مكتب التنظيم والرقابة لقطاع الكهرباء و المياه

RSB FOR ELECTRICITY & WATER

RENEWABLES STANDARDS

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Regulatory & Supervisory Bureau – Dubai, UAE

PO Box 121555, Dubai, U.A.E

Note: These standards do not apply to solar PV generators connected to the Distribution System, which are governed by standards issued by the Dubai Electricity & Water Authority and which are available from the DEWA website.

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1. GENERAL PROVISIONS

1.1. Definitions

Active Power - Active Power is the real component of the Apparent Power, expressed in watts or multiples thereof (e.g. kilowatts (kW) or megawatts (MW)).

Apparent Power - is the product of Voltage (in volts) and Current (in amperes). It is usually expressed in kilovolt-amperes (kVA) or megavolt-amperes (MVA) and consists of a real component (Active Power) and an imaginary component (Reactive Power).

Available Maximal Active Power Output - is the Active Power Output determined by the primary resource (for example, sun irradiance) or stored energy (where applicable) and by the maximum steady-state efficiency of the power conversion within the Generating Unit for this operating point.

Connection Point - is the point at which a Generating Unit is connected to DEWA's Network as agreed with DEWA (e. g. by PPA).

Contract - Any agreement between DEWA and a Generator, which stipulates the conditions and terms for the connection and operation of a Generating Unit.

Current - unless stated otherwise, current refers to the root-mean-square value of phase current.

Derogation - a time limited or indefinite (as specified) acceptance in writing of a non-compliance of a Power Generating Facility with regard to identified Standards requirements.

Distribution System - The electrical Network and its components which are owned and operated by DEWA with the main purpose of delivering electricity to consumers from the Transmission System. The 33kV and below Voltage levels are considered as Distribution System. The components of the Distribution System include all associated equipment including but not limited to interconnecting lines, electrical substations, pole mounted transformers, analogue electrical elements such as resistors, inductors, capacitors, diodes, switches and transistors

Electrical Delivery Point - is the point at which electrical energy is delivered in accordance with a Contract and by reference to which electrical energy is measured.

Existing Renewable Resource Generating Unit - a Renewable Resource Generating Unit which is either physically connected to the Network or under construction or for which a formal agreement exists between the owner and DEWA for the connection of the Generating Unit to the Network at the day of the entry into force of these Standards or at the day on which a revision comes into force.

Generating Unit - is either a Synchronously Connected Generating Unit or a Non-Synchronously Connected Generating Unit.

Generator - Any entity authorised by the Regulatory Authority to produce electricity in the Emirate and is connected to the Network.

Isolated Network Operation - independent operation of a part of the Network that is isolated after its disconnection from the interconnected Network, having at least one Generating Unit in operation with the ability to control speed.

Low Voltage Network – a Network with nominal Voltage lower than 1kV.

Manufacturer's Data and Performance Type Certificate (MD&PTC) - a certificate issued by authorised certifiers registered with DEWA defining verified data and performance, which can include models and testing for the purpose of replacing specific parts of the compliance process.

Maximum Capacity - the maximum continuous Active Power which a Generating Unit or Power Generating Facility, as the case may be, can feed into the Network as agreed between DEWA and the Power Generating Facility owner.

Network - plant and Apparatus connected together in order to transmit or distribute electrical power, and operated by DEWA.

New Renewable Resource Generating Unit - a Renewable Resource Generating Unit which is neither physically connected to the Network nor for which a formal agreement exists between the owner and DEWA for the connection of the Generating Unit to the Network at the day of the entry into force of these Standards or at the day on which a revision comes into force.

Non-Synchronously Connected Generating Unit - is a set of installations having a single Connection Point or operated as if they have a single Connection Point, which can generate electrical energy and is non-synchronously connected to the Network through power electronics. Installations that are fully connected to the Network through power electronic converters fall in this category.

Power Factor - the ratio of Active Power to Apparent Power.

Power Generating Facility - is a plant that converts primary energy into electrical energy and which consists of one or more Generating Units, under one Licence, connected to the Network at one or more Connection Points and includes, as applicable, all associated electric lines, electric plant and equipment.

P-Q-Capability Diagram - describes the Reactive Power capability of a Generating Unit in the context of varying Active Power at the high-voltage terminals of the step-up transformer to the Voltage level of the Connection Point taking into account its full tap-changing range.

Population - is a group of units behaving the same way in the power system and based on the same primary resource such that common mode events can appear. "All Small and Medium size PV Installations", "All Large Size PV Installations", All "Large Size Concentrated Solar Power Installations" are three examples of populations.

Population Ratio - is the ratio between the sum of the installed capacity of a Population and the peak load of the DEWA power system.

Reactive Power - is the imaginary component of the Apparent Power, usually expressed in kilovar (kVAr) or megavar (MVAr).

Regulatory Authority - is the Regulatory and Supervisory Bureau (RSB) for the Electricity and Water Sector in the Emirate of Dubai.

Representative - means any person representing or mandated to represent a party, including, but not limited to, its directors, members of management, officers, employees, or professional advisors.

Renewable Resource Generating Facility – is a Power Generating Facility containing one or more Renewable Resource Generating Units connected to DEWA's Transmission or Distribution Systems.

Renewable Resource Generating Unit - is a Generating Unit that produces power exclusively from renewable primary resources. This Renewable Resource Generating Unit can be part of a Power Generating Facility that includes non-renewable resources. In this last situation, the Renewable Resource Generating Unit mentioned in these Standards is the part of the facility that is able to produce energy without input from a non-renewable resource.

Slope - is the ratio of the change in Voltage, based on reference 1 per-unit (pu) Voltage, to a change in Reactive Power in-feed from zero to maximum Reactive Power, based on maximum Reactive Power.

Steady-State Stability - if the Network or a Generating Unit previously in the steady state reverts to this state again following a sufficiently minor disturbance, it has Steady-State Stability.

Synchronously Connected Generating Unit - is an indivisible set of installations which can generate electrical energy such that the frequency of the generated Voltage, the generator speed and the frequency of network Voltage are in a constant ratio and thus in synchronism. Partially or fully directly-connected synchronous generators and induction generators fall in this category.

Transient Stability - is the ability of a Generating Unit to remain connected to the Network following a severe transient disturbance.

Transmission Control Centres - means the main transmission control centre **(TCC1)** and emergency transmission control centre **(TCC2)** owned and operated by DEWA for the co-ordination and issuing of direct instructions for dispatch of available Generating Units and Desalination Units (including by way of an energy management system).

Transmission System - means the 400 kV and 132 kV system for the transport of electricity, which system consists (wholly or mainly) of high Voltage electric lines and electric plant (namely, electric lines and electric plant with a nominal Voltage equal to 400 kV and 132 kV) owned and operated by DEWA (in its capacity as transmission operator) and which is used for the transmission of electricity from a Power Generating Facility to a sub-station, from one Power Generating Facility to another, from one sub-station to another and any electric plant used for the purposes of Dispatch.

Voltage - unless stated otherwise, voltage refers to the root-mean-square value of phase-to-phase voltages.

All capitalized terms used but not defined herein shall have the meaning ascribed to them in the IWPP Code.

1.2. Subject Matter

These Standards define a common set of requirements for Power Generating Facilities containing one or more Renewable Resource Generating Units connected to DEWA's Transmission or Distribution Systems and set up a common framework for grid connection agreements between the Network operator and the Power Generating Facility owners.

1.3. Scope

1. The requirements set forth by these Standards describe the functional behaviour of Renewable Resource Generating Units as seen from the Connection Point unless otherwise specified in these Standards.

2. The requirements set forth by these Standards shall apply to New Renewable Resource Generating Units unless otherwise specified in these Standards. This principle also applies when requirements change over time. The new requirements only apply to New Renewable Resource Generating Units, after the date of implementation of those new requirements.

3. The requirements set forth by these Standards shall apply to Existing Renewable Resource Generating Units if this is requested by DEWA. However, the application of these Standards to Existing Renewable Resource Generating Units should be exceptional and in such case any cost implication should be dealt with according to the commercial agreements in place between DEWA and the Generators.

4. Existing Renewable Resource Generating Units shall continue to be bound by such technical requirements that apply to them.

5. With regard to Renewable Resource Generating Units not yet under construction:

   a) Within a delay not exceeding six months as from the day of entry into force of these Standards, the owner of the Renewable Resource Generating Units shall provide DEWA with a confirmation of each final and binding contract it has concluded for the construction, assembly or purchase of the main plant of a Renewable Resource Generating Unit and which exists on the day of entry into force of these Standards.

   b) The confirmation for each contract shall at least indicate the contract title, its date of signature and of entry into force, and the specifications of the main plant to be constructed, assembled or purchased.

   c) The Renewable Resource Generating Unit, confirmed in accordance with the procedure set forth in points a) to b) above, shall be considered as an Existing Generating Unit.

   d) In case the Renewable Resource Generating Unit does not provide DEWA with the confirmation within the delay set forth in point a) above, the Renewable Resource Generating Unit shall be considered as a New Renewable Resource Generating Unit.

6. The applicability and extent of the requirements a Renewable Resource Generating Unit has to comply with depends on their categories defined in paragraph 7 below, and in some cases, on the Voltage level of their Connection Point.

7. Two criteria are used to define the category in which the Renewable Resource Generating Unit falls:

   a) The first criterion is the "Maximum Capacity" in MW. This criterion is justified since investments in advanced technical abilities provide a better cost/benefit ratio for larger units. Furthermore, for the system operator, larger units have additional impact on the system security.

   b) The second criterion is the "Population Ratio".
   This criterion is justified by the fact that, when the number of units of one particular technology grows, common modes appear and, at the same time, it can be assumed that the cost of the technology decreases. It is thus acceptable to increase the level of requirements. It seems also « fair » to require a higher duty from the largest Populations. Three Populations are defined:

      i. All Small and Medium Photovoltaic (PV) Renewable Resource Generating Units that have Maximum Capacity lower than 15MW.
      ii. All Large Photovoltaic (PV) Renewable Resource Generating Units that have Maximum Capacity higher than or equal to 15MW.
      iii. All Large Concentrated Solar Power (CSP) Renewable Resource Generating Units that have Maximum Capacity higher than or equal to 15MW.

      The two latter Populations have distinct technical abilities due to the different connection technology as defined in paragraph d (below).

      The Population Ratio is computed by DEWA periodically (at least once a year) for the next period, that is, taking into account the forecasted penetration of each Population and the peak load.

   c) Requirements presented in these Standards are labelled by a level of strength which can take the different levels: "Minimum", "Low", "Medium", "High", "Very High". Requirements of Minimum level of strength guarantee that the Generating Unit has no negative impact on other users of the grid, that the Generating Unit does not impede existing protection philosophies & protects personnel and that the Generating Unit stays connected to the grid with a predictable behaviour. From requirements of Low to Very High level of strength, the Generating Unit is gradually requested to be able to control Active and/or Reactive Power and to share system duty. From requirements of High level of strength, the Generating Units shall be able to perform within the framework of specific modes of operation.

   d) Requirements presented in these Standards can be function of the type of connection of the Renewable Resource Generating Units with the Network. This connection type can be "Synchronously Connected" or "Non-Synchronously Connected". When a requirement does not make a reference to the type of the connection, it is therefore applicable for all types of connection.

e) Table 1 presents the relation between the categories of Renewable Resource Generating Units and the minimum strength of requirements the Power Generating Facilities have to comply with. A Power Generating Facility has to comply with all the requirements of level of strength lower and equal to the one defined in the table, as specified in the formal agreement entered into between the owner and DEWA for the connection of the Power Generating Facility to the Network. The relevant Population Ratio is the one expected for the year corresponding to the planned COD (commercial operation date) of the Power Generating Facility, based on the latest Population Ratio projection made available by DEWA. If two requirements are in contradiction, the requirement with the higher level of strength is to be fulfilled.

Table 1 - Strength of requirements the Power Generating Facility has to comply with.

Strength of requirements	Population Ratio < 3%	3% ≤ Population Ratio < 12%	12% ≤ Population Ratio
Maximum Capacity < 500 kW	Minimum	≤Low	≤Medium
500 kW ≤ Maximum Capacity < 15 MW	≤Low	≤Medium	≤Medium
15 MW ≤ Maximum Capacity < 150 MW	≤Medium	≤High	≤High
150 MW ≤ Maximum Capacity	≤High	≤High	≤Very high

f) For the avoidance of doubt, combined heat and power generating facilities will be assessed on their electrical Active Power output.

g) DEWA shall compute periodically the Population Ratios, based on the expectations for the next period of peak load and installed capacity of each Population, and communicate them to the relevant stakeholders.

1.4. Standards Review

A "Standards Review Panel" shall be established by DEWA, according to the following principles:

1.4.1. Standards Review Panel

DEWA shall establish and maintain the Standards Review Panel which shall be a standing body constituted to:

a) generally review, discuss and develop the Standards and its implementation;

b) review and discuss suggestions for amendments to the Standards which DEWA, the Regulatory Authority, or any Generator may wish to submit to DEWA for consideration by the Standards Review Panel from time to time;

c) discuss what changes are necessary to the Standards arising out of any unforeseen circumstances referred to it by DEWA;

d) publish recommendations and ensure that Generators consultation upon such recommendations has occurred through Standards Review Panel members; and

e) issue guidance in relation to the Standards and its implementation, performance and interpretation when asked to by a Generator.

The Standards Review Panel shall be governed by a constitution as approved by the Regulatory Authority, which defines its scope, membership, duties, and rules of conduct, operation and further development of the Standards.

The Standards Review Panel shall at least consist of:

a) a Chairman and up to 2 members appointed by DEWA;

b) a person appointed by the Regulatory Authority; and

c) up to 2 persons representing Generators, with no more than 1 person from an individual Generator.

1.4.2. Standards Revisions

All revisions to the Standards must be reviewed by the Standards Review Panel prior to application to the Regulatory Authority by the Chairman. All proposed revisions from Generators, the Regulatory Authority or DEWA shall be brought before the Standards Review Panel by the Chairman for consideration. The Chairman will advise the Standards Review Panel, all Generators, and the Regulatory Authority of all proposed revisions to the Standards with notice of no less than 28 days in advance of the next scheduled meeting of the Standards Review Panel.

Following review of a proposed revision by the Standards Review Panel, the Chairman will apply to the Regulatory Authority for revision of the Standards based on the Standards Review Panel recommendation. The Chairman, in applying to the Regulatory Authority, shall also notify each Generator of the proposed revision and other views expressed by the Standards Review Panel and Generators so that each Generator may consider making representations directly to the Regulatory Authority regarding the proposed revision within two weeks of the application.

The Regulatory Authority shall consider the proposed revision, other views, and any further representations and shall determine whether the proposed revision should be made and, if so, whether in the form proposed or in an amended form.

Having been so directed by the Regulatory Authority that the revision shall be made, the Chairman shall notify each Generator of the revision at least 10 Business Days prior to the revision taking effect, and the revision shall take effect (and these Standards shall be deemed to be amended accordingly) from (and including) the date specified in such notification or other such date as directed by the Regulatory Authority.

1.5. Unforeseen Circumstances

If circumstances arise which the provisions of the Standards have not foreseen, DEWA shall to the extent reasonably practicable in the circumstances, consult all affected Generators in an effort to reach agreement as to what should be done and submit a proposal to the Standards Review Panel for consideration.

Thereafter, DEWA shall refer the matter relating to the unforeseen circumstances and any such determinations to the Standards Review Panel with a proposal for consideration as defined in paragraph 1.4.

1.6. Hierarchy

In the event of any irreconcilable conflict between the provisions of the Standards and any Contract between DEWA and a new Generator, then the Standards shall prevail.

The Renewable Standards shall prevail over the IWPP Code in the event of conflicts between these two documents.

1.7. Illegality and Partial Invalidity

If any provision of the Standards should be found to be unlawful or wholly or partially invalid for any reason, the validity of all remaining provisions of the Standards shall not be affected.

If part of a provision of the Standards is found to be unlawful or invalid but the rest of such provision would remain valid if part of the wording were deleted, the provision shall apply with such minimum modification as may be (i) necessary to make it valid and effective; and (ii) most closely achieves the result of the original wording; but without affecting the meaning or validity of any other provision of the Standards. DEWA shall prepare a proposal to correct the default for consideration by the Standards Review Panel.

1.8. Time of Effectiveness

The Standards come into effect following their approval by the Regulatory Authority and as defined in clause 1.4.2.

1.9. Notices

Any notice to be given under the Standards shall be in writing and shall be duly given if signed by or on behalf of an entity duly authorised to do so by the party giving the notice and delivered by hand at, or sent by post, or facsimile transmission or e-mail to the relevant address, facsimile number or e-mail address last established pursuant to these Standards.

DEWA shall maintain a list of contact details for itself and all Generators containing the telephone, facsimile, e-mail and postal addresses for all Generators. DEWA shall provide

these details to any Generator in respect of any other Generator as soon as practicable after receiving a request.

Both DEWA and all Generators shall be entitled to amend in any respect their contact details previously supplied and DEWA shall keep the list up to date accordingly.

Any notice required to be given by these Standards shall be deemed to have been given or received:

a) if sent by hand, at the time of delivery;

b) if sent by post, from and to any address within Dubai, 4 days after posting unless otherwise proven; and

if sent by facsimile, subject to confirmation of uninterrupted transmission report, or by e-mail, one hour after being sent, provided that any transmission sent after 14:00 hrs on any day shall be deemed to have been received at 8:00 hrs on the following Business Day unless the contrary is shown to be the case.

1.10. Disputes in relation to the Standards

1.10.1. Amicable settlement

a) If any dispute arises between DEWA and any Generator or between two or more Generators, in relation to these Standards, either party may, by notice to the other, require seeking to resolve the dispute by negotiation in good faith.

b) If the parties fail to resolve any dispute by such negotiations within 14 days of such notice, either party shall be entitled to escalate such dispute as provided in sub-clauses 1.10.1 c) to 1.10.1.e) below.

c) For any dispute involving DEWA and any Generator connected to the Distribution System, or involving several Generators connected to the Distribution System:

   i. either party shall be entitled by written notice to the other to require the dispute to be referred to a meeting of designated Representatives of each party;

   ii. if either party exercises its right under the sub-clause 1.10.1.c).i above, each party shall procure that the relevant Representative considers the matter in dispute and meet with Representative of the other party within 21 days of receipt of the written notice of referral to attempt to reach agreement on the matter in question.

d) Sub-clause 1.10.1.c) shall also apply to any dispute involving a Generator connected to the Transmission System and one or several Generators connected to the Distribution System.

e) For any dispute involving DEWA and any Generator connected to the Transmission System or involving several Generators, connected to the

Transmission System clause **GC.12 Code Disputes** of the Independent Water and Power Producers' Code (IWPP) shall apply.

1.10.2. Determination by the Regulatory Authority

a) If the parties fail to resolve any dispute which has been escalated in accordance with sub-clauses 1.10.1.c) to 1.10.1.d) above, either party may refer the matter to the Regulatory Authority for determination as the Regulatory Authority sees fit within 21 days of receipt of the written notice of referral.

b) All parties shall be bound by any decision of the Regulatory Authority.

1.11. Confidentiality Obligations

DEWA shall be at liberty to share the needed data with Generators likely to be affected by the matters concerned. In all cases, DEWA is at liberty to share the data with the Regulatory Authority and shall do so at the Regulatory Authority's request.

1.12. Interpretation

In these Standards, unless the context otherwise requires:

a) references to "these Standards" are reference to the whole of the Standards, including any schedules or other documents attached to any part of the Standards;

b) the singular includes the plural and vice versa;

c) any one gender includes the others;

d) references to Standards sections, paragraphs, clauses or schedules are to sections, paragraphs, clauses or schedules of these Standards;

e) section, paragraph and schedule headings are for convenience of reference only and do not form part of and shall neither affect nor be used in the construction of these Standards;

f) reference to any law, regulation made under any law, standard, secondary legislation, contract, agreement or other legal document shall be to that item as amended, modified or replaced from time to time. In particular, any reference to any Licence shall be to that Licence as amended, modified or replaced from time to time and to any rule, document, decision or arrangement promulgated or established under that Licence;

g) references to the consent or approval of the Regulatory Authority shall be references to the approval or consent of the Regulatory Authority in writing, which may be given subject to such conditions as may be determined by the Regulatory Authority, as that consent or approval may be amended, modified, supplemented

or replaced from time to time and to any proper order, instruction or requirement or decision of the Regulatory Authority given, made or issued under it;

h) all references to specific dates or periods of time shall be calculated according to the Gregorian Calendar and all references to specific dates shall be to the day commencing on such date at 00:00 hours;

i) where a word or expression is defined in these Standards, cognate words and expressions shall be construed accordingly;

j) references to "person" or "persons" include individuals, firms, companies, government agencies, committees, departments, Ministries and other incorporate and unincorporated bodies as well as to individuals with a separate legal personality or not; and the words "include", "including" and "in particular" shall be construed as being by way of illustration or emphasis and shall not limit or prejudice the generality of any foregoing words.

2. TECHNICAL REQUIREMENTS

2.1. Protection Schemes (Earthing and protections)

2.1.1. Performance of the protections at the Connection Point

2.1.1.1. REQUIREMENTS OF MINIMUM STRENGTH:

1. The protection device of the Renewable Resource Generating Unit shall be compliant with the international standards:

   a) IEC 60364 for LV Connection Points

   b) IEC 61000 and IEC 60255 for MV and HV Connection Points

2. The protection system of the Renewable Resource Generating Facility, including connection installations to the Network, shall be able to eliminate faults inside the installation and, in backup, faults outside the installation, as defined in DEWA's protection code. For latest protection related requirements, protection code of DEWA to be referred to, which is available to relevant parties upon request to DEWA.

2.1.2. Short-circuit contribution of the Generating Unit

2.1.2.1. REQUIREMENTS OF LOW STRENGTH:

1. Requirements related to the neutral earthing and coupling of the transformer will be provided by DEWA.

   a) For a Non-Synchronously Connected Generating Unit, in 132kV solidly grounded systems, the minimum impedance of a 132kV/33kV or 132kV/MV transformer at nominal tap position shall be 24.3% on a 100 MVA base.

   b) For a Synchronously Connected Generating Unit with an Electrical Delivery Point in the 132kV system the resulting impedance of the transformer, sub transient reactance of generator and connection line shall be minimum 30% (MVA base is maximum power output at Electrical Delivery Point), without negative tolerance to limit the short circuit contribution to the 132 kV Network.

   c) For a Synchronously Connected Generating Unit with an Electrical Delivery Point in the 400kV system the resulting impedance of the transformer, sub transient reactance of generator and connection line shall be minimum 36.3% (MVA base is maximum power output at Electrical Delivery Point), without negative tolerance to limit the short circuit contribution to the 400 kV Network.

   d) In MV impedance grounded systems, the transformer will have an isolated neutral point at the primary side.

2. In 132kV Networks, the 3-phase short-circuit Current contribution shall be able to reach at least the equipment nominal rating in case of metallic short-circuit at the Connection Point, in order to contribute to fault detection.

2.1.3. Equipment rating and Insulation of the installation at the Connection Point

2.1.3.1. REQUIREMENTS OF MINIMUM STRENGTH:

1. The equipment rating and the insulation values of the Renewable Resource Facilities, including connection installations to the Network, shall be designed to withstand at least the Network side Currents and Voltages defined in Table 2.

Table 2: Equipment rating and Insulation of installation by Voltage level. The rating is expressed at maximum ambient operating conditions (55°C).

	Circuit breaker	Other equipment[1] (*)			All Equipment
Voltage level (kV)	**Isc (kA)**	**I thermal**		**I dynamic (kA)**	**Um (phase to phase) (kV)**
		(s)	**(kA)**		
400	**63**	**≥1**	**60**	**125**	**420**
132	**40**	**≥1**	**38**	**100**	**145**
33	**25**	**≥1**	**25**	**63**	**36**
11	**25**	**≥1**	**25**	**63**	**12**
6.6	**25**	**≥1**	**25**	**63**	**7.2**
LV	**Compliance with international standard IEC 947-2 is required.**				

2.2. Power quality (Phase unbalance, harmonics and flicker) and Electromagnetic compatibility

2.2.1.1. REQUIREMENTS OF MINIMUM STRENGTH:

1. The Renewable Resource Generating Unit's equipment emissions created on the grid shall be lower than the limits specified by DEWA. These individual emission levels for each Generating Unit are compliant with the following international standards and technical reports:

    a) Distortions in the Voltage waveform: **IEC/TR 61000-3-6-** Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems or **IEC 61000-3-12-** Limits for harmonic currents produced by equipment connected to public low-voltage systems with input Current >16 A and ≤75 A per phase

[1] The transformers are not included. The given Current levels are to be applied on the primary HV terminals of the transformer. For dynamic and thermal rating, the transformer will be calculated by the supplier, taking into account the short-circuit level of the grid on primary side and the short-circuit impedance of the transformer.

b) Rapid Voltage changes (& Flicker): **IEC/TR 61000-3-7**- Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems or **IEC/TR 61000-3-14**- Assessment of emission limits for harmonics, interharmonics, Voltage fluctuations and unbalance for the connection of disturbing installations to LV power systems

c) Voltage unbalances for 3-phase installations: **IEC/TR 61000-3-13**- Assessment of emission limits for the connection of unbalanced installations to MV, HV and EHV power systems

d) Electromagnetic Compatibility: **IEC 61000-2-2-** Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems or **IEC 61000-2-12** - Compatibility levels for low-frequency conducted disturbances and signalling in public medium-voltage power supply systems

e) Furthermore, no DC Currents injection shall come from Non-Synchronously Connected Units

2. The Renewable Resource Generating Unit's equipment immunity to grid disturbances shall be higher than DEWA's commitment to maintain Voltage in line with standard EN 50160 which describes the level of disturbances one should expect during normal operation.

   For the 400 kV Network:

   a) Voltage Total Harmonic Distortion (THD): the maximum Voltage THD shall not exceed a total Voltage harmonic distortion of 1.5% with no individual harmonic greater than 1.0%, unless abnormal conditions prevail.

   b) Phase Unbalance: under planned outage conditions, the maximum negative phase sequence component of the phase Voltage on the Transmission System should remain below 1%, unless abnormal conditions prevail.

   c) Voltage Fluctuations: Voltage fluctuations shall not exceed 1% of the Voltage level for step changes that may occur repetitively. Any large Voltage excursions other than step changes may be allowed up to a level of 3% provided that this does not constitute a risk to the Transmission System.

   For the HV below 400kV and MV and LV Networks, the equipment immunity to grid disturbances shall be higher than the maximum emission level stated in paragraph 1.

   For the 132 kV Network:

   Voltage Fluctuations: Voltage fluctuations shall not exceed 2% of the Voltage level for step changes that may occur repetitively. Any large Voltage excursions other than step changes may be allowed up to a level of 5% provided that this does not constitute a risk to the Transmission System.

2.3. Normal and Emergency mode of operation

2.3.1. Ability to stay connected - Voltage/Frequency/Change of frequency ranges

2.3.1.1. REQUIREMENTS OF MINIMUM STRENGTH:

1. In case of deviation of the Network frequency from its nominal value, due to a deviation within the frequency ranges and time periods specified by Table 3, any automatic disconnection of a Renewable Resource Generating Unit from the Network shall be prohibited and power infeed shall be maintained within the limits specified in section "Ability to predict the behaviour - Frequency behaviour". Disconnection is not mandatory outside this range unless stated in other sections of these Standards.

Table 3 : System Frequencies and minimum time

Frequency Range	Time period for operation (minimum)
47.5 Hz – 48.0 Hz	10 minutes
48.0 Hz – 48.5 Hz	20 minutes
48.5 Hz – 49.0 Hz	1 hour
49.0 Hz – 50.5 Hz	Unlimited
50.5 Hz – 52.5 Hz	1 hour

2. Any rate of change of frequency up to 2 Hz/s shall be withstood by the Renewable Resource Generating Unit without disconnection from the Network other than triggered by loss of mains protection. The frequency shall be measured using 100 ms average.

3. In case of a deviation of the Network voltage at the Connection Point from its nominal value, any automatic disconnection from the Network of a Renewable Resource Generating Unit shall be prohibited due to the deviation within the voltage ranges, expressed by the voltage at the Connection Point related to nominal Voltage (per unit), and within the time periods specified by Table 4. Disconnection is not mandatory outside this range unless stated in other sections of these Standards.

Table 4: Voltage range at Connection Point and minimum time

Voltage Range at 132kV-level and lower Voltage Levels	Voltage Range at 400kV- level	Minimum time period of operation
0.85 pu – 0.90 pu	0.85 pu – 0.90 pu	15 minutes in abnormal conditions for Non-Synchronously Connected Generating Units

0.90 pu – 0.95 pu	0.90 pu – 0.95 pu	15 minutes in abnormal conditions
0.95 pu – 1.05 pu	0.95 pu – 1.0375 pu	Unlimited
1.05 pu – 1.12 pu	1.0375 pu – 1.05 pu	15 minutes in abnormal conditions

4. Steady-State Stability of a Generating Unit is required for any operating point in the P-Q-Capability Diagram in case of power oscillations. Tripping and power reduction shall be prohibited.

    a) For Synchronously Connected Generating Units, the terms of the Steady-State Stability requirements are the following: the Turbine Speed Controller shall be sufficiently damped for both isolated and interconnected operation modes. Under all operation conditions, the damping coefficient of the Turbine Speed Control shall be above 0.25 for speed droop settings above 3% for gas turbines and 4% for steam turbines.

    b) For Non-Synchronously Connected Generating Units the terms of the Steady-State Stability requirements are that the damping ratio of the output Active Power oscillation shall be at least 0.05.

5. For Non-Synchronously Connected Generating Units, the unit shall remain stable under all grid fault conditions including three phase short circuits up to the Connection Point. All control and protection elements including but not limited to frequency and voltage elements shall remain stable during fault conditions.

2.3.2. Ability to predict the behaviour - Frequency behaviour

2.3.2.1. REQUIREMENT OF MINIMUM STRENGTH:

1. In case of deviation of the Network frequency from its nominal value above 52.5Hz, the Renewable Resource Generating Unit shall be disconnected from the Network.

2. In case of deviation of the Network frequency from its nominal value below 47.5Hz, the Renewable Resource Generating Unit shall be disconnected from the Network.

3. Following the disconnection stated in previous paragraphs (1 & 2), the Renewable Resource Generating Unit shall not be reconnected to the Network before the Network frequency is within the range 49 Hz – 50.5 Hz during a minimum of 60 seconds. The Active Power Output shall not be recovered with a gradient above 10% of the Maximum Capacity per minute.

2.3.2.2. REQUIREMENT OF LOW STRENGTH:

4. In case of deviation of the Network frequency from its nominal value, due to a deviation within the frequency ranges and time periods given in Table 3, the Renewable Resource Generating Unit shall have a predicable behaviour in terms of Active Power output:

a) **Due to** over-frequency deviations, the ratio between the Active Power Output and the Available Maximal Active Power Output of the Renewable Resource Generating Unit shall not be increased. Figure 1 illustrates in hatched area the acceptable range of operation.

b) **Due to** under-frequency deviations, the ratio between the Active Power Output and the Available Maximal Active Power Output of the Renewable Resource Generating Unit shall behave as follows:

i. For Synchronously Connected Generating Units, it shall not be decreased for frequencies above 49.8 and shall not be decreased by more than 10% at 47.5 Hz. Figure 1 illustrates in hatched area the acceptable range of operation.

ii. For Non-Synchronously Connected Generating Units, it shall not be decreased for frequencies above 49.8 and shall not be decreased by more than 3% at 47.5 Hz.

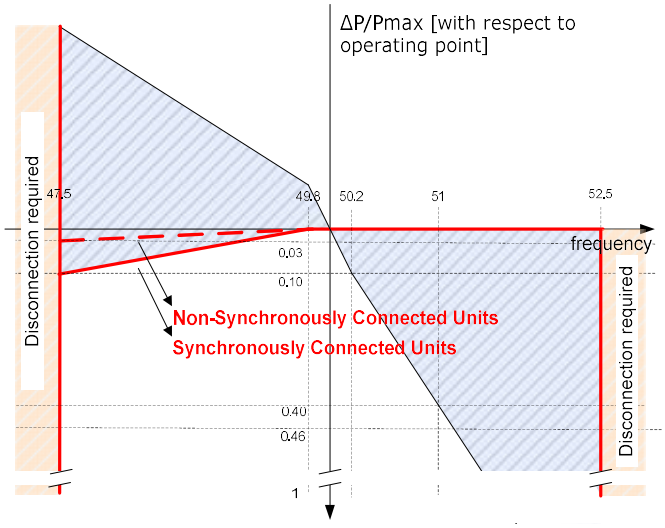


Figure 1- Limited Active Power output reduction due to under-frequency deviation (low strength)

2.3.2.3. REQUIREMENT OF MEDIUM STRENGTH:

5. In case of deviation of the Network frequency from its nominal value, due to a deviation within the frequency ranges and time periods specified in Table 3, the Renewable Resource Generating Unit shall have a predicable behaviour in terms of Active Power output:

a) **In case of** over-frequency deviations, the ratio between the Active Power Output and the Available Maximal Active Power Output of the Renewable Resource Generating Unit shall not be increased for frequencies below 50.2 and shall be decreased linearly by a minimum of 20% of nominal Active Power per Hertz until 52.5Hz. Figure 2 illustrates in hatched area the acceptable range of operation.

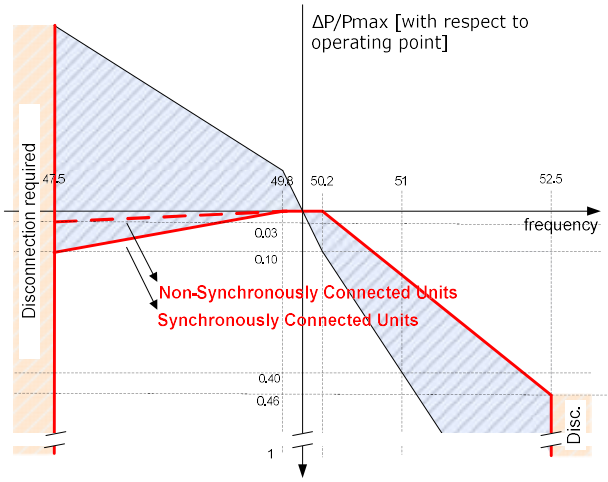


Figure 2: Limited Active Power output reduction due to under-frequency deviation and Active Power output reduction in case of over-frequency deviation (medium strength)

2.3.2.4. REQUIREMENT OF HIGH STRENGTH:

6. In case of deviation of the Network frequency from its nominal value, due to a deviation within the frequency ranges and time periods specified in Table 3, the Renewable Resource Generating Unit shall have a predicable behaviour in terms of Active Power output:

a. **In case of** under-frequency deviations, the ratio between the Active Power Output and the Available Maximal Active Power Output of the Renewable Resource Generating Unit shall not be decreased for frequencies above 49.8Hz and shall be increased linearly by a minimum of 5% per Hertz down to 47.5Hz unless and until the Renewable Resource Generator is operating at its Available Maximal Active Power Output. Figure 3 illustrates in hatched area the acceptable range of operation.

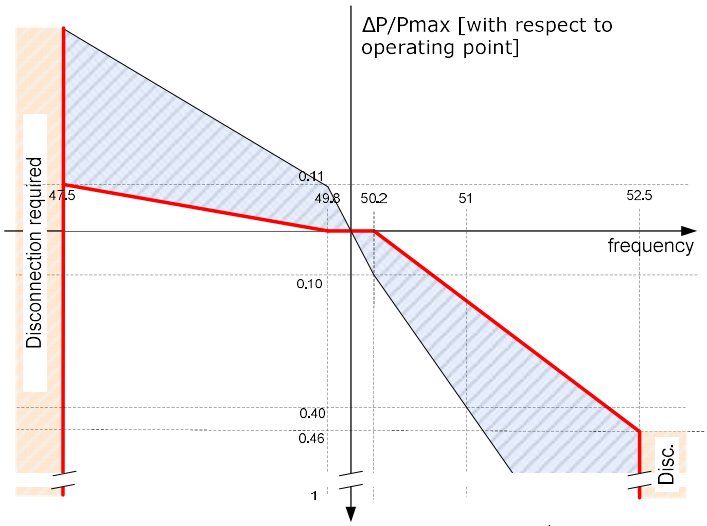


Figure 3 : Active Power output increase in case of under-frequency deviation and Active Power output reduction in case of over-frequency deviation (high and very high strength)

7. The Active Power output of the Renewable Resource Generating Unit connected to the Network shall be controllable. For this purpose, the Renewable Resource Generating Facility control system shall be capable of receiving an Instruction containing a required setpoint, given orally, manually or through automatic remote control system by DEWA.

8. The Renewable Resource Generating Facility shall, without prejudice to sub-clause 2.3.2.4-6.a., provide functionalities compliant with specifications defined by DEWA for secondary control in the ENG Code - OC-1.4.1, aiming at restoring frequency to its nominal value and/or maintain power exchange flows between control areas at their scheduled values.

9. The Renewable Resource Generating Facility control system shall accept target frequencies between 49.9 and 50.1 Hz in normal conditions and between 49.8 and 50.2 Hz after contingency.

2.3.2.5. REQUIREMENT OF VERY HIGH STRENGTH:

10. The Renewable Resource Generating Unit shall be capable of activating full Active Power frequency response in accordance with the parameters specified by DEWA for participation in primary control within the hatched zone defined in Figure 3 and as stated in ENG Code - OC-1.3.1. The initial delay of activation shall be as short as possible and reasonably justified by the Renewable Resource Generating Facility owner, by providing technical evidence for why a longer time is needed, if greater than 2 seconds (as stated in ENG Code - OC-1.3.1).

11. The accuracy of frequency measurements for Active Power frequency response must be better than 10 mHz.

2.3.3. Ability to predict the behaviour – Steady state Voltage behaviour

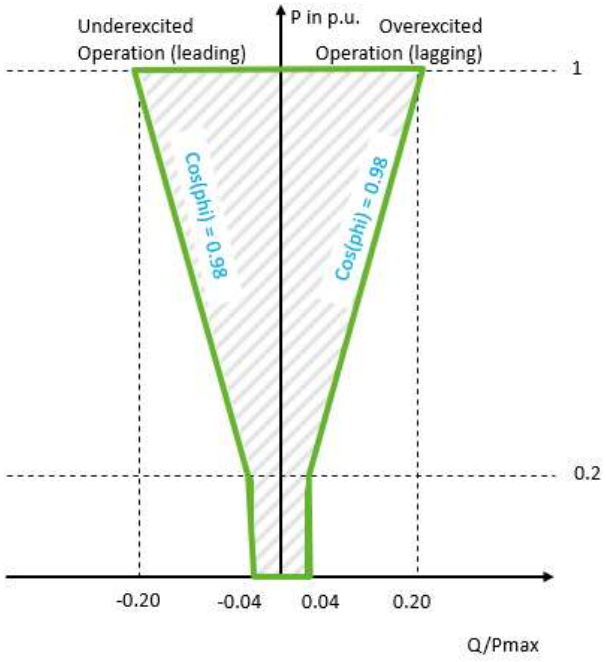
2.3.3.1. REQUIREMENT OF MINIMUM STRENGTH FOR ALL UNITS:

1. In LV Networks, in case of deviation of the Voltage at the Connection Point from its nominal value above 120% of nominal Voltage, the Renewable Resource Generating Unit shall be disconnected instantaneously from the Network.

2. Following the disconnection stated in paragraph 1, the Renewable Resource Generating Unit shall not be reconnected to the Network before the Voltage at the Connection Point is within the range 95% - 105% of nominal Voltage during a minimum of 60 seconds. The Active Power output shall not be recovered with a gradient above 10% of the Maximum Capacity per minute.

3. The Renewable Resource Generating Unit will maintain its Power Factor at its Connection Point in the range [0.98 leading, 0.98 lagging] for normal Voltage range if the Active Power output is above 20% of Maximum Capacity. When the Active Power output is below 20% of Maximum Capacity for Non-Synchronously Connected Generating Units or is below its technical minimum for Synchronously Connected Generating Units, the Renewable Resource Generating Unit will maintain its absolute Reactive Power below 4% of Maximum Capacity for nominal Voltage, subject to the

unit's capability curve. Deviation from these ranges due to Voltage deviation is



accepted.

4. Figure 4 illustrates in the two hatched areas the acceptable range of operation at nominal Voltage.

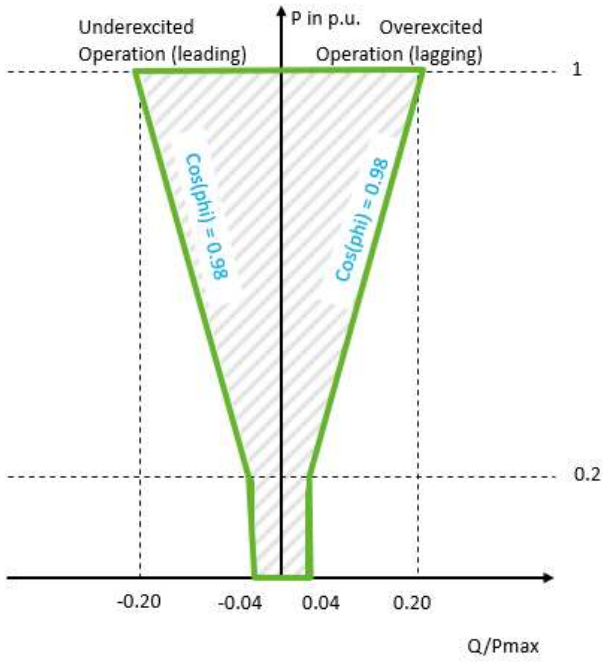


Figure 4: Passive P-Q domain of operation (minimum strength)

2.3.3.2. REQUIREMENT OF MEDIUM STRENGTH FOR NON-SYNCHRONOUSLY CONNECTED GENERATING UNITS:

5. In case of deviation of the Voltage at the Connection Point from its nominal value above 107.5% of nominal Voltage, the Renewable Resource Generating Unit shall reduce its Active Power output gradually to reach zero Active Power output at 115% of nominal Voltage. Figure 5 (a) illustrates in the hatched area the acceptable range of operation.

6. The Renewable Resource Generating Unit will maintain its Power Factor below 0.95 lagging if the Voltage at Connection Point is below 90% of nominal Voltage and below 0.95 leading if the Voltage at Connection Point above 110% of nominal Voltage. Between these limits of Voltage, Power Factor should be linearly adapted to reach unity Power Factor at nominal Voltage. Figure 5 (b) illustrates in the hatched area the acceptable range of operation.

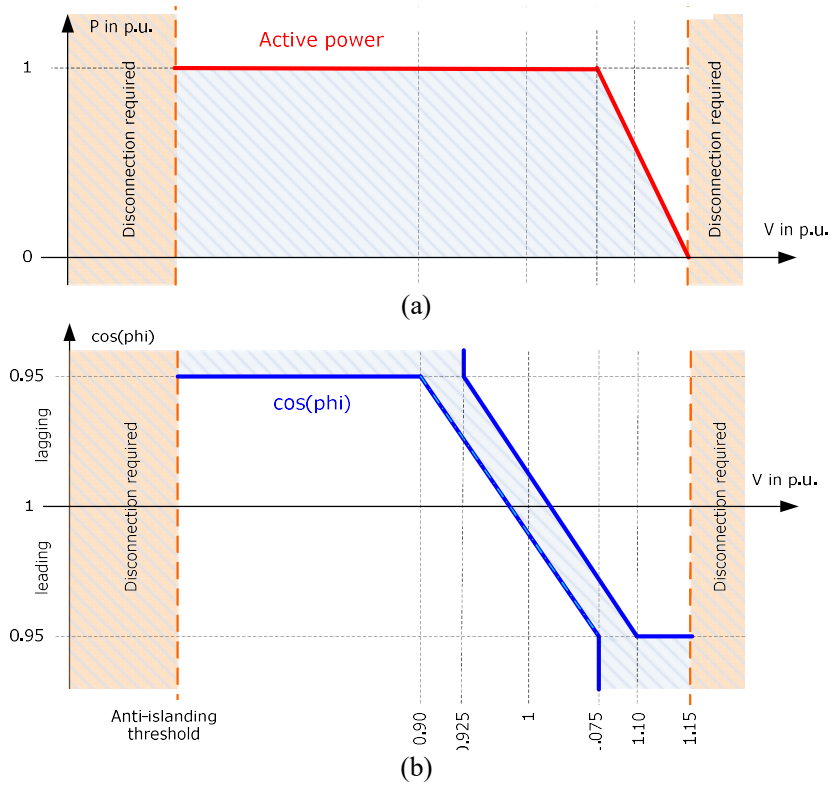


Figure 5: (a) Active Power and (b) Power Factor behaviour in case of Voltage deviation (medium strength for Non-Synchronously Connected Units)

2.3.3.3. REQUIREMENT OF MEDIUM STRENGTH FOR SYNCHRONOUSLY CONNECTED GENERATING UNITS:

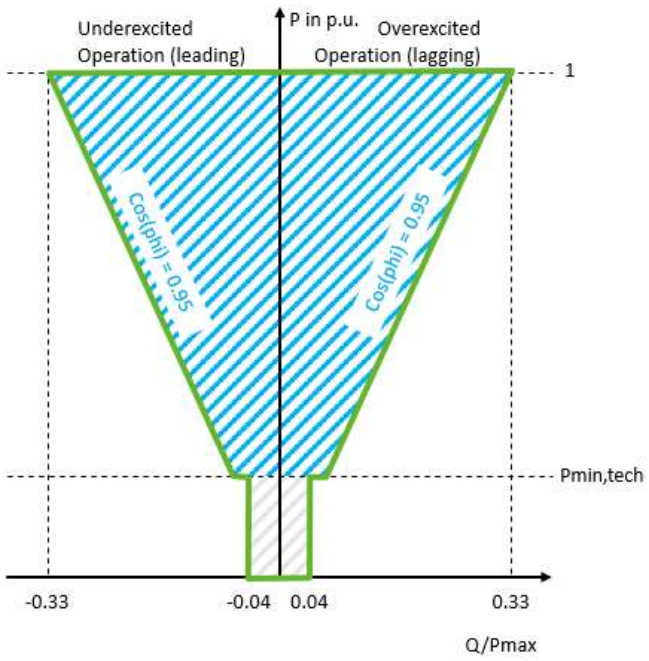
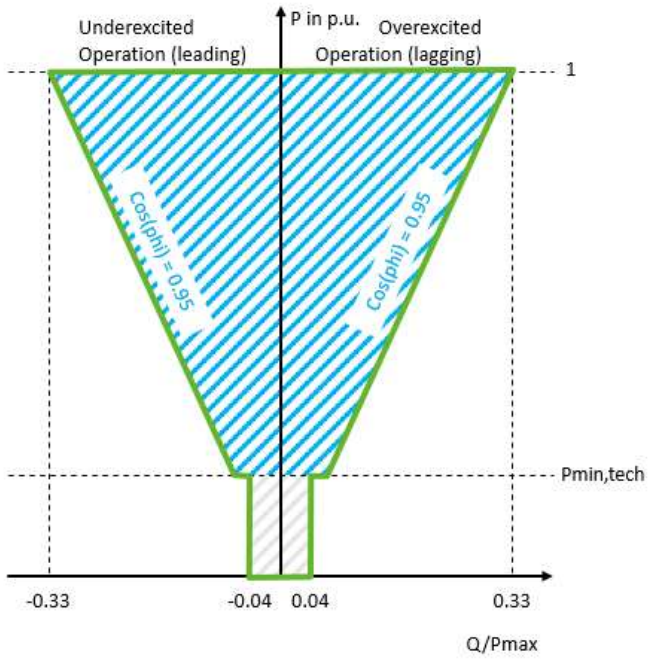


Figure 6: P-Q domain of operation for Synchronously Connected Generating Units (medium strength)

7. The Renewable Resource Generating Unit shall be able to operate at a Power Factor/reactive power value chosen by DEWA within the Power Factor range [0.95 leading, 0.95 lagging] when the Active Power output is between its technical minimum and Maximum Capacity. This range is valid as long as the Voltage stays within the range [0.95, 1.05]**.** When the Active Power output is below technical minimum of the Renewable Resource Generating Unit, it shall not take into account reactive or Power Factor control request from DEWA but will maintain its absolute Reactive Power below 4% of Maximum Capacity for nominal Voltage. Below the technical minimum,

deviation from the range of Reactive Power due to Voltage deviation is accepted.

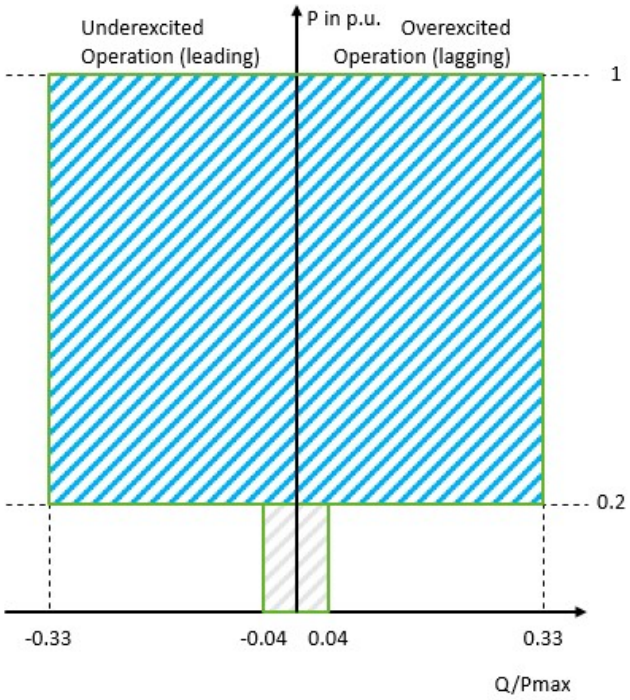


8. Figure 6 illustrates in the two hatched areas the acceptable range of operation at nominal Voltage.

2.3.3.4. REQUIREMENT OF HIGH STRENGTH FOR NON-SYNCHRONOUSLY CONNECTED GENERATING UNITS:

9. The Renewable Resource Generating Unit shall be able to operate at a Power Factor/Reactive Power/Connection Point voltage reference value chosen by DEWA within the Reactive Power range [-0.33, 0.33] if the Active Power output is above 20% of Maximum Capacity. This range is valid as long as the Voltage stays within the range [0.95, 1.05]. In voltage control mode, the Renewable Resource Generating Unit shall move from its initial setpoint to the new setpoint chosen by DEWA in steps of no greater than 0.01 pu, with a Slope having a range of 2 to 7% in steps of no greater than 0.5%**.** When the Active Power output is below 20% of Maximum Capacity, the Renewable Resource Generating Unit shall not take into account Reactive Power/Power Factor/Connection Point voltage control request from DEWA but will maintain its absolute Reactive Power below 4% of Maximum Capacity for nominal Voltage. Below 20% of Maximum Capacity, deviation from the range of

Reactive Power due to voltage deviation is accepted.



10. Figure 7 illustrates in the two hatched areas the acceptable range of operation at nominal Voltage.

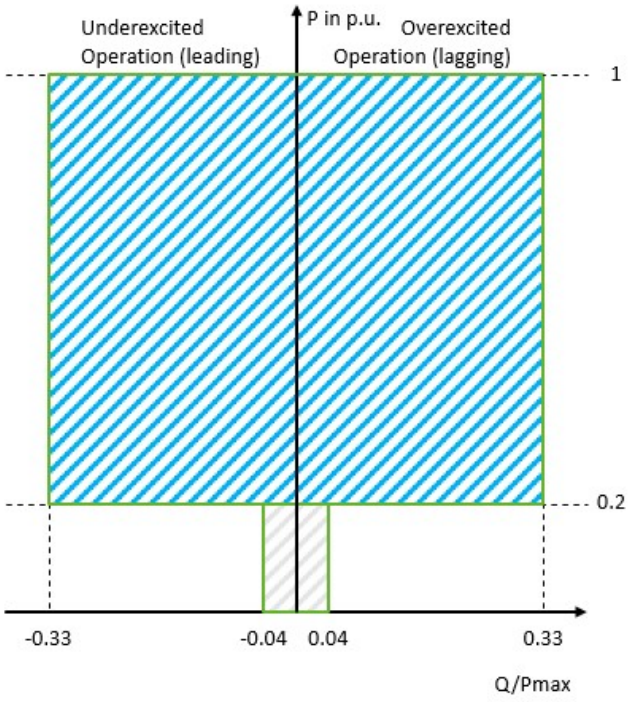
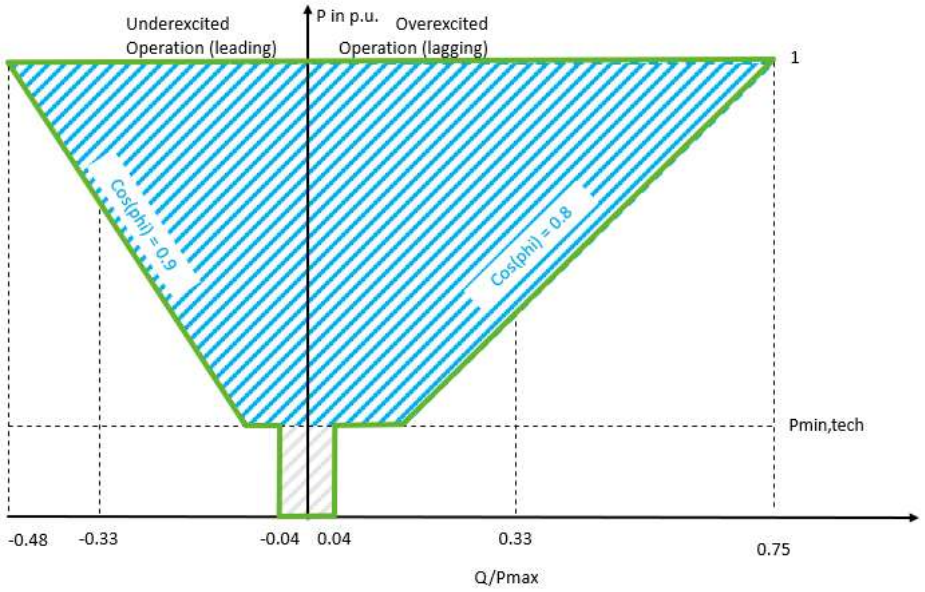


Figure 7: P-Q domain of operation for Non-Synchronously Connected Generating Units (high strength)

2.3.3.5. REQUIREMENT OF HIGH STRENGTH FOR SYNCHRONOUSLY CONNECTED GENERATING UNITS:

11. The Renewable Resource Generating Unit shall be able to operate at a Power Factor/Reactive Power/Connection Point voltage reference value chosen by DEWA within the Power Factor range [0.9 leading, 0.8 lagging]**.** This range is valid as long as the Voltage stays within the range [0.95, 1.05]**.** When the Active Power output is below technical minimum of the Renewable Resource Generating Unit, it shall not take into account Power Factor/Reactive Power/Connection Point voltage control request from DEWA but will maintain its absolute Reactive Power below 4% of Maximum Capacity for nominal Voltage. Below the technical minimum, deviation from the range of Reactive Power due to Voltage deviation is accepted.



12. Figure 8 illustrates in the two hatched areas the acceptable range of operation at nominal Voltage.

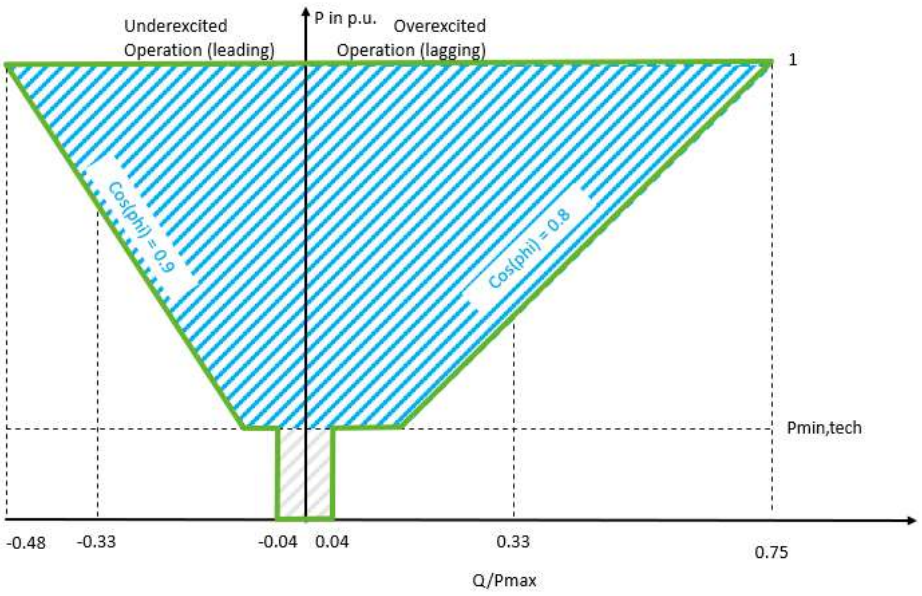


Figure 8: P-Q domain of operation for Synchronously Connected Generating Units (high strength)

2.3.4. Ability to predict the behaviour – Transient voltage behaviour

2.3.4.1. REQUIREMENT OF MINIMUM STRENGTH:

1. The Renewable Resource Generating Unit shall be disconnected from the Network if,

   a) for single-phase Generating Units, the Voltage at the Connection Point during a fault reaches the orange hatched area defined in Figure 9.

   b) for three-phase Generating Units, one of the three phase-to-phase Voltages or one of the three phase-to-neutral Voltages at the Connection Point which sustains the lowest retained Voltage during a symmetrical or asymmetrical fault reaches the orange hatched area defined in Figure 9.

2.3.4.2. REQUIREMENT OF LOW STRENGTH

2. In HV Networks, the Renewable Resource Generating Unit shall remain connected to the Network and continue stable operation if none of the three phase-to-phase Voltages and three phase-to-neutral Voltages at the Connection Point is above 140% of nominal Voltage for a duration lower or equal than 300 ms (over-voltage ride-through).

3. The Renewable Resource Generating Unit shall stay connected to the Network and continue stable operation when the actual course of each of the three phase-to-phase Voltages at the Connection Point remains within the blue hatched area defined in Figure 9.

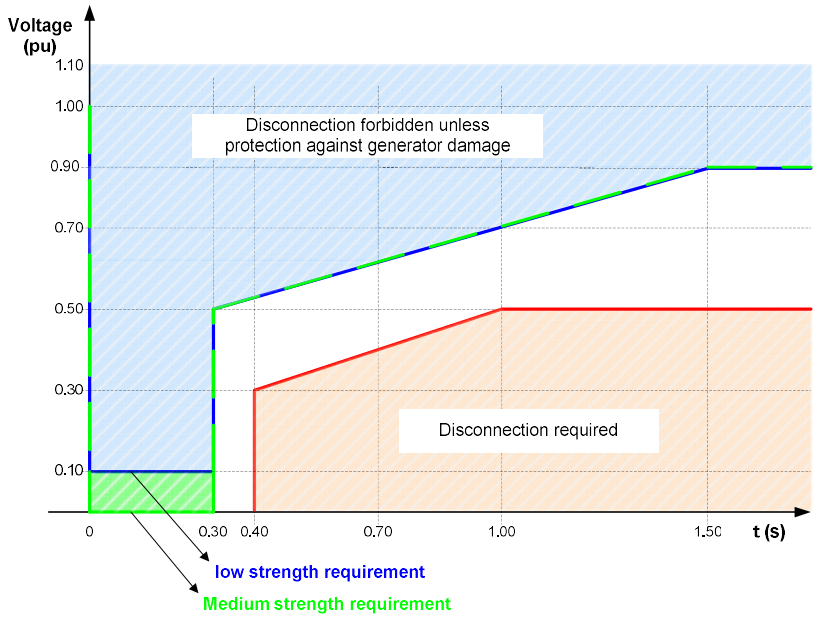


Figure 9: Fault ride through profile.

4. For units connected in MV and HV Networks:
   During fault, the Renewable Resource Generating Unit shall contribute to short-circuit

Current. Short-circuit Current contribution during fault should be above pre-fault Current.

2.3.4.3. REQUIREMENT OF MEDIUM STRENGTH:

5. The post-fault ratio between the active output power and the maximal available Active Power output of the Renewable Resource Generating Units shall be bigger than 90% of the pre-fault ratio within 5 seconds after fault clearing.

6. The Renewable Resource Generating Unit shall stay connected to the Network and continue stable operation when the actual course of each of the three phase-to-phase Voltages at the Connection Point remains within the green hatched area defined in Figure 9.

2.3.4.4. REQUIREMENT OF MEDIUM STRENGTH FOR NON-SYNCHRONOUSLY CONNECTED GENERATING UNITS

7. For unbalanced grid faults, Non-Synchronously Connected Generating Units shall provide negative sequence Current contribution according to any requirement agreed with DEWA.

8. The Renewable Resource Generating Unit shall provide reactive Current injection according to Figure 10 in the event of a transient Voltage deviation of more than 10%. Reactive Current supply during the fault duration shall not be less than 1 pu of the short term dynamic rating of the equipment (>=1.0 pu) if the voltage at the Connection Point is below 50%. Below 42% of retained Voltage, reactive Current shall be supplied as far as technically feasible but no less than 1.2pu.

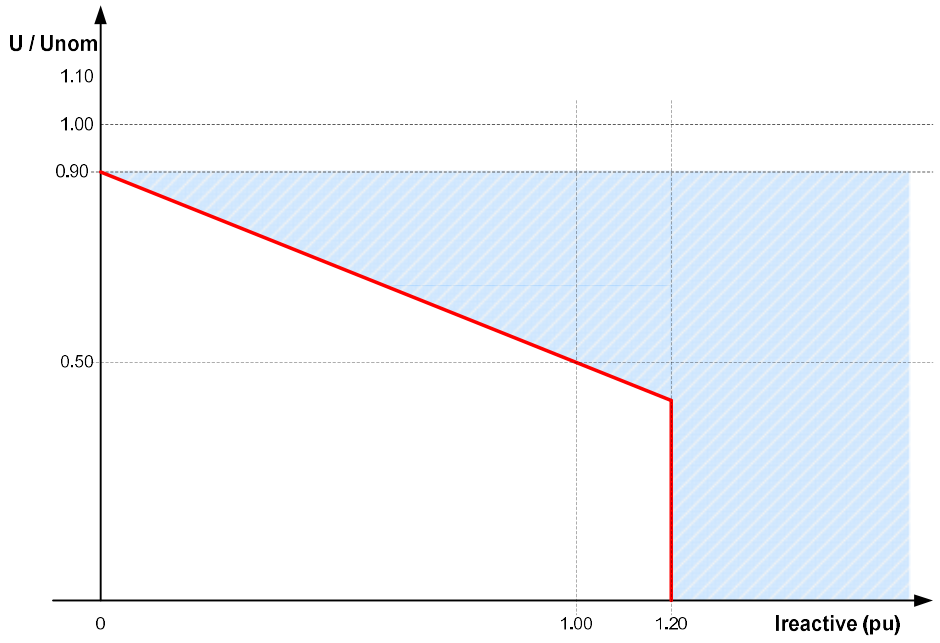


Figure 10: Reactive current injection during fault for Non-Synchronously Connected Generating Units

9. The Renewable Resource Generating Units shall be capable of feeding the required reactive Current with the following control response time after the fault inception into the Network:

a) Additional reactive Current up to 0.6pu must be provided within 20 milliseconds

b) The full range of additional Reactive Power must be provided no later than 60 milliseconds.

2.3.5. Monitoring, remote control and information exchange

2.3.5.1. REQUIREMENT OF LOW STRENGTH:

1. Requirements related to monitoring, remote control (communication with other protection relays, substations and the Supervisory Control and Data Acquisition) and information exchange will be provided by DEWA.

    a) The minimum communication requirements for MV and HV connected units are:

        - The meter data should be transmitted through secure wireless or optical fiber communication to the DEWA metering facility;
        - The communication channels should be capable of handling multiple applications over the same infrastructure;
        - The communication protocols should be *tunnelling through MPLS* or *transport over other IP infrastructure;*
        - The metering protocols should be interoperable with DEWA remote metering system.

2.3.5.2. REQUIREMENT OF MEDIUM STRENGTH:

2. For connection to the 400kV Network: the main Network requirements for data exchanges and telephone communications between Production Facilities and TCC1 and TCC2 are as follows:

    a) Each DCS shall be connected through duplicated fibre optic links to the communication equipment at the Transmission System substation or switching station compatible with DEWA's communication Network. The Generator shall provide and install all necessary devices to establish the DCS communication up to the communication equipment located in the Transmission System substation or switching station;

    b) The Electricity Metering System shall be connected through duplicated fibre optic links to the communication equipment at the Transmission System substation or switching station;

    c) All tele-protection communications shall be connected through duplicated direct fibre optic links between the Production Facilities and Transmission System substation or switching station. The Generators shall provide all necessary devices to establish the protection communication between the Production facilities and the Transmission System substation or switching station;

    d) The Generators shall provide, install and commission two redundant fibre optic cables between the Power Generating Facility and Transmission System substation or switching station to be used for all communications. These fibre optic links

form the Production Facilities to the end devices shall be the responsibility of the Generator.

2.3.5.3. REQUIREMENT OF HIGH STRENGTH:

3. The Renewable Resource Generating facility shall provide input for short-term planning. This information shall include at least: Active Power forecasts or power nomination and scheduled maintenance times.

4. The Renewable Resource Generating Facility shall be able to receive and automatically take into account remote control signals. This functionality shall enable the Renewable Resource Generating Unit to provide secondary frequency control, Voltage/MVAR /Power Factor regulation.

5. The Renewable Resource Generating Facility shall be able to provide fault recording and dynamic system behaviour monitoring. The recorded information shall include at least: Current, Voltage, Active Power, Reactive Power, Frequency and Harmonic content of Voltage and Current.

2.4. Specific mode of operation: Isolated Network Operation and (re-)synchronization

2.4.1.1. REQUIREMENT OF MINIMUM STRENGTH:

1. The synchronisation of the Renewable Resource Generating Unit to the Network should not create transient Voltage variation of more than 4%.

2. For units connected to LV and MV Networks:
   In case the Network, to which the Renewable Resource Generating Unit is connected, is considered by DEWA to be an isolated Network, the Renewable Resource Generating Unit shall be disconnected. This functionality, loss of mains protection, is considered achieved if one of the following methods is used:

   a) Vector phase jump: The disconnection shall be realized if a Voltage vector phase jump above 7° is monitored by the system. This functionality can be deactivated if the 3-phase Voltages are lower than 80% of nominal Voltage to avoid inopportune disconnection in case of low Voltage ride through.
   b) df/dt: The disconnection shall be realized if the rate-of-change-of-frequency (ROCOF) is bigger than 1 Hz/s and if the absolute frequency deviation is bigger than 0.2 Hz. The disconnection shall be ordered after a delay of 0.1 s to avoid inopportune disconnection in case of speed oscillation of nearby synchronous generator.
   c) Network impedance measurement: The disconnection shall be realized if the continuously measured Network impedance of the connected Network rises above a threshold given by DEWA for the Connection Point of the Renewable Resource Generating Unit.

2.4.1.2. REQUIREMENT OF HIGH STRENGTH:

3. The Renewable Resource Generating Unit shall be capable of continuing operation and ensure immediate reconnection for at least 15 minutes following a disconnection from the Network. The reconnection of the Renewable Resource Generating Unit shall be realized on request from DEWA in accordance with sub-clause 2.3.2.1-3., unless there exists a pre-agreed procedure between the Power Generating Facility owner and DEWA.

2.5. Metering

1. A dedicated metering system for the Renewable Resource Generating Unit is required.

   a) For units connected to LV and MV Networks, the characteristics of the Metering System are similar to the ones used by DEWA for demand facilities connected at the same voltage level.

   b) For units connected to HV Networks, the characteristics of the Metering System are the following:

2.5.1. Meter, CT and VT Requirements

2.5.1.1. EQUIPMENT REQUIRED

Meters

Electricity Metering Systems shall include Main Electricity Metering System and a Check Electricity Metering System. Main Electricity Metering System and Check Electricity Metering System equipment shall at all relevant times have the same levels of accuracy and functionality. Both the Main Electricity Meters and Check Electricity Meters shall measure the quantities defined below.

Main Electricity Meters and Check Electricity Meters shall be installed, operated and maintained so as to comply at all relevant times with the Standards and accuracy classes indicated in Appendix C1 (“Accuracy of electricity metering system”).

For each separate Actual Metering Point, an Electricity Metering System shall be installed, operated and maintained to measure the following parameters:

1. Entry and exit Active Energy
2. Entry and exit Reactive Energy

DEWA shall configure Main Electricity Meters and Check Electricity Meters such that active energy is measured with the number of measuring elements equal to or one less than the number of primary system conductors. These include the neutral and/or earth conductor where system configurations enable the flow of energy in such conductors.

All Main Electricity Meters and Check Electricity Meters shall be labelled by DEWA or otherwise be readily identifiable in accordance with Appendix C2 ("Labelling of meters").

The Electricity Metering Systems shall meter the quantities on a continuous basis and the information shall be displayed on a non-volatile Meter Register. The Meter Registers shall not pass through zero to zero more than once within the normal meter reading cycle.

Electricity Metering Systems shall be provided by DEWA with Outstations that shall provide two outputs per measured quantity, one for the use of the Generator and one for the use of DEWA.

The Outstations shall enable Metering Data to be interrogated locally and at a later date for Metering Data to be provided remotely over communications channels.

Where Electricity Metering Systems provide Metering Data to Outstations external to the Electricity Metering System, the Outstations shall provide two outputs per measured quantity.

DEWA shall provide Test terminals for Main Electricity Meters and Check Electricity Meters to facilitate on-site tests. These terminals shall be in close proximity to the Main Electricity Meters and Check Electricity Meters and shall be capable of providing suitable means for accessing Current and Voltage signals, injecting test quantities, connecting test Meters, and replacing Main Electricity Meters and Check Electricity Meters without a circuit outage.

Current Transformers

DEWA shall provide Current transformers in accordance with the Standards and accuracy classes indicated in Appendix C1 ("Accuracy of electricity metering system").

DEWA shall provide two of Current transformers. The Current transformers supplying Main Electricity Meters, the Current transformer windings and cables connecting such windings to Main Electricity Meters shall be dedicated for such purposes and such cables and connections shall be securely sealed.

The Current transformers supplying electricity Check Electricity Meters shall be dedicated for such purposes and such cables and connections shall be securely sealed

The total burden on each Current transformer shall not exceed the rated burden of such Current transformer. No other burden shall be connected to these Current transformers.

Current transformer test certificates showing errors at the overall working burden or at burdens which allow the error at working burden to be calculated shall be made available by DEWA, wherever possible, for inspection by the relevant parties.

Voltage Transformers

DEWA shall provide Voltage transformers in accordance with Standards and accuracy classes indicated in Appendix C1 ("Accuracy of electricity metering system").

DEWA shall provide one Voltage transformer with two or more secondary windings.

The Voltage transformer winding supplying Main Electricity Meters shall be dedicated to that purpose and such windings and connections shall be securely sealed.

The Voltage transformer winding supplying Check Electricity Meters shall be dedicated to that purpose and such windings and connections shall be securely sealed. No other burden shall be connected to these Voltage transformer secondary windings.

Separately fused Voltage transformer supplies shall be provided by DEWA for the Main Electricity Meter and the Check Electricity Meter. The fuses shall be located as close to the Voltage transformer as possible.

2.5.1.2. ACCURACY REQUIREMENTS

Overall Accuracy

The accuracy of the various items of measuring equipment comprising the Electricity Metering Systems shall conform to the relevant IEC standards. Standards relevant are listed in Appendix C1 ("Accuracy of electricity metering system").

Where relevant standards change from time to time, DEWA will review such changes and recommend to the Regulatory Authority the extent to which any such changes should be implemented.

Any errors arising from the Measurement Transformers and associated leads to the Main Electricity Meters and Check Electricity Meters that affect the overall accuracy shall be compensated such that the overall accuracy requirement is met. Values of the compensation factors and their justification including test certificates shall be established in accordance with Good Industry Practice and recorded and shall be available for inspection by the Generators. The compensation criteria and the justification shall be established in accordance with Good Industry Practice and recorded in the Meter Registration System.

2.5.1.3. METER APPROVAL AND CERTIFICATION

Meters used shall be the electricity meter types contained in DEWA's list of approved meters. The Generators shall have the right to approve the Electricity Metering Systems proposed by DEWA however the Meters shall be provided by DEWA from its list of approved meters.

2.5.1.4. OPERATION AND MAINTENANCE

Electricity Metering Systems shall be operated and maintained in accordance with the manufacturer's recommendations or as otherwise necessary for DEWA to comply with its obligations under these Standards.

2.5.2. Metering System Calibration and Testing

2.5.2.1. INITIAL CALIBRATION

All new Main Electricity Meters and Check Electricity Meters shall undergo relevant certification tests in accordance with Good Industry Practice.

All initial calibration of Main Electricity Meters and Check Electricity Meters shall be performed on behalf of DEWA in a recognised test facility (including any Meter manufacturer's works). These tests shall be performed in accordance with the relevant IEC standards and shall confirm that Main Electricity Meter and Check Electricity Meter accuracy is within the limits stated in Appendix C1 ("Accuracy of electricity metering system"). A uniquely identifiable calibration record shall be provided by the recognised test facility before the connection is made live.

DEWA will apply a certification seal following initial calibration. DEWA must maintain this seal intact in order for the Main Electricity Meter and Check Electricity Meter to retain certified status. No person shall break the seal unless properly authorised to do so. DEWA is responsible for ensuring that Main Electricity Meter and Check Electricity Meter certification is carried out for compliance with the provisions of these Standards.

Main Electricity Meters and Check Electricity Meters removed from service must be re-certified before reconnection for use under these Standards.

New Voltage transformers and Current transformers shall be calibrated prior to installation on any site. DEWA shall provide manufacturers' test certificates to show compliance with the accuracy classes.

2.5.2.2. COMMISSIONING

Commissioning tests shall be carried out on all new Electricity Metering Systems providing Metering Data before the connection is made live and in accordance with Good Industry Practice. Commissioning tests shall also be carried out before reconnection where a replacement Electricity Metering System is fitted as part of existing Electricity Metering System. No connection or reconnection shall be permitted unless the tests are passed.

Following commissioning, DEWA shall provide such evidence that may be required to confirm that Electricity Metering System meets the requirements of these Standards.

Appendix C3 ("Commissioning tests of meters") sets out the tests and checks that as a minimum shall be included in a commissioning programme.

All Main Electricity Meters, Check Electricity Meters, Measurement Transformers shall be tested by the respective DEWA for accuracy in accordance with Good Industry Practice at initial commissioning before the connection is made live, as indicated in Appendix C3.

2.5.2.3. PERIODIC CALIBRATION AND TESTING

General

Periodic Calibration of Electricity Metering Systems shall be undertaken by DEWA to ensure that the requirements of these Standards are met at all relevant times.

Periodic calibration of Main Electricity Meters and Check Electricity Meters shall be performed in DEWA's in-house meter calibration facilities or in a recognised test facility (including any Meter manufacturer's works) or by competent persons using standard Meters certified by a recognised authority. The tests shall be performed in accordance with the relevant IEC standards and shall confirm that Main Electricity Meter and Check Electricity Meter accuracy is within the limits stated in Appendix C1 ("Accuracy of electricity metering system"). The calibration record shall be uniquely identifiable, retained in a safe place and the significant details (Identification Number, date, names and status of authorised testing persons and accuracy results) recorded in the Meter Registration System.

Meters shall also be tested outside of the prescribed intervals stated below if the Main Electricity Meter and Check Electricity Meter diverge by more than 1.5 times the prescribed limit of error associated with the accuracy classes given in Appendix C1 ("Accuracy of electricity metering system").

Complete and accurate records of tests, work carried out and pertinent data to confirm successful testing/calibration in accordance with the requirements of these Standards shall be kept by DEWA and promptly registered in the Meter Registration System where appropriate.

Frequency of testing

For the Main Electricity Meter and Check Electricity Meters on-site accuracy tests shall be performed at intervals of not less than 18 months and not exceeding 5 years.

Periodic testing of Measurement Transformers is not required.

Suspected Metering errors

If any item of an Electricity Metering System is suspected of performing incorrectly, the Generators may request DEWA to carry out a test in accordance with Good Industry Practice to confirm correct operation and accuracy. DEWA shall carry out any test so requested. The Generators shall be given 24 hours' notice of such tests and be invited to witness the tests. Test results shall be made available promptly and in writing to the Generator.

Certified test equipment and reference standards (all traceable to recognised national or international standards) shall be used in such tests and if, by agreement, it is deemed necessary, an approved independent laboratory may be employed.

Where an accuracy test indicates that an error exceeds the limits of error associated with the accuracy classes given in Appendix C1 ("Accuracy of electricity metering system"), the errors shall be recorded before promptly adjusting, repairing or renewing the Electricity Metering System (or part thereof) or replacing defective components. In such cases substitute Metering Data shall be provided in accordance with DEWA.

The Electricity Metering System shall be restored to service and proved to be operating within the prescribed limits of accuracy as soon as is reasonably practicable. Upon the completion, examination, maintenance, repair, recalibration or replacement of any component in the Electricity Metering System, the Main Electricity Meter and Check Electricity Meter shall be sealed.

2.5.3. Meter and Data Security and Registration

2.5.3.1. METER ACCESS AND SEALING

All Electricity Metering Systems and associated communications equipment shall be located in secure metering cabinets located in an area that is readily accessible, free from obstructions and well lit by artificial light. The cabinets shall include as a minimum, effective protection from moisture and dust ingress and from physical damage, including vibration. Appropriate temperature controls shall be provided. The cabinets must be lockable and capable of being sealed to prevent unauthorised access.

DEWA and the Generators shall jointly seal the Main Electricity Meters and Check Electricity that shall include data collection equipment and associated modems and telephone links. Only DEWA's personnel shall break such seals. The Generator shall be given at least forty-eight (48) hours' advance notice of the breaking of any seals. No such notice will be necessary when the breaking of a seal is necessitated by the occurrence of an Emergency.

Neither DEWA nor the Generators shall tamper or otherwise interfere with any part of the Electricity Metering System in any way. Where it is established that the Electricity Metering System has been tampered or interfered with, then until such tampering or interference has been rectified either:

- the quantity measured or recorded shall be that measured or recorded by any other relevant installed metering, or
- if there is no other relevant Metering or it is established to have been tampered or interfered with, the quantity shall be agreed by the parties, or, in the absence of such agreement, either DEWA or the Generator shall be entitled to refer the matter to an Expert for determination.

Where the Generator requires the right of access or to deal in some other way with a Meter or Electricity Metering System for the purposes of these Standards, all such necessary rights shall be granted by DEWA. All such rights should be set down in the relevant contracts.

The right of access provided for in these Standards includes the right to bring onto DEWA's property any vehicles, plant, machinery and maintenance or other materials as shall be reasonably necessary for the purposes of performance of obligations under these Standards.

DEWA and the Generator shall ensure that all reasonable arrangements and provisions are made and/or revised from time to time as and when necessary or desirable in accordance with Good Industry Practice to facilitate the safe exercise of any right of access.

Meter Records

DEWA shall label all Main Electricity Meters and Check Electricity Meters with a unique identification number from lists maintained by DEWA.

DEWA shall ensure that complete and accurate records are maintained of the calibration and operation of the Electricity Metering System. These records shall include but not be limited to the dates and results of any tests, readings, adjustments or inspection carried out and the dates on which any seal was applied or broken. The reasons for any seal being broken and the Persons, and their affiliations, attending any such tests, readings, inspections or sealings shall be recorded.

DEWA shall ensure that the pertinent data (Appendix C4 "Meter registration data") is promptly entered into the Meter Registration System. Such data shall be kept up to date. They shall also provide any other Electricity Metering System data requested by other involved parties.

2.5.3.2. METER REGISTRATION

Electricity Metering Systems shall be registered in a central database, the Meter Registration System, which is to be operated and maintained by DEWA in accordance with Good Industry Practice. The purpose of the Meter Registration System is to provide a complete, accurate and up to date central database of all Meter Data and to ensure an auditable trail to demonstrate compliance with these Standards. The Meter Registration System shall contain, as a minimum, specific information at each Actual Metering Point as indicated in Appendix C4 ("Meter registration data").

DEWA is responsible for ensuring that data relating to all changes to DEWA's Electricity Metering System including any changes to the types of data set out in Appendix C4 are promptly reported in writing, to the Meter Registration System.

The Meter Registration System shall maintain the specified information for a minimum of seven years after the replacement or disconnection of a Meter.

Any data held in the Meter Registration System (a) shall be the intellectual property of DEWA and (b) may be viewed by the Generator.

3. COMPLIANCE

3.1. General provisions

1. Responsibility of the owner of the Power Generating Facility:

    a. The Generating Unit owner shall ensure that the Generating Unit is compliant with these Standards. This compliance shall be maintained throughout the lifetime of the facility.

2. Rights of DEWA:

    a. DEWA shall have the right to request that the Generating Unit owner carries out compliance tests and simulations not only during the operational notification procedure, but repeatedly throughout the lifetime of the Power Generating Facility after any failure, modification or replacement of any equipment that may have impact on the Generating Unit's compliance with these Standards.

    b. DEWA shall have the right to request that the Generating Unit owner submits recordings from available measurements, covering the period for which such data is available.

3. When DEWA's participation is needed to perform tests, DEWA will provide the Generating Unit owner with an offer for the cost of the tests.

3.2. Compliance Testing

3.2.1. Generalities for compliance testing

1. The proof of compliance of the Generating Units with these Standards requires the successful completion of several tests. These tests are divided into three categories:

    a. Laboratory testing:

        i. These tests are required from Renewable Resource Generating Units having Maximum Capacity lower than 500kW unless it is more cost-effective for the grid user to perform the tests required for units having Maximum Capacity above 500kW.

        ii. DEWA is entitled to provide a description of the tests and the criteria of fulfilment. Alternatively, and upon DEWA's approval, the laboratory may provide DEWA with the list of tests and fulfilment criteria for approval and validation.

        iii. These tests are to be performed by laboratories on request of a manufacturer. If the tests are successful, then the equipment will be provided with a Manufacturer's Data and Performance Type Certificate (MD&PTC) of compliance with DEWA Standards and the tested equipment will be registered and appear on the DEWA website.

        iv. These tests are required to certify that the equipment, meant to be sold in large quantities to DEWA grid users, is compliant with these Standards.

b. Simulations and field testing:

i. These tests are required from Renewable Resource Generating Units having Maximum Capacity above 500kW to validate that each Generating Unit of a Generating Facility is compliant with these Standards, taking into account the particular design of the plant and its location in the grid. If it is more cost-effective for the Generating Unit to perform laboratory tests, DEWA may grant the authorisation to provide MD&PTC as sole or partial evidence of compliance.

ii. DEWA is entitled to provide a description of the tests and the criteria of fulfilment, unless otherwise agreed between DEWA and the Generating Unit.

iii. These tests are to be performed by the owner of the Renewable Resource Generating Unit (or a third party on behalf of the Generating Unit owner), unless otherwise agreed between DEWA and the Generating Unit.

2. The Power Generating Facility owner is advised to check with DEWA at an early stage of a project what parts, if any, are acceptable in lieu of the full compliance process and how to proceed to make use of this facility.

3.2.2. Required tests for compliance

1. The list of the required tests used to prove to DEWA compliance of the Generating Units with these Standards is provided in Appendix B: Compliance Tests.

2. The successful completion of these tests shall not be used as sole proof of compliance and the Power Generating Facility owner shall refer to Section 4 on the Operational Notification procedure for connection describing the complete Compliance assessment of the Generating Unit.

3.3. Compliance Monitoring

1. Data from the monitoring and measurement devices, as required by these Standards, shall be made available by the owner of the Renewable Resource Generating Facility upon request from DEWA for the sole use of Compliance monitoring.

2. The term Compliance monitoring shall include verification of the continuous compliance of the Renewable Resource Generating Unit with both the requirements that where tested in the process of Compliance Testing and the requirements that were not tested in the process of Compliance Testing.

3. The Renewable Resource Generating Unit shall carry out compliance monitoring tests every three years or as reasonably required by DEWA subject to the terms and conditions of the Contract.

4. OPERATIONAL NOTIFICATION PROCEDURE

4.1. General provisions

1. The Power Generating Facility owner shall prove to DEWA its compliance with the requirements of these Standards by completing successfully the operational notification procedure for connection as defined below.

2. The operational notification procedure for connection shall comprise:

   a) Energization Operational Notification (EON);
   b) Interim Operational Notification (ION);
   c) Final Operational Notification (FON); and
   d) Limited Operational Notification (LON).

4.2. Energization operational notification

1. Energization Operational Notification (EON) shall only entitle the Power Generating Facility owner to energise its internal Network by using the grid connection.

2. Energization Operational Notification (EON) shall be issued by DEWA, subject to certification of the installation and the connection.

4.3. Interim operational notification

1. Interim Operational Notification (ION) shall entitle the Power Generating Facility owner to operate the Generating Unit by using the grid connection for a limited period of time not exceeding 6 months.

2. Interim Operational Notification (ION) shall be issued by the relevant Network operator, subject to the completion of data and study review process as required by these Standards.

3. With respect to data and study review the following must be submitted to the relevant Network operator by the Power Generating Facility owner:

   a) Itemized Statement of compliance. This list of statements, under the form of a table, shall be filled by the owner of the Power Generating Facility. The table format is determined by DEWA through an example of compliance statement provided in Appendix A.
   b) Detailed technical data of the Power Generating Facility with relevance to the grid connection;
   c) MD&PTCs of Generating Units, where these are relied upon as part of the evidence of compliance;
   d) Simulation models (including dynamic controller /governor model, etc. for protection studies, stability studies, etc.);
   e) Studies demonstrating expected steady-state and dynamic performance; and
   f) Details of intended practical compliance tests.

4.4. Final operational notification

1. Final Operational Notification (FON) shall entitle the Power Generating Facility owner to operate the Generating Unit by using the grid connection.

2. Final Operational Notification (FON) shall be issued by DEWA, upon prior removal of all incompatibilities identified for the purpose of the Interim Operational Notification (ION) status and subject to the completion of data and study review process as required by these Standards.

3. With respect to data and study review the following must be submitted to DEWA by the Power Generating Facility owner:

   a) Confirmation of compliance; and
   b) Update of applicable technical data, simulation models and studies, including use of actual measured values during testing.

4. In case of incompatibility identified for the purpose of the granting of the Final Operational Notification (FON), Derogation may be granted upon request made to the Regulatory Authority, in accordance with the Derogation procedure defined in these Standards. Final Operational Notification (FON) shall be issued by DEWA if the Generating Unit is compliant with the provisions of the Derogation. DEWA shall have the right to refuse the operation of the Generating Unit, whose owner's request for Derogation was rejected, until the Power Generating Facility owner and DEWA have agreed on a resolution of the incompatibility and the Generating Unit is considered to be compliant by DEWA.

4.5. Limited operational notification

1. Power Generating Facility owners to whom a Final Operational Notification (FON) has been granted shall inform DEWA immediately in the following circumstances:

   a) it is temporarily subject to either a significant modification or loss of capability, due to implementation of one or more modifications of significance to its performance; or
   b) in case of equipment failures leading to non-compliance with some relevant requirements.

2. The Power Generating Facility owner shall apply to DEWA for a Limited Operational Notification (LON), if the Power Generation Facility owner reasonably expects the circumstances according to paragraph 1 to persist for more than 3 months.

3. Limited Operational Notification (LON) shall be issued by DEWA with a clear identification of:

   a) the unresolved issues justifying the granting of the Limited Operational Notification (LON);
   b) the responsibilities and timescales for expected solution; and
   c) a maximum period of validity, which shall not exceed 6 months.

4. The Final Operational Notification (FON) shall be suspended during the period of validity of the Limited Operational Notification (LON) with regard to the subjects for which the Limited Operational Notification (LON) has been issued.

5. DEWA shall have the right to refuse the operation of the Generating Unit if the Limited Operational Notification (LON) expires prior to removal of the circumstances that caused its issuing. In such a case the Final Operational Notification (FON) shall automatically be invalid.

5. DEROGATIONS

If a Generator finds that it is, or will be, unable to comply with any provision of the Standards, then it shall, without delay, report such non-compliance to DEWA and the Regulatory Authority and shall make all reasonable efforts to remedy such non-compliance as soon as reasonably practicable. Non-compliance may arise;

- in respect of plant and Apparatus which are approved to connect or for which approval to connect to the Transmission or Distribution System is being sought; or
- in respect of plant and Apparatus connected to the Transmission or Distribution System in case of a revision to the Standards.

When a Generator believes either that it would be unreasonable (including cost and technical considerations) to require it to remedy such non-compliance or that it should be granted an extended period to remedy such non-compliance, it shall promptly submit to the Regulatory Authority a request for Derogation from such provision and shall provide DEWA with a copy of such application.

If DEWA finds that it is, or will be, unable to comply with any provision of the Standards at any time, then it shall make all reasonable efforts to remedy such non-compliance as soon as reasonably practicable.

In the case where DEWA or a Generator requests Derogation, the following information shall be submitted to the Regulatory Authority.

5.1. A Request for Derogation

A request for Derogation from any provision of the Standards shall contain:

i. the issue number and the date of the Standards provision against which the non-compliance or predicted non-compliance was identified;

ii. identification of the plant and/or Apparatus in respect of which a Derogation is sought and, if relevant, the nature and extent to which the non-compliance exists;

iii. identification of the provision with which the Generator is, or will be, unable to comply;

iv. the reason for the non-compliance; and

v. the date by which compliance will be achieved (if remedy of the non-compliance is possible).

On receipt of any request for Derogation, the Regulatory Authority shall promptly consider such a request. Provided that the Regulatory Authority considers that the grounds for the Derogation are reasonable, the Regulatory Authority shall grant such Derogation unless the Derogation would, or is likely to;

- have a material adverse impact on the security and/or stability of the Transmission or Distribution System, or
- impose unreasonable costs on the operation of the Transmission or Distribution System or on other Generators.

In its consideration of a Derogation request by a Generator, the Regulatory Authority may contact the relevant Generator and/or DEWA to obtain clarification of the request or to discuss changes to the request.

Derogations from any provision of the Standards shall contain:

i. the issue number and the date of the Standards provision against which the Derogation applies;

ii. identification of the plant and/or Apparatus in respect of which a Derogation applies and, if relevant, the nature and extent to which the Derogation applies including alternate compliance provisions;

iii. identification of the provision with which the Derogation applies;

iv. the reason for the non-compliance requiring Derogation; and

v. the date by which the Derogation ends if compliance will be achieved, or by which such Derogation expires.

To the extent of any Derogation granted in accordance with this paragraph, DEWA and/or the Generator (as the case may be) shall be relieved from their obligation to comply with the applicable provision of the Standards and shall not be liable for failure to so comply but shall comply with any alternate provisions as set forth in the Derogation.

DEWA shall:

- keep a register of all Derogations which have been granted, identifying the name of the person and Generator in respect of whom the Derogation has been granted, the relevant provision of the Standards and the period of the Derogation; and
- on request from any Generator, provide a copy of such register of Derogations to such Generator.

Where a material change in circumstance has occurred, a review of any existing Derogations, and any Derogations under consideration, may be initiated by the Regulatory Authority or at the request of DEWA or Generators.

6. APPENDIX A: ITEMIZED STATEMENT OF COMPLIANCE

Compliance Table

std n°	Short description of the standard	Short description of the performed test	Observations	User action	Flag
1	Capability curves	- increase reactive power injection at the connection point until over-excitation limit - decrease reactive power injection until under-excitation limit	- over-excition limit is beyon the required range (PF or Q) - under-excition limiter prevents covering the whole required range	the option of replacing the fixed ratio transformer by a variable-ratio transformer will be investigated, and new tests will be performed	
2	Voltage dip - ride through capability	- metallic fault close to the point of connection (zero-voltage remaining), eliminated after 300 ms by opening the line	- the unit loses the synchronism	option "zero-FRT" will be taken from the manufacturer package, and new tests will be performed	
3	Small-signal stability & PSS tuning	- eigenvalues analysis - time-simulation: step change in active power output and reactive power output	- all modes have a damping > 30 % - the output stabilises after less than 5 seconds	structure and paramters of both AVR and PSS are confirmed	

test criteria are all fulfilled	
test criteria are partially fulfilled	
test failed	

7. APPENDIX B: COMPLIANCE TESTS

7.1. List of tests

All tests have to comply with the requested measurement accuracies as defined in the latest version of IEC 61400-21 unless otherwise specified in this document

7.1.1. Laboratory testing for equipment certification

7.1.1.1. LABORATORY TESTS FOR REQUIREMENTS OF AT LEAST MINIMUM STRENGTH

1. **Laboratory test for short-circuit contribution**
    a. DEWA will specify the short-circuit impedance to be used and short-circuit duration to be performed.
    b. Perform short-circuits and measure the single-phase and three-phase short-circuit Currents.
2. **Laboratory test for Steady-State Stability:**
    a. Two situations will be considered:
        i. Low short-circuit level at the Connection Point (standard value determined by DEWA)
        ii. High short-circuit level at the Connection Point (standard value determined by DEWA)
    b. Test 1: for each of the 2 Network situations, the following steps are executed:
        i. Steady state operation of the Generating Units at Q=0.2PN (lagging Power Factor) and P=Pmin,tech.
        ii. Fastest possible increase of Active Power to reach PN
    c. Test 2: from the first Network situation (Low short-circuit level at the Connection Point), the Network impedance will be instantaneously modified to reach the second Network situation (High short-circuit level) and vice versa.
    d. For the 2 tests, the damping must be such that all variables stay within their final value +/- 2% after 5 seconds.
3. **Laboratory test for reconnection behaviour:**
    a. The Voltage at the Connection Point is brought from 130% of Nominal Voltage to 100% of Nominal Voltage and kept constant for the duration of the test. The behaviour of the Generating Unit should be compliant with the requirements of the Standards.
4. **Laboratory test for capability curves**

a. The following situations with constant nominal Voltage at the Connection Point will be considered:

   i. For Synchronously Connected Generating Units:

      i. P=PN, leading Power Factor 0.98;
      ii. P=PN, lagging Power Factor 0.98;
      iii. P=Pmin,tech, leading Power Factor 0.98;
      iv. P=Pmin,tech, lagging Power Factor 0.98;

   ii. For Non-Synchronously Connected Generating Units:

      i. P=PN, Q=0.2PN ;
      ii. P=PN, Q=-0.2PN;
      iii. P=0.2PN, Q=0.2PN ;
      iv. P=0.2PN, Q=-0.2PN ;

b. For each situation, the Generating Unit must be stable and operate in steady-state for an infinite time or at least three times the longest thermal time constant of the Power Generating Facility.

5. Laboratory test for loss-of-mains detection

a. Several input signals will be tested to verify whether they trigger a disconnection or not from the grid. For each signal, a value 5% below the required threshold and a value 5% above the threshold will be tested.

b. Input signals to be tested:

   i. Vector phase jump

   ii. ROCOF

   iii. Network impedance measurements

7.1.1.2. ADDITIONAL LABORATORY TESTS FOR REQUIREMENTS OF AT LEAST LOW STRENGTH

1. Laboratory test for Active Power sensitivity to frequency:

a. Test 1: Starting from f=fN and P=PN, the frequency is modified linearly with a rate of 0.1 Hz/s within the ranges 50 Hz to 47.5 Hz and 50 Hz to 52.5 Hz. The Active Power of the unit must be adjusted as required in these Standards.

b. Test 2: At constant frequency of 47.5 Hz and for a realistic time evolution of the available maximum output power, the Active Power of the unit must be adjusted as required in these Standards.

c. Test 3: At constant frequency of 52.5 Hz and for a realistic time evolution of the available maximum output power, the Active Power of the unit must be adjusted as required in these Standards.

2. Laboratory test for low-voltage ride-through

a. 3-phase symmetrical Voltage dips for 3-phase units and single phase Voltage dips for single phase units are created at the Connection Point of the unit. The units must stay connected and behave according to the Standards.

i. Dip lasting at least 290 ms down to 20% UN.
ii. Dip lasting at least 0.95 s down to 70% UN.

7.1.1.3. ADDITIONAL LABORATORY TESTS FOR REQUIREMENTS OF AT LEAST MEDIUM STRENGTH

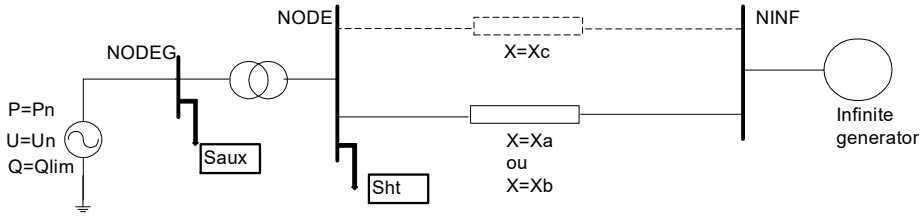
1. **New Laboratory test for Active Power and Power Factor sensitivity to Voltage for Non-Synchronously Connected Generating Units:**

   a. Starting from U=UN and during a realistic time evolution of the available maximum output power above P=0.5PN, the Voltage is modified linearly with a rate of 10%/min in the ranges 0.85 to 1 and 1 to 1.15. The Active Power and the Power Factor of the unit must be adjusted as required in these Standards.

7.1.2. Simulations testing

7.1.2.1. GENERALITIES FOR SIMULATION TESTS

1. **Test system for time simulations:**



   a. The node "NODE" represents by default the Connection Point of the Generating Unit with the corresponding nominal Voltage. For particular connection situations (such as the unit and its step-up transformer delivering power to the grid through a single cable), this NODE may be different from the Connection Point to the grid. DEWA will specify the node to be taken into account and any supplementary element to be added in the test grid between the NODE and the step-up transformer.
   b. The NODEG-NODE transformer models the step-up transformer that will provide the connection of the Generating Unit to the grid with the transformation ratio that will be used as a basis while the unit is operating.
   c. The Saux load represents the active and reactive consumption of the auxiliaries.
   d. The Sht load represents an active load of 10% PN under a lagging Power Factor 0.95.
   e. The line connecting NODE to the infinite node has an impedance that can have two values: The impedance for obtaining the maximum short-circuit power (Xa) on the one hand and the minimum short-circuit power (Xb) on the other. These values are provided by DEWA.
   f. For certain simulations described in these Standards, the test grid comprises two lines between the nodes NODE and NINF. The impedance of this second line is Xc.
   g. The Voltage at the infinite node is fixed so as to obtain the normal operating Voltage provided at the connection node (NODE) and provided by DEWA.

h. The Generating Unit is represented with a detailed model including its controls (Voltage and speed) and safety-devices (at least, protection against over- and under-voltage, over- and under-frequency, loss of synchronism and stator Current protection).
i. If the plant comprises several Generating Units, the simulations must be carried out for each separate unit in the plant. Two units are considered as being different if one of the following items of equipment is different (from the point of view of the manufacture, size, adjustment, etc.): the alternator, its drive, the safety devices, the turbine and its control, as well as the step-up transformer. In the illustrated case of a step-up transformer common to several units, those units will be represented in the same test grid and feeding it through that step-up transformer (as the case may be, a 3-coil transformer).

7.1.2.2. SIMULATION TESTS FOR REQUIREMENTS OF AT LEAST MINIMUM STRENGTH

1. Simulations for Steady-State Stability:

a. This analysis will be carried out in the two impedance situations (Xa and Xb) and for two of the unit's functioning points:
   i. P=PN, Q=0 (the reference Voltage (Uref) consequently adjusted)
   ii. P=PN, Q= -0.1*PN (the reference Voltage (Uref) consequently adjusted).
b. You are asked to present the characteristic values ($\sigma \pm j\omega$) for each functioning point in a table with:
   i. The oscillation frequency equal to $\omega/2\pi$;
   ii. Dying-out defined as equal to $\xi = -\sigma/\ \mathrm{sqrt}(\omega^2 + \sigma^2)$. This damping makes it possible to determine the number of cycles needed to dampen the oscillating mode concerned.
c. In all cases, the damping of all modes must be more than 0.25.
d. You are also asked to simulate an increase of +5% (in absolute value) of the voltage set-point. The unit's damping must be such that 5 seconds after the change of set-point the Active Power generated by the unit must be within a range of +/- 5% of its initial value.

7.1.2.3. ADDITIONAL SIMULATION TESTS FOR REQUIREMENTS OF AT LEAST LOW STRENGTH

1. Simulations for Active Power sensitivity to frequency:

a. The infinite node in the reference grid diagram is replaced by a large machine whose frequency can be modified.

b. Starting from f=fN and for a realistic time evolution of the available maximum output power, the frequency is modified linearly with a rate of 0.1 Hz/s within the ranges 50 Hz to 47.5 Hz and 50 Hz to 52.5 Hz. The Active Power of the unit must be adjusted as required in these Standards.

2. Simulations for capability curves:

a. The grid diagram includes two lines between NODE and NINF: X=Xa and Xc=Xa/10.

b. Any over-voltage relay must be de-activated.

c. The following situations with constant nominal Voltage at the Connection Point will be considered:

   i. For Synchronously Connected Generating Units:

      i. P=PN, leading Power Factor 0.98;
      ii. P=PN, lagging Power Factor 0.98;
      iii. P=Pmin,tech, leading Power Factor 0.98;
      iv. P=Pmin,tech, lagging Power Factor 0.98;

   ii. For Non-Synchronously Connected Generating Units:

      i. P=PN, Q=0.2PN;
      ii. P=PN, Q=-0.2PN;
      iii. P=0.2PN, Q=0.2PN;
      iv. P=0.2PN, Q=-0.2PN;

d. For each situation, the Generating Unit must be stable and operate in steady-state for an infinite time or at least three times the longest thermal time constant of the Power Generating Facility.

e. Moreover, for P < 0.2 Pmin,tech, the unit must be able to keep its Reactive Power in the limits Q=[-0.04 ; 0.04] PN.

3. Simulations for low-voltage ride-through:

a. The functioning point of the machine is P=PN, Q=0, U=UN; the impedance of the line connecting to the infinite node is equal to Xb. The grid diagram will be modified by adding a second line with impedance Xc = 2*Xb in parallel to that line.

b. The Transient Stability of the Generating Unit will be checked by simulating a 3-phase fault on the second line (with Xc impedance) at a distance of 1% from "NODE" node, with an impedance such that the remaining Voltage at "NODE" is equal to 20% of the nominal voltage. The default is eliminated by opening that line.

   i. The default lasts at least 290 ms. The unit must stay connected and keep the synchronism.
   ii. The critical time is defined as the minimum duration of default for which the unit loses synchronism with the main grid or goes off following the action of a safety device. The critical time is computed (as already required in the previous simulation, it must be at least 290 ms).

c. The ability to withstand falling Voltages of the Generating Unit will be checked by simulating a 3-phase fault on the second line (with Xc impedance) at a distance of 1% from "NODE" node, with an impedance such that the remaining Voltage at "NODE" is equal to 70%. The default is eliminated by opening that line.

   i. The default lasts 1s. It will be verified that the unit maintains stability and does not shut down following that disturbance.

7.1.2.4. ADDITIONAL SIMULATION TESTS FOR REQUIREMENTS OF AT LEAST MEDIUM STRENGTH

1. **New Simulations for capability curves for Synchronously Connected Generating Units:**

   a. The grid diagram includes two lines between NODE and NINF: X=Xa and Xc=Xa/10.

   b. Any over-voltage relay must be de-activated.

   c. The following situations will be considered

      i. P=PN, leading Power Factor 0.95;
      ii. P=PN, lagging Power Factor 0.95;
      iii. P=Pmin,tech, leading Power Factor 0.95;
      iv. P=Pmin,tech, lagging Power Factor 0.95;

   d. For each situation:

      iii. for any of the three initial Voltages at the Connection Point:

         i. Voltage equal to 95% UN;
         ii. Voltage equal to UN;
         iii. Voltage equal to 105% UN;

   e. For each situation, the Generating Unit must be stable and operate in steady-state for an infinite time or at least three times the longest thermal time constant of the Power Generating Facility.

   f. Moreover, for P < 0.2 Pmin,tech, the unit must be able to keep its Reactive Power in the limits Q=[-0.04 ; 0.04] PN.

2. **New simulations for Active Power and Power Factor sensitivity to frequency for Non-Synchronously Connected Generating Units:**

   a. Starting from U=UN and during a realistic time evolution of the available maximum output power above P=0.5PN, the Voltage is modified linearly with a rate of 10%/min in the ranges 0.85 to 1 and 1 to 1.15. The Active Power and the Power Factor of the unit must be adjusted as required in these Standards.

3. **Simulations for power recovery after low-voltage ride-through:**

   a. In the continuation of the simulation for low-voltage ride through verification, the recovery of power after fault elimination should be as described in these Standards.

4. **Reactive power contribution during low-voltage ride-through for Non-Synchronously Connected Generating Units.**

   a. In addition to the described simulations for low-voltage ride-through, the reactive Current injection should be as described in these Standards. This should be checked by simulating a 3-phase fault on the second line (with Xc impedance) at a distance of 1% from “NODE” node, with an impedance such that the remaining Voltage at “NODE” is equal to

      i. 50% of the nominal Voltage.

      ii. 20% of the nominal Voltage.

7.1.2.5. ADDITIONAL SIMULATION TESTS FOR REQUIREMENTS OF AT LEAST HIGH STRENGTH

Simulation tests shall be done through real time simulations. Simulation tool shall be mutually agreed between offtaker and Generator as applicable.

1. **New simulations for low-voltage ride-through:**

   a. The functioning point of the machine is P=PN, Q=0, U=UN; the impedance of the line connecting to the infinite node is equal to Xb. The grid diagram will be modified by adding a second line with impedance Xc = 2*Xb in parallel to that line.

   b. The Transient Stability of the Generating Unit will be checked by simulating a 3-phase fault on the second line (with Xc impedance) at a distance of 1% from "NODE" node, with an impedance such that the remaining Voltage at "NODE" is equal to 0% of Nominal Voltage. The default is eliminated by opening that line.

      i. The default lasts 300 ms. The unit must stay connected and keep the synchronism.

      ii. The critical time is defined as the minimum duration of default for which the unit loses synchronism with the main grid or goes off following the action of a safety device. The critical time is computed (as already required in the previous simulation, it must be at least 300 ms).

   c. The ability to withstand falling Voltages of the Generating Unit will be checked by simulating a 3-phase fault on the second line (with Xc impedance) at a distance of 1% from "NODE" node, with an impedance such that the remaining Voltage at "NODE" is equal to 70%. The default is eliminated by opening that line.

      i. The default lasts 1s. It will be verified that the unit maintains stability and does not shut down following that disturbance.

2. **New Simulations for capability curves:**

   a. The grid diagram includes two lines between NODE and NINF: X=Xa and Xc=Xa/10.

   b. Any over-voltage relay must be de-activated.

   c. The following situations will be considered

      i. For Synchronously Connected Generating Units:

         i. P=PN, leading Power Factor 0.8;
         ii. P=PN, lagging Power Factor 0.9;
         iii. P=Pmin,tech, leading Power Factor 0.8;
         iv. P=Pmin,tech, lagging Power Factor 0.9;

      ii. For Non-Synchronously Connected Generating Units:

         i. P=PN, Q=0.33PN ;
         ii. P=PN, Q=-0.33PN;
         iii. P=0.2PN, Q=0.33PN ;
         iv. P=0.2PN, Q=-0.33PN ;

   d. For each situation:

i. for any of the three initial Voltages at the Connection Point:

i. Voltage equal to 95% UN;
ii. Voltage equal to UN;
iii. Voltage equal to 105% UN;

ii. the unit must be stable and operate without any time limit.

e. Moreover, for P < 0.2 Pmin,tech, the unit must be able to keep its Reactive Power in the limits Q=[-0.04 ; 0.04] PN.

3. Simulations for household operation:

a. For each of the situation described in the previous simulations for capability curves verification, the unit is disconnected from the grid at the Connection Point. After the disconnection, the unit shall be able to adapt its power output to feed the auxiliaries only and remain stable for at least 15 minutes.

7.1.2.6. ADDITIONAL SIMULATION TESTS FOR REQUIREMENTS OF VERY HIGH STRENGTH

1. Simulations for primary frequency control:

DEWA is in entitled of providing a description of additional tests and the criteria of fulfillment. Alternatively, the Generating Unit and DEWA can agree on a set of tests to be performed.

7.1.3. On-site testing

7.1.3.1. GENERALITIES FOR FIELD TESTS

1. **Timing of the tests:**

a. DEWA shall specify the preferred time frame (moment of the day) for the tests.

b. DEWA shall give its approval before starting the tests and is entitled to suspend or cancel the tests at any time.

c. Any relevant stakeholder shall be informed of the tests (for example, Generating Units in the vicinity, neighbouring Network operators) and required to take possible actions to prevent damage in case of unwanted deviations from normal operation of the Connection Point. For some tests, DEWA shall also adapt the topology of the system to reduce possible impact on other users.

d. DEWA shall ensure enough reserve is available to prevent consequences of a forced outage.

e. Before starting the tests, the control centre of DEWA shall simulate the various actions taken and make sure the operational security criteria are met.

2. **Monitoring of the tests**

a. DEWA shall take care of measurements at the Connection Point. Where necessary, measuring equipment might be added for the tests (and even longer).

b. DEWA and the Generating Unit owner shall agree on the minimum set of measurements to be recorded by the Generating Unit. These measurements have to be provided to DEWA on request.

7.1.3.2. FIELD TESTS FOR REQUIREMENTS OF AT LEAST MINIMUM STRENGTH

1. **Field tests for impact of synchronization on the Network:**

   a. DEWA will determine one of more grid topologies for which switching actions will be tested.

   b. Validation of the impact on the grid Voltage during switching actions can also be performed through recording on a long period (e.g. one year) of the Voltage and Current waveforms through a permanent monitoring or disturbance recorders.

7.1.3.3. ADDITIONAL FIELD TESTS FOR REQUIREMENTS OF AT LEAST MEDIUM STRENGTH

1. **Field tests for capability curves:**

   a. The load tap changer of the (MV) transformer has to be set in manual mode. During the tests, the transformer tap will be chosen in order to put the unit in various conditions of Reactive Power, and verify where limits arise.

   b. The test will include tests Q(or PF)-control mode:

      i. Q-range at high power: For P = Pmax, fixed transformer tap, require various setpoints in Reactive Power and verify the Voltage limits reached at the Connection Point.

      ii. Q-range at low power: For P = Pmin, fixed transformer tap, require various setpoints in Reactive Power and verify the Voltage limits reached at the Connection Point.

7.1.3.4. ADDITIONAL FIELD TESTS FOR REQUIREMENTS OF AT LEAST HIGH STRENGTH

1. **Field tests for Active Power control:**

   Remote control of various outputs is tested, and the reaction time is measured.

2. **New field tests for capability curves:**

   a. The load tap changer of the (MV) transformer has to be set in manual mode. During the tests, the transformer tap will be chosen in order to put the unit in various conditions of Reactive Power, and verify where limits arise.

   b. The test will include tests in V-control and Q(or PF)-control mode:

      i. Q-range at high power: For P = Pmax, fixed transformer tap, require various setpoints in Reactive Power and verify the Voltage limits reached at the Connection Point.

      ii. Q-range at low power: For P = Pmin, fixed transformer tap, require various setpoints in Reactive Power and verify the Voltage limits reached at the Connection Point.

iii. V-setpoint for various taps: for P = Pmax, for various tap positions, required the unit to control the Voltage and verify the Reactive Power limits and Voltage reached at the Connection Point.

iv. V-setpoint step response: for P = Pmax, for various tap positions, required the unit to control the Voltage and measure the response time (and behaviour).

7.1.3.5. ADDITIONAL FIELD TESTS FOR REQUIREMENTS OF VERY HIGH STRENGTH

1. **New field tests for Active Power control:**

   DEWA is in entitled to provide a description of additional tests and the criteria of fulfillment. Alternatively, the Generating Unit and DEWA can agree on a set of tests to be performed.

8. APPENDIX C: ELECTRICITY METERING SYSTEM

8.1. Appendix C1: Accuracy of the Electricity Metering System

8.1.1. Standards

The following standards are among those related to these Standards:

- IEC Standard 62052-11 – Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 11: Metering equipment
- IEC Standard 62053-11 – Electricity metering equipment (a.c.) – Particular requirements - Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2)
- IEC Standard 62053-21 – Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)
- IEC Standard 62053-22 – Electricity metering equipment (a.c.) – Particular requirements – Part 22: Static meters for active energy (classes 0,2 S and 0,5 S)
- IEC Standard 62053-23 – Electricity metering equipment (a.c.) – Particular requirements - Part 23: Static meters for reactive energy (classes 2 and 3)
- IEC Standard 60044-1 – Instrument transformers – Current transformers
- IEC Standard 60044-2 – Instrument transformers – Voltage transformers
- IEC Standard 60044-3 – Instrument transformers – Combined transformers
- IEC Standard 60044-7 – Instrument transformers – Electronic voltage transformers
- IEC Standard 60044-8 – Instrument transformers – Electronic Current transformers
- IEC Standard 61107 – Data exchange for meter reading – direct local data exchange.
- The metering system shall withstand harmonic distortion as provided in EN 50160.

All electricity Metering Systems and electricity Meters shall comply with the relevant standards current at the time that the Contract is signed.

8.1.2. Overall Accuracy Requirements

For the measurement and Metering of Active Energy, Reactive Energy and Active Power, Metering System shall be tested and calibrated to operate within the overall limits of error set out in Table C-1, after taking due account of CT and VT errors and the resistance of cabling or circuit protection. Calibration equipment shall be traceable to a recognised national or international standard.

Table C-1: Overall Accuracy of an Electricity Metering System

Condition	Limits of Error at Stated Power Factor for Active Power and Energy Measurement	
Current Expressed as a Percentage of Rated Measuring Current	Power Factor	Limits of Error for Connections
120% to 10% inclusive	1	±0.5%
Below 10% to 5%	1	±0.7%
Below 5% to 1%	1	±1.5%
120% to 10% inclusive	0.5 lag	±1.0%
120% to 10% inclusive	0.8 lead	±1.0%

Condition	Limits of Error for Reactive Power and Energy at Stated Power Factor	
Current Expressed as a Percentage of Rated Measuring. Current	Power Factor	Limits of Error for Connections
{120%} to 10% inclusive	0	±4.0%
{120%} to 20% inclusive	0.866 lag	±5.0%
{120%} to 20% inclusive	0.866 lead	±5.0%

8.1.3. Metering System Accuracy Classes

The accuracy class or equivalent shall as a minimum be as given in the following tables depending on the Maximum Capacity of the Generating Unit:

Table C-2: Equipment Accuracy Classes for Generating unit with Maximum Capacity above than or equal to 500kW

Equipment Type	Equipment Accuracy Class
Current Transformers	0.2S
Voltage Transformers	0.2
Active Energy and Power Meters	0.2S
Reactive Energy and Power Meters	2

Table C-3: Equipment Accuracy Classes for Generating unit with Maximum Capacity lower than 500kW

Equipment Type	**Equipment Accuracy Class**
Current Transformers (if applicable)	1.0S
Voltage Transformers (if applicable)	1.0
Active Energy and Power Meters	1.0S

8.2. Appendix C2: Labelling of meters

8.2.1. General

Each Meter shall be allocated a unique Meter identification number that will be given by DEWA and recorded in the Meter Registration System.

The number shall be marked permanently on the Meter in a position that is clearly visible under all normal viewing of the Meter.

The number will be quoted on all records arising from and related to the Meter including Meter readings.

Test blocks and other related Metering equipment should be clearly identified with the Metering System with which they are associated.

8.2.2. Entry and Exit Labelling

The following standard method of labelling meters, test blocks, etc.; based on the definitions for entry and exit shall be incorporated. The required labelling shall be as follows:

Active Energy

Meters or Meter Registers shall be labelled

"Entry" for all Active Energy flows normally entering the Transmission and Distribution System, and

"Exit" for all Active Energy flows normally leaving or exiting the Transmission and Distribution System,

Reactive Energy

Within the context of these Standards the relationship between Active Energy and Reactive Energy can be best established by means of the Power Factor. The following table gives the relationship:

Table C-3: Reactive Energy entry/exit Convention

Flow of Active Energy	Power Factor	Flow of Reactive Energy
Entry	Lagging	Entry
Entry	Leading	Exit
Entry	Unity	zero
Exit	Lagging	Exit
Exit	Leading	Entry
Exit	Unity	zero

Meters or Meter Registers for registering entry Reactive Energy should be labelled "Entry" and those for registering exit Reactive Energy should be labelled "Exit".

8.3. Appendix C3: Commissioning tests for meters

This Appendix sets out the tests and checks that shall be included in the Metering Systems commissioning programme. Metering System shall in addition have basic tests carried out on earthing, insulation, together with all other tests that would normally be conducted in accordance with Good Industry Practice.

8.3.1. Measurement Transformers

For all installations with new/replaced Measurement Transformers DEWA shall ensure that from site tests and inspections the following are confirmed and recorded:

1. Details of the installed units, including serial numbers, rating, accuracy classes, ratio(s);

2. CT ratio and polarity for selected tap; and

3. VT ratio and phasing for each winding.

For installations with existing Measurement Transformers the Meter owner shall ensure that, wherever practically possible, 1, 2 and 3 above are implemented, but as a minimum must confirm and record VT and CT ratios. If it is not possible to confirm the CT ratio on site, the reason must be recorded on the commissioning record and details must be obtained from any relevant Person.

8.3.2. Measurement Transformer Leads and Burdens

For all installations the Meter owner shall wherever practically possible:

1. Confirm that the VT and CT connections are correct;

2. Confirm that the VT and CT burden ratings are not exceeded; and

3. Determine and record the value of any burdens (including any burdens not associated with Metering Systems or Meters) necessary to provide evidence of the overall metering accuracy.

8.3.3. Metering

8.3.3.1. GENERAL TESTS AND CHECKS

1. The following may be performed on-site or elsewhere (e.g. factory, meter test station, laboratory, etc.):

2. Record the Metering System details required by the Meter Registration System;

3. Confirm that the VT/CT ratios applied to the Meter(s) agree with the site Measurement Transformer ratios;

4. Confirm correct operation of Meter test terminal blocks where these are fitted (e.g. CT/VT operated metering);

5. Check that all cabling and wiring of the new or modified installation is correct;

6. Confirm that Meter registers advance (and that output pulses are produced for meters which are linked to separate Outstations) for entry and where appropriate exit flow directions. Confirm Meter operation separately for each phase Current and for normal polyphase Current operation;

7. Where separate Outstations are used confirm the Meter to Outstation channel allocations and that the Meter units per pulse values or equivalent data are correct; and

8. Confirm that the local interrogation facility (Meter or Outstation) and local display etc. operate correctly.

8.3.3.2. SITE TESTS

The following tests shall be performed on site:

1. Check any site cabling, wiring, connections not previously checked under clauses D.1, D.2 and D.3.1 above;

2. Confirm that Meter/Outstation is set to UTC (Dubai time) within +/- 5 seconds;

3. Check that the Voltage and the phase rotation of the measurement supply at the Meter terminals are correct;

4. Record Meter start readings (including date and time of readings);

5. Wherever practically possible, a primary prevailing load test (or where necessary a Primary injection test) shall be performed which confirms that the Meter(s) is registering the correct primary energy values and that the overall installation and operation of the metering installation are correct;

6. Where for practical or safety reasons (5) is not possible then the reason shall be recorded on the commissioning record and a secondary prevailing load or injection test shall be performed to confirm that the Meter registration is correct including, where applicable, any Meter VT/CT ratios. In such cases the VT/CT ratios shall have been determined separately as detailed under D.1: Measurement Transformers, above;

7. Record values of the Meter(s)/Outstation(s) displayed or stored Metering Data (at a minimum one complete half-hour value with the associated date and time of the reading) on the commissioning record;

8. Confirm the operation of Metering System alarms (not data alarm or flags in the transmitted data); and

9. Confirm from Meter owner that accuracy certificates exist for the Meters.

8.4. Appendix C4: Meter Registration Data

The Meter Registration System forms the Metering database and holds Metering Data relating to Metering.

Data in the Meter Register shall be treated as confidential and only relevant Metering Data should be released to the Generator.

Metering Data to be contained in the Meter Register should include, but is not limited to the following:

- A unique meter identification number;
- Connection and the Actual Metering Point data, including:

    - location and reference details (i.e. drawing numbers)
    - participant details at the Electrical Delivery Point
    - site identification nomenclature
    - Meter owner

- Meter installation details, including;

    - serial numbers
    - metering installation identification name
    - Meter types and models
    - instrument transformer ratios (available and connected)
    - test and calibration programme details: test results and reference test certificates for Meters and Measurement Transformers
    - asset management plan and testing schedule
    - calibration tables, where applied to achieve Meter installation accuracy

- any Meter summation scheme values and multipliers;
- data register coding details;
- Data communication details (when communication systems are used);
- telephone number for access to data;
- communication equipment type and serial numbers;
- communication protocol details or references;
- data conversion details; and
- Generator identifications and access rights.

9. APPENDIX D: CONSTITUTION OF THE RENEWABLES STANDARDS REVIEW PANEL

1 Definitions and Interpretation

1.1 The following words and expressions shall have the following meanings in this Constitution:

"Chairman" means the person appointed by DEWA under Clause 6 of this Constitution to act as the chairperson of the Panel.

"Constitution" means the constitution and rules of the Panel as set out herein and as may be amended from time to time with the approval of the Regulatory Authority.

"Renewables Standards" means the standards regulating the Generators connected to the Transmission and Distribution System.

"Member" means a person appointed to act as a Representative of the persons or groups referred to in Clause 3 on the Panel.

"Panel" means the Renewables Standards Review Panel established by DEWA in accordance with the Renewables Standards (section 1.4) and governed by this Constitution.

"Secretary" means the person appointed by DEWA pursuant to Clause 7 and named as such.

"DEWA" means the Dubai Electricity and Water Authority.

1.2 Except as otherwise provided herein and unless the context otherwise admits, words and expressions used herein shall have the meanings given to them in the Renewables Standards.

1.3 Words importing the singular only also include the plural and vice versa where the context requires. Words importing the masculine only also include the feminine.

1.4 Headings and titles shall not be taken into consideration in the interpretation or construction of the words and expressions used herein.

1.5 Unless otherwise stated, any reference to a Clause is a reference to a Clause of this Constitution.

2 Principal objects

2.1 The Panel has been established by DEWA to further the objectives set out below and such other objectives as the Regulatory Authority may stipulate from time to time:

a. to generally review, discuss and develop the Renewables Standards and their implementation;
b. to review and discuss suggestions for amendments to the Renewables Standards which DEWA, the Regulatory Authority or any Generator may wish to submit to DEWA for consideration from time to time;

c. to discuss what changes are necessary to the Renewables Standards arising out of any unforeseen circumstances referred to it by DEWA;
d. to publish recommendations and ensure that Generator consultation upon such recommendations has occurred through Members; and
e. issue guidance in relation to the Renewables Standards and their implementation, performance and interpretation when asked to by a Generator.

3 Membership and Appointment

3.1 The Panel shall comprise:
a. the Chairman and up to 2 persons appointed by DEWA; and
b. a person appointed by the Regulatory Authority; and
c. up to 2 persons representing Generators, with no more than 1 person from an individual Generator.

3.2 Each person appointed as specified at Clause 3.1 shall be a Member of the Panel. If at any time any of the persons or groups identified at Clauses 3.1 are unable to agree on a Representative to act as their Member, the Chairman shall contact (insofar as he is reasonably able) the person(s) or group(s) unable to agree and seek to encourage appointment or, as appropriate, unanimous agreement between relevant persons as to their prospective Member. If no such agreement is reached at least 21 Business Days prior to the next meeting of the Panel (or the first meeting of the Panel, as the case may be) the Chairman shall request the Regulatory Authority to make such appointment and the Regulatory Authority shall have the right, until the relevant person or group of persons has decided upon an appointment and notified the Regulatory Authority and the Chairman accordingly, to appoint a Member or Members on behalf of that person or group of persons, and to remove (if appropriate) any person so appointed by it.

3.3 No person other than an individual shall be appointed a Member or his alternate.

3.4 After the Panel has been established for one year, each Member shall retire automatically at the beginning of the meeting of the Panel held on the first Business Day in the month of April each year (or if no meeting is held on such day, at the meeting which is held on the date falling closest after that day) but shall be eligible for re-appointment.

3.5 Each person or group of persons entitled to appoint a Member (or a person within such group of persons) may, by notice in writing to the Chairman, indicate its wish to re-appoint the retiring Member or to appoint a new person as a Member in his place.

3.6 Such notifications for re-appointment or appointment must be delivered to the Chairman at least 21 Business Days in advance of the relevant meeting of the Panel by the relevant person(s) or group(s) entitled to appoint a Member. A notification for re-appointment in respect of an existing Member shall be deemed to be given if no notification is delivered to the Chairman at least 21 Business Days in advance of the relevant meeting of the Panel.

3.7 If only one notification is received for the re-appointment of a Member or appointment of a new person as a Member (or if all notifications received are unanimous), the person named in the notifications(s) will become the Member with effect from the beginning of the relevant meeting of the Panel. If the notifications are not unanimous, the provisions of Clause 3.2 shall govern the appointment of the Member.

3.8 These provisions shall apply equally to persons or groups of persons entitled to appoint more than one Member, with any necessary changes to reflect that more than one Member is involved.

4 Alternates

4.1 Each Member (and the Chairman) shall have the power to appoint any individual to act as his alternate and remove (at his discretion) any alternate Member or Chairman (as the case may be) so appointed. Any appointment or removal of an alternate Member or Chairman shall be effected by notice in writing executed by the appointor and delivered to the Secretary or tendered at a meeting of the Panel.

4.2 If his appointor so requests, an alternate Member or Chairman (as the case may be) shall be entitled to receive notice of all meetings of the Panel or of sub-committees or working groups of which his appointor is a member. He shall also be entitled to attend and vote as a Member or Chairman (as the case may be) at any such meeting at which the Member or Chairman (as the case may be) appointing him is not personally present and at any such meeting to exercise and discharge all the functions, powers and duties of his appointor as a Member or Chairman (as the case may be) and for the purpose of the proceedings at the meeting the provisions of this Constitution shall apply as if he were a Member or Chairman (as the case may be).

4.3 Every person acting as an alternate Member or Chairman (as the case may be) shall have one vote for each Member or Chairman (as the case may be) for whom he acts as alternate, in addition to his own vote if he is also a Member or Chairman (as the case may be). Execution by an alternate Member or Chairman (as the case may be) of any resolution in writing of the Panel shall, unless the notice of his appointment provides to the contrary, be as effective as execution by his appointor.

4.4 An alternate Member or Chairman (as the case may be) shall cease to be an alternate Member or Chairman (as the case may be) if his appointor ceases for any reason to be a Member or Chairman (as the case may be).

4.5 References in this Constitution to a Member or Chairman (as the case may be) shall, unless the context otherwise requires, include his duly appointed alternate.

5 Representation and voting

5.1 The Chairman and each other Member shall be entitled to attend and be heard at every meeting of the Panel. One adviser (or such greater number as the Chairman shall permit) shall be entitled to attend any meeting of the Panel with each Member and shall be entitled to speak at any meeting but shall not be entitled to vote on any issue.

5.2 Each Member (including the Chairman) shall be entitled to cast one vote. In the event of an equality of votes, the Chairman shall have a second or casting vote.

6 The Chairman

6.1 Upon retirement or removal by DEWA of the first and each successive Chairman, DEWA shall appoint a person to act as Chairman.

6.2 DEWA may at any time remove the Chairman from office.

6.3 The Chairman shall preside at every meeting of the Panel at which he is present. If the Chairman is unable to be present at a meeting, he may appoint an alternate pursuant to Clause 4.1 to act as Chairman. If neither the Chairman nor any other person appointed to act as Chairman is present within half an hour after the time appointed for holding the meeting, the Members present appointed by DEWA, may appoint one of their number to be Chairman of the meeting.

6.4 The Chairman, or the person appointed to act as Chairman by the Chairman shall be entitled to cast one vote. Where a Member is acting in the capacity of both Member and Chairman, he shall be entitled to cast one vote as Chairman, in addition to his one vote as Member.

7 The Secretary

7.1 DEWA shall have power to appoint and dismiss a Secretary and such other staff for the Panel as it may deem necessary. The Secretary may, but need not be, a Member, but shall not be a Member by virtue only of being Secretary. The Secretary shall have the right to speak at, but, unless a Member, no right to cast a vote at any meeting.

7.2 The Secretary's duties shall be to attend to the day to day operation of the Panel and, in particular, to:

i. attend to the requisition of meetings and to serve all requisite notices;

ii. maintain a register of names and addresses of Members and the Chairman and such alternates as may be appointed from time to time;

iii. maintain a register of names and addresses of persons in each of the groups of persons described in sub-clauses 3.1(a) to (c); and

iv. keep minutes of all meetings.

7.3 The Secretary shall make available the registers of names and addresses referred to in sub-clauses 7.2(ii) and (iii) above, for inspection by any Generator and/or the Regulatory Authority. The Secretary shall provide any Generator and/or the Regulatory Authority with a copy of the said registers within three Business Days of being requested to do so.

7.4 If the office of a Member is vacated the Secretary shall notify (insofar as he is reasonably able) the group or person whom the Member represented and they shall appoint a new Member as provided in Clause 3.

8 Meetings

8.1 Subject always to the direction of DEWA and the Regulatory Authority, the Panel meetings shall operate as follows:

a. the Panel shall meet on the first Business Day in the months of April and October and as necessary for the transaction of business whenever convened by the Chairman at such places and at such times as may be determined by the Regulatory Authority, and in any event shall meet not less than twice each year.
b. notwithstanding the right of the Chairman to call a meeting of the Panel whenever appropriate, the Chairman shall call a meeting when notified in writing to do so by the majority of Members;
c. unless agreed by all Members, not less than 14 Business Days prior written notice shall be given to all Members of all meetings of the Panel;
d. the quorum of Members required for the Panel meetings shall not be less than 4 of the Members;
e. if within one hour of the time appointed for a meeting of the Panel a quorum is not present, the meeting shall stand adjourned for at least 2 Business Days. The re-adjourned meeting shall be deemed quorate and its proceedings valid notwithstanding there being fewer than four Members present;
f. subject to sub-paragraphs (d) and (e) above the following circumstances shall not (of themselves) invalidate proceedings of the Panel:
    i. vacancies amongst the Panel;
    ii. any defects in the appointment of Members; or
    iii. the accidental omission to give notice of a Meeting to, or the non-receipt of notice of a meeting by a person entitled to receive notice.

9 Renewables Standards Revisions

9.1 All proposed revisions to the Renewables Standards must be reviewed by the Panel prior to their implementation. All proposed revisions from Generators, the Regulatory Authority or DEWA should be brought before the Panel by the Chairman for consideration. The Chairman will advise the Panel, all Generators, and the Regulatory Authority of all proposed revisions to the Renewables Standards with notice of no less than 20 Business Days in advance of the next scheduled meeting of the Panel.

9.2 Following review of a proposed revision by the Panel, the Chairman will, if appropriate, apply to the Regulatory Authority for revision of the Renewables Standards based on the Panel recommendation. The Chairman, in applying to the Regulatory Authority, shall also notify each Generator of the proposed revision and other views expressed by the Panel and Generators so that each Generator may consider making representations directly to the Regulatory Authority regarding the proposed revision, within two weeks of the application.

9.3 The Regulatory Authority shall consider the proposed revision, other views, and any further representations and shall determine whether the proposed revision should be made and, if so, whether in the form proposed or in an amended form.

9.4 If the Panel is directed by the Regulatory Authority that the revision shall be made, the Chairman shall notify each Generator of the revision at least 10 Business Days prior to the revision taking effect, and the revision shall take effect (and the Renewables Standards shall be deemed to be amended accordingly) from (and including) the date specified in such notification or other such date as directed by the Regulatory Authority.

10 Resolutions

10.1 A resolution of the Panel shall be passed by a simple majority of votes cast.

10.2 A resolution in writing signed by all Members shall be as valid and effective as if it had been passed at a meeting of the Panel duly convened and held. Written resolutions may be produced in one or more counterparts.

10.3 A meeting of the Panel may consist of a conference between Members who are not all in one place but who are able (directly or by telephonic communication) to speak to each of the others and to be heard by each of the others simultaneously. The word "meeting" shall be construed accordingly.

11 Minutes

11.1 The Secretary shall circulate copies of the minutes of each meeting of the Panel to each Member as soon as practicable (and in any event within ten Business Days) after the relevant meeting has been held.

11.2 Each Member shall notify the Secretary of his approval or disapproval of the minutes of each meeting within 15 Business Days of receipt of the minutes. A Member who fails to do so will be deemed to have approved the minutes. The approval or disapproval of the minutes aforesaid will not affect the validity of decisions taken by the Panel at the meeting to which the minutes relate.

11.3 If the Secretary receives any comments on the minutes, the Secretary shall circulate revised minutes as soon as practicable following the expiry of the period referred to in Clause 11.2, incorporating those comments that are of a typographical nature and indicating, where necessary, that Members disagree with certain aspects of the minutes. The Secretary shall then incorporate those aspects of the minutes upon which there is disagreement, into the agenda for the next following meeting of the Panel, as the first item for discussion, and, if possible, resolution.

12 Guidance from the Panel

12.1 The Panel may at any time, and from time to time, issue guidance in relation to the Renewables Standards and their implementation, performance and interpretation, and it may establish subcommittees and working groups to carry out such work.

13 Sub-committees and working groups

13.1 The Panel may establish such sub-committees from time to time consisting of such persons as it considers desirable. Each sub-committee shall be subject to such written terms of reference and shall be subject to such procedures as the Panel may determine. The meetings of sub-committees shall so far as possible be arranged so that the minutes of such meetings can be presented to the members in sufficient time for consideration before the next following meeting of the Panel.

13.2 The Panel may also establish working groups to advise it on any matter from time to time. Such working groups may consist of Members and/or others as the Panel may determine for the purpose.

13.3 Resolutions of sub-committees and working groups shall not have binding effect unless approved by resolution of the Panel.

14 Removal of Members and Chairman and vacation of office

14.1 The office of a Member shall be vacated if:

a. he resigns his office by notice delivered to the Secretary;
b. he becomes bankrupt or compounds with his creditors generally;
c. he becomes of unsound mind or a patient for any purpose of any statute relating to mental health; or
d. he or his alternate fails to attend more than three consecutive meetings of the Panel without submitting an explanation to the Chairman which is reasonably acceptable to the Chairman.

14.2 Further, any person or persons entitled to appoint a Member or the Chairman, as the case may be, pursuant to Clause 3 may at any time remove that Member or the Chairman, as the case may be, from office and appoint another person to be a Member or the Chairman, as the case may be, in its place. A person or persons will only have the right to remove from office the Member or the Chairman, as the case may be, that it or they have appointed, and will have no right to remove from office any Member or the Chairman, as the case may be, appointed by another person. Whenever any individual Member or the Chairman changes, the person or group of persons entitled to appoint that Member or the Chairman shall notify the Secretary in writing within seven days of the change taking effect.

15 Members on the panel's responsibilities and protections

15.1 In the exercise of its powers and the performance of its duties and responsibilities, the Panel shall have due regard for the need to promote the attainment of the principal objects of the Panel set out in Clause 2.

15.2 In the exercise of its powers and the performance of its duties and responsibilities as a Member, a Member shall represent the interests of that person or persons by whom he is for the time being appointed pursuant to Clause 3, provided that such obligation of representation shall at all times be subordinate to the obligations of the Member as a member of the Panel set out in Clause 15.1.

15.3 The Panel, each Member and the Secretary:

i. shall be entitled to rely upon any communication or document reasonably believed by it or him to be genuine and correct and to have been communicated or signed by the person by whom it purports to be communicated or signed.
ii. may in relation to any act, matter or thing contemplated by this Constitution act on the opinion or advice of, or any information from, any chartered engineer, lawyer, or expert in any other field, and shall not be liable for the consequences of so acting.

15.4 The Panel shall enjoy no status, immunity or privilege of the Emirate of Dubai. However, Members shall not be personally liable in respect of the performance of the functions of the Renewables Standards Review Panel.

16 Group Representatives' addresses

16.1 Each Member shall from time to time communicate his address to the Secretary and all notices sent to such address shall be considered as having been duly given to such Member.

17 Confidentiality

17.1 Each Member shall keep confidential all information which that Member might reasonably be expected to understand to be confidential.