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|  | <b>BMRCL 5RSDM -</b><br><br><b>Fully Automatic Train Wash Plant</b> | DOC. No. | GR/TD/6642 |
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**PROCUREMENT TECHNICAL SPECIFICATION (PTS) –**  
**FULLY AUTOMATIC TRAIN WASH PLANT**  
**for BMRCL- Kothanur, Airport & Baiyappanahalli Depot**  
**with 3 Years DLP**


|                 |             |               |   |
|-----------------|-------------|---------------|---|
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## 1. Introduction

This Procurement Technical specification (PTS) document describes the detailed technical requirements/ specifications for Design, Manufacture, Supply, Installation, Testing and Commissioning of Fully Automatic Train Washing Plant of including supply of tools, supply of software, supply of manuals, training of personnel along with supply of spares & consumables during 3 years of Defect Liability Period (DLP) for Kothanur, Airport & Baiyappanahalli Depot of Bangalore Metro Rail Corporation Limited (BMRCL) - 5RSDM project.

The Fully Automatic Train Washing Plant shall comply in all respects with PTS and BMRCL- ERGS (Employer Requirement General Specification).

## 2. Project and Permanent Works

### 2.1. Location and Boundaries

The location plans together with the indicative works and Site area boundaries are shown on the drawings in the Tender Document. The Designated Engineering Contractor shall set out the works and Site area boundaries of the Contract.

#### 2.1.1. Climatic Conditions and Operating Environment


The equipment shall be required to work under the following climatic conditions:

|                                       |                                    |
|---------------------------------------|------------------------------------|
| Maximum temperature during summer     | - 42.5 ° C                         |
| Relative humidity during rainy season | - 92 %                             |
| Minimum temperature during winter     | - 8 ° C                            |
| Environment                           | - Dusty with industrial pollutants |
| Water                                 | - Hard with high salt content.     |

#### 2.1.2. Definitions

Words and phrases defined in the Conditions of Contract shall retain the same meaning within the Technical Specification unless specifically redefined.

- "Client", "Purchaser" refers to Bharat Earth Movers Limited (BEMBL), a party to and Manager of the Contract to which this Tender invitation relates.
- "Client's Representative". "Purchaser's Representative" refers to responsible persons or parties designated by the Client to act in his name for all management tasks or actions concerning the works and installations defined in the contract.
- "Contractor", "Supplier", "Constructor" or "Manufacturer" refers to the party to which this procurement has been awarded.
- "In Principle": This term signifies that derogation may be granted to the specification to which it is associated.
- "External" This applies to everything not provided under this contract.
- "Commissioning" refers to the readiness of the equipment for putting into service after successful completion of installation works and Site tests.
- "Factory tests" refers to the tests to be carried out at the manufacturer's premises before shipment/dispatch of the equipment to the site.
- "Site tests" refers to the tests to be carried out after installation of the equipment at site.

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## 2.2. General Description of the Works.

The specification covers the design, manufacture, supply, installation, testing and commissioning of Fully Automatic Train Washing Plant for Kothanur, Airport & Baiyappanahalli Depot including DLP- 3 years, supplier shall be responsible for the design of the complete equipment, which shall include but not be limited to the following:

2.2.1. The Works shall comprise design, manufacture, supply, installation, testing and commissioning of Fully Automatic Train Washing Plants One Set Each at Kothanur, Airport & Baiyappanahalli Depot of Bangalore Metro Rail Corporation Limited (BMRCL).

2.2.2. The detailed design for Fully Automatic Train Washing Plant Kothanur, Airport & Baiyappanahalli Depot has to be carried out to install the Train Washing Plant. Special protection shall be taken to ensure no water leakage from any joints or tanks etc. takes place. The tentative layouts showing space for Washing Plant installation at depot are enclosed in this specification. The detailed layout will be provided during the final design stage.

2.2.3. The Automatic Train wash plant shall be designed to accommodate in the civil works of BMRCL at all depots. Accordingly, necessary interface works shall be ensured.

Execution of civil works are under progress & carried out by BMRCL at Kothanur depot & for the Baiyappanahalli Depot, Airport Depot civil works shall be executed accordingly after supplier finalization.

At BMRCL-Kothanur depot, if any further civil requirements / modifications, special material, inserts, foundation bolts required for grouting / foundation or inter connection shall be supplied & carried out by the supplier along with the instructions. It is the responsibility of Auto Wash Plant supplier to coordinate with civil contractor.


2.2.4. The Fully Automatic Train Washing Plant shall be complete with washing process stations, water recycle module, control consoles and all accessories required to make the equipment fully functional and a set of special tools and test equipment. The equipment / sub-assemblies which shall be used in the plant to be supplied under the contract should have already been used by the Contractor which shall be of reputed proven make with satisfactorily performance.

2.2.5. The Tenderer shall quote for supply of the specified Fully Automatic Train Washing plant capable of carrying out automatic washing of the body sides/sidewalls, roof top, front and rear end walls of the Trains deployed in third rail traction territory of metro rails.

2.2.6. The design, interface, manufacturing process, quality control shall be the responsibility of the OEM.

2.2.7. The OEM shall evaluate Joint venture company / contractor manufacturing and process for this project.

2.2.8. The manufacturing process and quality standards document of OEM shall be followed for the manufacturing at Joint venture company / contractor works and report shall be submitted after vendor selection.

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### 2.3. Detailed Scope of Works

The scope of the Works, in addition to those specified in the General Description shall include the following:

- 2.3.1. Design, manufacture, Supply, Installation, Testing and commissioning of Fully Automatic Train Washing Plant for washing of trains deployed in **Third Rail Traction** territory of metro rails.
- 2.3.2. Preparation and supply of drawings, documents, samples, specimens and operation & maintenance manuals as specified.
- 2.3.3. Supply of resources, materials, tools, plant and manpower for fabrication, supply, installation and testing of the equipment to meet the intended functions. The Contractor shall arrange for all the machines and equipment required for installation, commissioning, testing and proving of Automatic Train Wash Plant such as cranes, tools, tackles etc. The financial scope of this shall be included in the contract price by the Tenderer.
- 2.3.4. Where deemed necessary, confirm license applications and statutory submissions in accordance with its enactment's up to the commencement of the Defects Liability Period.
- 2.3.5. Training of Purchases staff as described in clause No.14 of this specification.
- 2.3.6. Maintenance of the Fully Automatic Train Washing Plant during the Defect Liability Period.

The Original Equipment Manufacturer (OEM) shall execute DLP should either directly or through their associate company with trained manpower and maintenance facilitates in India preferably in Bangalore. In case of maintenance from associate company, the associate company must have at least 3 years' experience in manufacturing of Auto wash plant or of giving after sales service for the Auto wash plant used in metro trains and the competency of the trained manpower deputed for the purpose of maintenance during DLP period shall be certified by the OEM. The contractor shall submit complete credentials of associate company in compliance with this clause within 2 months of placement of order. Tenderer shall submit undertaking form during tender submission.


- 2.3.7. The catalogue containing details of all Spares, spare parts, manufacturer details, tools, assemblies and sub-assemblies shall be provided as described in part catalogue part.
- 2.3.8. The Backup of the software (PLC programming for stage-wise washing, along with a standby hard disk with complete standard software) shall be provided along with the Automatic Train Wash Plant.
- 2.3.9. Maintenance of Automatic Train Wash Plant during DLP shall be the responsibility of the Successful Tenderer. The costs of all manpower, tools, oils, consumables, spare parts etc. needed shall be borne by the Contractor as per Contract conditions during this period. Electricity, compressed air, water and any facility available in the depot can be provided free of cost by BEML for the maintenance of the Auto Wash plant. However, in case any special machine/s or tool/s are needed for maintenance, they should be clearly specified in the Tender (cost of these items may be included in the financial evaluation of the Tenders).

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#### 2.4. Design Responsibility

The Contractor shall be responsible for the design of the Permanent works, which shall include but not be limited to the following: -

- 2.4.1. The development of the design shall be carried out in conjunction with the information contained in the Drawings and shall be in accordance with the Specification set out in the Contract.
- 2.4.2. The Contractor being responsible for the development and completion of the design of any other items of the Works as stated in the Contract, including, without limitation, the updating and amendment of the Drawings from time to time.
- 2.4.3. The Contractor, coordinating with BEML and Designated Contractors on all matters relating to design and documentation, shall retain full responsibility for managing such design and for the maintenance of all documentation associated with the design process. The personnel identified to fulfil these roles shall be direct employees of the Contractor.
- 2.4.4. The Contractor shall determine and verify as deemed appropriate, the materials, site measurements and installation criteria before adopting in the design of the equipment.
- 2.4.5. The Contractor shall ensure that the information contained in the submissions has been coordinated with the overall requirements of the Works in accordance to the specifications and the works of the Designated Contractors.
- 2.4.6. At all the 3 depots trainset operations are driver-less train / unattended train operation (GoA4); the Contractor of Auto wash plant shall be responsible for interface with **BMRCL signaling contractor** and **BEML** for all necessary interface, issues related to activation & deactivation of plant during the movement of trainset through the washing bay apron.
- 2.4.7. The information that is extracted from the Drawings and adopted by the Contractor in his design shall become the Contractor's design for which neither the Purchaser nor the Engineer shall be responsible.
- 2.4.8. The Contractor's designs, whether for Temporary Works or Permanent Works which are subject to the approval of any Relevant Authority, shall before submission to the Relevant Authority (wherever applicable), be first submitted to BEML for review without objection. The Contractor must make all due allowances for the requirements of the Relevant Authorities approval and consent process in the Works Programme and in the timing of the Works.
- 2.4.9. Responsibility for the Contractor's design proposals submitted to the Relevant Authorities shall remain with the Contractor who must provide sufficient resources to deal with subsequent questions, alterations etc. requested by the Relevant Authorities. All communications with any Relevant Authority, whether written or oral, must be copied / recorded to BEML.
- 2.4.10. The contractor may engage local agency for fabrication and installation related works at site subject to prior approval by BEML. The contractor shall solely be responsible for design, quality of fabrication works, its installation and shall issue quality certificate for the same. The contractor shall seek design approval of steel & fabrication, other item proposed to be used, from BEML in charge.

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2.4.11. Contractor shall use only Stainless steel pipes in the entire wash plant installation. All fasteners, nozzle shall be of stainless steel SS316L. All structures shall be of hot dip GI steel as per BS-729 with minimum coating of 120µm. The same GI steel shall be used in Blower body and side brush washing station main support column. All water pipelines and its associated pipes inside control room, tanks & thickness shall not be less than 3 mm. All other water and pneumatic pipelines shall also be of stainless steel. The detergent tank and pipeline shall be of stainless steel 316L and thickness shall not be less than 3 mm.

The contractor shall take prior approval of employer during the design stage for the selection of pipe, size of pipes and make of pipe and tanks etc. No drilling of holes in the Structural steel will be permissible after galvanizing. The selection of stainless steel & structural steel shall be made by the contractor duly considering the quality of water available at site in Bangalore (Tenderers are advised to carry out test of water sample in Kothanur, Baiyappanahalli and Airport Depot) and ensure no corrosion on any structure during the life of the plant for 35 years. All GI steel used by the contractor shall be established to have adequate corrosion resistance against the water & detergent by means of suitable powder coating and it shall be painted with washable paint in such a way that no dirt or dust accumulate on the structure. The contractor shall test water to his satisfaction & shall submit the report during the detailed design stage. The entire stainless-steel items which shall be provided by the contractor in the plant shall be of SS-316L. The thickness of stainless-steel water tanks shall not be less than 3mm.

2.4.12. The fully automatic train wash plant lifetime shall be of 35 years. Contractor shall demonstrate that the steel structure & metal component used in the plant will last for 35 years without any corrosion. In support of that Tenderer shall submit the detailed manufacturing procedure of surface preparation of steel structure & metal component which shall sustain for 35 years life without any corrosion, in the technical bid.

2.4.13. Contractor shall solely be responsible for installation, commissioning & testing of the plant and shall depute his engineers during installation, commissioning & testing.

2.4.14. Stress analysis of sensitive structures shall be carried out from a reputed test houses/labs certified by NABL in India and reputed laboratories of OEM's countries. Test report shall be submitted to BEML during inspection.


2.5. **Preliminary Works**

The Contractor shall inspect the Designated Contractors enabling works and satisfy himself that all works required to be carried out by the Designated Engineering Contractor are in accordance with the interface requirements as specified in the interface clause of this Specification.

2.6. **Site Visits**

a) The Tenderer is advised to visit and examine the Site of Supply and its surroundings and obtain for himself on his own responsibility all information that may be necessary for preparing the Tender and entering into a Contract for the proposed Supply. The costs of visiting the Site shall be borne by the



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Tenderer. It shall be deemed that the Tenderer has undertaken a visit to the site of Supply and is aware of the site conditions prior to the submission of Tender.

- b) The Tenderer and any of his personnel will be granted permission by BEML to enter upon his premises and lands for the purpose of such inspection, but only upon the express condition that the Tenderer and his personnel will release and indemnify the Purchaser and his personnel from and against all liability.

### 3. Eligibility Criteria


- 3.1. The Tenderer must be a proven Manufacturer for Design, Manufacture, Supply, Installation, Testing and Commissioning of Fully Automatic Train Wash plant compatible for UTO (Driver Less) Train, who must meet the following conditions.

| SN  | Conditions  | Minimum Requirement |
|-----|---|---------------------|
| i.  | The number of Fully Automatic Train Wash plants (with side & roof washing in dynamic conditions and front & rear washing in static conditions) designed, manufactured, supplied, installed, tested and commissioned in last five years* to any Metro Railway/ Suburban Railway/Main line Railway System.  | 3 units             |
| ii. | Out of above commissioned Fully Automatic Train Wash plant by the Tenderer in last <u>five years</u> * to any Metro Railway/Suburban Railway/Main line Railway System, minimum number of Fully Automatic Train Wash plant that should be in operation with satisfactory performance for a minimum period of 2 years after commissioning<br>(Shall be duly supported by a performance certificate issued by client/s.) | 1 unit              |

- a) The Tenderer shall submit the qualification document along with copies of certificate with the Tender.  
b) The Tenderer shall submit the technical proposal with the Tender.

- 3.2. In BMRCL 5RSDM Contract **ERTS** clause 5.1.5, "**Vendor Approval** - It shall be obligatory for the Contractor to obtain Notice of No Objection from the Project Manager for the selection of the sub-contractor and vendors for all items of work, even if the name of the subcontractor and vendor is named in the Contractor's Proposal and the works to be done including purchase of materials and equipment's is in accordance with the Standards specified in the Contract. List of items for which Project Manager's approval of vendors is obligatory shall be proposed by the Contractor during preliminary design (well before finalising the vendors), which will be reviewed for approval by the Project Manager. On

\*Starting from 28 days before the latest date of Tender submission.

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submission of the list by the Contractor, the Project Manager may direct the Contractor to include other items for which vendor approval shall be mandatory

The Vendor approval for Sub system (including M&P items) as per qualification criterion of the system will be part of the tender process.

The request for vendor approval shall be comprehensive with all relevant references and details establishing their compliance to the specified conditions. Along with the vendor approval proposal, a commitment from the proposed vendor shall also be submitted that in case of any future procurement action by Employer, they shall quote directly to Employer.

For sourcing the equipment from indigenous manufacturing facilities, following conditions shall be complied:

- a) In case OEM wants to use manufacturing facilities in India (other than his own) for items for which the OEM has been approved, it shall enter into an agreement with such selected Indian equipment manufacturer and obtain prior approval from the Employer. No change in composition, rating, type, model no., manufacturing process, quality standards, design, etc. and make of the components used in assemblies/sub-assemblies of such equipment as manufactured by the approved parent vendor shall be made without specific approval of the Project Manager.
- b) In case the vendor uses his own facilities for indigenization after part supply of equipment from the approved manufacturing unit, Contractor shall obtain prior approval from Employer. No change in design, component type/make, quality standards, manufacture procedure, etc. shall be made without specific approval of the Project Manager.
- c) In case OEM wishes to change make/type/specifications, etc. of any sub-components for supplies to be sourced from Indian facility, specific prior approval of the Project Manager shall be obtained for changes made, model, specification, etc. Responsibility for obtaining such prior approval shall rest solely with the Contractor. If the prior approval as per above is not obtained by the Contractor and supplies are sourced from the un-approved local Indian source, then the Project Manager at his sole discretion may direct the Contractor to replace equivalent no. of such items with supplies from approved sources free of cost.


Format for submitting the vendor approval request shall be given to the Contractor during initial design stage and the same shall be followed throughout the Contract”.

The firm shall submit all the required documents for obtaining the vendor approval from end customer. Selection of Vendors shall be subjected to end customer (GC / BMRCL) approval.

#### **4. General Design Requirements.**

The following general requirements on plant design shall apply to all equipment.

- 4.1. The Plant shall be of proven design and design life shall be of 35-years without rusting & corrosion in foundation, base frame and structural components. The design life for mechanism, driving components,

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spray poles, brushes (except bristles) and other parts of the Plant shall be at least 15 years. No major structural repairs and major component replacement shall normally be required during the design life. The material & parts used for the same shall be specified in detail design stage.


- 4.2. The Plant shall be designed for heavy-duty workshop use and shall be available throughout the year without any limitation in day to day washing process.
- 4.3. Provision of industrial Cameras with weatherproof covers must be provided.
- 4.4. Equipment that requires an electricity supply shall be compatible with the supply voltage 360 to 440V, 47.5 to 51.5 Hz & surge protection, low voltage protection to be included wherever necessary. Any regulation or protection required shall be the responsibility of supplier.
- 4.5. Equipment shall incorporate means of adjustment in order to allow for foundation differential settlement of maximum 25 mm.
- 4.6. Work related to the production of the equipment shall comply with the relevant European Standards or equivalent Indian standards, Codes of Practice and latest statutory requirements of India including the following:

The Machine & Plant to be supplied shall be newly manufactured according to the best manufacturing practices and according to the latest state of the art technology. The Machine & Plant shall be of proven design. Rigid quality control shall be followed by the main manufacturer of the equipment as well as his subcontractors for the sub-assemblies. The main manufacturers of the equipment as well as the supplier of main assemblies to the main manufacturer should have ISO9000/9001/9002 or equivalent certification.

**Standards list.**


The International/European/British/Indian standard/equivalent Indian Standards to be followed as per the specification shall be latest on the date of award of contract.

| Standard No. | Description.  |
|--------------|---|
| EN 60 204-1  | Safety of the machinery-Electrical equipment of machines-general requirement-09/1998.             |
| NF E 85-101  | Items used on industrial installations-Metal railing-10/1988                                      |
| NF C 15-100  | Low-voltage electrical installations-Rules.   |
| ISO 2632     | Surface texture - Method of measurement -Roughness comparison specimens                           |
| ISO 1217     | Displacement Compressors-Acceptance tests-09/1996.  |
| IS 4758      | Sound Level   |
| ISO 1711     | Assembly tools for screws and nuts- Technical Specification - Hand operated wrenches and sockets. |


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|---------------------|--|
| BS 4568             | Specification for steel conduit and fittings metric of ISO Form for electrical installations (page 26) |
| BS 7671             | Requirements for electrical installations. (Page 29) -1997   |
| BS 6651             | Code of practice for Protection of Structure against lightning (page 32)-1992.                         |
| BS 5378<br>ISO 3864 | Safety colors and safety signs.  |
| BS EN 60529         | Degrees of protection provided by enclosures (IP code)   |
| IS 4460/1967        | Specifications for gears   |
| IS 226 & IS 2062    | Specifications for carbon steel  |
| IS 816/823          | Welding  |
| IS 325              | Electric Motors  |
| IS 13947            | Degree of protection   |
| IS 2516/1985        | Moulded case circuit Breaker   |
| IS 8623/1977        | Factory built assembly switch gear and control gear  |
| IS 33043            | Code of practice for earthing.   |
| BSEN287             | Approval testing of welders for fusion welding   |
| BSEN288             | Specification and approval of welding procedures for metallic materials                                |
| BS4575              | Fluid power transmission and control systems   |
| BS5304              | Code of practice for safety of machinery   |
| BS5395              | Stairs, ladders and walkways.  |
| BS5950              | Structural use of steelwork in building  |
| BSEN60073           | Specification for coding of indicating devices and actuators by colors and supplementary means         |
| EN60204             | Electrical equipment   |
| BSEN60529           | Specification for degrees of protection provided by enclosures (IP code).                              |
| IS09001-3:1991      | Guideline for the Application of IS09001 to the Development, Supply and Maintenance of Software.       |

- 4.7. The layouts given on the Drawings shall be used for conceptual purposes. The Contractor shall furnish their requirements in accordance with the Schedule of Key Dates.
- 4.8. The equipment shall be designed and/or selected to allow operation without over stressing, damaging or interfering in any way whatsoever with other equipment in the Depot.
- 4.9. Components of equipment of similar construction or similar application shall be mutually interchangeable. The Contractor shall, to the extent that he is responsible for the design or component selections of equipment items recognize and implement all safety requirements and ensure that the design and performance of the equipment are compatible with the suitable international safety standards.

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- 4.10. The Contractor shall, to the extent that he is responsible for the design or for the selection of particular components of equipment items, recognise and implement all safety requirements and ensure that the design and performance of the equipment are compatible with the appropriate international safety standards and ambient conditions specified.
- 4.11. Equipment shall be “fail-safe” and “overload protected”. The equipment shall incorporate all necessary safety devices to protect the equipment, operators, and all other people and things in the vicinity of the equipment. No failure of the equipment shall cause or give rise to any damage or catastrophe of any nature whatsoever.
- 4.12. Equipment design shall take into considerations of fire protection, elimination of dust and dirt by means of suitable traps or the like, minimum maintenance requirements and ease of access for cleaning, routine maintenance and general disassembly.
- 4.13. Guards shall be fitted to all exposed moving parts of the equipment where the environment and working processes of the system dictate that there is a foreseeable risk of injury or causing ill health to personnel from sources such as moving parts, electricity, coolant, swarf, noise and vibration, dust and fumes, etc. Moving parts of the equipment shall be efficiently auto-lubricated to ensure quiet operation as well as durable and reliable life. Lubrication points shall be clearly identified for easy replenishment with minimum removal of other equipment components. Oil and lubricants used should preferably be available in India or equivalent Indian makes should be advised.
- 4.14. It shall be the responsibility of the Contractor to recommend equivalent indigenous detergent /washing agent after establishing their chemical equivalence and without compromising the quality of washes and effect on the car body.
- 4.15. The environment within which the equipment is to be operated shall be taken into consideration in the equipment design. The Contractor is advised to carefully examine the air pollutants and deposits generally encountered in Bangalore's ambience. The Contractor shall collect the sample of water from the work site before taking into consideration in the equipment design.
- 4.15.1. It is the sole responsibility of the supplier of the Automatic Train Wash Plant (ATWP) to ensure that the chloride content in the spray water of pre wet station, detergent station, water brush station, first rinsing station & final rinsing station of ATWP shall not exceed 100ppm, 50ppm, 50ppm, 50ppm and 25ppm respectively. The Tenderers are, therefore, advised to carry out test of water sample in Kothanur, Baiyappanahalli & Airport Depots.
- 4.15.2. The used water in ATWP has to be recycled for reuse in ATWP in order to economise in the overall water consumption without sacrificing the quality of water for washing of train. Tenderer shall include in his offer the detailed methodology for treatment of recycled water so as to make it fit for the use in ATWP with chloride level as mentioned above.
- 4.15.3. Tenderer is required giving the consumption of water in each stage, quantity of water to be recycled and quantity of water to be sent to ETP.

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- 4.16. Based on the experience gained during test, trials and use of machine or any problem arises during operation of the machine which warrants re-check of the design /manufacture/ quality of the equipment, the Contractor shall be responsible for all modification as required and these shall be done without any extra cost to BEML.
- 4.17. Any modification required to be done for satisfactory washing/rinsing/ water streak removal shall be mutually decided and carried out by the Contractor free of cost to the satisfaction of BEML engineer. Therefore, Contractor shall carefully consider local ambient condition like pollution, dust and quality of water in their design stage.
- 4.18. Type of water and consumption to be sprayed in various washing stations will be finalized during the detailed design stage of Automatic Train Wash Plant.
- 4.19. Water level indicators and drains shall be provided for each storage tank.
- 4.20. **Use of drawings and data**
- a) All data in concern with the rolling stock written in this specification is for information only and there may be slight variations.
  - b) The compatibility of the equipment with the rolling stock characteristics is the responsibility of the Contractor and he shall obtain the required data/documents from BEML.
  - c) All information or documents related to the Rolling Stock deemed necessary are to be taken from BEML by the Contractor.
  - d) The drawings shown on the plans define the operating conditions and are provided for indicative purposes only. These may be adapted by the Contractor in consultation with BEML.

**4.21. Data of Track Reference**

The driving and motor vehicles shall be operated on the tracks with the following specifications. The track specification may however vary slightly and the Contractor shall obtain the details from the Track Work Contractor.

Track Gauge - 1435 mm

Min Curve radius - 100 m for Depot

**4.22. Vehicle Dimensions**

The machine shall comply with the following configurations: -


6 Car Configuration Trainset: DMC-TC-MC-MC-TC-DMC



[DMC- Driving Motor Car; TC- Trailer Car; MC- Motor Car]

Minimum width of rolling stock 2,880 mm

Length over a body 20,800 mm (21,050 mm Driving car)

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Bogie wheel base 2,200 mm to 2400 mm.

Distance between bogie centres 14,700 + /- 250 mm

Max height of coupler above rail level for unloaded vehicle 815mm

Max height of coupler above rail level for loaded vehicle 740mm

**Note:** These data are indicative only & actual data will be supplemented during detail design stage.


- 4.23. Based on the experience gain during test, trials and use of plant or any problem arises during operation of the plant which warrants re-check of the design /manufacture/ quality of the equipment, the contractor shall be responsible for all modification as required and these shall be done without any extra cost to BEML.

### 5. Specific Requirements of Automatic Train Wash Plants

The scope of supply shall include all equipment and accessories required to make the Fully Automatic Train Washing Plant fully functional and the manufacturer shall be fully responsible for Design, Manufacture, Supply, Installation, Testing and Commissioning of Fully Automatic Train Washing Plant for Kothanur, Baiyappanahalli & Airport Depot of Bangalore Metro Rail Corporation Limited (BMRCL) - 5RS-DM project as per Technical Specifications including supply of tools, supply of softwares, supply of O & M manuals, Training of personnel along with supply of spares, consumables and maintenance during 3 years of Defect Liability Period (DLP) which shall not restrict to following minimum requirements and shall satisfy overall performance standard.

#### 5.1. Operating requirements

- 5.1.1. The Fully Automatic Train Washing Plant shall be designed to carry out automatic washing of body sides /side walls, roof top, front and rear end walls washing of the Metro Coaches. Rolling stock relevant key parameters like Kinematic Envelope (KE) will be furnished during detail design stage.
- 5.1.2. No fixed structure of the plant shall be installed within the specified limits of SOD of BEML Train. The copy of SOD will be provided during detailed design stage.
- 5.1.3. The Plant shall be of drive-through type and operated in a single direction of train movement. The entry and exit directions are marked on the drawing. The plant is designed to the satisfactorily wash the train running through the Plant under its own power at a specified washing speed of 3 - 5 km/h.
- 5.1.4. Driver Less train (GoA4) with Communication Based Train Control (CBTC) signaling system is used at three Depots, the Contractor of wash plant shall design for washing trains operating on CBTC & Distance-to-Go signaling system and need to interface with BEML and signaling Contractor for all issues related to movement of driverless train through the washing bay apron. The wash plant Contractor shall provide potential free contacts to signaling Contractor for smooth operation of train movement during the entry/exit to washing bay apron in addition to any other interface requirement of signaling Contractor.
- 5.1.5. The power to the train will be supplied via third rail 750 V DC except in the train wash plant area which is located within the bridgeable gap.
- 5.1.6. Selection switch for Wash / No wash shall be provided.
- 5.1.7. The train-washing plant shall be designed for both automatic, semi-automatic and manual mode washing process with selection switches. In automatic mode, the wash cycle shall be activated by

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the train movement and deactivated by wash plant exit command. In semiautomatic mode each stage of washing sequence shall be activated and deactivated by wash plant operator. In manual mode individual section can be activated/ deactivated which shall be for maintenance. It shall be the responsibility of the contractor to provide ultrasonic devices, photo electric cells or other proven approved means to enable the full length of train to complete the entire wash cycle. The limit switch/proximity switch/sensors etc. which are required to be provided by the Contractor in the tracks for sensing of the movement of trains shall have enough passage for the movement of the rolling stocks.

5.1.8. If the set parameters of washing cycle encounter any malfunctions like train speed, brush RPM and water flow, as mentioned in specifications, the entire plant shall come to halt automatically.

5.1.9. Separate program to be made for full and side washing mode.

- 5.1.10. The following facilities/ operation by the control console are required at the Depot Control Centre.
- i. Auto enabling of train wash plant so that the plant is being activated by the presence of train for ensuring complete wash.
  - ii. Selective disabling of plant so that the train can pass through the plant in either direction at a maximum speed of 25 km/h without the washing process taking place.
  - iii. Monitoring of details i.e., status/health, operating hours of the plant shall be monitored at control panel along with audio, Visual Display Unit (VDU) and Printer facility to be supplied by the Contractor.
  - iv. Complete graphical Indication of completion of washing cycle shall be available at control console.
  - v. No staffs shall be required to man the plant, other than to clean and replenish stocks of cleaning media.

5.1.11. Manual operation of the wash Plant shall be allowed at the local control console, which shall be located at the wash area, for maintenance work. Provision shall be made to switch over to "manual" mode of operation, in which the various sequences shall be regulated by individual controls. The design shall provide for by-passing anyone or more stages of washing if warranted.

5.1.12. In the event of lack of water, the pumps of the corresponding stations shall be automatically shut down and the corresponding brushes shall be retracted.

5.1.13. Water filling (to tanks) cycle must be possible irrespective of whether plant is in No Wash/ Washing Mode by which it should not in result in stopping of plant due to shortage of water for washing next trains.


5.1.14. The plant shall be protected against deterioration of the structure and base due to chemical contacts, site and operation conditions.

5.1.15. The brush material shall be soft enough so that it doesn't make mark on the car body.

5.1.16. Machine brushes shall be able to follow the contour of the body sidewalls, roof top, front and rear end walls of the train.

Variable Frequency drive (VFD) shall be incorporated for tuning the system for horizontal brush movement to follow the contour of the front and rear cab glass wall during its movement for Gantry



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horizontal / track movement motor, Gantry up & down movement motor and any other similar systems.

- 5.1.17. Remote downloading of the diagnostic and status/ health of plant, through Wi-Fi or network access shall be provided with in the depot premises, necessary arrangement for this purpose shall be provided so that commercially available laptop is used for the same. Any special hardware, software, if any, required for this purpose shall be provided by the Contractor. During operation of the plant if it becomes inevitable to isolate a particular sub system, the same should be possible through simple operation. Details of such requirements shall be finalized during design.
- 5.1.18. The wash plant shall be provided with necessary interlocking to avoid entry and exit of train into wash plant in case of failure.
- 5.1.19. The brushes shall automatically retract to their gauges in the event of any malfunction or activation of emergency stop buttons
- 5.1.20. The pumps shall automatically shut down in the event of lack of water or detergent solution.
- 5.1.21. The wash sequence shall include full wash, side wash only and No-wash mode of selection

## 5.2. Plant Capacity


- 5.2.1. The Plant shall wash the lateral sides of the coaches from the cant level to the deck level, full front and back, roof. The trains to be washed will consist of, 3 and 6 cars with train lengths of approximate 67.5m and 135m respectively.
- 5.2.2. The Plant shall be used to wash roof, side walls, front and rear of trains (135m length) for a minimum of 3 numbers of 6 car length each per hour and shall be available for 24 hours in a day. The Tenderer shall furnish details of the timed washing sequence.
- 5.2.3. The Plant shall be capable of allowing trains to pass through the plant in either direction at a maximum speed of 25 km/h without the washing process taking place.

## 5.3. Plant Assemblies

### 5.3.1. Assemblies by Train Washing Plant Contractor

The Plant shall comprise the following minimum sub stations and accessories, which shall be provided by the Contractor.

- Control Console at Depot Control Centre
- Local Control Console
- Validation position
- Pre-wet Station
- Detergent Brush Station
- Water Brush Station
- Final Rinse Station
- Water Recycle Module
- Detergent Dosing Module
- Water Streak Removal Module
- Accessories such as sensing device / switches, control gears and signage

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### 5.3.2. Provisions by Other Contractors

The Plant shall also include the following provisions, which will be provided by other Designated contractors to the Washing Plant Contractor for integration into the Plant.

- Underground Water Tank
- Used water collecting tanks
- Track work
- Drain points and pipes for effluents discharged to the Effluent Treatment Plant of the Depot.

### 5.3.3. Distance details of Control rooms (Indicative)

- Kothanur Depot- distance between wash plant and control room is apprx.20 m and wash plant control room to DCC is apprx.60 m.
- Baiyappanahalli Depot – distance between wash plant and control room is apprx.20 m and wash plant control room to DCC is apprx.250 m.
- Airport Depot - distance between wash plant and control room is apprx.30 m (the wash plant and control room are located at different levels) and wash plant control room to DCC is apprx.500 m.

**Note:** The values above are indicative, exact values will be shared during design phase.


### 5.4. Plant Layout

The wash plant shall be installed as shown in depot layout drawing.

- A wash area of 50 m X 8 m, which is at one of the tracks entering into Depot,
- Underground water storage tank close to wash area,
- Wash plant control console shall be provided in Depot Control Centre (DCC) with sufficient length of cable from wash plant control room to DCC through cable duct.
- The wash area shall accommodate the local control console, all washing stations, water recycle module, water tank, used water collecting tanks, and associated pumps, pipelines, valves, meters etc. inside a plant room.
- The wash area shall also accommodate the detergent dosing module and water streak removal module for the convenience of operation and maintenance.
- If store for any other items is required, it shall be accommodated on the wash area.
- The Depot Control Centre shall accommodate the control console for master control of the Plant at a remote location.
- In the event that insufficient space for accommodating the dosing modules at the wash area, all the cables and pipes linking the two areas shall run parallel to the track in a trench and cross the track in corrosion resistant sleeve pipes, perpendicularly under the tracks. Such a crossing shall be at either ends of the wash area.

### Reference Data of Coaches

The configuration of the Plant shall be designed to fit the characteristics of the CBTC Metro coaches. The car body is made of stainless steel for standard gauge. Final specification of the car body material shall be advised during design. The dimension of Rolling stock is specified at clause "Data of Track Reference"

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### 5.5. Washing Process Station

- a. The Tenderer shall submit complete details of stage wise washing process along with the reasons attributed to each step and additional measures taken in design for improving design to suit specified ambient conditions.
- b. As a train approaches the wash plant the sensors shall be provided for sensing of train and staggered start up to reduce the initial load along with water consumption.
- c. The washing process of the Plant shall be optimized, for maximum cleanliness of the coaches, with the parameters of the detergent composition, rotation of brush, spraying pressure and flow rate of each single process and water consumption. The Tenderer shall submit design details of wash plant along with optimization of consumables used for wash.
- d. The indicative flow rates of the washing stations are given below. Further optimization (considering the dusty weather condition as prevail in the city of Bangalore) will be preferred with advance design features without compromising on the washing quality.
  - Pre-wetting 300 litre/min
  - Detergent solution 90 litre/min
  - Water brushing Front and Rear 70 litre/min
  - Water brushing - first stage 180 litre/min
  - Water brushing - second stage 200 litre/min
  - Roof brushing 70 litre/min
  - First rinsing 250 litre/min
  - Final rinsing (from R.O) 100 litre/min

The Contractor shall carry out all necessary work complete with tanks (except civil work as specified clause no 1.2), pumps, pipes, valves, filters, meters and accessories as required in each station.

The Contractor has to provide a water consumption meter of reputed make at inlet line.

#### 5.5.1. Pre-wet Station

A pair of spray poles, one on each side, shall be provided for pre-wetting of the car body surfaces consisting of side walls, rooftop, front and rear end walls. The pre-wetting shall be performed by spray nozzles to break down surface tension for even adherence of further washing medium.

The pre-wetting process shall adopt recycled water, which shall be supplied from the water recycle module.


#### 5.5.2. Front and Rear wash station

As train approaches to front / rear wash station (gantry), the train needs to be stopped for detergent application, water spray along with brushes for proper washing of train mask. The Tenderer shall explain composition of front and rear wash station in tender submittal.

Stability of gantry for front and rear wash insisted for better wash.

#### 5.5.3. Detergent Station

- a. This station shall consist of a set of two vertical brushes suited to cleaning of the lateral faces of the trains, one horizontal brush to cover the full roof, one horizontal brush in split for front and back. Each

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brush shall include an arrangement to spray water and detergent mixed solution evenly on the car surface. Drawings shall be supplied with the offer for better understanding of the design along with the offer. Any alternative of proven design may be submitted with detail justification elaborating advantages and past experience.


- b. The Contractor shall interface with Rolling Stock Contractor for selecting detergent suitable for washing Rolling Stocks bodies taking to account the environmental condition of Bangalore. The Contractor shall preferably use Indian detergent; otherwise, Contractor shall propose equivalent Indian detergent within 6 months of plant commissioning. In case of imported detergent, technical and purchase specification shall be provided.
- c. The detergent solution shall not exceed a pH value of 9; so as to eliminate risks of detrimental chemical reactions but it will be decided after interface with Rolling Stock Contractor. The detergent shall preferably be either chemically neutral with capability of emulsifying the adhering dirt or slightly acidic with capability of loosening the adhering metal particles for easy removal.
- d. The lowest nozzles of spray poles of the water brush section station shall be suitably positioned so that mist / water does not trickle down to the under-frame parts of train.

#### 5.5.4. Water Brush Station

- a. Two pairs of vertical brushes, two on each side, shall be provided for water brushing on the car body surfaces and suitable arrangement for roof front and rear cleaning. Each brush shall be integrated with a spray pole with simultaneous operation. The water brushing process shall be divided into two stages. The first stage shall adopt recycled water while the second stage shall use fresh water supplied from the water tank.
- b. The two stages of water brush station shall be separated with appropriate distance such that the water sprayed at each stage can be individually collected by separate drain.
- c. Any alternative of proven design submitted with detail justification elaborating advantages based on past experience, will be treated as technical alternative.
- d. The lowest nozzles of spray poles of the water brush section station shall be suitably positioned so that mist / water does not trickle down to the under-frame parts of train.

#### 5.5.5. Final Rinse Station

- a. Final rinsing shall be in two stages, first stage rinsing with fresh water and second stage rinsing with R.O water. For first stage rinsing minimum one set of spray pole and for second stage rinsing, minimum two sets of spray poles to be provided but details may be worked out during the design stage as per train washing requirement to the satisfaction of BEML.
- b. The final rinsing process shall be designed with the consideration of water streak removal. A portion or all of the water for final rinsing shall be supplied from the water streak removal module.
- c. The lowest nozzles of spray poles of the water brush section station shall be suitably positioned so that mist / water does not trickle down to the under-frame parts of train.

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#### 5.6. Detergent Dosing Module


- a. The detergent-dosing module shall be equipped with tools to facilitate dosing of the detergent agent in the designed proportion controlled through PLC. Pump shall be of metering adjustable pumps. Any adjustment of detergent quantity metering shall be available through MMI.
- b. The module shall be complete with all necessary tanks of 150 Litres capacity, pumps, pipes, valves, meters and accessories. Stainless steel tanks with sufficient thick gauge walls shall be used for detergent storage.

#### 5.7. Water Streak Removal Module

- a. The water streak removal technique to be adopted shall effectively eliminate the possibility of water streaks after final rinsing. This can be achieved by providing series blowers of minimum air flow capacity 4.5 cubic meters per sec at 0.8 bars in both sides of the train to eliminate the possibility of water streaks after final rinsing. The adoption of the technique shall be taken into account the quality and ingredients of the water supply in Kothanur, Baiyappanahalli and Airport depots. The detail procedure / mechanism shall be explained by the Tenderer in the offer with drawings.
- b. Filtration of water shall be done with Reverse Osmosis (RO) system for the final wash of train coaches in the Auto train wash plant. The system shall be from reputed suppliers only. The plant shall be design after checking the water quality of the site only. Treated water from R.O shall be collected in a separate suitable tank of 8000 Litres capacity. The amount of water for final wash shall be sufficient enough to meet the plant capacity. Tenderer shall describe the entire process, supported by calculation.
- c. The module shall be complete with all necessary tanks, pumps, pipes, valves, meters and accessories. Stainless steel tanks shall be used for water storage.

#### 5.8. Water Recycle Module

- 5.8.1. The water recycle module shall be provided to minimize the water consumption of the train washing plant.
  - a. Fresh water from the main shall be used for R.O. Plant reservoir and for first rinse station and second water brush station.
  - b. Used water from the first and final rinse station and second stage water brush station shall be collected after proper screening by underground reinforced concrete recycling tanks. The recycling of the water shall be as per the process. The final recycled water shall then be reused in the pre-wet station, first stage water brush station and as make up water for detergent wash.
  - c. All water from the stations of pre-wetting, detergent spraying and first-stage water brushing shall be collected in a sump to discharge to the effluent treatment plant.
- 5.8.2. The module shall filter the used water to a standard that eliminates the possibility of spray nozzle clogging at the respective stations.
- 5.8.3. The module shall be complete with all necessary tanks, pumps, pipes, valves, meters and accessories.
- 5.8.4. Sufficient care shall be taken to prevent rusting at the plant design itself.

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#### 5.8.5. Water recycle Module using Filtration / Adsorption / Aeration

The water recycle module shall be provided to minimize the water consumption of the train washing plant and ensure that recycled water does not contain sediments, free oil viz. grease etc., residue detergent and odour

##### i. Particulars

The unit shall be designed to treat waste water coming from train washing. The aim is to recycle part of treated water and discharge the excess. The use of fresh water should be limited to first rinsing and water brush section and detergent wash only.

##### Treatment shall include the following:

- Filtration through Quartzite or similar
- Adsorption through activated carbon
- Oxidization by air injection
- Any latest proven economical methods.

##### The cleaning action is aimed at the destruction of:

- Suspended substances
- Surface-active agents,
- Anaerobic bacteria, responsible for the formation of unpleasant odours

The excess water can be discharged in to the drainage system connected to the effluent treatment plant (ETP).

##### ii. Procedure Description

This will be in three stages.

##### Stage I


##### Removal of sludge

The water used during the train wash phases shall be collected in the underground tank where heavy solids, sand and slurry settle by gravity. The sludge removal from the tanks shall be easy and fully accessible. The procedure of sludge removal shall be simple and should be mechanized. Tenderer shall include details of the sludge removal system.

##### Stage II

##### Removal of suspended particles. oils. hydrocarbon and residue detergents and filtration of used water from stage I.

The water shall then be further processed for removal of free oils and hydrocarbons. After pre-treatment of sedimentation and degreasing, the water shall be processed for removal of suspended particles, oils and residue detergents. For this the water shall be taken to the filtering column by using a pump and then to the activated carbon filter and then collected to the underground tank, shall then be collected in a tank to remove/withheld surface-active agents and organic pollutants. The filters shall have facility of automatic back washing (preferably minimum once a day but frequency will be decided as per the field trial) using fresh water.

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### Stage III

#### Removal of unpleasant odours from stage II

An oxidizing line shall be used by the accumulation tanks to ensure that no unpleasant odour arise, particularly during the hottest period of the year caused by the inevitable decomposition of the organic substances (ex. surface active agents) contained in the wastewater.

### Stage IV

#### Water softening plant

The water softening plant shall be used to reduce the hardness of the water of partially treated water coming from the fresh water from mains. The level of hardness of the water from softener plant shall be generally less than 5mg/L. The discharge or rejection from the softener plant normally shall be diverted to ETP unless vendor suggests otherwise. In that case vendor has to elaborate as how they shall control the chloride content in the recycled water within the permissible limit as mentioned at clause no 2.15.1. The Contractor shall provide the detailed maintenance schedule for Water recycle Module in the design proposal.


#### 5.9. Control Console

- 5.9.1. The control console at the Depot Control Centre (DCC) shall be provided for normal automatic operation of the Plant and the local control console at the wash area for manual operation during maintenance work of the Plant.
- 5.9.2. The control of the Plant shall be fitted with PLC to safeguard and sequence all automatic processes and movements. The changes required in sequencing or timing of various operations shall be implementable through control panel HMI touch screen Control of related and conflicting operation functions shall be interlocked to enable logical operation of wash cycle. The screen shall be selectable from menu and shall also provide diagnostic / faults messages. The control shall have the provision to revert back to a pre- determined setting of the plant should there be any wrong setting by an operator.
- 5.9.3. The Contractor shall furnish complete details of flow chart sequencing ladder diagram etc developed for plant operation. Necessary hard ware and software programme shall be provided to incorporate changes in installed application software.
- 5.9.4. The consoles shall be provided with HMI touch screen display /push buttons switches for various operations as well as indicating lamps I meters for monitoring the operations in progress.
- 5.9.5. The consoles shall allow spare spaces for apparatus installation, such as intercom and telephone, in the future.

#### 5.9.6. DCC Control Console

The DCC Control Console shall be provided with the following minimum control functions and monitoring functions.

- Main isolator Key switch on / off
- Console selection DCC console / local console

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- Washing plant mode wash / no wash
- Detergent spray station on / off
- Emergency stop button turn to release
- Washing in process flashing amber light
  - Train passing by green light
  - Common major fault signal flashing red light and E-stop
  - Common minor fault signal flashing yellow light for repair
  - Lamp test button pushbutton

#### 5.9.7. Local Control Console

A single control panel monitors (HMI) and operates the wash plant. The operation is fully automatic but panel shall also allow semiautomatic and manual mode of operations so that plant can be controlled from plant room. The local Control Console shall be provided with the following minimum control functions and monitoring functions.

- Console power on / off
- Plant power key switch key switch on / off
- Plant operation auto / manual
- Washing plant mode wash / no wash
- Detergent level low
- Individual washing process on / off
- Emergency stop button turn to release
- Status of individual process flashing amber light
- Fault signal for each sub-assembly flashing red light
- Pressure gauge for each pump line meter
- Lamp test button pushbutton
- Supply failure (water, pneumatic system, flashing red light  
Power failure)


#### 5.10. Signage

Signage shall be provided along the track of the washing plant to notice the train drivers of the operation status of the plant. The letters of the signage legends shall be of adequate size to be read at a distance of 20m.

A single illuminated signage with legends shall be erected at the entrance end of the washing plant. The legends shall indicate following messages depending on operational status of the plant;

- WASHING MODE START
- "WASHER DISABLED: DEPOT SPEED" if the Plant is switched off,
- "DO NOT ENTER" if the Plant is engaged for a train coming from exit end direction, or
- "TRAIN WASH: SPEED 3km/h MAX." at all other times.



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Similarly, a single illuminated signage with legends shall be erected at the exit end of the washing plant. The legends shall indicate the following messages depending on operational status of the plant;

- "DO NOT ENTER" if the Plant is engaged for entry end trains, or
- "DEPOT SPEED" at all other times.

Two panels duly painted with fluorescent paint shall be erected at 67.5 and 135 m, respectively, from the Plant with the legends of "END OF WASHING FOR 6-CAR" All the signage marked on metallic sheet shall be on stainless steel.

#### 5.11. Connection to Water Tank

The water tank will be constructed by a Designated Contractor and will be in a form of underground concrete pit with a capacity of approximately 30 m<sup>3</sup>. The tank will be filled up in 24 hours at a pressure of about 3 bars from the water mains.

Sump pumps and pipes shall be provided by the Washing Plant Contractor to pump the fresh water from a water tank, which is located close to wash area as indicated on the Drawing, for train washing process.

#### 5.12. Wash Pit

The wash pit shall be designed by washing plant Contractor with appropriate partitions, bunds, grating and drain valves for drainage of wastewater, the drainage of storm water and collection of recycle water. The wash pit shall be designed with reinforced concrete structure for the support of the railway track running through the facility.

The wash pit will be constructed by a Designated Contractor.

#### 5.13. Connection to Effluent Treatment Plant

The effluents to be discharged from the Train Washing Plant will be drained to the Effluent Treatment Plant (ETP) of the Depot. The ETP, which is not part of this Contract, will be located 600m from the washing plant. The piping for such drainage will be provided by the designated depot Contractor.


All water from the stations of pre-wetting, detergent spraying and first-stage water brushing shall be discharged to the ETP.

#### 5.14. Remote surveillance System

The surveillance system enables to pick up all washing plant information to record all data and display plant situation in real time, The operation of the washing plant controlled through control console and Depot Control Centre

The Supervisory control program has following Characteristics,

1. One industrial PC it will be installed a software with a graphic interface with login and password facility. All layout and control functions could be used.

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2. Facilities to be provided information related to washing plant functioning and recording of following data.

- Plant typology choice
- Rotating brush functioning (rpm, pressure, flow and temperature)
- Number of washings completed during desired period.
- Number of washings completed desired Coach/train
- Washing timing and consumption display (water, softened water and detergent product.)
- Alarm

3. Personalized extraction functions through some ad hoc filter that permit to see or/and to export some data to an analysed in excel.

4. Automatic production of statistics day per day, weekly, monthly and per yearly.

## 6. General Electrical Requirements

### 6.1. Operating Voltage

The equipment shall be powered from the depot's supply voltage 360 to 440, AC 3 Phase, 47.5 to 51.5 Hz and machine sub-assemblies to be protected from surge, low voltage through suitable devices to protect.

### 6.2. Electromagnetic Compatibility

The equipment shall be electromagnetically compatible within itself and shall not affect adjacent equipment.

### 6.3. General Installation Requirements

#### 6.3.1. Equipment Accessibility and Installation


- a. All gauges, adjustment points, switches, etc, shall be easily accessible and clearly identified with permanent identification markings. The device identification system shall be approved by BEML.
- b. All relays and Contractors shall be installed within enclosures, in the manufacturer's recommended orientation. Where the device is rail mounted, the Contractor shall demonstrate that the arrangement will satisfy requirement of this General Specification.

#### 6.3.2. Device Reference Designators

All electrical devices shall be identified with their alphanumeric designation corresponding to that used on the schematic. The method shall be presented to BEML for approval.

#### 6.3.3. Grounding

- a. Safety grounding points shall be provided on all electrical equipment, unless otherwise agreed to by BEML. Grounding points shall be of tinned copper, clean, free from paint, and of a sufficient area to ensure proper electrical contact for the grounding cable fasteners. Untinned bronze grounding points and austenitic grade stainless steel grounding points are also considered

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acceptable. The area of any weld joining the grounding pad to a surface shall be at least equal to the cross-sectional area of the grounding cable.

- b. Grounding points will have either a tapped hole or, preferably, a clearance hole (with access to both sides) suitably sized for the lug attachment fasteners.
- c. Suitable grounding cable shall be provided, unless otherwise approved by BEML, and the size will be equal to, or larger than, that of the largest power wire connected to that equipment. All grounding wires and cables shall utilize longitudinally striped green and yellow insulation, or heat shrinkable tubing applied over the conductor insulation.
- d. In circuits where a ground fault could result in current levels which are excessive, but below the operation of over current protection devices, BEML approved ground fault protection shall be provided.

#### 6.3.4. Wire Identification

All equipment wires shall be marked with a unique wire identification number by means of marker sleeves located within 50 mm of each end wire. In addition, the wire insulation shall be indelibly marked with the wire identification number at intervals not to exceed 0.5m. The Contractor shall be required to demonstrate the permanence of the inking system. The identification numbering system will correspond to the wire identification numbering system used on the schematic drawings and wiring diagrams, and shall be approved by BEML.

#### 6.3.5. Suppression

All relay coils, contactor coils, solenoid valve coils and other inductive devices shall be furnished with coil suppression, contract suppression shall be provided where necessary or specified.


#### 6.4. General Circuit Protection Requirements

- 6.4.1. All input power circuits shall be individually protected by circuit breakers, and no circuit breaker shall protect more than one circuit, unless specifically approved by BEML. Circuit breaker terminals shall not be used as junction points. All circuit breakers shall be sized by current rating and tripping time to protect both the associated equipment and the minimum wire size used for power distribution within the protected circuit over the expected ambient temperature range.
- 6.4.2. Fuses shall only be used where specifically required by this General Specification or where the use of circuit breakers is not technically feasible. The use of fuses requires the express approval of BEML.
- 6.4.3. Under no circumstances shall either the main or auxiliary contacts of contactors or relays be wired in parallel for the purpose of carrying a load at or above the manufacturer's tip rating.
- 6.4.4. Under no circumstances shall poles of switches be wired in parallel for the purpose of carrying a load at or above the manufacture's contact pole rating.

### 7. Standard Requirements

#### 7.1. Spray nozzles

- 7.1.1. The spray nozzles shall be arranged to wet the surfaces to be washed with optimum efficiency, number and flow rate. The numbers of spray nozzle shall preferably be not less than 10 nos. per set


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of brushes for rear and front as well as for side washing. Suitable numbers of spray nozzles shall be provided to wet the roof, sidewalls, front & rear end walls surface.

7.1.2. The spray nozzles shall be made of stainless steel or better corrosion resistant material and enclosed within structural steelwork to minimise the possibility of damage. All spray nozzles shall be of adjustable type. The spray nozzles shall emit wide-angle conical spray pattern, perpendicular to the area of sidewalls of the coaches being washed. The spray nozzles shall be set close enough to permit the overlapped spray cones for complete coverage of the surfaces to be washed. However, these nozzles shall be installed in such a manner that these remain clear of the structure gauge. These nozzles shall be from reputed manufacturers only and shall give optimum performance without clogging and frequent requirement of cleaning. The source of supply shall be provided in spare parts catalogue.

## 7.2. Brushes

- 7.2.1. The brushes shall be mounted on crank arms, which shall protrude the brushes from home positions during brushing as well as retract them after brushing, the device mechanism shall be describe in the offer. The protrusion shall prevent, by adjustable limit switches, any sturdy parts from encroaching the vehicle gauge under all conditions. The brushes shall reach the rotational speed prior to making contacts with the first car. In the event of brush mechanism failure, the brushes shall be retracted automatically from the operative positions. The characteristics of brushes (diameter, rotating speed, type of drive motor etc.) shall be indicated by the Tenderer in the offer.
- 7.2.2. The Contractor shall interface with BEML for exact profile of cars to suitably design the brushes for rooftop, side walls, front and rear end walls of cars.
- 7.2.3. The bristles of the brushes shall be the composition of LDPE + LLDPE +1% anti UV. The working life of brushes shall be in the order of 1000 hours. The Tenderer shall describe the material. The materials shall be soft enough so that it does not make mark on the train body.
- 7.2.4. The rotating brush diameter shall be determined after interfacing details from BEML.
- 7.2.5. The brush bristles shall be capable of ensuring proper friction against the sides of the cars while remaining flexible and strong enough so as not to be torn out or cause damage to the rolling stock during passage of various exterior fittings which may slightly protrude beyond the lateral gauge of the cars. The specified life of the brushes shall take into account the quality of water at work site and dust deposit in Bangalore ambient conditions.
- 7.2.6. The fixing of brushes to the member shall be strong enough to withstand shearing forces generated during its operation, the arrangement of fixing shall be explained in the offer.
- 7.2.7. In order to limit water splashes and to reduce the transmitted noise of the Plant, the plant shall be enclosed with screens erected alongside the washing area with structural members providing enough re-enforcement against strong wind blowing and reduce water spillage and wastage. Separate enclosures shall be made for local controls and electrical panels. The life of the screen shall be same as that of other structural members of the plant.
- 7.2.8. Minimum 6 vertical brushes (3 pairs) shall be provided for washing of side walls, two horizontal brushes for roof washing and one single horizontal brush in split for front and rear end walls washing.

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7.2.9. The speed of brush cylinder may be of the order of 200-250 RPM.

7.2.10. The spray nozzles shall be arranged to wet the surfaces to be washed with optimum efficiency, number and flow rate. The numbers of spray nozzle shall preferably be not less than 10 Nos per set of brushes for rear and front as well as for side washing. Suitable numbers of spray nozzles shall be provided to wet and wash the rooftop, front & rear surface.

7.2.11. The lower most bristle of all the brush stations shall be suitably positioned so that mist / water does not trickle down to the under-frame parts of train.

### 7.3. Pump Work

All the pumping system for the processes of detergent spraying and final rinsing shall be provided with 100% redundancy. Single failure of anyone pump shall not deteriorate the performance of the process.

i. The pumps shall be complete with alternate start-up control between on duty and on standby mode.

In the event of one pump failure, another pump shall be set as duty pump Indian equivalent of pump shall be advised. The pumps shall be metering adjustable pumps.

ii. Pump capacity of each section is indicated as below which has to confirmed and approved at the design stage: -

- Pre-welling pump 4.5 KW
- Detergent dosing pump 1.5 KW
- Water brushing - first stage pump 5.5 KW
- Water brushing - second stage pump 5.5 KW
- First rinsing pump 7.5KW
- Final rinsing pump 2 KW


### 7.4. Piping and Steelwork

7.4.1. All pipes for delivering the solutions from the detergent dosing module and the water streak removal module shall be of stainless-steel tubes. All other pipes shall also be of stainless-steel tubes. Stainless steel pipes and enclosures and fasteners shall only be used to minimize corrosion of mechanical fixtures. The piping and control elements shall be arranged for ease of removal and replacement operations of one or more elements such as solenoid valves, pumps and etc. Piping shall be securely fixed so as to prevent transmission of vibrations to the entire installation.

7.4.2. Water pipes shall be properly positioned to avoid low points all along the length of the pipes. Drain points shall be provided at all low points of the pipes for periodic drainage. Plant shall be designed to avoid any scale formation after prolonged idling.

### 7.5. Electrical / Electronic Equipment


7.5.1. All control and regulation electronic and electrical devices, etc. shall be mounted in dust-proof switchboards of IP-67 protected and the switched board frame shall cover with stainless steel enclosure. All electrical wiring shall be marked carefully in compliance with the electrical diagrams, and be properly protected against ingress of water.

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- 7.5.2. The temperature inside the closed cubicles installed in open area may rise to more than 50deg C during summers. Tender shall submit proposal containing the compatibility of the electronics / PLC etc to withstand the temperature.
- 7.5.3. The control circuit shall be supplied with low voltage protection.
- 7.5.4. Protective and safety devices shall be provided such as fuses, circuit breakers, and microprocessor-based relays, single-phase protection.
- 7.5.5. The main isolating switch shall be able to be padlocked. The control panel door shall be mechanically interlocked with isolating switch.
- 7.5.6. All electrical apparatus and metal surfaces of the plant shall be connected to the earthing circuit consisting of a 25mm<sup>2</sup> bare copper cables inside the suitable GI pipe which shall be provided for connection to the traction earth return system via an earth isolating switch. The earthing circuit shall be looped.
- 7.5.7. Pushbuttons and indicating lights on the consoles shall be grouped by functions and identified clearly with legends.
- 7.5.8. All controls elements shall be wired in generously sized terminal blocks and panels well ventilated, carefully marked and easily accessible. All electrical equipment shall be suitably earthed as per relevant standard.
- 7.5.9. All glands to the panel shall be of double compression type.

**7.6. Safety Provision**

- 7.6.1. Emergency stop push buttons shall be provided to halt the operation of the brushes, with suitable warning signs in English, at a suitable height to allow easy access. The buttons shall be located at each side of the track in corrosion-proof stainless-steel enclosures (IP 65), at each end of the wash, at rinse facilities and in the plant room.
- 7.6.2. Over-speed sensing device (settable) shall be provided to protect the coaches and the Plant against damage by retracting the brushes in the event that the trains are overspeed with the washing being taken place. These shall be only from reputed / proven suppliers having very good track record.
- 7.6.3. In the event of lack of water, the pumps of the corresponding stations shall be shut down and the corresponding brushes shall be retracted.
- 7.6.4. In the event of when a train stops within the plant during an automatic operation, the washing plant operation shall stop automatically after a pre-set time delay.
- 7.6.5. In the event of a failure of the activation system (one in one million operation), the retraction devices fitted on all brush stations shall automatically return the brush swing arms into their cowls clear of the car body sides.
- 7.6.6. Stainless steels guards shall be provided at all stations to guard against chemical solution or chemical polluted water from splashing off.
- 7.6.7. An alarm indication shall be provided in case of water flooding in underground sump to control wastage water by spilling.

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- 7.6.8. All electrical Wirings shall be terminated to junction boxes through proper size glands and no taping shall be permitted. The IP rating of the enclosure shall remain unchanged after provision of glands.
- 7.6.9. Each washing station shall be protected adequately at roof top and sideways from sun and rain for all its control console and equipment from direct sunlight and rain in addition to protection from splashes during washing, The arrangement of this protection shall be explained in detail in the Tender submittals.

#### **7.7. Maintenance Provision**

- 7.7.1. The brushes shall be made in sections, each capable of being changed individually when life expired. The rotating member of the brush shall be fully secured with respect to safety of the trains and arrangement shall be explained in the offer.
- 7.7.2. Spray jets, brushes, brush drive gear and other equipment shall be accessible by fixed lockable safety ladders and walkways that shall be provided on each washing bay to ensure routine inspection and maintenance. The interval of such maintenance should be seven days or more. No electrical overhead equipment or wiring should be accessible from these ladders and walkways. The detailed design shall be submitted in the Tender submittals
- 7.7.3. Sufficient number of weatherproof Floodlights of reputed suppliers as approved by BEML shall be provided to enable full visibility to the train driver and maintenance work to be carried out at dark.
- 7.7.4. All equipment that requires maintenance shall be arranged to permit that the equipment is readily accessible for maintenance. The plant equipment and piping layout shall not cause hindrance to the free movement of the maintainer/operator.


#### **7.8. Material Protection**

- 7.8.1. The Plant shall be protected against deterioration of the structure and base due to chemical contacts, site and operating conditions.
- 7.8.2. Piping or any metallic part of the Plant subject to chemical corrosion, shall be corrosion proof for the entire service life of the washing plant
- 7.8.3. Suitable well-ventilated enclosure shall be provided to safeguard the outdoor equipment from the ambient conditions.
- 7.8.4. Protection of all the steel structural elements shall be made by hot-dip galvanization.
- 7.8.5. All fixed elements of the Plant, all screws, nuts, bolts; clamps, etc. shall be of stainless steel.
- 7.8.6. The colours for the plant and equipment shall only be anti-rusting epoxy where galvanization not possible. The finishing coats shall be defined later.

#### **8. Noise Level**

The noise level of the machine shall not exceed 75dBA when measured at a distance of one meter from the machine. The noise level of the fans and blowers shall not exceed 75dBA when measured at a distance of ten meter.

Minor variation to above limits is acceptable on discretion of Purchaser.

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## 9. Finish

The surface treatment of the equipment shall be suitable for the working environment under the climatic conditions in Bangalore. The machine and related equipment (electrical switchboards, sliding rails, piles, hydraulic unit, etc.) shall be painted in a colour to be defined. The exact colours shall be determined during the execution study.

### 9.1. Painting

Preparation of work prior to painting:

- a. External surfaces: brushing, degreasing or sand blasting and blowing.
  - b. Anti-corrosion treatment: application of a coat of anti-corrosion paint. Thickness of this coat after drying should not be less than 180 microns.
  - c. Hollow parts: the internal parts shall be treated prior to assembly. The following shall be provided:
    - one polyurethane primer coat (thickness 40 microns dry),
    - two polyurethane lacquer top coats, thickness 50 microns dry each.
- Paint touch-ups shall be provided after assembly.

### 9.2. Unpainted parts

All rubbing parts or those to remain polished shall be covered with a coating designed to protect them from oxidation until such time as the equipment enters the service.

### 9.3. Identification

All machine components of the Automatic Train Wash Plant shall be identified and marked by means of durable engraved labels,


- Name of the manufacturer
- Year of manufacture,
- Serial number,
- Weight of the machine (in Kg)
- Max, Load of the machine
- Name plates to be both in English and Kannada
- Proper identification mark and labelling to be done on all pipe lines w.r.t flow directions for user friendly and safe maintenance purpose

## 10. Planning, Programme & Progress Monitoring

### 10.1. Preparation and submission of program of work

The Contractor shall interact with BEML to provide details and obtain approval where necessary on following for supply and installation of Plant /machine & Equipment as per the stipulated schedule:



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| <b>Activity</b>  |
|--|
| Submission of design documents and other technical documents from the manufacturers for approval |
| Program for manufacture of the equipment   |
| Documents for execution of works relating to installation  |
| Proposal for factory tests   |
| Program for installation   |
| Program for tests at site and commissioning  |
| Program for training of staff  |
| Program for supply of maintenance manuals and other documents                                    |
| Program for supply of spares   |

### 10.2. Progress Report

The Contractor shall prepare a Progress Report covering all aspects of the execution of works. Such Reports shall be delivered to the Purchaser's Representative on monthly basis.

### 10.3. Progress Meetings

In order to ensure execution of the Works in an efficient and proper manner, BEML and the Contractor will exchange technical information for approval of the solutions and equipment offered and hold periodical meetings. Two categories of meeting may be held for this purpose.

#### - Technical meetings

Attended by engineers and technicians, convened upon request by either party, during which, among other subjects, clarifications or additional information relative to the technical specifications may be provided.

#### - Periodical Progress Review Meetings

To be held as and when required by BEML during which:


- Certain problems that maybe holding progress of the work may be examined.
- Interface requirement with designated contractors may be discussed.

The Progress Review Meetings are attended, notably by the Contractor's Manager and BEML.

Progress Review Meetings relative to works will be held in BANGALORE and will be the subject of reports, in conditions, which remain to be defined.

## 11. Packaging

The Contractor shall provide suitable packing, crates and marking. In doing so, it shall comply with the following requirements:

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- Each packing case/crate shall be water proof, rot proof and insect / rodent proof and of robust construction. The Contractor shall in determining the packaging materials take cognisance of the climatic conditions likely to occur during the period of transport, shipment and storage.
- All items heavier than 100 Kg. shall be marked on the outside of the case to show the gross weight, the points for slinging and where the weight is bearing.
- 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 labels on which the quantity and name of the part and its catalogue or index number have been stamped.
- Electronic circuit boards shall be well protected by using anti-static bubble bag etc,
- Rubber products shall be suitably packed to avoid damage due to hardening, deforming and peeling off etc.
- Tubes, cables and conductor ends shall be properly sealed to prevent ingress of moisture.
- Each bulky/heavy case, crate or package shall include wedges for easy loading and unloading by mechanical handling equipment.

## 12. Transportation

The Contractor shall notify the Purchaser's Representative at least 15 days in advance of any expected date of transportation and give further notice of the actual transportation date. This shall be in addition to the inspection requirements as specified in clause 12.1.2 below.

Two copies of packing list and test certificates shall be delivered along with the package at site and one copy shall be dispatched in advance to the Purchaser.

## 13. Delivery

All documents, operational & maintenance manuals, inspection test procedure, drawings and other deliverables shall be supplied to the Purchaser's Representative along with delivery of the machine.

Any parts of the equipment that is damaged shall not be considered as delivered unless repairs or replacements as approved by the purchaser.

## 14. Checks & Tests


After completion of manufacture and before entry into service the ATWP shall be tested. The program of tests shall be submitted by the Contractor for BEML approval.

### 14.1. In-manufacturer's-plant

14.1.1. Checking of the assemblies and the supply prior to assembly on the machine.

The Contractor shall carry out all checks of supplies on his sub-contractor's premises prior to delivery of these supplies to his workshops.

14.1.2. Checks and tests carried out in Contractor's plant

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During manufacture, and especially prior to shipment, verifications and checks shall be carried out in order to ensure that the supply is in accordance with the technical specification and with the approved Design documents.

All quality checks shall be carried out, as required, during manufacture on the Contractor's or on the sub-contractor's premises. The Contractor shall arrange for quality check of supplies on his sub-contractor's premises before delivery of these supplies to his workshop.

The purchaser shall be intimated at least 4 weeks in advance along with inspection procedure and other protocols for execution of inspection and Factory acceptance test before the delivery. The checks and tests to be carried out by the Purchaser in the Contractor's premises shall include:

- check of proper operation of the machines,
- check of insulation (in case of electrical machine),
- check of assembly work (welds, hardware etc.),
- check of travel speeds,
- check of various safety devices.

Final adjustment shall be made possible by Contractor at the place of testing. The supplier shall provide all documents pertaining to FAT to BEML for verification before test.

All quality checks shall be carried out by the BEML as required, during manufacture on the Contractor's or on the sub-contractors' premises if desired.

All expenses for inspection except travel & lodging of inspecting engineers of purchaser shall be borne by the Contractor.

#### 14.2. **At-Site**


After delivery at site, the operating tests shall be carried out at site in presence of a Representative of the Contractor to check that the equipment fulfils the requirements of the specifications.

The Contractor shall check the workmanship and quality of entire installation including that of his sub-vendors upon completion of erection and commissioning work at site and before offering the same to BEML for inspection.

The installation shall be subjected to a series of practical tests, during which the Contractor according to the profile of the cars will adjust the spray nozzles.

The Contractor shall supply sufficient quantity of the washing products required for the tests.

The Contractor shall supply detergent / washing agent for minimum 1000 train wash for each plant after finalizing the type of detergent found most suitable for the trains (detergent / washing agent). The detergent shall be finalized after interfacing with BEML regarding the type of detergent / washing agent which will be used.

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Integration tests shall be carried out for the trial runs of the Plant with the Metro coaches in order to verify the satisfactory operation of the Plant.

The supplier shall demonstrate the plant performance after successful commissioning at the consignee's works. Thereafter the consignee shall watch the machine performance for a period up to 2 months or 100 numbers of trains wash, whichever is later before the final proving test certificate is issued.

The Contractor shall demonstrate the performance of equipment after successful commissioning at the consignee's works. **There after the consignee shall watch the machine performance for a period up to 2 months before the final proving certificate is issued.**

#### **15. Document submission for Execution and at Completion of work**

All documents shall be provided in English for 4 sets of hard copy of documents & 2 soft copies to be submitted by the contractor for each wash plant supplied.

##### **15.1. For Execution of Builder's Work**

The Contractor shall obtain an BEML consent on the interface and builder's work requirement for installation of the System. The documents shall include the following:

- detailed dimensional builder's works drawings and interface technical information including loads, wash pit configuration, foundations, cast-in items, electrical and mechanical provisions.

##### **15.2. For Execution of Work**


Prior to manufacture of equipment, the Contractor shall send the following documents:

- A detailed technical note, notably indicating the weight of components and removable parts, and including a list of all parts with the respective sub-contractor's references,
- General drawings, detailed assembly drawings, detailed drawings of mechanical parts,
- Electrical schematic drawings of complete system
- Descriptive and operating note with a description of the machine cycle and the operator input screen pages,
- Detailed hydraulic diagrams with markings,
- Detailed electrical diagram and electronics for troubleshooting including cable index,
- Control scheme, circuit diagram, flow chart of software, & logic diagram.
- Connection diagram with markings,
- List of basic spare parts to be kept in stock for repairs,
- Documentation, drawings, notes and references of suppliers and sub-contractors,
- Installation and commissioning procedure,
- Schedule of work and completion period.
- A life cycle cost plan of the equipment covering capital costs, operation costs & maintenance costs.

##### **15.3. At Completion of Work**

The Contractor shall provide the entire documentation for review and approval by BEML.

- the list or complete nomenclature of general drawings and detailed drawings of electronic and electrical diagrams,
- the general nomenclature of the supply including sub-contractors & parts catalogue.

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- mechanical drawings, electrical, hydraulic and electronic diagrams required for maintenance and troubleshooting of the machine,
- illustrated lists of mechanical and electrical parts itemized in accordance with the diagrams and drawings mentioned above and including the addresses of the various contractors,
- maintenance and adjustment manual with summary of circuits and functions and among other information, a lubrication manual including location of lubrication points, type of lubricants along with technical specification, frequencies and quantities,
- an operating manual (start and user's instructions) including the numeric control system,
- complete documentation of equipment from sub-contractors (including read and display apparatus, diameter measurement apparatus and numeric control system),
- complete documentation on motors and major components,
- spare part list with quantities for three years after handover of the Works, anticipated frequency of replacement and prices with a one-year validity period,
- the flow charts, the assembly listings and the copy of the PLC/User programme on a storage drive/CD for the software.
- Manual for hardware & software tools required for making changes in the application software
- Spare parts catalogue
- Vendor details

Note:

The layout of the elementary diagrams shall include the schematic with a maximum of significant information (voltage, signal shape, etc.), location and nomenclature of components, printed circuit drawing with representation of components.

## 16. Training


The Contractor shall provide comprehensive training to the BEML staff to enable safe and efficient maintenance and operation of the equipment supplied as part of the contract to achieve maximum reliability and economy of cost. The Contractor shall submit for review and approval a training plan at least 2 months before the readiness of the equipment for commissioning. The training plan shall include:

- schedule of training courses,
- syllabus, size of class and duration of each capsule,
- training facilities to be provided by the Client,
- qualifications and experience level necessary for the trainees,
- instructor's qualifications.


Trainings shall be in two stages: -

The Contractor shall provide training to the BEML staff on operation & maintenance aspects of Fully Automatic Train Washing Plant independently at Purchaser's nominated depots as below.

- a) Class room training (minimum 7 days) –

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- i) Detailed explanation for installation, testing, maintenance and operation including assembly and dis-assembly of machine parts, schedule of maintenance, electrical diagram, hydraulic circuits, trouble shooting, and familiarity programming language.
  - ii) Full exposure to assembling stages of the plant for understanding the sequential integration of the subassemblies and systems including electrical interface.
- b) On Job Training (minimum 7 days) - proficiency in operation, maintenance and safety of Train Wash Plant
- i) Interfacing of the equipment safety features and interlocking thereof. Interactive sessions, which can enhance operational and maintenance skills of the employer's staff.
  - ii) The operation training shall cover: -
    - a. Complete operation cycles of the equipment and all features including safety features.
    - b. All faults diagnostic and their remedial measure.
    - c. Minor faults diagnosis and quick remedial
    - d. Remote diagnostic & operator guidance
    - e. Real time washing of trains under supervision of the instructor
- c) The training on maintenance aspect of the plant shall cover: -
- i) Training on general maintenance, replacement of faulty parts of different sub systems of the equipment ex-lubrication system, electrical, control electronic and its controls including PLC programming software reloading & backup etc. Maintenance training for day-to-day maintenance, servicing of Fully Automatic Train Washing Plant including major overhaul.
  - ii) Checking of all interlocking & safety features/systems available in the equipment and fault attending.
  - iii) Training on Proactive, predictive and breakdown maintenance aspects of the equipment based on past experience of the instructor.
  - iv) The training shall essentially include extensive training on maintenance and troubleshooting of lubrication system, hydraulic system, pneumatic system, safety interlocking, panel AC, electrical and control electronics, programmable PLC, software reloading and similar other aspects.
  - v) Two sets of operation and maintenance manuals along with softcopy shall be supplied besides adequate number of small training material booklet to all the trainees.
- The training shall consist of classroom training and practical hands-on training. The Contractor shall depute competent trainers to carry out training to a high degree of proficiency with competency certificate issued by OEM. During the warrantee period when the Contractor is responsible for fault finding and repairs, he shall provide practical hands-on training to the BEML maintenance staff.
- The Contractor shall also provide training courses and training materials to the BEML training instructors to a level of competence to allow the instructors to subsequently train the Purchaser's staff in maintenance and operation of the equipment.

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## 17. Maintenance During Defect Liability Period (DLP)

The following are the general maintenance requirement in line with Conditions of contract.

- 17.1. The Fully Automatic Train Washing Plant shall be maintained for the scheduled and unscheduled maintenance by the successful Tenderer during the Defect Liability Period (DLP) of 36 months from the date of handing over of last Fully Automatic Train Washing Plant to the Purchaser. Tenderer shall submit in the offer, details/organization to carry out the maintenance during the Defect Liability Period.
- 17.2. The Tenderer shall have to meet the time frame for breakdown/corrective maintenance as below: -
- Minor maintenance:** - Inclusive of repairing and replacement of all spares/ components and all defects other than major defects,
- a. Response Time (Max) - 6 hours
  - b. Attention Time (Max) - 8 hours
- Major maintenance:** - Detection of hydraulic leakage, refilling of oil, pipefitting, welding/brazing works, rewinding/replacement of motors etc. Basically, it covers attention to all types of major failures/breakdown.
- a. Response Time (Max) - 24 hours
  - b. Attention: Time (Max) - 48 hours (Should be in proportion with the type of failure)
  - c. The Contractor shall maintain bank of spares at BMRCL's designated premises to optimize the machine down time. The Contractor shall themselves arrange for any transportation, loading/unloading, spares, lubricant and other consumables, tools/ tackles, labour, garbage disposal etc during DLP.
- 17.3. During maintenance, the Contractor shall follow all statutory acts, regulations, codes and practices in force like IE rules, Electricity act etc.
- 17.4. The equipment entrusted to Contractor for repair at their workshop shall be at the risk and cost of the Contractor, if any deduction is required to compensate any loss on this account. The same shall be adjusted from balance payments or by means of forfeiting the performance bank guarantee.
- 17.5. The breakdown of machine due to unscheduled repairs shall not be more than 1 day for local supply and small foreign equipment, 3 days for other foreign equipment after receipt of information from the Purchaser. Delay in attending defects on the part of the Contractor will invite penalty.

## 18. Warranty

- 18.1. The Contractor shall warrant that all equipment and spares etc. supplied against the contract shall be free from defects and faults in design, materials, workmanship and manufacture and shall be of the highest grade and consistent with the established and generally accepted standards for goods of the type ordered and in full conformity with the contract specifications.
- 18.2. The warranty period shall be 36 months after the date of issue of successful commissioning and proving test certificate of the machine at site. Any approval of acceptance issued by BEML during the course of installation, commissioning & proving out test shall not in any way limit the Contractor's liability.

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- 18.3. In case where replacement of parts takes place during the warranty period, for replaced item and concerned sub-assembly shall extend further 36 months from the date of replacement of the defective parts. This extended period shall be known as extended warranty period.
- 18.4. The Contractor's liability in respect of any defects shall be to supply, install & commission any defective part free of any charge or the repair the defective parts, so as to ensure minimum down time of the machine
- 18.5. In case of delay in replacement/repair of defective parts, BEML may get the replacement carried out through any other outside agency. In such a case the cost of repair, replacement shall be borne by the Contractor.
- 18.6. Failure of the Contractor to meet with the warrantee obligations shall result in unsatisfactory performance of the contractor and the consequence of the same shall be applicable at the risk and cost of the contractor.
- 18.7. The decision of BEML in regard to Contractor's liability and amount if any payable under this warranty shall be final and conclusive.

#### **19. Spares during Defect Liability Period (DLP)**

##### **Consumables & spare for schedule maintenance / unscheduled maintenance: -**


- a) The consumable spares shall include lubricants, oils, greases, sealants, filter medias, gaskets and any other items whose declared life is less than one year.  
Contractor shall provide all the consumables at respective BMRCCL depots for the smooth functioning of plant /machine and also, the spares required for scheduled maintenance and unscheduled repair of Fully Automatic Train Washing Plant during Defect Liability Period whose price shall be included in the supply part of basic equipment.
- b) Tenderer shall quote separately for list of recommended spares with price for equipment supplied after completion of 3 years DLP. The price offered shall remain valid for a period of 2 years beyond DLP. BEML at its sole discretion reserve the right to purchase recommended spares or not. (This shall not be included in the financial offer).

#### **20. Part catalogue**

Tenderer shall provide part catalogue for Automatic Train Wash Plant, containing details all equipment. The first subsection shall be on alphanumeric part list, which shall include: -

- a) Part no.
- b) Description.
- c) Name and contact address of manufacturer.
- d) Quantity/unit with cost.
- e) Country of origin.
- f) Part of next higher assembly.
- g) Cross reference to figure no.
- h) General or specific purpose.



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- i) Purchase and technical specification  
for every item of Automatic Train Wash Plant

**21. BMRCCL- Employer Requirement General Specification (ERGS), ATWP:**

The Fully Automatic Train Washing Plant shall comply in all respects with BMRCCL- ERGS and PTS.

**21.1. Scope of Work:**


Design, Manufacture, Supply, Installation, Testing and Commissioning of Fully Automatic Train Wash Plants along with supply of tools, software and O&M manuals, training of Operation and Maintenance (O&M) personnel.

**21.2. Description:**

The Fully Automatic Train Washing Plant is designed to carry out automatic washing of body Pre-wet, Front/Rear Application, Roof Brush Application, Side Brush Application, Roof Brush Application, Side Brush Application, Roof Brush Fresh Water, Side Brush Fresh Water First Rinse Fresh Water, Final Rinse RO Water, Blower Station of the Metro Coaches.

The Fully Automatic Train Wash Plant shall have the following minimum features but not limited to while working.

- a) The Plant is used to wash trains (130.4m length) for a minimum of 3 Nos 6 car Train sets (130.4m length) each per hour and is available for 24 hours in a day.
- b) The Plant is of drive-through type and operated in a single direction of train movement. The plant is designed to the satisfactorily wash the train running through the plant under its own power at a specified washing speed. (3 – 5 km/h).
- c) The wash plant shall allow trains to pass through the plant in either direction at a maximum speed of 25 km/h without the washing.
- d) The wash plant contractor shall design for washing trains operating on CBTC & Distance-to-Go signaling system.
- e) The train-washing plant is designed for automatic, semiautomatic and manual mode washing process with selection switches. In automatic mode, the automatic wash cycle is activated by the train movement in to wash plant and deactivated by wash plant exit command. In semiautomatic mode each stage of washing sequence shall be activated and deactivated by wash plant operator and manual mode shall be for maintenance.
- f) Selection switch for wash/No wash shall be provided.
- g) Monitoring of details i.e., status/health, operating hours of the plant is monitored at control panel along with audio, Visual Display Unit (VDU) and Printer facility to be supplied by the Contractor.
- h) Complete graphical Indication of completion of washing cycle is available at control console. The Plant is equipped with all safety provisions for safeguarding equipment as well as the operator.
- i) In the event of lack of water, the pumps of the corresponding stations shall be automatically shut down and the corresponding brushes shall be retracted.
- j) The plant shall be protected against deterioration of the structure and base due to chemical contacts, site and operation conditions.

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k) The brush material shall be soft enough so that it doesn't make mark on the car body.


**21.3. The Fully Automatic Train Wash Plant shall include following minimum features:**

- a) Pre-wet Station
- b) Front and Rear (Gantry) wash station with water & detergent.
- c) Roof brush water and detergent application
- d) Side brush water and detergent application
- e) First Rinse Fresh Water
- f) Final Rinse RO Water
- g) Blower Station
- h) Pump Work
- i) Piping and Steelwork
- j) Control Console (DDC & Local)
- k) Electrical / Electronic Equipment
- l) Water treatment stations.

**22. Delivery schedules / key dates**

M&P- Fully Automatic train wash plant for Kothanur, Baiyappanahalli and Airport Depots

| Key date no. | Stage  | KOTHANUR | BAIYAPPAN AHALLI | AIRPORT  |
|--------------|--|----------|------------------|----------|
| KD – 1       | Obtain Purchaser's approval on the overall design of the machine including Hydraulic, Pneumatic, Electrical Supply, Control system, General Arrangement Drawings (GAD) and machine foundation drawings with detailed requirements in accordance to the Technical Specifications. | 2 Weeks  | 6 Weeks          | 6 Weeks  |
| KD – 2       | Submission of detailed design drawings and documents of the machine as per Technical Specifications.   | 6 Weeks  | 12 Weeks         | 12 Weeks |
| KD – 3       | Supply of machine along with DLP spares, recommended spares and mandatory spares and submission of Operation & Maintenance manuals and as built design documents including catalogues of bought out items.   | 20 Weeks | 32 Weeks         | 72 Weeks |
| KD – 4       | Installation, testing and commissioning including integrated testing and commissioning of the machine as per Technical Specifications.   | 28 Weeks | 42 Weeks         | 82 Weeks |
| KD – 5       | Training to Purchaser's O & M personnel.   | 30 Weeks | 44 Weeks         | 84 Weeks |

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Schedule of access dates for installation, testing and commissioning of the Auto wash plant.

| SN. | Site areas      | Access date | Vacate date | Reason for vacation  |
|-----|-----------------|-------------|-------------|--|
| 1   | Kothanur        | 18 Weeks    | 32 Weeks    | Completion of the supply, installation, testing and commissioning of the work. |
| 2   | Baiyappanahalli | 30 Weeks    | 46 Weeks    | Completion of the supply, installation, testing and commissioning of the work. |
| 3   | Airport         | 70 Weeks    | 86 Weeks    | Completion of the supply, installation, testing and commissioning of the work. |

The dates given above are the week from commencement date of the Supply as per PO/Contract date.

Note:


1. The precise duration and location of access requirements shall be developed and be mutually acceptable to the Contractor and purchaser as required by Technical Specifications.
2. The date of delivery requirement may reschedule to any location (prepone/postpone) **based on readiness of respective depots.**
3. The areas of the Site to which the interface access dates apply are indicated within the Schedule of Access Dates and Technical Specifications.
4. Not less than two weeks or an appropriate period before access is due and on the date for access to an area of interface, the Contractor, the relevant Designated Contractor, the Purchaser and / or Relevant Authority shall inspect, assess, confirm and record the state of readiness achieved to the permanent works, temporary works, access arrangements and provision of attendances.

### 23. Interface & Coordination

The contractor shall co-ordinate interactively in order to achieve the functional and operational requirements of the system. The roles and activities of the two contractors shall include minimum following but not limited to:

#### 23.1. Interface with Designated Depot Civil Contractor


| Stage                        | Machinery Supplier  | Civil Contractor   |
|------------------------------|---|--|
| Design                       | Shall furnish GADs including detail foundations, drain point and other Civil works, electrical power requirements, and other requisite details to Depot contractor. | Shall consider the space, foundation, power, water and any other utility requirements in the design of depot facilities.   |
| Commissioning & Installation | Provide plant GAD and other details as required   | Demarcation of ATWP area according to Depot layout.<br><br>Construct the foundation requirement to install ATWP as required.<br><br>Control room for operating station of ATWP<br><br>Cable Trench for laying of cables & wires of the plant<br><br>Inlet water reserve to be provided & suitable piping to the inlet point / Tank |

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|  |  | <p>of the ATWP as per the suppliers GAD.</p> <p>Collection point for waste water</p> <p>Waste water drain / piping to transfer the waste water to the Depot ETP.</p> <p>Power connection within 15m of the plant panel as per the electrical load ratings provided by the supplier.</p> |
|--|--|---|

**23.2. Interface with Designated Depot E&M Contractor**

| <b>Stage</b>                 | <b>Machinery Supplier</b>   | <b>E&amp;M Contractor</b>   |
|------------------------------|---|---|
| Design                       | <p>Shall furnish the following requirements for Depot E&amp;M Contractor:</p> <p>GADs, layout drawings of M&amp;Ps</p> <p>Load requirement (normal, DG, UPS supply)</p> <p>Power sockets</p> <p>Fire protection</p> <p>Lighting &amp; ventilation</p> <p>Earthing</p> <p>Water &amp; Piping</p> <p>Any special requirement related to E&amp;M</p> | <p>Shall interface with M&amp;P contractor and factor in the relevant requirements in E&amp;M designs</p> <p>Shall prepare detailed drawings for cable routes, trenches, cable support infrastructure, earthing arrangement, lighting, ventilation, fire protection etc.</p>  |
| Commissioning & Installation | <p>Provide plant GAD and other details as required</p> <p>Install the power and control panel cables for the M&amp;P</p>  | <p>Provide Lighting, ventilation, fire protection system, power sockets, earthing systems etc. as required (considering day and night working)</p> <p>Provide Cable support infrastructure for laying of cables &amp; wires of the plant</p> <p>Provide Inlet water reserve &amp; suitable piping to the inlet point / Tank of the ATWP as per the suppliers GAD</p> <p>Provide Collection point for waste water</p> <p>Provide Waste water drain / piping to transfer the waste water to the Depot ETP if in the scope of E&amp;M contractor</p> |

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|  |  | Provide power connection within 15m from the plant panel, as per the electrical load ratings. |
|--|--|---|

**23.3. Interface with Designated Track Work (TRW) Contractor.**

| Stage                        | Machinery Supplier  | Track Work (TRW) Contractor  |
|------------------------------|---|--|
| Design                       | <p>Provide plant GAD and other details as required, study the GFC drawings of track slab and suggest for any modification required.</p> <p>Coordinate with TRW contractor for Track laying programs and track alignments. Connection of drainage to drain point</p> | To provide details of track slab and carry out possible modifications as suggested by M&P connector. |
| Commissioning & Installation | Shall manufacture and install / commission the respective M&Ps as per agreed interfaces.  | Shall Install the tracks as per agreed interfaces  |
| Testing & Commissioning      | Shall lead the testing & commissioning of respective M&Ps and collaborate / associate with BEML as required.  | Shall collaborate and associate for testing & commissioning of respective M&Ps as required.          |

**23.4. Interface with Rolling Stock (BEML) Contractor**

| Stage  | Machinery Supplier                                       | Rolling Stock Supplier-BEML  |
|--------|--|--|
| Design | Provide plant GAD and other details as required by BEML. | <p>Define special water quality requirements if any.</p> <p>Share the drawings of Train.</p> <p>To provide details of the infringing objects if any, which cause hindrance to the washing.</p> <p>Share rolling stock dimensions, profile SOD and other details to design wash plant.</p> <p>Provide the details of the detergents to be used.</p> |

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**23.5. Interface with Designated Signalling Contractor:**

| <b>Stage</b>  | <b>Machinery Supplier</b>   | <b>Signalling Contractor</b>   |
|---|---|--|
| Design  | Provide control console at DCC and complete wiring from wash plant to control console,  | Provision of interface drawings for DCC layout for wash plant panel location |
| Control of trains entering /leaving to washing bay. | Provide a/l information or potential free contacts for control train movement entering/ leaving to washing bay in case of Driver less train/unattended train operation. | Provision of interface with wash plant Contractor.                           |

**24. Submittals with Technical offer:**

- i. Contractor shall submit Clause by Clause compliance matrix of all the applicable clauses of PTS.
- ii. All GADs drawings including detail foundations to be submitted during technical evaluation.

NOTE: Latest GAD drawing of all 3 Depot BMRCL 5RSDM project will be shared during Design and Interface stage.

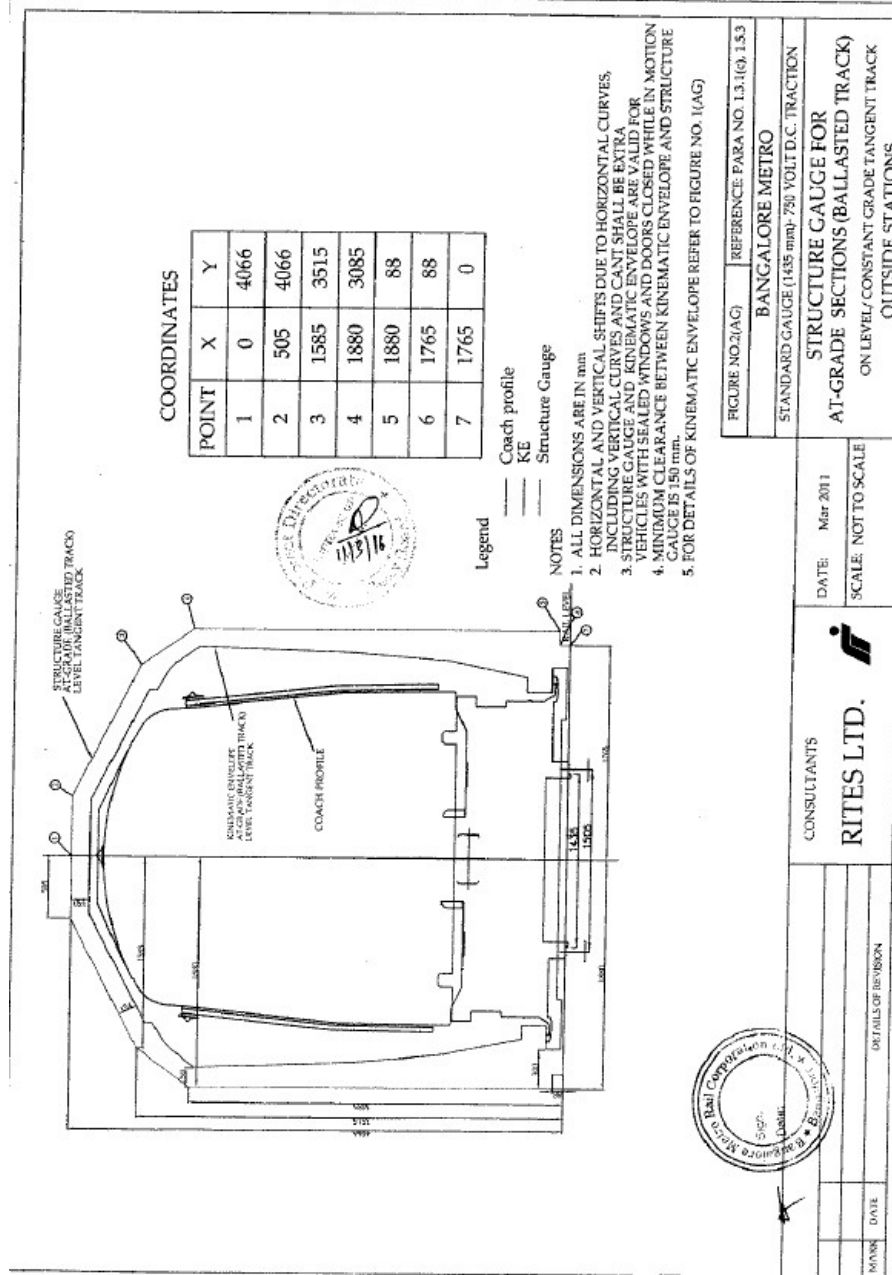


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**Appendix-1**

**Kinematic Envelope of Rolling Stock**





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