

**Diesel fuelled, 11 metre long, standard floor (900 mm floor height),
BS-VI compatible, non-AC, fully built Type I NDX bus - Specification**

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deluxe (Type I NDX) bus– Specification**

Tamil Nadu State Transport Corporation (TNSTC)

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PART I – GENERAL REQUIREMENT

Specifications for Non-AC diesel fuelled, BS VI compliant, Standard Floor (900 mm floor height), 11 metre long Fully built Type I Non Deluxe Buses.

1. INTRODUCTION AND SCOPE:

End-use requirement-oriented specifications, with maximum make / model neutrality, for fully built diesel fuelled Internal Combustion Engine (ICE) propelled Bharat Stage VI (BS VI) compliant non-air-conditioned (non-AC) 900 mm floor height 11-metre-long buses for Public Transport (PT) System in urban areas of TNSCTC are brought out here. Non-AC 11-metre-long type I NDX buses are proposed to be deployed for intra-city PT services. Bus Manufacturer would furnish technical details for assemblies / sub-assemblies/ systems/ equipment as per Technical Specification of this Section in appropriate formats.

The specifications cover end-use-based design, evaluation, fabrication & testing features of diesel fuelled non-AC 11-metre-long buses for PT operations for transportation of passengers mainly in TNSCTC urban areas. The bus design should be modern, energy efficient, environment friendly, safe, efficient and reliable besides meeting all statutory, regulatory, legal and other requirements, as also those related to easy passenger accessibility including for Persons with Disabilities (PwDs), passenger comfort, driver's workplace, internal and external aesthetics, ease of repair and maintenance etc.

Specifications would comply with all applicable Central, State and local laws (including Acts, Rules & Regulations). These would include, but not be limited to, the provisions of Disability Act 1995 as amended till date as well as state and local accessibility, safety, emission and other requirements. The bus would meet or exceed the Central Motor Vehicles Rules (CMVR) of India / Safety Norms, Emission, Noise & other norms applicable at the time of supply. In the event of any conflict between requirements emanating from this specification and those as per any statutory/legal, etc. in force, the superior/ higher requirements/Standards would prevail.

The word "Bus" or "Buses" wherever used in the specification means the "11000 \pm 200 mm long diesel fuelled BS VI compliant non-air-conditioned 11-metre-long standard floor bus of 900 mm \pm 10 mm floor height" as per specifications given in this document. The urban buses would have right hand drive.

For PT operations in urban areas of TNSCTC, a fully built bus as per specs detailed in this document and those of AIS 052 / AIS 153/ UBS II / CMVR / TNMVR, BIS Standards, etc. is envisaged.

The specifications / standards / norms / regulations etc. mentioned in this document are generally as prevalent in India. However, any other national / international specifications / standards / norms / regulations, equivalent and or better than those indicated in this document, would meet the requirement. The proof of ensuring equivalence etc. in all cases shall be enclosed with the bidding document by the agency referring to them.

The vehicle manufacturer shall ensure to meet the requirements as given in Bus body Code and CMVR (bus body code AIS052, AIS153 and others as applicable for fully built bus) and also comply with "Harmonised Guidelines and Space Standards for Barrier-Free Built Environment for persons with Disability and Elderly Persons – as applicable to Public Transport" for various floor heights of bus variants as per amendments and other statutory / mandatory provisions as on date, issued by the Government, at the time of submission of tender.

2. GENERAL DESIGN FEATURES OF THE 11-METRE-LONG FULLY BUILT TYPE I NDX BUSES:

- 2.1. Fully built type I NDX buses would generally be designed and manufactured in accordance with the Urban Bus Specification (UBS II) & 'Code of Practice for Bus Body Design and Approval' (AIS 052)- hereinafter referred to as Bus Code; as applicable to

buses in India /CMVR rules/Tamil Nadu Motor Vehicle Rules (TNMVR) whichever is superior. Details of relevant standard followed would be indicated against each item.

- 2.2. Fully built bus design would consider all other aspects / provisions to be made on proposed buses facilitating ease of its mounting /erection on the chassis without causing any damage / defect to chassis / its aggregates etc. and further facilitating ease of repair and maintenance of all other fitments / aggregates provided on bus chassis, etc.
- 2.3. Bus would be designed to carry commuters in TNSTC with ease of boarding and alighting especially for ladies, senior citizens and PwDs.
- 2.4. Bus design would be suitable for daily operation of 16 to 20 hours in TNSTC with peak loading of about 60 passengers in 11-metre-long buses (each passenger weighing 68 Kgs on an average and carrying a load of 7kgs each), average journey speed of about 25 Kms per hour with frequent starts/stops, say, after every 500 to 1000 mtrs. The minimum max attainable speed of the bus would be in range of 80 kmph with cruising speeds of 40-50 kms.
- 2.5. Bus design would be eco-friendly, energy efficient, safe, and comfortable meeting specified exhaust emissions norms (Bharat Stage VI or Euro-VI or latest as amended up to date of supply).
- 2.6. Bus must be of proven design suitably modified to climatic & operational conditions, infrastructure and road conditions obtaining in urban areas of TNSTC.
- 2.7. Bus design should meet all statutory requirements applicable to TNSTC in all respects.
- 2.8. The bus structure would meet requirements of structural strength, stability, deflection, vibration, crashworthiness, roll over protection etc. amongst others for at least the following main static and dynamic loads including those as per annexure 3 of UBS II:
 - i. Static loads
 - ii. Dynamic loads
 - iii. Single wheel bump loads
 - iv. Double wheel bump (diagonally opposite) loads
 - v. Braking and acceleration loads
 - vi. Front impact loads
 - vii. Rollover loads
 - viii. Speed breaker induced loads
- 2.9. Bus design would be a proved design duly evaluated by agencies authorized as per CMVR using Finite Element Analysis and or any other mechanism for above loads / performance requirements for values for above loads/ conditions /performance parameters as given in subsequent paragraphs.
- 2.10. Minimum required performance values/ data for above load conditions may be considered as follows:
 - i. Strength (Factor of safety): minimum of 1.35 i.e. design stress would be $1/1.35^{\text{th}}$ of yield stress.
 - ii. Stiffness (Deflection): 5mm.
 - iii. Vibrations (Lowest Natural Frequency):5Hz

iv. Frontal Impact:

(Velocity = 56 Kmph against fixed rigid barrier)

- Head Injury Criterion (HIC) = 1000
- Crumbled Zone = 132mm
- No part of structure would intrude into residual space.
- (HIC= Head Injury Criterion calculation is based on acceleration level at the head of driver/ passenger & time duration during which maximum value of above acceleration is build up. Typical acceleration at the head should not exceed 80g continuously for 3 milliseconds to avoid head cracks).

v. Roll over (as per bus code – AIS 052) tests with modifications of making the bus roll from ground level instead of the raised platform:

- (i) Bus tilted to its unstable position
- (ii) Bus allowed to fall freely under gravity from this position.
- (iii) Gross vehicle weight of the bus is to be considered
- (iv) The Energy absorbed by the structure = 0.75 E_R

{ E_R =Reference energy-- the Potential energy of the bus in its (unstable) equilibrium position}.

$E_R = M.g.h$, Where M= Effective weight of the bus; g = Acceleration due to gravity; h= Height of C.G. above ground level in (unstable) equilibrium position.}

- (a) Angular velocity should not exceed 5 deg/sec.
- (b) The unstable position should not occur before 35 deg.
- (c) No part of structure intrudes into residual space.

vi. Buckling Factor would be equal to or more than four.

vii. Various loads:

- Normal Loads (Static) = No. of Passengers x wt. of passengers (68 Kgs.) + passenger luggage weight (7 Kgs). (Besides the vehicle related loads).

- Bump Loads:

- Bump height = as per relevant Bureau of Indian Standards (BIS)/Indian Road Congress Guidelines.
- Case I: Single Wheel on Bump/Pot hole.
- Case II: Diagonally opposite wheels on Bump/Pot hole.
- Case III: Both wheels (Front & Rear) on Bump/Pot hole.

- Braking Loads:0.6g

Horizontal = 0.6g load, Vertical = 1g load, (Applied together)

- 2.11. The bus, loaded to Gross Vehicle Weight (GVW), with crush load and under static conditions, would not exhibit deflection or deformation that impairs the operation of steering mechanism, doors, windows, passenger escape mechanisms and service doors, etc.
- 2.12. Manufacturer's certificate supported by testing and type approval agency's certificates along with the bus as also technical specifications/drawings required for inspection, performance assessment as above to be supplied along with the bus. Besides meeting the statutory requirements, the bus would be designed with respect to its body and different aggregates/systems /sub systems to operate satisfactorily in urban transport service for at least 9 years or 12, 00,000Kms whichever is earlier.
- 2.13. Detailed schematic drawings of bus structure, seats, interior/ exterior fittings, electrical systems, wiring looms / harness, photometric items, and other accessories along with complete details of materials used, their specification, manufacturing tolerances etc. would be provided by the bus manufacturer. Additionally, details / drawings of mounting / fastening bus body to chassis to be provided along with the bid specifically bringing out whether bus body would be welded and integrated to chassis or fastened using fasteners along with applicable mechanism system /arrangement. Detailed Circuit diagrams for electricals be also provided by the bidder/bus manufacturer.
- 2.14. Details of general appearance, seating layout and structural of roof, floor, sides, front & rear show and driver cab, etc. would be supplied. Main dimensions of the fully built bus i.e., overall length, overall width, overall height, saloon height, pillar to pillar distance, seat pitch, number of seats (excluding seat for the driver), entry/exit gates, etc. would be supplied along with the schematic diagrams/printed literature of the bus.
- 2.15. Material used in construction of buses would be as per Bureau of Indian Standards (BIS)/ Automotive Industry Standards (AIS)/ specifications and/or other international specifications meeting/ surpassing performance & other requirements as given in the Bus Code. In absence of above specifications, Association of State Road Transport Undertakings (ASRTU) specifications could be followed. Wherever Indian Standards are not available, internationally acceptable Standards may be referred. Specifications/ Standards followed would conform to Specification/Standards as amended /up dated/ or the latest published by the concerned agencies. Wherever no specifications of any item have been notified as International/ National Standards etc. actual specifications of that item used be mentioned. Guaranteed life of the bus and its other aggregates be indicated item by item. Periodical maintenance schedule for obtaining the said life of the bus be also indicated.
- 2.16. BIS Standards are normally available from Bureau of Indian Standards, Manank Bhawan, 9-Bahadur Shah Zafar Marg, New Delhi-110 002. Web site: <http://www.bis.org.in>. Similarly, AIS Standards are available from Automotive Research Association of India, Post Box No.832, Pune-411 004. Web site: <http://www.araiindia.com>. ASRTU Specifications are available from Association of State Road Transport Undertakings, Sector 12, Dwarka, New Delhi. Web site: <http://www.asrtu.org>.
- 2.17. Suitable traps/openings with appropriate sealing and covers would be provided for repair and maintenance of various aggregate/systems/sub systems / chassis / body/ their components, etc. of the bus.

- 2.18. Any restriction in design, manufacture and mounting of bus body on chassis, as envisaged by chassis manufacture, as a part of detailed instructions for this purpose, be meticulously followed while mounting / joining / integrating bus body to bus chassis.
- 2.19. The bus would be so designed as to maintain operational stability requirement as per Bus Code. Interior noise and pass by noise of the vehicle would conform to BIS: 12832:1989 or latest and BIS: 3028:1998, 10399: 1998 or latest respectively.
- 2.20. It would be ensured that the design, manufacture, certification (wherever called for) & installation of major bus sub-components and systems are compliant with all such sub-component vendors' requirements & recommendations within the frame work of any statutory, legal and or any other lawful/functional requirements. A certificate of compliance would be shown on demand. Components used in the vehicle would be of heavy-duty design.
- 2.21. Any other provisions/fitments, required for safe and efficient operation and or for fulfilling statutory requirements be provided in the offered bus.

3. ENGINE:

- 3.1. Diesel fuelled engine would have appropriate horsepower to obtain desired performance in respect of its adequacy of power, acceleration levels, emission norms, specific fuel consumption etc. The engine to have adequate horsepower not only to propel the bus at its GVW but also to operate efficiently all other auxiliary devices, systems fitted to bus, simultaneously. As the bus is required for operation in urban services, characterized by frequent stops and starts, engines of adequate horsepower at lower Revolutions Per Minute (RPM) levels with a high torque over a larger RPM range (on the lower side of the RPM range) be considered for use. The Horsepower and torque at defined rpm levels of the engine be indicated by the bidder in his bid along with other details called for in Part II / A separate annexure may be added if so required by TNSTC.
- 3.2. Performance data/curves and other details of the engine have to be supplied. A detailed set of calculations indicating adequacy of said engine for proposed urban bus be provided along with all performance parameters of selected engine.
- 3.3. The engine and its accessories would be easily replaceable. Engine mounting would be such as to minimize transmission of vibrations to bus structure. Engine foundation & mounting would be so located as to facilitate easy accessibility & replacement. Engine design would be such that it would not be overheated during normal operating conditions of vehicle. An arrangement for audio-visual signal would be provided in the event of engine getting overheated excessively. The temperature at which signal operates would be indicated. Similar arrangement for other sub-system of engine with their monitorable indicators be made on dashboard. The engine would be equipped with electronic engine management and on-board diagnostic system.
- 3.4. Engine compartment would be insulated to avoid transmission of heat and noise to saloon area. This firewall would preclude or retard propagation of an engine compartment fire into passenger compartment. Only necessary openings would be allowed in the firewall, and these would be fireproofed. Wiring may pass through only if connectors or other means are provided to prevent or retard fire propagation through the firewall. Engine access panels in the firewall would be fabricated of fireproof material and secured with fireproof fasteners. These panels, their fasteners, and the firewall would be constructed and reinforced to minimize warping of panels during a fire that will compromise integrity of the firewall. Firewalls shall be provided between the bus interior areas and the engine

compartment which includes the areas in which the engine, transmission, and exhaust system are housed. The firewalls shall satisfy the requirements defined in Federal Transit Administration (FTA) of United States standard Docket 90, dated October 20,1993 or equivalent standards. Bus manufacturer would provide relevant details.

- 3.5. The engine would be suitably designed to operate optimally under TNSTC's operational areas of peak summer heat, humidity and dust.
- 3.6. Engine noise and emission levels must conform to the Central Motor Vehicle Rules (CMVR)/ UBSII /AIS 052 any other Indian Standards, adopting the most superior one.
- 3.7. Specific fuel consumption of diesel per KW hour at Standard conditions (e.g., Delhi Urban Driving Cycle and or any other equivalent or better followed by test agencies) would be indicated along with guaranteed fuel consumption level (kilometres per litre of diesel) under GVW and the standard urban operational conditions / cycle.
- 3.8. For sound-proofing & for protection against fire risk in engine compartment, no flammable material or material liable to soak fuel, lubricant or any combustible material would be used in engine compartment unless the material is clad by an impermeable fireproof sheet. A partition of heat-resistant material would be fitted between the engine compartment & any other source of heat.
- 3.9. The bus would have air intake design / location in a manner as to provide adequate quantity of dust free, restriction free air so as to avoid any operational problem of the engine.
- 3.10. Details of make / model etc. of various items of engine system and its subsystems would be provided as part of bid.

4. COOLING SYSTEM:

- 4.1. Heavy-duty radiator and other subsystems of cooling system would efficiently dissipate heat from the engine system. De-aeration tank and pressurized radiator cap would be provided. It would be easy for filling and level checking of coolant. Replacement/ maintenance of radiator and its items be also easily carried out. Details of radiator specifications, cooling capacity, coolant, repair and maintenance procedures etc. would be supplied.

5. TRANSMISSION SYSTEM:

- 5.1. Heavy duty Synchromesh Manual transmission system having minimum 5 forward and one reverse gear would be provided. All operational controls/buttons/switches etc. be conveniently located within easy reach of the driver. The transmission system and the control/operational sub systems be easily accessible for repairs and also be easily replaceable. Complete system details need to be supplied with the bus.
- 5.2. Transmission system be fitted with a mechanism which makes it possible to engage reverse gear only when vehicle is stationary.
- 5.3. Details of make / model etc. of various items of transmission system would be provided as part of bid.
- 5.4. Mechanical Clutch system using single dry plate push type clutching system would be provided

6. SUSPENSION:

- 6.1. The bus would be fitted with air suspension system at rear axles and parabolic leaf spring waveler type suspension at front. The suspension system would be fitted with shock absorbers, suitable for trouble free operation and jerk free comfortable ride in existing road conditions of TNSTC urban area.
- 6.2. The suspension system shall permit a minimum wheel travel of 90 mm jounce-upward travel of a wheel when the bus hits a bump (speed breaker), and 75 mm rebound-downward travel when the bus comes off a bump and the wheels fall relative to the body. Rebound travel may be limited hydraulically within the shock absorbers. Suspension system shall incorporate appropriate devices for automatic height control so that regardless of load the bus height relative to the centreline of the wheels does not change more than 12 mm at any point from the required height.
- 6.3. Vertical damping of the suspension system shall be accomplished by hydraulic shock absorbers mounted to the suspension arms or axles and attached to an appropriate location on the chassis. Damping shall be sufficient to control bus motion to 3 cycles or less after hitting road perturbations.

7. STEERING SYSTEM:

- 7.1. Hydraulic power steering with angle and height adjustment would be provided. Power steering failure shall not result in loss of steering control.

8. BRAKING SYSTEM:

- 8.1. The braking system would be full pneumatic type with fail-safe dual circuit having four-way protection valve, auto slack adjuster, disc brakes in front and drum brakes at rear, with non-asbestos brake pads / linings having temperature and wear characteristics suitable for harsh urban operations. Brake squeal would be absent under normal conditions of operation. An air compressor/dryer which minimizes oil carry over would be fitted. Braking system would be fitted with air dryer and oil/ water separator system. Buses would also be provided with hand operated pneumatic flick valve type parking brakes at rear wheels. Air pressure line would be treated for corrosion resistance.
- 8.2. In the event of failure of engine and or loss of air in system, adequate provision be made for obtaining effectiveness of service brake system and or for deactivating the spring actuated brakes.
- 8.3. The air compressor system should have sufficient capacity to meet large compressed air demand for braking in the start-stop type urban operations and frequent opening / closing of doors besides any other requirement

9. WHEELS AND TYRES:

- 9.1. The bus would be fitted with steel radial tubed tyres of optimal size and design conforming to AIS-044 Part I with wheel rims of corresponding size conforming to AIS/ BIS: 10694 (part 3)-1991 or latest. The bus would be supplied with 7 sets of tyres (two on front and four on rear wheels) fitted on the bus plus one set as spare stepney.
- 9.2. Details of type, specifications, capacity, make, model etc. of tyres/wheel rims would be provided as part of the bid.
- 9.3. Suitable guards be provided near wheels to prevent damage/ for obtaining safety from stones hurled from tyres.

- 9.4. Splash aprons of minimum 6.50mm thickness composed of rubberized fabric would be installed behind the wheels as needed to reduce road splash and protect under floor components. Splash aprons would extend downward to within 100mm of road surface at static conditions. Apron widths would be no less than tyre widths, except for the front apron, which may extend across the width of the bus. Splash aprons would be bolted to the bus under structure. Splash aprons and their attachments would be inherently weaker than the structure to which they are attached. The flexible portions of splash aprons would not be included in road clearance measurements. Other splash aprons would be installed where necessary to protect bus equipment.

10. AXLES:

- 10.1. Solid beam front axle & grease type front bearings & seals of reliable & proven design of adequate capacity to take care of maximum Gross Vehicle Weight (GVW) & crush loading expected during life span, of the bus, of minimum 9 years or 12,00,000 Kms. whichever is earlier, would be provided.
- 10.2. The bus would be driven by a single heavy-duty rear axle of proven design, single reduction, hypoid gears, full floating axle shafts with optimal gear ratios suitable for urban operations with adequate capacity to take care of maximum GVW & crush loading expected during life span of bus of minimum 9 years or 12,00,000 Kms. whichever is earlier. Transfer of gear noise to bus interior would be minimized. Lubricant drain plug would be magnetic type, external hex head. If a planetary gear design is employed, oil level in the planetary gears would be easily checked through plug or sight gauge.
- 10.3. The drive (propeller) shaft would be guarded to prevent it from striking floor of the bus or the ground in the event of a tube or universal joint failure.
- 10.4. Details of type, specifications, capacity, make, model etc. of Front& Rear Axles would be provided at in the bid.

11. DIESEL TANK:

- 11.1. Diesel fuelled bus must meet and satisfy safety and other requirements as per AIS 052, type approval; regulatory requirements as per CMVR / Tamil Nadu Motor Vehicle Rules (TNMVR) and any other applicable regulations for operation in the State of Tamil Nadu, if any.
- 11.2. Diesel tank of requisite capacity (165 litres) would be appropriately mounted on to the bus keeping in mind convenience of diesel filling, safety of system and its maintainability, operation in the urban areas.
- 11.3. Capacity of the diesel tank (165 litres) be adequate for over 300 kms of bus running without refilling.
- 11.4. Diesel tank and other components of diesel-fuelled vehicles should conform to applicable AIS / BIS standards or International Specs / standards in absence of AIS /BIS specs. Additionally, requirement of UN/ECE R34 for prevention of fires be satisfied.
- 11.5. Detailed drawing indicating location and mounting details of diesel tank / sub-systems be provided along with the bid
- 11.6. All requirements of AIS / BIS / CMVR/TNMVR etc. for diesel tank, sub-systems and components, etc.be fully met and test certificate for the same be provided.

12. UNDER FRAME & STRUCTURE:

- 12.1. The under frame and super structure would be suitably designed to carry peak load of 60 passengers and dense crush load of about 90 passengers in 11-metre-long buses (each passenger weighing 68 Kgs on an average and carrying a load of 7kgs each) consisting of seated and standee passengers; the superstructure of steel tubing, bus tare weight, all other fitments would meet performance requirements under various loads indicated earlier. The structure would be designed to withstand the transit service conditions of operation throughout its service life.
- 12.2. The bus body would be of integrated/ fastened/welded to chassis frame depending upon the chassis design, with the super structure fabricated using galvanized steel tubing (ERW– Rectangular / Square Sections) conforming to BIS 4923-1985 or latest, of grade Yst –240.
- 12.3. A comprehensive multi-stage anti-rust treatment would be provided to bus flooring, sides, roof, under-structure, axles, suspension, and all other components for resistance to corrosion or deterioration from atmospheric conditions & road salts so as to enable them & the bus frame to last for at least 9 years or 12,00,000 Kms. whichever is earlier.
- 12.4. Samples of all materials & connections / joints would withstand a two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%. Details of treatment provided with relevant specification details be indicated along with suitable calculations to reflect that the corrosion prevention treatment meets the requirements of minimum 9 years or 12,00,000 Kms. life whichever is earlier in TNSTC's operational environment. Details of the system followed for corrosion prevention of internal surfaces of structural tubing would be supplied. A certificate of testing from an authorized test lab be provided.
- 12.5. Front and rear structure design would be energy absorption type to reduce impact stresses into under frame/side structures/ other areas of the vehicle. Damaged area of the vehicle would be easily repairable and or replaceable in the event of any major damage at normally available workshop facilities and without any need for specialized tools / fixtures and equipment.
- 12.6. Entire surface of bus under floor and sides besides other fitments on chassis / under bus floor and exposed to ground would be covered with appropriate corrosion prevention & flame retardant paint coating for protection against harmful effects of water, mud etc. and to retard flames, if any. Wheel housings would be constructed to contain tyre bursts during operation and be flame retardant in case of tyre fire.
- 12.7. Sufficient clearance & air circulation would be provided around the tyres, wheels & brakes to preclude over-heating when the bus is operating
- 12.8. Metal Inert Gas (MIG) welding would be used for steel structural member's fabrication.
- 12.9. All structural members would be MIG welded besides suitable gussets/ brackets of adequate size & thickness be provided on floor, side, front, rear & roof structure to ensure structure rigidity & integrity. Material, shape size and specs of such gussets / brackets would be provided by the bus supplier in their supplied drawings.
- 12.10. After anti corrosive treatment, structural members would be coated with red oxide/ Zinc Chromate primer & superior quality black paint.
- 12.11. During structural assembly operations, a number of holes are drilled and or weldments made after the corrosion prevention treatment of components/structural items/members

causing loss of such treatment and exposing these items to corrosion. Manufacturer would take sufficient care to carry out corrosion prevention of items so exposed to effectively prevent corrosion.

12.12. Under floor to sidewalls would be sealed to prevent dust ingress.

13. PANELLING:

- 13.1. Bus exterior side panels would be fitted with stretched steel sheet at waist level. The exterior front-end panelling would be of steel sheet while roof, rear, sides & skirt panelling would be of aluminium. All interior panelling would be of Acrylonitrile Butadiene Styrene (ABS) conforming to relevant National or International Standards - equivalent or better. The space between interior and exterior panels shall be filled with thermocol of appropriate specifications.
- 13.2. Wherever aluminium is joined with steel or with/ any dissimilar metals together, the involved joints would be treated with thick layer of approved quality dielectric paint conforming to relevant Indian/ International Standards, before assembly. Adequate treatment be also provided to avoid any incidence of galvanic corrosion between dissimilar metals.
- 13.3. Panels would not have any waviness & would be so mounted as to present smart aesthetic exteriors. Details of the above said panelling including specifications / thickness/ sizes of panels, fittings, rivets/ bolt pitch etc. would be supplied.
- 13.4. All side skirt panels below stretch panel be of such design as would facilitate quick replacement of any damaged panel(s) with pre-painted panels. The side skirt would be able to withstand side impact as per provisions of BIS: 14682-1999 or latest. Similarly rear end would be able to withstand rear impact as per the provisions of BIS: 14812-2000 or latest
- 13.5. Anti-drumming compound would be applied on inner side (enclosed surfaces) of entire panelling.
- 13.6. Roof structure would be thermally insulated with flame retardant Polyurethane or glass wool of minimum 40 kgs/m³ density. The specifications/ BIS Standards for aforesaid insulating material would be supplied.
- 13.7. Metal Inert Gas (MIG) welding for fabrication of aluminium components would be used.
- 13.8. Rain gutters would be provided to prevent water flowing from the roof onto the passenger doors, driver's side window, and exterior mirrors. When the bus is decelerated, gutters would not drain onto windshield, or driver's side window, or into the door boarding area. Cross sections of the gutters would be adequate for proper operation.
- 13.9. Entire front end of the bus would be sealed to prevent debris accumulation behind the dashboard and to prevent driver's feet from kicking or fouling wiring and other equipment. Front end would be free of protrusions that are hazardous to passengers standing or walking in front of the bus during rapid acceleration.
- 13.10. Interior panels would be attached so that there are no exposed unfinished or rough edges or rough surfaces. Panels & fasteners would not be easily removable by passengers. Fasteners and or their capping used for above purpose be such as to resist vandalism / easy removal by any person including but limited to commuters.

14. PAINTS:

- 14.1. All structural members of the bus would be treated for corrosion prevention internally as well as externally and painted wherever required. Polyurethane (PU) painting based spray paint of standard companies conforming to latest/ international Standards as applicable would be used for exteriors painting of bus including interiors wherever required. Colour shade would match to the shades as per BIS: 5-1978 or latest. Details of paints used, surface treatment & preparation, corrosion prevention treatment, base primer coatings, number of paint coats to be applied etc. would be supplied.
- 14.2. All exterior surfaces would be smooth & free of wrinkles & dents. Exterior surface to be painted would be properly prepared as required by paint system supplier, prior to application of paint to ensure a proper bond between the basic surface and successive coats of original paint for stipulated service life of the bus. Paint would be applied smoothly and evenly with the finished surface free of dirt and following other imperfections:
 - i. Blisters or bubbles appearing in the topcoat film.
 - ii. Chips, scratches, or gouges of the surface finish.
 - iii. Cracks in the paint film.
 - iv. Craters where paint failed to cover due to surface contamination.
 - v. Overspray.
 - vi. Peeling.
 - vii. Runs or sags from excessive flow and failure to adhere uniformly to the surface.
 - viii. Chemical stains and water spots.

15. COLOUR SCHEMES:

- 15.1. Exterior, interior colour schemes and logo/ graphics would be painted as directed by TNSTC. Information, on seats, for reservation for persons with disabilities, ladies, senior citizens would be marked as per the details provided by the TNSTC.

16. SERVICE DOORS:

- 16.1. Two service doors (passenger entry / exit) with steps, one on rear side of the front axle and the other behind / ahead of rear axle as indicated in summarized specs in part II, would be provided on near side (on kerb side wall).
- 16.2. Layout of passenger service gates on near side generally as brought out in Part II of these specs.
- 16.3. Doors would be Jack-Knife (JK) type. The door flaps shall be so designed as to provide positive sealing against ingress of water in the bus particularly during any water logging / flooding on roads.
- 16.4. Operation of entry and exit doors would be electro-pneumatically controlled by driver with internal and external emergency operational controls. In an event of an emergency, it would be possible to open doors manually from inside the bus by using a force no more than 10 Kg. after actuating and unlocking device at each door. Unlocking devices would be clearly marked as an emergency device & would require two distinct actions to actuate.
- 16.5. Doors, operating mechanisms, door hinges and locks would comply with safety requirements as per Indian / International Standards (to be specified and supplied by the

bus manufacturer). Overall dimensions and construction of entry and exit doors would normally be identical so that doors and door operating mechanisms are interchangeable. Closing and opening time of doors should be in the range of 4 seconds each. There would be maximum opening area in longitudinal & vertical directions in fully open condition. Door operating mechanisms, brackets etc. would be maintenance free and designed with lifetime durability of minimum 9 years or 12,00,000 Kms. whichever is earlier.

- 16.6. A pilot lamp on the driver's dashboard would be provided to warn that the door is 'Open' or not fully closed.
- 16.7. Entry and Exit doors would be provided with suitable support in form of grab handles for boarding/ alighting passengers on JK door flaps. Electronic / other suitable sensors would be installed at all entry and exit doors to retract door automatically if any obstruction to door occurs during door closing. It must be effective until door is fully closed.
- 16.8. Colour shade would match to the shades as per BIS: 5-1978 or latest.
- 16.9. A red sign indicating "Door Closing / opening" would be installed above the entry-exit gates. The sign will blink when doors are closing or opening.
- 16.10. A suitable device to prevent doors from opening as long as bus is in motion would be provided.
- 16.11. Service Doors' operation would be controlled with help of separate push buttons and one switch for each door mounted over the doors. One each red master button to close all entrance and exit doors at same time would also be provided on driver dash-board and the conductor seat.
- 16.12. All buttons and switches would be labelled on a panel to right side of the driver.
- 16.13. Heavy-duty prominent nosing of bright yellow colour would be used to protect edge at entrance/exit.
- 16.14. Access door would be provided with heavy-duty sealing to avoid ingress of dust and water into passenger compartment. Upper & lower section of both front & rear door flaps would be glassed for not less than 45% of the respective door opening area of each section. Glazing material & glass in doors would be same as in side windows.
- 16.15. Details of above service doors including electro-pneumatically controlled door closing system with complete circuit diagram would be supplied. Photo-cell controlled opening / closing functions of doors and a "sensitive edge" made for safe entry-exit be fitted.
- 16.16. Doors would be fitted with heavy-duty hinges as per bus code.
- 16.17. Doors would be fitted with heavy-duty locks with &/ without lock & key depending upon their use. Striker plate would be fitted at the closing end of locks.
- 16.18. All handles would match to décor of its fitment location or would be chrome plated.
- 16.19. Doors would open or close completely in about 4 seconds from the time of control actuation and would be subject to closing force requirements and adjustment requirements. Front door would remain in commanded state position even if power is removed or lost. Operation of & power to, passenger door would be completely controlled by driver. A control or valve in driver's compartment would shut off power to, and/or dump the power from, front door mechanism to permit manual operation of front door with bus shut down.

17. GUARD / GUARD RAILS:

- 17.1. Suitable guard would be provided in areas such as service doors entry/exit areas where seated passengers are likely to be thrown into as a result of heavy braking, Guard height would be minimum 800mm from bus floor, and guard would extend inward from the wall at least 100mm more than the centre line of the seating position of the passengers who are prone to this risk.

18. WINDOWS:

- 18.1. Windows would be of large size for panoramic view. They would be in two/ three-piece window glasses. Toughened glass wherever used in bus body would be 4.8 mm to 5.3 mm thick for 11-metre-long buses– each aesthetically installed. Size and shape of the glasses would enable even the standees to have maximum outside view without kneeling. General requirements of windows would be as per the provisions of bus code (AIS 052).
- 18.2. Windows would have provision of suitable sealing to avoid ingress of dust and water and would have proper/ efficient drainage system as per AIS 052 /UBS II.
- 18.3. Details of window design; fitment etc. would be supplied by the bidder along with the bid.

19. WINDOW GUARDRAIL:

- 19.1. In non-AC Buses window guard rails as specified in bus code (AIS 052) shall be provided.

20. EMERGENCY EXIT:

- 20.1. Emergency exits would be provided in bus as per the provisions of Bus Code – AIS 052 / CMVR. Possibility of using passenger entry/exit gates on near side for said purpose would be explored by manufacturer and confirmed. Details of Emergency exits including their numbers, locations, sizes, markings etc. would be supplied.

21. ESCAPE HATCH:

- 21.1. In addition to emergency exits, at least two escape hatches (one each in front and rear half of bus) would be provided in roof as per bus code. A number of additional hatches may also be provided for facilitating ventilation inside bus.

22. STEPS:

- 22.1. There would be two steps provided at the entrance / exit gates on the near side

23. FLOOR:

- 23.1. Bus floor design would be with steps in boarding / alighting gates.
- 23.2. Floor height of the bus would be 900 ±10mm from ground level.
- 23.3. Internal saloon height would be 1900 mm minimum.
- 23.4. Floor design would allow easy cleaning including that of sweeping & drainage of water.
- 23.5. Floor would be fitted with fire retardant 15mm 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)

- 23.6. The said floor would be covered with anti-skid type silicon grain material of minimum 3mm thickness meeting Indian/ International Standards (to be indicated by the bus manufacturer in the bid), ISO 877/76 for colour, IS5509 for fire retardancy. Adequate sealing would be provided in the floor to prevent ingress of dust, gases, water etc. Provision of draining of water if any on bus floor would be made.

24. GANGWAYS:

- 24.1. Gangway-from front entry/exit gate walls through the entire bus length, would have clear space of minimum 650 mm for passenger movement and would be generally as per the provisions of the Bus Code (AIS 052)/ UBS II and meet statutory requirements. The clear space requirement would be minimum 850mm for wheel chair accessibility through the designated gate.

25. HANDRAILS AND HANDHOLDS

- 25.1. Handrails and Handholds would be provided as per provision of bus code (AIS 052) / UBS II. The surface of handrails & handholds would be colour contrasting and slip-resistant.
- 25.2. All handrails would be of aluminium tubing of 32 mm dia and 3 mm thick. Depending upon the size of the bay (i.e., between two consecutive roof hand rail brackets), minimum 2 to 4 numbers handholds per bay would be provided so that every standee passenger even during crush load is able to grab a hand hold.
- 25.3. Hand holds be made of transparent polycarbonates with provision for display of advertisements. Hand holds be appropriately fastened to the hand grab rails so as to prevent their axial sliding and or rotation. Details of the handrails & handholds fitted would be supplied.

26. STANCHIONS

- 26.1. Vertical stanchions would be so positioned to facilitate access to seats for those standing. Stanchions would be of 40.0 mm dia and 3.15 mm thick aluminium tubing with surface of colour contrasting and slip resistant and fitted vertically with attachment to roof and floor of bus.
- 26.2. Stanchion pipes and the handrails would be painted in cannerly yellow colour while the joining brackets be painted in grey colour generally matching with inner panelling.
- 26.3. A suitable device, such as high visibility bell pushes, for convenience of passengers to request for stopping bus be provided at appropriate locations.

27. PASSENGER SEATS:

- 27.1. Passenger seats would be front facing in city buses, comfortable, durable & maintenance free of 'PPLD/LDPE' (Polypropylene/Polyethylene Low Density) moulded construction and or any other suitable material for a fully built passenger seat meeting performance requirements of AIS023 and other requirements as per the Bus Code (AIS 052). The 'PPLD/LDPE' moulded seat would be fitted on metal frames.
- 27.2. Similarly, 'PPLD/LDPE' moulded seat backrest would be appropriately fitted. Suitable integral type seat hand grab rails would be provided one on top of backrest & one at the back of backrest for seated passengers.
- 27.3. Seat pitch would be maintained at 700 mm (minimum) (against 686 mm as per AIS 052 rounded off to 700mm) for non-AC buses.

- 27.4. Details of seat design, material, specifications, pitch and other relevant data and the seating layout would be supplied by the manufacturer for approval of TNSTC.
- 27.5. Details of seating lay out, accommodating maximum number of seats in 2x2 layouts in 11-metre-long buses for city operations meeting requirements of the bus code, would be supplied. Seating capacity would be minimum 40 pax plus the driver plus one wheel chair passenger, etc. Standee capacity of bus worked out as per system given in bus code (AIS 052) and extract placed at Annexure I, would be indicated by manufacturer. Seating and standee capacity of bus would be minimum 60 for 11-metre-long bus (worked out as per AIS 052).
- 27.6. Construction/ fitting of the seat would be such as to be easily replaceable and repairable.

28. SEAT BELTS AND ITS ANCHORAGES:

- 28.1. Seat belts would be provided for the seats as per the provisions of CMVR & Bus Code (AIS 052). Any seats provided at rear end of bus/seats in centre (facing the gangway) would necessarily be provided with seat belts. Seat belts and its anchorages would conform to the requirements of AIS 005 and AIS 015. Seat belt, wheel chair anchorage etc be provided as per applicable AIS.

29. DRIVER'S WORK AREA:

- 29.1. A driver door of not less than 1600 mm height and 650 mm width and with requisite steps would be provided for entry and exit to driver's work area. Proper hand holds and steps would be provided for easy access to driver's cabin. All other requirements of driver's work area would be as per the provisions of Bus Code -AIS 052. Driver's work area would have lighting arrangement to provide general illumination and it would illuminate half of the steering wheel nearest to the driver. Brake Pedal Angle would be determined from a horizontal plane regardless of slope of cab floor. Driver entrance-cum-exit door would be provided as per Bus Code (AIS 052) with a provision of maximum width of sliding window using material like glazing & glass as used in other side window glasses. Driver work area would be equipped with a 24V DC, 200mm diameter fan mounted at proper height on side structure. Colour of fan would match the interior decor of the bus.
- 29.2. Driver's visibility in front of the bus, seated on driver seat, be as per bus code (AIS 052) / CMVR
- 29.3. Driver's seat would meet the requirements of AIS 023.
- 29.4. Driver partition would be provided as per AIS 052.
- 29.5. A barrier of bulkhead between driver and front passenger seat would be provided. The barrier would minimize glare & reflection in windscreen directly in front of barrier from interior light during night time operation.
- 29.6. Dashboard Instrumentation and Control System
 - i. Bus would have ergonomically designed moulded type dash board and instrument panels made out of Fibre Reinforced Plastics (FRP) material. Details of materials used their specifications etc. of dashboard and instrument panel would be provided by the manufacturer.
 - ii. Bus would have dash board with full instrumentation panel containing meters and gauges to indicate important parameters like air pressure, coolant temperature, battery charging current, fuel level, side indicators, head lights, hand brakes engagement, engine oil pressure, status of

entry-exit gates, etc. In addition, warning lights for low engine oil pressure, high cooling system temperature & low coolant level, low pressure and high temperature of transmission oil, low fuel level, if any, low air , battery weak, would be provided at the driver's dash board. All the dashboard controls and instrumentation system would be as per the bus code.

- iii. On board electronic diagnostics system would be provided as per UBS II.

30. REAR-VIEW MIRRORS- INTERIOR AND EXTERIOR:

- 30.1. Rear-view mirrors would be provided on both sides of bus to enable driver to have clear side/rear views. One interior rear-view mirror would also be fitted for viewing saloon area by driver. Installation and performance requirements of rear-view mirrors would conform to AIS 001 and AIS 002. Exterior rear-view mirrors would also enable the driver to view object near bumper area.
- 30.2. CCTV camera and a buzzer would be provided at rear end of the bus along with audio video facility at driver dash board.

31. SUN VISOR AND HORN:

- 31.1. Adjustable sun visors would be provided for windshield & driver's side window. Visors would be shaped to minimize light leakage between visors & windshield. Adjustment of visors would be made easily by hand with positive locking & releasing devices and would not be subject to damage by over-tightening. Sun visor construction & material would be strong enough to resist breakage during adjustment. Visors may be transparent but would not allow a visible light transmittance in excess of 10%. Visors where deployed would be effective in driver's field of view at angles more than 5° above horizontal.
- 31.2. An electric horn conforming to BIS: 1884-1993 or latest and installation requirements conforming to AIS 014 would be fitted in bus and further conforming to the provisions of CMVR.

32. INTELLIGENT TRANSPORT SYSTEM (ITS) AND THE ITS DEVICES:

This section provides general end-use specifications of ITS systems and the devices to ensure that bus body building shall be done in a way as to provide for raceways/conduits for wiring (Data and Power) for these devices during bus body building. The devices shall also need mounting surfaces/ structures provisions for which shall be made as part of bus body building. TNSTC proposes to get ITS items fitted / installed in the bus, as per detailed specs provided herein. The bus supplier would acquire the entire ITS / devices / system, hardware, firmware, software, integration and data and any other item to make the system functional, install and commission the same on-board in a manner as to deliver the end use requirements simultaneously being fully compatible and synchronized with the back-end systems. The bus ITS would have, among other items, SCU (System Control Unit) and Bus Driver Console (BDC), PIS Boards, PA- Public Address System GPS system, Panic Button, Reverse Parking Camera, ***Provisions for In-Bus Security Camera Network***, Telematics system (J1939 – CAN 2.0), Wiring harness , etc. The detail minimum technical and functional specification of the ITS system available in Annexure IV – Specifications for Intelligent Transport System (ITS) of this document for compliance.

32.1. General Requirements

- i. **All On-Bus Intelligent Transport Systems, 'OBITS', (which includes SCU(OBU), BDC, PIS boards, PA system, Reverse parking camera panic button, Telematics system, Wiring and harness) equipment to be procured for diesel shall be integrated with one another and shall be capable of integration with the backend systems to be procured by the Purchaser in future.**
- ii. **The hardware to be procured for the ICT aggregates shall be compliant to any of the AIS-140, UBS II, IS 16833 with the subsequent amendments applicable.**
- iii. **The bidder shall support the operations, maintenance and integration of all supplied and installed ICT/ ITS systems on buses for a Contract Period of 9 years from the date of delivery & acceptance of each bus by authority.**
- iv. **All the component/sub-component of the OBITS system shall be internally integrated and single compact-box solution with easy to install and maintain.**
- v. **Operation and Maintenance requirements for ICT/ITS system:**
 - a. Bidder shall have to maintain the Hardware Unit during the contract period as per instruction of Purchaser
 - b. Any faulty equipment shall be replaced with a tested unit from the spares maintained by Bidder. Bidder will have to self-assess on the requirement of the spares in the project for the continuous service.
 - c. Repair and testing of equipment shall be done at Bidder's maintenance center and not at site/depot.
 - d. A repaired unit shall be tested for full functionality as at the time of deployment and certified before it is reinstalled at any site.
 - e. Spare Items shall be kept so as to replace as and when required throughout the contract period in provision of the RFP for the Buses.

The system shall build redundancy so that bus PIS boards can be functional in case of SCU(OBU) GPS outage.

Wiring provision to be maintained for installation and connection of in-bus surveillance systems in future. It should cover provision for.

- a. Minimum Two (2) wide angle cameras for clear view of driver and passenger cabin and reverse camera.
- b. Minimum Four (4) panic buttons on the bus located conveniently within bus such that it prevents accidental trigger. They are to be used for triggering the alerts in any emergency situations.

The ICT aggregates to be provided by the bidder shall have two (2) year default warranty and shall be extendable for a period of further 7 years. The warranty shall include continuous on-site support for the respective site locations.

The bidder shall have to provide the required protocol document and SDKs for the preparation the route configuration files to each STUs.

32.2. Fitment Requirements

Fitment of all on bus devices shall be as per UBS- II or equivalent international guidelines - Chapter 10 – 17.8.7 or or equivalent international guidelines:

- All On Bus Intelligent Transport Systems, 'OBITS', (which includes SCU(OBU), BDC, PIS boards, PA system, reverse parking sensor, panic button, Telematics system) equipment including wiring harness, antennas to be original factory fitment.
- Front, side, rear signs should be mounted with a gap with the glass so that the glass on signs and of the bus can be cleaned by swiping
- All equipment should be fitted in a way to minimize unintentional damage, shielded from direct engine heat, protected from water splash and dust.
- All equipment should be fitted with the gasket for the vibration free fitment.
- All cables need to be properly anchored, marked and labelled
- Others:
 - Front sign: central
 - Rear sign: central
 - Side sign: first window ahead of rear door (central line of sign should coincide with central line of window)
 - Inner sign: centralize along the width of bus behind the driver's partition
- Six Speakers with protective grill : one each near the doors and others equally distributed across the length of the bus.
- SCU(OBU), recorder, amplifier : secured and ventilated compartment right above the driver
- BDC: ergonomically placed for driver ease
- Combi antenna: suitable place to define inside the bus (preferably) with direct line of view for 'affixing' the unit.
- Reverse Parking Sensor: High resolution surveillance camera to be placed back-side of the buses for the clear view of the reverse area when reverse gear engage.

32.3. Integration Requirement

- Bidder shall mount ICT equipment's as specified herein on Buses.
- Bidder shall also ensure to supply equipment compatible with proposed ICT/ITS System of Authority so as to enable smooth integration.
- Integration of ICT aggregate with respective backend software shall be joint responsibility of bidder and the backend System Integrator. To that effect, the bidder shall be responsible for firmware modification, expose protocols/APIs as required to the backend SI and so on for integration purposes. In case of dispute, the Authority's decision shall be final, and both the parties will have to abide.
- ICT aggregate equipment's fitted in Diesel Buses should provide required data/information to backend system installed by the Authority appointed System Integrator so as to provide MIS reports such as Trip summary, Schedule adherence of Bus with respect to Trip, Real time information pertaining to "off route" (detour), Trip information with start and end destination, driver details, speed, missed stop, Bus details, driver behaviour and CAN parameters etc. It should also provide information so that Operations Centre is able to check whether on-board devices are alive and monitoring capability of PIS health (which PIS is working).
- Bidder is required to provide above functionalities with scalability to integrate with third party systems through standard Active Programming Interfaces (APIs) such as ICT/ITS backend system, city traffic management systems, journey planner app etc.

- Bidder and Authority shall agree to share interfacing protocols and APIs with each other for smooth integration with other ICT/ITS System as required by Authority.

32.4. Training Requirements

- Well trained, efficient and effective ground support staff shall be provided by the Bidder during the operation and maintenance phase of the project.
- The bidder shall be responsible for trainings for but not limited to operating equipment, reporting incidents, regular maintenance, spare replacement, route backups, video backups etc. for Drivers, Maintenance staff and Depot Supervisors/Staff.
- Training sessions shall be designed individually as per requirement for the drivers, maintenance staff and depot supervisors/staff.
- The Bidder, at its own cost, shall “Train the Trainers” on 1) BS VI technology and 2) on board ITS equipment to at least 25 Driving Instructors and 15 Maintenance Instructors per TNSTC STU. This shall also include training the Depot Managers and Engineers.
- The Bidder shall provide adequate material and resources required for the training.
- The Bidder shall submit the training content, Manuals and list of resources to the Authority within 10 days from the date of issue of Letter of Acceptance/ Work Order. The training content shall be reviewed by the Authority or representatives of the Authority in light of larger capacity building program proposed under the Bus Modernisation Plan. The Bidder shall immediately commence the training pursuant to clause above after incorporating the suggestions/modifications provided by the Authority or its representatives. The Bidder shall make available the finalised training manuals in English and Tamil languages for the purpose of imparting better understanding of the training content to the trainees.
- The training shall be provided at regional training centres of the Authority/IRT. The Bidder shall provide minimum 3 (nos) of training bus or simulator or similar adequate infrastructure for the purpose of Physical Training based on the requirement. The Bidder can also arrange such Physical Training at its own premises/facility at its own cost.
- The Bidder shall make available such infrastructure for Physical Training, till arrival of first lot of buses in each STU, for the purpose of Training by the Trainers to the other staff.
- The Training for all the required staff as provided above shall be completed before completion of Prototype Inspection of all the Bus Types.
- The Bidder shall have to certify the trainees for the said training programs and a satisfactory note to be issued by trainees at the end of training program.
- GPRS network for the data transmission from ITS system to the backend will be provided by the Authority.

32.5. The bus manufacturer shall be responsible to supply buses meeting ITS specifications outlined in this clause and compatible with off-board / control items and the communication systems. The ITS service provider hence needs to coordinate with various vendors/suppliers including but not limited to those responsible for supply of buses, ETVMs, routers, SCUs, display boards, cameras, GPS and other ITS equipment, etc.

33. STOP REQUESTS:

33.1. A suitable device for the convenience of passengers including PwDs / wheel chaired passengers, to request for stopping bus be provided at appropriate locations inside the bus on stanchions in a manner as to prevent un-intentional operation, deliberate

attempts by children, etc. Such stop request buttons shall be within easy reach of passengers including PwDs and wheel chair passengers.

34. BUMPERS:

- 34.1. Bus would be provided with front and rear bumpers of Steel or impact resistant polymer or combination of both meeting requirement of an energy absorbing system. The bumper would be easily repairable/ replaceable. Bumpers would conform to the requirements of CMVR, AIS, and Bus Code/any other international Standards (to be specified by the manufacturer). Details of above bumpers along with drawings including thickness of bumpers, section, profile etc would be supplied by the Successful bidder.
- 34.2. Bus manufacturer would provide details of materials used, their specifications and process followed for their repair and maintenance along with material required.

35. TOWING DEVICE:

- 35.1. Heavy-duty ring type towing devices would be provided in front and rear bumper area with load transfer to bus structural members. Capacity of each towing device would be 1.2 times (minimum) the kerb weight of the bus within 30 degrees of longitudinal axis of the bus. The manufacturer would supply a copy of the test certificate of the towing devices

36. WIND SCREENS:

- 36.1. Front wind screen in the bus would be in single piece design, plain/ flat with curved corners, intervening PVB film laminated safety glass of minimum thickness of 8.76 mm. Rear windscreen would also be in single piece design, flat in centre and curved on corners toughened glass of thickness of 5.5 mm + 0.5mm. Windscreen glasses would meet the requirements of BIS 2553: Part II-1992 or latest and that of CMVR and Bus code (AIS 052). The glazing used for fitment of glasses would be Ethylene Propylene Dien Monomer (EPDM) rubber of black colour or pasted with adhesive material conforming to Indian/ International Standards to be specified by the manufacturer. A grab handle and suitable handles on the outside of windshield centre at waist level would be provided to facilitate manual cleaning of the windscreens.
- 36.2. The windshield shall permit an operator's field of view as referenced in SAE recommended practice J1050. The vertically upward view shall be a minimum of 15 degrees, measured above the horizontal and excluding any shaded band. The vertically downward view shall permit detection of an object 1.35-metre-high no more than 600 mm in front of the bus. The horizontal view shall be a minimum of 90 degrees above the line of sight.
- 36.3. The windshield shall be easily replaceable by removing zip-locks from the windshield retaining mouldings. Bonded-in-place windshield shall not be used. The windshield glazing material shall have 8.76mm nominal thickness double laminated safety glass conforming with the requirements of ANSI Z26.1 Test Grouping 1A and the recommended practices defined in SAE J673.

37. WIND SCREEN WIPERS:

- 37.1. Electrically operated windscreen wiper system having two wiper arms with blades would be provided. Wiper motor would be heavy-duty steel body for minimum of two-speed operations. Wiper arms would rest horizontally when not in use. The sweep angle would be sufficiently wide for clear view during rainy days. Windscreen wiping system would be 24V, having speed control with fitment of time delay relay as per AIS 011. Windshield

washer system would spray washing fluid on windshield & when used with the wipers, would evenly & completely wet the entire wiped area. Windshield washer system would have a minimum of 3 litres capacity tank suitably located for easy refilling from inside the bus and two nozzles at suitable location for proper spray of fluid. Reservoir pumps, lines & fittings would be corrosion resistant & reservoir itself would be translucent for easy determination of fluid level. The windscreen wiping system would be in accordance with CMVR/ BIS: 7827 Part1, 2, 3 (section 1, 2) or latest.

38. FIRE EXTINGUISHERS:

- 38.1. Multipurpose fire extinguishers would be ISI marked conforming to BIS: 13849-1993 or latest, dry powder type (Stored pressure) duly filled, of capacity and quantity as per the provisions of GSR-853 (E) dated 19.11.2001 notification of Government of India, Bus Code, UBS II. Fire extinguishers would be encased & fitted with proper reinforcement. The enclosure box would have transparent breakable glass at front cover.

39. FIRST AID KIT:

- 39.1. First aid kit complete with items, medicines, bandages etc. would be provided as per provisions of CMVR fitted near driver seat at appropriate position and level on side with proper reinforcement.

40. PROVISIONS FOR PERSONS WITH DISABILITIES:

- 40.1. The manufacturer would provide for ease of accessibility, guidance, **anchorage of one wheel chair on-board**, positioning of aids etc. system for PwDs that meets the requirements as given in the Bus Code, AIS 153 and CMVR and **“Harmonized Guidelines and Space Standards for Barrier-Free Built Environment for persons with Disability and Elderly Persons – as applicable to Public Transport”**.

41. BATTERY:

- 41.1. Battery system would be 24V of minimum 180 Amps-hour capacity, low maintenance type lead acid batteries. Batteries would be well secured to a hinged/ pivoted or slide out type carrier for ease of access for repair & maintenance, replacement and suitably ventilated for escape of fumes but insulated against ingress of dust and moisture. Battery box would be mounted near/ next to engine compartment and would be well secured, easily accessible & ventilated. Performance requirements of batteries would conform to BIS: 7372-1995 (or latest).
- 41.2. Battery terminals with positive locking system (e.g., angle type terminal with provision for double bolting) duly protected against all possible short circuit risk would be provided.
- 41.3. Each battery cable would be covered with flame retardant Grey colour corrugated flexible pipe and would be properly encased & clamped.
- 41.4. A relay controlled Heavy-duty type battery cut-off switch (isolator switch) capable of carrying & interrupting total circuit load would be provided 1 each near battery / driver on side panelling at appropriate level for disconnecting all battery positives except for safety devices such as fire suppression system & other systems as specified. Two points of battery cut off switch would be connected with battery and two points would be connected with self-starter. The battery Cut-off switch with power plant operating, would not damage any components of electrical system in off position. The battery Cut-off switch would be capable of carrying & interrupting the total circuit load.

42. ELECTRICAL EQUIPMENT AND WIRING:

As per details given in UBS II and generally as under:

- 42.1. The bus would have 24 Volt D.C with multiplex wiring system for all its electrical equipment except in unavoidable circumstances to avoid sparking in buses. A separate system/ mechanism would be provided for discharge of electro static charge induced during the operation of vehicle. Adequate precaution would be taken in case of single pole wiring to avoid spark in items such as self-starter, alternator etc.
- 42.2. An adequate capacity alternator of 24V DC, minimum 150A rating with consistent output to take care of high idling periods of city operation, would be provided and so located as to minimize ingress of oil or rain water into it.
- 42.3. A pre-engaged type 24V DC Self-starter of adequate capacity (minimum 180Ah) with relay would be fitted in bus and so located as to minimize ingress of oil or rain water into it.
- 42.4. Details of specifications of Battery, Alternator and Self-starter along with circuit diagrams would be furnished by the manufacture along with their bids.
- 42.5. Electrical equipment and wiring would conform to Indian/ international Standards, bus code and UBS II. All cabling would be as per provisions of Bus code / UBS II. The wiring would be multiplex system, flame proof, ISI marked conforming to BIS: 2465-1984 or latest. As far as possible electrical system would be 24V double pole multiplex wiring system except in unavoidable condition. However, in case of single pole wiring all power & ground wiring would have double electrical insulation, which would be waterproof conforming to the Indian/ International Standards. Wiring would be grouped, numbered & colour coded. Wiring harnesses would not contain wires of different voltage classes unless all wires within the harness or insulated for highest voltage present in harness. Kinking, grounding at multiple points, stretching & exceeding minimum bend radius would be prevented.
- 42.6. Wiring looms/ harness for electrical system of bus would be properly routed, encased/ concealed type so mounted to eliminate chances of any spark. Details of above wiring loom including circuit diagram; layout of controls etc. would be supplied by the bidder along with the bid wiring support would be protective & non-conducting at areas of wire contact & would not be damaged by heat, water, solvents or chafing.
- 42.7. All electrical fittings and lights would be fully wired up, running in flame retardant black colour PVC sleeves as per applicable Indian Standards (to be specified by the manufacturer) and installed in a manner to facilitate easy inspection/ rectification/ replacement etc. as & when required without disturbing internal finish/ décor of the bus. Whenever any wire or cable or PVC sleeve carrying cable etc. passes through holes in sheet metals/ structural member, suitable rubber grommets/ Bakelite inserts would be provided in these holes to avoid direct contact between cables and sheet metal causing damage to insulation coating.
- 42.8. Bus manufacturer would furnish details of above wires/cables and battery cables.
- 42.9. Design of electrical, electronic & data communication systems would be modular so that each major component, apparatus panel or wiring bundle is easily separable with Standard hand tools or by means of connectors. Each module except main body wiring harness would be removable & replaceable. Power plant wiring would be an independent

wiring module. Replacement of engine compartment wiring module would not require pulling wires through any bulkhead or removing any terminals from the wires.

- 42.10. Electrical system & its electronic components would be capable of operating in area of the vehicle in which they will be installed. Electrical & electronic equipment would not be located in an environment that will reduce performance or shorten life of the component and or electrical system. No vehicle component would generate or be affected by electro-magnetic interference or radio frequency interference (EMI/RFI) that can disturb performance of electrical / electronic equipment.
- 42.11. Bus manufacturer would furnish recommendations regarding methods to prevent damage from voltage spikes generated from welding, jumps start shorts etc.
- 42.12. All electrical & electronics hardware would be accessible & replaceable easily. It would be mounted on an insulating panel to facilitate replacement. Mounting of hardware would not be used to provide sole source ground and all hardware would be isolated from potential EMI/ RFI.
- 42.13. All electrical/ electronic hardware mounted in interior of bus would be inaccessible to passengers & hidden from view unless intended to be viewed.
- 42.14. All electrical/ electronic hardware mounted on exterior of bus i.e., not designed to be installed in an exposed environment would be mounted in a sealed enclosure.
- 42.15. All electrical/ electronic hardware & its mountings would comply with shock & vibration requirements.
- 42.16. Bus manufacturer would provide a certificate of testing/estimation of electrical load for each system.
- 42.17. Alternator over voltage output protection would be provided.
- 42.18. All branch circuits except battery to starting motor & battery to generator/ alternator circuits would be protected by circuit breakers or fuses sized to requirements of the load. Circuit breakers or fuses would be sized to larger than total circuit load current as per UBS II/ AIS 052. Current rating for wire used for each circuit must exceed size of circuit protection being used.
- 42.19. Electronic Circuit protection for cranking motor would be provided to prevent engaging of motor for long time/to prevent overheating.
- 42.20. To the extent practicable, wiring would not be located in environmentally exposed locations under the vehicle. Wiring & electrical equipment necessarily located under the vehicle would be insulated from water, heat, corrosion & mechanical damage. Where feasible front to rear electrical harnesses should be installed above the window line of vehicle.
- 42.21. All electrical motors would be easily accessible for servicing.
- 42.22. Separate additional outlets, as required in UBS II/AIS 052, are to be provided with appropriate relays & fuses in wiring harness for fitment of electrical auxiliary devices/ systems to be added later on in buses, if required.
- 42.23. AC (Alternating Current) out-let of 220V, as required in UBS II if any, be provided at suitable location for charging of electrical/electronic equipment, etc.
- 42.24. If any electronic components have an internal clock, it would be provided with its own battery back up to monitor time when battery power is disconnected.

- 42.25. All electronic components/equipment would have self-protecting capability in event of shorts in cabling and also in over voltage and reverse polarity conditions. If an electronic component is required to interface with other components it would not require external pull up and/ or pull-down resistors.
- 42.26. RF components such as global positioning system (GPS) etc. whenever provided would use coaxial cable to carry the signal. The RF systems require special design consideration for losses along the cable. Connectors would be minimized, since each connector & crimp has a loss, which will attribute to attenuation of signal. Cabling should allow for removal of antennas or attached electronics without removing the installed cable between them.

43. LIGHTS AND LIGHTING SYSTEM:

- 43.1. Interior saloon lighting would be sunken type light assembly fitted with LED lights and mounted in staggered formation for uniform lighting in two separate circuits. First row of lamps provided in driver's cabin should be fitted with amber internal filter to reduce glare to driver at night. Overall bus lighting system would comply with CMVR provisions wherever falls short of it.
- 43.2. Modern rectangular type headlamps with relay and side light etc. would be suitably styled into front-end construction.
- 43.3. White and Red marker lights of 5 Watt each would be fitted at both top side corners of the front and rear panel of the bus respectively.
- 43.4. Identical signal lights of 15 Watts would be fitted for inter-changeability in each side i.e.; front, rear and side respectively
- 43.5. Brake lights (15 W) and taillights (10W) would be two separate lights to reduce heat generation.
- 43.6. Reverse light of 25W, square lamps with white covers would be provided.
- 43.7. Side markers would be provided on both sides as per bus code/ AIS 008
- 43.8. Rear signal lights, brake lights, taillights and reverse lights would be arranged vertically.
- 43.9. Light wattages given above are indicative, however, all the lights and lighting systems would conform to requirements of Bus code, CMVR/Tamil Nadu MVR / UBS II and other relevant AIS Standards.
- 43.10. Following lights would be actuated when the headlights are 'ON' and the doors are 'Open':
- i. Lights provided for illuminating exit/entrance door area, lights would illuminate outside area up to at least one metre when door/doors is/are opened. Lights for exit/entrance door areas would be flushed as far as possible to avoid tripping of passengers, protrusions if any would conform to relevant CMVR/ AIS Standards.
 - ii. Exterior door lights
 - iii. Lights would be automatically switched off when the door is closed.
- 43.11. A well-lighted bus registration number plate would be fitted at rear as per provisions of CMVR duly complying with directives/ regulations regarding high security number plates as notified by Government of India / Government of Tamil Nadu if any.

- 43.12. No Electrical fittings would be mounted on front and rear bumpers.
- 43.13. Switches would be fitted on right hand side of instrument panel through evenly loaded circuits & fuses as per bus code.
- 43.14. A reverse buzzer would be installed at the rear of bus to sound intermittently when reverse gear is engaged.
- 43.15. A suitable light would also be provided in engine compartment for ease of maintenance/ emergency repairing.
- 43.16. Following circuit diagrams would be supplied along with buses:
- i. Complete circuit drawings for exit/entrance door control system, door mechanism.
 - ii. Complete door sensor electrical circuit drawing.
 - iii. Complete circuit drawing for sensitive door edge system.
 - iv. A layout drawing for all door control switches, gauges, warning lights on driver's dashboard.
 - v. A layout drawing for all lighting and wiring circuits, control switches fuses and fitment details and diagrams along with item specs and types in each case.

44. PERFORMANCE STATEMENT:

- 44.1. Bus manufacturers would furnish following information for performance evaluation of fully built buses supplied to other customers and now in service for at least 3 years. The information should be furnished separately order wise:
- i. Type/Model
 - ii. Name and address of the bus operating agencies where this model is operating
 - iii. Number of the buses supplied
 - iv. Order no. against which buses have been supplied.
 - v. Date of supply and date from which in service
 - vi. Maximum/minimum turning radius.
 - vii. Maximum climbing ability/ gradeability
 - viii. Type of bus body
 - ix. Engine HP @ RPM
 - x. Engine Max Torque @ RPM, and RPM range for max torque
 - xi. Specific fuel consumption
 - xii. GVW / Kerb weight of buses
 - xiii. Emission Norms
 - xiv. Type of suspension
 - xv. Dimensions- Length, width, height, floor height, wheel base,
 - xvi. Angle of approach, departure and ramp over

- xvii. Axle –rear and front
- xviii. Passenger carrying capacity
- xix. safety devices/provisions, Specs and Stds. against each item,
- xx. Any other performance data.

45. TECHNICAL INFORMATION

Technical information required to be furnished by bus manufacturers along with Bid wrt the following amongst others:

- 45.1. Bus manufacturer's technical information of the bus i.e., General Drawings comprising of elevations –sides, front & rear ends along-with main dimensions i.e., overall length, overall width, overall height, saloon height, pillar to pillar distance, isometric views, exterior & interior details, seating layouts, no. of seats (excluding seat for driver), environmentally friendly colour scheme as per TNSTC etc. would be submitted along-with the Bid.
- 45.2. General appearance & structural details of roof, floor, sides, front & rear show and driver's cab, double folding ramp system, would be provided by the bidder along with their bids. Details of main structural members, material specifications, shape, size, thickness, etc. be indicated on the above drawings.
- 45.3. Power Point presentation material on a DVD for offered design of bus (indicative) and minimum 1:15 scaled Model (indicative & non-working)) duly furnished/ painted in environmentally friendly colour scheme as given by TNSTC would be submitted along-with the bid. The presentation will cover elevations –sides, front & rear ends along-with main dimensions, isometric views, exterior & interior details, seating layouts, colour scheme etc.

46. TOOLS, GAUGES AND TESTING INSTRUMENTS:

- 46.1. Bus manufacturers would furnish a list of special tools, gauges and testing instruments for inspection, repair and maintenance of buses along with a complete list of spare parts recommended for:
 - i. Normal wear and tear; and
 - ii. Emergency requirements for any breakdowns, damages etc.

47. OPERATION AND MAINTENANCE MANUAL:

- 47.1. At least 2 hard bound copies and 2 soft copies, for every 25 buses or part thereof, of operation and maintenance manual containing essential technical information required for satisfactory operation, inspection and maintenance would be supplied by bus manufacturers.
 - i. One set of Coloured wall charts along with soft copies of following units would also be provided for every ten buses or part thereof showing assembly details:
 - ii. Chassis lubrication and brake system.
 - iii. One set of Coloured wall charts along with soft copies of following units amongst others for every 25 buses or part thereof showing assembly details:
 - Engine

- Transmission system
- Drive line and Rear axle
- Front axle
- Steering system, alternator, starter, fuel injection system etc.
- Brake system, ABS etc.
- Safety devices,
- FDSS
- Any other system / sub-system necessary for skill development of operating / repair and maintenance staff

48. TRAINING

- 48.1. The Bidder, at its own cost, shall “Train the Trainers” on 1) BS VI technology and 2) on board ITS equipment to at least 25 Driving Instructors and 15 Maintenance Instructors per TNSTC STU. This shall also include training the Depot Managers and Engineers. The Bidder shall provide adequate material and resources required for the training.
- 48.2. The Bidder shall submit the training content, Manuals and list of resources to the Authority within 10 days from the date of issue of Letter of Acceptance/ Work Order. The training content shall be reviewed by the Authority or representatives of the Authority in light of larger capacity building program proposed under the Bus Modernisation Plan. on The Bidder shall immediately commence the training pursuant to clause 48.1 above after incorporating the suggestions/modifications provided by the Authority or its representatives. The Bidder shall make available the finalised training manuals in English and Tamil languages for the purpose of imparting better understanding of the training content to the trainees.
- 48.3. The training shall be provided at regional training centres of the Authority/IRT. The Bidder shall provide minimum 3 (nos) of training bus or simulator or similar adequate infrastructure for the purpose of Physical Training based on the requirement. The Bidder can also arrange such Physical Training at its own premises/facility at its own cost.
- 48.4. The Bidder shall make available such infrastructure for Physical Training, till arrival of first lot of buses in each STU, for the purpose of Training by the Trainers to the other staff
- 48.5. The Training for all the required staff as provided in the clause 48.1 above shall be completed before completion of Prototype Inspection of all the Bus Types .
- 48.6. The Bidder shall have to certify the trainees for the said training programs and a satisfactory note to be issued by trainees at the end of training program

49. TOOL KIT

- 49.1. Bus manufacturer would provide a suitable tool kit and other mandatory items as per CMVR 138 (4)/ other applicable rules comprising of common tools and other essential items required. Complete list of tools in tool kit to be supplied with every bus would be supplied by the manufacturer. One wheel nut spanner and one Hydraulic Jack per bus of a capacity of at least 10 Ton as per design of bus would also be supplied.

50. INSPECTION AND TESTING:

- 50.1. Bus may be inspected at various stages of fabrication by TNSTC's representative at manufacturer works. Inspection would comprise of ensuring that all materials, components, items, accessories and assemblies used in fabrication of buses conform to contractual specifications. Wherever required to ensure this, laboratory test would be carried out at bus manufacturer's cost.
- 50.2. The inspection, including operational demonstration of various sub-system, may be undertaken at any and or all stages such as component fabrication stage, chemical pre-treatment stage, fabrication of assembly/sub assembly stages, structure, panelling and equipping stage and Pre-dispatch inspection.
- 50.3. Final Inspection of buses would be carried out at manufacturer's facilities and or at a place finalised by TNSTC. After the bus is finally inspected, it would be subjected to test run and trials as required by TNSTC
- 50.4. The bus would be taken over by TNSTC after satisfactory final inspection, testing and trials in TNSTC.

51. MAINTENANCE SPARES AND MATERIALS

- 51.1. Bus manufacturer would provide details of components/spares required for maintenance of vehicle for twelve months' operation taking daily utilisation of bus of up to 300 Kms.
- 51.2. Manufacturer would also provide complete details of vendors, for every component / spare for complete bus and the spare parts catalogue (hard as well as soft copies) in 2 sets for every 25 buses or part thereof.
- 51.3. Manufacturer would ensure that during service life of 9 years or 12,00,000 Kms. (Whichever is earlier) of service, adequate spare parts in kit form/ individual components are made available in time to TNSTC on demand along with other essential items required.
- 51.4. All spare parts availability would be more than 95% at any time.

52. MAINTAINABILITY

- 52.1. Design and fabrication of bus would be such as facilitates easy access for repair & maintenance, removal, replacement of various bus components/ assemblies/ sub-assemblies/ systems by providing suitable traps/ flaps etc. Also, removal and re-fitment of engine, transmission, differential, radiator, door closing mechanism, PIS etc. would be easy for repair & maintenance purpose. Enough space would be provided between wind screen glasses and PIS boards for facilitating cleaning of glasses.
- 52.2. Radiator coolant/water filling and diesel filling inlets would be easily accessible with suitable closing devices complete with locking arrangement/-holding arrangement.
- 52.3. Also, an access would be provided for attending to air cleaner assemblies mounted in the vehicle.

53. WARRANTY/ GUARANTEE

- 53.1. Fully built bus would be covered under Warranty/ Guarantee for up to 2,50,000 Kms or 24 months whichever is later from the date of putting bus into operation after registration. All assemblies, sub-assemblies, fitments, components would be covered under Warranty Period as per commitment of bus manufacturer at the time of supply of bus.

- 53.2. Special Warranty Period, for any manufacturing Defect in design, material and workmanship of Bus structure shall be 9 years or 9,90,000 km per Bus whichever is later from the date of putting bus into operation after registration.

54. GENERAL REQUIREMENTS:

- 54.1. TNSTC reserves the right to alter, modify, change specifications as per requirement to suit the latest provisions of CMVR/ any other Notifications, safety aspects, emission aspects besides any practical/ operational difficulties etc. faced/likely to be faced by TNSTC. Vehicle Manufacturer would ensure that all alterations, changes or modifications in specifications, if necessary, as mentioned above would be carried out in buses built by them as per the advice of TNSTC without attributing any additional cost.
- 54.2. Ministry of Road Transport & Highways, Government of India (MORT&H) vide Notification in the Gazette of India, inter-alia stipulated the following measures which need to be complied with for enhancement of safety by the Vehicle Manufacturers as per the statutory requirement for registration of vehicles
- i. While registering every bus, Vehicle Manufacturers & transport authority would jointly examine the bus prior to registration. The registration of such a vehicle be done only after signing the report jointly by all concerned along with the transport authority.
 - ii. For electrical installations, flameproof cables would be used, especially positively locked battery terminals and others would be locked firmly with all cables & pipes with proper looming to take care of vibrations, fire retardant material would be used for seats, roof & sidewalls. Safety instructions about fire hazards would be displayed.
 - iii. Details of structural members, their material specifications & dimensions i.e., cab & saloon flooring, cross bearers, various angles, floor longitude, main body pillars, dummy/stump pillars, cant rail, vent rail, waist rail, skirt rail, wheel arch section, sole bar, seat rail, roof sticks & roof longitudes, diagonal bracing, rub rail tube, stretch & body panel stiffeners, gussets etc. would be provided by bus manufacturers.
 - iv. Similarly, details of aluminium sheets/sections & their alloys/specifications, aluminium sheet, rub rail, decorative mouldings, wire cover, wearing strips, footsteps edging, various panel beadings, window frames and its sections, finishers, water gutter channel, roof grab rail brackets would be provided by bus manufacturers.
 - v. All edges would be rounded off and would not cause injury to bus occupants.
 - vi. Complete bus would be rattle-free.
 - vii. All the rivet and bolt holes would be jig drilled as far as possible. The rivet holes should be drilled before the corrosion treatment. Holes drilled after the corrosion treatment be suitably treated with anti-corrosion materials. Rivet heads neatly formed and each bolt/ rivet would be tightened after full mating of the surfaces to be fastened.

- viii. All safety aspects should be considered while designing and fabricating the bus.
- ix. Continuous length piano type hinges and tower bolts of stainless steel would be used as per relevant Indian Standards.
- x. Similarly Aluminium extruded sections wherever not painted would be anodized.
- xi. All flaps wherever provided should have heavy-duty support to keep it open for ease of maintenance.
- xii. All miscellaneous M.S pipes would be phosphated with the coating of 2.16 to 2.70 gm/m² or by any other pre-treatment process conforming to Indian/ international Standards (to be specified by the manufacturer). Samples of all materials & components would withstand a two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%.
- xiii. Anodized decorative aluminium mouldings/ beadings etc. would be used.
- xiv. All M.S pipes used in the bus would be ERW conforming to BIS 3601:1984 or latest, of grade WT –160.
- xv. All rubber items used on the bus body would be made of Ethylene Propylene Dien Monomer (EPDM) rubber of black colour conforming to the Indian/ International Standards to be specified by the Manufacturer.
- xvi. EPDM rub rail of aesthetic profile would be fitted in anodized extruded aluminium channel between stretch panel and skirt rail longitudinally at the widest portion of the bus. The quality of EPDM material would be as per the Indian/ International Standards to be specified by the Bidder.
- xvii. Every trap/-opening flap would be secured in a manner that the vibrations can't dislodge it. Lifting devices must not protrude above the flap.
- xviii. Ease of accessibility to engine & other aggregates for easy maintenance would be ensured. Assemblies / units would be so mounted that they are easily accessible & can be removed without disturbing other components / assemblies.
- xix. All structure, body, and panel-bending mode frequencies, including vertical, lateral, and torsional modes, would be sufficiently removed from all primary excitation frequencies to minimize audible, visible, or sensible resonant vibrations during normal service.
- xx. Exterior protrusions if any would conform to the provisions of relevant CMVR/ AIS/ Bus Code. The exterior rear-view mirrors and required lights and reflectors are exempted from the protrusion requirement. Advertising frames would protrude no more than 22mm from the body surface and would have the exposed edges and corners rounded to the extent practicable. Grilles, doors, bumpers and other features on the sides and rear of the bus would be designed to minimize the ability of unauthorized riders to secure footholds or handholds. The exterior body features would

be shaped to allow complete & easy cleaning by automatic bus washers without snagging washer brushes or retaining water & dirt.

- xxi. Hydraulic Grease Nipples would be provided for ease of proper lubrication & maintenance.
- xxii. Front panels, bumpers and grill should be designed such that there are no pointed or sharp protrusions to minimize injuries to vulnerable road users in case of impact.
- xxiii. Any other safety and performance requirement features, to be provided.

55. QUALITY ASSURANCE

- 55.1. Bus manufacturer would use materials including fasteners conforming to relevant Indian/ International Standards and would get the same tested before use, meeting requirements of all specified parameters to ensure quality of material specified. However, random sample of materials picked up and duly sealed by representative of TNSTC in presence of bus manufacturer, out of purchased lot at works of the manufacturer or out of the bus under fabrication/ completed bus and be sent for testing quality of components at CIRT, Pune/ARAI/BIS approved testing laboratories having testing facilities for testing all parameters of specifications of materials/ items. In the event of failure of samples in lab tests, testing would be conducted in same way again from fresh lot. The bidder would replace failed materials by those duly passed in lab tests.
- 55.2. In the event of failure of material/ items in laboratory test, failure of material/ items (removed from completed bus) in laboratory test, acceptance decision about bus be taken by TNSTC after obtaining compensation/ recoveries of liquidated damages from bus supplier as per system decided by TNSTC. Wherever, failure of material on one parameter or more than one parameter, recoveries for complete lot of materials used in bus would be made from manufacturer plus 20% damages thereof.
- 55.3. Completed bus would be subjected to water leakage test conforming to BIS: 11865-1986 or latest.
- 55.4. A list of items to be tested for bus bodies would be provided by TNSTC. An indicative list of items to be tested is placed at Annexure III.
- 55.5. Manufacturer would also ensure compliance of quality at different stages of bus fabrication, including but not limited to prototype inspection as per details decided by TNSTC.

56. STATUTORY REQUIREMENT

- 56.1. Bus manufacturer would ensure that all statutory requirements in respect of each and every item of bus are fully met. Manufacturer would also obtain type approval certificates etc. for bus & any other items from testing agencies specified in the CMVR namely Vehicle Research & Development Establishment, Ahmednagar of the Ministry of Defence of Government of India or Automotive Research Association of India, Pune or Indian Institute of Petroleum, Dehradun, Central Institute of Road Transport, Pune; ICAT Manesar, Gurugram; and or any other agencies as specified by the Central Government on date of testing/ type approval or any other agency specified by competent authority. A certificate showing details of make/type/model of various units like engine, gear box/transmission system, clutch assembly, propeller shafts, rear axle, radiator, alternator, starter, regulator, batteries, tyres, steering, system, instruments on the panel, air compressor, shock absorbers, suspension system items, etc. would be furnished.

- 56.2. Bus Manufacture must make sure that the Fully built bus complies with standards and regulations for diesel fuelled vehicle provided in the AIS-052, AIS-153, besides others, UBS II, any other applicable standard; CMVR 1989 as amended till date, CMVR 1989 and Tamil Nadu MVR and all amendments thereto **as also to “Harmonized Guidelines and Space Standards for Barrier-Free Built Environment for persons with Disability and Elderly Persons – as applicable to Public Transport”**.

57. MANUFACTURER'S NAMEPLATE

- 57.1. Manufacturer's nameplate may be fixed as per approval of TNSTC.

58. POLLUTION UNDER CONTROL (PUC) CERTIFICATE HOLDER

- 58.1. A suitable holder with clear acrylic sheet cover would be provided in driver cab near driver seat at appropriate level for fixing of PUC certificate.

59. ANY OTHER PROVISIONS TO MAKE THE BUS FULLY FUNCTIONAL

- 59.1. Notes indicated in para 59.2 form part of the specs / bus fabrication requirements. Should however there be any conflict details contained in notes would over-ride others.

59.2. NOTES:

- i. All cross and or T or X-joints of structural elements of bus body structure (Front, rear, sides, roof, floor, etc.) be provided with MS gussets of min 2.5mm thickness. All Weldments / structural sub elements be properly cleaned and treated for corrosion prevention
- ii. Service / inspection hatches with covers be provided for servicing of various aggregates / sub-systems of bus.
- iii. Width of wheel arches frame be so maintained as to provide adequate ventilation to tyres amongst fulfilling other needs.
- iv. Stanchion pipes and grab rails to be of Aluminium tubing of appropriate specs, size / wall thickness etc. Handholds supporting hand rails and the stanchion pipes be painted in cannerly yellow colour, Brackets be of grey colour matching the colour of the inner paneling. Brackets however need to be of proper size and shape to ensure perfect fittings. No redundant fastening holes be provided on brackets
- v. Hand holds be of polycarbonate material, transparent and provision for space for advertisements
- vi. No Spare-wheel carrier and spare-wheel hatch need be provided on the city bus. As the same need not be carried on-board during urban operations. Spare wheel would be retained in bus depot as float.
- vii. Stop buzzers may be provided as one in frontal area, one in middle and one in the rear area on stanchions at reasonable height ensuring easy accessibility as well as preventing unnecessary usage. Design of buzzer switch be sturdy, long lasting and sunk-in type to avoid undesirable / inadvertent operation.
- viii. LED illumination provided in saloon area of the bus be covered with ground glasses to prevent glare.

- ix. Tail lamps be covered with metallic grill in a manner that not only protects the tail lamps but also facilitates easy lamp replacement etc.
- x. Front and rear facia of the bus body may be fabricated out of FRP suitably designed, ensuring its strength, finish and ease of repair / replacements at par or better than the metallic ones asked for in the specs.
- xi. Where type approval, of any of the bus body items including full bus body / bus is a mandatory requirement Type approval be undertaken by test agencies authorized under CMVR. In other cases, approval of selection of testing agency be obtained from TNSTC.
- xii. Design approval of multiplexing wiring in bus body / bus be obtained from test agencies authorized under CMVR or any other agency accredited for the purpose subject to approval of TNSTC.
- xiii. Bus Manufacturer to provide detailed drawings / specifications / make / model etc. as called for in specs for all items as generally indicated in RFP specs including but not limited to electrical Circuit diagrams of electrical subsystems in the bus.

60. FIRE DETECTION AND SUPPRESSION SYSTEM (FDSS)

60.1. General Requirements

Vehicles shall be equipped with fire detection & Suppression system detecting fires in the engine compartment based on sensors that senses either abnormally high temperature or rate of temperature rise, or both and suppress the same.

- 60.2. FDSS provision is to be made in the bus at appropriate location(s) for detection, alarming and suppression about any likely fire at all fire prone systems/sub-systems (bus supplier to identify such fire prone systems /sub-systems and make above provisions)
- 60.3. Vehicles shall be equipped with fire detection & suppression system detecting fires in the fire prone areas based on sensors that sense either abnormally high temperature or rate of temperature rise, or both and or any other parameter.
- 60.4. Upon detection of fire in the fire prone areas, the system referred in clause no 60.1, shall provide the driver with both an audio and a visual signal, and activate the hazard warning signal. The placement of the visual alarm shall be such that it is visible unobstructed while viewed from the driver seat.
- 60.5. The FDSS would simultaneously be able to suppress the fire immediately after detection.
- 60.6. The detection & suppression system shall be operational irrespective of whether the propulsion system of bus has been started and the vehicle's attitude.
- 60.7. The fire detection & suppression system shall be installed according to the system manufacturer's installation manual.
- 60.8. An analysis shall be conducted prior to the installation in order to determine the location of fire detectors and alarm system. Potential fire hazards at possible fire prone areas shall be identified and the fire detectors and suppression systems shall be so positioned as to commence suppression of the fire hazard immediately. The system shall also be ensured to work promptly and effectively regardless of the vehicle's attitude, road conditions etc.,

- 60.9. Fire hazards to be taken into account in the analysis shall at least consist of the following: Components whose surface may reach temperatures above the auto-ignition temperature for fluids, gases or substances that are present in the fire prone areas and electrical components and cables with a current or voltage high enough for an ignition to occur as well as hoses and containers with flammable liquid or gas (in particular if those are pressurized). The analysis shall be fully documented.
- 60.10. The Fire Detection and Suppression System (FDSS) installed in the Buses shall comply with the requirement of CMVR / AIS 135, UBSII as applicable, any other equivalent or better International Standards as well as best market practices.
- 60.11. Make, model, specs etc of various components / sub-systems / system of FDSS be clearly indicated for each item as part of the offer. A detailed drawing of the system details / specs be also provided for.

**PART II – SPECIFICATIONS OF DIESEL FUELLED NON-AC STANDARD FLOOR OF
900 MM FLOOR HEIGHT BS VI COMPLIANT 11-METRE-LONG TYPE I NON DELUXE
BUSES FOR OPERATIONS IN TNSTC – GENERALLY AS PER UBS II AND BUS
CODE (AIS 052)**

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
A	B	C	D
1	Bus Floor heights in mm	900±10 mm, shall be uniform inside the Bus generally as per AIS 052	Confirm
2	Propulsion System	Diesel fuelled Internal Combustion Engine (ICE);	Confirm
2.1	Emission norm and Fuel	BS-VI - Diesel	Confirm
3	Engine	Diesel Fuelled with 4 or more cylinder engine, water cooled, with Turbocharger, intercooler and conforming to BS VI emission norms. Engine be able to operate efficiently at ambient temperatures of approximately 10°C to 50°C, humidity level from 5% to 100%, and altitude levels of 0 to over 2000 metres, generally operating in the semi-arid / humid zone/ region prevailing in the area.	Confirm
3.1	Engine HP sufficient to provide:		Make & model of engine----- HP -----at Rpm--- Max torque -----NM at rpm-----& rpm range-----
a	Rated performance at GVW in a stop / start urban operations	Attain Geared minimum maximum speed of 80 kmph (without speed limiter) at GVW load and other systems operational	Minimum Max speed - --- kmph
b	Acceleration (metre/sec ²)	≥ 0.8	Confirm
c	Attain Bus speed of 0-30 kmph in seconds	≤ 10.5	Confirm
d	Maximum speed	Geared Minimum maximum speed without speed limiter to be 80 kmph as at 3.1. a	Confirm
e	Gradeability from stop, at GVW and other system operating.	17%	Confirm

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
f	Rated HP / torque preferably at lower rpm range	i. Rated HP at low rpm and Maximum engine torque required at lower range of RPM and spread over a wider range of RPM 2. Engine Power: Min. 140kW @ 1800-2400 RPM 3. Engine torque: Min. 700 Nm @ 1100 -2000 RPM Subject to meeting specified performance.	Engine HP ---- at ---- rpm & Engine peak torque --- - NM at ---- rpm; Range of rpm---- to---- for peak torque
g	Power requirements for other auxiliary system, ITS, etc.	Required to be provided by bus engine	Confirm and indicate power in terms of HP
3.2	Emission norms	BS VI/latest as applicable	Confirm
3.3	Engine management	Engine oil pressure, engine coolant temperature, engine speed in RPM, vehicle speed, engine % load (torque), diagnostic message (engine specific) generally as per UBS II	Confirm
3.4	Engine operational requirements	Engine should be able to operate efficiently at ambient temperatures / environmental conditions of TNSTC generally operating in the semi-arid & humid zone prevailing in the area as indicated in above sections	Confirm
3.5	Engine location	Front	specify
3.6	Transmission	Heavy duty Synchromesh transmission with minimum 5 forward and one reverse speed. Additionally, quote for Automatic transmission, be provided for price discovery and for further necessary action as deemed fit. Neutral during stops	1. Make --- model ----- of Transmission system 2.No. of forward speeds and their details
3.6.1	Operational safety	Transmission system to be fitted with a mechanism which makes it possible to engage reverse gear only when vehicle is stationary.	Confirm
4.0	Clutch System	Mechanical Clutch system using single plate push type dry clutching with asbestos free material lining	Provide details
5	Rear & Front Axles		
5.1	Rear axle	Single reduction, hypoid gears, full floating axle shafts with optimal gear ratios suitable for urban operations	Make --- model ----- of Rear Axle Type -- Gear ratio ----

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
5.2	Front axle	Heavy duty reverse Elliot type axle suitable for bus floor height, track rod with replaceable ball joints at both ends,	Make --- model ----- of Front Axle Type --
6	Steering system	Hydraulic power steering with height and angle adjustments	Make --- model ----- of Steering system Type --
7	Suspension system	Parabolic leaf spring with waveller type suspension at front axle and air suspension at rear axle complete with Anti-roll stabilisers & heavy duty hydraulic double acting Shock Absorbers at both axles	Confirm
7.1	Front	Parabolic leaf spring with waveller type suspension system	Make --- model -----, Type – specs ---size-- -
7.2	Rear	Air suspension system	Confirm Indicate make and model of air suspension system Indicate no. of air bellows
7.3	Anti-roll bars / stabilizers	Both front and rear	Confirm
7.4	Shock absorbers	Hydraulic double acting minimum 2 each at front & rear	Make --- model -----, of shock absorbers Type – specs --- Confirm
8	Braking system	Disc Brakes in front and drum brakes at rear wheels. Graduated hand controlled, spring actuated parking brakes acting on rear wheels. Asbestos free brake Pads / linings at all places.	Confirm: i. fitment of drum brakes at Rear ii. Disc brakes at front iii. Hand brakes iv. Asbestos free pads / linings v. Provide Make -----, model-----, specs-- - of brake system and its subsystems
8.1	Anti-skid anti brake locking system (ABS)	Required	Provide Make -----, model-----, specs--- of ABS
9	Electrical system	24-volt DC	Confirm
9.1	Batteries:	Low maintenance type lead acid batteries for 24 V system- performances as per BIS:	Confirm Make --- model -----, of Batteries

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
		14257-1995(latest). 2*12V maintenance free batteries of 180Ah rating.	Type – specs --- Rating ---- Ah
9.2	Self-starter	24V, 180 Ah	Make --- model -----, of Self starter Type – specs --- Rating ---- Ah
9.3	Alternator	24V, 150 A.	Make --- model -----, of Alternator Type – specs ---
9.4	Electrical wiring & controls –type	Multiplexing type -- As specified separately under ITS specifications	Confirm and provide details. Provide details of certifying agencies who had certified the multiplexing system design.
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 Vehicle manufacturer shall facilitate the Speed Limiting Device Serial number to be incorporated with MORTH by ensuring that requisite data is invariably added to the details submitted to STA at the time of registration of bus.	Make --- model -----, of speed limiting device Type – specs ---
11	Tyres	Steel radial tubed tyres– size and ply rating for urban operations as per CMVR Standards preferably 10.00*20 as per AIS 044 part 3.	Make --- model -----, of tyres Type –Size---, specs - -- Tread pattern for front---- & for rear tyres---
12	Diesel Fuel Tank capacity	165 litres capacity tank subject to being adequate to enable bus operation of more than 300 km between consecutive fillings	Confirm and provide details of diesel tank:
13	Bus characteristics		
13.1	Bus dimensions in mm		
a	Overall length (over body excluding bumper)	>10800 mm provided that the maximum number of seats and seat spacing are met as per AIS 052	Confirm and provide dimensional details
b	Overall width (sole bar/floor)	2600 - 50 mm	Confirm and provide dimensional details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
	level- extreme points)		
c	Overall height (unladen-at extreme point)	3800 mm max	Confirm and provide dimensional details
d	Overhang		
i	Front overhang	>32% of wheel base limited to 2400±200mm	Confirm and provide dimensional details
ii	Rear overhang	< 60% (preferably about 50%) of wheel base limited 3200 ±200mm	Confirm and provide dimensional details
iii	Note:	Overall length be maintained as >10800mm by adjusting tolerances appropriately on various dimensions such as wheel bases, overhangs, etc	Confirm and provide dimensional details
13.2	Turning circle radius (mm) (centre point of front wheel track) / Front overhang outer corner / rear overhang inner corner	11000±200 mm / 14000±200 mm / 7000±200 mm	Confirm and provide dimensional details
13.3	Floor height above ground (mm)	900 ± 10 mm	Confirm and provide dimensional details
13.4	Clearances (mm)		
a	Axle clearance(mm)	Minimum 190 mm	Confirm and provide dimensional details
b	Wheel area clearance(mm)	> 220 mm for parts fixed to bus body & > 170 mm for the parts moving vertically with axle.	Confirm and provide dimensional details
c	Minimum ground clearance at GVW	Within the wheelbase not less than 400mm	Confirm and provide dimensional details
13.5	Angles (degrees)		
a	Angle of approach (unladen)	Not less than 8.0°	Confirm and provide dimensional details
b	Angle of departure (unladen)	Not less than 8.5°	Confirm and provide dimensional details
c	Ramp over angle (half of	Minimum 4.8°	Confirm and provide dimensional details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
	break-over angle) unladen		
14	Bus Gates/Doors		
14.1	Entry-exit gates with doors	Double jack-knife (JK) type, 2 doors on near side. The door flaps shall be so designed as to provide positive sealing against ingress of water in the bus particularly during any water logging / flooding on roads	
a	Operating mechanism	Electro pneumatically controlled	Confirm Make -----, model ---- type --- & specs ---- of operating mechanism
b	Maximum opening / closing time in seconds per operation	4	Confirm and indicate closing / operational time
c	Positions of door controls	As per AIS 052	Confirm
14.2.	Passenger safety system - allowing bus motion only on doors closing. Front button to open the doors from outside required	Mandatory	Confirm and indicate type of system provided
14.3	Entry / Exit gates with doors – (near side / non driver side); Locations & dimensions	Front gate behind front axle., and Rear gate behind of rear axle such that distance between front edge of the gate and Centre Line of rear axle is 1500 mm.	Confirm and provide dimensional details
a	Door aperture in mm	1200 mm as per AIS 052.	Confirm and provide dimensional details
b	Clear door width (fully opened)	1000 ± 50 mm as per AIS 052.	Confirm and provide dimensional details
c	Door height	1900 mm as per AIS 052	Confirm and provide dimensional details
d	First step height from ground	≤ 400 mm	
e	Maximum height (mm) of other steps	≤ 250 mm	

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
14.6	Ramp / suitable mechanism for wheel chair access at the near side front gate, besides other safety features of gates	Sunken type wrap over (manually operated) ramp, for wheel chair of PwDs, fitted on floor at gate (preferably at the gate in front of wheel- chair space/PwD seat anchorage).	Suitable design mechanism (e.g. double folding manually operated ramp) for 900mm floor ht bus considering that floor level of bus stops at <400mm. Confirm Type, Size, Dimensions, Material, Specs, Load carrying capacity-- kgs m
a	Dimensions	Width \geq 900 mm	
b	Material	Aluminium alloy with anti-slip coating	
c	Load carrying capacity	>300Kg	
d	Device to prevent the wheel chair roll off the sides when the length exceeds 1200mm	√	Confirm
e	Device to lock wrapped up ramp	√	Confirm
f	Requirement for passenger with limited mobility	√	Confirm
g	Wheel chair anchoring - minimum for one wheel chair	Required as per Bus Code AIS 052 / UBS II / AIS 153 and other standards as applicable	Confirm
h	Priority seats - minimum 2 seats	√	Confirm
i	Stop request-on pillars--selected for operational convenience	√	Confirm
j	Emergency doors / exits or apertures (numbers)	As per AIS 052	Confirm Emergency door details----, type-----, size-----, locations--- -, nos--- Confirm
	Dimensions in mm	As per AIS 052	

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
k	Passenger safety system - allowing bus motion on doors closing and doors opening only when the bus is stopped	Mandatory	Confirm and provide details of mechanism
l	Power operated service door - construction & control system of a power operated service door be such that a Passenger is unlikely to be injured/trapped between the doors while closing.	As per AIS 052	Confirm and provide details of mechanism
m	Door components	As per AIS 052	Confirm
n	Door locks/locking systems/door retention items	As per AIS 052	Confirm
o	Door hinges	As per AIS 052	Confirm
15	Bus body		
15.1	Bus Design / Bus type approval	Design type approval as per Annexure-3 of UBS II/ AIS 052/ AIS 153 as applicable, "Harmonised Guidelines and Space Standards for Barrier-Free Built Environment for persons with Disability and Elderly Persons – as applicable to Public Transport" and the data given in this doc whichever is superior. The fully completed bus be type approved as per approved design.	Confirm and provide details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
15.2	Bus structure		
a	Bus structure – underframe, super-structure, roof, , etc, material specifications etc.	<p>The under frame and super structure suitably designed to carry dense load of over 60 passengers (assuming an average weight of 68 kg per passenger and hand luggage of 7kgs each) and crush load of 90 pax.</p> <p>The superstructure of the bus fabricated using Galvanised Steel Sheet Material (GS/GP) tubing (ERW– Rectangular / Square Hollow Sections) of grade Yst –240 for the bus body to be weld integrated /welded to the chassis frame depending upon the chassis design. Material size to be decided by the manufacturer. Material should fulfil structural strength etc. requirements indicated under Annexure-3 of UBS II and those in Part I above. Other requirements as per bus body code.</p>	Details of Structural materials fulfilling strength etc. requirements indicated under Annexure-3 of UBS II and those in part I of specs to be provided as a separate annexure / drawing with complete dimensional, materials and other details of specs at bidding stage.
b	Front and Rear End structures	Front and rear end structure design be energy absorption type steel, or FRP or a combination of both to reduce impact stresses into under frame/side structures/ other areas of the vehicle generally as per Bus code AIS 052	Details of design, materials, load bearing capability as evaluated for the offered design be submitted along with the bid.
15.3	Panelling	Bus exterior side panels fitted with stretched GI sheet at waist level. The exterior front-end panelling be of GI sheet while roof, rear, sides & skirt panelling be of aluminium. All interior panelling be of Acrylonitrile Butadiene Styrene (ABS) conforming. Space between exterior and interior roof panelling be filled with insulating material as per specs indicated in part I.	Detailed specs be provided along with the bid
15.4	Aluminium extruded sections for:		
a	Rub rail	Aluminium extrusion IS 733/1983 or better	Confirm and provide details of specs, sizes, make etc.at bidding stage.
b	Decorative moulding		
c	Wire cover		
d	Wearing strip		
e	Foot step edging		
f	Panel beading		
g	Window frame		

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
h	Roof grab rail brackets		
15.5	Floor type / materials etc.		
a	Type of floor	Uniform floor inside bus without steps	Confirm
b	Steps on floor	Not required	Confirm
c	Maximum floor slope	As per AIS 052	Confirm
d	Floor surface material	15mm 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 (BRW) as for marine board BIS:710-1976/ latest and fire retardant as per BIS:5509-2000(IS15061:2002)	Confirm and provide details
e	Anti – skid material	3 mm thick anti-skid type silicon grains ISO 877/76 for colour, IS5509 for fire retardancy	Confirm and provide details of material, specs, thickness, make etc.at bidding stage.
15.6	Safety glasses and fittings:		
a	Front windscreen (laminated) glass:	Full width single piece laminated safety glass, plain, flat / curved with curved corners with intervening Poly Vinyl Butyral (PVB) film IS 2553 (Part-2)-1992 / latest. Standard designs (Refer Annexure 1to UBS II) for 11metre long buses to be followed	Confirm and provide dimensional and specs details at bidding stage.
	Size:	Size 2200mm width*1500mm height plain / flat curved at corners*8.76mm thick	Confirm and provide dimensional and specs details, drawing etc. at bidding stage.
b	Rear windscreen:	Single piece flat/curved toughened glass-plain/flat/curved at centre & curved at corners IS 2553(Part-2)–1992/latest	Confirm and provide dimensional and specs details, drawing etc. at bidding stage.
	Size:	Size:1900mm width*950mm height (minimum)* 5.5+0.5mm thickness	Confirm and provide dimensional and specs details, drawing etc. at bidding stage.
c	Side windows:	Flat, 2-piece design-top fixed toughened glass IS 2553 (Part-2)-1992/latest.	Confirm and provide dimensional and specs details
d	Glass specifications	Toughened glass IS2553(Part-2)-1992/latest	Confirm and provide dimensional and

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
			specs details, etc.at bidding stage.
	Glass thickness:	4.8-5.3mm	
e	Window & other glasses - material specifications, thickness etc	Toughened as per IS 2553(Part-2)–1992/latest of 4.8-5.3 mm thickness	Confirm and provide dimensional and specs details, etc. at bidding stage.
f	Safety glass	As per AIS 052/CMVR	Confirm and provide dimensional and specs details
g	Rear view mirrors	As per AIS 052 & AIS 001/002	Confirm and provide dimensional and specs details
15.7	Seating and gangway etc.		
15.7.1	Passenger seating for non-AC type-1 buses	As per AIS 052	Confirm
a	Seat layout –city bus operations	2*2; As per AIS 052	Confirm and provide dimensional details
b	Seat layout –	Front facing	Confirm and provide dimensional details
c	Seat area/seat space per Passenger (width*depth) mm	400*350 as per AIS 052	Confirm and provide dimensional details
d	Seat pitch - minimum in mm	700 mm (686 mm in non-AC buses as per AIS 052 rounded off to 700mm.)	Confirm and provide dimensional details
e	Minimum backrest height-from floor to top of seat / headrest	900mm as per AIS 052	Confirm and provide dimensional details
	Seat base height-distance from floor to horizontal front upper surface of seat cushion mm.	450± 50mm as per AIS 052	Confirm and provide dimensional details
	Seat back rest height in mm	375 mm	Confirm dimensions
f	Torso angle (degrees)	Minimum 12 as per AIS 052	Confirm

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
g	Seat materials	'Poly Propylene Low Density / Low density Poly Ethylene (PPLD/LDPE)' moulded. Ref AIS:023 & bus code for performance	Confirm and provide dimensional and specs details
h	Seat frame structure material where required:	Frame Structure of ERW steel tube	Confirm and provide dimensional and specs details
i	Free height over seating position in mm	More than 900 as per AIS 052	Confirm dimensions
	Seat base height:	450± 50 as per AIS 052	Confirm dimensions
j	Clearance space for seated Passenger facing partition mm	AIS 052	Confirm dimensions
k	Upholstery:	Not required.	
l	Area for seated passengers (sq.mm.):	400*350	Confirm dimensions
m	Area for standee passengers (sq.mm.):	Ref Annexure I for ready ref. (As per AIS 052)	Confirm dimensions
n	Number of seats	Minimum 40	Confirm and provide no. of passenger seats
o	Number of standees (calculation as per AIS 052)	27-32	Confirm and provide no. of standees
p	Carrying capacity of bus (seated + standees) and crush load	Minimum 60, with crush loading of 90 passengers	Confirm and provide details
q	Seats side facing location	Not recommended	Confirm
r	Seat back rest	Fixed	Confirm
	Seat belts & their anchorage	Not necessary except diver seat and those facing aisle and the wheel chair passenger (performance etc. as per AIS 052)	Confirm
s	Performance & strength requirements of:	√	

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
i	Driver seat	As per AIS 023	Confirm and provide dimensional and specs details
ii	Passenger seats	As per AIS 023	As per AIS 023
15.7.2	Gangway:		
a	Minimum interior head room (centre line of gangway) in mm	1900 mm including that in the rear overhang area as per AIS 052.	Confirm and provide dimensions
i	At front axle:	As per AIS 052	Confirm and provide dimensions
ii	At rear axle:		
iii	Other areas		
b	Gangway Width (mm) from gates to longitudinal space between rows of seats (Access to service doors)	minimum 650 mm (Refer figure-1 of UBS II/AIS 052) for front gate, minimum 850 mm for wheel-chair movement as applicable.	Confirm and provide dimensions
c	Gangway Width (mm) in longitudinal space between rows of seats	Minimum 650 mm (Refer figure-1 in UBS II/AIS 052) excluding armrests (armrests are not required) and including stanchions- will be measured from seat edge to seat edge, minimum 850 mm for wheel-chair movement if planned through the aisle.	Confirm and provide dimensions
d	Driver's working space	As per AIS 052	Confirm and provide dimensions
	Driver's seat	As per AIS 023 & AIS 052	Confirm and provide dimensional and specs details
15.8	Corrosion prevention & painting	As per clause 3.17 of AIS 052 and details brought out in Part I. Samples of all materials & joints would withstand two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117. Corrosion prevention & painting- As per AIS 052	Confirm
a	Corrosion prevention treatment	As per clause 3.17 of AIS 052 and details brought out in Part I. Samples of all materials & joints would withstand two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117. Corrosion prevention & painting- As per AIS 052	Confirm
	Internal surfaces of structural members		Confirm and provide process followed

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
	External surfaces of structural members	All structural members be treated for corrosion prevention internally as well as externally and painted using Polyurethane (PU) painting-based spray paint Details of paints used, surface treatment & preparation, corrosion prevention treatment, base primer coatings, number of paint coats to be applied etc would be supplied.	Confirm and provide process followed
	After drilling holes/welding		Confirm and provide process followed
	Inter metallic galvanic corrosion prevention		Confirm and provide process followed
b	Primer coating		Confirm and provide process followed and specs of primer coating used
c	Painting:		Confirm and provide process followed and specs of primer coating used
16	Electricals	Multiplexing provision for electrical circuitry	Confirm, type. Provide details and the drawings
16.1	Electrical cables:	BIS marked, copper conductors with fire retardant as per IS/ISO: 6722:2006 as per appropriate class. Conductor cross-section varying as per circuit requirements, minimum cross-section 0.5 sq mm. Quality marking may also be as per equivalent or better European, Japanese, US standards.	Confirm and provide details of specs, sizes, make etc. of each type of cable
16.2	Conductor cross section	As above and suitable to carry rated current (Japanese auto Standard JASO D0609-75 AV)	Confirm and provide details of specs, sizes, make etc. of each type of cable
16.3	Safety requirements of electrical	As per AIS 052 /UBS II	Confirm
a	Fuse	As per AIS 052 - fuse of rated current 1.5 times the load current of electrical equipment. Necessary in every electrical circuit	Confirm and provide details of specs, sizes, make etc.
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	Confirm and provide details of specs, sizes, make etc.
c	Location of cables away	As per AIS 052- Required for each such circuit	Confirm

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
	from heat sources		
d	Type approval of circuit diagram as per standards related to electric equipment/wiring	As per AIS 052 - Required for all items.	Confirm and provide details along with relevant certificates
e	Cable insulation with respect to heat	As per AIS 052	Confirm and provide details etc.
f	Battery cut - off switch (isolator switch):	Heavy-duty type capable of carrying & interrupting total circuit load --1 each near battery/driver	Confirm and provide details of specs, make etc.
16.4	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	Confirm. Provide Make ----, model----, specs--- of wiper motors and its subsystems
a	Wiper motor:	Speed control with time delay relay as per AIS 011.	Confirm. Provide Make ----, model----, specs--- of wiper motors and its subsystems
b	Wiper arm/blade:	AIS011 /AIS 052	As above wrt arms / blade
16.5	Driver cabin fan	1 number, 24 volts, 200mmdia fan as per provision of CMVR, matching interiors	Provide Make ----, model----, specs--- of fan
16.6	Lighting - internal & external and illumination	As per AIS 052.	Confirm and provide details of lighting / illumination
16.7	Illumination requirements/performance of:	As per AIS 052 / AIS 012	
a	Dash Board Tell-tale lighting/control lighting	As per AIS 052 & bulbs tested for photometry as per IS 1606:1996	Confirm and provide details of specs, wattage, make etc.
b	Cabin Lighting - luminous flux of all lamps for cabin lighting	As per AIS 052 with illumination level of ≥ 100 lux & ≤ 200 lux	Confirm and provide details of specs, wattage, make etc.

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
c	Passenger area lighting - luminous flux of all lamps for Passenger area lighting	As per AIS 052 with illumination level of ≥ 100 lux and ≤ 150 lux	Confirm and provide details of specs, wattage, make etc.
17	ITS enabled bus	As specified separately under ITS chapter of UBS II specifications / and or by ITS Consultant and generally as brought out at Para 32 in Part I.	
18	Safety related items:		
18.1	Driver seat belt & anchorage duly type approved.	Adjustable type driver seat with seat belt ELR recoil type, 3-point mounting as per CMVR & AIS 052 conforming to AIS: 005& 015.	Confirm and provide details of specs, type, make etc. of seat belt and anchorage
18.2	Passengers seat belt: Number:	Not necessary except diver seat, for seats facing gangway if any and the wheel chair passenger (performance etc. as per AIS 052)	Confirm
18.3	Driver/Passenger/wheelchair Seat Belt Anchorage		
18.4	Fire extinguisher:	As per AIS 052	Provide Make ----, model-----, specs--- of fire extinguishers
18.5	First aid box:	1 number, as per provision of CMVR	Provide Make ----, model-----, specs--- of first aid box and its contents.
18.6	Handrails Minimum length*diameter * height above floor in mm	Colour contrasting and slip resistant of aluminium tubing 32 mm dia, 3 mm thick.	Confirm and provide details of specs, size make etc.
18.7	Handholds:	Colour contrasting and slip resistant. 2 to 4 Numbers. hand holds per bay of polycarbonate transparent with provision for advertisements	Confirm and provide details of specs, sizes, make etc.
18.8	Stanchions:	Vertically fitted, with attachment to bus floor and to roof, aluminium tubing with Colour contrasting and slip resistant. 40 mm dia. & 3.15 mm thick. Rest As per AIS 052.	Confirm and provide details of specs, sizes, make etc.
18.9	Bells for Passenger convenience	High visibility bell pushes shall be fitted at a suitable height (≥ 1.2 metre on all/ alternate/convenient stanchions keeping in view convenience of passengers (including	Confirm and provide details of specs, sizes, make etc.

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
		wheel-chair passenger) and avoidance of unnecessary/ inadvertent operation by passengers. These would assist PwDs	
18.10	Security Cameras	One rear camera for bus reversing and at least two cameras in the passenger cabin area as per the specifications / supplies made by the ITMS service provider. One more camera in front of Driver to capture vehicle front side blind spots coverages	Confirm and provide details
18.11	Window Guardrails:	As per AIS 052.	Confirm and provide details of specs, sizes, make etc. where provided
a	In all city buses - minimum numbers.		
d	Other details:		
i	First guard rail at a height from window sill in mm		
ii	The distance between two guard rails in mm		
18.12	Entrance/Exit Guard/Step well guard:	800 mm minimum height extending ≥ 100 mm more than centre line of sitting position of the Passenger.	Confirm and provide details of specs, sizes, etc.
18.13	Emergency exit doors, warning devices etc.	As per AIS 052/CMVR	Confirm and provide details of specs, make etc.
18.14	Front/rear door, stepwell lights, door open sign	LED as per AIS 008	Confirm and provide details of specs, wattage, make etc.
18.15	Mirrors right/left side exterior / interior:	Convex as per AIS 001 & 002. Interior with double curvature	Provide Make ----, model-----, specs--- of rear-view mirrors
18.16	Towing device front and rear	Heavy duty for loads of 1.2 times (minimum) the kerb weight of the bus within 30° of the longitudinal axis of the bus. As per CMVR & IS 9760 - ring type	Confirm and provide dimensional and specs details
18.17	Warning triangle	As per AIS 052/CMVR	Provide Make ----, model-----, specs--- of warning triangle
18.18	Bumpers - front and rear	Both made of Steel or impact resistant polymer or combination of both meeting requirement of an energy absorbing system. Impact strength as per AIS 052	Confirm and provide details of specs, sizes, make etc.

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
	Impact strength for bumpers	Meet requirements of Para 6.3.1 of AIS 052	Confirm and provide details of impact strength etc. Para 6.3.1 of AIS 052 does not give any values, test standard and or test procedure. VM would hence be required to provide above details at the time of pre-bid meeting.
19	Miscellaneous items/requirements		
19.1	Windows		
a	Type of window	Windows - two piece in non-AC buses, where top portion, would be fixed and bottom portion would have sliding glasses. Minimum window glass/aperture area (main windows) in cm ² 14000. Toughened Glass of thickness 4.8-5.3 mm	Confirm and provide details of specs, sizes, make etc.
b	Minimum height of window aperture (clear vision)	≥ 950 mm	Confirm and provide dimensions
c	Minimum height of upper edge of window aperture from bus floor	As per AIS 052	Confirm and provide dimensions
d	Minimum width of windows (clear vision zone)	As per AIS 052	Confirm and provide dimensions
19.2	Cabin luggage carrier	Not required	
19.3	Life cycle requirements of bus (whichever is earlier)	9 years or 12,00,000 km, which-ever is earlier.	Confirm and provide details of mechanism of assessing life of buses
20	Additional requirements		Additional requirements
20.1	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	

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
		Driver's work area to be provided with a 200 mm diameter 24 V fan to ensure proper ventilation. The fan to have 3 – speed adjustment	Confirm and provide details of make, model and rating of fan.
21	Noise, vibration and harshness etc		
a.	Maximum noise levels inside the saloon-test procedure as per AIS 020	81dba	Confirm and provide details
b	Noise Vibration and Harshness levels when measured under city driving conditions on city roads with pot holes and speed breakers, etc	<ul style="list-style-type: none"> Vibration levels / Noise, vibration and harshness (NVH) levels (interior): - Noise level in saloon from drive axle, etc.: Nil - Dominant frequencies to fall outside the ranges of: 0.5-1 Hz, 5-7 Hz and 18-20 Hz • Transient vibration level in seating area maximum:1g • Transient vibration level at driver seat maximum:0.1g • Vibration levels at driver/Pax seats (metre/sec²) ≤ 0.5 • Vibration level in gangway (metre/sec²) ≤ 1 	
22	Fire Detection and Suppression System (FDSS)	<p>An automatic fire detection & Suppression system be essentially provided for engine and other fire sensitive areas of the bus. Possibility of provision of FDSS for entire bus including but not limited to engine area, drive line, fuel tanks, fuel filling point and fuel distribution lines / cluster, wheel wells, electrical systems etc.</p> <p>Additional fire extinguishers as per AIS 052 be provided</p>	FDSS provided for: - Name all systems, sub-subsystems; Indicate type, make & model of provisions in each case
a	Fire Condition Monitoring device	Pneumatic Electronic Linear fire detector with stainless steel tube with suitable diameter	Make and model of the fire detector; Dia. and specs of SS tubing;
b	Components for Fire Condition Monitoring Device		
i		Detector operating on rate of rise with Advanced Built in Test Module.	Make, model & specs;

S No	Description	Specifications	Bidder to confirm and provide details
		Standard floor (900mm floor height), 11 m long Type I NDX buses	
ii	Generally, as per UBS II, AIS 135, CMVR	Stainless steel Tube sensor with suitable diameter and should be rodent free	Specifications and relevant documents be provided
c	Detector Specification/ requirements: Generally, as per UBS II, AIS 135, CMVR (if any)	Detector should operate with Rate of Rise along with advanced Built-in Test Module that indicates failure in the event of reduced performance over the entire range of sensor tube.	
i	IP Rating	IP67	
ii	Enclosure	Aluminium	
iii	Operational Temperature Range	-40°C to +125°C	
vi	Shock & Vibration:	Should comply with: BS EN 61373, Table 1,2,3 MIL STD- 810:501.4, 516.5.4.	
v	Sensor Tube	1 Mtr. to 100 Mtr. in length. Stainless steel material with suitable diameter.	
vi	Operating Voltage:	18 - 32 V DC	
vii	Alarm Current:	40mA	
23	General		Confirm
a	Capacity of the Fire suppression system for each of the different areas	--- as decided by the Vehicle Manufacturer	Confirm
b	Material of Construction	VM to decide optimal materials and the containers for fire supersession for each of the fire sensitive areas of the Bus.	Confirm
c	Fire suppression system trigger mechanism for each of the fire prone areas	Pneumatically/ mechanically / electro-mechanically and or any other mechanism Operated	Confirm
d	Powder (if any used)	UL listed ABC 90%	Confirm

Annexure 1 to Part II above

A system of assessment of standee capacity in the bus: Standee spaces available in the bus
Formula for calculation of number of seats and number of standees permitted.

Dimension	Description	Area (In mm ²)
Area of the Driver Compartment	Width x Depth of Driver Work Area	Ad
Total projected Step Well Area (all stepwells)	Sum of projected Area of all Step Wells	As
Projected area of Engine	Width x Length of Engine projected on the floor Area	Ae
Area of any part of the Vehicle where vertical clearance is less than 1350 mm (Engine etc.)		Aw
Area required to provide a clear work area at service floor area occupied by any stair case		Ast
Area of parts where clear height above floor level less than 1900 mm (1750mm in case of mini bus)		Ac
Area of seat in facing partition	(300 mm x Total seat width)	Ap
Area of the parts where slope exceeds the maximum specified value for purpose of passengers		Asl
Total Area excluded for purpose of calculating seated passenger capacity	Sum (Ad+As+Ae+Aw+Ag+Ast+Ap)	Aex

Area of Gangway		Ag
Total internal Floor Area	Internal Width x Internal Length	Aint
Area for seated Passengers	Aint-(Aex+Ag)	Apass
Area for standee passengers	2Ag – (Ac + Asl + 150mm x Length of Gangway)	Astd

Note: Value of Astd is the solution of following three equations –

$$A_{ex} = A_d + A_s + A_e + A_w + A_{sl} + A_g + A_{st} + A_p$$

$$A_{pass} = A_{int} - (A_{ex} + A_g)$$

$$A_{std} = A_{int} - (A_d + A_s + A_e + A_w + A_{st} + A_c + A_p + A_{sl} + A_{pass} + 150\text{mm} \times \text{Length of Gangway})$$

Formula for calculation of seating and standee passenger areas

Dimension	Description	Result
No of Seats permitted	$A_{pass} / (\text{seat pitch} \times \text{Seat Width})$	No. of seats
No of Standees permitted	$A_{std} \times 5 \times 10^{-6}$	No. of standees

Annexure II – A copy of bus code AIS 052

Annexure III – An indicative list of materials to be tested

Annexure III: Indicative list of items to be tested		
S No	Items to be tested	Specifications
1.	CR Tubular sections	BIS:4923-1997 (or latest) of Grade Yst.-240
2.	Phosphating / Galvanizing	BIS:3618-1966 (or latest) Class A-2 for Phosphating & BIS:277-2003 or latest - 120 gsm for Galvanizing (Zinc Coating) and two weeks (336 hours) Salt Spray Test for both in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%.
3.	EPDM Rubber	As per AIS 085
4.	Glasses Laminated	BIS: 2553 (Part-2)-1992 (or latest) Float Glass, Front 'AA' Grade Glass, PVB Film in Laminated Glass.
5.	Aluminum Parts	IS:733-1974 (or latest) for Solid Part, IS:1285-1975 or latest for Extruded Round Tube & Hallow Part and IS:738-1977 or latest for Drawn Tubes, Alloy 63400, tempering WP.
6.	Paint	PU Paint as per relevant IS: 13213:1991 (or latest) & any other relevant BIS Standards. For Matt Black Paint the Gloss Value is up to 30 units.
7.	LT Wire	BIS: 2465-1984(or latest). DIN 72551- Dimensional Test JIS C 3406- Spark, Immersion & Conductor Resistance Test' SAE recommended J 1127 & J 1128
8.	Aluminium Sheet	BIS:737-1986(or latest), Aluminium Alloy H-2/31000
9.	CR sheets	BIS:513-2008(or latest)
10.	GI Sheets	BIS:277-2003 (or latest), Class-VIII Medium Coating of Zinc Nominal Weight 120 grams/M2.

11.	Passenger Seat Assembly	As per AIS-023, Bus Code & BIS Standards. For MS components two weeks (336 hours) Salt Spray test for both in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%.
12.	Marine Board / Board / another floor material	BIS: 710-1976 (or latest) IS:5509-2000 (or latest) for Flammability.

Annexure IV – Specifications for Intelligent Transport System (ITS)

Functional Specifications for ITS		
#	Parameter	Specifications
AVLS		
1	Single Controller Unit (SCU)	<ul style="list-style-type: none"> The route programming file upload capability should also be catered through SD card/USB port to support redundancy Route selection function is to be provided on BDC with easy sorting of routes Integration with BDC through latest interface mechanism. The Controller Unit shall have a time-of-day clock and calendar. The time and date shall be synchronized as per IP based timing protocol (configurable) with the central software time. Local battery backup for minimum half hour for the smart start and shutdown of the SCU.
2	Bus Driver Console	<ul style="list-style-type: none"> All driver related route information to be displayed on BDC In-built light sensor with continuously variable brightness control to enable the display intensity to change based on ambient light conditions. BDC supports the following functions: <ul style="list-style-type: none"> Driver login & logout Route selection Route start Automatic Bus Stop Announcement Manual Bus Stop Announcement Special Announcements PA- Passenger Announcements Two-way voice communication

Functional Specifications for ITS		
#	Parameter	Specifications
		<ul style="list-style-type: none"> ○ SMS ○ Messaging • Emergency alarms • 4 section camera views to be supported on BDC after cameras are installed in future.
On-Board Display Units		
1	Viewing distance	<ul style="list-style-type: none"> • Front, side and rear signs 50 metres minimum, for single line text, in day and night. • Inner 15 metres minimum, for single line text in day and night.
2	Display Characteristics	<ul style="list-style-type: none"> • Fixed, scrolling and flashing mode (with fixed route number, up to minimum 40 characters for scrolling mode, on front, side and rear signs). • Capability to show customized graphics. • Scrolling Two lines - English followed by Tamil and then local language. • Total display height should accommodate two lines and the individual heights of each line should be adjustable to enable one line to be larger/smaller than the other line. However, during next stop announcement only single line text is required • It should be possible to display, concurrently, different messages on each of the signs (front, rear, side and inner). • It should be able to display special signs like signs for 'PWD enabled bus', 'ladies special'. • Capability to show special characters like (, “, . ! + - * : ?) • Signs should have ability to retain the last message displayed in the memory of the sign even in the event of power failure and without the message being reloaded. • Display and voice announcement in English, Tamil and other local languages • The display systems shall have in-built test facility, able to carry out self-check at periodic intervals, carry out exchange of diagnostic information from the central control stations including power availability, its current status etc. • The display system shall support remote settings such as display intensity, time synchronization etc. • PIS displays shall be managed locally without workstation or server.
3	Hardware Programming Capabilities	<p>The hardware to be procured shall have minimum below system programming capability:</p> <ul style="list-style-type: none"> • The system should enable driver to communicate via audio call to the control centre.

Functional Specifications for ITS		
#	Parameter	Specifications
		<ul style="list-style-type: none"> The system should enable driver to send out from a list of pre-defined messages to the control centre Support minimum 3000 routes UP and DOWN (average 10 stops per route) of signboards supplied. GPS triggered next stop display on Inner sign with synchronized voice announcement on each route. The system should be able to specify geo-fence boundary individually and collectively for next, upcoming and current station announcements. The current stop announcement should be correct to 5 metres. The inner sign should be able to display and announce up to three languages, one after the other in sequence. For example, make display an announcement in English, then Tamil and then any local language Display driver and conductor ID once in between the stops on Inner sign Inner sign should be able to display text and customized graphics and announce pre-recorded messages on SCU(OBU) display panel of the controller. The system should have provisions to add more text and audio messages. Functionality of Display 'clock'-GPS based or 'Default Messages' on Inner sign Emergency 'stop' request function- by pressing an emergency switch placed anywhere in the bus the inner sign should display 'stop' message and buzzer located near the driver makes the sound alerting the driver to stop the bus. In case one or more signs get disconnected (malfunction), the rest of the signs should continue to function regardless (including fresh communication from SCU) Sign should be able to store 'Diagnostic Trouble Codes' (DTC)', 'Parameters Identifiers (PID) and with retrievable data. The system should be capable of raising alarms based on vehicle statistics (engine overheating, low fuel, etc.) The route programming files, stops, messages, etc should be updated to the on-board unit over USB, Ethernet, Wi-Fi, etc. from Server (at least one online method and one offline method provision to be given). The system should allow the control centre to view the route selected by driver. It should be possible to change/choose/select a 'route' remotely over the air from Operations Control Centre. All SCUs (OBU) should connect in real-time to the central system via GPRS, 4G and above, Wi-Fi, etc. All firmware updates to the OBU should be via USB, Ethernet, W-Fi and OTA.

Functional Specifications for ITS		
#	Parameter	Specifications
		<ul style="list-style-type: none"> PIS displays should be capable to be managed locally without workstation or server. The SCU shall have the capacity to store static information in the display controller (including schedules), which shall be shown if the communication link is lost and after real-time information expires. The proposed hardware should be able to provide backend software capability to <ul style="list-style-type: none"> Assess the status of a running vehicle in terms of on-time, delayed and early arrival by comparing with schedule Generate Reports in terms of <ul style="list-style-type: none"> GPS outage, loss of connectivity and their frequencies and durations Missed trips, missed stops, route violation, un-scheduled stoppage, late start, etc. for performance analysis. <p>Driving patterns, over-speeding, harsh braking, etc.</p>
PA System		
1	Public Announcement (PA) System	The Voice PIS must play clearly audible pre-recorded voice announcements (in three languages) informing passengers of next bus stop on route. The voice PIS shall interface with the on-bus GPS module to gather location information and making the appropriate next station announcement.

Technical Specification for ITS - AVLS Hardware (SCU/OBU, BDC and Onboard Panic Button)		
#	Parameter	Minimum Specifications
I Single Controller Unit (SCU) / On-Board Unit (OBU)		
1.	Certification	Compliant to IS 16833 or UBS-II
2.	Operating Voltage	9 to 36 V DC
3.	Surge Protection	Enabled
4.	Power source	Connected to vehicle key-on/ignition-on
5.	Interface	CAN 2.0/ OBD II, RS 485, RS 232, fast Ethernet, USB, digital outputs, digital/Analog inputs, WLAN, audio input output, amplified audio output
6.	Communication	4G or above, Wi-Fi
7.	Protection	IP 65 or above as per UBS II or IP 54 as per IS 16833
8.	Temperature	-10° C to + 70° C
9.	Humidity	5% to 95 %
10.	Vibrations	10g
11.	Operating System	Embedded windows/Linux or similar (Latest version) (Windows 7 or latest at the time of calling the tenders)
12.	Processor	64-bit low power Industrial grade outdoor processing unit
13.	Memory	Flash: Min 4 GB, RAM: Min. 512 MB (RAM memory includes SCU (OBU) and BDC).

Technical Specification for ITS - AVLS Hardware (SCU/OBU, BDC and Onboard Panic Button)		
#	Parameter	Minimum Specifications
14.	Storage	Provision for 512 GB HDD (256 x2 GB – SSD) card and support up to 1 TB. OBU shall support at least 7 days of recording for all bus camera.
15.	GPS	In built GPS, 4G and above (GSM) modules
16.	Antenna	Combi antenna using RG174 cable. The connectors on Combi antenna will be preferably SMA(M) ST plug type for GPS and FME(F) jack type 1/4"-36UNS-2B for 4G and above
17.	Audio Storage and playback	<ul style="list-style-type: none"> In-built MP3, WAV, etc. files storage/playback function.
18.	Microphone Input and Audio Output	In built two channel amplifiers minimum 10 Watts rms each suitable for 4 ~8 Ohm impedance with input for external microphone
19.	Power Supply	Power to SCU (OBU) and BDC will be supplied through power-back external battery and subsequent bus multiplexing wiring system
20.	mNVR capabilities	Should have inbuilt or integrated capabilities for a SCN System as per UBS II guidelines or IS 16833 for future requirements where the system shall consist of High-Resolution cameras for Video and Audio recordings for monitoring purposes
II	Bus Driver Console (BDC)	
1.	Operating Voltage	9 to 36 V DC (preferable through SCU(OBU))
2.	Connectivity	Power/data connection to Single Controller Unit
3.	Protection	IP 65 or above as per UBS II
4.	Mounting	Theft/vandal proof
5.	Temperature	-10° C to + 70° C
6.	Humidity	5% to 95 %
7.	Vibrations	10g
8.	Display	Full colour graphic TFT - Min 640 x 480 dots, Size Min. 8"
9.	Viewing Angle	60 H / 70 (right/left) / 60 V / 70 (up/down)
10.	Backlight	Adjustable
11.	Keyboard	Display with physical keys OR Full touch screen with user friendly interface for navigation, scrolling, route destination code selection, etc.
III	GPS modules	
1.	Rating:	22 tracking/66 acquisition minimum
2.	Tracking sensitivity	(-) 165 dBm typ
3.	Navigation sensitivity	(-) 148 dBm typ
4.		<ul style="list-style-type: none"> Update rate 1 Hz (configurable to 10 Hz)

Technical Specification for ITS - AVLS Hardware (SCU/OBU, BDC and Onboard Panic Button)		
#	Parameter	Minimum Specifications
		<ul style="list-style-type: none"> Time to first fix cold acquisition 35 seconds typ Hot acquisition 1 second typ. Navigation accuracy 3M horizontal
IV	4G and above (GSM) modules	
1.	GSM/GPRS	GSM/GPRS SMT quad band and UMTS (4G and above)
2.	Data Acquisition and Transmission	Specifications as per AIS 140 standards. The detailed list of configurable data fields is provided in Annexure below
3.	Temperature	Temperature range -10° C to + 70° C
V	'Combi' Antenna	
1.		AMPS 850MHz, GSM900MHz, ISM868MHz, DCS1800MHz, PCS1900MHz, 4G UMTS 2.1GHz, Wi-Fi /Blue Tooth (2.4 GHz), GPS (1575.42MHz). Separate WLAN antenna may be provided if necessary.
2.	GPRS	<ul style="list-style-type: none"> Impedance 50 Ohm Radiation pattern Omni-directional Polarization linear (vertical)
3.	GPS	<ul style="list-style-type: none"> Impedance 50 Ohms VSWR <1.5:1 Polarization RHCP
4.	Waterproof	Waterproof IP-66
VI	On-board Panic Button	
1.	Power Supply	9 to 36 V DC
2.	Connectivity	Serial/digital input to SCU(OBU)
3.	Protection	IP 65 or above
4.	Temperature	-10° C to + 60° C
5.	Humidity	5% to 95 %
6.	Vibrations	10g
7.	Use	Easy to press
8.	Placement	Convenient placement. Prevent accidental trigger
9.	Mounting and Casing	<ul style="list-style-type: none"> Unit should be fixed securely at the chosen position The casing should be theft proof, tamper proof and vandal proof All fixtures and mounting should be certified by qualified structural engineers for capability to withstand vibrations and fixture safety

On Board Display Units and Announcement System		
#	Parameter	Minimum Specifications
I	Front Outer LED, Rear Outer LED, Inner LED, Side LED	

On Board Display Units and Announcement System		
#	Parameter	Minimum Specifications
1.	Certification	UBS II certification
2.	Route Board Sizes	<ul style="list-style-type: none"> • Front Outer LED - minimum 1800X220 mm • Rear Outer LED - minimum 900X220 mm • Side Outer LED - minimum 900X220 mm • Inner LED - 800X100mm
3.	Operating Voltage	9 to 36 V DC
4.	Power Consumption	1 Amp. @ 24 V DC
5.	Surge Protection	Enabled
6.	Connectivity	RS 485 or similar
7.	Protection	IP 65 or above
8.	Temperature	-10° C to + 70° C
9.	Humidity	5% to 95 %
10.	Vibrations	10g
11.	Firmware	Firmware update and version check through controller
12.	Colour	Single colour (Amber, can vary)
13.	Viewing Angle	Minimum 120 H / 60 V
14.	Intensity	Continuous variable brightness control
15.	Viewing Distance	50 m, Inner 15 metres minimum, for single line text in day and night
16.	Memory	Ability to retain last displayed message
17.	Display Modes	Fixed, scrolling, flashing
18.	Mounting	<ul style="list-style-type: none"> • All units should be fixed securely at the chosen position • The casing should be theft proof, tamper proof and vandal proof • All fixtures and mounting should be certified by qualified structural engineers for capability to withstand vibrations and fixture safety
19.	Display Language	Two Lines multi-language display capability (English, Tamil or other language as indicated.)
II	Announcement System	
1.	Coverage	The announcement system should provide uniform coverage throughout the vehicle at optimum decibels by use of multiple speakers placed for equal sound distribution
2.	Speakers	at least 6
III	Passenger Announcement (PA) System	
A	Microphone	
1.	Frequency Response	200 – 8000 Hz
2.	Sensitivity	2.3mV/Pa
3.	Impedance	500Ω
4.	Coiled Cord	1.8 – 2.5 m
B	Speakers	
1.	Nominal Impedance	4E ± 15%

On Board Display Units and Announcement System		
#	Parameter	Minimum Specifications
2.	D.C Resistance	3.7 ohms
3.	Resonance Frequency	170 Hz \pm 20%
4.	Frequency Range	Fo~ 20KHz
5.	Sound Pressure Level	90dB \pm 2dB @300,400,500,600Hz
6.	Buzz & Rattle test	6.99 V
7.	Rated Input	15-Watt, Maximum Input: 20 Watt

Bus Security Network Camera		
#	Parameter	Minimum Specifications
I Reverse Parking Sensor Camera		
1.	Power Supply	PoE through BDC, should be automatically switched on with engine and power down on ignition off.
2.	Fixed lens	3.6 mm
3.	Picture Resolution	752 H x 582 V (PAL)
4.	Resolution	25/30fps@1080P
5.	Picture Sensor	1/3" 2 Megapixel progressive scan Aptina CMOS,
6.	IR distance	Min 30 m
7.	Image Enhancement	DWDR, Day/ Night (ICR), 3DNR, AWB, AGC,BLC
8.	Protection	Minimum IP 66
9.	Temperature	-10 deg C to + 60 deg C
10.	Humidity	5% to 95 %
11.	Vibrations	10g
12.	Camera Ruggedness	<p>Rugged, vibration, shock and tamper proof Metal housing, Aviation Connectors</p> <p>Installation: Anti Vibration with Adjust Angle;</p> <ul style="list-style-type: none"> Horizontal: 0~355 degree with 3-point locking Vertical:0~90 degree with 2-point locking
13.	Function	Camera should engage with the reverse gear engage on buses and display the back-view of the bus on BDC display to the driver. Camera should make alert to the driver based on the distance from the objects while reverse the bus.

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
Telematics System		
1	Telematics Parameters	As per UBS II guidelines, the data from multiplexing nodes, on a single CAN 2B (J1939) bus should include parameters from:

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
		<ol style="list-style-type: none"> 1. Vehicle electrical system powered through multiplexing nodes 2. Vehicle safety and performance features 3. Engine and transmission 4. Diesel bus electronics data
1a	Vehicle electrical system	All external and internal fixtures like passenger/driver compartment illumination and ITS equipment
1b	Vehicle safety and performance features	<ul style="list-style-type: none"> • Fuel /Oil level/ Pressure • Fuel Level Indicator System (in Litres) - Display in Dashboard • Braking pedal position • Accelerator pedal position and kick down • Brake pad condition and brake pedal temperature (in case of electronically controlled disc brakes) • Door interlock • Kneeling interlock (wherever provided) • Gas leakage detection (wherever provided) • Fire detection/suppression (wherever provided) • Tyre Pressure Monitoring System (To ensure Tyre Air Pressure and Tyre Temperature in each wheel) • Tubeless Tyre -Parameters (like Pressure, skid indicators) • Battery Health condition monitoring System
1c	Engine	<ul style="list-style-type: none"> • Engine CAN status • Engine oil pressure • Engine coolant temperature • Engine speed in RPM • Vehicle speed (torque) • Diagnostic message (engine specific)
1d	Transmission	<ul style="list-style-type: none"> • Transmission CAN status • Transmission output shaft speed • Transmission input shaft speed • Transmission current gear • Transmission oil filter restriction switch • Transmission oil life remaining • Transmission service indicator • Transmission sump oil temperature • Transmission oil level high / low • Hydraulic retarder oil temperature • Accelerator pedal • Diagnostic message (transmission specific)

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
1e	Diesel bus electronics data	<ul style="list-style-type: none"> • Drivers demand of engine torque percentage • Actual engine torque percentage • Engine and retarder torque • Engine speed • Source address controlling device • Engine starter mode • Engine demand torque percentage • Accelerator pedal 2 low Idle switch • Road speed limit status • Accelerator pedal kick down switch • Accelerators pedal low Idle Switch • Accelerator pedal position • Percent load at current speed • Remote accelerator pedal position • Accelerator pedal position 2 • Vehicle acceleration rate limit status • Engine temperature • Engine coolant temperature • Fuel temperature • Engine oil temperature • Turbo oil temperature • Engine intercooler temperature • Engine intercooler thermostat opening • Engine fluid level pressure • Fuel delivery pressure • Extended crankcase blow by pressure • Engine oil level • Engine oil pressure • Crankcase pressure • Coolant pressure • Coolant level • Coolant level, Coolant Condition (% of Ethylene Glycol) • Alternator (Volt) Output monitoring System
1f	Connector	<ul style="list-style-type: none"> • CAN 2.0 (J1939 Connector) / OBD-II Connector
1g	Communication	Telematics System (VHMD) real time warning to CCC <ul style="list-style-type: none"> ○ Open public communications network services (4G and above) and download compatibility

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
		Telematics System (VHMD) end of the day to depot <ul style="list-style-type: none"> IEEE 802.11 Wireless LAN (Wi-Fi) via 'Back haul' at depot

Testing Standard Compliance		
#	Test standards compliance	Specifications
1.	Performance parametric test	Nine points, tri temperature/tri voltage- 18V, 27V, 32V, -25°C, room temperature, +85°C test. At each test point the system will be powered on and shut down 5 times as per the supplier's designated procedure and thereafter evaluated for malfunction if any
2.	Cold	IS 9000 (Part II/Sec 4)-1977 (reaffirmed 2004) at -25°C for 2 hours in 'on' condition
3.	Dry heat	IS 9000 (Part III/Sec 5)-1977: PIS Signs, SCU(OBU) and Nodes at +80°C for 16 hours in 'on' condition. BDC at +80°C for 2 hours
4.	Damp heat	IS 9000 (Part V/Sec 2)1981 at +25°C /+55°C, Humidity 95%, 24 hours for 6 cycles in off condition. Functional test with power in 'on' condition at start of 2nd, 4th and 6th cycle
5.	Vibration standard AIS 012/AIS:062 -10g	<ul style="list-style-type: none"> Frequency 5~50Hz and return to 5Hz at a linear sweep period of 1 minute/complete sweep cycle and 10g at maximum frequency Excursion -1.6 mm peak to peak over the specified frequency range Test duration 60 minutes Direction of vibration -X, Y, Z axis of device as it is mounted on the vehicle.
6.	Dust and water ingress protection	IS /IEC 60947-1:2004 in conjunction with IS/IEC 60529:2001- 'PIS signs' IP66, 'SCU'(OBU) IP 65, 'BDC' IP65, 'nodes' IP54
7.	Free fall	IS 9000 (Part VII/Sec 4) Free fall at 500 mm, (applicable to 'nodes' and 'controllers' only)
8.	Fire resistant	Regulation directive 95-28/EG dated 24-10-1995 horizontal Burning rate tested as per ISO 3795, Horizontal burning test HB as per UL 94 -1998 clause 7 (for wire harness)
9.	Reverse polarity protection without fuse	The component must fulfil the function- and service life requirements after being subjected to reversed polarity up to 27 V for 2 minutes.
10.	Over voltage protection	To ensure service life requirements and functionality. The component shall run for 60 minutes at 38V, without effecting the service life or function.
11.	Insulation resistance	The Insulation resistance measured as per ISO 16750-2 with a voltage of 500 V dc shall not be less than 1Mega ohm.
12.	Cranking voltage	The components shall have an electrical energy reserve that can handle voltage drop during cranking. Component shall not reset during cranking- 'FSC B'. The supply voltage during crank is 18.0 V for 40 ms. The test to be carried out as per ISO 7637

Testing Standard Compliance		
#	Test standards compliance	Specifications
13	Load dump test on controller	123V ,8 Ohms 200ms pulse 5a as per standard ISO 7637-2
14	Salt spray test	(AIS: 012/ IS10250) 96 hours
15	EMC/EMI	1.Electromagnetic radiation, radiated immunity and compatibility as per AIS 004 (Part 3) or 2.72/245/EEC last amended by 2009/19/EC (includes 2004/104/EC, 2005/83/EC, 2006/96/EC) and UN ECE Regulation Number 10 Rev 3:2008 Note: In case of product is 'e' marked and a detailed test report is submitted (which includes above tests) no fresh verification is necessary
16	Operating parameters	Supply voltage 24 V± 25%
17	LED colour test – dominant wavelength amber	AIS -012
18	LED chromaticity coordinates	Limit towards green: $y \leq x-0.120$ Limit towards red: $y \geq 0.390$ Limit towards white: $y \geq 0.790-0.670x$ In accordance with CIE 127 condition B
19	LED bulb/SMT intensity and viewing angle	In accordance with CIE 127 condition B

Test compliance as per IS 16833	
#	Tests
1.	Performance parametric test (Tri Temperature / tri voltage)
2.	Shock and Vibration test
3.	Ingress protection (IP)
4.	Over voltage protection test
5.	EMI/EMC test
6.	Load dump test, Pulse 5a
7.	Reverse polarity protection without fuse
8.	Test for wiring harness
9.	High temperature test
10.	Cold Test
11.	Damp heat test
12.	Insulation resistance test
13.	Thermal shock test
14.	Salt spray test
15.	High voltage test
16.	USB port overloading test
17.	Endurance test
18.	Free fall test

19.	Protocol testing
-----	------------------

Annexure V – Indicative List of Data Types and Packet Format for Onboard ITS for Integration with Backend Systems

#	Required Data Field	Descriptions
1.	Start Character	\$
2.	Header	The header of the packet/ identifier
3.	Vendor ID	Vendor identification header
4.	Firmware Version	Version details of the Firmware used in EX.1.0.0
5.	Packet Type	Specify the packet type <ul style="list-style-type: none"> • NR = Normal • EA = Emergency Alert • TA = Tamper Alert (Optional) • HP = Health Packet • IN = Ignition On • IF = Ignition Off • BD = Vehicle Battery Disconnect • BR = Vehicle Battery Reconnect • BL = Internal Battery Low
6.	Packet Status	L=Live or H= History
7.	IMEI	Identified of the sending unit. 15-digit standard unique IMEI no
8.	Vehicle Reg. No	Mapped vehicle registration number
9.	GPS Fix	1 = GPS fix OR 0 = GPS invalid
10.	Date	Date value as per GPS date time per GPS date time (DDMMYYYY)
11.	Time	Time value as per GPS date time in UTC format (hh:mm:ss)
12.	Latitude	Latitude value in decimal degrees (not less than 6 places)

#	Required Data Field	Descriptions
13.	Latitude Dir	Latitude Direction. Example N=North, S= South
14.	Longitude	Longitude value in decimal degrees (not less than 6 places).
15.	Longitude Dir	Longitude Direction. E=East, W= West
16.	Speed	Speed of Vehicle as Calculated by GPS module in VLT. (in km/hrs.) (Up to One Decimal Value)
17.	Heading	Course over ground in degrees
18.	No of Satellites	Number of satellites available for fix
19.	Altitude	Altitude of the device in metres
20.	PDOP	Positional dilution of precision
21.	HDOP	Horizontal dilution of precision
22.	Network Operator Name	Name of Network Operator
23.	Ignition	1= Ignition On , 0 = Ignition Off
24.	Main Power Status	0 = Vehicle Battery disconnected 1= Vehicle Battery reconnected
25.	Main Input Voltage	Indicator showing source voltage in Volts. (up to One Decimal Value)
26.	Internal Battery Voltage	Indicator for level of battery charge remaining. (up to One Decimal Value)
27.	Emergency Status	1= On, 0 = Off
28.	Tamper Alert (Optional)	C = Cover Closed, O = Cover Open
29.	GSM Signal Strength	Value Ranging from 0 – 31
30.	MCC	Mobile Country Code
31.	MNC	Mobile Network Code
32.	LAC	Location Area Code
33.	Cell ID	GSM Cell ID
34.	NMR (Network Measurement Report) Neighboring Cell ID	Neighboring 4 cell ID along with their LAC & signal strength
35.	Digital Input Status	4 external digital input status (Status of Input 1 to Input 3 (0=Off; 1=On))
36.	Digital Output Status	2 external digital output status (0=Off; 1=On)
37.	Frame Number	Sequence Number of the messages (000001 to 999999)
38.	Checksum	Insures No error in transmission (optimal)
39.	End Character	Indicated End of the frame

This are the indicative list of the data that required to integrate with backend system. Authority may come-up with the additional data types to be integrate with the backend system during the contract period. Bidder shall have to support into the requirement gathering and generation of the data types as and when authority desires in entire contract period.

**Diesel fuelled, 11 metre long, standard floor (1150 mm floor height),
BS-VI compatible, fully built Type II NDX bus - Specification**

1

**Diesel fuelled, 11 metre long, standard floor (1150 mm floor height), BS VI compatible, fully
built Type II Non-Deluxe (Type II NDX) bus –
Specification**

Tamil Nādu State Transport Corporation (TNSTC)

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PART I – GENERAL REQUIREMENT

**Specifications for diesel fuelled, BS VI compliant, Standard Floor (1150 mm floor height),
11 metre long Fully built type II NDX (Non-AC) Buses**

1. INTRODUCTION AND SCOPE:

End-use requirement-oriented specifications, with maximum make / model neutrality, for fully built diesel fuelled Internal Combustion Engine (ICE) propelled Bharat Stage VI (BS VI) compliant Non-Deluxe (NDX) **1150** mm floor height 11-metre-long **type II NDX** buses for Public Transport (PT) System of TNSTC are brought out here. 11-metre-long **type II NDX** buses are proposed to be deployed for PT operations in urban, peri-urban and the contiguous areas (designated areas). Bus Manufacturer would furnish technical details for assemblies / sub-assemblies/ systems/ equipment as per Technical Specification of this Section in appropriate formats.

The specifications cover end-use-based design, evaluation, fabrication & testing features of diesel fuelled 11-metre-long **type II NDX** buses for transportation of passengers mainly in TNSTC's designated PT operational areas. The bus design should be modern, energy efficient, environment friendly, safe, efficient and reliable besides meeting all statutory, regulatory, legal and other requirements, as also those related to easy passenger accessibility including for Persons with Disabilities (PwDs); passenger comfort, driver's work place, internal and external aesthetics, ease of repair and maintenance etc.

Specifications would comply with all applicable Central, State and local laws (including Acts, Rules & Regulations). These would include, but not be limited to, the provisions of Disability Act 1995 as amended till date as well as state and local accessibility, safety, emission and other requirements. The bus would meet or exceed the Central Motor Vehicles Rules (CMVR) of India / Safety Norms, Emission, Noise& other norms applicable at the time of supply. In the event of any conflict between requirements emanating from this specification and those as per any statutory/legal, etc. in force, the superior/ higher requirements/Standards would prevail.

The word "Bus" or "Buses" wherever used in the specification means the "> 10800 mm long diesel fuelled BS VI compliant non-air-conditioned 11-metre-long standard floor bus with **1150** mm \pm 10 mm floor height" as per specifications given in this document. The **type II NDX** buses would have right hand drive.

For PT operations in designated areas of TNSTC, a fully built **type II NDX** bus as per specs detailed in this document and those of AIS 052/ AIS 153 / UBS II / CMVR / TNMVR, BIS Standards, etc is envisaged.

The specifications / standards / norms / regulations etc mentioned in this document are generally as prevalent in India. However, any other national / international specifications / standards / norms / regulations, equivalent and or better than those indicated in this document, would meet the requirement. The proof of ensuring equivalence etc in all cases shall be enclosed with the bidding document by the agency referring to them.

The vehicle manufacturer shall ensure to meet the requirements as given in Bus body Code and CMVR (bus body code AIS052, AIS153 and others as applicable for fully built bus) and also comply with harmonized guidelines applicable for various floor heights of bus variants as per amendments and other statutory / mandatory provisions as on date, issued by the Government, at the time of submission of tender.

2. GENERAL DESIGN FEATURES OF THE 11-METRE-LONG FULLY BUILT TYPE II NDX BUSES:

- 2.1. Fully built buses would generally be designed and manufactured in accordance with the applicable aspects of urban Bus Specification (UBS II) & 'Code of Practice for Bus Body Design and Approval' (AIS 052)- hereinafter referred to as Bus Code; as applicable to

buses in India /CMVR rules/Tamil Nadu Motor Vehicle Rules (TNMVR) whichever is superior. Details of relevant standard followed would be indicated against each item.

- 2.2. Fully built bus design would consider all other aspects / provisions to be made on proposed buses facilitating ease of mounting /erection bus body on the chassis without causing any damage / defect to chassis / its aggregates etc. and further facilitating ease of repair and maintenance of all other fitments / aggregates provided on bus chassis, etc.
- 2.3. Bus would be designed to carry commuters in TNSTC with ease of boarding and alighting especially for ladies, senior citizens and PwDs.
- 2.4. Bus design would be suitable for daily operation of 10 to 14 hours in TNSTC with peak loading of more than 52 passengers in 11-metre-long buses (each passenger weighing 68 Kgs on an average and carrying a load of 25 kgs each), average journey speed of about 45 Kms per hour with frequent starts/stops, say, after every 1500 to 2500 metres. The minimum max attainable speed of the bus would be in range of 90 kmph with cruising speeds of about 60 kms per hour.
- 2.5. Bus design would be eco-friendly, energy efficient, safe, and comfortable meeting specified exhaust emissions norms (Bharat Stage VI or Euro-VI or latest as amended up to date of supply).
- 2.6. Bus must be of proven design suitably modified to climatic & operational conditions, infrastructure and road conditions obtaining in operational areas of TNSTC.
- 2.7. Bus design should meet all statutory requirements applicable to TNSTC in all respects.
- 2.8. The bus structure would meet requirements of structural strength, stability, deflection, vibration, crashworthiness, roll over protection etc. amongst others for at least the following main static and dynamic loads including those as per annexure 3 of UBS II:
 - i. Static loads
 - ii. Dynamic loads
 - iii. Single wheel bump loads
 - iv. Double wheel bump (diagonally opposite) loads
 - v. Braking and acceleration loads
 - vi. Front impact loads
 - vii. Rollover loads
 - viii. Speed breaker induced loads
- 2.9. Bus design would be a proved design duly evaluated by agencies authorized as per CMVR using Finite Element Analysis and or any other mechanism for above loads / performance requirements for values for above loads/ conditions /performance parameters as given in subsequent paragraphs.
- 2.10. Minimum required performance values/ data for above load conditions may be considered as follows:
 - i. Strength (Factor of safety): minimum of 1.35 i.e. design stress would be $1/1.35^{\text{th}}$ of yield stress.
 - ii. Stiffness (Deflection): 5mm.
 - iii. Vibrations (Lowest Natural Frequency): 5Hz

iv. Frontal Impact:

(Velocity = 56 Kmph against fixed rigid barrier)

- Head Injury Criterion (HIC) = 1000
- Crumbled Zone = 132mm
- No part of structure would intrude into residual space.
- (HIC= Head Injury Criterion calculation is based on acceleration level at the head of driver/ passenger & time duration during which maximum value of above acceleration is build up. Typical acceleration at the head should not exceed 80g continuously for 3 milliseconds to avoid head cracks).

v. Roll over (as per bus code – AIS 052) tests with modifications of making the bus roll from ground level instead of the raised platform:

- (i) Bus tilted to its unstable position
- (ii) Bus allowed to fall freely under gravity from this position.
- (iii) Gross vehicle weight of the bus is to be considered
- (iv) The Energy absorbed by the structure = 0.75 E_R

{ E_R =Reference energy-- the Potential energy of the bus in its (unstable) equilibrium position}.

$E_R = M.g.h$, Where M= Effective weight of the bus; g = Acceleration due to gravity; h= Height of C.G. above ground level in (unstable) equilibrium position.}

- (a) Angular velocity should not exceed 5 deg/sec.
- (b) The unstable position should not occur before 35 deg.
- (c) No part of structure intrudes into residual space.

vi. Buckling Factor would be equal to or more than four.

vii. Various loads:

- Normal Loads (Static) = No. of Passengers x wt. of passengers (68 Kgs.) + passenger luggage weight (25 Kgs). (Besides the vehicle related loads).

- Bump Loads:

- Bump height = as per relevant Bureau of Indian Standards (BIS)/Indian Road Congress Guidelines.
- Case I: Single Wheel on Bump/Pot hole.
- Case II: Diagonally opposite wheels on Bump/Pot hole.
- Case III: Both wheels (Front & Rear) on Bump/Pot hole.

- Braking Loads:0.6g

Horizontal = 0.6g load, Vertical = 1g load, (Applied together)

- 2.11. The bus, loaded to Gross Vehicle Weight (GVW), with crush load and under static conditions, would not exhibit deflection or deformation that impairs the operation of steering mechanism, doors, windows, passenger escape mechanisms and service doors, etc.
- 2.12. Manufacturer's certificate supported by testing and type approval agency's certificates along with the bus as also technical specifications/drawings required for inspection, performance assessment as above to be supplied along with the bus. Besides meeting the statutory requirements, the type II NDX bus would be designed with respect to its body and different aggregates/systems /sub systems to operate satisfactorily in designated transport services for at least 9 years or 12, 00,000Kms whichever is earlier.
- 2.13. Detailed schematic drawings of bus structure, seats, interior/ exterior fittings, electrical systems, wiring looms / harness, photometric items and other accessories along with complete details of materials used, their specification, manufacturing tolerances etc. would be provided by the bus manufacturer. Additionally, details / drawings of mounting / fastening bus body to chassis to be provided along with the bid specifically bringing out whether bus body would be welded and integrated to chassis or fastened using fasteners along with applicable mechanism system /arrangement. Detailed Circuit diagrams for electricals be also provided by the bidder/bus manufacturer.
- 2.14. Details of general appearance, seating layout and structural of roof, floor, sides, front & rear show and driver cab, etc. would be supplied. Main dimensions of the fully built bus i.e., overall length, overall width, overall height, saloon height, pillar to pillar distance, seat pitch, number of seats (excluding seat for the driver), entry/exit gates, would be supplied along with the schematic diagrams/printed literature of the bus.
- 2.15. Material used in construction of buses would be as per Bureau of Indian Standards (BIS)/ Automotive Industry Standards (AIS)/ specifications and/or other international specifications meeting/ surpassing performance & other requirements as given in the Bus Code. In absence of above specifications, Association of State Road Transport Undertakings (ASRTU) specifications could be followed. Wherever Indian Standards are not available, internationally acceptable Standards may be referred. Specifications/ Standards followed would conform to Specification/Standards as amended /up dated/ or the latest published by the concerned agencies. Wherever no specifications of any item have been notified as International/ National Standards etc. actual specifications of that item used be mentioned. Guaranteed life of the bus and its other aggregates be indicated item by item. Periodical maintenance schedule for obtaining the said life of the bus be also indicated.
- 2.16. BIS Standards are normally available from Bureau of Indian Standards, Manank Bhawan, 9-Bahadur Shah Zafar Marg, New Delhi-110 002. Web site: <http://www.bis.org.in>. Similarly, AIS Standards are available from Automotive Research Association of India, Post Box No.832, Pune-411 004. Web site: <http://www.araiindia.com>. ASRTU Specifications are available from Association of State Road Transport Undertakings, Sector 12, Dwarka, New Delhi. Web site: <http://www.asrtu.org>.
- 2.17. Suitable traps/openings with appropriate sealing and covers would be provided for repair and maintenance of various aggregate/systems/sub systems / chassis / body/ their components, etc. of the bus.
- 2.18. Any restriction in design, manufacture and mounting of bus body on chassis, as envisaged by chassis manufacture, as a part of detailed instructions for this purpose, be meticulously followed while mounting / joining / integrating bus body to bus chassis.

- 2.19. The bus would be so designed as to maintain operational stability requirement as per Bus Code. Interior noise and pass by noise of the vehicle would conform to BIS: 12832:1989 or latest and BIS: 3028:1998, 10399: 1998 or latest respectively.
- 2.20. It would be ensured that the design, manufacture, certification (wherever called for) & installation of major bus sub-components and systems are compliant with all such sub-component vendors' requirements & recommendations within the frame work of any statutory, legal and or any other lawful/functional requirements. A certificate of compliance would be shown on demand. Components used in the vehicle would be of heavy-duty design.
- 2.21. Any other provisions/fitments, required for safe and efficient operation and or for fulfilling statutory requirements be provided in the offered bus.

3. ENGINE:

- 3.1. Diesel fueled engine would have appropriate horsepower to obtain desired performance in respect of its adequacy of power, acceleration levels, emission norms, specific fuel consumption etc. The engine to have adequate horsepower not only to propel the bus at its GVW but also to operate efficiently besides all other auxiliary devices, systems fitted to bus, simultaneously. For operational services of type II NDX buses, engines of adequate horsepower and torque at optimal Revolutions Per Minute (RPM) levels to deliver specified performance. The Horsepower and torque at defined rpm levels of the engine be indicated by the bidder in his bid along with other details called for in Part II.
- 3.2. Performance data/curves and other details of the engine have to be supplied. A detailed set of calculations indicating adequacy of said engine for proposed type II NDX bus be provided along with all performance parameters of selected engine.
- 3.3. The engine and its accessories would be easily replaceable. Engine mounting would be such as to minimize transmission of vibrations to bus structure. Engine foundation & mounting would be so located as to facilitate easy accessibility & replacement. Engine design would be such that it would not be overheated during normal operating conditions of vehicle. An arrangement for audio-visual signal would be provided in the event of engine getting overheated excessively. The temperature at which signal operates would be indicated. Similar arrangement for other sub-system of engine with their monitorable indicators be made on dashboard. The engine would be equipped with electronic engine management and on-board diagnostic system.
- 3.4. Engine compartment would be insulated to avoid transmission of heat and noise to saloon area. This firewall would preclude or retard propagation of an engine compartment fire into passenger compartment. Only necessary openings would be allowed in the firewall, and these would be fireproofed. Wiring may pass through only if connectors or other means are provided to prevent or retard fire propagation through the firewall. Engine access panels in the firewall would be fabricated of fireproof material and secured with fireproof fasteners. These panels, their fasteners, and the firewall would be constructed and reinforced to minimize warping of panels during a fire that will compromise integrity of the firewall. Firewalls shall be provided between the bus interior areas and the engine compartment which includes the areas in which the engine, transmission, and exhaust system are housed. The firewalls shall satisfy the requirements defined in Federal Transit Administration (FTA) of United States standard Docket 90, dated October 20, 1993 or equivalent standards. Bus manufacturer would provide relevant details.

- 3.5. The engine would be suitably designed to operate optimally under TNSTC's operational areas of peak summer heat, humidity and dust.
- 3.6. Engine noise and emission levels must conform to the Central Motor Vehicle Rules (CMVR)/ UBSII /AIS 052 any other Indian Standards, adopting the most superior one.
- 3.7. Specific fuel consumption of diesel per KW hour at Standard conditions (e.g., an Indian / ECE's Highway Driving Cycle and or any other equivalent or better followed by the test agencies) would be indicated along with guaranteed fuel consumption level (kilometres per litre of diesel) under GVW and the standard operational conditions / cycle of type II NDX buses.
- 3.8. For sound-proofing & for protection against fire risk in engine compartment, no flammable material or material liable to soak fuel, lubricant or any combustible material would be used in engine compartment unless the material is clad by an impermeable fireproof sheet. A partition of heat-resistant material would be fitted between the engine compartment & any other source of heat.
- 3.9. The bus would have air intake design / location in a manner as to provide adequate quantity of dust free, restriction free air so as to avoid any operational problem of the engine.
- 3.10. Details of make / model etc. of various items of engine system and its subsystems would be provided as part of bid.

4. COOLING SYSTEM:

- 4.1. Heavy-duty radiator and other subsystems of cooling system would efficiently dissipate heat from the engine system. De-aeration tank and pressurized radiator cap would be provided. It would be easy for filling and level checking of coolant. Replacement/ maintenance of radiator and its items be also easily carried out. Details of radiator specifications, cooling capacity, coolant, repair and maintenance procedures etc. would be supplied.

5. TRANSMISSION SYSTEM:

- 5.1. Heavy duty Synchromesh Manual transmission system having minimum 5 forward and one reverse gear would be provided. All operational controls/buttons/switches etc. be conveniently located within easy reach of the driver. The transmission system and the control/operational sub systems be easily accessible for repairs and also be easily replaceable. Complete system details need to be supplied with the bus.
- 5.2. Transmission system be fitted with a mechanism which makes it possible to engage reverse gear only when vehicle is stationary.
- 5.3. Details of make / model etc. of various items of transmission system would be provided as part of bid.
- 5.4. Mechanical Clutch system using single dry plate push type clutching system would be provided. Clutch would be provided with asbestos-free disc lining

6. SUSPENSION:

- 6.1. The bus would be fitted with air suspension system at rear axles and parabolic leaf spring waveller type suspension at front. The suspension system would be fitted with shock absorbers, suitable for trouble free operation and jerk free comfortable ride in existing road conditions of TNSTC operational areas.

- 6.2. The suspension system shall permit a minimum wheel travel of 90 mm jounce-upward travel of a wheel when the bus hits a bump (speed breaker), and 75 mm rebound-downward travel when the bus comes off a bump and the wheels fall relative to the body. Rebound travel may be limited hydraulically within the shock absorbers. Suspension system shall incorporate appropriate devices for automatic height control so that regardless of load the bus height relative to the centreline of the wheels does not change more than 12 mm at any point from the required height.
- 6.3. Vertical damping of the suspension system shall be accomplished by hydraulic shock absorbers mounted to the suspension arms or axles and attached to an appropriate location on the chassis. Damping shall be sufficient to control bus motion to 3 cycles or less after hitting road perturbations.

7. STEERING SYSTEM:

- 7.1. Hydraulic power steering with angle and height adjustment would be provided. Power steering failure shall not result in loss of steering control.

8. BRAKING SYSTEM:

- 8.1. The braking system would be full pneumatic type with fail-safe dual circuit having four-way protection valve, auto slack adjuster, disc brakes in front and drum brakes at rear, with non-asbestos brake pads / linings having temperature and wear characteristics suitable for type II NDX bus operations. Brake squeal would be absent under normal conditions of operation. An air compressor/dryer which minimizes oil carry over would be fitted. Braking system would be fitted with air dryer and oil/ water separator system. Buses would also be provided with hand operated pneumatic flick valve type parking brakes at rear wheels. Air pressure line would be treated for corrosion resistance.
- 8.2. In the event of failure of engine and or loss of air in system, adequate provision be made for obtaining effectiveness of service brake system and or for deactivating the spring actuated brakes.
- 8.3. The air compressor system should have sufficient capacity to meet large compressed air demand for braking in the type II NDX bus operations and frequent opening / closing of doors besides any other requirement

9. WHEELS AND TYRES:

- 9.1. The bus would be fitted with steel radial tubed tyres of optimal size and design conforming to AIS-044 Part III with wheel rims of corresponding size conforming to AIS/ BIS: 10694 (part 3)-1991 or latest. The bus would be supplied with 7 sets of tyres (two on front and four on rear wheels) fitted on the bus plus one set as spare Stepney on-board complete with carrier system under the floor.
- 9.2. Details of type, specifications, capacity, make, model etc. of tyres/wheel rims would be provided as part of the bid.
- 9.3. Suitable guards be provided near wheels to prevent damage/ for obtaining safety from stones hurled from tyres.
- 9.4. Splash aprons of minimum 6.50mm thickness composed of rubberized fabric would be installed behind the wheels as needed to reduce road splash and protect under floor components. Splash aprons would extend downward to within 100mm of road surface at static conditions. Apron widths would be no less than tyre widths, except for the front apron, which may extend across the width of the bus. Splash aprons would be bolted to the bus under structure. Splash aprons and their attachments would be inherently weaker than the

structure to which they are attached. The flexible portions of splash aprons would not be included in road clearance measurements. Other splash aprons would be installed where necessary to protect bus equipment.

10. AXLES:

- 10.1. Solid beam reverse Elliot I-beam section type front axle & grease type front bearings & seals of reliable & proven design of adequate capacity to take care of maximum Gross Vehicle Weight (GVW) & crush loading expected during life span of the bus of minimum 9 years or 12, 00,000 Kms. whichever is earlier, complete with track rod with replaceable ball joints at both ends, would be provided.
- 10.2. The bus would be driven by a single heavy-duty rear axle of proven design, single reduction, hypoid gears, full floating axle shafts with optimal gear ratios suitable for type II NDX bus operations with adequate capacity to take care of maximum GVW & crush loading expected during life span of bus of minimum 9 years or 12,00,000 Kms. whichever is earlier. Transfer of gear noise to bus interior would be minimized. Lubricant drain plug would be magnetic type, external hex head. If a planetary gear design is employed, oil level in the planetary gears would be easily checked through plug or sight gauge.
- 10.3. The drive (propeller) shaft would be guarded to prevent it from striking floor of the bus or the ground in the event of a tube or universal joint failure.
- 10.4. Details of type, specifications, capacity, make, model etc. of Front & Rear Axles would be provided at in the bid.

11. DIESEL TANK:

- 11.1. Diesel fuelled bus must meet and satisfy safety and other requirements as per AIS 052, type approval; regulatory requirements as per CMVR / Tamil Nadu Motor Vehicle Rules (TNMVR) and any other applicable regulations for operation in the State of Tamil Nadu, if any.
- 11.2. Diesel tank of requisite capacity (>230 litres) would be appropriately mounted on to the bus keeping in mind convenience of diesel filling, safety of system and its maintainability, in the operational areas.
- 11.3. Capacity of the diesel tank (minimum 230 litres) be adequate for over 400 kms of bus running without refilling.
- 11.4. Diesel tank and other components of diesel fuelled vehicles should conform to applicable AIS / BIS standards or International Specs / standards in absence of AIS / BIS specs. Additionally, requirement of UN/ECE R34 for prevention of fires be satisfied.
- 11.5. Detailed drawing indicating location and mounting details of diesel tank / sub-systems be provided along with the bid
- 11.6. All requirements of AIS / BIS / CMVR/TNMVR etc. for diesel tank, sub-systems and components, etc. be fully met and test certificate for the same be provided.

12. UNDER FRAME & STRUCTURE:

- 12.1. The under frame and super structure would be suitably designed to carry peak load of over 52 passengers and dense crush load of about 80 passengers in 11-metre-long buses (each passenger weighing 68 Kgs on an average and carrying a load of 25kgs each) consisting of mainly seated / standee passengers; the superstructure of steel tubing, bus tare weight, all other fitments would meet performance requirements under various loads

indicated earlier. The structure would be designed to withstand the transit service conditions of operation throughout its service life.

- 12.2. The bus body would be of integrated/ fastened/welded to chassis frame depending upon the chassis design, with the super structure fabricated using galvanised steel tubing (ERW– Rectangular / Square Sections) conforming to BIS 4923-1985 or latest, of grade Yst –240.
- 12.3. A comprehensive multi-stage anti-rust treatment would be provided to bus flooring, sides, roof, under-structure, axles, suspension, and all other components for resistance to corrosion or deterioration from atmospheric conditions & road salts so as to enable them & the bus frame to last for at least 9 years or 12,00,000 Kms. whichever is earlier.
- 12.4. Samples of all materials & connections / joints would withstand a two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%. Details of treatment provided with relevant specification details be indicated along with suitable calculations to reflect that the corrosion prevention treatment meets the requirements of minimum 9 years or 12,00,000 Kms. life whichever is earlier in TNSTC's operational environment. Details of the system followed for corrosion prevention of internal surfaces of structural tubing would be supplied. A certificate of testing from an authorised test lab be provided.
- 12.5. Front and rear structure design would be energy absorption type to reduce impact stresses into under frame/side structures/ other areas of the vehicle. Damaged area of the vehicle would be easily repairable and or replaceable in the event of any major damage at normally available workshop facilities and without any need for specialised tools / fixtures and equipment.
- 12.6. Entire surface of bus under floor and sides besides other fitments exposed to ground would be covered with appropriate corrosion prevention & flame retardant paint coating for protection against harmful effects of water, mud etc. and to retard flames, if any. Wheel housings would be constructed to contain tyre bursts during operation and be flame retardant in case of tyre fire.
- 12.7. Sufficient clearance & air circulation would be provided around the tyres, wheels & brakes to preclude over-heating when the bus is operating
- 12.8. Metal Inert Gas (MIG) welding would be used for steel structural member's fabrication.
- 12.9. All structural members would be MIG welded besides suitable gussets/ brackets of adequate size & thickness be provided on floor, side, front, rear & roof structure to ensure structure rigidity & integrity. Material, shape size and specs of such gussets / brackets would be provided by the bus supplier in their supplied drawings.
- 12.10. After anti corrosive treatment, structural members would be coated with red oxide/ Zinc Chromate primer & superior quality black paint.
- 12.11. During structural assembly operations, a number of holes are drilled and or weldments made after the corrosion prevention treatment of components/structural items/members causing loss of such treatment and exposing these items to corrosion. Manufacturer would take sufficient care to carry out corrosion prevention of items so exposed to effectively prevent corrosion.
- 12.12. Under floor to sidewalls would be sealed to prevent dust ingress.

13. PANELLING:

- 13.1. Bus exterior side panels would be fitted with stretched steel sheet at waist level. The exterior front-end panelling would be of steel sheet while roof, rear, sides & skirt panelling would be of aluminium. All interior panelling would be of Acrylonitrile Butadiene Styrene (ABS) conforming to relevant National or International Standards - equivalent or better. The space between interior and exterior panels shall be filled with thermocol of appropriate specifications.
- 13.2. Wherever aluminium is joined with steel or with/ any dissimilar metals together, the involved joints would be treated with thick layer of approved quality dielectric paint conforming to relevant Indian/ International Standards, before assembly. Adequate treatment be also provided to avoid any incidence of galvanic corrosion between dissimilar metals.
- 13.3. Panels would not have any waviness & would be so mounted as to present smart aesthetic exteriors. Details of the above said panelling including specifications / thickness/ sizes of panels, fittings, rivets/ bolt pitch etc. would be supplied.
- 13.4. All side skirt panels below stretch panel be of such design as would facilitate quick replacement of any damaged panel(s) with pre-painted panels. The side skirt would be able to withstand side impact as per provisions of BIS: 14682-1999 or latest. Similarly rear end would be able to withstand rear impact as per the provisions of BIS: 14812-2000 or latest
- 13.5. Anti-drumming compound would be applied on inner side (enclosed surfaces) of entire panelling.
- 13.6. Roof structure would be thermally insulated with flame retardant Polyurethane or glass wool of minimum 40 kgs/m³ density. The specifications/ BIS Standards for aforesaid insulating material would be supplied.
- 13.7. Metal Inert Gas (MIG) welding for fabrication of aluminium components would be used.
- 13.8. Rain gutters would be provided to prevent water flowing from the roof onto the passenger doors, driver's side window, and exterior mirrors. When the bus is decelerated, gutters would not drain onto windshield, or driver's side window, or into the door boarding /alighting area. Cross sections of the gutters would be adequate for proper operation.
- 13.9. Entire front end of the bus would be sealed to prevent debris accumulation behind the dashboard and to prevent driver's feet from kicking or fouling wiring and other equipment. Front end would be free of protrusions that are hazardous to passengers standing or walking in front of the bus during rapid acceleration.
- 13.10. Interior panels would be attached so that there are no exposed unfinished or rough edges or rough surfaces. Panels & fasteners would not be easily removable by passengers. Fasteners and or their capping used for above purpose be such as to resist vandalism / easy removal by any person including but limited to commuters.

14. PAINTS:

- 14.1. All structural members of the bus would be treated for corrosion prevention internally as well as externally and painted wherever required. Polyurethane (PU) painting based spray paint of standard companies conforming to latest/ international Standards as applicable would be used for exteriors painting of bus including interiors wherever required. Colour shade would match to the shades as per BIS: 5-1978 or latest. Details of paints used,

surface treatment & preparation, corrosion prevention treatment, base primer coatings, number of paint coats to be applied etc. would be supplied.

14.2. All exterior surfaces would be smooth & free of wrinkles & dents. Exterior surface to be painted would be properly prepared as required by paint system supplier, prior to application of paint to ensure a proper bond between the basic surface and successive coats of original paint for stipulated service life of the bus. Paint would be applied smoothly and evenly with the finished surface free of dirt and following other imperfections:

- i. Blisters or bubbles appearing in the topcoat film.
- ii. Chips, scratches, or gouges of the surface finish.
- iii. Cracks in the paint film.
- iv. Craters where paint failed to cover due to surface contamination.
- v. Overspray.
- vi. Peeling.
- vii. Runs or sags from excessive flow and failure to adhere uniformly to the surface.
- viii. Chemical stains and water spots.

15. COLOUR SCHEMES:

15.1. Exterior, interior colour schemes and logo/ graphics would be painted as directed by TNSTC. Information, on seats, for reservation for persons with disabilities, ladies, senior citizens would be marked as per the details provided by the TNSTC.

16. SERVICE DOORS:

- 16.1. One service door (passenger entry / exit) with steps, on rear side of the front axle as indicated in summarised specs in part II, would be provided on near side (on kerb side wall)
- 16.2. Layout of passenger service gate on near side as brought out in Part II of these specs.
- 16.3. Doors would be Jack-Knife (JK) type. The door flaps shall be so designed as to provide positive sealing against ingress of water in the bus particularly during any water logging / flooding on roads.
- 16.4. Operation of entry and exit door would be electro-pneumatically controlled by driver with internal and external emergency operational controls. In an event of an emergency, it would be possible to open doors manually from inside the bus by using a force no more than 10 Kg. after actuating and unlocking device at the door. Unlocking devices would be clearly marked as an emergency device & would require two distinct actions to actuate.
- 16.5. Doors, operating mechanisms, door hinges and locks would comply with safety requirements as per Indian / International Standards (to be specified and supplied by the bus manufacturer). Overall dimensions and construction of entry / exit door flaps would normally be identical so that doors and door operating mechanisms are interchangeable. Closing and opening time of doors should be in the range of 4 seconds each. There would be maximum opening area in longitudinal & vertical directions in fully open condition. Door operating mechanisms, brackets etc. would be maintenance free and designed with lifetime durability of minimum 9 years or 12,00,000 Kms. whichever is earlier.

- 16.6. A pilot lamp on the driver's dashboard would be provided to warn that the door is 'Open' or not fully closed.
- 16.7. Entry / Exit door would be provided with suitable support in form of grab handles for boarding/ alighting passengers on JK door flaps. Electronic / other suitable sensors would be installed at the entry / exit doors to retract door automatically if any obstruction to door occurs during door closing. It must be effective until door is fully closed.
- 16.8. Colour shade would match to the shades as per BIS: 5-1978 or latest.
- 16.9. A red "Door Closing" sign would be installed above exit door. The sign will blink when door is closing.
- 16.10. A suitable device to prevent door from opening as long as bus is in motion would be provided.
- 16.11. Service Door' operation would be controlled with help of push button mounted over the door. One red master button to close the entrance / exit door would also be provided on driver dash-board and the conductor seat.
- 16.12. All buttons and switches would be labelled on a panel to right side of the driver.
- 16.13. Heavy-duty prominent nosing of bright yellow colour would be used to protect edge at entrance/exit.
- 16.14. Access door would be provided with heavy-duty sealing to avoid ingress of dust and water into passenger compartment. Upper & lower section of both door flaps would be glassed for not less than 45% of the door opening area of each section. Glazing material & glass in doors would be same as in side windows.
- 16.15. Details of above service door including electro-pneumatically controlled door closing system with complete circuit diagram would be supplied. Photo-cell controlled opening / closing functions of door and a "sensitive edge" made for safe entry-exit be fitted.
- 16.16. Door would be fitted with heavy-duty hinges as per bus code.
- 16.17. Door would be fitted with heavy-duty locks with &/ without lock & key depending upon their use. Striker plate would be fitted at the closing end of locks.
- 16.18. All handles would match to décor of its fitment location or would be chrome plated.
- 16.19. Door would open or close completely in about 4 seconds from the time of control actuation and would be subject to closing force requirements and adjustment requirements. Front door would remain in commanded state position even if power is removed or lost. Operation of & power to, passenger door would be completely controlled by driver. A control or valve in driver's compartment would shut off power to, and/or dump the power from, front door mechanism to permit manual operation of front door with bus shut down.

17. GUARD RAILS:

- 17.1. Suitable guard would be provided in areas such as service doors entry/exit areas where seated passengers are likely to be thrown into as a result of heavy braking, Guard height would be minimum 800mm from bus floor, and guard would extend inward from the wall at least 100mm more than the centre line of the seating position of the passengers who are prone to this risk.

18. WINDOWS:

- 18.1. Windows would be of large size for panoramic view. They would be in two/ three-piece window glasses. Toughened glass wherever used in bus body would be 4.8 mm to 5.3 mm thick for 11-metre-long buses– each aesthetically installed. Size and shape of the glasses would enable even the standees to have maximum outside view without kneeling. General requirements of windows would be as per the provisions of bus code (AIS 052).
- 18.2. Windows would have provision of suitable sealing to avoid ingress of dust and water and would have proper/ efficient drainage system as per AIS 052 /UBS II.
- 18.3. Details of window design; fitment etc. would be supplied by the bidder along with the bid.

19. WINDOW GUARDRAIL:

- 19.1. In type II NDX Buses window guard rails as specified in bus code (AIS 052) shall be provided.

20. EMERGENCY EXIT:

- 20.1. Emergency exits would be provided in bus as per the provisions of Bus Code – AIS 052 / CMVR. Possibility of using passenger entry/exit gates on near side for said purpose would be explored by manufacturer and confirmed. Details of Emergency exits including their numbers, locations, sizes, markings etc. would be supplied.

21. ESCAPE HATCH:

- 21.1. In addition to emergency exits, at least two escape hatches (one each in front and rear half of bus) would be provided in roof as per bus code. A number of additional hatches may also be provided for facilitating ventilation inside bus.

22. STEPS:

- 22.1. There would be three steps provided at the entrance / exit gates on the near side

23. FLOOR:

- 23.1. Bus floor design would be with steps in boarding / alighting gates.
- 23.2. Floor height of the bus would be 1150 ±10mm from ground level.
- 23.3. Internal saloon height would be 1900 mm minimum.
- 23.4. Floor design would allow easy cleaning including that of sweeping & drainage of water.
- 23.5. Floor would be fitted with fire retardant 15mm 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)
- 23.6. The said floor would be covered with anti-skid type silicon grain material of minimum 3mm thickness meeting Indian/ International Standards (to be indicated by the bus manufacturer in the bid), ISO 877/76 for colour, IS5509 for fire retardancy. Adequate sealing would be provided in the floor to prevent ingress of dust, gases, water etc. Provision of draining of water if any on bus floor would be made.

24. GANGWAYS:

- 24.1. Gangway-from front entry/exit gate walls through the entire bus length, would have clear space of minimum 650 mm for passenger movement and would be generally as per the provisions of the Bus Code (AIS 052)/ UBS II and meet statutory requirements.

25. HANDRAILS AND HANDHOLDS

- 25.1. Handrails and Handholds would be provided as per provision of bus code (AIS 052) / UBS II. The surface of handrails & handholds would be colour contrasting and slip-resistant.
- 25.2. All handrails would be of aluminium tubing of 32 mm dia and 3 mm thick. Depending upon the size of the bay (i.e., between two consecutive roof hand rail brackets), minimum 2 to 4 numbers handholds per bay would be provided so that every standee passengers, even during crush load is able to grab a hand hold.
- 25.3. Hand holds be made of transparent polycarbonates with provision for display of advertisements. Hand holds be appropriately fastened to the hand grab rails so as to prevent their axial sliding and or rotation. Details of the handrails & handholds fitted would be supplied.

26. STANCHIONS

- 26.1. Vertical stanchions would be so positioned to facilitate access to seats for those standing. Stanchions would be of 40.0 mm dia and 3.15 mm thick aluminium tubing with surface of colour contrasting and slip resistant and fitted vertically with attachment to roof and floor of bus.
- 26.2. Stanchion pipes and the handrails would be painted in cannerly yellow colour while the joining brackets be painted in grey colour generally matching with inner panelling.
- 26.3. A suitable device, such as high visibility bell pushes, for convenience of passengers to request for stopping bus be provided at appropriate locations.

27. PASSENGER SEATS:

- 27.1. Passenger seats would be front facing in type II NDX buses, comfortable, durable & maintenance free of 'PPLD/LDPE' (Polypropylene/Polyethylene Low Density) moulded construction and or any other suitable material for a fully built passenger seat meeting performance requirements of AIS023 and other requirements as per the Bus Code (AIS 052). The 'PPLD/LDPE' moulded seat would be fitted on metal frames and or any other material in a fully built passenger seat.
- 27.2. Similarly, 'PPLD/LDPE' moulded seat backrest and or any other material in fully built passenger seat would be appropriately fitted. Suitable integral type seat hand grab rails would be provided one on top of backrest & one at the back of backrest for seated passengers.
- 27.3. Seat pitch would be maintained at 700 mm (minimum) (as per AIS 052) for type II NDX buses.
- 27.4. Details of seat design, material, specifications, pitch and other relevant data and the seating layout would be supplied by the manufacturer for approval of TNSTC.
- 27.5. Details of seating lay out, accommodating maximum number of seats in 2x3 layouts in 11-metre-long type II NDX buses for operations in designated areas, meeting requirements of the bus code, would be supplied. Seating capacity would be more than

52 plus the driver, etc. as required, etc. Seating capacity of bus would be more than 52 passengers for 11-metre-long bus (worked out as per AIS 052).

27.6. Construction/ fitting of the seat would be such as to be easily replaceable and repairable.

28. SEAT BELTS AND ITS ANCHORAGES:

28.1. Seat belts would be provided for the seats as per the provisions of CMVR & Bus Code (AIS 052). Any seats provided at rear end of bus/seats in centre (facing the gangway) would necessarily be provided with seat belts. Seat belts and its anchorages would conform to the requirements of AIS 005 and AIS 015

29. DRIVER'S WORK AREA:

29.1. A driver door of not less than 1600 mm height and 650 mm width and with requisite steps would be provided for entry and exit to driver's work area. Proper hand holds and steps would be provided for easy access to driver's cabin. All other requirements of driver's work area would be as per the provisions of Bus Code -AIS 052. Driver's work area would have lighting arrangement to provide general illumination and it would illuminate half of the steering wheel nearest to the driver. Brake Pedal Angle would be determined from a horizontal plane regardless of slope of cab floor. Driver entrance-cum-exit door would be provided as per Bus Code (AIS 052) with a provision of maximum width of sliding window using material like glazing & glass as used in other side window glasses. Driver work area would be equipped with a 24V DC, 200mm diameter fan mounted at proper height on side structure. Colour of fan would match the interior decor of the bus.

29.2. Driver's visibility in front of the bus, seated on driver seat, be as per bus code (AIS 052) / CMVR

29.3. Driver's seat would meet the requirements of AIS 023.

29.4. Driver partition would be provided as per AIS 052.

29.5. A barrier of bulkhead between driver and front passenger seat would be provided. The barrier would minimize glare & reflection in windscreen directly in front of barrier from interior light during night time operation.

29.6. Dashboard Instrumentation and Control System

- i. Bus would have ergonomically designed moulded type dash board and instrument panels made out of Fibre Reinforced Plastics (FRP) material. Details of materials used their specifications etc. of dashboard and instrument panel would be provided by the manufacturer.
- ii. Bus would have dash board with full instrumentation panel containing meters and gauges to indicate important parameters like air pressure, coolant temperature, battery charging current, fuel level, side indicators, head lights, hand brakes engagement, engine oil pressure, status of entry-exit gates, etc. In addition, warning lights for low engine oil pressure, high cooling system temperature & low coolant level, low pressure and high temperature of transmission oil, low fuel level, if any, low air pressure and battery weak, would be provided at the driver's dash board. All the dashboard controls and instrumentation system would be as per the bus code.

- iii. On board electronic diagnostics system would be provided as per UBS II.

30. REAR-VIEW MIRRORS- INTERIOR AND EXTERIOR:

- 30.1. Rear-view mirrors would be provided on both sides of bus to enable driver to have clear side/rear views. One interior rear-view mirror would also be fitted for viewing saloon area by driver. Installation and performance requirements of rear-view mirrors would conform to AIS 001 and AIS 002. Exterior rear-view mirrors would also enable the driver to view object near bumper area.
- 30.2. CCTV camera and a buzzer would be provided at rear end of the bus along with audio video facility at driver dash board.

31. SUN VISOR AND HORN:

- 31.1. Adjustable sun visors would be provided for windshield & driver's side window. Visors would be shaped to minimize light leakage between visors & windshield. Adjustment of visors would be made easily by hand with positive locking & releasing devices and would not be subject to damage by over-tightening. Sun visor construction & material would be strong enough to resist breakage during adjustment. Visors may be transparent but would not allow a visible light transmittance in excess of 10%. Visors where deployed would be effective in driver's field of view at angles more than 5° above horizontal.
- 31.2. An electric horn conforming to BIS: 1884-1993 or latest and installation requirements conforming to AIS 014 would be fitted in bus and further conforming to the provisions of CMVR.

32. INTELLIGENT TRANSPORT SYSTEM (ITS) AND THE ITS DEVICES:

This section provides general end-use specifications of ITS systems and the devices to ensure that bus body building shall be done in a way as to provide for raceways/conduits for wiring (Data and Power) for these devices during bus body building. The devices shall also need mounting surfaces/ structures provisions for which shall be made as part of bus body building. TNSTC proposes to get ITS items fitted / installed in the bus, as per detailed specs provided herein. The bus supplier would acquire the entire ITS / devices / system, hardware, firmware, software, integration and data and any other item to make the system functional, install and commission the same on-board in a manner as to deliver the end use requirements simultaneously being fully compatible and synchronized with the back-end systems. The bus ITS would have, among other items, SCU (System Control Unit) and Bus Driver Console (BDC), PIS Boards, PA- Public Address System GPS system, Panic Button, Reverse Parking Camera, **Provisions for In-Bus Security Camera Network**, Telematics system (J1939 – CAN 2.0), Wiring harness , etc. The detail minimum technical and functional specification of the ITS system available in Annexure IV – Specifications for Intelligent Transport System (ITS) of this document for compliance.

32.1. General Requirements

- i. **All On-Bus Intelligent Transport Systems, 'OBITS', (which includes SCU(OBU), BDC, PIS boards, PA system, Reverse parking camera panic button, Telematics system, Wiring and harness) equipment to be procured for diesel shall be integrated with one another and shall be capable of integration with the backend systems to be procured by the Purchaser in future.**

- ii. **The hardware to be procured for the ICT aggregates shall be compliant to any of the AIS-140, UBS II, IS 16833 with the subsequent amendments applicable.**
- iii. **The bidder shall support the operations, maintenance and integration of all supplied and installed ICT/ ITS systems on buses for a Contract Period of 9 years from the date of delivery & acceptance of each bus by authority.**
- iv. **All the component/sub-component of the OBITS system shall be internally integrated and single compact-box solution with easy to install and maintain.**
- v. **Operation and Maintenance requirements for ICT/ITS system:**
 - a. Bidder shall have to maintain the Hardware Unit during the contract period as per instruction of Purchaser
 - b. Any faulty equipment shall be replaced with a tested unit from the spares maintained by Bidder. Bidder will have to self-assess on the requirement of the spares in the project for the continuous service.
 - c. Repair and testing of equipment shall be done at Bidder's maintenance center and not at site/depot.
 - d. A repaired unit shall be tested for full functionality as at the time of deployment and certified before it is reinstalled at any site.
 - e. Spare Items shall be kept so as to replace as and when required throughout the contract period in provision of the RFP for the Buses.

The system shall build redundancy so that bus PIS boards can be functional in case of SCU(OBU) GPS outage.

Wiring provision to be maintained for installation and connection of in-bus surveillance systems in future. It should cover provision for.

- a. Minimum Two (2) wide angle cameras for clear view of driver and passenger cabin and reverse camera.
- b. Minimum Four (4) panic buttons on the bus located conveniently within bus such that it prevents accidental trigger. They are to be used for triggering the alerts in any emergency situations.

The ICT aggregates to be provided by the bidder shall have two (2) year default warranty and shall be extendable for a period of 7 years. The warranty shall include continuous on-site support for the respective site locations.

The bidder shall have to provide the required protocol document and SDKs for the preparation the route configuration files to each STUs.

32.2. Fitment Requirements

Fitment of all on bus devices shall be as per UBS- II or equivalent international guidelines - Chapter 10 – 17.8.7 or or equivalent international guidelines:

- All On Bus Intelligent Transport Systems, 'OBITS', (which includes SCU(OBU), BDC, PIS boards, PA system, reverse parking sensor, panic button, Telematics system) equipment including wiring harness, antennas to be original factory fitment.
- Front, side, rear signs should be mounted with a gap with the glass so that the glass on signs and of the bus can be cleaned by swiping

- All equipment should be fitted in a way to minimize unintentional damage, shielded from direct engine heat, protected from water splash and dust.
- All equipment should be fitted with the gasket for the vibration free fitment.
- All cables need to be properly anchored, marked and labelled
- Others:
 - Front sign: central
 - Rear sign: central
 - Side sign: first window ahead of rear door (central line of sign should coincide with central line of window)
 - Inner sign: centralize along the width of bus behind the driver's partition
- Six Speakers with protective grill: one each near the doors and others equally distributed across the length of the bus.
- SCU(OBU), recorder, amplifier: secured and ventilated compartment right above the driver
- BDC: ergonomically placed for driver ease
- Combi antenna: suitable place to define inside the bus (preferably) with direct line of view for 'affixing' the unit.
- Reverse Parking Sensor: High resolution surveillance camera to be placed back-side of the buses for the clear view of the reverse area when reverse gear engage.

32.3. **Integration Requirement**

- Bidder shall mount ICT equipment's as specified herein on Buses.
- Bidder shall also ensure to supply equipment compatible with proposed ICT/ITS System of Authority so as to enable smooth integration.
- Integration of ICT aggregate with respective backend software shall be joint responsibility of bidder and the backend System Integrator. To that effect, the bidder shall be responsible for firmware modification, expose protocols/APIs as required to the backend SI and so on for integration purposes. In case of dispute, the Authority's decision shall be final, and both the parties will have to abide.
- ICT aggregate equipment's fitted in Diesel Buses should provide required data/information to backend system installed by the Authority appointed System Integrator so as to provide MIS reports such as Trip summary, Schedule adherence of Bus with respect to Trip, Real time information pertaining to "off route" (detour), Trip information with start and end destination, driver details, speed, missed stop, Bus details, driver behaviour and CAN parameters etc. It should also provide information so that Operations Centre is able to check whether on-board devices are alive and monitoring capability of PIS health (which PIS is working).
- Bidder is required to provide above functionalities with scalability to integrate with third party systems through standard Active Programming Interfaces (APIs) such as ICT/ITS backend system, city traffic management systems, journey planner app etc.
- Bidder and Authority shall agree to share interfacing protocols and APIs with each other for smooth integration with other ICT/ITS System as required by Authority.

32.4. **Training Requirements**

- Well trained, efficient and effective ground support staff shall be provided by the Bidder during the operation and maintenance phase of the project.
- The bidder shall be responsible for trainings for but not limited to operating equipment, reporting incidents, regular maintenance, spare replacement, route backups, video backups etc. for Drivers, Maintenance staff and Depot Supervisors/Staff.

- Training sessions shall be designed individually as per requirement for the drivers, maintenance staff and depot supervisors/staff.
 - The Bidder, at its own cost, shall “Train the Trainers” on 1) BS VI technology and 2) on board ITS equipment to at least 25 Driving Instructors and 15 Maintenance Instructors per TNSTC STU. This shall also include training the Depot Managers and Engineers.
 - The Bidder shall provide adequate material and resources required for the training.
 - The Bidder shall submit the training content, Manuals and list of resources to the Authority within 10 days from the date of issue of Letter of Acceptance/ Work Order. The training content shall be reviewed by the Authority or representatives of the Authority in light of larger capacity building program proposed under the Bus Modernisation Plan. The Bidder shall immediately commence the training pursuant to clause above after incorporating the suggestions/modifications provided by the Authority or its representatives. The Bidder shall make available the finalised training manuals in English and Tamil languages for the purpose of imparting better understanding of the training content to the trainees.
 - The training shall be provided at regional training centres of the Authority/IRT. The Bidder shall provide minimum 3 (nos) of training bus or simulator or similar adequate infrastructure for the purpose of Physical Training based on the requirement. The Bidder can also arrange such Physical Training at its own premises/facility at its own cost.
 - The Bidder shall make available such infrastructure for Physical Training, till arrival of first lot of buses in each STU, for the purpose of Training by the Trainers to the other staff.
 - The Training for all the required staff as provided above shall be completed before completion of Prototype Inspection of all the Bus Types.
 - The Bidder shall have to certify the trainees for the said training programs and a satisfactory note to be issued by trainees at the end of training program.
 - GPRS network for the data transmission from ITS system to the backend will be provided by the Authority.
- 32.5. The bus manufacturer shall be responsible to supply buses meeting ITS specifications outlined in this clause and compatible with off-board / control items and the communication systems. The ITS service provider hence needs to coordinate with various vendors/suppliers including but not limited to those responsible for supply of buses, ETVMs, routers, SCUs, display boards, cameras, GPS and other ITS equipment, etc.

33. STOP REQUESTS:

- 33.1. A suitable device for the convenience of passengers including PwDs to request for stopping bus be provided at appropriate locations inside the bus on stanchions in a manner as to prevent un-intentional operation, deliberate attempts by children, etc.

34. BUMPERS:

- 34.1. Bus would be provided with front and rear bumpers of Steel or impact resistant polymer or combination of both meeting requirement of an energy absorbing system. The bumper would be easily repairable/ replaceable. Bumpers would conform to the requirements of CMVR, AIS, and Bus Code/any other international Standards (to be specified by the manufacturer). Details of above bumpers along with drawings including thickness of bumpers, section, profile etc would be supplied by the Successful bidder.

- 34.2. Bus manufacturer would provide details of materials used, their specifications and process followed for their repair and maintenance along with material required.

35. TOWING DEVICE:

- 35.1. Heavy-duty ring type towing devices would be provided in front and rear bumper area with load transfer to bus structural members. Capacity of each towing device would be 1.2 times (minimum) the kerb weight of the bus within 30 degrees of longitudinal axis of the bus. The manufacturer would supply a copy of the test certificate of the towing devices

36. WIND SCREENS:

- 36.1. Front wind screen in the bus would be in single piece design, plain/ flat with curved corners, intervening PVB film laminated safety glass of minimum thickness of 8.76 mm. Rear windscreen would also be in single piece design, flat in centre and curved on corners toughened glass of thickness of 5.5 mm + 0.5mm. Windscreen glasses would meet the requirements of BIS 2553: Part II-1992 or latest and that of CMVR and Bus code (AIS 052). The glazing used for fitment of glasses would be Ethylene Propylene Dien Monomer (EPDM) rubber of black colour or pasted with adhesive material conforming to Indian/ International Standards to be specified by the manufacturer. A grab handle and suitable handles on the outside of windshield centre at waist level would be provided to facilitate manual cleaning of the windscreens.
- 36.2. The windshield shall permit an operator's field of view as referenced in SAE recommended practice J1050. The vertically upward view shall be a minimum of 15 degrees, measured above the horizontal and excluding any shaded band. The vertically downward view shall permit detection of an object 1.35-metre-high no more than 600 mm in front of the bus. The horizontal view shall be a minimum of 90 degrees above the line of sight.
- 36.3. The windshield shall be easily replaceable by removing zip-locks from the windshield retaining mouldings. Bonded-in-place windshield shall not be used. The windshield glazing material shall have 8.76mm nominal thickness double laminated safety glass conforming with the requirements of ANSI Z26.1 Test Grouping 1A and the recommended practices defined in SAE J673.

37. WIND SCREEN WIPERS:

- 37.1. Electrically operated windscreen wiper system having two wiper arms with blades would be provided. Wiper motor would be heavy-duty steel body for minimum of two-speed operations. Wiper arms would rest horizontally when not in use. The sweep angle would be sufficiently wide for clear view during rainy days. Windscreen wiping system would be 24V, having speed control, with fitment of time delay relay as per AIS 011. Windshield washer system would spray washing fluid on windshield & when used with the wipers, would evenly & completely wet the entire wiped area. Windshield washer system would have a minimum of 3 litres capacity tank suitably located for easy refilling from inside the bus and two nozzles at suitable location for proper spray of fluid. Reservoir pumps, lines & fittings would be corrosion resistant & reservoir itself would be translucent for easy determination of fluid level. The windscreen wiping system would be in accordance with CMVR/ BIS: 7827 Part1, 2, 3 (section 1, 2) or latest.

38. FIRE EXTINGUISHERS:

- 38.1. Multipurpose fire extinguishers would be ISI marked conforming to BIS: 13849-1993 or latest, dry powder type (Stored pressure) duly filled, of capacity and quantity as per the provisions of GSR-853 (E) dated 19.11.2001 notification of Government of India, Bus Code, UBS II. Fire extinguishers would be encased & fitted with proper reinforcement. The enclosure box would have transparent breakable glass at front cover.

39. FIRST AID KIT:

- 39.1. First aid kit complete with items, medicines, bandages etc. would be provided as per provisions of CMVR fitted near driver seat at appropriate position and level on side with proper reinforcement.

40. PROVISIONS FOR PERSONS WITH DISABILITIES:

- 40.1. The manufacturer would provide for ease of accessibility, guidance, for PwDs that meets the requirements as given in the Bus Code, AIS 153 and CMVR and the harmonised guidelines.

41. BATTERY:

- 41.1. Battery system would be 24V of minimum 180 Amps-hour capacity, low maintenance type lead acid batteries. Batteries would be well secured to a hinged/ pivoted or slide out type carrier for ease of access for repair & maintenance, replacement and suitably ventilated for escape of fumes but insulated against ingress of dust and moisture. Battery box would be mounted near/ next to engine compartment and would be well secured, easily accessible & ventilated. Performance requirements of batteries would conform to BIS: 7372-1995 (or latest).
- 41.2. Battery terminals with positive locking system (e.g., angle type terminal with provision for double bolting) duly protected against all possible short circuit risk would be provided.
- 41.3. Each battery cable would be covered with flame retardant Grey colour corrugated flexible pipe and would be properly encased & clamped.
- 41.4. A relay controlled Heavy-duty type battery cut-off switch (isolator switch) capable of carrying & interrupting total circuit load would be provided 1 each near battery / driver on side panelling at appropriate level for disconnecting all battery positives except for safety devices such as fire suppression system & other systems as specified. Two points of battery cut off switch would be connected with battery and two points would be connected with self-starter. The battery Cut-off switch with power plant operating, would not damage any components of electrical system in off position. The battery Cut-off switch would be capable of carrying & interrupting the total circuit load.

42. ELECTRICAL EQUIPMENT AND WIRING:

As per details given in UBS II and generally as under:

- 42.1. The bus would have 24 Volt D.C with multiplex wiring system for all its electrical equipment except in unavoidable circumstances to avoid sparking in buses. A separate system/ mechanism would be provided for discharge of electro static charge induced during the operation of vehicle. Adequate precaution would be taken in case of single pole wiring to avoid spark in items such as self-starter, alternator etc.
- 42.2. An adequate capacity alternator of 24V DC, minimum 150A rating with consistent output to take care of high idling periods during operations in designated areas would be provided and so located as to minimize ingress of oil or rain water into it.

- 42.3. A pre-engaged type 24V DC Self-starter of adequate capacity (minimum 180Ah) with relay would be fitted in bus and so located as to minimize ingress of oil or rain water into it.
- 42.4. Details of specifications of Battery, Alternator and Self-starter along with circuit diagrams would be furnished by the manufacture along with their bids.
- 42.5. Electrical equipment and wiring would conform to Indian/ international Standards, bus code and UBS II. All cabling would be as per provisions of Bus code / UBS II. The wiring would be multiplex system, flame proof, ISI marked conforming to BIS: 2465-1984 or latest. As far as possible electrical system would be 24V double pole multiplex wiring system except in unavoidable condition. However, in case of single pole wiring all power & ground wiring would have double electrical insulation, which would be waterproof conforming to the Indian/ International Standards. Wiring would be grouped, numbered & colour coded. Wiring harnesses would not contain wires of different voltage classes unless all wires within the harness or insulated for highest voltage present in harness. Kinking, grounding at multiple points, stretching & exceeding minimum bend radius would be prevented.
- 42.6. Wiring looms/ harness for electrical system of bus would be properly routed, encased/ concealed type so mounted to eliminate chances of any spark. Details of above wiring loom including circuit diagram; layout of controls etc. would be supplied by the bidder along with the bid wiring support would be protective & non-conducting at areas of wire contact & would not be damaged by heat, water, solvents or chafing.
- 42.7. All electrical fittings and lights would be fully wired up, running in flame retardant black colour PVC sleeves as per applicable Indian Standards (to be specified by the manufacturer) and installed in a manner to facilitate easy inspection/ rectification/ replacement etc. as & when required without disturbing internal finish/ décor of the bus. Whenever any wire or cable or PVC sleeve carrying cable etc. passes through holes in sheet metals/ structural member, suitable rubber grommets/ Bakelite inserts would be provided in these holes to avoid direct contact between cables and sheet metal causing damage to insulation coating.
- 42.8. Bus manufacturer would furnish details of above wires/cables and battery cables.
- 42.9. Design of electrical, electronic & data communication systems would be modular so that each major component, apparatus panel or wiring bundle is easily separable with Standard hand tools or by means of connectors. Each module except main body wiring harness would be removable & replaceable. Power plant wiring would be an independent wiring module. Replacement of engine compartment wiring module would not require pulling wires through any bulkhead or removing any terminals from the wires.
- 42.10. Electrical system & its electronic components would be capable of operating in area of the vehicle in which they will be installed. Electrical & electronic equipment would not be located in an environment that will reduce performance or shorten life of the component and or electrical system. No vehicle component would generate or be affected by electro-magnetic interference or radio frequency interference (EMI/RFI) that can disturb performance of electrical / electronic equipment.
- 42.11. Bus manufacturer would furnish recommendations regarding methods to prevent damage from voltage spikes generated from welding, jumps start shorts etc.
- 42.12. All electrical & electronics hardware would be accessible & replaceable easily. It would be mounted on an insulating panel to facilitate replacement. Mounting of hardware

would not be used to provide sole source ground and all hardware would be isolated from potential EMI/ RFI.

- 42.13. All electrical/ electronic hardware mounted in interior of bus would be inaccessible to passengers & hidden from view unless intended to be viewed.
- 42.14. All electrical/ electronic hardware mounted on exterior of bus i.e., not designed to be installed in an exposed environment would be mounted in a sealed enclosure.
- 42.15. All electrical/ electronic hardware & its mountings would comply with shock & vibration requirements.
- 42.16. Bus manufacturer would provide a certificate of testing/estimation of electrical load for each system.
- 42.17. Alternator over voltage output protection would be provided.
- 42.18. All branch circuits except battery to starting motor & battery to generator/ alternator circuits would be protected by circuit breakers or fuses sized to requirements of the load. Circuit breakers or fuses would be sized to larger than total circuit load current as per UBS II/ AIS 052. Current rating for wire used for each circuit must exceed size of circuit protection being used.
- 42.19. Electronic Circuit protection for cranking motor would be provided to prevent engaging of motor for long time/to prevent overheating.
- 42.20. To the extent practicable, wiring would not be located in environmentally exposed locations under the vehicle. Wiring & electrical equipment necessarily located under the vehicle would be insulated from water, heat, corrosion & mechanical damage. Where feasible front to rear electrical harnesses should be installed above the window line of vehicle.
- 42.21. All electrical motors would be easily accessible for servicing.
- 42.22. Separate additional outlets, as required in UBS II/AIS 052, are to be provided with appropriate relays & fuses in wiring harness for fitment of electrical auxiliary devices/ systems to be added later on in buses, if required.
- 42.23. AC (Alternating Current) out-let of 220V, as required in UBS II if any, be provided at suitable location for charging of electrical/electronic equipment, etc.
- 42.24. If any electronic components have an internal clock, it would be provided with its own battery back up to monitor time when battery power is disconnected.
- 42.25. All electronic components/equipment would have self-protecting capability in event of shorts in cabling and also in over voltage and reverse polarity conditions. If an electronic component is required to interface with other components it would not require external pull up and/ or pull-down resistors.
- 42.26. RF components such as global positioning system (GPS) etc. whenever provided would use coaxial cable to carry the signal. The RF systems require special design consideration for losses along the cable. Connectors would be minimized, since each connector & crimp has a loss, which will attribute to attenuation of signal. Cabling should allow for removal of antennas or attached electronics without removing the installed cable between them.

43. LIGHTS AND LIGHTING SYSTEM:

- 43.1. Interior saloon lighting would be sunken type light assembly fitted with LED lights and mounted in staggered formation for uniform lighting in two separate circuits. First row of lamps provided in driver's cabin should be fitted with amber internal filter to reduce glare to driver at night. Overall bus lighting system would comply with CMVR provisions where-ever falls short of it.
- 43.2. Modern rectangular type headlamps with relay and side light etc. would be suitably styled into front-end construction.
- 43.3. White and Red marker lights of 5 Watt each would be fitted at both top side corners of the front and rear panel of the bus respectively.
- 43.4. Identical signal lights of 15 Watts would be fitted for inter-changeability in each side i.e.; front, rear and side respectively
- 43.5. Brake lights (15 W) and taillights (10W) would be two separate lights to reduce heat generation.
- 43.6. Reverse light of 25W, square lamps with white covers would be provided.
- 43.7. Side markers would be provided on both sides as per bus code/ AIS 008
- 43.8. Rear signal lights, brake lights, taillights and reverse lights would be arranged vertically.
- 43.9. Light wattages given above are indicative, however, all the lights and lighting systems would conform to requirements of Bus code, CMVR/Tamil Nadu MVR / UBS II and other relevant AIS Standards.
- 43.10. Following lights would be actuated when the headlights are 'ON' and the doors are 'Open':
 - i. Lights provided for illuminating exit/entrance door area, lights would illuminate outside area up to at least one metre when door/doors is/are opened. Lights for exit/entrance door areas would be flushed as far as possible to avoid tripping of passengers, protrusions if any would conform to relevant CMVR/ AIS Standards.
 - ii. Exterior door lights
 - iii. Lights would be automatically switched off when the door is closed.
- 43.11. A well-lighted bus registration number plate would be fitted at rear as per provisions of CMVR duly complying with directives/ regulations regarding high security number plates as notified by Government of India / Government of Tamil Nadu if any.
- 43.12. No Electrical fittings would be mounted on front and rear bumpers.
- 43.13. Switches would be fitted on right hand side of instrument panel through evenly loaded circuits & fuses as per bus code.
- 43.14. A reverse buzzer would be installed at the rear of bus to sound intermittently when reverse gear is engaged.
- 43.15. A suitable light would also be provided in engine compartment for ease of maintenance/ emergency repairing.
- 43.16. Following circuit diagrams would be supplied along with buses:

- i. Complete circuit drawings for exit/entrance door control system, door mechanism.
- ii. Complete door sensor electrical circuit drawing.
- iii. Complete circuit drawing for sensitive door edge system.
- iv. A layout drawing for all door control switches, gauges, warning lights on driver's dashboard.
- v. A layout drawing for all lighting and wiring circuits, control switches fuses and fitment details and diagrams along with item specs and types in each case.

44. PERFORMANCE STATEMENT:

44.1. Bus manufacturers would furnish following information for performance evaluation of fully built buses supplied to other customers and now in service for at least 3 years. The information should be furnished separately order wise:

- i. Type/Model
- ii. Name and address of the bus operating agencies where this model is operating
- iii. Number of the buses supplied
- iv. Order no. against which buses have been supplied.
- v. Date of supply and date from which in service
- vi. Maximum/minimum turning radius.
- vii. Maximum climbing ability/ gradeability
- viii. Type of bus body
- ix. Engine HP @ RPM
- x. Engine Max Torque @ RPM, and RPM range for max torque
- xi. Specific fuel consumption
- xii. GVW / Kerb weight of buses
- xiii. Emission Norms
- xiv. Type of suspension
- xv. Dimensions- Length, width, height, floor height, wheel base,
- xvi. Angle of approach, departure and ramp over
- xvii. Axle –rear and front
- xviii. Passenger carrying capacity
- xix. safety devices/provisions, Specs and Stds. against each item,
- xx. Any other performance data.

45. TECHNICAL INFORMATION

Technical information required to be furnished by bus manufacturers along with Bid w.r.t the following amongst others:

- 45.1. Bus manufacturer's technical information of the bus i.e., General Drawings comprising of elevations –sides, front & rear ends along-with main dimensions i.e., overall length, overall width, overall height, saloon height, pillar to pillar distance, isometric views, exterior & interior details, seating layouts, no. of seats (excluding seat for driver), and other provisions for environmentally friendly colour scheme as per TNSTC etc. would submit same along-with the Bid.
- 45.2. General appearance & structural details of roof, floor, sides, front & rear show and driver's cab, would be provided by the bidder along with their bids. Details of main structural members, material specifications, shape, size, thickness, etc. be indicated on the above drawings.
- 45.3. Power Point presentation material on a DVD for offered design of bus (indicative) and minimum 1:15 scaled Model (indicative & non-working)) duly furnished/ painted in environmentally friendly colour scheme as given by TNSTC would be submitted along-with the bid. The presentation will cover elevations –sides, front & rear ends along-with main dimensions, isometric views, exterior & interior details, seating layouts, colour scheme etc.

46. TOOLS, GAUGES AND TESTING INSTRUMENTS:

- 46.1. Bus manufacturers would furnish a list of special tools, gauges and testing instruments for inspection, repair and maintenance of buses along with a complete list of spare parts recommended for:
- i. Normal wear and tear; and
 - ii. Emergency requirements for any breakdowns, damages etc.

47. OPERATION AND MAINTENANCE MANUAL:

- 47.1. At least 2 hard bound copies and 2 soft copies, for every 25 buses or part thereof, of operation and maintenance manual containing essential technical information required for satisfactory operation, inspection and maintenance would be supplied by bus manufacturers.
- i. One set of Coloured wall charts along with soft copies of following units would also be provided for every ten buses or part thereof showing assembly details:
 - ii. Chassis lubrication and brake system.
 - iii. One set of coloured wall charts along with soft copies of following units amongst others for every 25 buses or part thereof showing assembly details:
 - Engine
 - Transmission system
 - Drive line and Rear axle
 - Front axle
 - Steering system, alternator, starter, fuel injection system etc.
 - Brake system, ABS etc.
 - Safety devices,

- FDSS
- Any other system / sub-system necessary for skill development of operating / repair and maintenance staff

48. TRAINING

- 48.1. The Bidder, at its own cost, shall "Train the Trainers" on 1) BS VI technology and 2) on board ITS equipment to at least 25 Driving Instructors and 15 Maintenance Instructors per TNSTC STU. This shall also include training the Depot Managers and Engineers. The Bidder shall provide adequate material and resources required for the training.
- 48.2. The Bidder shall submit the training content, Manuals and list of resources to the Authority within 10 days from the date of issue of Letter of Acceptance/ Work Order. The training content shall be reviewed by the Authority or representatives of the Authority in light of larger capacity building program proposed under the Bus Modernisation Plan. on The Bidder shall immediately commence the training pursuant to clause 48.1 above after incorporating the suggestions/modifications provided by the Authority or its representatives. The Bidder shall make available the finalised training manuals in English and Tamil languages for the purpose of imparting better understanding of the training content to the trainees.
- 48.3. The training shall be provided at regional training centres of the Authority/IRT. The Bidder shall provide minimum 3 (nos) of training bus or simulator or similar adequate infrastructure for the purpose of Physical Training based on the requirement. The Bidder can also arrange such Physical Training at its own premises/facility at its own cost.
- 48.4. The Bidder shall make available such infrastructure for Physical Training, till arrival of first lot of buses in each STU, for the purpose of Training by the Trainers to the other staff
- 48.5. The Training for all the required staff as provided in the clause 48.1 above shall be completed before completion of Prototype Inspection of all the Bus Types .
- 48.6. The Bidder shall have to certify the trainees for the said training programs and a satisfactory note to be issued by trainees at the end of training program

49. TOOL KIT

- 49.1. Bus manufacturer would provide a suitable tool kit and other mandatory items as per CMVR 138 (4)/ other applicable rules comprising of common tools and other essential items required. Complete list of tools in tool kit to be supplied with every bus would be supplied by the manufacturer. One wheel nut spanner and one Hydraulic Jack per bus of a capacity of at least 10 Ton as per design of bus would also be supplied.

50. INSPECTION AND TESTING:

- 50.1. Bus may be inspected at various stages of fabrication by TNSTC's representative at manufacturer works. Inspection would comprise of ensuring that all materials, components, items, accessories and assemblies used in fabrication of buses conform to contractual specifications. Wherever required to ensure this, laboratory test would be carried out at bus manufacturer's cost.
- 50.2. The inspection, including operational demonstration of various sub-system may be undertaken at any and or all stages such as component fabrication stage, chemical pre-treatment stage, fabrication of assembly/sub assembly stages, structure, panelling and equipping stage and Pre-dispatch inspection.

- 50.3. Final Inspection of buses would be carried out at manufacturer's facilities and or at a place finalized by TNSTC. After the bus is finally inspected, it would be subjected to test run and trials as required by TNSTC
- 50.4. The bus would be taken over by TNSTC after satisfactory final inspection, testing and trials in TNSTC.

51. MAINTENANCE SPARES AND MATERIALS

- 51.1. Bus manufacturer would provide details of components/spares required for maintenance of vehicle for twelve months' operation taking daily utilization of bus of up to 400 Kms.
- 51.2. Manufacturer would also provide complete details of vendors, for every component / spare for complete bus and the spare parts catalogue (hard as well as soft copies) in 2 sets for every 25 buses or part thereof.
- 51.3. Manufacturer would ensure that during service life of 9 years or 12,00,000 Kms. (Whichever is earlier) of service, adequate spare parts in kit form/ individual components are made available in time to TNSTC on demand along with other essential items required.
- 51.4. All spare parts availability would be more than 95% at any time.

52. MAINTAINABILITY

- 52.1. Design and fabrication of bus would be such as facilitates easy access for repair & maintenance, removal, replacement of various bus components/ assemblies/ sub-assemblies/ systems by providing suitable traps/ flaps etc. Also, removal and re-fitment of engine, transmission, differential, radiator, door closing mechanism, PIS etc. would be easy for repair & maintenance purpose. Enough space would be provided between wind screen glasses and PIS boards for facilitating cleaning of glasses.
- 52.2. Radiator coolant/water filling and diesel filling inlets would be easily accessible with suitable closing devices complete with locking arrangement/-holding arrangement.
- 52.3. Also, an access would be provided for attending to air cleaner assemblies mounted in the vehicle.

53. WARRANTY/ GUARANTEE

- 53.1. Fully built bus would be covered under Warranty/ Guarantee for up to 2,50,000 Kms or 24 months whichever is later from the date of putting bus into operation after registration. All assemblies, sub-assemblies, fitments, components would be covered under Warranty Period as per commitment of bus manufacturer at the time of supply of bus.
- 53.2. Special Warranty Period, for any manufacturing Defect in design, material and workmanship of Bus structure shall be 9 years or 9,90,000 km per Bus whichever is later from the date of putting bus into operation after registration.
- 53.3.

54. GENERAL REQUIREMENTS:

- 54.1. TNSTC reserves the right to alter, modify, change specifications as per requirement to suit the latest provisions of CMVR/ any other Notifications, safety aspects, emission aspects besides any practical/ operational difficulties etc. faced/likely to be faced by TNSTC. Vehicle Manufacturer would ensure that all alterations, changes or modifications in specifications, if necessary, as mentioned above would be carried out

in buses built by them as per the advice of TNSSTC without attributing any additional cost.

54.2. Ministry of Road Transport & Highways, Government of India (MORTH) vide Notification in the Gazette of India, inter-alia stipulated the following measures which need to be complied with for enhancement of safety by the Vehicle Manufacturers as per the statutory requirement for registration of vehicles

- i. While registering every bus, Vehicle Manufacturers & transport authority would jointly examine the bus prior to registration. The registration of such a vehicle be done only after signing the report jointly by all concerned along with the transport authority.
- ii. For electrical installations, flameproof cables would be used, especially positively locked battery terminals and others would be locked firmly with all cables & pipes with proper looming to take care of vibrations, fire retardant material would be used for seats, roof & sidewalls. Safety instructions about fire hazards would be displayed.
- iii. Details of structural members, their material specifications & dimensions i.e., cab & saloon flooring, cross bearers, various angles, floor longitude, main body pillars, dummy/stump pillars, cant rail, vent rail, waist rail, skirt rail, wheel arch section, sole bar, seat rail, roof sticks & roof longitudes, diagonal bracing, rub rail tube, stretch & body panel stiffeners, gussets etc. would be provided by bus manufacturers.
- iv. Similarly, details of aluminium sheets/sections & their alloys/specifications, aluminium sheet, rub rail, decorative mouldings, wire cover, wearing strips, footsteps edging, various panel beadings, window frames and its sections, finishers, water gutter channel, roof grab rail brackets would be provided by bus manufacturers.
- v. All edges would be rounded off and would not cause injury to bus occupants.
- vi. Complete bus would be rattle-free.
- vii. All the rivet and bolt holes would be jig drilled as far as possible. The rivet holes should be drilled before the corrosion treatment. Holes drilled after the corrosion treatment be suitably treated with anti-corrosion materials. Rivet heads neatly formed and each bolt/ rivet would be tightened after full mating of the surfaces to be fastened.
- viii. All safety aspects should be considered while designing and fabricating the bus.
- ix. Continuous length piano type hinges and tower bolts of stainless steel would be used as per relevant Indian Standards.
- x. Similarly Aluminium extruded sections wherever not painted would be anodized.
- xi. All flaps wherever provided should have heavy-duty support to keep it open for ease of maintenance.

- xii. All miscellaneous M.S pipes would be phosphated with the coating of 2.16 to 2.70 gm/m² or by any other pre-treatment process conforming to Indian/ international Standards (to be specified by the manufacturer). Samples of all materials & components would withstand a two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%.
- xiii. Anodized decorative aluminium mouldings/ beadings etc. would be used.
- xiv. All M.S pipes used in the bus would be ERW conforming to BIS 3601:1984 or latest, of grade WT –160.
- xv. All rubber items used on the bus body would be made of Ethylene Propylene Dien Monomer (EPDM) rubber of black colour conforming to the Indian/ International Standards to be specified by the Manufacturer.
- xvi. EPDM rub rail of aesthetic profile would be fitted in anodized extruded aluminium channel between stretch panel and skirt rail longitudinally at the widest portion of the bus. The quality of EPDM material would be as per the Indian/ International Standards to be specified by the Bidder.
- xvii. Every trap/-opening flap would be secured in a manner that the vibrations can't dislodge it. Lifting devices must not protrude above the flap.
- xviii. Ease of accessibility to engine & other aggregates for easy maintenance would be ensured. Assemblies / units would be so mounted that they are easily accessible & can be removed without disturbing other components / assemblies.
- xix. All structure, body, and panel-bending mode frequencies, including vertical, lateral, and torsional modes, would be sufficiently removed from all primary excitation frequencies to minimize audible, visible, or sensible resonant vibrations during normal service.
- xx. Exterior protrusions if any would conform to the provisions of relevant CMVR/ AIS/ Bus Code. The exterior rear-view mirrors and required lights and reflectors are exempted from the protrusion requirement. Advertising frames would protrude no more than 22mm from the body surface and would have the exposed edges and corners rounded to the extent practicable. Grilles, doors, bumpers and other features on the sides and rear of the bus would be designed to minimize the ability of unauthorized riders to secure footholds or handholds. The exterior body features would be shaped to allow complete & easy cleaning by automatic bus washers without snagging washer brushes or retaining water & dirt.
- xxi. Hydraulic Grease Nipples would be provided for ease of proper lubrication & maintenance.

- xxii. Front panels, bumpers and grill should be designed such that there are no pointed or sharp protrusions to minimize injuries to vulnerable road users in case of impact.
- xxiii. Any other safety and performance requirement features to be provided.

55. QUALITY ASSURANCE

- 55.1. Bus manufacturer would use materials including fasteners conforming to relevant Indian/ International Standards and would get the same tested before use, meeting requirements of all specified parameters to ensure quality of material specified. However, random sample of materials picked up and duly sealed by representative of TNSTC in presence of bus manufacturer, out of purchased lot at works of the manufacturer or out of the bus under fabrication/ completed bus and be sent for testing quality of components at CIRT, Pune/ARAI/BIS approved testing laboratories having testing facilities for testing all parameters of specifications of materials/ items. In the event of failure of samples in lab tests, testing would be conducted in same way again from fresh lot. The bidder would replace failed materials by those duly passed in lab tests.
- 55.2. In the event of failure of material/ items in laboratory test, failure of material/ items (removed from completed bus) in laboratory test, acceptance decision about bus be taken by TNSTC after obtaining compensation/ recoveries of liquidated damages from bus supplier as per system decided by TNSTC. Wherever, failure of material on one parameter or more than one parameter, recoveries for complete lot of materials used in bus would be made from manufacturer plus 20% damages thereof.
- 55.3. Completed bus would be subjected to water leakage test conforming to BIS: 11865-1986 or latest.
- 55.4. A list of items to be tested for bus bodies would be provided by TNSTC. An indicative list of items to be tested is placed at Annexure III.
- 55.5. Manufacturer would also ensure compliance of quality at different stages of bus fabrication, including but not limited to prototype inspection as per details decided by TNSTC.

56. STATUTORY REQUIREMENT

- 56.1. Bus manufacturer would ensure that all statutory requirements in respect of each and every item of bus are fully met. Manufacturer would also obtain type approval certificates etc. for bus & any other items from testing agencies specified in the CMVR namely Vehicle Research & Development Establishment, Ahmednagar of the Ministry of Defence of Government of India or Automotive Research Association of India, Pune or Indian Institute of Petroleum, Dehradun, Central Institute of Road Transport, Pune; ICAT Manesar, Gurugram; and or any other agencies as specified by the Central Government on date of testing/ type approval or any other agency specified by competent authority. A certificate showing details of make/type/model of various units like engine, gear box/transmission system, clutch assembly, propeller shafts, rear axle, radiator, alternator, starter, regulator, batteries, tyres, steering, instruments on the panel, air compressor, shock absorbers, suspension system items, etc. would be furnished.
- 56.2. Bus Manufacture must make sure that the Fully built type II NDX bus complies with standards and regulations for diesel fuelled vehicle provided in the AIS-052, AIS 153,

UBS II, harmonised guidelines and any other standards as applicable; CMVR 1989 as amended till date, CMVR 1989 and Tamil Nadu MVR and all amendments thereto.

57. MANUFACTURER'S NAMEPLATE

57.1. Manufacturer's nameplate may be fixed as per approval of TNSTC.

58. POLLUTION UNDER CONTROL (PUC) CERTIFICATE HOLDER

58.1. A suitable holder with clear acrylic sheet cover would be provided in driver cab near driver seat at appropriate level for fixing of PUC certificate.

59. ANY OTHER PROVISIONS TO MAKE THE BUS FULLY FUNCTIONAL

59.1 Notes indicated in para 59.2 form part of the specs / bus fabrication requirements. Should however there be any conflict details contained in notes would over-ride others.

59.2. Notes:

- i. All cross and or T or X-joints of structural elements of bus body structure (Front, rear, sides, roof, floor, etc.) be provided with MS gussets of min 2.5mm thickness. All Weldments / structural sub elements be properly cleaned and treated for corrosion prevention
- ii. Service / inspection hatches with covers be provided for servicing of various aggregates / sub-systems of bus.
- iii. Width of wheel arches frame be so maintained as to provide adequate ventilation to tyres amongst fulfilling other needs.
- iv. Stanchion pipes and grab rails to be of Aluminum tubing of appropriate specs, size / wall thickness etc. Handholds supporting hand rails and the stanchion pipes be painted in cannery yellow color, Brackets be of grey colour matching the colour of the inner paneling. Brackets however need to be of proper size and shape to ensure perfect fittings. No redundant fastening holes be provided on brackets
- v. Hand holds be of polycarbonate material, transparent and provision for space for advertisements
- vi. Spare-wheel carrier, spare wheel assembly, and spare-wheel hatch need be provided on the **type II NDX** bus to facilitate the spare wheel assembly to be carried on-board during operations.
- vii. Stop buzzers may be provided as one in frontal area, one in middle and one in the rear area on stanchions at reasonable height ensuring easy accessibility as well as preventing unnecessary usage. Design of buzzer switch be sturdy, long lasting and sunk-in type to avoid undesirable / inadvertent operation.
- viii. LED illumination provided in saloon area of the bus be covered with ground glasses to prevent glare.
- ix. Tail lamps be covered with metallic grill in a manner that not only protects the tail lamps but also facilitates easy lamp replacement etc.
- x. Front and rear facia of the bus body may be fabricated out of FRP suitably designed, ensuring its strength, finish and ease of repair /

replacements at par or better than the metallic ones asked for in the specs.

- xi. Where type approval, of any of the bus body items including full bus body / bus is a mandatory requirement Type approval be undertaken by test agencies authorized under CMVR. In other cases, approval of selection of testing agency be obtained from TNSTC.
- xii. Design approval of multiplexing wiring in bus body / bus be obtained from test agencies authorized under CMVR or any other agency accredited for the purpose subject to approval of TNSTC.
- xiii. Bus Manufacturer to provide detailed drawings / specifications / make / model etc. as called for in specs for all items as generally indicated in RFP specs including but not limited to electrical Circuit diagrams of electrical subsystems in the bus.

60. FIRE DETECTION AND SUPPRESSION SYSTEM (FDSS)

60.1. General Requirements

Vehicles shall be equipped with fire detection & Suppression system detecting fires in the engine compartment based on sensors that senses either abnormally high temperature or rate of temperature rise, or both and suppress the same.

- 60.2. FDSS provision is to be made in the bus at appropriate location(s) for detection, alarming and suppression about any likely fire at all fire prone systems/sub-systems (bus supplier to identify such fire prone systems /sub-systems and make above provisions)
- 60.3. Vehicles shall be equipped with fire detection & suppression system detecting fires in the fire prone areas based on sensors that sense either abnormally high temperature or rate of temperature rise, or both and or any other parameter.
- 60.4. Upon detection of fire in the fire prone areas, the system referred in clause no 60.1, shall provide the driver with both an audio and a visual signal, and activate the hazard warning signal. The placement of the visual alarm shall be such that it is visible unobstructed while viewed from the driver seat.
- 60.5. The FDSS would simultaneously be able to suppress the fire immediately after detection.
- 60.6. The detection & suppression system shall be operational irrespective of whether the propulsion system of bus has been started and the vehicle's attitude.
- 60.7. The fire detection & suppression system shall be installed according to the system manufacturer's installation manual.
- 60.8. An analysis shall be conducted prior to the installation in order to determine the location of fire detectors and alarm system. Potential fire hazards at possible fire prone areas shall be identified and the fire detectors and suppression systems shall be so positioned as to commence suppression of the fire hazard immediately. The system shall also be ensured to work promptly and effectively regardless of the vehicle's attitude, road conditions etc.,
- 60.9. Fire hazards to be taken into account in the analysis shall at least consist of the following: Components whose surface may reach temperatures above the auto-ignition temperature for fluids, gases or substances that are present in the fire prone areas and electrical components and cables with a current or voltage high enough for an ignition

to occur as well as hoses and containers with flammable liquid or gas (in particular if those are pressurized). The analysis shall be fully documented.

- 60.10. The Fire Detection and Suppression System (FDSS) installed in the Buses shall comply with the requirement of CMVR / AIS 135, UBSII as applicable, any other equivalent or better International Standards as well as best market practices.
- 60.11. Make, model, specs etc of various components / sub-systems / system of FDSS be clearly indicated for each item as part of the offer. A detailed drawing of the system details / specs be also provided for.

**Diesel fuelled, 11 metre long, standard floor (1150 mm floor height),
BS-VI compatible, fully built type II NDX bus - Specification**

**PART II – SPECIFICATIONS OF DIESEL FUELLED STANDARD FLOOR OF 1150 MM FLOOR
HEIGHT BS VI COMPLIANT 11-METRE-LONG TYPE II NDX BUSES FOR OPERATIONS IN
TNSTC – GENERALLY AS PER BUS CODE (AIS 052) AND UBS II**

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
A	B	C	D
1	Bus Floor heights in mm	1150 ±10 mm, shall be uniform inside the Bus generally as per AIS 052	Confirm
2	Propulsion System	Diesel fuelled Internal Combustion Engine (ICE);	Confirm
2.1	Emission norm and Fuel	BS-VI - Diesel	Confirm
3	Engine	Diesel Fuelled 4 or more cylinder engine, water cooled, with Turbocharger, intercooler and conforming to BS VI emission norms. Engine be able to operate efficiently at ambient temperatures of approximately 10°C to 50°C, humidity level from 5% to 100%, and altitude levels of 0 to over 2400 metres, generally operating in the semi-arid / humid zone/ region prevailing in the designated operational areas of TNSTC.	Confirm
3.1	Engine HP sufficient to provide:		Make & model of engine----- HP -----at Rpm-- - Max torque ----- NM at rpm-----& rpm range-----
a	Rated performance at GVW in stop / start operations in designated areas	Attain Geared minimum maximum speed of more than 80 kmph (without speed limiter) at GVW load and other systems operational. There should be an in-built speed limiting device to restrict speeds to specified limits.	Minimum Max speed ---- kmph
b	Acceleration (metre/sec ²)	≥ 0.8	Confirm
c	Attain Bus speed of 0-30 kmph in seconds	≤10.5	Confirm
d	Maximum speed	Geared Minimum maximum speed without speed limiter to be more than 80 kmph as at 3.1. a	Confirm
e	Gradeability from stop, at GVW and other system operating.	17%	Confirm

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
f	Rated HP / torque preferably at optimal rpm range	1. Rated HP at low rpm and Maximum engine torque required at lower range of RPM and spread over a wider range of RPM. 2. Engine Power: Min. 140kW @ 1800-2400 RPM 3. Engine torque: Min. 700 Nm @ 1100 - 2000 RPM Subject to meeting specified performance.	Engine HP ---- at - ---rpm & Engine peak torque ---- NM at - --- rpm; Range of rpm---- to---- for peak torque
g	Power requirements for other auxiliary system, ITS, etc.	Required to be provided by bus engine	Confirm and indicate power in terms of HP
3.2	Emission norms	BS VI/latest as applicable	Confirm
3.3	Engine management	Engine oil pressure, engine coolant temperature, engine speed in RPM, vehicle speed, engine % load (torque), diagnostic message (engine specific) generally as per UBS II	Confirm
3.4	Engine operational requirements	Engine should be able to operate efficiently at ambient temperatures / environmental conditions of TNSTC generally operating in the semi-arid & humid zone prevailing in the area as indicated in above sections	Confirm
3.5	Engine location	Front	specify
3.6	Transmission	Heavy duty Synchromesh manual transmission with minimum 5 forward and 1 reverse speed. Neutral during stops	1. Make --- model - ---- of Transmission system 2.No. of forward speeds and their details
3.6.1	Operational safety	Transmission system to be fitted with a mechanism which makes it possible to engage reverse gear only when vehicle is stationary.	Confirm
4.0	Clutch System	Mechanical Clutch system using single plate push type dry clutching. Disc clutch lining be of asbestos free material.	Provide details
5	Rear & Front Axles		
5.1	Rear axle	Single reduction, hypoid gears, full floating axle shafts with optimal gear	Make --- model --- --- of Rear Axle

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
		ratios suitable for type II NDX operations in designated areas	Type -- Gear ratio ----
5.2	Front axle	Heavy duty reverse Elliot I-section beam type axle suitable for bus floor height, track rod with replaceable ball joints at both ends.	Make --- model --- --- of Front Axle Type --
6	Steering system	Hydraulic power steering with height and angle adjustments	Make --- model --- --- of Steering system Type --
7	Suspension system	Parabolic leaf spring (waveller type) suspension at front axle and air suspension at rear axle complete with Anti-roll stabilisers & heavy duty hydraulic double acting Shock Absorbers at both axles	Confirm
7.1	Front	Parabolic leaf spring (waveller type) suspension system	Make --- model --- ---, Type – specs --- size---
7.2	Rear	Air suspension system	Confirm Indicate make and model of air suspension system Indicate no. of air bellows
7.3	Anti-roll bars / stabilizers	Both front and rear	Confirm
7.4	Shock absorbers	Hydraulic double acting minimum 2 each at front & rear	Make --- model --- ---, of shock absorbers Type – specs --- Confirm

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
8	Braking system	Disc Brakes in front and drum brakes at rear wheels. Graduated hand controlled, spring actuated parking brakes acting on rear wheels. Asbestos free brake Pads / linings at all places.	Confirm: i. fitment of drum brakes at Rear ii. Disc brakes at front iii. Hand brakes iv. Asbestos free pads/ linings v. Provide Make - ----, model-----, specs--- of brake system and its subsystems
8.1	Anti-skid anti brake locking system (ABS)	Required	Provide Make -----, model-----, specs--- of ABS
9	Electrical system	24-volt DC	Confirm
9.1	Batteries:	Low maintenance type lead acid batteries for 24 V system- performances as per BIS: 14257-1995(latest). 2*12V maintenance free batteries of minimum 180Ah rating	Confirm Make --- model --- ---, of Batteries Type – specs --- Rating ---- Ah
9.2	Self-starter	24V, 180 Ah	Make --- model --- ---, of Self starter Type – specs --- Rating ---- Ah
9.3	Alternator	24V, 150 A.	Make --- model --- ---, of Alternator Type – specs ---
9.4	Electrical wiring & controls –type	Multiplexing type -- As specified separately under ITS specifications	Confirm and provide details. Provide details of certifying agencies who had certified the multiplexing system design.
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. Vehicle	Make --- model --- ---, of speed limiting device Type – specs ---

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
		manufacturer shall facilitate the Speed Limiting Device Serial number to be incorporated with MORTH by ensuring that requisite data is invariably added to the details submitted to STA at the time of registration of bus.	
11	Tyres	Steel radial tubed tyres– size and ply rating for type II NDX bus operations, as per CMVR Standards preferably 10.00*20 as per AIS 044 part 3.	Make --- model --- ---, of tyres Type –Size---, specs --- Tread pattern for front---- & for rear tyres---
12	Diesel Fuel Tank capacity	230 litres capacity tank subject to being adequate to enable bus operation of more than 300 km between consecutive fillings	Confirm and provide details of diesel tank:
13	Bus characteristics		
13.1	Bus dimensions in mm		
a	Overall length (over body excluding bumper)	> 10800 mm such that minimum number of seating spaces and specified seat pitches are maintained	Confirm and provide dimensional details
b	Overall width (sole bar/floor level- extreme points)	2600 - 50 mm	Confirm and provide dimensional details
c	Overall height (unladen-at extreme point)	3800 mm max	Confirm and provide dimensional details
d	Overhang		
i	Front overhang	Minimum 32% of wheel base limited to 2400±200mm	Confirm and provide dimensional details
ii	Rear overhang	<60% (preferably about 50%) of wheel base limited 3200 ±200mm	Confirm and provide dimensional details
iii	Note:	Overall length be maintained as > 10800- mm by adjusting tolerances	Confirm and provide

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
		appropriately on various dimensions such as wheel bases, overhangs, etc	dimensional details
13.2	Turning circle radius (mm) (centre point of front wheel track) / Front overhang outer corner / rear overhang inner corner	11000±200 mm / 14000±200 mm / 7000±200 mm	Confirm and provide dimensional details
13.3	Floor height above ground (mm)	1150 ± 10 mm	Confirm and provide dimensional details
13.4	Clearances (mm)		
a	Axle clearance(mm)	Minimum 190 mm	Confirm and provide dimensional details
b	Wheel clearance(mm) area	> 220 mm for parts fixed to bus body & > 170 mm for the parts moving vertically with axle.	Confirm and provide dimensional details
c	Minimum ground clearance at GVW	Within the wheelbase ≥ 400mm	Confirm and provide dimensional details
13.5	Angles (degrees)		
a	Angle of approach (unladen)	Not less than 8.0°	Confirm and provide dimensional details
b	Angle of departure (unladen)	Not less than 8.5°	Confirm and provide dimensional details
c	Ramp over angle (half of break-over angle) unladen	Minimum 4.8°	Confirm and provide dimensional details
14	Bus Gates/Doors		
14.1	Entry-exit gates with doors	Double jack-knife (JK) type, 1 door on near (left) side. The door flaps shall be so designed as to provide positive sealing against ingress of water in the bus particularly during any water logging / flooding on roads.	

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
a	Operating mechanism	Electro pneumatically controlled	Confirm Make ----, model ---- type --- & specs ---- of operating mechanism
b	Maximum opening / closing time in seconds per operation	4	Confirm and indicate closing / operational time
c	Positions of door controls	As per AIS 052	Confirm
14.2.	Passenger safety system - allowing bus motion only on doors closing. Front button to open the doors from outside required	Mandatory	Confirm and indicate type of system provided
14.3	Entry / Exit gate with doors – (near side / non driver side); Locations & dimensions,	Front gate behind front axle and Rear gate behind rear axle such that distance between front edge of the gate and Centre Line of rear axle is 1500 mm.	Confirm and provide dimensional details
a	Door aperture in mm	>850mm as per AIS 052	Confirm and provide dimensional details
b	Clear door width (fully opened)	> 650 mm as per AIS 052	Confirm and provide dimensional details
c	Door height	1900 mm as per AIS 052	Confirm and provide dimensional details
d	First step height from ground	≤ 400 mm	
e	Maximum height (mm) of other steps	≤ 250 mm	
14.6	Ramp / suitable mechanism for wheel chair access at the near side front gate,	Not Required	Confirm Type--- size--- Dimensions Material ---- specs----

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
			Load carrying capacity ----- kgs m
a	Dimensions		Confirm
b	Material		
c	Load carrying capacity		
d	Device to prevent the wheel chair roll off the sides when the length exceeds 1200mm		
e	Device to lock wrapped up ramp		
f	Requirement for passenger with limited mobility	√	Confirm
g	Wheel chair anchoring - minimum for one wheel chair	Not Required	Confirm
h	Priority seats - minimum 2 seats	√	Confirm
i	Stop request- on pillars--selected for operational convenience	√	Confirm
j	Emergency doors / exits or apertures (numbers)	As per AIS 052	Confirm Emergency door details----, type-- ----, size-----, locations----, nos--- Confirm
	Dimensions in mm	As per AIS 052	
k	Passenger safety system - allowing bus motion on doors closing and doors opening only when the bus is stopped	Mandatory	Confirm and provide details of mechanism
l	Power operated service door - construction & control system of a power operated service door be such that a Passenger is unlikely to be injured/trapped between the doors while closing.	As per AIS 052	Confirm and provide details of mechanism
m	Door components	As per AIS 052	Confirm

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
n	Door locks / locking systems / door retention items	As per AIS 052	Confirm
o	Door hinges	As per AIS 052	Confirm
15	Bus body		
15.1	Bus Design / Bus type approval	Design type approval as per Annexure-3 of UBS II/ AIS 052/ AIS 153 / harmonised guidelines as applicable and the data given in this doc whichever is superior. The fully completed bus be type approved as per approved design.	Confirm and provide details

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
15.2	Bus structure	Materials, corrosion prevention and paints	
a	Bus structure – underframe, super-structure, roof, etc, material specifications etc.	<p>The under frame and super structure suitably designed to carry nominal load of over 52 passengers (assuming an average weight of 68 kg per passenger and hand luggage of 25kgs each) and crush load of 80 pax.</p> <p>The superstructure of the bus fabricated using Galvanised Steel Material (GS/ GP) tubing (ERW– Rectangular / Square Hollow Sections) of grade Yst –240 for the bus body to be weld integrated /welded to the chassis frame depending upon the chassis design. Material size to be decided by the manufacturer. Material should fulfil structural strength etc. requirements indicated under Annexure-3 of UBS II and those in Part I above. Other requirements as per bus body code.</p>	<p>Details of Structural materials fulfilling strength etc. requirements indicated under Annexure-3 of UBS II and those in part I of specs to be provided as a separate annexure / drawing with complete dimensional, materials and other details of specs at bidding stage.</p>
b	Front and Rear End structures	Front and rear end structure design be energy absorption type steel, or FRP or a combination of both to reduce impact stresses into under frame/side structures/ other areas of the vehicle generally as per Bus code AIS 052	Details of design, materials, load bearing capability as evaluated for the offered design be submitted along with the bid.
c	Corrosion prevention	Samples of all materials & joints would withstand two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117. Corrosion prevention & painting- As per AIS 052	Confirm and provide details
d	Paints	All structural members be treated for corrosion prevention internally as well as externally and painted using Polyurethane (PU) painting-based spray paint Details of paints used, surface treatment & preparation, corrosion prevention treatment, base primer coatings, number of paint coats to be applied etc would be supplied.	Confirm and provide details

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
15.3	Panelling	Bus exterior side panels fitted with stretched GS sheet at waist level. The exterior front-end panelling be of GS sheet while roof, rear, sides & skirt panelling be of aluminium. Space between exterior and interior roof panelling be filled with insulating material as per specs indicated in part I.	Detailed specs be provided along with the bid
15.4	Aluminium extruded sections for:		
a	Rub rail	Aluminium extrusion IS 733/1983 or better	Confirm and provide details of specs, sizes, make etc.at bidding stage.
b	Decorative moulding		
c	Wire cover		
d	Wearing strip		
e	Foot step edging		
f	Panel beading		
g	Window frame		
h	Roof grab rail brackets		
15.5	Floor type / materials etc.		
a	Type of floor	Uniform floor inside bus without steps.	Confirm
b	Steps on floor	Not required	Confirm
c	Maximum floor slope	Less than 6 degrees as per AIS 052	Confirm
d	Floor surface material	15mm 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 (BRW) as for marine board BIS:710-1976/ latest and fire retardant as per BIS:5509-2000(IS15061:2002)	Confirm and provide details
e	Anti – skid material	3 mm thick anti-skid type silicon grains ISO 877/76 for colour, IS5509 for fire retardancy	Confirm and provide details of material, specs, thickness, make etc.at bidding stage.
15.6	Safety glasses and fittings:		
a	Front windscreen (laminated) glass:	Full width single piece laminated safety glass, plain, flat / curved with curved corners with intervening Poly	Confirm and provide dimensional and

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
		Vinyl Butyral (PVB) film IS 2553 (Part-2)-1992 / latest. Standard designs (Refer Annexure 1 to UBS II) for 11 metre long buses to be followed	specs details at bidding stage.
	Size:	Size 2200mm width*1500mm height plain / flat curved at corners*8.76mm thick ¹	Confirm and provide dimensional and specs details, drawing etc. at bidding stage.
b	Rear windscreen:	Single piece flat/curved toughened glass-plain/flat/curved at centre & curved at corners IS 2553(Part-2)-1992/latest	Confirm and provide dimensional and specs details, drawing etc. at bidding stage.
	Size:	Size:1900mm width*950mm height (minimum)* 5.5+0.5mm thickness ²	Confirm and provide dimensional and specs details, drawing etc. at bidding stage.
c	Side windows:	Flat, 2-piece design-top fixed toughened glass IS 2553 (Part-2)-1992/latest and the bottom portion sliding type	Confirm and provide dimensional and specs details
d	Glass specifications	Toughened glass IS2553(Part-2)-1992/latest	Confirm and provide dimensional and specs details, etc.at bidding stage.
	Glass thickness:	4.8-5.3mm	
e	Window & other glasses - material specifications, thickness etc	Toughened as per IS 2553(Part-2)-1992/latest of 4.8-5.3 mm thickness	Confirm and provide dimensional and specs details, etc. at bidding stage.

¹ IRT suggested laminated clear curved Glass 99 * 61 i.e. 2515mm*1550mm inches size with 8.76 mm thickness. It may be difficult to accommodate the said width of 2515mm within the bus width of 2600-50mm unless the glass is wrapped around, that would significantly increase cost and proneness to damage. Hence, IC suggested that the specified dimensions be maintained as size given by IC is generally as per UBS II to facilitate standardisation and thus ease of availability at minimum cost for replacement.

² IRT suggested Single toughened grey curved glass of 96 * 42 inches i.e. 2439mm*1067mm with 6 mm thickness. The suggested size is a non- standard size. Whereas, size given by IC is generally as per UBS II to facilitate standardisation and thus ease of availability at minimum cost for replacement.

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
f	Safety glass	As per AIS 052/CMVR	Confirm and provide dimensional and specs details
g	Rear view mirrors	As per AIS 052 & AIS 001/002	Confirm and provide dimensional and specs details
15.7	Seating and gangway etc.		
15.7.1	Passenger seating for type-II NDX buses	As per AIS 052	Confirm
a	Seat layout – type II NDX bus operations	2*3 standard seating as per Type II NDX buses in AIS 052	Confirm and provide dimensional details
b	Seat layout –	Front facing	Confirm and provide dimensional details
c	Seat area/seat space per Passenger (width*depth) mm	400*350 as per AIS 052	Confirm and provide dimensional details
d	Seat pitch - minimum in mm	700 mm as per AIS 052 for Type II NDX buses	Confirm and provide dimensional details
e	Minimum backrest height-from floor to top of seat / headrest	900mm as per AIS 052	Confirm and provide dimensional details
	Minimum Seat base height-distance from floor to horizontal front upper surface of seat cushion mm.	450± 50mm as per AIS 052	Confirm and provide dimensional details
	Seat back rest height in mm	375 mm	Confirm dimensions
f	Torso angle (degrees)	Minimum 15 as per AIS 052	Confirm
g	Seat materials	'Poly Propylene Low Density / Low density Poly Ethylene (PPLD/LDPE)' moulded and or any other seat material for fully-built ready to install cushioned and upholstered finished	Confirm and provide dimensional and specs, make,

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
		seats complete with all the requisite features called for in this doc. Ref AIS:023 & bus code for performance. Passenger seat frames behind rear right mudguard be provided with additional reinforcement	model and other details
h	Seat frame structure material where required:	Frame Structure of ERW steel tube.	Confirm and provide dimensional and specs details
i	Free height over seating position in mm	More than 900 as per AIS 052	Confirm dimensions
	Seat base height:	450± 50 as per AIS 052	Confirm dimensions
j	Clearance space for seated Passenger facing driver partition mm	AIS 052	Confirm dimensions
k	Seat cushion and Upholstery:	Seat cushion required as Polyurethane Foam, minimum thickness of front / rear ends of seat cushion/padding as 130/100 mm respectively; minimum thickness of back rest Foam cushion as 75mm; Upholstery – pile fabric / Jaccard of more than 0.7-1mm thickness. All above as per AIS 052 / UBS II	
l	Area for seated passengers (sq.mm.):	400*350	Confirm dimensions
m	Area for standee passengers (sq.mm.):	Not required	Confirm dimensions
n	Number of seats	Minimum 52	Confirm and provide no. of passenger seats
o	Number of standees (calculation as per AIS 052)	Nil	Confirm and provide no. of standees
p	Carrying capacity of bus (seated + standees) and crush load	>52, No standees, with crush loading of 80 passengers	Confirm and provide details
q	Seats side facing location	Not recommended	Confirm
r	Seat back rest	Fixed	Confirm
	Seat belts & their anchorage	Not necessary except diver seat and those facing aisle (performance etc.	Confirm

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
		as per AIS 052 and other applicable standards)	
s	Performance & strength requirements of:	√	
i	Driver seat	As per AIS 023	Confirm and provide dimensional and specs details
ii	Passenger seats	As per AIS 023	As per AIS 023
15.7.2	Gangway:		
a	Minimum interior head room (centre line of gangway) in mm	1900 mm including that in the rear overhang area as per AIS 052.	Confirm and provide dimensions
i	At front axle:	As per AIS 052	Confirm and provide dimensions
ii	At rear axle:		
iii	Other areas		
b	Gangway Width (mm) from gates to longitudinal space between rows of seats (Access to service doors)	i. minimum 650 mm (Refer figure-1 of UBS II/AIS 052) for front gate	Confirm and provide dimensions
c	Gangway Width (mm) in longitudinal space between rows of seats	Minimum 350 mm (Refer figure-1 in UBS II/AIS 052) excluding armrests and including stanchions- will be measured from seat edge to seat edge.	Confirm and provide dimensions
d	Driver's working space	As per AIS 052	Confirm and provide dimensions
	Driver's seat	As per AIS 023 & AIS 052	Confirm and provide dimensional and specs details
15.8	Corrosion prevention & painting	As per clause 3.17 of AIS 052 and details brought out in Part I	Confirm
a	Corrosion prevention treatment	As per clause 3.17 of AIS 052 and details brought out in Part I.	Confirm
	Internal surfaces of structural members		Confirm and provide process followed
	External surfaces of structural members		Confirm and provide process followed

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
	After drilling holes/welding		Confirm and provide process followed
	Inter metallic galvanic corrosion prevention		Confirm and provide process followed
b	Primer coating		Confirm and provide process followed and specs of primer coating used
c	Painting:		Confirm and provide process followed and specs of primer coating used
16	Electricals	Multiplexing provision for electrical circuitry	Confirm, type. Provide details and the drawings
16.1	Electrical cables:	BIS marked, copper conductors with fire retardant as per IS/ISO: 6722:2006 as per appropriate class. Conductor cross-section varying as per circuit requirements, minimum cross-section 0.5 sq mm. Quality marking may also be as per equivalent or better European, Japanese, US standards.	Confirm and provide details of specs, sizes, make etc. of each type of cable
16.2	Conductor cross section	As above and suitable to carry rated current (Japanese auto Standard JASO D0609-75 AV)	Confirm and provide details of specs, sizes, make etc. of each type of cable
16.3	Safety requirements of electrical	As per AIS 052 /UBS II	Confirm
a	Fuse	As per AIS 052 - fuse of rated current 1.5 times the load current of electrical equipment. Necessary in every electrical circuit	Confirm and provide details of specs, sizes, make etc.
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	Confirm and provide details of specs, sizes, make etc.

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
c	Location of cables away from heat sources	As per AIS 052- Required for each such circuit	Confirm
d	Type approval of circuit diagram as per standards related to electric equipment/wiring	As per AIS 052 - Required for all items	Confirm and provide details along with relevant certificates
e	Cable insulation with respect to heat	As per AIS 052	Confirm and provide details etc.
f	Battery cut - off switch (isolator switch):	Heavy-duty type capable of carrying & interrupting total circuit load --1 each near battery/driver	Confirm and provide details of specs, make etc.
16.4	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	Confirm. Provide Make ----, model----, specs-- - of wiper motors and its subsystems
a	Wiper motor:	Speed control with time delay relay as per AIS 011.	Confirm. Provide Make ----, model----, specs-- - of wiper motors and its subsystems
b	Wiper arm/blade:	AIS011 /AIS 052	As above wrt arms / blade
16.5	Driver cabin fan	1 number, 24 volts, 200mmdia fan as per provision of CMVR, matching interiors	Provide Make ----, model----, specs-- - of fan
16.6	Lighting - internal & external and illumination	As per AIS 052.	Confirm and provide details of lighting / illumination
16.7	Illumination requirements/performance of:	As per AIS 052 / AIS 012	
a	Dash Board Tell-tale lighting/control lighting	As per AIS 052 & bulbs tested for photometry as per IS 1606:1996	Confirm and provide details of specs, wattage, make etc.
b	Cabin Lighting - luminous flux of all lamps for cabin lighting	As per AIS 052 with illumination level of ≥ 100 lux & ≤ 200 lux	Confirm and provide details of specs, wattage, make etc.

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
c	Passenger area lighting - luminous flux of all lamps for Passenger area lighting	As per AIS 052 with illumination level of ≥ 100 lux and ≤ 150 lux	Confirm and provide details of specs, wattage, make etc.
17	ITS enabled bus	As specified separately under ITS chapter of UBS II specifications / and or by ITS Consultant and generally as brought out at Para 32 in Part I. Additionally Mobile / lap-top / ETVM chargers be provided at conductor seat and at every passenger seat. GPS and Vehicle tracking system	Confirm details
18	Safety related items:		
18.1	Driver seat belt & anchorage duly type approved.	Adjustable type driver seat with seat belt ELR recoil type, 3 point mounting as per CMVR & AIS 052 conforming to AIS: 005 & 015.	Confirm and provide details of specs, type, make etc. of seat belt and anchorage
18.2	Passengers seat belts: Number:	Not necessary except diver seat, for seats facing gangway if any (performance etc. as per AIS 052)	Confirm
18.3	Driver/Passenger Seat Belt Anchorage		
18.4	Fire extinguisher:	As per AIS 052	Provide Make ----, model----, specs-- of fire extinguishers
18.5	First aid box:	1 number, as per provision of CMVR	Provide Make ----, model----, specs-- of first aid box and its contents.
18.6	Handrails Minimum length*diameter* height above floor in mm	Colour contrasting and slip resistant of aluminium tubing 32 mm dia, 3 mm thick.	Confirm and provide details of specs, size make etc.
18.7	Handholds:	Colour contrasting and slip resistant. 2 to 4 Numbers. hand holds per bay of poly-carbonate transparent with provision for advertisements	Confirm and provide details of specs, sizes, make etc.
18.8	Stanchions:	Vertically fitted with attachment to bus floor and to roof, aluminium tubing with Colour contrasting and slip resistant. 40 mm dia & 3.15 mm thick. Rest As per AIS 052	Confirm and provide details of specs, sizes, make etc.

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
18.9	Bells for Passenger convenience	High visibility bell pushes shall be fitted at a suitable height (≥ 1.2 metre on all/ alternate/convenient stanchions keeping in view convenience of passengers and avoidance of un-necessary/ inadvertent operation by passengers. These would assist PwDs and all other passengers	Confirm and provide details of specs, sizes, make etc.
18.10	Security Cameras	One rear camera for bus reversing and at least two cameras in the passenger cabin area as per the specifications / supplies made by the ITMS service provider. One more camera in front of Driver to capture vehicle front side blind spots coverages	Confirm and provide details of specs, sizes, make etc.
18.11	Window Guardrails:	As per AIS 052.	Confirm and provide details of specs, sizes, make etc. where provided
a	In all type II NDX buses - minimum numbers.		
b	Other details:		
i	First guard rail at a height from window sill in mm		
ii	The distance between two guard rails in mm		
18.12	Entrance/Exit Guard/ Step well guard:	800 mm minimum height extending ≥ 100 mm more than centre line of sitting position of the Passenger.	Confirm and provide details of specs, sizes, etc.
18.13	Emergency exit doors, warning devices etc.	As per AIS 052/CMVR	Confirm and provide details of specs, make etc.
18.14	Front/rear door, stepwell lights, door open sign	LED as per AIS 008	Confirm and provide details of specs, wattage, make etc.
18.15	Mirrors right/left side exterior / interior:	Convex as per AIS 001 & 002. Interior with double curvature	Provide Make -----, model-----, specs-- - of rear-view mirrors
18.16	Towing device front and rear	Heavy duty for loads of 1.2 times (minimum) the kerb weight of the bus within 30° of the longitudinal axis of the bus. As per CMVR & IS 9760 - ring type	Confirm and provide dimensional and specs details

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
18.17	Warning triangle	As per AIS 052/CMVR	Provide Make -----, model-----, specs-- - of warning triangle
18.18	Bumpers - front and rear	Both made of Steel or impact resistant polymer or combination of both meeting requirement of an energy absorbing system. Impact strength as per AIS 052	Confirm and provide details of specs, sizes, make etc.
	Impact strength for bumpers	Meet requirements of Para 6.3.1 of AIS 052	Confirm and provide details of impact strength etc. Should Para 6.3.1 of AIS 052 not give any values, test standard and or test procedure. VM would hence be required to provide above details at the time of pre-bid meeting.
19	Miscellaneous items/requirements		
19.1	Windows		
a	Type of window	Windows - two piece in buses, where top portion, would be fixed and bottom portion would have sliding glasses. Minimum window glass/aperture area (main windows) in cm ² 14000. Toughened Glass of thickness 4.8-5.3 mm	Confirm and provide details of specs, sizes, make etc.
b	Minimum height of window aperture (clear vision)	≥ 950 mm	Confirm and provide dimensions
c	Minimum height of upper edge of window aperture from bus floor	As per AIS 052	Confirm and provide dimensions
d	Minimum width of windows (clear vision zone)	As per AIS 052	Confirm and provide dimensions
19.2	Cabin Luggage Rack inside the bus and under	Cabin luggage racks (350 width from side wall*250 mm height) on both	

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
	chassis / rear end Luggage Carrying facility with accessibility	side walls. Additionally luggage carrying space be provided under the chassis on sides as also at the rear end of the bus with adequate access	
19.3	Life cycle requirements of bus (whichever is earlier)	9 years or 12,00,000 km, which-ever is earlier.	Confirm and provide details of mechanism of assessing life of buses
20	Additional requirements		Additional requirements
a	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	
		Driver's work area to be provided with a 200 mm diameter 24 V fan to ensure proper ventilation. The fan to have 3 – speed adjustment	Confirm and provide details of make, model and rating of fan.
b	Folding table for each seat	Not required	Confirm and provide details
c	Magazine pouch	Not required	Confirm and provide details
d	Adjustable foot rest	Not required	Confirm and provide details
e	Back rest adjustment knob in case of reclining seats	Not required	Confirm and provide details
f	Individual seat reading light	Not required	Confirm and provide details
21	Noise, vibration and harshness etc		Confirm and provide details
a.	Maximum noise levels inside the saloon-test procedure as per AIS 020	81dba	Confirm and provide details
b	Noise Vibration and Harshness levels when measured under driving conditions on during operations in designated area roads with pot holes and speed breakers, etc	<ul style="list-style-type: none"> Vibration levels / Noise, vibration and harshness (NVH) levels (interior): <ul style="list-style-type: none"> Noise level in saloon from drive axle, etc.: Nil Dominant frequencies to fall outside the ranges of: 0.5-1 Hz, 5-7 Hz and 18-20 Hz Transient vibration level in seating area maximum:1g 	

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
		<ul style="list-style-type: none"> Transient vibration level at driver seat maximum:0.1g Vibration levels at driver/Pax seats (metre/sec²) ≤ 0.5 Vibration level in gangway (metre/sec²) ≤ 1 	
22	Fire Detection and Suppression System (FDSS)	<p>An automatic fire detection & Suppression system be essentially provided for engine and other fire sensitive areas of the bus. Possibility of provision of FDSS for entire bus including but not limited to engine area, drive line, fuel tanks, fuel filling point and fuel distribution lines / cluster, wheel wells, electrical systems etc.</p> <p>Additionally fire extinguishers as per AIS 052 be provided</p>	FDSS provided for: - Name all systems, sub-subsystems; Indicate type, make & model of provisions in each case
a	Fire Condition Monitoring device	Pneumatic Electronic Linear fire detector with stainless steel tube with suitable diameter	Make and model of the fire detector; Dia. and specs of SS tubing;
b	Components for Fire Condition Monitoring Device		
i	Generally, as per UBS II, AIS 135, CMVR	Detector operating on rate of rise with Advanced Built in Test Module.	Make, model & specs;
ii		Stainless steel Tube sensor with suitable diameter and should be rodent free	Specifications and relevant documents be provided
c	Detector Specification / requirements: Generally, as per UBS II, AIS 135, CMVR (if any)	Detector should operate with Rate of Rise along with advanced Built-in Test Module that indicates failure in the event of reduced performance over the entire range of sensor tube.	
i	IP Rating	IP67	
ii	Enclosure	Aluminium	
iii	Operational Temperature Range	-40°C to +125°C	
vi	Shock & Vibration:	<p>Should comply t:</p> <p>BS EN 61373, Table 1,2,3</p>	

S No	Description	Specifications provided by IC team	Bidder to confirm and provide details
		Standard floor (1150 mm floor height), 11 m long type II NDX buses	
		MIL STD- 810:501.4, 516.5.4.	
v	Sensor Tube	1 Mtr. to 100 Mtr. in length. Stainless steel material with suitable diameter.	
vi	Operating Voltage:	18 - 32 V DC	
vii	Alarm Current:	40mA	
2	General		Confirm
i	Capacity of the Fire suppression system for each of the different areas	--- as decided by the Vehicle Manufacturer	Confirm
ii	Material of Construction	VM to decide optimal materials and the containers for fire supersession for each of the fire sensitive areas of the Bus.	Confirm
iii	Fire suppression system trigger mechanism for each of the fire prone areas	Pneumatically/ mechanically / electro-mechanically and or any other mechanism Operated	Confirm
iv	Powder (if any used)	UL listed ABC 90%	Confirm

Annexure I to Part II above

A system of assessment of standee capacity in the bus: Standee spaces available in the bus

Formula for calculation of number of seats and number of standees permitted.

Dimension	Description	Area (In mm ²)
Area of the Driver Compartment	Width x Depth of Driver Work Area	Ad
Total projected Step Well Area (all stepwells)	Sum of projected Area of all Step Wells	As
Projected area of Engine	Width x Length of Engine projected on the floor Area	Ae
Area of any part of the Vehicle where vertical clearance is less than 1350 mm (Engine etc.)		Aw
Area required to provide a clear work area at service floor area occupied by any stair case		Ast
Area of parts where clear height above floor level less than 1900 mm (1750mm in case of mini bus)		Ac
Area of seat in facing partition	(300 mm x Total seat width)	Ap
Area of the parts where slope exceeds the maximum specified value for purpose of passengers		Asl
Total Area excluded for purpose of calculating seated passenger capacity	Sum (Ad+As+Ae+Aw+Ag+Ast+Ap)	Aex
Area of Gangway		Ag
Total internal Floor Area	Internal Width x Internal Length	Aint
Area for seated Passengers	Aint-(Aex+Ag)	Apass
Area for standee passengers	2Ag – (Ac + Asl + 150mm x Length of Gangway)	Astd

Note: Value of Astd is the solution of following three equations –

$$Aex = Ad + As + Ae + Aw + Asl + Ag + Ast + Ap$$

$$Apass = Aint - (Aex + Ag)$$

$$Astd = Aint - (Ad + As + Ae + Aw + Ast + Ac + Ap + Asl + Apass + 150mm^*$$

Length of Gangway

Formula for calculation of seating and standee passenger areas

Dimension	Description	Result
No of Seats permitted	$Apass / (\text{seat pitch} \times \text{Seat Width})$	No. of seats
No of Standees permitted	$Astd \times 5 \times 10^{-6}$	No. of Standees

Annexure II – A copy of bus code AIS 052

Annexure III – An indicative list of materials to be tested

Annexure III: Indicative list of items to be tested		
S No.	Items to be tested	Specifications
	CR Tubular sections	BIS:4923-1997 (or latest) of Grade Yst.-240
	Phosphating / Galvanizing	BIS:3618-1966 (or latest) Class A-2 for Phosphating & BIS:277-2003 or latest - 120 gsm for Galvanizing (Zinc Coating) and two weeks (336 hours) Salt Spray Test for both in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%.
	EPDM Rubber	As per AIS 085
	Glasses Laminated	BIS: 2553 (Part-2)-1992 (or latest) Float Glass, Front 'AA' Grade Glass, PVB Film in Laminated Glass.
	Aluminium Parts	IS:733-1974 (or latest) for Solid Part, IS:1285-1975 or latest for Extruded Round Tube & Hollow Part and IS:738-1977 or latest for Drawn Tubes, Alloy 63400, tempering WP.
	Paint	PU Paint as per relevant IS: 13213:1991 (or latest) & any other relevant BIS Standards. For Matt Black Paint the Gloss Value is up to 30 units.
	LT Wire	BIS: 2465-1984(or latest). DIN 72551- Dimensional Test JIS C 3406- Spark, Immersion & Conductor Resistance Test' SAE recommended J 1127 & J 1128
	Aluminium Sheet	BIS:737-1986(or latest), Aluminium Alloy H-2/31000
	CR sheets	BIS:513-2008(or latest)
	GI Sheets	BIS:277-2003 (or latest), Class-VIII Medium Coating of Zinc Nominal Weight120 grams/M2.
	Passenger Seat Assembly	As per AIS-023, Bus Code & BIS Standards. For MS components two weeks (336 hours) Salt Spray test for both in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%.
	Marine Board / Board / another floor material	BIS: 710-1976 (or latest) IS:5509-2000 (or latest) for Flammability.

Annexure IV – Specifications for Intelligent Transport System (ITS)

Functional Specifications for ITS		
#	Parameter	Specifications
AVLS		
1	Single Controller Unit (SCU)	<ul style="list-style-type: none"> The route programming file upload capability should also be catered through SD card/USB port to support redundancy Route selection function is to be provided on BDC with easy sorting of routes Integration with BDC through latest interface mechanism. The Controller Unit shall have a time-of-day clock and calendar. The time and date shall be synchronized as per IP based timing protocol (configurable) with the central software time. Local battery backup for minimum half hour for the smart start and shutdown of the SCU.
2	Bus Driver Console	<ul style="list-style-type: none"> All driver related route information to be displayed on BDC In-built light sensor with continuously variable brightness control to enable the display intensity to change based on ambient light conditions. BDC supports the following functions: <ul style="list-style-type: none"> Driver login & logout Route selection Route start Automatic Bus Stop Announcement Manual Bus Stop Announcement Special Announcements PA- Passenger Announcements Two-way voice communication SMS Messaging Emergency alarms 4 section camera views to be supported on BDC after cameras are installed in future.
On-Board Display Units		
1	Viewing distance	<ul style="list-style-type: none"> Front, side and rear signs 50 metres minimum, for single line text, in day and night. Inner 15 metres minimum, for single line text in day and night.
2	Display Characteristics	<ul style="list-style-type: none"> Fixed, scrolling and flashing mode (with fixed route number, up to minimum 40 characters for scrolling mode, on front, side and rear signs). Capability to show customized graphics. Scrolling Two lines - English followed by Tamil and then local language. Total display height should accommodate two lines and the individual heights of each line should be adjustable to enable one line to be larger/smaller than the other line. However, during next stop announcement only single line text is required It should be possible to display, concurrently, different messages on each of the signs (front, rear, side and inner).

Functional Specifications for ITS		
#	Parameter	Specifications
		<ul style="list-style-type: none"> It should be able to display special signs like signs for 'PWD enabled bus', 'ladies special'. Capability to show special characters like (, “. ! + - * : ?) Signs should have ability to retain the last message displayed in the memory of the sign even in the event of power failure and without the message being reloaded. Display and voice announcement in English, Tamil and other local languages The display systems shall have in-built test facility, able to carry out self-check at periodic intervals, carry out exchange of diagnostic information from the central control stations including power availability, its current status etc. The display system shall support remote settings such as display intensity, time synchronization etc. PIS displays shall be managed locally without workstation or server.
3	Hardware Programming Capabilities	<p>The hardware to be procured shall have minimum below system programming capability;</p> <ul style="list-style-type: none"> The system should enable driver to communicate via audio call to the control centre. The system should enable driver to send out from a list of pre-defined messages to the control centre Support minimum 3000 routes UP and DOWN (Average 10 stops per route) of signboards supplied. GPS triggered next stop display on Inner sign with synchronized voice announcement on each route. The system should be able to specify geo-fence boundary individually and collectively for next, upcoming and current station announcements. The current stop announcement should be correct to 5 metres. The inner sign should be able to display and announce up to three languages, one after the other in sequence. For example, make display an announcement in English, then Tamil and then any local language Display driver and conductor ID once in between the stops on Inner sign Inner sign should be able to display text and customized graphics and announce pre-recorded messages on SCU(OBU) display panel of the controller. The system should have provisions to add more text and audio messages. Functionality of Display 'clock'-GPS based or 'Default Messages' on Inner sign Emergency 'stop' request function- by pressing an emergency switch placed anywhere in the bus the inner sign should display 'stop' message

Functional Specifications for ITS		
#	Parameter	Specifications
		<p>and buzzer located near the driver makes the sound alerting the driver to stop the bus.</p> <ul style="list-style-type: none"> • In case one or more signs get disconnected (malfunction), the rest of the signs should continue to function regardless (including fresh communication from SCU) • Sign should be able to store 'Diagnostic Trouble Codes' (DTC)', 'Parameters Identifiers (PID) and with retrievable data. • The system should be capable of raising alarms based on vehicle statistics (engine overheating, low fuel, etc.) • The route programming files, stops, messages, etc should be updated to the on-board unit over USB, Ethernet, Wi-Fi, etc. from Server (at least one online method and one offline method provision to be given). • The system should allow the control centre to view the route selected by driver. • It should be possible to change/choose/select a 'route' remotely over the air from Operations Control Centre. • All SCUs (OBU) should connect in real-time to the central system via GPRS, 4G and above, Wi-Fi, etc. • All firmware updates to the OBU should be via USB, Ethernet, W-Fi and OTA. • PIS displays should be capable to be managed locally without workstation or server. • The SCU shall have the capacity to store static information in the display controller (including schedules), which shall be shown if the communication link is lost and after real-time information expires. • The proposed hardware should be able to provide backend software capability to <ul style="list-style-type: none"> ○ Assess the status of a running vehicle in terms of on-time, delayed and early arrival by comparing with schedule • Generate Reports in terms of <ul style="list-style-type: none"> ○ GPS outage, loss of connectivity and their frequencies and durations ○ Missed trips, missed stops, route violation, un-scheduled stoppage, late start, etc. for performance analysis. <p>Driving patterns, over-speeding, harsh braking, etc.</p>
PA System		
1	Public Announcement (PA) System	<p>The Voice PIS must play clearly audible pre-recorded voice announcements (in three languages) informing passengers of next bus stop on route. The voice PIS shall interface with the on-bus GPS module to gather location information and making the appropriate next station announcement.</p>

Technical Specification for ITS - AVLS Hardware (SCU/OBU, BDC and On board Panic Button)		
#	Parameter	Minimum Specifications
I	Single Controller Unit (SCU) / On-Board Unit (OBU)	
1.	Certification	Compliant to IS 16833 or UBS-II
2.	Operating Voltage	9 to 36 V DC
3.	Surge Protection	Enabled
4.	Power source	Connected to vehicle key-on/ignition-on
5.	Interface	CAN 2.0/ OBD II, RS 485, RS 232, fast Ethernet, USB, digital outputs, digital/Analog inputs, WLAN, audio input output, amplified audio output
6.	Communication	4G or above, Wi-Fi
7.	Protection	IP 65 or above as per UBS II or IP 54 as per IS 16833
8.	Temperature	-10° C to + 70° C
9.	Humidity	5% to 95 %
10.	Vibrations	10g
11.	Operating System	Embedded windows/Linux or similar (Latest version) (Windows 7 or latest at the time of calling the tenders)
12.	Processor	64-bit low power Industrial grade outdoor processing unit
13.	Memory	Flash: Min 4 GB, RAM: Min. 512 MB (RAM memory includes SCU (OBU) and BDC).
14.	Storage	Provision for 512 GB HDD (256 x2 GB – SSD) card and support up to 1 TB. OBU shall support at least 7 days of recording for all bus camera.
15.	GPS	In built GPS, 4G and above (GSM) modules
16.	Antenna	Combi antenna using RG174 cable. The connectors on Combi antenna will be preferably SMA(M) ST plug type for GPS and FME(F) jack type 1/4"-36UNS-2B for 4G and above
17.	Audio Storage and playback	<ul style="list-style-type: none"> In-built MP3, WAV, etc. files storage/playback function.
18.	Microphone Input and Audio Output	In built two channel amplifiers minimum 10 Watts rms each suitable for 4 ~8 Ohm impedance with input for external microphone
19.	Power Supply	Power to SCU (OBU) and BDC will be supplied through power-back external battery and subsequent bus multiplexing wiring system
20.	mNVR capabilities	Should have inbuilt or integrated capabilities for a SCN System as per UBS II guidelines or IS 16833 for future requirements where the system shall consist of High-Resolution cameras for Video and Audio recordings for monitoring purposes
II	Bus Driver Console (BDC)	
1.	Operating Voltage	9 to 36 V DC (preferable through SCU(OBU))
2.	Connectivity	Power/data connection to Single Controller Unit
3.	Protection	IP 65 or above as per UBS II

Technical Specification for ITS - AVLS Hardware (SCU/OBU, BDC and On board Panic Button)		
#	Parameter	Minimum Specifications
4.	Mounting	Theft/vandal proof
5.	Temperature	-10° C to + 70° C
6.	Humidity	5% to 95 %
7.	Vibrations	10g
8.	Display	Full colour graphic TFT - Min 640 x 480 dots, Size Min. 8"
9.	Viewing Angle	60 H / 70 (right/left) / 60 V / 70 (up/down)
10.	Backlight	Adjustable
11.	Keyboard	Display with physical keys OR Full touch screen with user friendly interface for navigation, scrolling, route destination code selection, etc.
III GPS modules		
1.	Rating:	22 tracking/66 acquisition minimum
2.	Tracking sensitivity	(-) 165 dBm typ
3.	Navigation sensitivity	(-) 148 dBm typ
4.		<ul style="list-style-type: none"> Update rate 1 Hz (configurable to 10 Hz) Time to first fix cold acquisition 35 seconds typ Hot acquisition 1 second typ. Navigation accuracy 3M horizontal
IV 4G and above (GSM) modules		
1.	GSM/GPRS	GSM/GPRS SMT quad band and UMTS (4G and above)
2.	Data Acquisition and Transmission	Specifications as per AIS 140 standards. The detailed list of configurable data fields is provided in Annexure below
3.	Temperature	Temperature range -10° C to + 70° C
V 'Combi' Antenna		
1.		AMPS 850MHz, GSM900MHz, ISM868MHz, DCS1800MHz, PCS1900MHz, 4G UMTS 2.1GHz, Wi-Fi /Blue Tooth (2.4 GHz), GPS (1575.42MHz). Separate WLAN antenna may be provided if necessary.
2.	GPRS	<ul style="list-style-type: none"> Impedance 50 Ohm Radiation pattern Omni-directional Polarization linear (vertical)
3.	GPS	<ul style="list-style-type: none"> Impedance 50 Ohms VSWR <1.5:1 Polarization RHCP
4.	Waterproof	Waterproof IP-66
VI On-board Panic Button		
1.	Power Supply	9 to 36 V DC
2.	Connectivity	Serial/digital input to SCU(OBU)

Technical Specification for ITS - AVLS Hardware (SCU/OBU, BDC and On board Panic Button)		
#	Parameter	Minimum Specifications
3.	Protection	IP 65 or above
4.	Temperature	-10° C to + 60° C
5.	Humidity	5% to 95 %
6.	Vibrations	10g
7.	Use	Easy to press
8.	Placement	Convenient placement. Prevent accidental trigger
9.	Mounting and Casing	<ul style="list-style-type: none"> Unit should be fixed securely at the chosen position The casing should be theft proof, tamper proof and vandal proof All fixtures and mounting should be certified by qualified structural engineers for capability to withstand vibrations and fixture safety

On Board Display Units and Announcement System		
#	Parameter	Minimum Specifications
I	Front Outer LED, Rear Outer LED, Inner LED, Side LED	
1.	Certification	UBS II certification
2.	Route Board Sizes	<ul style="list-style-type: none"> Front Outer LED - minimum 1800X220 mm Rear Outer LED - minimum 900X220 mm Side Outer LED - minimum 900X220 mm Inner LED - 800X100mm
3.	Operating Voltage	9 to 36 V DC
4.	Power Consumption	1 Amp. @ 24 V DC
5.	Surge Protection	Enabled
6.	Connectivity	RS 485 or similar
7.	Protection	IP 65 or above
8.	Temperature	-10° C to + 70° C
9.	Humidity	5% to 95 %
10.	Vibrations	10g
11.	Firmware	Firmware update and version check through controller
12.	Colour	Single colour (Amber, can vary)
13.	Viewing Angle	Minimum 120 H / 60 V
14.	Intensity	Continuous variable brightness control
15.	Viewing Distance	50 m, Inner 15 metres minimum, for single line text in day and night
16.	Memory	Ability to retain last displayed message
17.	Display Modes	Fixed, scrolling, flashing
18.	Mounting	<ul style="list-style-type: none"> All units should be fixed securely at the chosen position

On Board Display Units and Announcement System		
#	Parameter	Minimum Specifications
		<ul style="list-style-type: none"> The casing should be theft proof, tamper proof and vandal proof All fixtures and mounting should be certified by qualified structural engineers for capability to withstand vibrations and fixture safety
19.	Display Language	Two Lines multi-language display capability (English, Tamil or other language as indicated.)
II	Announcement System	
1.	Coverage	The announcement system should provide uniform coverage throughout the vehicle at optimum decibels by use of multiple speakers placed for equal sound distribution
2.	Speakers	at least 6
III	Passenger Announcement (PA) System	
A	Microphone	
1.	Frequency Response	200 – 8000 Hz
2.	Sensitivity	2.3mV/Pa
3.	Impedance	500Ω
4.	Coiled Cord	1.8 – 2.5 m
B	Speakers	
1.	Nominal Impedance	4E ± 15%
2.	D.C Resistance	3.7 ohms
3.	Resonance Frequency	170 Hz ± 20%
4.	Frequency Range	Fo~ 20KHz
5.	Sound Pressure Level	90dB ± 2dB @300,400,500,600Hz
6.	Buzz & Rattle test	6.99 V
7.	Rated Input	15-Watt, Maximum Input: 20 Watt

Bus Security Network Camera		
#	Parameter	Minimum Specifications
I	Reverse Parking Sensor Camera	
1.	Power Supply	PoE through BDC .should be automatically switched on with engine and power down on ignition off.
2.	Fixed lens	3.6 mm
3.	Picture Resolution	752 H x 582 V (PAL)
4.	Resolution	25/30fps@1080P
5.	Picture Sensor	1/3" 2 Megapixel progressive scan Aptina CMOS,
6.	IR distance	Min 30 m
7.	Image Enhancement	DWDR, Day/Night(ICR), 3DNR,AWB,AGC,BLC
8.	Protection	Minimum IP 66

Bus Security Network Camera		
#	Parameter	Minimum Specifications
9.	Temperature	-10 deg C to + 60 deg C
10.	Humidity	5% to 95 %
11.	Vibrations	10g
12.	Camera Ruggedness	<p>Rugged, vibration, shock and tamper proof Metal housing, Aviation Connectors</p> <p>Installation :Anti Vibration with Adjust Angle;</p> <ul style="list-style-type: none"> • Horizontal: 0~355 degree with 3-point locking • Vertical:0~90 degree with 2-point locking
13.	Function	Camera should engage with the reverse gear engage on buses and display the back-view of the bus on BDC display to the driver. Camera should make alert to the driver based on the distance from the objects while reverse the bus.

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
Telematics System		
1	Telematics Parameters	<p>As per UBS II guidelines, the data from multiplexing nodes, on a single CAN 2B (J1939) bus should include parameters from:</p> <ol style="list-style-type: none"> 1. Vehicle electrical system powered through multiplexing nodes 2. Vehicle safety and performance features 3. Engine and transmission 4. Diesel bus electronics data
1a	Vehicle electrical system	All external and internal fixtures like passenger/driver compartment illumination and ITS equipment
1b	Vehicle safety and performance features	<ul style="list-style-type: none"> • Fuel /Oil level/ Pressure • Fuel Level Indicator System (in Litres) - Display in Dashboard • Braking pedal position • Accelerator pedal position and kick down • Brake pad condition and brake pedal temperature (in case of electronically controlled disc brakes) • Door interlock • Kneeling interlock (wherever provided) • Gas leakage detection (wherever provided) • Fire detection/suppression (wherever provided) • Tyre Pressure Monitoring System (To ensure Tyre Air Pressure and Tyre Temperature in each wheel) • Tubeless Tyre -Parameters (like Pressure, skid indicators) • Battery Health condition monitoring System

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
1c	Engine	<ul style="list-style-type: none"> • Engine CAN status • Engine oil pressure • Engine coolant temperature • Engine speed in RPM • Vehicle speed (torque) • Diagnostic message (engine specific)
1d	Transmission	<ul style="list-style-type: none"> • Transmission CAN status • Transmission output shaft speed • Transmission input shaft speed • Transmission current gear • Transmission oil filter restriction switch • Transmission oil life remaining • Transmission service indicator • Transmission sump oil temperature • Transmission oil level high / low • Hydraulic retarder oil temperature • Accelerator pedal • Diagnostic message (transmission specific)
1e	Diesel bus electronics data	<ul style="list-style-type: none"> • Drivers demand of engine torque percentage • Actual engine torque percentage • Engine and retarder torque • Engine speed • Source address controlling device • Engine starter mode • Engine demand torque percentage • Accelerator pedal 2 low Idle switch • Road speed limit status • Accelerator pedal kick down switch • Accelerators pedal low Idle Switch • Accelerator pedal position • Percent load at current speed • Remote accelerator pedal position • Accelerator pedal position 2 • Vehicle acceleration rate limit status • Engine temperature • Engine coolant temperature

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
		<ul style="list-style-type: none"> Fuel temperature Engine oil temperature Turbo oil temperature Engine intercooler temperature Engine intercooler thermostat opening Engine fluid level pressure Fuel delivery pressure Extended crankcase blow by pressure Engine oil level Engine oil pressure Crankcase pressure Coolant pressure Coolant level Coolant level, Coolant Condition (% of Ethylene Glycol) Alternator (Volt) Output monitoring System
1f	Connector	<ul style="list-style-type: none"> CAN 2.0 (J1939 Connector) / OBD-II Connector
1g	Communication	<p>Telematics System (VHMD) real time warning to CCC</p> <ul style="list-style-type: none"> Open public communications network services (4G and above) and download compatibility <p>Telematics System (VHMD) end of the day to depot</p> <ul style="list-style-type: none"> IEEE 802.11 Wireless LAN (Wi-Fi) via 'Back haul' at depot

Testing Standard Compliance		
#	Test standards compliance	Specifications
1.	Performance parametric test	Nine points, tri temperature/tri voltage- 18V, 27V, 32V, -25°C, room temperature, +85°C test. At each test point the system will be powered on and shut down 5 times as per the supplier's designated procedure and thereafter evaluated for malfunction if any
2.	Cold	IS 9000 (Part II/Sec 4)-1977 (reaffirmed 2004) at -25°C for 2 hours in 'on' condition
3.	Dry heat	IS 9000 (Part III/Sec 5)-1977: PIS Signs, SCU(OBU) and Nodes at + 80°C for 16 hours in 'on' condition. BDC at + 80°C for 2 hours
4.	Damp heat	IS 9000 (Part V/Sec 2)1981 at +25°C /+55°C, Humidity 95%, 24 hours for 6 cycles in off condition. Functional test with power in 'on' condition at start of 2nd, 4th and 6th cycle
5.	Vibration standard AIS 012/AIS:062 -10g	<ul style="list-style-type: none"> Frequency 5~50Hz and return to 5Hz at a linear sweep period of 1 minute/complete sweep cycle and 10g at maximum

Testing Standard Compliance

#	Test standards compliance	Specifications
		<p>frequency Excursion -1.6 mm peak to peak over the specified frequency range Test duration 60 minutes</p> <ul style="list-style-type: none"> Direction of vibration –X, Y, Z axis of device as it is mounted on the vehicle.
6.	Dust and water ingress protection	IS /IEC 60947-1:2004 in conjunction with IS/IEC 60529:2001– ‘PIS signs’ IP66, ‘SCU’(OBU) IP 65, ‘BDC’ IP65, ‘nodes’ IP54
7.	Free fall	IS 9000 (Part VII/Sec 4) Free fall at 500 mm, (applicable to ‘nodes’ and ‘controllers’ only)
8.	Fire resistant	Regulation directive 95-28/EG dated 24-10-1995 horizontal Burning rate tested as per ISO 3795, Horizontal burning test HB as per UL 94 -1998 clause 7 (for wire harness)
9.	Reverse polarity protection without fuse	The component must fulfil the function- and service life requirements after being subjected to reversed polarity up to 27 V for 2 minutes.
10.	Over voltage protection	To ensure service life requirements and functionality. The component shall run for 60 minutes at 38V, without effecting the service life or function.
11.	Insulation resistance	The Insulation resistance measured as per ISO 16750-2 with a voltage of 500 V dc shall not be less than 1Mega ohm.
12.	Cranking voltage	The components shall have an electrical energy reserve that can handle voltage drop during cranking. Component shall not reset during cranking- ‘FSC B’. The supply voltage during crank is 18.0 V for 40 ms. The test to be carried out as per ISO 7637
13.	Load dump test on controller	123V ,8 Ohms 200ms pulse 5a as per standard ISO 7637-2
14.	Salt spray test	(AIS: 012/ IS10250) 96 hours
15.	EMC/EMI	<p>1.Electromagnetic radiation, radiated immunity and compatibility as per AIS 004 (Part 3) or</p> <p>2.72/245/EEC last amended by 2009/19/EC (includes 2004/104/EC, 2005/83/EC, 2006/96/EC) and UN ECE Regulation Number 10 Rev 3:2008</p> <p>Note: In case of product is ‘e’ marked and a detailed test report is submitted (which includes above tests) no fresh verification is necessary</p>
16.	Operating parameters	Supply voltage 24 V± 25%
17.	LED colour test – dominant wavelength amber	AIS -012
18.	LED chromaticity coordinates	<p>Limit towards green: $y \leq x \cdot 0.120$</p> <p>Limit towards red: $y \geq 0.390$</p> <p>Limit towards white: $y \geq 0.790 - 0.670x$</p> <p>In accordance with CIE 127 condition B</p>

Testing Standard Compliance		
#	Test standards compliance	Specifications
19.	LED bulb/SMT intensity and viewing angle	In accordance with CIE 127 condition B

Test compliance as per IS 16833	
#	Tests
1.	Performance parametric test (Tri Temperature / tri voltage)
2.	Shock and Vibration test
3.	Ingress protection (IP)
4.	Over voltage protection test
5.	EMI/EMC test
6.	Load dump test, Pulse 5a
7.	Reverse polarity protection without fuse
8.	Test for wiring harness
9.	High temperature test
10.	Cold Test
11.	Damp heat test
12.	Insulation resistance test
13.	Thermal shock test
14.	Salt spray test
15.	High voltage test
16.	USB port overloading test
17.	Endurance test
18.	Free fall test
19.	Protocol testing

Annexure V – Indicative List of Data Types and Packet Format for Onboard ITS for Integration with Backend Systems

#	Required Data Field	Descriptions
1.	Start Character	\$
2.	Header	The header of the packet/ identifier
3.	Vendor ID	Vendor identification header
4.	Firmware Version	Version details of the Firmware used in EX.1.0.0
5.	Packet Type	Specify the packet type <ul style="list-style-type: none"> • NR = Normal • EA = Emergency Alert • TA = Tamper Alert (Optional) • HP = Health Packet • IN = Ignition On • IF = Ignition Off • BD = Vehicle Battery Disconnect

#	Required Data Field	Descriptions
		<ul style="list-style-type: none"> BR = Vehicle Battery Reconnect BL = Internal Battery Low
6.	Packet Status	L=Live or H= History
7.	IMEI	Identified of the sending unit. 15-digit standard unique IMEI no
8.	Vehicle Reg. No	Mapped vehicle registration number
9.	GPS Fix	1 = GPS fix OR 0 = GPS invalid
10.	Date	Date value as per GPS date time per GPS date time (DDMMYYYY)
11.	Time	Time value as per GPS date time in UTC format (hh:mm:ss)
12.	Latitude	Latitude value in decimal degrees (not less than 6 places)
13.	Latitude Dir	Latitude Direction. Example N=North, S= South
14.	Longitude	Longitude value in decimal degrees (not less than 6 places).
15.	Longitude Dir	Longitude Direction. E=East, W= West
16.	Speed	Speed of Vehicle as Calculated by GPS module in VLT. (in km/hrs.) (Up to One Decimal Value)
17.	Heading	Course over ground in degrees
18.	No of Satellites	Number of satellites available for fix
19.	Altitude	Altitude of the device in metres
20.	PDOP	Positional dilution of precision
21.	HDOP	Horizontal dilution of precision
22.	Network Operator Name	Name of Network Operator
23.	Ignition	1= Ignition On , 0 = Ignition Off
24.	Main Power Status	0 = Vehicle Battery disconnected 1= Vehicle Battery reconnected
25.	Main Input Voltage	Indicator showing source voltage in Volts. (up to One Decimal Value)
26.	Internal Battery Voltage	Indicator for level of battery charge remaining. (up to One Decimal Value)
27.	Emergency Status	1= On, 0 = Off
28.	Tamper Alert (Optional)	C = Cover Closed, O = Cover Open
29.	GSM Signal Strength	Value Ranging from 0 – 31
30.	MCC	Mobile Country Code

#	Required Data Field	Descriptions
31.	MNC	Mobile Network Code
32.	LAC	Location Area Code
33.	Cell ID	GSM Cell ID
34.	NMR (Network Measurement Report) Neighboring Cell ID	Neighboring 4 cell ID along with their LAC & signal strength
35.	Digital Input Status	4 external digital input status (Status of Input 1 to Input 3 (0=Off; 1=On))
36.	Digital Output Status	2 external digital output status (0=Off; 1=On)
37.	Frame Number	Sequence Number of the messages (000001 to 999999)
38.	Checksum	Insures No error in transmission (optimal)
39.	End Character	Indicated End of the frame

This are the indicative list of the data that required to integrate with backend system. Authority may come-up with the additional data types to be integrate with the backend system during the contract period. Bidder shall have to support into the requirement gathering and generation of the data types as and when authority desires in entire contract period.

**Diesel fuelled, 12 metre long, standard floor (1150 mm floor height),
BS-VI compatible, non-AC, fully built Type II Deluxe bus - Specification**

**Diesel Fuelled, Standard 12 metre long, 1150 mm floor
height, BS VI compatible, Non-Air-Conditioned (Non-
AC) Fully built Type II Deluxe Bus –
Specification**

Tamil Nādu State Transport Corporation (TNSTC)

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PART I – GENERAL REQUIREMENT

Specifications for Non-AC diesel fuelled, BS VI compliant, Standard 12 metre long, 1150 mm floor height, fully built type II Buses

1. INTRODUCTION AND SCOPE:

End-use requirement-oriented specifications, with maximum make / model neutrality, for fully built diesel fuelled Internal Combustion Engine (ICE) propelled Bharat Stage VI (BS VI) compliant non-air-conditioned (non-AC) Standard 12-metre-long, **1150** mm floor height type II deluxe (Type II DLX) buses for Public Transport (PT) System of TNSTC are brought out here. Non-AC 12-metre-long type II deluxe buses are proposed to be deployed for PT operations in urban, peri-urban and the contiguous areas (designated areas). Bus Manufacturer would furnish technical details for assemblies / sub-assemblies/ systems/ equipment as per Technical Specification of this Section in appropriate formats.

The specifications cover end-use-based design, evaluation, fabrication & testing features of diesel fuelled non-AC 12-metre-long type II DLX buses for transportation of passengers mainly in TNSTC's designated PT operational areas. The bus design should be modern, energy efficient, environment friendly, safe, efficient and reliable besides meeting all statutory, legal and other requirements, as also those related to easy passenger accessibility including for Persons with Disabilities (PwDs), passenger comfort, driver's work place, internal and external aesthetics, ease of repair and maintenance etc.

Specifications would comply with all applicable Central, State and local laws (including Acts, Rules & Regulations). These would include, but not be limited to, the provisions of Disability Act 1995 as amended till date as well as state and local accessibility, safety, emission and other requirements. The bus would meet or exceed the Central Motor Vehicles Rules (CMVR) of India / Safety Norms, Emission, Noise& other norms applicable at the time of supply. In the event of any conflict between requirements emanating from this specification and those as per any statutory/legal, etc. in force, the superior/ higher requirements/Standards would prevail.

The word "Bus" or "Buses" wherever used in the specification means the "12000 - 200 mm long diesel fuelled BS VI compliant non-air-conditioned 12-metre-long standard floor bus with **1150** mm \pm 10 mm floor height" as per specifications given in this document. The type II DLX buses would have right hand drive.

For PT operations in designated areas of TNSTC, a fully built type II DLX bus as per specs detailed in this document and those of AIS 052 / AIS 153 / UBS II / CMVR / TNMVR etc. is envisaged.

The specifications / standards / norms / regulations etc. mentioned in this document are generally as prevalent in India. However, any other national / international specifications / standards / norms / regulations, equivalent and or better than those indicated in this document, would meet the requirement. The proof of ensuring equivalence etc. in all cases shall be enclosed with the bidding document by the agency referring to them.

The vehicle manufacturer shall ensure to meet the requirements as given in Bus body Code and CMVR (bus body code AIS052, AIS153 and others as applicable for fully built bus) and also comply with harmonized guidelines applicable for various floor heights of bus variants as per amendments and other statutory / mandatory provisions as on date, issued by the Government, at the time of submission of tender.

2. GENERAL DESIGN FEATURES OF THE STANDARD 12-METRE-LONG FULLY BUILT TYPE II DLX BUSES:

- 2.1. Fully built buses would generally be designed and manufactured in accordance with the applicable aspects of Urban Bus Specification (UBS II) & 'Code of Practice for Bus Body Design and Approval' (AIS 052)- hereinafter referred to as Bus Code; as applicable to buses in India /CMVR rules/Tamil Nadu Motor Vehicle Rules (TNMVR) whichever is superior. Details of relevant standard followed would be indicated against each item.
- 2.2. Fully built bus design would consider all other aspects / provisions to be made on proposed buses facilitating ease of mounting /erection bus body on the chassis without causing any damage / defect to chassis / its aggregates etc. and further facilitating ease of repair and maintenance of all other fitments / aggregates provided on bus chassis, etc.
- 2.3. Bus would be designed to carry commuters in TNSTC with ease of boarding and alighting especially for ladies, senior citizens and PwDs.
- 2.4. Bus design would be suitable for daily operation of 10 to 12 hours in TNSTC with peak loading of over 44 passengers in 12-metre-long buses (each passenger weighing 68 Kgs on an average and carrying a load of 25 kgs each), average journey speed of about 45 Kms per hour with frequent starts/stops, say, after every 1500 to 2500 metres. The minimum max attainable speed of the bus would be in range of 90 kmph with cruising speeds of about 60 kms per hour.
- 2.5. Bus design would be eco-friendly, energy efficient, safe, and comfortable meeting specified exhaust emissions norms (Bharat Stage VI or Euro-VI or latest as amended up to date of supply).
- 2.6. Bus must be of proven design suitably modified to climatic & operational conditions, infrastructure and road conditions obtaining in operational areas of TNSTC.
- 2.7. Bus design should meet all statutory requirements applicable to TNSTC in all respects.
- 2.8. The bus structure would meet requirements of structural strength, stability, deflection, vibration, crashworthiness, roll over protection etc. amongst others for at least the following main static and dynamic loads including those as per annexure 3 of UBS II:
 - i. Static loads
 - ii. Dynamic loads
 - iii. Single wheel bump loads
 - iv. Double wheel bump (diagonally opposite) loads
 - v. Braking and acceleration loads
 - vi. Front impact loads
 - vii. Roll over loads
 - viii. Speed breaker induced loads
- 2.9. Bus design would be a proved design duly evaluated by agencies authorized as per CMVR using Finite Element Analysis and or any other mechanism for above loads / performance requirements for values for above loads/ conditions /performance parameters as given in subsequent paragraphs.
- 2.10. Minimum required performance values/ data for above load conditions may be considered as follows:

- i. Strength (Factor of safety): minimum of 1.35 (tolerance $\pm 10\%$) i.e. design stress would be $1/1.35^{\text{th}}$ of yield stress.
- ii. Stiffness (Deflection): 5mm.
- iii. Vibrations (Lowest Natural Frequency): 5Hz
- iv. Frontal Impact:

(Velocity = 56 Kmph against fixed rigid barrier)

- Head Injury Criterion (HIC) = 1000
- Crumpled Zone = 132mm
- No part of structure would intrude into residual space.
- (HIC= Head Injury Criterion calculation is based on acceleration level at the head of driver/ passenger & time duration during which maximum value of above acceleration is build up. Typical acceleration at the head should not exceed 80g continuously for 3 milliseconds to avoid head cracks).
- v. Roll over (as per bus code – AIS 052) tests with modifications of making the bus roll from ground level instead of the raised platform:

- (i) Bus tilted to its unstable position
- (ii) Bus allowed to fall freely under gravity from this position.
- (iii) Gross vehicle weight of the bus is to be considered
- (iv) The Energy absorbed by the structure = 0.75 E_R

{ E_R =Reference energy-- the Potential energy of the bus in its (unstable) equilibrium position}.

$E_R = M.g.h$, Where M= Effective weight of the bus; g = Acceleration due to gravity; h= Height of C.G. above ground level in (unstable) equilibrium position.}

- (a) Angular velocity should not exceed 5 deg/sec.
 - (b) The unstable position should not occur before 35 deg.
 - (c) No part of structure intrudes into residual space.
- vi. Buckling Factor would be equal to or more than four.
 - vii. Various loads:
 - Normal Loads (Static) = No. of Passengers x wt. of passengers (68 Kgs.) + passenger luggage weight (25 Kgs). (Besides the vehicle related loads).
 - Bump Loads:
 - Bump height = as per relevant Bureau of Indian Standards (BIS)/Indian Road Congress Guidelines.
 - Case I: Single Wheel on Bump/Pot hole.
 - Case II: Diagonally opposite wheels on Bump/Pot hole.

- Case III: Both wheels (Front & Rear) on Bump/Pot hole.

- Braking Loads:0.6g

Horizontal = 0.6g load, Vertical = 1g load, (Applied together)

- 2.11.The bus, loaded to Gross Vehicle Weight (GVW), with crush load and under static conditions, would not exhibit deflection or deformation that impairs the operation of steering mechanism, doors, windows, passenger escape mechanisms and service doors, etc.
- 2.12.Manufacturer's certificate supported by testing and type approval agency's certificates along with the bus as also technical specifications/drawings required for inspection, performance assessment as above to be supplied along with the bus. Besides meeting the statutory requirements, the **type II DLX** bus would be designed with respect to its body and different aggregates/systems /sub systems to operate satisfactorily in designated transport service for at least 9 years or 12, 00,000Kms whichever is earlier.
- 2.13.Detailed schematic drawings of bus structure, seats, interior/ exterior fittings, electrical systems, wiring looms / harness, photometric items and other accessories along with complete details of materials used, their specification, manufacturing tolerances etc. would be provided by the bus manufacturer. Additionally, details / drawings of mounting / fastening bus body to chassis to be provided along with the bid specifically bringing out whether bus body would be welded and integrated to chassis or fastened using fasteners along with applicable mechanism system /arrangement. Detailed Circuit diagrams for electricals be also provided by the bidder/bus manufacturer.
- 2.14.Details of general appearance, seating layout and structural of roof, floor, sides, front & rear show and driver cab, etc. would be supplied. Main dimensions of the fully built bus i.e., overall length, overall width, overall height, saloon height, pillar to pillar distance, seat pitch, number of seats (excluding seat for the driver), entry/exit gates, etc. would be supplied along with the schematic diagrams/printed literature of the bus.
- 2.15.Material used in construction of buses would be as per Bureau of Indian Standards (BIS)/ Automotive Industry Standards (AIS)/ specifications and/or other international specifications meeting/ surpassing performance & other requirements as given in the Bus Code. In absence of above specifications, Association of State Road Transport Undertakings (ASRTU) specifications could be followed. Wherever Indian Standards are not available, internationally acceptable Standards may be referred. Specifications/ Standards followed would conform to Specification/Standards as amended /up dated/ or the latest published by the concerned agencies. Wherever no specifications of any item have been notified as International/ National Standards etc. actual specifications of that item used be mentioned. Guaranteed life of the bus and its other aggregates be indicated item by item. Periodical maintenance schedule for obtaining the said life of the bus be also indicated.
- 2.16.BIS Standards are normally available from Bureau of Indian Standards, Manank Bhawan, 9-Bahadur Shah Zafar Marg, New Delhi-110 002. Web site: <http://www.bis.org.in>. Similarly, AIS Standards are available from Automotive Research Association of India, Post Box No.832, Pune-411 004. Web site: <http://www.araindia.com>. ASRTU Specifications are available from Association of State Road Transport Undertakings, Sector 12, Dwarka, New Delhi. Web site: <http://www.asrtu.org>.

- 2.17. Suitable traps/openings with appropriate sealing and covers would be provided for repair and maintenance of various aggregate/systems/sub systems / chassis / body/ their components, etc. of the bus.
- 2.18. Any restriction in design, manufacture and mounting of bus body on chassis, as envisaged by chassis manufacture, as a part of detailed instructions for this purpose, be meticulously followed while mounting / joining / integrating bus body to bus chassis.
- 2.19. The bus would be so designed as to maintain operational stability requirement as per Bus Code. Interior noise and pass by noise of the vehicle would conform to BIS: 12832:1989 or latest and BIS: 3028:1998, 10399: 1998 or latest respectively.
- 2.20. It would be ensured that the design, manufacture, certification (wherever called for) & installation of major bus sub-components and systems are compliant with all such sub-component vendors' requirements & recommendations within the frame work of any statutory, legal and or any other lawful/functional requirements. A certificate of compliance would be shown on demand. Components used in the vehicle would be of heavy-duty design.
- 2.21. Any other provisions/fitments required for safe and efficient operation and or for fulfilling statutory requirements be provided in the offered bus.

3. ENGINE:

- 3.1. Diesel fueled engine would have appropriate horsepower to obtain desired performance in respect of its adequacy of power, acceleration levels, emission norms, specific fuel consumption etc. The engine to have adequate horsepower not only to propel the bus at its GVW but also to operate efficiently all other auxiliary devices, systems fitted to bus, simultaneously. For operational services of type II deluxe buses, engines of adequate horsepower and torque at optimal Revolutions Per Minute (RPM) levels to deliver specified performance. The Horsepower and torque at defined rpm levels of the engine be indicated by the bidder in his bid along with other details called for in Part II.
- 3.2. Performance data/curves and other details of the engine have to be supplied. A detailed set of calculations indicating adequacy of said engine for proposed type II deluxe bus be provided along with all performance parameters of selected engine.
- 3.3. The engine and its accessories would be easily replaceable. Engine mounting would be such as to minimize transmission of vibrations to bus structure. Engine foundation & mounting would be so located as to facilitate easy accessibility & replacement. Engine design would be such that it would not be overheated during normal operating conditions of vehicle. An arrangement for audio-visual signal would be provided in the event of engine getting overheated excessively. The temperature at which signal operates would be indicated. Similar arrangement for other sub-system of engine with their monitorable indicators be made on dashboard. The engine would be equipped with electronic engine management and on-board diagnostic system.
- 3.4. Engine compartment would be insulated to avoid transmission of heat and noise to saloon area. This firewall would preclude or retard propagation of an engine compartment fire into passenger compartment. Only necessary openings would be allowed in the firewall, and these would be fireproofed. Wiring may pass through only if connectors or other means are provided to prevent or retard fire propagation through the firewall. Engine access panels in the firewall would be fabricated of fireproof material and secured with fireproof fasteners. These panels, their fasteners, and the firewall would be constructed and

reinforced to minimize warping of panels during a fire that will compromise integrity of the firewall. Firewalls shall be provided between the bus interior areas and the engine compartment which includes the areas in which the engine, transmission, and exhaust system are housed. The firewalls shall satisfy the requirements defined in Federal Transit Administration (FTA) of United States standard Docket 90, dated October 20,1993 or equivalent standards. Bus manufacturer would provide relevant details.

- 3.5. The engine would be suitably designed to operate optimally under TNSTC's operational areas of peak summer heat, humidity and dust.
- 3.6. Engine noise and emission levels must conform to the Central Motor Vehicle Rules (CMVR)/ UBSII /AIS 052 any other Indian Standards, adopting the most superior one.
- 3.7. Specific fuel consumption of diesel per KW hour at Standard conditions (e.g., an Indian / ECE's Highway Driving Cycle and or any other equivalent or better followed by the test agencies) would be indicated along with guaranteed fuel consumption level (kilometres per litre of diesel) under GVW and the standard operational conditions / cycle of type II DLX buses.
- 3.8. For sound-proofing & for protection against fire risk in engine compartment, no flammable material or material liable to soak fuel, lubricant or any combustible material would be used in engine compartment unless the material is clad by an impermeable fireproof sheet. A partition of heat-resistant material would be fitted between the engine compartment & any other source of heat.
- 3.9. The bus would have air intake design / location in a manner as to provide adequate quantity of dust free, restriction free air so as to avoid any operational problem of the engine.
- 3.10. Details of make / model etc. of various items of engine system and its subsystems would be provided as part of bid.

4. COOLING SYSTEM:

- 4.1. Heavy-duty radiator and other subsystems of cooling system would efficiently dissipate heat from the engine system. De-aeration tank and pressurized radiator cap would be provided. It would be easy for filling and level checking of coolant. Replacement/ maintenance of radiator and its items be also easily carried out. Details of radiator specifications, cooling capacity, coolant, repair and maintenance procedures etc. would be supplied.

5. TRANSMISSION SYSTEM:

- 5.1. Heavy duty Synchromesh Manual transmission system having minimum 5 forward and one reverse gear would be provided. All operational controls/buttons/switches etc. be conveniently located within easy reach of the driver. The transmission system and the control/operational sub systems be easily accessible for repairs and also be easily replaceable. Complete system details need to be supplied with the bus.
- 5.2. Transmission system be fitted with a mechanism which makes it possible to engage reverse gear only when vehicle is stationary.
- 5.3. Details of make / model etc. of various items of transmission system would be provided as part of bid.
- 5.4. Mechanical Clutch system using single dry plate push type clutching system would be provided. Clutch would be provided with asbestos-free disc lining

6. SUSPENSION:

- 6.1. The bus would be fitted with air suspension system at rear axles and parabolic leaf spring waveler type suspension at front. The suspension system would be fitted with shock absorbers, suitable for trouble free operation and jerk free comfortable ride in existing road conditions of TNSTC operational areas.
- 6.2. The suspension system shall permit a minimum wheel travel of 90 mm jounce-upward travel of a wheel when the bus hits a bump (speed breaker), and 75 mm rebound-downward travel when the bus comes off a bump and the wheels fall relative to the body. Rebound travel may be limited hydraulically within the shock absorbers. Suspension system shall incorporate appropriate devices for automatic height control so that regardless of load the bus height relative to the centreline of the wheels does not change more than 12 mm at any point from the required height.
- 6.3. Vertical damping of the suspension system shall be accomplished by hydraulic shock absorbers mounted to the suspension arms or axles and attached to an appropriate location on the chassis. Damping shall be sufficient to control bus motion to 3 cycles or less after hitting road perturbations.

7. STEERING SYSTEM:

- 7.1. Hydraulic power steering with angle and height adjustment would be provided. Power steering failure shall not result in loss of steering control.

8. BRAKING SYSTEM:

- 8.1. The braking system would be full pneumatic type with fail-safe dual circuit having four-way protection valve, auto slack adjuster, disc brakes in front and drum brakes at rear, with non-asbestos brake pads / linings having temperature and wear characteristics suitable for type II DLX bus operations. Brake squeal would be absent under normal conditions of operation. An air compressor/dryer which minimizes oil carry over would be fitted. Braking system would be fitted with air dryer and oil/ water separator system. Buses would also be provided with hand operated pneumatic flick valve type parking brakes at rear wheels. Air pressure line would be treated for corrosion resistance.
- 8.2. In the event of failure of engine and or loss of air in system, adequate provision be made for obtaining effectiveness of service brake system and or for deactivating the spring actuated brakes.
- 8.3. The air compressor system should have sufficient capacity to meet large compressed air demand for braking in the type II DLX bus operations and frequent opening / closing of doors besides any other requirement

9. WHEELS AND TYRES:

- 9.1. The bus would be fitted with steel radial tubed tyres of optimal size and design conforming to AIS-044 Part III with wheel rims of corresponding size conforming to AIS/ BIS: 10694 (part 3)-1991 or latest. The bus would be supplied with 7 sets of tyres (two on front and four on rear wheels) fitted on the bus plus one set as spare Stepney on-board complete with carrier system under the floor.
- 9.2. Details of type, specifications, capacity, make, model etc. of tyres/wheel rims would be provided as part of the bid.
- 9.3. Suitable guards be provided near wheels to prevent damage/ for obtaining safety from stones hurled from tyres.

- 9.4. Splash aprons of minimum 6.50mm thickness composed of rubberized fabric would be installed behind the wheels as needed to reduce road splash and protect under floor components. Splash aprons would extend downward to within 100mm of road surface at static conditions. Apron widths would be no less than tyre widths, except for the front apron, which may extend across the width of the bus. Splash aprons would be bolted to the bus under structure. Splash aprons and their attachments would be inherently weaker than the structure to which they are attached. The flexible portions of splash aprons would not be included in road clearance measurements. Other splash aprons would be installed where necessary to protect bus equipment.

10. AXLES:

- 10.1. Solid beam reverse Elliot I-beam section type front axle & grease type front bearings & seals of reliable & proven design of adequate capacity to take care of maximum Gross Vehicle Weight (GVW) & crush loading expected during life span of the bus of minimum 9 years or 12, 00,000 Kms. whichever is earlier, complete with track rod with replaceable ball joints at both ends, would be provided.
- 10.2. The bus would be driven by a single heavy-duty rear axle of proven design, single reduction, hypoid gears, full floating axle shafts with optimal gear ratios suitable for type II DLX bus operations with adequate capacity to take care of maximum GVW & crush loading expected during life span of bus of minimum 9 years or 12,00,000 Kms. whichever is earlier. Transfer of gear noise to bus interior would be minimized. Lubricant drain plug would be magnetic type, external hex head. If a planetary gear design is employed, oil level in the planetary gears would be easily checked through plug or sight gauge.
- 10.3. The drive (propeller) shaft would be guarded to prevent it from striking floor of the bus or the ground in the event of a tube or universal joint failure.
- 10.4. Details of type, specifications, capacity, make, model etc. of Front & Rear Axles would be provided at in the bid.

11. DIESEL TANK:

- 11.1. Diesel fuelled bus must meet and satisfy safety and other requirements as per AIS 052, type approval; regulatory requirements as per CMVR / Tamil Nadu Motor Vehicle Rules (TNMVR) and any other applicable regulations for operation in the State of Tamil Nadu, if any.
- 11.2. Diesel tank of requisite capacity (>230 litres) would be appropriately mounted on to the bus keeping in mind convenience of diesel filling, safety of system and its maintainability, in the operational areas.
- 11.3. Capacity of the diesel tank (minimum 230 litres) be adequate for over 400 kms of bus running without refilling.
- 11.4. Diesel tank and other components of diesel fuelled vehicles should conform to applicable AIS / BIS standards or International Specs / standards in absence of AIS /BIS specs. Additionally, requirement of UN/ECE R34 for prevention of fires be satisfied.
- 11.5. Detailed drawing indicating location and mounting details of diesel tank / sub-systems be provided along with the bid
- 11.6. All requirements of AIS / BIS / CMVR/TNMVR etc. for diesel tank, sub-systems and components, etc. be fully met and test certificate for the same be provided.

12. UNDER FRAME & STRUCTURE:

- 12.1. The under frame and super structure would be suitably designed to carry peak load of 44 passengers and dense crush load of about 90 passengers in 12-metre-long buses (each passenger weighing 68 Kgs on an average and carrying a load of 25kgs each) consisting of mainly seated / standee passengers; the superstructure of steel tubing, bus tare weight, all other fitments would meet performance requirements under various loads indicated earlier. The structure would be designed to withstand the transit service conditions of operation throughout its service life.
- 12.2. The bus body would be of integrated/ fastened/welded to chassis frame depending upon the chassis design, with the super structure fabricated using galvanized steel tubing (ERW– Rectangular / Square Sections) conforming to BIS 4923-1985 or latest, of grade Yst –240.
- 12.3. A comprehensive multi-stage anti-rust treatment would be provided to bus flooring, sides, roof, under-structure, axles, suspension and all other components for resistance to corrosion or deterioration from atmospheric conditions & road salts so as to enable them & the bus frame to last for at least 9 years or 12,00,000 Kms. whichever is earlier.
- 12.4. Samples of all materials & connections / joints would withstand a two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%. Details of treatment provided with relevant specification details be indicated along with suitable calculations to reflect that the corrosion prevention treatment meets the requirements of minimum 9 years or 12,00,000 Kms. life whichever is earlier in TNSTC's operational environment. Details of the system followed for corrosion prevention of internal surfaces of structural tubing would be supplied. A certificate of testing from an authorized test lab be provided.
- 12.5. Front and rear structure design would be energy absorption type to reduce impact stresses into under frame/side structures/ other areas of the vehicle. Damaged area of the vehicle would be easily repairable and or replaceable in the event of any major damage at normally available workshop facilities and without any need for specialized tools / fixtures and equipment.
- 12.6. Entire surface of bus under floor and sides exposed to ground would be covered with appropriate corrosion prevention & flame retardant paint coating for protection against harmful effects of water, mud etc. and to retard flames, if any. Wheel housings would be constructed to contain tyre bursts during operation and be flame retardant in case of tyre fire.
- 12.7. Sufficient clearance & air circulation would be provided around the tyres, wheels & brakes to preclude over-heating when the bus is operating
- 12.8. Metal Inert Gas (MIG) welding would be used for steel structural member's fabrication.
- 12.9. All structural members would be MIG welded besides suitable gussets/ brackets of adequate size & thickness be provided on floor, side, front, rear & roof structure to ensure structure rigidity & integrity. Material, shape size and specs of such gussets / brackets would be provided by the bus supplier in their supplied drawings.
- 12.10. After anti corrosive treatment, structural members would be coated with red oxide/ Zinc Chromate primer & superior quality black paint.
- 12.11. During structural assembly operations, a number of holes are drilled and or weldments made after the corrosion prevention treatment of components/structural items/members

causing loss of such treatment and exposing these items to corrosion. Manufacturer would take sufficient care to carry out corrosion prevention of items so exposed to effectively prevent corrosion.

12.12. Under floor to sidewalls would be sealed to prevent dust ingress.

13. PANELLING:

13.1. Bus exterior side panels would be fitted with stretched steel sheet at waist level. The exterior front-end panelling would be of steel sheet while roof, rear, sides & skirt panelling would be of aluminium. All interior panelling would be of Acrylonitrile Butadiene Styrene (ABS) conforming to relevant National or International Standards - equivalent or better.

13.2. Wherever aluminium is joined with steel or with/ any dissimilar metals together, the involved joints would be treated with thick layer of approved quality dielectric paint conforming to relevant Indian/ International Standards, before assembly. Adequate treatment be also provided to avoid any incidence of galvanic corrosion between dissimilar metals.

13.3. Panels would not have any waviness & would be so mounted as to present smart aesthetic exteriors. Details of the above said panelling including specifications / thickness/ sizes of panels, fittings, rivets/ bolt pitch etc. would be supplied.

13.4. All side skirt panels below stretch panel be of such design as would facilitate quick replacement of any damaged panel(s) with pre-painted panels. The side skirt would be able to withstand side impact as per provisions of BIS: 14682-1999 or latest. Similarly rear end would be able to withstand rear impact as per the provisions of BIS: 14812-2000 or latest

13.5. Anti-drumming compound would be applied on inner side (enclosed surfaces) of entire panelling.

13.6. Roof structure would be thermally insulated with flame retardant Polyurethane or glass wool of minimum 40 kgs/m³ density. The specifications/ BIS Standards for aforesaid insulating material would be supplied.

13.7. Metal Inert Gas (MIG) welding for fabrication of aluminium components would be used.

13.8. Rain gutters would be provided to prevent water flowing from the roof onto the passenger doors, driver's side window, and exterior mirrors. When the bus is decelerated, gutters would not drain onto windshield, or driver's side window, or into the door boarding / alighting area. Cross sections of the gutters would be adequate for proper operation.

13.9. Entire front end of the bus would be sealed to prevent debris accumulation behind the dashboard and to prevent driver's feet from kicking or fouling wiring and other equipment. Front end would be free of protrusions that are hazardous to passengers standing or walking in front of the bus during rapid acceleration.

13.10. Interior panels would be attached so that there are no exposed unfinished or rough edges or rough surfaces. Panels & fasteners would not be easily removable by passengers. Fasteners and or their capping used for above purpose be such as to resist vandalism / easy removal by any person including but limited to commuters.

14. PAINTS:

14.1. All structural members of the bus would be treated for corrosion prevention internally as well as externally and painted wherever required. Polyurethane (PU) painting based

spray paint of standard companies conforming to latest/ international Standards as applicable would be used for exteriors painting of bus including interiors wherever required. Colour shade would match to the shades as per BIS: 5-1978 or latest. Details of paints used, surface treatment & preparation, corrosion prevention treatment, base primer coatings, number of paint coats to be applied etc. would be supplied.

- 14.2. All exterior surfaces would be smooth & free of wrinkles & dents. Exterior surface to be painted would be properly prepared as required by paint system supplier, prior to application of paint to ensure a proper bond between the basic surface and successive coats of original paint for stipulated service life of the bus. Paint would be applied smoothly and evenly with the finished surface free of dirt and following other imperfections:
- i. Blisters or bubbles appearing in the topcoat film.
 - ii. Chips, scratches, or gouges of the surface finish.
 - iii. Cracks in the paint film.
 - iv. Craters where paint failed to cover due to surface contamination.
 - v. Overspray.
 - vi. Peeling.
 - vii. Runs or sags from excessive flow and failure to adhere uniformly to the surface.
 - viii. Chemical stains and water spots.

15. COLOUR SCHEMES:

- 15.1. Exterior, interior colour schemes and logo/ graphics would be painted as directed by TNSTC. Information, on seats, for reservation for persons with disabilities, ladies, senior citizens would be marked as per the details provided by the TNSTC.

16. SERVICE DOORS:

- 16.1. One service door (passenger entry / exit) with steps, on rear side of the front axle as indicated in summarized specs in part II, would be provided on near side (on kerb side wall)
- 16.2. Layout of passenger service gate on near side as brought out in Part II of these specs.
- 16.3. Doors would be Jack-Knife (JK) type. The door flaps shall be so designed as to provide positive sealing against ingress of water in the bus particularly during any water logging / flooding on roads.
- 16.4. Operation of entry and exit door would be electro-pneumatically controlled by driver with internal and external emergency operational controls. In an event of an emergency, it would be possible to open doors manually from inside the bus by using a force no more than 10 Kg. after actuating and unlocking device at the door. Unlocking devices would be clearly marked as an emergency device & would require two distinct actions to actuate.
- 16.5. Doors, operating mechanisms, door hinges and locks would comply with safety requirements as per Indian / International Standards (to be specified and supplied by the bus manufacturer). Overall dimensions and construction of entry / exit door flaps would be identical so that door flaps are interchangeable. Closing and opening time of

doors should be in the range of 4 seconds each. There would be maximum opening area in longitudinal & vertical directions in fully open condition. Door operating mechanisms, brackets etc. would be maintenance free and designed with lifetime durability of minimum 9 years or 12,00,000 Kms. whichever is earlier.

- 16.6. A pilot lamp on the driver's dashboard would be provided to warn that the door is 'Open' or not fully closed.
- 16.7. Entry / Exit door would be provided with suitable support in form of grab handles for boarding/ alighting passengers on JK door flaps. Electronic / other suitable sensors would be installed at the entry / exit doors to retract door automatically if any obstruction to door occurs during door closing. It must be effective until door is fully closed.
- 16.8. Colour shade would match to the shades as per BIS: 5-1978 or latest.
- 16.9. A red "Door Closing" sign would be installed above exit door. The sign will blink when door is closing.
- 16.10. A suitable device to prevent door from opening as long as bus is in motion would be provided.
- 16.11. Service Door' operation would be controlled with help of push button mounted over the door. One red master button to close the entrance / exit door would also be provided on driver dash-board and the conductor seat.
- 16.12. All buttons and switches would be labelled on a panel to right side of the driver.
- 16.13. Heavy-duty prominent nosing of bright yellow colour would be used to protect edge at entrance/exit.
- 16.14. Access door would be provided with heavy-duty sealing to avoid ingress of dust and water into passenger compartment. Upper & lower section of both door flaps would be glassed for not less than 45% of the door opening area of each section. Glazing material & glass in doors would be same as in side windows.
- 16.15. Details of above service door including electro-pneumatically controlled door closing system with complete circuit diagram would be supplied. Photo-cell controlled opening / closing functions of door and a "sensitive edge" made for safe entry-exit be fitted.
- 16.16. Door would be fitted with heavy-duty hinges as per bus code.
- 16.17. Door would be fitted with heavy-duty locks with &/ without lock & key depending upon their use. Striker plate would be fitted at the closing end of locks.
- 16.18. All handles would match to décor of its fitment location or would be chrome plated.
- 16.19. Door would open or close completely in about 4 seconds from the time of control actuation and would be subject to closing force requirements and adjustment requirements. Front door would remain in commanded state position even if power is removed or lost. Operation of & power to, passenger door would be completely controlled by driver. A control or valve in driver's compartment would shut off power to, and/or dump the power from, front door mechanism to permit manual operation of front door with bus shut down.

17. GUARD RAILS:

- 17.1. Suitable guard would be provided in areas such as service doors entry/exit areas where seated passengers are likely to be thrown into as a result of heavy braking, Guard height would be minimum 800mm from bus floor, and guard would extend inward from the wall

at least 100mm more than the centre line of the seating position of the passengers who are prone to this risk.

18. WINDOWS:

- 18.1. Windows would be of large size for panoramic view. They would be in two/ three-piece window glasses. Toughened glass wherever used in bus body would be 4.8 mm to 5.3 mm thick for 12-metre-long buses– each aesthetically installed. Size and shape of the glasses would enable even the standees to have maximum outside view without kneeling. General requirements of windows would be as per the provisions of bus code (AIS 052).
- 18.2. Windows would have provision of suitable sealing to avoid ingress of dust and water and would have proper/ efficient drainage system as per AIS 052 /UBS II.
- 18.3. Details of window design; fitment etc. would be supplied by the bidder along with the bid.

19. WINDOW GUARDRAIL:

- 19.1. In type II DLX Buses window guard rails as specified in bus code (AIS 052) shall be provided.

20. EMERGENCY EXIT:

- 20.1. Emergency exits would be provided in bus as per the provisions of Bus Code – AIS 052 / CMVR. Possibility of using passenger entry/exit gates on near side for said purpose would be explored by manufacturer and confirmed. Details of Emergency exits including their numbers, locations, sizes, markings etc. would be supplied.

21. ESCAPE HATCH:

- 21.1. In addition to emergency exits, at least two escape hatches (one each in front and rear half of bus) would be provided in roof as per bus code. A number of additional hatches may also be provided for facilitating ventilation inside bus.

22. STEPS:

- 22.1. There would be three steps provided at the entrance / exit gates on the near side.

23. FLOOR:

- 23.1. Bus floor design would be with steps in boarding / alighting gates.
- 23.2. Floor height of the bus would be 1150 ±10mm from ground level.
- 23.3. Internal saloon height would be 1900 mm minimum.
- 23.4. Floor design would allow easy cleaning including that of sweeping & drainage of water.
- 23.5. Floor would be fitted with fire retardant 15mm 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)
- 23.6. The said floor would be covered with anti-skid type silicon grain material of minimum 3mm thickness meeting Indian/ International Standards (to be indicated by the bus manufacturer in the bid), ISO 877/76 for colour, IS5509 for fire retardancy. Adequate

sealing would be provided in the floor to prevent ingress of dust, gases, water etc. Provision of draining of water if any on bus floor would be made.

24. GANGWAYS:

- 24.1. Gangway-from entry/exit gate walls through the entire bus length, would have clear space of minimum 650 mm for passenger movement and would be generally as per the provisions of the Bus Code (AIS 052)/ UBS II and meet statutory requirements.

25. HANDRAILS AND HANDHOLDS

- 25.1. Handrails and Handholds would be provided as per provision of bus code (AIS 052) / UBS II. The surface of handrails & handholds would be colour contrasting and slip-resistant.
- 25.2. All handrails would be of aluminium tubing of 32 mm dia and 3 mm thick. Depending upon the size of the bay (i.e., between two consecutive roof hand rail brackets), minimum 2 to 4 numbers handholds per bay would be provided so that every standee passengers, even during crush load is able to grab a hand hold.
- 25.3. Hand holds be made of transparent polycarbonates with provision for display of advertisements. Hand holds be appropriately fastened to the hand grab rails so as to prevent their axial sliding and or rotation. Details of the handrails & handholds fitted would be supplied.

26. STANCHIONS

- 26.1. Vertical stanchions, fitted to floor at bottom end and to the roof at top end, would be so positioned to facilitate access to seats for those standing. Stanchions would be of 40.0 mm dia and 3.15 mm thick aluminium tubing with surface of colour contrasting and slip resistant.
- 26.2. Stanchion pipes and the handrails would be painted in cannerly yellow colour while the joining brackets be painted in grey colour generally matching with inner panelling.
- 26.3. A suitable device, such as high visibility bell pushes, for convenience of passengers to request for stopping bus be provided at appropriate locations.

27. PASSENGER SEATS:

- 27.1. Passenger seats would be front facing in type II DLX buses, comfortable, durable & maintenance free of 'PPLD/LDPE' (Polypropylene/Polyethylene Low Density) moulded construction ad or any other suitable material for a fully built adjustable, reclining, etc passenger seat meeting performance requirements of AIS023 and other requirements as per the Bus Code (AIS 052). The 'PPLD/LDPE' moulded seat would be fitted on metal frames and or any other material in a fully built passenger seat.
- 27.2. Similarly, 'PPLD/LDPE' moulded seat backrest and or any other material in fully built passenger seat would be appropriately fitted. Suitable integral type seat hand grab rails would be provided one on top of backrest & one at the back of backrest for seated passengers.
- 27.3. Seat pitch would be maintained at 825 mm (minimum) (as per AIS 052) for type II DLX buses.
- 27.4. Details of seat design, material, specifications, pitch and other relevant data and the seating layout would be supplied by the manufacturer for approval of TNSTC.

- 27.5. Details of seating lay out, accommodating maximum number of seats in 2x2 layouts in 12-metre-long type II DLX buses, for operations in designated areas, meeting requirements of the bus code, would be supplied. Seating capacity would be minimum 44 plus the driver, etc. Seating capacity of bus would be minimum 44 passengers for 12-metre-long bus (worked out as per AIS 052).
- 27.6. Construction/ fitting of the seat would be such as to be easily replaceable and repairable.

28. SEAT BELTS AND ITS ANCHORAGES:

- 28.1. Seat belts would be provided for the seats as per the provisions of CMVR & Bus Code (AIS 052). Any seats provided at rear end of bus/seats in centre (facing the gangway) would necessarily be provided with seat belts. Seat belts and its anchorages would conform to the requirements of AIS 005 and AIS 015

29. DRIVER'S WORK AREA:

- 29.1. A driver door of not less than 1600 mm height and 650 mm width and with requisite steps would be provided for entry and exit to driver's work area. Proper hand holds and steps would be provided for easy access to driver's cabin. All other requirements of driver's work area would be as per the provisions of Bus Code -AIS 052. Driver's work area would have lighting arrangement to provide general illumination and it would illuminate half of the steering wheel nearest to the driver. Brake Pedal Angle would be determined from a horizontal plane regardless of slope of cab floor. Driver entrance-cum-exit door would be provided as per Bus Code (AIS 052) with a provision of maximum width of sliding window using material like glazing & glass as used in other side window glasses. Driver work area would be equipped with a 24V DC, 200mm diameter fan mounted at proper height on side structure. Colour of fan would match the interior decor of the bus.
- 29.2. Driver's visibility in front of the bus, seated on driver seat, be as per bus code (AIS 052) / CMVR
- 29.3. Driver's seat would meet the requirements of AIS 023.
- 29.4. Driver partition would be provided as per AIS 052.
- 29.5. A barrier of bulkhead between driver and front passenger seat would be provided. The barrier would minimize glare & reflection in windscreen directly in front of barrier from interior light during night time operation.
- 29.6. Dashboard Instrumentation and Control System
- i. Bus would have ergonomically designed moulded type dash board and instrument panels made out of Fibre Reinforced Plastics (FRP) material. Details of materials used their specifications etc. of dashboard and instrument panel would be provided by the manufacturer.
 - ii. Bus would have dash board with full instrumentation panel containing meters and gauges to indicate important parameters like air pressure, coolant temperature, battery charging current, fuel level, side indicators, head lights, hand brakes engagement, engine oil pressure etc. In addition, warning lights for low engine oil pressure, high cooling system temperature & low coolant level, low pressure and high temperature of transmission oil, low fuel level, if any, low air pressure and battery weak

would be provided at the driver's dash board. All the dashboard controls and instrumentation system would be as per the bus code.

- iii. On board electronic diagnostics system would be provided as per UBS II.

30. REAR-VIEW MIRRORS- INTERIOR AND EXTERIOR:

- 30.1. Rear-view mirrors would be provided on both sides of bus to enable driver to have clear side/rear views. One interior rear-view mirror would also be fitted for viewing saloon area by driver. Installation and performance requirements of rear-view mirrors would conform to AIS 001 and AIS 002. Exterior rear-view mirrors would also enable the driver to view object near bumper area.
- 30.2. CCTV camera and a buzzer would be provided at rear end of the bus along with audio video facility at driver dash board.

31. SUN VISOR AND HORN:

- 31.1. Adjustable sun visors would be provided for windshield & driver's side window. Visors would be shaped to minimize light leakage between visors & windshield. Adjustment of visors would be made easily by hand with positive locking & releasing devices and would not be subject to damage by over-tightening. Sun visor construction & material would be strong enough to resist breakage during adjustment. Visors may be transparent but would not allow a visible light transmittance in excess of 10%. Visors when deployed would be effective in driver's field of view at angles more than 5° above horizontal.
- 31.2. An electric horn conforming to BIS: 1884-1993 or latest and installation requirements conforming to AIS 014 would be fitted in bus and further conforming to the provisions of CMVR.

32. INTELLIGENT TRANSPORT SYSTEM (ITS) AND THE ITS DEVICES:

This section provides general end-use specifications of ITS systems and the devices to ensure that bus body building shall be done in a way as to provide for raceways/conduits for wiring (Data and Power) for these devices during bus body building. The devices shall also need mounting surfaces/ structures provisions for which shall be made as part of bus body building. TNSTC proposes to get ITS items fitted / installed in the bus, as per detailed specs provided herein. The bus supplier would acquire the entire ITS / devices / system, hardware, firmware, software, integration and data and any other item to make the system functional, install and commission the same on-board in a manner as to deliver the end use requirements simultaneously being fully compatible and synchronized with the back-end systems. The bus ITS would have, among other items, SCU (System Control Unit) and Bus Driver Console (BDC), PIS Boards, PA- Public Address System GPS system, Panic Button, Reverse Parking Camera, ***Provisions for In-Bus Security Camera Network***, Telematics system (J1939 – CAN 2.0), Wiring harness, etc. The detail minimum technical and functional specification of the ITS system available in Annexure IV – Specifications for Intelligent Transport System (ITS) of this document for compliance.

32.1. General Requirements

- i. **All On-Bus Intelligent Transport Systems, 'OBITS', (which includes SCU(OBU), BDC, PIS boards, PA system, Reverse parking camera panic button, Telematics system, Wiring and harness) equipment to be procured for diesel shall be integrated with one another and shall be capable of**

integration with the backend systems to be procured by the Purchaser in future.

- ii. The hardware to be procured for the ICT aggregates shall be compliant to any of the AIS-140, UBS II , IS 16833 with the subsequent amendments applicable.**
- iii. The bidder shall support the operations, maintenance and integration of all supplied and installed ICT/ ITS systems on buses for a Contract Period of 9 years from the date of delivery & acceptance of each bus by authority.**
- iv. All the component/sub-component of the OBITS system shall be internally integrated and single compact-box solution with easy to install and maintain.**
- v. Operation and Maintenance requirements for ICT/ITS system:**
 - a. Bidder shall have to maintain the Hardware Unit during the contract period as per instruction of Purchaser
 - b. Any faulty equipment shall be replaced with a tested unit from the spares maintained by Bidder. Bidder will have to self-assess on the requirement of the spares in the project for the continuous service.
 - c. Repair and testing of equipment shall be done at Bidder's maintenance center and not at site/depot.
 - d. A repaired unit shall be tested for full functionality as at the time of deployment and certified before it is reinstalled at any site.
 - e. Spare Items shall be kept so as to replace as and when required throughout the contract period in provision of the RFP for the Buses.

The system shall build redundancy so that bus PIS boards can be functional in case of SCU(OBU) GPS outage.

Wiring provision to be maintained for installation and connection of in-bus surveillance systems in future. It should cover provision for.

- a. Minimum Two (2) wide angle cameras for clear view of driver and passenger cabin and reverse camera.
- b. Minimum Four (4) panic buttons on the bus located conveniently within bus such that it prevents accidental trigger. They are to be used for triggering the alerts in any emergency situations.

The ICT aggregates to be provided by the bidder shall have two (2) year default warranty and shall be extendable for a period of 7 years. The warranty shall include continuous on-site support for the respective site locations.

The bidder shall have to provide the required protocol document and SDKs for the preparation the route configuration files to each STUs.

32.2. Fitment Requirements

Fitment of all on bus devices shall be as per UBS- II or equivalent international guidelines- Chapter 10 – 17.8.7 or equivalent international guidelines:

- All On Bus Intelligent Transport Systems, 'OBITS', (which includes SCU(OBU), BDC, PIS boards, PA system, reverse parking sensor, panic button, Telematics system) equipment including wiring harness, antennas to be original factory fitment.
- Front, side, rear signs should be mounted with a gap with the glass so that the glass on signs and of the bus can be cleaned by swiping
- All equipment should be fitted in a way to minimize unintentional damage, shielded from direct engine heat, protected from water splash and dust.
- All equipment should be fitted with the gasket for the vibration free fitment.
- All cables need to be properly anchored, marked and labelled
- Others:
 - Front sign: central
 - Rear sign: central
 - Side sign: first window ahead of rear door (central line of sign should coincide with central line of window)
 - Inner sign: centralize along the width of bus behind the driver's partition
- Six Speakers with protective grill: one each near the doors and others equally distributed across the length of the bus.
- SCU(OBU), recorder, amplifier: secured and ventilated compartment right above the driver
- BDC: ergonomically placed for driver ease
- Combi antenna: suitable place to define inside the bus (preferably) with direct line of view for 'affixing' the unit.
- Reverse Parking Sensor: High resolution surveillance camera to be placed back-side of the buses for the clear view of the reverse area when reverse gear engage.

32.3. **Integration Requirement**

- Bidder shall mount ICT equipment's as specified herein on Buses.
- Bidder shall also ensure to supply equipment compatible with proposed ICT/ITS System of Authority so as to enable smooth integration.
- Integration of ICT aggregate with respective backend software shall be joint responsibility of bidder and the backend System Integrator. To that effect, the bidder shall be responsible for firmware modification, expose protocols/APIs as required to the backend SI and so on for integration purposes. In case of dispute, the Authority's decision shall be final, and both the parties will have to abide.
- ICT aggregate equipment's fitted in Diesel Buses should provide required data/information to backend system installed by the Authority appointed System Integrator so as to provide MIS reports such as Trip summary, Schedule adherence of Bus with respect to Trip, Real time information pertaining to "off route" (detour), Trip information with start and end destination, driver details, speed, missed stop, Bus details, driver behaviour and CAN parameters etc. It should also provide information so that Operations Centre is able to check whether on-board devices are alive and monitoring capability of PIS health (which PIS is working).
- Bidder is required to provide above functionalities with scalability to integrate with third party systems through standard Active Programming Interfaces (APIs) such as ICT/ITS backend system, city traffic management systems, journey planner app etc.
- Bidder and Authority shall agree to share interfacing protocols and APIs with each other for smooth integration with other ICT/ITS System as required by Authority.

32.4. **Training Requirements**

- Well trained, efficient and effective ground support staff shall be provided by the Bidder during the operation and maintenance phase of the project.
 - The bidder shall be responsible for trainings for but not limited to operating equipment, reporting incidents, regular maintenance, spare replacement, route backups, video backups etc. for Drivers, Maintenance staff and Depot Supervisors/Staff.
 - Training sessions shall be designed individually as per requirement for the drivers, maintenance staff and depot supervisors/staff.
 - The Bidder, at its own cost, shall “Train the Trainers” on 1) BS VI technology and 2) on board ITS equipment to at least 25 Driving Instructors and 15 Maintenance Instructors per TNSTC STU. This shall also include training the Depot Managers and Engineers.
 - The Bidder shall provide adequate material and resources required for the training.
 - The Bidder shall submit the training content, Manuals and list of resources to the Authority within 10 days from the date of issue of Letter of Acceptance/ Work Order. The training content shall be reviewed by the Authority or representatives of the Authority in light of larger capacity building program proposed under the Bus Modernisation Plan. The Bidder shall immediately commence the training pursuant to clause above after incorporating the suggestions/modifications provided by the Authority or its representatives. The Bidder shall make available the finalised training manuals in English and Tamil languages for the purpose of imparting better understanding of the training content to the trainees.
 - The training shall be provided at regional training centres of the Authority/IRT. The Bidder shall provide minimum 3 (nos) of training bus or simulator or similar adequate infrastructure for the purpose of Physical Training based on the requirement. The Bidder can also arrange such Physical Training at its own premises/facility at its own cost.
 - The Bidder shall make available such infrastructure for Physical Training, till arrival of first lot of buses in each STU, for the purpose of Training by the Trainers to the other staff.
 - The Training for all the required staff as provided above shall be completed before completion of Prototype Inspection of all the Bus Types.
 - The Bidder shall have to certify the trainees for the said training programs and a satisfactory note to be issued by trainees at the end of training program.
 - GPRS network for the data transmission from ITS system to the backend will be provided by the Authority.
- 32.5. The bus manufacturer shall be responsible to supply buses meeting ITS specifications outlined in this clause and compatible with off-board / control items and the communication systems. The ITS service provider hence needs to coordinate with various vendors/suppliers including but not limited to those responsible for supply of buses, ETVMs, routers, SCUs, display boards, cameras, GPS and other ITS equipment, etc.

33. STOP REQUESTS:

- 33.1. A suitable device for the convenience of passengers including PwDs to request for stopping bus be provided at appropriate locations inside the bus on stanchions in a manner as to prevent un-intentional operation, deliberate attempts by children, etc.

34. BUMPERS:

- 34.1. Bus would be provided with front and rear bumpers of Steel or impact resistant polymer or combination of both meeting requirement of an energy absorbing system. The bumper would be easily repairable/ replaceable. Bumpers would conform to the requirements of CMVR, AIS, and Bus Code/any other international Standards (to be specified by the manufacturer). Details of above bumpers along with drawings including thickness of bumpers, section, profile etc would be supplied by the Successful bidder.
- 34.2. Bus manufacturer would provide details of materials used, their specifications and process followed for their repair and maintenance along with material required.

35. TOWING DEVICE:

- 35.1. Heavy-duty ring type towing devices would be provided in front and rear bumper area with load transfer to bus structural members. Capacity of each towing device would be 1.2 times (minimum) the kerb weight of the bus within 30 degrees of longitudinal axis of the bus. The manufacturer would supply a copy of the test certificate of the towing devices

36. WIND SCREENS:

- 36.1. Front wind screen in the bus would be in single piece design, plain/ flat with curved corners, intervening PVB film laminated safety glass of minimum thickness of 8.76 mm. Rear windscreen would also be in single piece design, flat in centre and curved on corners toughened glass of thickness of 5.5 mm + 0.5mm. Windscreen glasses would meet the requirements of BIS 2553: Part II-1992 or latest and that of CMVR and Bus code (AIS 052). The glazing used for fitment of glasses would be Ethylene Propylene Dien Monomer (EPDM) rubber of black colour or pasted with adhesive material conforming to Indian/ International Standards to be specified by the manufacturer. A grab handle and suitable handles on the outside of windshield centre at waist level would be provided to facilitate manual cleaning of the windscreens.
- 36.2. The windshield shall permit an operator's field of view as referenced in SAE recommended practice J1050. The vertically upward view shall be a minimum of 15 degrees, measured above the horizontal and excluding any shaded band. The vertically downward view shall permit detection of an object 1.35-metre-high no more than 600 mm in front of the bus. The horizontal view shall be a minimum of 90 degrees above the line of sight.
- 36.3. The windshield shall be easily replaceable by removing zip-locks from the windshield retaining mouldings. Bonded-in-place windshield shall not be used. The windshield glazing material shall have 8.76mm nominal thickness double laminated safety glass conforming with the requirements of ANSI Z26.1 Test Grouping 1A and the recommended practices defined in SAE J673.

37. WIND SCREEN WIPERS:

- 37.1. Electrically operated windscreen wiper system having two wiper arms with blades would be provided. Wiper motor would be heavy-duty steel body for minimum of two-speed operations. Wiper arms would rest horizontally when not in use. The sweep angle would be sufficiently wide for clear view during rainy days. Windscreen wiping system would be 24V, having speed control, with fitment of time delay relay as per AIS 011. Windshield washer system would spray washing fluid on windshield & when used with the wipers, would evenly & completely wet the entire wiped area. Windshield washer system would

have a minimum of 3 litres capacity tank suitably located for easy refilling from inside the bus and two nozzles at suitable location for proper spray of fluid. Reservoir pumps, lines & fittings would be corrosion resistant & reservoir itself would be translucent for easy determination of fluid level. The windscreen wiping system would be in accordance with CMVR/ BIS: 7827 Part1, 2, 3 (section 1, 2) or latest.

38. FIRE EXTINGUISHERS:

- 38.1. Multipurpose fire extinguishers would be ISI marked conforming to BIS: 13849-1993 or latest, dry powder type (Stored pressure) duly filled, of capacity and quantity as per the provisions of GSR-853 (E) dated 19.11.2001 notification of Government of India, Bus Code, UBS II. Fire extinguishers would be encased & fitted with proper reinforcement. The enclosure box would have transparent breakable glass at front cover.

39. FIRST AID KIT:

- 39.1. First aid kit complete with items, medicines, bandages etc. would be provided as per provisions of CMVR fitted near driver seat at appropriate position and level on side with proper reinforcement.

40. PROVISIONS FOR PERSONS WITH DISABILITIES:

- 40.1. The manufacturer would provide for ease of accessibility, guidance, etc. for persons with disabilities and of aids etc. that meets the requirements as given in the Bus Code, AIS 153 and CMVR and the harmonized guidelines.

41. BATTERY:

- 41.1. Battery system would be 24V of minimum 180 Amps-hour capacity, low maintenance type lead acid batteries. Batteries would be well secured to a hinged/ pivoted or slide out type carrier for ease of access for repair & maintenance, replacement and suitably ventilated for escape of fumes but insulated against ingress of dust and moisture. Battery box would be mounted near/ next to engine compartment and would be well secured, easily accessible & ventilated. Performance requirements of batteries would conform to BIS: 7372-1995 (or latest).
- 41.2. Battery terminals with positive locking system (e.g., angle type terminal with provision for double bolting) duly protected against all possible short circuit risk would be provided.
- 41.3. Each battery cable would be covered with flame retardant Grey colour corrugated flexible pipe and would be properly encased & clamped.
- 41.4. A relay controlled Heavy-duty type battery cut-off switch (isolator switch) capable of carrying & interrupting total circuit load would be provided 1 each near battery / driver on side panelling at appropriate level for disconnecting all battery positives except for safety devices such as fire suppression system & other systems as specified. Two points of battery cut off switch would be connected with battery and two points would be connected with self-starter. The battery Cut-off switch with power plant operating, would not damage any components of electrical system in off position. The battery Cut-off switch would be capable of carrying & interrupting the total circuit load.

42. ELECTRICAL EQUIPMENT AND WIRING:

As per details given in UBS II and generally as under:

- 42.1. The bus would have 24 Volt D.C with multiplex wiring system for all its electrical equipment except in unavoidable circumstances to avoid sparking in buses. A separate

system/ mechanism would be provided for discharge of electro static charge induced during the operation of vehicle. Adequate precaution would be taken in case of single pole wiring to avoid spark in items such as self-starter, alternator etc.

- 42.2. An adequate capacity alternator of 24V DC, minimum 150A rating with consistent output to take care of idling periods during operations in designated areas would be provided and so located as to minimize ingress of oil or rain water into it.
- 42.3. A pre-engaged type 24V DC Self-starter of adequate capacity (minimum 180Ah) with relay would be fitted in bus and so located as to minimize ingress of oil or rain water into it.
- 42.4. Details of specifications of Battery, Alternator and Self-starter along with circuit diagrams would be furnished by the manufacture along with their bids.
- 42.5. Electrical equipment and wiring would conform to Indian/ international Standards, bus code and UBS II. All cabling would be as per provisions of Bus code / UBS II. The wiring would be multiplex system, flame proof, ISI marked conforming to BIS: 2465-1984 or latest. As far as possible electrical system would be 24V double pole multiplex wiring system except in unavoidable condition. However, in case of single pole wiring all power & ground wiring would have double electrical insulation, which would be waterproof conforming to the Indian/ International Standards. Wiring would be grouped, numbered & colour coded. Wiring harnesses would not contain wires of different voltage classes unless all wires within the harness or insulated for highest voltage present in harness. Kinking, grounding at multiple points, stretching & exceeding minimum bend radius would be prevented.
- 42.6. Wiring looms/ harness for electrical system of bus would be properly routed, encased/ concealed type so mounted to eliminate chances of any spark. Details of above wiring loom including circuit diagram; layout of controls etc. would be supplied by the bidder along with the bid wiring support would be protective & non-conducting at areas of wire contact & would not be damaged by heat, water, solvents or chafing.
- 42.7. All electrical fittings and lights would be fully wired up, running in flame retardant black colour PVC sleeves as per applicable Indian Standards (to be specified by the manufacturer) and installed in a manner to facilitate easy inspection/ rectification/ replacement etc. as & when required without disturbing internal finish/ décor of the bus. Whenever any wire or cable or PVC sleeve carrying cable etc. passes through holes in sheet metals/ structural member, suitable rubber grommets/ Bakelite inserts would be provided in these holes to avoid direct contact between cables and sheet metal causing damage to insulation coating.
- 42.8. Bus manufacturer would furnish details of above wires/cables and battery cables.
- 42.9. Design of electrical, electronic & data communication systems would be modular so that each major component, apparatus panel or wiring bundle is easily separable with Standard hand tools or by means of connectors. Each module except main body wiring harness would be removable & replaceable. Power plant wiring would be an independent wiring module. Replacement of engine compartment wiring module would not require pulling wires through any bulkhead or removing any terminals from the wires.
- 42.10. Electrical system & its electronic components would be capable of operating in area of the vehicle in which they will be installed. Electrical & electronic equipment would not be located in an environment that will reduce performance or shorten life of the component

and or electrical system. No vehicle component would generate or be affected by electro-magnetic interference or radio frequency interference (EMI/RFI) that can disturb performance of electrical / electronic equipment.

- 42.11. Bus manufacturer would furnish recommendations regarding methods to prevent damage from voltage spikes generated from welding, jumps start shorts etc.
- 42.12. All electrical & electronics hardware would be accessible & replaceable easily. It would be mounted on an insulating panel to facilitate replacement. Mounting of hardware would not be used to provide sole source ground and all hardware would be isolated from potential EMI/ RFI.
- 42.13. All electrical/ electronic hardware mounted in interior of bus would be inaccessible to passengers & hidden from view unless intended to be viewed.
- 42.14. All electrical/ electronic hardware mounted on exterior of bus i.e., not designed to be installed in an exposed environment would be mounted in a sealed enclosure.
- 42.15. All electrical/ electronic hardware & its mountings would comply with shock & vibration requirements.
- 42.16. Bus manufacturer would provide a certificate of testing/estimation of electrical load for each system.
- 42.17. Alternator over voltage output protection would be provided.
- 42.18. All branch circuits except battery to starting motor & battery to generator/ alternator circuits would be protected by circuit breakers or fuses sized to requirements of the load. Circuit breakers or fuses would be sized to larger than total circuit load current as per UBS II/ AIS 052. Current rating for wire used for each circuit must exceed size of circuit protection being used.
- 42.19. Electronic Circuit protection for cranking motor would be provided to prevent engaging of motor for long time/to prevent overheating.
- 42.20. To the extent practicable, wiring would not be located in environmentally exposed locations under the vehicle. Wiring & electrical equipment necessarily located under the vehicle would be insulated from water, heat, corrosion & mechanical damage. Where feasible front to rear electrical harnesses should be installed above the window line of vehicle.
- 42.21. All electrical motors would be easily accessible for servicing.
- 42.22. Separate additional outlets, as required in UBS II/AIS 052, are to be provided with appropriate relays & fuses in wiring harness for fitment of electrical auxiliary devices/ systems to be added later on in buses, if required.
- 42.23. AC (Alternating Current) out-let of 220V, as required in UBS II if any, be provided at suitable location for charging of electrical/electronic equipment, etc.
- 42.24. If any electronic components have an internal clock, it would be provided with its own battery back up to monitor time when battery power is disconnected.
- 42.25. All electronic components/equipment would have self-protecting capability in event of shorts in cabling and also in over voltage and reverse polarity conditions. If an electronic component is required to interface with other components it would not require external pull up and/ or pull-down resistors.

42.26. RF components such as global positioning system (GPS) etc. whenever provided would use coaxial cable to carry the signal. The RF systems require special design consideration for losses along the cable. Connectors would be minimized, since each connector & crimp has a loss, which will attribute to attenuation of signal. Cabling should allow for removal of antennas or attached electronics without removing the installed cable between them.

43. LIGHTS AND LIGHTING SYSTEM:

- 43.1. Interior saloon lighting would be sunken type light assembly fitted with LED lights and mounted in staggered formation for uniform lighting in two separate circuits. First row of lamps provided in driver's cabin should be fitted with amber internal filter to reduce glare to driver at night. Overall bus lighting system would comply with CMVR provisions where-ever falls short of it.
- 43.2. Modern rectangular type headlamps with relay and side light etc. would be suitably styled into front-end construction.
- 43.3. White and Red marker lights of 5 Watt each would be fitted at both top side corners of the front and rear panel of the bus respectively.
- 43.4. Identical signal lights of 15 Watts would be fitted for inter-changeability in each side i.e.; front, rear and side respectively
- 43.5. Brake lights (15 W) and taillights (10W) would be two separate lights to reduce heat generation.
- 43.6. Reverse light of 25W, square lamps with white covers would be provided.
- 43.7. Side markers would be provided on both sides as per bus code/ AIS 008
- 43.8. Rear signal lights, brake lights, taillights and reverse lights would be arranged vertically.
- 43.9. Light wattages given above are indicative, however, all the lights and lighting systems would conform to requirements of Bus code, CMVR/Tamil Nadu MVR / UBS II and other relevant AIS Standards.
- 43.10. Following lights would be actuated when the headlights are 'ON' and the doors are 'Open':
 - i. Lights provided for illuminating exit/entrance door area, lights would illuminate outside area up to at least one metre when door/doors is/are opened. Lights for exit/entrance door areas would be flushed as far as possible to avoid tripping of passengers, protrusions if any would conform to relevant CMVR/ AIS Standards.
 - ii. Exterior door lights
 - iii. Lights would be automatically switched off when the door is closed.
- 43.11. A well-lighted bus registration number plate would be fitted at rear as per provisions of CMVR duly complying with directives/ regulations regarding high security number plates as notified by Government of India / Government of Tamil Nadu if any.
- 43.12. No Electrical fittings would be mounted on front and rear bumpers.
- 43.13. Switches would be fitted on right hand side of instrument panel through evenly loaded circuits & fuses as per bus code.

- 43.14. A reverse buzzer would be installed at the rear of bus to sound intermittently when reverse gear is engaged.
- 43.15. A suitable light would also be provided in engine compartment for ease of maintenance/emergency repairing.
- 43.16. Following circuit diagrams would be supplied along with buses:
- i. Complete circuit drawings for exit/entrance door control system, door mechanism.
 - ii. Complete door sensor electrical circuit drawing.
 - iii. Complete circuit drawing for sensitive door edge system.
 - iv. A layout drawing for all door control switches, gauges, warning lights on driver's dashboard.
 - v. A layout drawing for all lighting and wiring circuits, control switches fuses and fitment details and diagrams along with item specs and types in each case.

44. PERFORMANCE STATEMENT:

- 44.1. Bus manufacturers would furnish following information for performance evaluation of fully built buses supplied to other customers and now in service for at least 3 years. The information should be furnished separately order wise:
- i. Type/Model
 - ii. Name and address of the bus operating agencies where this model is operating
 - iii. Number of the buses supplied
 - iv. Order no. against which buses have been supplied.
 - v. Date of supply and date from which in service
 - vi. Maximum/minimum turning radius.
 - vii. Maximum climbing ability/ gradeability
 - viii. Type of bus body
 - ix. Engine HP @ RPM
 - x. Engine Max Torque @ RPM, and RPM range for max torque
 - xi. Specific fuel consumption
 - xii. GVW / Kerb weight of buses
 - xiii. Emission Norms
 - xiv. Type of suspension
 - xv. Dimensions- Length, width, height, floor height, wheel base,
 - xvi. Angle of approach, departure and ramp over
 - xvii. Axle –rear and front
 - xviii. Passenger carrying capacity
 - xix. safety devices/provisions, Specs and Stds. against each item,

- xx. Any other performance data.

45. TECHNICAL INFORMATION

Technical information required to be furnished by bus manufacturers along with Bid wrt the following amongst others:

- 45.1. Bus manufacturer's technical information of the bus i.e., General Drawings comprising of elevations –sides, front & rear ends along-with main dimensions i.e., overall length, overall width, overall height, saloon height, pillar to pillar distance, isometric views, exterior & interior details, seating layouts, no. of seats (excluding seat for driver), environmentally friendly colour scheme as per TNSTC etc. would submit same along-with the Bid.
- 45.2. General appearance & structural details of roof, floor, sides, front & rear show and driver's cab would be provided by the bidder along with their bids. Details of main structural members, material specifications, shape, size, thickness, etc. be indicated on the above drawings.
- 45.3. Power Point presentation material on a DVD for offered design of bus (indicative) and minimum 1:15 scaled Model (indicative & non-working)) duly furnished/ painted in environmentally friendly colour scheme as given by TNSTC would be submitted along-with the bid. The presentation will cover elevations –sides, front & rear ends along-with main dimensions, isometric views, exterior & interior details, seating layouts, colour scheme etc.

46. TOOLS, GAUGES AND TESTING INSTRUMENTS:

- 46.1. Bus manufacturers would furnish a list of special tools, gauges and testing instruments for inspection, repair and maintenance of buses along with a complete list of spare parts recommended for:
 - i. Normal wear and tear; and
 - ii. Emergency requirements for any breakdowns, damages etc.

47. OPERATION AND MAINTENANCE MANUAL:

- 47.1. At least 2 hard bound copies and 2 soft copies, for every 25 buses or part thereof, of operation and maintenance manual containing essential technical information required for satisfactory operation, inspection and maintenance would be supplied by bus manufacturers.
 - i. One set of Coloured wall charts along with soft copies of following units would also be provided for every ten buses or part thereof showing assembly details:
 - ii. Chassis lubrication and brake system.
 - iii. One set of Coloured wall charts along with soft copies of following units amongst others for every 25 buses or part thereof showing assembly details:
 - Engine
 - Transmission system
 - Drive line and Rear axle

- Front axle
- Steering system, alternator, starter, fuel injection system etc.
- Brake system, ABS etc.
- Safety devices,
- FDSS
- Any other system / sub-system necessary for skill development of operating / repair and maintenance staff

48. TRAINING

- 48.1. The Bidder, at its own cost, shall “Train the Trainers” on 1) BS VI technology and 2) on board ITS equipment to at least 25 Driving Instructors and 15 Maintenance Instructors per TNSTC STU. This shall also include training the Depot Managers and Engineers. The Bidder shall provide adequate material and resources required for the training.
- 48.2. The Bidder shall submit the training content, Manuals and list of resources to the Authority within 10 days from the date of issue of Letter of Acceptance/ Work Order. The training content shall be reviewed by the Authority or representatives of the Authority in light of larger capacity building program proposed under the Bus Modernisation Plan. on The Bidder shall immediately commence the training pursuant to clause 48.1 above after incorporating the suggestions/modifications provided by the Authority or its representatives. The Bidder shall make available the finalised training manuals in English and Tamil languages for the purpose of imparting better understanding of the training content to the trainees.
- 48.3. The training shall be provided at regional training centres of the Authority/IRT. The Bidder shall provide minimum 3 (nos) of training bus or simulator or similar adequate infrastructure for the purpose of Physical Training based on the requirement. The Bidder can also arrange such Physical Training at its own premises/facility at its own cost.
- 48.4. The Bidder shall make available such infrastructure for Physical Training, till arrival of first lot of buses in each STU, for the purpose of Training by the Trainers to the other staff
- 48.5. The Training for all the required staff as provided in the clause 48.1 above shall be completed before completion of Prototype Inspection of all the Bus Types .
- 48.6. The Bidder shall have to certify the trainees for the said training programs and a satisfactory note to be issued by trainees at the end of training program

49. TOOL KIT

- 49.1. Bus manufacturer would provide a suitable tool kit and other mandatory items as per CMVR 138 (4)/ other applicable rules comprising of common tools and other essential items required. Complete list of tools in tool kit to be supplied with every bus would be supplied by the manufacturer. One wheel nut spanner and one Hydraulic Jack per bus of a capacity of at least 10 Ton as per design of bus would also be supplied.

50. INSPECTION AND TESTING:

- 50.1. Bus may be inspected at various stages of fabrication by TNSTC’s representative at manufacturer works. Inspection would comprise of ensuring that all materials, components, items, accessories and assemblies used in fabrication of buses conform

to contractual specifications. Wherever required to ensure this, laboratory test would be carried out at bus manufacturer's cost.

- 50.2. The inspection may be undertaken at any and or all stages such as component fabrication stage, chemical pre-treatment stage, fabrication of assembly/sub assembly stages, structure, panelling and equipping stage and Pre-dispatch inspection.
- 50.3. Final Inspection of buses would be carried out at manufacturer's facilities and or at a place finalized by TNSTC. After the bus is finally inspected, it would be subjected to test run and trials as required by TNSTC
- 50.4. The bus would be taken over by TNSTC after satisfactory final inspection, testing and trials in TNSTC.

51. MAINTENANCE SPARES AND MATERIALS

- 51.1. Bus manufacturer would provide details of components/spares required for maintenance of vehicle for twelve months' operation taking daily utilization of bus of over 400 Kms.
- 51.2. Manufacturer would also provide complete details of vendors, for every component / spare for complete bus and the spare parts catalogue (hard as well as soft copies) in 2 sets for every 25 buses or part thereof.
- 51.3. Manufacturer would ensure that during service life of 9 years or 12,00,000 Kms. (Whichever is earlier) of service, adequate spare parts in kit form/ individual components are made available in time to TNSTC on demand along with other essential items required.
- 51.4. All spare parts availability would be more than 95% at any time.

52. MAINTAINABILITY

- 52.1. Design and fabrication of bus would be such as facilitates easy access for repair & maintenance, removal, replacement of various bus components/ assemblies/ sub-assemblies/ systems by providing suitable traps/ flaps etc. Also, removal and re-fitment of engine, transmission, differential, radiator, door closing mechanism, PIS etc. would be easy for repair & maintenance purpose. Enough space would be provided between wind screen glasses and PIS boards for facilitating cleaning of glasses.
- 52.2. Radiator coolant/water filling and diesel filling inlets would be easily accessible with suitable closing devices complete with locking arrangement/-holding arrangement.
- 52.3. Also, an access would be provided for attending to air cleaner assemblies mounted in the vehicle.

53. WARRANTY/ GUARANTEE

- 53.1. Fully built bus would be covered under Warranty/ Guarantee for up to 2,50,000Kms or 24 months whichever is later from the date of putting bus into operation after registration. All assemblies, sub-assemblies, fitments, components would be covered under Warranty Period as per commitment of bus manufacturer at the time of supply of bus.
- 53.2. Special Warranty Period, for any manufacturing Defect in design, material and workmanship of Bus structure shall be 9 years or 9,90,000 km per Bus whichever is later from the date of putting bus into operation after registration.

54. GENERAL REQUIREMENTS:

- 54.1. TNSTC reserves the right to alter, modify, change specifications as per requirement to suit the latest provisions of CMVR/ any other Notifications, safety aspects, emission aspects besides any practical/ operational difficulties etc. faced/likely to be faced by TNSTC. Vehicle Manufacturer would ensure that all alterations, changes or modifications in specifications, if necessary, as mentioned above would be carried out in buses built by them as per the advice of TNSTC without attributing any additional cost.
- 54.2. Ministry of Road Transport & Highways, Government of India (MORT&H) vide Notification in the Gazette of India, inter-alia stipulated the following measures which need to be complied with for enhancement of safety by the Vehicle Manufacturers as per the statutory requirement for registration of vehicles
- i. While registering every bus, Vehicle Manufacturers & transport authority would jointly examine the bus prior to registration. The registration of such a vehicle be done only after signing the report jointly by all concerned along with the transport authority.
 - ii. For electrical installations, flameproof cables would be used, especially positively locked battery terminals and others would be locked firmly with all cables & pipes with proper looming to take care of vibrations, fire retardant material would be used for seats, roof & sidewalls. Safety instructions about fire hazards would be displayed.
 - iii. Details of structural members, their material specifications & dimensions i.e., cab & saloon flooring, cross bearers, various angles, floor longitude, main body pillars, dummy/stump pillars, cant rail, vent rail, waist rail, skirt rail, wheel arch section, sole bar, seat rail, roof sticks & roof longitudes, diagonal bracing, rub rail tube, stretch & body panel stiffeners, gussets etc. would be provided by bus manufacturers.
 - iv. Similarly, details of aluminium sheets/sections & their alloys/specifications, aluminium sheet, rub rail, decorative mouldings, wire cover, wearing strips, footsteps edging, various panel beadings, window frames and its sections, finishers, water gutter channel, roof grab rail brackets would be provided by bus manufacturers.
 - v. All edges would be rounded off and would not cause injury to bus occupants.
 - vi. Complete bus would be rattle-free.
 - vii. All the rivet and bolt holes would be jig drilled as far as possible. The rivet holes should be drilled before the corrosion treatment. Holes drilled after the corrosion treatment be suitably treated with anti-corrosion materials. Rivet heads neatly formed and each bolt/ rivet would be tightened after full mating of the surfaces to be fastened.
 - viii. All safety aspects should be considered while designing and fabricating the bus.
 - ix. Continuous length piano type hinges and tower bolts of stainless steel would be used as per relevant Indian Standards.

- x. Similarly Aluminium extruded sections wherever not painted would be anodized.
- xi. All flaps wherever provided should have heavy-duty support to keep it open for ease of maintenance.
- xii. All miscellaneous M.S pipes would be phosphated with the coating of 2.16 to 2.70 gm/m² or by any other pre-treatment process conforming to Indian/ international Standards (to be specified by the manufacturer). Samples of all materials & components would withstand a two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%.
- xiii. Anodized decorative aluminium mouldings/ beadings etc. would be used.
- xiv. All M.S pipes used in the bus would be ERW conforming to BIS 3601:1984 or latest, of grade WT –160.
- xv. All rubber items used on the bus body would be made of Ethylene Propylene Dien Monomer (EPDM) rubber of black colour conforming to the Indian/ International Standards to be specified by the Manufacturer.
- xvi. EPDM rub rail of aesthetic profile would be fitted in anodized extruded aluminium channel between stretch panel and skirt rail longitudinally at the widest portion of the bus. The quality of EPDM material would be as per the Indian/ International Standards to be specified by the Bidder.
- xvii. Every trap/-opening flap would be secured in a manner that the vibrations can't dislodge it. Lifting devices must not protrude above the flap.
- xviii. Ease of accessibility to engine & other aggregates for easy maintenance would be ensured. Assemblies / units would be so mounted that they are easily accessible & can be removed without disturbing other components / assemblies.
- xix. All structure, body, and panel-bending mode frequencies, including vertical, lateral, and torsional modes, would be sufficiently removed from all primary excitation frequencies to minimize audible, visible, or sensible resonant vibrations during normal service.
- xx. Exterior protrusions if any would conform to the provisions of relevant CMVR/ AIS/ Bus Code. The exterior rear-view mirrors and required lights and reflectors are exempted from the protrusion requirement. Advertising frames would protrude no more than 22mm from the body surface and would have the exposed edges and corners rounded to the extent practicable. Grilles, doors, bumpers and other features on the sides and rear of the bus would be designed to minimize the ability of unauthorized riders to secure footholds or handholds. The exterior body features would be shaped to allow complete & easy cleaning by automatic bus washers without snagging washer brushes or retaining water & dirt.
- xxi. Hydraulic Grease Nipples would be provided for ease of proper lubrication & maintenance.

- xxii. Front panels, bumpers and grill should be designed such that there are no pointed or sharp protrusions to minimize injuries to vulnerable road users in case of impact.
- xxiii. Any other safety and performance requirement features to be provided.

55. QUALITY ASSURANCE

- 55.1. Bus manufacturer would use materials including fasteners conforming to relevant Indian/ International Standards and would get the same tested before use, meeting requirements of all specified parameters to ensure quality of material specified. However, random sample of materials picked up and duly sealed by representative of TNSTC in presence of bus manufacturer, out of purchased lot at works of the manufacturer or out of the bus under fabrication/ completed bus and be sent for testing quality of components at CIRT, Pune/ARAI/BIS approved testing laboratories having testing facilities for testing all parameters of specifications of materials/ items. In the event of failure of samples in lab tests, testing would be conducted in same way again from fresh lot. The bidder would replace failed materials by those duly passed in lab tests.
- 55.2. In the event of failure of material/ items in laboratory test, failure of material/ items (removed from completed bus) in laboratory test, acceptance decision about bus be taken by TNSTC after obtaining compensation/ recoveries of liquidated damages from bus supplier as per system decided by TNSTC. Wherever, failure of material on one parameter or more than one parameter, recoveries for complete lot of materials used in bus would be made from manufacturer plus 20% damages thereof.
- 55.3. Completed bus would be subjected to water leakage test conforming to BIS: 11865-1986 or latest.
- 55.4. A list of items to be tested for bus bodies would be provided by TNSTC. An indicative list of items to be tested is placed at Annexure III.
- 55.5. Manufacturer would also ensure compliance of quality at different stages of bus fabrication, including but not limited to prototype inspection as per details decided by TNSTC.

56. STATUTORY REQUIREMENT

- 56.1. Bus manufacturer would ensure that all statutory requirements in respect of each and every item of bus are fully met. Manufacturer would also obtain type approval certificates etc. for bus & any other items from testing agencies specified in the CMVR namely Vehicle Research & Development Establishment, Ahmednagar of the Ministry of Defence of Government of India or Automotive Research Association of India, Pune or Indian Institute of Petroleum, Dehradun and or any other agencies as specified by the Central Government on date of testing/ type approval or any other agency specified by competent authority. A certificate showing details of make/type/model of various units like engine, gear box/transmission system, clutch assembly, propeller shafts, rear axle, radiator, alternator, starter, regulator, batteries, tyres, steering, instruments on the panel, air compressor, shock absorbers, suspension system items, etc. would be furnished.
- 56.2. Bus Manufacture must make sure that the Fully built type II DLX bus complies with standards and regulations for diesel fuelled vehicle provided in the AIS-052, AIS 153, UBS II, harmonized guidelines and any other standard as applicable; CMVR 1989 as amended till date, CMVR 1989 and Tamil Nadu MVR and all amendments thereto.

57. MANUFACTURER'S NAMEPLATE

57.1. Manufacturer's nameplate may be fixed as per approval of TNSTC.

58. POLLUTION UNDER CONTROL (PUC) CERTIFICATE HOLDER

58.1. A suitable holder with clear acrylic sheet cover would be provided in driver cab near driver seat at appropriate level for fixing of PUC certificate.

59. ANY OTHER PROVISIONS TO MAKE THE BUS FULLY FUNCTIONAL

59.1. Notes indicated in para 59.2 form part of the specs / bus fabrication requirements. Should however there be any conflict details contained in notes would over-ride others.

59.2. Notes:

- i. All cross and or T or X-joints of structural elements of bus body structure (Front, rear, sides, roof, floor, etc.) be provided with MS gussets of min 2.5mm thickness. All Weldments / structural sub elements be properly cleaned and treated for corrosion prevention
- ii. Service / inspection hatches with covers be provided for servicing of various aggregates / sub-systems of bus.
- iii. Width of wheel arches frame be so maintained as to provide adequate ventilation to tyres amongst fulfilling other needs.
- iv. Stanchion pipes and grab rails to be of Aluminum tubing of appropriate specs, size / wall thickness etc. Handholds supporting hand rails and the stanchion pipes be painted in cannerly yellow color, Brackets be of grey colour matching the colour of the inner paneling. Brackets however need to be of proper size and shape to ensure perfect fittings. No redundant fastening holes be provided on brackets
- v. Hand holds be of polycarbonate material, transparent and provision for space for advertisements
- vi. Spare-wheel carrier, spare wheel assembly, and spare-wheel hatch need be provided on the type II DLX bus to facilitate the spare wheel assembly to be carried on-board during operations.
- vii. Stop buzzers may be provided as one in frontal area, one in middle and one in the rear area on stanchions at reasonable height ensuring easy accessibility as well as preventing unnecessary usage. Design of buzzer switch be sturdy, long lasting and sunk-in type to avoid undesirable / inadvertent operation.
- viii. LED illumination provided in saloon area of the bus be covered with ground glasses to prevent glare.
- ix. Tail lamps be covered with metallic grill in a manner that not only protects the tail lamps but also facilitates easy lamp replacement etc.
- x. Front and rear facia of the bus body may be fabricated out of FRP suitably designed, ensuring its strength, finish and ease of repair / replacements at par or better than the metallic ones asked for in the specs.
- xi. Where type approval, of any of the bus body items including full bus body / bus is a mandatory requirement Type approval be undertaken by test

agencies authorized under CMVR. In other cases, approval of selection of testing agency be obtained from TNSTC.

- xii. Design approval of multiplexing wiring in bus body / bus be obtained from test agencies authorized under CMVR or any other agency accredited for the purpose subject to approval of TNSTC.
- xiii. Bus Manufacturer to provide detailed drawings / specifications / make / model etc. as called for in specs for all items as generally indicated in RFP specs including but not limited to electrical Circuit diagrams of electrical subsystems in the bus.

60. FIRE DETECTION AND SUPPRESSION SYSTEM (FDSS)

60.1. General Requirements

Vehicles shall be equipped with fire detection & Suppression system detecting fires in the engine compartment based on sensors that senses either abnormally high temperature or rate of temperature rise, or both and suppress the same.

- 60.2. FDSS provision is to be made in the bus at appropriate location(s) for detection, alarming and suppression about any likely fire at all fire prone systems/sub-systems (bus supplier to identify such fire prone systems /sub-systems and make above provisions)
- 60.3. Vehicles shall be equipped with fire detection & suppression system detecting fires in the fire prone areas based on sensors that sense either abnormally high temperature or rate of temperature rise, or both and or any other parameter.
- 60.4. Upon detection of fire in the fire prone areas, the system referred in clause no 60.1, shall provide the driver with both an audio and a visual signal, and activate the hazard warning signal. The placement of the visual alarm shall be such that it is visible unobstructed while viewed from the driver seat.
- 60.5. The FDSS would simultaneously be able to suppress the fire immediately after detection.
- 60.6. The detection & suppression system shall be operational irrespective of whether the propulsion system of bus has been started and the vehicle's attitude.
- 60.7. The fire detection & suppression system shall be installed according to the system manufacturer's installation manual.
- 60.8. An analysis shall be conducted prior to the installation in order to determine the location of fire detectors and alarm system. Potential fire hazards at possible fire prone areas shall be identified and the fire detectors and suppression systems shall be so positioned as to commence suppression of the fire hazard immediately. The system shall also be ensured to work promptly and effectively regardless of the vehicle's attitude, road conditions etc.,
- 60.9. Fire hazards to be taken into account in the analysis shall at least consist of the following: Components whose surface may reach temperatures above the auto-ignition temperature for fluids, gases or substances that are present in the fire prone areas and electrical components and cables with a current or voltage high enough for an ignition to occur as well as hoses and containers with flammable liquid or gas (in particular if those are pressurized). The analysis shall be fully documented.

- 60.10. The Fire Detection and Suppression System (FDSS) installed in the Buses shall comply with the requirement of CMVR / AIS 135, UBSII as applicable, any other equivalent or better International Standards as well as best market practices.
- 60.11. Make, model, specs etc of various components / sub-systems / system of FDSS be clearly indicated for each item as part of the offer. A detailed drawing of the system details / specs be also provided for.

**PART II – SPECIFICATIONS OF DIESEL FUELLED NON-AC STANDARD 12 METRE LONG, 1150 MM FLOOR HEIGHT BS VI COMPLIANT BUSES FOR TYPE II DELUXE BUS OPERATIONS IN TNSTC – GENERALLY AS PER BUS CODE (AIS 052) AND
UBS II**

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
A	B	C	D
1	Bus Floor heights in mm	1150±10 mm, shall be uniform inside the Bus generally as per AIS 052	Confirm
2	Propulsion System	Diesel fuelled Internal Combustion Engine (ICE);	Confirm
2.1	Emission norm and Fuel	BS-VI - Diesel	Confirm
3	Engine	Diesel Fuelled 4 or more cylinder engine, water cooled, with Turbocharger, intercooler and conforming to BS VI emission norms. Engine be able to operate efficiently at ambient temperatures of approximately 10°C to 50°C, humidity level from 5% to 100%, and altitude levels of 0 to over 2400 metres, generally operating in the semi-arid / humid zone/ region prevailing in the designated operational areas of TNSTC.	Confirm
3.1	Engine HP sufficient to provide:		Make & model of engine----- HP -----at Rpm--- Max torque -----NM at rpm-----& rpm range-----
a	Rated performance at GVW in stop / start operations in designated areas	Attain Geared minimum maximum speed of 90 kmph (without speed limiter) at GVW load and other systems operational. There should be an in-built speed limiting device to restrict speeds to specified limits.	Minimum Max speed - --- kmph
b	Acceleration (metre/sec ²)	≥ 0.8	Confirm
c	Attain Bus speed of 0-30 kmph in seconds	≤ 10.5	Confirm
d	Maximum speed	Geared Minimum maximum speed without speed limiter to be 90 kmph as at 3.1. a	Confirm
e	Gradeability from stop, at GVW and other	17%	Confirm

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
	system operating.		
f	Rated HP / torque preferably at optimal rpm range	1. Rated HP at low rpm and Maximum engine torque required at lower range of RPM and spread over a wider range of RPM 2. Engine Power: Min. 140kW @ 1800-2400 RPM 3. Engine torque: Min. 700 Nm @ 1100 - 2000 RPM Subject to meeting specified performance.	Engine HP ---- at ---- rpm & Engine peak torque -- -- NM at ---- rpm; Range of rpm---- to---- for peak torque
g	Power requirements for other auxiliary system, ITS, etc.	Required to be provided by bus engine	Confirm and indicate power in terms of HP
3.2	Emission norms	BS VI/latest as applicable	Confirm
3.3	Engine management	Engine oil pressure, engine coolant temperature, engine speed in RPM, vehicle speed, engine % load (torque), diagnostic message (engine specific) generally as per UBS II	Confirm
3.4	Engine operational requirements	Engine should be able to operate efficiently at ambient temperatures / environmental conditions of TNSTC generally operating in the semi-arid & humid zone prevailing in the area as indicated in above sections	Confirm
3.5	Engine location	Front	specify
3.6	Transmission	Heavy duty Synchromesh manual transmission with minimum 5 forward and one reverse speed. Neutral during stops	1. Make --- model ----- of Transmission system 2.No. of forward speeds and their details
3.6.1	Operational safety	Transmission system to be fitted with a mechanism which makes it possible to engage reverse gear only when vehicle is stationary.	Confirm
4.0	Clutch System	Mechanical Clutch system using single plate push type dry clutching. Disc clutch lining be of asbestos free material.	Provide details
5	Rear & Front Axles		
5.1	Rear axle	Single reduction, hypoid gears, full floating axle shafts with optimal gear ratios suitable for	Make --- model ----- of Rear Axle Type --

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
		type II DLX bus operations in designated areas	Gear ratio ----
5.2	Front axle	Heavy duty reverse Elliot I-section beam type axle suitable for bus floor height, track rod with replaceable ball joints at both ends.	Make --- model ----- of Front Axle Type --
6	Steering system	Hydraulic power steering with height and angle adjustments	Make --- model ----- of Steering system Type --
7	Suspension system	Parabolic leaf spring (waveller type) suspension at front axle and air suspension at rear axle complete with Anti-roll stabilisers & heavy duty hydraulic double acting Shock Absorbers at both axles	Confirm
7.1	Front	Parabolic leaf spring (waveller type) suspension system	Make --- model -----, Type – specs ---size-- -
7.2	Rear	Air suspension system	Confirm Indicate make and model of air suspension system Indicate no. of air bellows
7.3	Anti-roll bars / stabilizers	Both front and rear	Confirm
7.4	Shock absorbers	Hydraulic double acting minimum 2 each at front & rear	Make --- model -----, of shock absorbers Type – specs --- Confirm
8	Braking system	Disc Brakes in front and drum brakes at rear wheels. Graduated hand controlled, spring actuated parking brakes acting on rear wheels. Asbestos free brake Pads/ linings at all places.	Confirm: i. fitment of drum brakes at Rear ii. Disc brakes at front iii. Hand brakes iv. Asbestos free pads /linings v. Provide Make -----, model-----, specs--- of brake system and its subsystems
8.1	Anti-skid anti brake locking system (ABS)	Required	Provide Make -----, model-----, specs--- of ABS
9	Electrical system	24-volt DC	Confirm

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
9.1	Batteries:	Low maintenance type lead acid batteries for 24 V system- performances as per BIS: 14257-1995(latest). 2*12V maintenance free batteries of minimum 180Ah rating.	Confirm Make --- model -----, of Batteries Type – specs --- Rating ---- Ah
9.2	Self-starter	24V, 180 Ah	Make --- model -----, of Self starter Type – specs --- Rating ---- Ah
9.3	Alternator	24V, 150 A.	Make --- model -----, of Alternator Type – specs ---
9.4	Electrical wiring & controls –type	Multiplexing type -- As specified separately under ITS specifications	Confirm and provide details. Provide details of certifying agencies who had certified the multiplexing system design.
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 Vehicle manufacturer shall facilitate the Speed Limiting Device Serial number to be incorporated with MORTH by ensuring that requisite data is invariably added to the details submitted to STA at the time of registration of bus.	Make --- model -----, of speed limiting device Type – specs ---
11	Tyres	Steel radial tubed tyres,— size and ply rating for type II DLX bus operations, as per CMVR Standards preferably 10.00*20 as per AIS 044 part 3.	Make --- model -----, of tyres Type –Size---, specs - -- Tread pattern for front---- & for rear tyres---
12	Diesel Fuel Tank capacity	>230 litres capacity tank subject to being adequate to enable bus operation of more than 400 km between consecutive fillings	Confirm and provide details of diesel tank:
13	Bus characteristics		
13.1	Bus dimensions in mm		
a	Overall length (over body	12000 - 200 mm	Confirm and provide dimensional details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
	excluding bumper)		
b	Overall width (sole bar/floor level- extreme points)	2600 - 50 mm	Confirm and provide dimensional details
c	Overall height (unladen-at extreme point)	3800 mm max	Confirm and provide dimensional details
d	Overhang		
i	Front overhang	> 32% of wheel base limited to 2400±200mm	Confirm and provide dimensional details
ii	Rear overhang	< 60% (preferably about 50%) of wheel base limited 3200 ±200mm	Confirm and provide dimensional details
iii	Note:	Overall length be maintained as 11800-12000 mm by adjusting tolerances appropriately on various dimensions such as wheel bases, overhangs, etc.	Confirm and provide dimensional details
13.2	Turning circle radius (mm) (centre point of front wheel track) / Front overhang outer corner / rear overhang inner corner	11000±200 mm / 14000±200 mm / 7000±200 mm	Confirm and provide dimensional details
13.3	Floor height above ground (mm)	1150 ± 10 mm	Confirm and provide dimensional details
13.4	Clearances (mm)		
a	Axle clearance(mm)	Minimum 190 mm	Confirm and provide dimensional details
b	Wheel area clearance(mm)	> 220 mm for parts fixed to bus body & > 170 mm for the parts moving vertically with axle.	Confirm and provide dimensional details
c	Minimum ground clearance at GVW	Within the wheelbase not less than 400 mm.	Confirm and provide dimensional details
13.5	Angles (degrees)		
a	Angle of approach (unladen)	Not less than 8.0°	Confirm and provide dimensional details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
b	Angle of departure (unladen)	Not less than 8.5°	Confirm and provide dimensional details
c	Ramp over angle (half of break-over angle) unladen	Minimum 4.8°	Confirm and provide dimensional details
14	Bus Gates/Doors		
14.1	Entry-exit gates with doors	Double jack-knife (JK) type, 1 door on near (left) side. The door flaps shall be so designed as to provide positive sealing against ingress of water in the bus particularly during any water logging / flooding on roads.	
a	Operating mechanism	Electro pneumatically controlled	Confirm Make -----, model ---- type --- & specs ---- of operating mechanism
b	Maximum opening / closing time in seconds per operation	4	Confirm and indicate closing / operational time
c	Positions of door controls	As per AIS 052	Confirm
14.2.	Passenger safety system - allowing bus motion only on doors closing. Front button to open the doors from outside required	Mandatory	Confirm and indicate type of system provided
14.3	Entry / Exit gate with doors – (near side / non driver side); Locations & dimensions,	Front gate behind front axle. The gate location, aperture and depth of steps be suitable for facilitating smooth entry / exit of passenger with disabilities, without causing any safety hazard.	Confirm and provide dimensional details
a	Door aperture in mm	850mm as per AIS 052	Confirm and provide dimensional details
b	Clear door width (fully opened)	> 650 mm as per AIS 052	Confirm and provide dimensional details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
c	Door height	1900 mm as per AIS 052	Confirm and provide dimensional details
d	First step height from ground	≤ 400 mm	
e	Maximum height (mm) of other steps	≤ 250 mm	
14.6	Ramp / suitable mechanism for wheel chair access at the near side front gate,	Not Required	Confirm Type--- size---- Dimensions Material ---- specs--- - Load carrying capacity ----- kgs m
a	Dimensions		Confirm
b	Material		
c	Load carrying capacity		
d	Device to prevent the wheel chair roll off the sides when the length exceeds 1200mm		
e	Device to lock wrapped up ramp		
f	Requirement for passenger with limited mobility	√	Confirm
g	Wheel chair anchoring - minimum for one wheel chair	Not Required	Confirm
h	Priority seats - minimum 2 seats	√	Confirm
i	Stop request-on pillars--selected for operational convenience	√	Confirm
j	Emergency doors / exits or	As per AIS 052	Confirm

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
	apertures (numbers)		Emergency door details----, type-----, size-----, locations---, nos--- Confirm
	Dimensions in mm	As per AIS 052	
k	Passenger safety system - allowing bus motion on doors closing and doors opening only when the bus is stopped	Mandatory	Confirm and provide details of mechanism
l	Power operated service door - construction & control system of a power operated service door be such that a Passenger is unlikely to be injured/trapped between the doors while closing.	As per AIS 052	Confirm and provide details of mechanism
m	Door components	As per AIS 052	Confirm
n	Door locks / locking systems / door retention items	As per AIS 052	Confirm
o	Door hinges	As per AIS 052	Confirm
15	Bus body		
15.1	Bus Design / Bus type approval	Design type approval as per Annexure-3 of UBS II/ AIS 052 / AIS 153 / harmonised guidelines as applicable and the data given in this doc whichever is superior. The fully completed bus be type approved as per approved design.	Confirm and provide details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
15.2	Bus structure	Materials, corrosion prevention and paints	
a	Bus structure – underframe, super-structure, roof etc, material specifications etc.	<p>The under frame and super structure suitably designed to carry nominal load of over 44 passengers (assuming an average weight of 68 kg per passenger and hand luggage of 25kgs each) and crush load of 90 pax.</p> <p>The superstructure of the bus fabricated using Galvanised Steel Material (GS/ GP) tubing (ERW– Rectangular / Square Hollow Sections) of grade Yst –240 for the bus body to be weld integrated /welded to the chassis frame depending upon the chassis design. Material size to be decided by the manufacturer. Material should fulfil structural strength etc. requirements indicated under Annexure-3 of UBS II and those in Part I above. Other requirements as per bus body code.</p>	Details of Structural materials fulfilling strength etc. requirements indicated under Annexure-3 of UBS II and those in part I of specs to be provided as a separate annexure / drawing with complete dimensional, materials and other details of specs at bidding stage.
b	Front and Rear End structures	Front and rear end structure design be energy absorption type steel, or FRP or a combination of both to reduce impact stresses into under frame/side structures/ other areas of the vehicle generally as per Bus code AIS 052	Details of design, materials, load bearing capability as evaluated for the offered design be submitted along with the bid.
c	Corrosion prevention	Samples of all materials & joints would withstand two weeks (336 hours) Salt Spray test in accordance with ASTM procedure B117. Corrosion prevention & painting- As per AIS 052	Confirm and provide details
d	Paints	All structural members be treated for corrosion prevention internally as well as externally and painted using Polyurethane (PU) painting-based spray paint Details of paints used, surface treatment & preparation, corrosion prevention treatment, base primer coatings, number of paint coats to be applied etc would be supplied.	Confirm and provide details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
15.3	Panelling	Bus exterior side panels fitted with stretched GI sheet at waist level. The exterior front-end panelling be of GI sheet while roof, rear, sides & skirt panelling be of aluminium. All interior panelling be of Acrylonitrile Butadiene Styrene (ABS) conforming. Space between roof interior and exterior panels be filled with insulating material as specified in para 13.6 of part I or thermocol.	Detailed specs be provided along with the bid
15.4	Aluminium extruded sections for:		
a	Rub rail	Aluminium extrusion IS 733/1983 or better	Confirm and provide details of specs, sizes, make etc.at bidding stage.
b	Decorative moulding		
c	Wire cover		
d	Wearing strip		
e	Foot step edging		
f	Panel beading		
g	Window frame		
h	Roof grab rail brackets		
15.5	Floor type / materials etc.		
a	Type of floor	Uniform floor inside bus without steps.	Confirm
b	Steps on floor	Not required	Confirm
c	Maximum floor slope	Less than 6 degrees as per AIS 052	Confirm
d	Floor surface material	15mm 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 (BRW) as for marine board BIS:710-1976/ latest and fire retardant as per BIS:5509-2000(IS15061:2002)	Confirm and provide details
e	Anti – skid material	3 mm thick anti-skid type silicon grains ISO 877/76 for colour, IS5509 for fire retardancy	Confirm and provide details of material, specs, thickness, make etc.at bidding stage.
15.6	Safety glasses and fittings:		

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
a	Front windscreen (laminated) glass:	Full width single piece laminated safety glass, plain, flat / curved with curved corners with intervening Poly Vinyl Butyral (PVB) film IS 2553 (Part-2)-1992 / latest. Standard designs (Refer Annexure 1 to UBS II) for 12metre long buses to be followed	Confirm and provide dimensional and specs details at bidding stage.
	Size:	Size 2200mm width*1500mm height plain / flat curved at corners*8.76mm thick ¹	Confirm and provide dimensional and specs details, drawing etc. at bidding stage.
b	Rear windscreen:	Single piece flat/curved toughened glass-plain/flat/curved at centre & curved at corners IS 2553(Part-2)–1992/latest	Confirm and provide dimensional and specs details, drawing etc. at bidding stage.
	Size:	Size:1900mm width*950mm height (minimum)*5.5+0.5mm thickness ²	Confirm and provide dimensional and specs details, drawing etc. at bidding stage.
c	Side windows:	Flat, 2-piece design-top fixed toughened glass IS 2553 (Part-2)-1992/latest and the bottom portion sliding type	Confirm and provide dimensional and specs details
d	Glass specifications	Toughened glass IS2553(Part-2)-1992/latest	Confirm and provide dimensional and specs details, etc.at bidding stage.
	Glass thickness:	4.8-5.3mm	
e	Window & other glasses material specifications, thickness etc	Toughened as per IS 2553(Part-2)–1992/latest of 4.8-5.3 mm thickness	Confirm and provide dimensional and specs details, etc. at bidding stage.
f	Safety glass	As per AIS 052/CMVR	Confirm and provide dimensional and specs details
g	Rear view mirrors	As per AIS 052 & AIS 001/002	Confirm and provide dimensional and specs details
15.7	Seating and gangway etc.		

¹ IRT suggested laminated clear curved Glass 99 * 61 i.e. 2515mm*1550mm inches size with 8.76 mm thickness. It may be difficult to accommodate the said width of 2515mm within the bus width of 2600-50mm unless the glass is wrapped around, that would significantly increase cost and proneness to damage. Hence, IC suggested that the specified dimensions be maintained as size given by IC is generally as per UBS II to facilitate standardisation and thus ease of availability at minimum cost for replacement.

² IRT suggested laminated clear curved Glass 99 * 61 i.e. 2515mm*1550mm inches size with 8.76 mm thickness. It may be difficult to accommodate the said width of 2515mm within the bus width of 2600-50mm unless the glass is wrapped around, that would significantly increase cost and proneness to damage. Hence, IC suggested that the specified dimensions be maintained as size given by IC is generally as per UBS II to facilitate standardisation and thus ease of availability at minimum cost for replacement.

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
15.7.1	Passenger seating for non-AC type-II Deluxe buses	As per AIS 052	Confirm
a	Seat layout – type II DLX bus operations	2*2 adjustable reclining as per Type II deluxe buses in AIS 052	Confirm and provide dimensional details
b	Seat layout –	facing	Confirm and provide dimensional details
c	Seat area/seat space per Passenger (width*depth) mm	460*460 mm as per AIS 052	Confirm and provide dimensional details
d	Seat pitch - minimum in mm	825 mm as per AIS 052 for Type II Deluxe non-AC buses	Confirm and provide dimensional details
e	Minimum backrest height-from floor to top of seat / headrest	900mm as per AIS 052	Confirm and provide dimensional details
	Minimum Seat base height-distance from floor to horizontal front upper surface of seat cushion mm.	450± 50mm as per AIS 052	Confirm and provide dimensional details
	Seat back rest height in mm	375 mm	Confirm dimensions
f	Torso angle (degrees)	Minimum 15 as per AIS 052	Confirm
g	Seat materials	‘Poly Propylene Low Density / Low density Poly Ethylene (PPLD/LDPE’) moulded and or any other seat material for fully-built ready to install cushioned and upholstered finished seats complete with all the requisite features (adjustable, reclining, fitted with arm rests, folding table, etc.) called for in this doc. Ref AIS:023 & bus code for performance. Passenger seat frames behind rear right mudguard be provided with additional reinforcement	Confirm and provide dimensional and specs, make, model and other details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
h	Seat frame structure material where required:	Frame Structure of ERW steel tube or as in above paragraph.	Confirm and provide dimensional and specs details
i	Free height over seating position in mm	More than 900 as per AIS 052	Confirm dimensions
	Seat base height:	450± 50 as per AIS 052	Confirm dimensions
j	Clearance space for seated Passenger facing driver partition mm	AIS 052	Confirm dimensions
k	Seat cushion and Upholstery:	Seat cushion required as Polyurethane Foam, minimum thickness of front / rear ends of seat cushion/padding as 130/100 mm respectively; minimum thickness of back rest Foam cushion as 75mm; Upholstery – pile fabric / Jaccard of more than 0.7-1mm thickness. All above as per AIS 052 / UBS II	
l	Area for seated passengers (sq.mm.):	460*460	Confirm dimensions
m	Area for standee passengers (sq.mm.):	Ref Annexure I for ready ref. (As per AIS 052) – for assessing maximum number of standee pax that may be allowed in AIS 052 only for short distance travel in type II DLX buses	Confirm dimensions
n	Number of seats	Minimum 44	Confirm and provide no. of passenger seats
o	Number of standees (calculation as per AIS 052)	NIL However, ref Annexure I for ready ref. (As per AIS 052) – for assessing maximum number of standee pax that may be allowed in AIS 052 only for short distance travel in type II DLX buses	Confirm and provide no. of standees
p	Carrying capacity of bus (seated + standees) and crush load	Minimum 44, with crush loading of 70 passengers	Confirm and provide details
q	Seats side facing location	Not recommended	Confirm

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
r	Seat back rest	Reclining - adjustable	Confirm
	Seat belts & their anchorage	Not necessary except diver seat and those facing aisle (performance etc. as per AIS 052 and other applicable standards)	Confirm
s	Performance & strength requirements of:	√	
i	Driver seat	As per AIS 023	Confirm and provide dimensional and specs details
ii	Passenger seats	As per AIS 023	As per AIS 023
15.7.2	Gangway:		
a	Minimum interior head room (centre line of gangway) in mm	1900 mm including that in the rear overhang area as per AIS 052.	Confirm and provide dimensions
i	At front axle:	As per AIS 052	Confirm and provide dimensions
ii	At rear axle:		
iii	Other areas		
b	Gangway Width (mm) from gates to longitudinal space between rows of seats (Access to service doors)	i. minimum 650 mm (Refer figure-1 of UBS II/AIS 052)	Confirm and provide dimensions
c	Gangway Width (mm) in longitudinal space between rows of seats	Minimum 650 mm (Refer figure-1 in UBS II/AIS 052) excluding armrests and including stanchions- will be measured from seat edge to seat edge.	Confirm and provide dimensions
d	Driver's working space	As per AIS 052	Confirm and provide dimensions
	Driver's seat	As per AIS 023 & AIS 052	Confirm and provide dimensional and specs details
15.8	Corrosion prevention & painting	As per clause 3.17 of AIS 052 and details brought out in Part I	Confirm
a	Corrosion prevention treatment	As per clause 3.17 of AIS 052 and details brought out in Part I.	Confirm

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
	Internal surfaces of structural members		Confirm and provide process followed
	External surfaces of structural members		Confirm and provide process followed
	After drilling holes/welding		Confirm and provide process followed
	Inter metallic galvanic corrosion prevention		Confirm and provide process followed
b	Primer coating		Confirm and provide process followed and specs of primer coating used
c	Painting:		Confirm and provide process followed and specs of primer coating used
16	Electricals	Multiplexing provision for electrical circuitry	Confirm, type. Provide details and the drawings
16.1	Electrical cables:	BIS marked, copper conductors with fire retardant as per IS/ISO: 6722:2006 as per appropriate class. Conductor cross-section varying as per circuit requirements, minimum cross-section 0.5 sq mm. Quality marking may also be as per equivalent or better European, Japanese, US standards.	Confirm and provide details of specs, sizes, make etc. of each type of cable
16.2	Conductor cross section	As above and suitable to carry rated current (Japanese auto Standard JASO D0609-75 AV)	Confirm and provide details of specs, sizes, make etc. of each type of cable
16.3	Safety requirements of electrical	As per AIS 052 /UBS II	Confirm
a	Fuse	As per AIS 052 - fuse of rated current 1.5 times the load current of electrical equipment. Necessary in every electrical circuit	Confirm and provide details of specs, sizes, make etc.
b	Isolation switches for electrical circuits where	As per AIS 052- Isolation switch required for each such circuit	Confirm and provide details of specs, sizes, make etc.

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
	RMS value of voltage exceeds 100 volts		
c	Location of cables away from heat sources	As per AIS 052- Required for each such circuit	Confirm
d	Type approval of circuit diagram as per standards related to electric equipment/wiring	As per AIS 052 - Required for all items	Confirm and provide details along with relevant certificates
e	Cable insulation with respect to heat	As per AIS 052	Confirm and provide details etc.
f	Battery cut - off switch (isolator switch):	Heavy-duty type capable of carrying & interrupting total circuit load --1 each near battery/driver	Confirm and provide details of specs, make etc.
16.4	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	Confirm. Provide Make ----, model-----, specs--- of wiper motors and its subsystems
a	Wiper motor:	Speed control with time delay relay as per AIS 011.	Confirm. Provide Make ----, model-----, specs--- of wiper motors and its subsystems
b	Wiper arm/blade:	AIS011 /AIS 052	As above wrt arms / blade
16.5	Driver cabin fan	1 number, 24 volts, 200mmdia fan as per provision of CMVR, matching interiors	Provide Make ----, model-----, specs--- of fan
16.6	Lighting - internal & external and illumination	As per AIS 052.	Confirm and provide details of lighting / illumination
16.7	Illumination requirements/performance of:	As per AIS 052 / AIS 012	
a	Dash Board Tell-tale	As per AIS 052 & bulbs tested for photometry as per IS 1606:1996	Confirm and provide details of specs, wattage, make etc.

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
	lighting/control lighting		
b	Cabin Lighting - luminous flux of all lamps for cabin lighting	As per AIS 052 with illumination level of ≥ 100 lux & ≤ 200 lux	Confirm and provide details of specs, wattage, make etc.
c	Passenger area lighting - luminous flux of all lamps for Passenger area lighting	As per AIS 052 with illumination level of ≥ 100 lux and ≤ 150 lux	Confirm and provide details of specs, wattage, make etc.
17	ITS enabled bus	As specified separately under ITS chapter of UBS II specifications / and or by ITS Consultant and generally as brought out at Para 32 in Part I. Additionally Mobile / lap-top / ETVM chargers be provided at conductor seat and at every passenger seat. GPS and Vehicle tracking system	Confirm details
18	Safety related items:		
18.1	Driver seat belt & anchorage duly type approved.	Adjustable type driver seat with seat belt ELR recoil type, 3 point mounting as per CMVR & AIS 052 conforming to AIS: 005&015.	Confirm and provide details of specs, type, make etc. of seat belt and anchorage
18.2	Passengers seat belts:	Not necessary except diver seat, for seats facing gangway if any (performance etc. as per AIS 052)	Confirm
	Number:		
18.3	Driver/Passenger / wheelchair Seat Belt Anchorage		
18.4	Fire extinguisher:	As per AIS 052	Provide Make -----, model-----, specs--- of fire extinguishers
18.5	First aid box:	1 number, as per provision of CMVR	Provide Make -----, model-----, specs--- of first aid box and its contents.
18.6	Handrails Minimum length*diameter * height above floor in mm	Colour contrasting and slip resistant of aluminium tubing 32 mm dia, 3 mm thick.	Confirm and provide details of specs, size make etc.

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
18.7	Handholds:	Colour contrasting and slip resistant. 2 to 4 Numbers. hand holds per bay of poly-carbonate transparent with provision for advertisements	Confirm and provide details of specs, sizes, make etc.
18.8	Stanchions:	Vertically fitted, to floor at bottom end and to the roof at top end, aluminium tubing with Colour contrasting and slip resistant. 40 mm dia& 3.15 mm thick. Rest As per AIS 052.	Confirm and provide details of specs, sizes, make etc.
18.9	Bells for Passenger convenience	High visibility bell pushes shall be fitted at a suitable height (≥ 1.2 metre on all/ alternate/convenient stanchions keeping in view convenience of passengers and avoidance of un-necessary/ inadvertent operation by passengers. These would assist PwDs and all other passengers	Confirm and provide details of specs, sizes, make etc.
18.10	Security Cameras	One rear camera for bus reversing and at least two cameras in the passenger cabin area as per the specifications / supplies made by the ITMS service provider. One more camera in front of Driver to capture vehicle front side blind spots coverages	Confirm and provide details of specs, sizes, make etc.
18.11	Window Guardrails:	As per AIS 052.	Confirm and provide details of specs, sizes, make etc. where provided
a	In all type II DLX buses - minimum numbers.		
b	Other details:		
i	First guard rail at a height from window sill in mm		
ii	The distance between two guard rails in mm		
18.12	Entrance/Exit Guard/Step well guard:	800 mm minimum height extending ≥ 100 mm more than centre line of sitting position of the Passenger.	Confirm and provide details of specs, sizes, etc.
18.13	Emergency exit doors, warning devices etc.	As per AIS 052/CMVR	Confirm and provide details of specs, make etc.
18.14	Front/rear door, stepwell lights, door open sign	LED as per AIS 008	Confirm and provide details of specs, wattage, make etc.

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
18.1 5	Mirrors right/left side exterior / interior:	Convex as per AIS 001 & 002. Interior with double curvature	Provide Make ----, model-----, specs--- of rear-view mirrors
18.1 6	Towing device front and rear	Heavy duty for loads of 1.2 times (minimum) the kerb weight of the bus within 30° of the longitudinal axis of the bus. As per CMVR & IS 9760 - ring type	Confirm and provide dimensional and specs details
18.1 7	Warning triangle	As per AIS 052/CMVR	Provide Make ----, model-----, specs--- of warning triangle
18.1 8	Bumpers - front and rear	Both made of Steel or impact resistant polymer or combination of both meeting requirement of an energy absorbing system. Impact strength as per AIS 052	Confirm and provide details of specs, sizes, make etc.
	Impact strength for bumpers	Meet requirements of Para 6.3.1 of AIS 052	Confirm and provide details of impact strength etc. Should Para 6.3.1 of AIS 052 not give any values, test standard and or test procedure. VM would hence be required to provide above details at the time of pre-bid meeting.
19	Miscellaneous items/requirements		
19.1	Windows		
a	Type of window	Windows - two piece in non-AC type II DLX buses, where top portion, would be fixed and bottom portion would have sliding glasses. Minimum window glass/aperture area (main windows) in cm ² 14000. Toughened Glass of thickness 4.8-5.3 mm	Confirm and provide details of specs, sizes, make etc.
b	Minimum height of window aperture (clear vision)	≥ 950 mm	Confirm and provide dimensions

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
c	Minimum height of upper edge of window aperture from bus floor	As per AIS 052	Confirm and provide dimensions
d	Minimum width of windows (clear vision zone)	As per AIS 052	Confirm and provide dimensions
19.2	Cabin and under chassis Luggage Rack inside the bus and under chassis / rear end Luggage Carrying facility with accessibility	Cabin luggage racks (350 width from side wall*250 mm height) on both side walls. Additionally, luggage carrying space be provided under the chassis on sides as also at the rear end of the bus with adequate access. Maximum luggage space be provided under the bus floor area. Additional luggage space may also be provided as a Diggy at the rear end of bus	
19.3	Life cycle requirements of bus (whichever is earlier)	9 years or 12,00,000 km, which-ever is earlier.	Confirm and provide details of mechanism of assessing life of buses
20	Additional requirements		Additional requirements
a	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	
		Driver's work area to be provided with a 200 mm diameter 24 V fan to ensure proper ventilation. The fan to have 3 – speed adjustment	Confirm and provide details of make, model and rating of fan.
b	Folding table for each seat	√	Confirm and provide details
c	Magazine pouch	√	Confirm and provide details
d	Adjustable foot rest	√	Confirm and provide details
e	Back rest adjustment knob in case of reclining seats	√	Confirm and provide details
f	Individual seat reading light	√	Confirm and provide details

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
g	Vehicle Tracking System	Complete with GPS / on board Microprocessor etc.	
21	Noise, vibration and harshness etc		Confirm and provide details
a.	Maximum noise levels inside the saloon-test procedure as per AIS 020	81dba	Confirm and provide details
b	Noise Vibration and Harshness levels when measured under driving conditions during operations in designated area roads with pot holes and speed breakers, etc	<ul style="list-style-type: none"> Vibration levels / Noise, vibration and harshness (NVH) levels (interior): - Noise level in saloon from drive axle, etc.: Nil - Dominant frequencies to fall outside the ranges of: 0.5-1 Hz, 5-7 Hz and 18-20 Hz • Transient vibration level in seating area maximum:1g • Transient vibration level at driver seat maximum:0.1g • Vibration levels at driver/Pax seats (metre/sec²) ≤ 0.5 • Vibration level in gangway (metre/sec²) ≤ 1 	
22	Fire Detection and Suppression System (FDSS)	<p>An automatic fire detection & Suppression system be essentially provided for engine and other fire sensitive areas of the bus. Possibility of provision of FDSS for entire bus including but not limited to engine area, drive line, fuel tanks, fuel filling point and fuel distribution lines / cluster, wheel wells, electrical systems etc.</p> <p>Additionally fire extinguishers as per AIS 052 be provided</p>	FDSS provided for: - Name all systems, sub-subsystems; Indicate type, make & model of provisions in each case
a	Fire Condition Monitoring device	Pneumatic Electronic Linear fire detector with stainless steel tube with suitable diameter	Make and model of the fire detector; Dia. and specs of SS tubing;
b	Components for Fire Condition Monitoring Device		
i		Detector operating on rate of rise with Advanced Built in Test Module.	Make, model & specs;

S No	Description	Specifications	Bidder to confirm and provide details
		Standard 12 metre long, 1150mm floor height, type II DLX buses	
ii	Generally, as per UBS II, AIS 135, CMVR	Stainless steel Tube sensor with suitable diameter and should be rodent free	Specifications and relevant documents be provided
c	Detector Specification/ requirements: Generally, as per UBS II, AIS 135, CMVR (if any)	Detector should operate with Rate of Rise along with advanced Built-in Test Module that indicates failure in the event of reduced performance over the entire range of sensor tube.	
i	IP Rating	IP67	
ii	Enclosure	Aluminium	
iii	Operational Temperature Range	-40°C to +125°C	
vi	Shock & Vibration:	Should comply t: BS EN 61373, Table 1,2,3 MIL STD- 810:501.4, 516.5.4.	
v	Sensor Tube	1 Mtr. to 100 Mtr. in length. Stainless steel material with suitable diameter.	
vi	Operating Voltage:	18 - 32 V DC	
vii	Alarm Current:	40mA	
23	General		Confirm
a	Capacity of the Fire suppression system for each of the different areas	--- as decided by the Vehicle Manufacturer	Confirm
b	Material of Construction	VM to decide optimal materials and the containers for fire supersession for each of the fire sensitive areas of the Bus.	Confirm
c	Fire suppression system trigger mechanism for each of the fire prone areas	Pneumatically/ mechanically / electro-mechanically and or any other mechanism Operated	Confirm
d	Powder (if any used)	UL listed ABC 90%	Confirm

Annexure I to Part II above

A system of assessment of standee capacity in the bus: Standee spaces available in the bus

Formula for calculation of number of seats and number of standees permitted.

Dimension	Description	Area (In mm ²)
Area of the Driver Compartment	Width x Depth of Driver Work Area	Ad
Total projected Step Well Area (all stepwells)	Sum of projected Area of all Step Wells	As
Projected area of Engine	Width x Length of Engine projected on the floor Area	Ae
Area of any part of the Vehicle where vertical clearance is less than 1350 mm (Engine etc.)		Aw
Area required to provide a clear work area at service floor area occupied by any stair case		Ast
Area of parts where clear height above floor level less than 1900 mm (1750mm in case of mini bus)		Ac
Area of seat in facing partition	(300 mm x Total seat width)	Ap
Area of the parts where slope exceeds the maximum specified value for purpose of passengers		Asl
Total Area excluded for purpose of calculating seated passenger capacity	Sum (Ad+As+Ae+Aw+Ag+Ast+Ap)	Aex
Area of Gangway		Ag
Total internal Floor Area	Internal Width x Internal Length	Aint
Area for seated Passengers	Aint-(Aex+Ag)	Apass
Area for standee passengers	2Ag – (Ac + Asl + 150mm x Length of Gangway)	Astd

Note: Value of Astd is the solution of following three equations –

$$Aex = Ad + As + Ae + Aw + Asl + Ag + Ast + Ap$$

$$Apass = Aint - (Aex + Ag)$$

$$Astd = Aint - (Ad + As + Ae + Aw + Ast + Ac + Ap + Asl + Apass + 150\text{mm} \times \text{Length of Gangway})$$

Formula for calculation of seating and standee passenger areas

Dimension	Description	Result
No of Seats permitted	$Apass / (\text{seat pitch} \times \text{Seat Width})$	No. of seats
No of Standees permitted	$Astd \times 5 \times 10^{-6}$	No. of Standees

Annexure II – A copy of bus code AIS 052

Annexure III – An indicative list of materials to be tested

Annexure III: Indicative list of items to be tested		
S No	Items to be tested	Specifications
1	CR Tubular sections	BIS:4923-1997 (or latest) of Grade Yst.-240
2	Phosphating / Galvanizing	BIS:3618-1966 (or latest) Class A-2 for Phosphating & BIS:277-2003 or latest - 120 gsm for Galvanizing (Zinc Coating) and two weeks (336 hours) Salt Spray Test for both in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%.
3	EPDM Rubber	As per AIS 085
4	Glasses Laminated	BIS: 2553 (Part-2)-1992 (or latest) Float Glass, Front 'AA' Grade Glass, PVB Film in Laminated Glass.
5	Aluminum Parts	IS:733-1974 (or latest) for Solid Part, IS:1285-1975 or latest for Extruded Round Tube & Hollow Part and IS:738-1977 or latest for Drawn Tubes, Alloy 63400, tempering WP.
6	Paint	PU Paint as per relevant IS: 13213:1991 (or latest) & any other relevant BIS Standards. For Matt Black Paint the Gloss Value is up to 30 units.
7	LT Wire	BIS: 2465-1984(or latest). DIN 72551- Dimensional Test JIS C 3406- Spark, Immersion & Conductor Resistance Test' SAE recommended J 1127 & J 1128
8	Aluminium Sheet	BIS:737-1986(or latest), Aluminium Alloy H-2/31000
9	CR sheets	BIS:513-2008(or latest)
10	GI Sheets	BIS:277-2003 (or latest), Class-VIII Medium Coating of Zinc Nominal Weight 120 grams/M2.
11	Passenger Seat Assembly	As per AIS-023, Bus Code & BIS Standards. For MS components two weeks (336 hours) Salt Spray test for both in accordance with ASTM procedure B117 with no structural detrimental effect to normally visible surfaces & no weight loss of over 1%.
12	Marine Board / Board / another floor material	BIS: 710-1976 (or latest) IS:5509-2000 (or latest) for Flammability.

Annexure IV – Specifications for Intelligent Transport System (ITS)

Functional Specifications for ITS		
#	Parameter	Specifications
AVLS		
1	Single Controller Unit (SCU)	<ul style="list-style-type: none"> The route programming file upload capability should also be catered through SD card/USB port to support redundancy Route selection function is to be provided on BDC with easy sorting of routes Integration with BDC through latest interface mechanism. The Controller Unit shall have a time-of-day clock and calendar. The time and date shall be synchronized as per IP based timing protocol (configurable) with the central software time. Local battery backup for minimum half hour for the smart start and shutdown of the SCU.
2	Bus Driver Console	<ul style="list-style-type: none"> All driver related route information to be displayed on BDC In-built light sensor with continuously variable brightness control to enable the display intensity to change based on ambient light conditions. BDC supports the following functions: <ul style="list-style-type: none"> Driver login & logout Route selection Route start Automatic Bus Stop Announcement Manual Bus Stop Announcement Special Announcements PA- Passenger Announcements Two-way voice communication SMS Messaging Emergency alarms 4 section camera views to be supported on BDC after cameras are installed in future.
On-Board Display Units		
1	Viewing distance	<ul style="list-style-type: none"> Front, side and rear signs 50 metres minimum, for single line text, in day and night. Inner 15 metres minimum, for single line text in day and night.
2	Display Characteristics	<ul style="list-style-type: none"> Fixed, scrolling and flashing mode (with fixed route number, up to minimum 40 characters for scrolling mode, on front, side and rear signs). Capability to show customized graphics. Scrolling Two lines - English followed by Tamil and then local language. Total display height should accommodate two lines and the individual heights of each line should be adjustable to enable one line to be larger/smaller than the other line. However, during next stop announcement only single line text is required It should be possible to display, concurrently, different messages on each of the signs (front, rear, side and inner).

Functional Specifications for ITS		
#	Parameter	Specifications
		<ul style="list-style-type: none"> It should be able to display special signs like signs for 'PWD enabled bus', 'ladies special'. Capability to show special characters like (, “, ! + - * : ?) Signs should have ability to retain the last message displayed in the memory of the sign even in the event of power failure and without the message being reloaded. Display and voice announcement in English, Tamil and other local languages The display systems shall have in-built test facility, able to carry out self-check at periodic intervals, carry out exchange of diagnostic information from the central control stations including power availability, its current status etc. The display system shall support remote settings such as display intensity, time synchronization etc. PIS displays shall be managed locally without workstation or server.
3	Hardware Programming Capabilities	<p>The hardware to be procured shall have minimum below system programming capability;</p> <ul style="list-style-type: none"> The system should enable driver to communicate via audio call to the control centre. The system should enable driver to send out from a list of pre-defined messages to the control centre Support minimum 3000 routes UP and DOWN (Average 10 stops per route) of signboards supplied. GPS triggered next stop display on Inner sign with synchronized voice announcement on each route. The system should be able to specify geo-fence boundary individually and collectively for next, upcoming and current station announcements. The current stop announcement should be correct to 5 metres. The inner sign should be able to display and announce up to three languages, one after the other in sequence. For example, make display an announcement in English, then Tamil and then any local language Display driver and conductor ID once in between the stops on Inner sign Inner sign should be able to display text and customized graphics and announce pre-recorded messages on SCU(OBU) display panel of the controller. The system should have provisions to add more text and audio messages. Functionality of Display 'clock'-GPS based or 'Default Messages' on Inner sign Emergency 'stop' request function- by pressing an emergency switch placed anywhere in the bus the inner sign should display 'stop' message

Functional Specifications for ITS		
#	Parameter	Specifications
		<p>and buzzer located near the driver makes the sound alerting the driver to stop the bus.</p> <ul style="list-style-type: none"> • In case one or more signs get disconnected (malfunction), the rest of the signs should continue to function regardless (including fresh communication from SCU) • Sign should be able to store 'Diagnostic Trouble Codes' (DTC)', 'Parameters Identifiers (PID) and with retrievable data. • The system should be capable of raising alarms based on vehicle statistics (engine overheating, low fuel, etc.) • The route programming files, stops, messages, etc should be updated to the on-board unit over USB, Ethernet, Wi-Fi, etc. from Server (at least one online method and one offline method provision to be given). • The system should allow the control centre to view the route selected by driver. • It should be possible to change/choose/select a 'route' remotely over the air from Operations Control Centre. • All SCUs (OBU) should connect in real-time to the central system via GPRS, 4G and above, Wi-Fi, etc. • All firmware updates to the OBU should be via USB, Ethernet, W-Fi and OTA. • PIS displays should be capable to be managed locally without workstation or server. • The SCU shall have the capacity to store static information in the display controller (including schedules), which shall be shown if the communication link is lost and after real-time information expires. • The proposed hardware should be able to provide backend software capability to <ul style="list-style-type: none"> ○ Assess the status of a running vehicle in terms of on-time, delayed and early arrival by comparing with schedule • Generate Reports in terms of <ul style="list-style-type: none"> ○ GPS outage, loss of connectivity and their frequencies and durations ○ Missed trips, missed stops, route violation, un-scheduled stoppage, late start, etc. for performance analysis. <p>Driving patterns, over-speeding, harsh braking, etc.</p>
PA System		
1	Public Announcement (PA) System	<p>The Voice PIS must play clearly audible pre-recorded voice announcements (in three languages) informing passengers of next bus stop on route. The voice PIS shall interface with the on-bus GPS module to gather location information and making the appropriate next station announcement.</p>

Technical Specification for ITS - AVLS Hardware (SCU/OBU, BDC and On board Panic Button)		
#	Parameter	Minimum Specifications
I	Single Controller Unit (SCU) / On-Board Unit (OBU)	
1.	Certification	Compliant to IS 16833 or UBS-II
2.	Operating Voltage	9 to 36 V DC
3.	Surge Protection	Enabled
4.	Power source	Connected to vehicle key-on/ignition-on
5.	Interface	CAN 2.0/ OBD II, RS 485, RS 232, fast Ethernet, USB, digital outputs, digital/Analog inputs, WLAN, audio input output, amplified audio output
6.	Communication	4G or above, Wi-Fi
7.	Protection	IP 65 or above as per UBS II or IP 54 as per IS 16833
8.	Temperature	-10° C to + 70° C
9.	Humidity	5% to 95 %
10.	Vibrations	10g
11.	Operating System	Embedded windows/Linux or similar (Latest version) (Windows 7 or latest at the time of calling the tenders)
12.	Processor	64-bit low power Industrial grade outdoor processing unit
13.	Memory	Flash: Min 4 GB, RAM: Min. 512 MB (RAM memory includes SCU (OBU) and BDC).
14.	Storage	Provision for 512 GB HDD (256 x2 GB – SSD) card and support up to 1 TB. OBU shall support at least 7 days of recording for all bus camera.
15.	GPS	In built GPS, 4G and above (GSM) modules
16.	Antenna	Combi antenna using RG174 cable. The connectors on Combi antenna will be preferably SMA(M) ST plug type for GPS and FME(F) jack type 1/4"-36UNS-2B for 4G and above
17.	Audio Storage and playback	<ul style="list-style-type: none"> In-built MP3, WAV, etc. files storage/playback function.
18.	Microphone Input and Audio Output	In built two channel amplifiers minimum 10 Watts rms each suitable for 4 ~8 Ohm impedance with input for external microphone
19.	Power Supply	Power to SCU (OBU) and BDC will be supplied through power-back external battery and subsequent bus multiplexing wiring system
20.	mNVR capabilities	Should have inbuilt or integrated capabilities for a SCN System as per UBS II guidelines or IS 16833 for future requirements where the system shall consist of High-Resolution cameras for Video and Audio recordings for monitoring purposes
II	Bus Driver Console (BDC)	
1.	Operating Voltage	9 to 36 V DC (preferable through SCU(OBU))
2.	Connectivity	Power/data connection to Single Controller Unit
3.	Protection	IP 65 or above as per UBS II

Technical Specification for ITS - AVLS Hardware (SCU/OBU, BDC and On board Panic Button)		
#	Parameter	Minimum Specifications
4.	Mounting	Theft/vandal proof
5.	Temperature	-10° C to + 70° C
6.	Humidity	5% to 95 %
7.	Vibrations	10g
8.	Display	Full colour graphic TFT - Min 640 x 480 dots, Size Min. 8"
9.	Viewing Angle	60 H / 70 (right/left) / 60 V / 70 (up/down)
10.	Backlight	Adjustable
11.	Keyboard	Display with physical keys OR Full touch screen with user friendly interface for navigation, scrolling, route destination code selection, etc.
III	GPS modules	
1.	Rating:	22 tracking/66 acquisition minimum
2.	Tracking sensitivity	(-) 165 dBm typ
3.	Navigation sensitivity	(-) 148 dBm typ
4.		<ul style="list-style-type: none"> • Update rate 1 Hz (configurable to 10 Hz) • Time to first fix cold acquisition 35 seconds typ • Hot acquisition 1 second typ. • Navigation accuracy 3M horizontal
IV	4G and above (GSM) modules	
1.	GSM/GPRS	GSM/GPRS SMT quad band and UMTS (4G and above)
2.	Data Acquisition and Transmission	Specifications as per AIS 140 standards. The detailed list of configurable data fields is provided in Annexure below
3.	Temperature	Temperature range -10° C to + 70° C
V	'Combi' Antenna	
1.		AMPS 850MHz, GSM900MHz, ISM868MHz, DCS1800MHz, PCS1900MHz, 4G UMTS 2.1GHz, Wi-Fi /Blue Tooth (2.4 GHz), GPS (1575.42MHz). Separate WLAN antenna may be provided if necessary.
2.	GPRS	<ul style="list-style-type: none"> • Impedance 50 Ohm • Radiation pattern Omni-directional • Polarization linear (vertical)
3.	GPS	<ul style="list-style-type: none"> • Impedance 50 Ohms • VSWR <1.5:1 • Polarization RHCP
4.	Waterproof	Waterproof IP-66
VI	On-board Panic Button	

Technical Specification for ITS - AVLS Hardware (SCU/OBU, BDC and On board Panic Button)		
#	Parameter	Minimum Specifications
1.	Power Supply	9 to 36 V DC
2.	Connectivity	Serial/digital input to SCU(OBU)
3.	Protection	IP 65 or above
4.	Temperature	-10° C to + 60° C
5.	Humidity	5% to 95 %
6.	Vibrations	10g
7.	Use	Easy to press
8.	Placement	Convenient placement. Prevent accidental trigger
9.	Mounting and Casing	<ul style="list-style-type: none"> Unit should be fixed securely at the chosen position The casing should be theft proof, tamper proof and vandal proof All fixtures and mounting should be certified by qualified structural engineers for capability to withstand vibrations and fixture safety

On Board Display Units and Announcement System		
#	Parameter	Minimum Specifications
I	Front Outer LED, Rear Outer LED, Inner LED, Side LED	
1.	Certification	UBS II certification
2.	Route Board Sizes	<ul style="list-style-type: none"> Front Outer LED - minimum 1800X220 mm Rear Outer LED - minimum 900X220 mm Side Outer LED - minimum 900X220 mm Inner LED - 800X100mm
3.	Operating Voltage	9 to 36 V DC
4.	Power Consumption	1 Amp. @ 24 V DC
5.	Surge Protection	Enabled
6.	Connectivity	RS 485 or similar
7.	Protection	IP 65 or above
8.	Temperature	-10° C to + 70° C
9.	Humidity	5% to 95 %
10.	Vibrations	10g
11.	Firmware	Firmware update and version check through controller
12.	Colour	Single colour (Amber, can vary)
13.	Viewing Angle	Minimum 120 H / 60 V
14.	Intensity	Continuous variable brightness control
15.	Viewing Distance	50 m, Inner 15 metres minimum, for single line text in day and night
16.	Memory	Ability to retain last displayed message

On Board Display Units and Announcement System		
#	Parameter	Minimum Specifications
17.	Display Modes	Fixed, scrolling, flashing
18.	Mounting	<ul style="list-style-type: none"> All units should be fixed securely at the chosen position The casing should be theft proof, tamper proof and vandal proof All fixtures and mounting should be certified by qualified structural engineers for capability to withstand vibrations and fixture safety
19.	Display Language	Two Lines multi-language display capability (English, Tamil or other language as indicated.)
II Announcement System		
1.	Coverage	The announcement system should provide uniform coverage throughout the vehicle at optimum decibels by use of multiple speakers placed for equal sound distribution
2.	Speakers	at least 6
III Passenger Announcement (PA) System		
A	Microphone	
1.	Frequency Response	200 – 8000 Hz
2.	Sensitivity	2.3mV/Pa
3.	Impedance	500Ω
4.	Coiled Cord	1.8 – 2.5 m
B	Speakers	
1.	Nominal Impedance	4E ± 15%
2.	D.C Resistance	3.7 ohms
3.	Resonance Frequency	170 Hz ± 20%
4.	Frequency Range	Fo~ 20KHz
5.	Sound Pressure Level	90dB ± 2dB @300,400,500,600Hz
6.	Buzz & Rattle test	6.99 V
7.	Rated Input	15-Watt, Maximum Input: 20 Watt

Bus Security Network Camera		
#	Parameter	Minimum Specifications
I Reverse Parking Sensor Camera		
1.	Power Supply	PoE through BDC .should be automatically switched on with engine and power down on ignition off.
2.	Fixed lens	3.6 mm
3.	Picture Resolution	752 H x 582 V (PAL)
4.	Resolution	25/30fps@1080P
5.	Picture Sensor	1/3" 2 Megapixel progressive scan Aptina CMOS,
6.	IR distance	Min 30 m
7.	Image Enhancement	DWDR, Day/Night(ICR), 3DNR,AWB,AGC,BLC

Bus Security Network Camera		
#	Parameter	Minimum Specifications
8.	Protection	Minimum IP 66
9.	Temperature	-10 deg C to + 60 deg C
10.	Humidity	5% to 95 %
11.	Vibrations	10g
12.	Camera Ruggedness	<p>Rugged, vibration, shock and tamper proof Metal housing, Aviation Connectors</p> <p>Installation :Anti Vibration with Adjust Angle;</p> <ul style="list-style-type: none"> Horizontal: 0~355 degree with 3-point locking Vertical:0~90 degree with 2-point locking
13.	Function	Camera should engage with the reverse gear engage on buses and display the back-view of the bus on BDC display to the driver. Camera should make alert to the driver based on the distance from the objects while reverse the bus.

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
Telematics System		
1	Telematics Parameters	<p>As per UBS II guidelines, the data from multiplexing nodes, on a single CAN 2B (J1939) bus should include parameters from:</p> <ol style="list-style-type: none"> Vehicle electrical system powered through multiplexing nodes Vehicle safety and performance features Engine and transmission Diesel bus electronics data
1a	Vehicle electrical system	All external and internal fixtures like passenger/driver compartment illumination and ITS equipment
1b	Vehicle safety and performance features	<ul style="list-style-type: none"> Fuel /Oil level/ Pressure Fuel Level Indicator System (in Litres) - Display in Dashboard Braking pedal position Accelerator pedal position and kick down Brake pad condition and brake pedal temperature (in case of electronically controlled disc brakes) Door interlock Kneeling interlock (wherever provided) Gas leakage detection (wherever provided) Fire detection/suppression (wherever provided) Tyre Pressure Monitoring System (To ensure Tyre Air Pressure and Tyre Temperature in each wheel) Tubeless Tyre -Parameters (like Pressure, skid indicators)

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
		<ul style="list-style-type: none"> Battery Health condition monitoring System
1c	Engine	<ul style="list-style-type: none"> Engine CAN status Engine oil pressure Engine coolant temperature Engine speed in RPM Vehicle speed (torque) Diagnostic message (engine specific)
1d	Transmission	<ul style="list-style-type: none"> Transmission CAN status Transmission output shaft speed Transmission input shaft speed Transmission current gear Transmission oil filter restriction switch Transmission oil life remaining Transmission service indicator Transmission sump oil temperature Transmission oil level high / low Hydraulic retarder oil temperature Accelerator pedal Diagnostic message (transmission specific)
1e	Diesel bus electronics data	<ul style="list-style-type: none"> Drivers demand of engine torque percentage Actual engine torque percentage Engine and retarder torque Engine speed Source address controlling device Engine starter mode Engine demand torque percentage Accelerator pedal 2 low Idle switch Road speed limit status Accelerator pedal kick down switch Accelerators pedal low Idle Switch Accelerator pedal position Percent load at current speed Remote accelerator pedal position Accelerator pedal position 2 Vehicle acceleration rate limit status Engine temperature

Functional & Technical Specifications for Telematics System		
#	Parameter	Specifications
		<ul style="list-style-type: none"> Engine coolant temperature Fuel temperature Engine oil temperature Turbo oil temperature Engine intercooler temperature Engine intercooler thermostat opening Engine fluid level pressure Fuel delivery pressure Extended crankcase blow by pressure Engine oil level Engine oil pressure Crankcase pressure Coolant pressure Coolant level Coolant level, Coolant Condition (% of Ethylene Glycol) Alternator (Volt) Output monitoring System
1f	Connector	<ul style="list-style-type: none"> CAN 2.0 (J1939 Connector) / OBD-II Connector
1g	Communication	<p>Telematics System (VHMD) real time warning to CCC</p> <ul style="list-style-type: none"> Open public communications network services (4G and above) and download compatibility <p>Telematics System (VHMD) end of the day to depot</p> <ul style="list-style-type: none"> IEEE 802.11 Wireless LAN (Wi-Fi) via 'Back haul' at depot

Testing Standard Compliance		
#	Test standards compliance	Specifications
1.	Performance parametric test	Nine points, tri temperature/tri voltage- 18V, 27V, 32V, -25°C, room temperature, +85°C test. At each test point the system will be powered on and shut down 5 times as per the supplier's designated procedure and thereafter evaluated for malfunction if any
2.	Cold	IS 9000 (Part II/Sec 4)-1977 (reaffirmed 2004) at -25°C for 2 hours in 'on' condition
3.	Dry heat	IS 9000 (Part III/Sec 5)-1977: PIS Signs, SCU(OBU) and Nodes at + 80°C for 16 hours in 'on' condition. BDC at + 80°C for 2 hours
4.	Damp heat	IS 9000 (Part V/Sec 2)1981 at +25°C /+55°C, Humidity 95%, 24 hours for 6 cycles in off condition. Functional test with power in 'on' condition at start of 2nd, 4th and 6th cycle
5.	Vibration standard AIS 012/AIS:062 -10g	<ul style="list-style-type: none"> Frequency 5~50Hz and return to 5Hz at a linear sweep period of 1 minute/complete sweep cycle and 10g at maximum frequency

Testing Standard Compliance		
#	Test standards compliance	Specifications
		Excursion -1.6 mm peak to peak over the specified frequency range Test duration 60 minutes <ul style="list-style-type: none"> Direction of vibration –X, Y, Z axis of device as it is mounted on the vehicle.
6.	Dust and water ingress protection	IS /IEC 60947-1:2004 in conjunction with IS/IEC 60529:2001– ‘PIS signs’ IP66, ‘SCU’(OBU) IP 65, ‘BDC’ IP65, ‘nodes’ IP54
7.	Free fall	IS 9000 (Part VII/Sec 4) Free fall at 500 mm, (applicable to ‘nodes’ and ‘controllers’ only)
8.	Fire resistant	Regulation directive 95-28/EG dated 24-10-1995 horizontal Burning rate tested as per ISO 3795, Horizontal burning test HB as per UL 94 -1998 clause 7 (for wire harness)
9.	Reverse polarity protection without fuse	The component must fulfil the function- and service life requirements after being subjected to reversed polarity up to 27 V for 2 minutes.
10.	Over voltage protection	To ensure service life requirements and functionality. The component shall run for 60 minutes at 38V, without effecting the service life or function.
11.	Insulation resistance	The Insulation resistance measured as per ISO 16750-2 with a voltage of 500 V dc shall not be less than 1Mega ohm.
12.	Cranking voltage	The components shall have an electrical energy reserve that can handle voltage drop during cranking. Component shall not reset during cranking- ‘FSC B’. The supply voltage during crank is 18.0 V for 40 ms. The test to be carried out as per ISO 7637
13.	Load dump test on controller	123V ,8 Ohms 200ms pulse 5a as per standard ISO 7637-2
14.	Salt spray test	(AIS: 012/ IS10250) 96 hours
15.	EMC/EMI	1.Electromagnetic radiation, radiated immunity and compatibility as per AIS 004 (Part 3) or 2.72/245/EEC last amended by 2009/19/EC (includes 2004/104/EC, 2005/83/EC, 2006/96/EC) and UN ECE Regulation Number 10 Rev 3:2008 Note: In case of product is ‘e’ marked and a detailed test report is submitted (which includes above tests) no fresh verification is necessary
16.	Operating parameters	Supply voltage 24 V± 25%
17.	LED colour test – dominant wavelength amber	AIS -012
18.	LED chromaticity coordinates	Limit towards green: $y \leq x-0.120$ Limit towards red: $y \geq 0.390$ Limit towards white: $y \geq 0.790-0.670x$

Testing Standard Compliance		
#	Test standards compliance	Specifications
		In accordance with CIE 127 condition B
19	LED bulb/SMT intensity and viewing angle	In accordance with CIE 127 condition B

Test compliance as per IS 16833	
#	Tests
1.	Performance parametric test (Tri Temperature / tri voltage)
2.	Shock and Vibration test
3.	Ingress protection (IP)
4.	Over voltage protection test
5.	EMI/EMC test
6.	Load dump test, Pulse 5a
7.	Reverse polarity protection without fuse
8.	Test for wiring harness
9.	High temperature test
10.	Cold Test
11.	Damp heat test
12.	Insulation resistance test
13.	Thermal shock test
14.	Salt spray test
15.	High voltage test
16.	USB port overloading test
17.	Endurance test
18.	Free fall test
19.	Protocol testing

Annexure V – Indicative List of Data Types and Packet Format for Onboard ITS for Integration with Backend Systems

#	Required Data Field	Descriptions
1.	Start Character	\$
2.	Header	The header of the packet/ identifier
3.	Vendor ID	Vendor identification header
4.	Firmware Version	Version details of the Firmware used in EX.1.0.0
5.	Packet Type	Specify the packet type <ul style="list-style-type: none"> • NR = Normal • EA = Emergency Alert • TA = Tamper Alert (Optional) • HP = Health Packet • IN = Ignition On • IF = Ignition Off • BD = Vehicle Battery Disconnect • BR = Vehicle Battery Reconnect • BL = Internal Battery Low
6.	Packet Status	L=Live or H= History
7.	IMEI	Identified of the sending unit. 15-digit standard unique IMEI no
8.	Vehicle Reg. No	Mapped vehicle registration number
9.	GPS Fix	1 = GPS fix OR 0 = GPS invalid
10.	Date	Date value as per GPS date time per GPS date time (DDMMYYYY)
11.	Time	Time value as per GPS date time in UTC format (hh:mm:ss)
12.	Latitude	Latitude value in decimal degrees (not less than 6 places)
13.	Latitude Dir	Latitude Direction. Example N=North, S= South
14.	Longitude	Longitude value in decimal degrees (not less than 6 places).
15.	Longitude Dir	Longitude Direction. E=East, W= West
16.	Speed	Speed of Vehicle as Calculated by GPS module in VLT. (in km/hrs.) (Up to One Decimal Value)
17.	Heading	Course over ground in degrees
18.	No of Satellites	Number of satellites available for fix
19.	Altitude	Altitude of the device in metres
20.	PDOP	Positional dilution of precision
21.	HDOP	Horizontal dilution of precision
22.	Network Operator Name	Name of Network Operator
23.	Ignition	1= Ignition On , 0 = Ignition Off

#	Required Data Field	Descriptions
24.	Main Power Status	0 = Vehicle Battery disconnected 1= Vehicle Battery reconnected
25.	Main Input Voltage	Indicator showing source voltage in Volts. (up to One Decimal Value)
26.	Internal Battery Voltage	Indicator for level of battery charge remaining. (up to One Decimal Value)
27.	Emergency Status	1= On, 0 = Off
28.	Tamper Alert (Optional)	C = Cover Closed, O = Cover Open
29.	GSM Signal Strength	Value Ranging from 0 – 31
30.	MCC	Mobile Country Code
31.	MNC	Mobile Network Code
32.	LAC	Location Area Code
33.	Cell ID	GSM Cell ID
34.	NMR (Network Measurement Report) Neighboring Cell ID	Neighboring 4 cell ID along with their LAC & signal strength
35.	Digital Input Status	4 external digital input status (Status of Input 1 to Input 3 (0=Off; 1=On))
36.	Digital Output Status	2 external digital output status (0=Off; 1=On)
37.	Frame Number	Sequence Number of the messages (000001 to 999999)
38.	Checksum	Insures No error in transmission (optimal)
39.	End Character	Indicated End of the frame

This are the indicative list of the data that required to integrate with backend system. Authority may come-up with the additional data types to be integrate with the backend system during the contract period. Bidder shall have to support into the requirement gathering and generation of the data types as and when authority desires in entire contract period.