Mitigation of emissions in the transport sector in Costa Rica (MiTransporte)

PN 15.9082.7-001.00

DOCUMENT 1

TEHCNICAL SPECIFICATIONS

for the
purchase of three (3) electric buses
and
associated charging stations

October 21st, 2019

Content

TABLE 1 CHARACTERISTICS AND DESIGN OF ELECTRIC BUSES	
1	**CAPACITY**
1.1	Minimum number of passengers: 80
1.2	Minimum number of seated passengers:28
1.3	Length of the vehicle: minimum 11.9 meters, maximum 13.2 meters
1.4	Accessibility features (e.g. wheelchair access ramp, acoustic signals)
1.5	Minimum internal height of 2 meters, except in the area of the rear shaft.
2	**DESIGN**
2.1	The bidder shall submit a proposal of the external design of the vehicle, including colors, considering White as the predominant color, the international accessibility symbols, and logos indicating which the access doors are and which the disembarking doors are. All the external design shall be harmonic and shall integrate the external itinerary information screens in the front, side and back, together with mirrors and the rest of the external components of the vehicle.
2.2	The internal design shall integrate all the internal components and panels in a harmonic way and maintain visual continuity.
3	**EXTERNAL PANELS**
3.1	External panels shall have insulating properties in order to minimize the cold-heat exchange, and they shall also minimize the internal noise of the vehicle.
4	**FLOOR**
4.1	The bus shall have low floor; therefore, the floor in the seating area shall be at the same level than the floor in the circulation aisle, except in the area of the wheel covers and the area of the rear shaft.
4.2	It shall be washable and coated or made with anti-sliding fire-retarding material, and shall have thermal and acoustic insulation.
4.3	There shall be a space in the floor reserved for a wheelchair, with anti-sliding floor and in a color that contrasts with the rest of the floor. This space shall include the IAS symbol (International Accessibility Symbol).
5	**ACCESSIBILITY**
5.1	37 cm shall be the maximum height from the road to the first step.
5.2	Height between the first step and the aisle = 0 cm
5.3	Door operation
5.3.1	To open and close the doors, there shall be an electric or pneumatic device activated by the driver from the driving position, allowing for the activation of each door independently, and for the activation of all the door simultaneously. Opening and closing times shall not be over 3 seconds. The driver's panel shall have visual signs to identify if the doors are open or close.
5.3.2	The doors shall have part of the area in glass to facilitate the vision of the driver to the outside of the vehicle.
5.3.3	In case of emergency, it shall be possible to open all doors both from the inside and from the outside, with or without the power supply system in operation.

TABLE 1 CHARACTERISTICS AND DESIGN OF ELECTRIC BUSES	
5.4	The vehicles shall have at least two doors located in the right side, one at the front and one in the middle area. These doors shall have the following functions, which shall be indicated to the public in Spanish: front door for access; door in the middle zone of the vehicle to disembark.
5.5	Type and size of the doors
5.5.1	They shall be double pantographic doors, except in the front, where the option of sliding doors can be considered. The minimum dimensions of these doors shall be 90 cm width and 190 cm height.
5.6	The vehicle shall have an acoustic signal to alert about the operation of doors, both for opening and for closing.
5.7	The door opening device shall have an anti-smashing system with sensitivity adjustment to detect a collision with a passenger or an object. This device shall have an easy-to-operate mechanism to allow opening the door through a command different from the one located at the driver's position, in case of an emergency. It shall be designed to avoid any operation in events different from an emergency.
5.8	The vehicles shall have at least 4 emergency exits, excluding the service doors and the roof hatches. These emergency exits can be doors, windows and/or hatches that shall be uniformly located along the cabin of the bus.
5.9	The vehicles shall have, in at least one of the doors, a ramp/platform to allow for the access of users with restricted mobility (e.g. wheelchairs). It shall be manually activated, easy to operate and shall offer safe access with anti-sliding floor.
5.10.	Windows and ventilation systems
5.10.1	All the glass used in the lateral and rear windows and in the windshield shall be safety glass.
5.10.2	The surface of lateral windows, including the glass surface in the doors, shall be of at least 30%.
5.10.3	All windows shall have an easy-to-open mobile section.
5.10.4	The glass shall be tinted, with a transparency index between 50% and 70%.
5.10.5	The windshield shall have a minimum transparency index of 75% and shall be constructed in such a way that it reduces the reflex caused by internal lighting. It shall also have an anti-fog system.
5.10.6	The buses shall have a ventilation system made up by forced air devices and natural air vents; designed and constructed to ensure a renewal of at least 20 times per hour of the air contained inside the bus.
5.11.	Mirrors
5.11.1	The vehicles shall have external lateral mirrors. These shall be split, flat and with a convex area in the lower end.
5.11.2	These external mirrors shall be located in such a way that their lower edge is at a height of no less than 2 meters measured from the ground level to avoid accidents with pedestrians. If it is not possible for the bidder to achieve these dimensions, the bidder can work with the following recommendations: ▪ Left equal to or greater than 1.87 meters ▪ Right equal to or greater than 1.95 meters
5.12	The vehicles shall have electronic systems for the identification of the routes; they shall be visible from the outside and the information shall be readable both during daytime and during nighttime. These systems shall be located in such a way that it shall be possible to see the information from the front, the right side and the back of the vehicle.
5.13	External lights
	The vehicles shall have beams to project high and low intensity light, parking lights, turn signals, brake lights, backup lights and license plate lights.

TABLE 1 CHARACTERISTICS AND DESIGN OF ELECTRIC BUSES	
	The front beams shall be white or yellow. The backup lights shall be white, and the turn signals and the parking lights could be either red or orange.
5.14	Driver's booth
5.14.1	Driver's seat
	The seat shall allow for easy and quick adjustment ensuring a comfortable reach of the steering wheel, the pedals and the control panel, and favoring clear visibility to the road for different sizes of drivers. It shall be adjustable in the inclination of the back, the height of the seat and the distance between the seat and the panel. It shall also have a cushioning system and a well-ventilated seat.
	The control panel shall be laid out in such a way that it does not interfere with the vision of the driver, with the alert instruments located within a 30° angle in a horizontal view in each side of the line of the eyes.
	The following alert instruments are mandatory:
	Speedometer and odometer
	Manometer to record the pressure of the tanks of service brakes
	Charge status of the batteries
	Information to support efficient driving, instantaneous consumption and/or average power
	Signal for door opening/closing
5.14.2	Lay-out of the driver's position
	A diagram shall be attached with the location of the driver's seat and the panel, including the dimensions.
5.14.3	Acclimatization of the driver's booth
	Not required.
5.14.4	Driver's safety booth
	No safety booth is required. The driver shall have a screen on the right side of his booth to eventually facilitate manual payment by the users.
5.14.5	Close circuit TV
	Yes.
5.15	Habitability
5.15.1	The bidder shall attach a lay-out of the inside of the bus offered, including the lay-out of all the accesses, seats, handrails and drawers, indicating internal spaces and dimensions of the vehicle and the elements it incorporates. The bidder shall also attach a description of the seats.
5.15.2	The space of the bus offered shall meet at least the following requirements:
5.15.3	Passenger seats
	The seats for the passengers shall be located across the longitudinal axis of the vehicle facing frontwards; yet a different lay-out could be accepted provided that it does not affect the free movement of passengers, their comfort and safety.
	The floor in the seat zone shall be at the same level as the floor in the circulation aisle, except in the zone of wheel covers.
	The seats shall be cushioned with composite material or textile resistant to fire, durable and easy-to-clean. All the seats in the sides of the aisle shall have lateral handles in the upper part of the back, thus becoming part of the structure without affecting the width of the aisle. The height of the base of the seat shall allow all the adult users to have both feet firmly pressed on the floor.
	The following seat dimensions shall be respected:

TABLE 1 CHARACTERISTICS AND DESIGN OF ELECTRIC BUSES	
	Minimum depth of the seat: 36 cm
	Minimum height of the back: 40 cm
	Minimum width: 45 cm
	The minimal distance between the front part of the back of the seat and the rear part of the seat located immediately in front cannot be less than 65 cm.
	The structure of the seats and their fixtures shall be resistant and appropriate for the operation of an urban bus. The fixtures of the seat with the floor shall have a distance of at least 15 cm from the aisle.
5.16	There shall be handrails and/or handles in all the transit area; the bus shall have flexible hanging handles at a height of no more than 170 cm measured from the floor. Handrails and handles shall have adequate resistance and their installation shall not imply any risk for the users.
5.17	Internal lights shall be LED and white.
5.18	Stop alert
5.18.1	The vehicles shall have a system of various electric bells with short lasting sound to alert about the stop; it should be heard by the driver and the passengers, and shall be activated by either buttons or switches.
5.18.2	Together with the bells, there shall be a luminous signal to notify the driver and the passengers that a stop has been requested.
5.19	The internal panels in the passenger zone shall be assembled and set in such a way that they can endure the vibrations of the bus, ensuring that they will not get loose. They shall be reinforced, wherever needed, to resist vandalism and other wear due to the normal operation of a public transportation vehicle.
5.20	Each service door shall have a convex mirror to give the driver a broad view of passengers embarking and disembarking.
5.21	Fire detection and suppression system
5.21.1	The vehicles shall have a fire detection and suppression system both in the battery sector as well as in the engine zone.
5.21.2	The vehicles shall have at least 3 (three) dry chemical fire extinguishers of 5 kg, located at an easy-to-access place. The placement of extinguishers shall be designed to prevent vibration and noise and shall be resistant to vandalism.
5.22	Other systems
5.22.1	The vehicles shall have a Global Positioning System (GPS) unit compatible with the units used by the National Public Transportation Council to monitor public transportation units.
5.22.2	The vehicles shall have at least ten USB outlets, for the passengers to recharge their smart telephones during the trip. The Driver´s booth shall also have its own USB outlet.
5.23	Environmental protection
5.23.1	The battery system cannot contain lead or use materials that pose a health or environmental risk.
5.23.2	The bidder shall present a management and reuse plan for the batteries of the vehicles that allow for a second use once they finish their life cycle, complying with the provisions of Law 8839. The plan shall indicate proposed uses and who will be accountable for that. At the moment of adjudication, the accountable person indicated in the battery management and reuse plan shall sign a commitment for implementation, including also the batteries that have been discarded because they have reached the end of the life cycle, as well as those that shall be substituted due to failures in operation or anticipated degradation, pursuant to the provisions of the section on guarantees.
5.23.3	To ensure passenger comfort, the cabin shall be designed in such a way that the internal noise under normal bus operation conditions shall not exceed the 72 dBA.

TABLE 2 ELECTRIC BUSES: TECHNICAL REQUIREMENTS	
1	**GENERAL INFORMATION TO DESCRIBE IN THE PROPOSAL**
1.2	Manufacturer
1.3	Model
1.4	Gross vehicle weight in kg
1.5	Kerb weight in kg
1.6	External dimensions
1.7	Tires dimensions and characteristics
1.8	Guarantee a life of 10 years or 750.000 kilometers.
1.9	Proposals must present a management and reutilization plan of the batteries that allows a second-life use.
2	**COMPONENTS**
2.1	Structure of the vehicle can be chassis and body or monoblock
2.2	Total or partial lowering of the floor of the passenger compartment. No steps or obstacles in the lowered area of the floor.
2.3	The axles shall be sized to endure the highest value of static load, equivalent to a fully loaded vehicle. Minimum occupancy rate of 10 passengers per square meter of useful area.
2.4	Wheels and tires: Must comply with internationally accepted standards and dimensions.
2.5	Drive System:
2.5.1	100% electric traction system including one or more motors with cooling systems.
2.5.2	For the engine(s), at least the following information shall be indicated in the corresponding factsheet:
	Manufacturer and model
	Engine type
	Nominal power [kW]
	Maximum power [kW]
	Nominal torque [nm]
	The vehicles offered shall have a minimal nominal power of 180 kW and a minimal peak power of 250 kW.
2.5.3	The vehicle shall have a set of batteries that must be compatible with the chargers offered, being capable of enduring the currents, voltages and temperatures in different charging events.
2.5.4	The battery system shall have a thermal management system to ensure that the batteries will not exceed the temperature range recommended by the manufacturer in conditions of maximum environment temperature of 40°C for a period of 8 hours.
2.5.5	Indicate at least the following features of their battery systems:
	Manufacturer and Model
	Capacity [kWh]
	Total weight [kg]
	Composition
	Nominal voltage per cell [V]
	Maximum capacity per cell [Ah]
	Nominal voltage of the battery system [V]

TABLE 2 ELECTRIC BUSES: TECHNICAL REQUIREMENTS	
	Maximum capacity of the battery system [Ah]
	Maximum discharge current [A]
	Autonomy [km/charge] according to the chargers offered
	The battery set of the vehicle offered shall have a minimal capacity of 270 kWh.
	The battery set shall meet the specifications in section 2.1. Technical Standards of the present document.
2.6	The proposals shall include a monitoring system and diagnostic equipment for the batteries of each electric bus, including at least the following components:
	Data gathering in the vehicle
	Data transfer
	Data processing platform and back up
	Information deployment
2.7	Steering system
2.7.1	The steering system shall have hydraulic or electric assistance. In case of sudden interruption in the power supply, steering assistance shall be maintained at adequate levels for a minimum period of 20 seconds.
2.7.3	The steering shaft shall be adjustable.
2.8	Maneuverability
2.8.1	Maximum turn radius: the vehicle shall maneuver within a circle with a radius of 13 meters without any part of the vehicle outstanding outside the circumference of such radius.
2.9	Suspension system
2.9.1	Suspension shall be of the integral air suspension type and shall be equipped with a vertical movement system to allow for passenger embarkation and disembarkation. The system shall allow for the bottom boarding section to descend or “kneel” at least 60 mm on the right side of the vehicle. The vertical movement system shall not delay the operation of the vehicle and its components shall not present physical obstacles that affect the movement and comfort of the users.
2.9.2	The suspension system shall control vertical, longitudinal and transversal oscillations, thus guaranteeing comfortable conditions for the passengers and protecting the components of the vehicle. It shall also guarantee the stability of the vehicle, keeping the body permanently levelled.
2.10	Brake system
2.10.1	The vehicle shall have service brakes, regenerative electric brakes and parking brakes.
2.10.2	The service brakes shall be equipped with a Brake Anti-Blocking System (ABS) and shall be pneumatic and automatically assisted by the regenerative electric brakes.
2.10.3	The brake system shall fully inhibit the movement of the vehicle in case it is laterally inclined in maneuvers of embarkation and disembarkation of passengers with restricted mobility.
2.10.4	Parking brakes shall maintain the vehicle with maximum load stopped in a 22% slope. It shall remain active when the driver is not present.
3	**MINIMAL FEATURES OF THE VEHICLES**
3.1	Buses maximum speed of 90 km/h (speed limiter set to 60 km/h). At full load it must be able to accelerate from 0 to 20 km/h in 10 seconds and from 0 to 50 km/h in 30 seconds. It must be capable of overcoming a slope of 20% at full load.
3.2	Power consumption of the bus shall be reported in kWh/km under the following test conditions:
3.2.1	SORT 1 Heavy Urban Cycle

TABLE 2 ELECTRIC BUSES: TECHNICAL REQUIREMENTS	
3.2.2	Braunschweig City Driving Cycle
3.2.3	The bidders shall inform about the power consumption under the bus driving cycle of Santiago, Chile described in Resolution 2243 from 2018 from the Chilean Ministry of Transportation and Telecommunications. The Santiago Cycle can be replaced for another cycle, in case the offeror does not have access to it. This third cycle is not an indispensable requirement for the offer.
3.4	The battery system shall have a storage capacity in kWh that allows for an autonomy of at least 250 km.
3.5	Autonomy shall not be degraded over 15% during the first 24 months of operation (SOH = 85%).
3.6	Environmental conditions for operation
3.6.1	Relative humidity from 5 to 100%
3.6.2	Environment temperature from 5ºC to 45ºC
3.7	Manuals
3.7.1	The vehicle must come with at least 4 hard copies of the owner's manual per bus, in Spanish.

TABLE 3 CHARGING STATIONS: TECHNICAL REQUIREMENTS	
1	**THE PROPOSAL SHALL INCLUDE THE FOLLOWING CHARGING OPTIONS AND A DESCRIPTION OF THE CHARGING STRATEGY AND THE CHARGER TO BE USED, CONSIDERING THREE SCENARIOS:**
1.1	An alternative current, low voltage charging scenario with power fed to 120 Volt single phase two-wire charger or to 240/120 Volt single phase three-wire charger at 60 Hz.
1.2	An alternative current, mid voltage charging scenario with power fed to 120 Volt single phase two-wire charger or to 240/120 Volt single phase three-wire charger at 60 Hz.
1.3	A higher voltage charge scenario with power fed to 480 Volt three-phase charger.
2	**THE FOLLOWING GENERAL SPECIFICATIONS SHALL BE MET:**
2.1	Consistent with the Costa Rican electric distribution grid, the chargers shall be able to connect to a three-phase 3-wire (no neutral) electric power supply with a nominal voltage of 480 Volt and a frequency of 60 Hz, a single-phase two-wire of 120 Volt or a single-phase three-wire of 240/120 Volt and a frequency of 60 Hz, depending on each charging option being offered.
2.2	The battery chargers shall be configured to automatically apply an appropriate charging protocol for the charge status of the battery, pursuant to the practices recommended by the battery manufacturer. The battery chargers shall be configured to begin and sustain the charge of the battery in any charge status. The battery charger shall be configured to automatically finish charging when reaching a full charge or in case of facing dangerous or abnormal conditions. The battery chargers shall be configured to inter-connect with the battery management systems and the blocking systems on board the vehicle.
2.3	The buses shall be completely stopped during all the charging operations. After the successful link with the charging interface, the bus shall be blocked in such a way that it cannot be driven and the brakes are locked.
2.4	The connection cable shall meet norm IEC 62196-2 and shall be incorporated to the charger. The length of such cable, that is, between the charging station and the connection point to charge the bus, shall be of at least 4 (four) meters. For the option of charging with alternate current, it is possible to consider connection cables that meet norm IEC 62196-2 type 1 or SAE J1772.
2.5	The charging equipment shall operate continuously, without performance or safety degradations under the environmental conditions typically found at the place of the acquirer. For the effects of this request for proposal, environmental conditions shall be understood as:
2.5.1	Storage temperature when not in service: -5 °C to 50° C
2.5.2	Environment temperature in service: -5 °C to 45° C
2.5.3	Relative humidity: from 5% to 95%, without condensation allowed.
2.5.4	The equipment shall be installed outdoors, without additional protection to the normal housing of the equipment.
2.6	The chargers shall not produce harmonic distortion in more than 5% of the total harmonic distortion (THD) defined in the technical norm “Supervision of the quality of low and mid voltage power supply” (AR-NT-SUCAL) and its modification in RESOLUTION RJD-205-2015.
2.7	The bidder adjudicated shall deliver the following documentation together with each charger:

TABLE 3 CHARGING STATIONS: TECHNICAL REQUIREMENTS	
2.7.1	Installation manual: the manual shall be in Spanish and shall contain step-by-step details on how to make the installation, assembly and operation of the charger. Each step shall be described in detail with images and directions (assembly blueprints). If it was necessary to have specific elements, such as concrete housing, placement platforms and the like, these shall be clearly indicated and described, with their lay-out plans, in the manual.
2.7.2	Operation manual: the manual shall be in Spanish and shall contain step-by-step details on how to perform the normal operations of the equipment, such as connection, charging start up, charging stop, use of emergency stop and replacement, disconnection and other operations. Each step shall be described in detail with images and directions.
2.7.3	Maintenance plan: the plan shall be in Spanish and shall specify the preventive/predictive maintenance contemplated in the 10 years of operation of the equipment, including the list of spare parts associated to each maintenance intervention in the plan. The bidder shall provide a list with the type and quantity of wear and/or replacement pieces, according to the degree of use of each bus unit.
2.7.4	Trouble-shooting: this shall be in Spanish and can be contained within the operation manual. This shall list the main historical failures of the equipment and the step-by-step description to solve them. If any step implied the use of any specific spare-part, this shall be clearly specified.
2.8	The bidders and/or the manufacturers of the charger shall present the certificate ISO: 9001 for Quality Management Systems for the manufacture of chargers. That manufacturers that do not present evidence of the quality standard required shall not be considered any further as qualified bidders and, as such, are not eligible for the supply and manufacture of chargers for the Acquirer.
2.9	The bidders and/or manufacturers of the charger shall present the certificate of compliance with norm IEC 61851 or SAE J1772 for the charger, depending on the corresponding charging option.
2.10	The bidders and/or manufacturers of the charger shall present the certificate of compliance with norm IEC 62196 or SAE J1772 for the charger, depending on the corresponding charging option.
2.11	The bidders and/or manufacturers of the charger shall provide a commercial booklet – Brochure – OnePage – Datasheet of the chargers offered.
2.12	The bidders and/or manufacturers of the charger shall present the certificate of degree of protection IP44 or higher pursuant to international norm CEI 60529 Degrees of Protection.
2.13	The bidders and/or manufacturers of the charger shall present the certificate of degree of protection from impacts IK08 or higher pursuant to the international European norm EN 62262.
3	**SOME ESSENTIAL REQUIREMENTS ON THE CHARGING STATIONS INCLUDE:**
3.1	The economic offer shall include the unit price of the chargers included in the three charging options. The number of chargers to acquire for each option shall be determined by GIZ at adjudication.
3.2	Charging shall be supplied to the buses in Direct Current pursuant to IEC 61851, standard CCS1 Mode 4, but the bus shall always admit the Alternative Current charge due to the situation of the local electric structure. For this latter alternative, the buses shall have the option of simultaneously charging with two connectors.

TABLE 3 CHARGING STATIONS: TECHNICAL REQUIREMENTS	
3.3	The proposals must include different charging infrastructure options that allow adapting to the electricity supply conditions present in bus depots in San Jose, considering three scenarios mentioned above, incl. DC and AC options.
3.4	The applicant must adhere to different norms and standards related to the batteries and charging stations.
3.5	Charging equipment shall be capable of continuous operation without degradation of performance or safety in the environmental conditions typically found at the purchaser's site (e.g. operating ambient temperature of -5 °C to 45° C, relative humidity of 5% to 95%).
3.6	The applicant is required to adhere to different requirements on the charging process, including:
3.6.1	Automatic application of appropriate charging protocol to the battery state of charge,
3.6.2	Configuration to initiate and sustain battery charging in any SOC,
3.6.3	Automatic termination of charging when a full SOC is reached or in the event of hazardous conditions,
3.6.4	Emergency stop,
3.6.5	Cables of at least four (4) meters in length each,
3.6.6	Connectivity and communication protocol,
3.6.7	Continuous operation without performance or safety degradations under the environmental conditions typically found at the place of the acquirer.
3.7	Proposals must include a monitoring and management system and diagnostic equipment for the charging stations.
	The platform of the monitoring and management system for the chargers shall collect, store, monitor and allow for the configuration and adjustment of operational parameters in the chargers.
	The bidder adjudicated shall provide the monitoring and management system through which there shall be access to a control and monitoring panel. It shall allow making customized reports with the information mentioned in the paragraphs above; that is, consumption, status, duration, number of users, percentage of battery charge of the bus connected, average hours of daily recharge, costs, availability, causes of non-availability and most frequent cause of the charger, description and most frequent cause for charger maintenance, failure history, etc.
	The system shall allow for the configuration of alarms and trigger notifications based on the different variables monitored. The user granted to the Acquirer shall be capable of generating sub-users to have access to the same information.
	It shall also be a requirement that the system shall allow performing remote operations like turning off the system, restarting the system or suspending a charge, for example.
4	**BASIC DESCRIPTION OF THE FEEDING SYSTEM OF THE CHARGERS**
4.1	For the option of continuous current charging, power supply shall be considered to a three-phase 3-wire (no neutral) charger with a nominal voltage of 480 Volt and a frequency of 60 Hz.
4.2	For the options of alternative current charging, power supply shall be considered to single-phase two-wire charger of 120 Volt or to single-phase three-wire charger of 240/120 Volt and a frequency of 60 Hz.
5	**GUARANTEE**

TABLE 3 CHARGING STATIONS: TECHNICAL REQUIREMENTS	
5.1	All the charging equipment shall be guaranteed for 24 months after installation.
5.2	The equipment shall have a life cycle of 10 years and, according to the analysis of historical failures of the model of the charger presented, there shall be availability of basic spare-parts derived from such analysis to be able to guarantee such life cycle.
5.3	The guarantee shall not be applied to the failure of any piece or component of the charger proven to derive from misuse, negligence or accident. The guarantee shall also be void if the buyer does not submit the chargers to the preventive and predictive inspections / maintenance determined in the maintenance plan presented and executed by the bidder adjudicated or his designee by providing due notification to the buyer.
6	**SUPPORT**
6.1	The bidder adjudicated shall demonstrate to have at least two technicians that specialize in maintenance and possible repairs to the bus units hereby contracted, who will be available for the adjustment and/or repair of the bus units hereby contracted.
6.2	This personnel shall provide the necessary training and education for the provision of the recharge services to the operators of the buses under this tender and to the technical staff indicated by the enterprise that operates with the vehicles acquired.
6.3	The didactic materials and step-by-step guides to solve minor operational problems that might emerge during a charging operation shall be submitted.
6.4	At the end of the training program, the qualified personnel shall be credited by the bidder adjudicated to operate with the chargers and solve and/or report minor problems that might occur during charging.
6.5	The bidder adjudicated shall offer a training course including, but not limited to, the Firefighters Group, the Red Cross, Traffic Officers and Law Enforcement, so that in case of an accident involving one of the vehicles and/or chargers of this bid, they participate in the response to the emergency, with the necessary knowledge about the operation, the safety measures of the vehicle and the charger, and the way of performing a safe rescue.
6.6	The bidder adjudicated shall have technical support available to go to the place where the failing charger is installed within 48 working hours of the failure report.
7	**SAFETY**
7.1	The chargers shall have an “EMERGENCY STOP” in the format of direct punch, duly identified for quick activation in case of an emergency.
7.2	The charging equipment shall meet norms IEC 61851 and IEC 62196 in the applicable areas, and the different standards included within those norms. Local valid regulations with more stringent requirements than the ones in the above mentioned international norms shall also be met.
7.3	The bidder adjudicated shall indicate the requirements for protection against indirect contact and current peaks pursuant to norm IEC 61851 and the norms in force regarding local electric safety.
7.4	The equipment shall NOT allow, under any circumstance, automatic reassembly or remote reassembly of any of the protections that could affect the safety of individuals or of the equipment itself, which had been activated due to a failure or event.
8	**CONNECTIVITY AND COMMUNICATION PROTOCOL**
8.1	The chargers for the buses shall have the possibility of communication between the bus and the charger. In addition to this, they should be able to gather data through the charge management software regarding the instantaneous status of

TABLE 3 CHARGING STATIONS: TECHNICAL REQUIREMENTS	
	the charging equipment and of the power delivered, status (available, in failure, charging, connected, disconnected, etc.), power delivered individually and collectively, number of charging sessions, time and power delivered in each session, start and end date and time of each session and of any event that could be informed by the equipment, percentage of charge of the vehicle connected at the beginning and at the end of the charging session, status of the charger connection for which it shall meet the international norms and standards mentioned below instead of with the proprietary protocol in order to capture the data from different systems: IEC 61851, ISO 15118, DIN SPEC 70121. In turn, the communication protocol of the chargers shall be OCPP (Open Charge Point Protocol) version 1.6 or later.
8.2	The charging equipment shall have connection to the network to be able to send the information in real time, wherever it is installed. For this reason, it is required that the charger incorporates a connection device via GPRS, SIM, 3G, 4G or any other wireless technology proposed by the bidder. In addition to such connectivity, the equipment provided shall have Wi-Fi connection and Ethernet port.
8.3	The redundancy in the possibility of connecting the equipment to the network is due to the fact that the pilot test that will be performed shall have, as one of its main objectives data gathering and analysis.
9	**RESPONSIBILITY OF THE SUPPLIER REGARDING THE INSTALLATION**
9.1	Although the supplier of the chargers will not necessarily be the person responsible for the execution of the electric installation, the civil installation and the assembly of the charger, he/she shall provide all the necessary, essential and supplementary detailed information and the datasheet with sufficient information to make the calculations regarding cable to be placed, protections or any other additional details to improve safety in the installation. However, the installer shall respect the local regulations in force and apply international standards and best practices.
9.2	The bidder adjudicated shall be present when the charger is put into operation once the installation is over for configuration and operation. Charging tests shall be performed to validate the correct operation of the chargers with the buses of the contract, as well as communication and interrogation tests of the charger through the management software.

TABLE 4 TECHNICAL STANDARDS	
1	**CHARGE SHALL BE SUPPLIED TO THE BUSES IN DIRECT CURRENT UNDER STANDARD IEC 61851, IEC62196 AND THE CORRESPONDING CHARGING PARTS IN MODE 4 (CONTINUOUS CURRENT) AND USING STANDARD "CCS-1" ALSO KNOWN AS "CCS COMBO 1"**
2	**THE BUS SHALL ALWAYS ADMIT CHARGE IN ALTERNATIVE CURRENT DUE TO THE CONDITION OF THE LOCAL ELECTRIC INFRASTRUCTURE. THE BUSES SHALL HAVE THE OPTION OF CHARGING SIMULTANEOUSLY WITH TWO CHARGERS AND SHALL BE ABLE TO CHARGE IN ALTERNATIVE CURRENT, MAKING IT POSSIBLE TO HAVE SIMULTANEOUS CHARGE WITH TWO CONNECTORS.**
3	**SUPPLIERS SHALL MEET THE FOLLOWING STANDARDS:**
3.1	IEC 61851-1:2017 Part 1
3.2	IEC 61851-21-1: 2017
3.3	IEC 61851-21-2: 2018
3.4	IEC 61851-23: 2014
3.5	IEC 61851-24: 2014
4	**BATTERIES AND THEIR ASSOCIATED SYSTEMS SHALL MEET ANY OF THE FOLLOWING STANDARDS:**
4.1	Regulation N° 100 of the European Economic Commission from the United Nations (EEC/UN)
4.2	Global Technical Regulation (GTR) EEC/UN N°20, Global Technical Regulation on the Electric Vehicle Safety (EVS)
5	**FOR BATTERIES AND THEIR ASSOCIATED SYSTEMS, ONE OF THE FOLLOWING STANDARDS SHALL BE MET:**
5.1	GB/T 31467 (Standard for LFP battery systems for electric vehicles in the People´s Republic of China), or GB/T 31485 (Safety standard for battery systems for electric vehicles in the People´s Republic of China) or any other equivalent standard for the battery pack
5.2	JT/T 1026 (Standard with general requirements for urban electric buses in the People´s Republic of China) or any other equivalent standard for the vehicle