

Mitigation of emissions in the transport sector in Costa Rica (MiTransporte)  
PN 15.9082.7-001.00

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

July 19<sup>th</sup>, 2019

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## 1. MAIN CHARACTERISTICS OF THE TENDER

The current document sets the bidding basis for the purchase of three electric battery buses with their recharge systems to be donated to the environmental authority of the Government of Costa Rica, the Ministry of Environment and Energy (MINAE), by the German Ministry of Environment through its International Cooperation Agency (Gesellschaft für Internationale Zusammenarbeit GIZ, in German) as part of the GIZ-MiTransporte project.

### 1.1. Background

Law number 9518, Incentives and Promotion for Electric Transportation, has the objective of creating the regulatory framework to regulate the promotion of electric transportation in Costa Rica, and to strengthen the public policies to promote its use in the public sector and with all citizens in general.

The Law regulates the public administrative organization related to electric transportation, institutional competences and their promotion, through exemptions, incentives and public policies, in compliance with the commitments set in the international covenants, like the Paris Agreement, ratified by the country during 2016, when Law number 9405 entered into force, and consistent with article 50 of the Political Constitution.

The presentation of reasons that support Law 9518 stated that the problems that affect the country in terms of transportation infrastructure were due to a marked lack of planning and asset management, which are essential for an effective strategic and duly structured process in decision-making based on the development policies of the country, and to a lack well-oriented resource management, working methodology and organizational framework.

Additionally, since 2017, the Government of Costa Rica has been receiving technical assistance from the Government of the Federal Republic of Germany through the GIZ-MiTransporte Project, with the objective to support, among others, the Ministry of Environment and Energy (MINAE) and the Ministry of Public Works and Transportation (MOPT), Local Governments and other relevant entities, like the Public Transportation Council (CTP) in implementing a pilot project for electric buses in public transportation service routes, consistent with the infrastructure and the existing routes of the Metropolitan Area of San José, as the starting point for the electric public transportation service in the country.

In Costa Rica, buses are responsible for a high share of emissions and bad air quality, especially in urban areas. To reduce GHG emissions and air pollutants, the country is planning to replace its fuel-powered public transportation with electric vehicles. The first step will be a pilot project with 3 electric buses in Gran Area Metropolitana (GAM) of San José. These buses will be used to technically support the upscaling of electromobility in public transport in Costa Rica. Besides 3 electric buses, the tender includes also the delivery of charging stations, after-sales services and a training package for both drivers and service personnel.

Main characteristics of the buses include:

- **Length of ~12 meters,**
- **Low floor buses,**
- **100% electric traction system, allowing effective operation in San José, Costa Rica,**
- **Minimum capacity of 80 passengers,**
- **Autonomy of at least 250 km with full battery charge.**

The proposals should further include different charging options that allow adapting to the conditions of electricity supply present in San José. All buses and charging stations must comply with all the technical requirements indicated in this document, below.

Offers must include the costs for the following items:

- **Transport and insurance of buses and charging stations,**
- **IT tools and diagnostic equipment (e.g. for data monitoring),**
- **After-sales services (e.g. maintenance for the buses and charging stations) for a period of 24 months from the date of reception of the buses in San José,**
- **Training package for different target groups.**

DAT (*delivered at place*): Delivery of the goods (buses and charging stations) is at a tax warehouse in San José, Costa Rica. The final acceptance of the vehicles will be after a detailed review of each of the buses and charging stations, to verify that they conform to the characteristics committed in the supplier's offer. This inspection will be carried out by a technical committee that GIZ will define.

## 1.2. Introduction

The vehicle fleet in Costa Rica has doubled in the last decade (INEC, 2016). Ground transportation has become the most important energy consumer in the country, accounting for almost 53% of the final energy demand (MINAE, 2016), where private transportation has the largest share with respect to the total number of vehicles circulating; 61% are automobiles and 19% are motorcycles (INEC, 2016). Given its dependence on fossil fuels, ground transportation is the main source of air pollutants and one of the main sources of greenhouse gases (GHG) in the country (MINAE, 2015). In addition, UN Environment has estimated that, in the case of San Jose, the introduction of electricity will have important benefits for the transportation sector. The public transportation service could generate, by 2030, a reduction of 389 thousand tons of CO<sub>2</sub>eq, fuel savings for US \$316 million, and 108 prevented deaths from causes related to air pollution. With this scenario in mind, the idea is to develop the technical input to support the deployment of electric mobility in public transportation in Costa Rica as the starting point towards the streamlining of transportation fleets at the national level.

Within the transportation sector, public transportation moves over three fourths of the passengers in the Great Metropolitan Area, where most of Costa Rican population is concentrated. In spite of the re-activation of the inter-urban train since 2005, buses are, without doubt, the main public transportation means in the country (MOPT, 2011). However, the main public organizations demand a “transforming intervention”

to modernize public transportation and optimize its operation. The current National Transportation Plan 2011-2035, has provided, as part of its objectives, the evaluation of “technological alternatives for buses according to the type of routes and infrastructure restrictions” (MOPT, 2011). Additionally, the publication of **Law No. 9518 on Incentives and Promotion of Electric Transportation, provides, in Article 28, that the plan shall project the replacement of the bus fleet, with a goal of no less than 5% within two years<sup>1</sup>. Which is equivalent to a replacement of 125 buses to electric during the first year, and an incremental increase thereafter.** In addition to launching plans and promulgating laws for electric mobility, 100% of the public transportation concessions at the national level, which are set by law for 7 years, expire in September 2021. Therefore, this is the time to introduce most of the pilot projects operating under normal conditions in order to generate useful information and knowledge for the next stages.

Currently, the project “Leapfrogging to E-buses in Costa Rica”, executed by UN Environment with funds from the Costa Rica USA Foundation (CRUSA) is aimed towards transforming the transportation sector in Costa Rica by creating the conditions to accelerate the massive adoption of zero emissions transportation means. The objective is to achieve a substantial absorption of electric mobility in public transportation, specifically in buses with electric batteries, as a driver to enable an electric mobility ecosystem throughout the country. The project also allows for the creation of an ecosystem of new high value business and employment opportunities around electric mobility through public and private use (promotion of green economics) and provides the necessary tools to implement a financeable and economically sustainable project.

### 1.3. Objective

The objective of the bid is to purchase three new electric battery buses with the associated recharging systems, which shall be delivered in the bonded warehouse in Costa Rica indicated by GIZ when signing the contract for the delivery of the buses. These buses shall be used as a pilot project to provide technical support to plan the massive introduction of electric mobility in public transportation in Costa Rica, including driver and bus service staff training, enabling systems to monitor and acquire information about the condition of the buses, the battery systems and the charging systems to be used for maintenance and for service improvement.

**The buses shall have the capacity to carry at least 80 passengers, they shall have low floor, with 100% electric traction system to allow for an effective operation in San Jose, Costa Rica, and they shall meet all the technical details hereby indicated.**

**The buses shall have a minimal autonomy of 250 km, with complete battery charge under the conditions indicated later in this document.**

The proposals shall include different charging options to adapt to the electrical supply of the bus parks in San Jose, Costa Rica, considering three scenarios:

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<sup>1</sup> Total bus fleet: aprox. 5000 buses

- **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.**
- **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.**
- **A higher voltage charge scenario with power fed to 480 Volt three-phase charger.**

For each scenario, the bidders shall present a charging option. This charging option shall describe the charging strategy and the charger to be used. The economic proposal shall include the unit price of the chargers included in the three charging options.

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.

**The offers shall include the costs for the programmed maintenance of the buses and the chargers, insurances and bus monitoring and management services, batteries and recharge systems for a period of 24 months, starting at the date the busses are received at satisfaction in San Jose, Costa Rica.**

**The capacity of the batteries shall not be degraded in over 15% of the original nominal capacity during the 24 months mentioned above; therefore, the proposals shall guarantee that the State of Health (SOH) of the batteries could not be less of 85% during that period; additionally, the supplier shall present an SOH degradation curve for the rest of the lifecycle of the batteries of the bus thereby offered.**

#### **1.4. Requirements for the presentation of bids**

Bids can be presented by international manufacturers with demonstrated experience in the production, sale and support of the operation of electric battery buses at the international level; **the bidders shall also partner with a local enterprise in Costa Rica** with demonstrated experience in the maintenance and repairs of heavy vehicles, especially international, national or urban service buses. Bids can also be submitted by official representatives of electric bus manufacturers in association with a local enterprise with demonstrated experience in the maintenance and repairs of heavy vehicles, especially international, national or urban service buses, or certifying that the representative has such experience.

The local enterprise shall demonstrate that it has at least three years of experience in the maintenance and repairs of heavy vehicles, and that it has the appropriate shops, facilities and equipment for such activity. The enterprises that can demonstrate that they have the quality assurance certification ISO 9.001 will get a higher score in the technical assessment.

The manufacturer shall have proven experience in the design, manufacture, commercialization and support of electric buses, their parts and spare parts, and shall demonstrate that it has manufactured over 1.000 urban public transportation buses in the last two years, and at least 100 electric battery buses during the same period.

### **1.5. Contents for the proposals**

The proposals shall include a technical offer and an economic offer. The technical offer shall include an affidavit regarding the compliance with the minimal technical requirements hereby indicated both for buses and for the chargers and the batteries, accompanied by the documentation indicated in section 1.8. Technical Documentation Required, a guarantee of the offer for 10.000 USD, and the following background documentation:

- **Documentation to demonstrate the experience of the enterprises included in the proposal, according to the provisions of section 1.4. Requirements for the Presentation of Bids.**
- **Certifications of the quality assurance systems in the manufacture of chargers.**
- **Certifications of the quality assurance systems of the maintenance services for the bidders that want to get extra points.**
- **Results of the energy consumption test in the SORT 1 cycle (Standardised On-Road Test 1) and Braunschweig city Driving Cycle. It is also essential to attach the results of the energy consumption tests in the bus driving cycle from Santiago, Chile, pursuant to Resolution 2243 from the year 2018 from the Chilean Ministry of Transportation and Telecommunications.**
- **Affidavit with the time to deliver the three buses and the chargers, which shall be less than the six months hereby required, with details of the number of months in the commitment in order to compete to get a score in the evaluation of the offers.**
- **Guarantee for 10.000 USD for compliance with the term to deliver the buses and chargers in six months or less, if applicable.**
- **Presentation of a programmed maintenance plan for the electric bus units, as well as for the repair and immediate solutions of potential failures in parts of components of the electro-mechanical or operational system of the buses in this contract, detailing the set of tools, spare-parts and pieces considered for a two year period. The maintenance plan shall ensure a daily availability of the buses of 90% or greater.**
- **Commitment to have at least two technicians specialized in the maintenance of electric buses, certified by the headquarters of the manufacturer, for a period of at least two years from the reception of the buses at GIZ satisfaction.**
- **Proposal of a schedule for education and training in bus services, maintenance and driving, including preventive monitoring and maintenance systems for the batteries.**

- **Proposal of a schedule for training, maintenance and operation of the chargers for the participants in the Electric Bus Pilot GIZ/MINAE-MOPT-CNE-CRUSA-ICE, in Costa Rica.**

The economic offer shall include the following:

- **Unit price of the buses offered, placed in Costa Rica without taxes, including transportation, insurance, and monitoring services for the buses for two years, expressed in American Dollars.**
- **Unit price of the three options of chargers offered, placed in Costa Rica without taxes, including transportation, insurance and monitoring services of the buses for two years, expressed in American Dollars.**
- **Cost of the programmed maintenance for buses and other after-sales services for two years, expressed in American Dollars, according to the maintenance plan included in the technical offer.**
- **Cost of the programmed maintenance and other after-sales services for two years for each of the three options of chargers, expressed in American Dollars.**
- **Cost of the training program for operators, mechanics, drivers and other relevant stakeholders.**

### **1.6. Tender timeline**

Interested companies have 35 after sending days to prepare their proposals, including a consultation period of 15 days from the day the tender is launched. The client will respond to these consultations within a maximum of 10 days from the closing of the consultation period.

### **1.7. Guarantees**

Each bidder shall attach a bid security in the offer, with an amount of 10.000 USD in order to cover the risks of the sender of vehicles, chargers, services and support systems not complying with the offer.

**The bidder selected, when signing the supply contract, shall guarantee the correct operation of the vehicle, the batteries, the pieces and spare parts, for at least 200.000 km.**

In addition, regarding the batteries, the bidder shall guarantee:

- **That the capacity of charge will not be degraded during the first 2 years of operation – count from the moment the item is received in satisfaction – beyond 85% of the original nominal capacity, measuring this degradation as the State of Health (SOH),**
- **That they are free of imperfections for a period of 7 years. The battery shall be repaired or changed by the manufacturer if there are operation problems during the period hereby indicated.**

All charging equipment shall be guaranteed for 24 months after they are installed. The following warranties and guarantees are to be understood as minimum criteria:

- **Warranty on correct operation of all battery and vehicle parts: The applicant is requested to issue a warranty of at least 200,000 km of**

operation on the batteries and all vehicle parts (incl. propulsion, engines, axles, etc.).

- **Battery performance warranty:** The applicant is requested to issue a warranty on the battery performance, indicated as state-of-health (SOH). A minimum of 85% SOH after two (2) years is requested.
- **Warranty on batteries:** The applicant is requested to issue a warranty on a useful life of the batteries of at least seven (7) years.
- **Warranty on vehicle body:** The applicant is requested to issue a warranty on a useful life of the vehicle body of at least 10 years or 750,000 kilometers of operation.
- **Warranty on correct operation of charging stations:** The applicant is requested to issue a warranty on the correct operation of the charging stations of at least two (2) years.

### 1.8. Technical documentation required

#### Buses

- **Fact sheet of the vehicle, including the minimal information required in section 2. Electric Buses: Technical requirements. Fact sheet and features of the vehicle in general and the engine. Fact sheet of the batteries**
- **Blueprint of the bus offered**
- **Lay-out of the driver's booth**
- **Lay-out of the passenger cabin**
- **Certificates of compliance with the technical standards required in section 2.1. Technical Standards.**

#### Chargers

- **ISO 9001 Certificate for Quality Assurance Systems for the manufacture of chargers. The manufacturers that do not demonstrate the required quality standard will not be considered as qualified bidders and, as such, will not be eligible for the supply and manufacture of the chargers for the Acquiring party.**
- **Certificate of compliance with standard IEC 61851 or SAE J1772 for the charger.**
- **Certificate of compliance with standard IEC 62196 or SAE J1772 for the charger.**
- **Commercial booklet – Brochure – OnePage – Datasheet of the chargers offered.**
- **Certificate of degree of protection IP 44 or higher according to international standard CEI 60529 Degree of Protection.**
- **Certificate of degree of protection to impact IK08 or higher according to international European standard EN 62262.**
- **Technical information table of the chargers included in section 3. Charging Stations: Technical Requirements.**

#### Features

- **Results of the energy consumption tests in SORT 1 Heavy Urban Cycle and Braunschweig bus test cycle.**

Monitoring and management systems

- **Technical document with the description of the battery monitoring and management system**
- **Battery monitoring and management system manual**
- **Technical document of the charger monitoring and management system**
- **Charger monitoring and management system manual.**

Maintenance service program for the first two years

- **Technical document with the services, tools, fungibles and materials considered**
- **Consumption and/or spare parts of the buses, according to the experience of the manufacturer.**

Training service

- **Technical document about a training program for the different target groups (operators, drivers, mechanics, etc.).**

### 1.9. Proposer documentation

The following documents are required:

- **Document to demonstrate the relationship with the manufacturer of the vehicles offered; it can be a certification from the importer or the official representative, or an authorization letter from the manufacturer to participate in the bid.**
- **Document to demonstrate the relationship with the local enterprise with experience in the maintenance and repair of heavy vehicles.**
- **Document to demonstrate the experience of the bus manufacturer, demonstrating more than 1.000 urban transportation buses manufactured in the last two years, and at least 100 electric battery buses manufactured during the same period.**
- **Documentation to demonstrate the experience of the local enterprise responsible for maintaining and repairing heavy vehicles, including a general description of the infrastructure, the equipment and the personnel devoted to performing these tasks.**

### 1.10. Responsiveness of the tender

The buses and chargers shall be delivered in Costa Rica at the date and place (DAT = delivered at place) to be confirmed at the moment of signing the contract. The final acceptance of the vehicles shall take place after a detailed review of each of the three buses and the chargers to verify that they meet the characteristics set in the offer of the supplier. This inspection shall be performed by a technical committee that GIZ will duly define.

Should there be a discrepancy with the offer deemed significant by the technical inspection committee, the contract shall be rendered void and the guarantees of reliability of the offer shall be collected.

### 1.11. Tender evaluation criteria

The evaluation of offers is the full responsibility of the purchaser. The evaluation is done through a weighting and scoring system. Some criteria are shown on a qualitative basis which is indicated at the respective criteria.

The proposals will be evaluated against the following criteria:

#### 1.11.1. General

- **Time until delivery** for buses and charging stations: The applicant is requested to deliver the bus within 6 months after conclusion of contracting process. The less time is required, the more points can be achieved.
- **Environmental standards** for the entire lifecycle of battery, vehicle, charging infrastructure (qualitative criteria): The applicant is requested to meet environmental standards and to promote environmentally friendly procedures and mechanisms, including the origin of the batteries, the manufacturing process, recycling procedures, etc. It should support a precautionary approach to environmental challenges, undertake initiatives to promote greater environmental responsibility, and encourage the development and diffusion of environmentally friendly technologies. Certificates or similar proof should support efforts in this context. The better the environmental concept of the applicant, the more points can be achieved.
- **Corporate social responsibility and social standards** in the manufacturing process (qualitative criteria): The applicant is requested to support and respect the protection of internationally proclaimed human rights, make sure it is not complicit in human rights abuses, upholds the freedom of association and the effective recognition of the right to collective bargaining, eliminates all forms of forced and compulsory labor, supports the effective abolition of child labor, eliminates discrimination in respect of employment and occupation, work against corruption in all its forms, including extortion and bribery, and protects workers from exposure or risks that may be detrimental to their health in the short and long view. Certificates or similar proof should support efforts in this context. The better the social concept of the applicant, the more points can be achieved.

#### 1.11.2. Costs

- **Price for three (3) battery-electric buses:** This should include the transportation of the buses to San José, Costa Rica, door-to-door insurance, and the offered IT tools for monitoring.
- **Price per charging station:** The price has to be provided for all three required scenarios requested in section “3. Charging Stations: Technical requirements”. This includes transport of the charging stations to San José, Costa Rica, insurance and installation of the charging stations as well as IT tools for monitoring. The lower the price, the more points can be achieved.

- **After-sales costs for all buses:** This is to be calculated for 2 years of operation. It is expected that each bus will drive around 100,000 km per year. The lower the price, the more points can be achieved.
- **After-sales costs for all charging stations:** This is to be calculated for 2 years of operation. The lower the price, the more points can be achieved.
- **Training costs:** The applicant is requested to offer a training package at least for bus drivers, operators of buses and charging stations, workshop mechanics. The lower the price, the more points can be achieved.

#### 1.11.3. Technical

- **Urban public transport buses and electric buses experience:** The applicant is requested to show their experience in the design, manufacture, marketing and support of urban transport and electric buses and to specify the amount of manufactured urban transport and electric buses as well as the countries they have delivered electric buses to. A minimum of 1,000 manufactured urban transport buses and 100 manufactured electric buses is requested. The more electric buses produced, the more points can be achieved.
- **IT tools for monitoring and diagnostic equipment** (qualitative criteria): The applicant is requested to offer IT tools which allows GIZ and the involved stakeholders in the pilot project to monitor operational data of the buses and charging stations. The better the quality of the IT package, the more points can be achieved.
- **Warranty on correct operation of all battery and vehicle parts:** The applicant is requested to issue a warranty of at least 200,000 km of operation on the batteries and all vehicle parts. The longer the warranty, the more points can be achieved.
- **Battery performance warranty:** The applicant is requested to issue a warranty on the battery performance, indicated as state-of-health (SOH). A minimum of 85% SOH after two (2) years is requested. The higher the performance after two years, the more points can be achieved.
- **Warranty on battery:** The applicant is requested to issue a warranty of at least seven (7) years on the battery. The longer the warranty, the more points can be achieved.
- **Warranty on correct operation of charging stations:** The applicant is requested to issue a warranty on of at least two (2) years of operation on the charging stations. The longer the warranty, the more points can be achieved.

#### 1.11.4. Training and after-sales

**Training package quality** (qualitative criteria): The applicant is requested to offer a training package at least for bus drivers, operators of buses and charging stations, workshop mechanics, deposit logistics. The training package must include all the curricula material to replicate the training. The better the quality of the package, the more points can be achieved.

**Quality of after-sales service** (qualitative criteria): The applicant is requested to offer an after-sales service package, including repair, maintenance, spare parts, and

other relevant services. The better the quality of the package, the more points can be achieved.

#### 1.12. Purchaser and other relevant stakeholders

The goods and services will be purchased by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (German agency for international cooperation), financed by Germany's Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) which is supporting the initiative as part of its International Climate Initiative (IKI). On Costa Rican side the project is supported by the Ministry of Environment and Energy (MINAE), the Ministry of Public Works and Transport (MOPT), the Office of the First Lady and other public and private organizations.

After the purchase, the buses and charging stations will be donated to the Costa Rican Institute of Electricity (ICE). In cooperation with the Public Transport Council (CTP), the Regulatory Authority of Public Services (ARESEP), and other organizations, up to 3 bus operators will be selected for piloting daily operations with the electric buses on one specific route for approximately 6 months each.

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## 2. ELECTRIC BUSES: TECHNICAL REQUIREMENTS

The structure of the vehicle can be chassis and body or monoblock. These structures shall be suitable to support the operation of the vehicle in full load and **guarantee a life of 10 years or 750.000 kilometers.**

The proposal shall describe the general characteristics of the bus, including, at least, the following information:

- **Manufacturer**
- **Model**
- **Gross Vehicle Weight in kg**
- **Kerb weight in kg**
- **External dimensions**
- **Tires**

The manufacturer shall be allowed to choose the most feasible technical solution, considering development, manufacturing and operation cost.

Some essential requirements on the buses and the batteries include:

- **Vehicles must be designed to operate properly under a relative humidity from 5 to 100% and a temperature between 5°C to 45°C.**
- **The chassis or platform of the vehicle must have a total or partial lowering of the floor of the passenger compartment. There should be no**

steps or obstacles in the lowered area of the floor, allowing free movement also for passengers with reduced mobility.

- The axles must be dimensioned for a minimum occupancy rate of 10 passengers per square meter of useful area.
- The wheels and tires must be in accordance with internationally accepted standards and dimensions considering weights, environmental conditions, and functionality.
- The vehicle must have a 100% electric traction system. The traction system must include one or more motors, with cooling systems appropriate for operation in urban areas under the environmental conditions indicated above and must have a thermal warning to avoid damage and risks of overheating.
- The vehicles offered must have a minimum power rating of 180 kW and a minimum peak power of 250 kW.
- The vehicle must have a set of batteries that allow the features indicated in this document and must be compatible with the chargers offered, and must be able to withstand currents, voltages and temperatures in different charging events. The battery system must have a thermal management system that ensures that the batteries do not exceed the temperature range recommended by the manufacturer in conditions of maximum ambient temperature of 40 ° C for a period of 8 hours.
- The battery pack of the vehicle offered must have a minimum capacity of 270 kWh.
- The battery system must comply with the compliance certifications outlined in the section 2.1. Technical Standards.
- The applicant must present a management and reutilization plan of the batteries that allows a second-life use.
- Proposals must include a monitoring system and diagnostic equipment for the batteries of each electric bus.
- The electric traction system must allow the buses to achieve a maximum speed of 90 km/h with a speed limiter set to 60 km/h by default. 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.
- The battery system should be capable of having a storage capacity in kWh that allows an autonomy of 250 km from the average consumption measured in the Braunschweig cycle by discharging the batteries to 20% of their nominal capacity.
- This autonomy should not be degraded by more than 15% during the first 24 months of operation (SOH = 85%).
- The applicant is required to adhere to different minimum requirements for the vehicle itself including:
  - A minimum capacity of 80 passengers (min. 28 seated),
  - A vehicle length between 11.9 and 13.2 meters,
  - A minimum interior height of 2 meters,
  - Accessibility features (e.g. wheelchair access ramp, acoustic signals),
  - Specific design of driver's cabin and passenger area,

- **A harmonious interior and exterior design (including international accessibility symbols and trip information on the outside),**
- **Emergency exits,**
- **Specific windows dimensions,**
- **Ventilation system,**
- **Mirror and light specifications,**
- **Fire detection system,**
- **GPS.**

To ensure passenger comfort, the passenger compartment should be designed in a way that the interior noise under normal bus operating conditions should not exceed a maximum of 72 dBA.

#### 2.1. Technical Standards

**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” (CCS, Combined Charging System) defined in this standard, but the bus shall always admit charge in Alternative Current due to the condition of the local electric infrastructure. For this latter alternative, the buses shall have the option of charging simultaneously with two chargers and shall be able to charge pursuant to standard “IEC 62196 Type 1 or SAE J1772 in alternative current”, making it possible to have simultaneous charge with two connectors.**

To comply with safety and technical efficiency elements during electric bus charging, the suppliers shall meet the following standards mainly developed by the International Electro-technical Commission (IEC), covering both continuous current charge and alternative charge or standard SAE J1772:

- **IEC 61851-1:2017 Part 1:** about the general requirements of the conductive charging system for electric buses. This standard is applicable to equipment with power up to 1000 V for alternative current and up to 1500 V for continuous current, and it includes:
  - The operation characteristics and conditions of the power supply equipment
  - Description of the continuous current accessories for the different charge modes (for further details, see standards IEC 61851-23, IEC 61851-24 and IEC 62196-1, IEC 62196-2 and IEC 62196-3)
  - The specifications between the charger and the bus and its adapters
  - The inclusion of protection devices (including automatic equipment reclosure and cable protection)
  - Tests to evaluate compliance with charging cycles
  - Contents of installation and user manual (standard of coherence in fixed installation)
- **IEC 61851-21-1: 2017:** Conductive charge system for electric vehicle. Part 21-1, which provides the electromagnetic compatibility (EMC) requirements for

electrically operated vehicles in any charge mode (alternative and continuous current) while connected to the electric grid.

- **IEC 61851-21-2: 2018:** Conductive charging system for the electric vehicle. Part 21-2; which provides the electromagnetic compatibility requirements for any component or equipment external to the systems used to supply or charge electric vehicles with electric power through conductive power transfer (CPT).
- **IEC 61851-23: 2014:** about the requirements of the conductive charge system of the electric vehicle; which objective is to provide the control communication requirements between the vehicle and the charge station with an input voltage of alternative current of up to 1000 V and for continuous current of up to 1500 V (They shall meet norm IEC 60038 about normal voltage standards). The objective is to limit the capacitance to protect the environment from electric discharges.
- **IEC 61851-24: 2014:** about the demands of the conductive charge system of the electric vehicle; for digital communication between the continuous current charger and the vehicle. In this regard, there is supportive information in norm DIN SPEC 70121 for Electro-mobility – about digital Communication between a continuous current electric vehicle charging station and an electric vehicle for current control in the combined charging system. Finally, ISO 15118-1 about the communication interface shall be consulted and complied with, since this latter includes the electric battery and the communication controls in both sides of the system: the side of the vehicle and the side of the feeding equipment.

The batteries and their associated systems shall meet any of the following standards:

- **Regulation N° 100 of the European Economic Commission from the United Nations (EEC/UN);** Uniform provisions related to the homologation of vehicles with regards to the specific requirements of the electric power motor group [2015/505].
- **Global Technical Regulation (GTR) EEC/UN N°20, Global Technical Regulation on the Electric Vehicle Safety (EVS).**
  - 1.4.1. Low temperature protection essay, and
  - 1.4.2. Thermals propagation essay.

For batteries and their associated systems, one of the following standards shall be met:

- The battery pack: certified pursuant to **standard 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.
- The vehicle: certified pursuant to **standard JT/T 1026** (Standard with general requirements for urban electric buses in the People´s Republic of China) or any other equivalent standard.

## 2.2. Environmental conditions for operation

The vehicles shall be designed to operate correctly under the following conditions:

- Relative humidity from 5 to 100%
- Environment temperature from 5°C to 45°C

### **2.3. Manuals**

The bidder adjudicated shall submit, together with the bus, the vehicle owner's manual, in Spanish. There shall be at least 4 hard copies per bus.

### **2.4. Chassis**

The chassis or platform of the vehicle shall have, as a constructive characteristic, a total or partial lowering of the floor of the passenger cabin with respect to the horizontal line of the tire center. In the lowered area of the floor there shall not be stair or obstacles, to allow for the free movement of passengers.

### **2.5. Axles**

The axles shall be sized to endure the highest value of static load, equivalent to a fully loaded vehicle. To perform the sizing calculations, a minimal occupation rate of 10 passengers per square meter of usable area shall be used, together with the dynamic loads that correspond to the operation conditions of an urban bus.

The weight per axle of the vehicle offered shall be reported.

### **2.6. Wheels and tires**

The wheels and tires shall be appropriate for the vehicle offered and comply with the internationally accepted standards and dimensions considering weights, environmental conditions, dimensions and functionality of the bus and its systems.

Wheels and tires shall be new and shall be identical and interchangeable among them.

The dimensions and general characteristics of the tires offered shall be specified.

### **2.7. Drive System**

The vehicle shall have a 100% electric drive system that allows for the compliance with the features indicated below.

#### **2.7.1. Components**

The bidders shall describe the drive system with its components, indicating the main characteristics of the engines, battery systems, control, batteries and battery management systems.

The drive system shall include one or more engines, with appropriate cooling systems for operation in urban areas under the environmental conditions indicated above and shall have thermal warning to avoid damage and overheating risks.

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.**

The vehicle shall have a set of batteries that enable the features indicated below, and shall be compatible with the chargers offered, being capable of enduring the currents, voltages and temperatures in different charging events. 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.

The bidders shall inform, in their proposals and in the corresponding factsheets, 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]**
- **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 of compliance provided in section 2.1. Technical Standards of this document.

## **2.8. Minimal features of the vehicles**

**The vehicles shall have a 100% electric driving system to reach a maximum speed of 90 km/h with a speed limiting device configured by default at 60 km/h. In full charge, it shall be capable of accelerating from 0 to 20 km/h in 10 seconds and from 0 to 50 km/h in 30 seconds. It shall be capable of travelling a 20% slope in full charge.**

Power consumption of the bus shall be reported in kWh/km under the following test conditions:

- SORT 1 Heavy Urban Cycle
- Braunschweig City Driving Cycle

The certifications with the results of the tests shall explain the environmental conditions at the moment the tests were made, the initial and final condition of charge in the batteries, the test weight of the vehicle and the average power consumption.

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 and will receive a higher weigh in the technical assessment, as indicated in the corresponding section of this document.

The battery system shall have a storage capacity in kWh that allows for an autonomy of at least 250 km based on the average consumption measured in the Braunschweig cycle discharging the batteries up to 20% of their nominal capacity.

This autonomy shall not be degraded over 15% during the first 24 months of operation, count from the date of reception under the contract of the buses in San Jose, Costa Rica; therefore, the bidders shall guarantee that the State of Health of the Batteries (SOH) shall not be below 85% during the 24 months mentioned above. To verify compliance with this requirement, the information from the battery monitoring and management system shall be used.

## **2.9. Steering system**

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.

The steering shaft shall be adjustable.

## **2.10. Maneuverability**

Radio de giro mínimo: el vehículo deberá maniobrar dentro de un círculo de 13 metros de radio sin que ninguno de los puntos del vehículo se proyecte fuera de la circunferencia de dicho círculo.

## **2.11. Suspension system**

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.

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.

## **2.12. Brake system**

The vehicle shall have service brakes, regenerative electric brakes and parking brakes.

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.

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.

Parking brakes shall maintain the vehicle with maximum load stopped in a 22% slope. It shall remain active when the driver is not present.

### **2.13. Body**

#### **2.13.1. Capacity**

- **Minimum number of passengers: 80**
- **Minimum number of seated passengers: 28**
- **Minimum number of standing passengers: 52**
- **Length of the vehicle: minimum 11.9 meters, maximum 13.2 meters**
- **Floor lay-out: the offer shall include a blueprint with the lay-out of the seat, the location of the access doors, position of the driver, sectors for the location of wheelchairs and their corresponding access.**
- **Minimum internal height of 2 meters, except in the area of the rear shaft.**

#### **2.13.2. Design**

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.

The internal design shall integrate all the internal components and panels in a harmonic way and maintain visual continuity.

#### **2.13.3. External panels**

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.

#### **2.13.4. Floor**

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.

It shall be washable and coated or made with anti-sliding fire-retarding material, and shall have thermal and acoustic insulation.

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).

### **2.13.5. Accessibility**

#### **Height of the steps**

37 cm shall be the maximum height from the road to the first step.

#### **Height between the first step and the aisle**

0 cm

#### **Door operation**

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.

The doors shall have part of the area in glass to facilitate the vision of the driver to the outside of the vehicle.

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.

#### **Door position**

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.

#### **Type and size of the doors**

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.

#### **Acoustic signal**

The vehicle shall have an acoustic signal to alert about the operation of doors, both for opening and for closing.

#### **Sensitivity of the door operation system**

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.

#### **Emergency exits**

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.

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**Access ramp for wheelchairs**

The vehicles shall have, in at least one of the doors, a platform to allow for the access of users with restricted mobility. It shall be manually activated, easy to operate and shall offer safe access with anti-sliding floor.

**2.13.6.Windows and ventilation systems:**

All the glass used in the lateral and rear windows and in the windshield shall be safety glass.

The surface of lateral windows, including the glass surface in the doors, shall be of at least 30%.

All windows shall have an easy-to-open mobile section.

The glass shall be tinted, with a transparency index between 50% and 70%.

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.

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.

**2.13.7.Mirrors**

The vehicles shall have external lateral mirrors. These shall be split, flat and with a convex area in the lower end.

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.

**2.13.8.External information about routes**

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.

**2.13.9.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.

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.

**2.13.10. Driver's booth**

**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

**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.

**Acclimatization of the driver's booth**

Not required.

**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.

**Close circuit TV**

Yes.

**2.13.11. Habitability**

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.

The space of the bus offered shall meet at least the following requirements:

**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:

- 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.

#### **Handrails and handles**

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.

#### **Internal lights**

They shall be LED, white light.

#### **Stop alert**

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.

Together with the bells, there shall be a luminous signal to notify the driver and the passengers that a stop has been requested.

#### **Internal panels**

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.

#### **Internal mirrors**

Each service door shall have a convex mirror to give the driver a broad view of passengers embarking and disembarking.

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**2.14. Fire detection and suppression system**

The vehicles shall have a fire detection and suppression system both in the battery sector as well as in the engine zone.

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.

**2.15. Other systems**

**GPS device for tracking and remote information**

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.

**USB outlets to charge smart telephones**

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.

**2.16. Environmental protection**

**Battery second life and recycling**

The battery system cannot contain lead or use materials that pose a health or environmental risk.

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.

**Noise**

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.

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### 3. CHARGING STATIONS: TECHNICAL REQUIREMENTS

Below is a list of the different requirements for the charging equipment of the electric buses required in the current tender specifications.

As indicated above, the proposals shall include different charging options to adapt to the power supply conditions of the bus stations in San Jose, Costa Rica, considering three scenarios:

- **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.**
- **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.**
- **A higher voltage charge scenario with power fed to 480 Volt three-phase charger.**

**For each scenario, the bidders shall present a charging option.** This charging option shall describe the recharging strategy and the charger to be used. 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.

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.

The manufacturer shall be allowed to choose the most feasible technical solution, taking into account development, manufacturing and operation cost.

Some essential requirements on the charging stations include:

- 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, incl. DC and AC options.
- The applicant must adhere to different norms and standards related to the batteries and charging stations.
- 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%).
- The applicant is required to adhere to different requirements on the charging process, including:
  - **Automatic application of appropriate charging protocol to the battery state of charge,**
  - **Configuration to initiate and sustain battery charging in any SOC,**
  - **Automatic termination of charging when a full SOC is reached or in the event of hazardous conditions,**
  - **Emergency stop,**
  - **Cables of at least four (4) meters in length each,**

- **Connectivity and communication protocol,**
  - **etc.**
- Proposals must include a monitoring system and diagnostic equipment for the charging stations.
- The successful bidder shall deliver several manuals and plans including maintenance plan, installation manual and operational manual.

### **3.1. Basic description of the Feeding System of the Chargers**

The low voltage electric distribution system in Costa Rica is defined by the technical norm “Quality supervision of low and mid voltage power supply” (AR-NT-SUCAL) and its modification in RESOLUTION RJD-205-2015. The charging equipment for buses shall be compatible for their installation according to the references provided below and pursuant to such standard, its modifications and any requirement from the local Enhancement Authority.

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.

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.

The tolerance rates of such values are determined in the local regulations in force.

### **3.2. General requirements for the chargers**

These specifications do not include the total and complete description of all the pieces, materials, systems, services or processes needed to successfully integrate the chargers with the buses. The bidder adjudicated shall be responsible of working directly with the personnel of the Acquirer to ensure that all the aspects of integration and operation are fully adjusted to the local standards and the best practices recommended.

The charging systems shall be able to deliver the optimal battery charging profile according to the specifications of the battery manufacturer, and shall charge the battery of installed power to a full charge status from the minimum charge status recommended by the manufacturer, including the necessary cooling time provided by the battery manufacturer.

Below is a detailed list of the general specifications to be met:

- i. **According to the “Basic description of the Charger Feeding System” mentioned above, and 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.**
- ii. **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.
- iii. 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.
  - iv. 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.
  - v. 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:
    - i. Storage temperature when not in service: -5 °C to 50° C
    - ii. Environment temperature in service: -5 °C to 45° C
    - iii. Relative humidity: from 5% to 95%, without condensation allowed.The equipment shall be installed outdoors, without additional protection to the normal housing of the equipment.
  - vi. 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.
  - vii. The bidder adjudicated shall deliver the following documentation together with each charger:
    - a. 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.
    - b. 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.
    - c. 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.
- d. Troubleshooting: 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.
  - viii. 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.
  - ix. 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.
  - x. 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
  - xi. The bidders and/or manufacturers of the charger shall provide a commercial booklet – Brochure – OnePage – Datasheet of the chargers offered.
  - xii. 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.
  - xiii. 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.

### 3.3. Guaranteed technical information table per charger

Below is a detailed table that each bidder shall present for each of the options of chargers offered. A complete table shall be presented with the technical information guaranteed for the charger, and it shall be signed by the Legal Representative of the bidder.

| GUARANTEED TECHNICAL INFORMATION OF THE CHARGER - 1 of 3 |                                |      |                   |                    |
|--|--------------------------------|------|-------------------|--------------------|
| ITEM   | CONCEPT                        | UNIT | "SPECIFIED VALUE" | "GUARANTEED VALUE" |
| 1  | <b>GENERAL CHARACTERISTICS</b> |      |                   |                    |
| 1.1  | Manufacturer                   | -    | ( *)              |                    |

**Terms of Reference**  
**E-Buses**



|             |   |        |                            |
|-------------|---|--------|----------------------------|
| <b>1.2</b>  | Origin  | -      | (*)                        |
| <b>1.3</b>  | Model (Designated by factory)   | -      | (*)                        |
| <b>1.4</b>  | Connector type  | -      | Type 1 - CCS1<br>(Combo 1) |
| <b>1.5</b>  | Number of connectors / cable  | Units  | (*)                        |
| <b>1.6</b>  | Protection of connector when charging                                 | -      | Blocking system            |
| <b>1.7</b>  | Charging mode (IEC 61851)   | -      | "Mode 3 (AC) Mode 4 (DC)"  |
| <b>1.8</b>  | Meets standard  | -      | IEC 61851 - SAE<br>J1772   |
| <b>1.9</b>  | Meets standard  | -      | IEC 62196 - SAE<br>J1772   |
| <b>1.10</b> | Meets standard  |        | DIN SPEC 70121             |
| <b>1.11</b> | Meets standard  | -      | ISO 15118                  |
| <b>1.12</b> | Operation noise level   | dB/dBA | (*)                        |
| <b>1.13</b> | Intrinsic installation conditions or with the addition of accessories | -      | External (Outdoors)        |
| <b>2</b>    | <b>MECHANICAL CHARACTERISTICS</b>                                     |        |                            |
| <b>2.1</b>  | Body material   | -      | (*)                        |
| <b>2.2</b>  | Refrigeration system  | -      | (*)                        |
| <b>2.3</b>  | Degree of Protection IP   | IP     | 44                         |
| <b>2.4</b>  | Degree of Protection from Impact IK                                   | IK     | 8                          |
| <b>2.5</b>  | Range of operation temperature  | °C     | -5 to 45                   |
| <b>2.6</b>  | Range of storage temperature  | °C     | -5 to 50                   |
| <b>2.7</b>  | Humidity without condensation   | %      | 5 to 95                    |
| <b>2.8</b>  | Assembly type   | -      | (*)                        |

**GUARANTEED TECHNICAL INFORMATION OF THE CHARGER - 2 of 3**

| ITEM     | CONCEPT   | UNIT         | "SPECIFIED VALUE"                        | "GUARANTEED VALUE" |
|----------|---|--------------|--|--------------------|
| <b>3</b> | <b>ELECTRIC CHARACTERISTICS</b>                     |              |  |                    |
| 3.1      | Feeding type  | -            | 1P+PE                                    |                    |
| 3.2      | Feeding voltage                                     | VAC          | 120 +/- 10%                              |                    |
| 3.3      | Output voltage                                      | "VAC<br>VDC" | (*)                                      |                    |
| 3.4      | Maximum input current per phase                     | A            | (*)                                      |                    |
| 3.5      | Maximum output current per connector / cable        | A            | (*)                                      |                    |
| 3.6      | Feeding frequency                                   | Hz           | 60                                       |                    |
| 3.7      | Efficiency  | %            | (*)                                      |                    |
| 3.8      | Total electric power input                          | kW           | (*)                                      |                    |
| 3.8      | Total electric power output                         | kW           | (*)                                      |                    |
| 3.9      | Electric power output per connector / cable         | kW           | (*)                                      |                    |
| 3.10     | Power factor  | -            | (*)                                      |                    |
| 3.11     | Total Harmonic Distortion (THD)                     | %            | ≤ 5                                      |                    |
| 3.12     | Electric protection integrated in the equipment     | -            | (*)                                      |                    |
| <b>4</b> | <b>COMMUNICATIONS, INDICATORS AND HMI</b>           |              |  |                    |
| 4.1      | Human Machine Interface (HMI)                       | -            | Multi-lingual screen (English mandatory) |                    |
| 4.2      | Beacon to indicate status                           | -            | (*)                                      |                    |
| 4.3      | Identification / habilitation system of the charger | -            | (*)                                      |                    |
| 4.4      | Charger-network communication protocol              | -            | OCPP 1.4 or higher                       |                    |

|     |                                    |   |                   |
|-----|------------------------------------|---|-------------------|
| 4.5 | Connectivity                       | - | TCP-IP, ETHERNET  |
| 4.6 | Wireless connectivity              | - | WIFI + GPRS/3G/4G |
| 4.7 | Power meter                        | - | ( *)              |
| 5   | MONITORING AND MANAGEMENT SYSTEM   |   |                   |
| 5.1 | Data acquisition Software          | - | ( *)              |
| 5.2 | Backend management Software (OCPP) | - | ( *)              |

**GUARANTEED TECHNICAL INFORMATION OF THE CHARGER - 3 of 3**

| ITEM     | CONCEPT   | UNIT  | "SPECIFIED VALUE" | "GUARANTEED VALUE" |
|----------|---|-------|-------------------|--------------------|
| <b>6</b> | <b>MAINTENANCE, MANUALS AND GUARANTEE</b>             |       |                   |                    |
| 6.1      | Charger installation manual, Spanish                  | in    | -                 | YES/NO             |
| 6.2      | Charger operation manual, Spanish                     | in    | -                 | YES/NO             |
| 6.3      | Maintenance Plan (Attach), Spanish                    | in    | -                 | YES/NO             |
| 6.4      | Troubleshooting, in Spanish                           |       | -                 | YES/NO             |
| 6.5      | Guarantee for manufacturing defects in implementation | Years |                   | 2                  |
| 6.7      | Guarantee for manufacturing defects since delivery    | Years |                   | 3                  |
| 6.6      | Maintenance included                                  | Years |                   | 2                  |
| 6.7      | Life cycle  | Years |                   | 10                 |
| 6.8      | Spare-parts availability                              | Years |                   | 10                 |
| 6.9      | Free backend management software license period       | Years |                   | 2                  |

|  |
|--|
| <b>6.10</b> Failure rate of the charging equipment - (*) |
|--|

### 3.4. Guarantee

All the charging equipment shall be guaranteed for 24 months after installation.

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.

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.

### 3.5. Support

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.

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.

The didactic materials and step-by-step guides to solve minor operational problems that might emerge during a charging operation shall be submitted.

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.

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.

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.

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### 3.6. Safety

The chargers shall have an “EMERGENCY STOP” in the format of direct punch, duly identified for quick activation in case of an emergency.

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.

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.

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.

### 3.7. Connectivity and Communication Protocol

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 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.

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.

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.

### 3.8. Responsibility of the supplier regarding the installation

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

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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.

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.

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## **4. MONITORING**

### **4.1. General characteristics of the monitoring and management system**

**The applicant is requested to offer remote monitoring tools and diagnostic equipment to provide information and data related to the buses and charging stations. This includes aspects such as:**

- **Energy consumption data,**
- **Battery status (SOC, SOH, etc.),**
- **Charging data (status, duration, consumption, average hours of daily recharge, costs, etc.),**
- **Speed data,**
- **Geo position (incl. latitude, longitude, altitude),**
- **Trip data (distances, races, speeds, times, start/stop),**
- **Number of bus passengers,**
- **Average daily operating hours,**
- **Driving performance indicators,**
- **Availability data for buses and charging stations,**
- **Causes of unavailability,**
- **Consumption of spare parts,**
- **Maintenance data for buses and charging stations and history of failures,**
- **Etc.**

GIZ must have access to the data at any time it requires, which is why a platform and backup system for all collected data is required.

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.

Together with that, 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.

The system shall be capable of exporting data in modifiable formats like .xls, .xlsx, .txt, .csv, etc.

The proposals shall include a monitoring system and diagnostic equipment for the batteries of each of the electric buses offered.

This system shall consider at least the following components:

- Data gathering in the vehicle
- Data transfer
- Data processing platform and back up
- Information deployment

These components shall be described, including at least the following information:

#### **4.1.1. Primary measurements:**

- Voltage [V] and current [A] of each battery pack (sampling frequency 2Hz)
- Voltage [V] and current [A] of the engine(s) (sampling frequency 2Hz)
- Voltage [V] and current [A] of the electric accessories: AA compressor, power steering system, air compressor (sampling frequency 2Hz)
- Temperature [°C] of each battery pack (sampling frequency 0.5Hz)
- Charge status of the battery pack (SOC) [%] (sampling frequency 0.5Hz)

#### **4.1.2. Secondary measurements:**

- Temperature [°C] of battery pack per cell (sampling frequency 0.5Hz)
- Voltage [V] and current [A] per cell of the battery pack (sampling frequency 2Hz)

#### **4.1.3. General**

- Instantaneous speed [km/h] (of the CANBUS no GPS) (sampling frequency 2Hz)
- Geo-position: latitude, longitude, altitude (sampling frequency 0.5Hz).

All the variables shall be measured with respect to time, according to the sampling frequency. There shall be indication if a data gathering device is used or if the information is obtained from CANBUS; and in this latter case, there shall be indication

of whether it is compatible with the protocols of the bus included in the proposal. It is also important to indicate how the data will be transferred.

The system shall calculate the state of health (SOH) of the batteries of each vehicle, indicating the frequency and the methodology used for the calculation. The system shall also be capable of delivering information for predictive maintenance at the level of the cells and the complete battery pack.

The bidder shall indicate who the service supplier is and the type of contractual relationship to be established between them in case of being adjudicated in the bid.

Additionally, the monitoring and diagnostic system should provide data about the following aspects (for charging stations, see the corresponding chapter that comes later in this document):

- Power consumption
- Route data (distances, runs, speeds, time, start-ups/stops)
- Charge effect (number of passengers)
- Daily speeds
- Altitudes (GPS)
- Average daily operation hours
- Driving quality indicators (Driving type effect)
- Slope effects
- Break pressure
- Condition of the doors
- Line or route in which it will be operation
- Number of days with schedule time of departure
- Average daily availability
- Causes of non-availability and most frequent cause for the bus
- Consumption of spare-parts or accessories
- Maintenance costs
- Bus maintenance history
- Etc.

GIZ, and whomever it determines, shall have access to the data at any moment they are required; therefore, there shall be a storage and back-up system for all collected data.

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## 5. TRAINING

To build local capacity the manufacturer should organize a training package, including the conduction of several trainings by technical experts with an emphasis on:

- Personnel training for **maintenance, repair and servicing of buses**,
- Training for **operators and driving instructors**,
- **Driver training** with emphasis on fuel economy and safe driving,

- Training for **Fire Department, Red Cross, Transit Police** and the like with a focus on safety issues,
- Personnel training for **maintenance, repair and servicing of charging stations.**
- Bus deposit **logistics.**

The trainings are to be conducted prior to or soon after the delivery of the vehicles and must include all the curricula material to replicate the training. The trainings should take place at a location, specified by the purchaser before delivery (most probably at the ICE and/or operator's depots). It will comprise teams of a maximum of 10 people per session.

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## 6. AFTER-SALES

The applicant is requested to offer a service package for at least 24 months of operation. This includes:

- **Maintenance plan,**
- **Standard repair time,**
- **Technical support (personnel, electronic, etc.),**
- **Different manuals related to the vehicles and charging stations (for drivers, operators, workshops, etc.),**
- **Diagnosis and other IT tools,**
- **Support on data monitoring,**
- **Information on spare parts and spare parts management,**
- **Support network, communication and organization of after-sales,**
- **Etc.**

For the specific requirements, see the respective chapters of this document.

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## 7. FINANCIAL CONDITIONS

### 7.1 Payment timetable

- a) Invoicing on delivery (full VAT has to be paid)
- b) The deadline for payment should be as early as possible. Unless it is expressly stated otherwise, payment should take place 30 days after delivery and invoicing, but different terms may well be provided for or agreed upon, for example, if local rules or constraints so require or for a program of progress payments. Agreed payment terms are legally binding and must be respected. Delivery and invoicing must follow the vehicle inspection for acceptance. The payment deadline can be adjusted to include the time for vehicle inspection prior to acceptance. In this case and unless expressly stated otherwise:
  - Inspection for final acceptance must take place within 5 working days after availability

- notification, unless otherwise agreed (reception by full lots, daily limitation, pre-series vehicles, etc.).
- Under all circumstances, the acceptance process must be finalised within 30 days.
- When acceptance is fully agreed and without restrictions, the 30-day deadline starts from the acceptance day.
- When acceptance is not reached and the vehicles cannot be operated for valid reasons (e.g. safety, homologation, etc.) the deadline for payments is postponed until the defects are corrected.
- When vehicle acceptance includes remarks or reservations, but does not prevent the

vehicle from entering commercial operations, the purchaser may retain a limited portion of the payment. The level of retention is to be negotiated in accordance with the problems identified, and may not exceed a fixed percentage (for example up to 5 %), unless there are exceptional circumstances, such as that the operators are forced to put into commercial service buses which are not normally operated. In this case the retention can be higher (for example up to 10%).

### 3. Progress payments

The tender may also specify the condition for progress payment if local or internal customer rules do not exclude this method.

### 7.2 Financial guarantees

Several types of financial guarantees may be required by the customer. The intent is to protect the purchaser against supplier failure (bankruptcy, insolvency, non execution of the contract, etc.). It is generally observed that guarantee deposits and retention are used mainly for large risks (new products, introduction of a new supplier, a fragile or uncertain supplier, etc.). Financial guarantees are not to be maintained after vehicle acceptance, unless the tender invitation expressly states otherwise. For instance, in certain cases, if the guarantees are supposed to cover the potential warranty expenses (despite the fact that the European manufacturers book their own reserves according to generally accepted rules) they can be

maintained during the warranty period. The tender must clearly specify the terms, amount and type of the financial guarantees required in order to allow the supplier to incorporate their effect on the price offered and inform the purchaser. The tender must also specify the conditions under which a financial guarantee ends.

### 7.3 Penalties

#### Basic principles

- Penalties should be considered as a positive stimulating factor to fulfil a commitment, not as

“punitive damage” for the manufacturer or as a source of an “extra-revenue” for the purchaser.

- Penalties may relate to delays in delivery or delays in additional duties (such as delivery for product documentation, quality plans, ISO certification and so on). In certain cases penalties can be associated with product non-conformity acceptance and failure to fulfil after sales obligations.
- The invitation to tender must clearly specify the conditions and the limits under which penalties are applied.
- Before the penalties apply, UITP recommends a good faith negotiation. If a new agreement is reached which satisfies the purchaser’s expectations, penalties can either be suspended or substantially reduced. In any event, the penalty amount should be a point of balance between a push towards an efficient solution and the actual damage experienced by the purchaser.

#### Late delivery penalties

The pre-condition for late delivery penalties is the acceptance of a delivery plan with milestones regarding decisions and specifications. UITP suggests that:

- The tender includes a delivery schedule:
  - either a fixed delivery date, which implies that the decision and the official rectification must also take place at a pre-assigned date;
  - or delivery timing, with the freezing of specifications by the purchaser, and the day of acceptance of the vehicles (or the start of operations) as arrival point.
- Any change or modification to the specification originating from the purchaser after notification of the contract may generate - if the required changes are significant - a change in delivery commitments, details of which are to be agreed between the operator and the manufacturer. This procedure shall also define a fixed date for a “stop to any further modifications”.
- In order to be effective, the amount of the penalty can be progressive, for example:
  - Day 1 to 40: 0,05 % per day (per vehicle)
  - Day 41 to 100: 0,10 % per day (per vehicle)
- Beyond the maximum delay determined by the contract, it is recommended that a joint evaluation of the situation is conducted and a decision taken on whether to cancel the contract (and charge the actual damages suffered to the manufacturer), or to apply a new scheme of penalties.
- In all cases, the purchasers must evaluate their own losses or damages as a matter of fact (e.g. lost subventions, lost contracts, delays in starting new lines or businesses, need for replacement vehicles, lost training and so on). The defaulting suppliers can ask for a fair negotiation if they can prove that they have been faced with unforeseen problems (sub-supplier failure, strikes, new technology implementation, etc.).
- If the supplier proposes equivalent replacement vehicles, penalties may be substantially reduced or cancelled.

#### Other penalties

It is recommended that the problem be jointly analysed and a plan of correction be defined with the mutual goal of identifying the critical issues and, when the penalties are related to product non-conformities, acting to ensure the best final product quality.

The recommended process includes:

- Evaluation of actual damage to determine the penalty amount
- Proof of the damage before application of the penalties
- Possibility for the manufacturer to challenge and justify the problem
- Subsequent possible re-negotiation of penalties

It is recommended that the penalty amount, with the exception of those relating to late delivery, is maximized at a fixed percentage (for example up to 4% of total sales value), except in case of bad faith or clear failure to meet the contract.

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## 8. ANNEXES

*Annex 1: EVALUATION MATRIX*