

BHARAT HEAVY ELECTRICALS LIMITED

TIRUCHIRAPALLI-620 014

Ref: BHEL: NGA: SP: OT :19-20-10



Scope, Technical specification, Quality plan, Delivery schedule, packing procedure for prototype development and homologation of 7 m, low-floor, Air-Conditioned pure electric bus

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Scope of Supply:

The tender scope involves design, manufacture, assembly, testing and supply of two numbers of 7m, low floor (400 mm), Air Conditioned Electric bus as per BHEL specifications, providing support and ensuring successful completion of Homologation and obtaining type approval/homologation certificate for one prototype from Indian CMVR authorized agencies on BHEL's name. BHEL will identify the certifying agency. After completion of successful homologation of first prototype, second electric bus shall be manufactured by the vendor with same successful homologated design of first prototype.

Bidder shall comply the technical specifications of Electric Bus as mentioned in Annexure B and other requirements as enclosed in this tender. The fully built up 7 m E-bus prototype should conform to all the relevant specifications as prescribed under the Urban Bus specifications-II (UBS II), by MoUHA.

Sl.No	Bidder scope/ BHEL terms and conditions	Bidder response
1	Finalizing suitable design of the E-Bus with designated type of monocoque structural frame, traction motor, battery, and other essential fitments so as to address and satisfy all the tender conditions as detailed here in and additionally in Annexure B. Successful Bidder shall submit the detailed manufacturing and procurement plan within 10 days from the date of receipt of PO.	
2	Carrying out the needed design adequacy and stability tests with traction battery housing, motor supports, and auxiliary systems necessitated from the E-bus operation requirements and homologation testing need shall be suitably carried out using appropriate software tools and analysis. Successful Bidder shall provide the soft copy of 3D CAD models used for the above said analysis to BHEL within 30 days from the	

	date of receipt of PO. All the relevant design finalisation shall be approved by BHEL before their subsequent step.	
3.	Preparing the detailed technical specification of various aggregates/ components. Vendor shall submit the detailed technical specification of various aggregates/components to BHEL within 40 days from the date of receipt of PO.	
4	The finalised prototype design shall be approved by BHEL before any start of procurement/ Manufacture. Successful Bidder shall submit the soft copy of the CAD model of the Manufacturing drawings of chassis super structure (Super structure bottom, LH structure, RH structure, Rear structure, Roof structure etc.,) within 45 days from the date of receipt of PO. Also vendor should submit the CAD model of all the electrical wiring drawings within 60 days from the date of receipt of PO. Besides, vendor should submit the test certificates of homologated components such as motor, traction battery, etc., within 80 days from the date of receipt of PO.	
5	BHEL inspectors and/or third-party inspectors appointed by BHEL shall be involved in inspection/QC checks as deemed appropriate at following stages of manufacture, 1. Chassis bottom structure assembly 2. Chassis side structure assembly 3. Chassis rear structure assembly 4. Chassis Roof structure assembly 5. Paneling 6. Mechanical integration 7. Electrical integration 8. Body Building 9. Internal testing	

6	Body building, painting, fitment of seats and other internal fairings, incorporation of mandatory ITS systems and finishing the complete bus as per UBS-II and AIS code/standards and specific input conveyed by BHEL.	
7	The prototype bus need to be suitably packed/harnessed/restrained in a transit worthy manner and shipped to any one of the certifying agencies like ARAI-Pune, CIRT-Pune, ICAT-Manesar etc. Freight, incidental charges are to be borne by bidder.	
8	Providing the needed documentation and extending the required technical support and rectification to BHEL for obtaining homologation / type-test certificate in the name of BHEL from authorised agencies like ARAI-Pune, CIRT-Pune, ICAT-Manesar etc. Identification of testing agency for homologation will be carried out by BHEL. Successful Bidder shall furnish/make available all the documents /drawings, to BHEL which are required to be submitted to homologation agency within 105 days from the date of receipt of PO. BHEL will submit all the documents to certifying agency. The Cost of Technical Support and Coordination for Homologation Inclusive of two-way freight and incidental charges, payable to the bidder shall be mentioned separately while quoting. Successful Bidder shall deploy needed skilled manpower (at least two) continuously to complete homologation process at testing agencies. BHEL will carry out the application, payment etc. to the testing agency and the cost of homologation payable to the certification agency will be borne by BHEL.	
9	Upon successful passing and certification of prototype, the prototype bus shall be shipped to BHEL, Trichy by the Successful Bidder. Subsequently, second prototype shall be	

	manufactured by the Successful Bidder with same successful homologated design of first prototype and shall be shipped it to BHEL, Trichy.	
10	Undertaking to initiate/ carry out the needed permissions, paperwork and approvals with regard to RTO rules/processes on BHEL's behalf.	
11	Employees from BHEL, Trichy will participate and jointly work during various stages mentioned in SL.no 4, so as to gain knowledge on design, manufacture, testing, assembly and manufacturing during different stages of development of Electric bus prototype at bidder premises.	
12	Bidder shall get approved / vetted from BHEL the bus design and selection/finalization of make as well as ratings of the major aggregates before commencing their procurement/s for the purpose of carrying out the scope of this tender.	
13	Bidder shall share/part-with component level homologations/test certificates as well as bus-level type-test certificates along with pertinent documentation to BHEL, who may make use of them in their future endeavours.	
14	BHEL may manufacture any number of buses in any facility of BHEL's choice based on the homologation certification obtained for the 1 st prototype E Bus for its future commercial pursuit. Besides, as BHEL accepts to use bidder-chosen design configurations, styles and patterns as offered and recommended by the bidder, the bidder shall declare and undertake to indemnify and hold harmless BHEL from any inadvertent violations of Intellectual property rights, copyrights, registered designs etc., pertaining to the design of chassis, power train, aggregates etc. in relation to the E Bus,	

	manufactured and supplied by them during the commercial production by BHEL	
15	The bidder should be able to achieve and undertake to that effect a minimum percentage localisation content of greater than 40 % (In India on share of cost basis). Higher extent of localisation is preferable. At the start of manufacturing (after PO placement), bidder should specify the strategy and furnish needed supporting documents for the above declaration.	
16	Notwithstanding the above, the bidder shall necessarily procure/manufacture the following from indigenous sub-system manufacturer/s. 1. Li-ion Traction Battery pack with multiple modules along with BMS where the battery packing is carried out in India. 2. Monocoque Chassis fabrication 3. Front and Rear axle system 4. Brake system 5. Suspension system 6. Wheel rim, Tyre 7. Passenger seats and driver seat	

Quality Plan

Quality Plan

Inspection & Testing

1. The bidder shall comply with all the latest provisions of the Central Motor Vehicle Rules 1989 (CMVR), Motor Vehicle Act 1988 (MVA), relevant section of AIS, UBS-II and other standards and guidelines as applicable along with any and all amendments therein along with other statutory and legal requirements as applicable on the date of delivery/registration of Buses.
2. The bidder shall submit the Bidder Quality Plan (VQP). In case the bidder does not have a standard VQP format, VQP shall be furnished as per the "BHEL format". The same enclosed VQP will be subjected to BHEL/ customer approval after purchase order

SL.NO		COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	STANDARD QUALITY PLAN					PROJECT: PACKAGE: CONTRACT NO: CUSTOMER:								
						ITEM	QP NO: REV. NO: DATE: PAGE:	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS					
											M	C	B						
						QUANTUM OF CHECK													
						M	C/B												
1	2		3	4	5	6		7	8	9	D	10		11					
1	Battery																		
2	Motor																		
3	Controller																		
4	Monocoque structure																		
5	Steering system																		
6	Suspension system																		
7	Axles and Brakes																		
8	Tyres																		
9	Glasses/Wind shield																		
10	Air conditioning system																		
11	Lighting (headlamps, etc)																		
12	Seats																		
13	Safety																		
14	Cooling system for motor, controller, Battery																		
15	Battery Management System																		
16	Intelligent Transport Systems (ITS)																		
17	CCTV camera																		
18	Welding process adopted as applicable																		
19	Stretch Paneling																		
20	Mechanical Integration																		
21	Electrical Integration																		
22	Body Building																		
23	Painting																		
24	Leak Test																		
25	Additional Items/Processes shall be indicated																		

MANUFACTURER/SUB-SUPPLIER SIGNATURE		LEGEND: *RECORDS IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.		DOC. NO.:	
				REVIEWED BY	APPROVED BY
				APPROVAL SEAL	

3. Material Inspection – Quality of Material

- a) The materials to be used in manufacturing of prototype bus shall conform to the specified Bureau of Indian Standards (BIS)/ Automotive Industry Standards (AIS) surpassing the performance & other requirements as given in the Bus Code AIS 052. Wherever Indian standards are not available, internationally acceptable standards may be referred/indicated such as ECE, JIS, DIN, ASTM, ISO etc. for quality assurance of material. Indian and International standards wherever indicated in Technical Specification shall be conforming to the Standards as amended up to date/ or latest. Wherever the standards of any item have not been notified as International/ National Standard etc. the bidder shall provide actual specifications of that item along with the drawings of the items indicating all relevant details. In this case the bidder shall also submit the certificate for non- availability of International/National standard etc.
- b) BHEL at its discretion, if needed may depute third party (“Inspection Officer”) for inspecting Bus Body Building, related works and compliance to the specification.
- c) Bidder shall obtain type approval of all safety critical items/ materials from the authorized testing agencies before use. The Bidder shall be required to provide a list of such items along with their component level certificates to BHEL as well as to the certifying authority, if demanded during the course of the tender.
- d) If outsourcing the body building operation, the bidder shall only employ “a CMVR certified” Body Builder to fulfil the requirement and specification.

4. Alteration, Addition/ Deletion, Deviation, Defects/ Deficiencies

4.1 The bidder shall manufacture the Bus strictly in accordance with the technical specifications approved by BHEL. The bidder shall not allow any alteration, addition/ deletion, and deviation or leave any defect/deficiency in the manufacturing of the prototype bus. In case, any defects/ deficiencies/discrepancies are brought to the notice of the bidder during inspection at various stages, the same shall be immediately removed in the prototype bus under manufacturing without any cost implication before the final clearance.

4.2 BHEL shall issue Pre-Dispatch Inspection Certificate within seven days of satisfactory inspection of both Fully Built prototype bus and second bus. The bidder shall dispatch the

manufactured buses only after rectifying the defects/ deficiencies observed during Pre-Dispatch Inspection.

5. The bidder shall offer electric bus prototype for preliminary inspection at their works in every stage of prototype assembly.

The above inspections shall be carried out by inspectors of both BHEL and BHEL deputed third party, either together or separately at appropriate stages.

6. Bidder shall make available needed CAD details and loading data for enabling BHEL to carry out and ensure FEA/CAE analyses at their end at appropriate stages.

7. The bus shall be painted inside and outside with polyurethane paint and the colour scheme for the painting shall be as per BHEL requirement. This will be informed at suitable stage during manufacture. The bus shall be fitted with BHEL logo and monogram of suitable size and finish at the front as well as at other location/s as chosen by BHEL.

8. The prototype buses shall be delivered as per delivery Schedule (Appended in **Annexure F**) at BHEL Trichy.

9. Bidder shall clearly indicate the maximum charging rate (1C, 2C) and compatibility of the battery with 50 kW, 120 kW fast DC chargers. The on-board charging interface should have suitable interfaces shall be compatible to CCS combo 2 protocols. The Battery shall be suitable to be charged by conductive Off-Board DC Chargers, working on CCS Combo-2 protocol.

10. List of items to be supplied along with prototype Bus is given in below Table.

Sl.no	List of items to be supplied by bidder	Bidder response
a	One Spare Wheel of Tyre & Rim. This should be suitably fixed either under frame or at rooftop	
b	First aid kit as per the provisions of CMVR. This shall be fitted near driver seat at appropriate position and level with proper reinforcement	
c	Tool kit as per CMVR/other applicable rules	
d	Battery operated beacon flash light	
e	fluorescent warning triangles	
f	One set of Hydraulic jack	
g	Tyre change tools and tackles	
h	Part catalogue	

i	Service manual	
j	One Diagnostic Tool i.e. Handy Scanner or Software with Interface, if any for maintenance of Electric Bus	
k	List of Wall charts, Parts catalogue, Drawings, Seat Layout, etc.,	
l	One set of coloured wall charts of main aggregates, lubricating chart and specifications of oils/greases to be used	
m	The final version of soft copy of CAD drawing (2D/3D solid models) of chassis frame of Electric Bus showing the locations of major assemblies including electric power-train, battery power pack, ground clearance, wheel base, height and length of chassis, front and rear track width.	
n	Final version of the soft copy of the drawing of bus body showing exploded view of all body parts such as body panels, windows, seats, show grill, etc., as well as body structure of all sides including under frame & roof shall be submitted. These all drawings related of bus body shall be submitted in sets	
o	Final version of the electric wiring drawing for the prototype bus	
p	Final version of the soft copy of general schematic drawings, bus layout, front/rear and both side views of the offered designs of the prototype bus	

11. The bidder shall submit all the documents required for registration of the prototype buses at BHEL. The documents shall be submitted along with the bus. The list of the documents can be confirmed from RTO. The bidder shall assure all needed assistance while registration of bus. Bidder shall also make alterations/modifications, if any, suggested by the RTO Authority/Other Agencies during the registration process.

12. Bidder shall submit copy of all test certificates / documents as indicated in the approved VQP along with the prototype electric bus.

13. Bidder shall furnish information on maintenance practices to be followed for the prototype bus clearly spelling out the following:

- (i) Maintenance standards including clearances, settings, tolerances as applicable and permissible limits of wear for good riding comfort, performance and operation.
- (ii) Inspection procedure & periodicity of various preventive schedules in detail including gauging practices.
- (iii) Operation procedures in detail including preventive maintenance schedules
- (iv) Facilities required for maintenance, giving detailed information on the following:
 - a. Handling equipment, Plant & Machinery, Gauges, Jigs and Fixtures and Tools required during maintenance including the Space requirements for maintenance facilities.

14. Mandatory & Recommended Spares:

14.1 List of mandatory spares to be carried at all times and recommended set of spares for a typical specified period (say 2 years) shall be provided along with indicative price as part of the quote.

14.2 Detailed Maintenance & Service Manuals, Spare Parts Catalogues, Price List etc. shall be specially prepared for prototype bus. This shall also include spare parts catalogues pertaining to all components/sub-systems purchased.

14.3 Bidder shall also furnish printed price list (valid for the warranty period) giving cost of all components/ assemblies of the Bus for applicable spares parts/ aggregates/ consumables etc., along with applicable discount and applicable PVS terms. The rates of spare parts shall be valid for the warranty period extended.

14.4 The Manufacturer/ Supplier shall arrange to provide training to minimum 1 driver and 1 technical maintenance staff. This shall include training on the usage and troubleshoot of the ITS-Intelligent Transport System fitments also.

15. Packing procedure

Bidder should comply the packing procedure as given below

Packing Procedure	Bidder response
The completely built up prototype bus shall be suitably packed and transported to testing agency for homologation. After successful homologation, the prototype bus shall be transported on road to the BHEL. The completely built up second e-bus shall also be transported on road to the BHEL. Adequate and suitable packing/covering to ensure dust proof, water proof transit is to be employed. Suitable restraint, harness, slinging to be employed to ensure the buses withstand the ground forces/jolt/vibration of road transit. The transit procedure and transit packing shall be inspected and approved by BHEL as needed.	

Annexure B: Electric Bus Technical Specifications

Electric Bus Technical Specifications- Annexure- B			
Sl.No	Description	Specifications – 7 m Electric bus	Bidder response
1	Bus Characteristics	Monocoque, low floor Air conditioned city bus. Regenerative braking facility should be made available	
2	Bus Floor Height mm	400 mm. Bus should be Divyangjyan friendly.	
3	Propulsion System	Pure Electric, Battery operated	
4.1	Power Plant	Electric motor. The motor shall be PMSM motor.	
a	Rated performance at GVW in a stop / start urban operations	Geared maximum speed without speed limiter to be greater than 40 kmph but not to exceed 75 kmph	
b	Acceleration (meter/sec ²)	≥ 0.8	
c	Attain bus speed of 0-30 kmph in seconds	≤ 10.5	
d	Maximum speed	Geared maximum speed without speed limiter to be greater than 40 kmph but not to exceed 75 kmph	
e	Grade ability from stop at GVW	17%	
f	Range	Not less than 203 km	
g	GVW should not exceed, kg	10000	
h	Transmission	Automatic with torque convertor. Neutral during stops.	
4.2	Electrical Power Plant management	Motor coolant temperature, motor speed in RPM, vehicle speed, Motor load(torque),diagnostic message (Motor specific)	
a	Motor Type	PMSM (Permanent Magnet Synchronous Motor)	
b	Minimum Motor Rated Power, kW	80	

c	Minimum Motor Peak power, kW	160	
d	Motor Max RPM	3250	
e	Minimum Rated Torque, Nm	650	
f	Minimum Peak Torque, Nm	1700	
4.3	Motor/ Battery Power pack operational requirements	Motor/ Battery Power pack should be able to operate efficiently at ambient temperatures of approximately 0°to 50°C, humidity level from 5% to 100%, and altitude levels of up to 2000 meters, generally operating in the semi-arid zone / hilly region prevailing in the area.	
4.4	Battery Power pack location	Optional	
	Battery capacity	200 kWh	
	Battery Type	Advanced LI-ion	
	Battery Pack Protection Level	IP67	
	Battery Cooling System	Liquid / air Bidder has to quote separately to the following variants a. Electric bus with liquid cooling b. Electric bus with air cooling Note: Finalization of above variant will be decided by BHEL team during technical evaluation	
	BMS communication with Charger	CCS combo 2.0	
4.5	Operational safety	Power train to be fitted with (a) mechanism which makes it possible to engage reverse gear only when vehicle is stationary (b) Suitable interlocks to be provided so that Bus is not able to start when any of the passenger service doors are OPEN. Similarly operation of Service doors shall not be possible when the Bus is in motion)	
5.1	Rear axle	Single reduction, hypoid gears, full floating axle shafts with optimal gear ratios suitable for urban operations	

5.2	Front axle	Heavy duty reverse Elliot type axle suitable for various floor heights	
6	Steering system	Hydraulic Power steering	
7	Suspension system (Front and Rear)	Air-suspension or Superior	
7.1	Anti-roll bars / stabilizers	Both front and rear	
7.2	Shock absorbers	Hydraulic double acting 2 at front & 2 / 4 at rear	
7.3	Kneeling Mechanism	Yes	
7.4	Kneeling applicable in case of air suspension (required only for 400 mm floor height buses)	60 mm entry / exit side severally & collectively	
7.5	Controls (optional)	Mechanical or Electronically controlled air suspension system	
8	Braking System	Dual circuit full air brakes, with disc type arrangement for front and drum at rear brakes. Graduated hand controlled, spring actuated parking brakes acting on rear wheels	
8.1	Anti-skid anti brake locking system (ABS)	As per CMVR	
8.2	Regenerative braking system	Yes	
8.3	Electronic controls	Yes	
9	Electrical System	24 Volt DC	
9.1	Batteries for auxiliary power requirement	Low maintenance type Lead acid batteries for 24 V system-performance as per BIS: 14257-1995 (latest). 2*12V of commensurate capacity. Maintenance free batteries preferred.	
9.2	Electrical wiring & controls - type	As specified separately under ITS specifications	
10	Speed limiting device	Electronic type duly approved / certified as per AIS-018/2001 or latest, tamper proof and be adjusted to applicable speed limit	
11	Tyre	Steel radial tube-less, size and performance as per CMVR	
12	Fire suppression System	Suitable fire suppression system as applicable	

13	Bus Characteristics		
13.1	Bus dimensions (mm)		
a	Overall Length, mm	7000	
b	Overall Width, Mm	≤2500	
c	Overall Height, mm (unladen-at extreme point)	3800 (maximum)	
d	Wheel Base	≥ 3200	
e	Front and Rear Overhang	As per CMVR	
13.2	Minimum Turning Circle Radius (mm)	As per CMVR	
13.3	Clearances		
a	Min. axle clearance (mm)	175	
b	Wheel area clearance (mm)	> 220 mm for parts fixed to bus body & > 170 mm for the parts moving vertically with axle	
c	Minimum ground clearance (un-kneeled) in mm at GVW	Within the wheelbase not less than 240	
13.4	Angles (degrees)		
a	Angle of approach (unladen)	Not less than 8.0°	
b	Angle of departure (unladen)	Not less than 8.5°	
c	Ramp over angle (half of break-over angle)	Minimum 4.8°	
14	Number of seats including one for wheel chair	16-22 seats.	
15	Bus Gates/Doors		
15.1	Type of doors		
a	Operating mechanism	Electrically/Electro pneumatically controlled	
b	Maximum Opening / Closing time in seconds per operation	4	
c	Positions of door controls	As per AIS 052	
d	Passenger safety system - allowing bus motion on doors closing and doors opening only when the bus is stopped	Mandatory	
15.2	Front service doors – near side	Yes	
a	Door aperture (without flaps) in mm	As per AIS 052	
b	Clear door width (fully opened) in mm	As per AIS 052	
c	Door height in mm	As per AIS 052	

d	Positioning front service gate	As per AIS 052	
e	Number of gates minimum	1	
15.3	Rear service doors (near side)	where provided Optional and at the discretion of purchaser	
a	Door aperture (without flaps) in mm	As per AIS 052	
b	Clear door width (fully opened) in mm	As per AIS 052	
c	Door height in mm	As per AIS 052	
d	Positioning rear door with respect to centre line of rear axle	Preferably rear edge of gate 1500 mm ahead of centre line of rear axle or front edge of gate 1500 mm behind center line or rear axle.	
e	Number of gates minimum	1	
15.4	Maximum first step height (mm) from ground - unladen & un-kneeled position in buses with		
a	Stepped type entry, mm	400	
15.5	Maximum height (mm) of other steps		
a	if door ahead of rear axle, mm	250	
b	if door behind rear axle, mm	300	
15.6	Ramp for wheel chair at the gates	Sunken type wrap over (manually operated) ramp, for wheel chair of PWDs, fitted on floor at gate in front of PWD seat anchorage. Suitable design mechanism for 650mm floor height considering the safety and convenience for wheelchair bound Person with Disabilities at the time of boarding and deboarding.	
a	Dimensions	As applicable for Ramp for wheel chair at the gates	
b	Material		
c	Load carrying capacity (in kilograms)		
d	Device to prevent the wheel chair roll off the sides when the length exceeds 1200 mm		

e	Device to lock wrapped up ramp		
f	Kneel ramp control: (applicable in reference of clause 7.3)	Kneeling arrangement for kneeling on left side severally and combined. Kneeling up to 60 mm.	
g	Requirement for passenger with limited mobility	Yes	
i)	Wheel chair anchoring - minimum for one wheel chair	Yes	
ii)	Priority seats - minimum 2 seats	Yes	
iii)	Stop request	On every pillar	
h	Emergency doors / exits or apertures (numbers)	As per AIS 052	
	Dimensions in mm	As per AIS 052	
i	Door closing requirements for bus movement	Bus could move only after door closing completed	
	Power operated service door - construction & control system of a power operated service door to be such that a Passenger is unlikely to be injured/trapped between the doors while closing.	As per AIS 052	
	ii	Door components	As per AIS 052
	iii	Door locks / locking systems / door retention items	As per AIS 052
	iv	Door hinges	As per AIS 052
16	Bus body		
16.1	Design type approval	As per Annexure-3 of UBS-II	
16.2	Bus structure - materials specifications etc	Material to be decided by the manufacturer OR as per the tender specifications issues by purchaser. Other requirements as per bus body code. Material should fulfil strength etc. requirements indicated under Annexure-3 of UBS-II	
16.3	Insulation		
a	Roof structure/body	Material to be decided by the manufacturer OR as per the tender specifications issues by purchaser. Other requirements as per bus body code. Material should fulfil strength etc.	

		requirements indicated under Annexure-3 of UBS-II	
16.4	Aluminium extruded sections for:		
a	Rub rail	Aluminium extrusion IS 733/1983 or better	
b	Decorative moulding		
c	Wire cover		
d	Wearing strip		
e	Foot step edging		
f	Panel beading		
g	Window frame		
h	Roof grab rail brackets		
16.5	Floor type / materials etc.		
a	Type of floor	Flat except at wheel arches in the low floor area of bus-seats may be located over the wheel arches.	
b	Steps on floor	No steps except those necessary on near side gates or in rear side for rear engine buses	
c	Floor surface material	12 mm thickness phenolic resin bonded densified laminated compressed wooden floor board (both side plain surface) having density of 1.2 gms/cc conforming to IS 3513 (Part-3): type VI 1989 or latest. The flooring should also be boiling water resistant as for marine board BIS:710-1976 / latest and fire retardant as per BIS:5509- 2000 (IS15061:2002)	
d	Anti-skid material	3 mm thick anti-skid type silicon grains ISO 877/76 for colour, IS5509 for fire retardancy.	
16.6	Safety glasses and fittings		
a	Front windscreen (laminated) glass	Single piece laminated safety glass, plain, flat / curved with curved corners with PVB film IS 2553 (Part-2)-1992/latest. Standard designs for each variant of buses to be followed. (Refer Annexure-1 of UBS-II)	

	Size	Standard designs for each variant of buses to be followed. (Refer Annexure-1 of UBS-II)	
b	Rear windscreen: (wherever provided)	Single piece flat / curved toughened glass-plain / flat / curved at centre & curved at corners IS 2553 (Part-2)-1992/latest.	
	Size	Standard designs for each variant of buses to be followed. (Refer Annexure-1 of UBS-II)	
c	Side windows	Flat, 2-piece design-top fixed / sliding & bottom sliding toughened glass IS 2553 (Part-2)-1992/latest.	
d	Glass specifications	Toughened glass IS 2553 (Part-2)-1992/latest	
	Glass thickness	Minimum 4.0 mm	
e	Window & other glasses - material specifications, thickness etc.	Toughened as per IS 2553 (Part-2)-1992/latest of 4.8-5.3 mm thickness	
f	Safety glass	As per AIS 052 / CMVR	
g	Rear view mirrors	As per AIS 052	
16.7	Seating and gangway etc.		
16.7.1	Passenger seating's for ordinary type-1 buses	As per AIS 052	
a	Seat layout in the low floor area	As per AIS 052	
b	Seat layout in the higher floor area	As per AIS 052	
c	Seat area/seat space per passenger (width*depth) mm	400*350	
d	Seat pitch - minimum in mm	As per AIS 052	
e	Minimum backrest height- from floor to top of seat/headrest	As per AIS 052	
	Seat base height-distance from floor to horizontal front upper surface of seat cushion mm	As per AIS 052	
	Seat back rest height (mm)	375	
f	Torso angle (degrees)	Minimum 12°	
g	Seat materials	'PPLD/LDPE' moulded AIS 023 & bus code for performance	
h	Seat frame structure material where required	Frame structure of ERW steel tube	

i	Free height over seating position in (mm)	More than 800	
	Seat base height	As per AIS 052	
j	Clearance space for seated Passenger facing partition (mm)	As per AIS 052	
k	Seat back / Pad material / Thickness	Polyurethane foam IS15061:2002 30+5 mm(padding is optional)	
	Type	MDI moulded IS 5509	
	Upholstery	Pile Fabric /Jekard 0.7-1.0mm thickness	
l	Area for seated passengers (sq. mm.)	400*350 (Minimum)	
m	Area for standee passengers (sq. mm.)	As per AIS 052	
n	Number of seats including one for wheel chair	16-22	
o	Number of standees	As per AIS-052.However,standees should be discouraged.	
p	Seat back rest	Fixed	
q	Seat belts & their anchorage	Not Necessary except driver seat & wheel chair (performance etc. as per AIS 052)	
r	Performance & strength requirements of		
i	Driver seat	As per AIS 023	
ii	Passenger seats	As per AIS 023	
16.7.2	Gangway		
a	Minimum interior head room (centre line of gangway) in mm	1900 mm including that in the rear overhang area.	
i	At front axle	As per AIS 052	
ii	At rear axle	As per AIS 052	
iii	Other areas	As per AIS 052	
b	Gangway width (mm) from gates to longitudinal space between rows of seats (access to service doors)	(Refer figure-1 of UBS-II) minimum 600 mm excluding armrests (armrests are not required) and including stanchions - will be measured from seat edge to seat edge.	
c	Gangway width (mm) in longitudinal space between rows of seats	As above	

d	Gangway width (mm) in longitudinal space between rows of seats (rear of rear edge of the rear door in Rear Engine bus)	As above	
e	Driver's working space	As per AIS 052	
f	Driver's seat	As per AIS 052 and AIS 023	
16.8	Corrosion prevention & painting	As per clause 3.17 of AIS 052	
a	Corrosion prevention treatment Internal surfaces of structural members External surfaces of structural members After drilling holes/welding Inter metallic galvanic corrosion prevention Primer coating Painting	As per clause 3.17 of AIS 052	
17	Electrical	As per clause 3.17 of AIS 052 BIS marked, copper conductors with fire retardant as per IS/ISO:6722:2006 as per appropriate class. Conductor x-sec varying as per circuit requirements, min cross-section 0.5 sqm. Quality marking may also be as per equivalent or better European, Japanese, US standards	
17.1	Electrical cables	BIS marked, copper conductors with fire retardant as per IS/ISO:6722:2006 as per appropriate class. Conductor x-sec varying as per circuit requirements, min cross-section 0.5 sqm. Quality marking may also be as per equivalent or better European, Japanese, US standards	
17.2	Conductor cross section	As above and suitable to carry rated current(Japanese Auto Standards JASO D0609-75 AV)	
17.3	Safety requirements of electrical	As per AIS 052	

a	Fuse	As per AIS 052-Fuse operated current 1.5 times the load current of electrical equipment. Necessary in every electrical circuit.	
b	Isolation switches for electrical circuits where RMS value of voltage exceeds 100 volts	As per AIS-052- Isolation switch required for each such circuit	
c	Location of cables away from heat sources	As per AIS 052-Required for each such circuit.	
d	Type approval of circuit diagram as per standards related to electric equipment / wiring	As per AIS 052 –Required for all items.	
e	Cable insulation with respect to heat	As per AIS 052	
f	Battery cut - off switch (isolator switch)	Heavy-duty type capable of carrying & interrupting total circuit load. 1 each near battery/driver	
17.4	Wind screen wiper	Electrically operated with two wiper arms & blades, wiper motor heavy duty steel body with minimum 2-Speed operation wiping system as per CMVR / BIS: 7827 part-1, 2, 3 (Sec.1 & 2) / latest. As per AIS 011	
a	Wiper motor	Variable speed with time delay relay as per AIS-011	
b	Wiper arm / blade	As per AIS-019/AIS-011	
17.5	Driver cabin fan	1 number , 200 mm fan as per provision of CMVR, matching interiors	
17.6	Lighting - internal & external and illumination	As per AIS 052	
17.7	Illumination requirements / performance of		
a	Dash board tell-tale lighting / control lighting	As per AIS 052 and bulbs tested for photometry as per IS1606:1996	
b	Cabin lighting - luminous flux of all lamps for cabin lightning	As per AIS 052 with illumination level of ≥ 100 lux and ≤ 200 lux	

c	Passenger area lighting - luminous flux of all lamps for Passenger area lighting	As per AIS 052 with illumination level of ≥ 100 lux & ≤ 150 lux	
18	ITS enabled bus	Yes	
19	Safety related items		
19.1	Driver seat belt & anchorage duly type approved	ELR recoil type 3 point mounting as per CMVR & AIS 052 conforming to AIS 005 & 015	
19.2	Driver / Passenger / Wheelchair seat belt anchorage	Needed for diver seat & wheel chair (performance etc. as per AIS 052)	
19.3	Fire extinguisher	As per AIS 052	
19.4	First aid box	1 number, as per provision of CMVR	
19.5	Handrails minimum length*, diameter* height above floor in mm	Colour contrasting and slip resistant of aluminium tubing. 32 mm dia, 3 mm thick, rest as per AIS 052	
19.6	Handholds	Colour contrasting and slip resistant. 2 to 4 numbers. Handholds as per bay.	
19.7	Stanchions	Vertically fitted, aluminium tubing with colour contrasting and slip resistant. 40 mm dia & 3.15 mm thick. Rest As per AIS 052. As an alternative to stanchions mounted on bus floor, stanchions mounted on top of seat frames (new version seats) be explored (refer figure-2 as in UBS-II specifications)	
19.8	Bells for Passenger convenience	High visibility bell pushes shall be fitted at a height of 1.2 meter on all alternate stanchions. These would assist PwDs	
19.9	Window guardrails	Not applicable for AC buses	
19.1	Entrance / Exit Guard / Step well guard	800 mm minimum height extending ≥ 100 mm more than centre line of sitting position of the Passenger	
19.11	Emergency exit doors, warning devices etc	As per AIS 052/CMVR.	
19.12	Front/rear door, stepwell lights, door open sign	LED as per AIS 008	

19.13	Mirrors right / left side exterior / interior	Convex as per AIS 001 & 002. Interior with double curvature	
19.14	Towing device front / rear	Heavy duty 1.2 times (minimum) the kerb weight of the bus with 300 of the longitudinal axis of the bus. As per CMVR & IS 9760 - ring type	
19.15	Warning triangle	As per AIS 052/CMVR	
19.16	Fog lighting	As per AIS 052/CMVR	
19.17	Bumpers - front and rear	Both made of steel or impact resistant polymer or combination of both meeting requirement of any energy absorbing system.	
	Impact strength for bumpers	Meet requirements of Para 6.3.1 of AIS-052	
20	Windows		
a	Minimum height of window aperture (clear vision) in mm	≥ 950 mm	
b	Minimum height of upper edge of window aperture from bus floor	As per AIS 052	
c	Minimum width of windows (clear vision zone)	As per AIS 052	
21	Cabin luggage carrier	As per AIS 052	
22	Life cycle requirements of bus	12 years or 10,00,000 kms(whichever is earlier)	
23	Air conditioning system - test procedure for type approval		
23.1	Specifications	a) For upto 42°C of saloon temperature b) >42°C of saloon temperature	
23.2	Target results	a) 24+ -4°C(upto 42°C) b) Temperature gradient of 15°C(>42°C of saloon temperature) eg. If the saloon temperature is 45°C then the target temperature inside the bus will be 45-15=30°C c) Minimum average air velocity at air vent is 4.5 m/sec	
23.3	Apparatus	Lab condition and heating chamber:	

23.4	Procedure	1. Soak for 1 hour 2. At 2000 rpm 3. Upto 42°C: pull down time 30 minutes (maximum)(for more than 42°C of saloon temperature, pull down time within 40 minutes (maximum) 4. Thermocouple to be placed over place minimum 20 numbers. at nose level	
23.5	Air curtains on entry / exit gates to avoid loss / gain of heat and or cool air when doors are frequently opened for boarding / alighting of Passenger with min air flow of 1000 ± 50 m ³ /hr at each gate. Type of air curtains at entry exit gates their power consumption etc be accounted for while deciding engine power, etc	Required	
23.6	AC requirements	Automatic electronic temperature control management shall be provided for the AC system. In case of AC failure, proper air ventilation shall be provided on both sides of the bus.	
24	Air circulations and ventilation in driver's area	An air passage / duct / roof hatch to be provided in driver area at a suitable location for proper inflow of air inside the driver cab. Drivers work area to be provided with blower or suitable device (200 mm diameter fan) to ensure proper ventilation. These devices may be capable of 3 – speed adjustment;	
25	Maximum noise levels inside the saloon (irrespective of AC, Non-AC / fuel type / engine location)-test	84 dbA	

	procedure as per AIS 020)		
26	CCTV cameras	3 Nos IP Based.(1 covering the driver area and smart card validators,2 covering the saloon area). The system should be able to record and store data and live telecast the output on a screen inside vehicle and to OCC	
27	Charging Point	All buses should have atleast one point for charging which can be used for charging ticket vending machine etc.	
Guarantee / warranty:			
28	Guarantee/Warranty	Entire bus should be carrying a full replacement warranty covering performance failures during the first year or 1.0 Lakh kilometres, whichever is earlier. For traction batteries this shall be first 5 years of 5,00,000 kms.	
29	Other requirements		
29.1	Full body building including passenger cabin A/c, CMVR compliant doors, windshields, seating arrangement, easy access features to help the differently abled, ITS features, infotainment, GPS, cashless ticketing.		
29.2	All safety-critical sub-systems/ parts/ equipment shall be CMVR compliant and duly certified at "component level" by one of the authorized CMVR certifying agencies.		
29.3	All user-comfort-specific, safety-specific features like CC Camera, 2-way microphone/speaker for driver, emergency STOP button in passenger area, adequate number of Emergency doors/windows etc., Other CMVR compliant on-board Driver information & communication systems		
29.4	All mechanical drive train aggregates (axles, drive shaft, steering, suspensions, wheels, brakes, tires etc) duly assembled, fitted and tested for functional performance		

Annexure F

Delivery Schedule for two numbers of 7 m, 400 mm Floor height, Air-conditioned Electric bus

Sl.No.	Activity to be completed	Time (months)*	Bidder response
1	E-bus prototype made ready for homologation/type-test certification	4 months from PO date	
2	Obtaining homologation / type-test certificate in the name of BHEL from CMVR certifying agencies like ARAI / CIRT/ICAT.	3 months from submission of prototype to certifying agency	
3	Shipping of the certified prototype bus to BHEL Trichy after successful homologation and certification	1 month from date of receipt from certifying agency	
4	Manufacturing and completion of second prototype based on successful homologation of first prototype 7m e-bus	2 months after the receipt of first prototype successful homologation certificate from testing agencies.	
5	Shipping of the second bus to BHEL Trichy	15 days from the date of completion of second e-bus.	

*Bidders are encouraged to try and deliver earlier than their indicated delivery periods, so as to enable an earlier contract completion.

Annexure J

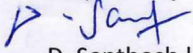
Pre-Qualifying Requirement

The bidder shall compulsorily meet the following mandatory criteria to get qualified.

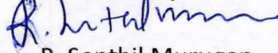
PQR Criteria	Bidder response
1. Bidder: The bidder shall be an Indian legal entity and meet the following mandatory criteria	
a. Financial Capability: The average Annual Turnover of the Bidder should be at least 300 Lakhs in last 3 years. Separate Chartered Accountant's certificate shall be attached along with the Bid.	
b. Bus Certification: The bidder, should have obtained necessary homologation certification for CMVR compliance for atleast 2 buses (any type of buses such as e-bus, Diesel driven buses, CNG buses, etc.,) from the designated approving authority (ies) such as Automotive Research Association of India (ARAI) or International Centre for Automotive Technology (ICAT) or equivalent approving authority(ies) in the last 5 years. Required documentary proof shall be submitted.	
c. Certified manufacturing facility: The bidder should have a certified manufacturing facility in India (certified / accredited by CMVR authorised agencies) for manufacturing buses (any type of buses such as e-bus, Diesel driven buses, CNG buses, etc.,). Required documentary proof shall be submitted.	
d. Localisation: The bidder should be able to achieve and undertake to that effect a minimum percentage localisation content of greater than 40 % (In India on share of cost basis). Higher extent of localisation is preferable. At the start of manufacturing (after PO placement), bidder should specify the strategy and furnish needed supporting documents for the above declaration. Notwithstanding the above, the bidder shall necessarily procure/manufacture the following from indigenous sub-system manufacturer/s. • Li-ion Traction Battery pack with multiple modules along with BMS where the battery packing is carried out in India. • Monocoque Chassis fabrication	
e. Homologation: The bidder shall develop prototype, coordinate and technically support BHEL for Homologation and ensure successful completion of Homologation and obtaining type approval/homologation certificate in BHEL's name.	
f. Commissioning & After Sale Support The bidder shall provide Commissioning support and after sales support.	

The above pre-qualification requirements are mandatory for technical offer evaluation. Pre-Qualification requirement shall be furnished by the bidder during offer submission.

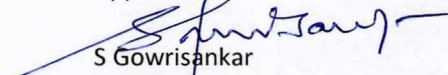
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