

L-S14

Aug 2012

**SPECIFICATION FOR 11 kV
SF6 RING MAIN UNIT**



Cawangan Kejuruteraan Elektrik
Jabatan Kerja Raya Malaysia

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
	CONTENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: 1 of 4

SECTION	CONTENT	REVISION	PAGE
1.0	General	1	S1/1 – S1/2
1.1	Scope	1	
1.2	Standards	1	
1.3	Technical Particulars	1	
1.4	Guarantees	1	
2.0	Ring Main Unit Equipment	1	S2/1 – S2/7
2.1	General	1	
2.2	Construction of RMU	1	
2.3	Rating of Switchgear	1	
2.4	Load Break Switches	1	
	2.4.1 Type	1	
	2.4.2 Operating Mechanism	1	
	2.4.3 Testing and Facilities	1	
2.5	Circuit Breaker	1	
	2.5.1 Type	1	
	2.5.2 Operating Mechanism	1	
	2.5.3 Testing Facilities	1	
2.6	Cable Termination	1	

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
	CONTENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: 2 of 4

SECTION	CONTENT	REVISION	PAGE
3.0	Earthing	1	S3/1 – S3/2
3.1	Earthing Systems	1	
4.0	Padlocks, Labelling and Painting	1	S4/1 – S4/1
4.1	Padlocks	1	
4.2	Labelling	1	
4.3	Painting	1	
5.0	Testing of RMU	1	S5/1 – S5/2
5.1	General	1	
5.2	Routine Tests	1	
5.3	Type Tests	1	
6.0	Site Inspection, Testing and Commissioning	1	S6/1 – S6/2
6.1	Site Inspection	1	
6.2	Testing	1	
6.3	Commissioning	1	

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
	CONTENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: 3 of 4

SECTION	CONTENT	REVISION	PAGE
7.0	Rejection of Plant	1	S7/1 – S7/1
8.0	Document Requirements	1	S8/1 – S8/4
8.1	Manufacturer's Catalogues and Drawings	1	
8.2	Recommended Spares	1	
8.3	Shop Drawings	1	
8.4	Installation, Operation and Maintenance Instructions	1	
8.5	As Built Document and Tools	1	
	8.5.1 As Installed Drawings	1	
	8.5.2 Manuals	1	
	8.5.3 Tools	1	

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
	CONTENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: 4 of 4

SECTION	CONTENT	REVISION	PAGE
9.0	Switchroom	1	S9/1 – S9/1
10.0	Service and Maintenance	1	S10/1 – S10/1
11.0	List of Standard	1	S11/1 – S11/2
Appendix A	: Acceptance Criteria for Routine Test	1	ApA/1 – ApA/1
Appendix B	: Acceptance Criteria for Type Test	1	ApB/2 – ApB/2
Annex : A	Technical Particulars and Guarantees	1	An/1 – An/3
A.1	Technical Particular and Guarantees		
1.0	General		
2.0	Load Break Switches		
3.0	Circuit Breaker		
4.0	Earthing Switches		
5.0	Busbars		
6.0	Schedule of Departures from Specification		

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 1.0	GENERAL	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S1/1 of 2

1.1 SCOPE

This section of the specification describes and specifies requirements of the supply, installation, testing, commissioning, handing over in approved working order and maintenance during the Defects Liability Period (DLP) of the 11 kV Sulphur Hexafluoride (SF6) Ring Main Unit (RMU) all in accordance with the Specification, Supplementary Notes, Bill of Quantities, Conditions of Contract, Drawings, etc.

1.2 STANDARDS

The material, equipment and installation shall conform to the principles of the standards laid down by the Malaysian Standards (MS), International Electro technical Commission (IEC) and British Standard Institution (BS). The RMU shall comply with the latest edition of relevant standards. The standards and/or relevant parts of standards include but not limiting to as per Section 11.0.

1.3 TECHNICAL PARTICULARS

Electrical Contractor shall submit at the time of tendering detailed Technical Particulars in respect of the equipment offered, which shall be binding. No departure from these Technical Particulars will be permitted except with the written approval of the Superintendent Officer's (S.O.'s) Representative. Notwithstanding any description, drawings, illustrations or pamphlets which may be submitted with the Tender, all details other than those stated by the Electrical Contractor in the Schedule of Departures from Specification at the time of tendering, will be deemed to be in full conformity with the Specification.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 1.0	GENERAL	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S1/2 of 2

1.4 **GUARANTEES**

Electrical Contractors shall guarantee the equipment to be supplied under this Contract against faulty design, materials and workmanship at the manufacturer's works within the DLP.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 2.0	RING MAIN UNIT EQUIPMENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S2/1 of 7

2.1 GENERAL

The RMU equipment shall be suitable for service on an electrical power system of 11kV, 3-phase, 50 Hz. They shall be of single busbar, metalclad, floor mounting type provided with integral earthing and testing terminals. They shall be fully tropicalised and suitable for used at an ambient temperature of 40^oC relative humidity up to 100% and at altitude up to 1000 meter above sea level.

2.2 CONSTRUCTION OF RMU

Unless otherwise specified, each RMU shall consist of the following equipment :-

- (a) Two SF6 gas-insulated 630A Load Break Switches (LBS) with one 630 A Vacuum Circuit Breaker (VCB)
- (b) Earthing switches
- (c) 630 A copper busbar fully encapsulated within the SF6 gas tank.

The configuration of RMU shall be extensible consisting of two LBS and one VCB having provision for adding one number of VCB in future.

Both the load break switch and circuit breaker shall be within the same SF6 tank.

The RMU shall be designed to withstand an internal arc supplied by the rated short circuit current at 20kA for 1s without any danger to the operator. The gas generated during the fault shall be released to the rear of the RMU without affecting the conditions of the front side.

All the above equipment shall be SF6 insulated and housed in cast resin module or modules hermetically sealed for life at atmospheric pressure or at a pressure slightly higher than atmospheric pressure so as to minimize the risk of leakage. The degree of protection of the inner enclosure and the complete RMU shall be IP67 and IP54 respectively.

The RMU shall be totally safe for operation with fully fool proof interlocking system and provided with padlocks.

Both LBS and circuit breaker shall be suitable for motorization in future.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 2.0	RING MAIN UNIT EQUIPMENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S2/2 of 7

2.3 RATING OF SWITCHGEAR.

The RMU shall be suitable for continuous operation on a 11 kV, 3-phase, 50 Hz, neutral earthed electrical system with fault level up to 350 MVA for 3 seconds. The impulse voltage withstand level, on 1.2/50 microsecond, shall not be less than **75 kV** peak.

The various components of the switchgear equipment shall have the following rating:-

(i) **Load Break Switches**

- | | | |
|-----|--|-------------------------|
| (a) | Rated Voltage | : 12 kV. |
| (b) | Rated Normal Current | : 630 A. |
| (c) | Rated Short Circuit Breaking Current | : 630 A |
| (d) | Rated Short Circuit Making Current | : 50kA peak
at 11 kV |
| (e) | Rated Short Time Withstand Current (3 sec) | : 20kAr.m.s
at 11 kV |

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 2.0	RING MAIN UNIT EQUIPMENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S2/3 of 7

(ii) Circuit Breaker

- (a) Rated Voltage : 12 kV.
- (b) Rated Normal Current : 630 A
- (c) Rated Short Circuit Breaking Current : 630 A
- (d) Rated Short Circuit Making Current : 50kA peak at 11 kV
- (e) Rated Short Time Withstand Current (3 sec) : 20 kAr.m.s at 11 kV

(iii) Earthing Switches

- (a) Rated Voltage : 12 kV.
- (b) Rated Short Circuit Making Current : 50kA peak at 11 kV
- (c) Rated Short Time Withstand Current (3 sec) : 20 kA peak

(iv) Busbars

- (a) Rated Voltage : 12 kV
- (b) Rated Normal Current : 630 A.
- (c) Rated Short Time Withstand Current (3 sec) : 20 kA peak

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 2.0	RING MAIN UNIT EQUIPMENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S2/4 of 7

2.4 LOAD BREAK SWITCHES

2.4.1 TYPE

LBS shall be in accordance with MS IEC 62271-102.

Each LBS shall be of triple pole, gang operated with quick break contacts housed in a sealed module filled with sulphur hexafluoride (SF6) gas. It shall be provided with integral feeder earthing equipment without the use of loose accessories.

2.4.2 OPERATING MECHANISM

Each LBS shall be fitted with a direct manually operated mechanism having three operating positions 'ON', 'OFF' and 'EARTH'. Inadvertent operation from 'ON' direct to 'EARTH' or vice versa shall be prevented by a manually operated gate type mechanical interlocking arrangement of a foolproof design. The interlocks may operate either in conjunction with the re-location of single operating handle or with two separate operating handles.

It shall possible to lock the operating mechanism in any of the three positions when the contacts have fully homed, and also independently lock off the 'ON' and 'EARTH' positions. The position 'ON', 'OFF' and 'EARTH' of the switch shall be clearly indicated such that the direction of movement of the operating handle from one position to another is readily apparent.

The switch mechanism shall give a quick make and quick break operation to all positions by the use of one set of springs. The speeds of make and break shall be independent of the rate of movement of the operating handle and the operator's strength and skill. In addition, the operating handle shall have an anti-reflex feature to ensure an inherent delay between the closing and re-opening of either the main load break switch or the earthing switch.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 2.0	RING MAIN UNIT EQUIPMENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S2/5 of 7

2.4.3 TESTING FACILITIES

Each LBS shall be provided with facilities for carrying out applied high voltage tests and injected current tests on the circuit connected to the earth. These may be affected by the insertion of a 3 phase testing device when the switch is in 'EARTH' position, to become effective only when the main contacts are in the 'OFF' positions. Alternatively these may take the form of a 3 phase built in test/earth bushing terminals enclosed within a cover which shall be fully interlocked with the operating handle to prevent access until the switch is in the 'EARTH' position. A full complement of foolproof mechanical interlocking shall be provided to prevent the following operations:

- (a) The opening of the testing access when the switch is in any other than 'EARTH' position.
- (b) The Testing device being inserted or withdrawn when the switch is in any other than 'EARTH' position.
- (c) The movement of the switch to the 'ON' position when the testing access is open, whether or not the testing device has been inserted.
- (d) The movement of the switch away from the 'EARTH' position, in cases where testing entails the removal of an earth connection from built in test/earth bushing, until the earth connection is restored.

The testing facilities shall provide for the attachment of test connection external to the switch for applied voltage and injected current tests. The test connection shall be capable of withstanding 25 kV d.c. to earth for 15 minutes and capable of carrying 630 A continuously.

One set of 3 phase testing device suitable for use with the type of LBS offered under this Tender shall be provided by the Electrical Contractor whether or not this item is separately itemized in the Bill of Quantities of the Tender Document.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 2.0	RING MAIN UNIT EQUIPMENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S2/6 of 7

2.5 CIRCUIT BREAKER

2.5.1 TYPE

The circuit breaker shall be in accordance with IEC 62271-100.

The circuit breaker shall have SF6 as medium of insulation and vacuum as means of interruption. It shall have mechanical interlocking arrangement and testing facility. A self-energizing type electronic protection relay complete with protection CT shall be provided to control the tripping of the circuit breaker.

2.5.2 OPERATING MECHANISM

The standard unit shall use vacuum bottles as interrupters of the currents. The circuit breaker main circuit is connected in series with a three-position disconnecter-earthing switch, which has no interrupting capacity. The operation between circuit breaker and disconnecter-earthing is interlocked. All mechanisms shall be situated in the mechanism compartment behind the front covers outside the SF6-tank. The mechanism for the switch and the earthing switch is operating both switches via one common shaft. The mechanism for the circuit breaker and disconnecter-earthing switch is operating the circuit breaker and the disconnecter-earthing switch via to separate shafts. The mechanism for the circuit breaker has stored spring energy and provides independent manual operation for closing and opening of the circuit breaker. The mechanism has a relay with related CT's and/or remote tripping device.

2.5.3 TESTING FACILITIES

Each circuit breaker shall be provided with facilities for carrying out applied high voltage tests and injected current tests on the circuit connected to the earth. These may be affected by the insertion of a 3 phase testing device when the switch is in 'EARTH' position, to become effective only when the main contacts are in the 'OFF' positions.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 2.0	RING MAIN UNIT EQUIPMENT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S2/7 of 7

Alternatively these may take the form of a 3 phase built in test/earth bushing terminals enclosed within a cover which shall be fully interlocked with operating handle to prevent access until the switch is in the `EARTH' position. A full complement of fool proof mechanical interlocking shall be provided to prevent the following operations:

- (a) The opening of the testing access when the switch is in any other than `EARTH' position.
- (b) The Testing device being inserted or withdrawn when the switch is in any other than `EARTH' position.
- (c) The movement of the switch to the `ON'position when the testing access is open, whether or not the testing device has been inserted.
- (d) The movement of the switch away from the `EARTH' position, in cases where testing entails the removal of an earth connection from built in test/earth bushing, until the earth connections is restored.

The testing facilities shall provide for the attachment of test connections external to the CB for applied voltage and injected current tests. The test connections shall be capable of withstanding 25 kV d.c to earth for 15 minutes and capable of carrying at least 630 Amperes continuously.

One set of 3 phase testing device suitable for use with the type of circuit breaker offered under this Tender shall be provided by the Electrical Contractor whether or not this item is separately itemised in the Bill of Quantities of the Tender Document.

2.6 CABLE TERMINATION

The cable termination for the LBS shall be of dry type suitable for 11 KV 3 core cable to BS 6480 of conductor size up to 300 mm². The termination shall normally be for a cable entering vertically from below. However, due to site conditions, a bottom angled entry or a vertical top entry may be required. In such case, the Electrical Contractor shall supply the appropriate termination accessories.

The cable termination compartment shall be arc resistant as per MS IEC 62271-200.

The clearance between phase to phase and phase to earth shall be as per IEC 61243-5.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 3.0	EARTHING	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S3/1 of 2

3.1 EARTHING SYSTEMS

All earthing system and accessories shall comply with Electricity Regulations 1994, MS IEC 60364-5-54, BS EN 13601 and BS 7430.

Unless otherwise specified, all metal parts of the RMU shall be provided with an earth bar of not less than 25 mm x 6 mm flat hard drawn copper. The earth bar shall be bolted to the main frame and located so as to provide convenient facilities for earthing cable sheaths and for use with earthing device. Means shall be provided for coupling earth bars of adjacent units.

The copper tape/bar with dimension not less than 25 mm x 6 mm shall be installed around the four walls of the switchroom at a height of 300 mm from the finished floor level.

Earth electrodes shall be of copper jacketed steel core rods with 16 mm nominal diameter and supplied in 1500 mm length and shall have provision for screw coupling with another standard length. The copper jacket of 99.9 % pure electrolytic copper shall be of minimum radial thickness 0.25 mm and shall be molecularly bonded to the steel core to ensure that the copper jacket and steel core are not separable.

Each earth electrode shall be driven 3000 mm in depth. Where the desired earth resistance value cannot be achieved after the first earth electrode have been driven, sufficient number of earth electrodes in parallel shall be installed outside the resistance area until required value is reached. Mutual separation between two earth electrodes shall be more than, but less than twice, the driven depth of the earth electrode. Earth electrodes shall not be installed close to a metallic fence. Unless the metallic fence is separately earthed, the fence shall be separated from the electrical earthing system by at least 2000 mm. Interconnection between different earth electrodes shall be by means of 25 mm x 3 mm annealed copper tape.

The connection of the earthing conductor and/or the earth electrode to the earth electrode shall be soundly made by the use of plumbed joints, either by brazing using zinc-free material with a melting point of at least 600 °C or by exothermic welding.

Each earth electrodes shall be provided with heavy duty type inspection chamber with removable cover. The inspection chamber shall be of square or round type and

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 3.0	EARTHING	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S3/2 of 2

tested in accordance with MS 26: Part 2. The minimum size of square type inspection chamber shall be 300 mm (width) x 300 mm (length) x 180 mm (height) and for round type inspection chamber, the minimum size shall be 300 mm (diameter) x 180 mm (height). The working load of the inspection chamber shall be minimum 4500kg. Lifting hook shall be provided on the cover. The brand name shall be durably marked on the removable cover.

The earthing points shall be identified by permanent label durably marked with the words `Ring Main Unit Earth' permanently fixed at the point of connection of every earthing conductor to an earth electrode.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 4.0	PADLOCK, LABELLING & PAINTING	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S4/1 of 1

4.1 PADLOCKS

The Electrical Contractor shall supply two 40 mm padlocks approved by S.O.'s Representative for every RMU. All padlocks in the same substation shall be supplied with keys alike.

4.2 LABELLING

Labels of size not less than 50 mm x 150 mm shall be fitted on the front of all RMU by means of non-corrosive screws or any other method approved by the S.O.'s Representative. The labels shall be of black laminated plastic with engraved white lettering with details such as rating, over current setting, earth fault setting to which it is connected etc. The exact wording of the labels shall be agreed by the S.O.'s Representative.

4.3 PAINTING

The RMU shall have one coat of primer, one undercoat and a third finishing coat of paint applied at the manufacturer's works or at an approved factory. The final coat shall be of oil-resisting enamel paint.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 5.0	TESTING OF RMU	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S5/1 of 2

5.1 GENERAL

New RMU shall be subjected to routine tests as specified in Section 5.2. Generally, the requirements for type tests will be waived if corresponding certification is made available for RMU of identical design. However, the S.O retains the right to have the same tests repeated. Electrical Contractor shall in any case quote at the time of tendering separate prices for conducting type tests.

Tests shall be made at the manufacturer's works or at an approved laboratory/factory, unless otherwise agreed between the Electrical Contractor and the S.O.'s representative. Before leaving the manufacturer's works, each RMU shall be inspected and tested. If the tests are to be carried out outside Peninsular Malaysia, the Electrical Contractor shall bear the cost of meal, accommodation, transportation and traveling expenses and all Government approved allowances for two (2) electrical engineers to witness the tests.

Upon satisfactory completion of the tests, the test reports shall be submitted to the S.O.'s representative for approval at least two weeks before leaving the manufacturer's works or shipment. Copies of all test reports shall be submitted to the S.O.'s representative in quadruplicate. No item or plant shall be dispatched to site until the S.O.'s representative has given approval in writing.

Manufacturers shall submit to S.O.'s representative a list of testing equipment and measuring instruments used in their factory. All measuring instruments used for the tests shall be certified by the accredited laboratory, traceable accuracy and subjected to periodic calibration, according to the MS ISO 9001.

5.2 ROUTINE TESTS

Routine tests as specified in MS IEC 62271-200 and other relevant IEC publications shall be carried out on each RMU and all its accessories so the results of the tests shall be formally submitted to the S.O.'s representative.

The routine tests to be carried out shall consist of the following tests as the minimum requirement:-

- (a) Design and visual checks
- (b) Dielectric test on the main circuit

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 5.0	TESTING OF RMU	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S5/2 of 2

- (c) Tests on auxiliary and control circuits
- (d) Measurement of the resistance of the main circuit
- (e) Tightness test
- (f) Mechanical operation tests

Refer to Appendix A for the details of acceptance criteria.

TYPE TESTS

Type tests as specified in MS IEC 62271-200 or otherwise as required in this specification, shall be carried out at an internationally recognized independent laboratory accredited to STLA such as ASTA, KEMA, CESI, PEHLA, etc. Type tests certificates shall be submitted with the tender. Failure to do so shall result in the RMU offered to be rejected.

The type tests to be carried out shall consist of the following tests as the minimum requirement:-

- (a) Power-frequency voltage tests
- (b) Lightning impulse voltage tests
- (c) Temperature-rise tests
- (d) Short-time withstand current and peak withstand current tests
- (e) Tightness tests
- (f) Measurement of the resistance of circuits
- (g) Verification of the Ingress Protection (IP) coding

Refer to Appendix B for the details of acceptance criteria.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 6.0	SITE INSPECTION, TESTING & COMMISSIONING	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S6/1 of 2

6.1 SITE INSPECTION

The whole of the plant and equipment to be provided under the Tender shall be subjected to inspection and test carried out on site by the S.O.'s Representative prior to commissioning. The approval by the S.O.'s Representative of the results of any such inspection or test shall not prejudice the right of the S.O.'s Representative to reject the plant if it fails to comply with the specification when erected or to give complete satisfaction in service within the DLP.

The costs of all tests including the provision of the necessary test equipment shall be deemed to be included in the Tender Price.

Adequate notice shall be given when the plant is ready for inspection or testing and every facility shall be provided by the Electrical Contractor to enable the S.O.'s Representative to carry out the necessary inspection and tests.

6.2. TESTING

On completion of the installation work on site, the Electrical Contractor shall, at his own expense, arrange for all necessary tests to be carried out on the equipment by a Service Engineer approved by the Suruhanjaya Tenaga(ST) as part of the tests required of him for the whole installation under this Contract. The tests to be carried out shall be as prescribed in the relevant Standards and other tests deemed necessary by the S.O.'s Representative. In the event the installation fails to pass any of these tests, The Electrical Contractor shall take such measures as are necessary to remedy the defects and the installation shall not be considered as completed until all such tests have been passed.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 6.0	INSPECTION, TESTING & COMMISSIONING	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S6/2 of 2

The tests to be carried out by the Electrical Contractor shall consists of the following tests as the minimum requirements:-

- (a) 2000 V insulation resistance tests.
- (b) Current injection test.
- (c) 24 kV a.c. pressure test for 1.0 minute.
- (d) Secondary injection of the protection relay on the circuit breaker
- (e) Other tests as recommended by the manufacturer and the supplier.

The S.O.'s Representative reserves the right to be present at all tests and the Electrical Contractor shall give at least one week notice in writing to the S.O.'s Representative for this purpose. In any case no test shall be carried out without prior approval of the S.O.'s Representative. Copies of all the test certificates shall be submitted to the S.O.'s Representative within one week after the completion of the testing.

6.3 COMMISSIONING

On successful testing of the complete installation, the Electrical Contractor shall arrange to commission the equipment in the presence of the S.O.'s Representative on a date to be decided by the S.O.'s Representative.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 7.0	REJECTION OF PLANT	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S7/1 of 1

Any item of plant or component which fails to comply with the requirements of the specification in any respect whatsoever at any stage of manufacture, test or erection or on completion at site within the DLP of the contract may be rejected by the S.O.'s Representative either in whole or in part as he considers necessary. After adjustment or modification if so directed by the S.O.'s Representative, the Electrical Contractor shall submit the item for further inspection and/or tests. Plant or components with defects of such nature that, in the opinion of the S.O.'s Representative, the requirements of this specification cannot be fulfilled by adjustment or modification shall be replaced by the Electrical Contractor at his own expense and to the satisfaction of the S.O.'s Representative.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 8.0	DOCUMENT REQUIREMENTS	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S8/1 of 4

8.1 MANUFACTURER'S CATALOGUES AND DRAWINGS

Manufacturer's catalogues and drawings giving detailed information on the general arrangement of the RMU, overall dimensions, general construction, position of main cable, grouting bolts, loading on foundation, minimum clearance to rear end wall, trenching details, technical specification and other useful details shall be submitted together with the Tender.

8.2 RECOMMENDED SPARES

The Electrical Contractor shall submit with his Tender separate Schedule of Spares recommended by the manufacturer of the equipment. This Schedule shall contain the price and delivery period of each item of the spares recommended. The Electrical Contractor shall also recommend the quantity of each item to be stored for the purpose of maintenance. The prices of these spares shall not be included in the total Tender Price and the purchase of all or any of the spares listed shall be at the option of the S.O.'s Representative. The prices quoted shall be valid for acceptance during Contract Period (extended if applicable) of the project.

All the spare parts shall be original and fully interchangeable with the corresponding part used in the main items of the equipment and with each other without having to resort to machining or additional, fittings at site. All spares shall be finished, protected, packed and labeled in suitable manner to prevent deterioration during prolonged storage in tropical climate.

8.3 SHOP DRAWINGS

Within two (2) weeks after award of the Tender or such shorter period as may be required by the S.O.'s Representative, the Electrical Contractor shall submit to the S.O.'s Representative for his approval four (4) sets of details of the layout of the RMU in the switchroom provided. The drawings submitted are to be modified if necessary as requested by the S.O.'s Representative and resubmitted for final approval. It is to be

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 8.0	DOCUMENT REQUIREMENTS	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S8/2 of 4

understood, however, that approval of the drawing will not exonerate the Electrical Contractor from any responsibility in connection with the work.

8.4 INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

As soon as the general arrangement and details of the equipment to be supplied have been finalized at and before the delivery of the equipment, the Electrical Contractor shall submit to the S.O.'s Representative two(2) copies of detailed installation, operation and maintenance instructions in respect of the equipment to be supplied. The instructions shall cover the main as well as any associated equipment. For this purpose, manufacturer's standard brochures will be acceptable provided that they refer particularly to the equipment to be supplied and are free from extraneous matter.

The instruction shall include essential details, drawings and sketches of the equipment installation, operation and maintenance techniques and make mention of special materials where used. Each of the above two (2) sets of manuals submitted shall be in a stiff cover ring file and with titles to the satisfaction of the S.O.'s Representative. The cost of these manuals shall be deemed to be included in the Tender Price.

8.5 AS-BUILT DOCUMENT AND TOOLS

As-Built document shall consist of but not limited to the As-Installed drawings, manuals, certificates, catalogues, inventories and parts lists. The drawings, manuals, tools etc. as mentioned below shall be provided whether or not they are separately itemized in the Bill of Quantities (BQ) of the Tender Document.

Each of the As-Built documents shall be bound together with hard cover and submitted in four (4) sets upon the issuance of Certificate of Practical Completion (CPC) of the project.

The cost of all these drawings, manuals, tools etc is deemed to be included in the Contract.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 8.0	DOCUMENT REQUIREMENTS	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S8/3 of 4

8.5.1 AS INSTALLED DRAWINGS

As-Installed drawing shall comprise of :-

- (a) Site plan.
- (b) Schematic Wiring Diagrams
- (c) Electrical Layout Plans.
- (d) Control Circuits drawings
- (e) Layout Plans of cable routes
- (f) Earthing points with reference to easily recognisable buildings and structures.

These drawings shall be labelled at the lower right hand corner the Electrical Contractor's name and address, date of commissioning, scale, drawing number (the drawing number to be obtained from S.O.'s Representative) title and the following particulars:

**JABATAN KERJA RAYA MALAYSIA
CAWANGAN KEJURUTERAAN ELEKTRIK
CONTRACT NO:**

If the drawings submitted are not according to the actual installation at site and/or not acceptable by the S.O.'s Representative, the Electrical Contractor shall amend and re-submit the drawings within two weeks from the date of return of the drawings to the satisfaction of the S.O Representative.

One set of the As-Installed drawing shall be submitted in the form of tracing/original document and two (2) sets in CD ROM.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 8.0	DOCUMENT REQUIREMENTS	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S8/4 of 4

8.5.2 MANUALS

The manual shall comprise of :-

- (a) Installation manual.
- (b) Operation manual.
- (c) Service and Maintenance manual.
- (d) Parts List.
- (e) Product data and detail technical catalogues.
- (f) Product Test Certificates.

The installation, operation, service and maintenance manuals shall be the same as those described in clause 8.4.

8.5.3 TOOLS

One (1) set of 3 phase testing device for LBS as mentioned in clause 2.4.3 and one(1) set of 3 phase testing device for circuit breaker as mentioned in clause 2.5.3 shall be provided. The testing devices shall be insulated to withstand 25 kV d.c. to earth for 15 minutes and shall be capable of carrying at least 630A continuously.

One set of standard tools as well as any special tools, gauges, handling appliance etc. as recommended by the manufacturer for the assembly, operation, checking adjustment and normal maintenance of RMU shall also be supplied.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION : 9.0	SWITCHROOM	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S9/1 of 1

Approved type of rubber mat shall be provided in front of the RMU. The rubber mat shall extend to the full length of the RMU panels and shall be of thickness not less than 6 mm and width 1000 mm.

'BAHAYA' sign, 'DILARANG MASUK' sign, sign indicating 'Substation No: ' and shock treatment chart shall be installed to the requirement of the ST and to the satisfaction of the S.O.'s Representative. 'DILARANG MEROKOK' sign shall also be installed.

All trenches in the switchrooms shall be filled up with clean sand to a level above cable ducts.

As fitted layout plans, schematic wiring diagrams, and plans showing cable routes and positions of earthing point with reference to easily recognised buildings and structures shall be suitably framed up in the switchroom. These plans and diagrams shall be in addition to the four (4) sets of as installed drawings required to be submitted to the S.O.'s Representative after completion of the project as stated in Section 10.0.

One 9 kg. dry powder fire extinguisher for A,B,C class of fire and complete with discharge hose, nozzle and wall bracket shall be supplied and installed in every switchroom. The extinguisher shall be certified by Jabatan Bomba Dan Penyelamat Malaysia valid to be used for a period of twelve (12) months from the completion date of the Contract.

A steel cabinet of suitable dimensions shall be supplied and installed in each substation for storing the RMU testing devices, HV fuses etc. The cabinet shall be completed with lock and keys. The design of the cabinet shall be submitted to the S.O.'s Representative for approval prior to fabrication.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION: 10.0	SERVICE & MAINTENANCE	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S10/1 of 1

During the DLP, The Electrical Contractor shall be responsible for the service and maintenance work for the complete installation. All works shall be carried out by competent personnel. All labour, material, tools and parts necessary to rectify the defects due to manufacturing/ installation faults shall be supplied/ executed at the Electrical Contractor's cost.

The service and maintenance to be performed shall include but not be limited to the following:-

- (a) Replacing or making good all parts and components of the RMU, fuses, wiring, etc.
- (b) Replacing or making good all loose and burnt cables and terminations, all mechanical support and linkage, earth electrodes, inspection chambers and covers, conduits, trunking etc.
- (c) Making good any damage to roads, buildings drains, cables, pipes, concrete areas, paved areas etc. which had not been properly made good arising out of his work.
- (d) All other works as deemed necessary by the S.O.'s Representative.

All works shall be carried out as soon as the Electrical Contractor has been informed by the S.O.'s Representative or the Occupant and shall be completed within a reasonable time except under emergency situation as stipulated in the Electrical Works Additional General Conditions. If the Electrical Contractor fails to comply with the above requirement, the S.O.'s Representative reserves the right to engage another party to carry out the works, in which case, the Electrical Contractor shall be responsible for all the expenses incurred

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION: 11.0	LIST OF STANDARDS	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S11/1 of 2

The standards and/or relevant parts of the standards include but not limiting to the following:

- MS IEC 60265-1 - High-voltage switches - Part 1: Switches for rated voltages above 1 kV and less than 52 kV
- IEC 62271-1 - High-voltage switchgear and controlgear - Part 1: Common specifications
- IEC 62271-100 - High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers
- MS IEC 62271-102 - High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches
- MS IEC 62271-105 - High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations
- MS IEC 62271-200 - High-voltage switchgear and controlgear - Part 200: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
- IEC 60376 - Specification of technical grade sulfur hexafluoride (SF6) for use in electrical equipment
- MS IEC 60502 - Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV)
- MS IEC 60529 - Degree of Protection Provided by Enclosures (IP Code) (First Revision)
- IEC 61243-5 - Live working - Voltage detectors - Part 5: Voltage detecting systems (VDS)
- BS EN 13601 - Copper and copper alloys. Copper rod, bar and wire for general electrical purposes
- BS 7430 - Code of practice for earthing

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
SECTION: 11.0	LIST OF STANDARDS	Revision: 1 (2011)
		Date: Ogos 2012
		Page: S11/2 of 2

- MS IEC 60364-5-54 - Electrical Installations of Buildings – Part 5-54: Selection and Erection of Electrical Equipment: Earthing Arrangements, Protective Conductors and Protective Bonding Conductors
- MS 26: Part 2 - Methods of testing concrete Part 2: Methods of Testing Hardened Concrete
- MS ISO 9001 - Quality Management Systems – Requirements (First Revision)

If the specifications conflict in any way, with any or all of the above standards, the specification shall have precedence and shall govern.

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
APPENDIX A	ACCEPTANCE CRITERIA FOR ROUTINE TEST	Revision: 1 (2011)
		Date: Ogos 2012
		Page: ApA/1 of 1

ROUTINE TEST

Test	Acceptance Criteria	Standards
(a) Design and visual checks	Verify the switchgear and controlgear compliance with the approved shop drawings and specification	MS IEC 62271-200 MS IEC 60694
(b) Dielectric test on the main circuit (i) Power-frequency voltage	Test is successful if no disruptive discharge occurs	MS IEC 62271-200 MS IEC 60694
(c) Tests on auxiliary and control circuits	Verification of conformity to the circuit diagrams and wiring diagrams Functional tests	MS IEC 62271-200 MS IEC 60694
(d) Measurement of the resistance of the main circuit	The measured values of the type test shall be used to determine the limit of resistance value for the routine test.	MS IEC 62271-200
(e) Tightness tests	The absolute leakage rate (F) shall not exceed the specified value of the permissible leakage rate (F_p)	MS IEC 62271-200 MS IEC 60694
(f) Mechanical operation tests	-	MS IEC 62271-200

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
APPENDIX B	ACCEPTANCE CRITERIA FOR TYPE TEST	Revision: 1 (2011)
		Date: Ogos 2012
		Page: ApB/1 of 1

TYPE TESTS

Test	Acceptance Criteria	Standards
(a) Short-duration power frequency withstand voltage tests	Test is successful if no disruptive discharge occurs	MS IEC 62271-200 MS IEC 60694
(b) Impulse tests	Test is successful if no disruptive discharge occurs	MS IEC 62271-200 MS IEC 60694
(c) Temperature-rise tests	Not exceed the temperature-rise limits specified in Table 3 of MS IEC 60694	MS IEC 62271-200 MS IEC 60694
(d) Short-time withstand current and peak withstand current tests (i) Test on main circuits (ii) Tests on earthing circuits	No deformation or damage to components or conductors within the enclosure Deformation and degradation of the earthing conductor, earthing connections or earthing devices is permissible, but the continuity of the circuit shall be preserved	MS IEC 62271-200 MS IEC 62271-200
(e) Tightness tests	The absolute leakage rate (F) shall not exceed the specified value of the permissible leakage rate (F_p)	MS IEC 62271-200 MS IEC 60694
(f) Measurement of the resistance of circuits	The measured values will be recorded and shall be used to determine the limit of resistance value for the routine test	MS IEC 62271-200 MS IEC 60694
(g) Verification of the ingress protection (IP) coding	Minimum IP2X	MS IEC 62271-200

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
ANNEX	TECHNICAL PARTICULARS & GUARANTEE	Revision: 1 (2011)
		Date: Ogos 2012
		Page: An/1 of 3

A.1 TECHNICAL PARTICULARS AND GUARANTEES
(To be filled in by the Electrical Contractor)

1.0 General

- (a) Name of Manufacturer:
- (b) Name and Address of Local Authorised Agent:
- (c) Country Of Origin
- (d) Model/Type Reference No.:
- (e) Type Testing Authority:
- (f) Test Certificate Report/Reference:
- (g) Rated Voltage (kV):
- (h) Rated Normal Current (A):
- (i) Rated Frequency (Hz):
- (j) Number of Phase:
- (k) Impulse Withstand Voltage On 1.2/50 micro second (kVp):
- (l) One-minute Power Frequency Withstand Voltage (kV r.m.s):
- (m) Number of seals in the SF6 module:
- (n) Relative Pressure of SF6 gas (Bar) Withstand Voltage
(kVr.m.s)

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
ANNEX	TECHNICAL PARTICULARS & GUARANTEE	Revision: 1 (2011)
		Date: Ogos 2012
		Page: An/2 of 3

2.0 Load Break Switches

- (a) Rated Normal Current (A) :
- (b) Rated Short Circuit Breaking Current (A) :
- (c) Rated Short Circuit Making Current (kAp) :
- (d) Rated Short Time Withstand Current.
3 seconds at 11 kV. (kA r.m.s) :

3.0 Circuit Breaker

- (a) Rated Normal Current (A) :
- (b) Rated Short Circuit Breaking Current (A) :
- (c) Rated Short Circuit Making Current (kAp) :
- (d) Rated Short Time Withstand Current.
3 seconds at 11 kV. (kA r.m.s)

4.0 Earthing Switches

- (a) Rated Normal Current (A) :
- (b) Rated Short Circuit Making Current (kAp) :
- (c) Rated Short Time Withstand Current.
3 seconds at 11 kV (kA r.m.s)

	SPECIFICATION FOR 11 kV SF6 RING MAIN UNIT (L-S14)	CKE.LS.01.14.(01).2012
		Date: Ogos 1986
ANNEX	TECHNICAL PARTICULARS & GUARANTEE	Revision: 1 (2011)
		Date: Ogos 2012
		Page: An/3 of 3

5.0 Busbars

- (a) Material :
- (b) Rated Normal Current (A) :
- (c) Rated Short Time Withstand Current
3 seconds at 11 kV (kA r.m.s) :

***6.0 Schedule of Departures from Specification:-**

* Electrical Contractor shall enter details at time of tendering. If no details are entered, the equipment shall be deemed to fully comply with the requirements of the specification.

Signature :.....

Name of Electrical Contractor :

Chop of Electrical Contractor :

Date:

