DEPARTMENT OF TRANSPORTATION
REPUBLIC OF THE PHILIPPINES

METRO MANILA SUBWAY PROJECT
PHASE 1

BIDDING DOCUMENTS

FOR

THE PROCUMENT OF

PACKAGE CP106: E&M SYSTEMS AND TRACK WORKS

Volume II of IV

PART 2 EMPLOYER'S REQUIREMENTS

December 2019

Employer:	**Department of Transportation**
Procuring Agent:	**Procurement Service**
Country:	**Republic of the Philippines**
Project:	**Metro Manila Subway Project (MMSP) Valenzuela - Paranaque**
Loan No.:	**PH-P267**

(This page is blank)

Table of Contents

c) Technical Requirements (ERT)

1) Track Works
2) Signaling System
3) Telecommunication System
4) Power Supply System
5) Overhead Catenary System
6) Automatic Fare Collection System
7) Platform Screen Door System
8) Maintenance Vehicle and Depot Equipment
9) Maintenance Management System (MMS)

Volume III. Part 2 – Employer's Requirements
Section VI. Employer's Requirements
d) Drawings

Volume IV. Part 3 – Conditions of Contract and Contract Forms
Section VII. General Conditions (GC)
Section VIII. Particular Conditions (PC)
Section IX. Annexes to Particular Conditions-Contract Forms (CF)

(This page is blank)

SECTION VI
EMPLOYER'S REQUIREMENTS

a) SCOPE OF WORKS (SOW)

(This page is blank)

Table Of Contents

1 INTRODUCTION

1.1 GENERAL

The purpose of this document is to provide the Scope of Works (SOW) for the Contractor for the procurement of E&M Systems and Track Works. A detailed description of the SOW is provided in the Bidding Document, Part 2- Employer's Requirements – Section VI – 2 Specifications, which is subdivided into General Requirements (ERG) and Technical Requirements (ERT). Should there be any discrepancies between the SOW and ERG and ERT, the provisions specified in the ERG and ERT shall prevail.

2 SCOPE OF CONTRACT

The Contract shall include the design, supply, fabrication, manufacture, installation, testing and commissioning of all equipment and systems required for the efficient operation and maintenance of this project all in compliance with the outline design described in the Employer's Requirements and Design Drawings.

This Contract includes the following parts:

1) Track Works on main line and depot.
2) Signaling System on main line and depot.
3) Telecommunications System on main line and depot.
4) Power Supply System.
5) AC/DC Power Distribution System on the mainline and depot.
6) Overhead Contact System along the main line and the depot.
7) Automatic Fare Collection System at stations and in OCC to monitor any emergency alarm.
8) Platform Screen Door System at stations and in OCC to monitor any emergency alarm.
9) Maintenance Vehicle and Depot Equipment
10) Maintenance Management System
11) E&M Equipment for PRI and Training Center located at the Depot area.
12) Detail works are described in ERT.

3 OUTLINE OF TRACK WORKS

1) Track Works consist of approximately 32.0 km of main line underground, 2 km of line at the depot (in the future the main line), 0.8 km at grade depot and approximately 23.8 km of depot tracks.
2) In the tunnel along the main line, track using the continuous welded rail, the double elastic fastenings and the elastic PSC sleeper directly fixed on concrete bed track which will be installed on the invert concrete surface and the shear connectors provided by civil contractors.
3) For the embankment portion, the above same PSC sleeper directly fixed track installed on the concrete slab on the strengthened embankment by RRR method. The civil slab structure surface has the drainage slope and the shear connectors provided by civil contractors.
4) If there is nothing of civil slab structure or an expecting formation level civil final settlement is more than 20mm, the elastic PSC on concrete bed track could not apply in such section, and

the ballast track could be applied along the settlement generating parts.

5) For the depot area the track work shall apply jointed rails, elastic fastenings and PSC sleepers on a ballast track for the rolling stock stabling tracks. The inspection tracks and maintenance tracks have special track forms like embedded track at grade, directly fixed fastener track on top of column type pit or wall type pit track, rolling stock washing track and all other tracks shall be installed in various areas at the depot depending on the functionalities.

6) For the turnouts or crossovers shall be installed using the plastic / FFU sleepers directly fixing on concrete bed in main line, but those turnouts will be installed using basically wooden sleepers in depot area.

7) The track is the standard gauge 1435mm gauge with rail type EN60E1 for the mainline and JIS-50N rail at the depot line.

8) Purchase cars, machines and tools for track maintenance works.

9) Purchase spare parts, equipment and material for emergency and at least 3 years operation term.

10) All crossover points in the Mainline shall be trailing in the normal direction of travel to minimise the risk of derailment.

11) Detail works are described in ERT.

4 OUTLINE OF SIGNALING SYSTEM

1) CBTC based Signaling System.

2) Signaling System and Train Control System works in conjunction with Automatic Train Operation System, Automatic Train Protection System, Train Detection System, Computer Based Interlocking System, and Automatic Traffic Supervision System.

3) MMSP interoperability with NSRP-S at Bicutan station as an interchange for signaling systems and vice versa.

4) System details are described in ERT.

5 OUTLINE OF TELECOMMUNICATIONS SYSTEM

1) Multi Service Network

2) Telephone and Wireless System

3) Radio System.

4) Recording System.

5) CCTV System.

6) Milimiter Wave Communication System

7) Passenger Information Display (PID) System.

8) Public Address (PA) System.

9) Time Server and Master Clock System.

10) Intercommunication System

11) Disaster Prevention System.

12) Telecommunication Equipment Monitoring System

13) Power Supply System Unit

14) Telecommunication Cables

15) System details are described in ERT.

6 OUTLINE OF POWER SUPPLY SYSTEM

1) Installation of 12 traction substations for main line, 1 traction substation at the Depot and 1 sectioning post located at Lawton West for the T3 branch line.

2) Power will be supplied from traction substation (TSS) and Station Substation (SSS) to the rolling stock through Overhead Contact System (OCS) and to the Building E&M facilities respectively through 34.5kV loop Power Distribution System (PDS).

3) Two 115kV Grid Power will be transformed to 34.5kV at Bulk Substations located at the Depot and adjacent of Lawton West station area.

4) Power SCADA System will be installed at OCC for TSS, SSS and Electric rooms.

5) System details are described in ERT.

7 OUTLINE OF POWER DISTRIBUTION SYSTEM

1) 34.5kV distribution cable network installation on the main line and depot.

2) Installation works at every station electrical room and high voltage electrical room in the depot.

3) System details are described in ERT.

8 OUTLINE OF OVERHEAD CONTACT SYSTEM

1) Installation of Overhead Rigid Suspension System (RISS) along the main line. Feeder-Messenger Catenary and Simple Catenary System to be installed at the depot.

2) System details are described in ERT.

9 OUTLINE OF AUTOMATIC FARE COLLECTION SYSTEM

1) This system is an AFC System for MMSP, using a contactless IC card that is interoperability with the existing LRT 1, 2, MRT 3. AFC System will also be used at NSCR, and NSRP-S.

2) In the future, the IC card will be developed as a common card that can be used for multiple purposes in the Manila Metropolitan area, including new or expanded transportation facilities.

3) Central Clearing House System and Card 1st Issuer are prepared at the higher level of this system for settlement and 1st Issuing of the common use cards. Therefore, upon constructing this system, the interface with the clearing house and the card must receive information from the clearing house operator side and card issuer side, and obtain the necessary cooperation.

4) Since this system is required to be equivalent to the existing AFC system as described above, the performance should conform to the MPSS (Minimum Performance Standards and Specifications) in the Concession Agreement of "PPP for the Automatic Fare Collection System Project for LRT Lines1 & 2 and MRT3 and NSCR" except section 2.12 (Level 4 Infrastructure MPSS).

5) System Details are described in ERT.

10 OUTLINE OF PLATFORM SCREEN DOOR SYSTEM

1) All stations shall be equipped with PSD for passenger safety.
2) Underground and elevated stations shall be equipped with the full height type PSD.
3) PSD's works safely in conjunction with the signaling system, telecommunication systems and onboard rolling stock equipment.
4) System Details are described in ERT.

11 OUTLINE OF MAINTENANCE VEHICLE & DEPOT EQUIPMENT

1) Workshop for rolling stock maintenance (including train inspections, repairs, overhaul and refurbishment);
2) Automatic carbody washer;
3) Weekly/monthly inspection and manual cleaning facility for Light Repair Shop;
4) Un-scheduled repair and maintenance facility for Unscheduled Repair Shop;
5) Underfloor wheel re-profiling facility for Wheel Re-profiling Shop;
6) Final adjustment facility for Final Adjustment Track in Workshop;
7) Test track.
8) Maintenance Vehicle & Depot Equipment

12 OUTLINE OF MAINTENANCE MANAGEMENT SYSTEM (MMS)

1) The Maintenance Management System supports and monitors the maintenance of the MMSP Systems (i.e. Rolling Stock, E&M systems, depot equipment, BMS and Civil Work etc.) and also monitors the performance of O&M operator and E&M systems. It is required to have well organized MMS system for operations and management of MMSP railway network.
2) The MMS Systems is part of the responsibility for the safety of train operation on the MMSP line. The MMS systems perform functions that affect safety and directly affect train operations, staff, and railway passengers.
3) All equipment's located along the MMSP line shall be connected to the various centralized control systems and communication systems located at both OCC and BOCC.

(This page is blank)

b) GENERAL REQUIREMENTS (ERG)

(This page is blank)

Table Of Contents

List of Tables

List of Figures

1 APPLICATION OF THE GENERAL SPECIFICATION

1.1 GENERAL

This General Requirements (ERG) is part of the Employer's Requirement, which consists of part of the Contract. The provision contained in the Technical Requirements (ERT) and the Employer's Drawings shall prevail over the provisions contained in the General Requirements. The provision contained in the General Requirements shall prevail over the provisions contained in Republic of the Philippines standards, Japanese standards, international standards, and similar standards documents stated in the Contract.

This General Requirements shall be read in conjunction with the General Conditions (GC), the Particular Conditions (PC), the Technical Requirements and the Employer's Drawings and any other documents forming part of the Contract.

All of the Plant and Materials intended to form or forming part of the Permanent Works shall be new.

The Contractor shall always immediately seek advice from the Engineer in the event of conflicts between the provisions in the documents.

The Employer's Drawings assist the Scope of the Works in general and clarify constraints, interface arrangements and the conceptual nature of the finished system outline. The Contractor shall carefully check all Employer's Drawings and advise the Engineer of discrepancies, omissions, errors or ambiguities should any be found.

The Contractor shall note that any drawings included but marked "For reference only" do not form part of the Contract. All content such as dimensions and system layout shown on the Employer's Drawings are indicative only and shall be determined by the Contractor.

1.2 DEFINITION AND ABBREVIATIONS

In addition to the words and expressions defined in the General Conditions and the Particular Conditions, further following words and expressions shall have the meaning assigned to them except where the context otherwise requires:

[1] "As-Built documents" means the As-Built Drawings and records submitted after Construction such as inspection and test records.

[2] "As-Built Drawings" means those drawings produced by the Contractor and endorsed by it as true records of construction of the Permanent Works and which have been agreed with the Engineer.

[3] "Combined Services Drawings" means drawings showing the locations, layouts and sizes of all services including those of the Contractor, and the interfaces with Interface Contractors, so as to eliminate all clashes.

[4] "Commissioning" means the process of setting to work the complete transportation system through a series of integrated tests that demonstrate the installation and performance in accordance with the specified criteria.

[5] "Consumables" means those parts that are not repairable and usually have a relatively short life span.

[6] "Critical Path Method Network" means a mathematically based algorithm chart set up for scheduling and monitoring a set of project activities.

[7] "Defect Notification Period" means the period during which the Contractor is responsible to remedy any defective work which become apparent during the Defect Notification Period (DNP).

[8] "Designer" means who is responsible for design of permanent works.

[9] "Design Package" means the drawings, documents, structural analysis, simulation and calculation, test reports etc. prepared by the Contractor.

[10] "External Interfacing Parties" means those parties with whom it is the Contractor's responsibility to co-ordinate the design of the Contract Works with; and includes all relevant bodies and entities, in particular government authorities, departments and regulatory bodies utility companies, and the consultants, Project Management Units and contractors of adjacent Projects whether ongoing or planned. The Contractor shall identify such interfacing parties in his Interface Management Plan (IMP).

[11] "Execution of the Works" means the manufacture, supply, transportation, delivery to Site, construction, erection, installation, testing, commissioning, performance testing, completion, and training in the use of the Works in accordance with the Contract; the preparation and/or delivery (as appropriate) of all information, drawings and manuals in respect of the Works required by the Contract, the provision of such spare parts, consumables, tools and spare materials as are required by the Contract to be provided by the Contractor for the performance of its Defects Liability obligations, and the management of all such matters.

[12] "Factory Acceptance Tests" means the tests to be performed at the Contractor's factories prior to delivery to the Site to verify compliance with the Specifications and quality standards.

[13] "Final Design" has the meaning identified in the Clause 7.9 of this ERG.

[14] "Installation Tests" means the tests to be performed to verify the conformity of completion of an installation/assembly to the design documents previously reviewed without objection by the Engineer prior to the start of Commissioning. Installation Tests do not form part of the Tests on Completion to be performed by the Contractor in order to achieve Employer's Taking Over of the Works or any Section however they must be successfully completed before the Tests on Completion can commence.

[15] "Integrated Testing and Commissioning" means those tests that demonstrate the integration of the complete transport system meeting the requirements of the Specification in an operating environment. Integrated Testing and Commissioning form part of the Tests on Completion to be performed by the Contractor in order to achieve Employer's Taking Over of the Works or any Section.

[16] "Key Personnel" means individuals who are considered by the Engineer to be critical for the Execution and completion of the Works in accordance with the Contract and as listed as such in the Contractor's Organization.

[17] "Railway System" is a general name showing the system consisting of sub-systems; in Track Works, Signaling System, Communication System, Power Supply System, Power Distribution System, Overhead Contact System, Automatic Fare Collection System, and Platform Screen Door system.

[18] "Software maintenance" means activities on debagging, improvement, modification or replace of software.

[19] "Spare Parts" means those parts which are generally repairable and have normally a service life of several years.

[20] "Specification" means the particular documents within which the reference is made.

[21] "Rolling Stock Gauge" means the maximum profile within which the rolling stock may be constructed or loaded.

[22] "Structure Gauge" means the profile related to the designated normal coordinated axis of the track into which no part of any structure or fixed equipment may penetrate.

[23] "Taking Over" means the point where the Contract Works or any part thereof has passed all relevant tests and can be Taken-Over by the Employer in accordance with Particular

Conditions notwithstanding the Contract Works may have certain outstanding works to be completed but nonetheless such will not affect the Employer's beneficial use of the Contract Works or part as intended by this Contract.

[24] "Temporary Works" means all temporary works of every kind (including, without limitation, false-work, temporary structures, temporary earthworks and other things), and the goods, materials and other constituent parts forming or intended to form part thereof, required for the Execution of the Works but does not include Contractor's Equipment.

[25] "Temporary Facilities" means the facilities constructed by the Contractor for his own use or for the use of the Employer or the Engineer.

[26] "The Engineer" means the general consultant who is engaged by the Employer as the consult to review and approve the system design, construction, testing and commissioning of the entire railway assets into revenue service.

[27] "The Employer" means the person named as employer in the Contract Data and the legal successors in title to this person.

[28] "Works Program" means the Contractor's Works program, showing the sequence, design, manufacture, delivery to Site, erection, construction, installation, testing, commissioning of the Contract Works and related activities in the form and content prescribed by the Specification, or any amended or varied version thereof, as submitted by the Contractor and approved by the Employer in accordance with the Works Requirements.

[29] "Working Drawing" means an accurately measured and detailed drawing of a structure, machine, etc., or of any part of one, used as a guide to workers in constructing it.

Common abbreviation used in the ERG and the ERT are set out in alphabetical order in Appendix 1 attached hereto.

Further abbreviation may be defined within the body of the GC or the PC where there is only local applicability.

2 MOBILISATION

2.1 CONTRACTOR'S MOBILIZATION PROGRAM

After maximum 28 calendar days after the Commencement Date the Contractor shall submit a Mobilization Program to the Engineer for his review and approval.

The program shall include a schedule showing arrival of all Railway System Construction Equipment's and Facilities as well as the arrival of all Key Contractor's Personnel and Subcontractors.

The Mobilization Program shall include a layout plan showing the location, size and arrangement of all Temporary Facilities for the Contractor, including site office, stores, security fencing, entrance and exit gates, sewage and water lines systems, electrical supply, access and facility roads.

The Mobilization Program shall clearly list all activities requiring the Engineer input and reflect any agreements regarding responses outside the standard 28-day response time.

The Mobilization Program shall include but not be limited to mobilization of staff, procurement of facilities, information required from the Engineer and deliverables to be submitted.

A narrative that clearly states any assumptions made by the Contractor, any items that the Contractor identifies as being at risk and any action required to be undertaken by the Engineer shall support the Mobilization Program.

2.2 MOBILIZATION REQUIREMENTS

Mobilization shall consist of preparatory works and operations, including but not necessarily limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the work site; for the establishment of offices, buildings and other facilities necessary to commence work on the Project; and for other work and operations which must be performed or costs incurred prior to beginning work on the various contract items on the project site.

Mobilization shall include providing prerequisite submittals prior necessary for starting the Works as decided by the Engineer out of those mentioned in the Appendix 4: Submittals. This will include proposed Organisation Chart that shall be submitted for approval by the Engineer.

The Contractor shall complete construction of all Temporary Facilities for the Contractor and mobilization of all Key Personnel, Equipment and Plant in such a time frame that the start and progress of works is not delayed due to late mobilization.

Temporary Facilities have been taken separately under the following Clause 4 of this General Requirements.

3 ENVIRONMENTAL CONDITIONS AND ENVIRONMENTAL PLAN

3.1 GENERAL

The design of equipment shall take account of the climatic conditions and operating conditions as specified in this General Requirements and Technical Requirements, as appropriate.

All equipment shall be designed to perform in a satisfactory manner in the environment in which it is installed and to withstand the effects of high winds, temperature, humidity, vibration, noise, air and water pollution.

3.2 CLIMATIC CONDITION

The performance specification shall take into consideration the following environmental factors:

a) Rainfall;

b) Temperature range;

c) Wind speeds;

d) Topography;

e) Geophysical conditions;

f) Isokeraunic levels (lightning strikes); and

g) Atmospheric pollution.

In addition, there are other adverse conditions that may be applicable to the area under consideration.

The general environmental conditions in the Manila area are as follows:

3.2.1 Rainfall

During the period from 1981 – 2010, Philippine Atmospheric Geographical and Astronomical Services Administration (PAGASA) stations in the vicinity of the Project area in Ninoy Aquino International Airport (NAIA) in Pasay City and Port Area Manila recorded an annual rainfall amount of 1,767.8 millimeters (mm), and 2,103.6 mm with a total of 101 and 139 rainy days, respectively.

Increase in rainfall is normally observed during the southwest monsoon season (June, July and August) until the transition month of September, October and November in most areas of Luzon. PAGASA's climate projections in the Philippines showed varied trends in magnitude and direction of the rainfall strongly indicating increase in the effects of southwest and northeast monsoons.

Based on the Report of the weather bureau PAGASA on Climate Change in the Philippines in February 2011, the projected seasonal rainfall change shall generally show a reduction in rainfall in most parts of the country during the summer season (March, April, May), but shall also show as increase in rainfall during the southwest monsoon season (June, July, August) until the transition season (September, October, November) in most areas of Luzon and Visayas.

Simply, this means that the usual wet seasons are expected to become wetter and the dry seasons drier all over the country. In addition, extreme rainfall events (heavy daily rainfall) may continue to become more frequent. Extreme rainfall is projected to increase in Luzon and Visayas only in 2020 and 2050.

3.2.2 Temperature

The average normal annual temperature recorded at above mentioned PAGASA stations were 27.8 °C, and 28.4 °C, in NAIA Pasay City, and Port Area Manila, respectively. Based on climate trends from PAGASA using observed data during the period 1951 – 2010, there has been an increase in annual mean temperature by 0.648 °C or an average of 0.0108 °C per year increase. The warmest months are

observed in April, May and June and the coldest months during December, January and February, with the temperature ranges of 28-30 °C and 25-27 °C.

3.2.3 Wind Speed and Direction

PAGASA weather stations recorded prevalent wind direction for the period 1981- 2010, as shown in Table 3.1. The average annual wind speed for NAIA, and Pasay City and Port Area, Manila are both 3 meters per second (mps).

Prevalent Wind Directions are indicated in the table below.

Table 3.1: Table Wind Directions

	PAGASA Weather Stations	
Month	NAIA, Pasay City	Port Area, Manila
January to April	E	N, E, and SW
May to September	W	SW
October to December	E	SW and N
Annual	E	SW

Source: PAGASA

3.2.4 Humidity

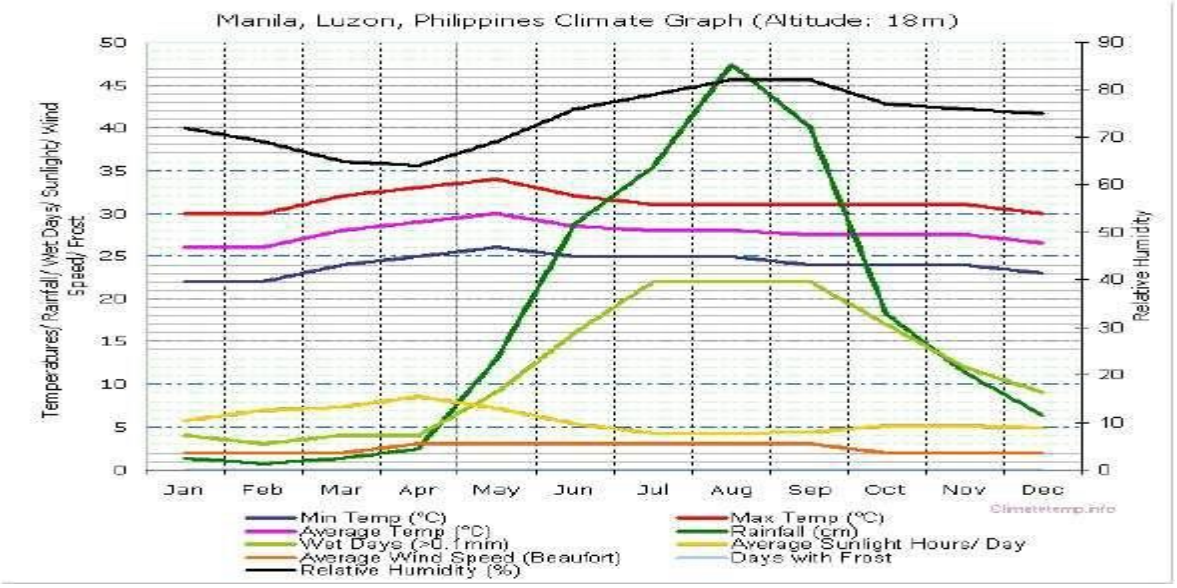
The monthly relative humidity from PAGASA typically ranges from 66% to 84% over the course of the year. The average values for relative humidity were 76%, 74% and 78%, recorded at NAIA Pasay City, Port Area Manila and Science Garden Quezon City, respectively.

3.2.5 Air Quality

Monitoring data show particulate matter (PM) levels in Metro Manila that have exceeded the Air Quality Guideline Values set by the Philippine Government. Measures have been made to address the air quality problem in Metro Manila, but more needs to be done.

Most of the particulate matter collected from different sites around Metro Manila was attributed to traffic sources. Black Carbon is a major component of particulate matter samples collected in Metro Manila.

Figure 3.1: Meteorological data of the Philippines (Metro Manila)



Source: Wikipedia

Meteorological Data of the Philippines is indicated in Figure 3.1. These figures are merely indicative, and detailed values shall be obtained from the Philippine Meteorological Services.

The Contractor's attention is drawn to the fact that because of solar load, track bed temperatures shall reach 55°C and temperatures inside closed boxes shall reach 70°C. Because Manila is near the bay of the South China Sea, the air is mildly corrosive atmosphere.

Manila having a dry climate for a considerable period of the year, the air frequently has high relative humidity aggravated by air pollutants (dust, etc.)

3.3 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The Contractor shall submit a detailed ste-specific and project specific Contractor's Environmental Management and Monitoring Plan (CEMMP) illustrating the intended means of compliance with the Employer's Requirements including noise standards for the cars 42 days after Commencement. The CEMMP shall be based on the outline Environmental Management Plan (EMP) of the Environmental Impact Statement (EIS) and shall state clearly the Contractor's environmental objectives in detail and demonstrate the proposed method of achieving the environmental objectives with regard to the requirements of the Contract.

The CEMMP, together with appropriate reporting and monitoring arrangements, represents an environmental management system. It aims to provide site-specific details on the mitigative measures which are the general requirements that may be superseded by actions required in specific locations.

The Contractor shall describe in the CEMMP, the proposed approach and mitigation measures that will be used to manage the environmental and social impacts to specific environmental components to be affected (i.e. Land, Air, Water and People) during the implementation of construction activities of this project. It shall provide enough details to demonstrate an understanding of the critical environmental and social issues related to the project.

4 TEMPORARY FACILITIES FOR THE CONTRACTOR

4.1 GENERAL

This section describes the Temporary Facilities with required infrastructure needed to be provided by the Contractor for the Works. These include, but are not necessarily limited to the provision and maintenance (including all reasonable operating costs) of:

a) Site offices, huts, workshops, warehouses and stores,

b) Temporary utilities such as water, electricity and mobile and fixed telephones, sanitary and medical facilities.

c) Enclosures, access roads and fencing,

d) Safety procedures for the Contractor's Construction Rail Traffic and compliance with requirements of the Particular Conditions,

e) Provision of an Operation and Control System for Construction Vehicle Movements within the site of Rail Mounted Equipment,

f) All necessary Police, Highway and Utility Approvals or Authorisations necessary for the Temporary Facilities and Controls,

g) Material Transportation Facilities inside the Contractor's site facilities, like Cranes, Lifting Plant and Machinery, with their foundations, rooms etc. as required,

h) Other Facilities related with Site Transportation,

i) Road Vehicles for Material Transportation, Site Transportation and Construction Vehicles,

j) All Equipment to be assigned to the Temporary Works including requirements for ladders, planks, hoists, scaffolding and similar items.

The Contractor shall use all means necessary to maintain the Temporary Facilities and control in proper and safe condition throughout the progress of the Works, moving as required during the construction of the Works and remove the same from the Site on completion of the Works and ensure that the area is left free of debris, excess materials, and obstructions.

The major Temporary Facilities for the Contractor are being described below.

4.1.1 The Contractor's Site Offices

The Contractor's Site Office shall be provided within or in the vicinity of work site with all necessary facilities including furniture, office equipment, office supply, utilities services, sanitary system and etc.

Adequate parking space for the vehicles shall be provided at the site offices.

4.1.2 Contractor's Labor Accommodation and Camps

The Contractor shall supply, equip and maintain for the Contract period all his own living accommodation, sheds and stores necessary for the execution of the Work, and shall make his own arrangements, with the owner of any land required and, if necessary, and pay for its use.

The accommodation shall comply with the appropriate Government Regulations, and standards like National Building Code, Republic of the Philippines. No dwelling shall be constructed with non-insulated metal walls, and thatch will not be permitted. Married Quarters as necessary shall be provided in the Contractor's camp. All hutments and buildings shall be adequately equipped and furnished. The Contractor shall also construct and maintain adequate roads or paths to all hutments and buildings.

All hutments and buildings must at all times be open to inspection by the Engineer and officers of the public health authorities and any instruction given for the proper cleaning, disinfecting and general

maintenance in a building must forthwith be carried out by the Contractor.

Temporary living accommodation for the use of watchmen and a limited number of workers and emergency personnel only may be provided by the Contractor within the Site. The accommodation shall always be kept clean and hygienic conditions.

4.1.3 Warehouse / Store

The Contractor shall have on the Site a suitable workshop, adequately equipped and provided with utilities, to allow for repairs of the equipment employed to carry out the Works. He shall also provide a warehouse for the equipment spare parts, mainly for the parts that frequently fail or are difficult to procure. A chief foreman qualified for mechanical repairs, with an adequate labor force must manage the workshop.

The Contractor shall provide, erect, construct and equip all offices, workshops, stores, sheds, loading and unloading facilities and the like required by him, complete with all machines and equipment and all services, access roads, rail tracks and the like, required by him for the site depot, in consultation with the Engineer.

4.1.4 Vehicles

The Contractor shall provide all necessary road vehicles for material transportation at the site depots like trucks (with cranes), trailers and cars. Vehicles shall also be provided by the Contractor for site transportation and work vehicles.

Furthermore, the Contractor shall also provide all necessary road-rail vehicles such as track- type (with cranes) for laying cables, and for material transportation at the sites.

Competent drivers shall be appointed for all the vehicles and the vehicles shall be well maintained throughout the Contract including the Defect Notification Period

4.1.5 Sanitation

The Contractor shall furnish temporary sanitary facilities at the Site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the Project. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view, to the greatest practical extent. The Contractor shall enforce the use of such sanitary facilities by all personnel at the Site.

4.1.6 Drainage

(1) For any sudden floods that may occur, pumping and dewatering shall be carried out by the Contractor.

(2) Before the start of construction work, The Contractor shall discuss with Interface Contractors for the amount and period of temporary drainage.

4.1.7 Fire

(1) The Contractor shall construct, equip and administer at his own cost fire control points in such positions and of such size as will provide an adequate service for the protection against fire of the work areas and all buildings, stores and properties of the Site.

(2) He shall provide and maintain a proper warning system to ensure that fire- fighting equipment can be concentrated on a fire before it has had time to spread.

4.1.8 Maintenance of Temporary Facilities

The Contractor shall keep all offices, stores, and other areas set up during the Contract clean and litter free. The Contractor shall be responsible for dealing with all forms of vermin at the Site during the Contract to the satisfaction of the Engineer. The Contractor shall be responsible for maintenance costs

and charges arising from the facilities provided or used by him and the Engineer site supervision staff until Contract demobilization.

4.2 DAMAGE TO EXISTING PROPERTY

The Contractor will be held responsible for any damage to existing structures, works, materials, or equipment because of his operations or the operations of any of his Subcontractors. The Contractor shall repair or replace any damaged structures, works, materials, or equipment to the satisfaction of the Engineer, and at no additional cost to the Employer.

The Contractor shall be responsible for all damage to streets, roads, railroads, curbs, sidewalks, highways, shoulders, ditches, embankment, culverts, bridges, or other public or private property, which may be caused by the transport of equipment, materials, or people to or from the Works.

4.3 ACCESS TO TEMPORARY FACILITIES SITES

The Contractor shall construct suitable entry and exit roads to/from and around all Temporary Facilities.

Security fencing shall be constructed around all Temporary Facilities. Fencing shall be provided with lockable gates at each entry and exit point.

Suitable external lighting shall be provided at the entrance to all buildings.

4.4 ADDITIONAL LAND FOR CONSTRUCTION PURPOSES

The Contractor shall acquire, if needed, additional working areas in the vicinity of the Works or elsewhere for his camp, yard, for the storage of equipment, for his own office buildings, housing, quarters, stores, plant yard, workshops, offices and any additional areas required for construction purposes and access or other uses.

Before entering the working site, the Contractor shall give written notice to the Engineer. The Contractor shall give separate notices for each owner and occupier or authority having charge over the working sites.

Before entering any additional working areas, the Contractor shall obtain, and forward to the Engineer, a copy of the written consent of the owner and occupier or authority having charge over the land, and stating the purposes for which such land is to be used. The Contractor shall define the extent and periods of occupation for which such consent is granted.

The Contractor shall select, arrange for, and if necessary pay for the use of sites for construction purposes, detours, plant and other uses necessary for the execution of the Works.

Before any land belonging to the Government or to a private landowner is used for any purposes in connection with the execution of the Work, the Engineer's approval shall be obtained.

Prior to placing the facilities in any area, all clearing and grubbing operations shall be to the satisfaction of the Engineer. The ground elevation of all temporary facilities shall be a minimum 20 cm above the adjacent existing ground. The surface shall be adequately sloped to allow rainwater to adequately drain.

If any utility for water, electricity, drainage, etc., passing through the temporary site will be affected by the Works, the Contractor at his own expenses, shall provide a satisfactory re- alignment or alternative in full working order to the satisfaction of the owner of the utility and the Engineer, before the cutting or removal or relocation of the existing utility.

On completion of the Contract, or earlier if so directed by the Engineer, all plant, Temporary Facilities and any other encumbrances shall be removed, the site and land use areas shall be properly cleaned, all damage made good, and, if necessary, the land-owner paid for the use of the land.

5 PROJECT MANAGEMENT BY THE CONTRACTOR

5.1 CONTRACTOR'S MANAGEMENT PLANS

In order to ensure satisfactory execution of the Contract, completion of the Works within specified time, and quality in design, manufacturing and execution of work, a series of Contractor's Management Plans shall be provided.

The Plans and Documents shall be coordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, Organisation and sequencing of activities to meet the requirements of the Employer's Requirement's ERG and ERT in respect of the subjects listed.

The respective Plans shall be submitted for the Engineer's review and approval as per the submission schedule furnished in the Table 4-1 of Appendix 3 attached hereto.

5.2 PROJECT MANAGEMENT PLAN

The Contractor shall submit the Project Management Plan for the Engineer's review and approval as per schedule of Table 4-1 of Appendix 3 attached to hereto. The Engineer will review the Contractor's Project Management Plan and will have the right to require the Contractor to make amendments as deemed necessary by the Engineer. The Contractor shall submit a detailed revised plan within 15 days of the review by the Engineer. It shall include;

(1) A diagram showing the organizational structure for the management of the Contract, with locations, names and position titles of key staff (including Key Personnel proposed in his Tender and accepted by the Employer) and their line and staff relationship. The diagram shall include associate organizations and subcontractors and show clearly the individuals and lines of responsibility linking the various groups. It shall also identify the persons designated as contacts towards the Engineer.

(2) The names, qualifications, positions and current resumes of key executive, supervisory and engineering staff to be employed full-time for the works, separately for principals and subcontractors.

(3) A narrative describing the sequence, nature and inter-relationship of the main Contract activities including timing for exchange of information.

(4) The Deputy Project Manager shall coordinate activities of the design offices and manufacturing works. The Deputy Project Manager shall be responsible to the Project Manager for all works executed outside Republic of the Philippines and in Republic of the Philippines for ensuring that effective coordination is maintained with the various manufacturing units of the Contractor, Subcontractors and Interface Contractors and that contract delivery schedules are met.

(5) The Project Manager shall, be on site in Republic of the Philippines and devote himself full-time to the Project, commencing not later than 30 days after the Commencement Date.

(6) To fulfil the Contractor's obligations during the Testing and Commissioning and the Defect Notification Period, the Contractor shall nominate experienced Engineers and organize deployment after obtaining the Engineer consent before undertaking Testing and Commissioning along the main line and at the depot.

5.3 INTERFACE MANAGEMENT PLAN

In order to ensure that the whole equipment is compatible with the Railway Systems, the Railway System Contractor shall make provision for expenses in management, coordination, and design activities in consultation with the interface Contractors. Description of Interfacing Contractors of following projects:

(1) Package 1 (CP101) : Tunnel, TBM, Cut and Cover -2km+772m to 4km+123m, the Depot and 3 Stations Works.

(2) Package 2 (CP102) : Tunnel, TBM, 4km+123m to 7km+102m, 2 Stations Works.

(3) Package 3 (CP103) : Tunnel, TBM, 7km+102m to 13km+618m, 2 Stations Works.

(4) Package 4 (CP104) :Tunnel, TBM, 13km+618m to 17km+015m, 2 Stations Works.

(5) Package 5 (CP105) : Tunnel, TBM, 17km+015m to 18km+339m, 2 Stations Works.

(6) Package 7 (CP107) : Rolling Stock.

(7) Package 8 (CP108) : Tunnel, TBM, 18km+339m to 22km+298m, 2 Stations Works.

(8) Package 9 (CP109) : Tunnel, TBM, 22km+298m to 24km+195 (to T3 Station), 1 Stations Works, and Tunnel, Cut and Cover 26km+447 to 26km+447m (between FTI Station and Bicutan Station).

(9) Package of NSRP-S Project (CP-S04) : Viaduct, Bicutan Station.

(10) Package of NSRP-S Project (CP-NS01) : E&M systems.

(11) Package of NSRP-S Project (CP-NS02) : Rolling Stock (Commuter train).

Note: Civil Packages; CP102, CP103, CP104, CP105, CP108 and CP109, may change in regards to chainage.

In case NSRP-S Project (CP-S04) is delayed a provisional sum for CP106 E&M System Package for Bicutan Station will be given by the contractor. If Bicutan E&M System Package will be excluded or included, to be determined by the Engineer in a later stage.

The Contractor shall interface and liaise with Interface Contractors and other contractors in accordance with the requirements of the ERG-ERT.

The Contractor shall develop and submit for the Engineer's review as per schedule in Table 4-1 of Appendix 3 attached hereto, an Interface Management Plan, which is mutually acceptable to both the Contractor and the Interface Contractors. The Interface Management Plan shall include:

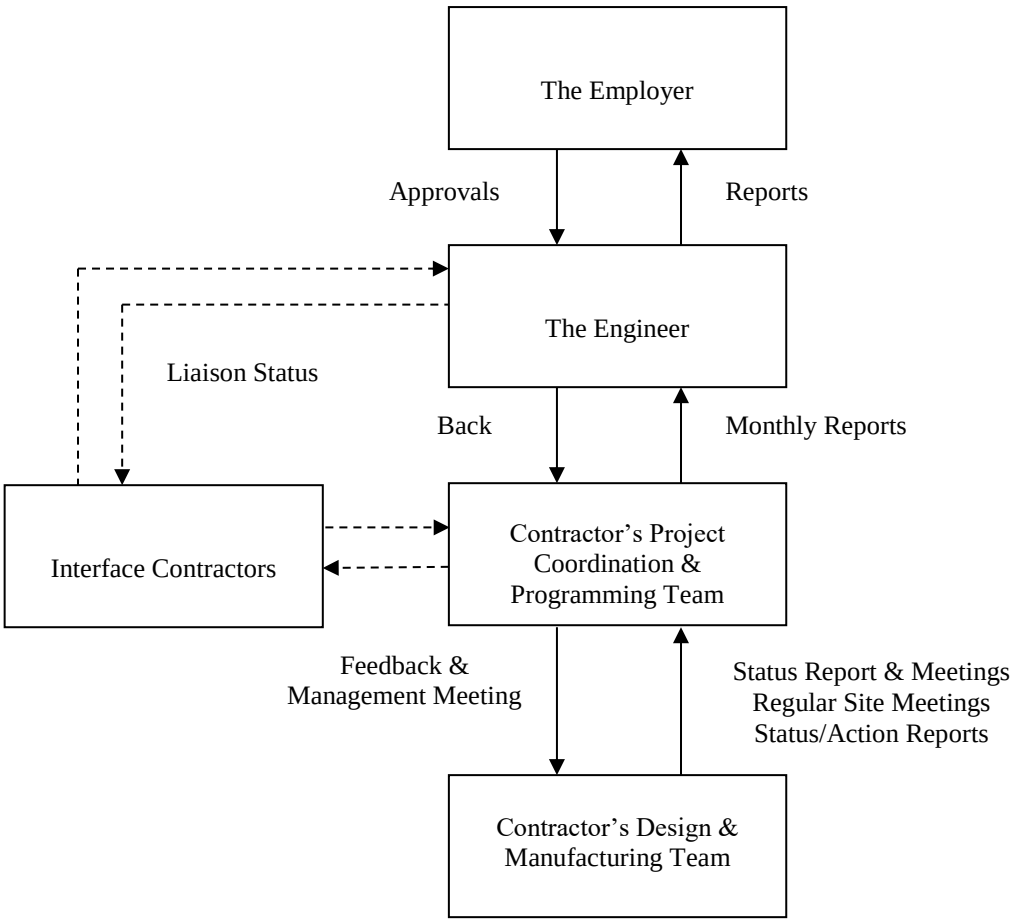
(1) Identify the Equipment as well as the Civil Works and facilities with Interfacing Requirements;

(2) Define the Authority and Responsibility of the Contractor's and Interface Contractors' (and any relevant subcontractors') staff involved in the Interface Management and Development;

(3) Identify the information to be exchanged, precise division of responsibility between the Contractor and Interface Contractors and Integrate all necessary police, highway and utility approvals or authorizations necessary for the Temporary Facilities and controls to be performed at each phase of the Contractor's and Interface Contractors' works; and

(4) After the review of the Interface Management Plan with no objections by the Engineer, the Contractor shall execute the works in accordance with the Plan.

Figure 5.1: Organisation Chart (Proposed Interfacing)



5.4 WORKS PROGRAM

5.4.1 Program Updating and Revisions

As the Works progresses, it may be necessary for the Contractor to update the Baseline Program, based on the actual dates and progress, but such updating shall only be carried out with the prior approval of the Engineer or when directed by the Employer. Normally, the frequency of updating should be a month, but the Engineer can ask for an update earlier if considered necessary.

5.4.2 Revised Programs

The Contractor shall submit revised programs when the Baseline is inconsistent with the actual progress or with the Contractor's obligations. The revised program and supporting report shall describe the revised methods which the Contractor proposes to adopt in order to expedite progress and complete within Time of Completion. No revisions can be made to the contract completion date, except as authorized by the Employer, and as authorized by the Contract.

5.4.3 Other Programs

The Contractor may be asked to submit by the Engineer, sub programs of a particular portion of the Works, or other programs like, what – if programs showing different options, based on work requirement.

5.5 QUALITY ASSURANCE MANAGEMENT PLAN

The supplying Contract shall be executed within the framework of an efficient quality system. The

international standard ISO 9001 is the standards of reference for the QA requirements applicable to the Contractor's (or subcontractor's) activities:

(1) Design;

(2) Manufacturing; and

(3) On-site activities.

The Contractor shall prepare the Quality Assurance Management Plan in detail and carry out the works subject to it.

The Quality Assurance Management Plan submitted to the Engineer for review as per schedule of Table 4-1 of Appendix 3 attached hereto, shall contain sufficient information to demonstrate clearly the proposed method of achieving the quality objectives with regard to the requirements of the Contract.

The Quality Assurance Management Plan shall indicate the approach and structure that the detailed plan will take and shall include the following:

(1) A summary of the Project requirements including all proposed quality activities;

(2) All quality assurance and quality control procedures proposed by the Contractor for his use in the execution of the Works;

(3) A list of all the codes of practice, standards and specifications that the Contractor proposes to apply to his work;

(4) The Contractor's proposals for internal and subcontractor quality assurance audits; and

(5) A statement detailing the records that the Contractor proposes to keep, the time during which they will be prepared and the subsequent period and manner in which they will be stored;

(6) Quality Control Points and Quality Hold Points during verification, surveillance, tests, trial and commissioning activities; and

(7) Procedure for maintenance of records of inspection/tests.

The Quality Assurance System shall be applied without prejudice to, or without in any way limiting, any Quality Assurance System that the Contractor already maintains.

The Contractor shall maintain the Quality Assurance Management Plan updated during the course of the execution of the Contract. All amendments to the original and approved Quality Assurance Management Plan shall be notified to the Engineer. The quality plan shall comprise:

(1) A Management Quality Plan for control of management related activities;

(2) A Design Quality Plan for control of design related activities;

(3) A Manufacturing (including Inspection and Testing) Quality Plan for the control of related activities; and

(4) Testing and Commissioning (including Integrated Testing and Commissioning) Quality Plan.

The Contractor shall submit a detailed organization chart identifying the responsibilities, authority and inter-relation of all personnel who manage, perform and verify work involving quality in respect of all the Quality Plans. The organization chart shall be specific to this Contract. The chart shall identify the Quality Management Representative who shall act as the Quality Coordinator for the Contractor in all dealings with the Engineer.

The Contractor shall audit all the activities in each Quality Plan at quarterly intervals or at other such intervals as the Engineer may require ensuring continuing suitability and effectiveness of the quality

management system. The Contractor shall make available upon request any document, which relates to his recent internal audits.

The Engineer may require compliance audits of the Contractor's quality system to be conducted. Not less than two weeks a notice will be given by the Engineer. During audits, the Contractor shall provide suitably qualified staff to accompany the auditor.

5.6 SYSTEM ASSURANCE PLAN

The Contractor shall prepare and submit a System Assurance Plan as per the requirements laid forth within this document, and any pertaining requirements within the system specific Appendix for RAMS Assurance.

5.7 SYSTEM SAFETY PLAN

The Contractor shall prepare an submit a System Safety Assurance Plan, as per the requirements laid forth within this document, and any pertaining requirements, within the system specific Appendix for RAMS Assurance.

5.8 RELIABILITY, AVAILABILITY AND MAINTAINABILITY PLAN

The Contractor shall prepare and submit a RAM Assurance Plan, as per the requirements laid forth within this document, and the system specific Appendix for RAMS Assurance.

5.9 SITE SAFETY ASSURANCE MANAGEMENT PLAN

The Contractor, its Sub-Contractors and suppliers of any tier and all employees performing any part of the Contract Works on the Site shall comply in every aspect with the provisions of any relevant statutory regulations, procedures manuals and notices and / or with requirements of Philippines law as may be considered applicable to the Works or "The Guidance for Management Safety for Construction Works in Japanese ODA Project", September 2014, Japan International Cooperation Agency (JICA), whichever is the more onerous.

The Contractor shall submit a Site Safety Assurance Management Plan for the Engineer's review as per schedule of Table 4-1 of Appendix 3 attached hereto. The Site Safety Assurance Management Plan shall contain sufficient information to demonstrate clearly the Contractor's proposals for achieving effective and efficient safety procedures and solutions in the Assembling, Installation, Testing and Commissioning of the Railway Systems of the MMS Project.

The Site Safety Assurance Management Plan shall contain, but not limited to, details of the following:

(1) A policy statement signed by the Management of the Contractor, declaring that the Contractor shall ensure that Safety and Health are given the highest priority in all aspects of the Works and in discharging his contractual obligations.

(2) The statutory and contractual obligations regarding Safety and Health imposed on the Contractor, and the means by which the Contractor shall supervise, monitor and audit his site Safety Assurance System to ensure due compliance with these obligations.

(3) Site organization structure for Safety Staff, which shall identify personnel to be engaged solely on-site Safety Assurance purposes and shall list their responsibilities;

(4) The powers vested in the Safety and Health Manager and other safety staff which would enable them to take urgent and appropriate action to make the Site Safe and Accident Prevention Practices.

(5) Emergency procedures and rescue teams. The Contractor shall formulate emergency procedures and organize rescue teams to deal with emergency situations on the Site.

5.10 SOFTWARE QUALITY ASSURANCE PLAN

The Contractor shall prepare and submit a Software Quality Assurance Plan, as per the requirements laid forth within this document, and the system specific Appendix for RAMS Assurance.

5.11 ENVIRONMENTAL MANAGEMENT PLAN

The Contractor shall take all necessary measures and precautions to ensure that the execution of the Works and all associated operations are carried out in conformity with statutory and regulatory environmental and social requirements of the Government of the Philippines and the Employer's Requirements.

The Contractor shall ensure that its activities are not likely to cause a significant environmental and social hazard and must comply with JICA's Environmental Guidelines which is available on the internet (https://www.jica.go.jp/english/our_work/social_environmental/guideline/pdf/guideline100326.pdf).

The Contractor shall prepare and submit, within 42 days after the Commencement Date, a detailed site-specific and comprehensive project-specific Contractor's Environmental Management and Monitoring Plan (CEMMP) to the Engineer for his review and approval. Once approved and upon receipt of the Notice of No Objection, the Contractor can commence the Works and shall implement his CEMMP for the whole Contract period.

The CEMMP shall contain sufficient information to demonstrate clearly the proposed method of achieving the environmental objectives with particular reference to air, water, noise, vibration and waste together with monitoring plan. A Noise and Vibration Analysis Report as well as a Social Management Plan (SMP) shall be submitted as part of the CEMMP.

The Contractor shall be responsible for ensuring that all Contractor's and his Subcontractor's Personnel understand and operate in accordance with the principles and requirements of the environmental and social impacts provisions. He should ensure that similar standards apply to the Subcontractor's environmental and social impacts management systems and performance by including it in all Subcontractors' Agreement/Contract.

The CEMMP shall demonstrate clearly the procedures and methods of working that the Contractor and its Subcontractors will comply.

The CEMMP shall include the technological approaches which aim to implement an efficient, effective, practical and economical application of the technologies in order to prevent, eliminate or control the negative impacts to the environment.

The Contractor shall describe in the CEMMP the proposed approach and mitigation measures that will be used to manage the environmental and social impacts to specific environmental components to be affected during the construction activities. It shall provide enough details to demonstrate an understanding of the critical environmental and social issues related to the project.

Example of the environmental management efforts through the technological approaches are:

(1) Control particulate matter or dust emission, carbon monoxide, nitrogen oxide, sulfur dioxide and greenhouse gases emissions as well as noise and vibration as affected by the operation of heavy-duty equipment in the construction phase;

(2) Anticipate the occurrence of erosion and landslides from earth works;

(3) Control the quality of surface water as well as underground water, as affected by construction works and disposal of domestic wastes from Workers as well as contaminated liquid and solid wastes;

(4) Collection of used oil and lubrication fluids in a drum and storage in an area with an

impervious flooring;

(5) Provide temporary toilets; and

(6) Anticipate and control any interruption to traffic stability during the construction phase by submitting a site specific "Traffic Management Plan" approved by MMDA and the Engineer.

The Contractor's CEMMP should follow, implement and abide all the stipulations and conditions stated and described in the EMP and EMoP of the EIS for MMSP. The Final EIS's requirement for CEMMP (construction Stage) are given below in Table 5.1.

The Final EIS's requirement for Contractor's Environmental Monitoring (Pre- construction Stage) and Construction stage are given below in Table 5.2 and Table 5.3 respectively.

Table 5.1: Final EIS's Requirement for CEMMP (Construction stage)

Category	Item	Expected Environmental and Social Impacts	Key Mitigations Measures
Pollution control	Air pollution	Air pollution caused by emissions gas from construction machine and vehicle, dust from construction works and materials as well as construction traffic	Sprinkling water at construction site Proper storage of construction materials including covering sand and gravel that are easily diffused into the atmosphere Covering bulk materials during transportation Regular maintenance of construction machines and vehicle reduce emissions
	Water pollution	Discharging turbid water from construction site Generation of domestic waste water from temporary construction office or related facilities	Discharging turbid water through sedimentation ponds or after simple turbid water treatment Installation of temporary septic tanks or other wastewater treatment facility for workers
	Waste	Surplus soil waste and other waste from construction Waste of existing devices replaced with newly installed devices such as bricks, ballast, etc. Solid and liquid wastes discharged from temporary construction office and other facilities	Reduce, reuse and recycle of construction and other type of waste Disposal of waste in a proper way Installation of temporary sanitation facility such as septic tank at construction office and other facilities
	Noise and vibration	Impacts of noise and vibration by construction machineries and vehicles	Installing noise barrier and selecting low-noise equipment as needed, especially near the residential area and/or sensitive receptor No construction activities with heavy equipment during night time if there are any sensitive receptors nearby Prior notice of construction schedule near the residential area

Category	Item	Expected Environmental and Social Impacts	Key Mitigations Measures
	Offensive odor	Offensive odor due to excavation or dredging in drainage channels or creek	Consideration of additional mitigation measures depending on an odor source and condition
Natural Environment	Flora, fauna and biodiversity	Loss of trees and other plant species	Replanting trees in suitable area as needed based on prior consultation with the relevant administrative
	Hydrological situation/drai n age system	Potential impacts on hydrological situation or drainage condition surrounding of MMSP Line due to improvement of drainage system of	Site patrol Consideration of additional mitigation measures if any issues are confirmed
Social Environment	Existing social infrastructure and services	Road traffic congestion in surrounding area during construction period of level crossing and other facilities	Advance announcement of construction schedule Preparation and implementation of the Traffic Management Plan by the Contractor including arrangement of watchmen and detour road signs
	Infectious diseases such as HIV/AIDS	Risks for infectious diseases due to inflow of	Awareness of public health for workers and local communities
	Working condition including occupational health and safety	Accidents in the operation of construction machinery and other works Risk of occupational health and safety for workers in case of severe working conditions	Compliance with requirement of Labor Law Preparation of a safety and health management plan and enlighten occupational safety to workers Providing proper personal protective equipment (PPEs) such as helmet, safety jacket, gloves and safety shoes for workers
Others	Traffic accident	The risk of accidents would be higher for informal occupants and other nearby residents due to their habits of crossing the land of PNR by walk and occupation on the land of PNR with shops, huts and vendors	Manage the construction site to prevent local people from entering the site by barricading and the site security gate.
	Climate change	GHG emissions from construction vehicles and machine	Saving on electricity in construction sites and office such as vehicle idle reduction

Category	Item	Expected Environmental and Social Impacts	Key Mitigations Measures
	Hazardous materials and oil management	Spoil of fuel or hazardous substance that is used for construction work	Training workers on appropriate handling of fuels and chemicals Measures for spill control and leakage control system

Table 5.2: Final EIS's Requirement for Contractor's Environmental Monitoring (Pre-Construction stage)

Category	Key Monitoring Item	Location	Frequency
Common	Review and update of the Environmental Management Plan based on the detailed project design Preparation of safety management plan for construction phase	Project area	Once before commencement of construction work

Table 5.3: Final EIS's Requirement for Contractor's Environmental Monitoring (Construction stage)

Category	Key Monitoring Item	Location	Frequency
Common	Progress of conducting mitigation measures	Project area	• Monthly and quarterly during construction period
Air quality	Site patrol Checking received complaints from residents Monitoring of air quality	Representative point(s) of construction site(s)	• Monthly • Whenever received • When needed
Water quality	Site patrol Monitoring of parameters stipulated by National Environmental Quality (Emission) Guideline	Creeks nearby construction site(s)	• Monthly • Biannually
Waste	Site patrol and housekeeping at construction site Checking waste-disposal method	Construction site(s)	• Monthly • Monthly
Noise and vibration	Site patrol Received complaints from residents Monitoring the noise and vibration level	Construction site(s)	• Monthly • Whenever received • When needed
Cutting of trees	Check of species and number of trees that need be cut Prior consultation with the relevant administrative authorities in charge.	Construction site(s)	• Quarterly • Once or more
Existing social infrastructure and services	Collection of complaints Physical observation of road traffic condition	Construction site(s) and surroundings	• Whenever received • Every day of

Category	Key Monitoring Item	Location	Frequency
	Interviewing/discussing with Traffic Police		construction period • When necessary
Infectious diseases such as HIV/AIDS	Received complaints from residents Record of awareness activities	Construction site(s)	• Quarterly at minimum • Quarterly
Working condition including occupational health and safety	Site patrol Record of implementing the safety and health management plan	Construction site(s)	• Monthly at minimum • Quarterly
Traffic accident	Site patrol Record of accidents Record of safety-awareness campaign and other measures	Construction site(s)	• Monthly at minimum • Monthly • Monthly
Hazardous materials and oil management	Site patrol to check a condition of handling or storing hazardous materials Record of training on handling hazardous materials for workers	Construction site(s)	• Monthly • Quarterly

5.12 INSPECTION, TESTING AND COMMISSIONING MANAGEMENT PLAN

The Contractor shall submit an Inspection, Testing and Commissioning Management Plan as per schedule of Table 4-1 of Appendix 3 attached hereto, for the Engineer's review as specified in Chapter 10 of this Employer's Requirements - General Specification and required in the Employer's Requirements - Particular Specification.

5.13 REVIEW PERIODS FOR CONTRACTOR'S SUBMISSIONS

The Engineer shall review those Contractor's plan and program submissions which require his acceptance/consent and shall signify his acceptance/consent or otherwise within 30 days. The Contractor shall, when required by the Engineer, re-submit his plan and/or programs within 14 days of the receipt of the Engineer's comments.

The Engineer will endeavor to review and respond to the Contractor on the adequacy and acceptability of the Contractor's submissions and re-submissions as soon as reasonably possible but the Contractor should always allow for a 30-day review period.

The Contractor shall allow in his program a 30-day review period for all submissions to the Engineer.

5.14 FAILURE TO MAKE SUBMISSIONS

Failure of the Contractor to submit any plan and program, or any required revisions thereto within the time limits stated shall be sufficient reason for certification that the Contractor is not performing the work required in a timely manner. The Engineer may certify retention of payment under the Milestone-related Cost Centre proposed for the Contractor, until his plans and programs are accepted / consented by the Engineer.

5.15 PLANS AND PROGRAM REVISION

The Contractor shall revise his plans and programs whenever necessary, with the consent of, or as required by the Engineer to ensure completion of the Works within the Time for Completion for the

Works.

5.16 PLANNING AND PROGRAMMING STAFF

The Contractor shall employ sufficient number of planning and programming staff competent in the use of the programming software and with a good knowledge of the type of work required to be performed by the Contractor under the Contract.

The Engineer shall have the discretion to require the Contractor to replace his planning and programming staff if the Engineer considers that they do not have the training or skill required for this specialized nature of work.

5.17 PROJECT CALENDAR

Project Weeks shall commence on a Monday. A day shall be deemed to commence at 0001 hours on the morning of the day in question. Where reference is made to the completion of an activity or Milestone by a particular week, this shall mean by midnight on the Sunday of that week.

5.18 PROGRESS REPORTS

Progress reports, as detailed in Appendix 5 attached hereto, shall be regularly submitted by the Contractor, on a monthly basis.

5.19 CO-ORDINATION AND INTERFACE WITH INTERFACE CONTRACTORS AND OTHERS

The Contractor is responsible for detailed co-ordination of his design and manufacturing activities with those of the Interface Contractors and Consultants whether or not specifically mentioned in the Contract, who may be working for the purpose of the Project.

The Contractor shall note that there are other contractors, consultants, agencies, etc. which the Employer may engage from time to time, and with whom the Contractor shall have to similarly co-ordinate. Such coordination responsibilities of the Contractor shall include the following, but need not be limited to:

(1) To provide all information reasonably required by the Interface Contractors in a timely and professional manner to allow them to proceed with their design, manufacturing, construction activities, and to meet their milestones and work program dates, if any.

(2) To ensure that the Contractor's requirements are provided to all other Interface Contractors, in a timely and reasonable manner.

(3) To obtain from the Interface Contractors information reasonably required, to enable the Contractor to meet his own design submission dates.

(4) To ensure very close coordination with the contractors in charge of Signaling System in respect of provision of on-board Signaling Equipment in the Rolling Stock, and finalising the interface between the Rolling Stock on board Signaling Equipment and way side Signaling Equipment.

(5) Where the execution of the work of the Interface Contractors depends upon the Site Management or information to be given by the Contractor, the Contractor shall provide to such Interface Contractors the services, or the correct and accurate information required, enabling them to meet their own program or construct their own works.

(6) To ensure that there is no interference with the works of Interface Contractors. To attend regular coordination meetings convened by the Interface Contractors and the Engineer. The Contractor shall conduct separate meetings with the Interface Contractors as necessary to clarify particular aspects of the designated requirements of the Works. A record of the decisions taken in each such meeting shall be furnished to the Engineer. The party who convenes the meetings shall prepare minutes recording all matters

discussed and agreed at the meeting.

(7) To ensure that all correspondence, drawings, meeting minutes, programs, etc. relating to the Contractor's coordination with the Interface Contractors are issued to all concerned parties and four copies issued to the Engineer no later than seven calendar days from the date of such correspondence andmeetings.

The Contractor shall, in carrying out his co-ordination responsibilities, raise in appropriate time and provide sufficient information for the Engineer to decide on any disagreement between the Contractor and the Interface Contractors as to the extent of services or information required to pass between them.

If such disagreement cannot be resolved by the Contractor despite having made all reasonable efforts, then the decision of the Engineer shall be final and binding on the Contractor.

Where an Interface Contract is yet to be awarded, the Contractor shall proceed with the co- ordination activities with the Engineer until such time as the Interface Contractor is available. The Contractor shall provide the Interface Contractor with all information necessary to enable the Interface Contractor to follow-on and proceed with their co- ordination.

Any claim of additional costs by other Interface Contractors as a result of the Contractor's failure to keep to specified dates shall be borne by the Contractor. The Contractor shall note that the information exchange is an iterative process requiring the exchange and updating of information at the earliest opportunity and shall be carried out on a regular and progressive basis in order for the process to be completed for each design stage by the specified dates.

The Contractor shall establish a dedicated co-ordination team, led by a Coordinator reporting to the Contractor's Project Manager. The primary function of the team is to provide a vital link between the Contractor's design and manufacturing teams and the Interface Contractors. The Engineer shall have the right to require the replacement of the Coordinator if in his opinion the Coordinator is unable to meet the coordination requirements of the Contract. The Contractor's attention is drawn to the need for the Coordinator to establish effective dialogues and communication links with the Interface Contractors. The Contractor's coordination team shall comprise a mix of personnel with experience in both design and manufacture of rolling stock necessary for effective co- ordination.

The Coordinator shall assess the progress of co-ordination with the Interface Contractors by establishing lines of communications and promoting regular exchange and updating of information so as to maintain the Contractor's program.

The complexity of the Project and the importance of ensuring that the work is executed within time limitations require detailed programming and monitoring of progress so that early program adjustments can be made in order to minimize the effects of potential delays.

The Coordinator in conjunction with the Interface Contractors shall identify necessary provisions in the Works for plant, equipment and facilities of the Interface Contractors. These provisions shall be allowed by the Contractor in his design of the Works.

During the course of the Contract, information will be obtained in a number of ways, including direct inspection, regular site meetings, the obtaining of progress reports and the use of turn around documents to obtain design and program data. Turn around documents shall be issued to the Interface Contractors to be returned giving the current positions on their program.

5.20 SPARE PARTS MANAGEMENT PLAN

The Contractor shall submit for review by the Employer's Representative a Spare Parts and Consumables Management Plan to furnish an individually priced, manufacturer- recommended list of spare parts and consumables and quantities necessary to support continuous operation of all such equipment for an initial operating period of five (5) months after the commencement of the Service

Revenue Operations.

The Contractor shall submit the Spare Parts and Consumables Management Plan by the date stated in the PS, or, if none is given, not less than six (6) months prior to the issue of the Taking Over Certificate for the Works.

6 WORKS TRAIN OPERATIONS

Requirements related to works train operation during the construction period of this project to be made available for track related electrical and mechanical installation. The area will be classified as a Defined Area within which Works Trains will be operated.

All persons whose duties require them to work within a Defined Area must observe safety rules and procedures to be provided by the Contractor and reviewed without objection by the Employer. It shall provide procedures and guidance for the safety of all persons in the Defined Area.

The Contractor shall establish and communicate the rules and procedures, which shall be published from time to time, to their workers and/or agents on Site, and to ensure all such rules and procedures are being observed in the course of all works and construction activities

Persons working on or near tracks in a Defined Area, either by themselves or supervising a working party, must be suitably trained and qualified by the Employer or his delegates in the safety provisions of the Works Train Manual. Persons who are not qualified shall not attempt to gain access to the railway tracks unless accompanied by a qualified person

When RISS Lines are energised, EMU's may be running at a higher speed than Operation Speed for testing. No work may be undertaken on the tracks when test trains are running. Procedures for gaining access to the energized track will be detailed in the Works Train Manual. The Interface Contractor shall make requests for any access to the energised track at the Weekly Coordination Meeting for Works Trains.

7 DESIGN SUBMISSION REQUIREMENT

7.1 GENERAL

The objective of the design submission process is to ensure that the proposed resulting works comply with the specification, are capable of being produced consistently to exacting quality standards, achieve low life cycle costs and can be operated safely to the satisfaction of the Engineer.

The Design Submissions include Design Reports, which shall include design calculations, simulation and calculation and all other design related information and Design Drawings.

In the event that a statutory body (e.g. Government of Republic of the Philippines - Department of Transport, etc.) requires design information in a particular format, it shall be incumbent upon the Contractor to provide the same, as directed by the Engineer.

7.2 REVIEW OF DATA

As soon as practicable after Contract award, the Contractor shall review all applicable data, criteria, standards, directives and information provided to him as the basis for design. Any apparent inconsistencies or erroneous information shall be brought to the attention of the Engineer. Such information shall not alleviate the Contractor from his responsibilities under the Contract.

7.3 FORMAT OF DELIVERABLES

Drawing and CAD Standards. Reports, calculations, specifications, technical data and similar documents shall be provided in A4 format, and one of the copies shall be ring bound to facilitate photocopying. A3 size drawings included in documents shall be folded to A4 size.

Drawing and CAD Data Format:

Within 30 days after the Commencement Date, the Contractor shall have prepared and submitted the Drawing and CAD procedure together with sample drawings and corresponding CAD data to demonstrate his understanding and compliance with Drawing and CAD Standards.

7.4 NUMBER OF COPIES

The following quantities of drawings and other documents shall be submitted to the Engineer, including preliminary, pre-final, and final design submissions, the final contract document, and all other submissions. These drawings and documents are in addition to those required for the exchange of information between the Interface Contractors and other submissions to statutory, governmental and local authorities, if required.

(1) 4 full-size sets of paper drawings (folded and collated)

(2) 4 sets of Design Reports including design documents and calculations, structural analysis, simulation and calculation and all other design related information.

(3) 4 sets of all other submissions.

(4) 2 sets of each of the above in electronic format

7.5 DESIGN SUBMISSION PROGRAM

The Contractor shall prepare the Design Submission Program, developing it from his Tender submission, which is to set out fully the Contractor's anticipated program for the preparation, submission and review of the Design Packages, the Final Design Submission and the Installation and Manufacturing Drawing Submissions and for the Issue of Notices in relation thereto.

The Design Submission Program shall:

(1) be consistent with and its principal features integrated into the Works Program, and show all relevant major activities;

(2) identify dates and subjects by which the Engineer's decisions should be made;

(3) make adequate allowance for periods of time for review by the Engineer;

(4) indicate the Design Interface and Coordination periods for each Interface Contractor; and

(5) include lists of requisite design details for each and every component or equipment of all systems.

The Contractor shall update the Design Submission Program suitably if the Engineer observes any deviation.

For system and components of the Works or the Plant, the Contractor shall submit documents and drawings describing function description, product description, interface requirement description, RAM requirement description, life cycle calculations, type & routine test specifications, list and details of spares, related calculations etc. The Design Submission Program shall also include listing of various plans, processes and other submissions.

7.6 DESIGN PROCESS

The Contractor shall deploy the staff having sufficient experience in the design of similar works at all times to maintain liaison with the Engineer. The principal requirement of the design phase is to undertake the design during this phase in three stages:

(1) the preparation of the Preliminary Design;

(2) the preparation of the Pre-final Design; and

(3) the preparation of the Final Design.

7.7 PRELIMINARY DESIGN

The purposes of the Preliminary Design submission are as follows:

(1) State the design criteria;

(2) Design the overall system, and propose the system configuration;

(3) Identify the functions of each system, equipment or other element within the overall design, and specify the relationships and interfaces between elements of the system; and

(4) Verify the tender designs and calculations.

(5) Conduct and finalize operability study and maintainability study together with the O&M Concessionaire.

7.8 PRE-FINAL DESIGN

In the Pre-final Design stage, the conceptual designs (including interfaces with those of Interface Contractors of the Employer, and of the Contractor's vendors) are required to be fully developed. In this stage, each element of the system will be considered and preliminary specifications with supporting calculations developed. Preliminary electrical and control schematics shall be developed to illustrate how various operational and functional requirements are achieved including structural analysis, simulation and calculation. Software design and development shall also be carried out at this stage.

Manufacturing units will be allowed to commence production only after receiving 'no objection' advice from the Engineer. This submission shall include sufficient detail from prospective suppliers to demonstrate that they have adequate understanding of the requirements. It will include either evidence of or proposals for design verification such as analysis and simulation. Interfaces with other Interface

Contractors shall be finalized by this stage.

7.9 FINAL DESIGN

The purpose of the Final Design submission is to agree with the Engineer that the equipment is satisfactory, compliant with the specification, fit for purpose and safe. The Final Design shall be the level of design developed to the stage where all manufacturing drawings (including those received from Interface Contractors of the Employer, and vendors of the Contractor) are fully defined and specified and in particular:

(1) calculations and analyses are complete;

(2) all main and other significant elements are delineated; and

(3) all other work, including studies, investigations and reports are complete.

7.10 DESIGN SUBMISSION AND REVIEW PROCEDURE

All design submissions from the Contractor shall be accompanied with a Design Review Certificate Application (DRCA) notice. The forms and numbering system of the DRCA notice shall be subject to prior approval of the Engineer.

Upon receipt of design submissions from the Contractor, a copy of the DRCA will be signed, dated and returned by the Engineer.

The Engineer shall issue Design Certificate Consent (DCC) Sheet properly dated and numbered to the Contractor for each of the DRCA. The DCC will carry status as Notices of "Not Accepted", "No Objection", "Notices of No Objection, subject to…." and decisions made by the Engineer in response to the DRCA made by the Contractor. The DCC sheet properly dated and numbered shall be sent to the Contractor. The consent sheet number shall be the same as the Design Review Certificate Application number except that the letters "DRCA" are replaced by "DCC".

When significant comments are noted by the Engineer on the design submission, the DRCA shall be returned "Not Accepted", and signed by the Engineer. One copy of the DRCA shall be returned to the Contractor together with the comments on why the submission was rejected.

When minor comments are noted by the Engineer on the design submission and it is "No Objection, but Subject to Comments" the DRCA will have the appropriate decision indicated upon it and be signed by the Engineer. One copy of the DRCA, together with comments, will be returned to the Contractor.

A submission will be rejected automatically if not signed by the Contractor's Representative or the Contractor's Authorized Design Representative.

Upon receipt of a decision sheet from the Engineer, the DCC will be signed, dated by the Contractor, and returned to the Engineer.

7.11 ENGINEER'S REVIEW

The Engineer will complete his review of the submission within 45 calendar days, after which the review comments in writing or on marked up drawings and specifications will be furnished to the Contractor. The Contractor shall then meet with the Engineer to discuss the review comments. Within two weeks of the receipt of the Engineer's comments the Contractor shall submit his proposals for implementation in the next submission. Where the comments are minor, such proposals may be clarified by calculations, part prints, etc. acceptable to the Engineer and included in the Contractor's next submission. Should the Engineer deem the submission to be unacceptable, the Contractor shall revise and re-submit the entire submission within two weeks, unless otherwise agreed with the Engineer.

After the Engineer's review of the design submissions, the Contractor shall update the documentation incorporating Engineer's observations and also other design requirements. For all subsequent

submissions, the Contractor shall demonstrate that all the previous comments by the Engineer have been incorporated. The Comments previously issued by the Engineer shall also become part of the submission.

The design submissions for relevant design of Railway Systems shall require the Employer's approval.

7.12 FINAL DESIGN DOCUMENT DELIVERY

To achieve agreement with the Engineer on the completion of the design and to allow the formal submission of the Final Design, the Contractor shall submit a list of all accepted design submissions to the Engineer for review along with self-adhesive stickers signed by the Contractor's Representative. If there is no objection by the Engineer, he shall then sign and return the self-adhesive stickers to the Contractor for affixing to the amended Final Design documents including Drawings (original) prior to their submission under the Final Design Document Delivery.

Based on the Engineer's review of the Final Design Submission, the Contractor shall then re-submit the entire Final Design Submission together with the following documents:

(1) joint statements of completed design interface with the Interface Contractors of the Employer, if applicable;

(2) a signed statement confirming that he has incorporated all comments of the Engineer;

(3) a Design Certificate duly endorsed, in the form accepted by the Engineer. These above jointly will be known as "Final Design Document Delivery".

7.13 AS-BUILT DRAWINGS AND RECORDS

The As-Built Drawings are intended to show the Works exactly as constructed. These are prepared by amending the installation and manufacturing drawings to consider changes necessitated by manufacturing methodology. These drawings shall be completed on a regular basis as the Works progress, and not left until the completion of the Defect Notification Period.

The As-Built Records shall include all record photographs, all test results and all inspection records and shall be endorsed by the Contractor as true records of the execution of the Works.

The Contractor shall supply to the Engineer, the required numbers and types of copies of the relevant As-Built Drawing / Completion Drawings. The Works shall not be considered to be completed for the purpose of taking over until the Engineer has received these drawings.

Two full size sets of Paper Copies and one set of Electronic Files of the As-Built Drawings shall be submitted to the Engineer prior to the commencement of the Tests on Completion.

Prior to the issue of the Handover Certificate and in accordance with the Conditions of Contract, the Contractor shall supply the 7 full-size sets and two sets of the electronic file of the As-Build Drawings and the 5 sets of hard copies and two sets of the electronic file the As-Build Records.

During the Defect Notification Period, if the Works would be modified due to the failure of the Contractor, the updated As-Built Drawings and Records shall be re-submitted at the end of the Defect Notification Period.

7.14 POST ACCEPTANCE CHANGES

The changes to accepted drawings, whether they are initiated by the Contractor or the Engineer, shall be submitted through the procedure prescribed in Sub Clause 6.10 above. Upon acceptance of the post acceptance change, the Engineer shall issue a DCC to this effect. Submission as a result of a post acceptance change shall use a new DRCA number, i.e. not a previously used one.

The Contractor may propose an alternative procedure for implementing post acceptance changes

(hardware and software) for review of the Engineer.

For requesting any change to the accepted design, the Contractor shall submit the relevant design details for review of the Engineer. The Contractor shall not implement any change without receiving 'No Objection' from the Engineer.

8 DOCUMENT AND DRAWING SUBMITTALS AND REVIEW

8.1 GENERAL

The Contractor shall transmit all submissions to the Engineer according to the procedure laid down in the following paragraphs. The general requirements are as follows:

The Contractor shall provide a non-web-based system of transmittal for formal project correspondence, documents, drawings and information and ensure efficient information management on the Project. The Contractor shall provide the Project-wide use of the system during the Design and Construction Phases and also the Defects Notification Periods.

8.2 PROJECT DOCUMENT CONTROL PROCEDURE

Within twenty-eight (28) days after Commencement Date, the Contractor shall submit a Project Document Control Procedure to the Engineer for review, which shall include but not be limited to the following:

(1) a document approval system which shall specify the level of authority for approval of all documents and material before submission to the Engineer,

(2) a system of issuing documents to ensure that pertinent documents are issued to all appropriate locations,

(3) a document changes or re-issue system to ensure that only the latest revision of a document can be used, and

(4) a submission identification system that identifies each submission uniquely by the following:

(5) Contract number, Discipline, Submission number; and Revision indicator.

8.3 DOCUMENT SUBMISSIONS

The Contractor shall submit a Drawing Register to the Engineer in electronic copy and hard copy with each submission of drawings and at an interval agreed by the Engineer. The drawing register shall be in a format submitted for review and agreed without objection by the Engineer and shall include each document reference number, version, date, title and data-file name.

8.4 SUBMISSION AND RESPONSE PROCEDURE

8.4.1 General

Where submissions related to the Works are required, except where specific procedures are given for certain items, all submissions shall be submitted and reviewed according to the procedure laid down in the following clauses.

8.4.2 Proposal

Each submission shall be accompanied by a brief introduction to explain which equipment, part or section of the Contract Works to which the submission refers, listing the documents enclosed with the submission, and describing in outline how all relevant requirements of the Works Requirements are achieved by the proposals.

8.4.3 Submission Response Request

For each submittal, the Contractor shall prepare a Submission Response Request (SRR) carrying the date of submission, the submission reference number, the submission title, and the authorized signature of the Contractor's responsible engineer to confirm that, in the opinion of the Contractor, the submission:

(1) complies with all relevant requirements of the Works Requirements,

(2) conforms to all interface requirements,

(3) contains, or is based on auditable and proven or verified calculations or design criteria,

(4) has been properly reviewed by the Contractor, according to the Contractor's Quality Assurance System, to confirm its completeness, accuracy, adequacy and validity,

(5) has taken account of all requirements for approval by statutory bodies or similar organizations, and that where required, such approvals have been granted, and

(6) contains 2 (two) properly signed copies of the Design Certificate (Form DC)

8.4.4 Reports and Records

(1) Reports and records are to be submitted to the Engineer and shall be in a format agreed by the Engineer. Reports and records shall be signed prior to submission by the Contractor's agent or by a representative authorized by the Contractor.

(2) The Contractor shall submit the documents as required by the Engineer as Project records in full and on time. The Engineer shall determine the adequacy of the Project record.

(3) The Contractor shall establish and maintain a place for the storage and archiving of all the documents relating to the Contract Works but not required to be submitted to the Engineer.

(4) Project records will eventually be used by the Employer to manage, operate and maintain the Contract Works after the completion of the Project under construction and for future reference.

9 MANUALS AND DOCUMENTS

9.1 MANUALS AND DOCUMENTS FOR EQUIPMENT AND SYSTEMS

The Contractor shall produce manuals and documents for all the equipment and systems supplied in Railway System works. These shall include, but may not necessarily be limited to, the following:

(1) Site offices, huts, workshops, warehouses and stores,

(2) Temporary utilities such as water, electricity and mobile and fixed telephones, sanitary and medical facilities,

(3) System Documents - a comprehensive description of all system principles at block diagram level,

(4) Operating / User Manuals - broken into as many sub-sections as may be necessary and providing sufficient information to enable non-technical staff to fully exploit the facilities of each system,

(5) Workshop Documents - installation and circuit descriptions, full schematics, circuits, wiring diagrams, mechanical construction drawings and itemized parts list to enable all maintenance rectification and setting-up to be carried out,

(6) Software System Documents - for each software package and each piece of equipment which incorporates programmable devices and for which bespoke software has been prepared specifically for this application, source code listings with comprehensive comments shall be provided for all bespoke software together with configuration listings for all configured standard software packages,

(7) Equipment Room Documents - all wiring diagrams and circuits, equipment layout, terminal and cable listing and including such external equipment as may be necessary for completeness,

(8) Maintenance and Servicing Manuals - to specify requirements, procedures and servicing intervals for planned preventative maintenance and in addition to convey sufficient information on equipment principles and practice to enable first line fault diagnosis and rectification by technician staff.

9.2 OPERATION MANUALS

The Contractor shall provide Operation manuals explaining the purpose and operation of the complete system together with its component subsidiary systems and individual item of equipment. The characteristics, ratings and any necessary operating limits of the equipment shall be provided. The Operation Manuals shall also include the Degraded Operation and/or Emergency Operation of MMSP Railway System.

The Contractor shall arrange all documentation in accordance with the following guidelines for all Operation manuals:

(1) The first section shall be an overview of the functions provided by the systems.

(2) All functions shall be described and all operator input clearly defined.

(3) All system operating sequences shall be explained.

(4) All indications and alarms shall be described together with the appropriate operator response.

(5) Descriptions of indications and operator inputs shall be accompanied by pictures or screen shots of the control interface.

(6) Lengthy technical descriptions of the systems in sections on operator input shall be avoided and if required shall be segregated into an appendix for reference.

(7) Relevant system block diagrams, drawings, flow charts etc. shall be provided where this assist understanding of the text and the significance of the equipment alarms and status indications.

9.3 MAINTENANCE PLAN AND MANUALS

The Maintenance manuals shall provide detailed instructions for the Railway Systems. These manuals shall be produced with due regard to the qualification of personnel who shall be required to refer to them. These documents will be issued as controlled documents and should therefore be collated and numbered in proper order corresponding to the contents and index pages. Nomenclature of equipment, diagrams and figure numbers or units shall be consistent throughout the text. In order to comprehend the text, diagrams, drawings, sketches and actual photographs shall be added where necessary. All manufacturers' literature identification codes or stamp markings shall be omitted. Precautions and warnings regarding the safety of life and equipment shall be included where applicable. Manuals shall be clearly identified as being:

(1) Preventive maintenance,

(2) Recovery/corrective maintenance, and

(3) Software maintenance.

The Contractor shall prepare an submit a Maintenance Plan, and Manuals, as per the requirements laid forth within this document, and the system specific Appendix for RAMS Assurance.

9.4 ELECTRONIC MANUALS

The Contractor shall provide manuals in the electronic format. This is in addition to the submission of manuals in hard-copies.

The format of the electronic copies shall be proven in at least two other applications and shall allow for links between parts catalogue and maintenance instructions.

The Document Management System and language used shall be subject to the Engineer's review.

9.5 OPERATING / USER MANUALS AND MAINTENANCE AND SERVICING MANUALS

Operating / User Manuals and Maintenance and Servicing Manuals shall be divided into indexed sections explaining the subject matter in logical steps. Most manuals shall consist of A4-size printed sheets bound in stiff-cover wear-resistant binders clearly and uniformly marked with the subject matter and reference number. Where alternative sizes are proposed, (e.g. A5/A6 pocket books of schematic wiring diagrams) these shall be for review and acceptance. The binding shall allow for all subsequent changes and additions to be readily affected.

Information shall be provided in pictorial form wherever and whenever possible and shall include step-by-step instructions and views of the particular equipment including exploded views.

The Contractor shall provide clarifications and amendments to the manuals as necessary during the execution of the Contract. Updates shall be provided for the originals and all copies.

9.6 SUBMISSION OF MANUALS AND DOCUMENTS

The Contractor shall submit at least (a) System Documents, (d) Software System Documents and (e) Equipment Room Documents in Sub-Clause 8.1 for review by the Engineer prior to Factory Acceptance Tests. All the other documents shall be submitted by the Contractor before the installation construction starts.

The Operating / User Manuals, the Maintenance and Servicing Manuals, and other technical manuals and documents shall be prepared in English.

All the manuals and documents shall be reviewed for the approval by the Engineer.

9.7 NUMBER OF SUBMISSION COPIES

The Contractor shall provide six (6) copies of all manuals and documents (and one CD) for the use of the Engineer and the Employer.

10 INSPECTION, TESTING AND COMMISSIONING

10.1 GENERAL

Inspection, Testing and Commissioning shall comply with all requirements of the GC supplemented, amplified, modified or superseded as applicable by the ERT and the ERG.

The Contractor shall perform all inspection, testing and commissioning activities to satisfactorily demonstrate that when completed, the Works would be fit for the purposes for which the Works are intended as defined in the Contract.

The Contractor shall submit the Inspection, Testing and Commissioning Management Plan for the Engineer's review as per schedule furnished in Table 4-1 of Appendix 3 attached hereto. The purpose of the Inspection, Testing and Commissioning Management Plan is:

(1) To provide evidence as to how the Contractor will plan and program his tests and inspection and test activities; and

(2) To allow the Contractor to indicate his "Witness and Quality Hold Points" for selected operations.

The Inspection, Testing and Commissioning Management Plan shall be prepared in accordance with the Employer's Requirements – Particular Specification. This plan shall also include integrated testing and commissioning of trains in the section and service trials before introduction in revenue service. The plan shall contain, but not limited to, the following topics:

(1) the Contractor's methodology for inspection, testing and commissioning;

(2) all Inspections and Quality Hold Points;

(3) inspection, testing and acceptance operations performed on the parts during and after fabrication;

(4) inspection, testing and acceptance operations performed on subassemblies composed of these parts, if any;

(5) inspection or test operations performed during on site activities;

(6) tests, inspections and examinations performed on systems assembled in shop and site;

(7) the interdependency and inter-relationship with Interface Contractors and their commissioning program;

(8) the objectives of each test and criteria for successful tests;

(9) organization chart and Curriculum Vitae of key personnel in the testing and commissioning team; and

(10) documentation for conducting tests and submission of testing and commissioning procedures.

Inspection Hold Points

(1) The Contractor shall propose a set of inspection hold points in the Inspection, Testing and Commissioning Management Plan. The hold points shall be structured so that a formal hold point is allowed for each significant element of the Railway System item's manufacturing process. At each hold point the Engineer shall hold a formal inspection, or advice that the inspection has been waived.

(2) The manufacturer of each Railway System equipment or part thereof shall not proceed until the inspection by the Engineer has been completed or while waived.

(3) No Railway System equipment shall be considered ready for delivery without the

Engineer's endorsement in writing. The Contractor shall bear the cost of attendance at the inspections made outside the Country including travel, flight charge (economy class) from Manila to the place where the inspection will be made, lodging, local transportation, safety tools, etc., for the Employer's and Engineer's Personnel. It is expected that three (3) Employer's and two (2) or (1) Engineer's Personnel will attend at each inspection of the railway systems (8 systems) at three (3) times with five (7) days including travel time for each inspection. Twenty-four (24) roundtrip group visits in total are estimated for the inspections as shown in Table 9.1. If the inspection will not be completed satisfactorily, the additional inspection attended by the Employer's and Engineer's Personnel will be arranged and the cost of attendance for such additional inspection shall be borne by the Contractor.

Table 10.1: Inspection

No.	User	Quantity	Remarks: Railway Systems
1	Employer	24 roundtrips * 7days * 3persons	Track works, Signaling System, Telecommunications System, Power Supply System, Overhead Contact System, Automatic Fare Collection System Platform Screen Door System Each system includes PRI & TC equipment.
	Engineer	24 roundtrips * 7days * 2 persons or one person	

(4) The Contractor shall advise the Engineer no fewer than 45 days in advance of Railway System equipment being available for inspection, and shall notify him of the tests proposed to be carried out. In case, inspection is not carried out at the time agreed upon as a result of the Engineer not being available, the Contractor shall notify the Engineer immediately and he will deploy the Engineer's representative within one week. In case the Engineer's representative fails to turn up within this period, the Contractor may proceed with the work and the Inspection Certificate issued by the manufacturer will be expected by the Engineer.

(5) Once the Inspection and any required remedial actions are completed to the satisfaction of the Engineer, he shall give consent for Railway System equipment' shipment and/or dispatch.

Basically, the Contractor or his subcontractor is responsible for the execution and recording of all inspections and tests which are to be found on the Inspection, Testing and Commissioning Management Plan. All the technical conditions of the material manufacturing and testing have to be included in the material and part acceptance certificates.

For manufacturing and on-site activity surveillance, the Contractor will develop and implement a test and commissioning plan, which includes acceptance tests.

The Engineer will then check the plans to see whether it meets the requirements or not. The Engineer shall inform the Contractor in writing within a reasonable period after receipt of the following information;

(1) that the Contractor's proposed methods of inspection, testing and commissioning (including Integrated Testing and Commissioning) have the consent of the Engineer;

(2) in what respects, in the opinion of the Engineer about the Contractor's proposed methods etc.;

(3) fail to comply with the Employer's Requirements and/or the Final Design Document;

(4) would be detrimental to the Works and/or to the other works comprising the Project;

(5) do not comply with the other requirements of the Contract; or

(6) as to the further documents or information which is required to enable the Engineer to properly assess the proposed methods of inspections etc.

In the event that the Engineer does not give his consent, the Contractor shall take such steps or make such changes in the said methods or supply such further documents or information as may be necessary to meet the Engineer's requirements and to obtain his consent. The Contractor shall not change the methods of inspection, testing and commissioning (including Integrated Testing and Commissioning) which have received the Engineer's consent without further review and consent in writing of the Engineer.

Notwithstanding the foregoing provisions of this Chapter, or that certain of the Contractor's proposed methods of inspection etc. may be the subject of the consent of the Engineer, the Contractor shall not be relieved of any liability or obligation under the Contract.

The Engineer shall have the facility to monitor all tests and have access to all test records. Ample time shall be allowed within the testing program for necessary alterations to equipment, systems and designs to be undertaken, together with re-testing prior to final commissioning.

Unless agreed in writing by the Engineer, personnel engaged on testing shall be independent of those directly engaged in the design or installation of that equipment.

All test equipment shall carry an appropriate and valid calibration label and / or certificate.

For each of the identified tests, the Contractor shall produce a test report, in three copies, and in an approved format, within an agreed period following the test, for acceptance by the Engineer. The Contractor shall sign all reports of tests. The Engineer reserves the right to reasonably call for additional tests if considered necessary.

10.2 NON-CONFORMITY AND DEVIATION DISPOSITION

The Non-Conformity and Deviation detected / observed during manufacturing, testing and commissioning shall be grouped into essentially three types and shall be dealt as under:

(1) Type 1: Non-conformity not in violation of the Particular Specification or design documents originated by the Contract and approved by the Engineer.

(2) Type 2: Non-conformity with the Particular Specification or design or documents issued by the Contractor and approved by the Engineer but which can be reconciled with the applicable specification.

(3) Type 3: Non-conformity with the Particular Specification or design or documents issued by Subcontractors and approved by the Engineer which cannot be reconciled with the applicable specification. Some examples of this group of non-conformity but not limited to are:

a) equipment, component or system unable to meet functional or performance requirements;

b) critical dimensions (involved in the stress analysis report of interface dimensions) out of tolerance;

c) inspection or control not carded out and being impossible to be repeated; component without appropriate identification to ensure its recording.

These types of non-conformity shall be recorded in a Non-conformity Report (NCR) and reported by

the Contractor to the Engineer for processing and disposition. The Contractor shall propose the final solution and submit to the Engineer for approval during a meeting before implementation.

10.3 ENGINEER'S STOP WORK ORDER (SWO)

The Engineer or his representative will have the general responsibility to verify that the manufacturing and its associated control or test operations are performed in accordance with the contractual documents and the Particular Specification.

A "Stop Work Order" is issued when significant situations adverse to quality are noted and immediate action is required.

The stop work order shall be issued under the following conditions:

(1) equipment procured by the Contractor is not able to meet the specified quality level,

(2) use of non-approved drawings or documents during the manufacturing of items or equipment by the Contractor (or his Subcontractor);

(3) repetitive non-conformity without appropriate corrective action by the Contractor (or his Subcontractor);

(4) the Contractor (or his Subcontractor) frequently ignores the Engineer's observations regarding inspections, or

(5) when a significant noncompliance of the Quality Assurance Management Plan is detected.

10.4 ENGINEER'S CORRECTIVE ACTION REQUEST (CAR)

During the course of performing audit or inspection, the Engineer may identify situations which are contrary to product quality or may lead to products of indeterminate quality and in such situation the Engineer shall issue a Corrective Action Request (CAR).

On receipt of CAR, the Contractor shall take Corrective Action and shall return the CAR to the Engineer. In this regard, the Engineer's decision shall be final.

10.5 TEST GROUPS

The tests are organized into two broad groups:

(1) Design qualification testing or type tests which include verification of the design to the performance specification and demonstration testing on single articles of equipment; and

(2) Acceptance testing or routine tests which verify that the equipment is conforming to, selected specification requirements at various stages of production and commissioning.

The tests also can be detail grouped as follows:

(1) Routine and type tests of components and equipment in accordance with relevant standards and specifications in the Contractor/Subcontractor's factories;

(2) Factory Acceptance Tests;

(3) Restoration Test;

(4) Unit Test;

(5) Comprehensive Test; and

(6) Handover Test (includes interoperability test with NSRP-South line).

11 DEFECT LIABILITY

11.1 REMEDYING DEFECTS

The Defect Notification Period of the Railway Systems shall be seven hundred thirty (730) days from the date of Handover of the Railway Systems subject to any extension under the Conditions of Contract and last paragraph of this clause.

The Contractor shall be responsible for any defect or failure attributable to defective design, material or workmanship, outcome or notified by (or on behalf of) the Employer during the Defect Notification Period. The Contractor will not be liable for damage caused because the Engineer or the Employer or any other third parties did not follow the written operation and maintenance instructions or did not use the trains in accordance with the technical documents.

During the Defect Notification Period, if any defect, imperfection or other fault will require any design modification to component of equipment, the Defect Notification Period of that part shall re-start from the date when such modification of the or component of equipment is completed to the satisfaction to the Engineer and commissioned into the service.

11.2 DEFECT LIABILITY

During the Defect Notification Period, the Contractor will undertake the necessary remedial works for defect or damage due to the Contractor's failure at his own risk and expense including spare parts and consumables, if required, and labor.

All the equipment and material necessary for testing and remedying defect or damage in connection with defect liability will be provided by the Contractor bearing all the related expenses.

Spare parts for faulty components to be replaced shall be provided by the Contractor and are not included in the stock of spare parts that will be provided for the regular maintenance purpose under the Contract.

The Contractor shall propose the plan how he will perform his obligation for defect liability including the set-up of the service organization, during the Defect Notification Period. The plan shall include the service organization including both in Republic of the Philippines and abroad, communication line with the Employer and/or the Engineer, stock of spare parts for defect liability, etc. During the Defect Notification Period, the Contractor shall be responsible, free of charge, for the detection and repair of defects and damage and replacement of components where the train does not conform to functional specification and performance requirements specified in the Employer's Requirements. Normal wears and tears are excluded from these defects.

The repair and/ or replacement of failed components and equipment and installation of repaired/replaced components/equipment shall be undertaken by the Contractor free of charge at site. The Contractor shall bear custom duty, freight charges and all other expenses involved in collection of defective components and equipment from the Site, and transportation to the manufacturer's works in Republic of the Philippines or abroad and its return to the Site after repairs.

All replacement and repairs under the defect liability shall be carried out by the Contractor promptly and completed to satisfaction of the Engineer, on notification of the defect by the Employer and/or the Engineer on behalf of the Employer so that no Railway System equipment is unfit for service for more than twenty-four (24) hours or other period the Engineer may agree to, which shall exclude time taken for withdrawal/ induction of trains from/to services.

The Employer or the Engineer on behalf of the Employer will notify the Contractor in writing of any defect together with a brief description thereof. Upon receipt of such notice, the Contractor shall within a reasonable period of time and at his own costs remedy this defect. If within reasonable time, the

Contractor fails to fulfil his obligations after a reasonable amount of trials for remedying defect (at least three trials), the Engineer may fix by written notice a reasonable final time for completion of the Contractor's obligations. In case the Contractor fails to fulfil his obligations within such final time, the Employer may himself undertake the necessary remedial works or employ a third party to do so, always at the risk and expense of the Contractor.

The Defect Notification Period of contractual spare parts and special tools, jigs and test equipment or any other item / equipment delivered shall be twenty-four (24) months from the delivery of such spare parts, jigs, tools and test equipment or any other equipment and accepted by the Employer. In case that the Contractor may be allowed to use the equipment or special tools and/or jigs delivered to the Employer, the Defect Notification Period will re-start from the date the Contractor will return such equipment or special tools and/or jigs to the Employer and the Employer will accept the return of these equipment or special tools and/or jigs.

12 SYSTEM SAFETY ASSURANCE REQUIREMENTS

12.1 TECHNICAL SAFETY REQUIREMENTS

1.1.1 Qualitative Technical Safety Requirements

Nomenclature dictates that any references to Vital or Safety Critical within this Technical Specification, shall be understood to mean Safety Integrity Level [SIL4], and not to be misunderstood to mean SIL2 or SIL0.

Nomenclature dictates that any references to Safety Relevant or Non-Vital within this Technical Specification, shall be understood to mean Safety Integrity Level [SIL2], and not to be misunderstood to mean SIL4 or SIL0.

Nomenclature dictates that any references to Non-Relevant Safety-Function within this Technical Specification, shall be understood to mean Safety Integrity Level [SIL0], and not to be misunderstood to mean SIL4 or SIL2

ISA Requirements within Safety Assurance Employers Requirements, do not apply to CP106 Automatic Fare Collection Contract, unless a Project Wide Independent Safety Assessor is engaged by the Engineer.

Safety activities shall be executed as an integral part of the design and development process, with participation in Interdisciplinary Design Review meetings, and regular disclosure of updated Designs to the Safety Assurance team.

The Contractors shall ensure direct participation of their system assurance team, in all Inter-Disciplinary and Non-Inter-Disciplinary Engineering Reviews.

All engineering submissions by the Contractors at any level shall be considered as incomplete without the completion and approval by the Engineer [issue of NoNo Notice of No Objection] of the planned safety activities required at given Design Gate/Milestone, in order for the Design to proceed.

The Design cannot be approved and commence [IFC Issue for Construction], until the Safety Assurance process for the design stage is completed and approved by the the Engineer.

The design cannot proceed independent of Systems Assurance approval by the Engineer, and on the Project-wide ISA's recommendation.

Contractors shall design their systems to comply with current accepted practices, codes, regulations, standards and other design safety principles.

Any Deviations from, or non-compliance with the codes, standards and regulations, listed within the Employers Requirements, in particular for new or novel equipment shall be assessed in terms of the impact on system safety.

The relevance and application of the design safety principles formulated for the design should be confirmed for normal, degraded and emergency operation of the system. Since safety is a proven integral part of these legislations, acts and technical standards, compliance to these documents, ensures safety of the system.

The Employer or Engineer, will employ a project level Independent Safety Assessment organisation, to carry out the Independent Safety Assessment of the MMSP project, including Civil Design, M&E Design, Rail Systems Design, Fire and Life Safety Design and Aspects, for the whole Alignment, inclusive of the Depot, PO section and Remaining Section, any adjacent Receiver Sub-Stations, the Integration of the MMSP Trains onto the Interoperable section NSRP, and the Interface between MMSP

to NSRP

The Employer or Engineer shall engage the ISA within 60 days of Detailed Design commencement, by way of Issuing a Call for Tender publically.

The Engineer will be responsible for preparation of the Tender Specification [Vol I-III], inclusive of Technical Employers Requirements.

The Engineer shall be responsible for management of the ISA, on behalf of the Employer.

The ISA shall present its proposal for execution of Independent Assessment services, based on the Employers Requirements, within the Tender package –Vol I-III].

Engagement of a Project Wide ISA, does not supersede, negate or circumvent the requirement for Contractors of Safety Critical sub-systems [Signalling, Rolling Stock, PSD, Telecommunications], to engage their own Contractor ISAs

Each Contractor tasked with engaging a Independent Safety Assessor for their scope of delivery, currently Signalling, Rolling Stock, PSD, Telecommunications, shall have the Option, at the Engineer's and Employer's instruction, to extend the ISA scope to a supplementary Independent RAM Assurance or IRA contract, which would include full assurance of RAM scope for the pertaining Contractor.

12.2 SAFETY MANAGEMENT REQUIREMENTS

The contractor must conduct hazard identification workshops with various stakeholders and SME's, for each system, then submit a preliminary hazard analysis (PHA), no later than 60 days after NTP.

The Contractor must conduct specific Hazard Analysis compliant to EN50126, at the appropriate point within the Design/Project phase. These analyses shall nominally include'

(1) Interface Hazard Analysis;

(2) Sub-system/System Hazard Analysis;

(3) Operations & Support Hazard Analysis; and

(4) Specific Hazard Identification workshops as requested by the the Engineer, for key project safety risks, dependent on the Safety Criticality of the Contractors scope, e.g. EMC Hazard Analysis, Fire Hazard Analysis, Security/Cyber-Security Hazard Analysis.

Each Contractor shall submit program for workshops to conduct the above Hazard Analysis, within 30 days of NTP Notice to Proceed;

Each Contractor shall submit a report for each Hazard Analysis type, to the Engineer for review and approval, within 60 days of NTP Notice to Proceed.

The Engineer may participate in the workshops, at the Engineer's request, on an observational basis only, and may intervene, if the topic is wildly diverges from the required deliverables, or is considered to be clearly unsafe or incorrect.

The contractor must provide a Safety Stock (SCIL items) of a minimum of one component in all cases.

12.2.1 Safety Target

Systems Safety shall provide optimal safety levels for Staff, Passengers, 3rd party employees/emergency workers, entering the MRT system

12.2.2 System Safety Plan

Nominally the SSMP shall describe the contractor's approach to determining Safety Integrity Levels (SIL) for each system, subsystem.

Nominally the SSMP shall include sections, describing the contractors approach to managing;

(1) System Safety Requirements;
(2) Safety Policy;
(3) Safety Approach;
(4) Safety Targets (SIL's);
(5) Contractors Safety Management Organization;
(6) Clients Safety Management Organization;
(7) Any sub consultants/contractors Safety Management Organizations;
(8) Safety Assurance Responsibilities;
(9) Competency Management;
(10) Safety Management processes and activities;
(11) Safety Lifecycle;
(12) Risk Assessment (including definition of Risk Matrix);
(13) Hazard Management;
(14) Tolerability of Risk (including Value per Fatality);
(15) SIL Assessment;
(16) Quantified Risk Assessment approach;
(17) Safety Verification and Validation process Design Safety Review;
(18) Safety Audit;
(19) Software Assurance Process;
(20) Safety Demonstration;
(21) Safety Critical Items List; and
(22) Safety Evidences.

12.2.3 Safety Audits

Each Contractor shall implement a Safety Audit program to the Engineer for review and approval, within 30 days of NTP Notice to Proceed.

12.2.4 System Safety Criteria

The contractor must produce a Safety Critical Items List, which will be an output from the FMECA and PHA process.

Systems and subsystem architectures shall employ redundant design and diversity design techniques, in order to guarantee safe operation.

When any faults n the sub-systems, equipment (LRU/LLRU) and devices could cause a hazardous event to occur, injury, main system damage, and/or service interruptions (MTBSAF), the contactor shall use redundancy, warm up auto backup or design according to the fail-safe principle.

Fail safe design principles shall be used for all systems deemed as safety critical [SIL4].

Use of design techniques, such as Redundancy, Diversity, Supervised Redundant Mechanisms, shall be employed to ensure a Risk Reduction for Safety Critical systems and functions.

Redundancy shall be employed within the design for all safety relevant and safety critical systems, and this shall be demonstrated by the contractor conducting Reliability Block Diagram modelling, to demonstrate the decomposition of their respective subsystems, and to calculate the top-level availability for each sub-system.

Ultimately the top-level availability calculation for each sub-system shall be used to demonstrate meeting of availability targets for each system and the ultimate whole operational Metro Manila Subway System.

The Contractor must submit the RBD Modelling Report, to the Engineer for review and issue of NoNo (Notice of No Objection) approval, for the Contractors respective system responsibilities.

Below is a breakdown of systems and responsibilities for submission of Safety document deliverables.

Table 12.1: Safety Level for Each System

PACKAGE	SYSTEM	SAFETY LEVEL	REMARKS
CP106	Signaling	Safety Critical	Refer to CP106, Signalling Employers Requirements
CP106	PSD	Safety Critical	Refer to CP106, PSD Employers Requirements
CP106	Telecommunications	Safety Critical	Refer to CP106, Telecommunications Employers Requirements
CP106	PST	Safety Relevant	Refer to CP106, PST Employers Requirements
CP106	OCS	Safety Relevant	Refer to CP106, OCS Employers Requirements
CP106	AFC	Safety Critical	Refer to CP106, AFC Employers Requirements
CP106	Trackwork	Safety Relevant	Refer to CP106, Trackwork Employers Requirements
CP107	Rolling Stock	Safety Critical	Refer to CP107, Rolling Stock Employers Requirements
CP101	TVS, including Axial Fans and Egress shaft pressurization system.	Safety Critical	Refer to CP101, E&M Employers Requirements
CP101	VAC [Environmental Control System]	Safety Critical	Refer to CP101, E&M Employers Requirements

PACKAGE	SYSTEM	SAFETY LEVEL	REMARKS
CP101	VAC incl Smoke Extraction	Safety Critical	Refer to CP101, E&M Employers Requirements
CP101	Fire Detection system [Station & Tunnel]	Safety Critical	Refer to CP101, E&M Employers Requirements
CP101	Fire Suppression system [Gas]	Safety Critical	Refer to CP101, E&M Employers Requirements
CP101	L&V Circulation [Station & Tunnel]	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Security System (Access Control)	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Building Management System [BMS]	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Facility-SCADA system [F-SCADA]	NA	NA
CP101	Lighting [Station & Tunnel]	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Emergency Lighting [Station & Tunnel]	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Station and Tunnel Emergency signage system	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Lightning Protection system	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Backup power UPS system	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Backup power DG system	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Backup power Battery system	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Earthing and Bonding, Cathodic Protection, Stray Current	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Low Voltage Distribution	Safety Relevant	Refer to CP101, E&M Employers Requirements
CP101	Fire and Life Safety compliant design [Station & Tunnels]	Safety Relevant	Refer to CP101, Civil Employers Requirements

All above CP 101 Civil/E&M Safety Requirements shall apply to Remaining Section Contracts – CP102, CP103, CP104, CP105, CP108

Design of Safety systems, shall employ Fail Safe principle or Checked Redundant principle.

Any single fault must not cause the loss of safety protection, and that no common cause or common mode fault must result in loss of safety function.

All common cause or common mode faults shall be eliminate from the design.

Under the checked redundant concept any failure that could adversely affect the comparison method must result in a fail-safe mode.

At the subsystem level, any wrong side failure of key safety critical subsystems (wrong side failures which may credibly lead to catastrophic consequences) must be shown to be better than10-9perhour.

No open circuit or short circuits shall result in a hazardous outcome.

No component, LRU/LLRU shall be allowed to emit voltage transients into the system.

Computer hardware shall be designed with redundant principles, where safety functions are present.

12.2.5 System Safety and Risk Acceptance Principle

The principle shall be selected by the Contractor, at the time of conducting the Hazard Analysis and demonstrated within the Hazard Record. The principles will be based on the CSM principle employed for numerous international projects, including Doha Metro, Riyadh Metro, and Dubai Metro. The Contractor can select from.

(1) Reference System/Project;

(2) Norms and Standards; and

(3) Quantitative Risk Acceptance.

Where Reference Project is selected, the Contractor shall refer to the project and provide sufficient evidence from the project, to demonstrate the safety, and requisite risk reduction of the Hazard.

Where Norms and Standards is used, the Contractor shall provide reference to the correct Standard, which sufficiently mitigates the hazard risk.

Where QRA is selected, the Contractor shall conduct a Quantitative Risk Analysis of the hazard space, to demonstrate the risk is ALARP and tolerable.

The Contractor shall use FTA Fault Tree Analysis, to demonstrate QRA and show the probability of the Top-Level Hazard or Event occurring.

It is requirement from the Engineer, and Manila Metro Subway Project [MMSP], that all Hazards with an Initial Risk Ranking that is R1 or Intolerable, and cannot be mitigated by Option 1 or 2, have a Quantitative Risk Assessment undertaken using FTA.

The Contractor must submit the QRA Quantitative Risk Assessment Report, to the Engineer for review and issue of NoNo (Notice of No Objection) approval, for the relevant high risk SIL4 systems, and Intolerable Hazards. A Safety Review shall b conducted, to determine if inclusion of relevant hazards, systems, sub-systems, safety functions, is robust, complete, and sufficient, prior to completing the QRA FTA Report.

The report, shall be submitted to the Engineer, prior to completion of Detailed Design phase, and prior to Issue for Construction approval.

Any recommendations or mitigations/controls within the report, shall be fed into the Final Design and reflected in the Final Design As-Builts.

12.2.6 System Safety Analysis

Safety analysis shall apply to all sub-systems, not only rolling stock.

The contractor must submit a PHA Report at 30 days after NTP. The PHA will be recorded within the relational database, such a "Complypro or DOORS" and becomes the Hazard Log.

The contractor must submit Hazard Log Compliance Report for each design package – Station, Tunnel section, per subsystem, to include a vertical slice or snapshot of the Hazard log, which includes an extract of all hazards applicable to the specific design package (location) for each given subsystem, including export of causes and control measures. The report must also include metrics for each design package/subsystem, containing numbers of Hazards, number of hazards open closed, number of hazards at R1, R2, R3, R4, etc.

The definition of risk tolerability, must at least meet IEC 62278 requirements.

Hazard Analysis will initially be conducted for the PHA, at 30 days after NTP, and must continue throughout the project lifecycle, until, all residual risk has been reduced top ALARP and hazards closed out.

The contractor must implement the Hazard Log within a relational database, such as Complypro or DOORS, or another similar specification relational database, to be approved by the Employer and the ISA.

The contractor must apply Control Measures to mitigate all hazards to reduce the residual risk to tolerable levels. These CM's or Control Measures, must be recorded within a relational database, such as Complypro or DOORS, as Derived Safety Requirements, and must be listed as tracked requirements (the hazard must be fulfilled by evidence.

The contractor must conduct Detailed Hazard Analysis workshops for each given system and sub-system, during Detailed Design Stages 1 and 2. The hazard analysis must include SHA, SSHA, IHA, OSHA.

FTA must be conducted for all safety critical systems or subsystems, with SIL2 or above, in addition to hazards with critical/catastrophic outcomes.

12.2.7 Safety Case

Safety Case structure shall be produced in accordance with recommended structure/headings within IEC 62280.

The Contractor must submit to the Employer and the ISA (Independent Safety Assessor) and ISSA (Independent Software Safety Assessor), according to the following schedule:

(1) Subsystem Final Safety Cases – 10 days prior to completion of Sub-system Validation

(2) System Final Safety Case – 10 days prior to completion of System Validation

(3) The contractor shall produce the following Safety Cases, as part of their assurance and approval requirements;

(4) Sub-System Design Safety Cases (per each sub-system) - (submit on completion of Detailed Design stage 2);

(5) System Design Safety Case (submit on completion of Detailed Design stage 2);

(6) Testing Readiness Safety Case- (submit 30 days prior to commencement of T&C phase);

(7) Sub-System Engineering Validation Safety Case (submit upon completion of Integrated

T&C phase);

(8) System Engineering Validation Safety Case Pre-Operation Safety Case (submit upon completion of Integrated T&C phase);

(9) Operation Safety Case (submit 10 days prior to commencement of Operations);

(10) The Contractor must submit to the Employer and the ISA (Independent Safety Assessor) and ISSA (Independent Software Safety Assessor), according to the following schedule;

(11) Subsystem Engineering Safety Validation Report – 10 days prior to completion of Sub-system Validation

(12) System Engineering Safety Validation Report – 10 days prior to completion of System Validation

(13) The Contractor must submit to the Employer and the ISA (Independent Safety Assessor) and ISSA (Independent Software Safety Assessor), according to the following schedule; and

(14) Software Safety Case – 10 days after completion of System Validation.

12.2.8 Risk

A risk identification process be defined by the contractor submitting a Risk Management Plan, and establish a corporate/enterprise level risk register, for all enterprise level risk.

Risk Management Plan [RMP] should be submitted by the Contractor, to the Employer, no later than 30 days after NTP.

Risk Register including Corporate/Enterprise risks, shall be submitted by the Contractor to the Employer, no later than 60 days after NTP. The register can be submitted in excel/tabular form. After submittal, the risk, register shall be transferred to the nominated relational database, such as Complypro/DOORS, and managed within here, for the remainder of the project.

12.2.9 Safety Management Documents

The Contractor shall provide a delivery plan, inclusive of gates for the following new plans & reports

(1) Risk Management Plan – Design phase
(2) Risk Register – Design phase, construction and test phases
(3) Hazard Log Reports - Design phase, construction and test phases
(4) IHA - Design phase, construction and test phases
(5) PHA – Design phase
(6) Hazard Log - Design phase, construction and test phases
(7) Design S safety Case - Design phase, construction and test phases
(8) Fire & Life Safety Plan – Design
(9) Fire & Life Safety – Design phase, construction, and test phases

12.3 ERGONOMIC REQUIREMENTS

All following Ergonomic Requirements, shall also extend to maintenance staff, operational staff, emergency services staff.

The contractor shall nominally conduct ergonomic studies for the following systems, during design phase:

(1) OCC/BOCC – layout, workstations, etc;
(2) CBTC onboard cab;
(3) SCADA/CBTC/PSD workstations in Station control rooms;
(4) Rolling Stock cab layout;
(5) Rolling stock passenger area (disability/universal access requirements);
(6) Depot accessibility;
(7) Maintainability for key maintenance tasks – per subsystem; and
(8) Controls panels/workstations in BSS/TSS.
    a) CCTV placement in Tunnels and Guideway (Comms).

Above Ergonomic Studies, shall also be conducted to be inclusive for Control Room and Station Managers .

All hazards identified from above, studies shall be included within an Ergonomics Hazard Record.

Particular attention shall be paid to Ergonomic study of Detrainment, and egress of passengers along the walkway, within Tunnel and Elevated sections, during emergencies

12.3.1 Backup Operational Control Center (BOCC)

The Contractor shall make provision for a Backup Operational Control Centre (BOCC) in the event of total Depot OCC shutdown or total system failure. A Failure Mode Criticality Analysis (FMECA) of OCC system architecture shall be carried out by the Contractor for the design of BOCC.

The BOCC shall encompass all aspects of the system to control the entire railway and Depot to assist the operator on the operational decisions for normal and degraded mode of operations. The design solution for the BOCC shall be accompanied with HAZOP log comprising of potential hazard, risk and mitigation. The BOCC shall be operational 24/7 even if the actual revenue service hours are less.

12.4 FIRE ENGINEERING REQUIREMENTS (FIRE AND LIFE SAFETY)

A Fire & Life Safety Engineering Plan must be submitted by the Contractor to the Employer, no later than 60 days after NTP.

The Fire & Life Safety Engineering Plan, must nominally contain chapters covering each major system:

(1) Rolling Stock;

(2) Depot/Stabling;

(3) OCC/BOCC; and

(4) Power Supply (other BSS outside Depot).

Fire & Life Safety Reports shall be submitted by the Contractor, during Design, construction and test phases.

12.5 GENERAL SYSTEM SAFETY REQUIREMENTS

The E&M contractor must conduct preliminary Hazard Identification workshops and submit the PHA Preliminary Hazard Analysis 60 days after NTP.

The E&M contractor must submit the System Assurance Plan, System Safety Plan and RAM Plan 30 days after NTP.

The contractor must include their approach to "Cost Benefit Analysis" and "Value of Preventing a Fatality (VPF) within the SAP.

12.5.1 Qualitative Technical Safety Requirements

Software must be designed in compliance to CENELEC EN 50128 requirements for the given Safety Integrity Level [SIL]. Software must employ diversity, as per SIL requirements.

Software must be designed to the following Safety Integrity Levels, in accordance with CENELEC EN 50128 requirements, unless the safety function is protected by mechanical interlocks.

The Contractor shall perform requisite analysis to ensure that all common cause failures shall be eliminated from the design.

The contractor must develop Safety Critical Items List (SCIL) sparing to a 99% confidence interval.

The following software must be designed to the following Safety Integrity Levels, in accordance with CENELEC EN 50128 requirements;

Relevant Systems Contractors must develop the respective systems & subsystems compliant to the

quantitative Safety Integrity Level, [SIL] requirements contained within the Technical Specification for each particular Subsystems contract.

12.5.2 Quantitative Technical Safety Requirements

The following systems/sub-systems must be designed to the following Safety Integrity Levels, in accordance with EM50126/EN50128/EN50129 & IEC 62279 requirements.

Table 12.2: Safety Integrity Level for Each System

System, Sub-system	Safety Integrity Level (SIL)
Signalling Trackside	SIL4
Signalling Onboard	SIL4
Power Supply Traction (HV, MV)	SIL2
OCS	SIL2
MEP	SIL2
Rolling Stock	SIL4
AFC	SIL4
OCC	SIL2
BOCC	SIL2
PSD Platform Screen Door	SIL4
Telecommunications	SIL2
Depot Equipment	SIL0
Depot Protection System	SIL2
Power SCADA	SIL2
Facilities SCADA	SIL2
BMS	SIL2
FDS/FSS	SIL4
Escalators & Elevators	SIL2
VAC - ECS	SIL0
VAC – Smoke Ext	SIL2
E&M (LVD)	SIL2
Lighting (Emergency)	SIL2
Lighting (Normal)	SIL0
E&B	SIL2
N&V	N/A

System, Sub-system	Safety Integrity Level (SIL)
Trackwork	N/A
Tunnel Ventilation System	SIL4

12.6 GENERAL SW ASSURANCE REQUIREMENTS

12.6.1 Software Framework

As defined in EN50128, all software produced or supplied for the project shall be subject to a defined quality framework.

The Contractor shall comply with all Software Requirements contined wihin Systems Assurance Apendix Requirements contained within this document, and the RAMS Appendix pertaining to its respective system.

The contractor must produce and submit the following core Software Assurance documents, to the Employer, no later than 60 days after NTP:

(1) System Software Architecture and Design Verification Report;

(2) Software Safety Case – Per System/Sub-System;

(3) System Software Quality Assurance Plan;

(4) System Software Safety Plan;

(5) System Software Verification and Validation Plan;

(6) System Software Requirements Specification;

(7) System Software Compliance Demonstration Plan [Cenelec];

(8) System Software Compliance Demonstration Report [Cenelec].

12.7 SYSTEM SAFETY DELIVERABLE REQUIREMENTS

The following table shows the indicative System Safety Deliverables Compliance Matrix.

Table 12.3: System Safety Deliverables Compliance Matrix

SI No.	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Construction & Installation	T&C	Defect Liability
1	Project Level System Assurance Plan	P	P	U	U	-
2	System System Assurance Plan	P	P	-	-	-
3	Sub- System System Assurance Plan	P	P	U	U	U
4	Project System Safety Plan	P	P	U	U	U

SI No.	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Construction & Installation	T&C	Defect Liability
5	System Safety Plan	P	P	U	U	U
6	Sub- System Safety Plan	P	P	U	U	-
7	Project Preliminary Hazard Analysis Report	-	-	P	U	U
8	System Preliminary Hazard Analysis Report	P	P	U	U	U
9	Sub-System Preliminary Hazard Analysis Report	-	-	P	U	-
10	Sub-system Safety Requirements Specification	P	P	U	U	U
11	Sub-system Safety Requirements Specification	-	-	-	P	U
12	Master Project Wide Hazard Log	-	-	-	-	P
13	System Hazard Log	-	-	-	-	P
14	Sub-system Hazard Log	-	-	-	-	P
15	System PHA Report	-	-	-	-	P
16	System IHA Report	-	-	-	-	P
17	System SSHA Report	-	-	-	-	P
18	System OSHA Report	-	-	-	-	P
19	Sub-system IHA Report	-	-	-	-	P
21	Sub-system SSHA Report	-	-	-	-	P
22	Sub-system OSHA Report	-	-	-	-	P

SI No.	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Construction & Installation	T&C	Defect Liability
23	Project System SIL Determination Reports – Per System	-	-	-	-	P
24	System SIL Allocation Reports	-	-	-	-	P
25	Sub-System SIL Allocation Reports	-	-	-	-	P
26	System SIL Demonstration Reports	-	-	-	-	P
27	Sub-System SIL Demonstration Reports	-	-	-	-	P
28	System SCIL	-	-	-	-	P
29	Sub-system SCIL	-	-	-	-	P
30	System Engineering Safety Validation Report	-	-	-	-	P
31	Sub-System Engineering Safety Validation Report	-	-	-	-	P
32	Project FTA Reports	-	-	-	-	P
33	System FTA Reports	-	-	-	-	P
34	Sub-System FTA Reports	-	-	-	-	P
35	Project Common Cause Failure Analysis Report	-	-	-	-	P
36	System Common Cause Failure Analysis Report	-	-	-	-	P
37	Sub-System Common Cause Failure Analysis Report	-	-	-	-	P

SI No.	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Construction & Installation	T&C	Defect Liability
38	System Human Reliability (Error) Analysis Reports	-	-	-	-	P
39	Sub-System Quantified Risk Assessment Reports	-	-	-	-	P
40	Sub-System Human Reliability (Error) Analysis Reports	-	-	-	-	P
41	Progressive Assurance - System Hazard Management Reports – Per Contract – Detailed Design	-	-	-	-	P
42	Progressive Assurance - System Hazard Management Reports – Per Contract – Final Design	-	-	-	-	P
43	Progressive Assurance - Interface Management Reports – Per Contract – Detailed Design	-	-	-	-	P
44	Progressive Assurance - Interface Management Reports – Per Contract – Final Design	-	-	-	-	P
45	Progressive Assurance - Requirements Management Reports – Per Contract – Detailed Design	-	-	-	-	P
46	Progressive Assurance – Requirements Management Reports – Per Contract – Final Design	-	-	-	-	P
47	System Design Safety Case	-	-	-	-	P

SI No.	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Construction & Installation	T&C	Defect Liability
48	Sub-System Design Safety Case	-	-	-	-	P
49	Project Wide Final Design Safety Case	-	-	-	-	P
50	Test Readiness Safety Case (including Trial Operations)	-	-	-	-	P
51	CBTC Signaling General Application Safety Case	-	-	-	-	P
52	PSD General Application Safety Case	-	-	-	-	P
53	PSD Specific Application Safety Case	-	-	-	-	P
54	Project-Wide Pre Operations Safety Case	-	-	-	-	P
55	Interoperable Section Final Design	-	-	-	-	P
56	Interoperable Section Pre Operations Safety Case	-	-	-	-	P
57	Project Level Software Quality Assurance Plan	-	-	-	-	P
58	Project Level Software Safety Plan					
59	Project Level Software Verification and Validation Plan	-	-	-	-	P
60	Project Software Requirements Specification	-	-	-	-	P
61	System Software Architecture and Design Verification Report	-	-	-	-	P

SI No.	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Construction & Installation	T&C	Defect Liability
62	Software Safety Case – Per System/Sub-System	-	-	-	-	P
63	System Software Quality Assurance Plan	-	-	-	-	P
64	System Software Safety Plan	-	-	-	-	P
65	System Software Verification and Validation Plan	-	-	-	-	P
66	System Software Requirements Specification	-	-	-	-	P
67	System Software Compliance Demonstration Plan [Cenelec]	-	-	-	-	P
68	System Software Compliance Demonstration Report [Cenelec]	-	-	-	-	P

1. P: Produce, U: Update, R: Review, "- ": Not Applicable

3. All Sub-System Specific documents, shall be prepared by employed Contractors

4. Item 19, shall be prepared by successful O&M PPP Entity

12.8 SAFETY ASSURANCE DELIVERABLE REQUIREMENTS, ALIGNED TO PROJECT LIFECYCLE PHASES

The following table shows deliverables and responsiblities of the the CENELEC and MMSP aligned Lifecycle Phases.

Table 12.4: CENELEC and MMSP Aligned Lifecycle Pahases

MMSP Project Stage	*EN 50126 Stage*		*MMSP Delivery Stage*	*Deliverable Compliant with Cenelec*	*Activities authorised at project level*
Approval of Concept Design	1	Concept	Pre-Operation MMSP responsible for establishing MMSP System.		*Approves general project concept and safety management approach. Authorises issue of tenders and award of contract.*
Approval of Preliminary Design	2	System Definition & Application Conditions	Pre-Operation MMSP responsible for establishing MMSP System.		*Approves preliminary functional and technical design and safety management approach. Authorises Commencement of Tier 1 D&C Consultants, to commence development of detailed design, Does not authorise commencement of construction / manufacture / installation.*
	3	Risk Analysis			
	4	System Requirements			
Approval of Final Detailed Design	5	Apportionment of System Requirements	Pre-Operation MMSP responsible for establishing MMSP System.		*Approves Final Detailed Design. Gate closure Authorises Commencement of Construction / manufacture / installation / site works* Completion of Gate, Authorizes commencement of T&C phase
	6	Design and Implementation			
	7	Manufacture Manufacturing activities in parallel to Finalization of Detailed Design			
Approval for Construction/Installation (Pre T&C)	8	Installation/Integration			

MMSP Project Stage	*EN 50126 Stage*		*MMSP Delivery Stage*	*Deliverable Compliant with Cenelec*	*Activities authorised at project level*
IT&C Phase	9	System Validation (including Safety Acceptance and Commissioning	**Pre-Operation** MMSP responsible for establishing MMSP System in corporation with Operator. During the Testing & Trail Running phase of the testing programme, Operator is responsible for operating the MMSP, subject to approval under its own SMS, approved by the Engineer		*Closure of Gate, Authorises Testing in the live Railway System including Test and Trial Running* *(note Testing does not include trial operation during normal railway services – assumes railway systems returned to normal after testing)*
Pre Operational Trials *Not optional – Trial Operations are Mandator y*	10	*System Acceptance*	Pre-Operation Mobilisation Operator as RO, IM and Railway Operator responsible for operating the Metrolink subject to approval of its own SMS.		*Closure of Gate, Authorises operational use of new assets / systems involving customers/passenger train services;*
			Operator as RO and Railway Operator responsible for providing services for the transport of passengers by rail) and RO responsible for operating Metrolink, subject to approval of its own SMS.		*Authorises operational use of new assets / systems involving customers/passenger train services.* *Safety Responsibility fully transferred to operators / maintainers of the asset* *Authorises closure of the project.*

MMSP Project Stage	*EN 50126 Stage*		*MMSP Delivery Stage*	*Deliverable Compliant with Cenelec*	*Activities authorised at project level*
Operations	*11-12*	*Commencement of Operations*	Operator as RO, IM and Railway Operator responsible for operating the Metrolink, subject to approval of its own SMS.	*Delivery and Approval of Operational Safety Case and O&M SMS. Delivery of ISA Certification for Metro*	*These stages will be managed by the yet to be determined Operator under their SMS*

12.9 REQUIREMENTS MANAGEMENT

Each Contractor and sub-contractor, shall procure and implement a Requirements Management System or Database, in accordance with the requirements contained within the General Specification for each contract, and the following requirements.

The Contractor shall procure a Requirements Management system, which uses relational Dynamic Object-Oriented Requirements System, technology, such as DOORS Classic, DOORS NG, ComplyPro, or Siemens Polarion.

The Contractor shall present its preferred choice for RM tool, within 28 days from NTP, to the Engineer for its approval.

In order to define how the requirements will be managed throughout the lifecycle of the Project, the Contractor shall provide a Requirements Management Plan which defines the requirements management process and the processes for the V&V stages, together with change management of the requirements.

The Requirements Management Plan shall include, but not be limited to, the following:

(1) A traceability system that tracks and demonstrates all aspects of the design and/or engineering of the contract package that fulfils the Employer's Requirements and Specifications;

(2) Setting out the strategy for V&V so that all parties may have a common understanding;

(3) Specifying the approach to be used on the Project, such that:

a) Requirements specifying systems, characteristics and context of use are defined in the Requirements Management Database;

b) Constraints that affect the design of the Project systems and the means to achieve it are defined;

c) Requirements for which verification is needed are identified;

d) Requirements for which validation is needed are identified;

e) Requirements which have an impact on safety are identified in conjunction with the other aspects of Systems Assurance;

f) Demonstrable traceability between requirements and the design;

g) Demonstrable traceability between the design and inspection and/or test reports; and

h) A defined basis for confirming with objective evidence that requirements are

satisfied within the Project Implementation Program.

(4) Definition of the responsible persons and their respective roles regarding V&V;

(5) Identification as to when key V&V activities are to be performed;

(6) Application of all phases of the Contract and all requirements irrespective of their source and applying the same processes for all requirements with regard to traceability; and

(7) Ensuring the Contractor uses their plan to expand on the V&V activities shown in their project quality plans.

Verification Process:

a) The purpose of the verification process is to determine that the output items of each stage of the Project life cycle commencing from the technical design stage, and to fulfil the requirements of the previous stage, and to demonstrate this fulfilment with objective evidence;

b) The process involves individuals who are independent for the checking of the above (all within the Engineer's organization, but adopting independent roles within the Requirements Management Database process); and

c) Offering output in the form of a traceability report and verification report.

Validation Process:

a) The purpose of the validation process is to determine whether or not the implemented system meets the requirements in terms of use or application and to be demonstrated with objective evidence;

b) Design requirements that are flagged for validation must be linked to the related inspection and/or test procedures;

c) Inspection and/or test procedure records are entered into the requirements management database; and

d) A requirement is considered to be validated when the corresponding inspection and/or test report has been linked to the relevant inspection and/or test procedure and has been reviewed by the Engineer.

(8) Requirements Change Control Management

Within the overall Requirements Management system, the Contractor shall provide a change control management system to be reviewed by the Engineer, by which any changes in the requirements are managed to ensure that all parties are working on the same revision of requirements.

(9) Reports

There shall be a mechanism for allowing different reports to be derived from the V&V system e.g. design verification tables, which shall be reviewed by the Engineer.

(10) Ongoing assessment

The Engineer reserves the right to further validate the documentation of V&V on an ongoing basis for safety-related and safety-critical systems to the relevant standards;

In this case, the validation may be performed within the existing arrangements or carried out by another agency as nominated by the Engineer / Employer; and

If this latter case applies, then the Contractor shall be required to supply relevant documents to the validation agency, as requested by the Engineer.

12.10 DESIGN SAFETY REVIEW SESSIONS

Each Contractor [CP101-108] and Sub-contractor, shall implement a Design Review Process, in accordance with IEC61160:2005, for Design and Implementation phase.

The Engineer shall be invited to attend the Design Safety Review workshops.

The outcome from the DSR workshops will be a Design Safety Review Report, to be submitted to the Employer, and Engineer, for review and approval.

12.11 ENGINEERING CHANGE MANAGEMENT

The Contractor shall mange the Configuration Control of all software changes, and notify the Engineer through the Configuration and Change Control process, of any changes to Software or Hardware baselines, including an updated Schedule of all Software/Hardware assets/fixed or moveable, installed within the Station/Tunnel/Depot Systems or Trains.

The Change Management process shall be included in the System Safety Plan.

Implementing Engineering Changes to the existing agreed baseline design, can often introduce, new safety risk into the existing Design. It is therefore highly important that the Engineering Change, is managed through a defined Change Management process, and that the impact upon safety risk is considered as part of the change management process.

The Contractor and the respective Subcontractors shall implement a robust Engineering and Configuration Change Management Process, that nominally includes the following:

(1) A systematic identification process to identify possible hazards associated with the proposed change;

(2) Performance of a Risk assessment to determine effects of the proposed change on the overall system risk;

(3) Identification of any necessary control measures, in order to reduce the overall safety risk to ALARP;

(4) Design solution details, to include the mitigation measures into the change;

(5) Review and approval of the proposed change by the Engineer and Employer.

To finalize the process, the Contractor shall prepare and submit to the Engineer an Impact Assessment Report, documenting the above to describe the effects of the change on system safety. This shall include the impact on related safety assumptions and requirements, systems and subsystems design and test, documented safety evidence and deliverables (including SOPs and SMPs) etc.

12.12 REQUIREMENTS MANAGEMENT SYSTEM

Each Contractor and sub-contractor, shall procure and implement a Requirements Management System or Database, in accordance with the requirements contained within the General Specification for each contract, and the following requirements.

12.13 COMPETENCE MANAGEMENT SYSTEM

Each Contractor and sub-contractor, shall procure and implement a Competence Management System, in accordance with the requirements contained within this General Specification, and any pertinent within the GS for each particular contract, and the following requirements.

12.14 DOCUMENTATION MANAGEMENT SYSTEM

Each Contractor and sub-contractor, shall procure and implement a Document Management System, in accordance with the requirements contained within this General Specification, and any pertinent within

the GS for each particular contract, and the following requirements.

12.15 INTERFACE MANAGEMENT SYSTEM

Each Contractor and sub-contractor, shall produce a Interface Management Plan and Matrix., in accordance with the requirements contained within this General Specification, and any pertinent within the GS for each particular contract, and the following requirements.

The Contractor shall manage Interface requirements in accordance with the Interface Requirements, contained within CP101-108 contracts.

The Contractor shall manage Interfaces, Internally to their Contract, between Contract Boundaries, and at External Boundaries to non-Contract entities.

12.16 CYBER SECURITY

Each Contractor and sub-contractor, shall produce a Cyber Security Management Plan.

Within the plan will be a Matrix. identifying., in accordance with the requirements contained within this General Specification, and any pertinent within the GS for each particular contract, and the following requirements.

The Contractor shall manage Interface requirements in accordance with the Interface Requirements, contained within CP101-108 contracts.

12.17 HAZARD IDENTIFICATION AND MANAGEMENT

In order to demonstrate compliance to Cenelec EN50126, and/or IEC 62278, the Contractor shall conduct and perform certain types of Hazard Identification and Analysis.

These hazard analysis types shall be performed in Detailed Design, and repeated during later phases, construction/installation and V&V.

The analysis results shall be submitted to The Engineer for review and approval, in a report format, along with source data [hazard logs], in excel format. It may be determined that Hazard Logs, shall be managed through a combined Requirements/Configuration/Hazard Management Tool, although this decision is yet to be decided.

Nominally the following Hazard Identification types, shall be executed by the Contractor, by running a series of workshops, per System, to identify Hazards, and Risk Assess/Analyze/Allocation Control Measures.

These workshops, shall be multi stakeholder, with representatives from Contractor, the Engineer, the Employer, ISA, Interfacing Parties, Operations, Maintenance, present.

The contractor shall refer to Cenelec EN50126 or IEC 62278 for Guidance notes on executing Analysis. These notes are to be taken as support to requirements and recommendations contained within the Project Level Systems Assurance Plan and Project Level System Safety Plan. Both plans will be issued by The Engineer and contained as part of and in support of this Bidding Specification.

12.17.1 Preliminary Hazard Analysis

Preliminary Hazard Analysis will be conducted by the Engineer to identify high level hazards, that will occur, at the Metro system level, during Operational and Maintenance phases. Some consideration will be given also to Emergency, Degraded Mode, Congested Mode phases. Hazards will be identified on a per System basis, and will form a reference of risks, to support Engineering Judgement, against the concept/reference design phase. Hazards will be collated and managed in the Project-Wide Hazard Record, which will be managed by The Engineer going forward into Detailed Design and beyond.

12.17.2 System Hazard Analysis

The Contractor shall perform System Hazard Identification and Analysis for their System, in isolation, to determine Hazards, Causes and Consequences on the greater MMSP metro system, based upon the System Level design. Types of hazards may include, system failure, sub-system failure, human error, critical human inputs.

12.17.3 Sub-system Hazard Analysis

The Contractor shall perform Sub-System Hazard Identification and Analysis, for their respective Sub-Systems, in isolation. The analysis shall determine Hazards, Causes and Consequences on the Sub-system and will identify have failures of the SS, contribute to at the System level, and further still, to the greater MMSP metro system, as a whole. This analysis, will be based upon the Sub-System Level design. Types of hazards may include, system failure, sub-system failure, human error, critical human inputs. An example would be to identify failures within the Brake sub-system on Rolling Stock, ATO sub-system in CBTC, and their effects at System and O&M level.

12.17.4 Interface Hazard Analysis

The Contractor shall perform Interface Hazard Identification and Analysis, for their respective Sub-system / Systems, and their Interfaces to other Systems and Sub-systems. This type of analysis differs from System and Sub-system analysis, in that System/Sub-system scope is not analysed in Isolation, instead Hazards occurring at the boundary between 2 sub-systems, or systems, or even processes, are assessed, for their impact on the top-level Metro O&M level. The analysis shall determine Hazards, Causes and Consequences on the Sub-system and will identify have failures of the Interfaces, that in turn, can contribute to failures, at the System level, and further still, to the greater MMSP metro system, as a whole. This analysis, will be based upon the varying System Level designs that have Interfaces and Dependencies between one another. Types of hazards may include, system failure, sub-system failure, human error, critical human inputs. An example would be to identify failures occurring between ATO sub-system, Signalling system, PSD system and Rolling Stock Door system. This analysis would then determine their effects at System and O&M level.

12.17.5 Operations and Support Hazard Analysis

This type of analysis shall be undertaken by the Contractor, including Systems Maintenance Contractors, to identify hazards associated with Operations and Maintenance specifically.

12.18 O&M OPERATIONS AND SUPPORT HAZARD ANALYSIS

This type of HAZID/HAZAN, is also to be undertaken by the eventual successful O&M Contractor, prior to their taking over and acceptance of the Railway. Their hazards will for the O&M PHA, which is a key deliverable to be submitted to The Engineer, for its review and approval, at least 90 days prior to commencement of Operations. The output of OS&HA and HAZOP, will form the basis of the O&M Hazard Record, which will be established as the single repository for managing Operational Risk. Design and Construction Hazard Records will have been accepted by the O&M Contractor, The Engineer, the ISA, and The Client prior to this, with outstanding Residual Risk transferred into the O&M HR or owning parties.

Commencement of O&M OS&HA, will be dependent on the completion, and acceptance of the O&M SMS Safety Management System, by The Engineer, the ISA, and The Client.

12.18.1 Fault Tree Analysis

Fault Tree Analysis [FTA], shall be produced by Contractors, in support of QRA Quantified Risk Assessment. This shall be performed for all Intolerable risks, that cannot be reduced, As Low as Reasonably Practicable, and remain with Residual Risk, after Residual Risk ranking, and Control Measure allocation, is completed.

12.18.2 Functional Failure Analysis

FFA shall be executed by Contractors, against their Detailed Design, for all Systems, Sub-systems within an assigned SIL of SIL2 – SIL4. The FFA is performed by identifying all Functions (Safety Critical and Safety Related). The analysis then considers what subsystems and components are required, to realize or implement the Safety function successfully. Failures of the Function are assessed, and effects on the sub-system, system and Operational level, are recorded. This safety assessment technique, is analogous and closely related to the core RAM analysis method of Failure Modes and Criticality Analysis [FMECA], which is to be undertaken and submitted to the Engineer, by each single Contractor within MMSP.

12.18.3 QRA Quantitative Risk Assessment

As above, this analysis, shall be performed by The Contractor, for all Intolerable risks, that cannot be reduced, As Low as Reasonably Practicable, by accepted Risk Acceptance Principles of, complying to a Code of Practice, demonstrable data provided for a Reference Systems, to sufficiently inform Engineering Judgement. On that basis, QRA shall be performed. FTAs shall be built to support QRA. The Contractor, shall use the specified software tool, as defined within this ERG Employers Requirements General Specification.

12.18.4 Regulatory Bodies/Agencies

(1) DoTR

(2) FPB Fire Protection Bureau

(3) Electrical Standards Department

12.18.5 Demonstration of SAFETY

Below is an example list of evidences and their source, that can be used to form the final body of evidence of Safety Justification Argument, to demonstrate that the MSSP system, a System/Sub-system is safe to be approved and accept.

(1) Certification by Trusted Agencies, both Governmental and Non-Governmental.

(2) Demonstrable Conformance to Codes and Standards.

(3) Demonstrable evidence taken from a Reference system, its existing Safety argument or Case.

(4) Statistical analysis tools, results or theorems, used for assuring software.

(5) Mathematical proofs, results, and proof-checkers.

(6) Assurance tests report.

(7) FAT, SAT, SIT Integration test reports.

(8) Modelling and Simulation Results.

(9) QA audit and assessment results.

(10) Safety Certificates, as issued by ISA or Independent Assessment Bodies.

(11) Compliance Certificates to International Codes, as issued by 3rd Party Assessment Bodies.

(12) Competence proof for Developers, Coders, Designers.

(13) Certification from Regulatory bodies, such as Electrical Regulatory Authority.

(14) Independent Evaluation results

(15) Data sourced from General (Trusted) databases, and certified acceptable for use in the context of MMSP.

(16) V&V approved test results.

(17) Field records (history), such as FRACAS, DRACAS, FAT results.

(18) OEM supplied Data.

(19) Calibration/test results for Tools, equipments, test benches, etc.

(20) Data, meta data, as acquired from OEM equipments.

(21) Data/Meta data, generated by use of 3rd party COTS tools, such as Revit, BIM, AutoCAD. etc.

(22) MoMs – Minutes of Meetings within project internal meetings, or with external parties/stakeholders.

13 RELIABILITY, AVAILABILITY AND MAINTAINABILITY ASSURANCE

13.1 RELIABILITY REQUIREMENTS

13.1.1 Qualitative Reliability Requirements

RAM requirements contained within this Specification, are also summarized within each respective subsystem specification, and the holistic RAM Assurance Employers Requirements.

RAM requirements within this specification, are not to be prioritized or considered in deference to RAM requirements within "RAM Assurance Employers Requirements", per CP106, CP107, CP101, CP102, CP103, CP104, CP105, CP108.

The requirements here are to be considered complimentary to RAM Requirements within each Particular Subsystem Specification.

The Contractor shall propose a "System RAM (Reliability, Availability and Maintainability) Plan" within 30 days after NTP according to the requirements of the system assurance by the Employer, which can be executed after approved by the Employer.

The RAM Assurance Plan must comply with the structural requirements, as laid out, within this RAM Assurance Employers Requirements.

The contractor shall submit a RAM Plan within 30 days of NTP.

The RAM schedule in cooperation with the milestones of the design, construction and plan shall be submitted.

A RAM Manager shall be appointed by the Contractor, he/she shall have at least 5 years' experience, within similar positions in RAM, and he/she must have the ability, to perform the duties of RAM Manager, and be pre-approved by the Employer.

All systems elements shall be categorized, in accordance with SBS, down to level 3, and include LRU (Line Replaceable Unit), and LLRU (Lowest Line Replaceable Unit).

The Contractors RAM Analysis shall nominally include;

(1) Reliability Allocation and Targets;

(2) Reliability Modelling and Predictions;

(3) Reliability Demonstration ;

(4) Defect Liability Period;

(5) Reliability Demonstration;

(6) RAM Demonstration Report;

(7) Reliability Assessment Reports.

The contractor must develop Safety Critical Items List and Reliability Critical Items List, as an outcome from the FMECA process.

The Contractor must conduct FMECA workshops, compliant to EN50126, at the appropriate point within the Design/Project phase.

Each Contractor shall submit program for workshops to conduct the above FMECA identification, within 30 days of NTP Notice to Proceed;

Each Contractor shall submit a report for each system FMECA, to the Engineer for Engineer review and approval, within 60 days of NTP Notice to Proceed.

The Engineer may participate in the workshops, at the Engineer's request, on an observational basis only, and may intervene, if the topic is wildly diverges from the required deliverables, or is considered to be clearly unsafe or incorrect.

The contractor must develop a Reliability Critical Items List (RCIL) and sparing to a 99% confidence interval.

The contractor must provide a schedule for LRU and LLRU sparing to a 99% confidence interval.

The contractor must design their Rolling Stock to be compliant to the following MDBF requirements;

(1) Shall be greater than 1.12×10^{6}, or 112,000 train-km, when the failure causing the train causes MTBSAF;

(2) Service withdrawal.

To verify that MDBF requirements are met, the contractor shall count the monthly MTBSAF (Mean time between service affecting failure) of the RS.

Proven systems shall be adopted wherever possible, where they have a known high degree of reliability within a similar environment.

Systems shall be designed such that service can be maintained in the presence of faults.

"Graceful degradation" or progressive reduction in functionality in the event of failures shall be implemented where possible, as a means of maintaining service following fault occurrence.

A common cause failure is one in which a single failure or condition affects the operation of multiple devices that would otherwise be considered independent. Common cause failures can for example have environmental causes (e.g. lightning, fire), result from faulty design or manufacturing (e.g. incorrect calibration) or simultaneous maintenance errors (e.g. wrong procedure applied to identical redundant elements).

Systems shall be designed to be resilient to such Common Cause Failures and solutions incorporated to reduce their criticality (e.g. routes diversity, equipment diversity etc.).

A common cause failure (CCF) analysis shall be conducted by the Contractor, in order to determine and eliminate Common Cause Failures from the design.

Common cause failure (CCF) shall be identified and modelled applying common cause analysis techniques, in accordance with sections from within, IEC 62278, and IEC 61508.

The contractor shall implement Reliability Centre Maintenance processes that will optimize the Maintenance program for assets, resulting in optimal reliability availability and maintainability levels.

The preventative Reliability Centered Maintenance (RCM) program shall be introduced, in accordance with IEC 60300-3-11, Dependability Management. Part 3-11: Application Guide. Reliability Centered Maintenance, IEC Standard.

The contractor shall undertake Spare parts Analysis, with the intention to optimize spare parts holding for the Depot. This analysis will include outputs from the SCIl and RCIL reports.

Contractor shall implement DRACAS, no later than 20 days prior to V&V phase.

Contractor shall submit a DRACAS Management Plan, to the Employer, not later than 120 days after NTP.

The Contractor shall carry out analyses to apportion the provided RAM targets to individual subsystems and equipment items.

The Contractor shall calculate an estimated Inherent Availability of the overall systems (Level 1).

The Contractor's calculation of the Operational Availability of each shall be based on a maximum logistical and administrative delay of 45 minutes for P1 Category failure (Performance targets set out in each individual volume per system.

The Contractor shall submit RAM Demonstration report(s) providing either evidence or traceable references of the RAM parameters (MTBF, MART etc.) i.e. manufacturer data sheets, technical publications etc., where applicable.

The Contactor shall submit RAM demonstration report(s) which contains the necessary level detail for each lifecycle phase and aligned & consistent with the system design for each baseline e.g. DD1, DD2.

The Contractor shall ensure the RAM demonstration report(s) are approved, either prior to or in parallel with the system design at each stage (DD1, DD2 etc.).

Mean Time Between Failures (MTBF): The Mean Time Between Failures is the ration of the total service hours and the total sum of fault events.

Mean Time Between Service Affecting Failures (MTBSAF): The Mean Time Between Service Affecting Failures is the performance target for total failure allowed per delay minute category.

The Contractor shall conduct and submit for approval, the following RAM deliverables to support their Detailed Design:

(1) System Breakdown Structure [SBS];

(2) Reliability Block Diagram [RBD];

(3) RAM Allocation and Apportionment;

(4) Failure modes, effects and criticality analysis (FMECA);

(5) Reliability critical items list;

(6) LRU/LLRU List;

(7) Function Block Diagram, including Functional Analysis;

(8) RAM Demonstration;

(9) Defect Liability Period;

(10) RAM Assessment Report;

(11) Reliability Critical Items List [RCIL].

Proven systems shall be adopted wherever possible, where they have a known high degree of reliability within a similar environment.

Systems shall be designed such that service can be maintained in the presence of faults.

"Graceful degradation" or progressive reduction in functionality in the event of failures shall be implemented where possible, as a means of maintaining service following fault occurrence.

A common cause failure is one in which a single failure or condition affects the operation of multiple devices that would otherwise be considered independent. Common cause failures can for example have environmental causes (e.g. lightning, fire), result from faulty design or manufacturing (e.g. incorrect calibration) or simultaneous maintenance errors (e.g. wrong procedure applied to identical redundant elements). Systems shall be designed to be resilient to such Common Cause Failures and solutions incorporated to reduce their criticality (e.g. routes diversity, equipment diversity etc.).

A common cause failure (CCF) analysis shall be conducted by the Contractor, in order to determine and eliminate Common Cause Failures from the design.

Common cause failure (CCF) shall be identified and modelled applying common cause analysis techniques, in accordance with section 3.12.11, IEC 62278, and IEC 61508.

The Contactor shall implement a Reliability Centered Maintenance process, that will optimize the Maintenance program, for all assets, in particular for all assets determined as Reliability Critical and Safety Critical items, as determined from the RCIL and SCIL processes within the Contractors Systems Assurance responsibilities to MMSP.

The RCM program shall result in optimal Reliability, Availability, Maintainability levels, for all assets under the specific Contractors scope.

The preventative Reliability Centered Maintenance (RCM) program, shall be introduced, in accordance with IEC 60300-3-11, Dependability Management, Part 3-11: Application Guide. Reliability Centered Maintenance, IEC Standard.

The Contractor shall undertake Spare Parts Analysis, with the intention to optimize the Spare Parts holding, for the Depot. This analysis will include outputs from the SCIL and RCIL reports.

Redundancy within the design of safety relevant and safety critical systems, shall be demonstrated by the contractor conducting Reliability Block Diagram modelling, to demonstrate the decomposition of their respective subsystems, and to calculate the top-level availability for each sub-system.

Ultimately the top-level availability calculation for each sub-system shall be used to demonstrate meeting of availability targets for each system and the ultimate whole operational Metro Manila Subway System.

The Contractor must submit the RBD Modelling Report, to the Engineer for review and issue of NoNo (Notice of No Objection) approval, for the Contractors respective system responsibilities. `

Each Contractor tasked with engaging a Independent Safety Assessor for their scope of delivery, currently Signaling, Rolling Stock, PSD, Telecommunications, shall have the Option, at the Engineer and Employer's instruction, to extend the ISA scope to a supplementary Independent RAM Assurance or IRA contract, which would include full assurance of RAM scope for the pertaining Contractor.

The Contractor shall procure software tools to develop Reliability, Availability and Maintainability Models. For this end, it is required the contractor procure Isograph Reliability and Availability Workbench.

The Contractor, shall give source references to the data, supplied to construct Reliability and Availability models.

The Contractor shall demonstrate traceability for sources of Failure Rate data, within their model. This data should be Supplier Data, Estimates, or sourced from generic databases, such as RiAC, MIL-217, NPRD.

Where estimate are used, the Contractor must support the estimates by referring to reference projects,

wherever possible.

The Contractor shall perform a Recovery Analysis, to determine if design and configuration of the system, will facilitate a swift recovery of the system under various conditions during the installation and operational stages. Analysis shall consider probable incidents that may occur during revenue operation.

The Engineer shall perform a similar desktop Recovery Analysis exercise, during Concept Design phase, to baseline a reference set of issues and apply design/process controls. The Contractors Recovery Analysis, will then be a deeper dive into scenario identification, for the refined Detailed Designs.

Each Package, shall obtain & consolidate the subsystem/equipment RAM data from their respective suppliers. Field service data/data from in-service operations to be obtained from suppliers. This data will be submitted to the Engineer to form the RAM Calculation Report.

The Engineer will build a reference RAM model, to validate initial assumptions on Inherent and Operational Availability for the top level MMSP project, and apportion down to System contracts. The Engineer will also validate initial Availability assumptions using Reliability Block Diagrams, to determine apportionment of RAM targets between and within System/Sub-system packages.

The Engineer, shall obtain & consolidate the subsystem/equipment RAM data from their respective Contracts. The Engineer will use data to validate the RAM model for the overall MMSP project, to validate target and assumptions for Availability.

13.1.2 RAM Assurance Criteria

Below is a breakdown of systems and responsibilities for submission of Safety document deliverables.

Table 13.1: RAM Rating for Each System

Contractor	System	RAM Rating	Due Safety Deliverable
CP106	Signalling	RAM Critical	Refer to CP106, Signalling Employers Requirements
CP106	PSD	RAM Critical	Refer to CP106, PSD Employers Requirements
CP106	Telecommunications	RAM Critical	Refer to CP106, Telecommunications Employers Requirements
CP106	PST	RAM Relevant	Refer to CP106, PST Employers Requirements
CP106	OCS	RAM Relevant	Refer to CP106, OCS Employers Requirements
CP106	AFC	RAM Critical	Refer to CP106, AFC Employers Requirements
CP106	Trackwork	RAM Relevant	Refer to CP106, Trackwork Employers Requirements

Contractor	System	RAM Rating	Due Safety Deliverable
CP107	Rolling Stock	RAM Critical	Refer to CP107, Rolling Stock Employers Requirements
CP101	TVS, including Axial Fans and Egress shaft pressurization system	RAM Critical	Refer to CP101, E&M Employers Requirements
CP101	VAC [Environmental Control System]	RAM Critical	Refer to CP101, E&M Employers Requirements
CP101	VAC incl Smoke Extraction	RAM Critical	Refer to CP101, E&M Employers Requirements
CP101	Fire Detection system [Station & Tunnel]	RAM Critical	Refer to CP101, E&M Employers Requirements
CP101	Fire Suppression system [Gas]	RAM Critical	Refer to CP101, E&M Employers Requirements
CP101	L&V Circulation [Station & Tunnel]	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Security System (Access Control)	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Building Management System [BMS]	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Facility-SCADA system [F-SCADA]	NA	NA
CP101	Lighting [Station & Tunnel]	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Emergency Lighting [Station & Tunnel]	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Station and Tunnel Emergency signage system	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Lightning Protection system	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Backup power UPS system	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Backup power DG system	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Backup power Battery system	RAM Relevant	Refer to CP101, E&M Employers Requirements

Contractor	System	RAM Rating	Due Safety Deliverable
CP101	Earthing and Bonding, Cathodic Protection, Stray Current	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	Low Voltage Distribution [DC]	RAM Relevant	Refer to CP101, E&M Employers Requirements
CP101	No Civil consideration to RAM.	Not RAM Relevant	Refer to CP101, Civil Employers Requirements

All above CP 101 Civil/E&M RAM requirements shall apply to Remaining Section Contracts – CP102, CP103, CP104, CP105, CP108.

13.1.3 Quantitative Reliability Requirements

Systems Contractors must develop the respective subsystems compliant to the MTBF requirements contained within the Technical Specification for each particular Subsystems contract [Vol II].

The MMSP shall be designed to 99% Inherent Availability Ai for the whole MMSP subway project. This target shall consider unavailability of the Metro system as its metric. Failures of systems and subsystems that absorb failures through principles, such as redundancy {2oo2, 2oo3, 3oo4] and graceful degradation, shall not contribute to this 98% high level target.

The Contractors shall design their Contracts and Systems, to meet their given portion and contribution to the high level 99% Ai target for MMSP.

Systems Contractors must develop the following subsystems compliant to the following MTBF requirements.

Table 13.2: MTBF Target for Each System

System, Sub-system	MTBF Target (Hrs)
Signalling Trackside	< =5000 hrs
Signalling Onboard	< =5000 hrs
Power Supply Traction (HV, MV)	<= 3000 hrs
OCS	<= 3000 hrs
MEP	<= 3000 hrs
Rolling Stock	< =5000 hrs
AFC	< =5000 hrs
OCC	<= 3000 hrs
BOCC	<= 3000 hrs
DCC	<= 3000 hrs

System, Sub-system	MTBF Target (Hrs)
SCR	<= 3000 hrs
SER	<= 3000 hrs
PSD Platform Screen Door	< =5000 hrs
Telecommunications	<= 3000 hrs
Depot Equipment	<= 2000 hrs
Depot Protection System	<= 3000 hrs
Power SCADA	<= 3000 hrs
BMS	<= 3000 hrs
FDS/FSS	< =5000 hrs
Escalators & Elevators	<= 3000 hrs
VAC – ECS	<= 2000 hrs
VAC – Smoke Ext	<= 3000 hrs
E&M (LVD)	<= 3000 hrs
Lighting (Emergency)	<= 3000 hrs
Lighting (Normal)	<= 2000 hrs
E&B	<= 3000 hrs
N&V	<= 0000 hrs
Track Works	<= 0000 hrs
Tunnel Ventilation System	< =5000 hrs

13.2 AVAILABILITY REQUIREMENTS

13.2.1 Qualitative Availability Requirements

Each system contractor shall comply to the following generic Availability Requirements:

(1) Routine scheduled maintenance activities should not affect normal passenger service hours. Where maintenance cannot be carried out during non-operating hours, maintenance during normal passenger operating hours may be considered. Isolation of specific functions or areas will be required to enable normal operation to continue. Such circumstances will only be considered following detailed justification and then only in exceptional circumstances;

(2) Provision shall be made to recover from any credible fault while minimizing disruption to passenger service;

(3) The Operational Availability (Ao)/Inherent Availability (Ai) target shall apply to all critical component/equipment of each system and subsystem, which is either critical to its main functions and/or to Operation;

(4) A report shall be submitted by the Contractor for Engineer's representative approval, containing a list of critical components of each system and subsystem which are either critical to its main functions and/or Operation;

(5) The Inherent Availability (Ai) of each system and subsystem shall be calculated using the following equation:

$$Ai = MTBF/(MTBF+MART)$$

Where:
MTBF = Mean Time Between Failures refers to the average (expected) time of a system before a failure occurs. The measure shall be represented as units of hours.

MART = Mean Active Repair Time refers to the average corrective action repair time ofa unit at its asset location. The measure is based on the time taken to diagnose the fault and to restore the asset back into a serviceable condition.

(6) The Operational Availability (Ao) of each system and subsystem shall be equal to or better than 99.95%;

(7) The Operational Availability (Ao) of each system and subsystem shall be calculated using the following equation:

$$Ao=MTBF/(MTBF+MTTR)$$

Where:
MTBF = Mean Time Between Failures refers to the average (expected) time of a system before a failure occurs. The measure shall be represented as units of hours.

MTTR = Mean Time to Restore is composed of corrective active repair time (MART), administrative delay, and logistic delay times.

13.2.2 Quantitative Availability Requirements

The contractor must provide a Maintenance Level 1 turnaround time of 7 days.

The contractor must provide a Maintenance Level 2 turnaround time of not more than 30 days.

Systems Contractors must develop the following subsystems compliant to the following Inherent Availability (iA) requirements.

The System Service Availability to be 99.8% to reflect International Best Practice (Included 99% for

operational demonstration period only).

Systems Contractors must develop the following subsystems compliant to the iA Inherent Availability requirements contained within the Technical Specification for each particular Subsystems contract [Vol II].

Each system contractor must develop their RAM apportionment, complaint to the following MTBSAF targets.

Table 13.3: Inherent Availability (iA) Target

System, Sub-system	Inherent Availability iA Target (%)
Signalling Trackside	99.999%
Signalling Onboard	99.999%
Power Supply Traction (HV, MV)	99.95%
OCS	99.95%
MEP	99.95%
Rolling Stock	99.999%
AFC	99.999%
OCC	99.95%
BOCC	99.95%
DCC	<= 3000 hrs
SCR	<= 3000 hrs
SER	<= 3000 hrs
PSD Platform Screen Door	99.999%
Telecommunications	99.95%
Depot Equipment	99.90%
Depot Protection System	99.95%
Power SCADA	99.95%
BMS	99.95%
FDS/FSS	99.999%
Escalators & Elevators	99.95%
VAC – ECS	99.90%

System, Sub-system	Inherent Availability iA Target (%)
VAC – Smoke Ext	99.95%
E&M (LVD)	99.95%
Lighting (Emergency)	99.95%
Lighting (Normal)	99.90%
E&B	99.95%
N&V [N/A]	99.95%
Track Works [N/A]	99.999%
Tunnel Ventilation System	99.999%

13.3 MAINTAINABILITY REQUIREMENTS

13.3.1 Qualitative Maintainability Requirements

Maintainability (M) indicates: Maintainability covers both Quantitative and Qualitative elements. Quantitative Requirements includes MTTR Mean Time to Repair, and MART Mean Active Repair Time. Qualitative aspect of Maintainability, includes identification of Maintainability requirements.

Maintainability Analysis shall also be carried out, in order to identify further maintainability requirements.

Maintainability analysis report must be submitted by the contractor for 60 days prior to completion of Detailed Design stage.

The maintainability analysis will be a separate report, to be submitted in parallel with availability and reliability analysis reports.

Maintainability Analysis shall be performed on all the equipment and systems supplied by the Contractor. This shall demonstrate the ease by which maintenance tasks can be done and ensure that the maintenance requirements for each subsystem and its aligned equipment can be met.

All sub-systems, equipment and components above-mentioned shall be targeted on line replacement unit (LRU) and Lowest Line Replaceable Unit (LLRU), and the list of LRU/LLRU shall be submitted to the Employer for approval.

Maintenance Task Analysis (MTA) covers both corrective and preventative maintenance tasks and when complete, identifies all physical resources required to support a system. RAM and safety issues that are related to the maintenance action will be considered in the justification of the maintenance periodicity. Maintenance Analysis will be performed for the subsystem equipment, both for preventive (scheduled) and corrective (unscheduled) maintenance tasks.

MTA shall be performed to identify the following:

(1) Description of the steps required to perform the maintenance task;

(2) Spares and materials needed;

(3) Tools and support equipment needed;

(4) Personnel skill levels;

(5) Any facility issues that must be considered the given repair task;

(6) The elapsed time required for each step;

(7) Total elapsed time for each step;

(8) Mean Time to Repair (MTTR).

The Contractor shall perform a Maintainability Demonstration to confirm the compliance to the Maintainability requirements. The demonstration shall be managed and controlled by the Maintainability Demonstration Procedure. The maintenance tasks to be demonstrated shall be selected by the Employer in agreement with the Contractors RAM Manager. The MTA shall form the basis of the tasks contained in the Procedure with space allocated for the actual times to be entered next to the theoretical values. The demonstration tasks shall be performed by suitably competent and qualified personnel, of a level as would normally be expected to perform each task.

Maintenance Procedures and Handbooks shall be prepared in accordance with guidelines contained within the Operation & Maintenance Plans.

No regular routine maintenance will be required to infrastructure (civil works or trackside systems) within boundaries of areas requiring track possession or permits during operating hours.

Systems which require routine maintenance shall be able to be isolated so that such maintenance can be carried out during normal service. If this is not practicable, then they shall be designed such that routine maintenance can be carried out during non-operating hours.

Systems shall be designed to optimize routine/preventive maintenance, whilst achieving high in-service availability. Condition-based maintenance shall be adopted where practicable in preference to scheduled maintenance for performance related systems.

Systems shall be designed to allow quick restoration to service following faults.

Systems shall be designed to provide indication of likely system failure and warning of potential system failure as components wear or approach the end of their life as far as is practically possible so that system failures during operation can be avoided.

The System Service Availability to be 99.8% to reflect International Best Practice (Included 99% for operational demonstration period only).

The Operational Availability (Ao)/Inherent Availability (Ai) target shall apply to all critical component/equipment of each system and subsystem, which is either critical to its main functions and/or to Operation.

A report shall be submitted by the Contractor for Engineer's representative approval, containing a list of critical components of each system and subsystem which are either critical to its main functions and/or Operation.

The Inherent Availability (Ai) of each system and subsystem shall be calculated using the following equation.

Ai= MTBF/(MTBF+MART)

Where:

MTBF = Mean Time Between Failures refers to the average (expected) time of a system before a failure occurs. The measure shall be represented as units of hours.

MART = Mean Active Repair Time refers to the average corrective action repair time of a unit at its asset location. The measure is based on the time taken to diagnose the fault and to restore the asset back into a serviceable condition.

The Operational Availability (Ao) of each system and subsystem shall be equal to or better than 99.95%.

The Operational Availability (Ao) of each system and subsystem shall be calculated using the following equation:

Ao= MTBF/(MTBF+MTTR)

Where:

MTBF = Mean Time Between Failures refers to the average (expected) time of a system before a failure occurs. The measure shall be represented as units of hours.

MTTR = Mean Time to Restore is composed of corrective active repair time (MART),administrative delay, and logistic delay times.

The Contractor shall propose Mean Active Repair Time (MART) values for each system, sub-system, down to the LRU and LLRU level, for the following core E&M sub-systems; Rolling Stock, Power Supply (including, HV, MV), OCS, incl, CBTC, OCC/BOCC/PSD, Communications, Depot Equipment and AFC.

No regular routine maintenance will be required to infrastructure (civil works or trackside systems) within boundaries of areas requiring track possession or permits during operating hours.

Systems which require routine maintenance shall be able to be isolated so that such maintenance can be carried out during normal service. If this is not practicable, then they shall be designed such that routine maintenance can be carried out during non-operating hours.

Systems shall be designed to optimize routine/preventive maintenance, whilst achieving high in-service availability. Condition-based maintenance shall be adopted where practicable in preference to scheduled maintenance for performance related systems.

Systems shall be designed to allow quick restoration to service following faults.

Systems shall be designed to provide indication of likely system failure and warning of potential system failure as components wear or approach the end of their life as far as is practically possible so that system failures during operation can be avoided.

13.3.2 Quantitative Maintainability Requirements

The average value of the Mean Active Repair Time (MART) over all the LRUs and LLRUs comprising a subsystem shall be equal to or less than 4 hours.

The Mean Active Repair Time (MART) shall be calculated using the following formulae:

MART= IDT+IRT+ITT+IReT

Where:
IDT= Incident Diagnosis Time: Time taken to diagnose the root cause of the failure of the unit
IRT= Incident Repair Time: Time taken to repair the unit
ITT= Incident Test Time: Time taken to Test to ensure the unit is correctly functioning.
IReT= Incident Restore Time: Time taken to restore the unit into operational condition.

Each Sub-system Contractor must develop the following subsystems compliant to the Quantitative MART requirements, contained within their Systems/Sub-systems Technical Employers Requirements.

The Contractor shall propose Mean Active Repair Time (MART) values for each system, sub-system, down to the LRU and LLRU level, for the Trackwork sub-system, where demonstrable improvements and value can be added to existing MART targets.

The contract must develop the following subsystems compliant to the following MART requirements.

Systems Contractors must develop the respective subsystems compliant to the MTTR & MART requirements contained within the Technical Specification for each particular Subsystems contract [Vol II].

Relevant Contractors, must develop the following subsystems compliant to the following MTTR requirements.

Table 13.4: MTTR Target

System, Sub-system	MTTR Target (Hrs)
Signalling Trackside	< =0.5hrs
Signalling Onboard	<= 0.5hrs
Power Supply Traction (HV, MV)	<=1hrs
OCS	<=1hrs
MEP	<=1hrs
Rolling Stock	<=0.5hrs
AFC	< =0.5hrs
OCC	<=1hrs
BOCC	<=1hrs
DCC	<= 3000 hrs
SCR	<= 3000 hrs
SER	<= 3000 hrs
PSD Platform Screen Door	< =0.5hrs
Telecommunications	<=1hrs

System, Sub-system	MTTR Target (Hrs)
Depot Equipment	<=1.5hrs
Depot Protection System	<=1hrs
Power SCADA	<=1hrs
BMS	<=1hrs
FDS/FSS	<=0.5hrs
Escalators & Elevators	<=1hrs
VAC – ECS	<=1.5hrs
VAC – Smoke Ext	<=1hrs
E&M (LVD)	<=1hrs
Lighting (Emergency)	<=1hrs
Lighting (Normal)	<=1.5hrs
E&B	<=1hrs
N&V [N/A]	<=1hrs
Trackwork [N/A]	<=1hrs
Tunnel Ventilation System	< =0.5hrs

Relevant Contractors must develop the following subsystems compliant to the following MART requirements.

Table 13.5: MART Target

Sub-system	MART (Hrs)
Signalling Trackside	<=0.75hrs
Signalling Onboard	<=0.75hrs
Power Supply Traction (HV, MV)	<=1.25hrs
OCS	<=1.25hrs
MEP	<=1.25hrs
Rolling Stock	<=0.75hrs
AFC	<=0.75hrs

Sub-system	MART (Hrs)
OCC	<=1.25hrs
BOCC	<=1.25hrs
DCC	<= 3000 hrs
SCR	<= 3000 hrs
SER	<= 3000 hrs
PSD Platform Screen Door	<=0.75hrs
Telecommunications	<=1.25hrs
Depot Equipment	<=1.75hrs
Depot Protection System	<=1.25hrs
Power SCADA	<=1.25hrs
BMS	<=1.25hrs
FDS/FSS	<=0.75hrs
Escalators & Elevators	<=1.25hrs
VAC – ECS	<=1.75hrs
VAC – Smoke Ext	<=1.25hrs
E&M (LVD)	<=1.25hrs
Lighting (Emergency)	<=1.25hrs
Lighting (Normal)	<=1.75hrs
E&B	<=1.25hrs
N&V	<=1.25hrs
Track Works	<=1.25hrs
Tunnel Ventilation System	<=0.75hrs

All above values, may be subject to further review and revision

13.4 PERFORMANCE REQUIREMENTS

Each system contractor must develop their RAM apportionment, complaint to the following MTBSAF targets, based on 8760 Operating Hrs per Year.

Table 13.6: MTBSAF Target

R2	Performance Requirement – Target System Failure Rates F(t) per Rolling 13 Operational Periods for the System	Steady State Target (No of Failures)	MTBSAF (Hours)	Core E&M Target number of Failures per 13 Operational period per Fleet
R2.1	Equivalent System Failure Rate per 13 Operational Periods attributed to causing delays of less than 2 min* shall not be more than;	2506	3	20
R2.2	Equivalent System Failure Rate per 13 Operational Periods attributed to causing delays of 2 min and more but less than 5 min shall not be more than;	1027	7	8
R2.3	Equivalent System Failure Rate per 13 Operational Periods attributed to causing delays of 5 min and more but less than 15 min shall not be more than;	146	53	1
R2.4	Equivalent System Failure Rate per 13 Operational Periods attributed to causing delays of 15 min and more but less than 30 min shall not be more than;	11.20	687	0
R2.5	Equivalent System Failure Rate per 13 Operational Periods attributed to causing delays of 30 min and more shall not be more than;	1.41	5458	0

13.5 RAM DELIVERABLES COMPLIANCE MATRIX

The following table shows the indicative RAM Deliverables Compliance Matrix.

Table 13.7: RAM Deliverables Compliance Matrix

SI No	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Submitted (Y/N)	NoNo Status	Construction & Installation	T&C	Defect Liability
1	Project Level System RAM Plan	P	P			U	U	
2	System RAM Plan	P	P			-	-	
3	Sub System RAM Plan	P	P			U	U	-
4	Project RAM Apportionment and Allocation Report	P	P			U	U	U
5	System RAM Apportionment and Allocation Report	P	P			U	U	U
6	Project Level FMECA Reports	P	P			U	U	-
7	System FMECA Reports	P	P			U	U	U
8	Sub-System FMECA Report	P	P			U	U	U
9	Project Level RBD Report	-	-			P	U	-
10	System RBD Reports	P	P			U	U	U
11	Sub-System RBD Reports	-	-			-	P	U
12	Project Level RAM Analysis and Prediction Report	-	-			-	-	P

SI No	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Submitted (Y/N)	NoNo Status	Construction & Installation	T&C	Defect Liability
13	System RAM Analysis and Prediction Report	-	-			-	-	P
14	Sub-System RAM Analysis and Prediction Report	-	-			-	-	P
15	System RAM demonstration Report	-	-			-	-	P
16	Sub-system RAM demonstration Report	-	-			-	-	P
17	Project Level [SBS] System Breakdown Structure Report	-	-			-	-	P
18	System [SBS] System Breakdown Structure Reports	-	-			-	-	P
19	Sub-System [SBS] System Breakdown Structure Reports	-	-			-	-	P
20	System RCIL Report	-	-			-	-	P
21	Sub-System RCIL Report	-	-			-	-	P
22	Failure Management System [DRACAS] Plan	-	-			-	-	P
23	Project Level Maintainability Demonstration Report	-	-			-	-	P
24	System Maintainability Demonstration Reports	-	-			-	-	P
25	Sub-System Maintainability	-	-			-	-	P

SI No	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Submitted (Y/N)	NoNo Status	Construction & Installation	T&C	Defect Liability
	Demonstration Reports							
26	Project Level Life Cycle Costing Report	-	-			-	-	P
27	System Life Cycle Costing Report	-	-			-	-	P
28	Sub-System Life Cycle Costing Report	-	-			-	-	P
29	System Maintainability Critical Items List [MCIL] Report	-	-			-	-	P
30	Sub-System Maintainability Critical Items List [MCIL] Report	-	-			-	-	P
31	System Monthly RAM Demonstration Report	-	-			-	-	P
32	System Monthly Systematic Defect Monitoring Reports	-	-			-	-	P
33	Sub-System Monthly Systematic Defect Monitoring Reports	-	-			-	-	P
34	Defect Monitoring Plan	-	-			-	-	P
35	System On-Site Maintainabilty Demonstration Reports	-	-			-	-	P

SI No	Deliverables	Preliminary Design & Implementation	Detailed Design & Implementation	Submitted (Y/N)	NoNo Status	Construction & Installation	T&C	Defect Liability
36	Sub-System On-Site Maintainabilty Demonstration Reports	-	-			-	-	P
37	Project Qualitative RAM Requirements Verification and Validation Report	-	-			-	-	P
38	System Qualitative RAM Requirements Verification and Validation Report	-	-			-	-	P
39	Sub-System Qualitative RAM Requirements Verification and Validation Report	-	-			-	-	P

Note :- P: Produce, U: Update, R: Review, "- ": Not Applicable

14 SUPPLY OF SPARE PARTS, SPECIAL TOOLS AND TEST EQUIPMENT

14.1 DETAILS OF SUPPLY

The Contractor shall provide spare parts, tools and test equipment for the maintenance of all Systems included in the Contract, in accordance with the provisions of this Section, as part of the Works:

(1) Spare parts including (but not limited to) sub-assemblies and those to be supplied by its sub-contractors of any tier ("Spare Parts");

(2) Special tools, jigs, fixtures and gauges and test and maintenance equipment, including those to be supplied by its subcontractors of any tier ("Special Tools and Test Equipment"),

The Spare Parts to be supplied by the Contractor shall consist of:

(1) Contract Spares (as hereinafter defined);

(2) Commissioning Spares (as hereinafter defined); and

(3) Defects Notification Period Spares (as hereinafter defined).

The Contractor shall recommend spare parts including quantities and individual prices for the maintenance of all Systems included in the Contract for the Defect Notification Period. The spare parts may be kept at material stores in stations and depot.

Construction overages shall become the property of the Employer, at the option of the Employer, once the Works are completed.

The Contractor shall submit with the Tender an indicative list of recommended spare parts for the Defect Notification Period. Spare parts shall be identified and individually priced.

The recommended list of spare parts shall be updated for the review by the Employer's Representative at the time of completion of the Technical Design and again at the time of Construction/Installation Design with the identity of parts by source, OEM part number, and individual price. A final update with the same details shall be made one year before completion of the works. Spare parts shall be delivered to the Employer no later than six (06) months before the completion of Works.

The information supplied in respect of each spare parts, special tool and test equipment shall include, but shall not be limited to, the following:

(1) core data - main assembly / equipment
   a) manufacturer/brand name
   b) manufacturer's type/model number
   c) rating
   d) serial number if applicable
   e) total number of the main assembly/equipment supplied under the contract
(2) core data - sub-assembly of main assembly / equipment
   a) manufacturer / brand name
   b) manufacturer's type/model number
   c) rating
   d) serial number, if applicable
   e) total number of sub-assemblies in the main assembly / equipment supplied

under the Contract

(3) individual item of main/sub assembly / equipment

a) manufacturer order number

b) parts description - a full description of the Spare Part, including a note as to whether it is a sealed unit or whether it is an assembly or sub-assembly which can be broken-down into component parts

c) manufacturer / brand name

d) the manufacturer's part number (if different from the ordering number)

e) the sub-contractor's ordering part number/reference, if applicable

f) recommended quantity

g) unit of measurement

h) unit price CIF to Manila including delivery to designated location

i) total number of the Spare Parts in the sub-assembly of the main assembly/equipment supplied under the Contract

j) total number of the Spare Parts in all the sub-assemblies of all the main assemblies/ different equipment supplied under the Contract the Contractor shall ensure that the ordering part numbers specified shall enable the Employer to procure the exact item in future without reference to the Contractor.

(4) primary data

a) parts catalogue number/cross reference (illustrated parts catalogues to be submitted together with the contract spares schedules to the Employer's Representative)

b) drawing number

(5) secondary data

a) lead times stating whether for ex-stock or for product manufactured upon receipt of order.

b) delivery schedule(s).

c) supplementary information:

1) special handling instruction, e.g. for fragile materials, hazardous substances, radioactive materials, etc.
2) storage requirements, e.g. overall dimensions including special packing (if any) for bulky materials, materials with limited shelf life, climate-controlled conditions, etc.
3) statutory requirements, e.g. licenses, test certificates, etc.
4) interchangeability information
5) tailor-made product for the Contract or a standard bought-in product
6) the source of the Spare Part or Special Tool and Test Equipment, including the manufacturer's name and address together with that of his agent in the Philippines and local sources
7) supplementary sheets to be used for detailed information that is important to the Employer's future procurement.

14.2 MANUFACTURE AND DELIVERY OF SPARE PARTS

The Spare Parts to be supplied under the Contract shall be manufactured at the same time as the Permanent Works. All Spare Parts shall be manufactured, works tested and inspected in accordance with the relevant quality system, suitably packed and labelled, and delivered to the Employer by the Contractor. Before the Spare Parts are delivered to the Employer, the Contractor shall submit to the Employer's Representative a shipment advice notifying details such as date of dispatch, date of arrival, vessel name, etc. as well as a packing list to indicate the contract number, variation order number, the lot size, quantity and weight.

The Spare Parts shall be consigned to the Employer and delivered in accordance with the Employer's Representative's instructions to a program which shall ensure that sufficient

Spare Parts are delivered to facilitate normal routine maintenance of the Permanent Works by the Employer or Employer's Representative at all stages of completion. The Spare Parts shall be supplied in total not later than the date set out forestage commissioning of the system.

Spare Parts shall be fully interchangeable with their corresponding part. All Spare Parts shall be configured to the latest revision during the Defects Liability Period. For Spare Parts such as electronic components, lamps, fuses, and high-use items, the Contractor shall ensure that a minimum of two alternative sources of supply are available.

An adequate supply of Spare Parts shall be available throughout the design life of the Works, from the date of the Employer's Taking Over of the Works. The Contractor undertakes to notify the Employer at least six (06) months prior to deleting any item used in the Works from general availability.

For any Spare Parts that the Contractor is unable to supply throughout the design life of the Works, or where the Contractor ceases availability support of that item before the end of such design life or if the Contractor ceases trading, the Contractor undertakes to transfer the relevant intellectual property rights, design rights and technology to the Employer and the Employer shall have the full right to manufacturing drawings, schedules, software and any other information needed to manufacture the relevant item. Such rights shall give the Employer complete freedom to manufacture the item in the Philippines or anywhere else world-wide. The Contractor shall also undertake to notify the Employer two (02) years in advance of the intended cessation of spares availability of any item.

If any Spare Part is rendered obsolete by a design change or material change during the design life of the Works supplied under the Contract, the Contractor shall design a replacement item to match the identical mechanical and electrical interfaces as the former item.

If, as a result of changes in technology, any Spare Part is not completely interchangeable with the original item, or the performance of any Spare Part is different from the original item, then the Contractor shall purchase the same from the Employer, at a price agreed between the parties, such quantities of the obsolete Spare Part as the Employer may possess.

14.3 CONTRACT SPARES

The quantities of recommended Spare Parts to be supplied by the Contractor to the Employer shall be included in the Spares Management Plan as described in Clause 4.19.

Notwithstanding the quantities defined in the Spares Management Plan the quantities of Spare Parts shall be sufficient for the full operation of the Works for the Defect Liability Period after Employer's Taking Over of the Works ("Contract Spares").

The Contractor shall supply and deliver the Contract Spares no later than six (06) months before the completion of the Works.

The Contractor shall submit the contract spares schedules for the Contract Spares in hard copies (including the illustrated parts catalogues) as well as soft copies to the Employer's Representative for review.

All the components and technologies adopted for MMSP shall not be product dependent on becoming obsolete (and unavailable), long before the system's life is exhausted.

All spares quantities shall be rounded up to the nearest deliverable unit e.g. cable shall be delivered in complete drums, liquids in complete sealed containers, small parts in complete packs.

14.4 COMMISSIONING SPARES

In addition to the Contract Spares, the Contractor shall keep on the Site throughout the installation, erection and commissioning periods, sufficient stocks of Spare Parts to enable immediate replacement of any item in the Permanent Works found to be defective or in any way in non-conformance with the Specification during the installation, erection and commissioning period ("Commissioning Spares").

The Contractor shall supply and deliver the Commissioning Spares on or before the commencement of testing & commissioning.

The Contractor shall submit to the Employer's Representative for review a list of all Commissioning Spares that shall be made available during the testing and commissioning period.

The Contractor shall not be entitled to use any of the Contract Spares to replace any item in the Permanent Works during the installation, erection and testing & commissioning periods.

14.5 DEFECTS LIABILITY SPARES

In addition to the Contract Spares, the Contractor shall keep sufficient stocks of Spare Parts in an off-site location in Manila throughout the Defects Liability Periods to enable rapid replacement of any item in the Permanent Works found to require replacement as part of the Contractor's obligations during the Defects Notification Period ('Defects Liability Spares ").

The Contractor shall supply and deliver the Defects Liability Spares on or before the commencement of the Trial Run.

The Contractor shall submit to the Employer's Representative for review a list of all Defects Liability Spares that shall be maintained by the Contractor during the Defects Notification Periods.

The Contractor shall not be entitled to use any of the Contract Spares to replace any item in the Permanent Works during the Defects Notification Periods.

14.6 SPECIAL TOOLS AND TEST EQUIPMENT

The Contractor shall supply tools, special tools, and test equipment for maintenance needs for all equipment and systems provided under the Contract. Tools, special tools and test equipment shall be provided for scheduled and unscheduled maintenance, including inspections, servicing, preventive maintenance, corrective maintenance, overhaul and testing.

The Tools, Special Tools and Test Equipment (together with the relevant calibration certificates) required to carry out all the functions described in the Operation and Maintenance Manual, shall be suitably packed and labelled, consigned to the Employer by the Contractor and delivered to the Employer in accordance with the Employer's Representative's instructions not later than the date scheduled for stage commissioning. The extent of supply shall include protective carrying cases as may be appropriate for the storage and use of each item.

All Special Tools and Test Equipment shall be supplied with Operation and Maintenance Manuals,

complete diagrams, schematics, assembly and connection drawings, calibration instructions and circuit diagrams/descriptions for future maintenance.

Where the Contractor has used the Special Tools and Test Equipment for installation and commissioning of the Permanent Works, he shall refurbish and re-calibrate each item to the satisfaction of the Employer's Representative prior to handover to the Employer, accompanied by the Certificate of Calibration traceable to a recognized Japanese or Philippine National Standard or other appropriate Standard previously reviewed without objection.

Where any item of Special Tools and Test Equipment is provided by the Contractor, it shall be accompanied by drawings, manuals and full operating instructions to enable them to be used by suitably skilled (but not necessarily specially trained) personnel in a non- hazardous manner and to achieve the desired result in terms of accuracy and quality.

The Contractor shall provide the means and instructions which describe the parameters of each item of Special Tools and Test Equipment that are critical to their proper methods of use and which enable the Employer's staff using the Special Tools and Test Equipment to achieve the proper performance and operation. Such means and instructions shall include, but not be limited to, any routine checking or re-calibration needs for the Special Tool and Test Equipment itself.

14.7 CODING AND TAGGING

All Spare Parts, Special Tools and Test Equipment to be delivered to the Employer shall each carry a metal tag suitably marked, bar-coded and numbered to sustain harsh environments.

The numbers on the tags shall correspond with those on the coding system developed by the Contractor for all E&M components, parts and equipment's.

15 PACKAGING, SHIPPING AND DELIVERY

15.1 GENERAL

The Contractor shall be fully responsible for the provision and maintenance of acceptable storage facilities for the Plant and any materials or equipment he intends to use for carrying out of the Works or for incorporating into the Works.

The Contractor shall prepare, protect and store, in a manner to be accepted by the Engineer, all equipment and materials so as to safeguard them against loss or damage from repeated handling, from climatic influences and from all other hazards arising during transport, shipment or storage on or off the site. Secured and covered storage shall be provided for all equipment and materials other than those accepted by the Engineer as suitable for open storage.

The Contractor must write the following items on all packages, but not limited to them.

(1) Name of packing content

(2) Quantity of packing content

(3) Size and weight of package

(4) Precautions of package handling

(5) Packing number or contract number

The Contractor must prepare a package list, and check it at the time of both shipment and delivery.

When the Contractor delivers a package from temporary site to actual use site, the Contractor must deliver it carefully by grasping its packing contents and observe strict precautions of package handling

15.2 CRATING

The Contractor shall provide all packing, crates and marking. The consignments for shipment shall be packed and marked in accordance with the Engineer's instructions. In doing so, it shall comply with the following requirements:

(1) Each case, crate or package shall be waterproof, rot-proof and insect/rodent-proof, of robust construction and suitable for the intended purpose. The Contractor shall, in determining the package materials to be used, take cognizance of the climatic conditions likely to occur during the period of transport, shipment and storage.

(2) Each case, crate or package shall be legibly and indelibly marked in large letters with the site address, Contract number, "right way up", opening points and other markings as necessary to permit materials to be readily identified and handled during transit and when received at the Site.

(3) Each case, crate or package shall contain a comprehensive packing list showing the number, mark, size, weight and contents together with any relevant drawings. A second copy of the packing list shall be enclosed in a watertight enclosure on the outside of each case or package. Distribution of additional copies of each packing list shall be in accordance with the Engineer's instruction.

(4) All items heavier than 100 kg shall be marked on the outside of the case to show the gross and net weights, the points for slinging, and where the weight is bearing.

(5) Care shall be taken to prevent movement of items within cases, crates or packages by the provision of bracing, straps and securing bolts as necessary. Bags of loose items shall be packed in cases, and shall be clearly identified by well-secured metal labels on which the quantity and name of the part and its index or catalogue number have been stamped.

(6) Plug connected electronic circuit boards shall be removed from their racks, packed and shipped separately.

(7) All packing shall be free from sharp edges to prevent injury to persons or other objects.

(8) Each bulky/heavy case, crate or package shall include wedge(s) for easy loading and unloading by mechanical handling equipment such as forklift truck.

(9) Electronic circuit boards, integrated circuits (IC) and the like shall be well protected by using appropriate packing, e.g. anti-static bubble bag or similar.

(10) Rubber products and the like shall be suitably packed to avoid damage including but not limited to hardening, deformation and peel-off.

15.3 GENERAL PRECAUTIONS

Spare parts shall be tropicalized in their packing for prolonged storage in accordance with appropriate international standards and shall be suitably and individually labelled to indicate:

(1) shelf life and date of manufacture;

(2) type or condition(s) of storage and special handling information;

(3) description of item and relevant part number;

(4) serial number, if applicable;

(5) inspection/test certificate number and batch number; and

(6) Contract number, variation order number and item number.

Tubes, cable and conductor ends and other similar openings shall be properly sealed and blanked off to prevent ingress of dirt or moisture. Flanged ends shall be protected by adhesive tape or jointing material covered by a properly secured wooden blank not smaller than the flange itself. Plain tube ends shall be closed off with bungs or plugs or suitable materials firmly fixed in position.

Particular care shall be taken to prevent mechanical transport related damage or corrosion of shafts and journals where they rest on timber or other supports which may contain moisture. At such points, wrappings impregnated with anti-rusting composition and of sufficient strength to resist chafing under the pressures and movements during transit shall be used.

Spare ball and roller bearings and similarly protected items shall not be removed from the manufacturer's wrappings or packing.

Fragile materials shall be packed in such a way that they shall not be damaged during transit and when they are properly unpacked for quality inspection. Glass items shall be capable of being easily re-packed without removing the original wrappings or packing for long-term storage within the same packing case.

Appropriate precautions in accordance with the Contractor's safety regulations, the regulations of the Employer, and statutory regulations shall be taken in respect of all hazardous, toxic, inflammable, etc. materials.

15.4 PACKING PROCEDURES

All required inspection/test certificates shall be supplied and packed together with individual material. All packaging materials and procedures shall be subject to review by the Engineer.

All empty cases, crates or packages, whether or not returnable, shall be removed from the Site by the Contractor or stored by the Contractor in such a way that they do not interfere with the progress of the works of the Contractors.

15.5 SHIPPING

The Contractor shall notify the Engineer ten (10) days in advance of any expected shipment date and give further notification of the actual shipment date and routing when such information is subsequently established. This shall complement the inspection requirements prior to delivery as specified herein.

Two copies of packing lists and quality certificates shall be attached to each case or package to be shipped. One copy shall be placed inside the package and the second copy shall be enclosed in a watertight enclosure on the outside of each case or package. A copy of packing lists and quality certificates shall be sent to the Engineer after each package of the Works, the equipment, spare parts and other items to be shipped have been shipped.

Without prejudice to any other provisions of the Contract, and unless otherwise specifically described, the Contractor shall be responsible for all legal requirements, duties, dues, taxes and other such requirements and expenditures required for the importation of the Works, the equipment, spare parts and other items to be supplied under the Contract into Republic of the Philippines.

The Contractor shall clear the Works, the equipment, spare parts and other items to be supplied under the Contract through Republic of the Philippines' customs/ Philippine port in accordance with all Government of Republic of the Philippines' Enactments.

15.6 DELIVERY

The Contractor shall deliver the materials / equipment and all items to be supplied under the Contract to the Site.

The Contractor shall unload the materials / equipment and all items to be supplied under the Contract at the designated delivery point and positioning or storing them.

Any part of the materials / equipment or any item to be supplied under the Contract that is damaged in transit shall not be considered as delivered until repairs or replacements have been made and all necessary spare parts or items have been delivered to the Site.

All documents, manuals, drawings and other deliverables shall be delivered to an address in Republic of the Philippines to be designated by the Engineer in writing.

The Contractor shall store and secure the Works, material / equipment, spare parts and other items until the same have been inspected and are considered delivered at the designated point by the Engineer.

The Contractor shall remove temporary fittings required for shipment and re-assembly of equipment and shall complete this prior to the equipment or parts thereof being inspected and before they are considered delivered.

An item shall be considered delivered when all damages have been repaired and all documentation and post-delivery preparation have been completed to the satisfaction of the Engineer.

16 TRAINING

16.1 GENERAL

The Contractor shall be required to train, or arrange training for, selected members of the Employer's Railway Operations staff in accordance with the requirements of the Railway Operator's program. These staff will include the Employer's and the Railway Operator's Instructors who will require training in technical matters according to their intended function and in instructional techniques. An important objective of the training is to increase the ability to operate, control, supervise and carry out maintenance work on Plant and Equipment supplied and installed by the Contractor.

16.2 TRAINING REQUIREMENTS

Contractors shall be required to provide the following five (5) types of training:

(1) Training for Experts who will be instructors

(2) Training for OCC staff

(3) Training for station staff

(4) Training for technical staff including Railway Systems operation and maintenance staff

(5) Training for PRI staff

The Contractor shall provide training for OCC staff and station staff before the Trial Runs or Trial Operation.

The Contractor shall provide training for PRI staff before class begins using the delivered equipment.

The Contractor shall consider methodology of the knowledge transfer. Knowledge includes not only the system itself, but also matters related to the operation.

16.3 TRAINING PERIODS

The Contractor shall propose appropriate man-months of training to be provided along with rates for adjustment to these requirements. The rates shall include, but not be limited to, providing instructors, training facilities and all teaching aids, materials and equipment necessary to fulfil the training requirements.

16.4 LANGUAGE OF TRAINING COURSES

All training courses will be conducted in British English.

16.5 TRAINING INSTRUCTORS

The Contractor's training instructors shall be fully qualified and experienced electrical and mechanical engineers, who have a good knowledge of the English language. They will have had experience of training engineers or technicians of the level stated on similar topics and will be fully familiar with the Plant and Equipment supplied and installed in the Works.

16.6 CONTRACTOR'S OBLIGATION TO OBTAIN APPROVAL OF INSTRUCTORS

Should, in the opinion of the Engineer, any of the Contractor's training instructors not be considered as competent or do not have a suitable attitude or aptitude for carrying out the training courses for whatever reason, the Contractor shall remove the said person and replace him as soon as possible with an acceptable substitute.

16.7 EMPLOYER'S RAILWAY OPERATIONS STAFF

Where the Employer's or the Railway Operator's staff (trainees) will be assigned to the Contractor (or his Subcontractor(s)) for the purposes of training. All such trainees must be properly supervised and monitored by the Contractor and/or Subcontractor's qualified training supervisor to ensure that each trainee has the best opportunity to benefit from the theoretical and practical experience.

16.8 TRAINING PROGRAM

The Contractor shall develop and plan detailed training programs using training methods most appropriate to the subject matter and the level of trainee specified. Details of these training programs shall be submitted to the Engineer not later than six (6) months from the award of Contract. The objectives, content, method, location, timing and duration of each program as provided in the Contractor's proposals.

16.9 TRAINING COURSES

The Contractor's training courses shall be programmed in phase with the progress of manufacture and installation to ensure that trainees are present during all stages of the manufacture, installation, testing, commissioning and integration testing of the Plant and Equipment that is the subject of the training program. The Contractor shall ensure that the courses fully encompass all aspects of the basic design, manufacture, installation, testing, commissioning and maintenance of the Plant and Equipment with maximum effort being directed at instruction in the maintenance of the installed Plant and Equipment.

16.10 ALL NECESSARY RAILWAY OPERATIONAL INSTRUCTION AIDS AND MATERIALS

The Contractor shall use all necessary teaching aids such as technical literature, manuals, photographs, drawings, films, models and all other instructional materials as may be necessary for the training of the Railway Operator's personnel. Instructional used in the performance of Training will become the property of the Employer for the purposes of Railway Operations and Maintenance.

16.11 PLANT AND MATERIALS SET ASIDE FOR TRAINING PURPOSES

In general, the Contractor shall use Plant and materials specifically set aside for training purposes. However, the Contractor may use, for the training of the Railway Operator's staff, subject to the agreement of the Engineer, installed Plant and Equipment when no other such plant and materials are otherwise available. The Contractor shall not use for this purpose and spare parts or assemblies that form the Contractor spares.

16.12 PROTECTIVE CLOTHING-TRAINING

The Contractor shall provide all special or protective clothing required by the trainee; undergoing instructed training. Personal items of clothing shall be of new issue and maybe retained by the trainee on completion of the training course.

16.13 MONITORING

Throughout the training program the Engineer shall have free access to all training sessions to monitor the progress of the trainees and the Contractor's training instructors.

16.14 TRAINING PRACTICAL TESTS AND APTITUDE REPORTS

To ascertain that the objectives of the courses have been achieved the Contractor shall set periodical theoretical and practical tests for the trainees. The results of these tests together with a report on the trainees' general attitude, ability, technical knowledge, aptitude and attendance record shall be forwarded at regular intervals to the Engineer who may also require the submission of additional reports in special cases.

16.15 MONITORING OF TRAINING PROGRESS

Methods for monitoring progress shall include, but will not necessarily limited to:

(1) Theoretical tests and systems of assessment;

(2) Practical test pieces and objective systems of assessment;

(3) Progress reports.

16.16 RECORDS OF TRAINING PROGRESS TO BE MAINTAINED

Records of the progress of trainees shall be kept up to date and shall be made available to the Engineer for examination when required.

16.17 ISSUE TEST RESULTS AND PROGRESS TO THE ENGINEER

Copies of the records of individual trainees, showing all test results and reports of progress, shall be sent to the Engineer on completion of each training course.

16.18 TRAINING LOCATION AND FACILITIES

The training of selected Employer's and Railway Operator's staff shall be carried out at such locations where the greatest benefit for trainees may be gained. This may be in Republic of the Philippines or at places of manufacture, assembly or testing or at such other locations as may be necessary. All places of training will be to the approval of the Engineer. Details of the facilities to be provided shall be included with the detailed training programs submitted by the Contractor.

16.19 OCCUPATIONAL HEALTH AND SAFETY OF TRAINEES

The Contractor shall be responsible for the safety, health and welfare of trainees when under training. Accordingly, an explanation of the safety rules and codes shall form part of a general induction course to be given by the Contractor and where considered necessary the Contractor shall issue a rulebook for which the trainee shall sign indicating his acceptance and understanding thereof.

16.20 ADMINISTRATION

The Contractor shall be:

(1) Responsible for the reception of, and hotel and travel arrangements for each trainee in regions other than Manila;

(2) Responsible for the general welfare of trainees under its control.

17 E&M EQUIPMENT FOR PRI AND TECHNICAL CENTER

17.1 RAILROAD MODEL FOR INTERLOCK EDUCATION

17.1.1 General

An Automatic Controlled Railroad Model (hereinafter referred to as The Equipment) shall be provided in order to understand the interlock between the signal and the track circuit. The equipment shall be installed in the signal training room of PRI. All railway companies in the Philippines will enroll new employees into PRI for training to get licenses for railway workers. In PRI, The Equipment will be used to understand that the importance of complying signal, and interlocks prevent collision and derailment of trains.

17.1.2 Required Main Functions and Performance

(1) **Hardware Overview**

The Equipment consists of one railroad model layout and a controller, and four root setting devices. For the good visibility of many students, the train model and layout (alignment) shall be chosen from "HO gauge" or larger.

As models, one depot, four interlocking stations, two non-interlocking stations (stops) shall be arranged. In principle it shall be double track, but in the depot and two sections between stations shall be single tracks. PRI students will be understood the role of direction lock in the single track section, also will be understood regarding root lock in double track. The figure shown below is a reference examples of size and layout.

The Equipment's layout decorates lightly by model roads, trees, houses, buildings, cars, people, and so on. Since it is a teaching material, excessive decoration is unnecessary. Stations in The model have no ceiling, Station has a big sign of its station name. The equipment has strong structure and covering the whole with a transparent cover and to be able to withstand the students' mild pranks. Explanation sign board for visitor shall be prepared by the Contractor.

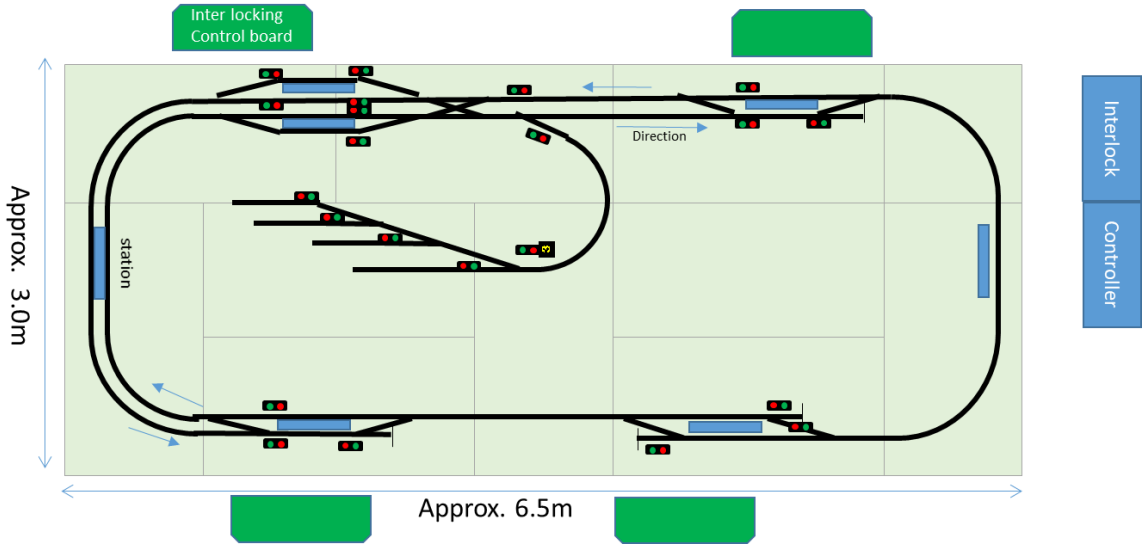


Figure 17.1: Reference size and layout of railroad model

(2) **Train model**

Three (3) model trains (vehicles) and additional two (2) trains (vehicles) as spare shall be prepared. Train opposite ends shall have front face. The vehicles automatically start

running when each course are set, continues to run in the range where the courses are set, and automatically stop. Trains shall be painted in different colors to make it easy to understand the difference.

(3) **Root Setting**

The roots of models are commanded from the interlocking control boards. The Contractor shall create interlocking charts first. Model vehicles shall be controlled course and its movement by interlocking system according to the charts. The interlocking system get order from students via switches and keys, and control boards display root conditions and traffic using LED lights. The interlocking charts shall be displayed around control board.

17.1.3 Major Sub Equipment

The detailed equipment list is shown below.

Table 17.1: Major Sub Equipment

System	Description	Qty.	Remarks
Railroad model	Vehicle model	3 sets	Not including spares
	Model Track	1 set	
	Model Signal	More than 22 sets	According to track layout
	Model station	6 sets	2 stations are without interlocking
	Station sign	6 sets	
	Model city or town	6 sets	Around stations
	Table for railroad model	1 set	Clear (see through) panel covered.
Interlocking system	Control board	4or5sets	
	Main controller	1 set	
	Programed Root controller	1 sets	Easy function

Spare and expendable parts shall be provided according to the following table;

Table 17.2: Spare and Expandable Parts

Description
Interlocking main controller
Model controller
Model Vehicle
Cleaning kit

17.1.4 Language

All subsystems and manuals shall be produced in English.

17.1.5 Design Life

The design life is eight (8) years after completion, visual devices and central processing unit shall be replaced to maintain its performance. 15 years after completion, all systems shall be replaced. The Contractor shall use parts which match the above design life. The designs shall be approved by the Engineer including the proposal of local maintenance organization in Manila. Also, the Engineer's approval shall be required for the maintenance cost.

17.1.6 Period of Defects Notification

The Contractor shall have the Defects Notification Period for 2 years upon issuance of TOC. Regardless of the above mentioned, the Defects Notification Period shall be not less than 1 year after hand over. Whichever comes later shall be applied.

17.1.7 Installation Requirements

(1) **Locations**

These equipment shall be installed in the designated place of the PRI building in depot.

(2) **Condition**

These equipment must be designed for the condition shown below.

- Temperature 16 – 36 °C (operation), 0 – 40 °C (reservation)
- Humidity 40- 70%
- Dust same level ISO6 in ISO 14644-1d

(3) **Power supply**

Single phase 230 V ac electricity will be provided from electric switch board. The contractor shall connect the equipment to designated switch board. The electric consumption of the equipment is assumed to be less than 3kW. A transformer shall be provided by the Contractor, if necessary.

17.1.8 Test

The Contractor shall submit a plan for testing and commissioning the equipment, as well as the test specification for the Engineer's review. Training of operation staff shall be completed two months prior to the commencement of the first train's running test. The number of staff and schedule shall be specified in due course. Major testing items after installing the equipment and software are as follows:

1) Visual check and safety inspection;
2) Grounding circuit, insulation resistance check, and dielectric test;
3) Equipment allocation;
4) Power ON, indication, electric meter, gauge check;
5) Equipment operability; and
6) Function check.

17.1.9 Staff Training

The Contractor shall supply the equipment. The equipment is a tool for operation staff to study the operation procedures in a realistic environment. After handing over the equipment, the Contractor shall have its commissioning engineers on stand-by during the experimental train running period and to train the Employer's instructors about the way to operate and maintain. Its time length of training period for instructors of the PRI teachers to be able to use the equipment shall be not less than 1 month.

17.1.10 Submitting Document

The Contractor shall provide the operation and maintenance manual of the equipment written in English. The equipment's maintenance manual shall include the following but not be limited to: schematic/electrical diagram, illustrated parts catalogue, and spare parts (complete with description and part nos.). Paper book and editable digital data shall be prepared. The technology and structure of important equipment shall be carefully described. The instruction manual shall be composed of many figures and sentences that are easy to read and understand. All books must be approved by the Engine. DOTr, the operation maintenance operator, and the contractors of JICA technical assistance services and related shall be permitted to prepare materials for the operation of MMSP using this part of the material by the contractor. However, when the documents conflict with the contractor's secret, the contractor can restrict distribution destination of the content when there is reasonable reason.

17.2 INTERLOCK MOCKUP

17.2.1 General

An Interlock mockup (hereinafter referred to as The Equipment) shall be provided in order to understand the most basic functions of interlocking system. The equipment shall be installed in the signal training room of PRI. All railway companies in the Philippines will enroll new employees into PRI for training to get licenses for railway workers. In PRI, The Equipment will be used to understand that the interlock system basic functions on turnout such as detector lock ("Tessa-Sajyo" in Japanese).

17.2.2 Required Main Functions and Performance

(1) **Hardware Overview**

The Equipment consists of a part of turnout, point machine, 3 signals, track circuits, interlocking machine, interlocking control board, and a small trolley as rail clamp shunt.

The main purpose of the equipment is "educate the work of interlocking system", especially root lock ("Shinro-Sajyo") and detector lock ("Tessa-Sajyo").

To understand the work between the system and signals, the real size 3 signals shall be arranged angle with the good visibility of many students. The interlock control board have Signal levers, point machine levers, direction levers, and related levers and keys. The interlocking system shall be worked by commands from its control board following interlock chart. The chart shall be made by the Contractor. A big mirror upon the control board shall be prepared for the good visibility of around students.

The trolley is such a kind of small train bogie, small and hand push/pull. The purpose of it is the simulation of train, each right-left wheels shall be shorted electrically.

Track circuits shall be more than 4. Track circuit shall detect trolley. And interlock system shall lock the point machine and/or signals. Also indicate the condition of track circuits on the interlock control board.

Signals shall be indicated green or red signal according the command from interlock system,

Impedance bonds shall be prepared.

The top cover of the point machine and impedance bond shall be clear panes (see through). Explanation board for visitor shall be prepared by the Contractor.

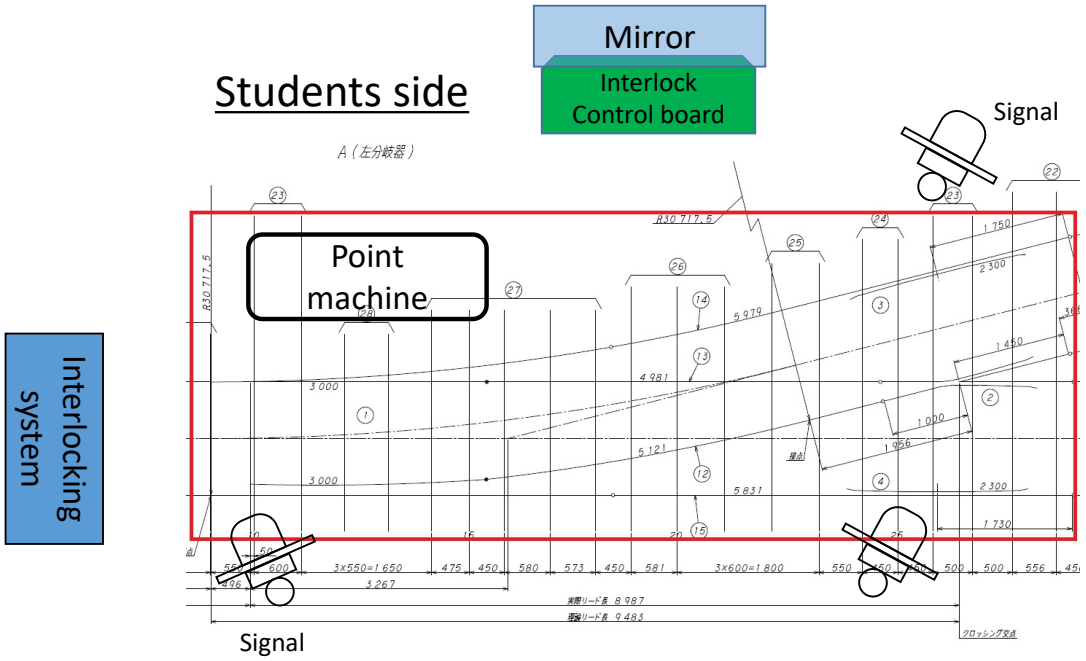


Figure 17.2: Reference size and layout of interlocking mockup

(2) **Signal**

Three (3) signals shall be prepared. The signal have Green and Red led lamps and its shape shall be accordance with Japan Railway Industrial Standard (JR/JNR type). It shall be controlled by interlock system of The Equipment.

(3) **Turnout and Point Machine**

A part of the JIS No4 turnout shall be prepared by the CP106 contractor. It includes rails and sleepers around turnout. The gauge will be standard (1435mm). The contractor shall prepare point machine, point rod, handle, power cut switch, its cover and related materials. The top cover of point machine shill be clear panel (see through).

17.2.3 Major Sub Equipment

The detailed equipment list is shown below.

Table 17.3: Major Sub Equipment

System	Description	Qty.	Remarks
Interlock Mockup	Interlock system	1 sets	Relay interlock
	Interlock control board	1 set	
	Point machine	1 set	Including related parts
	Signals	3 sets	Green/Red, more than 2 status
	Track circuit	4 sets	Mechanical track relay type
	Trolley	1 set	
	Turnout	1 set	

Spare and expendable parts shall be provided according to the following table;

Table 17.4: Spare and Expandable Parts

Description
Interlocking system power parts
LEDs for interlock control boards
LEDs for signals
Cleaning kit

17.2.4 Language

All subsystems and manuals shall be produced in English.

17.2.5 Design Life

The design life is fifteen (15) years after completion, visual devices and central processing unit shall be replaced to maintain its performance. 30 years after completion, all systems shall be replaced. The Contractor shall use parts which match the above design life. The designs shall be approved by the Engineer including the proposal of local maintenance orgnization in Manila. Also, the Engineer's approval shall be required for the maintenance cost.

17.2.6 Period of Defects Notification

The Contractor shall have the Defects Notification Period for 2 years upon issuance of TOC. Regardless of the above mentioned, the Defects Notification Period shall be not less than 1 year after hand over. Whichever comes later shall be applied.

17.2.7 Installation Requirements

(1) **Locations**

These equipment shall be installed in the designated place of the PRI building in depot.

(2) **Condition**

These equipment must be designed for the condition shown below.

- Temperature 16 – 36 °C (operation), 0 – 40 °C (reservation)
- Humidity 40- 70%
- Dust same level ISO6 in ISO 14644-1d

(3) **Power supply**

Single phase 230 V ac electricity will be provided from electric switch board. The contractor shall connect the equipment to designated switch board. The electric consumption of the equipment is assumed to be less than 3kW. A transformer shall be provided by the Contractor, if necessary.

17.2.8 Test

The Contractor shall submit a plan for testing and commissioning the equipment, as well as the test specification for the Engineer's review. Training of operation staff shall be completed two months prior to the commencement of the first train's running test. The number of staff and schedule shall be specified in due course. Major testing items after installing the equipment and software are as follows:

1) Visual check and safety inspection;

2) Grounding circuit, insulation resistance check, and dielectric test;

3) Visibility and brightness of the signal;

4) Equipment allocation;

5) Power ON, indication, electric meter, gauge check;

6) Equipment operability;

7) Function check;

8) Electro-Magnetic Interference check; and

9) Vibration, sound level check.

17.2.9 Staff Training

The Contractor shall supply the equipment. The equipment is a tool for operation staff to study the operation procedures in a realistic environment. After handing over the equipment, the Contractor shall have its commissioning engineers on stand-by during the experimental train running period and to train the Employer's instructors about the way to operate and maintain. Its time length of training period for instructors of the PRI teachers to be able to use the equipment shall be not less than 1 week.

17.2.10 Submitting Document

The Contractor shall provide the operation and maintenance manual of the equipment written in English. The equipment's maintenance manual shall include the following but not be limited to: schematic/electrical diagram, illustrated parts catalogue, and spare parts (complete with description and part nos.). Paper book and editable digital data shall be prepared. The technology and structure of important equipment shall be carefully described. The instruction manual shall be composed of many figures and sentences that are easy to read and understand. All books must be approved by the Engine. DOTr, the operation maintenance operator, and the contractors of JICA technical assistance services and related shall be permitted to prepare materials for the operation of MMSP using this part of the material by the contractor. However, when the documents conflict with the contractor's secret, the contractor can restrict distribution destination of the content when there is reasonable reason.

17.3 FIXED BLOCK MOCKUP

17.3.1 General

A fixed block mockup (hereinafter referred to as The Equipment) shall be provided in order to understand the most basic functions of fixed block system. The equipment shall be installed in the 3F corridor of PRI. All railway companies in the Philippines will enroll new employees into PRI for training to get licenses for railway workers. In PRI, The Equipment will be used to understand that the block system and signal control, the ("Heisoku").

17.3.2 Required Main Functions and Performance

(1) **Hardware Overview**

The Equipment consists of 5m rail, 4 signals, track circuits, interlocking machine, and a small trolley as rail clamp shunt.

The main purpose of the equipment is "educate the work of block system", especially relation of track circuit and signal indications.

To understand the work between the system and signals, the real size 4 signals shall be arranged angle with the good visibility of many students. The interlocking system shall be worked by information from track circuits following interlock chart. The chart shall be made by the Contractor.

The trolley is such a kind of small train bogie, small and hand push/pull. The purpose of it is the simulation of train, each right-left wheels shall be shorted electrically.

Track circuits shall be more than 3. Track circuit shall detect trolley. And interlock system shall change the indication of the signals according the trolley position. Also indicate the condition of track circuits on the interlock control (indication only) board.

Signals shall be indicated green yellow and red signal according the command from interlock system. Preparation of impedance bonds is not duty.

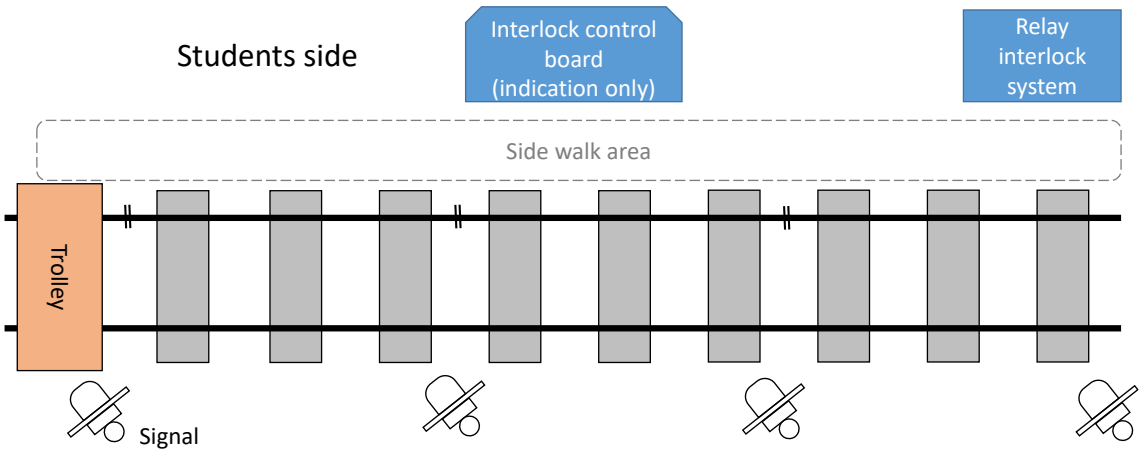


Figure 17.3: Reference size and layout of Fixed Block Mockup.

(2) **Signal and Interlock system**

Four (4) signals shall be prepared. The signal have Green, Yellow and Red led lamps and its shape shall be Subway type (No sun shade). It shall be controlled by interlock system of The Equipment. The interlock system shall get condition of track circuits regarding

trolley is there or not. The system shall control signals to be red when related track is shorted, and one before signal shall be controlled to be yellow. The mechanical interlock system is preferable.

(3) **Track circuit**

Four (4) simple track circuits shall be prepared by the Contractor. Track relays shall be mechanical type and actually used for train detection, and its cover shall be clear cover (see through). The rails and sleepers shall be prepared by this Contractor.

In addition, the Contractor shall prepare the model of rail isolation for track circuit. It shall have connected 2 cut short length rails and tied by the rail joint. Quantity shall be 2.

17.3.3 Major Sub Equipment

The detailed equipment list is shown below.

Table 17.5: Major Sub Equipment

System	Description	Qty.	Remarks
Interlock Mockup	Interlock system	1 sets	Relay interlock
	Interlock control board	1 set	Only indicator of track conditions
	Signals	4 sets	Green/Yellow/Red
	Rail and track	1 set	Standard gauge
	Track circuit	4 sets	Mechanical track relay type
	Trolley(hand push car)	1 set	Standard gauge

Spare and expendable parts shall be provided according to the following table;

Table 17.6: Spare and Expandable Parts

Description
Interlocking system power parts
LEDs for interlock control boards
LEDs for signals
Cleaning kit

17.3.4 Language

All subsystems and manuals shall be produced in English.

17.3.5 Design Life

The design life is fifteen (15) years after completion, visual devices and central processing unit shall be replaced to maintain its performance. 30 years after completion, all systems shall be replaced. The Contractor shall use parts which match the above design life.

17.3.6 Period of Defects Notification

The Contractor shall have the Defects Notification Period for 2 years upon issuance of TOC. Regardless of the above mentioned, the Defects Notification Period shall be not less than 1 year after hand over. Whichever comes later shall be applied.

17.3.7 Installation Requirements

(1) **Locations**

These equipment shall be installed in the designated place of the PRI building in depot.

(2) **Condition**

These equipment must be designed for the condition shown below.

- Temperature 16 – 36 °C (operation), 0 – 40 °C (reservation)
- Humidity 40- 70%
- Dust same level ISO6 in ISO 14644-1d

(3) **Power supply**

Single phase 230 V ac electricity will be provided from electric switch board. The contractor shall connect the equipment to designated switch board. The electric consumption of the equipment is assumed to be less than 3kW. A transformer shall be provided by the Contractor, if necessary.

17.3.8 Test

The Contractor shall submit a plan for testing and commissioning the equipment, as well as the test specification for the Engineer's review. Training of operation staff shall be completed two months prior to the commencement of the first train's running test. The number of staff and schedule shall be specified in due course. Major testing items after installing the equipment and software are as follows:

1) Visual check and safety inspection;

2) Grounding circuit, insulation resistance check, and dielectric test;

3) Visibility and brightness of the signal and control devices;

4) Equipment allocation;

5) Power ON, indication, electric meter, gauge check;

6) Equipment operability; and

7) Function check.

17.3.9 Staff Training

The Contractor shall supply the equipment. The equipment is a tool for operation staff to study the operation procedures in a realistic environment. After handing over the equipment, the Contractor shall have its commissioning engineers on stand-by during the experimental train running period and to train the Employer's instructors about the way to operate and maintain. Its time length of training period for instructors of the PRI teachers to be able to use the equipment shall be not less than 1 week.

17.3.10 Submitting Document

The Contractor shall provide the operation and maintenance manual of the equipment written in English. The equipment's maintenance manual shall include the following but not be limited to: schematic/electrical diagram, illustrated parts catalogue, and spare parts (complete with description and part nos.). Paper book and editable digital data shall be prepared. The technology and structure of important equipment shall be carefully described. The instruction manual shall be composed of many figures and sentences that are easy to read and understand. All books must be approved by the Engine. DOTr, the operation maintenance operator, and the contractors of JICA technical assistance services and related shall be permitted to prepare materials for the operation of MMSP using this part of the material by the contractor. However, when the documents conflict with the contractor's secret, the contractor can restrict distribution destination of the content when there is reasonable reason.

17.4 SIGNAL PART MODELS FOR EDUCATION

17.4.1 General

Signal part models shall be provided in order to establish a high quality approach for understanding maintenance of railway.

There are two training organizations in MMSP depot. One is the Training Center of this project as a department of this subway operator, the other one is the Philippine Railway Institute as the governmental training school to get railway staff license. All employees in railway operators shall get license first in PRI, then they will learn in training center of each railway operators.

In PRI, the students have to know "What is train" to get license, then they have to be familiar with the technologies and structures of the train parts using parts models in TC before starting their maintenance work.

17.4.2 Required General Functions and Performance

(1) **General**

Self-standing signal part models shall be installed in PRI and TC.

These model shall be the same hardware as the actual ones, as much as possible.

The part models shown below shall be installed in PRI by the Contractor,

P1) Railway side indicators;

P2) Level crossing;

P3) Emergency train stop warning system; and

P4) Auto fare collection system.

Also the part models shown below shall be installed in TC by the Contractor,

T1) CBTC equipment;

T2) Emergency train stop warning system;

T3) PSD equipment; and

T4) Auto fare collection system.

All models without "P1 Railside indicators" shall be worked an elementary functions.

(2) **Railway side indicator**

The Railway side indicators are the signs for drivers which will placed along the railway. The indicators are placed to inform the attention or order for driver. The contractor shall prepare replica of indicators for PNR, LRT1, LRT2, MRT3, LRT7, NSCR and MMSP. And it shall be displayed in PRI by the Contractor.

(3) **Level Crossing**

The level crossing shall have one (1) controller, two (2) sets of road warning device, two (2) sets of crossing gates and two (2) sets of train detector. Train detectors shall be axel count type. The level crossing shall be installed the non-electrified track in PRI. The load warning devices and crossing gates shall be same manner as PNR or NSRP. Since the

controller is also used to explain the risk of reset operation etc., Level crossing shall not be installed at the position where it is expected to function properly from people in PRI.

(4) **Emergency train stop warning system**

Two (2) emergency train stop warning systems shall be prepared by the Contractor. One shall be installed near level crossing in PRI, other one shall be installed in a signal training room in the MMSP Training Center. The function of it, flashes strong red lights and sound loudly when the user pushes its emergency button.

(5) **3rd rail model**

20m non electrified 3rd rail model for maintenance training shall be installed at the end of non electrified track of PRI. This equipment is not specified in MMSP drawings. It shall be designed by the given conditions from the Engineer for PRI education equipment, LRT7 type or Japanese subway type will be applied to design. This model shall be non electrified; however electric isolation structure and isolation test shall not be omitted. It will be used just know what is 3rd rail and know the structure.

(6) **CBTC equipment**

The CBTC equipment shall have radio equipment, root indicator and station controller. These equipment are same as main line equipment as much as possible. These equipment will be used for maintenance work, especially railway staff will learn procedure and the risk of reset operation.

(7) **PSD equipment**

The PSD equipment shall have one (1) set of door, one (1) set of door local switches, one (1) set of sensors, one (1) door controller and one (1) station office control board. These equipment are same as main line equipment as much as possible. These equipment will be used for maintenance work, especially parts change and how to cut off (kill safety function) door temporary.

(8) **Auto fare collection system**

The Auto fare collection system equipment shall have automatic gate, ticket machine, counter computer, station server and training tickets. The equipment shall be installed in 2 place. In PRI mockup station and in TC signal training room. For PRI, one pair of fare collection gates(In/OUT), ticket machine, counter computer, station server shall be one (1) each, for TC fare collection gates, ticket machines, counter computers shall be three (3) each.
Additional equipment will be procured by DOTr for PRI, the Contractor shall coordinate for it. Until the additional equipment will be installed by DOTr, dummy gate or machines will be prepared by the CP101 contractor.

(9) **Major Equipment of the Signal Part Model**

The related parts and equipment shall be basically the same as in the main line. The detailed equipment list is shown below.

Table 17.7: Major Equipment of the Signal Part Model

System	Description	Qty. for PRI	Qty. for TC	Remarks
Railway indicator	PNR indicator	1 set		
	LRT1 indicator	1 set		
	LRT2 indicator	1 set		
	MRT3 indicator	1 set		
	LRT7 indicator	1 set		
	NSCR indicator	1 set		
	MMSP indicator			
Level crossing	Controller	1 set		
	Road warning device	2 set		
	Crossing gate	2 set		
	Train detector.	2 set		Single track, 2 directions
Emergency train stop warning system	Signal	1 set	1 set	
	Switch and sound device	1 set	1 set	
3rd rail model	20m 3rd rail model	1 set		Non electrified model Install at end of non electrified track.
CBTC equipment	Radio		1 set	
	Root indicator		1 set	Or point direction indicator
	controller		1 set	
PSD equipment	Doors		1 set	
	Door local switch		1 set	
	Door sensors		1 set	
	Door controller		1 set	
	Station office control board		1 set	
Auto fare collection system	Automatic gate	1 pair	3 sets	AFC in PRI shall set as different Sta.
	Ticket machine,	1 sets	3 sets	
	counter computer,	1 sets	3 sets	
	Station server	2 set	1 set	1 servers in PRI shall set as different Sta.
	Training tickets.	500 tickets	300 tickets	

Spare and expendable parts shall be provided according to the following table;

Table 17.8: Spare and Expandable Parts

Description
Level crossing controller
Level crossing gate parts
Other electrical parts in case not same as mainline

17.4.3 Language

All subsystems and manuals shall be produced in English.

17.4.4 Design Life

The design life is fifteen (15) years after completion, visual devices and central processing unit shall be replaced to maintain its performance. 30 years after completion, all systems shall be replaced. The Contractor shall use parts which match the above design life. The designs shall be approved by the Engineer including the proposal of local maintenance organization in Manila. Also, the Engineer's approval shall be required for the maintenance cost.

17.4.5 Period of Defects Notification

The Contractor shall have the Defects Notification Period for 2 years upon issuance of TOC. Regardless of the above mentioned, the Defects Notification Period shall be not less than 1 year after hand over. Whichever comes later shall be applied.

17.4.6 Installation Requirements

(1) **Locations**

These equipment shall be installed in the designated place of the PRI building in depot.

(2) **Condition**

These equipment must be designed for the condition shown below.

- Temperature 16 – 36 °C (operation), 0 – 40 °C (reservation)
- Humidity 40- 70%
- Dust same level ISO6 in ISO 14644-1d

(3) **Power supply**

Single phase 230 V ac electricity will be provided from electric switch board. The contractor shall connect the equipment to designated switch board. The electric consumption of the equipment is assumed to be less than 3kW. A transformer shall be provided by the Contractor, if necessary.

17.4.7 Test

The Contractor shall submit a plan for testing and commissioning the equipment, as well as the test specification for the Engineer's review. Training of operation staff shall be completed two months prior to the commencement of the first train's running test. The number of staff and schedule shall be specified in due course. Major testing items after installing the equipment and software are as follows:

1) Visual check and safety inspection;
2) Grounding circuit, insulation resistance check, and dielectric test;
3) Visibility and brightness of the screen;
4) Equipment allocation;
5) Power ON, indication, electric meter, gauge check;
6) Equipment operability; and
7) Function check.

17.4.8 Staff Training

The Contractor shall supply the equipment. The equipment is a tool for operation staff to study the operation procedures in a realistic environment. After handing over the equipment, the Contractor shall have its commissioning engineers on stand-by during the experimental train running period and to train the Employer's instructors about the way to operate and maintain. Its time length of training period for instructors of the PRI teachers to be able to use the equipment shall be not less than 1 week.

17.4.9 Submitting Document

The Contractor shall provide the operation and maintenance manual of the equipment written in English. The equipment's maintenance manual shall include the following but not be limited to: schematic/electrical diagram, illustrated parts catalogue, and spare parts (complete with description and part nos.). Paper book and editable digital data shall be prepared. The technology and structure of important equipment shall be carefully described. The instruction manual shall be composed of many figures and sentences that are easy to read and understand. All books must be approved by the Engine. DOTr, the operation maintenance operator, and the contractors of JICA technical assistance services and related shall be permitted to prepare materials for the operation of MMSP using this part of the material by the contractor. However, when the documents conflict with the contractor's secret, the contractor can restrict distribution destination of the content when there is reasonable reason.

17.5 CBTC AND PRC SIMULATOR

17.5.1 General

Communication Based Traffic Control system and Programed Route Control system simulator shall be installed in the Training Center as an equipment for OCC staff to learn how to control traffic and how to keep safety when CBTC system fail.

This equipment provides fonctions for 1) make diagram, 2)check diagram 3) know how to set route 4) know how to reset route 5) know how to manage traffic 6) know how to change train departure priority 7)how to manage in case interlocking system down 8) how tomanage in case CBTC down (server & local) 9) how to manage onboard CBTC system down.

especially the cases the CBTC loses the location of trains, or if tracking is continuously lost, what happens on the mainline existing trains and what kind of trouble may be occur, shall be included. All scenarios may not be able to install to the equipment. Therefore, as a support education materials, the Contractor shall prepare video and training materials for risk prediction training.

This teaching material shall be created on the assumption that the driver also uses part of it. In addition, video education materials shall be assumed to be played not only also in Training center but also PRI audio-visual classrooms.

17.5.2 Required Main Functions and Performance

(1) **CBTC Land Equipment Simulation**

The functions of central equipment and field equipment of CBTC signal system shall be reproduced. These equipment will be created as harware or virtual in software. , and real or virtual hardware will be prepared to understand what will be displayed on the OCC and in the field when the power of the central/field equipment is turned off or reset. It is up to the Contractor to have the actual print board and local functions. However, in production, it must have sufficient software and hardware functions for education, and approved by the Engineer who is in charge of PRI/TC education facility will be required.

(2) **OCC route controller and ATS Simulation**

The Contractor shall install ATS and PRC equipment for training in Training Center.

This equipment basically shall has the same or similar functions as the production ATS and PRC installed in the OCC. It can be integrated with computers for CBTC simulator.

In addition, it shall have a simulator that can reproduce automatic or manual route control, train location indication, and other system equipment status display in the real.

The term "other system equipment" mentioned here assumes overhead contact wire power, signal system, radio, PSD, and fire alarm, but there may be cases where educational or other necessary functions shall be added.

A plurality of trains reproduced on the software of this equipment provide functions such as the positions of the trains move virtually in accordance with the following scenarios.

1) Run according to the inputted diagram. As a result, it is also possible to find out the planning error of the inputted diagram;
2) Follow the previous train, regardless of the schedule or according diagram with delay; and
3) It is possible to reproduce the fail of the train and stopping train according OCC's order

at the station.

17.5.3 Subsystems of CBTC and PRC Simulator

Subsystems of the CBTC and PRC Simulator shall be typically categorized as seen below and the functions and performance shall be defined and specified on each subsystem.

1) CBTC land equipment simulator;
2) Train and CBTC onboard equipment simulation software; and
3) OCC dispatcher system simulator (CBTC, ATS and PRC console).

17.5.4 Hardware Required Subsystem Functions and Performance

(1) **CBTC land equipment simulator**

Following equipment and switches shall be reproduced as hardware or virtual equipment in software. The contractor shall prepare each set of CBTC central equipment, CBTC local control equipment, and a railway side equipment case as a set of The CBTC land equipment simulator. Each equipment shall have at least a cabinet with the same appearance as a real one, a power switch, reset switch, status indications.These indications and switches are used as input for the simulator to reproduce what kind of failure in OCC and in Trains will occur after each CBTC Equipment is reset or turned off. CBTC backup signal parts shall be included.

(2) **Train position and CBTC onboard equipment simulator;**

The Contractor shall prepare a monitor to show the location of trains on simulator sodtware.

The train location monitor shall be installed for the purpose of reproducing the situation where trains cannot be seen or cannot be tracked if the train is running and the CBTC land equipment stops. The Contractor shall provide the same equipment as the production OCC dispatcher desk, related to CBTC, ATS and PRC. However, the radio shall place an interphone to tala with the driver cabin mockup, and PSD or a fire alarm and such kind of equipment switches shall place as a dummy panel.

(3) **OCC route controller and ATS Simulation**

The Contractor shall install ATS and PRC equipment for training in Training Center.This equipment basically shall has the same or similar functions as the production ATS and PRC installed in the OCC.

In addition, it shall have a simulator that can reproduce automatic or manual route control, train location indication, and other system equipment status display in the real.

The term "other system equipment" mentioned here assumes overhead contact wire power, signal system, radio, PSD, and fire alarm, but there may be cases where educational or other necessary functions shall be added.

A plurality of trains reproduced on the software of this equipment provide functions such as the positions of the trains move virtually in accordance with the following scenarios.

1) Run according to the inputted diagram. As a result, it is also possible to find out the planning error of the inputted diagram;
2) Follow the previous train, regardless of the schedule or according diagram with delay; and
3) It is possible to reproduce the fail of the train and stopping train according OCC's order

at the station.

In addition, the system shall have functions to make diagrams for train running, check diagram feasibility and print it. Also the system shall provide function to make departure timetables for each stations and a worksheet for each drivers.

17.5.5 Major Equipment of the Simulator

The detailed equipment list is shown below. All computers shall have UPS.

Table 17.9: Major Equipment of the Simulator

System	Description	Qty.	Remarks
CBTC land equipment simulator;	CBTC central equipment,	1 set	Equipment case, indications, and switches (harware or virtual)
	CBTC local control equipment	1 set	Equipment case, indications, and switches (harware or virtual)
	Radio system and other land equipment	1 set	Equipment case, indicators, and switches. CBTC backup signal parts shall be included. (harware or virtual)
OCC dispatcher system simulator	OCC dispatcher desk	1 set	Desk, chairs, interphone, and picture panel which reproduce other system equipment.
	ATS and PRC console	2 sets	Two set of Computer which have same or similar functions as the production ATS and PRC installed in the OCC.

Spare and expendable parts shall be provided according to the following table;

Table 17.10: Spare and Expandable Parts

Description
Monitor
Processing Unit
Other electrical parts
UPS
Cab parts
Other mechanical parts

17.5.6 Language

All subsystems and manuals of the Train Operation Simulator shall be produced in English.

17.5.7 Software Installation and Upgrade

1st stage: Temporary data and functions, 6 months before main line first taking-over

2nd stage; Real mainline data and functions shall be installed by the Contractor, it is preferable after taking-over of the all main line.

17.5.8 Design Life

The design life is eight (8) years after completion, visual devices and central processing unit shall be replaced to maintain its performance. 15 years after completion, all systems shall be replaced. The Contractor shall use parts which match the above design life. The designs shall be approved by the Engineer including the proposal of local maintenance organization in Manila. Also, the Engineer's approval shall be required for the maintenance cost.

17.5.9 Period of Defects Notification

The Contractor shall have the Defects Notification Period for 2 years upon issuance of TOC. Regardless of the above mentioned, the Defects Notification Period shall be not less than 1 year after hand over. Whichever comes later shall be applied.

17.5.10 Installation Requirements

(1) **Locations**

The train operation simulator shall be installed in the designated place.

(2) **Condition**

Train Operation Simulator must be designed for the condition shown below.

1) Temperature 16 – 36 °C (operation), 0 – 40 °C (reservation)
2) Humidity 40- 70%
3) Dust same level ISO6 in ISO 14644-1d

(3) **Power supply**

Single phase 230 V ac electricity shall be provided for the simulator in the Training Center.

17.5.11 Test of the Simulator

The Contractor shall submit a plan for testing and commissioning the Simulator, as well as the test specification for the Engineer's review. Training of operation staff shall be completed two months prior to the commencement of the first train's running test. The number of staff and schedule shall be specified in due course. Major testing items after installing the equipment and software are as follows:

1) Visual check and safety inspection;
2) Grounding circuit, insulation resistance check, and dielectric test;
3) Visibility and brightness of the screen;
4) Equipment allocation;
5) Power ON, indication, electric meter, gauge check;
6) Equipment operability;
7) Function check; and
8) Electro-Magnetic Interference check.

17.5.12 Staff Training

The Contractor shall supply the train operation simulator. The simulator is a tool for operation staff to study the operation procedures in a virtual reality environment. After handing over the simulator, the Contractor shall have its commissioning engineers on stand-by during the experimental train running period and to train the Employer's instructors about the way to operate and maintain the simulator as well as how to install and modify the software. Its time length of training period for instructors of the railway operator to be able to use simulator shall be not less than 1 month.

17.5.13 Submitting Document

The Contractor shall provide the operation and maintenance manual of the simulator written in English. The simulator maintenance manual shall include the following but not be limited to: schematic/electrical diagram, illustrated parts catalogue, and spare parts (complete with description and part nos.). Paper book and editable digital data shall be prepared. The technology and structure of important equipment shall be carefully described. The instruction manual shall be composed of many figures and sentences that are easy to read and understand. All books must be approved by the Engine. DOTr, the operation maintenance operator, and the contractors of JICA technical assistance services and related shall be permitted to prepare materials for the operation of MMSP using this part of the material by the contractor. However, when the documents conflict with the contractor's secret, the contractor can restrict distribution destination of the content when there is reasonable reason.

17.6 SAFETY WORK EDUCATION VIDEO

17.6.1 General

Three (3) computer graphic movies shall be provided in order to understand the danger of working at the side of the track. For example, when the train pantograph is broken, this video will teach to the PRI students how to proceed emergency repair safely at the station.

The Contractor shall prepares also videos to educate about counter measure in case of disaster occurrence fire and water flood at the station or train, the accident that occurs when the signal or the rule is not observed. The Content make these videos get accordance with the PRI Technical Assistant team

Rail staff may work around the track. In addition, because of accident of the daytime etc., electricity is energized or not, trains are stopped or not, are not sure when they go there.

17.6.2 Required Main Functions

Video shall be supplied in data file and DVD format. The videos are used by the Training Center and the Philippine Railway Institute. In particular, in the case of PRI, since the video close to the actual experience is played using the three screens arranged in front and left and right, CG movies shall be prepared for one screen and three screens. The Contractor shall conform to the data format of the PRI video playback device provided by the CP101 Contractor, as well as the general Personal Computer data format. Resolution of movie file shall be 1920x1080.

17.6.3 Major Sub Equipment

The detailed equipment list is shown below.

Table 17.11: Major Sub Equipment

System	Description	Qty.	Remarks
Safety Education Videos	Data file	Each 2 sets	3 types of content
	DVD disk	Each 2 sets	3 types of content
	Education manual	Each 5 sets	3 types of content

17.6.4 Language

All movies and manuals shall be produced in English. Tagalog subtitle shall be required only for DVD.

17.6.5 Period of Defects Notification

The Contractor shall have the Defects Notification Period for 2 years upon issuance of TOC. Regardless of the above mentioned, the Defects Notification Period shall be not less than 1 year after hand over. Whichever comes later shall be applied.

17.6.6 Installation Requirements

(1) **Locations**

These movies shall be installed in the designated place of the PRI building and TC building in depot.

(2) **Condition**

These equipment must be designed for the condition shown below.

- Temperature 16 – 36 °C (operation), 0 – 40 °C (reservation)
- Humidity 40- 70%
- Dust same level ISO6 in ISO 14644-1d

17.6.7 Test

The Contractor shall submit a plan for commissioning the movies, as well as the acceptance check for the Engineer's review. Major check items are as follows:

1) Visual check;

2) Contents check; and

3) Subtitle check.

17.6.8 Submitting Document

The Contractor shall provide the scenarios of contents, education manual written in English and Filipino languages.

17.7 TRAINING EQUIPMENT FOR POWER SUPPLY SYSTEM

17.7.1 General

Electric power supply equipment shall be provided in order to establish a high quality approach for understanding maintenance of railway.

There are two training organizations in MMSP depot. One is the Training Center of this project as a department of this subway operator, the other one is the Philippine Railway Institute as the governmental training school to get railway staff license. All employees in railway operators shall get license first in PRI, then they will learn in training center of each railway operators.

In PRI, the students have to know "What is train" to get license, then they have to be familiar with the technologies and structures of the train parts using parts models in TC before starting their maintenance work.

Regarding PRI equipment, basically all students haven't worked for high voltage equipment, so it is too dangerous to start working with high voltage environment. Therefore, equipment shall be operated by low voltage to avoid risk from the critical electric accident to die, and these will be provide to study methods and risks of checking for a high voltage equipment in a relatively safe environment. However, the possibility of light injury due to electric shock can not be completely eliminated, it shall be on the user risk. The Contractor shall try to avoid student's injury to use clear plastic cover on high voltage area than AC 230 V. These equipment shall be installed at 2 floor in electric building of PRI

Equipment for TC, staff shall be able to learn how to maintain these equipment in actual machines. At TC, maintenance training is conducted using equipment that does not affect the main line. It shall be that the circuit can supply the actual specified voltage to the equipment, but in principle, it will be used in power off condition.

Therefore, the equipment shall be warned by an easy-to-understand indicator when power is on, as it may be mistaken for power off. These equipment shall be installed in 4th floor of Training center building in Depot.

17.7.2 Major Equipment and Required Functions for PRI

(1) **Training equipment for Power supply system equipment and others**

The following equipment shall be installed in PRI:

1- 34.5 kV Switchgear for Reception;

1- 34.5kV Switchgear for Rectifier;

1- Rectifier transformer 1200kVA;

1- Rectifier 1000kW;

1- DC switchgear for Rectifier secondary;

1- DC switchgear for Feeder;

1- DC switchgear for Negative disconnect switch;

1- 6.6 kV switchgear for Distribution transformer secondary ;

1- 6.6 kV switchgear for feeder;

1- 6.6 kV switchgear for OT Cubicle;

5- control boards;

1- RTU for TSS;

1set- Battery and charger (but not dual battery);

2set- Telecommunication Breaking device (stored in control board);

1- Transformer 400V / 20V 1kVA Dd0 type (for test low voltage application, Dry type);

1- Transformer 400V / 20V 1kVA Dy11 type (for test low voltage application, Dry type);

2- Resister 30V 1Ω 1kW (for test current change);

1- MCCB 500V 32A (for test current change);

1- Box (for Resisters and MCCB) 400 x 400 x 140 1 set (DC volt meter; DC 2000 A is displayed at DC 27 V, AC 1 φ 30 V volt meter installation);

1- Power management system (but single system) contents below; and

1- Software (simplifies the function and reduces the number of functions as well as the on-off and data logger).

The specifications conform to the indoor specifications of each device installed to the substation and SCADA. However, although the test circuit component equipment is not specified in particular, the transformer shall be dry, and the whole transformer shall be covered and terminals shall not be exposed. (MMSP-ELEC-0000-DD-0208)

Pull out the wiring to the terminal block to connect a voltmeter to check the voltage from the 6.6 kV Switchgear bus. However, it is a single phase. Within the PRI, this device shall not be applied except for the test voltage (AC 20 V).

Here it will be learned about the operation of substation equipment and the handling of each device. Also, by learning and operating the operation method of SCADA, it is confirmed that the switching of the equipment of the substation and the information of the equipment are reflected on the screen of SCADA.

As for the Telecommunication Breaking device, it simulates the reception of the signal and thereby learns that the device is open. The equipment learns that the bolt meter and ammeter (attached to the test terminal box) operate and pressurize by applying a low voltage that does not cause an electric shock. However, since 34.5kV switchgears are only for power reception and rectifier, and there is no switchgear for distribution, the 6.6kV device for distribution is connected to parallel from the switchgear for rectifier so that voltage can be applied.

A single-line diagram of this test facility is attached.

(2) **Tunnel lighting, outlet training equipment and others**

The Contractor shall provide tunnel lighting and tunnel outlet on Mock-UP tunnel. Both specifications are the same as the lighting equipment and outlet used for the main line (including accessories):

6-LED Light for tunnel lighting (Waterproof type)

2- Waterproof tunnel outlet (stored in waterproof box)

The tunnel lighting and outlets shall be installed by relevant Civil Contractors. Contractor shall manage, liaise and interface with relevant Civil Contracotor (s) for the design

installation details. Testing and commisioning shall be carried out by the Contractor.

Here it will be learned where the tunnel lights and tunnel outlets are located and how to handle them.

The tunnel lighting power supply and the tunnel outlet power supply shall be distributed from the distribution board of the PRI power supply equipment.

The required power supply capacity is 230V AC 1φ 1A or less for lighting power supply, and 230V AC 1φ 20A for tunnel plug power supply.

17.7.3 Major Equipment and Required Functions for TC

(1) **Training equipment for Power supply system equipment and others**

The following equipment shall be installed in TC. The specifications are the same as the equipment used for the main line:

- 1-DC switchgear for rectifier secondary;
- 2-DC switchgear for feeder;
- 1-Negative disconnect switch board;
- 1-Control board (for feeder);
- 2set - Telecommunication Breaking device (mounted on control board);
- 1set - Optical cable (for Telecommunication Breaking device); and
- 1set -Battery and charger (but not dual battery).

Here it will be learned the operation of DC switchgear and the handling of DC circuit breakers. As there are two DC switchgears, will be learned of the operation of the Telecommunication Breaking devices between these two DC switchgears.

The Telecommunication Breaking device regards one of the two as a device of the adjacent substation, and connects the optical cables between the two.

Attach the two devices to the control board and minimize the optical cable.

17.7.4 Language

All subsystems and manuals shall be produced in English.

17.7.5 Design Life

The design life is fifteen (15) years after completion, visual devices and central processing unit shall be replaced to maintain its performance. 30 years after completion, all systems shall be replaced. The Contractor shall use parts which match the above design life. The designs shall be approved by the Engineer including the proposal of local maintenance organization in Manila. Also, the Engineer's approval shall be required for the maintenance cost. This provision does not apply to general instruments procured on the general market.

17.7.6 Period of Defects Notification

The Contractor shall have the Defects Notification Period for 2 years upon issuance of TOC. Regardless of the above mentioned, the Defects Notification Period shall be not less than 1 year after hand over. Whichever comes later shall be applied. This provision does not apply to general instruments procured on the general market.

17.7.7 Installation Requirements

(1) **Locations**

These equipment shall be installed in the designated place in depot.

(2) **Condition**

These equipment condition must follow specification for Main line.

17.7.8 Staff Training

The Contractor shall supply the equipment. The equipment is a tool for operation staff to study the operation procedures in a realistic environment. After handing over the equipment, the Contractor shall have its commissioning engineers on stand-by during the experimental train running period and to train the Employer's instructors about the way to operate and maintain. Its time length of training period for instructors of the PRI teachers to be able to use the equipment shall be not less than 1 week. For TC, the Contractor shall follow general specification of CP106

17.7.9 Submitting Document

The Contractor shall provide the operation and maintenance manual of the equipment written in English. The equipment's maintenance manual shall include the following but not be limited to: schematic/electrical diagram, illustrated parts catalogue, and spare parts (complete with description and part nos.). Paper book and editable digital data shall be prepared. The technology and structure of important equipment shall be carefully described. The instruction manual shall be composed of many figures and sentences that are easy to read and understand. All books must be approved by the Engine. DOTr, the operation maintenance operator, and the contractors of JICA technical assistance services and related shall be permitted to prepare materials for the operation of MMSP using this part of the material by the contractor. However, when the documents conflict with the contractor's secret, the contractor can restrict distribution destination of the content when there is reasonable reason.

This provision does not apply to, non-electrified equipment and general instruments procured on the general market.

17.8 MAINTENANCE TOOLS FOR EDUCATION

17.8.1 General

Maintenance tools shall be provided for PRI in order to establish a high quality approach for understanding maintenance for railway work through practice using these which mentioned here.

17.8.2 Required General Functions and Performance

(1) **General**

Special equipment / tools and general equipment / tools for practical maintenance of the railway shall be provided for PRI.

Tools means mainly specialized measuring instruments, expensive measuring instruments, equipment for securing safety, equipment for performing work, etc.

Equipment type, required quantity, specifications shall be approved by the Engineer and JICA PRI technical assistance service team.

The equipment shown below shall be installed in PRI by the Contractor:

- P1) Equipment for track work
- P2) Equipment for high voltage electric and machine work;
- P3) Equipment for signal and telecom work; and
- P4) Equipment for rolling stock work (CP106 preparation equipment only).

(2) **Equipment for track work**

The Contractor shall prepare equipment for basic education equipment on track work and building maintenance. The equipment are basically selected from the list of maintenance parts listed in the CP106 truck section. The main purposes of using the equipment are as follows. Ballast track maintenance, sleeper replacement, rail replacement, rail welding, turnout maintenance, track specification measurement (gauge length, twist, etc.), tunnel wall inspection, building inspection (X ray, tile drop and etc.), water pipe repair and etc. The contractor shall propose a list of basic equipment required for these trainings, and shall get approval from the Engineers and JICA PRI technical assistance team. Also need to include high place work equipment like a ladder trolley.

(3) **Equipment for high voltage electric and machine work**

The Contractor shall prepare equipment for basic education equipment on high voltage electric work and machine maintenance. The equipment are basically selected from the list of maintenance parts listed in the CP106 all electric related sections. The main purposes of using the equipment are as follows. Contact wire maintenance, high voltage equipment maintenance (e.g. 6.6KV switch, transformer, rectifier, etc.), low voltage equipment maintenance (switch board, UPS, lights, etc.), machine equipment maintenance (emergency generator, cooler and fan at station, pump, PSD etc.). The equipment to be able to educate the theory of dangerous prevention, isolation, measuring, inspection and data recording. The contractor shall propose a list of basic equipment required for these trainings, and shall get approval from the Engineers and JICA PRI technical assistance team.

(4) **Equipment for signal and telecom work**

The Contractor shall prepare equipment for basic education equipment on signaling and telecom work and machine maintenance. The equipment are basically selected from the

list of maintenance parts listed in the CP106 all electric related sections. The main purposes of using the equipment are as follows. Signal radio and interlock maintenance, track circuit maintenance, turnout machine maintenance, radio maintenance, AFC maintenance, network maintenance, telephone maintenance, cable and fiber emergency repair work and etc. The equipment to be able to educate the theory of dangerous prevention, isolation, measuring, inspection and data recording. The contractor shall propose a list of basic equipment required for these trainings, and shall get approval from the Engineers and JICA PRI technical assistance team.

(5) **Equipment list**

The equipment are basically selected from the list of maintenance parts listed in the CP106. The contractor shall prepare a list to install to the PRI. Equipment means equipment, device and tool. The contractor shall be able to inquire at the clarification stage of bidding via the Engineer to the JICA technical assistance service team. The regarding the types and quantities of equipment to be procured. However, bidders' equipment-specific measuring equipment or equipment not generally available in the market will not be answered in this query. These shall be selected and prepared by the Contractor on their own without the Engineer or JICA team instructions. For all equipment that are difficult to obtain in these markets, the minimum delivery number is two. Shelfs with widow and key to store the equipment shall be prepared by the Contractor.

All the equipment which the contractor need to prepare are required the Engineer and JICA team approval. It is not only specialized equipment.

17.8.3 Language

All subsystems and manuals shall be produced in English.

17.8.4 Design Life

The design life is fifteen (15) years after completion, visual devices and central processing unit shall be replaced to maintain its performance. 30 years after completion, all systems shall be replaced. The Contractor shall use parts which match the above design life. The designs shall be approved by the Engineer including the proposal of local maintenance organization in Manila. Also, the Engineer's approval shall be required for the maintenance cost. This provision does not apply to general instruments procured on the general market.

17.8.5 Period of Defects Notification

The Contractor shall have the Defects Notification Period for 2 years upon issuance of TOC. Regardless of the above mentioned, the Defects Notification Period shall be not less than 1 year after hand over. Whichever comes later shall be applied. This provision does not apply to general instruments procured on the general market.

17.8.6 Installation Requirements

(1) **Locations**

These equipment shall be installed in the designated place of the PRI building in depot.

(2) **Condition**

These equipment must be designed for the condition shown below.

- Temperature 16 – 36 °C (operation), 0 – 40 °C (reservation)
- Humidity 40- 70%
- Dust same level ISO6 in ISO 14644-1d

This provision does not apply to general instruments procured on the general market.

17.8.7 Staff Training

The Contractor shall supply the equipment. The equipment is a tool for operation staff to study the operation procedures in a realistic environment. After handing over the equipment, the Contractor shall have its commissioning engineers on stand-by during the experimental train running period and to train the Employer's instructors about the way to operate and maintain. Its time length of training period for instructors of the PRI teachers to be able to use the equipment shall be not less than 1 week.

17.8.8 Submitting Document

The Contractor shall provide the operation and maintenance manual of the equipment written in English. The equipment's maintenance manual shall include the following but not be limited to: schematic/electrical diagram, illustrated parts catalogue, and spare parts (complete with description and part nos.). Paper book and editable digital data shall be prepared. The technology and structure of important equipment shall be carefully described. The instruction manual shall be composed of many figures and sentences that are easy to read and understand. All books must be approved by the Engine. DOTr, the operation maintenance operator, and the contractors of JICA technical assistance services and related shall be permitted to prepare materials for the operation of MMSP using this part of the material by the contractor. However, when the documents conflict with the contractor's secret, the contractor can restrict distribution destination of the content when there is reasonable reason.

This provision does not apply to, non-electrified equipment and general instruments procured on the general market.

17.9 MMSP TEST TRACK FOR WORK SHOP AND TRAINING CENTER

17.9.1 General

A test track, mock-up platforms and buffer stops shall be prepared near the work shop to test train functions such as traction, braking, signals and communications, and also for driver training. Length of test track will be approx. 900m. Some part of the mock-up platform structure will be built by the CP101 Contractor.

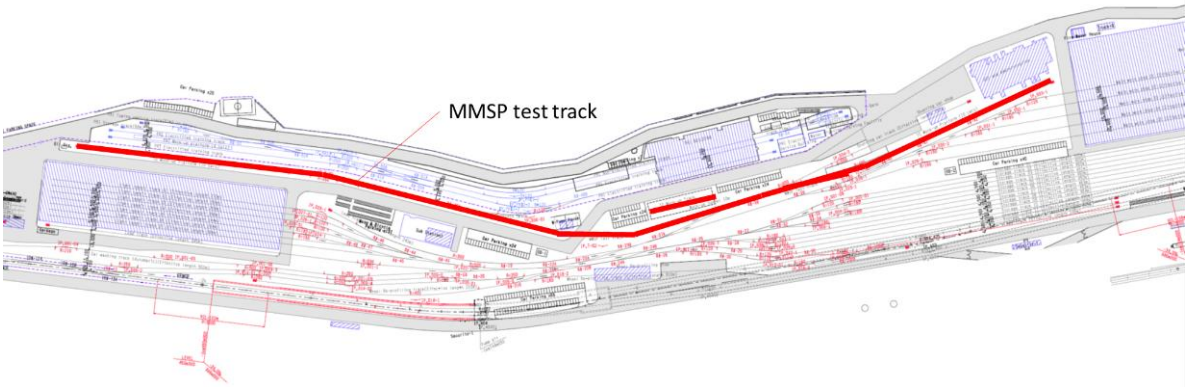


Figure 17.4: Location of MMSP test track

The major equipment prepared by the CP106 contractor for the training center is as shown in the table below. For details of each equipment, check each chapter of this technical specification. These devices shall be prepared by The Contractor without items which other contractor is assigned. In this chapter, we will focus on the test and training track in particular.

Table 17.12 Major equipment for education in Training Center

TC Training Equipment List											
TC	4F	SPECIAL LECTURE RM.4 (OPERATION 1)	CP106	CBTC equipment (interlocking)	1 set	300kg	1700	850	2300	AC220V single phase 15A,1 LAN	Detail is in this Technical Specificaton
			CP106	CBTC equipment (radio and signal)	1 set	100kg	450	450	3000	AC220V single phase 7.5A	Detail is in this Technical Specificaton
			CP106	CBTC,ATS, PRC simulator	See TS						Detail is in this Technical Specificaton
	4F	SPECIAL LECTURE RM.5 (OPERATION 2)	CP106	REAL AFC	See TS	100kg	1,800	270	1,100	AC220V single phase 5A	Detail is in this Technical Specificaton
			CP106	REAL TVM	See TS	300kg	1,000	600	1,700	AC220V single phase 5A	Detail is in this Technical Specificaton
			CP106	Manual TVM	See TS		1000	500	500	AC220V single phase 5A	Detail is in this Technical Specificaton
	Outside			600m DEPOT TEST TRACK	Same rule as mainline						
				10m ELECTRIFIED RAILWAY TRACK MOCK-UP	Ditto						

17.9.2 Required Main Functions and Performance

(1) **System equipment**

Test track is mainly used for functional inspection of trains and for driver training. The maximum speed shall be 40KPH, Train can be operated automatically or manually by the driver. The all system equipment shall be prepared for all train operations of the MMSP, the NSCR South and PRI. The contractor provides system equipment and tracks capable of functional inspection of these signals, radios, PSDs, PIDs and etc. including manual for it. Bufferstops with damper for the building safety shall be prepared at both end of test track including shunting car track which is a branch line of test track. The Chain and poles along test track to keep out staff or car shall be prepared. In case the Contractor of South NSCR provides some equipment, the Contractor is exempt from procuring the equipment.

The TC mock-up track is a training facility for electrical personnel involved with overhead lines. it can be energized by DC 1500 V independently to confirm the works required for ensuring safety, the emergency shut-off and communication procedure in case of an accident. In addition, staffs can practice the work of the wire replacement under ensured safety. The Contractor shall prepare the track, turnout, overhead lines, poles or bracket for

it, cutoff switches, energized indicators, fixed telephone for tunnel, aerial work hand push vehicle, work education manual and tools to keep safety.

(2) **Function requirement**

For all equipment, in particular, matters not described in this chapter shall be equivalent to the specifications of each device installed on the main line. However, apply outdoor conditions. In addition, devices that will not be installed outdoors on the main line shall be equipped with devices that block solar radiation and installation of cooling devices. Obtain approval for The Employer when using equipment or parts of different specifications from the mainline.

For the signal, wayside signals and signs shall not be omitted, as it is necessary to train the driver. Also, it is not possible to omit backup track circuits. The system shall be designed for the training using 2 trains to educate how signal system work. All functions of CBTC and ATP shall be able to be tested. In addition, in CBTC, it is necessary to be able to inspect all frequencies. If it is difficult to test on the test track due to functional reasons, apply for exclusion to the Employer and obtain permission. The adoption of TETRA-ETCS is being considered for the NSCR South Line. The way of thinking about this is the same

For the radio, at the time of the test, there were too many accidents to stop other operating trains due to wrong procedure of the test of emergency stop radio. Therefore, the Contractor shall install the emergency stop test function on the both radio equipment (land and onboard). However, if the radio is set to the test mode in order to avoid "not work" when it goes out to the main line in the test mode, 2 functions shown below shall be installed in radio system. A sound of alarm with a volume not disturbing other tests, and the lifted lid to warning that test switch is on, or equivalent.

For PSD, each 1 PSD controller and track side indicator which shows condition wither door is open or close (total 2 sets) shall be installed at the both end of platform for the 8 car train on each mock-up station, to check the communication function and to train drivers. It means total 4 sets PSD shall be prepared by the Contractor. These door shall also have a small doors that one is the driver can open manually, other is passenger can open manually. All doors other than these two PSD doors including small each 2 doors can be omitted. In each devices, indicators and switches similar to the main line shall be prepared.

For CCTV, The contractor shall install a ground cameras and processor that can monitor the sides of the eight car train in each mock-up stations. If the CCTV display device is mounted on a vehicle, the contractor shall prepare transmission devices tor 2 mock-up stations. In the case the CCTV display devices will be installed platform in main line, the contractor shall install display devices equivalent to the outdoor station in each mock-up stations. Also, install a monitor device at the place where the signal route controller is installed.

For telecom, The Contractor shall install telephone equipment similar to the mainline station. Track-side telephones shall be placed 3, these 3 telephones are separated, and away from the mock-up platform. The emergency stop alarms / devices similar to the mainline station shall be installed in each mock-up stations.

For station equipment related to service, such as signs and sticker, it shall be arranged in coordination with The CP101 contractor. At least those involved in operation shall be prepared by the CP106 contractor.

For track, route selection device in turnout shall be installed according to the signal drawing. For manual turnout, indicators that driver can see the condition from a distance.

Even also test tracks, a route check (verify) device will be incorporated and linked with the signal system to ensure the safety of train. Remember to build track on the mockup track.

17.9.3 Design Life

Follow the conditions of each equipment for mainline

17.9.4 Period of Defects Notification

Follow the conditions of each equipment for mainline

17.9.5 Installation Requirements

(1) **Locations**

Equipment shall be installed according to depot drawings.

(2) **Condition**

Follow the conditions which ever higher shown in this section or for mainline.

(3) **Power supply**

The Contractor shall prepare same conditions as in mainline.

17.9.6 Test of the Simulator

Follow the conditions of each equipment for mainline

17.9.7 Staff Training

After handing over, the Contractor shall have its commissioning engineers on stand-by during the experimental train running period and to train the Employer's instructors about the way to operate and maintain the equipment. Its time length of training period for instructors of the railway operator to be able to use test track shall be not less than 1 month.

17.9.8 Submitting Document

The Contractor shall provide the operation and maintenance manual of the test track written in English. The maintenance manual shall include the following but not be limited to: schematic/electrical diagram, illustrated parts catalogue, and spare parts (complete with description and part nos.). Paper book and editable digital data shall be prepared. The technology and structure of important equipment shall be carefully described. The instruction manual shall be composed of many figures and sentences that are easy to read and understand. All books must be approved by the Engine. DOTr, the operation maintenance operator, and the contractors of JICA technical assistance services and related shall be permitted to prepare materials for the operation of MMSP using this part of the material by the contractor. However, when the documents conflict with the contractor's secret, the contractor can restrict distribution destination of the content when there is reasonable reason.

17.10 MMSP TEST TRACK FOR PRI

17.10.1 General

A Training track, mock-up bridge and a mock-up platform shall be prepared in river side to educate PRI students. Length of test track will be approx. 600m. 2 electrified tracks, 1 non electrified track and some short track including upon the bridge shall be constructed. Some part of the mock-up platform and all bridge structure without track and track bed will be built by the CP101 Contractor.

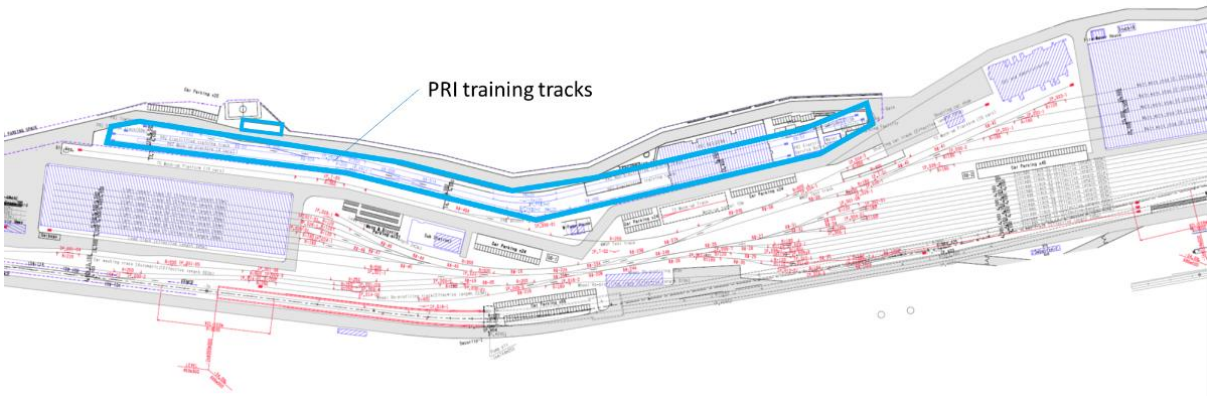


Figure 17.5: Location of PRI training tracks

The major equipment prepared by the CP106 contractor for the training center is as shown in the table below. For details of each equipment, check each chapter of this technical specification. These devices shall be prepared by The Contractor without items which other contractor is assigned. In this chapter, we will focus on the training track in particular.

Table 17.13: Major equipment for education in PRI

PRI Training Equipment List

Building	Floor	Room name	Contractor	Equipment name	Quantity	Assumed Weight for building design	Assumed Size(mm)			Assumed equipment condition	Remark
							W	D	H	CP101 Prepared electric condition (Braker flame)	
PRI	GF	SIMULATOR RM. 1	JP GOV	REAL SIZE TRAIN SIMULATOR with 1 PSD	1set	approx20,000kg / 1set	6,700	2,850	3,800	AC220V 3 pahse 110A	Corridor end loading. Loading window W4,000 x H3,800 If JP government's contractor pay to the CP106 contractor, The contractor shall accept system related construction.
	GF	SIGNAL MACHINE RM.	CP106	Signal system (for training track)	1set	300～400kg * approx 20	by	mainline	drawing	AC220V 3 pahse 150A	Detail is in this Technical Specificaton
	GF	MOCK-UP PLATFORM	CP106	Platform screen door	16 doors		90000	1000	to roof	AC220 single 50A	Detail is in this Technical Specificaton
			CP106	Platform screen door controller(under stairs)	1set	300kg	850	850	2000	AC220V single phase 15A,	Detail is in this Technical Specificaton
	2F	TEACHER'S RM.	CP106	Signal controller	See TS	300kg	1400	1000	1400	AC220V single phase 15A,	Detail is in this Technical Specificaton
	2F	MOCK-UP CONCOURSE	CP106	REAL AFC	See TS	100kg	1,800	270	1,100	AC220V single phase 7.5A,	Cable pit D200, H100, Detail is in this Technical Specificaton
			CP106	REAL TVM	See TS	300kg	1,000	600	1,700	AC220V single phase 7.5A,	Cable pit D200, H100, Detail is in this Technical Specificaton
	2F	STATION OFFICE	CP106	Manual ticket vendering	See TS	100kg	1000	800	800	AC220V single phase 7.5A,	Including ticket window, Detail is in this Technical Specificaton
			CP101&106	Station Master console for station accident	1	100kg	2500	850	1300	AC220V single phase 15A, 2 LAN,tel,intercom	According to Mainline demarcation
	3F	SIMULATOR RM. 2	JP GOV	desk size simurator	30	600kg / 台	1,240	1,275	1,500	20A	If JP government's contractor pay to the CP106 contractor, The contractor shall accept system related construction.
			JP GOV	teacher's controller	1	100kg	700	2,400	800	20A	Ditto
			JP GOV	simuration server	1	200kg	870	570	2,146	20A	Ditto
	3F	STUDENT LOUNGE	CP107 (RS)	train bogie with rail	1 set	6000kg	3,500	2,800	880	-	3F Corridor end loading. If CP107 contractor pay to the CP106 contractor, The CP106 contractor shall accept track construction.
			CP106	High speed braker	1	500kg	1,500	1000	2,300	AC220V single phase 7.5A	High speed type for DC 1500V
			CP106	track, railway signals and controller	See TS	500kg	3000	3000	4000	AC220V single phase 15A,	3 signal pols (H=4000) and 1 controller (W1400,D1000,H1400) Detail is in this Technical Specificaton
	3F	SPECIAL LECTURE RM. 1 (SIGNAL 1)	CP106	track and tunout	See TS	3000kg(base not incl)	11200	3000	200	AC220V single phase 7.5A	3F Corridor end loading. Detail is in this Technical Specificaton
			CP106	point machine	See TS	250kg	700	500	300	power from signal system	
			CP106	signal controller	See TS	500kg	3000	1000	2300	AC220V single phase 15A,	
	3F	SPECIAL LECTURE RM. 2 (SIGNAL 2)	CP106	Railway model for signal education	See TS	200kg/㎡	6,500	3,000		AC220V single phase 7.5A	
			CP106	Control system for Railway model	See TS	500kg/台	900	600	2,350	AC220V single phase 7.5A,	
			CP106	Controller for Railway model	See TS	300kg/台	1,400	1,000	1,400	AC220V single phase 15A,	
	Outside		CP101&106	PLATFORM (far side)	Same rule as mainline						3 tracks, Telephone, Sign, Lights, Evacuation way, etc same as mainline
			CP101&106	BRIDGE AND ELEVATED RAILWAY	Ditto			20m			Track construction
			CP101&106	MOCK-UP TUNNEL	Ditto			50m			2 tracks, Telephone, Sign, Lights, Evacuation way, etc same as mainline
			CP106	600m ELECTRIFIED RAILWAY TRACKS	Ditto						
Elec	2F	ELECTRICAL TRAINING RM.	CP106	Powerelectric educatoin facilities	1 set						Detail is in this Technical Specificaton

17.10.2 Required Main Functions and Performance

(1) **System equipment**

Test track is mainly used for education. PRI will provide basic education for employees who have just joined each railway operator and education to acquire basic skills to get driver's license. The maximum speed shall be less than 40KPH, Train can be operated manually by the driver. The all system equipment shall be prepared for 2 half trains and some maintenance locomotives operations. The train prepared by CP107 contractor, train can divide 4 cars x 2 trains. The half train have simple and tentative train controller in 4th and 5th car, and simple ATP device to avoid over run at station shall be provided by the CP106 contractor for it. In addition to this ATP devices shall be provided to maintenance locomotive also.

The contractor provides system equipment and tracks capable of railway system education of signals, PSDs and etc. including manual for it. As the driver is a beginner, install ATP for emergency stop to prevent the signal ignorance and the accident of overrunning the station. The contractor should make the best use of CBTC transponders and other equipment to reduce costs. Perform simple speed checks for station overruns. The platform on the ground floor of the PRI building shall have PSDs for only one side and 4 train cars. In simple station other far side from PRI building, it shall be installed that a PSD controller only. Track-side telephones and indicators shall be installed in the same rules as the MMSP main line.

The Contractor shall set up the track for the mock-up bridge and perform related work.

(2) **Function requirement**

For all equipment, in particular, matters not described in this chapter shall be equivalent to the specifications of each device installed on the main line. However, apply outdoor conditions. In addition, devices that will not be installed outdoors on the main line shall be equipped with devices that block solar radiation and installation of cooling devices. Obtain approval for The Employer when using equipment or parts of different specifications from the mainline. The educational functions, indicators, and display of fixed status etc. shall be discussed with the JICA PRI technical assistance team.

For the signal, wayside signals and signs shall not be omitted, as it is necessary to train the driver. Also, it is not possible to omit track circuits. The system shall be designed for the training using 2 electrified half trains and 2 non-electrified locomotives to educate how signal system work. Route controller shall be installed in teacher's room.

For the radio, Handy radios which are sell in Philippine market shall be procured by the PRI school own self.

For PSD, 1 PSD controller and 16 PSD doors shall be installed at the 1 side of platform in PRI building and 1 PSD controller for 1 side of platform far from PRI building. These doors shall also have 2 kind of small doors that one is the driver can open manually, other is passenger can open manually. In each devices, indicators and switches similar to the main line shall be prepared.

For CCTV, All CCTVs are prepared by CP101 contractor including platform monitor. CCTV transmission system shall not use in PRI.

For telecom, mainly prepared by CP101 contractor. However, communication devices which prepared by CP106 and need to be installed in station of mainline, CP 106 contractor shall install these items in station desk at mock up station office.

For station equipment related to service, such as signs and sticker, it shall be arranged in coordination with The CP101 contractor. At least those involved in operation shall be prepared by the CP106 contractor.

For power equipment to energize contact wire for train, Electricity shall be supplied from the MMSP substation. Install a meter to measure electricity charges, because the operator of MMSP and PRI will not be same. Electricity can be turned on and off in the teacher's office. In addition, on the track side, according to the drawing of the contact wire, the Contractor shall prepare mechanical switches that can be switched on and off manually. Also shall provide devices that can indicate the status of electricity on contact wire for user's safety.

For track, route selection device in turnout shall be installed according to the signal drawing. For manual turnout, indicators that driver can see the condition from a distance. Even also test tracks, a route check (verify) device will be incorporated and linked with the signal system to ensure the safety of train. Remember to build track on the mockup track.

For catenary, planned PRI training tracks have 2 electrified lines and 1 non electrified line, in addiotion to this there are some sub short tracks for t maintenance vehicle traning. For 2 electrified tracks, it shall be installed that manual contactors to cut off these catenary power. In addition, Catenary power controller indipendent from MMSP OCC operation shall be installed into the teachers room in PRI building around signal interlocking system. Catenary equipment shall be installed according to the carenary work drawings in CP106.

17.10.3 Design Life

Follow the conditions of each equipment for mainline

17.10.4 Period of Defects Notification

Follow the conditions of each equipment for mainline

17.10.5 Installation Requirements

(1) **Locations**

Equipment shall be installed according to depot drawings.

(2) **Condition**

Follow the conditions which ever higher shown in this section or for mainline.

(3) **Power supply**

The Contractor shall prepare same conditions as in mainline.

17.10.6 Test of the Simulator

Follow the conditions of each equipment for mainline

17.10.7 Staff Training

After handing over, the Contractor shall have its commissioning engineers on stand-by during the experimental train running period and to train the Employer's instructors about the way to operate and maintain the equipment. Its time length of training period for instructors of the railway operator to be able to use test track shall be not less than 1 month.

17.10.8 Submitting Document

The Contractor shall provide the operation and maintenance manual of the test track written in English. The maintenance manual shall include the following but not be limited to: schematic/electrical diagram, illustrated parts catalogue, and spare parts (complete with description and part nos.). Paper book and editable digital data shall be prepared. The technology and structure of important equipment shall be carefully described. The instruction manual shall be composed of many figures and sentences that are easy to read and understand. All books must be approved by the Engine. DOTr, the operation maintenance operator, and the contractors of JICA technical assistance services and related shall be permitted to prepare materials for the operation of MMSP using this part of the material by the contractor. However, when the documents conflict with the contractor's secret, the contractor can restrict distribution destination of the content when there is reasonable reason.

18 TRAFFIC, ROAD & APPURTENANCES

18.1 GENERAL

The Contractor shall conform to the applicable requirements under the law, act, regulations and decision issued by the Government of Republic of the Philippines and/or the Governmental authorities and imposed in Republic of the Philippines. The Contractor shall ensure compliance with the requirements regarding the registration of vehicles. Vehicle size and load limitations shall be in accordance with all statutory requirements.

18.2 TRANSPORTATION TO SITE

The Contractor shall make all arrangements and assume full responsibility for transportation to the Site of all plant, equipment, materials and supplies needed for the proper execution of the Works. Procedures for the access to and from the Site shall be coordinated with the relevant authorities, if required.

The Employer will obtain any required permits or licenses from relevant authorities for the import of the Goods intending to form or forming part of the Permanent Works or required for sole purpose of carrying out the Works. Furthermore, the Employer shall assist the Contractor in procuring any necessary Government consent and in obtaining clearance through Customs of the Goods imported for the Works.

If requested by the Contractor, the Employer shall facilitate transport of the imported items for Railway System works, via railway from Manila Port or an available nearest port to the Site, which, however, will not relieve the Contractor of any of his obligation under the Contract. The Contractor shall inspect condition of Railway System equipment at Manila Port or an available nearest after customs clearance and also at the Site when arrived at the Site.

The Contractor shall use such routes and rights of access to the site as proposed by the Contractor and agreed by the Engineer from time to time. Routes for 'very large' or 'very heavy' loads shall be discussed with the Engineer in advance and all arrangements thereafter shall be submitted to the Engineer. In this context, the definition of the terms "very large" and "very heavy" refer to articles that cannot be transported by normal road vehicles or be handled by readily available methods.

The Contractor shall be responsible for obtaining permission from the traffic police and other relevant authorities to move "very large" and "very heavy" loads and for arranging police escorts if required. The Contractor shall ensure that all roads and pavements, etc. leading to and around the Site are kept free from obstructions and shall not cause inconvenience or hindrance to traffic or persons either by its vehicle or its workmen, scaffolding, plant, materials, equipment, etc. All workmen working on the road shall wear approved reflective safety vests at all times.

The Contractor shall repair damage caused to existing roads, footpaths, steps, cables, sewers, drains, etc. and shall reinstate the same at his own expense to the satisfaction of the relevant authorities.

Access road planning during construction/installation time in viewpoint of maintaining work progress for supply of materials and manpower, removal of construction disposals through public roads outside of MMSP and railway in MMSP. It is quite required to secure transportation access from major roads for this project works.

Traffic Control Plan should be prepared and developed by the Contractor before or during the construction time. The Contractor strictly shall apply the plan with taking prior permission from the Client (DOTr), the relevant agencies, the Engineer / the Project Manager and taking consent from the residents concerned.

The major access routes for construction vehicle will be the trunk road running in parallel with MMSP line. It is required to have some alternative plans to prevent the access roads from passing through high

population and public density areas, such as residence and commercial areas, school and hospital areas.

19 MEETINGS REQUIREMENTS

19.1 GENERAL

The Employer and the Engineer will conduct project meetings throughout the Contract period to enable an orderly review of the progress of the Works to be undertaken, and to provide for systematic discussion of problems and issues, if any.

Besides the project meetings above, the Employer and the Engineer will also conduct an operating meeting with the Contractor at least once a week in (a) places to be designated by the Employer. This meeting will cover train operation issues related with the construction works on weekly basis, including revenue train operation, window time and material transport.

The Contractor shall also arrange and attend meetings as required by the Engineer.

The Contractor shall endeavor to ensure that his Subcontractors, suppliers and sub- consultants attend meetings when so required.

As for the meetings not included in this Requirement, such as the Contractor's relations with his Subcontractors and materials suppliers, and discussions relative thereto, these matters are the Contractor's responsibility and shall not be a part of project meetings content.

Persons designated by the Contractor to attend and participate in the project meetings shall have all required authority to commit the Contractor to solutions agreed upon in the project meetings.

To the maximum extent practicable, the Contractor should advise the Engineer at least 24 hours in advance of project meetings regarding all items to be added to the agenda.

The Contractor shall compile minutes of each meeting and will furnish three copies to the Engineer for review and acceptance. The Contractor may make and distribute such other copies as he wishes.

All meetings shall be scheduled as per requirement. However, generally, Project progress and track possession meetings will be held monthly, and site meetings and the operating meetings weekly. Necessary coordination shall be made to establish a mutually acceptable schedule for meetings.

To the maximum extent practicable, monthly meetings will be held at the Engineer's Office, and site meetings at the Engineer's Representative's site office.

19.2 STATUS REVIEW MEETINGS

Different types of meetings may be held as per requirement. Project Status review meetings shall be mandatory to be held.

Periodic project status review meetings shall be held (monthly/biweekly/weekly/daily or at any time requested by the Engineer/ Employer) as desired by the Engineer/ Employer. It may also be necessary to hold review meetings at regular intervals at management levels as deemed necessary by Company. Such meetings shall generally be arranged at the place of activity concerned.

Attendance: To the maximum extent practicable, the same person or persons who shall represent the Contractor at project meetings shall attend throughout progress of the Works including the person responsible for Document Control. Subcontractors, material suppliers and others may be invited to attend those project meetings in which their aspects of the Works are involved.

Minimum suggested agenda:

(1) Review, revise as necessary, and approve minutes of previous meeting.

(2) Review progress of the Works since last meeting, including status of submittals for approval.

(3) Identify problems that impede planned progress.

(4) Develop corrective measures and procedures to regain planned schedule.

(5) Changes to the Track Possession schedule.

(6) Complete other current business.

Minutes of Meetings

(1) The Contractor shall provide draft Minutes of Meetings to the Engineer within a reasonable period for comment and approval, following which the minutes shall be tabled at the following Monthly or Weekly meetings and shall be signed by the representatives of the three parties.

(2) The Engineer shall retain the original of the agreed minutes.

(3) The agreed Minutes of Meeting shall be considered as formal correspondence and shall be binding on all parties.

20 LIAISON WITH OTHERS

20.1 APPROVALS FROM GOVERNMENT AUTHORITIES AND AGENCIES

The Contractor shall assist the Employer to make all necessary arrangements with and obtain all necessary approvals from Government departments, utility agencies, NSRP-S, and other relevant competent authorities.

20.2 MEETINGS WITH THE ENGINEER

The Contractor shall arrange and attend meetings as required by the Engineer. The Contractor shall use its best endeavors to ensure that its Subcontractors, suppliers andsub- consultants attend meetings when so required.

20.3 MEETINGS WITH GOVERNMENT DEPARTMENTS AND AGENCIES

When the Contractor arranges meetings with External Interfacing Parties including government departments and utility undertakings or Interface Contractors, it shall inform the Engineer at least four (4) official working days (excluding general holidays) or such shorter period permitted by the Engineer, before they are to be held and shall give the Engineer and the Employer the agenda and objective of the meetings.

20.4 CORRESPONDENCE WITH GOVERNMENT DEPARTMENTS AND AGENCIES

Copies of correspondence received from or dispatched to Government Departments, utility undertakings, and Interface Contractors shall be submitted to the Engineer for information within two (2) days of receipt or dispatch.

21 DEMOBILIZATION AND CLOSING WORKS

21.1 DEMOBILIZATION

This section specifies the carrying out of final close out activities in preparation for completion of all construction and installation work under the Contract; all in accordance with the Contract Documents.

Demobilization will be considered as complete when all of the Contractor's Equipment, materials, personnel, Temporary Facilities, construction plant or otherwise belonging to the Contractor not required for the Defect Notification Period have been removed from the project site.

Demobilization shall include providing required submittals prior to close-out of the Works, including but not necessarily limited to the following:

(1) Spare parts, tools, equipment, machinery and rail vehicles required by the Contract;

(2) Operating and maintenance data as required;

(3) Project "As-Built Drawings" and documentation as required;

(4) Railway equipment as required under these specifications;

(5) Schedule and price of Plant installed under the contract;

(6) Schedule of installed works and materials; and

(7) Contractor's completion report and photo and video record.

21.2 CLOSING WORKS

Closing works shall be inspected by the Engineer and/or the Employer as the condition for pre-requisite to completion inspections - written notice submitted by the Contractor requesting a final or partial completion inspection.

Inspection by the Engineer and/or the Employer shall mean that the Works is substantially complete and the Contractor has:

(1) Inspected and checked all the Works installed;

(2) Compared all the Works with the drawings, specifications, and submittals as approved;

(3) Confirmed that all conditions, provisions and requirements of Contract Documents have been fulfilled, other than any maintenance and incidental works and procedures necessarily to follow;

(4) Clean-up operations complete;

(5) Temporary Facilities and utilities properly disconnected and removed, except those needed for the Defects Liability Period;

(6) Systems, equipment and devices properly adjusted, serviced, tested and fully operable;

(7) Materials and finishes neat, clean and undamaged; accessory parts and items securely attached;

(8) Broken or damaged work repaired or replaced as required;

(9) Spare parts delivered and stored as required;

(10) Recovered materials catalogued and neatly stacked for removal by the Engineer;

(11) Test reports and other required documentation assembled and delivered to the Engineer;

(12) The documents including manuals, and warranties, assembled and delivered to the Engineer, and

(13) Written notice of readiness for Final Completion Inspection filed with the Engineer.

21.3 TRAINING COMPLETION

Training will be required to be completed before the commercial operation of trains by the Contractor. Training requirements details are given in Section 16 of the General Requirements as well as the Particular Specifications.

22 SECURITY AND INSURANCE

22.1 SECURITY

The Contractor shall provide the following securities in accordance with the Contract requirement:

(1) Performance Securities; and

(2) Other Securities, as required under the Contract.

The detailed requirements are stipulated in the General Conditions and the Particular Conditions.

22.2 INSURANCE

The Contractor shall purchase and maintain the following insurances in accordance with the requirements stipulated in the General Conditions and Particular Conditions:

(1) Insurance for the Works (Contractor's All Risk Insurance); Insurance for the Contractor's Equipment;

(2) Insurance against Injury to Persons and Damage to Property (Third Party Liability Insurance);

(3) Cargo Insurance during Transport (Marine Cargo Insurance, Inland Transport Insurance); Insurance for Contractor's Personnel (Workers' Compensation, Employer's Liability); Automobile Liability Insurance; and

(4) Other Insurances as may be required under the Law of the Country or agreed specifically agreed between the Employer and the Contractor.

- END OF DOCUMENT -

APPENDICES TO GENERAL SPECIFICATION

TABLE OF CONTENTS