NC RfG, DCC and HVDC which will need a national choice and to provide a general guidance on these parameters. Specific guidelines on some technical issues are foreseen in other IGDs (e.g. Voltage issues, Frequency parameters, restoration issues). |
| i | Parameters related to frequency stability | Its objective is to give guidance on considerations on national choices for all frequency related non-exhaustive aspects. |
| j | Post fault active power recovery | Its objective is to give guidance on the purpose of these requirements and on how to proceed when implementing the requirements on post-fault active power recovery for Types B, C and D of both Synchronous Power Generating Modules and Power Park Modules and also for HVDC systems. |
| k | Reactive power control mode | This IGD gives guidance relating to the choice of control mode for reactive power and allowing the selection to reflect the national / local needs. When |

| | | |
|---|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | choosing relevant national parameters, considerations includes how to link from steady-state operation to dynamic fast fault current contribution. |
| l | Reactive power management at transmission/distribution interface | The purpose of this IGD is to collate the main considerations associated with the 3 requirements in NC DCC for reactive power exchange, including changing needs to regulate voltage as embedded RES capacity increases and availability of transmission based capacity reduces. |
| m | Reactive power requirement for PPMs & HVDC converters at low / zero active power | Its objective is to give guidance on considerations relevant to defining the need for reactive power at low active power operation, including impact of switching capability on and off whenever an active power is exceeded or gone below, as the power source (e.g. wind) or set-point varies. |
| n | Real time data and communication | Its objective is to give a general overview of the different categories of information flows (e.g. DSO-TSO, DSO-DSO, DSO-Generating unit) and its purposes. |
| o | Rate-of-change-of-frequency withstand capability (RoCoF) | Its objective is to give advice on what considerations are appropriate before selecting a national value for RoCoF withstand for generators within scope of RfG. Consider also the relevance of the fully exhaustive withstand values in NC HVDC for both HVDC and for HVDC connected PPMs. |
| p | Selection of national parameters for RfG type classification | The purpose of this IGD is to collate the main considerations in defining lower MW boundaries for the type B, C and D as defined in the NC RfG. |
| q | Special issues for Type A generators | Its objective is to give guidance on how to deal with small units largely “off the shelf” with less individual engineering. This could represent a significant share of the installations in a country. |
| r | Voltage related parameters for non-exhaustive requirements | Its objective is to give guidance on considerations on the non-exhaustive voltage parameters of the NC RfG, DCC and HVDC needed to make the national choices. |