



Attachment 4 - Suburb LRV Reference Design



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1. INTRODUCTION

This Attachment intends to present, in general lines, the reference design of Suburb LRV connecting the neighborhood Comércio to São Luis de Paripe including systems, rolling material, as well determinants that shall be obeyed in the basic design and executive development of this modal. The Bidder shall verify and evaluate the compliance of information, as well as gathering complementary information necessary for knowledge of the issue for elaboration of a Work Plan and a Business Plan.

The Bidder shall, exclusively, conduct sizing of quantitative and LRV works costs, as well as the evaluation regarding partial utilization of existent installations, once it was previously approved by the Grantor. It is established that all risks resulting from the utilization of existing infrastructure are exclusive of the Concessionaire.

The Reference Design presented in this Attachment establishes the minimum parameters for the enterprise execution, enabling the Concessionaire to propose separate conditions in quantity and quality, once it is previously approved by the Grantor.

All elements summarized in this Attachment are, in a detailed form, in the referenced document and in the Appendix. In case of divergences between provisions herein and its Appendix, shall prevail those established in this Annex.

2. ENTERPRISE PRESENTATION

The Reference Design for Suburb LRV foresees the implantation of a Light Rail Vehicle System - LRV, light, modern, between Comércio, at Av. da França and Av. São Luís, in Paripe on an approximate extension of 18.5 km and shall be constituted by passengers transport vehicles over rails, of electric traction, incorporating latest technology on a LRV in order to assure the population with a reliable, safe, fast and comfortable transport system.

The Design main objectives are:

- Implement a new stretch of railway corridor by LRV, connecting the Centro Antigo from the neighborhood Comércio, in the surrounding of the Elevador Lacerda and from Mercado Modelo up to Calçada Station;
- In the current stretch Suburb Train, today in operation by the Companhia de Transportes do Estado da Bahia - CTB (Transportation Company of the State of Bahia), between Calçada and Paripe Stations, reclassify the permanent way and implement all modern and necessary systems;



- Between Paripe Station and along the Av. São Luís de Paripe, reestablish in the railway corridor, existing before and currently deactivated, the new system in LRV.

The design is conceived with LRV circulation on soil level, with vehicles in low floor, passages in strategic located levels to vehicle and pedestrians cross, predicting the implantation and standardization of stops, all equipped with lowered platforms.

3. PROJECT DESIGN

The Reference Design follows the orientations from existing Plans and Programs in federal, state and municipal levels and from Brazilian current standards. In this context, it is important to register some principles and guidelines that guided it, such as:

- Implantation of a collective public transport system of quality, integrated and fast;
- Minimization of impacts from proposed interventions over the traffic flow existing in Salvador;
- Minimization of environmental impacts caused by the urban transport system;
- Attention to the urbanistic concept of the structures set to be implanted in a way to minimize the visual impact;
- Promote low fares to be charged in the metropolitan transport proposed, considering the tariff integration.
- Operational sustainability of system management;
- Physical and/or operational integration with road, railway and not motorized urban collective public transport systems, existing in the Municipalities of Salvador and Metropolitan Region;
- Implantation of a urbanistic treatment along the rail mesh already existing, contemplating sidewalks, crossings, areas for service, parking lots and signaling;
- Implantation of bicycle stands and/or racks, besides bicycle paths and/or lanes and/or bicycle route in the immediate surrounding of stops, where local topographic conditions allow ;
- Improvement in accessibility in the immediate surroundings of stops;



- it shall be predicted a way closing in the stretch Calçada - São Luis in order to assure the operational and user safety, although assuring visual permeability. Crossings shall be predicted in the draft for pedestrians and vehicles through crossings in levels and/or other devices in strategic points of the outlined, respecting the Reference Design and considering the user experience.

Shall be observed other designs under development or in implantation phase by the Municipal Government of Salvador - PMS and by the State Government for due compatibility with the LRV Executive Design.

The reference elements for the development of Basic and Executive Designs has as purpose not only to establish the characteristics and technical specifications that the Suburb LRV System design must observe, but primarily, to establish the parameters for the operational requirements, in minimum terms, that assure the adequate service provision to users and the adequate continuity of physical and operational integration between LRV and other modals in operation in the city.

The Suburb LRV has its outlined guideline developed mainly along the railway mesh already existing, especially in the stretch Calçada / Paripe, where the Suburb Trains system operates and characterizes by the insertion of the connection Calçada/Comércio that shall render from the implantation of permanent way in central worksite from Avenues Oscar Pontes and França.

The conditioning and basic guidelines for replacement of the current trains system were defined and approved by the State Government, contemplating the global and strategic planning from the Metropolitan Region from Salvador. Therefore, the LRV is duly aligned and reconciled with important studies and transport designs in progress for the region, such as:

- Integration with New Transport Corridors: such integration must occur through the Transversal Structuring Corridor, Red Line that interconnects Paripe / São Tomé de Paripe, to the Edge of Salvador.
- Integration with the Metro System of Salvador and Lauro de Freitas SMSL: such integration must occur through the Lapa station of the SMSL (PHASE 2).

Due to the large volume of vehicle and pedestrians traffic in the Stretch Comércio / Calçada it is considered very important the minimization of inconveniences during the construction period, aiming at the use of constructive processes of less impact and of smaller interference with local traffic, should the Concessionaire prepare a Contingency Plan that considers the smaller interference in traffic, specially in main and structural roads.



4. ROLLING MATERIAL

Information referring to rolling material to be used, are fundamental for the establishment of several parameters to be used in the design.

The systems specification was conceived in a way to allow the use of rolling material from main Brazilian and world manufacturers, namely: Bombardier, Alstom, CAF, Siemens, Vossloh, Rotem and other.

Minimum characteristics of rolling material are:

- Acquired as new;
- Composition of Operational Unit (LRV): with minimum capacity for 600 passengers each;
- Lowered floor: between 70% to 100% low floor;
- Movement: Bidirectional;
- Box manufacture material: Stainless Steel or aluminium;
- Equipped with air conditioning.

5. DEPLOYMENT AND OPERATION DESIGNS

The draft and executive designs for implantation, operation and maintenance of the Suburb LRV System to be developed by the Concessionaire shall be object of evaluation and approval by the Government, directly and/or by means of third parties designated by them.

The Government shall have access, in real time, to all designs developed or under development by the Concessionaire, by using only one Information Management System, collaborative in a way to allow the proceeding and approval of documents can occur in a digital form. System implantation, operation and maintenance shall be the Concessionaire's responsibility.

The Government shall judge the pertinence of evaluation and total or partial approval of civil works designs, systems and signaling, control, telecommunication, electrification equipment, rolling material and functional, operational and safety installations. After completion of works shall be delivered the as built in up to 90 days after the beginning of operation in each Operational Milestone. The as built shall consolidate all services effectively executed, all operational equipment implanted and all rolling material made available.



The concessionaire must deliver in up to 30 (thirty) days after the signing of the contract of the works detailed schedule, that shall be resent at each rescheduling made and within a maximum period of 90 (ninety) days, deliver the LRV implantation draft for Grantor's approval.

The Concessionaire shall be responsible for elaborate the Executive Designs of all disciplines component of the transport system to be implanted, as well as obtaining the permissions, licenses and approval of designs with the competent agencies, necessary for the implantation of LRV system.

For elaboration of Executive Designs, must be considered all applicable Technical Standards and Municipal, State and Federal Legislations, also meeting conceptual designs beside the standards and technical specifications from international entities of respective modalities. The delivery of Executive Designs must comply with the previously approved schedule, according to the events schedule, should all civil works designs and the systems corresponding to each works phase be delivered up to 60 (sixty) days before the implantation beginning.

Such designs must use as reference the information and minimum elements presented by the Government in the Reference Design, including files supplied to the bidders in electronic media.

The drawings must contain stamp with signature of the professionals responsible for the design, with their respective registries in Class Councils and designer approval.

5.1 Draft and Executive Designs

The Concessionaire shall elaborate the urban Intervention Draft containing drawings, descriptive memorials, main technical specifications and other technical elements necessary and sufficient to the precise characterization of the work to be executed, meeting the technical Standards and current legislation.

For such, the Basic Solution presented on Appendix A must be used as reference.

Alterations can be presented, provided that offer advantages and maintain or improve the service level and operational conditions of the LRV system corridor, road system and urban mobility. Such alterations must be duly justified and submitted for approval from the Government.

The Draft must be composed of the following elements:



-
- General layout of the enterprise;
 - Geometric;
 - Railway Infrastructure;
 - Drainage;
 - Paving;
 - Contention Works;
 - Urbanization;
 - Landscaping;
 - Draft of boarding and disembarkation stops;
 - Maintenance yard draft;

Once the Draft is approved by the Government, the Concessionaire shall elaborate the Executive Designs of Urban Intervention.

The Executive Designs to be presented by the Concessionaire shall offer a broad and clear demonstration of the solutions adopted containing, at least the following elements:

- Geometric;
- Railway Infrastructure;
- Drainage;
- Paving;
- Recovery or reinforcement design of Special Work of Art;
- Contention Works Design;
- Road Signaling and Safety;
- Public Lighting for the intervention polygonal;
- Urbanization;
- Landscaping;
- Design of boarding and disembarkation stops;
- Maintenance yard design;
- Design of power supply systems, signaling, telecommunications and centralized control

The Executive Designs shall include calculation memories, specifications, service notes and enterprise execution plan considering the logistic question of local traffic maintenance, simultaneously with the service execution, aiming at minimum inconvenience as possible to goods and people circulation during all



the works development period.

It is worth highlight that the operational conditions expected, as expected in the Notice and its Attachments, are minimum requirements.

5.2 Roadmap for Development of the Executive Designs

The development of executive designs shall be conducted by steps, which may occur concomitantly with the execution of another work step previously approved.

After draft approval the Concessionaire shall initiate the development of the executive design, which shall also be subject to approval so that the Concessionaire can initiate the implantation works.

The designs can be presented separately by disciplines, since such methodology offers easiness and agility in the analysis and acceptance by the Government. Such designs shall be delivered according to roadmap established between the parties. However, depending on the design discipline to be analyzed the presentation can occur in only one phase, also with a single acceptance.

The Government must, in the term of 15 (fifteen) days counted from the final design receipt, issue an acceptance or request modifications. In case of request for modifications by the Government, the Concessionaire shall have an extension of term to be defined by the parties to perform such modifications.

All technical documents elaborated by the Concessionaire related to works or designs, shall be of exclusive property from the Government from which shall use according to your convenience. This documentation shall also be delivered in editable media. It is forbidden for the Concessionaire to inform, transmit or give to third parties any data or document prepared or received for the implementation of designs, except with previous express authorization by the Government.

5.2.1 Geometric design

The elaborations of the Geometric Design must follow the DNIT Instructions. In this Attachment are presented the LRV technical characteristics which were used for the development of the respective studies adopting the indicated guidelines speeds.



Except in case of improvement of operational conditions expected, such technical characteristics must be maintained considering as assumptions:

- The LRV shall circulate on an exclusive track delimited next to the road pavement (if exists) by a curb;
- Not segregated way in Calçada-Comércio stretch including intersections in level with urban road on crossings points and in the Calçada-São Luis stretch, way with closing in a material that allows visual permeability in order to provide operational security.
- Shall be provided crossings for pedestrians, LRV users or not, in all stops;
- In the intersections, the ways/tracks must have signposts that allow the LRV to meet its route with normal vehicle traffic.

The Intersections Design has as fundamental purpose to assure the ordenated circulation of vehicles and LRV, assuring safety of operations and maintaining the tracks service level, being necessary when there are intersections, returns and accesses.

For consideration of tracks' geometric design effect shall be considered the following tracks' width:

- Collective transport system (LRV) circulation tracks = minimum of 8.00 m for double track;
- Other vehicles circulation tracks = minimum of 2.80 m;
- Bus circulation tracks = minimum of 3.50 m;
- Circulations and public promenade tracks=- minimum of 1.50 m;
- Bicycle paths and lanes tracks = minimum of 1.20 m by direction;

5.2.2 Drainage design

The drainage design objective is to assure the interception and capture of waters that come or precipitate over the LRV implantation track, assuring its driving.

For the drainage design elaboration must be considered the elements present in the Reference Design supplied and existing register, as appropriate, being allowed the presentation of alternative solutions that keep or improve the driving conditions of the water that reach the way.



In stretches where solutions extrapolate the railway domain track, in addition to the Reference Design, the Concessionaire must present the solutions for due referrals to the Government.

In some stretches are notorious the severe problems in draining the areas adjacent to the enterprise outline not being the scope of the design the general solution but only those related to its polygonal.

The drainage system of the stretch between the Paripe and São Luis de Paripe stops to be implanted must be entirely new, formed by coated canals, channels and longitudinal galleries along the trackbed. Such element must be projected in a way to assure the drainage of permanent way in the region and LRV platform sustainability.

In case the drainage devices existing within the design polygonal are damaged they shall be replaced and those in good state of conservation must be kept at Concessionarie's criterion.

The Stretch 1 (Comércio - Calçada) is inserted in the existing road system intervening with the drainage system that refer the drainage water flow to the sea, through crossing that intersect the Companhia das Docas do Estado da Bahia - CODEBA (Company of the Docks of the State of Bahia) track.

With the LRV inclusion shall be restored the drainage system along its implantation, considering:

- The LRV platform drainage elements itself, such as capture channels, wells visits, passage boxes, deep drains, gutters, longitudinal collector;
- Microdrainage of the road system with the insertion of the LRV;
- The interconnection between two systems: existing and to be implanted;
- Macrodrainage is not part of this Concession escape.

The elements projected shall be constituted according to Standards and/or when it does not have details, according to the Album for Design of Drainage Type Devices, version 1996 of DNIT.

All studies necessary for the designs shall take into consideration the recurrence time of 25 (twenty-five) years.

Macrodrainage is not part of this Concession escape.

5.2.3 Paving design



In the Calçada-Comércio stretch, the adjacent and existing tracks that are used in the design shall have its paving surface recomposed (asphalt resurfacing) when damaged by LRV interventions. Likewise, shall be completely recovered the other components of the road system, for example the horizontal and vertical signaling, curb, sidewalks, fenders, etc, when damaged by the LRV interventions.

In the Calçada-Comércio stretch the paving destined to the LRV exclusive corridors shall be completely executed in interlocked paving (surfacing) and in the Calçada-São Luis stretch the paving shall be executed in gravel ballast.

In all stretches, where there are intersections, the surfacing must be used reinforced concrete of Portland Cement.

Such surfacings can be altered since present advantages in relation to the Reference Design and be duly approved by the Government and competent agencies.

5.2.4 Design of Special Work of Art

I) Periperi tunnel and São João Bridge

The Suburb LRV Design contemplates, as Special Work of Art already installed, the São João Bridge that connects the União and São João stops to the Periperi Tunnel. For such Work of Art, the Concessionaire shall elaborate recovery designs and specific reinforcements, if needed, after all essays, studies and surveys are conducted.

Currently, the bridge supports the Suburb Train operated by CTB - Companhia de Transportes do Estado da Bahia that has metre gauge railway.

The interventions predicted for the Periperi Tunnel shall also be detailed in adequate design and can include recovery works and reinforcement of structural aspects of sealing of surfacing, as well as drainage and enlargement works, among others. For the design elaborations, the Concessionaire shall evaluate the LRV passage dynamic gauge according to the composition model selected. From this evaluation shall be verified the need of tunnel enlargement and expansion during implantation works.

Bidders can present alterations or alternatives in its proposes for recovery of the Special Work of Art that keep or improve the service level and way operation which shall be subject to approval by the Government.

II) Road Viaduct



The LRV Design also predicts, as Special Work of Art, the implantation of a road viaduct in Calçada region with the purpose of minimize the LRV impacts in the region road traffic. The road viaduct Design must be submitted by the Concessionaire to the Government for evaluation and approval before its implantation, observed the Reference Design contained in Appendix A.

5.2.5 Contention Works Design

The contention works are necessary for protection of ways and for the safety of users, assuring LRV perfect functioning and operation.

In all stretch that comprehend Calçada and São Luis do Paripe there is a very large occurrence of contentions in the way domain track limitations and that are completely degraded when not already broken. It is the Concessionaire's responsibility all recovery of existing contentions using the best methods and following the relevant Standards.

As purpose to give better safety to the enterprise, new contention works shall be performed where necessary, according to topographic and geotechnical conditions.

In Appendix A are presented propositions of such elements that aim at assuring the perfect functioning and operation of the road complex due to the adopted conception. Such elements can be altered since present advantages in relation to the Reference Design and be duly approved by the Government.

5.2.6 Signaling Design and Road Safety

The Signaling Design shall be composed of vertical, horizontal and sound signaling or works and auxiliary devices. It must be conducted with the purpose of advise, regulate and indicate the correct and safe form to motor, non-motorized vehicles and pedestrians movement.

The Signaling Design must observe all symbols, captions and diagramation of signs contained in the Brazilian Books of Traffic Signs - CONTRAN, as well as solutions suggested in the Reference Design supplied and those specifically defined for LRV. Standardization that comes to be specifically defined for LRV must be observed.

5.2.7 Lighting Design



For the Lighting Design elaboration shall be used the data supplied by the Reference Design and by design recommendations of the Government. Shall also be observed the ABNT prescriptions.

The public lighting electrical systems shall be supplied by the distribution networks of the power Concessionaire of the State, COELBA, according to standards defined by the Regulation of Consumer Installations of that concessionaire.

Public lighting design along all LRV path must be executed by the Concessionaire.

5.2.8 Urbanization Design

The urbanization design elaboration must follow the orientation supplied in the Reference Design presented by the Government.

The Design shall contemplate the livingness, parking lots and accesses, bicycle paths, lanes, routes, stands and racks areas, located in strategic points defined by potentialities along the intervention.

Shall be implanted bicycle stands with capacity of at least 50 bicycles adjacent to Calçada, Santa Luzia, Suburbana, Plataforma, Periperi and Paripe Stops. The other stations shall count with bicycle racks for at least 10 bicycles, where applicable.

5.2.9 Landscaping Design

Shall be presented landscaping solution in areas affected by LRV interventions.

In the stretch between Calçada and Comércio, if necessary suppression of the vegetation, it shall be recomposed.

The design to present by the Concessionaire shall identify and quantify the preventive and corrective measures of environmental protection that shall rehab and recover the areas affected by the enterprise: support/adjacent areas (loans, deposits, dump, sands, beds, service paths, etc).

5.2.10 Architecture Design of boarding and disembarkation stops

The Architecture Design of LRV System Stops must be in accordance with minimum requirement and with precepts of functionality, accessibility, comfort



and users safety, observed in Appendix A and in accordance with current legislation.

Its dimensioning shall consider the demand elements to be confirmed by the Concessionaire and its evolution within the concession horizon besides other elements of the Reference Design.

Shall predict basic infrastructure for: areas destined to installation of electronic ticket equipment, automatic point-of-sale of tickets, electronic communication system and safety equipment in particular CCTV.

Boarding and disembarkation stops may be central or lateral depending on the availability of physical space and operational conditions proposed.

Boarding and disembarkation stops shall be projected aiming at integration with other modals, predicting in its surrounding, easy access in a way to provide boarding and disembarkation of passengers in a comfortable and safe way.

Foresee, at least 3 (three) physical point for selling tickets (conventional ticket office with clerks) in the vicinity of stops along all the LRV path.

The Concessionaire shall foresee the installations of devices for access control to stops paid areas in a way to rebut the fare revenue evasion.

5.3 Construction site

Can be used the area within the domain track for installation of working site once it is previously approved by the Companhia de Transportes do Estado da Bahia- CTB. The Concessionaire must also submit for approval the “layout” of the construction sites with support facilities such as offices, toilets, storeroom, canteen, mounting center, carpentry center and other facilities.

In all construction sites, where there is administrative area, it must be reserved place for the inspection team of the Government.

5.4 Technical Specifications

Drawings shall contain stamp with signature of the engineer(s) or architect(s) responsible for design, with its CREA (Regional Council of Engineering and Architecture) or CAU (Council of Architecture and Urbanism) or compatible registry and designer approval.

Concessionaire shall adopt all specifications and ABNT current Technical



Standards and those complementary and particular of respective designs and others relevant to these services. Those present on instructions, recommendations and determinations of CTB inspection, environmental and control agencies, and regulator institutes referring to services execution, supply of materials besides defining essays methods and acceptance criteria.

5.5 Final Presentation of Urban Intervention Design

Shall be presented the Design of each Operational Milestone initially under the Draft and CD-ROM form in two copies. After Government exam and acceptance with the inspection support, the Concessionaire shall present the Design in a Definitive Printing and CD-ROM, containing:

- Copies of ARTs (Statement of Technical Responsibility) and/or RRTs (Technical term of Responsibility) from the company responsible for the design elaboration, along with proof of payment to CREA/CAU or correlate registry;
- Copies of ARTs and/or RRTs from the professionals that elaborated each one of the items part of the design, along with proof of payment to CREA/CAU or correlate registry;
- identification of professionals responsible for each one of the items part of the design with full names, their respective registry number at CREA/CAU or correlate registry;

The designs shall be protocolled with the Government. In relation to Urban Intervention Designs, if the Concessionaire considers appropriate, can be presented proposals since of proven better quality, on the Concessionaire's account and risk without impact the implantation schedule.

6. STOPS

The architectural environment of passengers boarding and disembarkation stops is based on current models, duly adapted to local climate conditions in order to assure comfort to user, sustainability and energetic efficiency.

Shall be also considered the visual impact of its insertion in the urban fabric and its landscaping adequacy in the region and its surroundings.

The stops are composed by an elevated platform with enough height so that the platforms and train heights are leveled. The passengers stops shall



contemplate, besides the boarding and disembarkation platform, user information system and other installations that provide a positive experience in transportation for the passenger. Such installations shall be housed against storms, present trash cans for waste disposal and adequate lighting for the volume of passenger and local dimensions.

The cover shall not only assure the users protection regarding storms and the direct incidence of sun rays, as well thermal-acoustic protection.

The stops shall have enough size to encompass the LRV compositions in a way that it does not surpass the boarding platform limit. The size of stops shall also take into consideration the estimated demand for peak hours, according to Attachment 8. To assure minimum comfort for users, one-way stops shall present minimum width of 2.65m. In case of bidirectional stops, shall be respected the minimum limite of 3.45m for width, such dimensions shall be compatible to each stop demand in a way to assure comfort and safety for users, as well meet the recommendations of the Technical Notebook for Urban Mobility Designs from the Ministry of Cities.

7. ENTERPRISE IMPLANTATION AND OPERATION

Enterprise implantation is divided into three Stretches:

- **STRETCH 1:** extension with approximately 3.5 KM, comprised between Comércio and Calçada Stops that encompasses a new implantation of permanent way in area occupied and with road interferences;
- **STRETCH 2:** extension with approximately 1.1 KM, comprised between Calçada and Baixa do Fiscal Stops. This stretch comprises a part of the Suburb Train current path and shall be implanted through requalification of current permanent way for adequacy to the LRV requirements. Completion of segment formed by this stretch and the STRECH 1 corresponds to the Operational Milestone 1;
- **STRETCH 3:** extension with approximately 13.9 KM, comprised between Baixa do Fiscal and São Luis de Paipe Stops. This stretch comprises a part of the Suburb Train current path (between Baixa do Fiscal and Paripe stops), that shall be implanted through requalification of current permanent way for adequacy to the LRV requirements. In Paripe to São Luis segment there was already a railroad operation in the past, however, due to lack of use and recent occupation by the local populations, currently there is no permanent way. In this segment, the way shall be reimplemented for LRV path completion. The completion of STRETCHES 1, 2 and 3 correspond to



Operational Milestone 2.

7.1 Works for Implementation of Superstructure and Infrastructure of LRV Guideways

Stretch 1 has its beginning at Comércio region, at Avenida da França occupying the central worksite, following the Avenida Oscar Pontes up to Avenida Jequitaia, reaching Largo da Calçada up to Calçada Stop.

In Stretches 2 (Calçada Stop - Baixa do Fiscal Stop) and 3 (Baixa do Fiscal Stop - São Luis de Paripe Stop), the LRV ways are implanted in the current railway line trackbed with due adaptations, expansions and improvements of geometry at the plant and in a level to meet the specific conditions of LRV trains.

The removal services of all permanent way existent (ballast, dormant, rails and overhead grid) are under the Concessionaire's responsibility. It shall stock dormants and rails suitable for reuse and unused by the Concessionaire in a area to be defined by CTB, being its final destiny consequently under the CTB's responsibility.

7.1.1 Stretch 1

In Stretch 1 between Comércio and Calçada, the LRV way shall be implanted along the road system existing which shall be readequated in a way to assure free flow traffic capacity of vehicles that transit through its influence area.

For the LRV superstructure, the Reference Design considered the implantation of permanent way with ballast in reinforced concrete structure and throat-type embedded trails .

On the subgrade shall be assured the adequate conditions of support, considering the geotechnical conditions existing in each region, duly dimensioning the tickness of subgrade layer, specification of materials to use and implementation conditions.

The rail fixation shall be elastic with electric insulation to assure the functioning of the LRV signaling system. The AMVs are electrically insulated to meet the signaling system and have remote driving system of the needles movement switch machine.



7.1.2 Stretches 2 and 3

In Stretches 2 (Calçada Stop - Baixa do Fiscal Stop) and 3 (Baixa do Fiscal Stop - São Luis de Paripe Stop) are implanted with a superstructure in gravel ballast, composed by Vignoles-type rail seated over dorments supported on ballast.

The Reference design presented on Appendix A suggest the gauge change from 1.0m to 1.435m, however it shall be allowed, at the Concessionaire's discretion, the adoption of the metre gauge railway.

Considering the current state of the track, it shall be foreseen the implantation of a new ballast layer.

The dorments and rails shall also be replaced by new ones. In case the Concessionaire identifies the possibility of using part of those existing, it shall be evaluated and tested for CTB approval.

The Track Switching Devices - AMVs shall be electrically insulated to meet the signaling system and have remote driving system of the needles movement switch machine.

Shall be conducted the following services for system modernization:

- Disassembly and removal of overhead grid from the power distribution existing;
- Disassembly and removal of grid from the permanent way existing;
- Recomposition of sub-ballast and base, where necessary, in a way to assure support to the implantation of the permanent way;
- Implantation of a ballast layer;
- Grid assembly;
- Drainage execution;
- Assembly of overhead grid;
- Execution of technical ditches.

7.2 Works for Implementation of Stops

The stops shall be in central or lateral platform, such definition shall be taken due to ways alignment, assuring the attendance to accessibility of people with reduced mobility (NBR 9050).

All stops existing in the suburban train shall be demolished for implantation of



new ones.

The stop should be provided for future closure in panel with covering and all installations needed for its operation, such as: electrical, hydraulic, lighting and systems.

In Stretch 1 between Comércio Stop and Calçada Stop are foreseen the following Stops:

- Comércio;
- França;
- Porto;
- São Joaquim.
- Calçada;

In Stretch 2 between Calçada Stop and Baixa do Fiscal Stop is foreseen the following Stop:

- Baixa do Fiscal

In Stretch 3 (Comércio - Calçada) are foreseen the following Stops:

- Santa Luzia;
- Viaduto da Suburbana;
- Lobato;
- União;
- São João;
- Plataforma.
- São Brás (Mocotó);
- Itacaranha;
- Escada;
- Praia Grande;
- Periperi;
- Setúbal;
- Coutos;
- Paripe;
- São Luís de Paripe Stops, at the end of the stretch.

7.3 Works at Road System



In stretches where the LRV domain track interferes with local road existing, it shall be adapted in a way to allow the LRV implantation. In Stretch 1, LRV shall circulate on an exclusive track delimited next to the road paving by a curb. In stretches in which the LRV track cross the road system or on passages on access level to surrounding properties, the LRV track shall be projected to allow road vehicles circulation over it.

Theses works include: new geometry of ways, demolition and construction of guide and gutters, recomposition of public sidewalks impacted by works, demolition of central worksites existing and implantation of new ones, enlargement and/or narrowing of way existing, paving extension and concordance, regularization of paving impacted by works, recomposition of geometry in corners, execution of horizontal signaling of road, passages of level for entrance and exist of surrounding buildings, for crossing of way and special accesses such as, for example, Ferryboat System and to the Passengers Terminal, Federal Police station and others, passages of level for LRV crossings, passages of level for return in the road system existing, implantation of contention lateral walls on unevenness between the road ways and the track occupied by the LRV, where applicable.

7.4 Relocation of Public Services Network

Shall be performed deployment of public services networks that interfere with the LRV implantation track, such as potable water networks, sanitary exhaustion (including interceptor along Avenida da França), lighting systems, power feeding networks in medium and low voltage, buried and overhead highways, among others, if any.

The public services concessionaires' registries are presented in Appendix B, and the bidders should confirm the information made available.

7.5 Operational Milestones

Are foreseen two OPERATIONAL MILESTONES that are detailed in Attachment 5 - Implantation and Operation Plan - PIO, knowing:

- **Milestone Operation 1** - consist on the LRV Operation in Stretches 1 and 2, comprised between Comércio and Baixa do Fiscal Stops, being this the first stretch to be operated by the Concessionaire.
- **Milestone Operation 2** - consist on the LRV Operation in Stretch 3,



comprised between the Comércio and São Luis Stops.

8. MAINTENANCE YARD

The LRV Maintenance Yard was predicted in Periperi area, where already operated a Railway Maintenance Yard with area sufficient for implantation of necessary building in LRV system full operation. Other building and railway system elements existing that interfere with the proposed Yard implantation shall be demolished and removed.

The area of Calçada Yard used by Suburb Train, including the Calçada Station building shall be object of associated design to be presented to the Grantor respecting the standards of conservation and restoration. The associated design must be elaborated according to specified in Contract.

All rolling material and equipment existing in operation or not, shall be removed by the Concessionaire and deposited on a place indicated by the Grantor in order to release the areas for LRV implantation. The LRV yard internal tracks shall be in gravel ballast with concrete dorments.

The program foreseen for the Maintenance Yard consists, at least, on the implantation of the following structures:

- Two accesses for the compositions;
- Track for parking lot of all compositions for the functioning of the total stretch;
- Compositions' wash way including internal daily cleaning spaces, external mechanical cleaning and vehicle blowing;
- Circulation track;
- Ambulatory;
- Cabin;
- Reception;
- Administration;
- Operational Control Center - CCO;
- Landfill;
- Water reservoir;
- Reservoir for rainwater accumulation;
- Flammable deposit;
- Cafeteria / Restaurant;



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- Rectifier substation;
 - Civil maintenance workshop;
 - Permanent way workshop, overhead grid, auxiliary vehicles;
 - Warehouse;
 - Trains maintenance blocks, mechanic, electric and electronic workshops with technical gap for inspection and maintenance under the train with capacity for a complete composition;
 - Building for conductors, cleaning, dressing room;
 - Automobiles parking lot;
 - Open air storage yard.

Shall be contemplated in design the areas of parking lot of the compositions that are not in use and for vehicles under maintenance.

Shall be also foreseen all installations of utilities necessary for the functioning of the Maintenance Yard, such as: potable water supply system, industrial water, pipes for compressed air, sewer system, lighting and power, gas, CCTV, ADPS, ventilation and exhaustion, system of protection and fire fighting, pipe for voice and data system, etc.

Maintenance Yard can be performed in steps in a way to meet the Operational Milestones.

8.1 Maintenance Yard Workshops

Shall be performed all infrastructure necessary for installation and functioning of equipment from workshops, including wheel lathe. Supply and installation of equipment/tools/furniture from the Yard workshops shall be the Concessionaire's responsibility.

8.2 Permanent way

The permanent way shall be composed by Vignoles-type rail supported over dorments supported on gravel ballast.

8.3 Drainage works

Shall be implemented in the Maintenance Yard a drainage system that allows to assure the water precipitate flow over this area.



8.4 Road System of Access to the Yard and Internal Circulation

Shall be foreseen the access to the Maintenance Yard from the external road system existing. Internal ways shall allow the interconnection of different buildings that comprise the Yard and are compatible with heavy vehicles traffic.

9. GENERAL DESCRIPTION OF SERVICES FOR IMPLANTATION

9.1 Removal/Relocation of Interferences

The relocation services performance in the LRV intervention track aims at adequacy of all possible interventions with the public service concessionaires assuring its preservation after work implantation.

Has as purpose to leave the LRV occupation track free and clear of interferences for the implantation of its structure, there is, planning the use of subsoil in a way to preserve the systems existing and its interfaces, besides assuring safety in the phase of execution of works avoiding downtime in public services.

The Concessionaire must observe that for the relocation solution proposed in design is confirmed along with the service supplier company in a way to be planned avoiding possible interruptions. Before the beginning of any adequacy in the service networks, the design shall be formally approved by the concessionaire responsible for the public service and presented to the Government for authorization for the service to begin.

The networks that interfere with the LRV project shall be replaced for adequate places. At the works moment, when verified the need to relocate a network, identified or not in design, the respective service concessionaire shall be informed.

The proponent shall prevail in its Business Plan resources sufficient for relocation, deployment or removal of all interferences found in step of LRV implantation, as well as performing own studies to map other possible interferences that shall be its only and exclusive responsibility. The documents present in Appendix B - Interference are reference for studies, should the proponent perform the complementary surveys for pricing of interferences existing in the track. The discovery or occurrence - at any time along the concession of any interferences not foreseen shall be considered the Concessionaire's exclusive risk.



9.2 Traffic Diversion

It should be provided for Stretch 1, between Comércio Stop and Calçada Stop, temporary diversions that ensure the movement of vehicles in the region during the various stages of implementation of the works.

The implementation of traffic diversion in the areas directly affected, must follow the guidelines presented in the design, including:

- Diversion alternative geometry;
- Signaling and safety devices;
- Steps of diversion implantation.

Due to the closing of some returns, the opening of new streets and changes in direction sense, intervention of vertical signaling can extend along the adjacent streets to the outlined specially the indicative signaling and direction senses.

The traffic light system existing shall be provisionally adequate regarding the implantation of traffic diversion and returned to its original or definitive status after the return of the definitive traffic.

Proposed diversions can adequate to the attack plan and works schedule according to the need of traffic peak hours. It is important to provide that for some places, it must be noted an attack sequence so that the road joints are maintained, although with certain restriction of capacity, which is inherent in the implementation of a work on a main road system.

Before the execution, the Concessionaire shall prepare Traffic Diversion plans, Works Signaling for approval from the Municipal Government of Salvador.

The Concessionaire must foresee the insulation of construction sites of the traffic of vehicles and pedestrians by installing specific elements available for this purpose.

9.3 Social communication

The overall purpose of the social communication program is the implementation of official channels for dissemination of activities of the enterprise, with the creation of an interactive system with the interest groups and institutions, in order to achieve the leveling and democratization of information and enable the public involvement and participation in efforts to them and aimed at creating a positive image of the enterprise and its benefits, especially the negotiation



process of real estate vacancy.

10. SYSTEMS

10.1 Power system

The design of the electric power supply system of all parts (Comércio/São Luis de Paripe) is guided in its design, by the optimization of the benefit-cost ratio of the facilities, within the reliability standards required by a mass transport system with the features of the Light Rail Vehicle (LRV).

The location of substations shall consider the area available for installation close to the route of the line and the proximity to the concessionaire power utility substations. Once defined the substations place, it shall be presented to the Government for previous approval.

The rectifier substations will be responsible for the reliable and secure supply of traction power, needed to train circulation in permanent track and Maintenance Yard.

It should be provided for an automatic transfer of power system between the electrical sectors in the case of under voltage in one of the inputs of the power utility company, as well as interlocks between the input circuit breaker of the utility company in order to avoid the parallelism between substations.

The power supply to power the trains will be made by rectifier substations, located nearby the stops (in the proportion of a substation every two stops). The system rated power and the distance between substations must be planned according to cars composition and operation headway aiming at power stability.

Shall also be installed a rectifier substation in the interior of the Maintenance Yard that shall feed the lines internal to the Yard and the initial stretch of the main way in the surroundings of Calçada Stop with independent sectioning for the Line and for the Yard.

The supply of power for the trains shall be done by overhead grid in continuous current feeded by mediation of extra fast circuit breakers and counters of rectifier substations. The current return shall be done by bearing trails with the interconnection of four trails of two tracks in parallel.

The power supply of the stops that do not have the medium voltage system will be made independently and directly from the Low voltage distribution network of the local electricity power company.

The stops that will receive direct feeds from the local power utility at low voltage (220/127 Vac), will feed the General Switchboard (QDG), which in turn, will feed



only the loads of these stations. In the Maintenance Yard should also be provided for the entry of Diesel Generator Set (GGD) to be installed, which will assume the essential loads in the event of failure of the main power.

Shall also be considered in the power system the implantation of a No Break. The emergency feeding system - No Break, has as purpose to supply continuous, stable and centralized electrical power to the several Telecommunication Systems, Special Systems, Traffic Signaling System and Signaling System installed in the stops, substations and CCO, protecting the equipment of any variation or lack of power from the local electric power concessionaire.

During the design elaboration, shall be drafted and supplied to the Government the gear simulation studies, traffic simulation and electric simulation that shall, among other, give necessary support so the system is dimensioned on a more economic form.

10.2 Overhead grid system

Shall be elaborated a design of a overhead grid that shall be responsible for electrical traction feeding of the LRV system. The overhead grid is composed by a contact wire supported by consoles to one or two ways or by portico in case of zones with track switching devices, stops and Maintenance Yard.

It will be used across the line, the conventional self-tensioned catenary system. In the executive design to be developed by the Concessionaire, the displacements of the catenary (zig zags) will be chosen, depending on the curve radius and the allowable range of separation of the pantograph axis in the support and in the middle of the span, as well as the relative position of the utility pole in the centers of the tracks switch devices.

The overhead grid shall consist, at least in the following materials and equipment:

- Cables and contact wires using conventional catenary;
- Devices and supporting structures with insulators and fastening devices for the regions of the stops platforms;
- Utility poles for support of catenaries in open air tracks including anchor bolts and fixing devices of the utility poles to the bases;
- Complete suspensions, consisting of cantilevers and insulators;
- Contact wires, connection cables;



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- Cables for grounding;
 - Sectioning of catenary;
 - Complete anchoring structures;
 - Electrical interconnection cables between the contact lines or between the line and disconnector, and voltage sensors, with their respective connectors;
 - Other cables necessary for the proper performance of the overhead grid;
 - Facilities and accessories for cable connection in general;
 - Insulating protection cover of rigid overhead grid in special places;
 - Clamps or connecting plates and link connectors with power supply cables and electrical continuity of the contact line;
 - Switch-gears of complete manual triggering complete for the line and line transition / yard (overhead grid and return);
 - Lightning rod, spark igniter type, for lightning protection in exposed parts;
 - Surge protection devices on power cable connections from the substations in the overhead grid.

The overhead grid distribution system will be designed following simple construction guidelines, easy maintenance and high reliability. The main operational concept is to divide the network into several parts, delimited by sectioning through air blade or section insulators, whether kept connected or not by disconnecting switches, monitored by the CCO. The optimal length of the sections will be made to adapt the linear resistance of the grid, in order to enable good detection by the extra-rapid protection devices, short-circuiting on the line.

The executive design should provide that operations are oriented with a view to the need to connect or electrically insulate sections of the overhead grid, within pre-established sequences. Thus, it safely allows the search and insulation of permanent defects on the line, execution of temporary services in the grid or release the temporary movement of trains on single track, due to degraded operation.

In Stretch 1 shall be adopted poles for catenaries with different aspect that are in accordance with the region's tourist potential reducing the visual impact of equipment in urban landscape.

The distribution of the rectified current will be carried out separately by direction of the track, so you can turn off or feed one direction of the track without doing it on the other. However, in case of operational need, both directions may remain



electrically connected, through equalizing contactors.

10.3 Telecommunication Systems

The Telecommunications System to be deployed in the Suburb LRV will have as main goals to support the voice communication, data and images for the perfect operation, maintenance and administration of the LRV, ensure security levels, fast service in emergencies, ensure operational performance and structure the media to enable a dynamic interaction between the various systems that will be deployed in the Operational Control Center (CCO) - Maintenance Yard, boarded in the LRV, boarded in the Auxiliary Vehicles, the Yard, the stops, the substations, on tracks and in environments where the LRV will pass.

The Telecommunication System will foresee the adequate interfaces of hardware and software to assure perfect system operation.

The Telecommunication System is divided into the following subsystems, specified on Attachment 5 - Implementation and Operation Program:

- Telephony;
- Digital transmission;
- Radiocommunication between rolling material, stops and operations center;
- Chronometry;
- Sound System - stops and rolling material;
- Stops control and supervision;
- Voice recorder.

10.4 Signaling and Control System

The LRV driving will be made through "Running on sight" all the way from the main track. Thus, the Signaling and Control System (SSC) must ensure the LRV Movement along the main track, stop at intermediate stations and maneuvers in the final Stop. The LRV driver is responsible for the safe driving of the vehicle throughout the main track, and must drive on sight, guided by the side signals installed on the edge of the track, adjusting the speed to the conditions that are present.

The Signaling and Control System - SSC should be designed to allow the safe



movement of LRV's in the regions of AMVs.

The inherent conditions of the permanent track such as civil speed limits, radii of curvature, longitudinal gradients (ramps), precise positions of signaling equipment installed on the track, regions of AMVs, platforms positions with their extensions with the stop points provided for LRVs will be clearly defined in a Signalized Tracks Plan - PVS.

All information represented in the PVS, along with the LRV conditions (Braking, Acceleration, "Jerk," Speed, Maximum Speed, Length and Reaction Times), associated with the operational dynamics of the system, such as destination of the LRV, possible routes, blocks situations ahead, braking profiles and existing restrictions, should allow safe traffic across the section, even under adverse conditions wheel/rail grip existing in the section, caused for example by atmospheric precipitation.

Under normal operating conditions, the movement of LRV's all along the section of the main track and their interface with the Maintenance Yard and Parking Lot, should be supervised by the Operational Control Center, across the stretch.

10.5 Traffic Signal Control System

The Traffic Signal Control System is responsible for the road traffic control around LRC, providing interface with the LRV Signaling and Controle System integrating the opening and closing time of traffic lights to allow LRV priority, essential for the operation and to what determines the forecast for trains travel time.

Through video cameras shall be conducted the monitoring by images of all LRV axis, of different spaces in the Maintenance and Parking Lot Yard, Stops, Rectifier Substations and along the track, in intersections with the public road. The CCO Controllers shall be based on vehicles traffic status in its covering area and the information of LRV compositions positioning in the roads to operate with safety the traffic lights control system.

The operation of each LRV vehicle shall be performed by its driver which shall be responsible for all LRV's acceleration, braking, opening and closing of doors commands. Thus, the Traffic Signal Control System must be developed in a way that assure high availability and reliability. The Traffic Signal Control System and other systems integrated to it shall also be capable of enable the traffic light priority of the LRV, enabling the trains to have priority in intersections of road level.



Shall be the Concessionaire's responsibility the implantation of the Traffic Signal Control System as well as the articulation with competent agencies regarding its deployment. Possible delays in implantation of traffic light priority, once not attributable to the Concessionaire and proven the diligent acting on obligations that belong to the competent agencies, are not passible of punishment in the PPP Contract scope.

Anticipating that the images of intersections with public roads can be viewed through Transalvador - Superintendency of Traffic and Transportation of Salvador, an agency of the Municipal Government of Salvador, will be made available via optical port located in the telecommunications room of the Maintenance Yard.

The configuration of the computer system of traffic control must allow any operation terminal to operate in either system controllers. This system shall also be designed in a way to allow future expansion, if the LRV stretches are implanted.

11. OPERATIONAL INSTALLATIONS

In line course will be installed some Track Switching Devices - AMVs, in order to facilitate the activities of commercial operation in stages, all of them with remote electric control. All AMVs along the line, as far as installed at the end of the line for reversal will have remote electric control, the CCO, or in case of failure of local manual control. Exception may be used for the AMVs in the entrance of maintenance workshops that can have manual control only. The AMVs in the entrance of the vehicle parking lot in the Maintenance Yard should be electrically controlled, to be commanded by the CCO.

11.1 Operational Control Center - CCO

The structure of LRV management and operational control services shall have the support of the Operational Control Center - CCO with all the elements necessary for its operation, capable of supply adequate conditions to the team that shall conduct the tasks of logistic support to the LRV operation management and its patrimony. CCO shall allow the management of all LRV operations in a way to assure its effectiveness, efficacy and efficiency within the resources allocated and is fully operational before the beginning of commercial operation.

All CCO must be equipped with air conditioning and must be designed to



comprise all of its work positions with ergonomics and comfort adequate for the fulfillment of its functions. Shall be respected the screen, acoustic, lighting and screens luminosity and projectors installation standards. The CCO implantation design shall also foresee the creation of a meeting room with the operational areas. This room may be used as “crisis room” to conduct meeting for decision making in case of issues or important events during the LRV operation.

The CCO installations shall foresee the physical space capable of shelter people and electronic equipment of communication that use informatics resources to process and store data received from the LRV and transform them in information perceptible to its operators, such as video, tables and radiocommunication monitors, telephony and telecommunications devices besides mimic panels.

CCO shall be integrated with public utility services to ease the immediate acting in case of accidents. Public services integrated shall include Military Police, Fire Fighters, Civil Defense, etc.

CCO shall count with a system capable of receiving operational and physical data, process, transform them into information and distribute them to other systems, subsidising the decision making process, the actions and elaboration of managerial reports. This system structure shall enable the management, supervision and control of everything that happens in the LRV and still, allow, permanently, its verification by Inspection by means of inviolable registries.

This system shall, still, dispose of element of support to decisions on maintenance interventions and patrimony conservation with possibility to transmit to the responsible teams request of action over the need of elements cleaning, solution for technical problems in equipment or replacement of devices in installations.

The system used in the CCO shall allow to turn on, turn off or set all operational equipment installed in stops, yards, permanent way and trains in real time, due to the preestablished programming functions and the operational needs. This system functionalities shall be grouped by a subsystem, divided into workstations according to predicted in LRV Implantation Design. CCO must be capable of monitor and act in the traffic light along the LRV path.

The Control Systems Designs shall allow its logic and physical expansion, there is, enable the increase of its capacity of acquisition of controlled points, of processing and storing, as well as the implementation of new functionalities. CCo must be configured in a way that any simple fault does not cause its operational unavailability. In the case of a fault shall occur the automatic switch of the damaged unit to another in a maximum period of 2 seconds without



downtime of the operation system.

Shall be supplied and installed, in places determined by CTB, the Monitoring and Control Central of the managing entity with all equipment, software and material necessary to its installation and accommodation. These equipment shall be used for monitoring of operational information herein specified. The work stations shall be connected to the system communication network and allow the access to its data base, in real time, for researches related to the operational occurrences.

Shall be also supplied all software used and its respective use license.

The Concessionaire shall provide all interfaces between the control system and the other systems as well as assuring its interoperability. All types of interfaces used shall be presented and submitted for Grantor's acceptance. The communication interfaces shall have electric insulation, protection against transitory, noises, electromagnetic interference and protection against improper operation. The communication interfaces shall be conceived aiming at meeting the safety and functional, availability, reliability, connectivity and other requirements herein. The use of proprietary protocols is not allowed.

The communication protocol shall be open, commercially used in the market and allow total interoperability between equipment and system, regardless the development platform, including in interfaces with other systems.

The control system shall be capable of provide daily reports with operational information to the Grantor. Shall be provided the resources necessary for the transmission, storage and handling of such information in the dependencies defined by the Grantor.

Shall be foreseen the resources necessary to the correct operation of the Centralized Control System - SCC. Such resources shall be compatible with open pattern technologies and industry standard equipment in which shall be in accordance with the "State of Art" for the technology sector of information, in terms of software as well in terms of hardware.

The Centralized Control System to be proposed will be based on current and proven technologies, applied in Metro-railway and LRVs systems, and applicable certifications. All developed systems will follow the applicable rules and standards for software engineering established by the Institute of Electrical and Electronics Engineers (IEEE), World Wide Web Consortium (W3C) and Object Management Group (OMG), especially for use of the standards "Systems Modeling Language" (SysML) and Unified Modeling Language (UML).

This system design gives the requirements to be met during all stages of the



supply and implementation of the SCC, comprising a systemic view of the Centralized Control System, Scope of Supply, Operational Requirements, Functional Requirements, Technical Requirements of the Design and the Technical Requirements for Subsystems and Equipment.

As a premise to be adopted, the CCO will be powered from an exclusive Uninterruptible Power System in order to meet its operating needs. The characteristics of the Uninterruptible Power System are described in the Drafting of the Electrical Feeding System.

The SCC must have characteristics of high availability and reliability system characteristics and control the transport system through commands sent to the field devices, these commands are defined from predetermined goals, such as the interval between LRV and stop times at stations, depending on the operational characteristics of the rolling stock, the system must provide information to the LRV operator to assist in maintaining the goals and strategies scheduled for the operation.

SCC shall include functionalities that allow:

- Control System and Regulation of LRVs;
- Yard control
- Track energy and yard control;
- Auxiliary equipment control;
- Collection control and passenger flow;
- Administration and services;
- Offer programming;
- Support to maintenance;
- Traffic light control;
- Telecommunication.

The SCC must enable the automation of routine tasks, so that operators can perform strategic, contingency and communication functions.

The supervision and control of the power system, auxiliary equipment and LRV drive process must be exercised primarily from the SCC, allowing the running of all functional and operational requirements established herein. There should be local resources in substations and along the track to allow control of power systems and auxiliary equipment due to operational strategies or contingencies in the system.



11.2 LRVs Maintenance Yard and Parking Lot

The buildings in the Maintenance Yard should provide for compliance with the Preventive and Corrective Maintenance activities of the LRV System in its essential components: vehicles - LRV's, fixed systems and permanent track. The buildings should include the following systems:

- Power Supply System;
- Electromechanical systems;
- Electronic Systems.

The LRV's parking lot will have enough space to contain all fleet necessary for compliance with the transport capacity of the Line, for the Design's scope.

11.3 Maneuver Yard

Over the section of the permanent track, parking lots/maneuver should be deployed, in order to optimize the storage of the compositions in launching strategic locations of the same operation.

A mandatory deployment yard should be located on the Platform, in the vicinity of where today is the current Almeida Brandão Station. This yard will provide the performance of the maneuvers relating to the operation in isolated carousel Comércio-Platform. Another mandatory implementation yard should be located in Periperi, in the area around the current station of the same name.

12. EXPROPRIATIONS

According to the Reference Design, a small amount of building that can be demolished was identified.

Occupations along the domain track are not subject of expropriation since it is a land of Federal Government's property. However, the families that have occupations removed as result of LRV implantation/operation must be indemnified by the benefactors. The registration work of real estate and media is the Concessionaire's responsibility, as well as all actions to that area to be free and clear.

Between the Paripe - São Luis de Paripe Stops, where there is a dense irregular occupation along the right of way of the LRV, it not has expropriations, since the occupation came erratically on area belonging to the Federal Government, in this situation should be implemented relocation procedures or other appropriate legal measures.



Before the concession assumption by the Concessionaire, the Government shall be responsible for providences necessary to the statement of public utility of real estate necessary for implantation of Subway System involving area complementary to the LRV implantation.

The Concessionaire shall comply with the applicable legislation provisions, promote expropriations, administrative servitude institutions or administrative limitations to the right of property, amicable or legal providing the expropriation of referred to areas, always submitting its planning to previous acceptance of Inspection regarding its terms.

The CONCESSIONAIRE shall present to the CTB a social-economic registry of owners or occupants of affected areas, physical registry detailing the properties according to title situation specifying the extension, by property of affected areas and other information that CTB considers relevant.

If the Concessionaire, in the Design development, identify other areas to be expropriated in a way to offer some operational gain to the system or even elimination of critical points, such study shall be presented to the Government for approval.

13. ASSOCIATED INTERVENTIONS

Besides necessary interventions for the implantation of Suburb LRV are foreseen works of social nature to be conducted in the Centro Antigo de Salvador - CAS (Old City Center of Salvador) according to present on Appendix D.

The Concessionaire, based on content presented in this item and in designs referred to Appendix D shall present to the Grantor the executive design and budget detailed for its approval on a 12 months period, counting from Contract signature with the limit of BRL 48,000,000.00 (forty-eight millions of reais) (base January/2017) for the performance of interventions.

The implantation of interventions by the Concessionaire shall observe the schedule approved by the Grantor.

13.1 São Dâmaso Real Estate Recoveries

The Concessionaire shall perform works of reform in old real estate for production of housing directed to public servants, located in the Centro Antigo de Salvador. This is a liability of extinct Monumental Program from which there are thirty real estate to be recovered.



13.2 Relocation of Families in Social Risk - Frontspiece Hillside

Production of social housing in vacante CAS areas for attendance of known demand of families in social risk, for example Chácara Santo Antônio, from Participative Rehab Plan from the Centro Antigo de Salvador.

The enterprises are: Water Center (49 housing units - Avenida Jequitaia, no. 217) and Attachment Water Center - Porto Salvador (32 housing units - Avenida Jequitaia, no. 215).

13.3 São Dâmaso Parking Lot

The preliminary study developed for the parking lot was elaborated to attend the housing and economic demands from São Damaso / Historical Center. The architectural environment adopted used the court core, subsoil and the volumetry maintenance existing. In its surrounds there are designs under development for housings.

14. SOCIAL TECHNICAL WORK

The Concessionaire shall elaborate and, after approval from Granting Power, execute the Social Technical Design (PTS) with the population struck by the Suburb LRV Design with the purpose of developing support actions and strengthening to effective participation of beneficiary families in the modal implantation, through the activity of promoting social and productive inclusion, in view of assuring the design sustainability.

For such shall propose in PTS mechanisms capable of enabling the participation of beneficiaries in decision, implantation and maintenance of goods and services processes, in order to adequate them to the needs and reality of social groups attended as well as encourage the participative management.

Social technical Work must begin right after the Contract signature and extend for a period of six months after completion of works.

Its execution comprehends the following phases:

- Pre-works: starts at the Contract signature up to the beginning of works and covers activities of release of information on intervention, design of works and social work;



- During the works: covers all period of enterprise physical production. In this phase are developed the activities related to constitution of design follow up groups, representative entity of affected population as well as preparation of beneficiaries for equipment appropriation.
- Period of beginning of Commercial Operation: this step shall occur concomitantly to the beginning of each Operational Milestone, thus resulting overlap of making it due to the existence of stretches still under work with approach along the community over the beginning of operation, of how the operation shall be.

Must include a communication plan with insertion in means of mass communication, including television, radio and newspapers of wide circulation.

15. ACCESSIBILITY

The Brazilian Law of accessibility (Federal Law no. 10.098/2000, Decree No. 5296/2004 and technical accessibility standards of ABNT) establishes the general rules and basic criteria for the promotion of accessibility for people with disabilities in public spaces and roads, the urban furniture, in construction and renovation of buildings and means of transport.

All interventions included in the design, including access to Stops and their immediate surroundings, must comply with the accessibility requirements pursuant to NBR 9050.

16. SURROUNDINGS

It is defined in this item the Concessionaire's responsibilities in the implementation of tracks, accessibility equipment and urban furniture in the surrounding of the rail system.

It is understood as surrounding areas for intervention purposes in this project those located adjacent in the rail mesh with potential of interconnection between the LRV system and the other transport modals offered by the municipality according to indicated in the Reference Design.

According to NBR 9283, it is understood as urban furniture all objects, elements and small constructions being part of the urban landscape, whether from utility nature or not, established with the authorization of the public authorities, in public and private spaces. In this case, it is applied sidewalks, bicycle stands, footbridges, underground passage, LRV access, paving, ramp and staircase,



luminaires, light pole and wiring. All urban furniture being the responsibility of the Concessionaire must follow the pattern established in NBR 9283 (1986) - Urban Furniture - Classification, and must be submitted to the Government.

The Concessionaire is responsible for implementation of urban furniture of surrounding areas and adjacent to the railway system, as described below:

- Sidewalks in the stops adjacent areas with all elements defined by NBR 9050 as necessary to assure universal accessibility;
- Paving in asphalt concrete, of access routes to stops and parking lots that are for the exclusive use of the power system within the limit established as surrounding;
- Public lighting and landscaping in areas where there is Concessionaire's intervention;
- Bicycle stands and/or racks according to defined in item 5.2.8

In the intervention polygonal the signaling shall be requalified, enabling the use, when possible, of the signaling currently existing, such as portico, plates, etc.

Shall be implanted bicycle paths and/or racks and/or routes in the stations surroundings where are foreseen road access works to the Stops, duly connected to the Bicycle Paths system existing, where applicable.

Maintenance of interventions performed in the enterprise surroundings shall not be the Concessionaire's responsibility, should it bare only with the implantation investment.

17. EXPANSION

Implantation and operation of PHASES 2 and 3 of the Suburb LRV System, so named:

- PHASE 2: comprehend the stretch of a line over the integration trail with Line 1 of SMSL;
- PHASE 3: comprehend the metropolitan stretch between the municipalities of Camaçari, Simões Filho, Candeias and Dias D'Ávila including the LRV extension stretch from Subúrbio to Mapele;

The Government's decisions regarding the implementation of these expansions will be preceded by the realization, by the Concessionaire, of the studies mentioned as appropriate, in order to assess their need and real sizing and consequent rebalancing of the agreement.



The modal used for the expansion must be the rail modal. The choice of the modal to be used should take into account the demand of users, length of the section, the sharing of tracks and maintenance yards with existing rail systems, etc.

In addition to the LRV System integration with the Subway System presented below, the Concessionaire can present other connection alternatives between these modals for the Government's evaluation.

The Concessionaire must submit, for approval by the Government, the studies on the connections between the railway systems. The delivery of studies shall be performed according to terms established in the Contract and follow the specifications presented below:

17.1 Integration with SMSL from Comércio

This connection is made from the last stop of the LRV in Comércio, following up the subway station of LAPA, through tunnel. Shall be presented:

- Demand study considering the operation of the connection;
- Identification and description of the route to be deployed;
- Preliminary engineering design; and
- Economic proposal considering the implementation of the Expansion, calculated under the Agreement.

17.2 Expansion with Implantation of Metropolitan LRV

This expansion allows the service to the Municipalities of Camaçari, Simões Filho, Candeias, Dias D'Ávila, with the implementation of the Metropolitan LRV in simple track, also including the LRV expansion from Subúrbio up to Mapele. For such alternative shall be presented:

- Demand study considering the operation of the connection;
- Identification and description of the route to be deployed;
- Preliminary engineering design; and
- Economic proposal considering the implementation of the Expansion, calculated under the Agreement.



18. ACRONYMS USED

<i>Acronym</i>	<i>Description</i>
AMV	Track Switching Device
CCO	Operational Control Center
PDF	Power Distribution Panel
PVC	Polyvinyl Chloride or Vinyl Polychloride
PVS	Signalized Tracks Plan
SCA	Access Control System
SCC	Centralized Control System
SSC	Signaling and Control System

19. GLOSSARY / TERMINOLOGIES

Expression	Definition
Remote access to systems	Function that enables remote access to hardware and software of a particular system in order to confirm a diagnosis or alarm, checking the software release, reboot the machine, allowing remote maintenance of the system.
Automatic analysis of failure trend	Function that calculates the probability of failure occurrence on a determined system (predictive maintenance), through measurements and parameters analysis, control of number of operations, control of number of interventions, etc.
Smart stop	It is an automation concept applied to systems such as lighting, HVAC, water, normal states of auxiliary equipment, reducing the need for human resources in routine activities and reducing maintenance costs.
Mobility of operating employee	It is a concept that allows the operator to monitor and control systems or equipment from any point of the Stop or train, through portable devices.
Centralized continuous monitoring	Function that enables the monitoring of all systems through self diagnostics, alarms and number of operations, which are now available centrally.
Test Jiga	Tool or device designed to evaluate the operation of the equipment out of the environment in which it must operate or in which it is installed, facilitating fault diagnosis for maintenance and also allowing the analysis and/or comparison of different operating scenarios for the same activities.
Assisted Maintenance	Period, which starts from the Commercial Operation, during which will be monitored the operation of the whole system provided to the Operator of the LRV, with a qualified technical staff, and will deploy the preventive maintenance



	process. During this period, in the first phase, it will immediately resume failures, such as monitoring the LRV Operator and, in a second phase, monitor and guide the LRV Operator's maintenance staff in the performance of these activities.
Signaling element	Signaling equipment on the ground - key, signal.

20. TECHNICAL STANDARDS AND REFERENCE DOCUMENTS OF STANDARD-SETTING AGENCIES

- ABNT - Brazilian Association of Technical Standards
- ANATEL - National Agency for Telecommunications
- ANSI - American National Standards Institute.
- ASTM - American Society for Testing and Materials.
- BSI - British Standards Institution.
- CENELEC - European Committee for Electrotechnical Standardization.
- CECC - CENELEC Electronic Components Committee - Rules and Administrative Documents Collection.
- CMU/SEI - Carnegie Mellon University/Software Engineering Institute.
- DIN - Deutsches Institut fuer Normung.
- EIA - Electronic Industries Association.
- IEC - International Electrotechnical Commission.
- IEEE - Institute of Electrical and Electronics Engineers.
- ISO - International Standards Organization.
- MIL - Military Standards.
- TIA - Telecommunications Industry Association.
- UIC - Union Internationale des Chemins de Fer.
- UL - Underwriters Laboratories.
- UNISIG - Union Industry of Signalling.

20.1 TECHNICAL STANDARDS APPLICABLE

The following are technical standards that should be applied in the preparation stages of the Design, Manufacture and Deployment of the Signaling and Control System (SSC) of the Suburb LRV System, in addition to:

- NBR 14035:1998 - Light rail vehicle - Requirements.



20.2 GROUNDING

- NBR 5419 - "Protection of Structures Against Atmospheric Discharges"
- NBR 13184 - "Railway signalization – Use of Elements of Electrical Protection of Equipment against Atmospheric Discharges".

20.3 BUSES, CONNECTORS, WIRES AND ELECTRICAL CABLES

- NBR NM-247-3 - " Polyvinyl chloride (PVC) insulated cables for rated voltages up to and including 450/750 V- Non-sheathed - Part 3: Insulated conductors (non-sheathed) for fixed wiring (IEC 60227-3 MOD)".
- NBR NM280 - " Conductors of insulated cables".
- NBR 5474 - " Electrical connector."
- NBR 6251 - "Extruded insulated power cables, for Voltages of 1kV to 35kV — Constructive requirements".
- NBR 7289 - "Control cables with extruded PE or PVC insulation for Voltages from up to 1kV - Performance requirements".
- NBR 7290 - "Control cables with extruded XLPE, EPR insulation for Voltages from up to 1 kV - Performance requirements".
- NBR 8661 - "Flat polyvinyl chloride (PVC) insulated cables for voltage up to 750 V - Specification".
- NBR 12762 - "Control cable without shield to Railway Signaling".
- NBR 12925 - "Railway signaling - Control Cable - Emend - Connector".
- NBR 12926 - "Railway Signaling and Telecommunication - Control Cable - Emend Specification".
- NBR 13248 - "Power and Control Cables and Insulated Conductors with Extruded Insulation and Low Smoke Emission Voltages up to 1 kV - Performance requirements".
- NBR 13486 - "Optical fibers" NBR 13487 - "Multimode graded index optical fiber - Specification."
- NBR 13570 - "Electrical Installations in place with high flow of persons - Specific Requirements."
- NBR 14773 - "In duct rodent protected dielectric optical fiber cable - Specification".
- NBR 60317-8 - "Specifications for particular types of winding wires Part 8: Polyesterimide enamelled round copper wire, modified polyester-based,



thermal class 18".

- NBR IEC-60529 - "Degrees of protection provided by enclosures (IP Code - Protection index)."
- IEC61754 - "Fibre optic connector interfaces".
- EN50124 - 1:2001+A2:2005-"Railway Applications. Insulation coordination. Basic requirements. Clearances and creepage distances for all electrical and electronic equipment".
- EN 50124-2:2001 -"Railway applications - Insulation Coordination - Over voltages and related protections". EIA700BAAD-"Detail Specification for Shielded Rectangular Connectors for Universal Serial Bus Plus Power Connectors Series "A".

20.4 RELIABILITY, AVAILABILITY AND MAINTAINABILITY

- NBR 5462 - "Reliability and Maintainability."
- NBR 9320 - "Equipment Reliability - General Recommendations."
- NBR 13728 - "Metro-Railway signaling - Reliability."
- BS5760 - "Reliability of Systems, Equipments and Components - Parts 2, 10, 12 and 13".
- BSEN60300-3-4 - "Dependability management. Application guide. Guide to the specification of dependability requirements."
- BSEN60812 - "Analysis techniques for system reliability. Procedure for failure mode and effects analysis (FMEA)."
- BS EN 61014 - "Programmes for reliability growth."
- BS EN61078 - "Analysis techniques for dependability. Reliability block diagram and Boolean methods."
- BSEN61160 - "Design Review"
- EN 50126 - "Railway Applications -The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - All Parts".
- IEC60605 - "Equipment Reliability Testing - Parts 2, 4 e 6".
- IEC60706 - "Maintainability of Equipment - Parts 2, 3 e 5".
- IEC60812 - "Analysis Techniques for System Reliability - Procedure for Failure Mode and Effects Analysis (FMEA)".
- IEC61025 - "Fault Tree Analysis (FTA)".
- IEC/TR62380 - "Reliability data handbook - Universal model for reliability prediction of electronics components, PCBs and equipment."



- MIL-RTD-HDBK-217-"Reliability Prediction Of Electronic Equipment"
- MIL-HDBK-781 - "Reliability Test Methods, Plans and Environments for Engineering, Development, Qualification and Production."
- MIL-RTD-721 - "Definition of Terms for Reliability and Maintainability".
- MIL-RTD-756 - "Reliability Modeling & Prediction".
- MIL-RTD-785 - "Reliability Program for systems and equipment develop."

20.5 QUALITY CONTROL

- NBR ISO 9000 - "Quality Management Systems - Fundamentals and Vocabulary."
- NBR ISO 9001 - "Quality Management Systems - Requirements."
- NBR ISO-10007 - "Quality management systems - Guidelines for configuration."

20.6 ELECTRICAL INSTALLATIONS

- NBR 5410 - "Electrical Installations of Low Voltage".
- NBR IEC 60439-3 - "Low voltage control and maneuver sets Part 3: Particular requirements for Low voltage accessories assemblies intended to be installed in places where unskilled persons have access for their use - Distribution boards".
- NBR IEC 60947-2 - "Low voltage switchgear and maneuver devices - Part 2: Circuit breakers."
- IEC60364 - "Electrical Installations of Buildings - Part 4".
- NEMA250 - "Enclosures for Electrical Equipment (1000V max)".
- NEMA BA 1 - "Panel boards".
- NEMARN1 - "Polyvinyl-Chloride(PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit".
- NEMATC2 - "Electrical Polyvinyl Chloride(PVC) Tubing and Conduit".
- NEMATC3 - "PVC Fittings for Use with Rigid PVC Conduit and Tubing".
- NEMAVE1 - "Metal Cable Tray Systems".
- NBR 13897 - "Flexible corrugated spiraled duct in high-density polyethylene for use in metro-railway"
- NBR 15465 - "Plastic conduit systems for low voltage electrical"



installations – Performance requirements."

- IEC61558-2-12 - "Safety of power transformers, power supply units and similar devices - Part 2-12: Particular requirements for constant voltage transformers".
- ANSI/IEEE-C2-2007 - "National Electrical Safety Code" (NESC).

20.7 GENERAL TESTS, MATERIALS, PAINTS, MECHANICAL STRESSES AND NOISE LEVELS

- ASTM B117 - "Standard Practice for Operating Salt Spray (Fog) Apparatus"
- NBR 6323 - "Hot dip galvanized on steel or cast iron product - Specification"
- NBR 6655 - "Hot rolled killed steel plates and sheets with improved mechanical properties, drawability and weldability."
- NBR 6658 - "Steel sheet and coils - Carbon for general use - Specification"
- NBR 7400 - "Hot dip galvanizing of steel or cast iron products - Dipping checking coating uniformity - Test method"
- NBR 15928 - "Non-destructive testing - Evaluation of vibration - Terminology".
- EN 50125-1 - "Railway Applications - Environmental Conditions for Equipment – Part 1: Equipment on Board Rolling Stock".
- EN 50125-2 - "Railway Applications - Environmental Conditions for Equipment-Part 2: Fixed Electrical Installations".
- BS EN50125-3 - "Railway Applications - Environmental Conditions for Equipment - Part 3: Equipment for Signalling and Telecommunications".
- ISO 1520 - "Paints and varnishes - Cupping test".
- ISO 2409 - "Paints and Varnishes - Cross-Cut Test".
- ISO 3668 - "Paints and varnishes — Visual comparison of the colour of paints".
- ISO 9227 - "Corrosion tests in artificial atmospheres - Salt spray tests"
- MIL-RTD167-1 - "Mechanical Vibrations of Shipboard Equipment".
- MIL-RTD-810 - "Test Method Standard for Environmental Engineering."
- MIL-RTD-45662 - "Calibration Systems Requirements."
- RAL - Color Standard



- UL - 94 - "Plastics Flammability Standard".

20.8 ELECTRICAL PROTECTION, INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY

- EIA/IS-648 - "Measurement of Electromagnetic Interference Characteristics of Equipments Intended to Operate in Severe Electromagnetic Environments".
- BSEN50121-1 - "Railway Applications - Electromagnetic Compatibility - Part 1 - General."
- BSEN50121-2 - "Railway Applications - Electromagnetic Compatibility- Part2: Emission of the Whole Railway Systems With the Outside World".
- BSEN50121-3-1 - "Railway Applications - Electromagnetic Compatibility- Part3: Rolling Stock.Train and complete vehicle".
- BSEN50121-3-2 - "Railway Applications - Electromagnetic Compatibility - Part 3: Rolling Stock. Apparatus".
- BSEN50121-4 - "Railway Applications - Electromagnetic Compatibility - Part 4: Emission and Immunity of the Signaling and Telecommunications Apparatus".
- IEC61000 - "Electromagnetic Compatibility - Parts 1, 2, 3, 4, 5 and 6".
- IEC62305 - "Protection against lightning - All Parts".
- MIL-HDBK-237 - "Electromagnetic Compatibility Management Guide for Platforms, Systems and Equipments".
- MIL-RTD-461 - "Requirements for the Control of Electromagnetic Interference characteristics of subsystems and equipment".

20.9 SAFETY

- ANSI/IEEE-C2-2007 - "National Electrical Safety Code" (NESC).
- IEC 61508 - "Functional safety of electrical / electronic / programmable electronic safety-related systems".
- MIL-RTD-882 - "System Safety Program Requirements"

20.10 METRO-RAILWAY SIGNALS AND SPECIFIC EQUIPMENT

- AREMA - "Communications & Signals Manual".



- NBR 7635 - "Railway Signaling - Terminology."
- NBR 8362 - "Railway signaling — Circuit track — Classification"
- NBR 11764 - "Track Switching Device - Switch machine".
- NBR 11882 - "Railway sign - Equipment - Metallic covering"
- NBR 12511 - "Railway signaling — Light signal - One or two light units"
- NBR 12732 - "Railway Signaling - Impedance Bond."
- NBR 12908 - "Railway signaling - Lens - Specification."
- NBR 13309 - "Electrohydraulic key machine - Specification"
- IEEE1483 - "IEEE Standard for Verification of Vital Functions in Processor- Based Systems Used in Rail Transit Control".
- UNIEN 12368 - "Traffic Control Equipment - Signal Heads".
- EN 50126 Railway Applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
- EN 50128 Railway applications - Signaling, telecommunications and data processing systems - Software for protection systems and rail control.
- EN 50129 Railway applications - Signaling, telecommunications and processing systems – Electronic safety systems for signaling.
- EN50155 - "Railway Applications - Electronic Equipment used in Rolling Stock".
- IEC60077 - "Railway Applications - Electric Equipment for Rolling Stock - All Parts".
- IEC60571 - "Electronic Equipment Used on Rail Vehicles".
- IEC62290.1- "Railway applications - Urban guided transport management and command/control systems - Part 1: System principles and fundamental concepts".
- IEC62290.2 - "Railway applications - Urban guided transport management and command/control systems - Part 2: Functional requirements specification".
- IEC61131 - All Parts - "Programmable controllers"
- NBR 13885 - "Printed circuit board for metro-railway telecommunication equipment - Repair or modification"

20.11 SOFTWARE AND INFORMATION SYSTEMS

- IEEE 828 - "Software Configuration Management Plans".



- IEEE 829 - "Software Test Documentation".
- IEEE 830 - "Guide to Software Requirement Specification".
- IEEE1008 - "Software Unit Testing".
- IEEE1012 - "Software Verification and Validation Plans".
- IEEE 1044-1 - "Classification for Software Anomalies".
- IEEE1061 - "Software Quality Metrics Methodology".
- IEEE1062 - "Recommended Practice for Software Acquisition".
- IEEE1063 - "Software User Documentation".
- IEEE1074 - "Developing Software Life Cycle Processes".
- IEEE1228 - "Software Safety Plans"
- IEEE1394 - "High Performance SerialBus".
- CMMI-DEV - Capability Maturity Model Integration (CMMI), CMMI for Development- Version 1.2,CMU/SEI-2006-TR-008.
- SCAMPI - Standard CMMI Appraisal Method for Process Improvement (SCAMPI) A,Version1.2:Method Definition Document,CMU/SEI-2006-HB-002.
- ISO 9075 - "Information technology - Database languages - SQL".
- ISO/IEC9126 - "Software engineering - Product quality - All Parts".
- ISO/IEC15939 - "Software Engineering - Software Measurement Process".
- ISO/IEC TR 24774 - "Systems and software engineering - Life cycle management - Guidelines for process description".
- MIL-RTD-498 - "Software Development and Documentation"

20.12 TELECOMMUNICATIONS

- IEC61850-3 - "Communication networks and systems in substations-Part3: General requirements".
- IEEE 802.3 - "IEEE Standard for Information Technology - Telecommunications and information exchange between systems-Local and Metropolitan Area Networks - Part 3:Carrier Sense Multiple Access with Collision Detection(CSMA/CD) Access Method and Physical Layer".
- IEEE-802.3x - "Specification for 802.3 Full Duplex Operation and Physical Layer Specification for 100Mb/s.
- IEEE802.11 - "Standart for Information Technology - Telecommunications and information exchange between systems -- Local and metropolitan



Area networks- Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

- IEEE-802.11 i - "Wireless Lan Specification".
- IEEE-802.11a - "Wireless Lan MAC and PHY specifications: Higher speed Physical Layer (PHY) extension in the 5.8 GHz band.
- IEEE-802.11 b/g - "Wireless Lan MAC and PHY specifications: Highspeed Physical Layer (PHY) extension in the 2.4GHz band.
- IEEE-802.1d - "Information Technology - Telecommunications and Information Exchange Between Systems - IEEE Standards for Local and Metropolitan Area Networks - Common Specifications - Media Access Control (MAC) Bridges."
- IEEE-802.3.1g - "Information Technology - Telecommunications and Information Exchange Between Systems - IEEE Standards for Local and Metropolitan Area Networks - Common Specifications - Part 5: Remote Media Access Control (MAC) Bridges."
- IEEE1613 - "IEEE Standard Environmental and Testing Requirements for Communications Networking Devices in Electric Power Substations."
- TIA-232 - "Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange".
- EN 50129 - "Railway Applications - Communication, Signalling and Processing Systems - Safety Related Electronic Systems for Signaling"
- EN 50159-1 - "Railway Applications - Communication, Signalling and Processing Systems - Part 1: Safety-Related Communication in Closed Transmission Systems".
- EN 50159-2 - "Railway Applications - Communication, Signalling and Processing Systems-Part 2: Safety Related Communications in Open Transmission Systems".
- ISO/IEC 8802-3 - "Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks-Specific Requirements - Part 3. Carrier Sense Multiple Access With collision Detection (CSMA/CD) Access Method and Physical Layer".
- TIA/EIA 568-A - "Commercial Building Telecommunications Cabling Standard".
- ITU-TV.10 - "Data Communications over the telephone network - Electrical Characteristics for Unbalanced Double-Current Interchange Circuits Operating at Data Signalling Rates Nominally up to 100 kbit/s".
- ITU-TV.11 - "Data Communications over the telephone network - Electrical Characteristics for Balanced Double - Current Interchange



Circuits Operating at Data Signalling Rates up to 10 Mbit/s".

- ITU-TV.24 seriesV: Data Communications Over The Telephone Network - List Of Definitions For Interchange Circuits Between Data Terminal Equipment (DTE) And Data Circuit-Terminating Equipment(DCE)
- ITUX.21 - "Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment for Synchronous Operation on Public Data Networks".
- ITUX.25 - "Interface Between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit".

20.13 TERMINOLOGY

- IEEE610.12 - "Standard Glossary of Software Engineering Terminology".
- APTA - "Glossary of Reliability, Maintainability and Availability Terminology for Rail Rapid Transit".
- SI - International System of Units.

20.14 REGULATORY STANDARDS FOR HEALTH AND SAFETY AT WORK - MINISTRY OF LABOR

- NR-1 - General Provisions;
- NR-6 - Personal Protective Equipment;
- NR-10 - Electricity Facilities and Services;
- NR-12 - Machinery and Equipment;
- NR-16 - Hazardous Activities and Operations;
- NR-17 - Ergonomics.
- NR 24 - Sanitary Conditions and Comfort in the Workplace;
- NR-26 - Safety Signaling.
- NR 33 - Health and Safety at Work in confined environment.
- NR 35 - Working at heights;