

Capacity Terms in the Grid Code

A Paper by National Grid

1.0 Overview

1.1 The aim of this paper is to examine each of the capacity terms in the Grid Code and to identify the scenarios in which they are utilised. The Grid Code itself utilises terms that are defined specifically for Grid Code purposes (and which are defined within it) but also contains certain capacity terms that are defined in codes other than the Grid Code.

1.2 The Capacity Terms used in the Grid Code are as follows:

Grid Code Defined Terms

- Export and Import Limits (MEL and MIL)
- Full Output
- Import Usable
- Output Usable
- Rated MW
- Registered Capacity
- Registered Import Capacity/Capability
- System Constrained Capacity

CUSC Defined Terms

- Connection Entry Capacity
- Transmission Entry Capacity

BSC Defined Terms

- Demand Capacity
- Generation Capacity

1.3 Of the Grid Code defined terms they can then be broken down into one of two categories. There are those terms that represent an inherent physical capability of a Generating Unit (or Power Station), while there are others which represent the physical capability of the generating unit or power station at a particular time or under certain conditions. These can be summarised as follows.

Terms indicating an inherent physical capability:

- Full Output
- Rated MW
- Registered Capacity

Terms indication the capability for certain times / conditions

- Export and Import Limits (MEL and MIL)
- Import Usable
- Output Usable
- Registered Import Capacity/Capability

- System Constrained Capacity

1.4 Section 2 below describes each of the above terms in greater detail and also indicates the circumstances in which the Grid Code utilises the terms.

2.0 Grid Code Capacity Terms

Connection Entry Capacity

2.1 Connection Entry Capacity (CEC) is a CUSC defined term. Essentially it represents the maximum physical capability of the transmission connection assets installed at a connection site. At each transmission connected Power Station both the Power Station as a whole and each Generating Unit at that Power Station will have a CEC. Power Station owners are required by the CUSC not to export power in excess of their CEC from a generating unit or Power Station.

2.2 The term Connection Entry Capacity is used in the following areas of the Grid Code:

Clause	Description of Usage
PC.4.3.1	It is noted that National Grid will use the Connection Entry Capacity data provided by Users through the CUSC in the preparation of the Seven Year Statement
PC.4.4.1	Users are required to submit their desired Connection Entry Capacity as part of the data required in connection with a CUSC Contract
PC.5.4 & PC.5.6	Clause notes that once an offer for a CUSC Contract has been accepted by a User then its Connection Entry Capacity in that offer is used in the future assessment of new connection applications to the GB Transmission System

Demand Capacity

2.3 Demand Capacity is a BSC defined term. Its definition is set out in BSC section K.3.4.8. It is defined as the maximum expected magnitude of a negative value of a BM Unit's metered volume determined at the Transmission System Boundary in the relevant BSC season. It is expressed in MW.

2.4 The term Demand Capacity is used in the following areas of the Grid Code:

Clause	Description of Usage
BC1.4.2 (a) (1) (i) and definition of Control Point	Demand Capacity is the capacity term used to judge whether a Demand BMU must submit Physical Notifications and/or have Control Point.
BC2.5.5.1 & BC2.5.5.2	Referenced in the procedure through which a Demand BMU who has chosen (and is not compelled) to submit Bids and Offers, may cease its participation in the Balancing Mechanism

Export and Import Limits

2.5 These are set out in Appendix 1 to BC1 which defines the **Maximum Export Limit (MEL)** and the **Maximum Import Limit (MIL)**

“Maximum Export Limit” “the profile of the maximum level at which the **BM Unit** may be exporting (in MW) to the **GB Transmission System** at the **Grid Entry Point** or **Grid Supply Point** as appropriate”.

“Maximum Import Limit” “the profile of the maximum level at which the **BM Unit** may be importing (in MW) to the **GB Transmission System** at the **Grid Entry Point** or **Grid Supply Point** as appropriate”.

2.6 The term Maximum Export Limit is used in the following areas of the Grid Code:

Clause	Description of Usage
Definition of “Part Load”	Definition states that a unit is part-loaded if it is operating at a level other than its Maximum Export Limit
BC1.5.4 (c) & BC2.4.2	Notes that the aggregate submissions of Maximum Export Limit are used by National Grid in the assessment of whether there is adequate System Margin
BC2.5.3.1	Notes that a BM Unit must re-declare its Maximum Export Limit as soon as reasonably practicable after a System to Generating Unit Operational Intertrip has fired to more accurately reflect its output capacity.

2.7 The term Maximum Import Limit is used only where is defined in appendix 1 to BC1.

2.8 The term Export and Import Limits is used more generally through the Grid Code, specifically in the following areas:

Clause	Description of Usage
OC5	Noted throughout OC5 that one test that may be carried out is to ensure that the BM Unit is able to operate in accordance with its submitted Export and Import Limits.
OC5.5.1.3	Also noted that a test will only be carried out should the Export and Import Limits specify that the BM Unit is available for the relevant Operational Day. Once a test commences the Export and Import Limits must be submitted with a magnitude greater than zero for the duration of the test.
BC1.4.1 and BC2.5.3	Notes that any Plant failure or similar that might lead to a significant deviation away from a BM Units PN should be notified as soon as possible through a revision to the relevant Export and Import Limits.
BC1.4.2 (c)	Notes that a BM Participant may submit their Export and Import Limits at the Day Ahead Stage.
BC1.4.5	Notes that Export and Import Limits are subject to the Data Validation, Consistency and Defaulting Rules.
BC2.7.1	Notes that any Bid-Offer Acceptances issued by National Grid will be consistent with the BM Unit’s declared Export and Import Limits.
BC2.8.2	Notes that any Ancillary Services Instructions issued by National Grid will be consistent with the BM Unit’s declared Export and Import Limits.
BC2.9.1.3	Notes that Emergency Instructions may require actions to be taken by a BM Unit or Generating Unit that are outside of declared Export and Import Limits.

Full Output

2.9 This term whilst not defined in the Glossary and definitions section of the Grid Code it is defined in BC2.A.3.1 concerning the submission of revised MVAR data. It is closely linked to the definition of Registered Capacity and is defined as “being measured at the generator stator terminals representing the LV equivalent of the Registered Capacity [of the Synchronous Generating

Unit] at the Grid Entry Point” For Non-Synchronous Generating Units it is defined as equalling the Registered Capacity at the Grid Entry Point.

- 2.10 As noted above the term Full Output is used exclusively in relation to the resubmission of MVAR data.

Clause	Description of Usage
PC.4.3.1	It is noted that National Grid will use the Connection Entry Capacity data provided by Users through the CUSC in the preparation of the Seven Year Statement
PC.4.4.1	Users are required to submit their desired Connection Entry Capacity as part of the data required in connection with a CUSC Contract
PC.5.4 & PC.5.6	Clause notes that once an offer for a CUSC Contract has been accepted by a User then its Connection Entry Capacity in that offer is used in the future assessment of new connection applications to the GB Transmission System

Generation Capacity

- 2.11 Generation Capacity is another BSC defined term. Its definition is set out in BSC section K.3.4.8. It is defined as the maximum expected magnitude of a positive value of a BM Unit’s metered volume determined at the Transmission System Boundary in the relevant BSC season. It is expressed in MW.

- 2.12 The term Generation Capacity is used in the following areas of the Grid Code:

Clause	Description of Usage
BC1.4.2 (a)	One limit around the submission of a Physical Notification for a generation BMU is that it must not exceed its declared Generation Capacity

Import Usable

- 2.13 Import Usable is defined as “that portion of **Registered Import Capability (Capacity)** that is expected to be available and which is not unavailable due to a **Planned Outage**”.

- 2.14 The term Import Useable is used in the following areas of the Grid Code:

Clause	Description of Usage
PCA.3.2.2 (j)	As part of a Generator’s annual Week 24 data submissions under the Planning Code owners of DC Converter Stations are expected to provide the monthly profile of their Import Useable.

Output Usable

- 2.15 Output Usable is defined as “the (daily or weekly) forecast value (in MW), at the time of the (daily or weekly) peak demand, of the maximum level at which the **Genset** can export to the **Grid Entry Point**, or in the case of **Embedded Power Stations**, to the **User System Entry Point**”.

- 2.16 Output Usable is generally used in the assessment under OC2 of whether there is an adequate surplus of generation available to meet Demand and the Operational Planning Margin.

- 2.17 The term Output Useable is specifically used in the following areas of the Grid Code:

Clause	Description of Usage
PCA.3.2.2 (b)	As part of a Generator's annual Week 24 data submissions under the Planning Code the monthly profile of their Import Useable is expected to be provided.
OC2.4.1.2.1	Weekly Output Usable forecasts are required from each Generator for each week of Years 3, 4 and 5 in Week 2 of each Calendar Year. An update is required in Week 25.
OC2.4.1.2.2	Weekly Output Usable forecasts are required from each Generator for each week of Years 1 and 2 in Week 10 of each Calendar Year. An update is required in Week 25. An update is required in Week 34
OC2.4.1.2.3	Each Wednesday a Generator is required to submit an updated view of its weekly Output Usable from the 2 nd week ahead through to the 52 nd week ahead.
OC2.4.1.2.4	By 1100 hours on each Business Day each Generator must supply details of daily Output Usable for each Genset for the period starting on the 2 nd day ahead and finishing on the 14 th day ahead (inclusive).

Rated MW

2.18 Rated MW is defined as:

"The "rating-plate" MW output of a **Generating Unit, Power Park Module** or **DC Converter**, being:

- (a) that output up to which the **Generating Unit** was designed to operate (Calculated as specified in **British Standard BS EN 60034 – 1: 1995**);or
- (b) the nominal rating for the MW output of a **Power Park Module** being the maximum continuous electric output power which the **Power Park Module** was designed to achieve under normal operating conditions; or
- (c) the nominal rating for the MW import capacity and export capacity (if at a **DC Converter Station**) of a **DC Converter**.

2.19 The use of the term Rated MW is generally restricted within the Grid Code to defining the reactive power capability of a Generating Unit. To allow this process it is also referenced numerous times in the Planning Code as a key item of data required to be submitted by a Generator.

Clause	Description of Usage
PC (general)	Rated MW is a key item of data that must be submitted by Generators and owners of DC Converter Station Owners in routine submissions under the Planning Code
CC.6.3.2 & CC.6.3.4	Referenced numerous times in connection with the capability that is required of Synchronous and Non-synchronous Generating Units connected to the Total System
CC.6.3.15 (c) (i)	Referenced once in the clause that relaxes the Fault Ride through requirements on Power Park Modules where the Power Park Module is operating at less than 5% of its Rated MW.

Registered Capacity

2.20 Registered Capacity is defined as:

- (a) In the case of a **Generating Unit** other than that forming part of a **CCGT Module** or **Power Park Module**, the normal full load capacity of a **Generating Unit** as declared by the **Generator**, less the MW consumed by the **Generating Unit**

- through the **Generating Unit's Unit Transformer** when producing the same (the resultant figure being expressed in whole MW, or in MW to one decimal place).
- (b) In the case of a **CCGT Module** or **Power Park Module**, the normal full load capacity of the **CCGT Module** or **Power Park Module** (as the case may be) as declared by the **Generator**, being the **Active Power** declared by the **Generator** as being deliverable by the **CCGT Module** or **Power Park Module** at the **Grid Entry Point** (or in the case of an **Embedded CCGT Module** or **Power Park Module**, at the **User System Entry Point**), expressed in whole MW, or in MW to one decimal place.
 - (c) In the case of a **Power Station**, the maximum amount of **Active Power** deliverable by the **Power Station** at the **Grid Entry Point** (or in the case of an **Embedded Power Station** at the **User System Entry Point**), as declared by the **Generator**, expressed in whole MW, or in MW to one decimal place. The maximum **Active Power** deliverable is the maximum amount deliverable simultaneously by the **Generating Units** and/or **CCGT Modules** and/or **Power Park Modules** less the MW consumed by the **Generating Units** and/or **CCGT Modules** in producing that **Active Power**.
 - (d) In the case of a **DC Converter** at a **DC Converter Station**, the normal full load amount of **Active Power** transferable from a **DC Converter** at the **Grid Entry Point** (or in the case of an **Embedded DC Converter Station** at the **User System Entry Point**), as declared by the **DC Converter Station** owner, expressed in whole MW.
 - (e) In the case of a **DC Converter Station**, the maximum amount of **Active Power** transferable from a **DC Converter Station** at the **Grid Entry Point** (or in the case of an **Embedded DC Converter Station** at the **User System Entry Point**), as declared by the **DC Converter Station** owner, expressed in whole MW.

2.21 Registered Capacity is perhaps the most widely used Capacity Term within the Grid Code, the table below lists some of its more common uses:

Clause	Description of Usage
Definitions	Registered Capacity is the key term used in describing whether a Power Station is Small, Medium or Large. It also forms the basis on which a number of other parameters are defined (e.g. System Constrained Capacity, HP Turbine power Fraction, IP Turbine Power Fraction, Reheater Time Constant etc)
Planning Code	Registered Capacity Submissions are required as a key element of all Users Planning Code submissions either directly, or through its use in defining the entities upon which data is require to be provided.
Connection Conditions	Some of the Connection Conditions are subject to exclusions based around generators below a certain Registered Capacity threshold. Certain other connection Conditions (e.g. Steady State Load Inaccuracies) are defined with reference to the Registered Capacity of the relevant Generating Unit.
Operating Codes	Restricted to a single instance in OC2 where an obligation exists for owners of CCGTs to indicate how the output of the CCGT varies according to ambient temperature (including the indication of which ambient temperature corresponds to Registered Capacity)
Balancing Codes	BM Participants must not submit Physical Notifications that would put the operation of the BM Unit above it Registered Capacity. Again certain obligations concerning the despatch of Frequency Response in BC3 are carved out based upon the Power Station's Registered Capacity)

Registered Import Capability / Capacity

2.22 Registered Import Capability is defined as:

“In the case of a **DC Converter Station** containing **DC Converters** connected to an **External System**, the maximum amount of **Active Power** transferable into a **DC Converter Station** at the **Grid Entry Point** (or in the case of an **Embedded**

DC Converter Station at the **User System Entry Point**), as declared by the **DC Converter Station** owner, expressed in whole MW.

In the case of a **DC Converter** connected to an **External System** and in a **DC Converter Station**, the normal full load amount of **Active Power** transferable into a **DC Converter** at the **Grid Entry Point** (or in the case of an **Embedded DC Converter Station** at the **User System Entry Point**), as declared by the **DC Converter** owner, expressed in whole MW.”

- 2.23 The term Registered Import Capability / Capacity is used in the following areas of the Grid Code:

Clause	Description of Usage
PCA.3.2.2 (j)	As part of a Generator's annual Week 24 data submissions under the Planning Code owners of DC Converter Stations are expected to provide the Registered Import Capacity of their DC Converter Stations.

System Constrained Capacity

- 2.24 System Constrained Capacity is defined as:

“That portion of **Registered Capacity** or **Registered Import Capacity** not available due to a **System Constraint**.”

- 2.25 The term System Constrained Capacity is used in the following areas of the Grid Code:

Clause	Description of Usage
PCA.3.2.2 (c)	As part of a Generator's annual Week 24 data submissions under the Planning Code owners of Embedded Power Stations / Network Operators are expected to provide any details of System Constrained Capacity i.e. if a constraint within the Network Operators System would place restrictions on the export of electrical power from an Embedded Power Station.

Transmission Entry Capacity

- 2.26 Transmission Entry Capacity (TEC) is defined in the CUSC. TEC and its short term derivatives) cumulatively represent the maximum level of transmission access at which a Power Station owner wishes to purchase and use for a given financial year. It is measured on a Power Station basis only and is specified at the relevant Connection Site.

- 2.27 The term Transmission Entry Capacity is used in the following areas of the Grid Code. Essentially they are identical to the instances where Connection Entry Capacity is used within the Grid Code, with the exception of the data required on Mothballed Generating Units in PC.A.5.6.2:

Clause	Description of Usage
PC.4.3.1	It is noted that National Grid will use the Transmission Entry Capacity data provided by Users through the CUSC in the preparation of the Seven Year Statement
PC.4.4.1	Users are required to submit their desired Transmission Entry Capacity as part of the data required in connection with a CUSC Contract
PC.5.4 & PC.5.6	Clause notes that once an offer for a CUSC Contract has been accepted by a User then its Transmission Entry Capacity in that offer is used in the future assessment of new connection applications to the GB Transmission System

PC.A.5.6.2	Notes that where Generators have provided expected time periods in which Mothballed Generating Units could be returned to service they are not to factor in whether or not they would be able to obtain sufficient Transmission Entry Capacity.
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