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WFPS1 WIND FARM POWER STATION GRID CODE PROVISIONS

WFPS1.1 INTRODUCTION

WFPS1.1.1 All **Generators** connecting to the **Transmission System** are required to comply with the **Grid Code**. The **Grid Code** was originally developed with synchronous generators in mind. Since **Wind Turbine Generators (WTG)** do not have the same characteristics as synchronous generators, it was considered appropriate to develop a new set of **Grid Code** provisions specifically for **Wind Farm Power Stations**. This section of the **Grid Code** is intended to refer specifically to **Wind Farm Power Stations**.

WFPS1.1.2 In addition to WFPS1, the **Users** listed in WFPS1.3 are required to comply with the following sections of the **Grid Code**:

- GC - General Conditions
- PC - Planning Code
- CC- Connection Conditions (excluding CC7.3.1.1 (a) to (v) inclusive, CC7.3.1.2, CC7.3.5, CC7.3.6, CC7.3.7, CC7.3.8, CC8.3.1, CC8.3.2, CC.12.2 (e) to (g) inclusive and CC.12.3)
- OC1
- OC2
- OC4 (excluding OC4.3.4, OC4.4.5.3, OC4.4.5.4, OC4.4.5.5)
- OC6
- OC7 (excluding OC7.2.4.2)
- OC8
- OC9
- OC10 (excluding sections OC10.5.6; OC10.7.1; OC10.7.2; OC10.7.3; OC10.7.4; OC10.7.6),
- OC11

In all other sections of the **Grid Code**, where applicable, for the purposes of **Wind Farm Power Stations** references to **Generation Unit** or **Generator** should be interpreted to mean **Wind Farm Power Station**.

WFPS1.2 OBJECTIVE

The primary objective of WFPS1 is to establish the technical rules which **Wind Farm Power Stations** must comply with in relation to their connection to and operation on the **Network**.

WFPS1.3 SCOPE

WFPS1 applies to the **TSO**, the **DSO** and to the following **Users**:

- (a) Grid Connected Wind Farm Power Stations;**
- (b) Wind Farm Power Stations** with a **MEC** of 5MW or more connected to the **Distribution System**; and
- (c) Wind Farm Power Stations** with a **MEC** less than 5MW and which shall be developed on a **Contiguous Wind Farm Power Station Site**, where the development of the **Wind Farm Power Station** results in, or maintains, an aggregate **MEC** on the **Contiguous Wind Farm Power Station Site** of 5MW or more.

WFPS1.4 FAULT RIDE THROUGH REQUIREMENTS

WFPS1.4.1 A **Wind Farm Power Station** shall remain connected to the **Network** for **Voltage** dips on any or all phases, where the **Voltage** measured at the HV terminals of the **Grid Connected Transformer** remains above the heavy black line in *Figure WFPS1.1*.

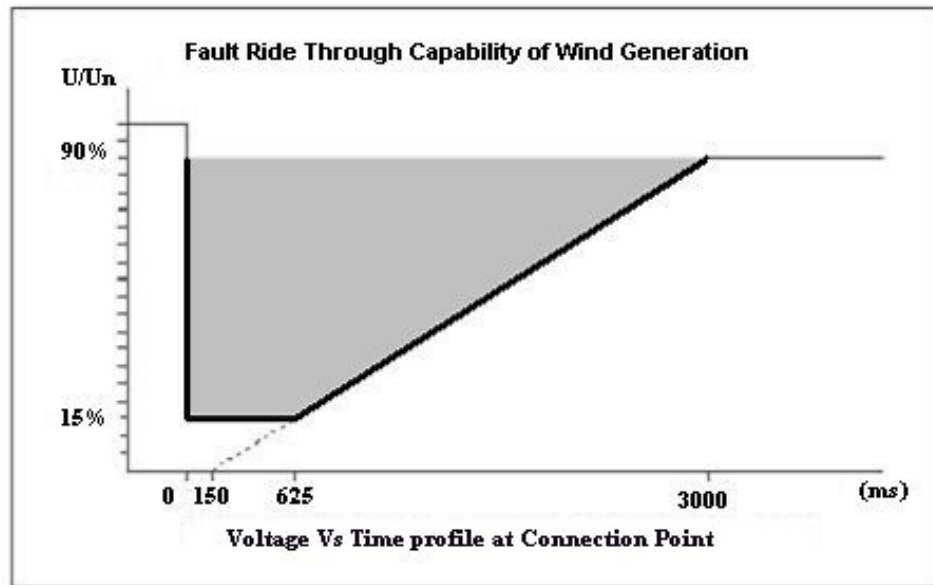


Figure WFPS1.1 - Fault Ride-Through Capability for Wind Farm Power Stations

WFPS1.4.2 In addition to remaining connected to the **Network**, the **Wind Farm Power Station** shall 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 **Network** without exceeding **WTG** limits. The maximisation of reactive current shall continue for at least 600ms or until the **Voltage** recovers to within the normal operational range of the **Transmission System** (ref. WFPS1.6.1), whichever is the sooner.
- b) Within 1 second of the **Voltage** recovering to the normal operating range (ref. WFPS1.6.1), the **Wind Farm Power Station** shall provide at least 90% of its maximum **Available Active Power**.

The **TSO** reserves the right to require a more enhanced Fault Ride-Through capability, or refuse connection to the **Network**, for system security reasons. If applicable, this shall be notified by the **TSO** or **DSO** during the **Connection Offer** process.

WFPS1.5 FREQUENCY REQUIREMENTS**WFPS1.5.1 FREQUENCY RANGES**

Wind Farm Power Stations shall have the capability to:

- a) operate continuously at normal rated output at **Frequencies** in the range 49.5Hz to 50.5Hz;
- b) remain connected to the **Network** at **Frequencies** within the range 47.5Hz to 52.0Hz for a duration of 60 minutes;
- c) remain connected to the **Network** at **Frequencies** within the range 47.0Hz to 47.5Hz for a duration of 20 seconds required each time the **Frequency** is below 47.5Hz;
- d) remain connected to the **Network** 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 50.2Hz.

WFPS1.5.2 FREQUENCY RESPONSE

A **Frequency Response System** shall be installed by the **User** 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 WFPS1.5.2.

WFPS1.5.2.1 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** output 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 by 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**.

WFPS1.5.2.2 Power-Frequency Response Curve

WFPS1.5.2.2.1 The **Frequency Response System** shall have the capabilities as displayed in the *Power-Frequency Response Curve* in *Figure WFPS1.2*.

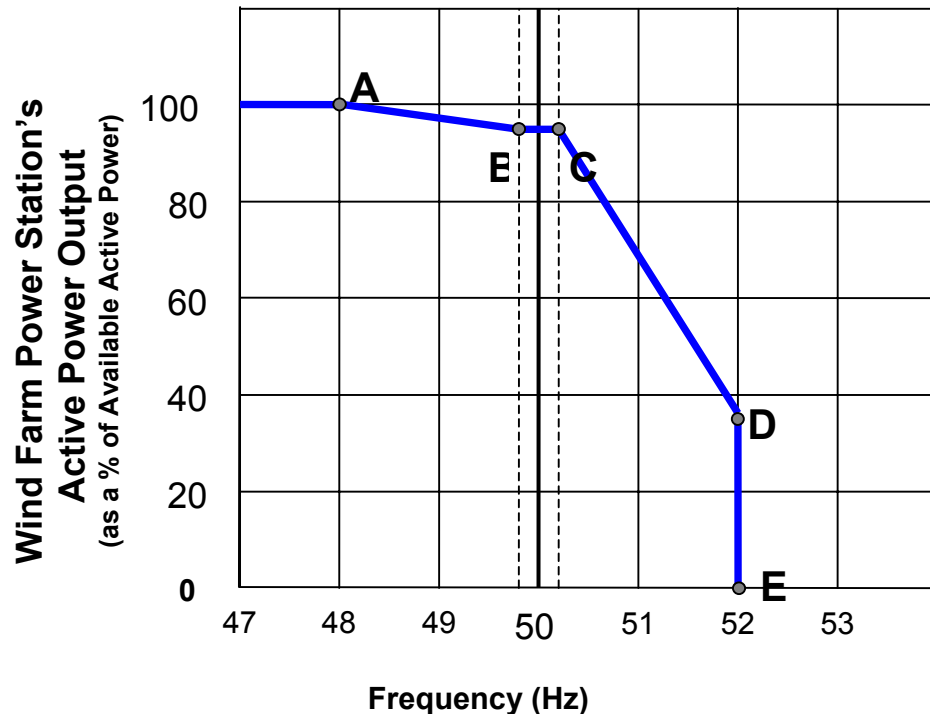


Figure WFPS1.2 - Power-Frequency Response Curve

WFPS1.5.2.2.2 Under normal **Frequency** ranges, the **Wind Farm Power Station** shall typically operate with an **Active Power** output as set by 'B' and 'C'. If the **Frequency** falls below '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', to 100% of **Available Active Power** as quickly as possible.

WFPS1.5.2.2.3 As the **Frequency** recovers back to 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' to its pre-incident **Active Power** output level (the range between 'B' and 'C' on the curve).

WFPS1.5.2.2.4 A **Frequency** dead-band shall be applied between the **Frequencies** corresponding to points 'B' and 'C', where no change in the **Wind Farm Power Station's Active Power** output shall be required.

WFPS1.5.2.2.5 Once the **Frequency** rises to a level above '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**.

WFPS1.5.2.2.6 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 WFPS1.1* below.

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

Table WFPS1.1: Frequency and % Available Active Power Settings for the Points 'A', 'B', 'C', 'D' and 'E' illustrated in Figure WFPS1.2

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 **User** 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**.

WFPS1.5.2.2.7 The table below, *Table WFPS1.2*, shows the **Frequency** and **Active Power** ranges for F_A , F_B , F_C , F_D , F_E , P_A , P_B , P_C , P_D and P_E .

	<i>Frequency (Hz)</i>		<i>Available Active Power (%)</i>	
			<i>MEC >10MW</i>	<i>MEC > 5MW</i>
F_A	47.0-51.0	P_A	50-100	100
F_B	49.5-51.0	P_B	50-100	100
F_C	49.5-51.0	P_C	50-100	100
F_D	50.5-52.0	P_D	20-100	20-100
F_E		P_E	0	0

*Table WFPS1.2: Frequency & Active Power ranges
appropriate to Figure WFPS1.2.*

For the **Frequency** values in *Table WFPS1.2* above, $F_A \leq F_B \leq F_C \leq F_D = F_E$.

WFPS1.5.2.2.8 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, in so far as possible.

WFPS1.5.2.2.9 The **Frequency Response System** shall respond to **Frequency** changes as close to real-time as possible. The expected 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**.

WFPS1.5.2.2.10 If the **Frequency** rises to a level above 'D'-'E', as defined by the *Power-Frequency Response Curve in Figure WFPS1.2*, the **TSO** accepts 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).

WFPS1.5.2.3 Procedure for Setting and Changing the Power-Frequency Response Curves

Two *Power-Frequency Response Curves* shall be specified by the **TSO** at least 60 business days prior to the **Wind Farm Power Station's** scheduled **Operational Date**. The **User** 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 **User** a minimum of 2 weeks notice if changes to either of the curve's parameters (*i.e.* F_A ,

$F_B, F_C, F_D, F_E, P_A, P_B, P_C, P_D$ or P_E), are required. The **User** shall formally confirm that any requested changes have been implemented within two weeks of receiving the **TSO's** formal request.

WFPS1.5.3 RAMP RATES

WFPS1.5.3.1 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 the **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. The **TSO** acknowledges that falling wind speed or **Frequency Response** may cause the maximum ramp down rate setting to be exceeded.

WFPS1.5.3.2 It shall be possible to vary each of these two maximum ramp rate settings independently over a range 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.

WFPS1.5.3.3 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 **User** 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 give the **User** a minimum of two weeks notice if a change is required. The **User** shall formally confirm that any requested changes have been implemented within two weeks of receiving the **TSO's** formal request.

WFPS1.6 VOLTAGE REQUIREMENTS**WFPS1.6.1 VOLTAGE RANGE**

WFPS1.6.1.1 **Wind Farm Power Stations** shall remain continuously connected to the **Transmission System** at maximum **Available Active Power** or **Curtailed Active Power** output for the following normal **Transmission System Voltage** ranges:

- (a) 400kV system: 370kV to 410kV;
- (b) 220kV system: 210kV to 240kV;
- (c) 110kV system: 105kV to 120kV.

WFPS1.6.1.2 **Wind Farm Power Stations** shall remain continuously connected to the **Transmission System** at maximum **Available Active Power** or **Curtailed Active Power** output for the following ranges which may arise during **Transmission System** disturbances or following transmission faults:

- (a) 400kV system: 350kV to 420kV;
- (b) 220kV system: 200kV to 245kV;
- (c) 110kV system: 99kV to 123kV.

WFPS1.6.2 STEP CHANGE

Wind Farm Power Stations shall remain connected to the **Transmission System** at maximum **Available Active Power** or **Curtailed Active Power** output at **Transmission System Voltages** within the ranges specified WFPS1.6.1.2 for step changes in steady state **Transmission System Voltage** of up to 10%.

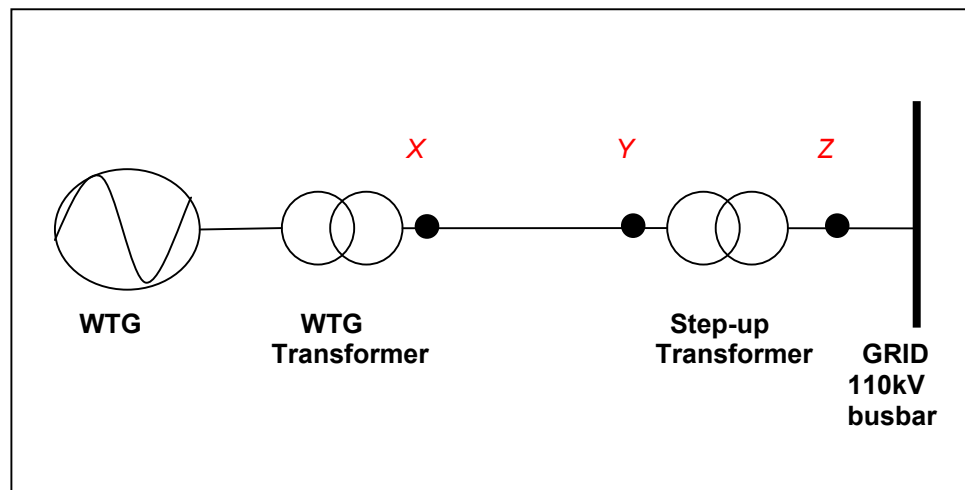
WFPS1.6.3 AUTOMATIC VOLTAGE REGULATION

WFPS1.6.3.1 **Wind Farm Power Stations** shall have a continuously-variable and continuously-acting **Voltage Regulation System** with similar response characteristics to a conventional **Automatic Voltage Regulator** and shall perform generally as described in BS4999 part 140, or equivalent European Standards.

WFPS1.6.3.2 The **Voltage Regulation System** shall be capable of receiving a **Voltage** set-point for the **Voltage** at the high-voltage side of the **Wind Farm Power Station's Grid Connected Transformer** (Point Z in Figure WFPS1.3). The **Voltage Regulation System** shall act to regulate the **Voltage** at this point by continuous modulation of the **Wind Farm Power Station's Reactive Power** output, within its **Reactive Power** range and without violating the **Voltage Step Emissions** limits as set out in the IEC standard 61000-3-7:1996 *Assessment of Emission limits for*

fluctuating loads in MV and HV power systems. A change to the **Voltage** set-point shall be implemented within one minute of receipt of the appropriate signal from the **TSO**.

- WFPS1.6.3.3 The droop or slope of the **Voltage Regulation System** shall be capable of being set to any value between 0% and 10%. The setting shall be specified by the **TSO** at least 60 business days prior to the **Wind Farm Power Station's** scheduled **Operational Date**. The **User** shall be responsible for implementing the appropriate settings during **Commissioning**. The droop or slope setting may be varied from time to time depending on **Network** needs. The **TSO** shall give the **User** a minimum of two weeks notice if a change is required. The **User** shall formally confirm that any requested changes have been implemented within two weeks of receiving the **TSO's** formal request.
- WFPS1.6.3.4 The speed of response of the **Voltage Regulation System** shall be such that, following a step change in **Voltage** at the reference point (**Connection Point**), the **Wind Farm Power Station** shall achieve 90% of its steady-state **Reactive Power** response within 1 second.
- WFPS1.6.3.5 *Figure WFPS1.3* shows the relevant points appropriate to the **Voltage Regulation System** for a 110kV connected **Wind Farm Power Station**. X is the high-voltage (HV) side of the **WTG** transformer, Y is the low-voltage (LV) side of the **Grid Connected Transformer** and Z is the high-voltage side of the **Grid Connected Transformer**. The **Wind Farm Power Station's Voltage Regulation System** shall act to regulate the **Voltage** at point Z.



*Figure WFPS1.3 - Locations for **Voltage Regulation** set-point (Z) and the **Power Factor** range (Y). The high-voltage side of the **WTG** transformer is (X).*

WFPS1.6.4 REACTIVE POWER CAPABILITY

WFPS1.6.4.1 **Wind Farm Power Stations** shall be capable of operating at any point within the **Power Factor** ranges illustrated in *Figure WFPS1.4*, as measured at the LV side of the **Grid Connected Transformer** (point Y in *Figure WFPS1.3*), for any **Voltage** at the **Connection Point** within the ranges specified in WFPS1.6.1.2.

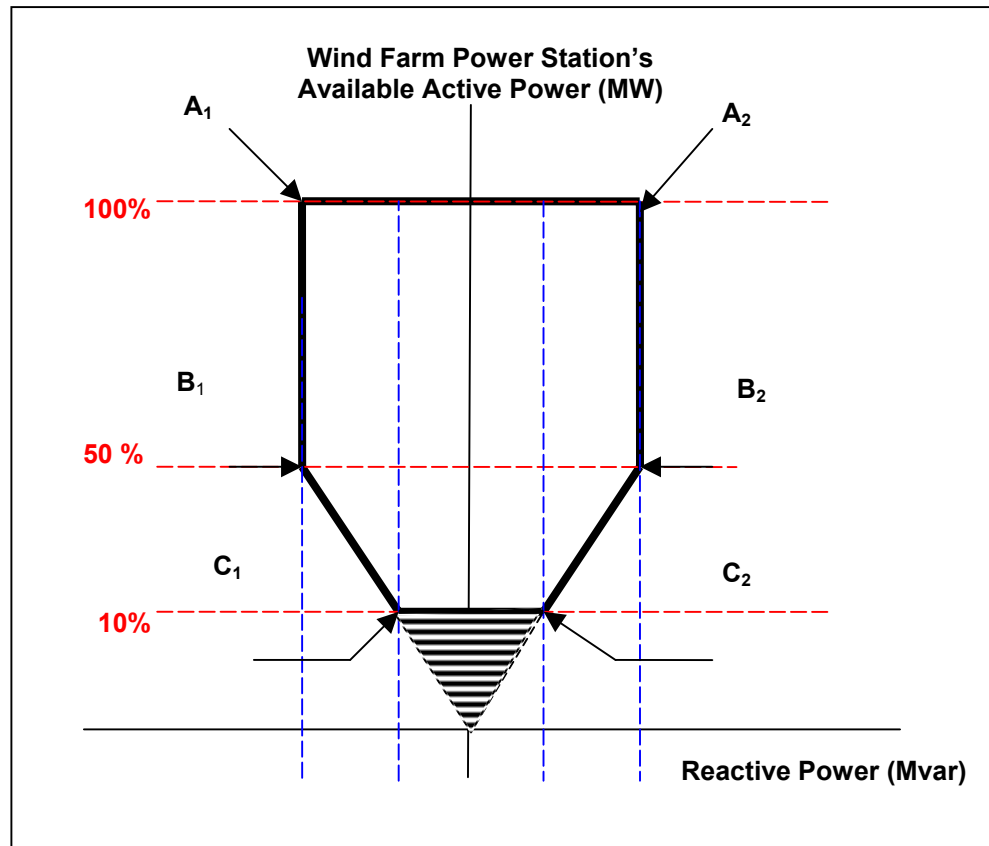


Figure WFPS1.4 - Reactive Power Capability of Wind Farm Power Station

- | | |
|---|--|
| A ₁ Equivalent to 0.950 leading Power Factor | A ₂ Equivalent to 0.950 lagging |
| B ₁ Equivalent to 0.835 lead | B ₂ Equivalent to 0.835 lagging |
| C ₁ Equivalent to 0.835 lead | C ₂ Equivalent to 0.835 lagging |

WFPS1.6.4.2 For operation below 10% of the **Wind Farm Power Station's MEC**, the **Wind Farm Power Station** shall operate within the shaded triangle in *Figure WFPS1.4*. However, the total charging of the **Wind Farm Power Station** network during no load operation shall be examined during the **TSO's Connection Offer** process, following which, the above requirement for operation below 10% may need to be altered.

WFPS1.6.5 VOLTAGE STEP EMISSIONS

IEC 61000-3-7:1996 *Assessment of Emission limits for fluctuating loads in MV and HV power systems*, gives a table of the emission limits for **Voltage** changes as a function of the number of changes, R, per hour. This standard shall also apply to **Wind Farm Power Stations**.

WFPS1.6.6 WIND FARM POWER STATION'S GRID CONNECTED TRANSFORMER

All relevant references in the **Grid Code** to **Generator Transformers** shall be interpreted to mean the **Wind Farm Power Station Grid Connected Transformer** rather than the individual **WTG** transformers.

WFPS1.7 SIGNALS, COMMUNICATIONS & CONTROL

WFPS1.7.1 SIGNALS FROM THE WIND FARM POWER STATION TO THE TSO

Signals from the **Wind Farm Power Station** to the **TSO** shall be broken up into a number of logical groups. There shall be different requirements for **Wind Farm Power Stations** depending on the **Wind Farm Power Station's MEC** and/or its connection method. The following groups shall apply:

- **Signals List #1** - applies to **Grid Connected** and **Distribution System Connected (from 110kV Substation) Wind Farm Power Stations**.
- **Signals List #2** - applies to **Distribution System Connected (embedded) Wind Farm Power Stations**

In addition, **Users** shall be required to provide signals from *Signals Lists 3, 4, 5* or *6*. These lists relate to:

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

WFPS1.7.1.1 **Signals List #1**

The **User** shall make the following signals available at the **TSO's** and/or, where appropriate, the **DSO's RTU** designated for that **Wind Farm Power Station**.

Where appropriate, the **DSO** shall make these signals available to the **TSO**:

- a) **Grid Connected Transformer** tap positions (for **Grid Connected Wind Farms Power Stations** only);
- b) **Voltage** (in kV) at the **Grid Connected Transformer's** low voltage terminals (for **Grid Connected Wind Farms Power Stations** only);
- c) **Active Power** output (MW) at the LV side of the **Step-up Transformer**;
- d) **Available Active Power** (MW) at the LV side of the **Step-up Transformer**;
- e) **Reactive Power** output/demand (+/-Mvar) at the LV side of the **Step-up Transformer**;
- f) **Voltage Regulation System** set-point (in kV) ;
- g) On/off status indications for all **Reactive Power** devices exceeding 5Mvar;
- h) 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, where appropriate, subsequently advised by the **DSO**, at least 60 business days prior to the **Wind Farm Power Station's** scheduled **Operational Date**.

WFPS1.7.1.2 Signals List #2

The **User** shall make the following signals available at the **DSO's RTU** designated for that **Wind Farm Power Station**. The **DSO** shall make these signals available to the **TSO**:

- a) **Active Power** output (MW) at the LV side of the **Step-up Transformer**;
- b) **Available Active Power** (MW) at the LV side of the **Step-up Transformer**;
- c) **Reactive Power** output/demand (+/-Mvar) at the LV side of the **Step-up Transformer**;
- 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**.

WFPS1.7.1.3 Signals List #3

WFPS1.7.1.3.1 Wind Farm Power Stations with a **MEC** of 10MW or more shall make the following signals available at the **TSO's** and/or, where appropriate, the **DSO's RTU** designated for that **Wind Farm Power Station**. Where appropriate, the **DSO** shall make these signals available to the **TSO**:

- a) **Wind Farm Power Station Availability** (0-100% signal);
- b) Percentage of **WTG** shutdown due to high wind-speed conditions (0-100%);
- c) Percentage of **WTG** not generating due low wind-speed shutdown (0-100%).

WFPS1.7.1.3.2 For **Wind Farm Power Stations** with a **MEC** of 10MW, 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 above data set (ref. WFPS1.7.1.3.1) 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**). 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** at least 60 business days prior to the **Wind Farm Power Station's** scheduled **Operational Date**.

WFPS1.7.1.4 Signals List #4

The **User** shall make the following signals available at the **TSO's** and/or, where appropriate, the **DSO's RTU** designated for that **Wind Farm Power Station**. Where appropriate, the **DSO** shall make these signals available to the **TSO**:

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

WFPS1.7.1.5 Signals List #5

The **User** shall make the following signals available at the **TSO's** and/or, where appropriate, the **DSO's RTU** designated for that **Wind Farm Power Station**. Where appropriate, the **DSO** shall make these signals available to the **TSO**:

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

WFPS1.7.1.6 Signals List #6

WFPS1.7.1.6.1 Wind Farm Power Stations with a **MEC** of 10MW of more shall make the following meteorological data signals available at the **TSO's** and/or, where appropriate, the **DSO's RTU** designated for that **Wind Farm Power Station**. Where appropriate, the **DSO** shall make these signals available to the **TSO**:

- 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.

WFPS1.7.1.6.2 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**). 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 **User** and the **TSO**.

WFPS1.7.1.7 Data and Communications Specifications

WFPS1.7.1.7.1 Signals from the **Wind Farm Power Station** shall be updated at a rate between 1 and 30 seconds at the **Wind Farm Power Station's** designated **RTU**, to provide an average value over that rate. The actual rates required shall be specified by the **TSO** at least 60 business days prior to the **Wind Farm Power Station's** scheduled **Operational Date**.

WFPS1.7.1.7.2 The location of the **RTU** shall be agreed between the **TSO** and the **User** no more than 60 business days after a **Connection Agreement** has been signed between the **User** and the **TSO**.

WFPS1.7.1.7.3 The necessary communications links, communications protocol and the requirement for analogue or digital signals shall be specified by the **TSO** no more than 60 business days after a **Connection Agreement** has been signed between the **User** and the **TSO**. Current applicable standards shall apply and the accuracy class for signals shall comply with the prevailing European Standard at that time.

WFPS1.7.2 CONTROL SIGNALS FROM THE TSO TO WIND FARM POWER STATIONS

WFPS1.7.2.1 The control signals described in WFPS1.7.2 shall be sent from the **TSO** to the **Wind Farm Power Station**. The **Wind Farm Power Station** shall be capable of receiving these signals and acting accordingly.

WFPS1.7.2.2 MW Curtailment

A **MW Curtailment Set-point** signal shall be sent by the **TSO** via the **Wind Farm Power Station's RTU** to its **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** shall 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.

WFPS1.7.2.3 Power-Frequency Response Curve Mode

This signal shall be sent by the **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.

WFPS1.7.2.4 Voltage Regulation

This signal shall allow the **TSO** to send a kV set-point for **Voltage Regulation** purposes.

WFPS1.7.2.5 Black Start Disconnection

Means shall be provided by the **User** to facilitate the disconnection of the **Wind Farm Power Station** by the **TSO** and to also prevent re-connection in the event of **Black Start**. It shall be possible for the **TSO** to send a trip and inhibit signal to the circuit-breaker(s) at the **Wind Farm Power Station's Connection Point**. The precise circuit-breakers for which this facility shall be provided shall be specified by the **TSO** no more than 60 business days after a **Connection Agreement** has been signed between the **User** and the **TSO**. **Wind Farm Power Stations** may only be reconnected (i.e. made live) when the **Network** is fully restored following instruction from the **TSO** and only earlier if the **TSO** deems it acceptable to do so.

WFPS1.7.3 RESPONSIBLE OPERATOR

A designated **Responsible Operator** shall be contactable by the **TSO** at all times to discuss operational matters without undue delay and in any case within 15 minutes. Following a request from the **TSO**, the **Responsible Operator** shall be present at the **Wind Farm Power Station's Connection Point** without undue delay and in any case within one hour and shall be capable of taking any required appropriate actions. The **Responsible Operator** shall be contactable 24 hours a day, 365 days a year.

WFPS1.7.4 DATA AND COMMUNICATIONS SPECIFICATIONS

WFPS1.7.4.1 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 **TSO**.

WFPS1.7.4.2 If **MW Curtailment, Frequency Response** or **Voltage Regulation** facilities at the **Wind Farm Power Station** become unavailable, the **User** shall contact the **TSO** without undue delay.

WFPS1.7.4.3 Where signals or indications required to be provided by the **User** under WFPS1.7.1 and WFPS 1.7.2 become unavailable or do not comply with applicable standards due to failure of the **Users'** technical equipment or any other reason under the control of the **User**, the **User** shall, acting in accordance with **Good Industry Practice**, restore or correct the signals and/or indications as soon as possible.

WFPS1.7.5 MW FORECASTS

MW forecasts shall be provided by **Wind Farm Power Stations** with a **MEC** in excess of 30MW. These forecasts shall be provided at 10:00a.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 the **TSO's** data system.

WFPS1.7.6 WIND FARM POWER STATION MW AVAILABILITY DECLARATIONS

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