

JOHANNESBURG WATER (SOC) Ltd.
BULK WASTEWATER

PARTICULAR SPECIFICATION
E19 : ELECTRICAL 11kV RING MAIN UNIT



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PARTICULAR SPECIFICATION: VOLUME E19: ELECTRICAL 11kV RING MAIN UNIT

CONTENTS

E19.1	SCOPE.....	3
E19.2	STANDARDS.....	3
E19.2.1	Standards.....	3
E19.2.2	Particular specifications to be read in conjunction with this specification.....	3
E19.3	CONSTRUCTION AND OPERATION REQUIREMENTS.....	3
E19.3.1	11kV cable termination	4
E19.3.2	Ratings	4
E19.3.3	Combined fuse-switch.....	4
E19.3.4	Ring Main Network Isolators.....	5
E19.3.5	Circuit breaker with overcurrent and earth fault relay	5
E19.4	ELECTRICAL DATA AND SERVICE CONDITIONS	6
E19.5	RMU TECHNICAL DATA	6
E19.6	REQUIRED TESTS.....	7
E19.7	GUARANTEE.....	8
E19.8	DOCUMENTATION	8
E19.9	NAMEPLATE INFORMATION	8
E19.10	MEASUREMENT AND PAYMENT.....	8

E19.1 SCOPE

This specification covers the design, supply, delivery, installation, testing and commissioning of 11kV medium voltage ring main unit (RMU).

E19.2 STANDARDS

E19.2.1 Standards

The latest edition, including all amendments to until the date of tender, of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SANS 62271-1	:	High-voltage switchgear and controlgear Part 1: Common specifications for alternating current switchgear and controlgear
SANS 62271-200	:	High-voltage switchgear and controlgear Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
SANS 62271-102	:	High-voltage switchgear and controlgear Part 102: Alternating current disconnectors and earthing switches
SANS 60529	:	Degrees of Protection Provided by Enclosures (IP Code)
SANS 62271-103	:	High-voltage switchgear and controlgear Part 103: Switches for rated voltages above 1 kV up to and including 52 kV
SANS 62271-102	:	High-voltage switchgear and controlgear Part 100: Alternating-current circuit-breakers
SANS 62271-105	:	High-voltage switchgear and controlgear Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV
SANS 61869-2	:	Instrument transformers Part 2: Additional requirements for current transformers
SANS 61869-3	:	Instrument transformers Part 3: Additional requirements for inductive voltage transformers
IEC 60255	:	Measuring relays and protection equipment

E19.2.2 Particular specifications to be read in conjunction with this specification

The following particular specifications shall be read in conjunction with the product specification:

(a) E26	:	ELECTRICAL COLOUR CODING OF EQUIPMENT
(b) G02	:	PARTICULAR SPECIFICATION FOR THE CORROSION PROTECTION

E19.3 CONSTRUCTION AND OPERATION REQUIREMENTS

The RMU will have the following characteristics:

- (a) The busbars and switching elements of each module shall be in a separate vacuum/gas tank. Each tank will be equipped with a meter showing vacuum/gas pressure values;
- (b) Suitable for indoor/outdoor use;

- (c) It must be possible to operate all the switch mechanisms from the front;
- (d) Three manually selected positions (ON-OFF or EARTH) on all modules. The operating handle is to be such that it must be relocated from the ON – OFF position to the EARTH position before the earthing switch can be closed;
- (e) Clearly visible ON – OFF and OFF – EARTH indicators shall be provided and provision shall be made for locking the mechanisms by means of selector levers, preventing the insertion of the operating handle in any position;
- (f) A mechanical interlock will prevent the opening of the cable termination cubicle if the module is not in the EARTH position;
- (g) Transparent inspection windows that display the position of the earthing contacts, allowing; a visually check that the earthing switch is in the closed position;
- (h) A voltage presence-indicating device on all modules to check whether a voltage is present across the cables. (IEC 62271-206: Part 206: Voltage presence indicating systems for rated voltages above 1 kV and up to and including 52 kV);
- (i) Cable test facility where the cable can be tested without disconnecting the cable from the switchgear bushings or opening the cable termination cubicle;
- (j) The switchgear must be designed to withstand the impact of an internal arc caused by a fault current in order to provide the maximum protection to switching operators;
- (k) All bushings shall be Type C rated at 630Amp according to BS EN 50181;
- (l) A protection relay (self-powered from the CT units) on the circuit breakers connected to the ring circuit with:
 - i. Overcurrent and earth fault protection
 - ii. Thermal overload protection
 - iii. Current measurement functions
 - iv. No PC or specific tool required for setting or commissioning
- (m) No oil-filled circuit breakers are accepted in the miniature substations.

E19.3.1 11kV cable termination

The Contractor must ensure that suitable methods of 11kV cable termination are applied. Indoor terminations with screened separable connectors (SSC's) must be used to terminate 11kV cables on the RMU. This allows for the use of PILC cable for 11kV reticulation. Because of the short clearances in the switchgear cable termination box the flashover risk is minimised by ensuring that the terminations and SSC's are type tested in accordance with IEC 60055-1 and IEC 60502-4.

E19.3.2 Ratings

The continuous current rating of the Ring Main Unit shall not be less than 630A. The continuous current rating of the combined fuse-switch shall not be less than 90A with overload making capacity minimum 32.5kA. The short circuit rating shall be at least 350MVA at 11kV.

E19.3.3 Combined fuse-switch

The combined fuse-switch shall be in accordance with SANS 60282.

The operating mechanism of the combined fuse-switch shall be of the fixed trip type, which ensures the full closure of the switch and full clearance of fault by the fuses before tripping the switch.

- (n) The fuse carriage must be so arranged that when the striker pin fuses are fitted, the operation of a fuse in any phase trips all the phases simultaneously. Conversely, if any one fuse is blown, then it shall not be possible to close the switch.
- (o) Manual tripping is to be provided by means of a pushbutton and not by using the operating handle.
- (p) Automatic shutters shall be provided, to safe-guard against inadvertent contact with "live"

parts when the fuse carriage is removed.

- (q) The operating mechanism must be interlocked with the fuse carriage cover, to allow access to the fuse carriage only when the operating mechanism is in the OFF position.
- (r) The fuses and carriage shall be housed vertically in a separate compartment on the front of the unit. The fuse carriage design is preferred which would accept both 336mm and 254mm long by 64mm diameter HRC fuses.
- (s) One designation blank label shall be provided.
- (t) Fuses shall be fitted before delivery.

E19.3.4

Ring Main Network Isolators

- a) The triple pole contacts of the isolators shall be gang-operated by a spring assisted manual mechanism.
- b) Integral cable test terminals shall be provided and shall only be accessible from the front of the unit when the switch is in the EARTH – TEST position. Interlocks shall be provided to ensure that the switch cannot be moved from the EARTH – TEST position when the test terminal cover is open. If alternative ring main units are offered, then one set of test prongs shall be supplied for each unit.
- c) No cable end boxes are required. However, provision shall be made for the clamping of cross-linked polyethylene and PILC type cables by means of a split wooden block.
- d) The size of cables used shall be 70mm², 3 core and 185mm² PILC. The clamps which must accept different sizes of cable shall be mounted approximately 600mm below the terminals.
- e) Each isolator shall be provided with a designation white sandwich board label which shall be left blank.

E19.3.5

Circuit breaker with overcurrent and earth fault relay

- (a) It is required that these miniature substations be supplied with at least 630A 11kV circuit breaker ring main units with overcurrent and earth fault protection relay switches or protection relay that has the same tripping curves as normal HRC MV fuses.
- (b) Manually operated mechanisms for cable and transformer switches are to be supplied as standard with an option that they can also be fitted with motor operation.
- (c) The circuit breaker system of protection shall not require an external power supply.
- (d) SF6 or vacuum circuit breakers shall be acceptable for this purpose although a virtually maintenance-free system with a high level of reliability is preferred.
- (e) This RMU is required to be supplied with the following standard equipment:
 - i. Earthing switches
 - ii. Operating mechanisms with integral mechanical interlocking
 - iii. Operating handle
 - iv. Facilities for padlocks on all switches functions
 - v. Bushings for cable connection in front with cable covers.
 - vi. Manometer for SF6 pressure/density monitoring (where applicable).
 - vii. Lifting lug for easy handling.
 - viii. All units are designed for the subsequent fitting of an integral remote control and monitoring unit.
 - ix. Three-way configuration.
- (f) All R.M.U. shall comply with SANS 1874.
- (g) All R.M.U. operating, cable testing facilities cable terminating and indication devices must be fully accessible only from the front of the MV compartment.
- (h) The R.M.U. configuration shall be Switch Disconnecter, Circuit Breaker

- (i) The cable boxes shall comply with SANS 876 and shall require type 2 terminating clearances.

The design of the switchgear shall take due consideration of the safety of personnel and equipment during operation and maintenance, reliability of service, ease of maintenance, mechanical protection of equipment and interchangeability of equipment. The offered equipment should be capable of continuous operation under the indicated environmental conditions for the project. The panel must be able to withstand lifting and installation stresses without deforming. There must be consideration for corrosion prevention measures indicated elsewhere in this tender documentation. The panel finish must be epoxy coated and be able to sustain the UV impact of outdoor installation without peeling or discolouration.

E19.4

ELECTRICAL DATA AND SERVICE CONDITIONS

Item	Parameter	Unit	Value
1	Rated Voltage	kV	12/13.8
2	Power frequency withstand voltage	kV	75/95
3	Impulse withstand voltage	kV	75/95
4	Rated frequency	Hz	50
5	Rated current busbars	A	630
6	Rated current (cable switch)	A	630
7	Rated Current T-OFF	A	200
	Breaking capacities		
8	Active Load	A	630
9	Closed loop (cable switch)	A	630
10	Off-load cable charging (Cable switch)	A	135
11	Earth fault (Cable switch)	A	200
12	Earth fault cable charging (cable switch)		115
13	Short Circuit breaking current (T-OFF Circuit breaker)	kA	20
14	Rated making capacity	kA	52
15	Rated short time current 3 sec	kA	20
	Ambient temperature		
16	Maximum value	°C	+50
17	Maximum value of 24hr mean	°C	+35
18	Minimum value	°C	0
19	Altitude for erection above sea level	m	1500
20	Relative humidity		Max 95%

E19.5

RMU TECHNICAL DATA

Item	General data, enclosure and dimensions		
1	Standard to which switchgear complies		IEC
2	Type of RMU		Metal enclosed, Panel type, Compact module
3	Number of phases		3
4	Whether RMU is type tested		Yes
5	Whether facility is provided with pressure relief		Yes
6	Insulating gas		SF6/Vacuum
7	Nominal operating gas pressure		1.4 bar abs 20° C
8	Gas leakage rate/annum	%	0.075
9	Expected operating lifetime		30 years
10	Whether facilities are provided for gas monitoring		Yes, temperature compensated manometer
11	Material used in tank construction		Stainless steel sheet, 3mm/

			metallised cast resin
	Operations, Degree of protection and colours		
1	Means of switch operation		Separate handle
2	Means of circuit breaker operation		Separate handle and push buttons
3	Rated operating sequence of circuit breaker		O 3min CO 3 min CO
4	Total opening time of circuit breaker		Approx. 45 ms
5	Closing time of circuit breaker		Approx. 40 ms
6	Mechanical operations of switch	CO	1000
7	Mechanical operations of CO earthing switch		1000
8	Mechanical Operations of circuit breaker	CO	2000
9	Principal switch/earth switch		3 position combined switch/earth switch
	Degrees of Protection		
1	High Voltage live parts, SF6/Vacuum tank		IP 67
2	Front cover mechanism		IP 2X
3	Cable covers		IP 3X
4	Outdoor enclosure		IP 56

E19.6

REQUIRED TESTS

All component parts of the equipment shall be subject to type tests and routine tests in accordance with the relevant SANS, BSI or IEC standard specifications.

Circuit breakers shall be subjected to the following tests in accordance with IEC 62271-1, adjusted for atmospheric correction:

(j) Type Tests

- x. Mechanical endurance
- xi. Temperature rise
- xii. Dielectric strength and impulse voltage
- xiii. Making and breaking capacity and short time current

(k) Routine tests

- i. Power, frequency, voltage
- ii. Resistance of the main circuit
- iii. Mechanical operation.

(l) On site tests

The equipment shall be tested on site after erection and prior to commissioning. The following minimum tests shall be performed:

- i. Pressure tests on the primary and secondary circuits in accordance with IEC 62271-1.
- ii. Insulation resistance tests.
- iii. Primary injection tests.
- iv. Earth continuity and earth resistance tests.
- v. Operating tests.
- vi. Any other tests which may be required to ascertain the correct functioning of the equipment.

After putting the panel to service for a minimum 1 week, a thermal image must be scanned and analysed for any hot spots. The image should be presented as part of the Operations and Maintenance manual.

E19.7 GUARANTEE

The equipment must be guaranteed against latent defects for a minimum of 18 months from date of delivery or 12 months from date of commissioning, whichever is later.

E19.8 DOCUMENTATION

The following documentation will be required for the RMU at tender stage:

- (a) Type test certificate
- (b) Data sheet
- (c) Workshop drawings – prior to manufacture, weights and dimensions included

The following documentation will be required for the RMU with delivery:

- (a) Factory tests results

The following documentation will be required for the RMU at handover:

- (a) Certificate of compliance (design, manufacture and installation)
- (b) Operations and maintenance manual
- (c) Recommended spare parts list
- (d) Drawings – unit drawings and reticulation drawings – as built

E19.9 NAMEPLATE INFORMATION

- (a) Name of manufacturer
- (b) Type, design and serial number
- (c) Rated voltage and current
- (d) Rated frequency
- (e) Rated symmetrical breaking capacity
- (f) Rated making capacity
- (g) Rated short time current and its duration
- (h) Purchase order number and date
- (i) Month and year of supply
- (j) Rated lightning impulse withstand voltage

E19.10 MEASUREMENT AND PAYMENT

<u>Item</u>	<u>Unit</u>
Supply and deliver 11kV RMU	No
The unit of measurement shall be the number of conductor terminals installed.	
The tendered rate shall include full compensation for the design, supply, handling, inspection and installation of the the Ring main Unit.	