

GENERAL GUIDANCE ON COMPLIANCE VERIFICATION – COMPLIANCE TESTING AND USE OF EQUIPMENT CERTIFICATES

ENTSO-E guidance document for national implementation of network codes on grid connection – Compliance testing and application of equipment certificates in the verification process.

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From: Steering Group Connection Network Codes

DESCRIPTION

Introduction As per the Connection Network Codes (CNCs) the equipment connected to the system for the first time or significantly modernised need to be compliant with the technical requirements forming part of the CNCs and its compliance need to be verified at the time of the request of the Operational Notification and monitored throughout its life.

For any new equipment or significantly modernised one being connected to the system, it shall be carried out the applicable compliance tests, modelling and simulations during the operational notification issuing process.

To make sure that equipment complies with the requirements of the CNC during its lifecycle, the RSO shall have the right to request that the power generating facility owner carries out compliance tests, verification and eventually simulations according to an accepted Compliance Verification Programme. In particular:

- Compliance tests and simulations to be carried out based on a Compliance Testing and Simulations programme during the Operational Notification issuing process.
- Compliance test and eventual applicable simulations to be carried in accordance a Compliance Monitoring Programme, after any failure, modification or replacement of any equipment that may have an impact on compliance with the applicable requirements as described by RSOs and in line with CNCs, during the lifetime of the facility.

Based on the above, the following phases of the Compliance Verification Process can be defined:

- Compliance Testing (CT) – CT is an activity that takes place during the Operational Notification period (for type D during Interim Operational Notification and Limited Operational Notification) with the purpose of demonstrating the compliance with the minimum required functionality and parameter ranges, based on site testing or/and equipment certificates (issued based on tests) according to NC RfG, NC HVDC and NC DC. Compliance tests are executed as site test by PGM owner. The RSO may participate in such tests and record the performance of the PGM as per Art 40.5 of RfG. The CT closes with the issuing of the Operational Notification (for Type D Final Operational Notification).
- Compliance Simulation (CS) – CS is an activity that takes place during the Operational Notification period (for type D during Interim Operational Notification and Limited Operational Notification) with the purpose of demonstrating the compliance with the minimum required functionality and parameter ranges, based on simulations or/and equipment certificates (issued based on simulations) according to NC RfG, NC HVDC and NC DC. The simulated verifications of the availability of the minimum required functionality and parameter ranges are foreseen whenever testing is not applicable due to a the risk of damaging the facility. The simulation model should be certified by an

authorized body, in line with the requirements for the equipment certification. The certification of the simulation model should verify that the model is representative of the tested unit. Compliance Simulations are executed by PGM owner and are verified by the RSO. The Compliance verification based on simulation and equipment certificates (backed by simulations) closes with the issuing of the Operational Notification.

- **Compliance Monitoring (CM)** – process for the recursive verification of the availability of the minimum required functionality and parameter ranges still exist. This activity is an on-going activity throughout the life of the facility, and it starts after the issue of the operational notification (for Type D Final Operational Notification) and it ends when the generating is disconnected from the grid and decommissioned or the Operational Notification is not valid anymore

These requirements are in line with the ACER Framework Guidelines on Connection Codes Article 2.4 “the basis of the Compliance testing, compliance monitoring and enforcement” and are likely to be similar in principle to many of the existing national processes through which RSOs seek assurance that equipment connected to their systems is technically appropriate and is capable of meeting standards in terms of technical capability, behaviour or provision of services.

The aim of the present document is to describe CT and the application of equipment certificates in the fulfilling of the compliance process during the connection of the equipment.

In addition, the document describes also the role and responsibilities of the parties in the CT in the framework of the operational notification process.

CS and CM will be covered each by dedicated documents.

Definitions
and
hierarchy of
the
equipment
certificates

PGM type definitions

The EU regulation 2016/631 defines four types of PGM A, B, C and D in Article 5 “Determination of significance”.

The fundamental rationale for creating the type definition is that the size of a power generating module impacts the stability of the grid – the larger the more impact.

All requirements in the said regulation are cumulative, with some exemptions, sorted into the four types. The compliance testing and simulation of power generating modules follow the same basic principle.

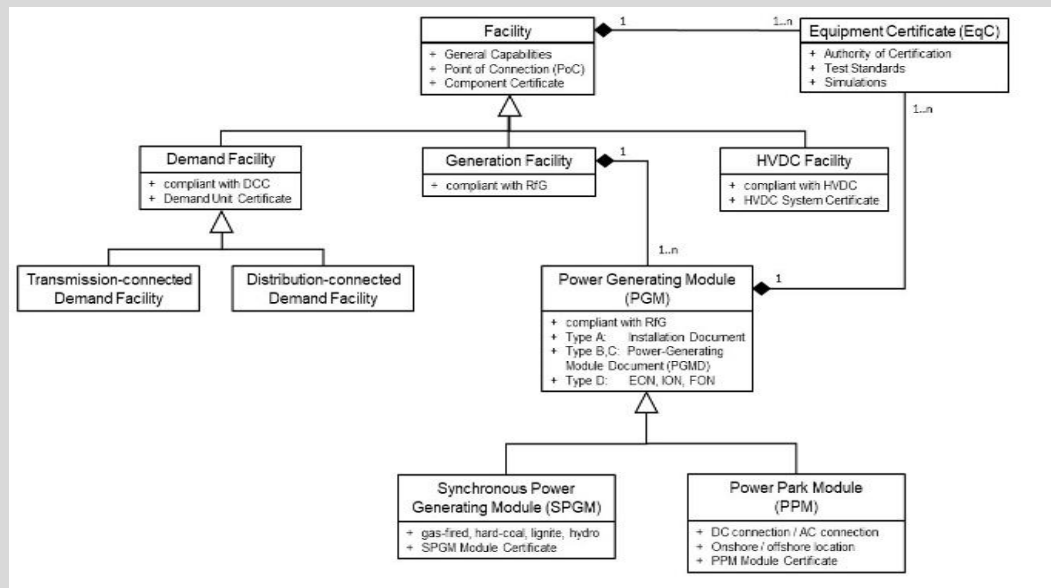
The following terms, are used in this document

Authorised certifier: means an entity that issues equipment certificates and power generating module documents and whose accreditation is given by the national affiliate of the European cooperation for Accreditation ('EA'), established in accordance with Regulation (EC) No 765/2008;

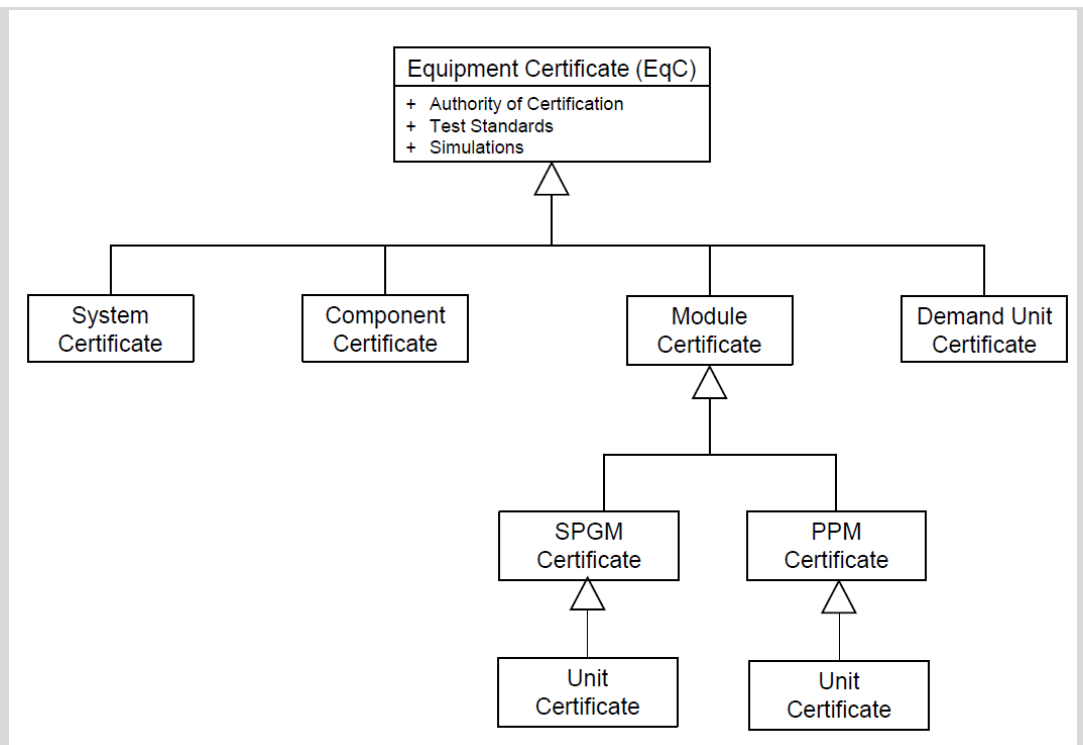
Compliance Verification Programme: repeat plan or general scheme specifying tests and simulations aimed to demonstrate the compliance of the equipment with the requirements of the CNC both during the Operational Notification issuing process and throughout the lifetime of the facility. It should be provided by the PGM owner, included the details related to the Compliance testing, Compliance Simulation and Compliance Monitoring processes. In addition, it should include the certification programme developed by an authorised certifier.

Equipment certificate: means a document issued by an authorised certifier for an entire PGM, HVDC system, demand unit or for equipment used as component by a power generating module, demand unit, distribution system, demand facility or HVDC system. An equipment certificate can be either a System Certificate, Component Certificate, Module PGM,SPGM or PPM) Certificate, Unit Certificate or Demand Unit Certificate.

Please refer to the Unified Modelling Language (UML) ¹diagram below for the graphical representation of the relationship between the Equipment certificate and the facility for whom it is issued.



¹ For a guidance on how to read the UML diagram, please refer to the information included in the Annex



For graphical relationship of different kind of facilities, a static class UML diagram can be applied. E.g. a generation facility is a facility which aggregates one or more power generating modules, which can be SPGM or PPM. Different types of equipment certificates are applicable to the PGM and therefore also to the derived SPGMs and PPMs respectively. As shown in the second-class diagram above, an equipment certificate can be

- **System Certificate** (as HVDC system): A system can be defined as an aggregation of components related to a transmission or distribution system. A system does not comprehend generating facilities. A System Certificate is valid until the point of connection of the system and aggregates its components.
- **Component certificate**; a component can be defined as any hardware or software active elements having an impact in the operation of a System, a PGM or Unit. As example, components can be converters, turbines, electrical generator, cables, transformers tap change controllers, fun, pumps, speed controllers, decentralized systems controllers or plant controllers.
- **Module Certificate** (as PGM certificate); a Module can be defined as a generation facility (please refer to the schematic above). Module certificates are valid until the Single Point of connection and certify the compliance with the requirements in the single point of connection.
- **Unit certificates**: a Unit can be defined as an aggregation of components converting a primary source of energy into electricity at the terminal point. The Unit certificate is valid until the Unit terminal connections and certify the compliance with the requirements at the terminal connection itself.

- **Demand unit certificate:** a demand unit can be defined an indivisible set of components which can be actively controlled by a demand facility owner or by a CDSO (Closed Distribution System Operator), either individually or commonly as part of demand aggregation through a third party. A Demand Unit certificate is valid until the Single Point of connection and certify the compliance with the requirements of all the equipment and the aggregated demand underlying the single point of connection of the demand unit.

Note 1: according to the above definition, for type A, and in some simplified cases as a single synchronous power-generating facility, a wind turbine generator system, a wave generating system, an inverter, a heating plan system etc., could be identified as a unit generating electricity and, therefore, be subject to a unit certificate.

Based on the information above, a higher class of certificates could include the verification of the compliance for the single equipment (i.e. Units) and for their operation as an ensemble (i.e. Module). This means for example that a Module certificate could include the demonstration of the compliance of both the whole Module and the Units composing it.

Installation document: according to the NC RfG means a simple structured document containing information about a type A power generating module or a demand unit, with demand response connected below 1000V, and confirming its compliance with the specified NC RfG requirements. This document can contain an equipment certificate or unit certificate referring at the entire PGM or a sum of equipment/unit certificates for its units and/or components;

Statement of compliance: according to the NC RfG means a document provided by the power generating facility owner, demand facility owner, distribution system operator or HVDC system owner to the RSO stating the current status of compliance with the relevant specifications and requirements;

Compliance
Verification
Programme
and use of
the
equipment
certificates²

The CT and CS assessment shall follow a clear Compliance Verification Programme and can be made through testing (generally for units and components) as per existing standards or through simulation (generally for Modules) via validated models.

Equipment certificates can be used in place of testing procedures to verify the compliance of the equipment. Double certification and double testing should be avoided, meaning that for a component for which is provided a valid equipment certificate, the RSO should avoid requiring the site test. The final site testing needs to select test cases that confirm the configuration and performance of the Module or more in general the Facility. (the full extent of the tests is carried out during the certification process).

The equipment certificates define the scope of their validity at a national or other level, at which a specific value is selected from the range allowed at a European level (as per the NC RfG). In the specific case of units and components however the scope of the certificates will be related to the demonstration of the single capabilities.

² The details of the Compliance Monitoring in the framework of a Compliance Verification Programme shall be covered in the dedicated Implementation Guidance Document.

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For the purpose of replacing specific parts of the compliance verification process, the equipment certificate may include models that have been validated³;

Depending on the requirements to be verified, during the certification process the sensitive components - affected by these requirements - have to be identified, and checked, using the method specified in certification scheme/program, according to the EN 17067, separately or together as the set of the components. In extreme case a set of the components can compose a complete unit or even a whole Module. .

Different methodologies can be used for the compliance assessments e.g:

- Physical tests in accredited testing house, or as an onsite test carried out by an authorized certifier;
- Assessment based on validated simulations models;
- Combination the physical test and validated simulations models

The methodology defining how to verify the capabilities of the equipment, must be specified in a certification programme selected and issued by the authorized certifier. The RSO has the right, based on art. 41(3) to define list of information and documents to be provided as well as the requirements to be fulfilled by the power-generating facility owner within the framework of the compliance process. This information shall be publicly available.

Based on pt. a), f) and g) the RSO shall specify the following (making it publicly available)

- all the documentation and certificates to be provided by the power-generating facility owner;
- conditions and procedures, including the scope, for registering equipment certificates;
- the conditions and procedures for the use of relevant equipment certificates issued by an authorized certifier.

Taking the information above into account, and that a certificate for the whole PGM would include the requirements applicable at the lower level (as per the UML Schematic), the Relevant SO have a right to accept the use of the different types of equipment certificates (System, Component, Module, Unit, Demand Unit certificates) and in general to adapt the certification programme chosen by the Authorized Certifier based on its technical needs.

Thus the PGM owner, in compliance with the conditions and procedures made publicly available by the RSO, has the right to provide equipment certificates instead of the compliance test or compliance simulations and, in case required by the RSO, to provide equipment certificates for the requirements not covered by the compliance test or compliance simulations.

Compliance testing requirements

Compliance testing requirements specify to which level the facility owner shall demonstrate compliance to the minimum technical requirements set out in the CNC in order to be granted a Operational Notification (in case of Type D PGM a Final Operational Notification or FON).

³ The details on the validation of simulation models shall be included in the Implementation Guidance Document on Compliance Simulation.

Each of the CNCs includes requirements that vary on the basis of technical capabilities, scale and the ability of the owner of such facilities to undertake compliance testing or justify the compliance.

Justifications for applying EqCs as a part of the demonstration can be accepted as well as demonstrating via application of electrical simulation models for specific functions of the facility and attributes that could be irreversible to undertake, e.g. a three phase short circuit failure in order to demonstrate the capability of the LVRT/FRT functionality.

The responsibility for performing the CT procedures, test specifications and any related effort to fulfil the CT requirements is allocated to the facility owner.

The role of the RSO and TSO is

- to define (through the publicly available conditions and procedures) the CT acceptance criteria in order for the facility owner to demonstrate compliance to the minimum requirements set out in the CNC's,
- to accept/approve the proposed CT procedures and test specifications and,
- to accept corresponding EqCs, as a compliance evidence for specific parts of the CT procedure.

As a general indication the Compliance Verification Programme, and hence the CT procedures, should be approved before the beginning of the Operational Notification issuing process. However timing could change at national level based on the procedures in place.

The CT requirements are specified in the CNCs in the articles following:

EU Regulation 2016/631 (NC RfG)

Title IV Compliance: Chapters 2-7 – Compliance testing & simulations

Chapter 2 – Compliance Testing for Synchronous Power Generating Modules

Article 44 – Compliance tests for type B synchronous power generating modules

Article 45 – Compliance tests for type C synchronous power generating modules

Article 46 – Compliance tests for type D synchronous power generating modules

Chapter 3 – Compliance Testing for Power Park Modules

Article 47 – Compliance tests for type B power park modules

Article 48 – Compliance tests for type C power park modules

Article 49 – Compliance tests for type D power park modules

Chapter 4 – Compliance Testing for Offshore Power Park Modules

(Note that this is only for AC connected. DC connected offshore PPMs are covered under the 2016/1447)

Selected criteria only drawn from articles 44 and 48.

EU Regulation 2016/1388 (NC DCC)

Title IV Compliance: Chapters 2-3 – Compliance testing & simulations

Chapter 2 – Compliance Testing

Article 36 – Common provisions for compliance testing

Article 37 – Compliance testing for disconnection and reconnection of transmission-connected distribution facilities

Article 38 – Compliance testing for information exchange of transmission-connected distribution facilities

Article 39 – Compliance testing for disconnection and reconnection of transmission-connected demand facilities

Article 40 – Compliance testing for information exchange of transmission-connected demand facilities

Article 41 – Compliance testing for demand response active power control, reactive power control and transmission constraint management

EU Regulation 2016/1447 (NC HVDC)

Title VI Compliance: Chapters 2-3 – Compliance testing & simulations

Chapter 2 – Compliance Testing

Article 69 – Compliance testing for HVDC systems

Article 70 – Compliance testing for DC-connected PPMs and remote end HVDC convertor units

Operational Notification Procedure

The first aspect of compliance is the operational notification procedure that all new equipment falling within the scope of the CNCs is required to go through as part of the process of connecting to the system. Each of the CNCs includes similar provisions as summarised below.

2016/631

Title III Chapter 1 - Operational Notification Procedure for New Power Generating Modules

This chapter sets out the requirements for new generators to demonstrate their compliance with title II (articles 13-28), being the detailed technical specifications for generators, as part of their connection process. The operational notification process sets out the steps through which demonstration of these requirements can be achieved including steady state and dynamic performance as required by chapters 2-7 of title IV.

The operational notification procedure are specified for each type A-D of power generating module and are broadly as follows.

Type A PGM:

Submission of an installation document as required by the RSO to a minimum standard as detailed in article 30. For type A, EqC will preferably cover the whole PGM.

In principle the EqCs should be base document used in compliance process during notification procedure. Scope of use of EqCs is specified by the authorized certifier, but the RSO shall specify if an EqC can be used to certify a specific kind of equipment in the publicly available document ***conditions and procedures for the use of relevant equipment certificates issued by an authorised certifier.***

EqCs could certify the compliance of specific equipment but not necessarily of the power generating module. However, EqCs may provide essential information such as type-testing results, proved manufacturer's information (e.g. parameter ranges and functional characteristics) and a validated equipment's model and, hence, contribute to the subsequent assessment on PGM level, in point of connection

There is no specific requirement against title IV to demonstrate performance, since Articles 40 and 41 specify that the owner of the power generating facility may rely upon EqCs.

For type A the installation document shall include the EqCs and other additional information such as source (e.g. PV) and kW rating. The RSO will decide if the execution of compliance tests and compliance simulations on site, are required in compliance monitoring process.

Type B, C, D generators – use of equipment certificates (EqCs)

The information above related to the type A generators is not applicable to other types as B, C and D, which need significant site-specific supporting compliance evidence in addition to the type tests performed once for the type of module during e.g. its unit certification process.

However as per the type A, EqCs could certify the compliance of specific equipment but not necessarily of the power generating module. However, EqCs may provide essential information such as type-testing results, proved manufacturer's information (e.g. parameter ranges and functional characteristics) and a validated equipment's model and, hence, contribute to the subsequent assessment on PGM level, in point of connection

As part of the evidence used to prove compliance against the relevant grid codes in a corresponding assessment as detailed below, the use of EqCs issued by an authorised certifier is allowed.

Type B-C generators:

A Power Generating Module Document (PGMD) is to be provided to the RSO for each power generating module by the power generating facility owner (or authorized certifiers, based on national implementation of the RfG) including a statement of compliance; the PGMD is to include information as specified by the RSO within the scope set out in article 32 and shall include where required compliance test reports as required by chapters 2-4 of title IV including use of actual measured values during testing and studies demonstrating steady state and dynamic performance as required by chapters 5-7 of title IV. Simulations can be based on validated equipment models provided by the EqCs. On acceptance of a complete and satisfactory PGMD the RSO will issue a final operational notification to the facility owner.

PGMD is not the same as the EqC. PGMD is the list of documents to be provided by the power generating facility owner to the RSO prior to the FON and it includes the EqC.

Type D generators:

For type D generators the Operational Notification issuing process is more complex, taking into account their size and potential impact on the system. Given the extent of the services and technical capabilities that they should be able to provide or demonstrate, and this type of generators shall be involved in more detailed testing procedures.

The operational notification procedure for **type D** generators comprises:

Energisation operational notification (EON)

An EON entitles the facility owner to energise their equipment using their connection but not to generate and is subject to the agreement with the RSO of protection and control settings.

Interim operational notification (ION)

An ION entitles the facility owner to operate their power generating module and to generate for a limited period of time – which is to be specified by the RSO but will be no more than 24 months (an extension of this period may be granted if a request for derogation is made to the RSO before the expiry of that period in accordance with the derogation procedure laid down in article 60). Issue of an ION is subject to completion of the data and study review as specified/requested by the RSO including simulation models and studies demonstrating steady state and dynamic performance as required by chapters 5-7 of title IV, and details of the intended compliance tests that are to be undertaken to fulfil chapters 2-4 of title IV. Tests may to some extent be substituted by the provision of EqCs. Simulations can be based on validated equipment models provided by the EqCs.

Final operational notification (FON)

A FON signifies the completion of the operational notification process and allows the power generating facility owner to operate a power generating module using their grid connection.

To progress a FON the facility owner must already hold an ION. Completion of the FON is subject to completion of any outstanding requirements set out in the ION and must include submission, by the facility owner, of an itemized statement of compliance and an update of the technical data, studies and models provided as part of the ION but now also validated and using actual values found through testing and/or simulations.

As part of the FON, the RSO and the facility owner should reach an agreement on how the compliance will be monitored over the life time of the generator, taking into account possible changes in generator software, hardware and also changes in the connection point characteristics like short circuit power and frequency impedance characteristics. This should be detailed in the Compliance Verification Programme.⁴

Limited Operational Notification (LON)

A type D generator holding a FON must inform the RSO with whom they hold a connection agreement in the case that their equipment is affected by a temporary loss of capability, is subject to significant modification affecting performance, or is affected by equipment failure affecting performance, in each case where this is expected to last for more than 3 months.

Issue of a LON by the RSO should be subject to identification of the means and timescales by which the non-compliance will be resolved and can last for a maximum of 12 months without requiring a further derogation. A further expansion of the period of validity of the LON may be granted upon a request for a derogation made by the RSO before the expiry of that period, in accordance with the derogation described in Title V

2016/1388

Title II Connection of Transmission Connected Demand Facilities, Transmission Connected Distribution Facilities and Distribution Systems

Chapter 3 – Operational Notification Procedure

The requirements in 2016/1388 are fairly similar to those in 2016/631. This chapter sets out that each transmission-connected demand facility owner or DSO to which one or more of the requirements in Title II (articles 12-21) apply shall confirm to the RSOs its ability to satisfy these by following an operational notification procedure.

Unlike in EU regulation 2016/631 there are no distinctions in terms of scale or connection voltage to the process which comprises:

⁴ The details of the Compliance Monitoring in the framework of a Compliance Verification Programme shall be covered in the dedicated Implementation Guidance Document.

Energisation Operational Notification (EON)

This allows energisation of the facility subject to satisfying the RSO of preparations including agreement of protection and control settings.

Interim Operational Notification (ION)

As with 2016/631, an ION entitles the facility owner to operate connected to the system for a limited period of time – which is to be specified by the RSO but will be no more than 24 months (an extension of this period may be granted if a request for derogation is made to the relevant TSO before the expiry of that period in accordance with the derogation procedure laid down in article 50. Issue of an ION is subject to completion of the data and study review as specified and including simulation models as specified in article 21 and studies demonstrating steady state and dynamic performance as required in articles 43 and 46-7. An itemised statement of compliance supported by any EqCs cited in this is also required.

Final operational notification (FON)

A FON signifies the completion of the operational notification process and allows the facility to operate without a time limitation.

To progress a FON the facility owner must already hold an ION. Completion of the FON is subject to completion of any outstanding requirements set out in the ION and must include submission, by the facility owner, of an itemized statement of compliance and an update of the technical data, studies and models provided as part of the ION but now also validated and using actual values found through testing.

2016/1447:

Title V Operational Notification Procedure for Connection

The requirements in HVDC are very similar to those in EU regulation 2016/631 but are subdivided into two sections as follows:

Chapter 1 – Connection of New HVDC Systems

Chapter 2 – Connection of New DC-connected Power Park Modules

Each HVDC system owner is required to demonstrate to the RSO that it has complied with the relevant requirements set out in Titles II-IV articles 11-37 and 46-54 for general HVDC systems, and additionally title III for DC connected PPMs (articles 38-45 but also articles 13-22 of 2016/631) at the connection point through the operational notification procedure.

Similarly to 2016/1388 but again unlike in EU regulation 2016/631 there are no distinctions in terms of scale or connection voltage to the process which comprises:

Energisation Operational Notification (EON)

This allows connection and energisation of the facility subject to satisfying the RSO of preparations including agreement of protection and control settings at the connection point.

Interim Operational Notification (ION)

As with 2016/631, an ION entitles the facility owner to operate connected to the system for a limited period of time – which is to be specified by the RSO but will be no more than 24 months (an extension of this period may be granted if a request for derogation is made to the RSO before the expiry of that period in accordance with the derogation procedure laid in Title VII). Issue of an ION is subject to completion of the data and study review as specified and including simulation models as specified in article 54 and studies demonstrating steady state and dynamic performance as required in titles II-IV. An itemised statement of compliance supported by any EqCs cited in this is also required plus details of any intended compliance tests according to article 70 (general HVDC systems) or article 71 (DC-connected PPMs).

Final operational notification (FON)

A FON signifies the completion of the operational notification process and allows the facility to operate without a time limitation.

To progress a FON the facility owner must already hold an ION. Completion of the FON is subject to completion of any outstanding requirements set out in the ION and must include submission, by the facility owner, of an itemised statement of compliance and an update of the technical data, studies and models provided as part of the ION but now also validated and using actual values found through testing.

Limited Operational Notification (LON)

A DC connected PPM holding a FON must inform the RSO with whom they hold a connection agreement in the case that their equipment is affected by a temporary loss of capability, is subject to significant modification affecting performance, or is affected by equipment failure affecting performance, in each case where this is expected to last for more than 3 months.

Issue of a LON by the RSO should be subject to identification of the means and timescales by which the non-compliance will be resolved and can last for a maximum of 12 months without requiring a further derogation.

Derogations to 2016/631, 2016/1388, 2016/1447:

In case of a derogation request, the connection procedure for the Operational Notification should be put on hold. Details to be provided in the derogation process depending on the relevant regulatory authority.

<u>Summary of Common Provisions for Compliance Testing and use of equipment certificates</u>	<p>The following tables provide a non-binding guideline on the requirements for which the compliance could be demonstrated via equipment certificates and detail if the equipment certificate (for each requirement) should be based on testing or simulation.</p> <p>The detailed list of accepted EqCs must be specified by the RSO at national level.</p> <p>The term “Mandatory” in the header row is referred to those requirements for which the PGM owner must demonstrate the compliance with the CNC to the RSO.</p>
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EU regulation 2016/631 (NC RfG) compliance tests and simulations:

Summary of requirements for which compliance verification tests and/or simulations must be carried out:

EqC Testing – EqC backed by a test

EqC backed by a simulation

MANDATORY REQUIREMENTS FOR EQUIPMENT CERTIFICATION (EqC)								
					EqC TESTING		EqC Simulation	
Requirements	PGM Type				A	B	C	D
	A	B	C	D	A	B	C	D
LFSM-O	M	M	M	M			M	M
LFSM-U			M	M			M	M
FSM			M	M			M	M
Reactive power capability		M	M	M			M	M
Active Power Controllability	M	M	M	M			M	M
Voltage Control Mode			M	M			M	M
Reactive Power Control Mode			M	M			M	M
Power Factor Control Mode			M	M			M	M
Island Operation			M	M			M	M
FRT Capability (profiles different B/D)						M	M	M
Post Fault Active Power Recovery		M	M				M	M
Fast Fault Current Injection		M	M					M

M: mandatory requirement to be verified by tested and/or simulations.

NON-MANDATORY REQUIREMENTS FOR EQUIPMENT CERTIFICATION (EqC)									
		EqC TESTING				EqC Simulation			
PGM Type Requirements		A	B	C	D	A	B	C	D
Frequency restoration			O	O	O		O	C	C
Black Start Capability			O	O	O			C	C
Tripping to houseload			O	O	O			C	C
Power Oscillation Damping Control (POD)			O	O	O		O	O	C
Synthetic Inertia							C		C

O: Optional, possibly required by national implementation.

C: Conditional – if the functionality exist it must be verified by verification tests or by simulations.

	MANDATORY REQUIREMENTS COMPLIANCE VERIFICATION TESTS				
Type Requirements	PGM	A	B	C	D
	FSM			M	M
Active Power Controllability			M	M	M
Voltage Control Mode				M	M
Reactive Power Control Mode				M	M
Power Factor Control Mode				M	M

M: mandatory requirement to be verified by tested and/or simulations.

O: Optional, possibly required by national implementation.

NON - MANDATORY REQUIREMENTS COMPLIANCE VERIFICATION TESTS			
Requirements \ PGM Type	B	C	D
Frequency restoration	O	C	C
Black Start Capability	O	O	O
Tripping to houseload	O	C	C
Power Oscillation Damping Control (POD)	O	O	O

O: Optional, possibly required by national implementation.

C: Conditional – if the functionality exist it must be verified by verification tests or by simulations.

Concerning the specific compliance verification tests accepted by the RSO will have a variability depending on generation module type and applied technology.

EU regulation 2016/1388 (NC DCC) compliance tests and/or simulations:

EqC - Testing	Transmission Connected Distribution Facilities	Transmission Connected Demand Facilities	Demand Units with DSR	Site testing
Capability of Reconnection after Incidental Disconnection	M	M	M	M
Synchronization Test	M	M	M	M
Remote Disconnection test	M	M	M	M
Low Frequency Demand Disconnection	O	O	O	O
Low Frequency Demand Disconnection Relays	O	O	O	O
Low Voltage Demand Disconnection	O	O	O	O
Information Exchange	M	M	M	M
Demand Modification	M	M	M	M
Disconnection or Reconnection of Static Compensation Facilities	M	M	M	M

M: mandatory requirement to be verified by tested and/or simulations.

O: Optional, possibly required by national implementation.

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EqC - Simulations	Transmissio n Connected Distribution Facilities	Transmissio n Connected Demand Facilities	Demand Units with DSR	Site testing
Reactive Power Capability without onsite Generation	M	M	M	M
Active Control of Reactive Power with onsite generation	M	M	M	M
Very Fast Active Power Control	M	M	M	M

M: mandatory requirement to be verified by tested and/or simulations.

O: Optional, possibly required by national implementation.

EU regulation 2016/1447 (NC HVDC) compliance verification tests and/or simulations:

EqC - Testing	HVDC Systems	DC Connected PPMs	Remote HVDC Converter Units	Site testing
Reactive Power Capability	M	M	M	M
Voltage Control Mode	M	M	M	M
Reactive Power Control Mode*	M	M	M	O
Power Factor Control Mode *	M	M	M	O
FSM Response	M	M	M	M
LFSM-O Response	M	M	M	M
LFSM-U Response	M	M	M	M
Frequency Restoration Control	M	M	M	M
Active Power Controllability	M	M	M	M
Ramping Rate Modification	M	M	M	M
Black Start	O	O	O	O
Fast Signal Response	O	O	O	O

M: mandatory requirement to be verified by tested and/or simulations.

O: Optional, possibly required by national implementation.

EqC - Simulations	HVDC Systems	DC Connected PPMs	Remote HVDC Converter Units	Site testing
Fast Acting Reactive Current Injection	M	M	M	-
Fault Ride Through Capability	M	M	M	-
Post Fault Active Power Recovery	M	M	M	O
Reactive Power Capability	M	M	M	O
Power Oscillation Damping Control (POD)	M	M	M	O
Active Power Modification in case of disturbance	M	M	M	O
Black Start	M	M	M	O
Fast Active Power Reversal	M	M	M	M

M: mandatory requirement to be verified by tested and/or simulations.

O: Optional, possibly required by national implementation.

With regard to the compliance verification tests on voltage control mode, reactive power control mode and power factor control mode, the relevant RSO may select only two of the three control options for testing.

It is the responsibility of the RSO to the site tests the facility owner must perform as part of the compliance verification process.

Role of Third Parties: Authorised certifiers and

Whereas regulation (EC) No. 765/2008 defines the general requirements for accreditation and market surveillance relating to the marketing of products with a special focus on the accreditation of compliance assessment bodies, the national accreditation bodies and their respective European co-operation for Accreditation (the EA), it does not give a specific framework for the compliance assessment process itself. This framework is in fact provided by the IEC standard EN ISO/IEC 17065 on the

equipment
certificates

compliance assessment with respect to the requirements for bodies certifying products, processes and services.

Next to specific regulations for such certification bodies (referring to their structural requirements e.g. on liability, impartiality, confidentiality, their resources/personnel' qualifications and the overall management system) the standard also gives a precise structure on the compliance assessment, which consists of four phases: Application Review – Evaluation – Review – Certification Decision.

The EN ISO/IEC 17065 standard thus contributes to the main purpose of certifying products: to ensure a high degree of confidence to all interested parties that these products fulfil specified standards.

The EN ISO/IEC 17065 standard gives a special emphasis on the precise definition of the product-specific certification process, i.e. the certification scheme, defining its scope, corresponding product standards to be applied, evaluation and assessment methodologies and criteria as well as some formal requirements on issuing, monitoring and terminating certificates.

The evaluation may include any kind of determination and selection of any information that are incorporated in the subsequent compliance assessment (according to the certification scheme) – i.e. measurement results, simulation data, model validation results or manufacturers information. Evaluation activities may be delegated to external resources, that meet the applicable requirements of relevant standards and documents as specified in the certification scheme. I.e., for testing it shall meet the procedural requirements stated in the EN ISO/IEC 17025 or be an accepted IECRE test lab for the competence area electrical characteristics, which are the corresponding accreditation standard for testing laboratories

Application of EqCs

The application of equipment certificates is defined in two different contexts of compliance testing within the EU regulation 2016/631:

1. As specified in the operational notification procedure for commissioning new installations, Title III, chapter 1, articles 30ff introduce equipment certificates being an optional element.
2. By way of the continued compliance monitoring within the lifetime of existing installations (being subject to the scope of the 2016/631, 2016/1388 and 2016/1447)

a) Title IV, chapter 1, articles 40 and 41 introduce equipment certificates being an optional element of the compliance monitoring process for type A power-generating modules, providing relevant information to the relevant system operator. Moreover, article 41 empowers the relevant system operator to define conditions and procedures to register equipment certificates.

b) Chapter 2 and 3 (articles 44 to 49) provide the option that required tests and measurements in order to demonstrate compliance of synchronous power-generating modules and power park modules (as of type B, C and D) may be substituted by the provision of equipment certificates to the relevant system operator.

c) Chapter 5 and 6 (articles 51 to 56) provide the option that required simulations in order to demonstrate compliance of synchronous power-generating modules and power park modules (as of type B, C and D) may be based on validated unit models provided by equipment certificates to the relevant system operator.

Note 1: for the appropriate deployment of equipment certificates especially in the (long-term) view of the facilities' lifetime, the monitoring of the certificates' ongoing validity is crucial. However, according to chapter 7.9.4 of DIN EN ISO/IEC 17065 a surveillance scheme has to be established and shall include periodic surveillance activities to ensure ongoing validity of the demonstration of fulfilment of process or service requirements.

Note 2: as by definition, a equipment certificate provides a statement of the compliance

to standards with a standardised environment (e.g. testing provisions). Therefore, the assessment of the equipment behaviour and characteristics within specific project environments (e.g. a specific power-generating module / facility) has always to be evaluated on a site-specific analysis. Hence, the full substitution of required simulations by equipment certificates may be not eligible.

Deployment of Equipment Certificates

The use of EqCs, issued by an authorised certifier is allowed as part of the fulfilment of the operational notification requirements.

According to the art. 41(3) (g) the RSO is obliged to elaborate and make publicly conditions and procedures for the use of equipment certificates which can be used in the compliance monitoring process. These conditions and procedure have met the frames requirements given in the NCs, i.e.:

- With regard to the site test:
 - For type A PGMs the relevant system operator may rely upon equipment certificates issued by an authorized certifier for the assessment (art. 41 (1), also art. 40 (1).
 - For type B, and by default to the type C and D synchronous PGMs and PPMs the certificates can be used to demonstrate the compliance with relevant

requirements which can be not tested in real life/on side (art. 44(1) and art. 47(1)), (art. 46 (2) and art 49 (2))..

- With regard to the simulations:
 - For type B, C, D synchronous PGMs and PPMs instead of the relevant simulations RSO can use equipment certificates to verify PGM compliance with the relevant requirement (art. 51(1), art. 52 (1), art. 53 (1), art. 54 (1), art. 55 (1) and art 56 (2)).
 - For type B, C, D synchronous PGMs and PPMs, the software tool used (EMT based or RMS based) should be coordinated in advanced with the RSO in order to allow sharing files containing simulation data
 - Concerning the model validation, in order to accept the mismatch between simulations and measurements, it is advisable establishing variable thresholds of tolerance according to the different stages of the phenomena/test instead of a fixed tolerance.
 - In the evaluation of the model both a qualitative approach and a quantitative approach can be used. The qualitative approach is aimed to demonstrate the compliance to the requirements. The quantitative approach is aimed to detailing verify the model (or its component). The tolerances shall be such to permit the use of transfer function commonly in use in the industrial practice.

With regard to the operational notification procedure:

- For type A PGMs compliance process based on the equipment's certificates included in the installation document (art. 30(2) (f)). The relevant system operator may rely upon equipment, certificates issued by an authorised certifier for the assessment. Compliance tests and simulations are not required by the provisions of the EU regulation 2016/631 but possible to execute based on the art. 42 (2) (b) which authorizes RSO to require additional or alternatives tests, if information provided by the power-generating owner is not sufficient.
- In general, for type B, C and D PGMs it is allowed to use the equipment, in the notification process. According to the art 32(6) Member States may provide that the Power Generating Module Document (PGMD) designed for Type B and C shall be issued by an authorised certifier.

Summarizing, in principle the equipment, certificates should be used by RSO as part of the verification compliance process of the single components of the PGM with the relevant requirements and it should be treated as the additional (complementary) confirmation that the whole PGM meets the requirement. In case of multiple Units composing the Module, the compliance verification process shall ensure that the system as a whole is compliant with the requirements.

For the power generating facility owner these certificates should be primary guarantee that the used equipment will allow to meet the relevant requirements specified for whole PGM.

In conclusion, for type A units in principle equipment certificates are to be used by the RSO for the assessments in the compliance process. For type B,C,D PGMs

equipment, can be used instead of the relevant test or simulations exclusively if It is provided in the rules and procedures elaborated by the TSO, according to the art. 41 (3)(g).

Accreditation of Third Parties

Since CNCs allow it, RSOs shall identify advantages and disadvantages for implementing different compliance verification schemes:

- Completely performed by RSOs:
 - o high level of expertise needed,
 - o compliance verification procedure developed by the RSO,
 - o total control of the process.
- Totally delegated to third parties:
 - o lower level of control of the process,
 - o need for a very detailed compliance verification procedure to make sure that different certification entities (to whom RSO delegated) have the same criteria,
 - o low work burden for the RSO once the compliance verification procedure is signed by the facility owner , receive and accepting and archiving the certificates
- Partially delegated to third parties

Compliance
Testing and
Simulation
based on
certificates
issued
according to EN
ISO/IEC 17065

Product certificates being applied as unit or component certificates according to type C and type D facilities provide a highly-qualified, independent and reliable base for the evidence of compliance with the EU regulations within the 2016/631, 2016/1388 and 2016/1477 context both, on the equipment and on the power-generating module level. Therefore, equipment certificates shall include at least, but are not limited to the following information:

- the technical specification of the equipment entitled by the equipment certificate;
- the results of equipment-specific measurements, including the certifiers' assessment, that the tests have been conducted in compliance to given standards and that results do comply with given certification criteria;
- a qualified evaluation of respective manufacturers' declaration, where tests are neither technical nor economically feasible;
- an equipment's electrical simulation model, that has been validated against measurement results with respect to given validation criteria (procedure, thresholds, tolerances); including the certifiers assessment, that the validation have been conducted in compliance to given standards

GENERAL GUIDANCE ON COMPLIANCE VERIFICATION - Compliance testing and application of equipment certificates in the verification process.

	<p>In the same manner power-generating module certificates (PGMD issued by certifiers or facility owners) provide all benefits of the well-structured, standardized and high-level compliance assessment processes of accredited certification bodies which are supervised by the national accreditation authorities according to regulation (EC) No. 765/2008.</p> <p>As product certificates, by their nature, do not replace routine tests of the respective products it is highly recommended to amend the power-generating module certification by site specific inspections confirming the correct values of control and protection settings.</p>
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INTERDEPENDENCIES

<u>Within CNCs</u>	This IGD covers the CT activities required in three Connection Network CNCs – 2016/631; 2016/1388; 2016/1447
<u>In other NCs</u>	Yes, non-mandatory services (such as black start which is detailed in the NC Emergency & Restoration) offered to the TSO will be subject to compliance monitoring.
<u>System characteristics</u>	All Compliance Monitoring activities shall be addressed to the connection point for the facility.
<u>Technology characteristics</u>	N/A

COORDINATION

<u>TSO – MS-NRA</u>	In the event that compliance is not established the right to connect to the system or to import/export power through the connection point can be withheld or removed from the facility owner by the RSO; alternatively, a derogation could be sought from the NRA.
<u>TSO – facility owner – DSO-CDSO</u>	<p>Compliance Monitoring is required as part of the connection procedure and has to be maintained during the lifetime of the facility.</p> <p>Compliance Monitoring is the responsibility of the relevant TSO and the RSO and will be guided in details in the IGD on compliance verification – compliance monitoring</p>

**GENERAL GUIDANCE ON COMPLIANCE
VERIFICATION - Compliance testing and application
of equipment certificates in the verification process.**



ANNEX

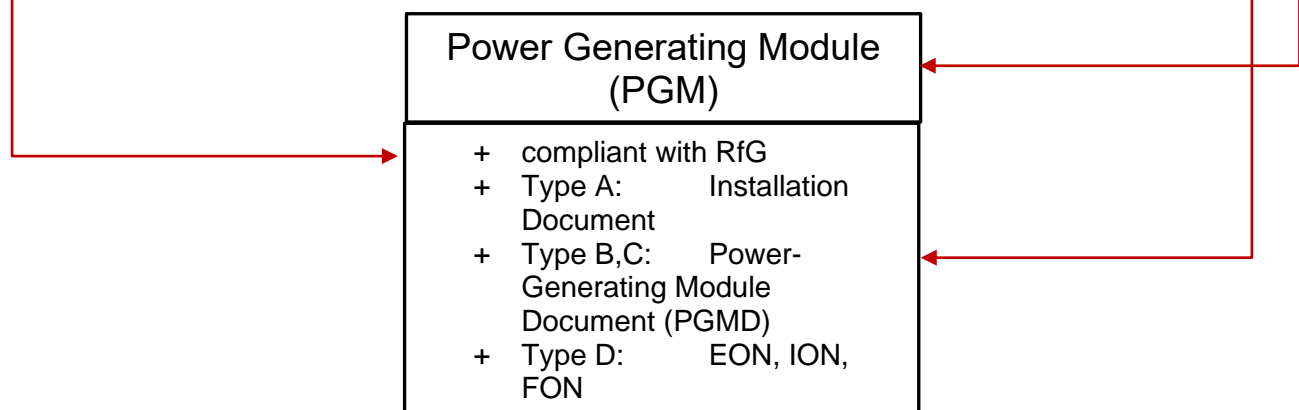
Current
practices
across Europe

<u>Other References</u>	<p>The following documents have been considered relevant by the Expert Group on Compliance Monitoring:</p> <ul style="list-style-type: none">• <u>Source 1</u>: National Grid (GB TSO) <p>Annexes to National Grid’s internal Transmission Procedure TP130 – New Connections Operational Approval:</p> <ul style="list-style-type: none">• Compliance statement• Operational notification compliance checklist (ONCC) <p>The ONCC is required to be completed as part of the Operational Notification process. The compliance statement is filled in as part of the testing, by National Grid, of a transmission connected generator.</p> <ul style="list-style-type: none">• Guidance Notes – Power Park Modules• Compliance process
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ANNEX – Unified Modelling Language

In the UML a “class diagram” is a static structure diagram and describes the structure of a system (not only a software system but any kind of hierarchy!). The class diagram shows the system's classes, their properties (so-called “attributes”, operations (so-called “methods”) and the static relationships among other objects.

- Classes are represented by boxes and up to three compartments in one box:
 - The top compartment contains the name of the class.
 - The middle compartment contains the attributes of the class.
 - The third compartment contains the methods of the class (not necessarily applicable in the context of the IGD).
- Visibility of the class member
 - +: public access, unlimited external access
 - #: protected access, only class itself and derived classes
 - -: private access, only for class itself
 - “Public” means: accessibility of attribute (e.g. to TSO, certifier or NRA) must guaranteed otherwise PGM is not RfG compliant or has no legal operational notification.
 - “Protected” and “private” access are no meaningful use cases in the context of this IGD .



The UML distinguishes between class-level relationships and instance-level relationships.

The Class-level relationships (generalization/inheritance relationship) are the following

- A hollow triangle shape (\triangle) in a class diagram indicates the relationship between the parent or super class and its derived child or sub class.
- The child class inherits all public and protected attributes and methods of its parent class (like in “real life”).
- Additionally the child class can add new attributes (and methods) and becomes specialized in this way (like in “real life”).
- The inheritance relationship is also called a “is a” relationship.

While the Instance-level relationships are the following

- The association presented by a simple arrow expresses the relationship between classes or by usage of numbered multiplicity the relationship between a certain number of objects (instances) of classes.
- The aggregation presented by a hollow diamond shape indicates the collection of other classes (and their objects) but without a strong lifecycle dependency on the container. The container’s content still exists when the container is destroyed.
- The composition presented by a filled diamond shapes has the container function as the aggregation but a much stronger lifecycle dependency on the container. The container’s content depends on the existence composing container.

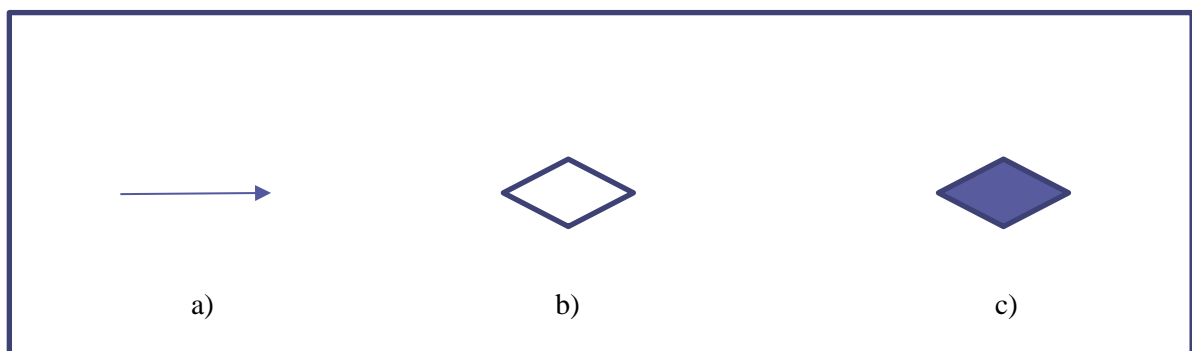


Figure 1 - Inheritance relationships symbols: association (a), aggregation (b), composition (c)

The application of class-level (inheritance) relationships and instance-level relationships leads to the presentation (extract from the IGD on Compliance Testing & Monitoring) shown in figure 2:

GENERAL GUIDANCE ON COMPLIANCE VERIFICATION - Compliance testing and application of equipment certificates in the verification process.

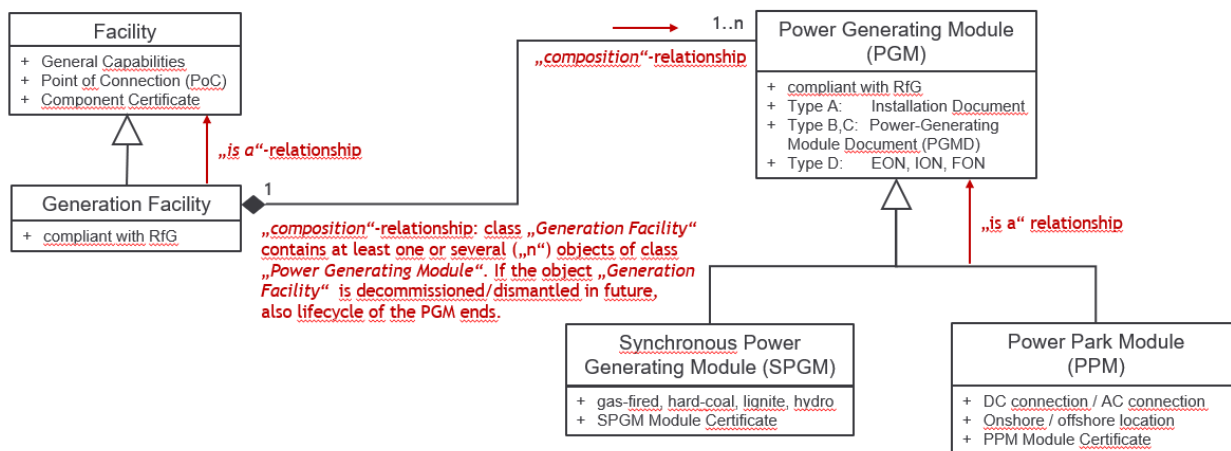


Figure 2 - UML class diagram of the different kind of generation facilities.