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**NEW ZEALAND ELECTRICAL CODE OF PRACTICE**

**for**

**ELECTRICAL INSTALLATIONS**

**SUPPLY BY GENERATING SYSTEMS NOT EXCEEDING LOW VOLTAGE**

Issued by the Office of  
The Chief Electrical Inspector,  
Energy and Resources Division, Ministry of Commerce

**THE ELECTRICITY ACT 1992**

**APPROVAL OF ELECTRICAL CODE OF PRACTICE**

**FOR**

**ELECTRICAL INSTALLATIONS**

**SUPPLY BY GENERATING SYSTEMS NOT EXCEEDING LOW VOLTAGE**

Pursuant to Section 36 of the Electricity Act 1992 ("the Act")

On the 1st day of February 1993, the Secretary of Commerce issued the Electrical Code of Practice for Electrical Installations - Supply by Generating Systems Not Exceeding Low Voltage ("the Code")

On the 4th day of February 1993, pursuant to Section 38 of the Act the Secretary published in the Gazette a notice of intention to apply to me for approval of the code, and there has been consultations with such persons (or their representatives) as will be affected by the Code and they have had the opportunity to consider possible effects and comment on those effects.

I have considered the comments concerning those effects and where necessary amendments were made to the Code.

Therefore Pursuant to Section 38 of the Act, I, John Luxton, Minister of Energy, have this day approved the Code as attached to this approval, which Code shall come into force on the 1st day of April 1993.

Dated this 18th day of March 1993.

John Luxton  
Minister of Energy.

## **COMMITTEE REPRESENTATION**

This Code of Practice was prepared by the Ministry of Commerce, Chief Electrical Inspector's Office with reference to the following organisations:

Electricity Supply Engineers' Association of NZ Inc.  
Electrical Inspectors' Association  
New Zealand Electrical Institute  
Telecom  
Ebbett Automation  
Electrical Contractors' Association of NZ Inc.  
Electricity Corporation

## **ACKNOWLEDGEMENT**

It should be noted that the source material for this Code was derived from the following documentation, Australian Standards AS 2790, AS 3010.1 and AS 3011.

## **REVIEW**

This Code of Practice will be revised as occasions arise. Suggestions for improvement of this Code will be welcomed. They should be sent to the Chief Electrical Inspector's Office, Ministry of Commerce, PO Box 1473, WELLINGTON.

## CONTENTS

	Page
INTRODUCTION .....	1
SECTION 1	
SCOPE, APPLICATION, REFERENCED DOCUMENTS, INTERPRETATIONS, GLOSSARY AND NUMBERING	
1.1 SCOPE.....	2
1.2 APPLICATION.....	2
1.3 REFERENCED DOCUMENTS .....	2
1.4 INTERPRETATIONS .....	2
1.5 GLOSSARY OF ABBREVIATIONS USED IN THIS CODE.....	3
1.6 NUMBERING SYSTEM OF THIS CODE.....	3
SECTION 2	
GENERAL REQUIREMENTS FOR THE INSTALLATION OF GENERATING SETS	
2.1 GENERAL .....	4
2.2 LOCATION.....	4
2.3 MECHANICAL AND THERMAL PROTECTION .....	4
2.4 ELECTRICAL PROTECTION.....	5
2.5 CONTROL.....	5
2.6 EARTHING AND BONDING.....	7
2.7 SWITCHBOARDS AND CONTROL PANELS .....	9
2.8 SWITCHGEAR.....	9
2.9 BATTERY AND BATTERY CHARGING .....	10
SECTION 3	
ADDITIONAL REQUIREMENTS FOR PERMANENTLY CONNECTED GENERATING SETS	
3.1 GENERAL .....	11
3.2 LOCATION.....	11
3.3 GUARDING OF LIVE PARTS .....	12
3.4 TRANSFORMERS.....	12
SECTION 4	
ADDITIONAL REQUIREMENTS FOR PORTABLE OR TRANSPORTABLE PLUG AND SOCKET - OUTLET CONNECTED GENERATING SETS	
4.1 GENERAL .....	13
4.2 EARTHING AND BONDING.....	13
4.3 MARKING.....	14
4.4 CONTROL OF SOCKET-OUTLETS.....	14

SECTION 5

ADDITIONAL REQUIREMENT FOR TRANSPORTABLE CONNECTED GENERATORS BY TEMPORARY CABLES

5.1 GENERAL .....	15
5.2 ISOLATION.....	15

SECTION 6

REQUIREMENTS FOR ELECTRICITY SUPPLY CHARACTERISTIC CHANGERS

6.1 GENERAL .....	16
6.2 CONTROL .....	16
6.3 ISOLATION.....	16
6.4 OVERCURRENT PROTECTION.....	16
6.5 BATTERIES .....	17

## INTRODUCTION

The majority of electrical installations in New Zealand derive their power supply from the national electrical grid.

There are, however, installations where the supply is derived from local generating equipment.

With the increasing development of alternative engineering and electrical technology-such as solar and wind generation, generation by a standard diesel system alone is becoming less common place.

Where supply is derived from local generating equipment the electrician is required to install items which normally would be part of the supply network.

This Code sets out those additional requirements necessary to ensure that installations supplied from local generation provide the same safety levels as those supplied from the national electricity grid.

This Code sets down requirements for generating systems and any special requirements connected hereto.

The Code also sets requirements for portable generators in addition to permanently installed generators.

## **ELECTRICAL INSTALLATIONS - SUPPLY BY GENERATING SYSTEMS**

### **SECTION 1**

#### **SCOPE, APPLICATION, REFERENCED DOCUMENTS, INTERPRETATIONS, GLOSSARY AND NUMBERING**

##### **1.1 SCOPE**

This Code sets out the minimum electrical safety requirements related to the use of generating systems for the supply of electricity at voltages normally exceeding 32V a.c. or 115V d.c. but not exceeding low voltage. The Code applies to electricity generating systems that form part of an electrical installation or are used solely for the supply of appliances.

This Code does not:

- (a) Set out performance and constructional requirements for generating plant; or
- (b) Specifically apply to specialised automatic sources of supply, e.g. no-break systems;
- (c) Emergency power supplies in hospitals.

##### **1.2 APPLICATION**

##### **1.3 REFERENCED DOCUMENTS**

The following Standards are referred to in this Code:

NZS 6200	General Requirements for Electrical Apparatus and Material.
AS 1939	Classification of Degrees of Protection Provided by Enclosures for Electrical Equipment.
AS 2790	Electricity Generating Sets - Transportable (up to 25 kW).

##### **1.4 INTERPRETATIONS**

For the purposes of this Code, the definitions given below shall apply.

- 1.4.1 Generating set - means a group of rotating machines transforming mechanical or thermal energy into electricity.
- 1.4.2 Emergency supply system - means a supply system used in case of failure of the normal supply, in order to maintain operation of the installation or part thereof for safety reasons.

- 1.4.3 Independent supply system - means a supply system which forms the only source of supply to an installation or load.
- 1.4.4 Standby supply system - means a supply system used in case of failure of the normal supply in order to maintain normal operation of the installation or part thereof.
- 1.4.5 Transportable generating set - means a generating set which can be moved from place to place by one or more persons, by mechanical means, or by means of its own wheels, tracks or skids.
- 1.4.6 Electricity supply characteristic changers - means static and dynamic equipment designed either to stabilize the supply voltage or to change the voltage or frequency of an electricity supply or to maintain a continuous electricity supply when the primary source of electricity is interrupted. (Electronic Power Inversion).
- 1.4.7 Secondary battery - means two or more cells electrically connected and used as a source of electricity.

## 1.5 GLOSSARY OF ABBREVIATIONS USED IN THIS CODE

a.c.	Alternating current
AS	Australian standard
kW	Kilowatts
d.c.	Direct current
mA	Milliamperes
m	Metres
NZS	New Zealand standard
RCD	Residual current device.

## 1.6 NUMBERING SYSTEM OF THIS CODE

- 1.6.1 Sections are numbered from 1 to 6.
- 1.6.2 Subsections are numbered by one full stop between two numbers.(eg:1.6)
- 1.6.3 Clauses are numbered by two full stops between three numbers.(eg:4.18.3)
- 1.6.4 Subclauses are numbered by three full stops between four numbers.(eg:3.2.1.1)
- 1.6.5 Paragraphs contain numbering punctuated by one or more full stops together with a parenthesised letter.
- 1.6.6 Subparagraphs are represented by lower case roman numerals enclosed in parenthesis following paragraphs.

## SECTION 2

### GENERAL REQUIREMENTS FOR THE INSTALLATION OF GENERATING SETS

#### 2.1 GENERAL

This section gives general requirements for the location, protection, control and connection of generating sets. Additional requirements, relevant to permanently connected generating sets and plug and socket-outlet connected generating sets, are given in Sections 3 to 6.

#### 2.2 LOCATION

2.2.1 Generating sets shall not be operated in locations where exhaust gases, smoke or fumes could reach dangerous concentrations or directly or indirectly enter rooms occupied by persons.

2.2.2 In addition, generating sets shall not be installed:

- (a) In damp situations or in situations exposed to the weather unless suitably protected; or
- (b) In hazardous areas, unless the equipment and method of installation complies with the requirements for the hazardous area.

#### 2.3 MECHANICAL AND THERMAL PROTECTION

2.3.1 All components of a generating set including mechanical parts, fuel systems, wiring, switches, instruments and controls shall be adequately protected against mechanical damage.

2.3.2 All moving parts which may cause injury to persons shall be enclosed to prevent accidental contact with such parts. The protection shall be provided by guards in accordance with Subclause 2.3.2.1, railings or fences in accordance with Subclause 2.3.2.2 or a suitable enclosure designed to protect persons operating the machine.

2.3.2.1 Guards required by Clause 2.3.2 shall comply with the requirements of AS 1939 with a minimum degree of protection complying with:

- (a) When located within 100 mm of such parts, IP3X; or
- (b) When located further than 100 mm from such parts, IP2X.

2.3.2.2 Railings and fences required by Clause 2.3.2 shall be constructed and situated to prevent accidental contact.

2.3.3 All parts of a generating set which operate at temperatures in excess of 120°C shall be protected by guards or positioned to prevent accidental contact. However for domestic installations, guards shall be required where the set operates at a temperature in excess of 70°C.

- 2.3.4 Tanks or filling facilities associated with flammable fuels shall not be:
- (a) Installed in the vicinity of high temperature surfaces or equipment which may emit arcs, sparks or hot particles; or
  - (b) Located in such a position that spilled or leaking fuel could fall on such high temperature surfaces or equipment.

## 2.4 ELECTRICAL PROTECTION

- 2.4.1 Persons shall be protected against dangers that may arise from contact with live parts of the installation.
- 2.4.2 Live parts of a generating set shall be:
- (a) Enclosed in accordance with the requirements of NZS 6200; and
  - (b) Located in an area accessible only to authorised persons; or
  - (c) Arranged so that prevention of accidental contact or approach to within a dangerous distance is provided by barriers (such as enclosures, guards, fences or similar obstacles).
- 2.4.2.1 Enclosures, guards or the like, which are provided to prevent accidental contact with live parts, shall not deflect sufficiently under a force of 100 N to reduce the minimum clearances in air between the enclosure and such live parts.
- 2.4.2.2 Barriers, such as wire mesh fences, railings or grilles which provide protection against accidental contact with bare live parts shall maintain minimum safety clearances between intended working areas and such live parts.  
Such barriers may also guard against the inadvertent access to moving parts.
- 2.4.3 Insulating materials shall have a temperature rating adequate for the conditions under which they are used.
- 2.4.4 Outgoing circuits from a generating set shall be provided with over-current protection.

## 2.5 CONTROL

- 2.5.1 Adequate means shall be provided to control:
- (a) The sequence of operations necessary for the safe starting, running and stopping of the generating set; and
  - (b) The output voltage and frequency of supply.
- 2.5.2 Automatic or manual control, or both, shall be provided to regulate and adjust the speed of the prime mover to prevent excessive speeds of rotating equipment.
- 2.5.2.1 Generating sets having a rated output above 15 kW shall be provided with overspeed shut-down devices.

- 2.5.2.2 Where speed-limiting or stopping devices are electrically operated, the control circuits by which such devices are actuated shall be:
- (a) Protected against mechanical damage by enclosure in conduits or other suitable measures; and
  - (b) Protected against the effects of electromagnetic interference by suitable isolation or screening.
- 2.5.3 Every prime mover shall be provided with an isolating device to prevent the starting of the generating set when inspection, repair or maintenance is being carried out.  
An emergency shut-down device may also be necessary under certain conditions.
- 2.5.3.1 The isolating device shall prevent the generating set being started by any automatic device or remote controlled switch. Where a switch located in a control or starting circuit is used for this purpose, it shall physically isolate all live conductors of the circuit.
- 2.5.3.2 The isolating device shall be accessible to maintenance or other authorised personnel and be:
- (a) Installed adjacent to or on the generating set so that a person operating the device has a clear view of any person working on the machine; or
  - (b) Provided with a means of securing the isolating device in the open position so that a deliberate action is required to engage or disengage it.
- 2.5.4 Where a generating set is to be run as an emergency or standby supply system in the case of failure of a reticulated system, one or more changeover devices shall be provided.
- 2.5.5 Changeover devices shall:
- (a) Interrupt one source of supply before connecting the other.
  - (b) Operate in all phase conductors.
  - (c) Operate in the neutral conductor only where:
    - (i) the generator is not part of an MEN installation; or
    - (ii) generators run in parallel.
- 2.5.5.1 A changeover device that operates in the neutral conductor shall be so arranged that it will not connect any phase conductor before the neutral is connected nor disconnect the neutral before all phase conductors have been disconnected.

- 2.5.5.2 Changeover devices shall not operate in the earthing conductor except where generators are run in parallel, and earthing of the neutral is maintained from only one machine at a time.
- 2.5.5.3 Changeover devices shall incorporate a mechanical interlock to prevent the simultaneous connection of the generating set system and the grid reticulation system.  
Where mechanical interlocking of the changeover devices is impracticable, the initiating contactors shall be mechanically interlocked and the changeover devices shall be electrically interlocked, or a duplicate system of electrical interlocking applied.
- 2.5.5.4 A permanently wired changeover device having an intermediate 'off' position may be used in place of a main switch or a switch controlling an individual circuit such that supply may be obtained from either of two sources and isolated from both. Such a device may also be connected as in Subclause 2.5.5.3.  
Changeover devices having an intermediate 'off' position would normally be used for manual operation only.
- 2.5.5.5 A permanently wired changeover device or contactor having no 'off' position shall have a rated voltage capacity to the maximum voltage that is generated between contacts, and be connected in one of the following ways:  
(a) Ahead of an installation main switch, (see Figure 1 (a) Page ?).  
(b) Ahead of switches or circuit-breakers controlling a sub main or final sub circuit, (see Figure 1 (b) Page ?).  
(c) Ahead of a switch controlling an individual circuit (see Figure 1 (c) Page ?).
- 2.5.5.6 Changeover devices shall be accessible only to authorised persons and shall be marked to indicate the purpose and switching positions of the device. Terminals of changeover devices shall also be provided with warning notices to indicate the origin of such supplies.
- 2.5.5.7 Any bypass switch shall not defeat the safety requirements.
- 2.5.6 Where generators require synchronisation, consideration shall be given to the particular requirements for control, protection and synchronization.

## **2.6 EARTHING AND BONDING**

- 2.6.1 The following parts shall be in effective electrical contact with each other:
- (a) The prime-mover frame.
  - (b) The generator frame.
  - (c) All external metal enclosing electrical equipment or wiring.
  - (d) The earth terminals of all outlet plug-sockets and any earth leakage device.
  - (e) The main frame terminal.

- (f) The main winding only as specified in clause 2.6.2 herein. The earth point of any electronic circuitry may need to be connected to the above items.

2.6.2 Connections between main winding(s) and the frame shall be as follows:

- (a) The winding of single-phase windings (without earth-leakage protection) shall not be connected to the frame.
- (b) Single-phase winding shall be connected to a current-operated (core balance) earth-leakage device complying with the requirements for an RCD affording personal protection, and having a residual operating current not exceeding 30 mA.

The input neutral terminal of the RCD shall be connected to the earth terminal of the device (where that terminal exists) or to a frame terminal.

This shall be the only connection between the winding and the frame.

- (c) The star point of three-phase winding (star-connected) shall be connected to the frame via a removable connection or link.
- (d) The neutral or centre-tap of a two-phase winding (or single-phase centre-tapped winding) shall be connected to the frame via a removable connection or link.

In the absence of earth-leakage protection, a single-phase winding is safer when isolated from frame. In the event of a single fault to the frame, the situation then resembles an MEN installation (where one conductor is earthed).

- (e) Where a core balance earth-leakage device is fitted the connection between winding and frame is necessary to permit correct operation of device. If the device were subsequently removed, it is likely (and recommended) that the winding-to-frame connection would be removed. This arrangement is unsuitable for connection to a fixed MEN installation (where the neutral and the earth are connected together on the load side of the device) because the device would trip on the load due to the division of current between the neutral and earth conductors to the installation.
- (f) A removable connection or link is specified in two instances, (c) and (d) so, that it may be easily removed (by an appropriately licensed person) when the set is to be permanently connected to a fixed MEN installation.

2.6.3 Where a generating set supplies an installation which incorporates an earthing system, the points of the generating set which have been bonded together in accordance with Clause 2.6.1 shall be earthed by connection to an appropriate point on the earthing system of the installation.

Connection to earth shall not be made by means of a separate earth electrode.

2.6.3.1 The following points, as applicable, shall be connected to the relevant neutral busbar of the installation and not be directly connected to the generating set bonding system:

- (a) The generating set winding connections referred to in Clauses 2.6.2 (c) and (d); and
- (b) One side of an otherwise unpolarized single-phase generating set winding.

Alternatively, the generating set windings referred to in Paragraphs (a) and (b) of this Subclause may be arranged through a protection system in a manner which ensures the disconnection of the installation in the event of an earth fault.

2.6.4 Where a generating set supplies one or more electrical appliances:

- (a) By individual attachment; or
- (b) As a part of a fixed installation which does not incorporate an earthing system;

the exposed metal of each electrical appliance being supplied shall be effectively connected to the generating set bonding system described in Clause 2.6.1.

## **2.7 SWITCHBOARDS AND CONTROL PANELS**

2.7.1 Switchboards and control panels for the control of generators or their output circuits, shall be equipped with such instruments, relays and control equipment as may be necessary for safe and correct operation. All starting and stopping devices, isolating switches, changeover devices and other devices which may require reading or adjustment, shall be accessible.

## **2.8 SWITCHGEAR**

2.8.1 Switches, circuit-breakers, fuses, contactors, reclosers and other switchgear shall be selected with appropriate regard to the rated values of voltage, service duty and continuous and instantaneous current of the circuits on which they are installed.

2.8.1.1 All protective devices shall be capable of safely interrupting the prospective short-circuit current at the point where the devices are installed.

2.8.1.2 All switchgear used to break load current shall be marked with the rated breaking and making current capacity of the device. Switches that are not rated to interrupt the full-load current of the circuit shall be interlocked with load-breaking devices to prevent the possibility of the switches being opened under load.

- 2.8.2 Where the accidental opening of switches may cause a hazard, means shall be provided for retaining the device in the closed position. This may apply to manual changeover switches or some switches associated with the security of supply to essential emergency services.

## **2.9 BATTERY AND BATTERY CHARGING**

Batteries associated with prime movers shall be suitable for continuous float charging and the starting duty of the generating set.

## SECTION 3

### ADDITIONAL REQUIREMENTS FOR PERMANENTLY CONNECTED GENERATING SETS

#### 3.1 GENERAL

These provisions are to be applied in addition to the general requirements for generating sets given in Section 2 of this Code.

#### 3.2 LOCATION

3.2.1 Permanently connected generating sets shall be located and installed in accordance with Subsection 2.2 and, in addition, means shall be provided to prevent the entrance of, or interference by, unauthorised persons by the erection of suitable fences, screens, partitions, walls or similar barriers.

3.2.1.1 Such barriers shall not impede the access required for authorised persons for maintenance, testing or inspection as provided in Clause 3.2.2. This shall not preclude the installation of a generating set in an enclosure or room with other equipment for which access is similarly restricted to authorised persons.

3.2.2 Adequate space shall be provided around a generating set on all sides where persons are to pass, to enable all equipment to be safely and effectively operated and adjusted.

3.2.2.1 The electrical equipment shall be arranged so as to afford as may be necessary:

- (a) Sufficient space for the initial installation and later replacement of individual items of electrical equipment; and
- (b) Accessibility for operation, testing, inspection, maintenance and repair.

3.2.3 Where a permanently connected generating set is installed in a room or enclosure, suitable means of egress shall be provided.

3.2.3.1 All barriers or doors provided to prevent the entry of unauthorised persons to any room or enclosure shall open outwards away from the generating set without the use, on the generating set side of the door, of a key or tool, and shall be capable of being locked from the outside.

3.2.3.2 Doors and openings providing entrance to and exit from a generating set area shall have a height of not less than 1.8 m from the floor or walked-on surface and width of not less than 0.6 m.

3.2.4 Any room or enclosure containing a permanently connected generating set shall be adequately ventilated so that:

- (a) The room associated with the running of the generating set is limited to 15°C temperature rise; and
- (b) Dangerous concentrations of toxic or explosive fumes and gases are prevented.

3.2.5 Adequate lighting shall be provided to enable equipment and controls of generating sets to be effectively and safely operated.

### **3.3 GUARDING OF LIVE PARTS**

3.3.1 In addition to complying with the general requirements of Clause 2.4.1, walked-on surfaces which are located above exposed live parts shall have no openings. Kickboards at least 0.15 m high and handrails shall be provided at all edges of the walked-on surfaces.

### **3.4 TRANSFORMERS**

3.4.1 Transformer tanks and enclosures shall be earthed in accordance with the requirements for exposed conductive parts.

3.4.2 One side of the secondary circuits of instrument transformers shall be effectively earthed except where functional requirements do not permit earthing to such circuits.  
Current transformers shall have provision for short-circuiting the secondary winding.

## SECTION 4

### **ADDITIONAL REQUIREMENTS FOR PORTABLE OR TRANSPORTABLE PLUG AND SOCKET - OUTLET CONNECTED GENERATING SETS**

#### **4.1 GENERAL**

- 4.1.1 The provisions of this Section are to be applied in addition to the general requirements for generating sets given in Section 2 of this Code.
- 4.1.2 The supply lead shall be of a heavy duty tough rubber sheathed or tough plastic sheathed type cable or cord which shall be in one continuous length. The earth continuity conductor shall be contained in the flexible cable or cord and connected to the installation inlet by a pin integral with the other conductors of the plug/socket.
- 4.1.2.1 All components of the supply lead shall be appropriate rated for the maximum demands likely to be imposed on them.
- 4.1.2.2 The flexible cable or cord shall be protected from mechanical damage.
- 4.1.3 Plug and socket-outlets used for connection of portable/transportable sets shall be of a type which does not expose live parts to accidental contact whilst disconnected or in the normal process of plug insertion or withdrawal.

#### **4.2 EARTHING AND BONDING**

- 4.2.1 The equipotential bonding and earthing requirements for plug and socket-outlet connected generating sets shall be as specified in Clause 2.6.1 and 2.6.2. Attention is drawn to the provisions of Subclause 2.6.3.1 and Clause 2.6.4 which require the generating set bonding system to be connected to the exposed conductive parts of any equipment being supplied by the generating set and, in certain circumstances, connected to earth.
- 4.2.2 The neutral or centre-point of multiphase and single-phase centre-tapped generating set winding shall be connected to the generating set bonding system in accordance with Clause 2.6.2 paragraphs (c) or (d).
- 4.2.3 No point of a single phase non centre-tapped generating set winding shall be connected at the generating set to the generating set bonding system.
- 4.2.3.1 This does not preclude an indirect connection occurring between one side of the generating set winding and the generating set bonding system where-
- (a) the generating set winding is connected to the neutral of a fixed installation in accordance with Subclause 2.6.3.2; and
  - (b) the earthing system of the installation is permitted to be connected to the neutral of the installation.

### **4.3 MARKING**

Socket-outlets or inlet-sockets provided for the connection of a generating set shall be legibly and indelibly marked to indicate their purpose.

### **4.4 CONTROL OF SOCKET-OUTLETS**

Socket-outlets need not be provided with an isolating switch for generator sets up to 2.5 kW not supplying permanent wiring. For generators above 2.5 kW, all outlets shall be provided with an isolating switch which operates in all live conductors.

## **SECTION 5**

### **ADDITIONAL REQUIREMENT FOR TRANSPORTABLE CONNECTED GENERATORS BY TEMPORARY CABLES**

#### **5.1 GENERAL**

- 5.1.1 This section gives particular requirements for the temporary supply to an installation by a transportable generator, connected by the use of temporary cables. This is usually an emergency supply to an installation where the mains supply network has failed.
- 5.1.2 The installation shall comply with the appropriate requirements of Section 2 of this Code and in addition with Subsection 5.2.
- 5.1.3 Phase, neutral and earth conductors of the cables from the generator shall be of the same cross sectional area and the class of cable shall ensure adequate insulation and be protected against mechanical damage.

#### **5.2 ISOLATION**

- 5.2.1 Unless the method of isolation of the reticulated supply to the installation has been specified by the electricity supplier there shall be physical isolation of all phase and neutral conductors from the installation. Bonding and earthing of the installation shall not be disconnected.
- 5.2.1.1 The removal of fuses is not considered physical isolation.
- 5.2.1.2 It is vital that no feedback to the reticulated system from any generator occurs in an emergency situation.

## SECTION 6

### REQUIREMENTS FOR ELECTRICITY SUPPLY CHARACTERISTIC CHANGERS

#### 6.1 GENERAL

This Section gives particular requirements for an electricity supply characteristic changer (electronic power inversion) which includes static and dynamic equipment designed either to stabilize the supply voltage, or to change the voltage or frequency of an electricity supply, or to maintain a continuous electricity supply when the primary source of electricity supply is interrupted.

Transformers shall not be considered as electricity supply characteristic changers.

#### 6.2 CONTROL

6.2.1 Electricity supply characteristic changer shall be controlled by switches or devices suitable for starting and stopping the equipment.

6.2.1.1 Where there is more than one switch or device for this purpose, they shall be grouped together and clearly identified.

#### 6.3 ISOLATION

6.3.1 Electricity supply characteristic changer shall be provided with an independent isolating device which shall be capable of isolating the incoming supply.

6.3.2 The isolating device shall:

- (a) Be installed adjacent to or on the equipment so that a person operating the device has a clear view of any person working on the equipment;
- (b) Comply with the requirements for isolation;
- (c) Be under manual control only; and
- (d) Not be capable of being overridden or bypassed by programmable control systems or the like.

6.3.3 Where static output switching is incorporated in the equipment, appropriate safeguards shall be provided to prevent feedback to the incoming supply.

#### 6.4 OVERCURRENT PROTECTION

6.4.1 Electricity supply characteristic changers shall be provided with overcurrent protection which shall be located so that the interconnecting conductors between the input terminals of the electricity supply characteristic changer and the overcurrent protection device are as short as practicable.

- 6.4.2 Every sub-main or final sub-circuit supplied by an electricity supply characteristic changer shall be individually protected at its origin by an overcurrent device. A rewirable fuse shall not be used for this purpose.
- 6.4.3 The output of an electricity supply characteristic changer shall be provided with the same type of earthing system as employed for the associated electrical installation.
- 6.4.4 Electrical fittings and appliances connected to the output side of an electricity supply characteristic changer shall be suitable for the voltage, current and frequency of the output of the unit.

## **6.5 BATTERIES**

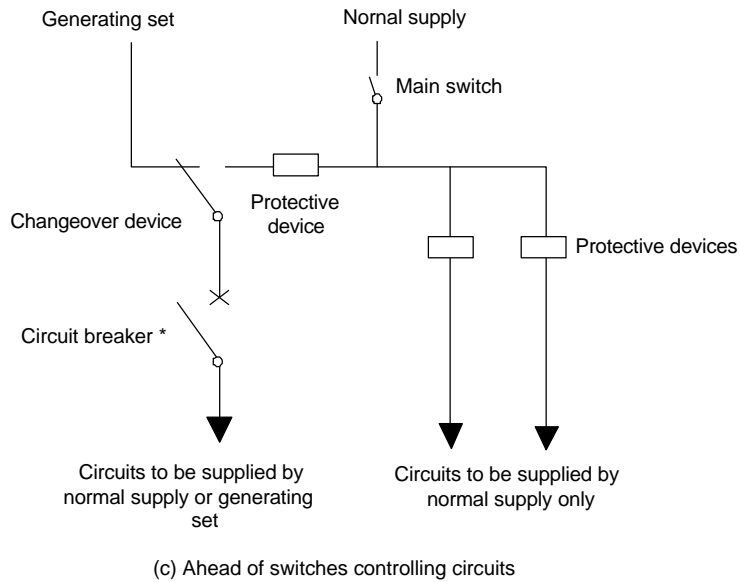
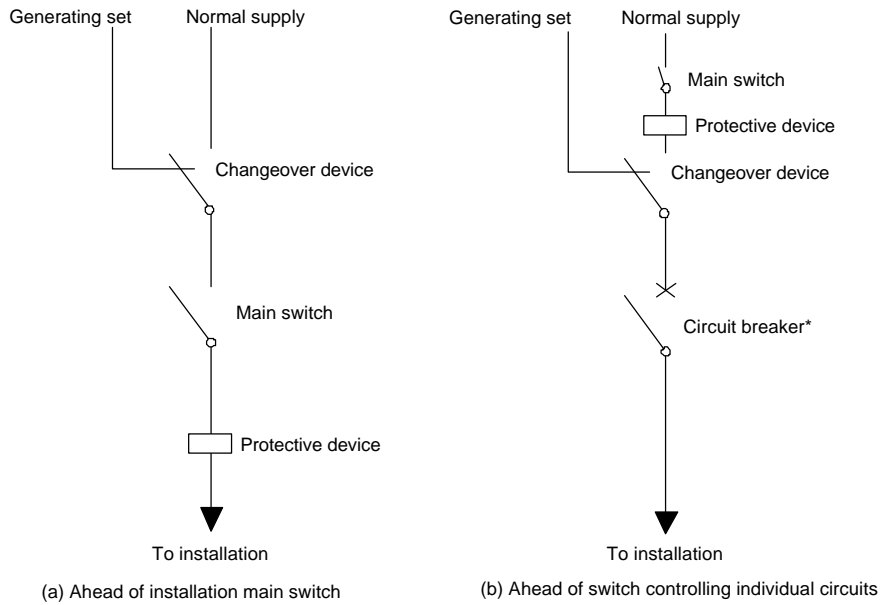
- 6.5.1 Where electricity is supplied to equipment from secondary batteries, the equipment and all wiring and connections thereto shall comply with the requirements for extra-low voltage, or low voltage as appropriate to the nominal battery voltage.
- 6.5.2 Where fixed a.c. and d.c. conductors are used in an installation, the colour black shall be used for the neutral conductor only.  
The colour green or green/yellow in combination shall be used for protective earthing conductors only.
- 6.5.3 Every battery shall be arranged so that each cell is easily reached from the top and at least one side for the purpose of examination, refilling and removal.
- 6.5.4 Where the battery exceeds 120 volts, the cells shall be arranged to minimise the risk of electric shock. Where this is not practicable physical barriers or insulated terminals and busbars shall be used.  
Cell tops and containers shall be kept clean and dry to avoid a shock from earth-leakage current.
- 6.5.4.1 Where the voltage is in excess of 120 volts each battery supply conductor which is not at earth potential shall be protected by an earth-leakage detector and be installed to warn of any breakdown of the conductor or conductors to earth: that detector shall operate at a maximum earth-leakage current of 10 mA.
- 6.5.4.2 The battery terminals, busbar and cable interconnections between inter-row and inter-tier terminals shall be either:
- (a) Insulated; or
  - (b) Protected by insulated barriers to prevent accidental contact.

- 6.5.5 Each non-earthed battery output conductor shall be individually protected against overload by a protective device positioned as close as practicable to the battery terminals. A rewirable fuse shall not be used for this purpose.
- 6.5.5.1 Fault-current limiters shall be used where the requirements of Clause 6.5.5 cannot be achieved.
- 6.5.6 The battery installation shall have an isolating device as close as possible to the main terminals of the battery.
- 6.5.6.1 Where a busbar system is installed the isolating switch may be incorporated into the end of the busbar.
- 6.5.6.2 Where the removal of a fuse carrier or a circuit breaker isolates all non earthed battery conductors simultaneously, this shall suffice as an isolating device.
- 6.5.7 Where the battery section voltage exceeds extra-low voltage the installation shall be fitted with an isolating switch, plugs or links as required to isolate sections of the battery, or part of the battery for maintenance.
- 6.5.7.1 The isolating switch, plugs or links shall be operated only for major maintenance of batteries, such as removal or replacement of cells corrosion repair etc., to provide protection from electric shock to operators.
- 6.5.8 A battery shall only be installed in a room or enclosure which is adequately ventilated. Where mechanical ventilation is not provided, both high and low vents shall be installed.
- 6.5.9 In addition to the control equipment required for each battery installation, suitable means shall be provided for the control and limitation of the battery charging current and voltage.
- 6.5.10 Where the nominal battery voltage is in excess of extra-low voltage, a suitable danger notice shall be prominently displayed on the battery rack, battery room or enclosure to indicate the battery voltage.
- 6.5.10.1 Full safety instructions for isolation and maintenance shall be displayed adjacent to the equipment.

**Figure 1**

**LOCATION OF CHANGEOVER DEVICE WITHOUT AN OFF POSITION**

Metering not shown



\* May also be control switch or switch fuse