Connection Conditions Code

Issued April 2010

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Connection Conditions Code

CC.1 Introduction

The Connection Conditions Code specifies the minimum technical, design and operational criteria that must be complied with by Users Connected or seeking to be Connected to the Transmission System, and the minimum technical, design and operational criteria, which must be complied with by OETC. These criteria are required for the protection of the Transmission System and Users' Plant Directly Connected to the Transmission System, and to enable OETC to comply with its Licence.

If a User considers that it is unable to meet any of the conditions, they should seek derogation from the Regulatory Authority.

Each User will have a ECA/ECUOSA with OETC that is specific to that User's Connection to the Transmission System. Where there is any possible conflict, these Connection Conditions take precedence.

CC.2 Objective

The objective of the Connection Conditions Code is to ensure that by specifying minimum technical, design and operational criteria the basic rules for Connection to the Transmission System and to a User's System are similar for all Users of an equivalent category and will enable OETC to comply with the Sector Law and its Licence obligations in a non-discriminatory way.

CC.3 Scope

The Connection Conditions Code applies to OETC and to Users, including;

- Power Producers Directly Connected to the Transmission System;
- Potential Power Producers seeking to be Directly Connected to the Transmission System;
- Power Producers with large Embedded CDGensets;
- Licensed Distributors;
- Licensed Suppliers;
- Directly Connected Consumers;
- PWP (in its role in procuring New Capacity);
- Internally Interconnected Parties;
- International Interconnected Parties; and
- RAEC if Connected to the Total System.

CC.4 Procedure

The ECA/ECUOSAs contain provisions relating to the procedure for Connection to the Transmission System or, in the case of Embedded CDGensets, include provisions relating to certain conditions to be complied with by Users prior to OETC notifying the User that it has the right to become operational.

CC.5 Connection

The provisions relating to Connecting to the Transmission System are contained in each ECA/ECUOSA with a User and include provisions relating to the submission of information and reports relating to compliance with the relevant Connection Conditions for that User, Safety Rules, commissioning programmes, Operation Diagrams and approval to Connect.

Prior to the Completion Date under the ECA/ECUOSA, the following information is to be submitted by the User;

(a) updated Planning Code data with any estimated values assumed for planning purposes confirmed or, where practical, replaced by validated actual values and by updated estimates for the future and by updated forecasts for items such as Demand;

(b) details of the Protection arrangements and settings;

(c) copies of all Safety Rules and Local Safety Instructions applicable at Users' sites which shall be used at the OETC/User interface;

(d) information to enable OETC to prepare Site Responsibility Schedules on the basis of the provisions set out in Appendix A;

(e) an Operation Diagram for all HV Plant on the User side of the Connection Point;

(f) the proposed name of the User site (which shall not be the same as, or confusingly similar to, the name of any OETC site or of any other User site);

(g) a list of Safety Coordinators;

(h) a list of the telephone numbers for joint System Incidents at which senior management representatives nominated for the purpose can be contacted and confirmation that they are fully authorised to make binding decisions on behalf of the User;

(i) a list of managers who have been duly authorised to sign Site Responsibility Schedules on behalf of the User;

(j) information to enable OETC to prepare Site Common Drawings; and

(k) Metering System Registration Data.

CC.6 Technical, design and operational criteria

CC.6.1 Transmission System performance characteristics

OETC shall ensure that the Transmission System complies with the following technical, design and operational criteria in relation to the part of the Transmission System at the Connection Site with a User.

CC.6.1.1 Frequency deviations

During normal operating conditions, the nominal System Frequency of the Transmission System shall be 50.00 Hz and will be controlled normally between 49.95Hz and 50.05Hz. During exceptional steady state conditions, Frequency deviations will not exceed 49.90Hz to 50.1Hz unless Disturbed circumstances prevail.

Under Disturbed conditions, System Frequency could rise transiently to 51.50 Hz or fall to 48.00 Hz.

CC.6.1.2 Voltage variations

(a) The voltage on the 220kV and 132kV parts of the Transmission System at each Connection Site with a User will remain within the limits of a minimum voltage of -10.0% and a maximum voltage of +10.0%.

(b) The voltage on the 66kV, 33kV and 11kV sides of Transmission transformers at Connection Sites with Users will normally remain within the limits +/-6.0% of the nominal value unless abnormal conditions prevail.

During some System Disturbances such as where short circuits occur, the voltage may collapse transiently to zero at the point of fault until the fault is cleared.

CC.6.1.3 Voltage waveform quality

All Plant Connected to the Transmission System, and that part of the Transmission System at each Connection Site, should be capable of withstanding the following distortions of the voltage waveform in respect of harmonic content and phase unbalance.

CC.6.1.3.1 Harmonic distortion

The maximum total levels of harmonic distortion on the Transmission System at 220kV and 132kV, from all sources under both normal, Planned Outage and Forced Outage conditions, (unless abnormal conditions prevail) shall not exceed a total harmonic distortion of 2.0% with no individual harmonic greater than 1.5.0%.

CC.6.1.3.2 Phase unbalance

Under Planned Outage conditions, the maximum negative phase sequence component of the phase voltage on the Transmission System should remain below 1.0% unless abnormal conditions prevail.

Under Planned Outage conditions infrequent short duration peaks with a maximum value of 2.0% are permitted for phase unbalance, subject to the prior agreement of OETC under the ECA/ECUOSA.

CC.6.1.4 Voltage fluctuations

Voltage fluctuations arising from a fluctuating Load Directly Connected to the Transmission System at the Connection Point to the Transmission System shall not exceed 1.0% 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 3.0% provided that this does not constitute a risk to the Transmission System or to the System of any User.

CC.6.1.5 Flicker Severity:

The level of voltage fluctuations at a Connection Point shall be within the limits defined in IEC 61000-3-7, with a Flicker Severity (Short Term) of 0.8 Unit and Flicker Severity (Long Term) of 0.6 Unit.

CC.6.2 Plant relating to User/OETC Connection Site

The following requirements apply to Plant at User/OETC Connection Points. Each User must ensure that its Plant comply with these conditions.

CC.6.2.1 General requirements

The design of Connections between any CDGenset and the System of a Licensed Transmission System Operator or Licensed Distribution System Operator shall be consistent with the Licence requirements of the Licensed Transmission System Operator or Licensed Distribution System Operator. Under fault conditions the rated Frequency component of voltage could fall transiently to zero on one or more phases or rise to 140.0% phase-to-earth voltage. The voltage rise would last only for the time that the fault conditions exist. The fault conditions referred to here are those existing when the type of fault is single or two phase-to-earth.

All User Plant associated with the Connection to the Transmission System shall comply with the following standards, as applicable. (in the following order of precedence);

(a) Safety Rules;

(b) Omani Electrical Standards, which are such national standards as may be approved by and amended by the Grid Code Review Panel from time to time or which are imposed under the Sector Law;

(c) the standards and recommendations of the International Standards Organisation and the International Electrotechnical Commission; and

(d) national standards and codes which are accepted internationally.

In the event that any standard or specification with which a User's Plant is required to comply under CC.6 is amended, OETC, after having consulted with the affected Users will bring the issue to the Grid Code Review panel for consideration. Following the review, the Grid Code Review Panel shall make a recommendation to the Regulatory Authority as to what action should be taken, if any, regarding compliance.

Where OETC determines that in order to ensure safe and co-ordinated Operation of a User's Plant with the Transmission System, there is a requirement for supplemental specifications and/or standards to apply to the design of a User's Plant, OETC shall notify the User and the User shall comply with the additional requirements. On request from the User, OETC shall provide reasonable evidence as necessary to demonstrate the need for the supplemental specifications and/or standards. If a User is still not satisfied, the User may refer the issue to the Grid Code Review Panel for review

Power Producers shall provide on-load tap-changing (OLTC) facilities for all Genset transformers if requested by OETC. Demand Users shall provide OLTC facilities for all transformers Connected to the Transmission System if requested by OETC. All Users shall liaise with OETC on the design specification for the performance of the tap-changing facility.

All Users shall ensure that the Power Factor of Demand at the Connection Point never falls outside the limits of 0.95 lagging and 0.95 leading. If the Power Factor falls outside these limits then the Users shall take all necessary steps to add reactive compensation capability to rectify the situation.

It is recommended that Users take precautions against Disturbances on the Transmission System including Protection against;

(a) load unbalance (negative sequence) protection

(b) over/under voltage

(c) over/under Frequency

(d) any combination of (b) and (c) that may result in overfluxing

(e) automatic reclosing (either single or three phase)

Users may consult OETC with respect to Protection adequacy.

CC.6.2.2 Power Producer/OETC Connection Points

CC.6.2.2.1 Short circuit levels

Each Connection between a CDGenset and the Transmission System must be controlled by a circuit breaker capable of interrupting the maximum short circuit current at the Connection Point as determined by OETC.

CC.6.2.2.2 Genset and Production Facility Protection arrangements

Protection of CDGenset and their Connections to the Transmission System must meet the minimum requirements given below. These are necessary to reduce to a practical minimum the impact on the Transmission System of faults on circuits owned by Power Producers.

CC.6.2.2.3 Fault clearance times

The fault clearance times for faults cleared by Main Protection on the Power Producers' equipment Directly Connected to the Transmission System and for faults on the Transmission System Directly Connected to the Power Producers' equipment, from fault inception to the circuit breaker arc extinction, shall not be longer than 120 ms for Plant Connected to the 132kV or 220 kV Systems

Slower fault clearance times may be specified for faults on the Transmission System, subject to written agreement by OETC. Slower fault clearance times for faults Production Facilities may be agreed in accordance with the terms of the ECA/ECUOSA but only if System requirements, in OETC's view, permit. The probability that the fault clearance times derived in accordance with the ECA/ECUOSA shall be exceeded by any given fault must be less than 2.0%.

The Power Producers shall provide Back-Up Protection to cover the possible failure of the Main Protection systems. OETC shall also provide Back-Up Protection and these Back-Up Protections shall be coordinated so as to provide discrimination and protect equipment from damage.

CC.6.2.2.4 Protection requirements

(a) Protection of interconnecting Connections

The requirements for the provision of Protection equipment for interconnecting Connections (i.e. the primary conductors from the current transformer accommodation on the circuit side of the circuit breaker to the Connection Point) shall be specified in the ECA/ECUOSA.

(b) Circuit-breaker fail Protection

When a CDGenset is Connected to the Transmission System at 220kV or 132kV and a circuit breaker is provided by the Power Producer or OETC, circuit breaker fail Protection shall be provided by the Power Producer or OETC on this circuit breaker. In the event, following operation of a Protection system, of a failure to interrupt fault current by these circuit-breakers within the fault current interruption time, the circuit breaker fail Protection is required to initiate tripping of all the necessary electrically adjacent circuit-breakers so as to interrupt the fault current within the next 200 ms.

(c) Loss of Excitation

The Power Producers must provide Protection to detect loss of excitation on a CDGenset and initiate a CDGenset trip.

(d) Pole-Slipping Protection

Where System requirements dictate, OETC shall specify in the ECA/ECUOSA a requirement for Power Producers to fit pole-slipping Protection to their CDGensets.

(e) Work on Protection Equipment

No busbar Protection, circuit-breaker fail Protection relays, AC or DC wiring (other than power supplies or DC tripping associated with the CDGenset itself) may be worked upon or altered by Power Producer personnel in the absence of a representative of OETC.

(f) Relay Settings

Protection and relay settings shall be coordinated across the Connection Point in accordance with the ECA/ECUOSA to ensure effective disconnection of faulty Plant.

CC.6.2.3 Licensed Distributors and Directly Connected Consumers/OETC Connection Points

CC.6.2.3.1 Protection arrangements

Protection of Distribution Systems of Licensed Distributors and Directly Connected Consumers must meet the minimum requirements referred to below.

CC.6.2.3.2 Fault clearance times

The fault clearance times for faults on the System of a Licensed Distribution System Operator and Directly Connected Consumers' equipment Connected to the Transmission System, and for faults on the Transmission System Directly Connected to the Licensed Distributors' or Directly Connected Consumers equipment, from fault inception to the circuit breaker arc extinction, shall be set out in each ECA/ECUOSA.

The times specified in accordance with the ECA/ECUOSA shall not be longer than 120ms for Plant Connected to the 132kV or 220 kV Systems.

Slower fault clearance times may be specified in accordance with the ECA/ECUOSA for faults on the Transmission System. Slower fault clearance times for faults on the Licensed Distributors' and Directly Connected Consumers' Plant may be agreed in accordance with the terms of the ECA/ECUOSA but only if System requirements permit. The probability that the fault clearance times stated in accordance with the ECA/ECUOSA shall be exceeded by any given fault must be less than 2.0%.

The Licensed Distributors or Directly Connected Consumers shall provide Back-Up Protection to cover the possible failure of the Main Protection systems. OETC shall also provide Back-Up Protection, which shall result in a fault clearance time slower than that specified for the Licensed Distributors' or Directly Connected Consumers' Back-Up Protection so as to provide discrimination. The Back-Up Protection to be provided by the Licensed Distributors or Directly Connected Consumers shall have fault clearance times not slower than 300ms for faults on the Licensed Distributors' or Directly Connected Consumers' Plant Connected with the Transmission System at 220kV or 132kV,

CC.6.2.3.3 Fault disconnection facilities

Where a OETC circuit breaker is not provided at the User Connection voltage, the User must provide OETC with the means of tripping all the User circuit breakers necessary to isolate faults or System abnormalities on the Transmission System. In these circumstances, the User Protection shall also provide signals to trip the appropriate OETC circuit breakers for faults on the User System. These tripping facilities shall be in accordance with the requirements specified in the ECA/ECUOSA.

CC.6.2.3.4 Automatic switching equipment

Where automatic reclosure of OETC circuit breakers is required following faults on the User System, automatic switching equipment shall be provided in accordance with the requirements specified in the ECA/ECUOSA.

CC.6.2.3.5 Relay settings

Protection and relay settings shall be coordinated across the Connection Point in accordance with the ECA/ECUOSA to ensure effective disconnection of faulty Plant.

CC.6.2.3.6 Work on Protection equipment

Where OETC owns the busbar at the Connection Point, no busbar Protection, AC or DC wiring (other than power supplies or DC tripping associated with the Licensed Distributors' or Directly Connected Consumers' Plant) may be worked upon or altered by the Licensed Distributors' or Directly Connected Consumers' personnel in the absence of a representative of OETC.

CC.6.2.3.7 Neutral earthing

At nominal System voltages of 132kV and above the higher voltage windings of three phase transformers and transformer banks Connected to the Transmission System must be star connected with the star point suitable for Connection to earth.

CC.6.2.3.8 Frequency sensitive relays

As required under the Operating Code, each Licensed Distributor shall make arrangements that shall facilitate automatic under-frequency de-energisation of Demand. Grid Code OC4 specifies the manner in which Demand subject to under-frequency de-energisation shall be split into discrete MW blocks with associated under-frequency relay settings. Technical requirements relating to under-frequency relays are listed in Appendix E.

CC.6.3 CDGenset requirements

This section sets out the technical and design criteria and performance requirements that each Power Producer must ensure are complied with in relation to its CDGensets.

CC.6.3.1 Plant performance requirements

All CDGensets must be capable of contributing to Primary Control by supplying Active Power (MW) at any point between the limits 0.80 Power Factor lagging and 0.95 Power Factor leading at the CDGensets' terminals. The short circuit ratio of CDGensets shall be not less than 0.5. A CDGenset must be capable of continuously supplying its rated Active Power output within the System Frequency range 49.50 to 50.50Hz. Any decrease of Active Power output occurring in the Frequency range 49.50 to 48.00Hz should not be more than pro-rata with Frequency. CDGensets must remain synchronised to the Transmission System at Total System Frequencies within the range 48.00Hz to 51.50Hz.

The Active Power output under steady state conditions of any CDGenset Directly Connected to the Transmission System should not be affected by voltage changes in the normal operating range. The Reactive Power output under steady state conditions should be fully Available within the range of Transmission System voltages within the ranges specified in CC.6.1.2.

It is an essential requirement that the Transmission System must incorporate a Black Start Capability. This shall be achieved by agreeing a Black Start Capability at a number of strategically located Production Facilities. For each Production Facility OETC shall state in the ECA/ECUOSA whether or not a Black Start Capability is required.

CC.6.3.2 Control arrangements

Each CDGenset must be capable of contributing to Primary Response by supplying Active Power according to its Primary Response capabilities as set out in the PPA or PWPA or the ECA/ECUOSA.

The capability for contributing to Secondary Response shall be as set out in the PPA or PWPA or the ECA/ECUOSA. OETC shall determine the required participation.

Each CDGenset must be capable of supporting voltage regulation at the interconnection point by continuous modulation of Reactive Power supplied.

CC.6.3.2.1 Turbine control system

Each Genset must be fitted with a fast acting Turbine Speed Controller. The turbine speed control principle shall be in such a way that the CDGenset Active Power output shall vary with rotational speed according to a proportional droop characteristic.

Superimposed load control loops shall have no negative impact on the steady state and transient performance of the Turbine Speed Control.

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 Controller shall be above 0.25 for speed droop settings above 3.0% for Gas Turbines Gensets and 5.0% for Steam Turbines Gensets.

Under all System operating conditions, the CDGenset speed shall not exceed 106.0%. For Genset oscillations with frequencies below 2 Hz, the Turbine Controller shall have no negative effect on Genset oscillation damping.

The Turbine Speed Controller and any other superimposed control loop (load control, gas turbine temperature limiting control, etc.) shall contribute to the Primary Control as set out in the PPA /PWPA or the Connection Conditions Code.

Where a CDGenset becomes isolated from the rest of the Total System but is still supplying Consumers, the Turbine Speed Controller must also be able to control System Frequency below 52.00Hz unless this causes the CDGenset to operate below its designed minimum operating level when it is possible that it may trip after a time.

All Steam Turbine Gensets must be fitted with a Turbine Speed Controller which is designed and operated to the requirements of IEC 600.

All Gas Turbine Gensets must be fitted with a Turbine Speed Controller capable of a power related speed droop characteristic of between 3.0% and 5.0%.

CC.6.3.2.2 Automatic Voltage Regulator

A continuous Automatic Voltage Regulator (AVR) acting on the excitation system is required to provide constant terminal voltage of the Genset without instability over the entire operating range of the Genset.

Control performance of the voltage control loop shall be such that under isolated operating conditions the damping coefficient shall be above 0.25 for the entire operating range.

The AVR shall have no negative impact on Genset oscillation damping.

The specific requirements for AVR facilities, including power system stabilisers where these are necessary for System reasons, shall be specified in the PPA/PWPA or the ECA/ECUOSA. Operation of such control facilities shall be in accordance with the Scheduling and Dispatch Code.

CC.6.3.2.3 Dispatch inaccuracies

The standard deviation of Load error at steady state Load over a 60-minute period must not exceed 2.5 percent of the Dispatch Instructions.

CC.6.3.3 Negative phase sequence loadings

Each CDGenset shall be required to withstand, without tripping, the negative phase sequence loading incurred by clearance of a close-up phase-to-phase fault, by Back-Up Protection on the Transmission System or Distribution System in which it is Embedded.

CC.6.3.4 Neutral earthing

At nominal System voltages of 132kV and above the higher voltage windings of a transformer of a CDGenset must be star connected with the star point suitable for Connection to earth.

CC.6.3.5 Frequency sensitive relays

The System Frequency could rise to 51.50Hz or fall to 47.5Hz and CDGenset must continue to operate within this Frequency range unless OETC has agreed to any frequency-level relays and/or rate-of-change-of-frequency relays which shall trip such CDGenset within this Frequency range, under the ECA/ECUOSA.

Power Producers shall be responsible for protecting all their CDGensets against damage should Frequency excursions outside the range 51.5Hz to 47.5Hz ever occur. Should such excursions occur, it is up to the Power Producers to decide whether to disconnect his Plant for reasons of safety of Plant and/or Persons.

CC.6.4 Communications equipment

In order to ensure control of the Transmission System, telecommunications between Users and OETC must, if required by OETC, be established in accordance with the requirements set down below.

CC.6.4.1 Control telephony

Control telephony is the method by which a User operator and OETC control engineers speak to one another for the purposes of control of the Total System in both normal and emergency operating conditions (all communications being confirmed either by fax or by other electronic means). Control telephony provides secure point-to-point telephony for routine control calls, priority control calls and emergency control calls.

OETC shall install control telephony at the User location where the User telephony equipment is not capable of providing the required facilities or is otherwise incompatible with the OETC control telephony. Details of and relating to the control telephony required are contained in the ECA/ECUOSA.

CC.6.4.2 Operational Metering

OETC shall provide supervisory control and data acquisition (SCADA) Outstation interface equipment at each Connection Site. The User shall provide such voltage, current, frequency, Active Power and Reactive Power measurement outputs and Plant status indications and alarms to the OETC SCADA Outstation interface equipment as required by OETC in accordance with the terms of the ECA/ECUOSA.

Active Power and Reactive Power measurements, circuit breaker and disconnector status indications from Gensets and Genset transformer tap positions must each be provided to OETC on an individual Genset basis. In addition, measured or derived Active Power output on each fuel, from CDGensets that can continuously fire on more than one fuel simultaneously must be provided.

The general requirements for connection of such signals to the OETC SCADA system are set out in Appendix D.

Metering System requirements shall be provided in accordance with MDEC.

CC.6.4.3 Facsimile machines

Each User and OETC shall provide a facsimile machine or machines;

(a) in the case of Power Producers, at each Production Facility;

(b) in the case of OETC and Licensed Distributors, at the respective Control Centre(s); and

(c) in the case of Directly Connected Consumers at the Control Centre.

Each User shall, prior to Connection to the System of the User Plant notify OETC of its telephone number or numbers, and shall notify OETC of any changes.

Prior to Connection to the System of the User Plant OETC shall notify each User of the telephone number or numbers of its facsimile machine or machines and shall notify any changes.

CC.6.4.4 Busbar voltage

OETC shall provide to each Power Producer with voltage signals at a Connection Point to enable the Power Producers to synchronise the CDGensets to the Transmission System.

CC.6.5 System monitoring

Some monitoring equipment is installed on the Transmission System to enable OETC to monitor the System dynamic performance. Further such equipment will be installed in future. To allow the monitoring of individual CDGenset, OETC requires voltage and current signals from the secondary windings of CDGenset circuit current transformers and voltage transformers. They shall be provided by the User with the installation of the monitoring equipment being dealt with in the PPA/PWPA.

CC.7 Site related conditions

In the absence of agreement between the parties to the contrary, construction, commissioning, control, Operation and maintenance responsibilities follow ownership.

CC.7.1 Responsibilities for Safety

Any User entering and working on its Plant on a OETC site will work to the “MEW Safety Rules (Electrical and Mechanical) Second Edition issued 1989 and amended in 1995”, (and any future revisions of these rules) unless otherwise agreed in writing.

OETC entering and working on its Plant on a User site shall work to the User Safety Rules. Until receipt of such notice, the “MEW Safety Rules (Electrical and Mechanical) Second Edition, issued 1989 and amended in 1995” will apply.

A User may apply to OETC for permission to work according to that Users own Safety Rules when working on its Plant on OETC sites. If OETC is of the opinion that the User Safety Rules provide for a level of safety commensurate with that of the OETC Safety Rules, it shall notify the User, in writing, that the User may use its own Safety Rules.

OETC may apply to a User for permission to work according to OETC Safety Rules when working on its Plant on that User sites. If the User is of the opinion that OETC Safety Rules provide for a level of safety commensurate with that of that User Safety Rules, it shall notify OETC, in writing, that OETC may use its own Safety Rules. Until receipt of such notice, the OETC Safety Rules will apply.

CC.7.2 Connection Site Schedules

A set of Connection Site schedules shall be prepared identifying the equipment and ownerships at the Connection Site, the Connection Points and the responsibilities for safety, control and maintenance.

The responsibilities for safety, control and maintenance shall be included in a Site Responsibility Schedule to inform site staff and OETC of agreed responsibilities for Plant at the operational interface.

Appendix A sets down the requirements for Connection Site Schedules. The attachment to Appendix A provides a format to be used in the preparation of Site Responsibility Schedules.

CC.7.3 Operation and Gas (SF_6] Zone Diagrams

CC.7.3.1 Operation Diagrams

An Operation Diagram shall be prepared for each Connection Site at which a Connection Point exists using, where appropriate, the graphical symbols shown in Appendix B. The Operation Diagram shall include all HV Plant and the Connections to all external circuits and incorporate numbering, nomenclature and labelling, as set out in the Operating Code OC 8. At those Connection Sites where SF_6 gas-insulated metal enclosed switchgear and/or other SF_6 gas-insulated HV Plant is installed, those items must be depicted within an area delineated by a chain dotted line which intersects SF_6 gas-zone boundaries. The nomenclature used shall conform to that used on the relevant Connection Site and circuit. The Operation Diagram (and the list of technical details) is intended to provide an accurate record of the layout and circuit interconnections, ratings and numbering and nomenclature of HV Plant and related Plant.

CC.7.3.2 Gas (SF_6] Zone Diagrams

An SF_6 Gas Zone Diagram shall be prepared for each Connection Site at which a Connection Point exists where SF_6 gas-insulated switchgear and/or other SF_6 gas-insulated HV Plant is utilised. They shall use, where appropriate, the graphical symbols shown in Appendix B. The nomenclature used shall conform to that used in the relevant Connection Site and circuit.

CC.7.3.3 Preparation of Operation and Gas (SF_6] Zone Diagrams for User Sites

In the case of a User site, the User shall prepare and submit to OETC, an Operation Diagram for all HV Plant on the User side of the Connection Point and OETC shall provide the User with an Operation Diagram for all HV Plant on the OETC side of the Connection Point.

The User shall then prepare, produce and distribute, using the information submitted on the User Operation Diagram and the OETC Operation Diagram, a composite Operation Diagram for the complete Connection Site.

CC.7.3.4 Preparation of Operation and Gas (SF_6] Zone Diagrams for OETC Sites

In the case of a OETC site, the User shall prepare and submit to OETC an Operation Diagram for all HV Plant on the User side of the Connection Point. OETC shall then prepare, produce and distribute, using the information submitted on the User Operation Diagram, a composite Operation Diagram for the complete Connection Site.

CC.7.3.4.1 Changes to Operation and Gas (SF_6] Zone Diagrams

When OETC has decided that it wishes to install new HV Plant or it wishes to change the existing numbering or nomenclature of its HV Plant at a OETC site, OETC shall one month prior to the installation or change, send to each such User a revised Operation Diagram of that OETC site, incorporating the new OETC HV Plant to be installed and its numbering and nomenclature or the changes, as the case may be.

When a User has decided that it wishes to install new HV Plant, or it wishes to change the existing numbering or nomenclature of its HV Plant at its User site, the User shall one month prior to the installation or change, send to OETC a revised Operation Diagram of that User site incorporating the new User HV Plant to be installed and its numbering and nomenclature or the changes as the case may be.

CC.7.3.5 Validity

The composite Operation Diagram prepared by OETC or the User shall be the definitive Operation Diagram for all operational and planning activities associated with the Connection Site. If a dispute arises as to the accuracy of the composite Operation Diagram, a meeting shall be held at the Connection Site, as soon as reasonably practicable, between OETC and the User, to endeavour to resolve the matters in dispute.

CC.7.4 Site Common Drawings

Site Common Drawings shall be prepared for each Connection Site and shall include Connection Site layout drawings and electrical layout drawings and they will identify the responsibilities for common services drawings. These items will form part of the ECA/ECUOSA that will also require common Protection/control drawings to be available to all relevant parties,

CC.7.4.1 Preparation of Site Common Drawings for a User Site

In the case of a User site, OETC shall prepare and submit to the User, Site Common Drawings for the OETC side of the Connection Point.

The User shall then prepare, produce and distribute, using the information submitted by OETC, Site Common Drawings for the complete Connection Site.

CC.7.4.2 Preparation of Site Common Drawings for a OETC Site

In the case of a OETC site, the User shall prepare and submit to OETC Site Common Drawings for the User side of the Connection Point.

OETC shall then prepare, produce and distribute, using the information submitted by the User, Site Common Drawings for the complete Connection Site.

CC.7.4.2.1 User changes to Site Common Drawings

When a User becomes aware that it is necessary to change any aspect of the Site Common Drawings at a Connection Site it shall;

(a) if it is a User site prepare, produce and distribute revised Site Common Drawings for the complete Connection Site; and

(b) if it is a OETC site prepare and submit to OETC revised Site Common Drawings for the User side of the Connection Point and OETC shall then prepare, produce and distribute, using the information submitted in by the User, revised Site Common Drawings for the complete Connection Site.

If the User change can be dealt with by it notifying OETC in writing of the change and for each party to amend its copy of the Site Common Drawings then the User shall so notify and each party shall so amend.

CC.7.4.2.2 OETC changes to Site Common Drawings

When OETC becomes aware that it is necessary to change any aspect of the Site Common Drawings at a Connection Site it shall;

(a) if it is a OETC site prepare, produce and distribute revised Site Common Drawings for the complete Connection Site; and

(b) if it is a User site prepare and submit to the User revised Site Common Drawings for the OETC side of the Connection Point and the User shall then prepare, produce and distribute, using the information submitted in by OETC, revised Site Common Drawings for the complete Connection Site.

If the OETC change can be dealt with by it notifying the User in writing of the change and for each party to amend its copy of the Site Common Drawings then OETC shall so notify and each party shall so amend.

CC.7.4.3 Validity

The Site Common Drawings for the complete Connection Site prepared by the User or OETC, as the case may be, shall be the definitive Site Common Drawings for all operational and planning activities associated with the Connection Site. If a dispute arises as to the accuracy of the Site Common Drawings, a meeting shall be held at the site, as soon as reasonably practicable, between OETC and the User, to endeavour to resolve the matters in dispute.

CC.7.5 Access

The provisions relating to access to OETC sites by Users, and to User sites by OETC, are set out in each ECA/ECUOSA with OETC and each User. In addition to those provisions, where a OETC site contains exposed HV conductors, unaccompanied access shall only be granted to individuals holding appropriate authorisation.

CC.7.6 Maintenance standards

It is a requirement that all User Plant on OETC sites is maintained adequately for the purpose for which it is intended and to ensure that it does not pose a threat to the safety of any of OETC Plant or personnel on the OETC site.

OETC shall have the right to inspect the test results and maintenance records relating to such Plant at any time.

It is a requirement that all OETC Plant on User sites is maintained adequately for the purposes for which it is intended and to ensure that it does not pose a threat to the safety of any of the User Plant or personnel on the User site. Users shall have the right to inspect the test results and maintenance records relating to such Plant, at any time.

CC.7.7 Site operational procedures

OETC and Users with an interface with OETC, must make available staff to take necessary Safety Precautions and carry out operational duties as may be required to enable work/testing to be carried out and for the Operation of Plant Connected to the Total System.

Appendix A Principles and basic procedure to be used in the preparation of Connection Site Schedules

A.1 Principles

At all Complexes the following Connection Site Schedules shall be drawn up in accordance with the Site ECA/ECUOSAs or with such variations as may be agreed between OETC and Users.

(a) Connection Site details and equipment, including;
- (i) Connection Site location;
- (ii) Ownership of assets;
- (iii) Connection Points;
- (iv) Site Responsibility Schedule; and
- (v) Operational Diagram.

(b) Site Capacity and tariff Metering;
- (i) Actual Metering Point; and
- (ii) Electrical Delivery Point.

(c) Site services;

(d) Site specific technical conditions; including
- (i) Special technical facilities;
- (ii) Protection requirements;
- (iii) Operational Metering;
- (iv) Control telephony;
- (v) Special equipment requirements;
- (vi) System monitoring inputs; and
- (vii) Other site services.

Each set of Connection Site Schedules for a Connection Site shall be prepared by OETC in consultation with other Users and be agreed at least 2 weeks prior to the Completion Date under the ECA/ECUOSA for that Connection Site (which may form part of a Complex). Each User shall, in accordance with the timing requirements of the ECA/ECUOSA, provide information to OETC to enable it to prepare the Site Responsibility Schedule.

Each set of Connection Site Schedules shall be subdivided to take account of any separate Connection Sites on that Complex.

Each Site Responsibility Schedule, (a) (iv) above, shall detail for each item of Plant;

- i) Plant ownership;
- ii) Safety (applicable Safety Rules and Control Person or other responsible Person (Safety Coordinator), or such other Person who is responsible for safety);
- iii) Operations (applicable operational procedures and control engineer);
- iv) Responsibility for statutory inspections;
- v) Maintenance and fault investigation;
- vi) Responsibility for site security; and
- vii) Access.

The Site Responsibility Schedule shall be prepared in accordance with the attachment to this Appendix unless otherwise agreed in writing with OETC and shall include, for each Connection Site, lines and cables emanating from the Connection Site.

Every page of each Connection Site Schedule shall bear the date of issue and the issue number.

Following preparation of a set of Connection Site Schedules, OETC shall send it to the Users involved for confirmation of its accuracy.

The Connection Site Schedules shall be signed on behalf of OETC by the representative responsible for the area in which the Complex is situated and on behalf of each User involved by the manager nominated in accordance with A.3 of this Appendix, by way of written confirmation of its accuracy. Once signed, OETC shall distribute two copies, not less than two weeks prior to its implementation date, to each User that is a party on the Connection Site Schedule, accompanied by a note indicating the issue number and the date of implementation.

A.2 Alterations to existing Site Responsibility Schedules

When a User identified on a Connection Site Schedule becomes aware that an alteration is necessary, it must inform OETC immediately and in any event 8 weeks prior to any change taking effect.

Where a User has informed OETC of a change, or OETC proposes a change, OETC shall prepare a revised Connection Site Schedule not less than 8 weeks prior to the change taking effect.

The revised Connection Site Schedule shall be signed and accompanied by a note indicating where the alteration(s) has/have been made, the new issue number and the date of implementation.

When a User identified on a Connection Site Schedule, or OETC, as the case may be, becomes aware that an alteration to the Connection Site Schedule is required urgently to reflect an emergency situation for example, the User shall notify OETC, or OETC shall notify the User, as the case may be, immediately and shall discuss;

i) what changes are necessary to the Connection Site Schedules;

ii) whether the Connection Site Schedules are to be modified temporarily or permanently; and

iii) the distribution of the revised Connection Site Schedules.

OETC shall prepare the revised Connection Site Schedules as soon as possible, and in any event within seven days of it being informed of or knowing the necessary required alteration. The Connection Site Schedules shall be confirmed by Users and signed on behalf of OETC and Users as soon as possible after it has been prepared and sent to Users for confirmation.

A.3 Responsible managers

Each User shall, prior to the Completion Date under each ECA/ECUOSA, Supply to OETC a list of managers who have been duly authorised to sign Connection Site Schedules on behalf of the User and OETC shall, prior to the Completion Date under each ECA/ECUOSA, Supply to that User the name of the manager responsible for the area in which the Complex is situated.

Attachment to Appendix A
Proforma for Site Responsibility Schedule
for Connection Point

Connection Site:. …….

Company: …….

Item of Equipment	Equipment Owner	Safety Rules[1]	Safety Co-ordinator[2]	Operational Procedures	Control Responsibility	Party Responsible for Statutory Inspections, Maintenance and Fault Investigations	Security Responsibility	Access[3] [4]	Comment
		.						.	

Signed on behalf of the OETC **Date**

Signed on behalf of each User involved

by way of written confirmation of its accuracy.

[1] PAEW Safety Rules were formerly referred to as the MEW Safety Rules, as changed from time to time in accordance with the Grid Code.

[2] At all interfaces OETC and the User must co-ordinate activities but the OETC authorized Person has overall responsibility.

[3] Access applies to authorised subcontractors of the OETC and the User also.

[4] Access to the OETC compound is with the OETC's approval, exercised by the site security officer.

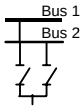
Appendix B Symbols for Operation Diagrams

Circuit Breaker

Circuit Breaker

Isolator

Earth Switch



Double Busbar with Selection

2 Winding Transformer

Earthing Resistance

Surge Arrester

Capacitor

A. C. Generator

Motor

Fuse

Automatic Reclose Switch

Cable

Overhead Line

Current Transformer

Voltage Transformer

Appendix C Plant to be included on Operation Diagrams

C.1 Basic principles

i) Where practicable, all the HV Plant on any Connection Site shall be shown on one Operation Diagram. Provided the clarity of the diagram is not impaired, the layout shall represent as closely as possible the geographical arrangement on the Connection Site.

ii) Where more than one Operation Diagram is unavoidable, duplication of identical information on more than one Operation Diagram must be avoided.

iii) The Operation Diagram must show accurately the current status of the Plant e.g. whether commissioned or decommissioned. Where decommissioned, the associated switchbay shall be labelled "spare bay".

iv) Provision shall be made on the Operation Diagram for signifying approvals, together with provision for details of revisions and dates.

v) Operation Diagrams shall be prepared in A4 format or such other format as may be agreed with OETC.

vi) The Operation Diagram should normally be drawn single line. However, where appropriate, detail that applies to individual phases shall be shown. For example, some HV Plant is numbered individually per phase.

C.2 Plant to be shown on Operation Diagram

1. Busbars;
2. Circuit breakers;
3. Disconnectors (isolators);
4. Switch disconnectors (Switching isolators);
5. Bypass facilities;
6. Earthing switches;
7. Maintenance earths;
8. Overhead line entries;
9. Overhead line traps;
10. Cable and cable sealing ends;
11. Capacitor voltage transformers (CVTs);
12. Power line carrier line matching units (LMUs);
13. Gensets;
14. Generator transformers;
15. Genset unit transformers;
16. Station transformers;
17. Static VAr compensators;
18. Series or shunt capacitors;
19. Series or shunt reactors;
20. System transformers including tertiary windings;

21. Earthing and auxiliary transformers;
22. Voltage transformers (VTs) and current transformers (CTs);
23. Surge arrestors/diverters;
24. Neutral earthing arrangements on HV Plant;
25. Fault throwing devices;
26. Phase shifting transformers (quadrature boosters);
27. Arc suppression coils;
28. Wall bushings;
29. Shorting and discharge switches; and
30. SF_6 gas zones.

Appendix D SCADA Outstation interfacing

D.1 Introduction

This Appendix sets out the technical requirements for connections to the OETC SCADA system Outstation in terms of electrical characteristics.

D.2 General requirements

In all cases signals shall be arranged such that the level of electrical interference does not exceed those defined in IEC 870-2-1: "Telecontrol Equipment and Systems - Operating Conditions Power Supply and Electromagnetic Compatibility" and IEC870-3: "Telecontrol Equipment and Systems - Specification for Interfaces (Electrical Characteristics)".

D.2.1 Digital inputs

Digital inputs cover both single and double points for connection to digital input modules on the OETC Outstation equipment. The initiating switch contacts shall be free of potential, whereas the input circuitry of the Outstation is common to the negative 48 volt potential.

D.2.2 Single points

Single point inputs must be used for alarms and where single contact indications are available. The off (contact open or 0) state is considered to be the normal state and the on (contact closed or 1) state the alarm condition.

D.2.3 Double points

Double points are used to indicate primary plant states by the use of complementary inputs for each plant item. Only the "10" and "01" states are considered valid with the "00" and "11" states considered invalid. The "10" state is considered to be the normal or closed state.

D.2.4 Energy Meter inputs

Energy meter input pulses for connection to pulse counting input modules on the OETC Outstation equipment must operate for a minimum of 100ms to indicate a predetermined flow of MWh or Mvarh. The contact must open again for a minimum of 100ms. The normal state of the input must be open.

D.2.5 Analogue inputs

Analogue inputs for connection to analogue input modules on the OETC Outstation equipment must all be electrically isolated with a two wire connection required. Signals shall be in the form of 4-20mA (or other range to be agreed between the User and OETC) for both unidirectional and bi-directional measured values. Signal converters shall be provided as necessary to produce the correct input signals.

D.2.6 Command outputs

All command outputs for connection to command output modules on the OETC Outstation equipment switch both the 0 volts and -48 volts for a period of 2.5 seconds at a maximum current of 1 amp. All outputs shall electrically isolated with a two wire connection to control interposing relays on the plant to be operated.

Appendix E Technical requirements for under-frequency relays for the automatic de-energisation of Supplies at low Frequency

E.1 E.1 Under-frequency relays

The under-frequency relays to be used shall be in accordance with the requirements of the ECA/ECUOSA. Under-frequency relays shall have a frequency setting range of 46.0 to 52.0Hz and be suitable for operation from a nominal AC input of 63.5, 110 or 240V. The following general parameters on the requirements of approved Frequency Relays for automatic installations is given as an indication to the provisions that may be included in a ECA/ECUOSA;

i) Frequency settings: 46.00 – 52.00Hz in steps of 0.01Hz;

ii) Measurement period: Within a minimum settings selectable settings range of 3 to 7 cycles;

iii) Operating time: Between 100 and 160ms dependent on measurement period setting;

iv) Voltage lock-out: 20 to 90% of nominal voltage;

v) Facility stages: Five stages of Frequency operation; and

vi) Output contacts: Two output contacts per stage.

E.2 Under-frequency relay voltage supplies

The voltage supply to the under-frequency relays shall be derived from the System at the supply point concerned so that the Frequency of the under-frequency relays input voltage is the same as that of the primary System. This requires either;

i) the use of a secure supply obtained from voltage transformers directly associated with the Transmission System interconnection transformer(s) concerned, the supply being obtained where necessary via a suitable automatic voltage selection scheme; or

ii) the use of the substation 240V phase-to-neutral selected auxiliary supply, provided that this supply is always derived at the supply point concerned and is never derived from a standby supply CDGenset or from another part of the Distribution System.

E.3 Scheme requirements

The tripping facility should be engineered in accordance with the following reliability considerations;

i) Dependability: Failure to trip at any one particular Demand shedding point shall not harm the overall operation of the scheme. However, many failures would have the effect of reducing the amount of Demand under low frequency control. An overall reasonable minimum requirement for the dependability of the Demand shedding scheme is 96%, i.e., the average probability of failure of each Demand shedding point should be less than 4%. Thus the Demand under low Frequency control shall not be reduced by more than 4% due to relay failure; and

ii) Outages: Under-frequency Demand shedding schemes shall be engineered such that the amount of Demand under control is as specified by OETC and is not reduced unacceptably during equipment outage or maintenance conditions.