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FOREWORD

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INTRODUCTION

Portable generators are widely used to provide electricity in case of a mains power failure. This document deals specifically with those installations at which a stand-by generator is interfaced with the same circuitry as is used to locally distribute mains-supplied electrical power. This in turn presents a risk of inadvertent paralleling of sources of supply. Certain sections of this document are applicable also to stand-alone generator sets. Consumers who have purchased portable generators to provide electricity in the event of a power outages must use safety precautions. Portable generators can be hazardous if used improperly. The principal hazards are: (1) **carbon monoxide (CO) poisoning** from the toxic engine exhaust and (2) **electrocution** from connecting the generator to the home electrical wiring system. The document is specifically aimed at "Non-qualified" persons who may purchase portable generators due to the perception that the grid reliability is reducing and inadvertently creating hazardous conditions when using them.

1. SCOPE

The purpose of this document is to specify the technical requirements to be met with the interfacing of low voltage generating sets with the local supply networks and to ensure that they do not compromise the network integrity or safety of the utility or user. The document describes some of the dangers presented by interfacing a stand-by generator with mains-supplied premises.

This document deals specifically with those installations at which a stand-by generator is interfaced with the same circuitry as is used to locally distribute mains-supplied electrical power. Generator sets that are operated separately from the local supply (e.g. portable generator sets supplying lighting or heating circuits directly) are excluded from the requirements of this document, although some of the safety precautions may still be applicable.

The document applies specifically to installations where the generator set is prohibited from paralleling with the mains supply. Where it is required for a generator set to parallel with the mains supply, for whatever reason, this shall be agreed to beforehand by the affected parties, and may be subject to additional technical requirements.

This document shall be read in conjunction with SANS 10142-1, specifically Section 7.12.

2. NORMATIVE REFERENCES

The following documents contain provisions which, through reference in this text, constitute provisions of this guideline. All documents are subject to revision and, since any reference to a document is deemed to be reference to the latest edition of that document, parties to the use of this document are encouraged to take steps to ensure the use of the most recent editions of the documents listed below

SANS 10142-1 The wiring of premises Part 1 Low Voltage Installations

Occupational Health and Safety Act, 1993 (Act 85 of 1993)

Relevant Municipal Electricity Supply and other Bylaws, as applicable & Eskom Electricity supply agreements / conditions with individual customers, as applicable

3. DEFINITIONS AND ABBREVIATIONS

3.1. General

- 3.1.1. **Circuit Breaker:** Mechanical switching device that is capable of making, carrying and breaking currents under normal conditions and of making, carrying for a specified time, and automatically breaking currents underspecified abnormal circuit conditions such as those of overcurrent.
- 3.1.2. **Certificate of Compliance:** Certificate that is issued by an accredited person in respect of an electrical installation or part of an electrical installation that ensures that the installation complies with SANS 10142
- 3.1.3. **Customer:**
- 3.1.4. **Electricity distribution utility:** The electricity supply authority, being either Eskom or the Municipal electricity service provider in the area of the installation.
- 3.1.5. **Current:** Flow of electric charge through a conductor.
- 3.1.6. **Accredited person:** person who is registered in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).
- 3.1.7. **Distribution Board:** enclosure that contains electrical equipment for the distribution or control of electrical power from one or more incoming circuits to one or more outgoing circuits.
- 3.1.8. **Fault Current:** current that results from an insulation failure or from bridging of insulation or live components.
- 3.1.9. **Local Authority:** - Municipality
- 3.1.10. **Point of common coupling:** - The point on the Utility's network, electrically nearest to a particular customer's installation, at which more than one consumer is or may be connected or metered
- 3.1.11. **Point of Supply:-** the point of metered electrical connection between the Utility & Customer
- 3.1.12. **Portable / Standby Generators:** a source of electrical power, typically a diesel generator, that is used as back-up or an alternative to a grid supply.
- 3.1.13. **Protective Earthing Conductor:-** conductor provided for purposes of safety (protection against electric shock) and that connects the supply earth to the consumer earth terminal

3.1.14. **Protective Earth and Neutral Conductor:-** conductor that forms part of a supply combining the functions of both, protective earthing conductor and neutral conductor. The conductor is also connected to other earth electrodes and exposed conductive parts of the low voltage supply

3.2. Abbreviations

SANS	South African National Standards
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
COC	Certificate of Compliance
MV	Medium Voltage
LV	Low Voltage
N	Neutral
PE	Protective Earthing Conductor
AMF	Automatic changeover panel
DB	Distribution Board

4. INSTALLATION REQUIREMENTS

4.1 Legal Requirements

An application for the use of Portable Generating Sets (new or existing) in cases where it will be required to interface with the same circuitry as is used to locally distribute mains-supplied electrical power, shall be submitted to the relevant Electricity Distribution Utility

The application shall include, but may not be limited to, the following:

- 1) Contact details of the owner
- 2) Site Address
- 3) Make & Model of the Generating unit
- 4) Capacity of the Generating unit
- 5) Control circuit diagram of the generating unit including all interlocks with the main grid.

Only upon written approval from the relevant Electrical Utility, shall the work commence.

4.2 Safety Requirements

The attention of the owner/tenant of a stand-by / portable generator is drawn to the following requirements of the Occupational Health and Safety Act, 1993 (Act 85 of 1993):

“Any user of machinery shall:

- a) Ensure that all machinery used by him is suitable for the purpose for which it is used, and that it is installed, operated and maintained in such a manner as to prevent the exposure of persons to hazardous or potentially hazardous conditions or circumstances.
- b) In particular cause every exposed and dangerous part of the machinery, which is within the normal reach of a person to be effectively safeguarded by means of insulation, fencing, screening or guarding, except where an inspector has granted written permission for the omission of such safeguarding.
- c) Ensure that all safety equipment is kept in a good working condition and is properly used; and ensure that the quality of material used in; and the construction of the machinery or safety equipment is suitable for the purpose for which it was intended.
- d) Unless a person has been authorized thereto, no person shall remove any safety equipment, which relates to the machinery in question.
- e) Shall provide devices to start and stop machinery, and these devices shall
 - i. Be in a position where they can readily and conveniently be reached by the person who operates such machinery; and
 - ii. Be so constructed and arranged as to prevent the accidental starting of such machinery.
- f) Shall provide positive means for rendering the controls of machinery driven by an electric motor inoperative while repairs or adjustments are being made, and such means shall not only be the mere tripping of a switch.”

4.3 Additional Safety Requirements & Recommendations

- a) The installation shall take place within the boundaries of the approved application.
- b) The owner/tenant shall comply with the relevant noise and pollution legislation.
- c) Where new buildings are erected or alterations to existing buildings are made, building plans are to be submitted to the relevant Local Authority for approval
- d) The owner/tenant shall comply with the relevant legislation for the storage of fuel
- e) **NEVER** use a generator in enclosed or partially-enclosed spaces. Generators can produce high levels of CO (Carbon Monoxide) very quickly. When using a portable generator, remember that one cannot smell or see CO. Even if a person can't smell exhaust fumes, he/she may still be exposed to CO. Adequate ventilation shall be provided.

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- f) Only operate the generator outdoors in a well-ventilated, dry area, away from air intakes to the home, and protected from direct exposure to rain, preferably under a canopy, open shed, or carport. Do not enclose the generator in any structure.
 - g) Keep flammable materials away from the generator.
 - h) Always fuel the generator in a well ventilated area. Fuel vapours are flammable and may ignite after the engine is started, be sure that any spilled fuel is cleaned up before restarting.
 - i) Always check for fuel leaks.
 - j) Before refuelling the generator, turn it off and let it cool down, fuel spilled on hot engine parts may ignite.
 - k) Do not leave the generator unattended.
 - l) The total rated capacity of the generator should never be exceeded.
 - m) Keep cords / cables out of the way so as to avoid the danger of tripping over them
 - n) Ensure that the generator's terminal voltage rating matches that of the load equipment (typically 230V ± 10%)
 - o) Ensure that emergency isolation of the generator is possible
 - p) In the case of temporary generators being connected, ensure that there is complete isolation of the consumers apparatus to the Utility's equipment
 - q) Have the generator run at full speed before placing load on it, this prevents damage as the generator starts and reaches full speed
 - r) For permanently installed generators ensure that permanent electrical interlocking exists between the customer and the utility.
 - s) Ensure that all appliances/equipment connected to the generator have overcurrent protection or preferably the supply from the generator shall be equipped with overcurrent protection.
 - t) All loads should be turned off before the Generator is turned off
 - u) Check that the any cords are free of cuts or tears and that the plug has all three prongs, especially a grounding pin. Never try to power the house wiring by plugging the generator into a wall outlet, a practice known as "back feeding." This is an extremely dangerous practice that presents an electrocution risk to utility workers and neighbours served by the same utility transformer.
 - v) Consider using surge protection, it is common for generators to damage more sensitive electronic equipment.

4.4 Connection requirements

- a) Where necessary for the installation of the generator set, it is the responsibility of the applicant to arrange with the Electricity distribution utility for the disconnection/reconnection of mains supply to the premises. Please note that the latest Electricity distribution tariffs will apply for this service.
- b) A COC must be completed for the installation and submitted to the relevant Electricity distribution electricity prior to reconnection of supply to the premises.
- c) A permanent red label (PVC or aluminium) with white lettering (at least 10mm high) shall be affixed to the main distribution board inside the premises as well as to all other distribution boards fed from the main board and the main incoming utility supply circuit breaker. The label shall read "DANGER GENERATOR CONNECTED". Where only parts of the installation are supplied by alternative means, only these circuits shall be labelled.
- d) Where any form of alternate supply (generating set, UPS, etc.) is connected and automatically supplies power to circuits on the distribution board, a visible indicator (light) shall be provided on each distribution board where such circuits are live after the main supply on that board has been switched off.
- e) Appropriately rated protective devices shall be supplied for short-circuit and earth fault conditions to protect the distribution board, generating set and user. The protective devices shall prohibit feedback onto the utility system once the main incoming supply has been switched off. The generating set shall be provided with separate appropriately-rated over current protection circuit breaker, over and above any devices installed on the generating set itself. Earth leakage protection shall be provided in accordance with SANS10142-1 Section 6.8.
- f) **Unless specifically agreed to between the Electricity Distribution utility and owner/tenant, the generating set shall not run in parallel with the main supply at any time.**
- g) The consumer shall be held responsible for any and all damages incurred by the utility or by himself if the devices are found to be incorrectly rated and/or the utility supply and generator supply are paralleled.
- h) Neutral earthing of the generator set shall be done in accordance with SANS 10142-1 Section 7.12.3

4.4.1 Single residential houses/individual commercial units

- a) The installation of generating sets at single residential premises shall conform to the above requirements as well as the following requirements.
- b) A control panel shall be installed after the meter point for both conventional and prepayment meters, as close to the main distribution board as possible.
- c) The control panel shall include at least,
 - 1) A main circuit breaker.

- 2) A manual changeover switch. This changeover switch shall be of a three-position type, break-before-make (see annexure I) and have an appropriate rating for the size of the generating set.
- 3) No other means of connection is allowed

4.4.2 Commercial/Office or Multi-unit Blocks

- a) The installation of generating sets at commercial premises or multi unit premises shall conform to the above requirements as well as the following requirements. Generating sets shall be installed so as to be an alternative supply to the main supply of the entire block.
- b) An automatic or manual changeover panel shall be installed.
- c) The control panel shall have at least,
 - 1) A main circuit breaker.
 - 2) A visible indicating light that is on when the generation set is supplying power.
 - 3) A manual changeover switch. This changeover switch shall be of a three-position type, break-before-make (see connection diagram) and have an appropriate rating for the size of the generating set.
 - 4) An emergency stop button that is easily accessible shall be provided for the generating set, this emergency stop button shall stop and prevent the generating set from starting.
 - 5) There shall be a remote emergency stop button (utility controlled). The remote emergency stop button will be installed next to the main incoming utility supply circuit breaker with a label identifying it. Alternatively a circuit breaker can be installed with auxiliary contacts connected to the emergency stop/starter preventing the generator from starting if the main incoming supply is switched off due to safety reasons (i.e. in case of fire, etc.)
 - 6) In the case of an automatic changeover panel:

A foolproof interlocking system shall prevent the main supply from being connected to generating set supply. This interlocking system shall incorporate a mechanical as well as an electrical interlock on the change over contactors/relays.
- d) Where an individual unit within an office/multi-unit block has a generating set, requirements for single residential houses shall be applied.
- e) Where two adjacent commercial plots are supplied from a shared generating set, each plot/connection shall have its own control/changeover panel as above.

5. DISCLAIMER OF LIABILITY

Portable generators can pose serious health hazards if used improperly as they **produce carbon monoxide (CO) and other risks.**

Portable generators are a useful tool during power interruptions, however their carbon monoxide risks are more potent than many people realize. A typical 5.5-kilowatt home generator can produce the same amount of CO as six idling cars, according to a study by the US Centre for Disease Control and Prevention (CDC). Gasoline-engine generators are not designed for indoor use.

Please note: Your home's wiring is likely not matched for your Generator use. Connecting your portable generator to your home's electrical power system or wiring can be lethal. It is recommended that a qualified electrical engineer or contractor install a transfer switch, which is used to load and unload power and is also able to cut-off the electrical output being produced by the generator, once the main-supply is restored.

Every generator manual includes the manufacturer's guidelines for safety and usage, including warnings urging users to operate their generators in a dry, well-ventilated area to avoid both electrocution and CO poisoning. It is therefore highly recommended that any running of a generator is conducted with a healthy dose of common sense and in strict compliance with the manufacturer's requirements for safe use. Please pay heed to their advice, use recommended oils and lubrication, attend to the regular maintenance schedules and keep the standard operating procedures adhered to, at all times.

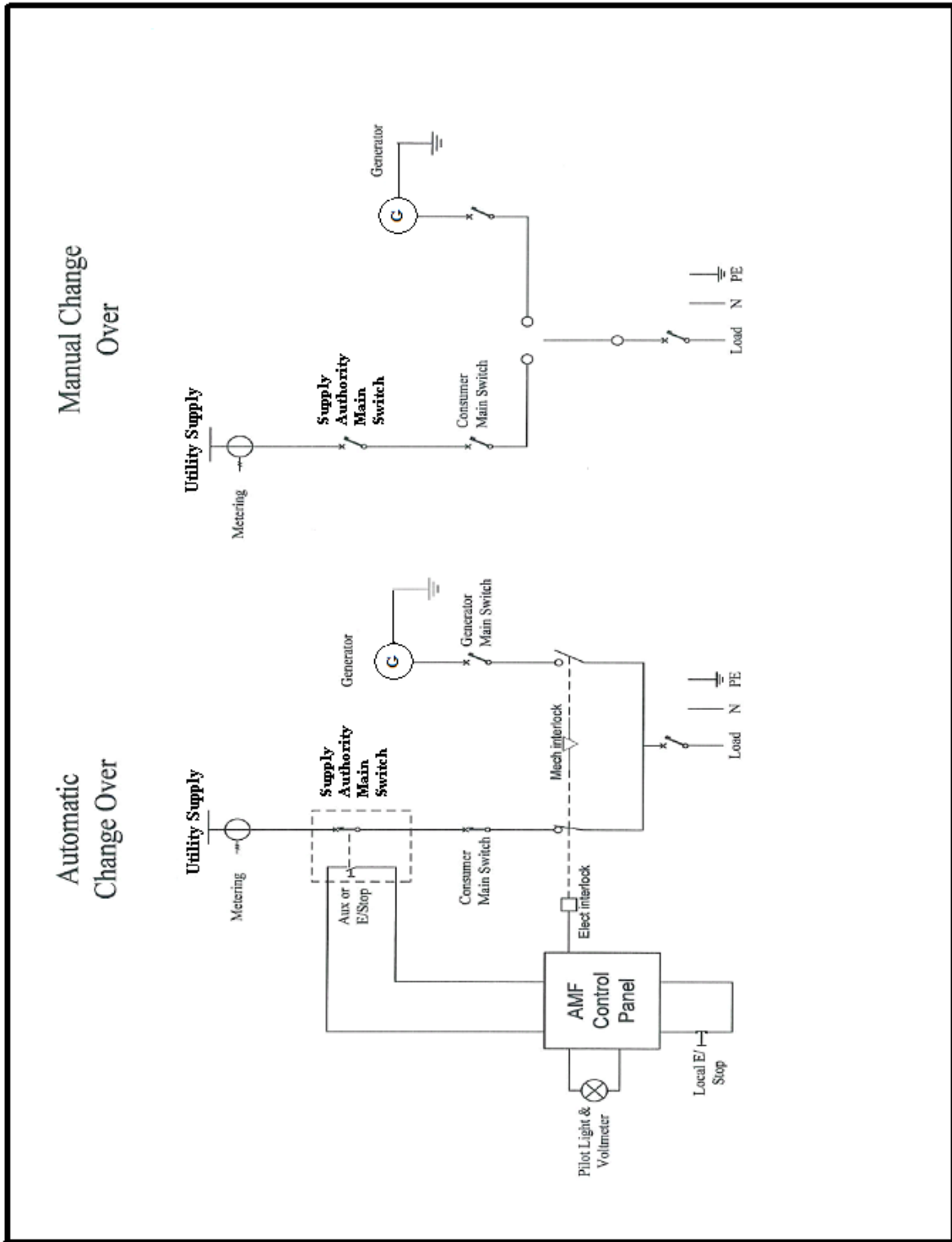
The guidelines expressed in this document are not intended to infringe nor replace the manufacturer's guidelines for safety and usage. This document is only a suggested guideline for the safe use of portable generators on utilities networks.

These guidelines are only intended to provide general information regarding the safe use of portable generators on utilities networks, it is not intended to be exhaustive of any subject dealt with. The information in these guidelines, including, without limitation, all research, opinions or other content is therefore not intended, nor does it constitute consulting or other professional advice or services. Before any decision is made or any action taken which might affect the user, consultation with your own professional is advised.

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Annex A – Wiring Diagram



Annex B – Typical appliance ratings (may vary from table below)

Electrical Appliance		Rating (kW)
Lamps	100W	0.10
	75W	0.075
	60W	0.06
	40W	0.04
Stove		
	Small hot plate (on high)	1.50
	Small hot plate (on low)	0.375
	Large hot plate (on high)	2.00
	Large hot plate (on low)	0.50
	Oven (approximately 200°C)	2.00
Dish Washer		1.00
Electric Blanket		0.05
Electric Frying Pan		1.50
Fan		0.07
Floor Polisher / Vacuum Cleaner		1.00
Hair Dryer		0.50
Hi-Fi Equipment		0.20
Iron		0.60
Kettle		2.00
Microwave (800W)		0.80
Personal Computer		0.05
Power Drill		0.25
Deep Freezer		0.20
Refrigerator		0.10
Sewing Machine		0.07
Slow Cooker		0.15
Space Heating	1-Bar Heater	1.00
	2-Bar Heater	2.00
Swimming Pool Pump		1.00
Television Set		0.30
Tumble Dryer		3.00
Washing Machine	(Hot Wash)	1.00
	(Cold Wash)	0.50