

NO. CLW/ES/C/47
TOTAL NO. OF SHEETS -

ALT		A	B	C	D	E					
No. of Sheets	39	42	43	44	44						

SPECIFICATION FOR
VACUUM CIRCUIT BREAKER WITH SINGLE INTERRUPTER
FOR
25 KV AC ELECTRIC LOCOMOTIVES
CLASS: WAG7, WAG9, WAP1, WAP4, WAP5 & WAP-7

ISSUED BY:

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DIST: BURDWAN, WEST BENGAL, INDIA.

AEE/SEE

CHKD.

DRN.

Specification of
Vacuum Circuit Breaker
for AC Electric
Locomotives

DY. CEE/Design.



CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA.

DATE: 28 /07/2011 .
NO. CLW/ES/ C-47
ALT.-F,G

1. DRG. NO. CLW/ES/SK-1/C-47

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2. DRG. NO. CLW/ES/SK-2/C-47

A	B										
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3. . DRG. NO. CLW/ES/SK-3C-47

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4. DRG. NO. CLW/ES/SK-4/C-47

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5. DRG. NO. CLW/ES/SK-5/C-47

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DETAILS OF ALTERATIONS

ALT. NO	DATE	DESCRIPTION	SIGN.	REM-ARKS
A	27.4.99	R-C DAMPING NET WORK DRG. AND SOCKET CONNECTOR DRGS ARE ADDED FROM SHEET 40 TO 42, PARA 6.9 IN SHEET 11 IS MODIFIED, AND CLAUSE 11-1.3 IN SHEET NO. 24 IS ADDED. SHEET 38 & 39 DELETED, SH- 38A & 39A IS ADDED		
B	3.8.2000	ANNEXER C IN SHEET 34A IS ADDED		
C	07.05.2005	TO SOLVE INTERCHANGEABILITY PROBLEM, SHEET NO. 34A IS DELETED. SHEET NO. 34B & 43 ARE ADDED VIDE RDSO/LKO LETTER NO. EL/3.2.61 Dtd. 8/11-10-2004		
D	27.10.06	REPLACED G.I. BRAIDED 27" LONG AIR HOSE PIPE BY FLEXIBLE REINFORCED RUBBER PIPE IN ITEM NO. 2 OF REVISED SCOPE OF SUPPLY SHEET NO. 34B VIDE RDSO's MODIFICATION SHEET NO. RDSO/WAM4/199		
E	9.4.07	SOURCES OF SUPPLIERS OF CAPACITOR FOR R.C DAMPING PANEL HAVE BEEN INCLUDED IN SHEET NO. 34B . AS THEIR NAME ARE ALREADY MENTIONED IN THE RDSO SPECN.OF UPRATED SILICON RECTIFIER.		
F	25.10.10	IN SOURCES OF SUPPLIERS OF CAPACITOR FOR RC DAMPING PANEL M/s ZEONICS SYSTEM/BANGALORE INCLUDED AS PER RDSO LETTER NO. EL/3.2.61/GEN DT. 18.10.10		
G	20.07.11	<ul style="list-style-type: none"> * SPECIFICATION REVISED. * CLAUSE NO 1.2; 2.1; 3; 5.2; 5.5; 6.6.2; 6.6.3; 6.7; 6.9; 7.2.1; 7.2.3; 7.2.4; 7.2.5.1 ;8.5; 9; 10.6; 10.7; 10.8; 17.1; 20; ARE REVISED AS PER RDSO'S CONFIRMATION Lt. No. EL/3.2.61 DT. 18/22.07.13. * CLAUSE 20 ADDED AND CONNECTION DIAGRAM OF DIFFERENT SUPPLIERS ADDED. * GI-BRAIDED 10" LONG AIR HOSE CHANGED TO FLEXIBLE REINFORCED RUBBER AS PER RDSO SMI 340 DT.29.06.05. *SCOPE OF SUPPLY FOR 3-PH. LOCOS ARE INCORPORATED AS PER RDSO SMI 0345 REV.1 DATED. 13/02/2014. 		

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1.0 SCOPE

- 1.1** The Indian Railways have a fleet of AC electric locomotives and motor coaches used in electric multiple units (EMUs) operating on 25kV,50Hz, used for the haulage of passenger and freight traffic.
- 1.2** This specification applies to single phase roof-mounted vacuum circuit breakers **with short circuit breaking capacity of 400 MVA** with single interrupter for 25kV AC single phase, 50Hz, electric locomotives / Electric Multiple Units (motor coaches).
- 1.3** Ordinarily types/makes/designs of VCB proved in service on similar application will only be considered for this procurement. Particulars in support of proven experience shall be furnished with the offer, giving inter-alia, the following information in respect of each type of VCB supplied:
- Approximate numbers supplied as up to current year.
 - Distribution of the above amongst user Railways specifying the names of the User and, if possible, the application, i.e. electric loco/EMU, with ratings.
 - Years in regular service
 - Performance with particular reference to reliable trouble-free service.
- 1.3.1** On typical railway applications where a large number of similar/identical VCBs are in service, the performance data may, if possible, include the following statistical information pertaining to the latest one or two years of operation:
- Number of locomotives/motor coaches in service on the Railway system concerned using the particular type/make of VCB.
 - Number of failures/problems reported during service, attributable to any defect/failure of the VCB.
 - Number of incidence of problems/defects reported by the maintaining depots/sheds, warranting special attention/replacement of components beyond the stipulated scheduled maintenance/ attention prescribed by the manufacturer.
- 1.3.2** Reputed electrical equipment manufacturers may, however make offers of VCB conforming to this Specification.

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- 1.4** The VCBs offered shall be complete with all parts and accessories necessary, for its efficient operation. All such parts and accessories shall be deemed to be within the scope of this specification, whether specifically mentioned or not.

2.0 GOVERNING SPECIFICATIONS

- 2.1** IEC Publication **60077-4** “IEC Specification for High-Voltage Alternating Current Circuit Breakers” shall be the governing specification for this provisions of this procurement except where modified/amended by the provisions of this Specifications.
- 2.2** Other IEC, IS and BS Specifications, as relevant, have been quoted in the appropriate clause of this Specification and the provision of such specification will also apply except where modified/amended by the provisions of Specification.

3.0 RATINGS

- | | | | |
|-------------|---|---|---|
| 3.1 | Nominal operating voltage | - | 25kV, 50Hz, single phase AC. |
| 3.2 | Rated current | - | 1000Amp r.m.s. |
| 3.3 | Rupturing capacity at 25kV | - | 400MVA |
| 3.4 | Rated duration of short circuit current of 16 KA | - | 3 seconds |
| | clause 8.2.10 of IEC-60077-4 : 2003 | | |
| 3.5 | Total Break time | - | Not more than 60ms. |
| 3.6 | Rated operating sequence | - | O – 3 min – CO – 3 min – CO. |
| 3.7 | Rated short circuit breaking Current (sym) | - | 16 KA rms (400 MVA). |
| 3.8 | Rated short circuit making current | - | 40 KA peak. |
| 3.9 | Rated lightning impulse voltage Withstand | - | 175 KV peak. |
| 3.10 | Rated power frequency voltage (Dry & Wet) | - | 75 KV rms. |
| 3.11 | Number of phases | - | One |
| 3.12 | Auxiliary Switch | - | Fishbone type with available contact as 4 NO + 4 NC. |
| 3.13 | Operational frequency | - | C3 (as per Para 5.4 of IEC:60077-4). |

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4.0 DIMENSIONS AND WEIGHT


- 4.1 The overall dimension of the Vacuum Circuit Breaker type Secheron design of Ms. AAL. & BT make, currently also in use, are given in the sketch at sheet no 36, forming part of this Specification. The mounting arrangement on the roof as well as the particulars of projection above and below roof are also given therein. As the VCB to be procured is also likely to be used at the same location, it would be advantageous if an offer for VCB complying with this Specification and falling within the overall dimension shown in sketch mentioned above, is made by the tenderer. In regard to the mounting arrangement also, it would be advantageous if the

VCB has an identical mounting arrangement; alternatively, a suitable and satisfactory adaptor plate design shall be worked out and included in the offer.

- 4.2 The total weight of the Vacuum circuit Breaker including the operating mechanism and accessories is around 150 kg. The weight of VCB offered including the operating mechanism accessories etc., shall as far as possible, not exceed 150kg.

5.0 PRINCIPLE OF OPERATION

- 5.1 The VCB will be used for controlling power supply to the Loco/EMU under normal operating conditions as well as for protection through tripping under abnormal conditions.
- 5.2 The opening and closing of Main Contact of VCB shall take place in a high degree of vacuum. Destruction of vacuum shall be checked periodically in the maintenance depots. by Dielectric Withstand Voltage Test **which shall be defined by the VCB manufacturers.**
- 5.3 The movement for the opening and closing of contacts shall ordinarily be through use of compressed air supply available on the loco/EMU at pressure which may vary between 5 kg/cm² and 11 kg/cm² depending upon the type of stock, compressor operation etc.

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5.4 Necessary air filter, air drier, air reservoir, pressure regulator and such other accessories / equipments as may be required to utilize the available compressed air pressure on the loco/EMU as above, for satisfactory operation of the VCB under all conditions, shall be included in the offer. In addition , a pressure switch shall also be incorporated to ensure that in the event of failure of the pressure regulator, the VCB shall trip if the pressure of compressed air supply falls below the designed pressure for satisfactory performance of the VCB. The design of the pressure regulator and the pressure switch shall be such that it will, in no case, be possible to close the VCB if the pressure of the incoming compressed air supply to the pressure regulator goes below the minimum pressure required for the safe operation

5.5 For the operation of control coils/magnet coils connected with the operation of the VCB and forming part of the VCB equipment, control supply voltage at 110V DC (nominal) available in the electric loco/EMU shall be made use of. This voltage may vary from 77V to 137.5V (as per IEC: 60077-1). Coils shall be so designed as to work entirely satisfactorily through out this voltage range.

In particular the coils shall be so designed that-


- (a) at the lowest voltage of 77V, the coils will pick up even when they are at the maximum operating temperature and
- (b) Maximum temperature of the coils shall be well within the safe values permissible for the class of insulation (insulation class of coil shall be class F or above) and construction of the coils as employed even when continuously operated at the maximum voltage of 137.5 V.

6.0 CONSTRUCTIONAL FEATURES

6.1 The VCB shall be of a robust and compact construction suitable for outdoor use.

6.2 The construction of the VCB shall be such that parts of breaker shall easily be accessible for inspection and maintenance. Dust and water-proof cover should be provided on control and operating mechanism.

6.3 The component parts of the breaker shall be of simple construction and shall be assembled in such a way that they can be connected directly as far as possible with minimum links.

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6.4 The steel bellows of the VCB should be suitably designed so as to ensure long life. This is necessary to avoid failure of the VCB due to premature break in the steel bellows. A life of 25 years under normal operating conditions is considered to be a satisfactorily long life as far as the steel bellows are concerned. Adequate safety factors shall be provided for, in the design/construction/materials to achieve this requirement.

The manufacturer shall furnish the details of any special endurance/investigational tests conducted by him to establish reliability/long life of the steel bellows.


6.5 In the present scheme of operation of the Air Blast Breaker, **one/two** operating coils are **being** used. – **In one coil design VCBs, closing coil is meant for closing as well as holding the VCBs and remains energized continuously during the operation . In two coil design a closing coil, which is short time rated and is energized only for the purpose of closing, and a maintaining coil, which is continuously energized for keeping the breaker in closed position. Removal/failure of the control supply opens the breaker. The various protective circuits for opening/tripping the circuit breaker are so arranged that in the event of any abnormal situation, warranting tripping, the maintaining coil circuit is de-energized. It will be preferable, if the VCB offered permits similar operation so that the adaptation of the external circuitry causes no difficulty whatsoever. However, there is no objection to the offer of a VCB which may have a different arrangement of operating coils for closing, maintaining and opening of the VCBs. Details shall be clearly indicated in the offer together with technical particulars of the coils.**

6.6 Auxiliary contacts (Interlocks), which close/open with the closing/opening of the VCB shall be required to be provided as part of the equipment for use with external circuits and operate at a nominal voltage of 110V DC. A minimum number of eight such contacts shall be provided, of which four shall be in the ‘close’ position and four in the ‘open’ position, when the VCB is in the open position

It shall be possible for any of the contacts to be converted from “normally closed” to “normally open” position and vice versa, if so required. Only fish bone type contacts shall be used.

6.6.1 Auxiliary contacts shall have the following ratings:-

- Continuous current carrying capacity - 10 Amp DC
- Breaking capacity - 2 Amp at 110V DC with a circuit time constant of not less than 15ms

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6.6.2 Auxiliary Cables

Elastomeric cables 3.0 sq mm/ 750V as per RDSO's specn. no. E-14/01 Pt. I-1993(Rev.-1) or Thin walled cable having wire cross-section 1.0 /1.5 sq mm or more should be used for auxiliary cables for wiring the VCB internal connection and auxiliary connection.

6.6.3 Hardware


Stainless steel fasteners of property clause A2-70 Grade should be used by the firm to avoid rusting. OR HT hardware should be suitably passivated /Cd.-plating and hardware should be procured from reputed suppliers of CLW approved vender list for the said item or approved by RDSO.

6.7 For maintenance work on the HT equipment of the electric Locos/EMUs, it will be necessary not only to isolate the equipments by opening the VCB but also to earth both the terminals of the VCB effectively. Necessary earthing terminals which will be required for this purpose, shall be incorporated in the VCB.

6.8 Porcelain housing suitable for outdoor use shall conform to IS:5621/IEC:233. the porcelain housing shall be capable of safely withstanding all electrical and mechanical stress that might be produced during operation of the circuit breaker under normal and short circuit conditions. Porcelain housing/ support insulators used shall have adequate Creepage distance. All ferrous parts used shall be hot dip galvanized.

6.9 Connectors shall generally confirm to IS:5561/BS:159 connector type SICEM-35P both male and female of M/s. GIMOTA AG/Switzerland make or similar CLW approved sources of that item shall be supplied along with each VCB.

6.10 The protection scheme at present adopted for electric locos/EMUs for protection against lightning surges as well as voltage surges developing from operation of the circuit breakers, is briefly described below:

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ELECTRIC LOCOMOTIVES.

GAPLESS LIGHTING ARRESTER IS PROVIDED.


ELECTRIC MULTIPLE UNITS.

ONLY ONE LIGHTNING ARRESTER IS PROVIDED HAVING 100% IMPULSE SPARK OVER VOLTAGE OF 110 KV PEAK WITH 1/50 WAVE.

- 6.10.1** There is a likelihood that due to the faster interruption of current that may be achieved with VCB, the over voltage arising from the tripping of the breaker may substantially be higher than what is currently being imposed on the equipment by use of air blast circuit breaker. The VCB offered shall take care of this possibility and be designed in such a manner as to limit the switching surges. The Tenderer shall furnish a Technical Note with his offer bringing out his comments in this regard with particular reference to experience on Railway systems where the VCB proposed by him, has been used.

In case the Tenderer considers provision of additional surge absorbing (RC) networks or some such measures to reduce the extent and incidence of such surges to acceptable levels, the same shall be included in the offer. The Tenderer shall also agree to furnish details of the protective measures that will become additionally necessary in the event of over voltage using this VCB in Indian Railways operating conditions exceeding, substantially, the levels that are currently being experienced. This aspect may require studies during field trials and comparative analysis on locomotive having VCBs and operating under identical/similar conditions of service. All additional equipments required to limit the surges or to protect the equipments in the event of over voltages exceeding the present levels with the use of vacuum circuit breakers shall form part of the offer.

- 6.11** Each VCB shall be provided with a name plate carrying the following data, marked in a durable manner and located in a place such that they are visible and legible when the breaker is installed: -


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- the manufacturer's name and trade mark
- type, designation and serial number
- rated voltage
- rated current
- rated short circuit breaking current
- rated short time current and duration
- rated insulation level
- rated operating sequence
- control supply voltage
- governing specification
- year and month of manufacture
- total weight

7.0 CLIMATIC, ENVIRONMENTAL AND OPERATING CONDITIONS

7.1 Climatic & environmental conditions

- Temperature - Normal ambient temperature may vary from 0 to 55°C inside the loco/EMU. The exposed parts mounted on the roof of the loco/EMU may be subjected to temperatures as high as 70°C.
- Humidity - 100% saturation during rainy season
- Average annual rainfall - 1750 to 6250 mm
- Number of rainy days } May be as high as 120 days
Per annum }
- Number of thunder storm - May be as high as 85 day
per annum
- Number of dust storm - May be as high as 35 days
Days per annum
- Wind pressure - May be as high as 200 kg/m²
- Altitude - Not exceeding 1776 meters above mean sea level

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NOTE: The locomotives/EMU operate for long distances along sea coast and in dusty atmospheric conditions and the VCBs shall be adequately designed for this duty.

7.2 OPERATING CONDITIONS

7.2.1 The breaker will be required to open and close **for so many** times every day on 'No Load'. The total number of such operations per annum may be taken as **15000**. Besides, the breaker will have to trip to clear the faults due to abnormality in the loco/motor coach equipments. There may be occasions for the breaker to close and open on fault during trouble shooting. The estimate of number of such occasions of opening on load/fault can be taken to be 1000 per annum. In some of these operations, the tripping may not necessarily be due to fault conditions, but due to spurious action of the protective circuits.

The number of instances where a dead short may have to be cleared by the breaker is not expected to exceed about 2 per annum and the level of short circuit to be cleared in such conditions may be about 400 MVA.

7.2.2 VCB may be used on different types of locos/EMU in service / to be constructed for operation on Indian Railways. The maximum continuous rated current corresponding to continuous rated output of the traction equipments used on the most powerful series of locos/EMUs are expected to be as under


- Loco application – 300A(**approx**). - EMU application – 60A(**approx**).

7.2.3 Overhead equipment (catenary) supply conditions

- Voltage - Nominal 25 KV AC single phase, variation 19 KV to 27.5 KV
occasional maximum 30 KV, occasional minimum **16.5 KV**
- Frequency - Nominal 50 Hz.
Variation $\pm 3\%$ (48.5 - 51.5 Hz)

The ratings of the single pole track feeder circuit breakers installed at the sub-stations are given below: -

- Rated current - 1600A
- Rated short circuit breaking current - 16 KA at 25 KV

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- Rated short circuit Making current - 40 KA (peak)
- Rated short time current - 16 KA for 3 seconds
- Rated breaking capacity At 27.5 KV - 440 MVA
- Total break time - Not more than 60 ms.


7.2.4 The equipment and its mounting arrangement shall be of robust design for traction duty and shall withstand satisfactorily the vibration and shocks as per **IEC: 61373** normally encountered in service as indicated below:-

- Maximum vertical acceleration - $\pm 3.0g$
 - Maximum longitudinal acceleration - $\pm 5.0g$
 - Maximum transverse acceleration - $\pm 3.0g$
- (‘g’ being acceleration due to gravity.)

7.2.5 Apart from exceptions of improved reliability, one of the primary considerations that has governed the present tender for VCB is the expectation that it will require considerably reduced maintenance effort and expenditure. The manufacturer shall clearly indicate the following in his offer :-

- (i) Items to be inspected (visually checked) periodically, including the frequency of such inspection.
- (ii) Measurements to be recorded on components as well as operating parameters like clearance, pick-up voltage, wear and such other measurable quantities, original and condemning limits and the periodicity of such checks.
- (iii) The estimated lives of the critical components under the conditions of operation should be specified. This shall preferably be given under two headings :-
 - a) Components subjected to normal wear and tear which require to be renewed / replaced periodically for satisfactory performance and
 - b) Components which may be subjected to fatigue, which based on experience, may require timely replacement to forestall failure in service.

The lists may be separately made out indicating item-wise expectation of life for both (a) and (b) above and furnished with the offer.

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7.2.5.1 The inspection and overall schedule currently followed by the Indian Railways are given below: -
Electric Locomotives

- Fortnightly Inspection
- Monthly Inspection (IA)
- Two monthly Inspection (IB)
- Four monthly Inspection (IC)
- Annual Overhaul (AOH) (yearly for passenger loco and 1½ year for Goods loco)
- Intermediate Overhaul (IOH) (3 yearly for passenger loco and 4½ yearly for Goods loco)
- Periodical Overhaul (POH) (6 yearly for passenger loco and 9 yearly for Goods loco)

Electric Multiple Units

- Fortnightly Inspection
- Monthly Inspection (IA)
- Six months (IC)
- POH (18 months).


Details of inspection/checks and maintenance attention/replacements required to be carried out on the VCBs during the above programmed inspection/overhaul schedules of locos/EMUs shall be furnished with the offer.

8.0 INSPECTION AND TESTING

8.1 The inspection of the VCBs will be carried out by an authorized representative of Indian Railways designated at the time of contract by Indian Railways.

8.2 The inspection will extend to the following areas: -

- Visual inspection and check of the various components, sub-assemblies, assemblies and completed equipment at various stages of manufacture so as to ensure conformance to the manufacturer's specifications and drawings.
- Tests to be done on the completed equipment to establish compliance with this specification.

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8.3 The type tests and the routing tests to be carried out on the equipments, as part of the above inspection, are given below. Irrespective of the equipment being a standard/proven item of the manufacturer for which type tests have already been conducted and the test results are available, the type tests may nevertheless, be repeated for the procurement against any Contract.

8.4 The type tests may, at the discretion of the purchaser, be carried out on one or more of the following equipments even though they conform to a standard basic design.

- i) Equipment completely manufactured at the manufacturer's works overseas.
- ii) Equipment assembled in India using CKD if the Tenderers so desire.
- iii) Equipment indigenized by the Indian manufacturer (stages/indigenization levels at which the type tests will require to be carried out, will be settled mutually between the Indian manufacturer and the Railways, in consultation with the collaborator).


8.5 The Inspecting Officer nominated shall invariably witness all the Type Tests, **if type testing is included in the scope of contract**. The witnessing of Routine tests may be mutually settled between the manufacturer/supplier and the inspecting authority at the appropriate stages.

9.0 TYPE TESTS

A broad outline of the Type Tests proposed is given below. The detailed test programme will be required to be finalized by the supplier with Research Design & Standards Organization/Lucknow & Chittaranjan Locomotive Works/Chittaranjan after placement of the Contract. **Type test shall be conducted jointly by RDSO & CLW.**

9.1 Mechanical Endurance Test

This test shall be conducted in accordance with **IEC: 60077-4**, with the number of operations shall be **2,00,000 (two lacs)**. During the first **20,000** operations, lubrication if any, in accordance with the manufacturer's instructions but no mechanical adjustment shall be permitted.

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For the next 20,000 operations, replacement of parts as per manufacturer's recommendations may be permitted in addition to lubrication. After the test, all parts including contacts, shall be in good condition and the VCB shall continue to open/close satisfactorily. The manufacturer shall indicate the parts that would require replacement during the mechanical endurance test after 20,000 operations together with the periodicity for replacement of these parts, alongwith the tender. The data of the manufacturer in this regard shall be consistent with the recommendations to be made by him for normal maintenance with reference to requirement specified in Clause 7.2 above.

9.2 Temperature rise test on main and Auxiliary Circuits

The temperature rise test on main circuit and auxiliary circuit like closing, maintaining and trip coils, auxiliary contacts etc. shall be carried out as per IEC: 60077-4. Resistance of main circuit shall also be measured and recorded as per IEC.

The temperature rise of parts shall not exceed the following values when the circuit breaker is carrying its rated current continuously: -

- | | |
|---|-------|
| a) Terminals of circuit breaker to be connected to external conductors by bolts | 40°C |
| b) Metal parts in contact with insulators | 45°C |
| c) Auxiliary contacts | 30°C |
| d) Copper contacts | 35 °C |


9.3 Temperature rise test on control coils

The temperature rise of coils rated for continuous duty at 125 V DC measured by resistance method shall not exceed the values specified below for the particular class of insulation.

- | | |
|--------------------------|---------|
| - For class F insulation | - 60 °C |
| - For class H insulation | - 80 °C |

9.4 Impulse voltage Tests

The VCB shall successfully withstand 175 KV (peak) impulse voltage tests with impulse of 1.2/50 micro second wave shape in accordance with clause no. 9.3.3.3 of IEC: 60077-4. Rated impulse voltage shall be applied three times for each polarity at intervals of 1 sec. minimum.

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9.5 Power Frequency Voltage (dry) test

The VCB shall successfully withstand 75 KV (rms) power frequency voltage for one minute.

9.6 Power Frequency Voltage (wet) test

The VCB shall successfully withstand 75 KV (rms) power frequency voltage for one minute.

9.7 Dielectric test on auxiliary and Control Circuits

Auxiliary and control circuits of the VCB shall successfully withstand 2 KV (rms) power frequency voltage for one minute.

9.8 Short Circuit Making & Breaking Capacity Test

These tests shall be carried out as per **clause no.9.3.4 of IEC: 60077-4** at a recovery voltage of not less than 25.0 KV. **Test sequence as mentioned in the clause shall also be followed.**

Sequence of tests shall be as under:

- (i) Measurement of resistance of main circuit.
- (ii) Short time withstand current and peak withstand current.
This tests shall be conducted at short time current not less than 16 KA for a period of 3 Sec.
- (iii) Ability to make and break under short circuit connections.
- (iv) Verification of dielectric withstand.
- (v) Verification of the resistance of the main circuit.

9.9 Transient recovery voltage test

This test shall be conducted as per clause no. 9.3.6 of IEC: 60077-4.

9.10 Travel characteristics measurement tests

(i) Closing Speed 0.1 m/s to 0.4 m/s

(ii) Opening time **within 60 ms**

(iii) Contact bounce duration Not to exceed 10 ms

Variation of Closing speed and opening time of VCB depend upon VST, may be acceptable with prior approval from RDSO/CLW.

(iv) Closing time **As per manufacturer guaranteed data**

(v) Contact gap **As per manufacturer guaranteed data**

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9.11 Tests to withstand vibration and shock

These tests shall be carried out in accordance with clause 9.3.5 of IEC 60077-4 and relevant method of IEC: 61373. During the test, sequence of tests mentioned in the clause no. 9.3.5 of IEC: 60077-4 shall be followed.

9.12 The test reports/certificates from manufacturers for auxiliary contacts, limit switch, insulators etc. carried out as per relevant IEC or IS shall also be submitted to the Inspecting Authority.

9.13 Air tightness test

Air leakage test shall be conducted at 6.5 kg/cm² . Pressure for a period of 30 min. At the end, no pressure drop should be observed in the set value.

10.0 ROUTINE TESTS**10.1 Power frequency Voltage (Dry) Tests**

The VCB shall successfully withstand 75 KV (rms) power frequency voltage for one minute.

10.2 Dielectric test on auxiliary and Control Circuits


Auxiliary and control circuits of the VCB shall successfully withstand 2 KV (rms) power frequency voltage for one minute.

10.3 Measurement of resistance of main circuit

The resistance of the main circuit measured in the closed position of VCB shall not exceed 1.2 times the measured resistance of the prototype breaker.

10.4 Mechanical operating test with air pressure

This test requires 20 closing and 20 opening operations to be satisfactorily carried out each at the maximum, minimum and at rated control supply voltages. Time interval between successive closing operations shall be 30 seconds (maximum).

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During this test, the incoming air pressure may be varied between the limits of 5-11 Kg/cm² prescribed in clause 5.3 above to ensure that the operation is satisfactory at any air pressure over this range. Further, the feature that the breaker will not close/operate if the incoming air pressure goes below the minimum specified safe working pressure which will be indicated by the Tenderer.

10.5 **Manual closing and tripping operation test**

Twenty manual closing and tripping operations shall be carried out to ensure satisfactory operation.

10.6 **Travel characteristics measurement tests**

These tests shall be carried out in accordance with clause 9.10 of this specification for 100% of the lot offered for routine inspection.

10.7 **Air leakage test :**

Air leakage test shall be conducted at 6.5 kg/cm² . Pressure for a period of 30 min. At the end, no pressure drop should be observed in the set value.

10.8 **Drop out and pick-up voltage of magnet coil :**


Drop out and pick-up voltage shall be measured.

11 **TOOLS, GAUGES & TESTING INSTRUMENT/KITS**

11.1 The Tenderer shall list out the special tools, gauges and testing instruments/kits which will be required for inspection, adjustment and maintenance of the VCB. Any special testing kit which may be required for periodically checking the condition of the vacuum in the VCB may also be included in such a list along with the offer.

11.1.1 Individual prices for the items included in the above list should also be furnished.

11.1.2 The exact quantities/items of tools, gauges and testing instruments/kits to be procured initially, will be decided at the time of the contract for the VCBs based on the above price list.

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11.1.3 RE-VALIDATION OF TYPE TEST

As per RDSO's/LKO letter No.EL/01/16 dtd.22/27.1.99. THE MANDATORY PROTOTYPE TESTS WILL BE REPEATED AT AN INTERVAL OF EVERY 5 YEARS IN PRESENCE WITH RDSO & CLW REPRESENTATIVE JOINTLY.


11.1.4 RAILWAYS RESERVE THE RIGHT TO PROCURE MATERIALS ONLY FROM ISO CERTIFIED FIRMS.**12.0 SPARES****12.1** A complete list of spare parts recommended for

- a) replacements due to normal wear and tear and
- b) emergency replacements for any breakages, damages etc.

shall be made out and an item-wise priced offer for such a list submitted along with the offer for the VCBs. The quantities recommended to be purchased by the Indian Railways to cover the requirements for five years for the total quantities of VCBs covered by the tender enquiry, should also be indicated in such a list.

13.0 OPEERATING AND MAINTENANCE MANUAL**13.1** Operating and Maintenance Manual containing essential technical information for understanding the operation of the VCB as well as for carrying out inspection, maintenance and overhaul will be required to be supplied as part of the first lot of the VCBs. The Manual shall be in English and 6 sets such Manual shall be supplied. No separate price for these Manuals shall be quoted and the supply of the 6 sets will be treated as part of and included in the supply of the VCBs. The supplier may follow his standard practices in regard to the preparation of such a Manual but the following information shall necessarily included.

- (i) General assembly drawing including mounting details and overall dimensions.
- (ii) Explanation for operation.
- (iii) Diagrams of pneumatic and electrical connections including connections of the Auxiliary contacts;
- (iv) Drawings of wearing components indicating designed dimensions and their wear limits;
- (v) Detailed instructions for inspection, maintenance and overhaul in the manner called for a clause 7.2.5.1 above;

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(vi) Dimensional drawings and key drawings for such other components and parts which will be required for proper appreciation of the offer and functioning of the VCB.

(vii) A spare parts list with reference numbers.

This may also include items which may be required only in emergencies such as breakages, damages etc. The Manual, as above, in draft form shall first be got approved by the Research, Design and Standards Organization and Chittaranjan Locomotive Works in the course of the contract and thereafter the required number of copies supplied along with the VCBs.

13.2 Suppliers should submit their list of Sub-suppliers for major sub-assemblies along with their offer.

14.0 TRAINING OF INDIAN RAILWAY ENGINEERS


14.1 Along with the offer, the tenderer shall submit his willingness to impart training free of cost to two engineers of Indian Railways at the manufacturer's works abroad and/or in India and at the maintenance depots/workshops of such railway system where electric locos and EMUs deploying similar/identical VCBs are in operation. The total duration of training for each engineer will be 4 weeks, suitably split up between the manufacturer's works and on the railway system(s). The to and from travel in India and abroad will be borne by the Railways as also the expenditure on boarding and lodging.

15. DELIVERY

15.1 The tenderer shall offer the earliest deliveries possible. He shall indicate in his offer a programme for establishing series manufacture in India, if required under their offer.

16. WARRANTY

16.1 All VCBs supplied against this contract irrespective of origin (imported or indigenous) shall be guaranteed for trouble-free and fully satisfactory performance for a period of 30 months from the date of supply or 24 months from the date of commissioning of the loco/EMU by user Railways whichever is earlier. Details of the warranty clause, the extent of responsibility on the part of the supplies and other relevant aspects will be included in the contract. The tenderer may furnish his detailed terms in this regard in his offer.

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17. SERVICE TRIALS

17.1 Two nos. proto type units shall be subjected for field trials for a period of six months on the zonal railways of the Indian Railways on locos/EMUs so as to gain field experience under different environmental and operating conditions, in case the offered VCBs are being supplied to Indian Railways for the first time. The tenderer shall make necessary arrangements for close monitoring of the performance of the VCBs on service trials by periodical visits to the sheds/depots concerned for observations.

Arrangement may also be made for emergency/standby spare parts to be kept in India to meet exigencies warranting replacement so as to keep the VCBs in service without unduly long interruption. Such spares will be in addition to the spare to be procured by Indian Railways against the offer to be made in terms of Clause 12.1 above.

17.2 Technical guidance and assistance for proper operation and maintenance, trouble-shooting, investigations and generally all aspects of technical lesson that may be required during the initial service trial period, shall also be organized.


18. DATA TO BE FURNISHED ALONG WITH THE TENDER OFFER

18.1 The special technical data to be furnished by the tenderer along with his offer has been indicated at various places in the preceding clauses of this specification. These are listed out again for convenience of reference at Annexure-A. Further, the following should also form a part of the tender offer:


- i) General assembly drawing including mounting details and overall dimensions;
- ii) Explanation for operation;
- iii) Diagram for pneumatic and electrical connections including connections of the auxiliary contacts.

18.2 Certain operating requirements and ratings have been specified for the VCB in this specification. The tenderer shall indicate separately in his offer the parameters / values of the VCB offered vis-à-vis the values specified.

18.3 The details of price, delivery terms of the VCBs, spare parts, tools, etc. may be furnished in one place for ready reference.

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- 18.4 A statement indicating clause-wise comments on this specification shall accompany the offer. In particular, clear acceptance shall be conveyed wherever the tenderer fully accepts the requirement indicated. Where there is any deviation or an alternative proposal, the same shall be indicated clearly against the clause concerned.
- 18.5 At the end of this statement, the tenderer may add, any further comments or observations which he may wish to make on this specification.
- 18.6 The list of additional technical information's /data which the Indian Railway would like to have for evaluation of the offer is at Annexure-B. The tenderer may, to the extent possible, furnish this information.
- 19.0 Destruction of vacuum shall be checked periodically in the maintenance depot. by di-electric withstand voltage test.
- 20.0 Manufacturer should punch / embossed firm's identification mark and date of supply in **vital components of VCBs wherever possible.**

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ANNEXURE-ASPECIAL TECHNICAL DATA TO BE FURNISHED BY THE
MANUFACTURER ALONG WITH THE TENDER OFFER

Sl. No.	Item	Clause reference of specification
1	(a) Details of proven design	1.2
	(b) Proven service experience	1.3
2	Mounting arrangement – Adapter plate design if any.	4.1
3	Details of accessories	5.4
4	Reliability aspects of steel bellows	6.4
5	Arrangement of operating coils	6.5
6	Earthing switch details	6.7
7	Technical Note on surge absorbing networks	6.10.1
8	(a) Expected life of components	7.2.5
	(b) Details of maintenance attention required during programmed inspection/overhaul schedules.	7.2.5.1
9	List of parts requiring replacement after 20,000 operations and their periodicity of replacement.	9.1

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ANNEXURE-BADDITIONAL TECHNICAL INFORMATION

Sl. No.	Description	Units of measurement
A	<u>RATINGS</u>	
1	Type of interrupter	
2	Insulation level of circuit breaker	
	(i) One minute dry and wet power frequency voltage withstand	KV (rms)
	(ii) Impulse voltage withstand, 1.2/50 micro-second wave	KV (peak)
3	Rated short circuit making current	KA (peak)
4	Breaking capacity	
	(i) Maximum breaking capacity (Type Test certificate to be furnished)	MVA
	(ii) Rated breaking capacity at a recovery voltage of 25 KV.	MVA
B	<u>CONSTRUCTIONAL FEATURES</u>	
5	Type of main contacts	
6	Type of vacuum bottle	
7	If capacitance grading is used, state the value of capacitance and its rated voltage.	
8	Degree of vacuum in the bottle	
9	Materials of contacts (Including chemical composition)	
	i) Main contacts	
	ii) Arching contacts, if any.	
10	Minimum air clearance between live parts and earth.	

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Sl.No.	Description	Unit of Measurement
C. OPERATING PARTICULARS		
11	opening time from the instant of trip coil energisation	
	i) with no current	ms
	ii) at rated current of 1000A	ms
	iii) at rated breaking current of 16 KA	ms
12	Arcing time	
	i) at rated current of 1000A	ms
	ii) at rated breaking current of 16 KA	ms
13	Total interrupting time from the instant of trip coil energisation to the final extinction of arc	
	i) at rated current of 1000A	ms
	ii) at rated breaking current of 16 KA	ms
14	Making time from the instant of closing coil energisation	ms
15	Minimum time interval between successive operation at 1000A	Second
16	Minimum number of operations without replacement of vacuum bottle.	
	i) at the rated breaking current of 16 KA	nos.
	ii) at a breaking current of 8kA	nos.
	iii) at a breaking current of 6kA	nos.
	iv) at a breaking current of 4kA	nos.
	v) at the normal breaking current of 1000A	nos.
	vi) at the normal breaking current of 400 A	nos.
	vii) at the normal breaking current of 250 A	nos.
17	a) The Level at which chopping occurs while breaking magnetizing current at a recovery voltage of 25.0kV	A
	b)The expected peak restriking voltage transient during the above	kV

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<u>Sl.No.</u>	<u>Description</u>	<u>Unit of Measurement</u>
D.	<u>OTHER TECHNICAL PARTICULARS</u>	
18	Porcelain housing	
	i) Maker's name	
	ii) Governing Specification	
	iii) Rated Voltage	kV
	iv) Rated Current	A
	v) Wet one minute power frequency voltage withstand	kV (rms)
	vi) Impulsive voltage withstand 1.2/50 micro-second wave	kV (peak)
	vii) Creepage desistance (total)	mm
19	Connectors	
	i) Size and details of the external power and auxiliary connectors power and auxiliary connectors (suitable for external wiring)	
	ii) Size and details of the auxiliary and power cable connections (internal wiring).	
20	Oscillographic recordings of the surge, without the RC network arising due to the closing / opening of the circuit breaker on (a) lead, and (b) fault as measured on the AC electrified systems where the breaker has been supplied for rolling stock application preferably for 3 MW/5MW loco.	
21	Same as item 20 but with RC network.	

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Scope of Supply

Ref: R.D.S.O./LKO Letter No. RL/3.2.61 Dtd:08/11-10-04

Each VCB shall be provided with the following accessories:-

Sl.No.	Description	Quantity	
		Conv.	3 Ph.
1.	High pressure (20 Kg.) Flexible Reinforced rubber 10" long air hose pipe I.D. 5/16" with 3/8" BSP female metallic coupling fitting at both ends. Metallic Nut should be confirm to IS:226 GI coated SAE-100 R1.	1	1
2	High pressure (20 Kg.) Flexible Reinforced Rubber 27" long air hose pipe I.D. 5/16" with 3/8" BSP female coupling fitting at both ends. Metallic Nut should be confirm to IS:226 GI coated SAE-100 R1.	1	1
3	Male Stud Coupling (3/8) " BSP x 3/8Tube.	1	1
4	Air Drier	1	1
5	Male Connector 1/2" X 3/8" BSP(Nipple)	3	3
6	RC Damping panels (for conventional Locos.)	2	nil
7	Male and Female Connector SICEM-35P (as per para 6.9)	1 Set	1 set.

As per Modification Sheet No. **RDSO/2006/EL/MS/0345(Rev.'1')** dated **13.02.2014** of M/s. Schneider make VCB for 3-ph. Locomotive firm should supply extra material

(1) Copper connections along with jaw contact assembly at incoming and outgoing terminal of VCB to receive earthing blade.


(2) Long arm of earthing blade in one piece for earthing switch, and

(3) Insulating cap as per Schneider drg. No. LSC:842 rev-A provide at lower terminal to cater 250mm earth clearance.

SOURCE OF CAPACITOR OF RC DAMPING PANEL FOR TAP AUXILIARY WINDING

- i) CAPACITOR 25MFD (C) 560V (RMS) M/s GE,USA
M/s ICAR, Italy
M/s. Zeonics Systech./ Bangalore

Note:- Conical fittings of hose with integral connector are not acceptable.

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MATERIAL SCHEDULE FOR SK.NO. CLW/ES/SK-5/C-47

16		CABLE SOCKET	4			
15		CABLE 3 mm ² 750V/ Thin wall cable of 1sq.mm or higher size	AS REQUIRED	ELASTOMERIC/ THIN WALLED		
14		SPRING WASHER M5	12	SPR . STL	IS:3063	CAD PLTD
13		NUT HEX M5	12	STEEL	IS:2389	-DO-
12		PLANE WASHER M5	22	-DO-	IS:2016	-DO-
11		CSK SCREW M5 X 40	6	-DO-	IS:1365	-DO-
10		NUT HEX M10	4	-DO-	IS:1364	-DO-
9		PLANE WASHER M10	8	-DO-	IS:2016	-DO-
8		SPRING WASHER M10	4	-DO-	IS:3063	-DO-
7		MOUTING SCREW HEX HD M10 X 40	4		IS:1364	-DO-
6		SEALING BOARD 2 THK 400 X 250mm (INSULAING)	1	PAPER BASE HYLAM SHEET		-DO-
5		PANEL BOARD 10 THK 400 X 250mm (INSULAING)	1	FABRIC BASE HYLAM SHEET		-DO-
4		ASBESTOS SHEET 2 THK (CEMENT) 345 X 60mm	1			-DO-
3		NAME PLATE	1	ANODISED ALU SHT		
2		CAPACITOR 25 MFD (C) 560V (rms)	1			
1		RESISTER 4.7 OHM 380 WATT	1			
REF		DESCRIPTION	QTY.	MATL	SPECN.	WT

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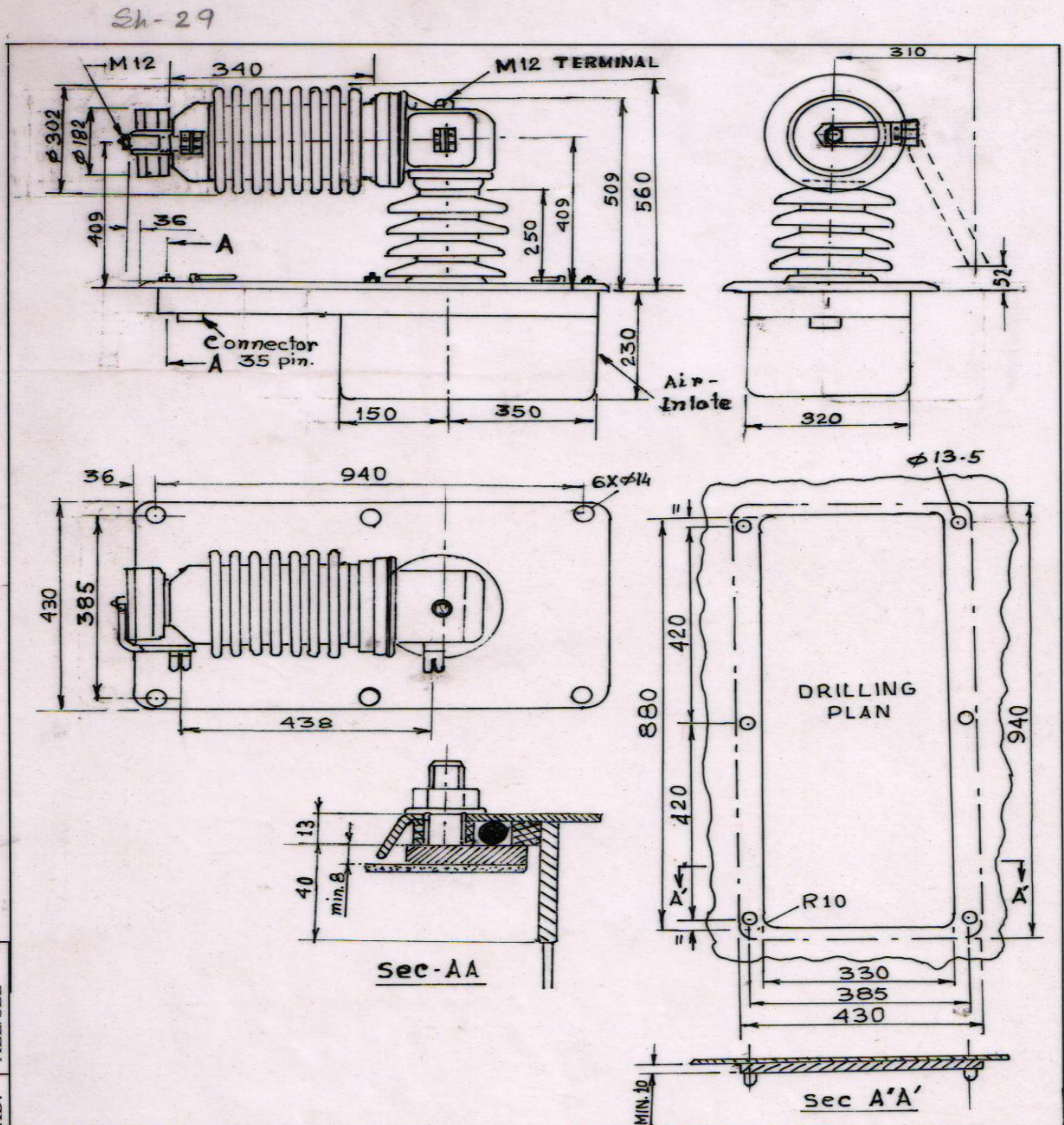
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**OUTLINE DIMENSIONAL
DRAWING OF VCB
OF M/S. BT/AAL MAKE**

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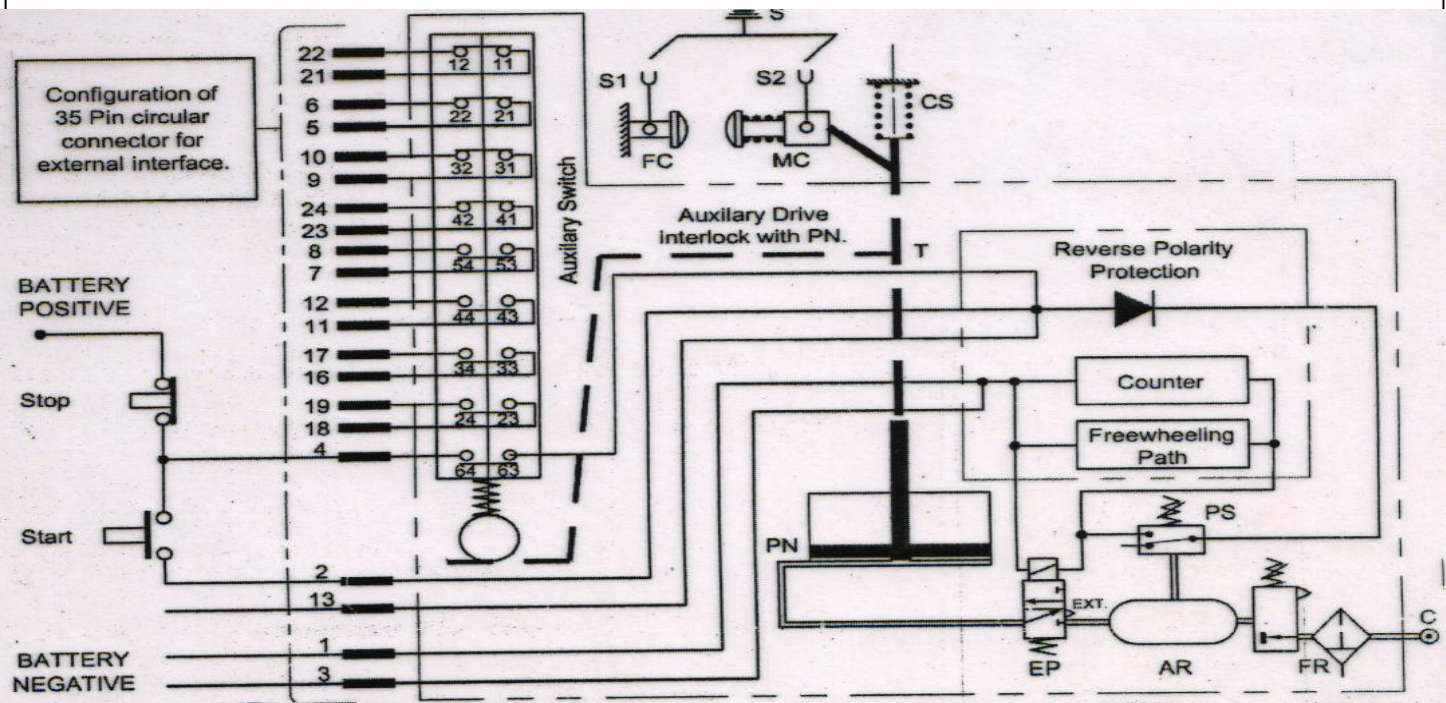


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M/s. Autometers make Electrical and Pneumatic Connections Diagram

Legend:

FC Fixed contact
MC Moving contact
AR Air Reservoir
PS Pressure Switch
C Air Inlet
PN Pneumatic Cylinder

S Earthing Switch
S1, S2 VCB Earthing Terminals
EP Electro Pneumatic Valve
FR Air Filter Regulator
T Operating rod
CS Opening spring

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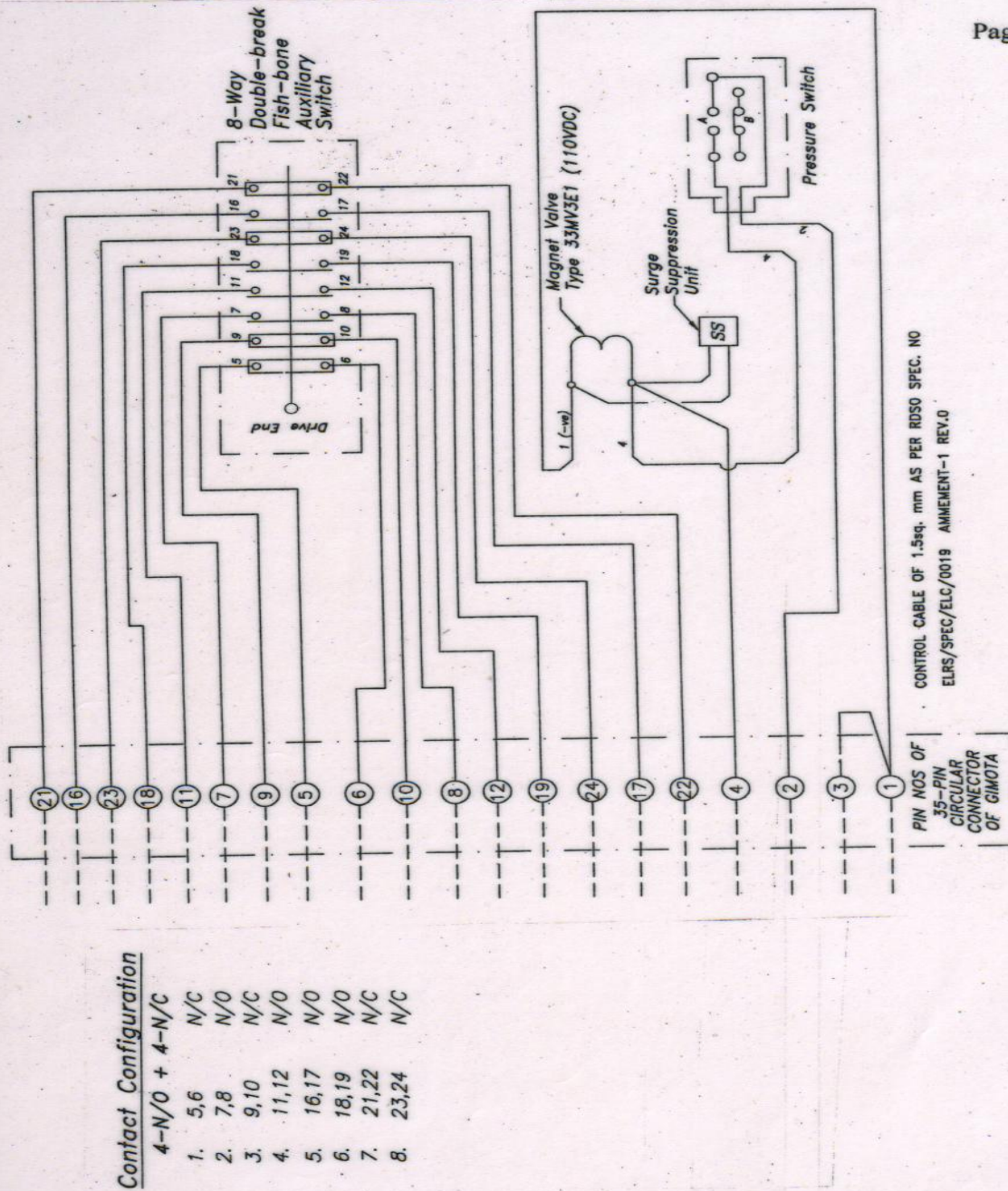
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M/s. AREVA make Internal Wiring Diagram for VCB Type 22CB for Locomotive/EMU Application



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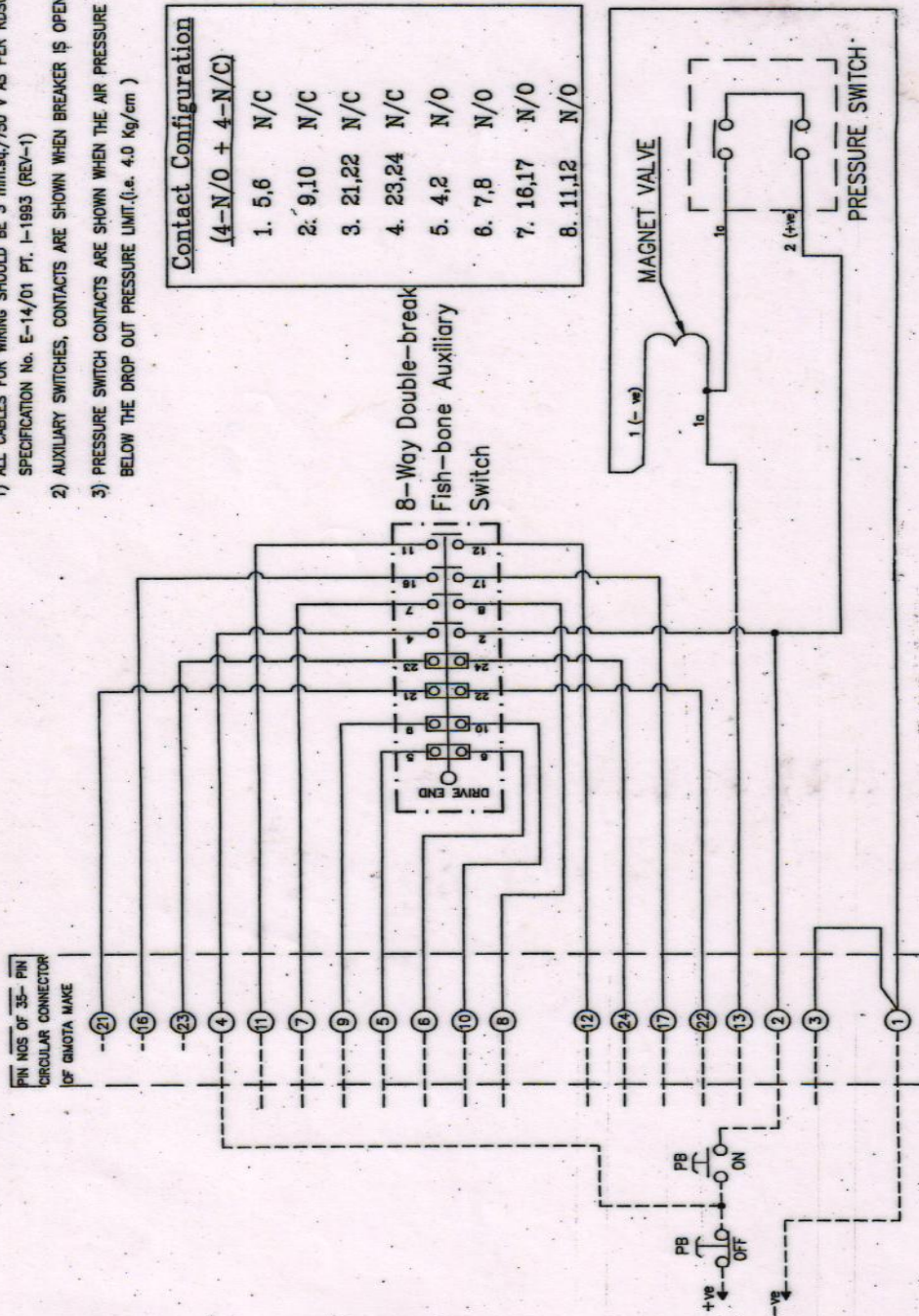
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NOTE:

- 1) ALL CABLES FOR WIRING SHOULD BE 3 mm.sq./750 V AS PER RDSO'S SPECIFICATION No. E-14/01 PT. I-1993 (REV-1)
- 2) AUXILIARY SWITCHES, CONTACTS ARE SHOWN WHEN BREAKER IS OPEN.
- 3) PRESSURE SWITCH CONTACTS ARE SHOWN WHEN THE AIR PRESSURE IS BELOW THE DROP OUT PRESSURE LIMIT. (i.e. 4.0 Kg/cm)



INTERNAL WIRING DIAGRAM OF M/S. BIECCO MAKE VCB.

CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA.

NO. CLW/ES/SK-4 / C/47
DATE: /07/201 .



DY. CEE/D-II.

AEE/SEE

CHKD.

DRN.

Specification of
Vacuum Circuit Breaker
for AC Electric
Locomotives

DY. CEE/Design.

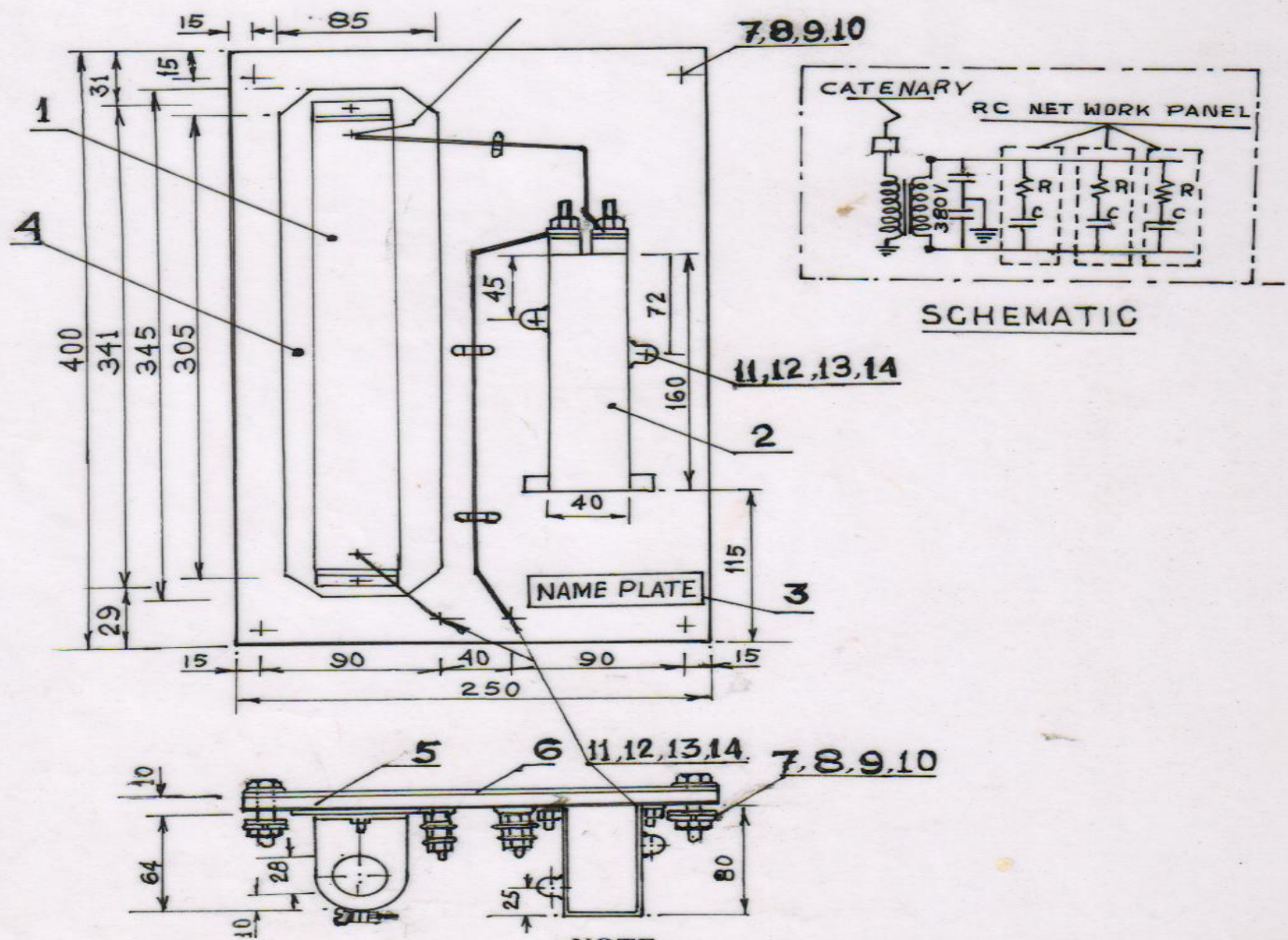


CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA.

DATE: 28 /07/2011 .

NO. CLW/ES/ C-47

ALT.-F,G

**NOTE:-**

1. ALL DIMENSIONS ARE IN MM
2. THE PANEL SHALL BE COMPLETE IN ALL RESPECT SHALL BE SUPPLIED WITH MOUNTING FASTNERS
3. SUITABLE NAME PLATE INDICATING FIRM'S NAME, SL. NO. AND YEAR OF MFG. TO BE PROVIDED.
4. ALL HARDWARE SHALL BE CADMIUM PLATED AND PASSIVATED.
5. INSULATING BOARD SHALL BE COATED WITH ANTITRACKING INSULATING VARNISH AT CUT END/EDGES.
6. ALL CONNECTIONS SHALL BE PROVIDED WITH PLAIN AND SPRING / LOCK WASHERS.
7. QTY. REQUIRED 3 PANELS / LOCO & 8. FOR MATERIAL SCHEDULE SEE SHEET NO.

SPECIAL NOTE:-

1. THIS RC NETWORK IS TO BE USED IN CONJUNCTION WITH VACUUM CIRCUIT BREAKERS ONLY.
2. THIS DRG. IS FOR THE SAKE OF GUIDANCE ONLY. ANY IMPROVEMENT IN DESIGN OR PANEL LAYOUT SHALL BE ACCEPTABLE TO CLW.

**R-C DAMPING PANEL FOR
TFP AUX. WINDING USED WITH
Vacuum Circuit Breaker
for AC Electric
Locomotives**

DY. CEE/Design

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NO. CLW/ES/ SK- 5 /C-47

ALT

**Specification of
Vacuum Circuit Breaker
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Locomotives**

DY. CEE/Design.

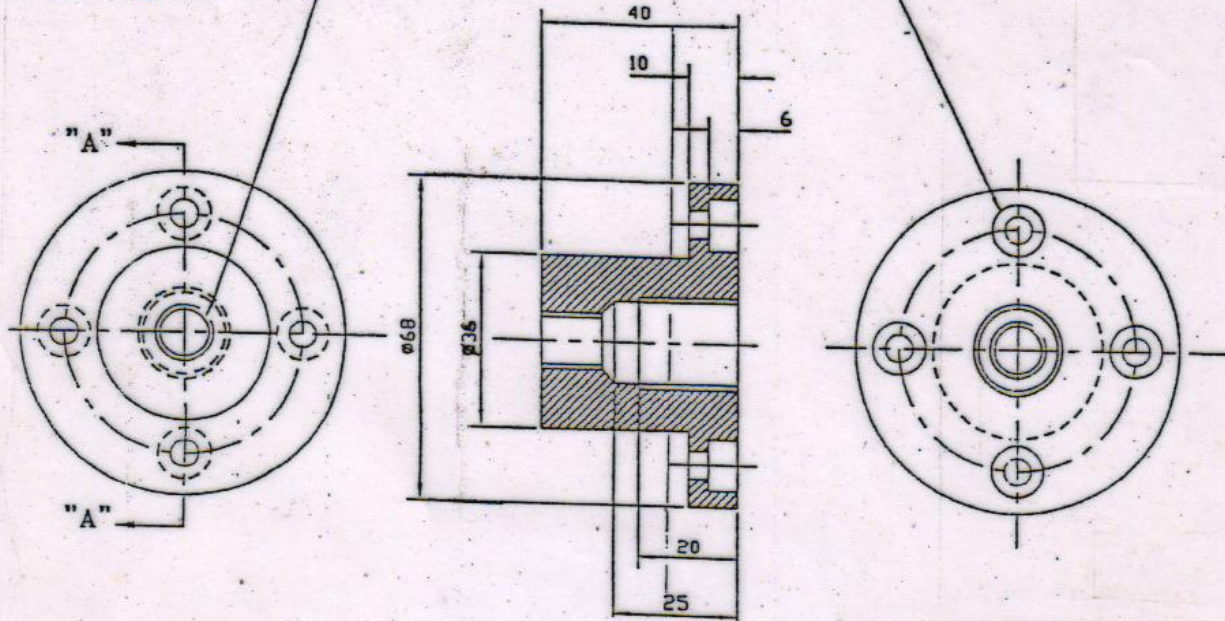
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ALT.-F,G

ALL DIMENSIONS ARE IN mm

ONE HOLE TAP BS2779:1986 G1/4
OPEN OUT TO BS2779:1986-G1/2
TO DEPTH SHOWN

FOUR HOLES ϕ 5.8 C'BORE ϕ 11
TO DEPTH SHOWN SPACED
AS SHOWN ON ϕ 50 \pm 0.15 PC



3 RD. ANGLE PROJECTION

SECTION - A' - A'

NOTE: ALL MACHINED SURFACES TO BE $\frac{3.2}{\sqrt{ }}$
UNLESS OTHERWISE SHOWN.

FINISH: ALOCROM TO PS 950/3002/10

QTY/ SET	ITEM NO.	DESCRIPTION	MATERIAL	CODE NO.
1	1	AIR CONNECTOR	ϕ 68 x 40 LG ALUMINIUM ALLOY BAR TO BS:1474 (HE30) COND TF OR IS:733	55100306

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CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA.

DY. CEE/D-II.

NO. CLW/ES/SK-6/C/47
DATE: /07/201 .

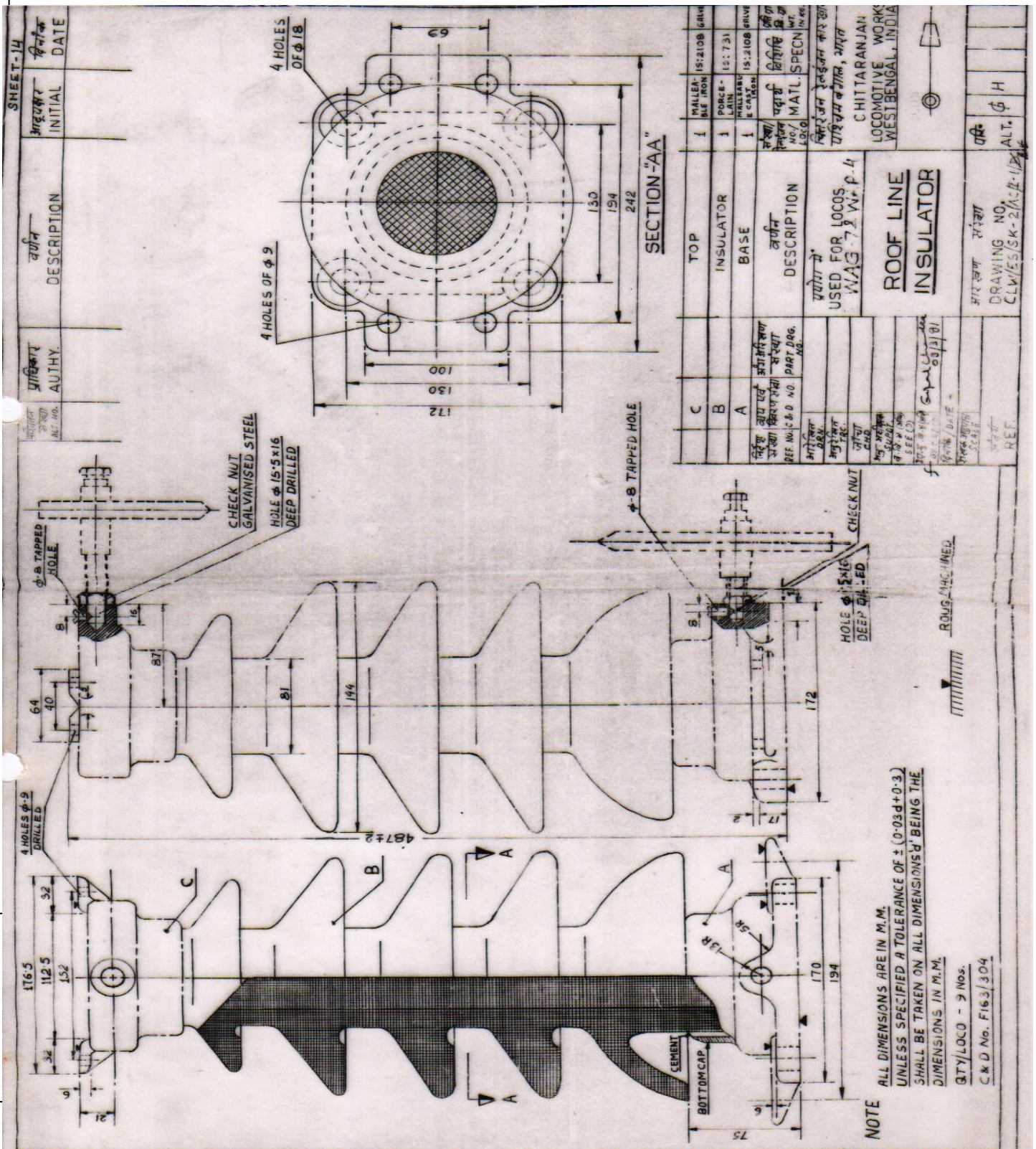


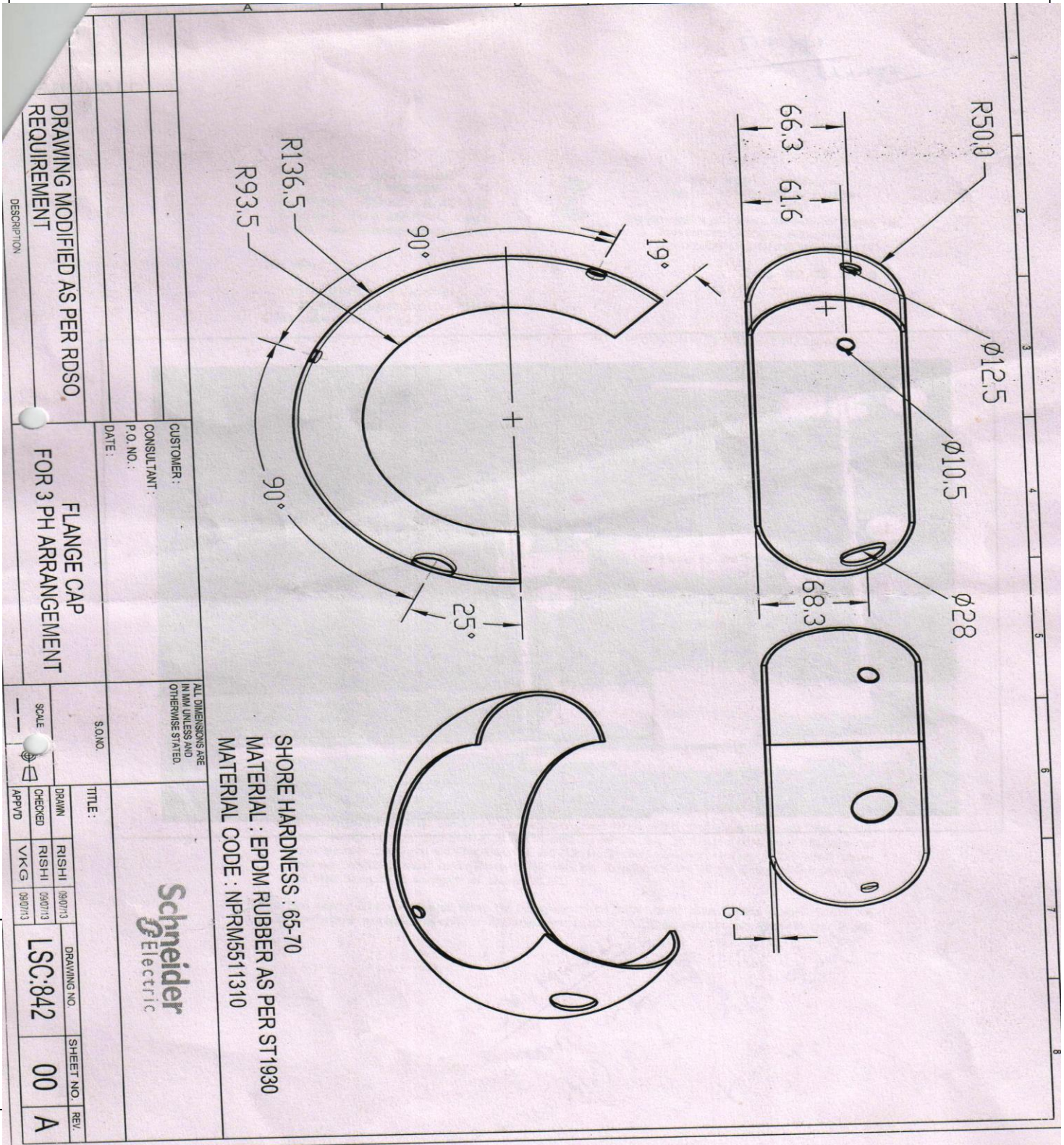
DRN.	CHKD.	AEE/SEE
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Specification of Vacuum Circuit Breaker for AC Electric Locomotives

DY. CEE/Design.

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DATE: 28 /07/2011 .
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ALT.-FG





Specification of
Vacuum Circuit Breaker
for AC Electric
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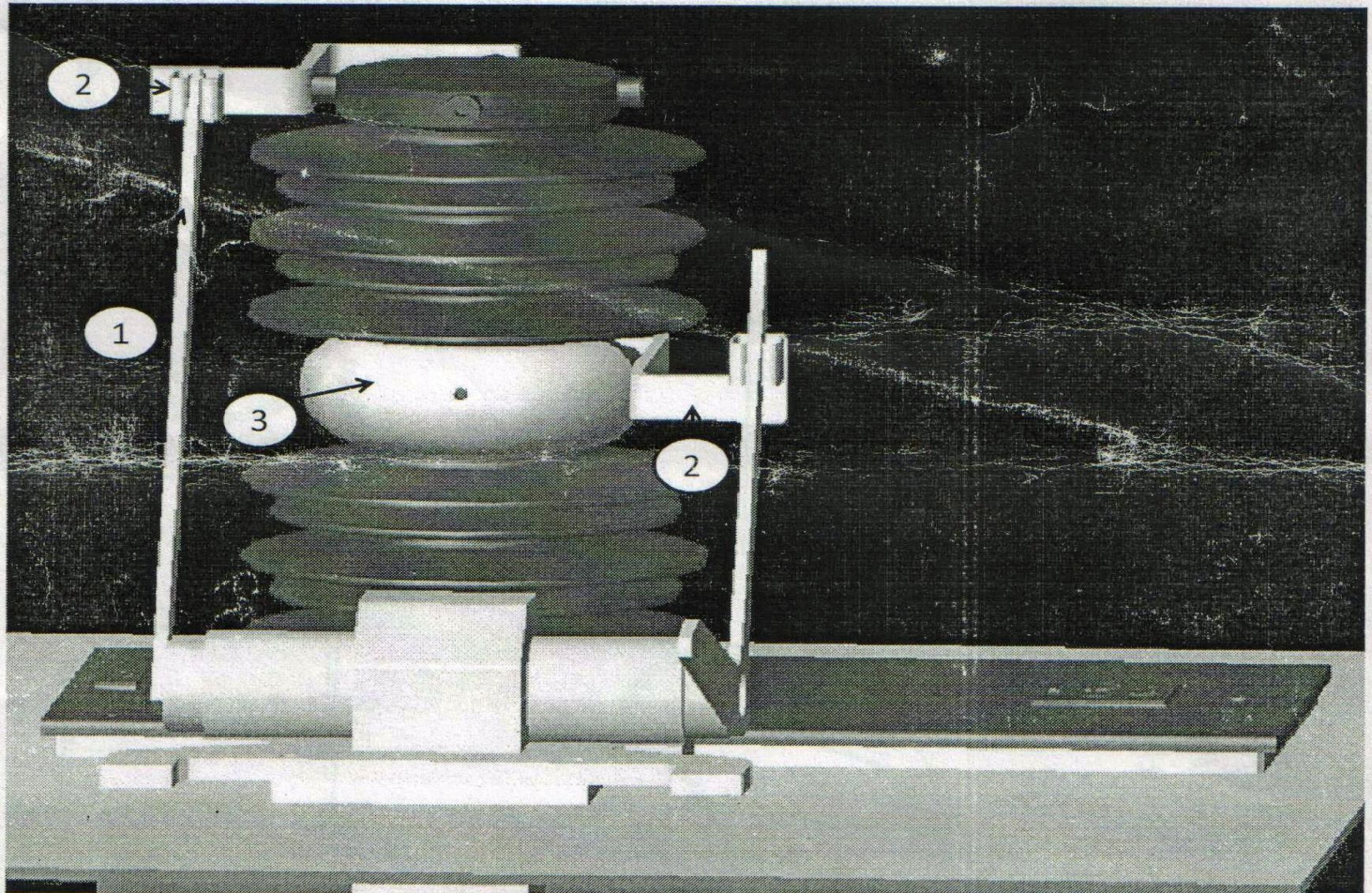
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DRN.



- (1) Long arm of earthing blade in one piece for earthing switch,
- (2) Copper connections along with jaw contact assembly at incoming and outgoing terminal of VCB to receive earthing blade.
- (3) Insulating cap as per Schneider drg. No. LSC:842 rev-A provide at lower terminal to cater 250mm earth clearance.

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AEE/SEE			
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DRN.	<p><u>Specification of</u> <u>Vacuum Circuit Breaker</u> <u>for AC Electric</u> <u>Locomotives</u></p>	<p>DY. CEE/Design.</p>	 CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA. DATE: 28 /07/2011 . NO. CLW/ES/ C-47 ALT.-F,G