



**KOLKATA METRO RAIL CORPORATION LIMITED
EAST WEST METRO PROJECT**

CONTRACT – BPEL (R)

**DESIGN, MANUFACTURE, SUPPLY, TESTING & COMMISSIONING
AND TRAINING OF PERSONNEL
OF BATTERY POWERED ELECTRIC LOCO
FOR CENTRAL PARK DEPOT**

**TENDER DOCUMENTS
VOLUME 3**

PARTICULAR SPECIFICATION

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1.0 PROJECT AND PERMANENT WORKS

1.1 Location and Boundaries

The location plans together with the indicative works and Site area boundaries are shown on the drawings in the Tender Document. The Designated Engineering Contractor shall set out the works and Site area boundaries of the Contract.

1.1.1 Climatic Conditions and Operating Environment

The machine/equipment shall be required to work under the following climatic conditions:

- Maximum temperature during summer: 45 °C
- Relative humidity during rainy season: 100 %
- Minimum temperature during winter: 3 °C
- Environment: Dusty with industrial pollutants
- Water Quality: Hard with high salt content

1.2 General Description of the Works

The Works shall comprise the Design, Manufacture, Supply, Testing & Commissioning of one no. of road-cum-rail Battery Powered Electric Loco (BPEL) for the Central Park Depot of Kolkata Metro Rail Corporation Ltd. (KMRCL) and Training of Personnel. The BPEL shall be used for shunting and positioning of individual cars or 3/6-car trains and other metro vehicles on different lines with standard gauge 1435 mm in Central Park Depot as well for hauling coaches/wagons carrying re-railing & rescue equipment and other relief materials over the entire network of East-West metro line of KMRCL. The BPEL may also be used to haul stranded 6-car empty rakes on line over the entire network of East-West metro in case of emergency.

The scope of supply shall include all accessories to make the machine/equipment fully functional, first fill of oil/grease, with sufficient quantity of lubricants for commissioning, and a set of special tools and test equipment for BPEL besides supply of spares and lubricants as stipulated in this Specification for maintenance of the machine.

All the major bought out items which are required to be used in the machine shall be of proven make and shall be procured only after taking Employer's approval for the same, with a complete submission of each item mentioning, make, country of origin, parts numbers, catalogue etc. during Design Submission.

1.3 Detailed Scope of Works

The Scope of the Works is as follows:

- (i) Detailed design, manufacture, supply, Testing & Commissioning of the machine/equipment as described in this specification.
- (ii) Preparation and supply of drawings, documents, samples, specimens and Operation & Maintenance Manuals as required.
- (iii) Supply of resources, materials, tools, plant and manpower for manufacture, transportation, testing and commissioning of the equipment that will be necessary to meet the intended function.
- (iv) Training of Employer's staff.
- (v) Maintenance of Machine during Defects Liability Period (DLP).
- (vi) Supply of consumables and other spares required for maintenance of the machines after completion of the DLP.
- (vii) Comprehensive Annual Maintenance of the supplied BPEL after completion of the DLP.

1.4 Design Responsibility

The Contractor shall be responsible for the design of the complete system for the Machine/Equipment, which shall include but not be limited to:

- (i) The development of the design shall be carried out in conjunction with the information contained in the Drawings and conforming to the Schedule of Dimensions of KMRCL and

shall be in accordance with the Specification set out in the Contract. The Contractor shall obtain design approval from the Engineer before starting the manufacturing of the BPEL.

- (ii) The development and completion of the design of any other items of the Works as stated in the Contract.
- (iii) The Contractor, coordinating with the Engineer and Designated Contractors on all matters relating to design and documentation, shall retain full responsibility for managing such design and for the maintenance of all documentation associated with the design process. The personnel identified to fulfill these roles shall be direct employees of the Contractor.
- (iv) Responsibility for the Contractor's design proposals submitted to the Relevant Authorities shall remain with the Contractor who must provide sufficient resources to deal with subsequent questions, alterations etc. requested by the Relevant Authorities. All communications with any Relevant Authority, whether written or oral, must be copied/recorded to the Engineer.
- (v) Whenever a new rolling stock is introduced, a Provisional Speed Certificate, based on the design parameters of the vehicle, is issued by the Research Design & Standards Organization (RDSO) of Indian Railways / any agency approved by the Employer. Final Speed Certificate for the vehicle is given by RDSO / any agency approved by Employer after conducting detailed instrumented tests & trials. The Contractor shall be responsible for furnishing all design details within stipulated Key Dates and for necessary interface for the purpose of obtaining the Provisional Speed Certificate required for running of the vehicle on KMRCL track in the interim period.
- (vi) The Contractor shall fully associate in detailed instrumented tests & trials to be conducted on the vehicle for evaluation of safe running behavior of the vehicle for the purpose of obtaining final Speed Certificate and shall retain full responsibility for adjusting the design/construction of the BPEL, if required, for the purpose of obtaining the Final Speed Certificate and clearance from the Commissioner of Railway Safety for running the BPEL on mainline.

2.0 GENERAL DESIGN REQUIREMENTS

2.1 General

2.1.1 The Contractor shall be responsible for the design of the complete system for the BPEL, which shall include but not be limited to:

- (a) A list of National and International Standards & Norms used and applied to the material and workmanship to be supplied will be prepared and updated during the design stage. This list will be mutually agreed to.
- (b) During the design phase the Contractor shall provide to KMRCL two sets of original copies (soft & Hard copy) in English language of the standards used.
- (c) Work related to the production of the machine/equipment shall comply with relevant European standards, Codes of Practice and the latest statutory requirements of India including, but not be limited to, the following:

Standards list

<u>Standard No.</u>	<u>Description</u>
NF E 85-101	Items used on industrial installations-Metal railing-10/1988
NF C 15-100	Low-voltage electrical installations-Rules
ISO 2632	Surface texture - Method of measurement - Roughness comparison specimens
IS 4758	Sound Level
ISO 1711	Assembly tools for screws and nuts- Technical Specification - Hand operated wrenches and sockets.
BS 5378	Safety colors and safety signs
ISO 3864	
BS EN 60529 & IS 816/823	Degrees of protection provided by enclosures (IP code)

IS 4460/1967	Specifications for gears
IS 226 & IS 2062	Specifications for carbon steel Welding
IS 8623/1977	Factory built assembly switch gear and control gear
BS EN 287	Approval testing of welders for fusion welding

The Contractor may propose to work to equivalent internationally or nationally recognized standards. Not systematically, but if necessary, the Engineer can require the Contractor to prove the equivalence between the European and other Standards. Submission for Approval are to be supported by a copy of the proposed standards, a detailed comparison of the quoted and proposed standards and where applicable, an English translation of the proposed standard.

- (d) The layout given on the Drawings shall be used for conceptual purposes. The machine/equipment Manufacturer shall furnish their requirements in accordance to the Schedule of Key Dates specified in attachment to Appendix FT-1 to Form of Tender.
- (e) The machine/equipment shall be designed and/or selected to allow operation without over stressing, damaging or interfering in any way whatsoever with other equipments in the Depot.
- (f) Components of machine/equipment of similar construction or similar application shall be mutually interchangeable. The Manufacturer shall, to the extent that he is responsible for the design or component selection of items of the machine/equipment, recognize and implement all safety requirements and ensure that the design and performance of the equipment are compatible with the suitable International safety standards.
- (g) The machine/equipment shall be "fail-safe" and "overload protected", and shall incorporate all necessary safety devices to protect the machine/equipment, operators, and all other people in the vicinity of the machine/equipment. No failure of the machine/equipment shall cause or give rise to any damage or catastrophe of any nature whatsoever.
- (h) Machine/equipment design shall take into consideration elimination of dust and dirt by means of suitable traps or the like, minimum maintenance requirements and ease of access for cleaning, routine maintenance and general disassembly.

2.2 Use of drawings and data

- 2.2.1 All data concerned to the rolling stock written in this specification are for information only and there may be slight variations.
- 2.2.2 The compatibility of the machine/equipment with the rolling stock characteristics is the responsibility of the Contractor and he shall obtain the required data/documents from the Rolling Stock Contractor.
- 2.2.3 The drawings shown on the plans define the operating conditions and are provided for indicative purpose only. These may be adapted by the Contractor in consultation with the Purchaser.

2.3 Reference Data of Track / Rolling Stock

2.3.1 Track:

- (a) The Track Structure parameters for At-grade, Elevated and Underground sections are given below.

Item Description		Item Data
Track Laying Gauge		1435mm
Track Structure	Elevated and At-Grade sections	Ballasted or Ballastless
	Tunnel sections	Ballastless
	Depot	Ballasted
Rail Type	Main Line and Test Track in Depot	60 E I Grade 1080 HH conforming to Specification IRS/T -12
	Depot	UIC 60 Kg (Grade 880) conforming to Specification IRS/T -12
Inclination of Rail		1:20
Standard Rail Length		13m and 18m

Rail Panel Lengths		Long welded rails
Ballast Cushion (Depot)		300mm
Minimum Radius of Curvature	Mainline - Elevated and At-grade	120m
	Mainline - Underground	200m
	Depot	100m
Minimum Turn-out Radius	Mainline	190m (Tentative)
	Depot	140m (Tentative)
Minimum Turn Out Angle Main line		1 in 9, except connection to Depot transfer in 1 in 7
Maximum Cant Permissible in curves		125 mm
Maximum Cant Deficiency Permissible		100mm
Maximum Permissible Cant Gradient		1 in 440
Turn-out Speed (maximum permissible)	Turn-out (Main line)	45 km/h
	Scissors (Main line)	45 km/h
	In Depot	35 km/h
Maximum Gradient	Mainline	4% (compensated)
	Depot	1%
Minimum vertical curve radius crest		1500m
Maximum track axle load		16 tonnes
Widening of track Gauge on curves		Up to 9 mm
Structural gauge and passing clearance in straight line, in curves, in open air grade, in tunnel		Refer to SOD
Tunnel Profile (tentative)		Refer to SOD

Detailed track alignment drawings showing the line profiles shall be provided to the Contractor during Design Stage.

- (b) The Track Tolerances for At-grade, Elevated and Underground sections are given below.

Ballastless Track	
Item Description	Value
Gauge (Installation)	+2mm
	-1mm
Gauge (Maintenance)	+4mm
	-2mm
Gauge(Maintenance) at < 500m radius curve (with respect to 1435mm)	+13mm
	-0mm
Cross level on straight track (Installation)	±1.5mm
Cross level on straight track (Maintenance)	± 5mm
Super elevation on curved track (Installation)	±1.5mm
Super elevation on curved track (Maintenance)	±3mm
Vertical alignment over a 20m chord (Installation)	±3mm
Vertical alignment over a 20m chord (Maintenance)	±6mm
Lateral alignment over a 20m chord on straight track (Installation)	±2mm
Lateral alignment over a 20m chord on straight track (Maintenance)	+2mm
	-1mm
On curves-variation over the theoretical versine on 20m chord (Installation)	±2mm
On curves-variation over the theoretical versine on 20m chord (Maintenance)	13mm
	-0mm

Ballasted Track	
Item Description	Value
Laying Tolerance of Vertical Alignment measured by 10m chord (Designed level)	±4mm
Alignment (Laying) (Base 10m)	±5mm
Cross Level Laying Tolerance (Designed)	±3mm
Twist (Other than transition curve) (Laying)	1mm/600mm
Cross Level Difference (Maintenance)	10mm
Gauge measured at a point 14mm below crown of rail (laying) (with respect to 1435 mm)	+3mm
	-3mm
Unevenness (Maintenance) (Base 10m)	±12mm
Alignment (Maintenance) (Base 10m)	±6mm
Gauge variation maintenance (sleeper to sleeper)	±3mm
Gauge (Maintenance) – Tangent track (with respect to 1435 mm)	+10mm
	-3mm
Gauge (Maintenance) - >500m radius (with respect to 1435 mm)	+10mm
	-3mm
Gauge (Maintenance) - <500m radius (with respect to 1435 mm)	+19mm
	- 0mm
Gauge Face Wear	10mm

2.3.2 Rolling Stock:

ITEM DESCRIPTION		ITEM DATA
Traction System		750V DC Third Rail Top Collection system
Rail car length-	DMC:	21.75 m
	MC:	21.70 m
	TC:	21.70 m
Rail car width:		2.88 m
Height of coupler above rail level		740 – 815 mm
Empty rail car weight-	DMC:	40.9 tonnes
	MC:	40.0 tonnes
	TC:	39.3 tonnes
Maximum axle load (Fully loaded)		16 tonnes permissible on track
No. of axles per car-	DMC	4
	MC	4
	TC	4

Note: DMC means Driving Motor Coach, MC means Motor Coach and TC means Trailer Coach. The normal composition of a 6-car metro rake is DMC+TC+MC+MC+TC+DMC. The composition may however change depending on needs.

The overall dimensions of the metro cars are indicated in the drawing given in Annexure-1.

2.3.3 The values given above are indicative only. Further details to be obtained from Track Contractor / Rolling Stock Contractor during detailed design interface meeting.

2.3.4 The following formulae / parameters for Metro Rolling Stock of KMRCL may be taken for estimation of Tractive / Braking effort:

Starting Resistance (N) : 50W

Rolling Resistance (N) : $6.4W + 130n + 0.14WV + \{0.046 + 0.0065(Q-1)\}AV^2$
(Modified Davies Formula)

where, W = Total mass of train in tonnes
 n = Number of axles in the train
 Q = Number of cars in the train
 V = Speed of train in km/h
 A = Frontal area of train in m^2 (may be assumed as $10 m^2$)

Inertia Coefficient of DMC/MC : 10%

Inertia Coefficient of TC : 5%

2.4 General Electrical Requirements

2.4.1 Operating Voltage

The machine/equipment shall be powered from re-chargeable storage cells which are to be normally charged from the 360 to 440V AC, 3-Phase, 47.5 to 51.5 Hz Depot supply. The machine sub-assemblies shall be protected from surge, low voltage through suitable devices to protect.

2.4.2 Electromagnetic Compatibility

The machine/equipment shall be electromagnetically compatible within itself and shall not affect adjacent equipment.

2.4.3 General Installation Requirements

2.4.3.1 Equipment Accessibility and Installation

- (a) All gauges, adjustment points, switches, etc, shall be easily accessible and clearly identified with permanent identification markings. The device identification system shall be approved by KMRCL.
- (b) All relays and contactors shall be installed within enclosures, in the manufacturer's recommended orientation. Where the device is rail mounted, the Contractor shall demonstrate that the arrangement will satisfy requirement of this general specification.

2.4.3.2 Device Reference Designators

All electrical devices shall be identified with their alphanumeric designation corresponding to that used on the schematic. The method shall be presented to KMRCL for approval.

2.4.3.3 Earthing/Grounding

- (a) Safety grounding points shall be provided on all electrical equipment, unless otherwise agreed to by KMRCL. Grounding points shall be of tinned copper, clean, free from paint, and of a sufficient area to ensure proper electrical contact for the grounding cable fasteners. Un-tinned bronze grounding points and austenitic grade stainless steel grounding points are also considered acceptable. The area of any weld joining the grounding pad to a surface shall be at least equal to the cross sectional area of the grounding cable.
- (b) Grounding points will have either a tapped hole or, preferably, a clearance hole (with access to both sides) suitably sized for the lug attachment fasteners.
- (c) Suitable grounding cable shall be provided; unless otherwise approved by KMRCL, and the size will be equal to, or larger than, that of the largest power wire connected to that equipment. All grounding wires and cables shall utilize longitudinally striped green and yellow insulation, or heat shrinkable tubing applied over the conductor insulation.
- (d) In circuits where a ground fault could result in current levels which are excessive, but below the operation of over current protection devices, KMRCL-approved ground fault protection shall be provided.
- (e) The machine/equipment body shall be electrically bonded to the rail protection.

2.4.3.4 Wire identification

All equipment wires shall be marked with a unique wire identification number by means of marker sleeves located within 50 mm of each end wire. In addition, the wire insulation shall be indelibly marked with the wire identification number at intervals not exceeding 0.5 m. The identification numbering system will correspond to the wire identification numbering system used on the schematic drawings and wiring diagrams, and shall be approved by KMRCL.

2.4.3.5 Suppression

All relay coils, contactor coils, solenoid valve coils and other inductive devices shall be provided with coil suppression. Contact suppression shall be provided wherever necessary or specified.

2.5 **General Circuit Protection Requirements**

- 2.5.1 All input power circuits shall be individually protected by circuit breakers, and no circuit breaker shall protect more than one circuit, unless specifically approved by KMRCL. Circuit breaker terminals shall not be used as junction points. All circuit breakers shall be sized by current rating and tripping time to protect both the associated equipment and the minimum wire size used for power distribution within the protected circuit over the expected ambient temperature range.
- 2.5.2 Fuses shall only be used where specifically required or where the use of circuit breakers is not technically feasible. The use of fuses requires the express approval of KMRCL.
- 2.5.3 Under no circumstances shall either the main or auxiliary contacts of contactors or relays be wired in parallel for the purpose of carrying a load at or above the manufacturer's tip rating.
- 2.5.4 Under no circumstances shall poles of switches be wired in parallel for the purpose of carrying a load at or above the manufacture's contact pole rating.

3.0 **SPECIFIC TECHNICAL REQUIREMENTS**

- 3.1 The BPEL shall be designed for shunting and positioning of 6-car trains on various depot workshop lines. There may also be need for shunting and positioning of individual 3-car units or individual coaches. The BPEL may also be used to haul stranded 6-car empty rakes on line over the entire network of East-West metro in case of emergency. The Contractor shall be responsible for the design of BPEL, which shall include but not be limited to the following.

3.2 **Operating Principle**

- 3.2.1 The BPEL shall be of rail cum road type with rubber tyres or high polyurethane (Vulcollan) tyres for travelling on concrete floor of the workshop/depot or on metallic road and metal wheels for running/guidance on railway tracks.
- 3.2.2 The BPEL shall be driven by AC 3-phase electric motors and powered by re-chargeable storage batteries through IGBT based inverter. Suitable battery charger, which will normally receive power from Shed supply lines, shall be provided on the BPEL for charging the batteries.
- 3.2.3 A suitable on-board diesel generator set (DG set) shall be provided that can feed the battery charger for charging the batteries on line, when surroundings permit for operation of the DG set. The DG set shall turn on when command is received from the BPEL operator's console. Suitable interlock shall be provided to prevent simultaneous feeding of the battery charger from the Shed Supply lines and the DG set.
- 3.2.4 The BPEL shall have local on-board control for its operation. It shall be possible to drive the BPEL either in forward or in reverse direction from the control console. The control console shall be operated by an Operator.
- 3.2.5 The BPEL shall have the following indications at Operator's desk:
 - • Speedometer
 - • Meter for the indication of Battery Voltage and current
 - • Emergency Switch / Push Button
 - • Indication for parking brake
 - • Indication for mode of operation (Rail / Road)
 - • Indication for low thickness of service brake shoes
 - • Indication for low hydraulic oil, if applicable

3.3 **Battery Powered Electric Loco Traveling**

- a) The maximum operating speed of the BPEL shall be 15 km/h while travelling on rail or road. It shall be designed for giving safe running behavior of the vehicle on specified track at the 'Test Speed' which shall be higher by 10% than the maximum operating speed.
- b) The BPEL shall be designed to start and haul a trailing load of 240 tonnes (6-car empty metro train) on dry tracks with a maximum track gradient of 4% with 120 m minimum radius

of curvature on main line, including turnouts and crossings. While starting the aforesaid trailing load of 240 tonnes on a section having track gradient of 4% with 120 m radius of curvature on main line the BPEL shall provide adequate acceleration to achieve a speed of 2 km/h within 20 seconds.

- c) The BPEL shall be able to generate adequate draw bar pull so as to reach a balancing speed of 7 km/h while hauling a 6-car train of 240 tonnes on a section having level tangent track. It shall be possible to control the speed from 0 to 7 km/h by the operator.
- d) The travel speed shall be continuously variable from 0 to 3 km/h while towing a 6-car train of 240 tonnes on track having maximum of 1 % gradient with a curve radius of 100 m
- e) Under unloaded conditions, the travel speed shall be continuously variable from 0 to 15 km/h while running on tracks and shall be continuously variable from 0 to 15 km/s while running on roads.
- f) The BPEL travelling under unloaded condition on the ground shall be capable of climbing 10% gradient over a length up to 20 m.
- g) The BPEL shall be capable of generating the needed continuous Tractive Effort to meet the above requirements. Tenderer shall submit the performance curves / trial result in confirmation to above. Tractive Effort Calculations shall be included in tender submission.
- h) The BPEL shall have two braking systems – one independent braking system for the BPEL itself (Vehicle Braking) and one braking system for braking of the trailing cars / wagon (Train Braking).
- i) Vehicle Braking shall be hydraulically actuated and controlled by a foot pedal.
- j) Train Braking shall be pneumatically operated and controlled by a brake control handle on the driving desk. The metro rolling stock are proposed to be provided with an EP brake system for normal service braking and an Automatic Indirect Brake (brake pipe controlled brake) for braking the train in case of failure of EP brake or in case the train is towed by a rescue locomotive (BPEL). The Brake Pipe pressure is proposed to be kept at 5 bar. The brake pipe of the towed train / wagon shall be connected to the BPEL through the automatic coupler for activation and release of train brake of the entire 6-car train or wagon. The brake control handle shall have the facility of graduated application/braking as well as emergency braking. Details of the brake system of the train shall be provided during design stage. The BPEL Contractor shall interface with the Rolling Stock Contractor for this purpose.
- k) The BPEL shall have provision of an air compressor of adequate capacity along with an air dryer to generate compressed air at a sufficiently higher pressure and a suitable air reservoir for storage of compressed air required for the Train Brake system.
- l) The Train Brake shall be designed to be able to stop a train of 6 coupled railcars (240t) within safe braking distance while towing the train down a 4% gradient on wet rails.
- m) On level track with wet rails, Braking Distance shall not exceed 6 meters with 6 coupled railcars (240t) towing after the application of brake from a speed of 5 km/h and not exceed 4 meters with 3 coupled railcars (120t) towing after the application of brake from a speed of 5 km/h. Preliminary calculations shall be included in the Tender submission. Detailed calculations shall be submitted by the Contractor in the design documents.
- n) The BPEL shall have sufficient brake accumulator capacity or similar arrangement as a backup in case of failure of the designated brake system.
- o) The BPEL shall have suitable sand spraying system to have adequate adhesion during operation on wet track.
- p) The BPEL shall have two axles and shall have high degree of maneuverability by means of hydraulic system both for front and rear wheel steering giving a minimum turning radius of not more than 12000 mm.
- q) The BPEL shall be able to transfer among tracks and workshop floor by built-in in-railing mechanism. The in-railing procedure shall allow the operator to operate and monitor the in-railing process from operator's seat.
- r) The vehicle shall have self-regulating system and shall have suitable suspension system for smooth negation of curve radius while moving on rail, as mentioned in Clause 2.3.1 of this particular specification.
- s) The BPEL shall have the provision of automatic flash light arrangement as indication for its movement in any direction in rail mode.

Note: Haulage means both pulling and pushing, for the purpose of this clause.

3.4 Coupling

- a) Present 6-car metro rakes are provided with automatic couplers at the front and back of

individual 3-car units and semi-permanent couplers between intermediate car and end cars of a 3-car unit. Coupler details will be provided during design stage.

- b) A suitable automatic coupler shall be provided at one end (Front End) and a Coupler Adapter at the other end (Rear End) of the BPEL.
- c) The automatic coupler shall be designed for pulling or pushing of rated load. Its height shall be adjustable by hydraulic mechanism from the operator's console as well as manually after the vehicle has stopped. It shall be possible to position the coupler head at the same height as that of the car coupler. Pneumatic supply for Train Brake shall be made available from the BPEL through the automatic coupler.
- d) The coupler adapter shall be designed for pulling or pushing of rated load. It shall have provisions for fitment of different types of coupler heads and semi permanent coupler for coupling all types of rail cars / metro vehicles.
- e) Coupler adapter height shall be adjustable by mechanical or hydraulic mechanism. Its height shall be adjustable by hydraulic mechanism from the operator's console as well as manually after the vehicle has stopped. It shall be possible to position the coupler head at the same height as that of the metro car coupler / vehicle.
- f) The end of the coupler adapter shall have the provision to clamp/chain the side members of car bogies.

3.5 BPEL Construction

- a) The BPEL shall be designed to be as compact as possible, especially in length, in order to facilitate travel in tunnel and ground. It shall have maximum height of 3700 mm above top of rail and its width should not be more than 2800 mm. Overall dimensions of the BPEL and its Kinematic Envelope shall conform to the Schedule of Dimensions of KMRCL. Special care shall be taken in the design, in consultation with Designated Contractors and KMRCL Engineers, to ensure that the BPEL neither causes any damage to track side equipment nor does it cause such equipment to malfunction, during movement of the BPEL on track.
- b) The wheel size shall be such that operation of BPEL under all conditions shall not result in any rail damage, corrugation, plastic deformation or any such effect.
- c) An Operator's Cabin having minimum height of 1600 mm inside the cabin with suitable illumination shall be provided for the BPEL. It shall have one lockable door, safety glass and screen wipers. The cab itself shall have several grips for the operator to hold on. The cabin shall have all around visibility and shall be made of 2-3 mm thick steel.
- d) Operator's seat on the BPEL shall be provided preferably always facing the direction of movement in two types of operation with 360 degree visibility and maneuverability. The Operator's control shall match with orientation of operator's seat. The operator's seat shall be cushioned, preferably height adjustable and with adjustable backrest angle.
- e) The operator's console shall be ergonomically designed and allow operation of the BPEL in both direction of travel without need to twist or turn. Push button and switches used in the console shall be of IP-55 protection.
- f) Headlights shall be provided at both ends.
- g) Spring actuated and hydraulically release type parking brakes shall be provided. It shall get automatically applied when the BPEL is switched off.
- h) Horn sound shall be 70dB or more and they shall be provided one for each direction movement.
- i) Emergency Stop push button shall be provided in each side of the BPEL.
- j) The Central Park Depot shall have one fully automatic CNC under floor wheel lathe to re-profile wheels of the metro cars in position. The profile of the coach wheel is enclosed as Annexure-2 for guidance of the Tenderer. Tenderer shall propose the profile of the BPEL rail wheels and its service limit. Any gauge or instrument etc required to check the wheel profile of the BPEL shall be supplied by the Contractor to KMRCL, if required / necessary. The Tenderer shall elaborate the procedure for wheel re-profiling in his technical offer, if required / necessary.
- k) The proposed wheel life of the BPEL shall not be less than 20 years in case of rail wheels. In case of rubber tyred wheels, Contractor shall ensure supply of required number of rubber tyres on completion of its service life after expiration of DLP upon request from KMRCL. The Tenderer shall indicate the expected service life of rubber tyres in his Technical Bid.
- l) Special attention shall be drawn to the following points for the design and manufacture of the BPEL:
 - Operational safety

- General ruggedness,
- Accessibility to control of traction/braking devices,
- Four hoisting points/support areas on four corners for easy lifting of tractor using EOT crane/screw jacks,

3.6 Control Requirements

- a) A control console, required control gears and monitoring measures shall be provided at the Operator's seat for full operation of the BPEL.
- b) The BPEL shall have the provision to monitor rail position by the operator, without leaving his seat, with the help of a video camera & LCD display, while the vehicle moves on the rail.
- c) The BPEL shall have state-of-the-art traction control system for control of its AC motor drives.

3.7 Battery and Battery Charger

- a) The BPEL shall have a battery capacity for approximately 60 kms travelling on rail under unloaded condition at a speed ranging from 0 to 15 km/h and at least 30 kms travelling on rail under fully loaded condition (hauling a trailing load of 240 tonnes) on level tangent track at a speed ranging from 0 to 7 km/h on single charging.
- b) Battery shall be of rechargeable type and shall have a lifetime of minimum 1000 charging cycles and shall be commercially available in India.
- c) Details of the battery capacity, voltage, type etc shall be submitted in the offer.
- d) An on-board charger for battery recharging shall be provided on the BPEL. Charger shall be compatible with the input supply voltage 360 to 440V, TPN, 47.5 to 51.5 Hz. The Contractor shall provide necessary cabling and connections to a power supply isolator provided by Designated Contractor in the depot. Recharging period of a fully discharged battery shall be less than 10 hours.
- e) The battery charger shall have provision for taking 3-phase power supply input either from the Depot supply line or from the on-board DG set. Suitable interlocking arrangement shall be provided to prevent simultaneous input from both the above mentioned sources.
- f) The battery charger unit shall be equipped with volt meter, ammeter to monitor battery and charger conditions.

3.8 Diesel Generating Set

3.8.1 A suitable Diesel Generating Set shall be provided on the BPEL to feed 415V, 50 Hz 3-phase supply to the on-board battery charger when the normal 3-phase supply from Depot lines is not available. Suitable interlocking arrangement shall be provided to prevent simultaneous input from both the above mentioned sources.

3.8.2 The DG Set shall have a capacity to meet the requirements of maximum charging period as stipulated in Clause 3.7(d) above.

3.8.3 The DG set shall be preferably floor-mounted and easily removable for maintenance elsewhere, if required. The enclosure shall be properly designed to prevent water, dust ingress

3.8.4 The general technical requirements of the DG set are prescribed in the following clauses.

3.8.5 Diesel Tank

Diesel fuel tank size shall be 45 litre or more.

3.8.6 Diesel Engine

- (a) The engine, which shall be four stroke, self-start type capable of developing required BHP to drive the Generator coupled to it, shall be of a proven design for operating under the climatic conditions in India. The supplier of the engine shall have overhaul facilities available in the region of Kolkata.
- (b) The engine shall be of silent type and shall be designed to operate in tunnel, without affecting the health and safety of staff working in the vicinity. It shall be of the type having a pre-ignition swirl chamber, operating on low- sulphur content fuel, available in India.
- (c) The engine shall give audio-visual alarms to the operator in the cab in the event of any of the following. The engine shall be automatically shut down if necessary for safety.
 - engine over-speed

- low engine lubrication oil pressure
 - high cooling water temperature
 - high transmission oil temperature
 - air filter clogging
- (d) HSD oil conforming to IS 1460:1995 for diesel fuels shall normally be used. Necessary provision shall also be made for use of low sulphur diesel oil in the future.
- (e) The Generator Control Panel shall be fitted with an engine hour meter in such a position where it can be easily checked by the operator.
- (f) The engine mounting shall be arranged to ensure that no excessive vibrations occurs under all service conditions.
- (g) The engine shall comply with latest Euro standards for emission from DG sets, as applicable. Further, it shall meet the latest emission standards prescribed by Central Pollution Control Board (CPCB) of India for noise and emission of diesel engines, in case any of the criteria stipulated by CPCB is more stringent as compared the Euro standard.
- (h) The engine shall be equipped with an electric starter motor, which shall be powered by a rechargeable battery. The starter motor shall be automatically disengaged once the engine has started. Low maintenance cost and long life of the battery shall be of prime importance. The battery shall be capable of taking cold start load in winter.
- (i) The governor shall be of a type proven in Railway applications or similar application. Overloading of the diesel engine shall not be possible.
- (j) It shall be ensured that before engine starting the lubricating oil priming is done automatically.
- (k) The engine shall preferably be water-cooled with a radiator for cooling the circulating water.
- (l) The engine shall conform to ISO 8528 and ISO 3046/BS:5514 standards.

3.8.7 Generator

- (a) The Generator shall be a synchronous brushless type self-excited & regulated alternator suitable for continuous operation to generate required power at 415V, 50 Hz 3-phase for the battery charger to charge the traction battery of the BPEL.
- (b) The alternator shall have IP-23 protection, Class-'H' insulation and shall be provided with all standard protections.
- (c) The alternator shall be of self-ventilated air cooled type.
- (d) The tolerance for output voltage shall be $\pm 5\%$ and that for the output frequency shall be $\pm 1\%$.
- (e) The alternator shall conform to IS 4722 / BS 5000 standards.

3.9 **Protection and Safety**

3.9.1 Safety devices shall be provided to impede any damage to the machine and serious personnel injury in the event of false manoeuvres.

3.9.2 The cabin shall be appropriately illuminated for Operator's safety.

3.9.3 Fire Protection - The design parameters of electrical installations in the machine shall be in safer range to prevent and protect from fire.

3.9.4 Provision of all the measures for protection and safety, mentioned anywhere in this Specification, shall be ensured by the Contractor. Following minimum protection should be included in the working of BPEL:

- Protection for low battery voltage alarm
- No movement in case of charging cable is plugged in power source
- Protection against low oil level in hydraulic system
- Protection against over current of electric motor
- Provision of auto parking brake
- Provision of dead man switch
- No traction with parking brakes / service brakes ON
- Protection against low hydraulic pressure and low air pressure in the brake system
- Protection against derailment of the vehicle

3.10 Maintenance and Upkeep Conditions

- 3.10.1 Sensitive components / parts of the machine must be appropriately protected to stop ingestion of any foreign material, dirt and dust. All covers and hoods shall be easy to remove.
- 3.10.2 The machine and its accessories shall be designed to facilitate maintenance operation.

4.0 FINISH

The surface treatment of the equipment shall be suitable for the working environment under the climatic conditions in Kolkata.

4.1 Painting

4.1.1 Preparation of work prior to painting:

- External surfaces: Brushing, Degreasing or sand blasting and blowing.
- Anti-corrosion treatment: Application of a coat of anti-corrosion paint. Thickness of this coat after drying should not be less than 180 microns.
- Hollow parts: The internal parts shall be treated prior to assembly.

4.1.2 Painting:

- External and related parts shall be prepared as described above and then given two coats of polyurethane lacquer with a dry unit thickness of at least 50 microns. The second coat shall be applied over the first coat when it is still wet. Colour of the tractor shall be "dark red" matching 1805 C of Pantone shade card or equivalent red colour in RAL.
- The contractor shall touch up at site any paint as may be necessary.

4.1.3 Unpainted Parts:

All covered parts or those to remain polished shall be covered with a coating designed to protect them from oxidation until such time as the equipment enters the service.

4.2 Identification

- 4.2.1 All equipment and sub-assemblies shall be identified and marked, corresponding to the panel, by means of durable engraved labels.
- 4.2.2 The manufacturer's identification plate and the year of manufacture shall be affixed to the BPEL. In addition, KMRCL logo shall be painted on the BPEL body.
- 4.2.3 Name plates shall be both in English and Hindi.

5.0 INSPECTION

5.1 The Employer and the Engineer shall at all reasonable times:

- (a) have full access to all parts of the Site and to all places from which natural materials are being obtained, and
- (b) during manufacture and installation (at the site and elsewhere) be entitled to inspect, examine, measure and test the materials and workmanship, and to check the progress of manufacture, of all Machine / Equipment and Materials to be supplied under the Contract.

The Contractor shall give the Engineer full opportunity to carry out these activities including providing access, facilities, permissions and safety equipment. No such activity/inspection shall relieve the Contractor from any obligation or responsibility.

- 5.2** When Inspection during manufacture or before delivery or dispatch is required, notice in writing shall be sent by the Contractor to the Inspecting Officer when the stores or material to be supplied are ready for inspection and test, and no stores shall be delivered or dispatched until the Inspecting Officer has certified in writing that such stores have been inspected and approved by him. At least 4 weeks' notice must be given to the Inspecting Officer to enable him to arrange the necessary inspection. The examination of stores will be made as soon as practicable after the same have been submitted for inspection and the result of the examination will be notified to the Contractor.

- 5.3** In cases where the Inspecting Officer requires that inspection of the raw material to be used and/or stage inspection during the manufacturing process of the components stores etc is also be done, notice in writing shall be sent by the Contractor to the Inspecting Officer to visit his premises/works to test the raw materials and/or conduct necessary inspection during the manufacturing process of the component/store etc as deemed essential.

5.4 Marking of Inspection

- 5.5** The Contractor shall, if so required, at his own expense, mark all the approved stores with a recognized Purchaser's mark. The stores which cannot be so marked shall, if so required by the Inspecting Officer, be packed at the Contractor's expense in suitable packages or cases, each of which shall be sealed and marked with such mark.

6.0 CHECKS AND TESTS

The checks and tests shall be carried out as per following in line with Inspection clause 7.3 of General Conditions of Contract.

6.1 In Manufacturer's Plant

- a) During manufacture, and especially prior to shipment verifications and checks shall be carried out in order to ensure that the supply is in accordance with the technical specification and with the approved design documents.
- b) All quality checks shall be carried out as required, during manufacture on the Contractor's or on the vendors' premises.
- c) The Contractor shall provide for all checks of supplies on his vendors' premises prior to delivery of these supplies to his workshops.
- d) Operation of safety and protection devices shall also be checked.
- e) These checks and tests shall also comprise:
 - Check of proper operation of the BPEL.
 - Check of vital dimensions as per design.
 - Traction and braking tests.
 - Leak tightness of the cab and power package enclosures.
 - Check of assembly work (welds, hardware etc.)
 - Behaviour of the BPEL during run at various speeds, vibrations and oscillations
 - Check of various safety devices.
- f) The entire supply shall be inspected by the Employer's representative at the Contractor's premises before shipment to the site.
- g) Test protocol for Factory Acceptance Tests shall be jointly agreed between the Contractor and the Engineer prior to FAT.

6.2 At Site

- a) After delivery at site, the operational tests shall be carried out at the site in presence of Employer's representative to confirm that the equipment fulfills the requirements of the specifications. These shall include all tests carried out in the Factory as well as additional capability test related with train shunting/haulage requirements and braking performance as prescribed in the specification.
- b) The Contractor shall check the workmanship and quality of entire work including that of his vendors upon completion of testing & commissioning work at site and before offering the same to Employer for inspection.
- c) The final commissioning shall be subject to a series of practical tests including statutory instrumented tests & trials required to be carried out for evaluation of stability, riding behavior etc of the vehicle before permitting operation of the BPEL on line. Acceptance criteria for such tests and trials shall be based on international practice/norms subject to approval of the same by the Commissioner of Railway Safety, and shall be mutually agreed during detailed design stage.
- d) Integration tests shall be carried out for the trial runs of the machine/equipment with the metro coaches in order to verify the satisfactory operation of the BPEL.
- e) The supplier shall demonstrate the BPEL performance after successful commissioning at the Employer's site. Thereafter the Employer shall watch the machine performance for a period of at least 1 (one) month before the final Taking Over Certificate is issued.

7.0 PACKING AND MARKING

7.1 Packing

The Contractor shall pack at his own cost the store sufficiently and properly for transit by rail/road, air and/or sea as provided in the contract so as to ensure their being free from loss or damage on arrival at their destination. He shall decide the packing for the stores by taking into account the fact that the stores will have to undergo arduous transportation before reaching the destination and will have to be stored and handled in tropical climatic conditions (Including Monsoons) before being put to actual use. Unless otherwise provided in the contract, all containers (including packing cases, boxes, tins, drums and wrappings) in which the stores are supplied by the Contractor shall be considered as non-returnable and their cost as having been included in the contract price. Each package shall contain a packing note specifying the name and address of the Contractor, the number and date of the acceptance of tender and the Designation of the Purchase Officer issuing the supply orders, the description of the stores and the quantity contained therein. The general requirements for packaging are as under:

- Each packing case/crate shall be water proof, rot proof and insect/rodent proof and of robust construction. The Contractor shall in determining the packaging materials take cognisance of the climatic conditions likely to occur during the period of transport, shipment and storage.
- All items heavier than 100 Kg. shall be marked on the outside of the case to show the gross weight, the points for slinging and where the weight is bearing.
- Care shall be taken to prevent movement of items within cases, crates or packages by the provision of bracing, straps and securing bolts as necessary. Bags of loose items shall be packed in cases and shall be clearly identified by well-secured labels on which the quantity and name of the part and its catalogue or index number have been stamped.
- Electronic circuit boards shall be well protected by using anti-static bubble bag etc.
- Rubber products shall be suitably packed to avoid damage due to hardening, deforming and peeling off etc.
- Tubes, cables and conductor ends shall be properly sealed to prevent ingress of moisture.
- Each bulky/heavy case, crate or package shall include wedges for easy loading and unloading by mechanical handling equipment.

7.2 Marking

The marking of all goods supplied shall comply with the requirement of the Indian Acts relating to merchandise marks or any amendment thereof and the rules made there under. The following marking of the material is required. The following particulars should be stenciled with indelible paint on all the materials/packages:-

- a. Contract No.
- b. Specification no.
- c. Item No.
- d. Post Consignee (wherever applicable)
- e. Abbreviated Consignee marks.

In addition to the marking as specified above, distinguishing colour marks should be given so as to distinguish the ultimate Consignees in India.

7.3 Delivery

All documents, inspection test procedure, drawings and other deliverables shall be supplied to the Employer's Representative of KMRCL 1 month before the despatch of the machine.

Any parts of the equipment that is damaged shall not be considered as delivered unless repairs or replacements have been made. Contractor's local associate shall take over all the materials on arrival of when machine at the site and shall take care the machine / materials till the time the machine gets commissioned at site by the Contractor in all respect.

8.0 TRAINING OF EMPLOYER'S STAFF

- 8.1** The Contractor shall provide comprehensive training to the Employer's staff to enable safe and efficient maintenance and operation of the equipment supplied as part of the contract to achieve maximum reliability and economy of cost. The Contractor shall submit to the Engineers for review and approval a training plan at least two months before the readiness of the equipment for commissioning. The training plan shall include:
- Schedule of training courses,
 - Syllabus, size of class and duration of each capsule,
 - Training facilities to be provided by the Employer,
 - Qualifications and experience level necessary for the trainees,
 - Instructor's qualifications.
- 8.2** The training shall consist of classroom training and practical hands-on training. The Contractor shall depute competent trainers to impart training to a high degree of proficiency with competency certificate issued by OEM. During the DLP when the Contractor is responsible for fault finding and repairs, he shall provide practical hands-on training to the Employer's maintenance staff.
- 8.3** The training shall be in two stages:
- a) The Contractor shall provide training to Employer's staff of minimum 30 trainer-days i.e. 10 trainer-days for operation and 20 trainer-days for maintenance at commissioning site. The training shall focus on subjects to well verse the O&M staff with the standard features of machine/equipment's design & assembly aspects, operational and maintenance aspects, fault diagnostics etc.
 - b) The operational training shall cover:
 - i) Exposure to technical details of the BPEL for understanding the location of the sub-assemblies and systems .
 - ii) Interfacing of the equipment and interlocking thereof, which can enhance operational skills of the operator.
 - iii) Details of Operator's console and controls
 - iv) Complete operation of the BPEL and its equipments and all features including safety features etc.
 - v) Fault diagnostics and their remedial measure.
 - vi) Electrical Circuit/Schematic & interlockings
 - c) The training of the maintenance aspects of the BPEL shall cover:
 - i) Complete technical details of the BPEL for understanding the stages of assmby of the sub-assemblies and systems.
 - ii) Training on general maintenance, replacement of faulty parts of different subsystems of the machine, e.g. pneumatics, lubricaion system, electrical control, electronics and its controls including programming software reloading & back up etc.
 - iii) Checking of all interlocking and safety features / systems available in the machine and fault attending.
 - iv) Special tools for maintenance and troubleshooting.
 - v) Training on proactive, predictive and breakdown maintenance aspects of the machine/equipment based on past experience of the Instructor.
- 8.4** The training shall consist of classroom training and practical hands-on training. The Contractor shall depute competent trainers to impart training to a high degree of proficiency with competency certificate issued by OEM. During the DLP when the Contractor is responsible for fault finding and repairs, he shall provide practical hands-on training to the Employer's maintenance staff.
- 8.5** Two sets of Operation and Maintenance Manuals along with soft copy in English language shall be supplied besides adequate number of small training material booklets to all the trainees. The Contractor shall also provide training courses and training materials to the Employer's Training Instructors to a level of competence to allow the Instructors to subsequently train the Employer's staff in maintenance and operation of the machine/equipment.
- 8.6** Certificate to each trainee shall be issued after imparting the training.
- 8.7** All expenses of training except travel & lodging of trainees shall be borne by the Contractor.

9.0 MAINTENANCE DURING DEFECT LIABILITY PERIOD

The following are the general maintenance requirement in line with Clause 10 of Conditions of Contract.

- 9.1** The BPEL shall be maintained free of cost for the scheduled and unscheduled maintenance by the successful Tenderer during the Defect Liability Period (DLP) of 24 months from the date of handing over of installed & commissioned Machine to the Employer.
- 9.2** The manufacture should either directly or through associate company have trained manpower and maintenance facilities in India preferably in Kolkata. The associate company must have at least 03 years' experience of manufacturing the machine for railways/metros application or of giving after-sales service for machine used in railways/metros. The Tenderer shall submit in the offer, details/organization to carry out the maintenance during the Defect Liability Period.
- 9.3** The Contractor shall have to meet the time frame for breakdown/corrective maintenance as below: -

Minor maintenance: - Inclusive of repairing and replacement of all spares/ components and all defects other than major defects.

- a. Response Time (Max) – 6 hours
- b. Attention Time (Max) – 8 hours

Major maintenance: - Detection of hydraulic leakage, refilling of gear oil, pipefitting, welding/brazing works, rewinding/replacement of motors & other major equipments etc. Basically it covers attention to all types of major failures/breakdown.

- a. Response Time (Max) – 12 hours
- b. Attention Time (Max) – 24 hours

(Shall be in proportion with type of defect).

- 9.4** The Contractor shall maintain bank of spares at KMRCL's designated premises to optimize the Machine downtime. The Contractor shall arrange for any transportation, loading/unloading, spares, machinery & plants, tools/ tackles, labour, garbage disposal etc required for attending break down/ maintenance of the Machine during DLP.
- 9.5** During maintenance, the Contractor shall follow all statutory Acts, Regulations, Codes and Practices in force like IE Rules, Electricity Act etc.
- 9.6** The machine/equipment entrusted to the Contractor for repair at their workshop shall be at the risk & cost of the Contractor; if any deduction is required to compensate any loss on this account, the same shall be adjusted from balance payments or by means of forfeiting the Performance Bank Guarantee.
- 9.7** The Contractor shall provide the spares and consumables required for scheduled maintenance and unscheduled repair of BPEL during DLP. The Contractor shall give a list of spares to be maintained by him at Employer's works for the scheduled maintenance and unscheduled repair of BPEL during DLP. If spares provided fall short of the requirement, it shall be made available by the supplier at his cost at the earliest. The Contractor shall not claim any charge against the maintenance work performed during DLP nor they will claim any cost against the replacement / repairing of defective materials /equipment.
- 9.8** The breakdown of BPEL due to unscheduled repairs shall not be more than two days for local supply and seven days for other foreign equipment after receipt of information from the Engineer/Employer, failing which penalty will be imposed at the rate of 0.01% of the contract value per day during the DLP. The days for calculating the penalty shall be counted from the day defects are brought to the notice of the Contractor by the Engineer.
- 9.9** The Tenderer shall in his bid provide a list of spares required for scheduled maintenance and unscheduled repair of BPEL for 3 years after completion DLP.
- 9.10** The Contractor shall provide to the Employer all special tools and instruments required for the maintenance of the equipment. These shall be supplied in protective boxes provided with padlocking facilities.
- 9.11** The Contractor shall guarantee supply support of spares & tools for a period of 10 years after completion of the DLP of the last machine.

- 9.12** The Contractor shall furnish an undertaking that he has no objection whatsoever to and shall not in any way deter or obstruct the KMRCL, its licensee or its representative from dealing directly with the Contractor's vendors/OEM for the purchase of the spares during & after the contract period.

10.0 COMPREHENSIVE ANNUAL MAINTENANCE

10.1 General

- 10.1.1** The Contractor shall carry out the Comprehensive Maintenance, which will include breakdown attention, any overhaul of the sub-system, repair of sub-system, and replacement of defective worn out parts of the BPELs supplied under the Contract.
- 10.1.2** All maintenance activity should be carried out as per the Schedule of work given in Maintenance Manuals and as per the Technical Specification provided by the OEM of the machine/equipment, sub-systems.
- 10.1.3** The scheduled maintenance activity is envisaged quarterly. Annual maintenance activity may be more elaborate than the quarterly maintenance.
- 10.1.4** For any breakdown of the BPEL or its sub-systems, the authorized person from depot shall give the call at the Contractor's office and such a communication shall be recorded. The Contractor's engineer / representative shall attend the BPEL or its sub-systems, within the timeframe prescribed below.

10.2 Timeframe for Corrective Maintenance:

Minor Maintenance: - Inclusive of Repairing and Replacement of all Spares/Components and all other associated accessories which are covered otherwise and attention of all defects other than major defects.

a.	Response Time (Max.)	-	6 hours
b.	Attending Time (Max.)	-	8 hours

Major Maintenance: - Detection of hydraulic leakage, Refilling of oil, Pipefitting, Welding /brazing works, Rewinding/replacement of Motors etc. Basically it covers attention of all types of major failures/breakdowns.

a.	Response Time (Max.)	-	12 hours
b.	Fault Attending Time (Max.)	-	24 hours

(Should be commensurate with the Type of Failure)

- 10.3** The Contractor shall take proper prior permission from nominated KMRCL personnel in prescribed format to carry out maintenance activity at KMRCL site. The work is to be carried out under the supervision of KMRCL representative only.
- 10.4** The Contractor during the execution of maintenance work shall follow the Indian Electricity Rules, Indian Electricity Act & all other Statutory Rules, Regulations & Acts as available on date & during the period of contract.
- 10.5** Replacement/replenishment of oil/lubricant due to leakage in the system arising out of fair wear and tear shall be done by the Contractor.
- 10.6** Tools & tackles as required for the maintenance of the system shall be provided by the Contractor or their associates.
- 10.7** Checking condition and setting of panel controls, safety controls, operating controls to ensure optimum performance, reliability and replacement if necessary shall be done by the Contractor.
- 10.8** Lubricating the bearings of rotating parts, when found necessary, shall be done by the Contractor.
- 10.9** Touch up painting on the damages due to maintenance requirement shall be done by the Contractor.
- 10.10** Checking the operation of each assembly/sub-assembly/equipment and recording the abnormalities observed of the machine, readings in log sheet shall be done by the Contractor for its normal operating, conditions and informing the abnormalities to KMRCL's concerned

officials.

- 10.11** All transportation charges including loading and unloading charges for the spares, lubricants, materials, tools & plants shall be borne by the Contractor.
- 10.12** In case repair works are to be carried out by the Contractor at his workshop/premises, the defective part shall be permitted to be taken out only after replacement is done with a healthy similar part bearing same part and Mode Number and having same make as the original part. Equipment entrusted to Contractor for repair at their workshop will be at the risk of the Contractor for any loss or damage.
- 10.13** The Contractor has to maintain sufficient stock of such spares and consumables that are required to be procured for comprehensive maintenance, from other original equipment manufacturers to minimize the breakdown period and to keep the BPEL in working condition, as stipulated in this document.
- 10.14** The cleaning works are to be carried out as per international norms/standards and in such a manner that machine/equipment look neat and clean. Eco-friendly chemicals / reagents to the extent possible shall be used.
- 10.15** The Comprehensive Annual Maintenance Contract can be terminated by KMRCL at any time by giving one-month notice to the Contractor without giving any reason what so ever.

10.16 Maintenance Work:

- (i) The maintenance work is based on scheduled service visits at three-month intervals. Any intermediate visit required by the Contractor for attending the unscheduled maintenance requirement will be the obligation of the Contractor under this comprehensive maintenance contract.
- (ii) The Contractor shall educate the Employer's staff to carry out the routine maintenance as required during the period Contractor's staff is not visiting the site. Routine preventive maintenance check sheets shall be prepared for the Employer's staff to carry out daily, weekly checks. The Contractor shall be in regular contact with the Depot officials for smooth running of the BPELs and its associated accessories, etc.
- (iii) At the end of the visit the Contractor shall submit a detailed checklist of the completed activities. The Contractor shall provide all the required service engineers. However, the Purchaser will provide the operator of the BPELs and a helper during the visit of service engineers. The Contractors shall attend the BPELs within the specified time failing which the penalty clause as advised in the document will apply.

10.16.1 Material Required:

The Contractor will decide equipment and materials normally required during the servicing. However items such as spare tyres, spare battery, wearable components of brake system & hydraulics, fuses/MCBs etc are expected to be required:

The Tenderer shall provide the list of spares they plan to store at the Employer's premises or their local office for the maintenance of the BPEL.

S.N	Description	Qty.

10.16.2 Time Frame:

The BPELs will not be out of service for more than 2 days during each quarterly schedule and 5 days during annual schedule.

10.16.3 Details of Routine Maintenance

It is important to have regular maintenance of BPEL to ensure the best possible reliability of the BPEL. Routine cleaning and checking of various functions will be carried out. This program of routine maintenance is generic in nature and will be tailored by the Contractor specific to certain features of the BPEL supplied. Further, the Contractor based on the data gathered for the BPELs from previous supplies, shall prepare the check sheets for quarterly and annual checks and maintenance.

11.0 PLANNING, PROGRAMME AND PROGRESS MONITORING

11.1 Preparation and submission of program of work

The Contractor shall interact with Employer / Engineer to provide details and obtain approval where necessary on following for Supply Equipment as per the stipulated schedule:

Activity
Submission of design documents and other technical documents from the manufacturers for approval
Program for manufacture of the equipment
Documents for execution of works relating to commissioning
Proposal for factory tests & procedure
Program for tests at site and commissioning
Program for training of staff
Program for supply of maintenance manuals and other documents
Program for supply of spares

11.2 Progress Report

The Contractor shall prepare a Progress Report covering all aspects of the execution of works. Such Reports shall be delivered to the Employer's Representative on monthly basis.

11.3 Progress Meetings

In order to ensure commissioning of the Works in an efficient and proper manner, the Employer and the Contractor will exchange technical information for approval of the solutions and equipment offered and holds periodical meetings. Two categories of meeting may be held for this purpose

Technical meetings:

Attended by engineers and technicians, convened upon request by either party, during which, among other subjects, clarifications of additional information relative to the technical specifications may be provided.

Periodical Progress Review Meetings:

To be held as and when required by Engineer during which:

- Certain problems that may be holding up progress of the assembly & commissioning may be examined.
- Interface requirement with designated contractors may be discussed.

The Progress Review Meetings are attended, notably by the Contractor's Manager and the Employer's or the Administration's discipline Manager or their Deputy and Engineer.

Progress Review Meetings relative to works will be held in KOLKATA and will be the subject of reports, in conditions, which remain to be defined.

12.0 DOCUMENT SUBMISSION

All documents shall be provided in English. 4 sets of hard copy of documents and 2 soft copies are to be submitted by the Contractor.

12.1 In the Bid

The Tenderer shall provide:

- A detailed technical note containing the description of the machine, indicating main dimensions, the grade of steels used in this construction and the total weight of main assemblies
- Photographs or sketches of similar machine/equipment with a list of references
- Diagrammatic plan view with main dimensions, showing compatibility between the equipment dimensions and the provisions indicated in the drawing

- General Arrangement drawing substantiating the satisfactory mounting and movement of the BPEL on specified track, including Static and Kinematic Envelope of the vehicle superimposed on limiting envelopes as shown in KMRCL's Schedule of Dimensions
- References of the vendors
- References and characteristics of the main assemblies
- Approximate weight of removable parts and components
- The standards and specifications that the main components used in the installation satisfy

Full technical details of the BPEL shall be submitted in the proforma given in Schedule-1 of Appendix FT-4 to Form of Tender (Vol.1 of Tender Documents).

12.2 For Execution of Work

Prior to manufacture of the component, the Contractor shall submit the following documents to Employer's Representative for approval:

- Design calculation for all important equipment and dimensions
- A detailed technical note with weight of components and removable parts and including a list of parts with references of the vendors
- Tractive effort-speed and braking effort-speed characteristics and calculations, to substantiate capability of the machine for haulage and braking of specified trailing load
- Characteristics of the traction motors, and other assemblies
- General Arrangement drawings, detailed assembly drawings and detailed drawings of mechanical parts and electrical/electronic panels
- Calculations for Kinematic Envelope of the vehicle
- Vehicle Dynamics calculations to substantiate safe running behavior of the vehicle on specified track at the Test Speed specified earlier
- Descriptive and operating note, including interlocking/interface for remote and local operation
- Detailed electrical diagram and electronics for trouble shooting including cable index, connection diagram with markings
- Control scheme, circuit diagram, flow chart of software, & logic diagram
- List of spare parts to be kept in stock for repairs
- Documents, drawings, notes and references of the vendors
- Installation and commissioning procedure
- Schedule of work and completion period
- Details of the provisions concerning personnel safety and use of apparatus in hazardous work areas.
- A life cycle cost plan of the machine covering capital costs, operation costs and maintenance costs
- Any other details which is required to be submitted in reference to design clarification / validation in the understanding of the Contractor.

12.3 At Completion of Work

The Contractor shall provide up-to-date documentation including:

- List of general drawings and detailed drawings of electrical and electronic diagrams with complete nomenclature
- Tractive effort-speed and braking effort-speed characteristics,
- The general nomenclature of the supply including vendors,
- Drawings required for maintenance and troubleshooting of the machine/equipment,
- Illustrated list of mechanical & electrical parts itemized in accordance with the diagrams and drawings. The following information shall be provided for each part:
 - a) Part No.
 - b) Description
 - c) Name and contact address of manufacturer with contract details.
 - d) Quantity & unit.
 - e) Part of next higher assembly.

- f) Cross reference to figure no.
- g) General or specific purpose.
- h) Purchase & technical specification
- Maintenance Manual with details of maintenance schedules and repair procedure for important equipment, summary of circuits, functions and adjustments and a lubrication manual including location of lubricating points, type of lubricants, frequencies and quantities,
- Operating Manual (user's instructions for start-up and operation)
- Complete documentation of equipment from vendors
- Complete documentation on motor and major components,
- The flow charts, the assembly listings and the copy of source program on a CD for any application software used.
- Manual for hardware & software tools required for making changes in the application software
- Spare parts catalogue
- Vendor details

13.0 INTERFACE AND COORDINATION

13.1 Interface with Rolling Stock Contractor-

Scope	BPEL Contractor	Rolling Stock Contractor
Design of BPEL	Design, Manufacture, Supply, testing & commissioning of BPEL.	Provide wheel, coupler, brake system and other relevant rolling stock details required for design of BPEL.

For the parameters of any upcoming rolling stock, the Contractor shall interface with Engineer.

13.2 Interface with Designated Track Work Contractor

Scope	BPEL Contractor	Track Contractor
Design of BPEL	Design, Manufacture, Supply, testing & commissioning of BPEL.	Supply of detailed track interface drawings as well as track parameters. Provide details of track related equipment in Depot and mainline.

13.3 Interface with Designated Signaling Contractor

Scope	BPEL Contractor	Signaling Contractor
Interfacing with signaling	Interface for movement on tracks within Depot and on mainline.	Provide details of signaling in Depot and mainline.

13.4 Interface with Designated Depot Civil Contractor

Scope	BPEL Contractor	Depot Civil Contractor
Interfacing with Depot layout	Interface for electrical requirements and logistics	Provide details of electrical requirements and logistics in Depot.

14.0 RAM TARGETS

14.1 Reliability

The Mean Time Between Failures (MTBF) target is 8760 hours per equipment. A failure is defined as one event leading to the Machine being unable to perform its service (equipment out of order).

14.2 Availability

The availability of each Machine shall be at least 99%. This figure includes both the time when the Machine is not available due to breakdowns and the call out time. The call out time is the time required to get to the site of breakdown (Response Time). For each Machine/equipment, the maximum call-out time plus the maximum time for minor maintenance shall not be more than 14 hours. Similarly for major maintenance required for breakdown, response time plus attention time should not be more than 72 hrs.

14.3 Maintainability

For each Machine/equipment, the Contractor shall provide routine / preventative maintenance activities, frequencies, and estimated durations. The maintenance requirements and routines shall be included in the maintenance documentation to be supplied with the equipment. The Mean Time to Repair (MTTR) shall be as proposed by the Tenderer in his technical bid and in any case shall not be more than 72 hours after failure including the time to repair. The Calculations with respect to RAM targets shall be done every month based on the data collected in the previous month. The collection of data with respect to RAM targets shall commence from the time of issuance of Provisional Taking Over Certificate by the Engineer.

14.4 Safety

The Contractor shall comply with all local applicable regulations. The Contractor shall liaise with all affected parties in the production of a Method Statement covering all operational and maintenance aspects of the equipment. The Method Statement shall include, but not be limited to risks associated with:

- Requirements for personal protective equipment;
- Safety instructions and control measures for residual risk;
- Recordkeeping; The Contractor shall demonstrate by assessment that the equipment operational environment is safe at any time during the operation.

14.5 Hazard analysis

The results of a hazard identification exercise carried out by the Contractor shall be entered into a hazard log. The Contractor shall additionally demonstrate that all reasonably foreseeable hazards have been identified and risks reduced to ALARP (As Low As Reasonably Practicable). The Contractor shall produce a hazard analysis, assessing the risks to staff, rolling stock and to the provided equipment resulting from, but not limited to, the following feared events and demonstrate that hazards resulting from these are ALARP:

- Working in confined spaces;
- Societal injury through noise pollution or contamination;
- Noise to surrounding environment.

As a minimum, a safety risk assessment of the equipment shall be carried out at the following stages and the results communicated to the Employer:

- Design stage;
- Initial installation stage;
- Final installation stage, prior to commissioning.

Where control measures are introduced to reduce risk to ALARP, the Contractor shall demonstrate that where residual risk may remain, the control measures are suitable and sufficient. The results obtained from hazard analysis and risk assessment must be compatible with the Employer's safety targets.

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The technical drawings illustrate the 1000 Series Electric Multiple Unit (EMU) car, showing both interior and exterior views with detailed dimensions and component labels.

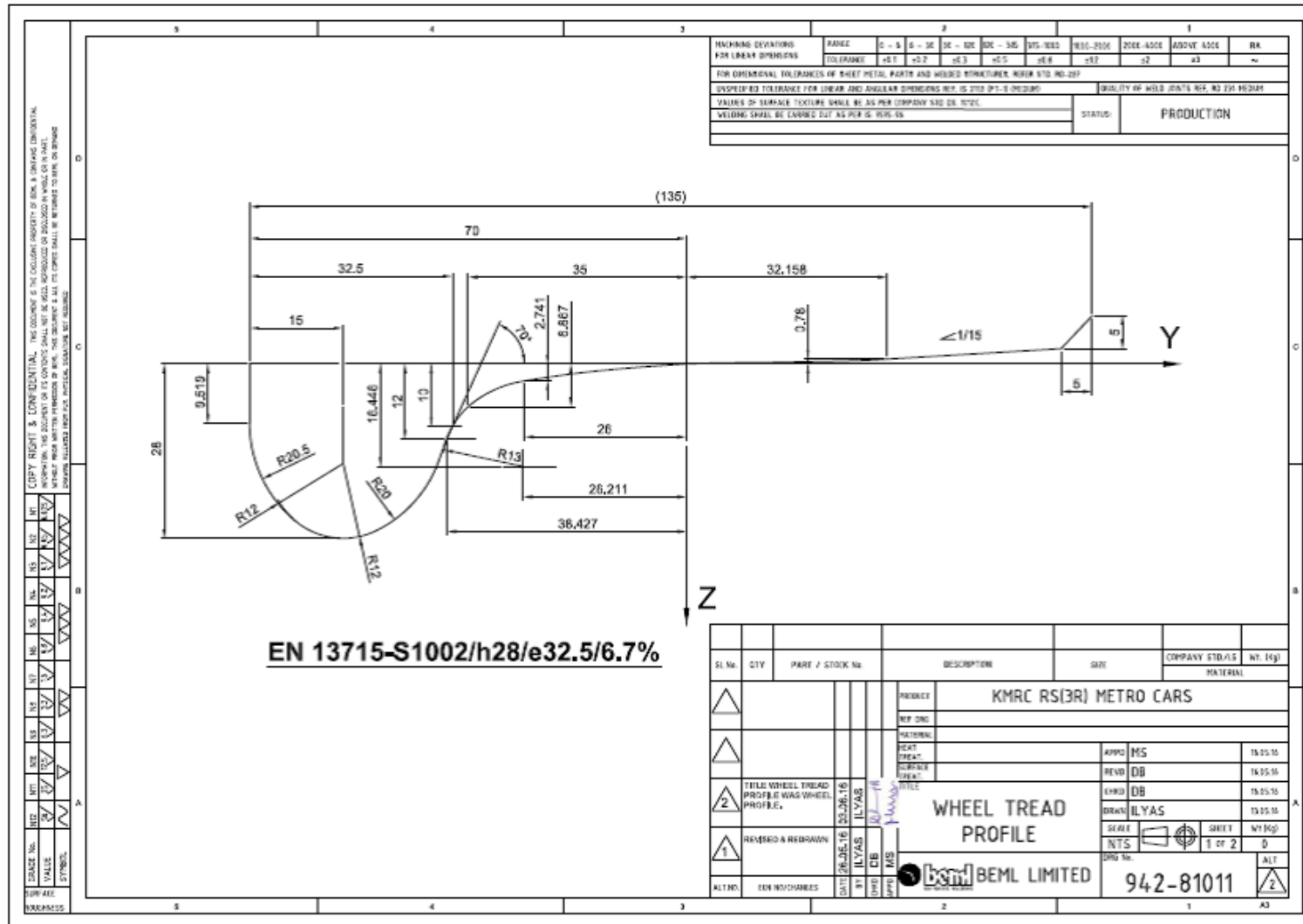
VIEW A-A (Interior View): This cross-section shows the internal layout of the car. Key features include:

- Passenger Saloon Door:** Located at the front and rear of the car.
- Passenger Seat:** Seats are arranged in rows along the sides of the car.
- Driver's Cab:** Located at the front of the car.
- Dimensions:** The overall length is 27000 mm. The width of the passenger area is 2700 mm. The height of the car is 2700 mm. The distance between the centerlines of the passenger doors is 1400 mm. The distance between the centerlines of the passenger seats is 1400 mm. The distance between the centerlines of the passenger seats and the centerline of the driver's cab is 1400 mm.

VIEW B (Exterior View): This side view shows the external dimensions and components of the car. Key features include:

- Saloon Vent Grille:** Located on the side of the car.
- Dimensions:** The overall length is 27000 mm. The width of the car is 2700 mm. The height of the car is 2700 mm. The distance between the centerlines of the passenger doors is 1400 mm. The distance between the centerlines of the passenger seats is 1400 mm. The distance between the centerlines of the passenger seats and the centerline of the driver's cab is 1400 mm.

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