

The South African Grid Code

Preamble

Version 7.0

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1. Introduction

This preamble sets the context for the sections of the *Grid Code*, and an explanation of the terms used in it.

The South African government has approved proposals for a strategy to reform the *electricity supply industry (ESI)* in South Africa to ensure a managed liberalisation of the energy sector. To this end various arrangements are needed to support the implementation of the new industry structure. The arrangements fall largely into three groups: government policy, instruments issued by the *National Energy Regulator of South Africa (NERSA)* in line with that policy and commercial and stakeholder arrangements.

Among the instruments issued by the *NERSA* are licences, codes of conduct, directives, regulations, guidelines and revenue and tariff determinations.

Given government policy to permit open and non-discriminatory access to the *transmission system (TS)* as set out in the Energy White Paper, the *NERSA* has undertaken the responsibility to develop the *Grid Code* with the co-operation of *stakeholders* by way of a consultative process. The *Grid Code* will be introduced before the implementation of the wholesale market, and will serve to achieve the objectives as defined in section 3.

As part of its rule-making approach, the *NERSA's* responsibility is to ensure that stakeholders and future market participants have an opportunity to provide input to the development and ongoing updating of the *Grid Code*. This is ensured through the creation of a *Grid Code Advisory Committee (GCAC)*, which is a body constituted of *stakeholders* whose function is to review proposed changes to the *Grid Code* and make recommendations to the *NERSA* regarding the *Grid Code*.

The *National Transmission Company (NTC)* is licensed as the national provider of *transmission* services. Independent *transmission network service providers (TNSP's)* are licensed, in accordance with current policy, only for specific requirements such as facilitating cross-border trade.

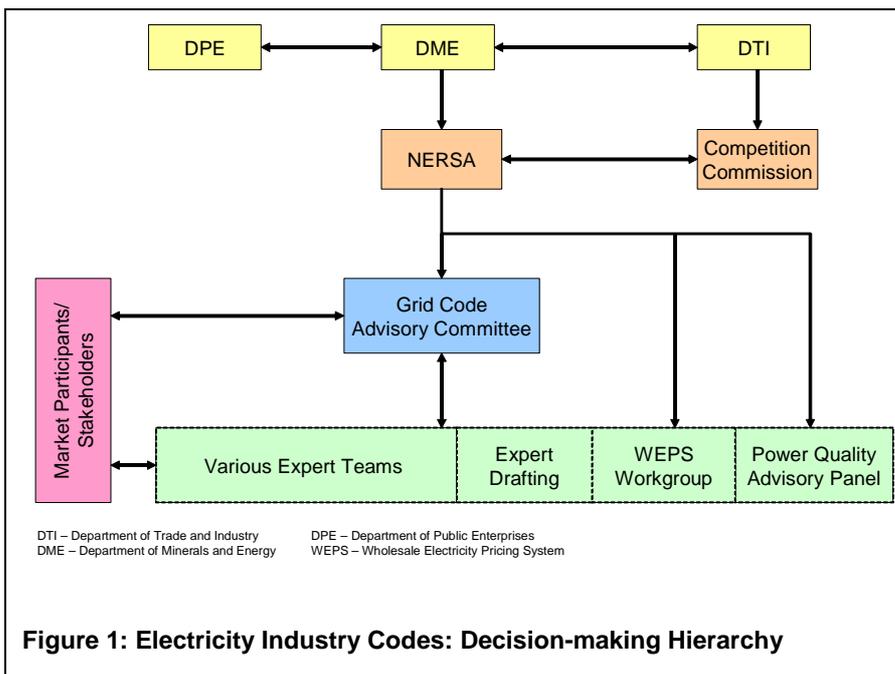
The *Grid Code* applies to the South African *ESI*, and will be aligned to the following government policy statements for the *transmission* sector and the industry:

- Government will establish a separate, national, state-owned transmission company (the *NTC*), independent of generation and retail businesses with ring-fenced system operations and network service provision.
- The *NTC* will be established before any new investment is made in current or new generation capacity. Initially the *NTC* will be a subsidiary of Eskom Holdings, separate from the generation and retail businesses of Eskom Holdings.
- In the long term a "multi-market model" will be developed to ensure transactions between generators, traders and power purchasers take place on a variety of platforms.

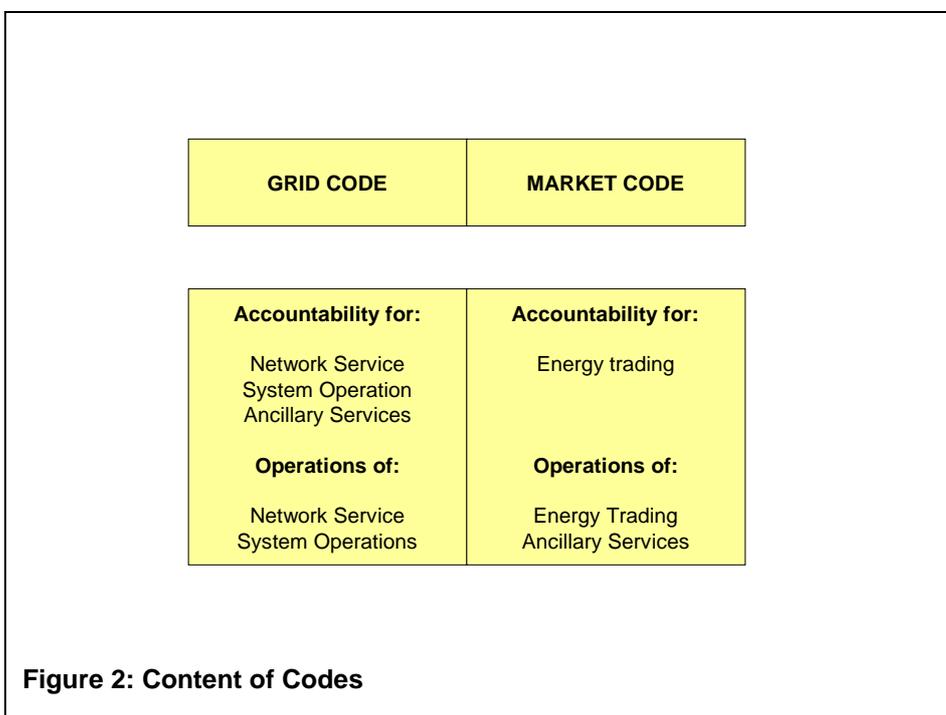
The elements of the industry structure for which the *Grid Code* therefore makes provision are the following:

- A South African *NTC*, consisting of the *System Operator* and the national *TNSP*
- One or more independent *TNSP's* as licensed by the *NERSA*
- A generation sector consisting of Eskom-owned *generators* and independent *generators*
- A distribution sector within which 6 regional *distributors* are formed from Eskom Distribution and municipal distributors
- Introduction of a wholesale electricity market
- Market and *ancillary service* codes operating in parallel with the *Grid Code*
- Directly connected *end-use customers*, either contestable and participating in the wholesale market, or being supplied via a *retailer*
- International trading via the interconnectors with other countries, and in line with the *SAPP* rules

The various entities in the industry involved in the *Grid Code* are sketched in figure 1.



The *Grid Code* is enforced through the licensing requirements of the transmission *service providers* and registration of other *participants*. The *Grid Code* and the *Market Code* are the two main documents in terms of which the electricity market will be governed. The areas covered in each code are illustrated in figure 2.



2. Interpretation

Any dispute relating to the interpretation of this *Grid Code* or any of its sections shall be referred to the *NERSA* for deliberation.

3. Grid Code objectives

The *Grid Code* is intended to establish the reciprocal obligations of industry participants around the use of the *TS* and operation of the *interconnected power system (IPS)*.

The *Grid Code* shall ensure the following:

- That accountabilities of all *parties* are defined for the provision of *open access* to the *TS*
- That minimum technical requirements are defined for *customers connecting to the TS*
- That minimum technical requirements are defined for *service providers*
- That the *System Operator's* obligations are defined to ensure the integrity of the *IPS*
- That obligations of *participants* are defined for the safe and efficient operation of the *TS*
- That the relevant information is made available to and by the industry *participants*
- That the major technical cost drivers and pricing principles of the *service providers* are transparent

The responsibility of the *service providers* under this *Grid Code* shall be:

- to show no interest in whose product is being transported
- to ensure that investments are made within the requirements of the *Grid Code*
- to provide *open access*, on agreed standard terms, to all parties wishing to connect to or use the *TS*.

The *Grid Code* defines what is understood by non-discrimination through the definition of consistent and transparent principles, criteria and procedures.

4. Grid Code overview

The *Grid Code* has the following sections:

- A Governance Code, detailing all aspects of *Grid Code* governance
- A Network Code, focusing on the *TNSP* and *customer* technical (QOS, reliability and system capacity) network requirements. It is broken down into sections defining connection conditions (for *generators*, *distributors* and *end-use customers*), defining technical design requirements applicable to the *service providers* and finally defining the *TS* development process and methodology
- A System Operation Code, defining the rights and obligations of the *participants* regarding operation of the *IPS*
- A Metering Code, specifying the requirements for tariff metering at the *TS* interface level
- A Transmission Tariff Code, specifying the objectives and structure of the *transmission* tariff and the methodologies employed
- An Information Exchange Code, specifying the information requirements and obligations of all the *parties*

The *Grid Code* is intended to provide the following assurances:

- To the *NERSA*, that the *service providers* operate according to the relevant parts of their licences.
- To *customers*, that *service providers* operate transparently and provide *open access* to their defined services.
- To *service providers*, that *customers* will honour their mutual *Grid Code* obligations and that there is industry agreement on these.

5. Glossary

Italicised words and expressions in the *Grid Code* shall bear the following meanings:

Alternator

The rotating electrical machine operated, by a *generator*, which can be connected to the *TS* for the purpose of generating or consuming electrical power or for rendering an *ancillary service* to the *TS*. Refer to figure 3

Ancillary services

Services supplied to the *NTC* by *generators*, *distributors* or *end-use customers*, necessary for the reliable and secure transport of power from *generators* to *distributors* and other *customers*, as defined in the system Operation Code, section 4.

Area control error (ACE)

The mismatch between instantaneous demand and supply in a control area. It combines the *frequency error* and the *tie-line error*.

Automatic generation control (AGC)

The automatic centralised closed loop control of *units* by means of the computerised *EMS* of the *System Operator*. *Unit* output is controlled by changing the set-point on the governor.

Auxiliary supply

Supply of electricity to auxiliary systems of a *unit* or *substation* equipment.

Black start

The provision of generating capacity that, following a total system collapse (black out), is able to
(a) start without an outside electrical supply and
(b) energise a defined portion of the *TS* so that it can act as a start-up supply for other capacity to be synchronised as part of a process of re-energising the *TS*.

Budget quotes

The provision of financial terms and physical supply conditions with a confidence of 85%, subject to certain conditions negotiated between the *participants*. The *customer* may pay more if the stipulated conditions cannot be met, or pay less if the actual costs are less than those quoted.

Busbar

An electrical conduit at a *substation* where lines, transformers and other equipment are connected.

Co-generator

A legal entity who operates a *unit(s)* that is (are) part of a specific industrial or production process.

Cold reserve plant

A *unit* available for operation, but not synchronised with the *IPS*, that can be connected to the *IPS* within 12 to 24 hours.

Connection (connected) to the TS

Physical connection of *customer* equipment to the *TS* either directly or through a transformer provided by the *TNSP*. The *PCC* needs to be on the *TS*, that is a voltage above 132 kV.

Constrained schedule

A generation schedule, prepared by the market operator and suitable for implementation by the *System Operator*, that includes the effects of *TS* constraints.

Contracted standby capacity

The total synchronised plant capacity contracted a day ahead between the parties as specified by the *Market Operator*, available to meet the hourly demand.

Control area

A subset of *SAPP* that adheres to the minimum requirements for a control area as defined in the *SAPP* Operating Guidelines. (South Africa, Namibia, Botswana, Mozambique, Swaziland and Lesotho currently operate as one control area.)

Control centre

A function responsible for the operational control of electricity network assets.

Customer

A legal entity that contracts directly with the *service provider* for the provision of *transmission* services. These include *generators*, *distributors*, *end-use customers* and *retailers*.

Customers' voluntary automatic under-frequency load shedding (CVA-U/F-LS)

Supply interruption as negotiated and agreed between the *System Operator* and *customers* owing to low frequency.

Day

A period of 24 consecutive hours commencing at 00:00 and ending at 24:00.

Demand side managed load

Load that may be reduced (or increased) in response to a signal from the *System Operator*. It includes *interruptible load*, ripple controlled residential geysers and dual fuel boilers but excludes under-frequency *customer* load shedding.

Dependability (protection)

The probability of not failing to operate under given conditions for a given time interval [IEC 50 – 448].

Develop(ment) (of the TS)

Capital investment in the *TS* that will either expand existing capacity or improve reliability or Quality of Supply. Development projects fall into categories of expansion, refurbishment or replacement.

Distribution

The conveyance of electricity through a *distribution system*.

Distribution system

An electricity network consisting of assets operated at a nominal voltage of 132 kV or less.

Distributor

A legal entity that owns or operates/distributes electricity through a *distribution system*.

Droop

The MW/Hz characteristic according to which *governing* will take place. This is expressed as the percentage increase in *frequency* that will theoretically cause a *unit* to go from *MCR* to zero.

Electricity Supply Industry (ESI)

The industry consisting of generation, transmission, distribution and retailing of electricity.

Embedded generator

A legal entity who operates a *unit*, other than a *co-generator*, that is not *connected to the TS*.

Emergency

A situation where *generators*, *transmission* or *distribution service providers* have an unplanned loss of facilities, or another situation beyond their control, that impairs or jeopardises their ability to supply their system demand.

Emergency level 1 (EL1) generation

Extra capacity from generating *units* over and above their *maximum continuous ratings* that can be supplied as agreed with the system operator. This level is achieved without significant additional cost.

Emergency level 2 (EL2) generation

Extra capacity from generating *units* over and above their *Emergency Level 1* and hydro plant under abnormal (low reservoir) conditions that can be supplied as agreed with the system operator.

Emergency outage

An outage when plant has to be taken out of service immediately to prevent further damage or loss.

Emergency reserves

Reserves that are infrequently used. The *System Operator* can use this capacity not only for reserves but also for emergency operation and voltage control.

End-use customer

Users of electricity *connected to the TS*.

Energy imbalance

The mismatch between the energy scheduled at a *point of supply* or a *unit point of connection* and the actual energy metered at that *point of supply* or *unit point of connection* over a scheduled period.

Energy imbalance - constrained generation

The difference between the energy scheduled at the *point of connection* of the *generator* under the unconstrained schedule, and the energy scheduled at the *point of connection* under the constrained schedule derived to accommodate *TS* constraints.

Expert team

A team of subject experts as established by the *GCAC*.

Feeder

An overhead line or underground cable connecting a *substation* or *power station* to another *substation* or *power station*.

Firm quote

The provision of final conditions, including financial terms. This quote could take the form of the contract negotiated and signed with the *customer*.

Firm supply

A supply that enjoys a level of reliability where one network component can be on outage without overloading any other network component and still meet the *customers'* contractual quality of supply.

Flicker

A cyclic voltage fluctuation, normally between 0,1 Hz and 10 Hz, that causes optical stress to humans.

Forced outage

An outage that is not a *planned outage*.

Frequency

The number of oscillations per second on the *AC* waveform.

Frequency error

The algebraic difference between the actual *TS frequency* and the target *frequency* scheduled by the *System Operator*.

Generator

A legal entity licensed to engage in the production of electricity through a *unit* or *power station*.

Generator breaker

A circuit breaker that connects or separates the *alternator* from the *generator transformer*. Refer to figure 3.

Generator HV circuit breaker

A circuit breaker that connects or separates a *unit* from the rest of the *TS*, other *units* and *participants*. Refer to figure 3.

Generator Transformer

A transformer of a *unit* that is connected to the *alternator* through which the output power of the *alternator* is transmitted to the *TS*. Refer to figure 3.

Governing

A mode of operation where any change in system *frequency* beyond the allowable *frequency* dead band will have an immediate effect on the *unit* output according to the *governor droop characteristic*.

Grid Code

The “South African Grid Code”, which consists of the following documents:

- Preamble (this document)
- Governance Code
- Network Code
- System Operation Code
- Metering Code
- Tariff Code
- Information Exchange Code

as approved by the *NERSA* and updated from time to time by the *Secretariat*.

Grid Code Advisory Committee (GCAC)

A panel of stakeholder representatives tasked with functions regarding the *Grid Code*, as defined in the Governance Code, constituted in terms of section 5 of the Electricity Regulation Act (Act 4 of 2006).

Grid Code Secretariat

The entity responsible for the administrative functions as defined in the Governance Code.

HV yard

The *TS substation* closest to a *power station* to which *units* are connected.

Hydro alternator / power station / unit

An *alternator / power station / unit* that uses the gravitational flow of liquid water to generate electricity.

Information owner

The *party* to whose system or installation the *information* pertains

Instantaneous reserve

Generation capacity or demand side managed load that is available to respond fully within 10 seconds to a drop in *frequency*. This response must be sustained for at least 10 minutes.

Interconnected power system (IPS)

The *IPS* consists of

- the *TS*
- assets *connected to the TS* and belonging to the *NTC*
- *power stations* connected to the *TS*
- international interconnectors
- the *control area* for which the *System Operator* is responsible.

The IPS definition is not linked to specific assets, but includes those components of the electrical network that have a measurable influence, at transmission level, on each other as they are operating as one power system.

Interruptible load

Consumer load or a combination of consumer loads that can be contractually interrupted without notice or reduced by remote control or on instruction from the *System Operator*. Individual contracts place limitations on usage.

Interruption of supply

An interruption of the flow of power to a *point of supply* not requested by the *customer*.

Largest single contingency limit

The largest single event of the sudden and unplanned disconnection of the largest *unit* from the *IPS* or the largest single credible other contingency. The largest single contingency is the loss of a Koeberg *unit* at full load, i.e. 920 MW (the Cahora Bassa infeed is classified as a multiple incident).

Largest credible multiple contingency limit

The largest credible multiple event of the sudden and unplanned disconnection of a unit from the *IPS* or the largest credible other contingency. The largest credible multiple contingency is the loss of 1 800 MW generation (typically three coal-fired *units*, both Koeberg *units*, or the loss of the Cahora Bassa infeed).

Load curtailment

The load reduction obtained from *customers* who are able and willing to curtail their usage of power. These loads are to be curtailed within one hour of the instruction being issued by the *System Operator*.

Load following

The provision of generation and load response capability, including capacity, energy and manoeuvrability, that is dispatched by the *System Operator* to match power generation and load demand within a scheduling period.

Load reduction

The ability to reduce *customer* demand by *load curtailment* and *load shedding*.

Load shedding

The load reduction obtained from *customers* who are able and willing to interrupt their usage of power for a defined period, magnitude and intervals. These loads are to be interrupted by the *System Operator* as agreed with the *customer*.

Losses

Electrical energy losses associated with generation, transformation or transmission of electricity.

Loss of load probability

A calculated risk of loss of generation capacity or loss of *customer* load.

Major incident

An incident where

- more than 1 *system minute* of load was interrupted
- a zone 3 *MUT* or other major loss of generation occurred
- severe damage to plant has occurred
- an incident occurred that caused the network *frequency* to deviate by more than 0.7Hz from 50Hz up or down, for any duration of time
- the TS fragmented into more than one island.

Mandatory automatic under-frequency load shedding (MA-U/F-LS)

Interruption of supply owing to low *frequency*.

Manual load shedding

The load reduction obtained by manually shedding load at convenient points on the *distribution system* within 10 minutes of the instruction being issued by the *System Operator*.

Market operator

The legal entity licensed or registered by the *NERSA* to administer the electric energy market and the *ancillary services* market. This includes daily *scheduling* and settlement.

Maximum continuous rating (MCR)

The capacity that a *unit* is rated to produce continuously under normal conditions.

Maximum demand (MD)

The maximum hourly integrated energy consumption measured at the point of supply to a customer for a particular year.

Metering installation

An installation that comprises an electronic meter that is remotely interrogated, has an electronic communication link and is connected to the *NTC's* metering database. The installation includes VT and CT as required.

Month

A calendar month comprising a period commencing at 00:00 on the first day of that month and ending at 24:00 on the last day of that month.

Multiple unit trip (MUT)

More than one *unit* trip at a *power station* within one hour due to a common cause.

National Nuclear Regulator (NNR)

The legal entity established in terms of the National Nuclear Regulator Act (Act 47 of 1999).

National Transmission Company (NTC)

The South African legal entity licensed to execute the national *transmission* responsibility. It consists of a *System Operator* and a national *transmission network service provider*.

National Energy Regulator of South Africa (NERSA)

The legal entity established in terms of the National Energy Regulator Act, 2004 (Act 40 of 2004). NERSA replaces the National Electricity Regulator (NER) which was established in terms of the Electricity Act, 1987 (Act No.41 of 1987).

NERC CPS1, CPS2 and DCS criteria

The *control area* and disturbance performance criteria of the North American Electricity Reliability Council (NERC) that are applicable to control areas in *SAPP*.

Net interconnected power flow

The sum of all power flows on interconnections to other *control areas*.

Network service provider

A legal entity that is licensed to provide network services through the ownership and maintenance of an electricity network.

Nuclear Operating Licence

Licence issued by the *National Nuclear Regulator* to operate a nuclear facility in terms of the National Nuclear Regulator Act (Act 47 of 1999).

Open access

The supply of *transmission* services to any *participant* on non-discriminatory terms and conditions.

Opportunity maintenance

The maintenance taken as a result of the network configuration changing in such a way that the plant can be taken out of service without impacting on the required generation or system security.

Participant

A legal entity registered with or licensed by the *NERSA* in terms of the Electricity Act, and as listed in the Governance Code.

(1) *Participants* are defined as the following entities:

- *Generators* with *power stations* where the total installed generating capacity is greater than 50 MVA or any *unit* where the installed generating capacity is greater than 20 MVA, and who *participates in the wholesale electricity market*
- *Generators* with *power stations* connected to the *transmission system (TS)*
- *Generators* providing *ancillary services* for system operation purposes
- *Distributors* connected to the *TS*
- *End-use customers* connected to the *TS*, or their respective *distributor* acting on their behalf
- A *retailer* or other wholesale market participant required to contract for the use of the *TS*

- *Transmission network service providers*
- *The System Operator*
- Other participants in the *ancillary services* market; e.g. persons with *interruptible loads*
- *The Market Operator*

Party

Any current or future *participant*, or the *NERSA*.

Planned interruption

A *planned outage* that will interrupt *customer* supply.

Planned outage

An outage of equipment that is requested, negotiated, scheduled and confirmed a minimum of 14 (28 days for generators) days prior to the maintenance or repairs taking place.

Plant outage

Mutually agreed prearranged outage of *transmission* equipment between the *TNSP* and the affected participants.

Point of common coupling (PCC)

The electrical node, normally a busbar, in a *transmission substation* where different feeds to *customers* are connected together for the first time.

Point of connection

The electrical node on a *transmission system* where a *customer's* assets are physically connected to the *TNSP's* assets.

Point of supply (POS)

An electrical node where energy can be supplied from the TS to *distributors, end-use customers* or *retailers*.

Power station

One or more *units* at the same physical location.

Power quality directive

The *NERSA* power quality directive, for the management of power quality in the *ESI*.

Primary frequency control (governor control)

The automatic adjustment of a *unit* output in response to deviations in the system *frequency*, by means of the local *governor* control system of the turbine. This control is proportional to the system *frequency* deviation.

Primary substation equipment

High voltage equipment installed at *substations*.

Quick start plant

The available generating plant not synchronised to the system but capable of serving demand within 10 minutes of being requested by the System Operator. It consists of reservoir hydroelectric plant and pumped storage plant that is available but not generating and gas turbines.

Quote

A legal document given to a *customer* for the purpose of providing a price for one or more specified *transmission service(s)*.

Regulating reserve

Generation capacity or demand side managed load available to start responding to AGC instructions within 10 seconds and be fully activated in 10 minutes. This reserve category *reserves* capacity as part of the *regulation ancillary service*. The purpose of this is to allow for enough capacity to control the *frequency* and control area tie-lines power within acceptable limits in real time.

Regulation

The provision of generation and load response capability, including capacity, energy and manoeuvrability, that responds to automatic control signals issued by the *System Operator*.

Reliability of supply

The ability of the *IPS* to endure a generation or network contingency without interrupting the supply to the *customers*.

Reserved capacity

A negotiated capacity in *MVA* that is allocated by the *service provider* to the *customer* at a particular *point of supply*.

Retailer

A legal entity licensed to engage in the retail buying and selling of electricity as a commercial activity, whether for the account of the person involved therein, or on behalf of someone else.

Risk-related outage

A *planned outage* where the next credible contingency would result in a loss of load, loss of supply, voltage slide, thermal overload or dynamic stability constraint.

SAPP non-firm sales interruption

The interruption of non-firm supply to other operating members (utilities) of *SAPP* during periods of shortage.

SAPP emergency energy

Additional energy supplied by other operating members (utilities) of *SAPP* for assistance during periods of shortage.

Scheduling

A process to determine which *unit* or equipment will be in operation and at what loading.

Secretariat

See *Grid Code Secretariat*.

Security

The probability of not having an unwanted operation, or the ability of the *IPS* to continue to operate satisfactorily following a contingency.

Service provider

Any *TNSP*, the *NTC* or the *System Operator*.

Shutdown

When a unit is run down as per the rundown program leading to a planned outage, unplanned outage or to place the unit in cold reserve. The unit can be tripped manually when below its minimum load.

Southern Africa Power Pool (SAPP)

The legal entity established under an inter-governmental and inter-utility Memorandum of Understanding among various Southern African countries in order to operate a regionally interconnected power system.

Speed of operation (protection)

The time taken to clear a fault on the *IPS*.

Stakeholders

The entities affected by or having a material interest in the *Grid Code*. This includes *parties* and other industry entities, e.g. the *SAPP*.

Substation

A site at which switching and/or transformation equipment is installed.

Supplemental reserve

Generating capacity or *demand side managed load* that can respond within six hours to restore the other reserves.

System frequency

The *frequency* of the fundamental AC voltage as measured at selected points by the *System Operator*. The scheduled (target) system *frequency* for the SAPP is 50 Hz.

System healthy

A system condition where all commissioned plant is operational in the affected area.

System islanding

The event where a power station(s) supplies an isolated system, independent of the main network, following the separation from the TS.

System minutes

The normalised performance indicator for interruptions, defined as follows:
system minutes interrupted = energy interrupted (MWh) (multiplied by) 60 (divided by) system peak demand (MW) of the previous calendar year.

System operator

The legal entity licensed to be responsible for short-term reliability of the *IPS*, which is in charge of controlling and operating the *TS* and dispatching generation (or balancing the supply and demand) in real time.

Ten-minute reserve

Generating capacity (synchronised or not) or *demand side managed load* that can respond within 10 minutes when called upon. The purpose of this reserve is to restore *instantaneous reserve* and *regulation reserve* to the required levels after an incident. *Emergency reserve* is excluded from *ten-minute reserve*.

Tie-line error

The algebraic difference between actual and scheduled power flow on a tie-line interconnecting adjacent *control areas*.

Transmission

The conveyance of electricity through the *TS*.

Transmission equipment

Any cable, overhead line, transformer, switchgear, etc. installed on the *TS* for *transmission* purposes, together with any ancillary equipment necessary for and used in connection with such equipment, including such buildings or any part thereof as may be required to accommodate such equipment or ancillary equipment.

Transmission network service provider (TNSP)

A legal entity that is licensed to own and maintain a network on the *TS*.

Transmission substation

A *substation* where the primary voltage is above 132 kV.

Transmission system (TS)

The *TS* consists of all lines and *substation* equipment where the nominal voltage is above 132 kV. All other equipment operating at lower voltages are either part of the *distribution system* or classified as *transmission transformation equipment*.

Transmission transformation equipment

Transformers linking the *TS* to the distribution system, units or end-use customers.

Trip

Any protection operation or manual intervention (excluding *shut-down*) of synchronised plant, which causes the *generator breaker* or *HV circuit breaker* to open.

Trip to house load

The protection function that allows a power station to *island* its *units* that were connected to the *TS* and are capable of islanding, following the loss of active power export and import capability due to the *TS* conditions.

Unconstrained schedule

A generation schedule, prepared by the market operator, which ignores the effect of *TS* constraints.

Unit

An *alternator* and all the related equipment, including the *generator transformer*, that can be connected to the *TS*. Refer to figure 3 below for a typical layout of a *unit*.

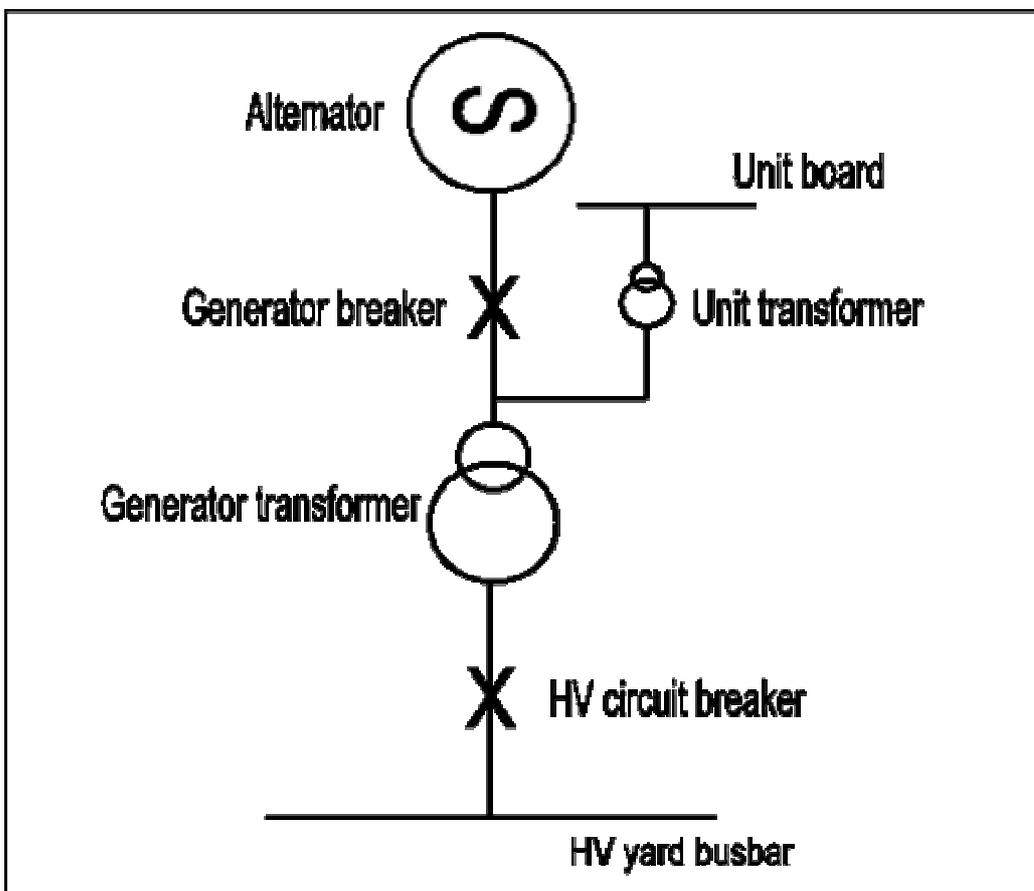


Figure 3: Typical layout of a unit

Unit board

The electrical distribution board of a unit that is normally supplied by the *alternator* of the *unit* and from where the associated auxiliaries of the *unit* are normally supplied. Refer to figure 3.

Unit islanding

The ability of a *unit*, loaded to any load up to *MCR*, to suddenly disconnect from the *TS* by opening the *HV circuit breaker* and to control all necessary critical parameters to a sufficient degree to maintain the *alternator* at speed and excited, supply its own auxiliaries for at least two hours, allowing the *unit* to re-synchronise the *TS*.

Unit transformer

The transformer that connects the *alternator* of a *unit* to the *unit board*. Refer to figure 3

Unplanned outage

An outage that is not requested, negotiated, scheduled and confirmed 14 days before taking place. This type of outage, which must still have been requested and approved, is not a *forced outage*, *emergency outage* or *opportunity maintenance*.

Working day

A weekday, excluding public holidays.

6. Acronyms/abbreviations

Note: Standard SI symbols and abbreviations are used throughout the *Grid Code* without redefinition here.

AAICOG:	Annual average incremental cost of generation
AC:	Alternating current
ACE:	Area control error
ACSR:	Aluminium conductor steel reinforced
AGC:	Automatic generation control
ARC:	Auto reclose
AVR:	Automatic voltage regulator
BECOUE:	Break-even cost of unserved energy
B/U:	Backup
CAPEX:	Capital expenditure
COUE:	Cost of unserved energy
CT:	Current transformer
CVA-U/F-LS:	Customers' voluntary automatic under-frequency load shedding
DC:	Direct current
DCF:	Discounted cash flow
DLC:	Dead line charge
DPI:	Dip proofing inverter
EEAR:	Expected energy at risk
EENS:	Expected energy not served
E/F:	Earth fault
EIA	Environmental Impact Assessment
EMS:	Energy management system
FACTS:	Flexible AC transmission system
F/L:	Fault level
GCAC:	Grid Code Advisory Committee
GCR:	Grid Code requirement
GPS:	Global positioning system
HV:	High voltage (primary side)
HVDC:	High voltage direct current
Hz:	Hertz
IDMT:	Inverse definite minimum time
IEC:	International Electrotechnical Commission
IPS:	Interconnected power system
kV	kilovolt
kVA	kilovolt-ampere
kW	kilowatt
LPU:	Large power user
MA-U/F-LS:	Mandatory automatic under-frequency load shedding
MCR:	Maximum continuous rating
MUT:	Multiple-unit tripping
MV:	Medium voltage
MVA:	Megavolt-ampere
MW:	Megawatt
NCR:	Non-conformance report
NERSA:	National Energy Regulator of South Africa

NERC:	North American Reliability Council
NNR	National Nuclear Regulator
NPV:	Net present value
NTC:	National Transmission Company
OEM:	Original equipment manufacturer
O&M:	Operating and maintenance
O/C:	Overcurrent
PCC:	Point of common coupling
PCLF:	Plant capability loss factor
POS:	Point of supply
P.S.:	Power station
PSB:	Power swing blocking
p.u.:	per unit
PV:	Present value
QOS:	Quality of supply
RED:	Regional electricity distributor
RTU:	Remote terminal unit
SAPP:	Southern African Power Pool
SATEPSA:	South African Telecommunications and Electrical Power Supply Authority
SCADA:	Supervisory control and data acquisition
SSR:	Sub-synchronous resonance
SVC:	Static VAR compensator
THD:	Total harmonic distortion
TMA:	Transmission metering administrator
TNSP:	Transmission network service provider
TOSP:	Time of system peak
TRFR:	Transformer
TRUNC:	Truncated to the integer
TS:	Transmission system
UAGS:	Unplanned automatic grid separations
UCLF:	Unit capability loss factor
Um, Umax:	Maximum rated voltage
Un:	Nominal voltage
VT:	Voltage transformer
WEPS:	Wholesale electricity pricing system

7. Notices and domicilium

Communication with the *Secretariat* in respect of the *Grid Code* shall be sent to the following chosen address until such time as an independent NTC is established:

Managing Director (System Operations and Planning)
Attention: Grid Code Secretariat
P O Box 103
Germiston
1400

Communication with the *NERSA* in respect of the *Grid Code* shall be sent to the following chosen address:

The Chief Executive Officer
National Energy Regulator of South Africa
P O Box 40343
Arcadia
0007

Communication with the *NTC* in respect of the *Grid Code* shall be sent to the following chosen address until such time as an independent NTC is established:

Managing Director (Transmission)
P O Box 1091
Johannesburg
2000

Any changes to the above addresses shall be communicated by the relevant *party* to all *parties*.

Any notice given in terms of this *Grid Code* shall be in writing and shall

- if delivered by hand, be deemed to have been duly received by the addressee on the date of delivery and a receipt will have to be produced as proof of delivery
- if posted by pre-paid registered post, be deemed to have been received by the addressee 10 working days after the date of such posting
- if successfully transmitted by facsimile, be deemed to have been received by the addressee one day after dispatch
- when successfully transmitted and received e-mail, be deemed to have been received on the date of confirmation of receiving.

Any notice that is telephonically conveyed shall subsequently be reduced to writing and conveyed by one of the above-mentioned means, to be regarded as effective.

8. Acknowledgement

The *Grid Code* has been developed by an industry team in South Africa. In the development process other international codes, particularly those published by "The National Grid Company" (UK) and the "National Electricity Code Administrator" (Australia), have been accessed in order to assist with the drafting.