GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

TECHNICAL SPECIFICATION FOR VACUUM CIRCUIT BREAKER FOR AC TRACTION VEHICLES

TECH. SPEC./E-2/05/84

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ISSUED BY

ELECTRICAL DIRECTORATE

RESEARCH DESIGNS & STANDARDS ORGANISATION

LUCKNOW

SPECIFICATION NO.SPEC/E-2/05/84

SPECIFICATION FOR VACUUM CURCUIT BREAKER FOR AC TRACTION VEHICLES

1.0 SCOPE

1.1 The Indian Railways have a fleet of about 1000 ac electric locomotives and 400 motor coaches used in electric multiple units (EMUs) operating on 25 kV, 50 Hz, used for the haulage of passenger and freight traffic. The number of locomotives/EMUs (motor coaches) presently manufactured is of the order of 60/20 per year respectively.

1.2 Currently, the circuit breaker employed for controlling the incoming 25 kV ac supply in these locomotives and EMUs is the Air Blast type DBTF 30 i 250 of Hindusthan Brown Boveri Limited, India.

1.3 Indian Railways are currently considering a proposal to adopt Vacuum Circuit Breakers (VCB) in place of Air Blast Circuit Breakers for future builds of electric locomotives and EMUs and also for the replacement of the existing breakers as and when required. As a first step, it is proposed to procure a limited number of VCBs and try them out through extensive field trials on Indian Railways. In the event of successful and satisfactory performance during field trials, procurement of larger quantities for regular use in future builds/replacement as indicated above, will be considered. Even for this initial procurement, a certain number of breakers may be considered for complete import, a certain number in CKD to be assembled by an Indian manufacturer and the balance to be supplied by the Indian manufacturer with technical collaboration, with progressively increasing indigenous content. The total number to be procured and the numbers to be supplied from import/CKD/indigenous supplies are indicated in the tender enquiry of which this specification forms a part.

1.4 This Specification applies to single phase 250 MVA roof-mounted Vacuum Circuit Breakers for 25 kV ac, single phase, 50 Hz, electric locomotives/Electric Multiple Units (motor coaches), to be procured in limited quantities in the manner indicated in para 1.3 above.

1.5 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:

(a) Approximate numbers supplied as on December 1983

(b) 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,

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(c) Years seen in regular service

(d) Performance with particular reference to reliable trouble-free service.

1.5.1 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 VCBs

- Number of incidences 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.

1.5.2 Reputed electrical equipment manufacturers may, however, make offers of VCB conforming to this Specification currently under design/development stages.

1.6 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 56 "IEC Specification for High-voltage alternating Current Circuit Breakers" shall be the governing specification for this procurement except where modified/amended by the provisions of this Specification.

2.2 Other IEC, IS and BS Specifications, as relevant, have been quoted in the appropriate clauses of this Specification and the provisions of such specifications will also apply except where modified/amended by the provisions of this Specification.

3.0 RATINGS

3.1	Nominal operating voltage	-	25 kV, 50 Hz, single phase ac
3.2	Rated current	-	600 amps. r.m.s.
3.3	Rupturing capacity at 25 kV	-	250 MVA
3.4	Rated duration of short circuit current of 10 kA (reference clause 10 of IEC-56/2)	-	3 seconds

(c) Years seen in regular service

(d) Performance with particular reference to reliable trouble-free service.

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3.5 Total Break Time (Clause 29 of IEC-56/1) - Not more than 60 ms.

3.6 Rated operating sequence (Clause 11 of IEC-56/2) - CO-5 Sec-CO

4.0 DIMENSIONS AND WEIGHT

4.1 The overall dimensions of the Air Blast Breaker type DBTF 30 i 250 of Hindusthan Brown Boveri make, currently in use, are given in R.D.S.O's sketch No.SK-EL 3703, forming part of this Specification. The mounting arrangement on the roof as well as particulars of projection above and below roof are also given therein. As the VCB to be procured is also likely to be used as replacement, it would be advantageous if an offer for VCB complying with this Specification and falling within the overall dimensions shown in Sketch No. SK EL-3703, 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 adapter plate design shall be worked out and included in the offer.

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

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 contacts of the VCB shall take place in a high degree of vacuum. Destruction of vacuum shall result in opening of the contacts.

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 pressures which may vary between 5 kg/cm^2 and 11 kg/cm^2 depending upon the type of stock, compressor operation, etc.

5.4 Necessary air filter, air drier, air reservoir, pressure regulator and such other accessories/equipments as may be required to utilise 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 4 kg/cm^2.

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 110 V dc (nominal) available in the electric loco/EMU, shall be made use of. This voltage may vary from 70 V to 125 V. Coils shall be so designed as to work entirely satisfactorily throughout this voltage range. In particular, the coils shall be so designed that

(a) at the lowest voltage of 70 V, 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 and construction of the coils as employed, even when continuously operated at the maximum voltage of 125 V.

6. 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.

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 20 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, two operating coils are used - a closing coil, which is short time rated and is energised only for the purpose of closing, and a maintaining coil, which is continuously energised 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-energised. 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 VCB. 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 will be required to be provided as part of the equipment for use with external circuits and operate at a nominal voltage of 110 V dc. A minimum number of six such contacts shall be provided, of which two 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 close' to 'normally open' position and vice-versa, if so required.

6.6.1 Auxiliary contacts shall have the following ratings:

- Continuous current carrying capacity	- 10 Amps dc
- Breaking capacity	- 2 Amps at 220 V dc with a circuit time constant of not less than 20 ms.

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. Besides, the manufacturer's standard earthing switch which will permit the above operation, may also be included in the offer and specifically indicated as such.

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 stresses that might be produced during the 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 galvanised.

6.9 Connectors shall generally conform to IS 5561/BS 159.

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:

Electric locomotives

There are two spark gaps - ET1 on the pantograph side and ET2 towards the equipment side of the air blast breaker mounted on the roof, with the following settings:

Loco roof spark gap	Setting range (mm)	Present setting (mm)	100% impulse spark over voltage with 1/50 wave in KV (peak) (approx.)
ET1	200-250	210	200
ET2	70-125	70*	90

* In some of the locomotives imported from Japan this setting is presently 125 mm.

Electric Multiple Units

Only one lightning arrestor 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 to the extent to which they are now being experienced with air blast breakers. 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 should 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 loco/EMUs having air blast breakers and VCBs and operating under identical/similar conditions of service. All additional equipment required to limit the surges or to protect the equipment in the event of over voltages exceeding the present levels with the use of air blast 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:

- 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
- total weight
- year and month of manufacture

7. 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 per annum	-	May be as high as 120 days
- Number of thunder-storm days per annum		May be as high as 85 days
- Number of duststorm days per annum	-	May be as high as 35 days
- Wind pressure	-	May be as high as 200 kg/m^2
- Altitude	-	Not exceeding 1000 metres above mean sea level

Note: The locomotives/EMUs 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 about 20 times every day on No Load. The total number of such operations per annum may be taken as 6000.

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 125 MVA.

7.2.2 VCB may be used on different types of locos/EMUs in service/to be constructed for operation on Indian Railways. The maximum continuous rated currents 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 - 300 A.
- EMU application - 60 A.

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 17.5 kV
- Frequency - Nominal 50 Hz
  Variation ± 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 - 1250 A
- Rated short circuit breaking current - 12.5 KA
- Rated short circuit making current - 31.9 KA (peak)
- Rated short time current - 12.5 KA for 3 seconds
- Rated breaking capacity at 27.5 KV - 340 MVA
- Total break time - Not more than 60 ms.

It is necessary, for proper co-ordination, that for any fault on the loco/EMU, the VCB provided on the loco/EMU trips in preference to the breaker provided at traction sub-station. How this feature will be achieved may be indicated in the offer.

7.2.4 The equipment and its mounting arrangement shall be of robust design for traction duty and shall withstand satisfactorily the vibrations and shocks normally encountered in service as indicated below:

- Maximum vertical acceleration - ± 1.0 g
- Maximum longitudinal acceleration - ± 3.0 g
- Maximum transverse acceleration - ± 3.0 g

('g' being acceleration due to gravity).

7.2.5 Apart from expectations of improved reliability, one of the primary considerations that has governed the present proposal to go in 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 inspections

ii) Measurements to be recorded on components as well as operating parameters like clearances, pick-up voltages, 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 itemwise expectation of life for both (a) and (b) above and furnished with the offer.

7.2.5.1 The inspection and overall schedules 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)
- Intermediate Overhaul (IOH) (3 yearly)
- Periodical Overhaul (POH) (6 yearly)

Electric Multiple Units

- Fortnightly Inspection
- Monthly Inspection
- Annual Overhaul

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 authorised representative of the Indian Railways to be designated at the time of contract.

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.

8.3 The type tests and the routine 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 shall, nevertheless, be repeated for the procurement against this 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:

- equipment completely manufactured at the manufacturer's works overseas

- equipment assembled in India using CKD

- equipment indigenised by the Indian manufacturer (stages/indigenisation 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. The routine tests on series supplies may be carried out by the manufacturer and witnessing of such tests may be mutually settled between the manufacturer/supplier and the inspecting authority at the appropriate stage.

9.0 TYPE TESTS

A broad outline of the Type Tests proposed is given below. The detailed test programme will be required to be finalised by the supplier with Research Designs & Standards Organisation of the Indian Railways after placement of the contract.

9.1 Mechanical Endurance Test

This test shall be conducted in accordance with IEC 56 with the modification that the number of operations shall be 30,000 (thirty thousands) instead of 1000 specified in the IEC. During the first 10,000 operations, lubrication if any, in accordance with the manufacturer's instructions but no mechanical adjustment shall be permitted. 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 10,000 operations together with the periodicity for replacement of these parts, along with 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 requirements 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 56. 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) Copper contacts - 35°C

b) Terminals of circuit breaker to be connected to external conductors by bolts - 40°C

c) Metal parts in contact with insulators - 45°C

d) Auxiliary contacts - 30°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 various classes of insulation:

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

9.4 Impulse Voltage test

The VCB shall successfully withstand 250 kV (peak) impulse voltage tests with impulse of 1.2/50 micro second wave shape.

9.5 Power Frequency Voltage (dry) test

The VCB shall successfully withstand 105 KV (rms) power frequency voltage for one minute.

9.6 Power frequency voltage (wet) test

The VCB shall successfully withstand 105 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 Tests

These tests shall be carried out as per IEC 56 at a recovery voltage of not less than 25.0 kV.

9.9 Short Time Current Test

This test shall be carried out as per IEC 56. The short time current shall not be less than 10 KA for a period of 3 seconds.

9.10 Tests to withstand vibration and shock

These tests shall be carried out in accordance with clause 16 of IEC 77 (1968).

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

10.0 ROUTINE TESTS

10.1 Power Frequency Voltage (Dry) test

The VCB shall successfully withstand 105 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). During this test, the incoming air pressure may be varied between the limits of 5-11 kg/cm^2 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 4 kg/cm^2 as stipulated in clause 5.4 above, will also be verified.

10.5 Manual closing and tripping operation test

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

11. TOOLS, GAUGES & TESTING INSTRUMENTS/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.

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 itemwise 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 OPERATING 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 of such Manuals shall be supplied. No separate price for these Manuals shall be quoted and the supply of the six 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 should be 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 in clause 7.2.5.1 above;

vi) Dimensional drawings and key drawings of such other components and parts which will be required for proper appreciation of the 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 should first be got approved by the Research Designs and Standards Organisation of the Indian Railways in the course of the contract and thereafter the required number of copies supplied along with the VCBs.

14.0 TECHNICAL COLLABORATION & INDIGENISATION

14.1 Progressive indigenisation of the VCBs covered by this Specification is contemplated, as will be seen from clause 1.3 of this Specification. Design calculations, detailed manufacturing processes and all relevant information pertaining to transfer of technical knowhow in this regard will be carried out in such a manner between the overseas manufacturer and the Indian manufacturer as to ensure that the indigenous content of the VCBs made in India increases progressively and rapidly without sacrificing quality and reliability. Research Designs and Standards Organisation of the Indian Railways are to be associated at various stages of indigenisation so as to take into account service experience while attempting progressive indigenisation.

14.2 The information exchanged between the overseas manufacturer and the Indian manufacturer is not ordinarily required to be passed on to the Indian Railways. However, the authorised representatives of the Indian Railways shall have access to the above information at the manufacturer's works overseas or the manufacturer's works/Design offices in India whenever it becomes necessary for the purpose of inspection and acceptance of the product at the manufacturer's works or for the purpose of analysis/investigation for overcoming difficulties and problems and for improving performance reliability in service.

15. TRAINING OF INDIAN RAILWAY ENGINEERS

15.1 The offer shall include training for two Engineers of Indian Railways to be arranged free of cost at the manufacturer's works overseas and at the maintenance depots/workshops on Railway systems, where electric locos and EMUs employing similar/identical VCBs are in operation. The total duration of training for each Engineer will be 12 weeks of which approximately 6 weeks will be spent at the Manufacturer's works and 6 weeks on the Railway system/s. The to and fro travel from India to the country of manufacture will be borne by the Indian Railways. Other details will be settled at the time of contract.

16. DELIVERY

16.1 The tenderer shall offer the earliest deliveries possible. He shall indicate in his offer a programme for establishing series manufacture in India. The desired deliveries are indicated below, reckoned from the date of placement of the contract:

i)	Prototype VCB to be put up for inspection and testing	4 months
ii)	Supply of VCBs to be completed by the Overseas manufacturer	8 months
iii)	Prototype VCB to be put up for inspection at the Indian manufacturer's works using CKD components	18 months
iv)	Programme for subsequent manufacture in India and delivery of series supplies:	To be settled in due course during execution of the contract depending upon the stages and extent of indigenisation programme.

17. WARRANTY

17.1 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 36 months from the date of supply or 18 months from the date of commissioning on the loco/EMU, whichever is earlier. Details of the warranty clause, the extent of responsibility on the part of the supplier and other relevant aspects will be included in the contract. The tenderer may furnish his detailed terms in this regard in his offer.

18. SERVICE TRIALS

18.1 The initial lot of VCBs supplied against the contract irrespective of the origin (imported or indigenous) will be tried out on the various Zonal Railways of the Indian Railways on locos/EMUs so as to gain field experience under different environmental and operating conditions. 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. Arrangements 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

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long interruptions. Such spares will be in addition to the spares to be procured by Indian Railways against the offer to be made in terms of clause 12.1 above.

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

19. DATA TO BE FURNISHED ALONG WITH THE TENDER OFFER

19.1 The special technical data to be furnished by the tenderer along with his offer has been indicated at various places in the preceeding 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) Diagrams for pneumatic and electrical connections including connections of the auxiliary contacts.

19.2 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-a-vis the values specified.

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

19.4 The proposed method of indigenisation, transfer of technical knowhow and matters connected therewith may also be indicated separately for ready reference.

19.5 A statement indicating clausewise comments on this Specification should accompany the offer. In particular, clear acceptance should be conveyed wherever the tenderer fully accepts the requirements indicated. Where there is any deviation or an alternative proposal, the same shall be indicated clearly against the clause concerned.

19.5.1 At the end of this statement, the tenderer may add any further comments or observations which he wishes to make on this Specification.

19.6 A list of additional technical information/data which the Indian Railways would like to have for evaluation of the offer is at Annexure B. The tenderer may, to the extent possible, furnish this information.

ANNEXURE 'A'

SPECIAL TECHNICAL DATA TO BE FURNISHED BY THE MANUFACTURER ALONG WITH THE TENDER OFFER

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Sl.No.	Item	Clause reference of Specification
1. (a)	Details of proven design	1.5
(b)	Previous service experience	1.5.1
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	6.10.4
8.	Co-ordination with sub-station breaker	7.2.3
9. (a)	Expected life of components	7.2.5
(b)	Details of maintenance attention required during programmed inspection/overhaul schedules	7.2.5.1
10.	List of parts requiring replacement after 10,000 operations and their periodicity of replacement	9.1

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ANNEXURE 'B'

ADDITIONAL TECHNICAL INFORMATION

S. No.	Description	Unit of Measurement
A	RATING	
1.	Number of interruptors in series	No.
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 (test certificate to be furnished)	MVA
	ii) Rated breaking capacity at a recovery voltage of 25 kV	MVA
B	CONSTRUCTIONAL FEATURES	
5.	Type of main contacts	
6.	Type of vacuum bottle	
7.	Method of voltage grading adopted (if more than one interruptor is used in series).	
8.	If capacitance grading is used, state the value of capacitance and its rated voltage.	
9.	Degree of vacuum in the bottle.	
10.	Material of contacts (including chemical composition)	
	i) Main contacts	
	ii) Arcing contacts, if any	
11.	Minimum air clearance between live parts and earth.	

C OPERATING PARTICULARS

12. Opening time from the instant of trip coil energisation

    i) with no current — ms

    ii) at rated current of 600 A — ms

    iii) at rated breaking current of 10 KA — ms

13. Arcing time

    i) at rated current of 600 A — ms

    ii) at rated breaking current of 10 KA — ms

14. Total interrupting time from the instant of trip coil energisation to the final extinction of arc

    i) at the rated current of 600 A — ms

    ii) at the rated breaking current of 10 KA — ms

15. Making time from the instant of closing coil energisation — ms

16. Minimum time interval between successive operations at 600 A. — seconds

17. Minimum number of operations without replacement of vacuum bottle

    i) at the rated breaking current of 10 KA — Nos.

    ii) at a breaking current of 8 KA — Nos.

    iii) at a breaking current of 6 KA — Nos.

    iv) at a breaking current of 4 KA — Nos.

    v) at the normal rated current of 600 A — Nos.

18. a) The level at which chopping occurs while breaking magnetising current at a recovery voltage of 25.0 kV — A.

    b) The expected peak restriking voltage transient during the above — kV.

D OTHER TECHNICAL PARTICULARS

19. Porcelain housings

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)	Impulse voltage withstand 1.2/50 micro-second wave	kV (peak)
vii)	Creepage distance (total)	mm

20. Connectors

i) Size and details of the external power and auxiliary connectors (suitable for external wiring)

ii) Size and details of the auxiliary and power cable connectors (internal wiring).

21. Oscillographic recordings of the surges, without the RC network arising due to the closing/opening of the circuit breaker on (a) load; and (b) fault as measured on the ac electrified systems where the breaker has been supplied for rolling stock application preferably for 3 MW/5 MW loco.

22. Same as item 21 but with RC network.

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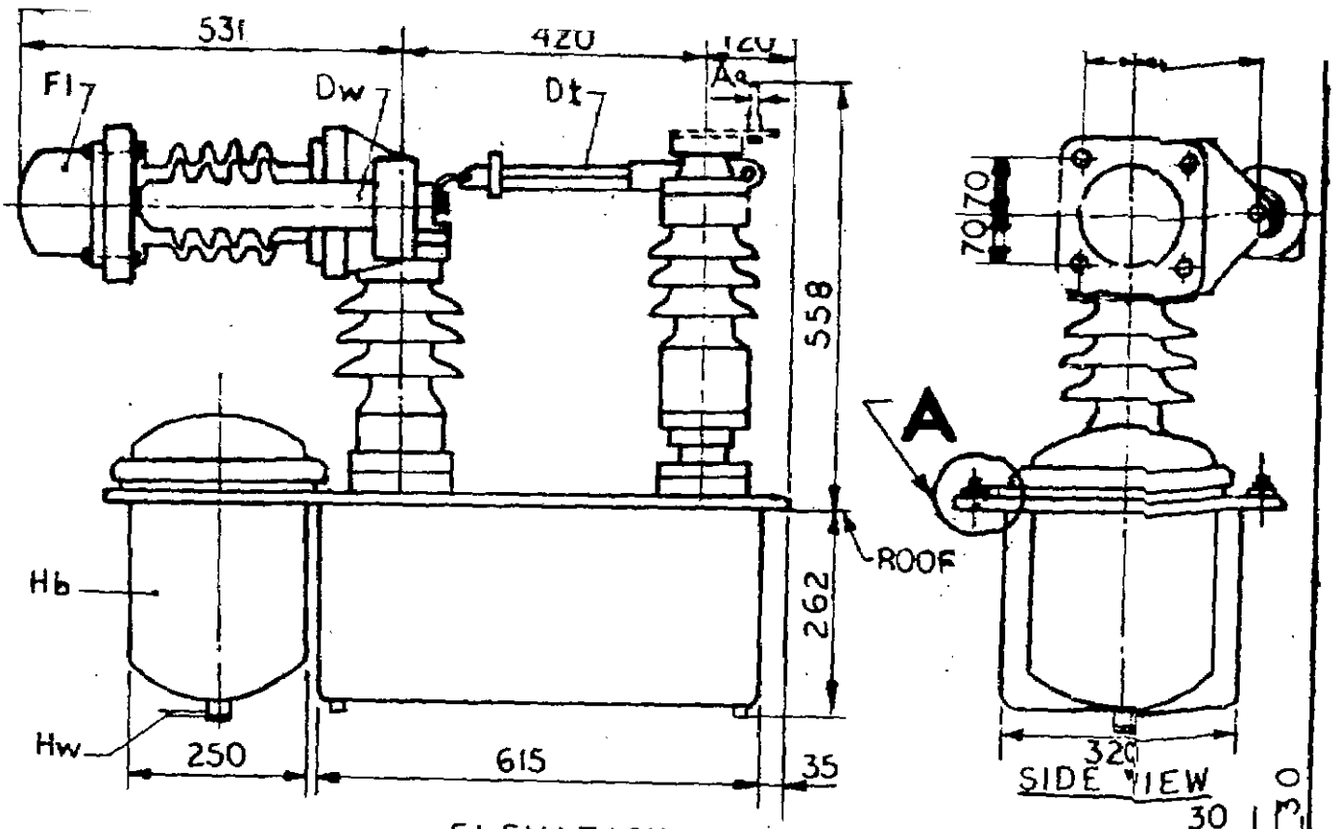

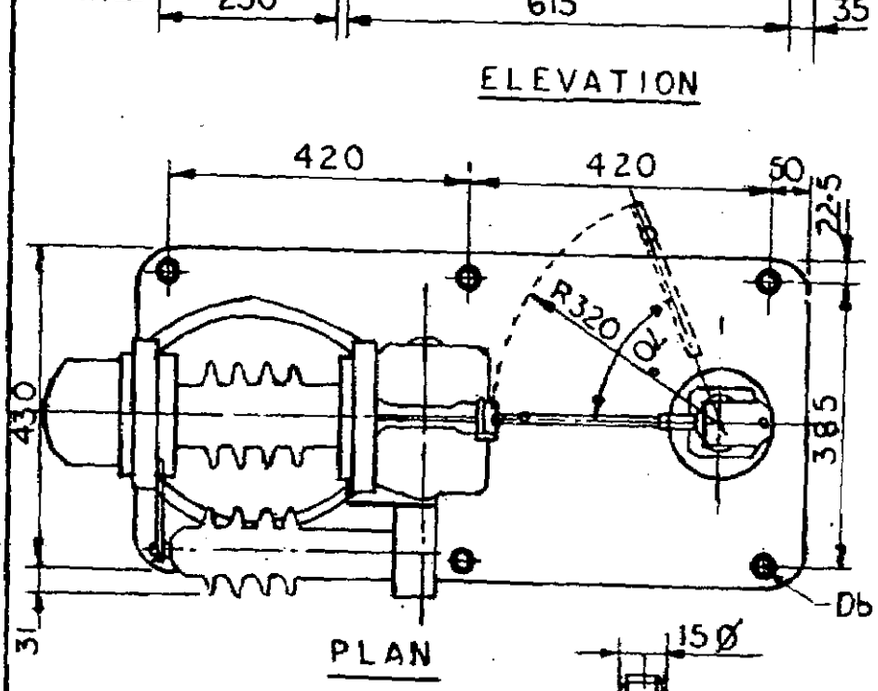

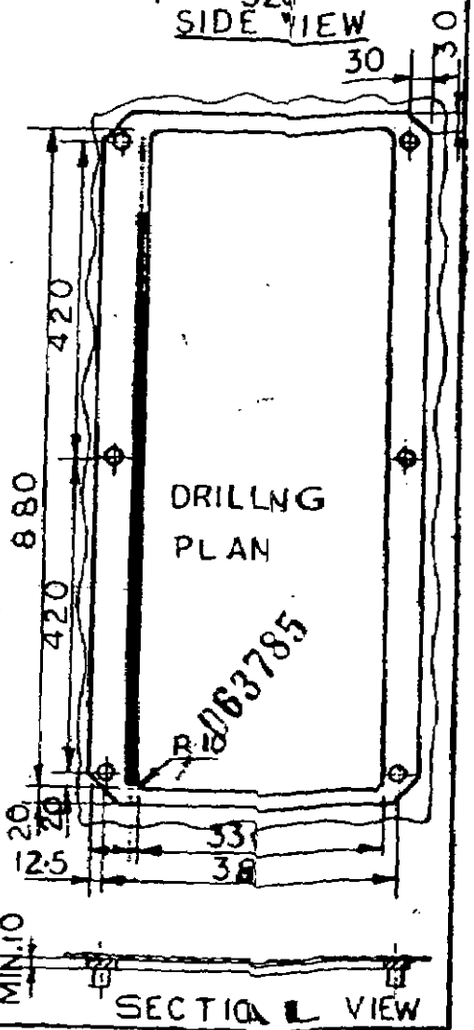

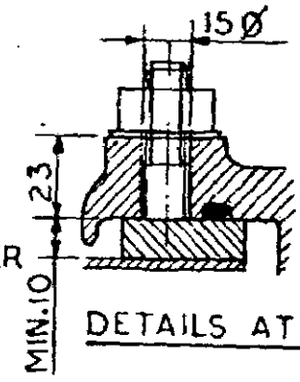

Aa	TERMINALS
Db	MOUNTING HOLES
Dt	ISOLATING BLADE
Dw	RESISTANCE
Fl	EXTINCTION CHAMBER
Hb	AIR RECEIVER
Hw	DRAIN CONNECTION

ALL DIMENSIONS ARE IN mm | SCALE:- 1:2, 1:10 | APPROVED

OUTLINE DIMENSIONAL DRAWING OF AIRBLAST CIRCUIT-BREAKER TYPE DBTF 30 i 250 OF M/S HBB

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No. EL/3.2.61 Dated: 01.07.99

CHIEF ELECTRICAL ENGINEER,

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Eastern Railway, Fairlie Place, Calcutta-700 001
South Eastern Railway, Garden Reach, Calcutta-700 043
Central Railway, Mumbai CST-400 001
Western Railway, Churchgate, Mumbai-400 020
Southern Railway, Park Town, Chennai-600 003
South Central Railway, Rail Nilayam, Secunderabad-500 071
General Manager (Elect.), C.L.W., Chittaranjan-713 331
Integral Coach Factory, Perambur, Chennai-600 038

Sub :- Amendment to Technical Specification for Vacuum Circuit Breaker for AC Traction Vehicle.

Ref.:- RDSO Spec. No. E-2/05/84 of Jan.'1984.

The following clauses of the above RDSO specification under reference have been modified as follows :-

Cl. 2.1	Read IEC Publication 56 (1987) in place of IEC Publication 56.
Cl. 3.5	Read IEC:56 (1987) in place of IEC:56-1
Cl. 3.6	Read IEC:56 (1987) in place of IEC:56-2
Cl. 6.8	Read IS:5621 (1980) / IEC:233 (1974) in place of IS:5621 / IEC:233
Cl. 6.9	Read IS:5561 (1970) / BS:159 in place of IS:5561 / BS:159
Cl. 9.8	Read IEC:56 (1987) in place of IEC: 56
Cl. 9.9	Read IEC:56 (1987) in place of IEC:56

-: 163786

Siya Ram

(Siya Ram)
for Director General (Elect.)

Encl: Nil.

ADE/DOC