DISTRIBUTION CODE MODIFICATION PROPOSAL FORM

Modification Proposal submitted By:	**DATE OF SUBMISSION OF PROPOSAL:**	**Modification Proposal Number:** *(to be assigned by Review Panel Secretary)*
TSO	18TH AUGUST 2004	03

CONTACT DETAILS FOR MODIFICATION PROPOSAL ORIGINATOR: (IF NOT DISTRIBUTION CODE REVIEW PANEL

NAME: ESB NATIONAL GRID	**TELEPHONE NUMBER:**
E-MAIL ADDRESS:	
MODIFICATION PROPOSAL TITLE:	**WIND CODE CHANGES**

DISTRIBUTION CODE SECTION(S) AFFECTED BY PROPOSAL:

- FIGURE 1 – INSERTED "DSO CONNECTED WIND GENERATION > 5 MW" AND QUALIFED "EMBEDDED GENERATION" WITH "<5 MW"
- INSERTED NEW SECTION DCC10 CALLED "ADDITIONAL REQUIREMENTS FOR EMBEDDED WIND GENERATION"
- ADDED RELEVANT DEFINITIONS TO THE "GLOSSARY AND DEFINITIONS" SECTION

MODIFICATION PROPOSAL DESCRIPTION

(Clearly state the desired amendment and all text changes. Attach further information if necessary)

- FIGURE 1: UPDATED FIGURE (ATTACHED IN SCHEDULE 1)
- DCC10 "ADDITIONAL REQUIREMENTS FOR EMBEDDED WIND GENERATION": FULL SECTION (ATTACHED IN SCHEDULE 2)
- TERMS ADDED TO "GLOSSARY AND DEFINITIONS" SECTION (ATTACHED IN SCHEDULE 3)

MODIFICATION PROPOSAL JUSTIFICATION

(Clearly state the reason for the modification. Attach further information if necessary)

THE WIND CONSULTATION GROUP WAS ASSIGNED TO IDENTIFY THE NECESSARY TECHNICAL CONDITIONS TO ACCOMMODATE NEW WIND GENERATION WHILE MAINTAINING THE SAFE, SECURE AND RELIABLE OPERATION OF THE SYSTEM. FOLLOWING THIS PROCESS, THE TSO PROPOSED CHANGES TO THE GRID CODE TO REFLECT THESE CONDITIONS. THE TSO IS PROPOSING CERTAIN CONDITIONS BE ADOPTED IN THE DISTRIBUTION CODE TO REFLECT THE IMPACT THAT DISTRIBUTION CONNECTED WIND GENERATION HAS ON SYSTEM OPERATION AND TO SAFEGUARD THE INTEGRITY OF THE SYSTEM.

IMPLICATIONS OF NOT IMPLEMENTING THIS MODIFICATION

BY CORRESPONDENCE OF THE 23RD DECEMBER 2003, THE CER INSTRUCTED THE TSO TO ENSURE THAT "INTERACTING ISSUES WITH THE DISTRIBUTION CODE ARISING FROM THE GRID CODE FOR WIND REVIEW BE RESOLVED". THIS PROPOSAL IS INTENDED TO MEET THIS INSTRUCTION. ANY IMPLICATIONS OF NOT IMPLEMENTING THIS PROPOSAL ARE A MATTER FOR THE CER.

PLEASE SUBMIT MODIFICATION PROPOSALS TO THE PANEL SECRETARY BY E-MAIL TO: DISTCODEPANEL@MAIL.ESB.IE

SCHEDULE 1:

THE DISTRIBUTION CODE

GRID CODE AND DISTRIBUTION CODE BOUNDARIES

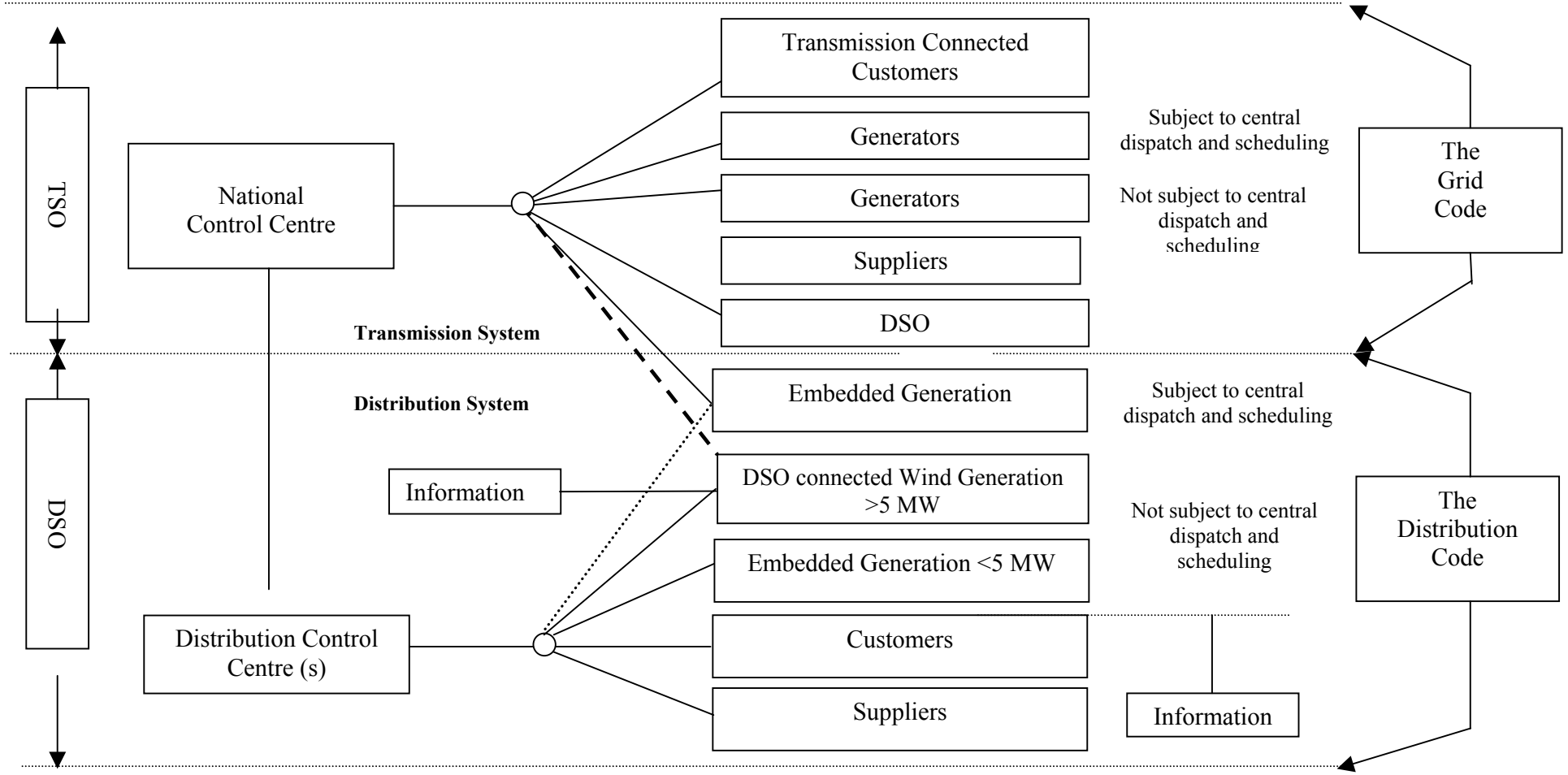


Figure 1

SCHEDULE 2:

ADDITIONAL REQUIREMENTS FOR EMBEDDED WIND GENERATION

DCC10 ADDITIONAL REQUIREMENTS FOR WIND GENERATION

DCC10.1.1 OBJECTIVE

The primary objective of DCC10 is to establish the technical rules to which **Wind Farm Power Stations** must comply in order to ensure that the **DSO** and the **TSO** can operate the **Distribution System** and **Transmission System** reliably, maximising wind penetration on both systems.

DCC10.1.2 SCOPE

DCC10 applies wholly or in part to the following **Users**:

(a) **Wind Farm Power Stations** with **Registered Capacity** of 5 MW or more; and

(b) "**Wind Farm Power Stations** with **Registered Capacity** less than 5 MW due to be developed on a **Contiguous Wind Farm Site** where the development of the **Wind Farm Power Station** results in the total **Registered Capacity** of **Wind Farm Power Stations** on the **Contiguous Wind Farm Site** exceeding or remaining above 5 MW unless the DSO agrees that the proposed **Wind Farm Power Station** is unrelated and independent of the **Wind Farm Power Stations** already present in the **Contiguous Wind Farm Site**;

(c) DCC10.5 shall apply to **Wind Farm Power Stations** with **Registered Capacity** of 2 MW or more.

DCC10.1.4 APPLICABILITY

An applicability matrix, which details the extent of application of DCC10 to various categories of **Wind Farm Power Station**, is given in Table 5. For the purposes of this section, four categories of **Wind Farm Power Station** connection types are identified for reference. These are defined as follows:

Connection Type B

Wind Farm Power Stations are classed as being **Connection Type B** when connected at a **Distribution System Voltage** (≤ 38 kV) to a dedicated **Wind Farm Power Station**(s) transmission station. There are no load customers connected to the **DSO** operated 38/20/10 kV busbar.

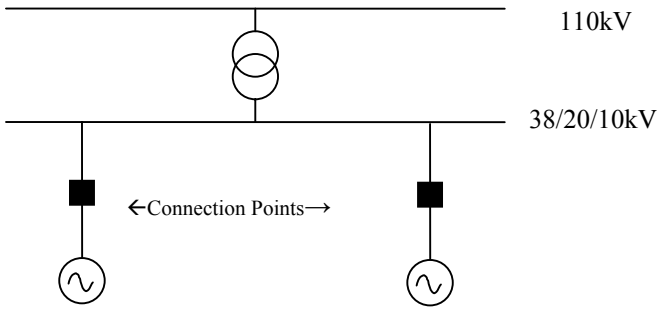


Figure 4

Connection Type C

Wind Farm Power Stations are classed as being **Connection Type C** when connected to the **Distribution System**, via a dedicated feeder, into an existing 110kV transmission station.

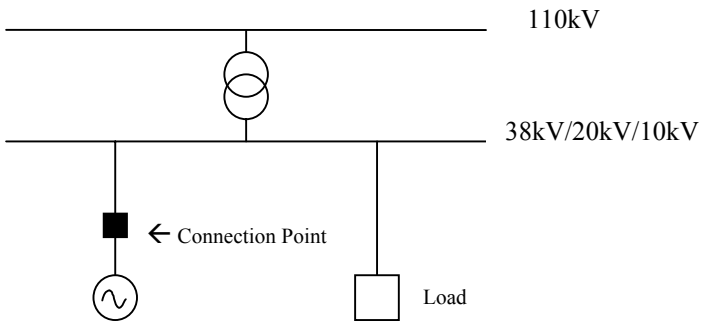


Figure 5

Connection Type D

Wind Farm Power Stations are classed as being **Connection Type D** when connected to the D**istribution System** via a dedicated feeder into an existing 38kV distribution station.

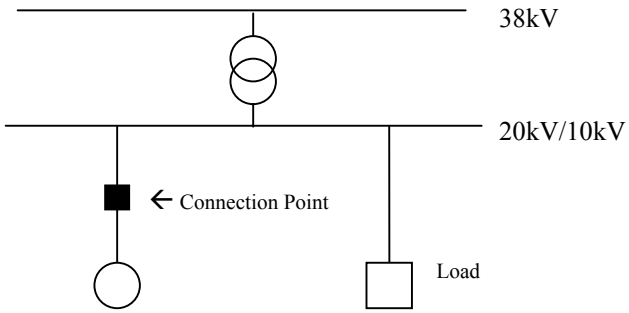


Figure 6

Connection Type E

Wind Farm Power Stations are classed as being **Connection Type E** when connected to an existing distribution line with load.

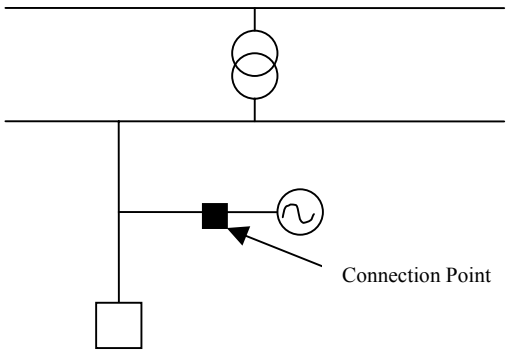


Figure 7

Table 5 indicates how the various requirements outlined in DCC10, will apply to the connection types described above.

Table 5: Applicability Matrix

	TYPE B	TYPE C	TYPE D	TYPE E
Fault Ride-Through	> 5 MW	> 5 MW	> 5 MW	> 5 MW
FREQUENCY				
Tolerance over Frequency Range	All	All	All	All
Participation in High Frequency Control	>5 MW	>5 MW	>5 MW	>5 MW
Participation in Low Frequency Control	>10 MW	>10 MW	>10 MW	>10 MW
Adherence to Maximum Ramp Rates	>5 MW	>5 MW	>5 MW	>5 MW
MW Curtailment Participation	>5 MW	>5 MW	>5 MW	>5 MW
VOLTAGE				
Voltage Regulation[1]	>5 MW	N/A	N/A	N/A
Reactive Power Range	>5 MW	>5 MW	N/A	N/A
SIGNALS/COMMUNICATIONS/CONTROL				
Signal List 1	>5 MW	>5 MW	N/A	N/A
Signal List 2	N/A	N/A	>5 MW	>5 MW
Signal List 3: Availability	>10 MW	>10 MW	>10 MW	>10 MW
Signal List 4: MW Curtailment	>5 MW	>5 MW	>5 MW	>5 MW
Signal List 5: Frequency Control	>5 MW	>5 MW	>5 MW	>5 MW
Signal List 6: Meteorological Data	>10 MW	>10 MW	>10 MW	>10 MW
Signal List 7: DSO SCADA Signals[2]	≥2 MW ≤5 MW[3]	≥2 MW ≤5 MW[3]	≥2 MW ≤5 MW[3]	≥2 MW ≤5 MW[3]
Ability to Accept Control Signal- MW Curtailment	>5 MW	>5 MW	>5 MW	>5 MW
Ability to Accept Control Signal- Frequency Control Curve Mode Change	>5 MW	>5 MW	>5 MW	>5 MW
Ability to Accept Control Signal- Voltage Control	>5 MW	N/A	N/A	N/A
Ability to receive Connection Point CB trip command from DSO	≥2 MW ≤5 MW[3]	≥2 MW ≤5 MW[3]	≥2 MW ≤5 MW[3]	≥2 MW ≤5 MW[3]
Ability to receive Connection Point CB trip and inhibit commands from DSO	>5 MW	>5 MW	>5 MW	>5 MW
Responsible Operator	All	All	All	All
Declarations	>30 MW	>30 MW	>30 MW	>30 MW
MW Forecasts	>30 MW	>30 MW	>30 MW	>30 MW

[1] Participation in Voltage Regulation- Mechanism to be agreed between TSO/DSO

[2] In certain circumstances, depending on future changes to the network connection, topology, the amount of embedded generation on the particular network and system reasons, generators with an MEC <2MVA may be required to provide telecommunication infrastructure for SCADA.

[3] In certain circumstances an RTU and necessary telecommunications infrastructure may not be required at wind farm power station site initially. This will be advised in the Connection Agreement.

DCC10.2 FAULT RIDE THROUGH REQUIREMENTS

DCC10.2.1 A **Wind Farm Power Station** shall remain connected to the **Distribution System** for **Voltage** dips on any or all phases, where the **Distribution System Voltage** measured at the **Connection Point** remains above the heavy black line in Figure 8.

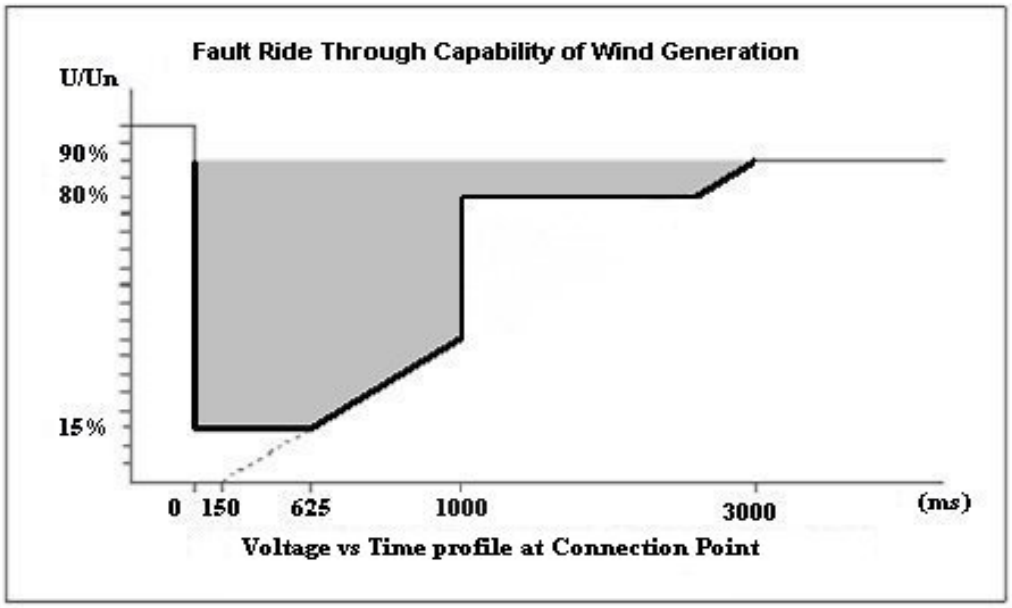


Figure 8: Fault Ride-Through Capability for Wind Farm Power Stations connected to the Distribution System

DCC10.2.2 In addition to remaining connected to the **Distribution System**, the **Wind Farm Power Station** shall have the technical capability to provide the following functions:

a) During the **Voltage** dip the **Wind Farm Power Station** shall provide **Active Power** in proportion to retained **Voltage** and maximise reactive current to the **Distribution System** without exceeding **WTG** limits. The maximisation of reactive current shall continue for at least 600ms or until the **Distribution System Voltage** recovers to within the normal operational range of the **Distribution System**, whichever is the sooner.

b) The **Wind Farm Power Station** shall provide at least 90 % of its maximum **Available Active Power** as quickly as the technology allows and in any event within 1 second of the **Distribution System Voltage** recovering to the normal operating range

DCC10.3 FREQUENCY REQUIREMENTS

DCC10.3.1 FREQUENCY RANGES

Wind Farm Power Stations shall have the capability to:

a) operate continuously at normal rated output at **Frequencies** in the range 49.5 Hz to 50.5 Hz

b) remain connected to the **Distribution System** at **Frequencies** within the range 47.5 Hz to 52 Hz for a duration of 60 minutes. Note that setting of the G10 Generator Interface Protection will determine actual operation in this range (see Table 6).

c) remain connected to the **Distribution System** at **Frequencies** within the range 47.0 Hz to 47.5 Hz for a duration of 20 seconds required each time the **Frequency** is below 47.5 Hz.

d) remain connected to the **Distribution System** during rate of change of **Frequency** of values up to and including 0.5 Hz per second.

No additional **WTG** shall be started while the **Frequency** is above 50.2 Hz.

Protection Function	Frequency Setting	Time Setting
Over Frequency	50.8Hz	0.5s
Under Frequency	47Hz	0.5s
Rate-of-change-of-Frequency	0.55Hz/s	< 0.5s
Under-voltage	80% of nominal	1s

Table 6: Currently applicable Generator Interface Protection settings

DCC10.3.2 FREQUENCY RESPONSE

DCC10.3.2.1 A **Frequency Response System** shall be installed by the **Wind Farm Power Station** to allow for the provision of **Frequency Response** from the **Wind Farm Power Station**. The **Frequency Response System** shall provide the functionality as specified in this section DCC10.3.2.

DCC10.3.2.2 **MW Curtailment**

The **Wind Farm Power Station** shall be capable of operating each **WTG** at a reduced level if the **Wind Farm Power Station**'s **Active Power** has been curtailed by the **TSO** for system security reasons. The **Wind Farm Power Station** shall be capable of receiving an on-line **MW Curtailment Set-point** sent from the **TSO** and acting accordingly. For system security reasons it may also be necessary for the **TSO** to constrain off the **Wind Farm Power Station**.

DCC10.3.2.3 Power-Frequency Response Curve

The **Frequency Response System** shall have the capabilities as displayed in the Power-Frequency Response Curve in Figure 9.

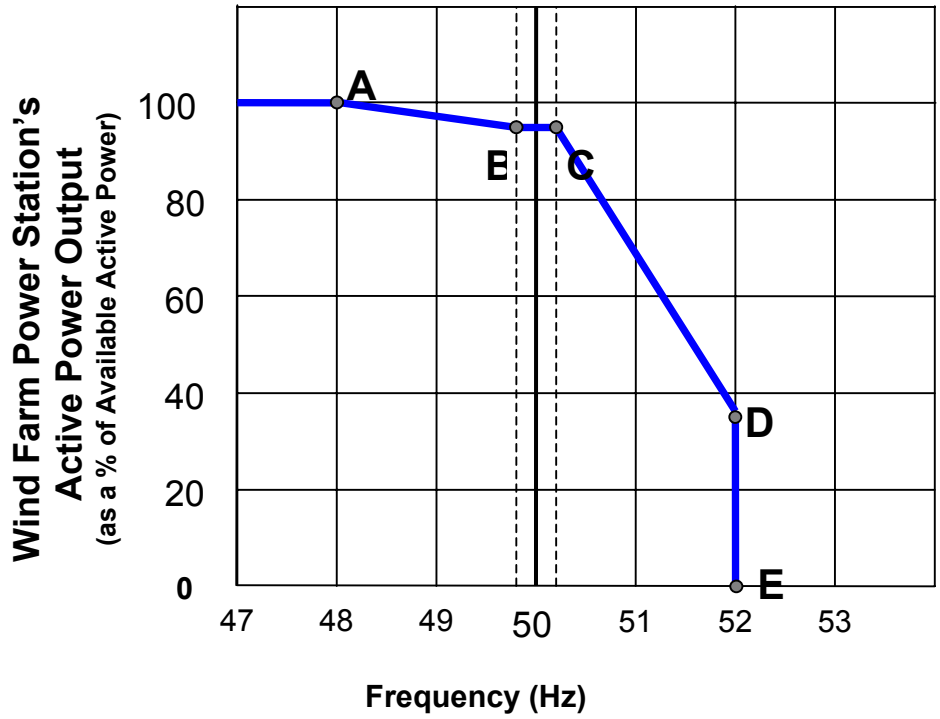


Figure 9 - Power-Frequency Control Curve

DCC10.3.2.3.1 Under normal **Frequency** ranges, the **Wind Farm Power Station** shall operate with an **Active Power** output as set by the line 'B' - 'C'. If the **Frequency** falls below point 'B', then the **Frequency Response System** shall act to ramp up the **Wind Farm Power Station**'s **Active Power** output in accordance with the **Frequency**/**Active Power** characteristic defined by the line 'B'-'A'.

DCC10.3.2.3.2 Where the **Frequency** is below the normal range and is recovering back towards the normal range, the **Frequency Response System** shall act to ramp down the **Wind Farm Power Station**'s **Active Power** output in accordance with the **Frequency**/**Active Power** characteristic defined by the line 'A'-'B'.

DCC10.3.2.3.3 A **Frequency** dead-band shall be applied between the **Frequencies** corresponding to points 'B' and 'C', where no change in **Wind Farm Power Station Active Power** output shall be required.

DCC10.3.2.3.4 Once the **Frequency** rises to a level above point 'C', the **Frequency Response System** shall act to ramp down the **Wind Farm Power Station**'s **Active Power** output in accordance with the **Frequency**/**Active Power** characteristic defined by the line 'C'-'D'-'E'. At **Frequencies** greater than or equal to 'D'-'E', there shall be no **Active Power** output from the **Wind Farm Power Station**.

DCC10.3.2.3.5 Points 'A', 'B', 'C', 'D' and 'E' shall depend on a combination of the **Frequency**, **Active Power** and **MW Curtailment Set-point** settings,. These settings may be different for each Wind **Farm Power Station** depending on system conditions and **Wind Farm Power Station** location. These settings are defined in Table 7.

Point	**Frequency** (Hz)	**Wind Farm Power Station Active Power** Output (% of **Available Active Power**)
A	$\mathbf{F_A}$	$\mathbf{P_A}$
B	$\mathbf{F_B}$	Minimum of : $\mathbf{P_B}$ or **MW Curtailment Set-point** (converted to a % of **Available Active Power**)
C	$\mathbf{F_C}$	Minimum of: $\mathbf{P_C}$ or **MW Curtailment Set-point** (converted to a % of **Available Active Power**)
D	$\mathbf{F_D}$	Minimum of: $\mathbf{P_D}$ or **MW Curtailment Set-point** (converted to a % of **Available Active Power**)
E	$\mathbf{F_E}$	$\mathbf{P_E}$ = 0 %

Table 7: Frequency and % Available Active Power Settings for the Points A, B, C, D and E illustrated in Figure 10

Two settings for each of F_A, F_B, F_C, F_D, F_E, P_A, P_B, P_C, P_D and P_E shall be specified by the **TSO** at least 60 business days prior to the **Wind Farm Power Station's** scheduled **Operational Date**. The **Wind Farm Power Station** shall be responsible for implementing the appropriate settings during **Commissioning**. Alterations to the **MW Curtailment Set-point** may be requested in real-time by the **TSO** and these alterations shall be implemented by the **Wind Farm Power Station** within one minute of receipt of the appropriate signal from the **TSO**.

DCC10.3.2.3.6 The table below, Table 8, shows the **Frequency** and **Active Power** ranges for $\mathbf{F_A}$, $\mathbf{F_B}$, $\mathbf{F_C}$, $\mathbf{F_D}$, $\mathbf{F_E}$, $\mathbf{P_A}$, $\mathbf{P_B}$, $\mathbf{P_C}$, $\mathbf{P_D}$ and $\mathbf{P_E}$

	Frequency (Hz)		**Available Active Power** (%)	
			MEC ≥ 10 MW	5 MW ≤ **MEC** <10 MW
$\mathbf{F_A}$	47.0-51.0	$\mathbf{P_A}$	50-100	100
$\mathbf{F_B}$	49.5-51.0	$\mathbf{P_B}$	50-100	100
$\mathbf{F_C}$		$\mathbf{P_C}$		
$\mathbf{F_D}$	50.5-52.0	$\mathbf{P_D}$	20-100	20-100
$\mathbf{F_E}$		$\mathbf{P_E}$	0	0

Table 8: Frequency & Active Power ranges appropriate to Figure 10.

For the **Frequency** values in Table 8 above, $\mathbf{F_A} \leq \mathbf{F_B} \leq \mathbf{F_C} \leq \mathbf{F_D} = \mathbf{F_E}$.

DCC10.3.2.3.7 Alterations to the **Wind Farm Power Station**'s **Active Power** output, triggered by **Frequency** changes, shall be achieved by proportionately altering the **Active Power** output of all available **WTG** as opposed to switching individual **WTG** on or off, insofar as possible.

DCC10.3.2.3.8 No time delay other that those necessarily inherent in the design of the **Frequency Response System** shall be introduced. The response rate of each available online **WTG** shall be a minimum of 1% of **WTG** rated capacity per second (MW/second). The **Frequency Response System** shall continuously monitor the **Frequency** in order to continuously determine the **Wind Farm Power Station**'s appropriate **Active Power** output by taking account of the **Wind Farm Power Station**'s **Available Active Power** or **Curtailed Active Power**.

DCC10.3.2.3.9 If the **Frequency** rises to a level above the line 'D'-'E', as defined by the Power-Frequency Response Curve in Figure 9, **DSO** recognises that **WTG** may disconnect. Any **WTG** which has disconnected shall be brought back on load as fast as technically feasible (provided the **Frequency** has fallen to below 50.2 Hz).

DCC10.3.3 PROCEDURE FOR SETTING AND CHANGING THE POWER-FREQUENCY RESPONSE CURVES

Two Power-Frequency Response Curves (Curve 1 and Curve 2) shall be specified by the **TSO** at least 60 business days prior to the **Wind Farm Power Station**'s scheduled Operational Date. The **Wind Farm Power Station** shall be responsible for implementing the appropriate settings during Commissioning. The **Frequency Response System** shall be required to change between the two curves within one minute from receipt of the appropriate signal from the **TSO**. The **TSO** shall give the **Wind Farm Power Station** a minimum of 2 weeks if changes to any of the curve's parameters (i.e. $\mathbf{F_A}$, $\mathbf{F_B}$, $\mathbf{F_C}$, $\mathbf{F_D}$, $\mathbf{F_E}$, $\mathbf{P_A}$, $\mathbf{P_B}$, $\mathbf{P_C}$, $\mathbf{P_D}$ or $\mathbf{P_E}$) are required. The **Wind Farm Power Station** shall formally confirm that any requested changes have been implemented within two weeks of receiving the **TSO**'s formal request.

DCC10.3.4 RAMP RATES

DCC10.3.4.1 The **Wind Farm Power Station** shall be capable of controlling the ramp rate of its **Active Power** output with a maximum MW per minute ramp rate set by **TSO**. There shall be two maximum ramp rate settings. The first ramp rate setting shall apply to the MW ramp rate average over one (1) minute. The second ramp rate setting shall apply to the MW per minute ramp rate average over ten (10) minutes. These ramp rate settings shall be applicable for all ranges of operation including start up, normal operation and shut down. DSO acknowledges that falling wind speed or **Frequency Response** may cause either of the maximum ramp rate setting to be exceeded

DCC10.3.4.2 It shall be possible to vary each of these two maximum ramp rate settings independently over a wide range of between 1 and 30 MW per minute. The **Wind Farm Power Station** shall have the capability to set the ramp rate in MW per minute averaged over both one and ten minutes.

DCC10.3.4.3 PROCEDURE FOR SETTING AND CHANGING THE RAMP RATE LIMITATIONS

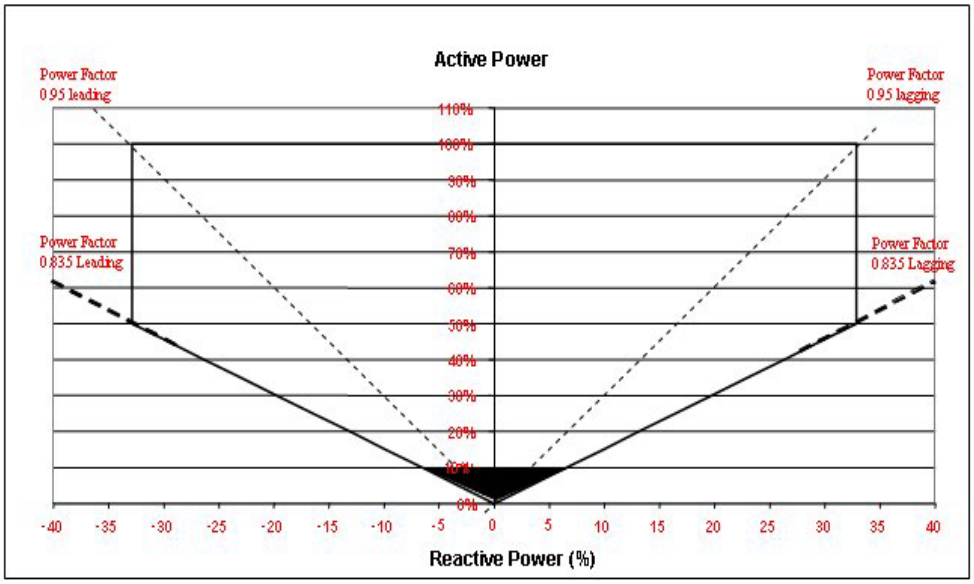
The ramp rate settings shall be specified by the **TSO** at least 60 business days prior to **the Wind Farm Power Station**'s scheduled Operational Date. The **Wind Farm Power Station** shall be responsible for implementing the appropriate settings during Commissioning. The ramp rate settings may need to be changed from time to time depending on system needs. The **TSO** shall formally give the **Wind Farm Power Station** a minimum of two weeks notice if a change is required. The **Wind Farm Power Station** shall formally confirm that any requested changes have been implemented within two weeks of receiving the **TSO**'s formal request.

DCC10.4 VOLTAGE REQUIREMENTS

DCC10.4.1 For **DSO Type B connected Wind Farm Power Stations**, a form of **Voltage Regulation** will be required.

DCC10.4.2 REACTIVE POWER CAPABILITY

Wind Farm Power Stations, **Type B connected** and **Type C connected**, shall be capable of operating at any point within the **Power Factor** ranges illustrated in Figure 10. The capability must be implemented at the **Connection Point**



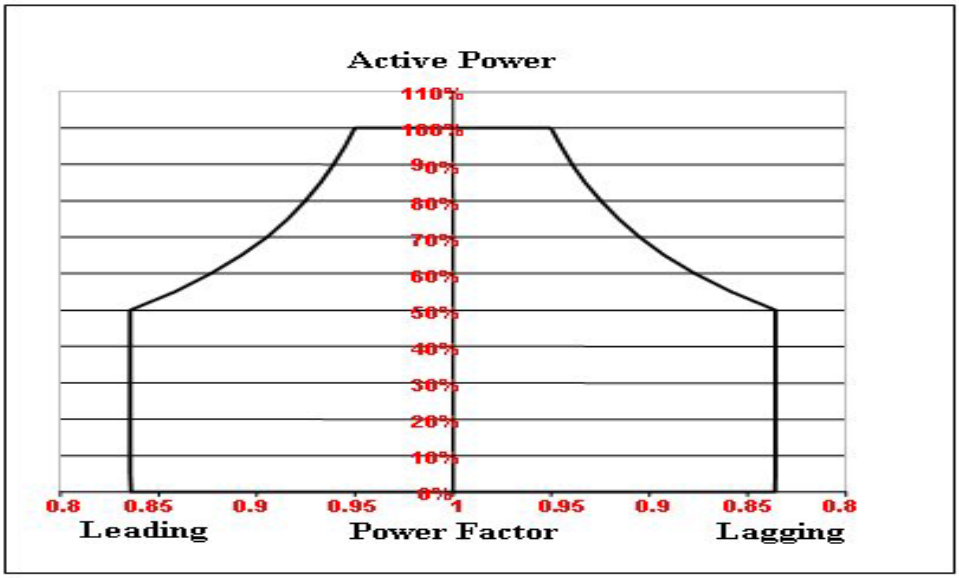


Figure 10 - Reactive Power Capability of Wind Farm Power Station

DCC10.5 SIGNALS, COMMUNICATIONS & CONTROL

DCC10.5.1 SIGNALS FROM THE WIND FARM POWER STATION TO TSO

Signals from the **Wind Farm Power Station** to the **TSO** shall be broken up into a number of logical groups. There are different requirements for **Wind Farm Power Stations** depending on the **Wind Farm Power Station**'s **MEC** size. Refer to Table 5 for a summary of the signal requirements for different **Wind Farm Power Station MEC**.

The following groups shall apply:

- **Signals List #1** - applies to **Wind Farm Power Station Connection Types B** and **C**.
- **Signals List #2** - applies to **Wind Farm Power Station Connection Types D** and **E**.

In addition, **Wind Farm Power Stations** shall be required to provide certain signals from Signals **Lists 3**, **4**, **5**, **6** and **7**. These lists relate to:

- **Signals List #3** **Wind Farm Power Station Availability** Data;
- **Signals List #4** **Wind Farm Power Station MW Curtailment** Data;
- **Signals List #5** **Frequency Response System** Settings;
- **Signals List #6** **Wind Farm Power Station** Meteorological Data;
- **Signals List #7** **DSO SCADA** Signals.

DCC10.5.1.1 Signals List #1

The **Wind Farm Power Station** shall make the following signals available at a **DSO** designated **RTU** located at the **Wind Farm Power Station** site:

a) **Active Power** output (MW) at the **Connection Point**;
b) **Available Active Power** (MW) at the **Connection Point**;
c) **Reactive Power** output/demand (+/-MVAr) at the **Connection Point**;
d) On/off status indications for all **Reactive Power** devices exceeding 5 Mvar;
e) Circuit-breaker position indication shall be required. These may include indications from MV circuit-breakers on individual **WTG** circuits. Signals from individual **WTG** circuit-breakers shall not be required. The actual circuit-breaker signals required shall be specified by the **TSO** and subsequently advised by the **DSO**, at least 60 business days prior to the **Wind Farm Power Station**'s scheduled Operational Date.

DCC10.5.1.2 Signals List #2

The **Wind Farm Power Station** shall make the following signals available at a **DSO** designated **RTU** located at the **Wind Farm Power Station** site:

a) **Active Power** output (MW) at the **Connection Point**;
b) **Available Active Power** (MW) at the **Connection Point**;
c) **Reactive Power** output/demand (+/-MVAr) at the **Connection Point**;
d) Circuit-breaker position indication shall be required. These may include indications from MV circuit-breakers on individual **WTG** circuits. Signals from individual **WTG** circuit-breakers shall not be required. The actual circuit-breaker signals required shall be specified by the **TSO** and subsequently advised by the **DSO** at least 60 business days prior to the **Wind Farm Power Station**'s scheduled Operational Date.

DCC10.5.1.3 Signals List #3

DCC10.5.1.3.1 **Wind Farm Power Stations**, with an **MEC** in excess of 10 MW, shall make available the following signals at a **DSO** designated **RTU** located at the **Wind Farm Power Station** site:

a) **Wind Farm Power Station Availability** data (0-100% signal);
b) Indication for percentage of the **Wind Farm Power Station**'s **WTG** that are shutdown due to high-wind-speed conditions (0-100% signal);
c) Indication for percentage of the **Wind Farm Power Station**'s **WTG** that are shutdown due to low-wind-speed conditions (0-100% signal).

DCC10.5.1.3.2 For **Wind Farm Power Station** sites with an **MEC** in excess of 10 MW, where the **WTG** are widely dispersed over a large geographical area and rather different weather patterns are expected for different sections of the **Wind Farm Power Station** site, the above data set (specified in DCC10.5.4.1) shall be provided for a number of groups of **WTG** (e.g. 1 signal for each group of XX **WTG** within the **Wind Farm Power Station** site). It is expected that **WTG** within an individual group shall demonstrate a high degree of correlation in **Active Power** output at any given time. The actual signals required shall be specified by the **TSO** and subsequently advised by the **DSO**, at least 60 business days prior to the **Wind Farm Power Station**'s scheduled Operational Date.

DCC10.5.1.4 Signals List #4

The **Wind Farm Power Station** shall make the following signals available at a **DSO** designated **RTU** located at the **Wind Farm Power Station** site:

a) **Wind Farm Power Station MW Curtailment Set-point** value (MW);
b) **Wind Farm Power Station MW Curtailment** facility status indication (ON/OFF).

DCC10.5.1.5 Signals List #5

The **Wind Farm Power Station** shall make the following signals available at a **DSO** designated **RTU** located at the **Wind Farm Power Station** site:

a) **Frequency Response System** Mode signal (i.e. Power-Frequency Response Curve 1 or 2);
b) **Frequency Response System** Mode status indication (ON/OFF).

DCC10.5.1.6 Signals List #6

DCC10.5.1.6.1 **Wind Farm Power Stations**, with an MEC in excess of 10 MW, shall make the following signals available at a **DSO** designated **RTU** located at the **Wind Farm Power Station** site:

a) Wind speed (at hub height) – measurand signal;
b) Wind direction (at hub height) – measurand signal;
c) Air temperature- measurand signal;
d) Air pressure- measurand signal.

DCC10.5.1.6.2 The meteorological data signals shall be provided by a dedicated **Meteorological Mast** located at the **Wind Farm Power Station** site or, where possible and preferable to do so, data from a means of the same or better accuracy. For **Wind Farm Power Stations** where the **WTG** are widely dispersed over a large geographical area and rather different weather patterns are expected for different sections of the **Wind Farm Power Station**, the meteorological data shall be provided from a number of individual **Meteorological Masts**, or where possible and preferable to do so, data from a source of the same or better reliability for groups of **WTG** (e.g. 1 set of meteorological data for each group of XX **WTG** within the **Wind Farm Power Station** site). It is expected that **WTG** within an individual group shall demonstrate a high degree of correlation in **Active Power** output at any given time. The actual signals required shall be specified by the **TSO** no more than 60 business days after a Connection Agreement has been signed between the **Wind Farm Power Station** and the **DSO**.

DCC10.5.1.7 Signals List #7

The following data signals and commands shall be provided by **Wind Farm Power Stations**:

a) MW
b) MVAr
c) kV
d) Connection Point Circuit Breaker Trip / Close command and status

These readings (a, b, c) will be taken at the generator site from a transducer mounted in the **DSO** metering cabinet

DCC10.5.1.8 Update Rates

DCC10.5.1.8.1 Signals shall be updated at a rate of between 1 and 30 seconds at the **DSO** designated **RTU** located at the **Wind Farm Power Station** site, to provide an average value over the previous 1-30 seconds, as appropriate.

DCC10.5.2 CONTROL SIGNALS FROM DSO/ TSO TO WIND FARM POWER STATIONS

The control signals described in DCC10.5.10.1.1 shall be sent from **DSO** or **TSO** to the **Wind Farm Power Station**. The **Wind Farm Power Station** shall be capable of receiving these signals and acting accordingly.

DCC10.5.2.1 MW Curtailment

A **MW Curtailment Set-point** signal shall be sent by **TSO** via the **Wind Farm Power Station**'s **RTU** to the **Wind Farm Power Station**'s **Frequency Response System**. This set-point shall define the maximum **Active Power** output permitted from the **Wind Farm Power Station**. The **Wind Farm Power Station**'s **Frequency Response System** must be capable of receiving this signal and acting accordingly to achieve the desired change in **Active Power** output. This signal shall most likely be in the form of a single analogue value.

DCC10.5.2.2 Power-Frequency Response Curve Mode

This signal shall be sent by **TSO** to the **Wind Farm Power Station** in the event that a change from Power Frequency Response Curve 1 to Power Frequency Response Curve 2, or vice versa, is required.

DCC10.5.2.3 Connection Point CB Trip facility

A facility shall be provided to facilitate the disconnection of the **Wind Farm Power Station**. It shall be possible for **DSO** to send a trip and / or inhibit signal[3] to the circuit breaker at the **Wind Farm Power Station Connection Point**.

DCC10.5.2.4 Responsible Operator

A designated Responsible Operator shall be contactable by **DSO** or **TSO** at all times to discuss operational matters without undue delay and in any case within at most 1 hour. Following a request from **DSO**, the Responsible Operator shall be present at the **Wind Farm Power Station**'s **Connection Point** without undue delay and in any case within two hours and shall be capable of taking any appropriate actions. The Responsible Operator shall be contactable 24 hours a day, 365 days a year. Specialist response shall be available on the next working day following a request from the **DSO** or **TSO**.

DCC10.5.2.5 Data and Communications Specifications

DCC10.5.2.5.1 The location of the **RTU** shall be agreed between the **DSO** and the **Wind Farm Power Station** no more than 60 business days after a Connection Agreement has been signed between the **Wind Farm Power Station** and the **DSO**.

[3] Refer to Table 5.

DCC10.5.2.5.2 The necessary communications links, communications protocol and the requirement for analogue or digital signals shall be specified by the **TSO**/**DSO** as appropriate no more than 60 business days after a Connection Agreement has been signed between the **Wind Farm Power Station** and the **DSO**. Current applicable standards shall apply and the accuracy class for signals shall comply with the prevailing European Standard at that time.

DCC10.5.2.5.3 For loss of communications links, persistence (i.e. continuing to operate with the most recent data set) shall be used in terms of set-points until the designated Responsible Operator has been contacted by the **DSO**/**TSO** as appropriate.

DCC10.5.2.5.4 If **MW Curtailment**, **Frequency Response** or **Voltage Regulation** facilities at the **Wind Farm Power Station** become unavailable, the **Wind Farm Power Station** shall contact **TSO** without undue delay.

DCC10.5.2.5.5 Where signals or indications required to be provided by the **Wind Farm Power Station** under DCC10.5 become unavailable or do not comply with applicable standards due to failure of the **Wind Farm Power Station**'s technical equipment or any other reason under the control of the **Wind Farm Power Station**, the **Wind Farm Power Station** shall, acting in accordance with Good Industry Practice, restore or correct the signals and/or indications as soon as possible.

DCC10.5.3 MW FORECASTS

MW forecasts shall be provided by **Wind Farm Power Stations** with an MEC in excess of 30 MW. These forecasts shall be provided at 10:00 a.m. on a daily basis for the following 48 hours for each 30 minute time-period, by means of an electronic interface in accordance with the reasonable requirements of **TSO**'s data system.

DCC10.5.4 WIND FARM POWER STATION MW AVAILABILITY DECLARATIONS

Wind Farm Power Stations with an **MEC** in excess of 30 MW shall submit **Wind Farm Power Station MW Availability** Declarations whenever changes in MW Availability occur or are predicted to occur. These declarations shall be submitted by means of an electronic interface in accordance with the reasonable requirements of **TSO**'s data system.

SCHEDULE 3: ADDITIONAL DEFINITIONS

Available Active Power	The amount of **Active Power** that the **Wind Farm Power Station** could produce based on current wind conditions. The **Available Active Power** shall only differ from the actual **Active Power** if the **Wind Farm Power Station** has been curtailed, constrained or is operating in a restrictive **Frequency Response** mode.
Contiguous Wind Farm Site	A geographical area containing a number of **Wind Farm Power Stations** with signed **DSO** connection agreements, where any individual wind turbine generator on a **Wind Farm Power Station** site with a signed **DSO** connection agreement is within 1.5 kilometre of any individual wind turbine generator on another separate **Wind Farm Power Station** site with a signed **DSO** connection agreement. A proposed **Wind Farm Power Station** will be deemed to be considered part of a **Contiguous Wind Farm Site** where any individual wind turbine generator on the proposed **Wind Farm Power Station** site is within 1.5 kilometre of any individual wind turbine generator on a second **Wind Farm Power Station** site, where that second **Wind Farm Power Station** has a signed **DSO** connection agreement.
Curtailed Active Power	The amount of **Active Power** that the **Wind Farm Power Station** site is permitted to generate based on the **MW Curtailment Set-point** signal sent by the **TSO**.
Frequency Response	The automatic adjustment of **Active Power** output from a **Generation Unit(s)** in response to **Frequency** changes.
Frequency Response System	A facility providing the means to automatically adjust the **Active Power** output from a **Generation Unit(s)** in response to changes in **Frequency**.
Meteorological Mast	A device erected at the **Wind Farm Power Station** site which has the capability measure representative wind speed, wind direction, air temperature and air pressure to a degree of accuracy corresponding to the appropriate prevailing European Standard at that time.
MW Curtailment	The automatic reduction of Active Power output from a Generation Unit(s) in response to a MW Curtailment Set-point signal being received from the TSO.
MW Curtailment Set-point	The limit set by the **TSO** for the amount of **Active Power** that the **Wind Farm Power Station** site is permitted to generate.

Remote Terminal Unit (RTU)	A device that collects, codes and transmits data. An **RTU** collects information from a master device and implements processes that are directed by that master. **RTU**s are equipped with input channels for sensing or metering, output channels for control, indication or alarms and a communications port.
Step Change	A step change is defined as a single, rapid change of the RMS voltage. **Distribution System Voltage** step changes can occur due to switching in and out of capacitors, lines, cables, transformers and other plant.
Voltage Regulation	The automatic adjustment of **Reactive Power** output from a **Generation Unit(s)** in response to **Voltage** changes.
Voltage Regulation System	A facility providing the means to automatically adjust the **Reactive Power** output from a **Generation Unit(s)** in response to changes in **Voltage**.
Wind Farm Power Station	A Site containing at least one **WTG**.
Wind Farm Power Station Availability	The amount of MW the wind farm can produce given favourable wind conditions
Wind Farm Power Station MW Availability Declaration	A measure of the maximum **Active Power** output which can be produced by a **Wind Farm Power Station** given favourable wind conditions. Account shall be taken of partial and/or full outages of individual **WTG** within the **Wind Farm Power Station**.
Wind Farm Power Station Operator	The operator of the Wind Farm Power Station
Wind Turbine Generator (WTG)	A Generation Unit(s) generating electricity from wind