

**South African Distribution Code
System Operating Code**

Version 6.0

July 2014

**This document is approved by the National Energy Regulator of
South Africa (NERSA)**

Issued by:

RSA Grid Code Secretariat
Contact: Mr. Bernard Magoro
Eskom Transmission Division
P.O Box 103, Germiston 1400
Tell: +27 (0)11 871 2774
Fax: +27 (0)86 663 8418
Email: magorotb@eskom.co.za

Table of Contents

1. OBJECTIVE.....	4
2. SCOPE OF APPLICATION.....	4
3. OPERATIONAL RESPONSIBILITIES OF <i>DISTRIBUTORS</i>	4
4. OPERATIONAL RESPONSIBILITIES OF <i>EMBEDDED GENERATORS AND OTHER CUSTOMERS</i>	5
5. OPERATIONAL AUTHORITY.....	6
6. OPERATING PROCEDURES.....	6
7. OPERATIONAL LIAISON.....	7
8. EMERGENCY AND CONTINGENCY PLANNING.....	7
9. OPERATION DURING <i>ABNORMAL CONDITIONS</i>	9
10. INDEPENDENT ACTIONS BY PARTICIPANTS.....	9
11. DEMAND AND VOLTAGE CONTROL.....	9
12. FAULT REPORTING AND ANALYSIS/INCIDENT INVESTIGATION.....	10
13. DISTRIBUTOR MAINTENANCE PROGRAM.....	11
14. TESTING AND MONITORING.....	11
15. SAFETY CO-ORDINATION.....	11
16. DISCONNECTION AND RECONNECTION.....	12
17. COMMISSIONING AND CONNECTION.....	12
18. OUTAGE SCHEDULING AND CO-ORDINATION.....	13
18.1 RESPONSIBILITIES OF THE <i>DISTRIBUTOR</i>	13
18.2 RISK-RELATED OUTAGES.....	14
18.3 COMMUNICATION OF SYSTEM CONDITIONS, OPERATIONAL INFORMATION AND <i>DISTRIBUTION SYSTEM</i> PERFORMANCE.....	14
18.4 UNPLANNED INTERRUPTIONS OR OUTAGES.....	14
18.5 REFUSAL/CANCELLATION OF OUTAGES.....	15
18.6 PLANNED INTERRUPTIONS OR OUTAGES.....	15
19. TELECONTROL.....	15

1. Objective

- (1) To set out the responsibilities and roles of the *participants* as far as the operation of the *Distribution System* is concerned and more specifically issues related to:
 - (a) economic operation, *reliability* and security of the *Distribution System*
 - (b) operational authority, communication and contingency planning of the *Distribution System*
 - (c) management of power quality
 - (d) operation of the *Distribution System* under normal and abnormal conditions
 - (e) field operation, maintenance and maintenance coordination/ outage planning
 - (f) safety of personnel and public

2. Scope of Application

- (1) The *Distribution System Operating Code* shall apply to all *Users* of the *Distribution System* including:
 - (a) *Distributors*
 - (b) *Embedded Generators*
 - (c) *Generators*
 - (d) *End-use customers*
 - (e) *Traders / Retailers*
 - (f) *Resellers*
 - (g) Any other entities with equipment connected to the *Distribution System* (for example *transmission national service providers (TNSPs)*)
 - (h) *System Operator (SO)*

3. Operational Responsibilities of *Distributors*

- (1) The *Distributor* shall operate the *Distribution System* to achieve the highest degree of reliability and shall promptly take appropriate remedial action to relieve any condition that may jeopardise reliability.
- (2) The *Distributor* shall co-ordinate voltage control, demand control, operating on the *Distribution System* and security monitoring in order to ensure safe, reliable, and economic operation of the *Distribution System*.

- (3) In the event of an *embedded generator* having to shutdown or *island* plant because of a disturbance on the *Distribution network*, the *Distributor* shall carry out network restoration to minimise the time required to resynchronise the shed embedded generating *units*.
- (4) Ensuring that the availability and reliability of every power station supply is maximised at all times under normal and abnormal conditions
- (5) The *Distributor* may shed *customer* load to maintain system integrity. Following such action, *customer* load shall be restored as soon as possible after restoring and maintaining system integrity.
- (6) The *Distributor* shall operate the *Distribution System* as far as practical so that instability, uncontrolled separation or cascading outages do not occur.
- (7) The *Distributor* is responsible for efficient restoration of the *Distribution System* after *supply interruptions*. The restoration plans shall be prioritised in accordance with customer requirements and as described in *NRS 047*.
- (8) The *Distributor* shall ensure it has sufficient *resources* to continuously monitor and operate the *Distribution System*.
- (9) The *Distributor* shall establish and implement operating instructions, procedures, standards and guidelines to cover the operation of the *Distribution System* under normal and abnormal system conditions.
- (10) The *Distributor* shall operate the *Distribution System* within defined technical standards and equipment operational ratings.
- (11) The *Distributor* shall ensure adequate and reliable communications to all major users of the *Distribution System*. Communication with all *customers* shall be provided in terms of *NERSA* license requirement.

4. Operational Responsibilities of *Embedded Generators* and *Other Customers*

- (1) When conditions on the *Distribution System*, under normal or abnormal conditions, become such that it may jeopardise plant or personnel of *customers*, *customers* shall immediately disconnect from the *Distribution System*.
- (2) The *Embedded Generator* shall ensure that its *generating units* are operated within the capabilities defined in the *Connection Agreement* entered into with the *Distributor*.
- (3) The *Embedded Generator* shall reasonably cooperate with the *Distributor* in executing all the operational activities during an emergency generation condition.
- (4) *Customers* shall assist the *Distributors* in correcting *quality of supply* problems caused by the *Customer's* equipment connected to the *Distribution System*.

- (5) *Customers* shall at all times operate their equipment in such a manner to ensure that they comply with the conditions specified in their supply agreement.
- (6) All *customers* must declare any generating plant (except for *Embedded Generators*) that may be paralleled with the Distribution network via switching, and specify the interlocking mechanism to prevent inadvertent parallel operation with the Distributor network.
- (7) *Embedded generators* shall have the required protection to trip in the event of a momentary supply loss causing an island condition to prevent paralleling out of synchronism due to auto-reclose functionality on the *Distributor's* network.

5. Operational Authority

- (1) The *Distributor* shall have the authority to instruct operating on the *Distribution System*. Operational authority for other networks shall lie with the respective asset owners.
- (2) Network control, as it affects the interface between the *Distributor* and a *customer*, shall be in accordance with the *operating agreements* between the *participants*.
- (3) Except where otherwise stated in this code, no *participant* shall be permitted to operate the equipment of another without the permission of such other *participant*. In such an event the asset owner shall have the right to test and authorise the relevant operating staff in accordance with its own standards before such permission is granted.
- (4) Notwithstanding the provisions of section 3 of this code, *participants* shall retain the right to safeguard their own equipment.

6. Operating Procedures

- (1) The *Distributor* shall develop and maintain operating procedures for the safe operating of the *Distribution System*, and for assets connected to the *Distribution System*. These operating procedures shall be adhered to by *participants* when operating equipment on the *Distribution System* or connected to the *Distribution System*.
- (2) Each *customer* shall be responsible for his own safety rules and procedures at least in compliance with the relevant safety legislation. *Customers* shall ensure that these rules and procedures are compatible with the *Distributor* developed procedures defined in paragraph 6 (1) above.
- (3) *Customers* and service providers shall enter into operating agreements where not included in the supply agreement, as defined in the *service provider* licenses.

7. Operational Liaison

- (1) The *Distributor* shall be responsible for ensuring adequate operational liaison with connected *participants*.
- (2) The *participants* shall appoint competent personnel to operate their network and where needed shall establish direct communication channels amongst themselves to ensure the flow of operational information between the *participants*.
- (3) If any *participant* experiences an emergency, the *Distributor* may call upon other *participants* to assist to an extent as may be necessary to ensure that such emergency does not jeopardise the integrity of the *Distribution System*.
- (4) Pursuant to 7(3) above, the relevant *participant* shall ensure that the emergency notification contain sufficient details in describing the event including the cause, timing and recording of the event to assist the *Distributor* in assessing the risk and implications to the *Distribution System* and all the affected *Customers'* equipment.
- (5) For planned events, which have an identified operational effect on the *Distribution System*, or on *Customers'* equipment connected to the *Distribution System*, the relevant *participant* shall notify the *Distributor*.
- (6) Where it is possible for a *customer* to *parallel supply points* or transfer load or *embedded generation* from one *point of supply* to another by performing switching operations on the *customer's* network, the *operating agreement* shall cover at least the operational communication, notice period requirements and switching procedures for such operations.
- (7) The *Distributor* and *customers* shall agree on the busbar configuration(s) at each point of supply during normal and emergency conditions. The *Distributor* and *customers* shall agree on the busbar configuration(s) at each *point of supply* during normal and emergency conditions. The *Distributor* shall keep updated records of such agreements.

8. Emergency and Contingency Planning

- (1) The *Distributor* shall develop and maintain emergency and contingency plans to manage the system contingencies and emergencies that affect the delivery of the *Distribution System* and the Interconnected Power System. Such plans shall be developed in consultation with all affected *participants*, and shall be consistent with internationally acceptable practices, and shall include but not be limited to:
 - (a) under-frequency load shedding,
 - (b) Prevention of voltage slide and collapse,

- (c) meeting any national disaster management requirements including the necessary minimum load requirements,
 - (d) forced outages at any point of connection,
 - (e) restoration and continuation of supply to every power station during normal and abnormal conditions is to be classified as a high priority,
 - (f) supply restoration.
- (2) Emergency plans shall enable the safe and orderly recovery from a partial or complete system collapse, with minimum impact on *customers*.
- (3) All contingency and emergency plans shall be reviewed biennially or in accordance with changes in network conditions.
- (4) All contingency and emergency plans shall be verified by audits, if possible by using onsite inspections and actual tests. In the event of such tests causing undue risk or undue cost to a participant, the *Distributor* shall take such risks or costs into consideration when deciding whether to conduct the tests. Any tests shall be carried out at a time that is least disruptive to the *participants*. The costs of these tests shall be borne by the respective asset owners. The *Distributor* shall ensure the co-ordination of the tests in consultation with all affected *participants*.
- (5) The *Distributor* shall, in consultation with the *NTC* and *SO*, set the requirements and implement:
- (a) Automatic and manual under frequency load shedding in accordance with the *System Operator's* requirements.
 - (b) Automatic and manual under voltage load shedding to prevent voltage collapse.
 - (c) Manual load shedding to maintain network integrity.
- (6) *Participants* shall make available loads and schemes to comply with these requirements.
- (7) The *Distributor* shall be responsible for determining emergency operational limits on the *Distribution System*, updating these periodically and making these available to the *participants*.
- (8) The *Distributor* shall conduct network studies which may include but not be limited to load flow, fault *level*, stability and resonance studies to determine the effect that various component failures would have on the reliability of the *Distribution System*.

9. Operation during *Abnormal Conditions*

- (1) During *abnormal operating conditions* the *Distributor* shall be obliged to take necessary precautionary measures to prevent network disturbances from spreading and to restore supply to *consumers*.
- (2) The *Distributor* shall cooperate with the *SO* and *TNSP* in taking corrective measures in the event of abnormal conditions on the *Distribution System*. The corrective measures shall include both supply-side and demand-side options. Where possible, warnings shall be issued by the *Distributor* to affected *participants* on expected utilisation of any contingency resources.
- (3) The *Distributor* shall be entitled to disrupt some sections of the network in the event of a prolonged disturbance resulting from unsuccessful corrective measures undertaken.
- (4) Termination of the use of emergency resources shall occur as the order of return being determined by the most critical loads, first in terms of safety and then plant.
- (5) During emergencies that require load shedding, the request to shed load shall be initiated in accordance with procedures prepared by the *Distributor*.

10. Independent Actions by Participants

- (1) Each *participant* shall have the right to reduce supply or demand, or disconnect a *point of connection* under emergency conditions, if such action is necessary for the protection of life or equipment and shall give advance notice of such action where possible.

11. Demand and Voltage Control

- (1) The *Distributor* shall implement demand control measures when:
 - (a) Instructed to by the *SO*
 - (b) Abnormal conditions exist on the *Distribution System*,
 - (c) Multiple outage contingency exists resulting in *island* grid operation
 - (d) Any other operational event the *Distributor* deems to warrant the implementation of demand control measures for the safe operation of the *Distribution System*.
- (2) Demand control shall include but not limited to:
 - (a) *Customer* demand management
 - (b) Automatic under-frequency load shedding

- (c) Automatic under-voltage load shedding
 - (d) Emergency manual load shedding
 - (e) Voluntary load curtailment
- (3) The *Distributor* shall develop load reduction procedures, which shall be regularly updated, to reduce load in a controlled manner taking cognisance of the type of load.
- (4) The *Distributor* shall endeavour to maintain system voltage to be within statutory limits at the *points of supply* or otherwise as agreed in the operating / supply agreement.

12. Fault Reporting and Analysis/Incident Investigation

- (1) The *end-use customers* and *Embedded Generators* shall report the loss of major loads or *generation* (as agreed by the *participants*) to the *Distributor* within 15 minutes of the event occurring. Notice of the intention to reconnect such shall be given with at least 15 minutes advance notice to enable the *Distributor* to take any necessary action required.
- (2) The *Distributor* shall investigate all incidents that materially affected the quality of supply to another *participant*. The *Distributor* shall initiate and co-ordinate such an investigation and make available the findings of such investigation to affected *participants* on request.
- (3) The findings of such an investigation shall include where relevant:
- (a) Date and time of the incident
 - (b) Location of the incident
 - (c) Duration of the incident
 - (d) Equipment involved
 - (e) Cause of the incident in compliance with *NRS048*.
 - (f) Demand control measures undertaken specifically recording the customer MWs shed and energy lost as a result of the measures taken.
 - (g) Supply restoration details.
 - (h) *Embedded Generation* interrupted
 - (i) Under-frequency Load Shedding response
 - (j) Estimated date and time of return to normal service
 - (k) *Customer* load tripped MW and energy lost when incident occurred or as a direct result of incident not including any Demand Control Measures taken
 - (l) Estimate number of *customers* having lost supply.
 - (m) Recommendations

- (4) Any *participant* shall have a right to request an independent audit of the findings, at its own cost. If these audit findings disagree with the original findings, the *participant* may follow the dispute resolution mechanism as specified in the *Governance Code*.

13. Distributor Maintenance Program

- (1) Each *Distributor* shall have a maintenance philosophy against which their maintenance practices and programs are compiled and documented in accordance with *NRS082*. These documented maintenance programs must be auditable.
- (2) The *Distributor* shall compile at least an annual maintenance plan in line with the budget period.
- (3) Accurate records of maintenance done shall be kept for a period of at least 5 years.
- (4) Scheduling of planned outages should coincide with the maintenance requirements of other *participants* connected to the affected network.
- (5) All participants that may be affected by the planned outages will be informed at least 2 days or 48 hours in advance.

14. Testing and Monitoring

- (1) A *participant* has the right to request to test and / or monitor any equipment at the *point of connection* to the *Distribution System* to ensure that the *participants* are not operating outside the technical parameters specified in any part of the *Distribution Grid Code* and other applicable standards which the *participants* are required to comply with. Such testing and / or monitoring shall be carried out as mutually agreed by the *parties*.
- (2) A *participant* found to be operating outside the technical parameters shall, within such time agreed upon by the parties involved, remedy the situation or disconnect from its network the equipment causing problems.
- (3) Any dispute arising out of the test and monitoring process shall be resolved through the *dispute resolution* mechanism in the *Governance Code*.

15. Safety Co-ordination

- (1) The *Distributor* shall comply with relevant legislation and develop Operating Regulations to ensure safety of personnel whilst operating on the *Distribution System* or any equipment connected to the *Distribution System*.
- (2) Where operational boundaries exist, there shall be a joint agreement on operating procedures to be complied with by all affected *participants*.

- (3) There shall be written authorisation of personnel who operate on or work on live equipment forming part of or connected to the *Distribution System*.
- (4) The "Operating Regulations" referred to in section 15 (1) of this code shall include rules and regulations for the safe operating of plant, continuity of supply and authorisation of personnel related to the operating of *HV, MV* and *LV* equipment.

16. Disconnection and Reconnection

- (1) The *Distributor* may disconnect supply to the *customer's* supply address if the *customer* fails to comply with the written notice of non-compliance issued by the *Distributor* or any arrangement entered into by the *Distributor* and the *customer* which the *customer* has failed to comply with including non-compliance with the *Distributor* applicable standards.
- (2) The *Distributor* shall have the right to interrupt or disconnect supply if a threat of injury or material damage is anticipated as a result of the malfunctioning of the electrical installation equipment on the *Customer's* premises or on the *Distribution System*.
- (3) The *Distributor* may disconnect immediately without notice the supply to the *customer's* supply address if:
 - (a) The supply of electricity to a *customer* is used anywhere else other than at the *customer's* premises as specified in the *connection agreement*.
 - (b) A *customer* takes at the *customer's* supply address electricity supplied to another *customer*.
 - (c) A *customer* is tampering with or permits tampering with the meter and associated components.
 - (d) A *customer* allows electricity supply to bypass the meter without the *Distributor's* consent.
- (4) *Customer* (connected at *MV* and *HV* levels) shall give written notice to the *Distributors* of any intended voluntary disconnection.
- (5) The *Distributor* shall reconnect supply to the *customer* on request by the customer or retailer on behalf of the *customer* subject to compliance with the relevant provisions of the *Distribution Code* and other *Distributor* applicable standards including the timing of reconnection and any reconnection charge imposed by the *Distributor*.

17. Commissioning and connection

- (1) *MV and HV customers* shall supply commissioning programmes to the *Distributor* control and operating facility at least 1 month in advance. Subsequently, a notice of first connection shall be given to the *Distributor* control and operating facility at least 2 weeks before actual connection. Details of the information required shall include but not be limited to the following:
 - (a) Commissioning procedures and programmes
 - (b) Documents and drawings required
 - (c) Proof of compliance with standards
 - (d) Documentary proof of the completion of all required tests
 - (e) SCADA information, to be available and tested before commissioning
 - (f) Site responsibilities and authorities.
- (2) When commissioning equipment at the point of connection, the *Distributor* shall liaise with the affected participants on all aspects that could potentially affect their operation.
- (3) The *Distributor* and *customers* shall perform all commissioning tests required in order to confirm that the *Distributor's* and the *customers'* plant and equipment meet all the requirements of the *Distribution Code* before being connected to and energised from the *Distribution* system.

18. Outage scheduling and co-ordination

18.1 Responsibilities of the *Distributor*

- (1) *Distributors* shall, with reference to the relevant network *Service Providers* outage plans and relevant *Generators* outage programs, compile the daily outage schedule which shall:
 - (a) endeavour to cater for the planned maintenance and commissioning of new equipment
 - (b) describe the planned outage
 - (c) identifies the risks and impact on network performance in accordance with NRS 047
 - (d) describe the practical contingency plans devised to counter risks, and
 - (e) define the roles and responsibilities of the personnel designated to manage and minimise the impact of these outages on the *Distribution System* and its users.
- (2) Notwithstanding clause 18.1 (1) above, the *Distributor* shall co-ordinate relevant outages with the *SO*.

- (3) In addition to paragraph 18.1 (1) above, the *Distributor* may require information from the *Customers* regarding major plant and associated equipment which may affect the performance of the *Distribution System* and may require additional resources to be committed during the outage planning process.
- (4) *Customers* with co-generation and *Embedded Generators* with the maximum capacity greater than 1MW shall furnish to the *Distributor* information on *planned outages* in order for the *Distributor* to properly plan, and coordinate its control, maintenance and operation activities.
- (5) The *Distribution* outage schedule shall be submitted to the *NERSA* upon request.

18.2 Risk-related Outages

- (1) All risk-related outages shall be scheduled with an executable contingency plan in place. The compilation of the contingency plan is the responsibility of the relevant *Distributor*.
- (2) Contingency plans shall address:
 - (a) Safety of personnel
 - (b) Security and rating of equipment
 - (c) Continuity of supply
- (3) The relevant control centres shall confirm that it is possible to execute the contingency plan successfully.

18.3 Communication of System Conditions, Operational Information and *Distribution System* Performance

- (1) The *Distributor* shall be responsible for providing *participants* with operational information as may be agreed from time to time. This shall include information regarding *planned* and *forced outages* on the *Distributor*.
- (2) The *Distributor* shall inform *participants* of any network condition that is likely to impact the short and long-term operation of that *participant*.
- (3) The *Distributor* shall record operational information as specified in the *Information Exchange Code*. This information shall be made available to all *participants* on request.

18.4 Unplanned Interruptions or Outages

- (1) In case of unplanned interruptions or *outages* the *Distributor* may require a *customer* to comply with reasonable and appropriate instructions from the *Distributors* and may further:
 - (a) Require the *customer* to provide the *Distributor* emergency access to *customer* owned distribution equipment normally operated by the *Distributor* or *Distributor* owned equipment on *customer's* property.
 - (b) Interrupt supply to the *customer* to effect repairs to the *Distribution System*.
- (2) Subsequent to clause 18.4 (1), the *Distributor* shall make arrangements to keep customers informed about the expected duration and other details following unplanned interruptions.

18.5 Refusal/Cancellation of Outages

- (1) No *participant* may unreasonably refuse an outage request. No *participant* may unreasonably postpone or cancel a previously accepted outage.
- (2) The direct costs related to the cancellation/postponement of an outage shall be borne by the respective asset owners.

18.6 Planned Interruptions or Outages

- (1) For planned interruptions or outages the *Distributor* shall act in accordance with *NRS047* and provide the affected *Customers* with information relating to the expected date of the outage, time and duration of the outage and shall established reasonable means of communication to the *Customers* for outage related enquiries.

19. Telecontrol

- (1) Where Telecontrol facilities are shared between the *Distributor* and other *participants*, the *Distributor* shall ensure that operating procedures are established in consultation with the *participants*.