



TITLE	SPECIFICATION FOR METAL CLAD WITHDRAWABLE SWITCHGEAR	REFERENCE	REV
		CP_TSSPEC_035	5
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TABLE OF CONTENTS

	Page
FOREWORD	3
INTRODUCTION	4
1. SCOPE	4
2. NORMATIVE REFERENCES	4
3. DEFINITIONS AND ABBREVIATIONS	4
4. REQUIREMENTS	4
4.1 General	4
4.2 Service conditions	5
4.3 Ratings	5
4.4 Design and construction	7
4.5 SCADA interface	11
4.6 Protection	12
4.7 Voltage drop and supply interruption	12
4.8 Electromagnetic compatibility (EMC)	13
4.9 Luminous indicators	13
4.10 Voltage detection system (VDS)	13
4.11 Flammability	13
4.12 Terminals	13
4.13 Rating Plates	13
5. TESTS	14
5.1 Type tests	14
5.2 Routine Tests	14
5.3 Inspection of equipment	14
6. DOCUMENTATION	14
7. TRAINING	14
8. QUALITY MANAGEMENT	15
9. ENVIRONMENTAL MANAGEMENT	15
Annex a - Bibliography	16
Annex B - Revision information	17
Annex C - Technical schedules A and B for 11 kV switchgear	20
Annex C - Technical schedules A and B for 22 kV switchgear	29
Annex D – Stock Items	38

**SPECIFICATION FOR 11kV AND 22 kV
INDOOR METAL-CLAD SWITCHGEAR FOR
DISTRIBUTION SUB-STATIONS**

REFERENCE	REV
CP_TSSPEC_035	5
PAGE 2	OF 38

**SPECIFICATION FOR 11kV AND 22 kV
INDOOR METAL-CLAD SWITCHGEAR FOR
DISTRIBUTION SUB-STATIONS**

REFERENCE
CP_TSSPEC_035

REV
5

PAGE **3** OF **38**

FOREWORD

Recommendations for corrections, additions or deletions should be addressed to the:

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2016

INTRODUCTION

City Power utilises traditional withdraw able metal clad switchgear in their distribution substations, to open and close (under normal and fault conditions), isolate and earth sections of the power system. The panels are intended for indoor application with secure and restricted access to the building. These panels have to meet specified technical requirements to ensure their reliability and safety to personnel.

1. SCOPE

This specification details specific requirements for 11kV and 22kV indoor metal-clad switchgear and control gear to be installed in City Power's substations in accordance with IEC 62271-200.

2. NORMATIVE REFERENCES

The following documents contain provisions that, through reference in the text, constitute requirements of this specification. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

- IEC 62271-200, *High-voltage switchgear and control gear – Part 200: A.C. metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.*
- IEC 62271-100, *High-voltage switchgear and control gear – Part 100: High-voltage alternating-current circuit-breakers.*
- IEC 62271-102, *High-voltage switchgear and control gear Part 102: Alternating current disconnectors and earthing switches*
- IEC 60947-5-1, *Low-voltage switchgear and control gear Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices.*
- IEC 61000-4-29, *Electromagnetic compatibility (EMC) Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on D.C. input power port immunity tests*
- IEC 60529, *Degrees of protection provided by enclosures (IP Code)*
- IEC 60071-1, *Insulation co-ordination – Part 1: Definitions, principles and rules.*
- IEC 61243-5, *Live working — Voltage detectors Part 5: Voltage detecting systems (VDS)*
- SANS 61869-1, *Instrument Transformers Part1: General Requirements*
- SANS 60694, *Common specifications for high-voltage switchgear and control gear standards.*
- SANS 1885, *AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 36 kV*
- SANS 1019, *Standard voltages, currents and insulation levels for electricity supply*
- SANS 1091, *National colour standard*
- SANS 876, *Cable terminations and live conductors within air-insulated enclosures (insulation co-ordination) for rated A.C. voltages of 7.2 kV and up to and including 36 kV.*
- CP_TSSPEC_001, *Specification for 11 kV and 22 kV PILC and XLPE cables*
- CP_TSSPEC_002, *Specification for low voltage insulated wires, power and multi-core control cables*
- CP_TSSPEC_053, *Accessories for medium voltage power cables for systems with nominal voltage of 11 kV to 33 kV*

City Power Environmental Policy

3. DEFINITIONS AND ABBREVIATIONS

The definitions and abbreviations in the above normative references shall apply to this specification.

4. REQUIREMENTS

4.1 General

- 4.1.1 Metal-clad switchgear and control gear shall be manufactured in accordance with IEC 62271-200. Where conflicting requirements with IEC 62271-200 occur, this specification shall take precedence.

4.1.2 Metal-enclosed switchgear and control gear shall be designed so that the following events could be done safely:

- normal service,
- inspection,
- maintenance operations,
- determination of the energized or de-energized state of the main circuit,
- checking of phase sequence,
- earthing of connected cables,
- test plug to facilitate the locating of cable faults,
- voltage tests on connected cables or other apparatus,
- the elimination of dangerous electrostatic charges and
- Condition monitoring.

4.1.3 All removable parts and components of the same type, rating, and construction shall be mechanically and electrically interchangeable.

4.2 Service conditions

The switchgear shall be suitable for operating under the following environmental conditions:

Altitude	1800m AMSL (Above Mean Sea Level)
Ambient temperature	5°C to 40°C
Relative humidity	10% to 95%
Pollution levels within enclosure	Light for indoor application.

4.3 Ratings

4.3.1 Rated voltage

4.3.1.1 The rated voltage of the switchgear shall be in accordance with the values given in Table 1. The rated voltage will be specified in schedule A.

4.3.1.2 The number of phases shall be three.

4.3.2 Rated insulation level (BIL)

4.3.3.1 The rated insulation levels of the switchgear shall be in accordance with the values given in Table 1. The rated insulation levels offered shall be in stated in schedule B.

4.3.3.2 The network frequency shall be 50Hz.

Table 1: Rated voltage and insulation levels¹

Nominal system voltage Un [kV (rms.)]	Rated voltage Ur [kV (rms.)]	Rated short – duration power – frequency withstand voltage Ud [kV (rms.)]	Rated peak lightning impulse withstand voltage Up [kV(peak)]
		Common value	Common value
11	12	28	95
22	24	50	150
1. The information in this table is extracted from SANS 1019			

4.3.3 Rated normal current

4.3.3.1 For 11kV switchgear, the rated normal current of the bus bar, bus-section and incomer panel main circuits shall be 1250 A or 2500 A.

4.3.3.2 For 22kV switchgear, the rated normal current of the bus bar, bus-section and incomer panel main circuits shall be 1250 A.

4.3.3.3 The rated normal current of all feeder panel main circuits shall be 800 A

4.3.3.4 The standard rated normal currents of the panel main circuits are given in Table 2.

Table 2: Rated normal currents (Ir)

Nominal system voltage Un [kV]	1250 A Busbar rating			2500 A Busbar rating		
	Panel application			Panel application		
	Incomer	Bus-section	Feeder	Incomer	Bus-section	Feeder
	Ir [A]	Ir [A]	Ir [A]	Ir [A]	Ir [A]	Ir [A]
	1250	1250	800	2500	2500	800
11	x	x	x	x	x	x
22	x	x	x	-	-	-

4.3.3.5 The associated temperature rise for the normal currents given in Table 2 shall be in accordance with SANS 62271-200.

4.3.3.6 All normal current rating and associated temperature rises shall be based on natural air cooling. Forced air cooling shall not be accepted.

4.3.4 Rated short time and peak withstand currents

4.3.4.1 The rated R.M.S. short-time withstand current (Ik) of the main circuit (i.e. including bus bars and circuit breakers) and earthing switches shall be in accordance with the values

given in Table 3. The rated short-time withstand current offered shall be stated in schedule B.

4.3.4.2 The rated R.M.S. short-time withstand current (I_{ke}) of the earthing circuit of the switchgear (i.e. earthing bars of the earthing system) shall be in accordance with the values given in Table 3. The rated short-time withstand current offered shall be stated in schedule B.

4.3.4.3 The rated peak withstand current (I_p) of the main circuit (i.e. including busbars and circuit breakers) and earthing switches shall be in accordance with the values given in Table 3. The rated short-time withstand current offered shall be stated in schedule B.

4.3.4.4 The rated peak withstand current (I_{pe}) of the earthing circuit of the switchgear (i.e. earthing bars of the earthing system) shall be in accordance with the values given in Table 3. The rated short-time withstand current offered shall be stated in schedule B.

4.3.4.5 Rate of operating sequence shall be as specified in **schedule A**.

Table 3: Rated short-time and peak withstand current

Nominal system voltage U_n [kV]	Rated short-time withstand current I_k, I_{ke} [kA(rms.)]	Rated peak withstand current I_p, I_{pe} [kA(peak)]
11	25	63
22	20	50

4.4 Design and construction

4.4.1 Loss of service continuity category (LSC)

The panels shall be classified LSC2B-PM and the mechanism of the shutters shall be designed to be failure proof.

4.4.2 Internal arc classification (IAC)

Internal arc classification (IAC) shall be AFLR in accordance with IEC 62271-200, i.e. restricted access and tested for all sides (front, lateral and rear).

Note: *A pressure relief duct, to release the gases resulting from a possible internal arc can be additionally provided to improve the level of safety for the operators.*

4.4.3 Internal arc detection

4.4.3.1 The circuit breaker, bus bar and cable compartments of the circuit breaker panel shall be fitted with arc-light detection sensors for detecting internal arcs. The designs shall have been successfully tested according to Internal Arc Classification.

4.4.3.2 The arc protection detection device shall be positioned such that the breakers are not tripped due to the light from the arc inside the vacuum interrupter.

4.4.4 Circuit breaker type

4.4.4.1 Trolley type withdrawable type circuit breaker shall be acceptable.

4.4.4.2 Circuit breakers shall be suitable for the following switching duties:

- Mechanical endurance class M2;
- Electrical endurance class E2 and
- Capacitive switching class C2.

4.4.5 Circuit breaker interrupting medium

- 4.4.5.1 Only circuit breakers utilising vacuum interrupting medium shall be acceptable.
- 4.4.5.2 Vacuum bottles shall be capable of 30 000 operations for normal load and fault current handling before replacement.
- 4.4.5.3 The Vacuum bottles shall be accompanied by the Manufacturer's Data Sheet proving the quantity/number of operation the bottle can do.

4.4.6 Busbars

- 4.4.6.1 The panel shall be of single bus bar configuration.
- 4.4.6.2 Busbar insulating materials shall be of the heat shrink type with non-static characteristics.
- 4.4.6.3 The insulation material shall not contribute to the partial discharge of the switchboard and shall be identical to the material used in the type testing for insulation testing (impulse, power frequency type testing and temperature rise type testing).
- 4.4.6.4 All power circuit insulation and segregation materials shall have an expected life exceeding the switchgear life by a factor of two without degrading due to age, temperature for normal service conditions or contribute to the partial discharge of the entire switchboard.
- 4.4.6.5 The point of connection of the cable/s onto the switchgear shall provide for each cable-core to be connected by means of a lug onto a separate copper bus bar section. The arrangement is intended to allow for the fitting of a shroud over the lug and fasteners.
- 4.4.6.6 The creepage distances for post insulators holding the bus bars shall be 20 mm/kV.

4.4.7 Enclosure

- 4.4.7.1 Protection against corrosion shall be ensured by the use of suitable materials, taking into account the intended conditions of use and in accordance with the service conditions.
- 4.4.7.2 Degrees of protection shall be detailed in **schedule A** for all enclosures of MV switchgear and control gear containing parts.
- 4.4.7.3 Hole pre-drilling and vermin proofing shall be provided to all cable access points.
- 4.4.7.4 Enclosure shall be designed for ease of access to the cables for the purposes of termination and connecting. The termination enclosure cover and the glade plate shall be removable

Note: *The gland plate shall have a predrilled/punched cable entry hole of the diameter of 630mm²(single core) or 185mm²(three core) cable for copper cables and 1000mm²(single core) or 300mm² for aluminium cables.*

4.4.8 Power cable terminations enclosure

- 4.4.8.1 The power cable compartment shall be accessible from the rear of the switchboard.
- 4.4.8.2 Power cable terminations for feeder and distribution transformer panels shall be suitable for three-core XLPE insulated cables that comply with City Power cable specification (CP_TSSPEC_053).
- 4.4.8.3 Only type 2 terminations with fully shrouded cable terminals shall be acceptable.
- 4.4.8.4 Power cable terminations and live conductor arrangements in air-filled enclosures shall comply with the minimum clearances c and d of SANS 876.
- 4.4.8.5 No surge arresters shall be installed in feeder panels.

Note: *Possible connection for incomer 12 x 630mm² (4x630mm² per phase) for copper and 12 x 1000mm² (4x1000mm² per phase) for aluminium single core XLPE insulated cables*

Note: *Type 2 termination: lugs connected onto bushings or post insulators with a shrouded insulation termination.*

4.4.9 Interlocks

- 4.4.9.1 The panel shall be designed for full operation behind closed doors.
- 4.4.9.2 The circuit breaker interlocks shall be designed so that the circuit breaker when in the service position can only be operated if the auxiliary supply is connected. Conversely, it shall prevent the disconnection of the auxiliary circuits with the circuit-breaker closed in the service position.

4.4.10 Panel colours

The panel colour coding system provided shall be as per table 1.

Panel Type	Colour required on panel	Colour required on shutters	
		Bus bars	Cable
Incomer & Inter-connector	Signal Red (A11)	Signal Red (A11)	Signal Red (A11)
Bus-section	Orange (B26)	Golden Yellow (B29)	Golden Yellow (B29)
Pairing inter-connectors	Light Stone (C37)	Signal Red (A11)	Signal Red (A11)
Feeder	Grey (G29)	Signal Red (A11)	Golden Yellow (B29)

Table 1: Panel colour coding system

4.4.11 Inspection window

An inspection window shall be provided for the enclosure with at least the degree of protection specified for the enclosure. It shall be covered by a transparent sheet of mechanical strength comparable to that of the enclosure. Precautions shall be taken to prevent the formation of dangerous electrostatic charges, either by clearance or by electrostatic shielding.

4.4.12 Infra-Red Scanning Window

- 4.4.12.1 Infra-Red scanning windows shall be provided at all cable boxes and on the side of the busbars.

- 4.4.12.2 These windows shall be tested for internal arc at 12kV or 24 kV according to the requirements of IEC 62271-200.
- 4.4.12.3 Full type test reports shall be provided.

4.4.13 Earthing

To ensure personnel protection during maintenance work, all parts of the main circuit to which access is required shall be capable of being earthed prior to becoming accessible.

- 4.4.13.1 Busbar or bus section earthing facility shall not be provided.
- 4.4.13.2 Earthing facilities for all main circuits shall be provided and comply with IEC 62271-102; and have a class of E2 rating.
- 4.4.13.3 The earthing shall have a fault make capacity that can withstand the switchboard short circuit current rating.
- 4.4.13.4 The earth switch shall be properly interlocked and manually operated from the front of the switchboard.
- 4.4.13.5 NO earthing by means of a specially designed earth truck will be accepted.

4.4.14 Energy storage in springs

It shall not be possible for the moving contacts to move from the open position unless the charge is sufficient for satisfactory completion of the closing operation.

Note: It must also not be possible to activate the closing of the breaker if the spring is not fully charged.

4.4.14.1 Manual charging

If a spring is charged by hand, the direction of motion of the handle shall be marked.

4.4.14.2 Motor charging

Motors and their electrically operated auxiliary equipment for charging a spring shall operate satisfactorily at the rated supply voltage.

4.4.15 Position indication

- 4.4.15.1 In order to provide increased operator safety and minimise the chance of error, all metal-clad switchgear shall be supplied with an indication on the front panel.
- 4.4.15.2 The colours of the position-indicating device in the open, closed, or, where appropriate, earthed position shall be in accordance with IEC 60073.
- 4.4.15.3 The closed position shall be marked, preferably with an, **I**. The open position shall be marked, preferably with an **O** as per IEC 60417.

4.4.16 Auxiliary and control circuits

- 4.4.16.1 The supply voltage for auxiliary and control circuits shall be 110V D.C.

4.4.17Wiring

- 4.4.17.1 Current and voltage transformer wiring shall be 2, 5 mm² and colour coded according to the phase colours.
- 4.4.17.2 All auxiliary wires shall be 1, 5 mm² and grey.
- 4.4.17.3 If auxiliary wiring has two different voltage levels, the lower voltage level shall be purple in colour to differentiate it from the other wiring.
- 4.4.17.4 All wiring shall comply with the requirements of CP_TSSPEC_002.

4.4.18Protection of auxiliary circuits

All DC circuits shall be protected by double pole MCB's fitted with an auxiliary contact (one normally open and one normally closed contact).

4.4.19Current and voltage measuring facilities

- 4.4.19.1 Ammeters and voltmeters for measuring primary current and voltage respectively shall **NOT** be provided.
- 4.4.19.2 A voltmeter shall be installed onto the LV compartment of the incomer panel for measuring the battery voltage.
- 4.4.19.3 It shall be possible to read the circuit breaker voltage, current, power demand and for measuring the DC voltage on the incomer panel via a LCD display on the protection and control IED.
- 4.4.19.4 The detailed current transformer and voltage transformer requirements shall be as specified by City Power Protection Department in the relevant tender document.

4.4.20Auxiliary termination boxes

All auxiliary termination boxes shall be provided horizontally across the back of all circuit breaker panels.

4.4.21Control facilities

- 4.4.21.1 All protection and control equipment shall be housed in a separate control room. The protection and control facilities shall be housed in clearly designated, custom designed cubicles with tiled mimics and shall be linked to the switchgear by a multi core cable.
- 4.4.21.2 The protection, control and metering cable shall be run in ducts or on cable trays within the confines of the substation.
- 4.4.21.3 Remote control hand-held units shall be provided as specified in **clause 4.4.21.4** of this specification.
- 4.4.21.4 It is possible that in retrofitting existing substations, no separate control room will be available. This would require mounting of control equipment on the switchgear in the conventional manner, in which case the switchgear shall be supplied with an umbilical cord and remote control unit for operating of the switchgear in the event of SCADA failure.

4.5 SCADA interface

- 4.5.1 Circuit breaker and other bay information shall be linked to an RTU via a serial communication port or a fibre optic connection on the rear of the protection and control IED.

The IED to RTU communication protocol interface shall be IEC 61850 as specified in the SCADA/RTU specification.

- 4.5.2 Facilities shall be available to manually operate the circuit breaker at the switch bay, in the separate control room and via SCADA.
- 4.5.3 The RTU shall be housed in the separate control room when the room is provided.
- 4.5.4 Each switchgear panel shall have a manually operating switch to select the breaker operation on Local/Supervisory.
- 4.5.5 Within each switchgear panel, the protection IED shall provide one hard-wired output contact to indicate a protection failure alarm in the event of the IED device failing or the DC power to the device failing (fail safe mode). This shall be paralleled with any indication of an MCB's (miniature circuit breaker) trip that results in inoperable protection, to indicate a protection urgent alarm.

NOTE: *The detailed SCADA requirements shall be as specified in the relevant tender document.*

4.6 Protection

- 4.6.1 Incoming and outgoing circuit breakers shall be fitted with IDMT and DT overcurrent and IDMT and DT sensitive earth fault protection, operating a trip coil shunted by a relay.
- 4.6.2 Incomer switchgear shall have facilities for differential protection if so stated in tender. It may be necessary to adapt to existing systems.
- 4.6.3 Only relays operating from the auxiliary station DC supply shall be utilised. This will depend on the arrangement at the substation concerned and shall be clarified in the tender. The station DC supply shall be as specified in relevant tender document.
- 4.6.4 The cable box compartment shall be protected using arc protection. Only the circuit breaker associated with the cable box must trip for a fault within the cable box. An arc fault in the incomer cable compartment shall also trip the associated HV breaker to isolate the affected transformer. A trip shall be initiated by the detection of arc-light **AND** current.
- 4.6.5 The bus bar and circuit breaker compartment shall be protected using arc protection. The entire switchgear zone associated with the bus bar or circuit breaker compartment arc fault must trip. A trip shall be initiated by the detection of arc light **AND** current.
- 4.6.6 Each circuit breaker shall have a single IED that will incorporate protection, control, interlocking and SCADA.
- 4.6.7 Incomers and parallel feeders shall have unit protection of the differential type.
- 4.6.8 All generic switchgear wiring schematic shall be adopted as per drawing number **CP_TSDRAW_050/052/053 and 054**, final approval shall be provided by Protection.

Note: *The detailed Incomer, Bus Section and Feeder protection requirements shall be as specified in relevant tender document.*

4.7 Voltage drop and supply interruption

The system shall be considered to perform correctly even if a sequential supply interruption has taken place and there are no false operations; no false alarms or false remote signaling and any pending action is correctly completed, even with a short delay.

4.8 Electromagnetic compatibility (EMC)

The secondary system shall be able to withstand electromagnetic disturbances without damage or malfunction. This applies both under normal operation and under switching conditions, including interruption of fault currents in the main circuit. EMC requirements shall comply with sub-clause 2.1.1 g) of IEC 60694.

4.9 Luminous indicators

4.9.1 Indicator lights are associated with the control circuit equipment; therefore, they shall meet the requirements of IEC 60947-5-1.

4.9.2 Trip indicators shall be a green indicator and the closed indicator shall be red.

4.10 Voltage detection system (VDS)

4.10.1 Each incoming and feeder cubicle shall be fitted with live voltage detection system.

4.10.2 The system shall detect the voltage on power cables connected to the cubicle, and indicate the presence of voltage via lamps.

4.10.3 It shall be possible to connect phase balance or phase comparators to VDS system in front.

4.10.4 The voltage detection system shall comply with IEC 61243-5.

4.11 Flammability

The auxiliary materials shall be chosen and designed such that they retard the propagation of any flame resulting from accidental overheating in the switchgear and control gear.

4.12 Terminals

4.12.1 Only hook blade type lugs shall be provided.

4.12.2 No joints shall be allowed in any panel wiring.

4.13 Rating Plates

4.13.1 The switchboard rating plate shall be attached to the front of the bus section's LV compartment.

4.13.2 The removable parts shall have a separate nameplate with the data relating to the functional units.

4.13.3 This plate shall be of intrinsically corrosion-resistant material with the following details legibly and indelibly marked as follows:

- The manufacturer's name;
- The product type number;
- The voltage and current rating; and
- The insulation level.

5. TESTS

5.1 Type tests

- 5.1.1 Type tests shall be performed as per IEC 62271-200.
- 5.1.2 Internal arc tests shall be mandatory as detailed in this specification.
- 5.1.3 The circuit breaker shall be tested for M2, E2 and C2 classification for electrical, mechanical and capacitive tests respectively in accordance with IEC 62271-100.

5.2 Routine Tests

- 5.2.1 Routine tests shall be performed as per IEC 62271-200. The following minimum test shall apply:
 - Wiring and function tests
 - Equipment verification tests
 - Low voltage circuit insulation test
 - High voltage power frequency test
 - All current and voltage transformers shall be partial discharged tested. The results for phase to neutral shall be partial discharge free.

5.3 Inspection of equipment

City Power retains the right to inspect any switchgear before delivery. This inspection entails a thorough check to ensure complete compliance with this specification, switchgear schedules and the approved manufacturer's drawings by Protection department.

6. DOCUMENTATION

- 6.1 Technical product catalogue, tools, operating, installation and maintenance manuals shall be provided.
- 6.2 Full detailed dimensions drawings shall be provided.
- 6.3 A copy of all type test reports shall be provided.
- 6.4 A copy of the proposed routine test reports shall be provided.

Note: *All the above documents shall be in English.*

7. TRAINING

- 7.1 The following certified training courses, for City Power's staff; shall be provided:
 - 7.1.1 Operating and troubleshooting of switchgear supplied,
 - 7.1.2 minor service/ first line maintenance of switchgear supplied,
 - 7.1.3 condition monitoring & refurbishment of units and
 - 7.1.4 Protections relay programming and setting (if applicable).

7.2 Basic training material in the form of hardcopy material as well as electronic format must be handed to the attendees.

7.3 The associated costs for the certified training courses in 7.1 shall be given per person and shall be fixed for the period of the contract/tender.

8. QUALITY MANAGEMENT

A quality management plan shall be set up in order to assure the proper quality management of the metal-clad switchgear during design, development, production, installation and servicing phases. Guidance on the requirements for a quality management plan may be found in the ISO 9001. The details shall be subject to agreement between City Power and the Supplier.

9. ENVIRONMENTAL MANAGEMENT

An environmental management plan shall be set up in order to assure the proper environmental management of the metal-clad switchgear throughout its entire life cycle (i.e. during design, development, production, installation, operation and maintenance, decommissioning and disposal phases). Guidance on the requirements for an environmental management system may be found in ISO 14001 standards. The details shall be subject to agreement between City Power and the Supplier. This is to ensure that the asset created conforms to environmental standards and City Power SHEQ Policy.

10. Health and Safety

A health and safety plan shall be set up in order to ensure proper management of the fixed pattern non-withdrawable switchgear and compliance of the queuing system during installation, operation, maintenance, and decommissioning phases. Guidance on the requirements of a health and safety plan may be found in OHSAS 18001 standards. This is to ensure that the asset conforms to standard operating procedures and City Power SHERQ Policy.

Annex a - Bibliography

DSP_34-1157 REV 2: Eskom distribution groups requirements for 11kV, 22kV and 33kV indoor switchgear manufactured in accordance with SANS 1885.

Annex B - Revision information

DATE	REV. NO.	NOTES
Dec 2002	0	First issue
Mar 2006	1	Reference to IEC 62271-200 Feeder breaker normal current rating revised to 630 A (minimum) Specified only vacuum interrupting medium Included material of partitions and shutters, loss of supply continuity, internal arc classification, protection and SCADA requirements, DC voltmeter required on the LV compartment of the incomer panel. Reviewed type tests to include mandatory internal arc testing for all categories in accordance with IEC 62271-200. Included the environmental management system
Jun 2006	2	Addition of clause 4.2.2 point 2): 1250 A rating for incomers to be used in secondary (switching) stations.

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REFERENCE
CP_TSSPEC_035

REV
5

PAGE **18** OF **38**

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3

Updated logos and title

Edited general requirements (4.1)

Inclusion of Service conditions (4.2)

Exclusion of 1250A incomer to secondary switching stations (4.3.2).

Inclusion of a note below (4.3.4)

Inclusion of detailed design and construction sub-clues (4.4)

Inclusion of generic schematic drawing number (4.6)

Inclusion of voltage drop and supply interruption (4.7)

Inclusion of electromagnetic compatibility (EMC) (4.8)

Inclusion of voltage detection system(VDS) (4.10)

Inclusion of flammability (4.11)

Edited rating plates (4.13)

Edited tests requirements (5)

Edited documentation (6)

Edited training requirements (7)

Edited quality management (8)

Edited environmental management (9)

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DISTRIBUTION SUB-STATIONS**

REFERENCE
CP_TSSPEC_035
PAGE **19**

REV
5
OF **38**

August
2019

4

Title change

Inclusion of 22kV in the Scope

Rephrasing of sub heading 4.3.1

Rephrasing of sub heading 4.3.2

Rephrasing of sub heading 4.3.3

Rephrasing of sub heading 4.3.4

Addition of Table 1 to 3

Revised Annex A: Bibliography

Addition of Annex C- Technical Schedule A and B for
22kVswitchgear.

Addition of Deviation schedule for 22kV switchgear.

Created stock item s for Switchgear.

Nov 2019

5

NRS 012 changed to SANS 876

NRS 003 changed to SANS 1885

Normal rated current of the main feeder is 800A

Added clause 10, Health and Safetey

Annex C - Technical Schedules A and B for 11 kV switchgear

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
1		General		
		a) Manufacturer	XXXX	
		b) Country of origin	XXXX	
		c) Catalogue model/type designation	XXXX	
		d) Total switchboard mass Kg	XXXX	
2	4.2	Service conditions		XXXX
		a) Altitude (AMSL) m	1800	
		b) Ambient air temperature range °C	-5 to 40	
		c) Relative humidity range %	10 to 95	
		d) Pollution conditions	light for indoor enclosures	
3	4.3	Ratings		XXXX
		Metal-clad switchgear manufacturing standard Yes/No	IEC 62271-200	
		Rated voltage kV	12	
	4.3.2.1	Incomer and Inter-connector rated nominal current A	2500	
		Feeder: rated nominal current A	800	
		Rated peak insulation level (BIL) kV	95	
		Rated rms. short time withstand current kA	28	
		Network frequency Hz	50	
		Rated internal arc withstand current @ 3sec kA	25	
		Rated peak withstand current kA	63	
		Internal arc withstand current @ 200 ms kA	25	
		Auxiliary supply voltage? V	110 V D.C	
		Rated operating sequence	O-0,3s-CO-3min-Co	
NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.				

Tender Number: _____

Tenderer's Authorised Signatory: _____
Name in block letters Signature

Full name of company: _____

Annex C - Technical Schedules A and B for 11kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
4	4.4	Design and construction		XXXX
		Loss of service continuity category	LSC2B	
		Material for partitions and shutters	Metallic	
		Internal arc classification	AFLR	
		Internal arc detection sensors (IAC) Yes/No	Yes	
		Internal arc protection using arc-light and current	Required	
	4.4.4.1	Circuit breaker type (withdraw able)	Truck or trolley	
	4.4.4.2	Circuit breaker switching duties:		
		a) mechanical endurance class	M2	
		b) electrical endurance class	E2	
		c) capacitive switching class	C2	
	4.4.5	Circuit-breaker interrupting medium	Vacuum	
	4.4.5.2	Vacuum bottle number of operations (On-Load and fault condition)	30 000	
	4.4.5.3	Manufacturer's Data Sheet for Vacuum bottles Yes/No	Yes	
	4.4.6	Bus bars		XXXX
		Complying with Single bus bar configuration? Yes/No	Yes	
		Bus bars insulated Yes/No	Yes	
		Creepage distance mm/kV	20	
	4.4.7	Enclosure		XXXX
		a) Degree of protection - Compartment	IP2X	
		b) Degree of protection - Enclosure	IP 4X	
		c) Pre-drill cable entries and vermin proofed Yes/No	Yes	

NOTE: TICKS [✓×], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

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Annex C - Technical Schedules A and B for 11kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
4 cont.	4.4.8	Power cable compartment		XXXX
		a) Cable compartment accessible side	Rear	
		b) Suitable for PILC/XLPE Yes/No	Yes	
		c) Cable termination offered for Incomers, inter-connectors and Feeders	Type 2	
	4.4.9	d) Surge arresters on feeder panels	Not required	
		Interlocks		XXXX
	4.4.10	Full operation behind closed doors Yes/No	Yes	
		Panel colours		XXXX
	4.4.11	Complies to colour coding system on Table 1? Yes/No	Yes	
		Inspection window provided? Yes/No	Yes	
	4.4.12	Earthing		XXXX
		Clearance hole or stud size of earthing bar offered	M12	
		Front accessible earthing facilities required for all main circuits?	Required	
		Earthing facilities offered complying to class of E2 rating Yes/No	Yes	
		Busbar or Bus section earthing facility?	Not required	
NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.				

Tender Number: _____

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Name in block letters Signature

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Annex C - Technical Schedules A and B for 11kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
4 cont.	4.4.13	Circuit-breaker open / closing mechanism	Mechanical Spring	
		Charging spring motor supply voltage V	110	
		Number of trip coils per mechanism for incomers, inter-connectors, bus-sections / couplers panels	2	
		Number of close coils per mechanism	1	
	4.4.14	Breaker position indication provided Yes/No	Yes	
	4.4.16	Current and voltage transformer wiring and colour coded mm ²	2.5	
		Auxiliary wires (Grey) mm ²	1.5	
	4.4.17	Protection of auxiliary circuits	Double pole MCB	
	4.4.18	Voltmeter on incomer panel for battery voltage indication provided? Yes/No	Yes	
	4.4.19	Auxiliary termination boxes at the back of panel Yes/No	Yes	
5	4.4.20	Complying to control facilities requirements? Yes/No	Yes	
	4.4.20.3	Remote control hand-held units provided? (See Note under control facilities) Yes/No	Yes	
6	4.5	Complying with SCADA interface requirements? (See Note under control facilities) Yes/No	Yes	
	4.6	Comply with Protection requirements? Note: Request for generic switchgear wiring schematics CP_TSDRAW_050/052/053/054. Yes/No	Yes	
7	4.7	Complying with voltage drop and supply interruption requirements? Yes/No	Yes	

NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

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Annex C - Technical Schedules A and B for 11kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
8	4.8	Complying with EMC requirements? Yes/No	Yes	
9	4.9	Complying with luminous indicators requirements? Yes/No	Yes	
10	4.10	Comply with voltage detection system requirements? Yes/No	Yes	
11	4.11	Complying with flammability requirements? Yes/No	Yes	
12	4.12	Complying with terminals requirements? Yes/No	Yes	
13	4.13	Complying with rating plate requirements? Yes/No	Yes	
14	4.6	* Number of current transformers required for: a) overcurrent and earth fault protection b) differential protection c) metering		XXXX
15		*State the following requirements for each current transformer application: a) class CI b) burden VA c) tap ratios d) tap points e) knee-point voltage V f) secondary resistance Ω g) excitation current at knee-point voltage mA		XXXX

***Note: This section is to be completed by Protection Department**

Tender Number: _____

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Full name of company: _____

Annex C - Technical Schedules A and B for 11kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
16		* Details of terminal block/rail mounted terminals offered for current transformers		
17		* Where are voltage transformers required		
		* Information on required voltage transformers:		
		a) one or three-phase		
		b) ratio		
		c) class CI		
		d) burden VA		
		e) voltage factor	1.9	
		f) location of test block		
		g) number of limbs 3 / 5		
		h) primary connection	cable side	
18		Details of protection equipment offered		XXXX
		a) manufacturer		
		b) type		
		c) rating		
19		Details of alarm circuits required		XXXX
		Are there alternative wiring requirements? Yes/No	XXXX	
		If yes, state details		
		Is approval required for any alternative wiring offered? Yes/No	XXXX	

NOTE: TICKS [✓*], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

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Annex C - Technical Schedules A and B for 11kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
20		Requirements for protection equipment		XXXX
		Details of terminal blocks offered	XXXX	
		Markings of current and voltage transformers terminals if other than as specified	XXXX	
		State alternative circuit designations required		
21		State method used to attach rating pates	XXXX	
22		State method used to attach labels	XXXX	
		State requirements for main circuit designation labels	XXXX	
		State details of labels	XXXX	
		Test blocks required? Yes/No	Yes	
		If yes, type required		
		Type of test blocks offered	XXXX	
		Is the switchgear to be joined to an existing switchboard? Yes/No	XXXX	
		Make of existing switchboard (if applicable)	XXXX	
23		Minimum number of spare contacts over and above the contacts required for circuitry design:		
		a) circuit-breaker auxiliary 'a'	2	
		b) circuit-breaker auxiliary 'b'	2	
		c) circuit-breaker earthed	2	
		d) circuit-breaker racked in / out	2	
24	4.12	Comply with rating nameplate requirements Yes/No	Yes	
NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.				

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Annex C - Technical Schedules A and B for 11kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
25		Dimensions of panel		
		Height	XXXX	
		Width (Incomer/Feeder)	XXXX	
		Depth	XXXX	
26		Isolation displacement of circuit-breaker	Vertical / horizontal	
27		Provided :-Integral circuit-breaker transporting device (Two for feeders, one for incomers and Bus-section/Bus-couples) Yes/No	Yes	
28		Withdraw able circuit breaker	Horizontal	
29	5.10	Equipment type tested? (With certificates) Yes/No	Yes	
30	5.11	Equipment routine tested as specified in clause 5.11? (With certificates) Yes/No	Yes	
31	6	Required technical documents provided? Yes/No	Yes	
32	7	Training provided Yes/No	XXXX	
33	8	Quality management accreditation Yes/No	XXXX	
34	9	Environment management accreditation Yes/No	XXXX	
NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.				

Tender Number: _____

Tenderer's Authorised Signatory: _____
Name in block letters Signature

Full name of company: _____

Technical Schedules A and B for 11kV switchgear

Deviation schedule

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by City Power.

Item	Sub clause of CP_TSSPEC_035	Proposed deviation

Tender Number: _____

Tenderer's Authorised Signatory: _____
Name in block letters Signature

Full name of company: _____

Annex C - Technical Schedules A and B for 22 kV switchgear

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
1		General		
		e) Manufacturer	XXXX	
		f) Country of origin	XXXX	
		g) Catalogue model/type designation	XXXX	
		h) Total switchboard mass Kg	XXXX	
2	4.2	Service conditions		XXXX
		e) Altitude (AMSL) m	1800	
		f) Ambient air temperature range °C	-5 to 40	
		g) Relative humidity range %	10 to 95	
		h) Pollution conditions	light for indoor enclosures	
3	4.3	Ratings		XXXX
		Metal-clad switchgear manufacturing standard Yes/No	IEC 62271-200	
		Rated voltage kV	24	
	4.3.2.1	Incomer and Inter-connector rated nominal current A	1250	
		Feeder: rated nominal current A	800	
		Rated peak insulation level (BIL) kV	125	
		Rated rms. short time withstand current kA	50	
		Network frequency Hz	50	
		Rated internal arc withstand current @ 3sec kA	20	
		Rated peak withstand current kA	50	
		Internal arc withstand current @ 200 ms kA	20	
		Auxiliary supply voltage? V	110 V D.C	
		Rated operating sequence	O-0,3s-CO-3min-Co	
NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.				

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Annex C - Technical Schedules A and B for 22kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
4	4.4	Design and construction		XXXX
		Loss of service continuity category	LSC2B	
		Material for partitions and shutters	Metallic	
		Internal arc classification	AFLR	
		Internal arc detection sensors (IAC) Yes/No	Yes	
		Internal arc protection using arc-light and current	Required	
		4.4.4.1 Circuit breaker type (withdraw able)	Truck or trolley	
		4.4.4.2 Circuit breaker switching duties:		
		d) mechanical endurance class	M2	
		e) electrical endurance class	E2	
		f) capacitive switching class	C2	
		4.4.5 Circuit-breaker interrupting medium	Vacuum	
		4.4.5.2 Vacuum bottle number of operations (On-Load and fault condition)	30 000	
	4.4.6	Bus bars		XXXX
		Complying with Single bus bar configuration? Yes/No	Yes	
		Bus bars insulated Yes/No	Yes	
		Creepage distance mm/kV	20	
	4.4.7	Enclosure		XXXX
		d) Degree of protection - Compartment	IP2X	
		e) Degree of protection - Enclosure	IP 4X	
		f) Pre-drill cable entries and vermin proofed Yes/No	Yes	

NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

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Annex C - Technical Schedules A and B for 22 kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
4 cont.	4.4.8	Power cable compartment		XXXX
		a) Cable compartment accessible side	Rear	
		b) Suitable for PILC/XLPE Yes/No	Yes	
		c) Cable termination offered for Incomers, inter-connectors and Feeders	Type 2	
		d) Surge arresters on feeder panels	Not required	
	4.4.9	Interlocks		XXXX
		Full operation behind closed doors Yes/No	Yes	
	4.4.10	Panel colours		XXXX
		Complies to colour coding system on Table 1? Yes/No	Yes	
	4.4.11	Inspection window provided? Yes/No	Yes	
	4.4.12	Earthing		XXXX
		Clearance hole or stud size of earthing bar offered	M12	
		Front accessible earthing facilities required for all main circuits?	Required	
		Earthing facilities offered complying to class of E2 rating Yes/No	Yes	
		Busbar or Bus section earthing facility?	Not required	
NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.				

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Annex C - Technical Schedules A and B for 22 kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
4 cont.	4.4.13	Circuit-breaker open / closing mechanism	Mechanical Spring	
		Charging spring motor supply voltage V	110	
		Number of trip coils per mechanism for incomers, inter-connectors, bus-sections / couplers panels	2	
		Number of close coils per mechanism	1	
	4.4.14	Breaker position indication provided Yes/No	Yes	
	4.4.16	Current and voltage transformer wiring and colour coded mm ²	2.5	
		Auxiliary wires (Grey) mm ²	1.5	
	4.4.17	Protection of auxiliary circuits	Double pole MCB	
	4.4.18	Voltmeter on incomer panel for battery voltage indication provided? Yes/No	Yes	
	4.4.19	Auxiliary termination boxes at the back of panel Yes/No	Yes	
5	4.4.20	Complying to control facilities requirements? Yes/No	Yes	
	4.4.20.3	Remote control hand-held units provided? (See Note under control facilities) Yes/No	Yes	
	4.5	Complying with SCADA interface requirements? (See Note under control facilities) Yes/No	Yes	
6	4.6	Comply with Protection requirements? Note: Request for generic switchgear wiring schematics CP_TSDRAW_050/052/053/054. Yes/No	Yes	
7	4.7	Complying with voltage drop and supply interruption requirements? Yes/No	Yes	
NOTE: TICKS [✓x], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.				

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Annex C - Technical Schedules A and B for 22kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
8	4.8	Complying with EMC requirements? Yes/No	Yes	
9	4.9	Complying with luminous indicators requirements? Yes/No	Yes	
10	4.10	Comply with voltage detection system requirements? Yes/No	Yes	
11	4.11	Complying with flammability requirements? Yes/No	Yes	
12	4.12	Complying with terminals requirements? Yes/No	Yes	
13	4.13	Complying with rating plate requirements? Yes/No	Yes	
14	4.6	* Number of current transformers required for: a) overcurrent and earth fault protection b) differential protection c) metering		XXXX
15		*State the following requirements for each current transformer application: a) class CI b) burden VA c) tap ratios d) tap points e) knee-point voltage V f) secondary resistance Ω g) excitation current at knee-point voltage mA		XXXX

***Note: This section is to be completed by Protection Department**

Tender Number: _____

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Name in block letters Signature

Full name of company: _____

Annex C - Technical Schedules A and B for 22kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
16		* Details of terminal block/rail mounted terminals offered for current transformers		
17		* Where are voltage transformers required		
		* Information on required voltage transformers:		
		a) one or three-phase		
		b) ratio		
		c) class CI		
		d) burden VA		
		e) voltage factor	1.9	
		f) location of test block		
		g) number of limbs 3 / 5		
		h) primary connection	cable side	
18		Details of protection equipment offered		XXXX
		a) manufacturer		
		b) type		
		c) rating		
19		Details of alarm circuits required		XXXX
		Are there alternative wiring requirements? Yes/No	XXXX	
		If yes, state details		
		Is approval required for any alternative wiring offered? Yes/No	XXXX	

NOTE: TICKS [✓*], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

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Annex C - Technical Schedules A and B for 22kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
20		Requirements for protection equipment		XXXX
		Details of terminal blocks offered	XXXX	
		Markings of current and voltage transformers terminals if other than as specified	XXXX	
		State alternative circuit designations required		
21		State method used to attach rating pates	XXXX	
22		State method used to attach labels	XXXX	
		State requirements for main circuit designation labels	XXXX	
		State details of labels	XXXX	
		Test blocks required? Yes/No	Yes	
		If yes, type required		
		Type of test blocks offered	XXXX	
		Is the switchgear to be joined to an existing switchboard? Yes/No	XXXX	
		Make of existing switchboard (if applicable)	XXXX	
23		Minimum number of spare contacts over and above the contacts required for circuitry design:		
		a) circuit-breaker auxiliary 'a'	2	
		b) circuit-breaker auxiliary 'b'	2	
		c) circuit-breaker earthed	2	
		d) circuit-breaker racked in / out	2	
24	4.12	Comply with rating nameplate requirements Yes/No	Yes	

NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

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Annex C - Technical Schedules A and B for 22kV switchgear (continues)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Clause	Description	Schedule A	Schedule B
25		Dimensions of panel		
		Height	XXXX	
		Width (Incomer/Feeder)	XXXX	
		Depth	XXXX	
26		Isolation displacement of circuit-breaker	Vertical / horizontal	
27		Provided :-Integral circuit-breaker transporting device (Two for feeders, one for incomers and Bus-section/Bus-couples) Yes/No	Yes	
28		Withdrawable circuit breaker	Horizontal	
29	5.10	Equipment type tested? (With certificates) Yes/No	Yes	
30	5.11	Equipment routine tested as specified in clause 5.11? (With certificates) Yes/No	Yes	
31	6	Required technical documents provided? Yes/No	Yes	
32	7	Training provided Yes/No	XXXX	
33	8	Quality management accreditation Yes/No	XXXX	
34	9	Environment management accreditation Yes/No	XXXX	
NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.				

Tender Number: _____

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Name in block letters Signature

Full name of company: _____

Technical Schedules A and B for 22kV switchgear

Deviation schedule

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by City Power.

Item	Sub clause of CP_TSSPEC_035	Proposed deviation

Tender Number: _____

Tenderer's Authorised Signatory: _____
Name in block letters Signature

Full name of company: _____

**SPECIFICATION FOR 11kV AND 22 kV
INDOOR METAL-CLAD SWITCHGEAR FOR
DISTRIBUTION SUB-STATIONS**

REFERENCE
CP_TSSPEC_035

REV
5

PAGE **38** OF **38**

Annex D – Stock Items

1	4432	11 KV INDOOR METAL CLAD SBST- SWG	11KV INDOOR METAL CLAD SUBSTATION SWITCHGEAR. ITEM SPECIFICATION NUMBER CP_TSSPEC_035.
2	4433	22 KV INDOOR METAL CLAD SBST- SWG	22KV INDOOR METAL CLAD SUBSTATION SWITCHGEAR. ITEM SPECIFICATION NUMBER CP_TSSPEC_035.