

Volume-III C
Employer's Requirement and Technical Specifications
For 24x7 Water Supply

1. SCOPE OF WORK, EMPLOYERS REQUIREMENT AND INSTRUCTION TO BIDDERS FOR 24X7 WATER SUPPLY

1.1 Brief Scope of work:

Scope of work includes Refurbishment of existing network in ABD and Outer Area including all work of Mechanical, Electrical, SCADA, Household Connections, Consumer Water Meter Fittings work with three months trial run and post completion Management of 24 x 7 Water Supply in Smart City for a period of 5 years including 5 years defect liability period on DBO basis.

The works under Contract comprises the Survey, Designing, Providing, Lowering, Laying, Jointing, Testing and Commissioning of Distribution Pipeline, Instrumentation and SCADA Works, Mechanical Electrical, House Hold connections, Meter Installations including all allied civil works complete and post completion Operation & Maintenance for five years for 24*7 Water Supply Scheme of Mor Raipur City Center Area, Raipur on Design, Build & operate Basis.

The Work Shall be executed on Design, Build, and Operate Basis. Details and drawings given in Tender document are for information purpose only and successful bidder shall undertake confirmatory survey for accuracy and completeness of data. It is in scope of successful Bidder to undertake all site surveys, route surveys for ascertaining the terrain and planning the scheme as well as to conduct geotechnical investigations. The Contractor shall carry out the design and submit to the client, along with all the good for construction drawings for all the components of the work as per Employers requirement and submit the same to client for review and approval.

1.2 Site Location

At present the ABD Area is being supplied from Four (4) different ESR's, whose capacities, staging height and locations are as listed below :

S.No	Particulars	Capacities (ML)	Staging Ht (m)
1.	Moti Bagh ESR	5.1	25
2.	Ganj ESR	3.4	15
3.	Devendra Nagar ESR	3.4	15
4.	Bairen Bazar School ESR	3.4	15

For MRCC/ABD Area fairly all the streets are well connected with Pipe Water Supply. Currently these areas are receiving water from the four Reservoirs as listed above. During Summer Months in some areas acute shortage of water is observed, which is mainly due to uneven distribution of Pipe Lines in the area coupled with high leakage loses in Distribution system (mainly due to old age of pipes, tampering of the line etc.), In order to mitigate the same Tankers are supplied at regular intervals by Municipal Corporation of Raipur.

1.3 Detail Scope of Work

The Scope of Services (SoS) described hereunder is neither exhaustive nor complete and is

indicative only. The Contractor shall undertake detailed investigation of the Project Facilities, study, make assessments and ascertain all by itself the required tasks, interventions, inputs, and all other necessities to determine the complete Scope of Services for achieving the Minimum Service Levels as stipulated in Volume II(B) Operation & Maintenance Conditions.

The Services shall include all technical, managerial, administrative, commercial, social interventions as required in accordance to acceptable, prudent water utility management practices for ensuring safe and sustainable drinking water supply services to approximately total number of 24000 Consumers in the project area of RMC/RSCL.

Part-2 Area : Scope of Contract during Design & Construction Period

S.N.	Components	Indicative Quantities
1.	Preparation of System Improvement Plan SIP within specified period and according to the contract conditions. SIP Preparation & Implementation shall include but not limited to the Survey & investigations of existing assets, distribution network, mapping, freezing selected DMA boundaries, Hydraulic Modelling, ascertain the necessity and the extent of rehabilitation required. SIP submission for priority zones shall be within 90 days.	7.0 sqkms
2	Instrumentation and SCADA work for Distribution Network, installation of flow control valve, flow meter, construction of SCADA control room, valve chamber and flow meter chamber.	7.0 sqkms
3.	Provide/Replace consumer service connections on approval or sanction by Employer (RMC/RSCL) with consumer water meter, DI Strap saddle, Ferrule, G pipe, ball valve, meter box etc.	Approx. 14000 No's
4.	Finding invisible leaks in pipeline network, carrying out repairs and allied works in Project area	150 Km

Note:- 1. Quantities indicated in the Table above are indicative and need to be confirmed by Contractor through SIP.

2. All components of implementation of SIP are to be understood including commissioning and duly approved by Engineer / PMC.

1.4 Scope of work during Operation & Maintenance period

From the design, construction completion date (which shall also mean sectional/

priority works completion date of priority zone) the Contractor shall take over the Operation and maintenance services from RMC/RSCL for the project area within selected DMA's. Contractor shall be responsible for operation, maintenance and management of water supply in project / service area as detailed below. Contractor shall act as back office support to RMC/RSCL while managing the customer related services or complaints. The Scope of O&M shall include but not limited to the following: -

Part-2 : Scope of Works under Operation Phase

No	Obligation	Period
1.	Operation and Maintenance of Entire system including water distribution pipeline network (155 km), mechanical / electrical / instrumentation works and SCADA System for 05 years.	7.0 sq.km. project area
2	O & M of the distribution network for distributing water efficiently, equitably and minimizing water loss / non-revenue water (NRW), providing expert services for leak detection, reduction and maintaining the infrastructure on DMA basis	From initial takeover date
3	Providing continuous (24 x7) pressurized water supply to the connected consumers and maintaining the infrastructure	From initial takeover date
4	Detecting and monitoring non-revenue connections and consumption and inform such connections to RMC/RSCL and install meters to measure	From initial takeover date
5	Operation and Maintenance of House Service Meter Connection for 05 years.	Approx.21000 connections of different sizes+ Approx.3000 Commercial connections
6	Bill generation of Water Supply for 05 years	Approx.21000 connections of different sizes+ Approx.3000 Commercial connections

The Scope of Services shall include all technical, managerial, administrative, commercial, environmental, and social interventions as required in accordance with acceptable, prudent water utility construction and management practices, ensuring safe and sustainable bulk drinking water supply services to total number of 24,000 (approx.) connections spread out in the Project Area. The Scope of contract mentioned in Tables above is indicative only and the Contractor is required to undertake his own detailed investigation of the Project Facilities to determine the complete Scope of Services for achieving the Minimum Service Levels.

1.5 Phasing of contract Works

The Contract is divided into two phases ;

- i. Design & Construction phase
- ii. Operation & Maintenance Phase spread over the contract period; from the stipulated date of Contract Commencement up to the Contract Completion Date.
Design & Construction phase includes;
 - I. Mobilization, consumer survey, topographical surveys, investigations, mapping, preparatory works for DMA Establishment works and construction period as per approved service improvement plan (SIP) and
O & M Phase includes;
 - II. Operation, Maintenance, Manage, Repairs of the entire water supply system (all civil works, pipeline network, mechanical / electrical / instrumentation and SCADA system) and consumer meter connection and Monitoring and Service Delivery Period during the contract period as per the sectional / priority completion of work.

1.5.1 Mobilization Phase

During mobilization period Contractor is required to:

- ☐ Arrange / rent for Office space within project area
- ☐ Establish a furnished project office in Raipur city limit
- ☐ Employ the staff required for starting the preparatory work
- ☐ Mobilise the team for survey and investigations
- ☐ Mobilise the teams for baseline studies of selected priority DMAs
- ☐ Provide the computer hardware, software required for, mapping preparation, hydraulic modeling, project management etc. along with connectivity
- ☐ Provide vehicles to RMC/RSCL as per set up requirements
- ☐ Establish furnished Engineer's office
- ☐ Start of Baseline study works for priority DMA's

Baseline study and SIP phase for Priority DMA's

- ☐ Survey, investigations, mapping
- ☐ Door to door consumer survey
- ☐ Distribution network assessment
- ☐ Freezing of boundary of DMA
- ☐ Water inlet / outlet flow measurement
- ☐ Pressure measurement,
- ☐ Design, drawings, hydraulic modeling, System Improvement Plan.

1.5.2 Preparatory Phase for DMA Establishment Phase

During the Preparatory Period, the Contractors required to:

- ☐ Be Familiar with the project site condition after required consultation
- ☐ Collect data and maps, reports, freezing of boundary etc.
- ☐ Conform/ conduct survey to ascertain the data, information, designs, existing services etc.

- ☐ Network mapping surveys and investigations, isolation of areas
- ☐ Install boundary valves, flow meters, zero pressure test etc.
- ☐ Conduct door to door survey and prepare data base of the existing properties with service connections details, using base map image of the service area
- ☐ Review the detailed project report in water supply provided by RMC and prepare a Distribution Network Improvement Plan for water supply
- ☐ Prepare System Improvement Plan in water supply
- ☐ Prepare an asset inventory report, baseline water balance and strategy for improving services with a focus on improving Consumer services.
- ☐ Submit revised SIP

1.5.3 Final System Improvement Plan

Deliverables of Final SIP phase are:

- ☐ Final output for survey, design, drawings, mapping etc.
- ☐ Hydraulically Distribution network and frozen boundaries for DMA
- ☐ Completion all baseline studies, demand assessment etc.
- ☐ Hydraulic Network model built on Digital Elevation model (DEM)
- ☐ The results of flow and pressure management, water balance
- ☐ Improved pressure management plan, SCADA plan
- ☐ Implementation plan, procurement plan, design drawings, as built etc.

Sectional Completion of DMA or Requirements for Initial Take Over of DMA's

Requirements of this phase are:

- ☐ Hydraulically district network establishment
- ☐ Completion of zero pressure test
- ☐ Completion of construction works
- ☐ Water balance
- ☐ Commissioning of selected DMA and etc.
- ☐ SCADA installed
- ☐ Achieving 24 x 7
- ☐ Commissioning of selected DMA Water loss detection & reduction.
- ☐ Taking over of O & M of DMA

1.5.4 Design & Construction Work Phase:

Requirements of this phase shall be completion of ;

- ☐ SIP should be approved & started for execution based on Employer's requirement including priority work completion requirement. The civil construction works will start simultaneously with the preparation of SIP.
- ☐ Detailed design, survey & investigations, drawings and cost estimates of work and improvement as a part of Value Engineering should be completed to meet the Performance Standards.
- ☐ Door to door consumer survey for 24,000 (approx.) number connections shall be completed

- ☐ Work plan, Methodology and timelines for implementation should be in line with the employers' broad concept /requirement, GCC & PCC.
- ☐ Detailing of integrated Contract Management Information System by using latest software like Primavera, Microsoft office architecture, data capture, management and reporting structures, protocols including all related hardware, software, installation;
- ☐ Contractor Personnel deployment plan;
- ☐ Construction Plant and equipment deployment plan;
- ☐ Cash-flow for both parts;
- ☐ Detailed methodology for continuous monitoring of the performance of the Contractor in achieving and maintaining the Performance Standards for release of the eligible Operating Payments;
- ☐ Compliance matrix of contract and service requirement, O&M requirement and other requirement like social, environmental etc. and;

1.5.5 Operating and Management Phase:

- i. Annual Operating Plan (AOP) covering all operations, maintenance and management requirements in the selected DMAs of operational zones within project Area for 24,000 (approx.) number of connections;
- ii. Emergency Response Plan (ERP);
- iii. Consumer Management Plan;
- iv. Standard Operating Procedures (SOPs) for routine operations and emergency responses;
- v. Water Quality Surveillance Program;
- vi. Energy optimization program;
- vii. Connections policy for all types of connections including services to the urban poor and treatment of illegal connections;
- viii. Network expansion policy;
- ix. Detailing of an Integrated Management Information System (MIS) including computerized water distribution management software, its architecture, data capture, management and reporting structures, protocols including all related hardware, software, installation, and operation and maintenance requirements; and
- x. Periodic reporting plan including the formats for different performance reports.

The computer hardware and software improvement plan for continued operation of the MIS, instrumentation, SCADA & Web Server etc.

1.5.6 System Improvement Plan (SIPs) requirements

- i. Works of priority DMAs on immediate basis- The Contractor is required to validate and finalise and execute the works in selected DMAs on priority as specified by RMC/RSCL and shall responsible to start baseline study of these selected DMA's and submit / prepare the SIP on immediate basis. After approval of SIP all procurement and construction works of this priority DMA's shall be on top priority. The work of such DMAs should be completed within stipulated time as suggested in Contract Milestone.
- ii. In case of any interventions proposed in the SIP, which are not part of the DPR or those interventions which are part of the DPR but require improvement from conventional design practices, the Contractor shall provide sufficient explanation and justification as to how implementing such interventions would influence the achievement of the Performance Standards stipulated in the document.
- iii. In a situation where the Employer does not agree to the interventions proposed in SIP, there may be mutually agreed revision of the Performance Standards.
- iv. The Scope of Services during the implementation Period shall essentially comprise of implementing the approved SIP based on the hydraulic model prepared for water distribution based on DMA approach. SIP will be implemented in accordance to international best practice and industry standards and sufficient care shall be taken by the Contractor in minimizing supply interruptions, traffic disruptions and ensuring good and timely communications with the Consumers in the Service Area. During work execution, Contractor would be required to inform the residents, say, of a particular street, well in advance about the type of work, inconvenience expected, timelines for various works, etc. Contractor to have a strong Public Relations and Community Outreach team. Contractor will plan sequencing of activities to synchronize water pipeline works with other related works to minimize the road excavation and restoration in the streets.
- v. All the Works and interventions proposed as part of the SIP shall be in conformity with the
- vi. Specifications set out in the Employer's Requirements.
- vii. After implementation SIP plan and upon successful commissioning of DMA's for continuous water supply within stipulated constructed period or actual commissioning period whichever is earlier shall be handed over to Contractors for further Operation and Maintenance per DMA wise.
- viii. The Contractor shall submit the draft SIP within 90 days for Priority DMA first from the Contract commencement date and within next 90 days for complete DMA's / operational zones to allow the Employer to undertake a thorough review of the SIP and suggest amendments if any.

1.6 Bulk Supply point and Boundary Limits

Scope of Contractors obligations starts from the Bulk Water Supply point i.e. ESR/ GSR Inlet point onwards for total 21,000 (approx.) number of connections+ Approx.3000 Commercial Connections. Boundary Limits for undertaking planning, validation of baseline data, verification of designs, construction, rehabilitation, distribution, operations, maintenance and management by the Contractor, include the water supply operational zones as marked project area and extending up to the customer boundary limits including the customer meter if installed on the existing connections and up to the customer meter in all the new or rehabilitated connections of selected Operational zones.

Selected operational zones (Tentative) as indicated above and mentioned below are subject to change / modify within 24,000 (approx.) number connections as per requirements of RMC/RSCL.

Details of Selected Water districts / operational zones is as following;

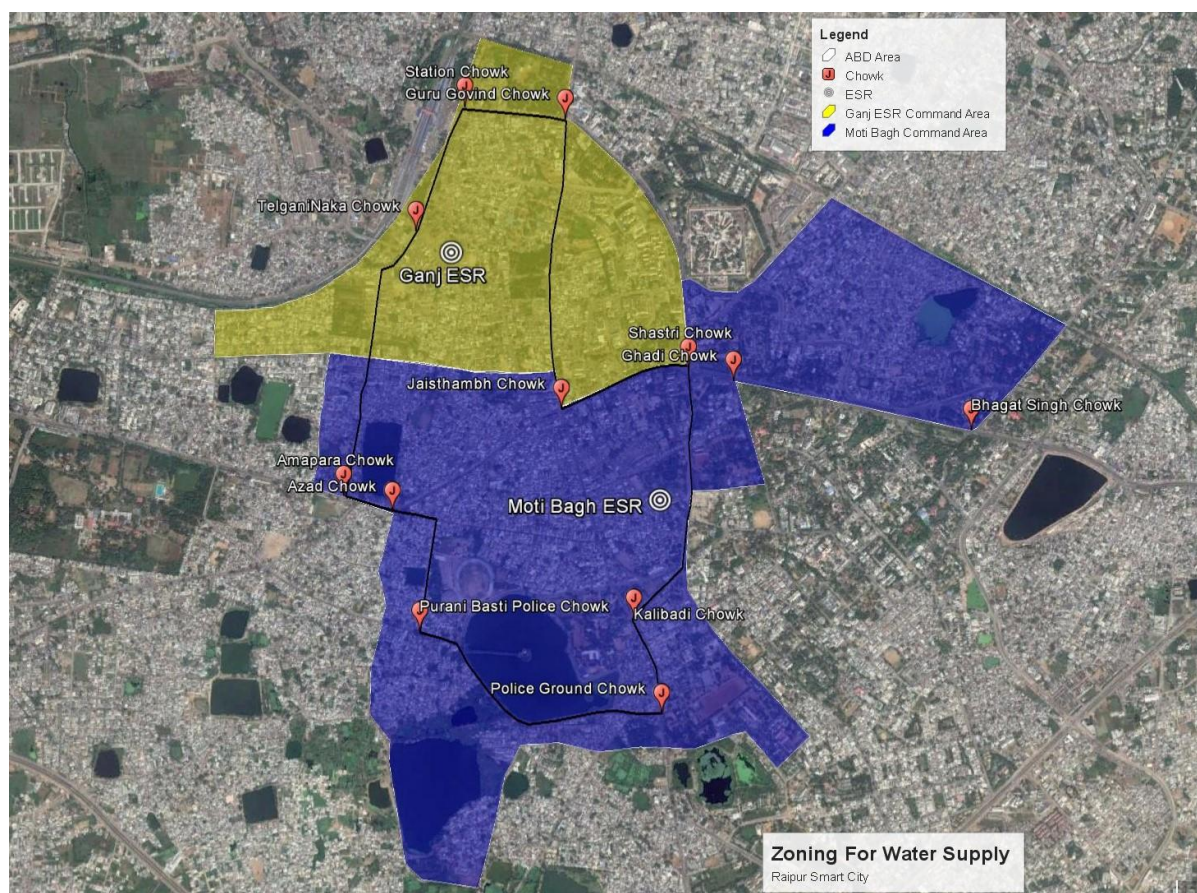


Table 8. Tentative Operational Zones.

Ganj ESR Command Area :

ESR Name	Ward No.	Percentage of Area Covered	Population 2011	Population 2020	Population 2035	Population 2050
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Ganj	Ward No.20	100	9541	11231	13477	16170
Ganj	Ward No.17	100	8709	9376	10782	12400
Ganj	Ward No.36	100	9716	10678	11746	13510
Ganj	Ward No.37	80	6142	6200	6820	7504
Total			34108	37485	42825	49584
Population of ABD Area Under Gunj ESR			17174	18749	21644	25023
Population of Non-ABD Area Under Gunj ESR			16934	18736	21181	24561

Moti Bagh ESR Command Area :

ESR Name	Ward No.	Percentage of Area Covered	Population 2011	Population 2020	Population 2035	Population 2050
Moti Bagh	Ward No.37	20	1535	1550	1705	1876
Moti Bagh	Ward No.38	55	7586	7598	7674	7749
Moti Bagh	Ward No.39	100	8037	8059	8139	8220
Moti Bagh	Ward No.40	75	6820	7516	9020	10822
Moti Bagh	Ward No.41	100	8602	8688	9123	10040
Moti Bagh	Ward No.42	30	3640	4002	4402	4842
Moti Bagh	Ward No.49	70	9067	9333	10266	11291
Moti Bagh	Ward No.57	100	7594	8000	8400	8820
Moti Bagh	Ward No.58	60	5310	5320	5373	5424
Moti Bagh	Ward No.61	40	4522	4746	4984	5232
Moti Bagh	Ward No.62	70	14053	15489	17812	20482
Total			76766	80301	86898	94798
Population of ABD Area Under Motibagh ESR			39978	40956	42985	45540
Population of Non-ABD Area Under Motibagh ESR			36788	39345	43913	49258

Sr. No.	Description of Operational Zone	Remarks
1	Moti Bagh ESR Command Area	Infrastructure facilities (i.e. WDS, ESR, Pipeline Network, Mech./Elec./Inst./SCADA) for 24 x 7 Water Supply to be Implemented
2	Ganj ESR Command Area	

Note:- Above operational zones / water district areas are tentative and shall be subject to addition of additional zones depending upon technical feasibility for bulk water supply and hydraulic modeling for total 21,000 (approx.) Residential + Approx.3000 Commercial number of connections.

Boundaries for selected operational zones shown above are tentative and indicative only. Finalization of boundaries of selected operational zone is responsibility of Contractor. Contractor while assessing the operational feasibility shall verify the boundaries of DMA's for hydraulically districts zones. In the process, if any adjoining area is being affected for water supply, it is in the scope of Contractors to make alternative arrangement of water supply for the area affected. Drawing of selected Operational Zones is enclosed.

The project area under selected operational zones is within the existing jurisdiction of Raipur Municipal Corporation which may decrease or increase at its sole discretion for total 21,000 (approx.) numbers of connections.

1.6.1 Preparative Activities

The Contractor shall establish contact with all relevant stakeholders and become familiar with the RMC/RSCL water supply system, and the applicable standards and guidelines for water supply design, and with past and current on-going works in the Service Area.

The Contractor shall satisfy itself to the nature and scope of work and the prevailing site conditions.

The contractor shall be deemed to have carefully examined the work & site conditions including labour, the general and the detailed specifications, schedules & drawings & shall be deemed to have visited the project area /site of the work & to have fully informed himself regarding the local conditions & carried out his own investigations to satisfy himself. In this regard, he will be given necessary information to the best of knowledge of Employer/RMC/RSCL, but without any guarantee about it. If the Contractor have any doubts as to the meaning of any portion of the general conditions, the special conditions, the scope of work, the specifications and drawings, or any other matter concerning the contract he shall, in good time before submitting his tender, set forth, the particulars thereof and submit them to the Engineer in writing, in order that such doubts may be clarified authoritatively before or during prebid meeting. Once a tender is submitted the matter will be decided in accordance with the tender conditions.

The Contractor shall liaise with the RMC/RSCL, the local traffic police and other government Agencies regarding governing laws and regulations in order to undertake studies and construction activities under the Contract such as:

Environmental and social impact assessments and prevention, mitigation and monitoring of impacts during construction;
Compensation for damages to property;
Occupational health and safety including workers compensation;
Consultation of beneficiary populations; and
Signage for construction works.

There are several other water supply related works on-going or have been recently been completed by RMC/RSCL for the entire water supply system. The Contractor shall review all the reports and ensure that the Construction Plan, the Operation and Maintenance Plan and the Training Plan to be prepared by the Contractor do not duplicate any measure already financed and implemented. The Contractor shall also ensure that investments proposed as part of the Construction Plan are well coordinated and scheduled so that it can be adequately implemented, constructed, managed, supervised, monitored and finally be evaluated in terms of its impact.

The Contractor shall make a comprehensive assessment of details Drawings as provided under Volume-IV, performance and condition of existing water supply and distribution facilities. Contractors scope shall starts from Outlet supply point onward at service reservoirs (ESR's/GSRs). Bulk water up to service reservoirs shall be ensured by RMC/RSCL.

The Contractor will prepare three Plans,
Construction Plan describing implementation of all System Improvement Plan with emphasis on the time sequence followed for the implementation and completion of Works in the different Sections, taking into account the conversion of priority DMA's in continuous (24x7) pressurized water supply and laying of pipelines (primary mains to Selected DMA's).
Operation and Maintenance Plan, after successful commissioning of DMA's in continuous (24x7) water supply for selected operational zones;
Training Plan, describing all RMC/RSCL staff training activities to be conducted.

A preliminary draft of the Construction Plan or SIP Plan shall be submitted by the Contractor with the detailed time program as required under the Section 7 [General Conditions of Contract], in sufficient detail to support the detailed time programme.

A draft of the three Plans shall be submitted by the Contractor to the Engineer at least three (3) months from the Commencement Date for review and comments by the Employer. Any comments on the Plans will be furnished within one (1) month from receipt of the draft Plans and the final Plans shall be submitted by the Contractor at least five (5) months from the Commencement Date for approval.

The Contractor shall supply software for GIS, Hydraulic Modeling and maintenance management.

1.6.2 DMA Establishment Requirements

1.6.2.1 Assessment of Distribution System on DMA basis

The distribution network assessment and updation shall be based on DMA's selected under Project Area of RMC/RSCL. During this phase of the work the Contractor shall study the water transmission and distribution network within the Service Area i.e. selected operational zones to establish and improve network management and for ensuring the minimum Service Levels as specified under this contract to the Consumers within the Service Area.

The Contractor shall review previous studies and reports; interview the existing key staff in the Service Area; line staff, other consultants, companies, and Contractors currently working on the distribution system in order to prepare a baseline report describing the water transmission and distribution system including water sources, boundary limits, storage, and supply zones; and their condition to include pipe materials, dimensions, age, and condition; extent of Consumer water connections, meters and their operating condition; current estimates of illegal connections.

Contractor shall review the Detailed Project Report for project area and shall immediately start working on priority DMA's which can be easily converted into continuous water supply and submit the procurement plan on immediate basis. It is assumed that the available information and drawings in DPR are indicative and Contractor shall validate such information on pipeline location, length, diameters and materials on his own during baseline study. Contractor shall submit the condition Assessment Report of such network information.

The Contractor shall review the present network management practice and develop an improved robust network management practice for improving the services.

1.6.2.2 Distribution Network Improvement on DMA basis

The Distribution Network Improvement shall be executed based on priority DMA selected under operational zones. The Contractor shall finalise the boundaries of DMA while assessing the operational feasibility and proceed to isolate the same without affecting the adjoining areas for water supply. Contractor shall be responsible to provide alternative arrangement for such affected areas, if any, for water supply. The Contractor shall, set up hydraulically isolated District Metered Areas (DMAs) within the Service Area/ operational zone of each ESR. Each DMA comprising of about 500 -3000 consumer connections shall be considered as basic administrative unit for the purpose of sectional commissioning and management services. The Contractor shall design water supply distribution network on DMA basis to ensure equitable, continuous, pressurized water supply to the Consumers by using the hydraulic model and simulating both present (2020) and future (Year 2050) conditions,. Each DMA preferably have one inflow point and be isolated by installing valves / end plugs. DMA at entry point will be provided with a bulk flow meter. Each DMA will have at least five Critical Measurement Points (CMPs) for continuous logging of pressure, and the CMPs shall be such that they should be at the highest and farthest points from the command reservoir. The performance parameters of the Contractor including O& M period shall be started after successful commissioning of DMA's for

continuous water supply. DMA wise bimonthly reports will be generated to assess the DMA performance. Bimonthly meter readings will be taken and data shall be provided to RMC billing department. Contractor, Consultant / third Party also may suggest good management practices. Lessons learnt from other utilities/agencies will also be incorporated for better management services.

1.6.2.3 Establishment of DMA's in Operational Zones

The Contractor shall prepare the designs submit to the Employer and rehabilitate and build the distribution network for the priority operational zones while establishing DMA's in project area. Contractor shall immediately submit the procurement plan for these priority zones and start executing the construction works. This activity will be simultaneous with baseline studies of other DMA's and shall be completed within three months from the commencement date.

The Works will be implemented DMA wise. The Contractor shall be allowed to do works for Selected DMA's of Project area (tentative 10 operational zones) simultaneously and subsequently. Operational zones indicated below are tentative and are subject to add / modify depending upon feasibility of bulk water supply or as specified by RMC/RSCL within 24,000 (approx.) numbers of connections.

The Contractor shall make arrangements for maintaining the service of the presently connected consumers at the current level during the execution of the Works or arrange for alternative arrangement for water supply at his own cost.

The Contractor shall also lay pipelines for the extension of the distribution network to the areas presently populated but uncovered in terms of piped water supply services.

All installed pipelines and appurtenances shall be disinfected to the satisfaction of the Engineer.

All Works involving excavation shall be finalized through reinstatement of the surface to the initial condition.

The Contractor shall make arrangements for maintaining the service of the presently connected consumers under selected operational zones though not covered under DMA's finalised at the current level during the execution of the Works.

All Works involving traffic blocking shall be coordinated timely with RSCL/RMC/traffic department and traffic diversion measures shall be implemented by the Contractor. The Contractor shall endeavour at any time to maintain the inconvenience caused by the construction works at the lowest possible level.

1.6.2.4 DMA Creations

- a. One of the main activities of this Contract is the Creation of District Metered Areas (DMAs) for 24,000 (approx.) connections. The population projections and ward wise

water demand as included in DPR will be applicable. The Contractor has to confirm the DPR and define DMA boundaries actually on ground. If needed the Contractor has to redefine the DMA boundaries. The total number of DMAs are tentative to 8 numbers & Contractor may revise as per site condition. Total area can be increased or decreased within total number of 24,000 (approx.) connections at sole discretion of RMC/RSCL/Employer.

- b. The scope of work for each DMA established includes (but is not limited to):
 - i. Detailed site investigations, updating of distribution network drawings, complete with all trial holes that might be required to verify pipe connections (and the consequent re-instatement of road, sidewalk or any other surface);
 - ii. Hydraulic modeling as basis for optimum DMA design and determination of feeder main diameter. The Contractor shall use either Water Gems or any equivalent software that has the same functionality or better.
- c. Verification and finalisation of suggested DMA boundaries; locating of existing boundary valves, functioning and tightness checks of existing boundary valves, identification of location for additional boundary valves to be installed, identification of locations where the pipes will be disconnected and capped.
- d. Selection of location for DMA inflow chamber;

Identification of customer service connections that have to be re-located from a trunk or distribution main outside the DMA (or in a neighboring DMA) to a distribution main inside the DMA.

Site survey for DMA inflow point and location of underground assets

- e. Detailed design of:
 - i. All pipelines that have to be laid
 - ii. Location and installation details of new boundaries valves
 - iii. DMA inflow point arrangement design, pressure reducing valve chamber complete with all pipe work and structural design; inflow meter and PRV specifications; location and design of above ground instrumentation box
 - iv. Standard design and map with location of all customer connections to be relocated
 - v. All other civil, mechanical, installation or plumbing works that might be required
 - vi. Construction of FCV chamber, underground installation of electromagnetic
 - vii. Flow meter, construction of above ground instrumentation box; including supply of all required pipes, materials, fittings and equipment, as per the specifications
 - viii. Construction of the critical point above ground instrumentation box; including supply of all required materials, fittings and equipment, as per the specifications
 - ix. Execution of all other civil, mechanical, installation or plumbing works, including supply of all required pipes, materials, fittings and equipment required for DMA establishment, as per the specifications;
 - x. For all works carried out: reinstatement of road and sidewalk surface
 - xi. Supply and installation of all instrumentation and SCADA work as per Schedule.

- xii. Execution of zero-pressure-test and execution of all subsequent investigations and works should the first zero pressure- test have failed until the test is successfully performed.
 - xiii. Commissioning of FCV and controller
 - xiv. 50.14. Preparation of as-built drawings for all works executed.
- f. Where hydraulically possible, DMAs shall be single feed as proposed in the DPR. In cases where it is advisable (for hydraulic or other reasons) to establish multiple feed DMAs, the same shall be subject to approval by the Engineer.
- g. The Contractor shall verify the DMA boundaries specified in the DPR, on the pipelines to be kept in use: locating of existing boundary valves, functioning and tightness checks of existing boundary valves, identification of location for additional boundary valves to be installed, and identification of locations where the pipes will be decommissioned. No consumer connection pipe shall cross a district boundary. If a boundary is in the middle of the road, the main needs to be on the side of the road of the district to which it belongs, or the boundary should be behind the line of houses.
- h. The Contractor shall identify customer service connections that have to be re-located from a trunk or distribution main outside the DMA (or in a neighbouring DMA) to a distribution main inside the DMA.
- i. In preparation of Sections of DMA Works, the Contractor shall undertake a Consumer Water Connection survey in the concerned DMA. The parameters to be surveyed will at least include: type of Consumer (residential, commercial, governmental, etc.), geo-location, type of structure or dwelling, type of existing water connection. The Consumer Water Connection survey will determine the present status of water supply to each Consumer, whether they have an authorized water connection, illegal water connection or no water connection. The data so collected shall be shared / submitted to RMC/RSCL for transfer to GIS for web enabled application software and will be used at the time of rehabilitation of existing consumer connections and while releasing new consumer connections in future. The structure of data base and details of the Consumer Connection survey shall be finalized in consultation with the Engineer. RMC/RSCL shall provide the consumer connections list with unique ID of existing billing database for consumers of selected operational zones. Contractor shall maintain and update database of such consumers with same unique ID while pre-fixing any letter for further segregation /identification.
- j. In preparation of Sections of DMA Works, the Contractor shall undertake a detailed site condition survey in each DMA. The survey data shall be sufficient to develop a comprehensive Geographical Information System (GIS) clearly showing the location of underground and over ground water supply assets and all physical features like roads, culverts, drains, nalas, electrical transformers and any other relevant features which would influence installation and maintenance of existing and/or new pipelines. All key elevations with geo-reference shall be captured in the survey and the DMA service area maps are to be prepared in 1:2000 scale.
- k. For each DMA, the Contractor shall apply hydraulic modelling as basis for

verifying the optimum DMA design and determination of feeder main diameter. Flow velocities should be less than or equal to 2.0 m/s. Pressures shall not be less than 7 m. The Contractor can use the hydraulic model used by the Employer or may use either Water Gems or any other software that has the same functionality or better and transfer the results to the GIS system. The data pertaining to reservoirs, pipes, valves and demand locations shall be included in the model. DMA specific hydraulic models shall be integrated into one Overall Hydraulic Network Model covering the entire Service Area.

- l. A sufficient number of valves for future operation shall be provided for each DMA, in such a way to enable 4 or 5 steps for Step Test to be executed in leak detection campaigns.
- m. The complete detailed design of the each DMA thus verified shall be submitted to the Engineer for approval.
- n. Public awareness programs planned to achieve people's participation in managing demand by using the continuously available water to their absolute need only and not to waste, and to communicate importance of metered system and its benefit
- o. The Contractor shall construct the 5 pressure monitoring stations in each DMA including protection encasement and data logger facility.
- p. The Contractor shall construct the above ground instrumentation box at strategic locations, including supply of all required materials, fittings and equipment, as specified. However, if suitable place is not available for locating the above ground instrument box, the same may be placed in the Monitoring station chamber.
- q. Monitoring stations and meters shall be installed at safe locations onto the sidewalk where possible. Proposed instrumentation and SCADA shall be provided as per tender specification and items.
- r. After the finalization of the construction, the DMA will be commissioned according to the requirements set out for Testing and commissioning of this Section.

1.6.3 Consumer Survey requirements

A complete consumer survey to ground truth the footprints and the properties in the project area shall be carried out.

The Contractor shall undertake a door-to-door survey of all properties whether connected to the network or un-connected and obtain the details in regard to name, address, number of resident members, categories of general residential households (independent housing, group housing connections, societies and apartments), urban poor households, government housing, non-domestic, commercial, institutional, religious places, industrial and fire services and any other category of resident, consumers income status in the Service Area ,availability of water connection, metering status, estimated consumption levels, alternate water supply arrangements, willingness to pay, etc. The Contractor shall get the data from

RMC/RSCL billing department about the authorised water connection and their location of properties. The data collected from household survey shall be geo coded to the satellite image / base map. This database will be used for the water demand of each property to be collected at the junction of distribution network pipe and the system shall be designed and modelled accordingly.

1.6.4 Hydraulic Modeling requirements

- a. The Contractor shall develop a Hydraulic Network Model (HNM) for water supply system based on DMAs of Operational zones. The data related to water supply infrastructure like Reservoirs, Pumping Stations, rising mains and distribution system , valves and demand allocations shall be obtained through field baseline study and consumer survey captured on the network model.
- b. The hydraulic network modelling by using latest soft-wares shall be carried out by collecting the actual property wise water demand allocated to the nearest junction. Following broad guidelines may be followed during hydraulic modeling:
- c. The junction shall be placed at the branching out/ at the crosses at the valves and where there is a large straight length at every 200 m. The model shall be worked out by considering the domestic demand as 135 lpcd water supply and actual demand for commercial and industrial requirement.
- d. The hydraulic water use pattern for the day spread over 24 hours shall be based on the survey data captured through consumer habits of water use in different hours at present and by following the standard pattern, after continuous water supply is successfully implemented.
- e. The storage reservoir capacities shall be modelled to verify the water level in various hours. It shall neither be empty nor overflow. The incoming flow at constant rate shall be decided accordingly.
- f. The DMAs which are still to develop where the present water requirement is quite less as compared to the design demand, the present scenario with existing water demand shall be run and the incoming flow shall be adjusted accordingly.
- g. The minimum pressure in the distribution network when full demand in the zone cum DMA is developed shall not be less than 8 m of water column at consumer meter point. The excessive pressure in the typical areas shall be managed using the appropriate pressure management techniques at distribution system level and other at the individual connection level.
- h. All new connections shall considered and captured as additional demand in the model and updated model.

1.6.5 Pipe laying requirements

- a. After validation of DPR data and completion baseline study of distribution pipeline network, Contractor shall carry out the old pipeline replacement programme and

laying of new pipelines. The discarded pipelines may remain in the ground. The old pipe line shall be left open at both ends (not plugged) to ensure that it is not brought back into service.

- b. For successful transformation and operation of DMA's selected for 24 x 7 water supply, strengthening of primary network is suggested in the DPR. Construction of primary network shall be executed on top priority. Contractor shall be responsible to submit the procurement and time schedule for works within 60 days from the commencement date.
- c. The pipe network in the selected area shown in the enclosed drawing is as per DPR.
- d. Operation and Maintenance of above distribution network / pipeline laid / executed as per SIP shall be covered in Contractors O & M Plan.
- e. Ductile Iron class K-7 pipes as per detailed specifications will be used for new distribution pipelines and GI pipe as per specifications will be used for consumer service pipe lines.
- f. The Contractor has to plan and implement its pipe laying works in a detailed and strict manner as per approved SIP plan. The planning has to be coordinated with the Engineer and RMC/RSCL. The expected date of decommissioning of the existing pipeline and the commissioning of the new pipeline together with the exact location of the old and new pipeline have to be properly documented.
- g. Pipe laying and decommissioning of old pipes should be done in the following way:
 - i. Preparation of skilled labor, tools, fittings, dewatering pump, chlorine water solution (10 ppm), hoses, electric source, grinder, welding machine (where required) etc.
 - ii. Excavation around the pipe at the pre-determined location of disconnection. It has to be ensured that there is enough working space according to the pipe diameter and the method of disconnection.
 - iii. Marking on the pipe, showing the length of the existing pipe to be cut out. The length to be removed piece shall generally be of at least 1.5 meters.
 - iv. Cutting the pipe perpendicular to the pipe center line, using grinder, metal saw or cutter according to the pipe material. Extreme care is to be taken to avoid any dirt or foreign material entering the existing (and remaining) pipe.
 - v. Installation of the required fittings to plug the existing (and remaining) pipe. All new parts are to be submerged completely in the chlorine solution (10 ppm) for at least 15 minutes directly before being installed.
 - vi. Installation of thrust block, where required.
 - vii. Repair of any possibly damaged protection layer.
 - viii. Greasing of bolts and washers and installing of the protective coat.
 - ix. After the one week period, described hereafter, all temporary parts are to be removed.
 - x. The excavation shall be left open for about one week. During such time the pipe end has to be observed very frequently in order to ensure immediate recognition of a possible flow of water.

- xi. After the one week period and with the consent of the Engineer and his approval on the appropriate form, the excavation shall be backfilled and the surface brought back to former condition.
- xii. If, at certain points or situations, public safety does not allow for leaving the pipe ends open for the mentioned time, other means shall be found to control the appearance of water at the pipe ends. Possible solutions, to be decided on from case to case could be the following:
 - o Plug the end where there are restrictions in a temporary form and leave only one end of the decommissioned pipe open.
 - o A pipe connection in a side street can be used for observation.
 - o A temporary pipe could be laid to the shoulder of the road to bring the possible water flow to the open.
 - o Former house-connections could be prepared for observation, after the pipe ends are plugged temporarily.

1.6.6 Consumer Service Connections requirements

- a. The scope includes providing / replacing of 24,000 (approx.) Connections in project area. The actual number of connections may vary which may include many unauthorized ones. All existing service connections shall be replaced and new connections provided.
- b. RMC/RSCL will provide information about the existing authorized consumers. Contractor will use this information for verification of the same during consumer survey and also for identifying unauthorized service connections in existence during the Consumer Connection surveys. The results of such verification of authorized connections and identified unauthorized connections will be submitted to the Engineer and RMC/RSCL for further needful action.
- c. Existing authorized Connections: Contractor will replace the existing service pipe lines from distribution main pipe lines to the consumer premises with new saddles, ferrule, stop cock, GI pipe. as per detailed specifications for the authorized consumers from the newly laid distribution pipe lines under a DMA. The work shall include excavation and cutting of road surface as required, making connection with distribution line under pressure, installation of service pipe and accessories including water meter and refilling the ground and bringing the road surface to original condition. This work will be done DMA wise on completion and commissioning of transmission main feeding the DMA. A water meter with a meter box will be provided at the end of the consumer service pipe line securely inside premises of the Consumer as per detailed specifications.
- d. New Service Connections: Contractor will provide new service pipe lines from distribution lines to the consumer premises with new saddles, ferrule, GI pipe, stop cock etc. as per detailed specifications for the unauthorized consumers from the newly laid distribution pipe lines under a DMA on receiving approval from RMC/RSCL. This work will also be done DMA wise on completion and commissioning of transmission main feeding a particular DMA. A water meter with a meter box will be provided at the end of the consumer service pipe line securely inside the premises of

the consumer as per detailed specifications. The work shall include excavation and cutting of road surface as required, making connection with distribution line under pressure, installation of service pipe and accessories including water meter and refilling the ground and bringing the road surface to original condition. Contractor will also be responsible for providing new consumer service connections from time to time on receiving approval from RMC/RSCL for the same. This will be an ongoing work during the entire contract period. The work of new service connections will be done as per detailed specifications within 3 days of receipt of approval from RMC/RSCL.

- e. Services to the Urban Poor: In the case of urban poor areas in the Service Area, the Contractor, in accordance to the approved connections policy, shall undertake provision of individual. Such water connections shall also be provided with same specifications and procedures as mentioned above for regular consumer connections. However, the water meter and meter box shall be installed at a safe place as agreed with the Consumer and approved by RMC/RSCL.
- f. Public Stand Posts: All public stand post shall be removed after providing individual connection or if RMC/RSCL instruct to install public stand post. All permitted public stand posts as per list to be provided by RMC/RSCL shall be rehabilitated and constructed with sturdy plumbing and good quality stopcocks and shall be provided with a Consumer meter for the purpose of accounting the consumption from the respective tap. The location and operation arrangement of each stand post will be determined in coordination with the future tap users. The Contractor is required to participate in the coordination process.
- g. Bulk Water Supply Connections: In the case of bulk water supply connections of sizes equivalent or higher than 25mm dia. to bulk consumers such as apartments, housing societies or private layouts within the Service Area, the Contractor shall install a suitably sized, accurate consumption meter.
- h. Illegal Connections: The Contractor based on the findings from the Consumer Connection survey, and in accordance to the approved connections policy, shall identify the illegal or un- authorized connections and inform RMC/RSCL for regularization / disconnections of the connections. On approval and after payment of prescribed charges by the Consumer, the Contractor shall then rehabilitate the connection with good plumbing material and a Consumer meter. Final decision on regularisation or disconnection of such Consumers shall solely be the responsibility of RMC/RSCL and Contractor shall be more particular in bringing to the notice of RMC/RSCL such connections.
- i. The responsibility of the Contractor will be limited to providing service pipe line up to the water meter, water meter, stopcock and meter box in the consumer premises. All works beyond the water meter will be the responsibility of the Consumer, except for the public stand posts.
- j. The Contractor shall set up and operate temporary Customer service points in those DMAs where Works are ongoing and Consumer Service Connections are being provided, to facilitate easy communication with Consumers.

1.6.7 Testing and commissioning

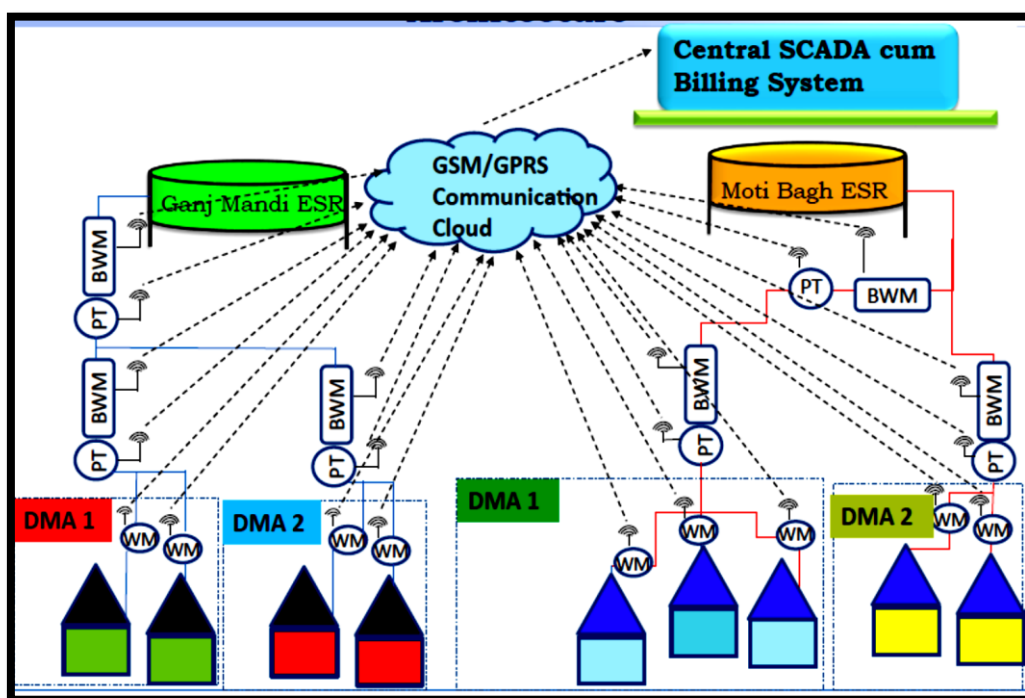
- a. Testing of all materials, equipment and instrumentation shall be done as specified in the Technical Specifications. Installation of all electro-mechanical equipment shall be carried out strictly as per recommendations of the manufacturers. Pre-commissioning and trial run shall be undertaken as specified in Detailed Technical Specifications covered under this document.
- b. Supplying for the first time water to the DMA, the Contractor has to check that none of the replaced pipelines is still supplied with water via another pipeline inside or outside the DMA. In case of water flowing from the replaced pipeline, the Contractor has to take all necessary measures to stop the supply of water to the replaced pipeline. The measures at least include:
- c. Valves in the immediate vicinity of the decommissioned pipe shall be closed to assess the location of the connection.
- d. Start digging out the decommissioned pipe from both ends until the unknown connection is found. The found pipe has to be followed until at least the border of the DMA, in order to isolate the DMA properly.
- e. Gather latest information from RMC/RSCL on valve settings and pump operations. If it becomes evident that the water comes through a connection from outside the district, it will be necessary to examine jointly with the Engineer what changes in pump- or valve settings has been done recently.
- f. Testing for commissioning of a completed DMA shall consist of flow measurements at DMA inlet and at all service connections to determine whether the target level of water loss, as specified in Schedule 7 of PCC [Target Performance & Standards], Parameter has been met.
 - i. Simultaneous flow measurements shall be undertaken during a 24-hour period.
 - ii. In case the actual water loss thus measured is more than twice the target level, the Contractor shall propose a work method, to be approved by the Engineer, to determine the cause(s) of water loss.
 - iii. The Contractor shall investigate the cause(s) of water loss accordingly and shall make the necessary rectifications.
 - iv. The testing for commissioning shall then be repeated till the requirements are met&
 - v. 24x7 water supply achieved in the project area.
 - vi. Internal water Audit / leak test shall be carried out at the time of DMA commissioning. Further audit will be carried out during O&M period atleast once in a year for high water consumption consumers and perform the test.

1.6.8 Meter Reading, water billing and Management requirements.

Meter reading & water billing of consumer meters and associated software development is covered under the scope of Contractor. Operator shall develop the system to read water meter readings and issue the water bills on a periodic basis through latest technology available. The individual readings shall be downloaded at a central terminal of RMC/RSCL at regular intervals to create a billing schedule. Contractor shall be responsible to verify the volumetric consumption readings of DMA consumers during DMA / baseline study and also be responsible for spot / random checking as and when desired by RMC/RSCL.

The Water Billing Solutions systems shall be a comprehensive commercial management system equipped with functionality to cover all operational areas of revenue management and customer information as well as to manage commercial data quality. The proposed system shall perform following functions :-

- ☐ Billing, statement delivery, debt management, customer services, enquiries, new accounts, pricing & consumer analysis, meter reading & control, meter & connection maintenance and reporting.
- ☐ Dealing with customer complaints and enquiries, and efficiently administer and process applications for new services.
- ☐ System shall be online, semi-offline with batch updating of a central server, and stand alone (offline).
- ☐ The systems shall be integrated with geographical information systems (GIS) to enable optimized walk route management and property/connection reconciliation and should be able to interface with existing system.



1.6.9 The Contractor shall:

- i. Develop and implement: (i) meter reading procedures and arrangements; (ii) Digital record of meter readings (iii) meter reading and billing control, and (iv) efficient and accurate meter reading system & technology; (v) Development water billing software with web enabled GIS application module
- ii. During DMA study, read all consumer water meters of selected DMA consumers in accordance with requirements laid down under this contract.
- iii. develop a monitoring program of random spot-checks to ensure the accuracy of the - meter calibration and the meter reading process and provide written reports to the RMC/RSCL on the results of the monitoring programme;
- iv. read all Consumer Meters in accordance with the general instructions of the RMC;
- v. register all Consumer Revenue Meters readings in the appropriate computer data base as desired by RMC/RSCL
- vi. Develop and implement a plan, the intent of which is to ensure that:
 - a. All consumer meters are in working condition
 - b. All consumer meters are accurate,
 - c. All consumer meters are read,
 - d. All consumer meters are in suitable and easily approachable locations,
 - e. Problems related to unprotected and unsealed consumer meters are resolved,
 - f. Develop and implement a program to estimate consumption in circumstances where metering problems exist, and
 - g. Provide advice as to methods to improve the meter reading process to ensure greater accuracy;
- vii. Identify consumer meters which have not been read; and
- viii. Respond to reports of malfunctioning consumer revenue meters from Consumers.

1.6.10 Water Loss reduction & management Services

The Contractor has to take all necessary action, provide all required services and materials and equipment and carry out all works required to achieve the main objective of the Contract and reduce water loss for total number of 24,000 (approx.) connections in selected DMA's of operational zones. The following (non-exhaustive) list summarizes the activities the Contractor is normally expected to carry out (without limiting the Contractor's obligations and the scope of work):

- a. no water loss reduction works shall be carried out prior to the 7-day inflow and pressure measurement baseline measurement to be carried out by the Contractor, jointly with and supervised by the Engineer;
- b. leak detection surveys (using all kind of equipment and technologies, from simple sounding with a listening stick to leak noise correlators and leak noise loggers as appropriate, helium gas), note that all required leak detection equipment has to be provided by the Contractor (but will not revert to the Employer at the end of the Contract).
- c. Pressure management: stabilizing, managing and reducing average DMA pressure using PRVs and controllers and various techniques as appropriate; when doing pressure reduction, the Contractor has to ensure that all the volume of water supplied to consumers in the DMA is the same or better than the baseline levels at the start of the

project. Level of minimum pressure will depend on the type of housing and the general availability of tanks. Pressure management has to be done in close co-operation with the consumers in the DMA to reduce the risk of complaints. All required customer information and education is part of the Contractor's duties and cost for these activities covered under scope of services envisaged in this contract.

- d. Service connection replacement: it is anticipated that most of the service connections are leaking or are in bad condition and must be replaced. Detailed design, supply and installation complete with all fittings and road and sidewalk reinstatement are included. The Contractor shall decide which connections shall be replaced but in any case, if a leak is found on any part of the service connection, the entire connection including the pipe saddle shall be replaced
- e. Leak detection surveys, repairs and pressure fine-tuning shall be repeated and/or shall continue until an acceptable level of leakage is achieved. The acceptable level of leakage might vary from one DMA to the other, it is up to the Contractor to decide at which point the effort for further leakage reduction becomes prohibitively high;
- f. continuous flow and pressure data logging and data transfer to the central server establishment of the Target Night Flow Level (TNFL) in m³/h after completion of all water loss reduction activities in a DMA and continuous monitoring of inflow, pressure and minimum night flow to become aware of new leaks; and
- g. Repeating of leak detection and repair should the minimum night flow exceed the tolerance limits .
- h. Detecting illegal connections: Should the Contractor find illegal connections he shall report them to the Employer.
- i. The fixed and performance fee together cover all fixed cost, overheads, profit and all manpower, machinery, equipment, transport as well as all materials and works required to carry out all activities that might become necessary to achieve the objective of the Contract.
- j. Water Audit for Consumer Connections:- Contractor shall identify the consumers with very high consumption of water and prepare the list and maintain the record of such consumers. While Establishment of DMA's, the list of such consumers shall be submitted to Engineer for internal water audits within consumer premises. Contractor shall be responsible to carry out Internal water audit for such identified consumers and submit the Internal Water Audit Report to Engineer with the consent of Consumer.

1.6.11 Road cutting & Restoration

The Contractor shall take a timely action in accordance to the Approved Implementation Plan for obtaining the necessary permissions for road cutting from RMC/ PWD / CPWD. A comprehensive list of locations with respective time schedules shall be provided to RMC who intern shall assist the Contractor in obtaining the permissions.

The Operator shall adhere to the standards, specifications and all requirements in compliance to the prevailing Dig and Restore Protocols prescribed by RMC / PWD / CPWD from time to time. On completion of work on pipelines, the Operator shall ensure standard refilling of the trench and inform RMC for timely restoration of the road for minimizing inconvenience to the users and residents.

While Road restoration Following guidelines should be followed :

1. The contractor shall have to restore the road up as per RMC norms including refilling trench in layers, watering, rolling and compacting to within 10days after trenching is completed in a particular street/reach.
2. Contractor shall erect informatory board at his own cost showing type of work, inconvenience expected and timeline for various construction activities going to take place in a particular street or a particular reach of road as per direction of Employer's Representative in charge.
3. The contractor shall have to do the sequencing of activities as per direction of Employer's Representative in charge to synchronize sewer work and water pipe line work to minimize the road excavation and restoration in the street which will have both pipe lines.

1.6.12 The Scope of Work further includes:

1.2 Construction and completion of the following;

- a. Designing, Providing, Lowering, Laying, Jointing, Testing and Commissioning of Distribution Network of DI Pipe with all specials, accessories, Valves, Valve Chamber's, Thrust Block, Demolishing of Structures, Dismantling of Pipe Lines, House Service Connections etc. all complete for ABD area of Mor Raipur City Center Area.
- b. Integration of the above DI Pipe Line along with the existing M.S. /R.C.C. /D.I. /P.S.C. and G.I./ A.C./ P.V.C./ S.W./ H.D.P.E. Pipe Line of the system. All the removed M.S. /R.C.C. /D.I. /P.S.C. and G.I./ A.C./ P.V.C./ S.W./ H.D.P.E. Pipe Line of existing Network shall be submitted to RSCL store at no extra cost.
- c. Connecting the DI pipeline from main road to the individual house service connection of potable type ensuring continuous water supply and in line with the technical specifications.
- d. All the removed existing Service Connections shall be submitted to the RSCL store at no extra cost.
- e. Necessary restoration works to be carried out after providing connection as per the instruction of Engineer in charge.
- f. Instrumentation Works such as Supply, Installation, Testing and Commissioning of Multijet/Volumetric Type GSM/ GPRS Water Meters, Battery operated Electromagnetic Type Bulk Flow Meter & SCADA System in accordance with the Employer's requirements and to the satisfaction of the Engineer in charge. Procurement shall be done on the basis of actual number and technical specifications. Proper record system for installation of meters shall be developed by the contractor duly signed by the respective customer. The record shall be submitted to RSCL every fortnightly by the contractor.
- g. All the bulk flow meters shall also have provision to log pressure data at that position to register through GPRS/GSM.
- h. The Manufacture will have a full system of local offices in the city as well as in India and full services capability in the Metro-cities throughout the country. Full contact details for key personnel, both national and local shall be furnished on request.

i. Erection and maintaining of Centralized Data Collection, Monitoring And Analysis Centre

- Construct as per the structural design approved by RSCL and operate a complete engineering office setup i.e. Main server, Computers, AutoCAD facilities with plotting and scanning with leak detection, pipe locator, and conference room facilities at the Centralized Data Collection, Monitoring And Analysis Centre. The Centralized Data Collection, Monitoring And Analysis Centre shall be of 60sqm as per the site given by RSCL after the work order is given. Brick masonry construction having good architectural view with aluminum doors and window with proper lighting, ventilation, fan/AC and toilet facility, furniture and cupboard. This centre shall be located in the respective ESR/GSR premises or as proposed by Managing Director, RSCL. Collect and analyze flows in and out of ESR/GSR to network with monitoring of pressure and flow throughout the water supply system.
 - The Centralized Data Collection, Monitoring And Analysis Centre shall also include a CUSTOMER CARE CENTER for collection, analysis and solving of the customer complaints.
 - All the electrical works required for this building shall be done by the bidder/operator as per IS specifications. Power connection from nearby point shall be done by the operator.
 - The firm must provide telephone for receipt of complaints for removing / repairs of meters and fixing of meters, manpower should be arranged by the operator as detailed in O and M schedule
- j. Construction of Allied Civil Works in accordance with the Employer's requirements and to the satisfaction of the Engineer in charge.
- k. All other works and services ancillary or related to the full completion of the Works in accordance with the Employer's requirements

1.3 The Contractor shall co-ordinate and interfaces his works with that of all other contractors, subcontractors, utility services, statutory authorities, etc. and achieve the completion of the Works to the satisfaction of the Engineer

1.4 The proposed scheme shall be designed for uninterrupted 24*7 Water Supply for ABD area of Mor Raipur City Center Area. Proposed scheme shall include Improvement & revamping of existing water supply, Transmission and Distribution Network under Mor Raipur city center area for reduction in NRW/UFW & improvement in service including Performance based maintenance for the period of Five years. Considering these parameters and Employers requirement, design and drawings shall be prepared by contractor and submit the same to client for review and approval.

1.5 The Contractor shall make good all works including road surfaces, drains, concrete slabs, gratings, kerbs, pavements, fence, boundary wall, etc. affected or damaged during the course of construction, to the satisfaction of the Engineer. The costs of making good all these defects shall be borne solely by the Contractor and deemed included in his Contract Sum

1.6 All works specified shall include the provision of all labour, tools, equipment, material, traffic control, transport and everything else necessary for the satisfactory completion of the Work by the Contractor to the satisfaction of the Engineer.

1.7 Construction, management and quality of the Works shall comply with the Drawings, Specifications and Employers requirement.

1.8 The scope of work further includes an **Operation and Maintenance period** of five years for ABD area of Mor Raipur City Center Area only in which the Contractor is required to carry out the following activities as provided in brief.

- Day to Day Operation & Maintenance of the system including Valve operations, leak repairs, assistance to customer complaints.
- Intensive maintenance training to minimum two of purchaser's personnel shall be given at bidder's facility for a period of 2months. Operation and maintenance training at site shall also be given.
- Contractor shall arrange minimum 2 training programs per year to benefit its employee and the RSCL staff on good engineering practices and development in water supply and O&M.
- Operation shall include training to RSCL nominated Staff in.
 - 1) Installation of metering equipments
 - 2) Programming of meters and data loggers
 - 3) Meter reading practices
 - 4) Download of data from data loggers
 - 5) Operation & Maintenance of portable download devices
 - 6) Analysis of the data
 - 7) Operation & Maintenance of the online calibration validation equipment
 - 8) Planned Preventive Maintenance of meters and other accessories
 - 9) Remote monitoring setup by GSM/GPRS technology.
 - 10) Public awareness by presentations, meetings, etc.
- Contractor shall arrange minimum one public program every six months on WATER CONSERVATION AND AWARENESS either by arranging exhibitions or school competitions, publications of news articles, brochures, and holdings.
- Customer billing shall be done on monthly basis and the soft copies of all the bills shall be submitted to the RSCL.
- Contractor shall establish customer care centre within the zone. The customer care centre shall prominently display information to the customer. The contact details shall be printed on the bill.
- The water audit is also under the scope of bidder only in order to predict the real losses of water. The bidder shall prepare the Water balance and submit the same with monthly reports of O&M.
- The operator shall arrange a minimum of seven meetings with stake holders (Citizens and representatives) on behalf of RSCL during the project and minimum two meetings during first year of the execution of project
- Laboratory Testing facilities for All water Meters and repairs facilities:
 - Operator shall provide and maintain a complete of laboratory for testing of All water meters which are found to be out of order and then repairing the same.
 - If found impossible to repair, the water meter shall be replaced by the operator on his own cost.

- Monitoring and maintaining the system using necessary inventory with proper storage and required staff :
 - The operator shall monitor the system using necessary number and required diameter of clamp on flow meters as well as other inventory and transportation facility to check the problematic areas or for general maintenance.
 - This inventory shall be in the custody of operator/bidder and stored properly. The operator shall provide his staff and the inventory as and when required or proposed by the RSCL.
 - The Contractor will also be responsible for the replacement of any theft/stolen of Bulk Flow Meters.
- 1.9 Water, audit shall be done for a thorough accounting of all water into and out of a utility as well as an in-depth record and field examination of the distribution system that carries the water, with the intent to determine the operational efficiency of the system and identify sources of water loss and revenue loss. For conducting water audit, System maps shall be prepared based on the design of network finalised. For it, the water distribution pipe network is divided into a number of sectors (Zones).
- 1.10 The main purpose of the O&M is to reduce the NRW/UFW to the acceptable level benchmark as set forth in clause Volume-II, Section-VI.
- 1.11 The successful bidder will be expected to complete the works by the intended completion date specified in the contract data.
- 1.12 Precaution has to be taken while preparing the estimate. However, if bidder feels that any item is missing or left out which is necessary for functional requirement of said work, cost of that item should be considered while bidding. It is assumed that rate quoted is final to carryout said work. So, bidder should quote rate considering the same.

2. TECHNICAL SPECIFICATIONS

2.1 Design Specifications:

Distribution System:

CPHEEO manual recommends considering following peak factors for the city with a population ranges as follows:

For Population less than 50,000	3.0
For a population range of 50,000 to 2,00,000	2.5
For population above 2,00,000	2.0
For small water supply schemes	3.0

Residual Pressure:

As per CPHEEO Manual, distribution system should be designed for the following minimum residual pressures at ferrule points:

Single Storey Building: 7 m

Two Storey building: 12 m

Three Storey building: 17 m

A minimum residual head at ferrule point is considered as 7 m

Network Design:

The design of the transmission system and the distribution system is in the form of an optimal mix of tree network and looping of pipelines will be designed using software by Bentley, namely Water GEMS v8i. For major smart roads, distribution network has to be considered on both sides of road.

Hydraulic Gradient:

Pipes are designed keeping in mind friction loss of less than 4 in 1000.

Minimum Pipe Size:

Minimum diameter of 100 mm to be considered for distribution network. For diameter 200mm & above, parallel pipes are to be considered for house connections.

Hazen William's Coefficient:

As per CPHEEO Manual 1999 (Ref Table 6.1.page 108), a 'C' value of 140 has been recommended for Centrifugally Lined DI pipes. However for Design Purpose a C-value of 130 has been considered keeping in mind the ageing of the pipe and encrustation inside the pipe line.

2.2 Survey and Preparative Works

2.2.1 Topographical Survey and Mapping

A detailed topographical survey, of the components involved as shown in the boundary limit, within the project area shall be carried out using Total Station equipment and the spot levels and the contours at 0.5 m interval shall be carried out & stored in editable digital format on the GIS base. Contractor will survey all underground utilities located within the Sub Project Area up to 1.5 m depth and mark on GIS based maps.

2.2.2 CONSUMER SURVEY

SCOPE OF WORK:

This specification covers the work of carrying out a consumer survey in the Service Area to record all potential and existing consumers. The survey should capture, inter alia, the number of existing and potential domestic, commercial, bulk and industrial consumers. The data to be collected during the survey will be finalized in consultation with RMC.

OBEJECTIVES:-

The objectives of the survey are:

Details of consumption of water by different beneficiaries, i.e. Domestic, Industrial Commercial, non domestic etc.

- Determine the perception of water services received.
- Provide facts for formulation of policy for Water consumption
- Provide information and measures to be taken to improve the efficiency and financial performance of the Water distribution system.
- Evaluate the quality of service when reporting problems or making enquiries.
- Determine the level of awareness of promotional water conservation initiatives.

2.2.3 COMPONENT INCLUDES

Survey of the Utility

- 1 Survey of Consumers in all households in water Distribution area (Residential consumption).
- 2 Survey has to be conducted in all non-domestic consumers like hotels, Lodge, shops (Commercial consumption).
- 3 Survey has to be conducted in all institutions like Schools, hostels, Bus stands, Government offices, hospitals, etc (Institutional consumption).
- 4 Survey has to be conducted in industrial area. (Industrial consumption)
- 5 Survey has to be conducted at all public stand posts (public stand post consumption)
- 6 No of properties dependent on stand post should be found out Also No. of stand post working / non-working should be noted during surveys.

2.2.4 DATA COLLECTION

Survey form has main five categories as below

1. Identification –

Under this category basic information has to collect his house number, complete address, telephone number, etc.

2. Economic status -

Under this category data has to be collected like name of respondent, sex, education, occupation, family income and size of family etc.

3. Details of House / Building –

Data to capture in this section are type of building, where they live, and construction of building. Also information about number of water closet, number of total taps use in house, uses of water like whether they use water for gardening.

4. Connection Details

In this data collect information of the customer / owner on whose name the connection is Register. Bill connection no. of connection name must be fill accurately.

5. Quantity and use –

Use of water for daily activities in liters from various sources.

6. Health Information:

Information of main diseases occurred in last one year.

2.2.5 TRAINING

Two days training course has to be conducted for surveyor by staff of the company. The aim of the training will be to build their capacities to conduct survey successfully. All surveyors will be given two days training on how to conduct survey, how to interact with respondent, how to facilitate to respondent, how to fill information in the survey form. How to read facial expression of respondent, so that surveyor can get correct information.

2.2.6 METHODOLOGY

Survey has to be conducted house to house

The survey has to simply design to collect information about customer perceptions, their billing habits, their water consumption and usage, their misunderstanding about the water tariff and system, their satisfaction area.

Methodology is an operational framework within which facts are placed so that their meaning may be seen more clearly. The scientific method is further a systematic and organised series of steps that ensures maximum consistency and objectivity in researching a problem.

This survey has to be conducted in which data collectors have to participate as facilitator to the respondents. Data has to be collected by utilizing structured interviews conducted for a total number Household recorded in Municipals Corporation.

A disadvantage of employing interviews to gather data is that the responses given may not be accurate and may not reflect real behavior. Respondents may also provide wrong information and may forget or lack the information required. These disadvantages of the selected data gathering method may well influence the findings of this survey. The surveyor should take care such matters.

The interview schedules questionnaires for the structured interviews have to supply by the Water supply and Sanitation Department. These schedules and survey approach had to be kept consistent for all areas and wards.

Properties shall be taken as per the property register of SMC.

If a single property / Building contains no. of flats, then nomenclature of flat in the building

shall be represented as 300/1, 300/2 and so on.

For Chawls and or tenants within a property extra numbers to be considered.

Illegal properties or M.C. water connections shall be identified during consumer survey and shall be shown on G.I.S. Map. By checking day today Register or unregistered consumer & take note in consumer form also.

The contractor has to find out total No. of properties having connection and total no. of properties without connection. Also he has to find out from where the properties without connection gets the water. This should clearly be mentioned in the consumer survey report.

Mode of Measurement and Payment :

Breakup of Payment of rate stipulated in schedule B shall be based on completion of activities at stages below:

1. After completion of consumer survey 50 %
2. After computerization & submission 20 % of computerised data in excel worksheet for checking.
3. After submission of analysis of data and report of computerization data. 10 %
4. After validation approval for the data and report 10 %
5. Submission of G.I.S. layer 10 %

Preparation of GIS Map

Preparation of GIS based consumer mapping, survey & investigation, plotting assets on GIS map by linking with Geospatial data base and hydraulic modeling using suitable software for water supply system.

Survey of Existing water supply System and digitization on GIS Platform

Scope of the Work

This specification covers the survey, investigation, digitization work and also preparation and maintenance of comprehensive data regarding complete water supply system with the help of latest softwares for optimization of maintenance works and future documentation and digitization of the same on GIS platform.

General

Carry out preliminary activities of surveying all the components of existing water supply system with their details by GPS mapping.

Confirm all ground and underground assets such as pipeline, pumping station, service reservoirs and other important appurtenances by using GPS & pipe locator or GPR technique.

Confirmation of location and other important information of all existing components related

to water supply project and correcting same on the base map.

Inserting all the collected information on GIS platform (satellite image & existing Base map will be provided) and preparation of the detailed base map of existing water supply system.

While updating the base map the alignment of existing pipeline (whether left or right side of the road) and interconnections of the existing pipeline network should be corrected according to the road along which the pipelines are laid.

Survey form for surveying existing water supply system should be approved from the authority and bellow is the list of existing Water Supply System Components to be surveyed as per approved survey form & the collected information to be updated on the base map and GIS platform.

2.3 Preparation of Service Improvement Plan

2.3.1 Hydraulic Modeling requirements

The Contractor shall develop a Hydraulic Network Model (HNM) for water supply system based on DMAs of Operational zones. The data related to water supply infrastructure like Reservoirs, Pumping Stations, rising mains and distribution system , valves and demand allocations shall be obtained through field baseline study and consumer survey captured on the network model.

The hydraulic network modelling by using latest soft-wares shall be carried out by collecting the actual property wise water demand allocated to the nearest junction. Following broad guidelines may be followed during hydraulic modeling:

The junction shall be placed at the branching out/ at the crosses at the valves and where there is a large straight length at every 200 m. The model shall be worked out by considering the domestic demand as 135 lpcd water supply and actual demand for commercial and industrial requirement.

The hydraulic water use pattern for the day spread over 24 hours shall be based on the survey data captured through consumer habits of water use in different hours at present and by following the standard pattern, after continuous water supply is successfully implemented.

The storage reservoir capacities shall be modelled to verify the water level in various hours. It shall neither be empty nor overflow. The incoming flow at constant rate shall be decided accordingly.

The DMAs which are still to develop where the present water requirement is quite less as compared to the design demand, the present scenario with existing water demand shall be run and the incoming flow shall be adjusted accordingly.

The minimum pressure in the distribution network when full demand in the zone cum DMA is developed shall not be less than 7 m of water column at consumer meter point. The excessive pressure in the typical areas shall be managed using the appropriate pressure management techniques at distribution system level and other at the individual connection level.

All new connections shall considered and captured as additional demand in the model and updated model.

The work also includes the following :

2.3.2 Pressure Zero Tests:-

A Pressure Zero Test (PZT) shall be carried out in accordance with the procedure detailed in this clause in order to prove that the DMA can be isolated fully from the rest of the pressurized distribution system. PZTs shall not be undertaken when the DMA is isolated from the rest of the distribution system, e.g. as part of a water rationing schedule.

In order to undertake the Pressure Zero Tests sufficient pressure logging points shall be installed to verify that the mains pressure has dropped to zero across all parts of the DMA during the test. Suitable locations for pressure monitoring shall also be identified and installed to regularly monitor Average Zonal Pressure (AZP) and Critical Pressure Points (CPP) in each DMA. All AZP and CPP pressure points shall be permanently monitored at the central SCADA server. The PZT procedure shall be as follows:

1. Any sensitive (e.g. hospitals or schools) or large consumers shall be identified and individually informed of the proposed PZT. A general warning shall be given to all other consumers in accordance with the Employer's procedures.
2. Valves isolating the DMA from the rest of the distribution system shall be confirmed operable prior to undertaking the PZT.
3. PZT's are to take place between 1.00am and 5.00am, or during an alternative suitable period when water is available.
4. Deploy pressure loggers on the pressure logging points and set to 5 minute intervals.
5. Shut the supply valve(s) and boundary valves in order to isolate the DMA.
6. The pressure on the loggers, as read on-site, should fall as soon as the supply and boundary valves are closed. If the pressure falls to zero excluding static head, or reduces but will remain steady for more than one hour, this will be accepted as a successful PZT.
7. If a successful PZT is not achieved, check and sound each supply and boundary valve in turn. Passing valves should be fully closed, where possible, and the PZT repeated.

8. If the PZT is not successful, the Contractor shall organise further investigations to find the cause of the failure and then repeat the PZT.
9. On successful completion of the PZT, open the supply valve(s) and confirm that supplies have been restored to their former level within the DMA. Loggers deployed under (4) above shall be left in place for 7 days after the completion of a successful PZT to confirm the impact of the new boundary on local pressures. Customer contact shall be monitored and reviewed over this period also and any necessary action to rectify supply problems shall be taken by the Contractor in consultation with the Engineer-in charge.
10. Ensure all relevant records are completed before leaving site. Paper and electronic copies of the pressure data logging results shall be retained.
11. Prepare the PZT Completion Report in both hard and soft copies and submit to the Engineer.
12. Dial pressure gauges to also be installed during PZT.

All down loading of data form any logging equipment has to be done in the presence of engineer or may on the written permission of engineer. The printout be taken immediately and signed by engineer.

2.3.3 DMA Establishment: -

Following approval of the DMA Design Report by the Engineer-in charge, establishment of the DMA shall commence.

If consumers experience any water supply problems during the creation and proving of a DMA, or when operating DMA valves, the Contractor shall investigate the water supply problem immediately and make any adjustments to DMA design and implementation necessary to resolve it. Similarly, if the DMA boundary is breached, or boundary valves are operated by others, or the water supply regime is changed after DMA formation, the Contractor shall investigate and rectify such breaches. No claims or requests for extension of time will be considered for' such investigations, remedial work or consequent delays.

All installation of pipelines, meters and ancillary works shall be carried out in accordance with the relevant clauses of this Specification.

During installation works pipe sections removed shall be bagged, tagged and sent for analysis in order to provide additional data for pipe condition assessment.

DMA boundaries may only be modified, or DMAs combined or sub-divided, with the approval of the Engineer.

With the isolation of DMA's if any area affected for water supply, Contractors shall need to

make temporary arrangement of water supply for the affected area. It also includes the new proposal of the pipe line, valves etc. complete to establish the hydraulically discrete areas.

Close liaison with TMC staff is essential when undertaking any operations on live mains. Arrangements for communications shall be agreed and documented prior to any such operations commencing.

2.3.4 Record Plans

The Contractor shall prepare a DMA record plan showing:

- Limit of the DMA
- Names of all roads in which mains are laid
- Diameter and material type for each main
- Locations and sizes of flow meters
- Locations of all valves, with boundary isolating valves, circulating and step-test valves clearly indicated, numbered and marked Clockwise or anti-clockwise closing
- Valve operating schedule for step-testing
- Total number of domestic and non-domestic consumers (all consumers shall be metered) in the DMA and in each step-test area
- Location of any metered consumers that use large quantities of water in relation to the rest of the DMA or use high flow rates at specific times of the day or week
- Location of all public stand posts

The Contractor shall also provide an Operating and Maintenance (O&M) Manual that details a specification and describes operation and maintenance information for all equipment installed under the Contract, together with the procedures for water loss and leakage reduction and control in each DMA. For each DMA there will also be a DMA File recording the historical development of the DMA, its features, results achieved flows and leakage levels, trends, etc. The DMA Files shall be up-dated regularly as work is undertaken in each DMA.

All record plans and the O&M Manual shall be prepared in electronic format using the specified software and copied to CD. Paper copies of the record plans shall be A1 size. Five copies (paper) and two digital on CD Of each DMA shall be issued to the Engineer-in charge.

2.3.5 Deliverables

Deliverables are briefly summarized below:

- Undertake pipeline mapping, location and interconnectivity surveys, and house connection survey
- Development of the Hydraulic Model and Hydraulic Analysis by providing Water Gems /equivalent software of unlimited nodes and pipes.
- Hydraulic analysis shall be done through latest version of Water Gems/equivalent software. The cost of Water Gems /equivalent software need to be considered in the item. No separate payment shall be considered.
- Design DMA (including initial network models) and Establish DMA boundary (install boundary valves / cap mains, and install pressure monitoring points)Formation of District Meter Areas
- Identification of Average Zonal Pressure (AZP) and Critical Pressure Points (CPP) for each of the Pilot zones and providing of data logger on the same & Undertake Pressure Zero Test
- Procurement and installation of bulk / DMA meter on inlet and outlet: volume of production (Distribution input). The cost of bulk / DMA meters, valves, rehabilitation of network will be paid separately as per bill of quantities.
- Procurement of DMA meters, for flow measurement, and consumer meters, valves for assessing consumption need to be done during this phase of the contract. The cost of the same will be paid from price bid.
- Preparation & execution of rehabilitation & Development plan for achievement of the performance targets as set in the contract.
- Record DMA meter readings and all consumer connections, stand post and slum area meters over set period.
- Final out put of DMA establishment is development of initial water balance and initial water loss levels as per formula below.

Water Loss (NRW) is widely reported in percentage terms. However, the water loss for each DMA should be expressed as follows:

$$\text{Initial \% NRW} = X - (A + B + C + D) \times 100 \%, X$$

Where:

X = Water input to the system (DMA) during the period

A = Water billed during the period

B = Water legally supplied but not billed (including slum and stand post consumption) during the period

C = Operational use (scouring, jetting, dust suppression, etc.) during the period

D = Tankers metered and billed/unbilled during the period

Cost under this item includes:-

1. Experts services
2. Design & SIP
3. Survey & investigation
4. Software (ARC GIS Editor, Water GEMS) & hardware's
5. Report generation
6. Water balance
7. Man power , equipment's
8. All item other than bills of quantity
9. Training

Cost under this item excludes:-

Cost to be paid separately under respective bills of quantity.

1. All items executed like house service connection, repairs, rehabilitation of network, pipe laying, valves, meters, water meters etc.

The performance of the contractor will be evaluated based on the successful establishment of the DMA's and will payable in terms of DMA fees. The formula to derive the DMA Fees as per performance is detailed out in Schedule 5 : Contract Payment Terms of the bid document.

Mode of Payment :

The payment shall be made on the approval of SIP by competent authority of RMC / consultant basis.

2.4 DI PIPES

Applicable Codes:

The manufacturing testing, supplying, at work sites of Ductile Iron pipes shall comply with all currently applicable statutes, regulations, standards and codes.

In particular, the following standards, specified herein shall be referred. In all cases, the latest revision of the codes shall be referred to. If requirements of specifications conflict with the requirements of the codes and standards, this specification shall govern.

IS: 8329	Specification for Centrifugally Cast (spun) Ductile Iron pressure pipes for water, gas and sewage specification.
IS: 1387	General requirements for supply of metallurgical materials.
IS: 1500	Methods for Brinell hardness test for metallic materials.
IS: 9523	Ductile Iron fittings for pressure pipes for water, gas and sewage.
IS: 12820	Dimensional requirements. of rubber gaskets for mechanical Joints and push on joints for use with cast Iron pipes and fittings for carrying water, gas and sewage.
ISO: 4179	Ductile iron pipes for pressure and no pressure-Centrifugal cement mortar lining - General requirements.
ISO: 2531	Ductile iron pipes, fitting and accessories for pressure pipe lines.
IS: 12288	Code of practice for use & laying of Ductile iron pipes.

Manufacturing

General

1. The pipes shall be of centrifugally cast (spun) Ductile Iron pipes K-7 class with internal cement mortar lining confirming to IS 8329: 2000. The pipes shall be of push on joint type (Rubber Gasket Joints). The flange connection shall be used only in case of fitting of specials or under special circumstances as directed by Engineer in Charge.
2. The pipes shall be coated with zinc coating and finishing layer shall be of bitumen and have factory provided internal cement mortar lining as per the provisions of IS 8329: 2000 the mortar thickness shall be minimum 5 mm as per Table 15 of the code. The tolerances for pipes and fittings regarding dimensions, mass, ovality and deviations from straight line in case of pipes shall be as per IS 8329/IS 9523.
3. The pipes shall be supplied in standard length of 5.50 and 6.00 meters length with suitably rounded or chamfered ends. Each pipe of the push on joint variety shall also be supplied with a rubber EPDM/ (SBR) gasket. The flanged joints shall confirm to Clause 6.2 of IS: 8329. The pipe supply shall include one rubber gaskets for each flange. Any change in the stipulated lengths will be approved by the Engineer- in -Charge. The gaskets shall conform to IS 5382:1985. The gaskets shall also be supplied by the contractor. They shall preferably be manufactured by the manufacturer of the pipes. In case they are not, it shall be the responsibility of the contractor to have them manufactured from a suitable manufacturer under his own supervision and have it tested at his / sub contractors premises as per the instruction and to the satisfaction of the Engineer- in -Charge. The pipe contractor shall however be responsible for the compatibility and quality of the products. The flanged joints shall conform to Clause 6.2 of IS 8329
4. RSCL representative shall at all reasonable times have free access to the place where the pipes are manufactured for the purpose of examining and testing the pipes and for witnessing the test and manufacturing.
5. All tests specified either in this specification or in the relevant Indian Standards shall be performed by the supplier/contractor at his own cost and in presence of employer's representative if desired. For this, sufficient notice before testing of the pipes shall be given to employer.

6. If the test is found unsatisfactory, employer may reject any or all pipes of that lot. The decision of RSCL representative in this matter shall be final and shall be binding to the contractor and not subject to any arbitration or appeal.

Inspection and Testing of pipes during manufacture

Mechanical Tests

Mechanical tests shall be carried out during manufacture of pipes and fittings as specified in IS: 8329 / IS: 9523. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS: 8329. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS: 8329/IS: 9523.

Brinell Hardness Test

For checking the Brinell hardness, the pipes used for the ring test and tensile test shall comply with the requirements specified in IS: 1500/IS: 8329.

Retests

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements, the lot shall be accepted. Should either of these additional test pieces fail to pass the test, the lot shall be liable for rejection.

Hydrostatic Test

For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in IS: 8329 / IS: 9523 for a period of minimum 15 seconds, during which the pipes shall be struck moderately with a 700 g hammer for confirmation of satisfactory sound. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.

The pipes shall be subjected to following tests for acceptance:

Visual and dimensional check as per Clause 13 and 15 of IS 8329

Mechanical Test as per Clause 10 of IS 8329

Hydrostatic Test as per Clause 11 of IS 8329

The test report for the rubber gaskets shall be as per acceptance tests of IS 5832 and will be in accordance to Clause 3.8. The sampling shall be as per the provisions of the IS 8329.

Markings

All pipes will be marked as per Clause 18 of IS 8329 along with the requisite information as provided below:

- Manufacturer name / stamp
- Nominal diameter
- Class reference
- A white ring line showing length of insertion at spigot end
- Employers mark as "RSCL"

Coatings

Pipe shall be supplied internally (cement mortar lining) and externally with Zinc coating along with a finishing layer of bituminous coating as per IS 8329:2000. The materials and finishing shall be as per the relevant specifications.

Joints

General

Jointing of DI pipes and fittings shall be done as per IS 12288 and manufacturer's recommendations. Rubber sealing rings/gaskets used for jointing shall conform to IS 638, IS 12820 and IS 5382.

Spigot and Socket joints

These shall have sockets which are integral with the pipe and incorporate an elastomeric rubber ring gasket conforming to IS 12820. The gaskets/sealant used for joints shall be suitable for water conveyance. The material of rubber gaskets for use with mechanical joints and push-on-joints shall conform to IS: 5382.

Flanged Joints

These shall be of 10 bar rating and shall comply with dimensions and drilling details as specified in IS 8329. These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts. The bolts shall be of mild steel unless otherwise specified. They shall be coated with cal tar epoxy coating after tightening.

Slip on Type Couplings

Slip-on type couplings shall include the following couplings:

- Straight flexible couplings
- Stepped flexible couplings

Slip-on type couplings shall be procured from approved suppliers whose fittings meet the same Specification. The preparation of pipe ends for slip-on type couplings shall be in accordance with the requirements and the tolerances specified by the joint manufacturer. Couplings shall be installed fully in accordance with the manufacturer's recommendations.

Slip-on type couplings shall be protected if buried with Densomastic and Densotape wrapping or similar approved material applied in accordance with the manufacturer's recommendations. Flexible joints shall be harnessed or tied where shown on the Drawings. Flexible couplings shall be supplied with transit protection.

Lubricant for Pipes and specials

Lubricant for the assembly of Ductile Iron pipes and specials suitable for Tyton push-on rubber ring joints shall conform to IS 9523.

Please add Dimensions and Tolerance on Diameter, Tolerance on Thickness, Tolerance on Length, Permissible Deviation from Straight Line , Tolerance on Mass , Lining Thickness etc.

DI Pipe handling, Laying, jointing, testing and Commissioning

- Laying of DI pipes shall conform to IS: 12288-1987. All pipes, fittings and material shall be tested and approved by the Engineer- in -Charge before being laid. Polyethylene sleeves wound pipes shall be used for water logged areas as directed by the Engineer- in -Charge.
- The transportation and handling of pipes shall be made as per IS 12288-1987.
- Cranes or chain pulley block or other suitable handling and lifting equipment shall be used for loading and un-loading of heavy pipes. However, for pipes up to 400 mm nominal bore, skid timbers and ropes may be used. When using crane hooks at sockets and spigot ends; hooks shall be broad and protected by rubber or similar material, in order to avoid damage to pipe ends and lining. Damage to lining must be repaired before pipe laying according to the instructions of the pipe manufacturer. the trench must not be refilled before laying of the pipes.
- All specials like bends, tees etc. and appurtenances like sluice or butterfly valves etc. shall be laid in synchronization with the pipes. No pipe shall be laid in wet trench conditions. On gradients of 1:15 or steeper, precautions should be taken to ensure that the spigot of the pipe laid does not move into or out of the socket of the laid pipe during the jointing

operations. The designed anchorage shall be provided to resist the thrusts developed by internal pressure at bends, tees, etc.

- Where a pipeline crosses a watercourse, the design and method of construction should take into account the characteristics of the watercourse to ascertain the nature of bed, scour levels, maximum velocities, high flood levels, seasonal variation, etc. which affect the design and laying of pipeline. The assembly of the pipes shall be made as recommended by the pipe manufacturer using suitable tools.
- Where a pipe line crosses State highway, National highway, canals, railways etc., pipe shall be laid after taking approval of the competent authority. All the expenses in this regard shall be taken care by contractor.

Pipe testing and commissioning

- The pipeline shall be tested for tightness of barrels and joints, and stability of thrust blocks in sections. Preferably the pipeline stretches to be tested shall be between two chambers (air valve, scour valve, bifurcation, other chamber). Contractor shall test stretches not exceeding 1 km.
- The water required for testing shall be arranged by the contractor himself. The Contractor shall fill the pipe and compensate the leakage during testing. Complete setting of the thrust blocks. Water used for testing should not be carelessly disposed off on land which would ultimately find its way to trenches. The testing conditions for the pipelines shall be as per the test pressures and condition laid out in IS 8329 for DI pipes.

The testing conditions for the pipelines are summarized as follows:

A test shall not be more than 1000m. initially on straight or curved line.

- All air shall be expelled from the test segment by making air vents at the highest point of test section and or both of testing segment.
- The first part of the testing shall be stabilize the section at a lower pressure of 1-2 kg/sq. cm at the highest point for a duration of at least 4 hours. On satisfactory completion of this joints shall be tested against leakage by increasing the test pressure to 5.50 Kg/Cm² and holding it for 15 minutes.
- If the pressure drop is less than 0.2 kg/sq. cm. over this period, the test shall be deemed satisfactory.
- For the purpose of the test, either power-driven or manual reciprocating pumps shall be used with clean water. The contractor has to arrange water for testing.
- The pressure gauges shall be in good condition and of suitable ranges and least count of atleast 0.2 kg/cm².
- The air vent holes shall be properly plugged and sealed with coupling/nut on completion of the test. The suitable water sealing chemical shall be used in case of any leakage.
- At the end of testing section temporary concrete thrust block shall be casted of sufficient size and strength to resist the testing pressure. The cost of such thrust block, jacks, wedge etc are inclusive in the rate.

A pipe segment once tested shall not be used as a support to anchor the end blocks used for testing the next segment.

The length of this period of time depends on many factors such as slight movement of the pipeline under pressure whether air is trapped in the pipeline has concrete lining which absorbs water.

The pipeline is then pressurized up to the full test pressure and the section under test

completely closed off. The test should be maintained for a period of not less than 15 minutes to reveal any defects in the pipes, joints or anchorages.

The test pressure should be measured at the lowest point of the section under test or alternatively, an allowance should be made for the static head between the lowest point and the point of measurement, to ensure that the required test pressure is not exceeded at the lowest point.

For the test section required end cap at both the end for testing purpose shall be arranged by the contractor at his own cost. It includes jointing & removing after testing, including all cost of jointing materials & labour etc comp.

If the test is not satisfactory the fault should be found and rectified. Where there is difficulty in locating a fault, the section under test should be sub divided and each part tested separately.

Methods employed for finding leaks include :

- a) Visual inspection of each joint if not covered by the backfill;
- b) Use of a bar probe to detect signs of water in the vicinity of joints, if backfilled;
- c) Aural inspection using a stethoscope of listening stick in contact with the pipeline;
- d) Use of electronic listening device which detects and amplifies the sound or vibration due to escaping of water, actual contact between the probe and the pipe is not essential.
- e) Injection of a dye into the test water particularly suitable in water logged ground.
- f) Introduction of nitrous oxide in solution into the test water and using an infra-red gas concentration indicator to detect the presence of any nitrous oxide that has escaped through the leak.

After all sections have been joined together on completion of section lasting a test on the complete pipe line should be carried out. This test should be carried out at a pressure not less than the maximum sustained operating pressure or the maximum static pressure of the pipeline and during the test, inspection made of all work which has not been subject to section tests.

It is important to ensure that proper arrangement are made for the disposal of water from the pipeline after completion of hydrostatic testing and that all consents which may be required from authorities have been obtained. In some cases, for example, heavily chlorinated water some treatment may be necessary before final disposal.

2.5 DI SPECIALS

Providing & Supplying at store or site of work D.I. Flange, Socket & Spigot specials like bends, tees, reducers, caps etc. as per I.S. 9523 class A, series K-12 with ISI mark suitable for push on joint or mechanical joint.

The rate inclusive of all taxes, loading, unloading, carting, stacking, insurance, inspection charge, octroi, weighing etc. complete with internal cement mortar lining.

The rate shall be per Kilogram basis as per actual weight. The contractor shall produce weight slip for each specials.

D.I. Pipe and specials like Tee, Bend, reducer etc shall be laid in line & level in the trench. If required DI pipe shall be cut using appropriate cutting equipment, after cutting pipe edge shall be grind by grinding machine suitable to tyton joint. Rate is inclusive of cutting, grinding, labour, power, SBR rubber ring, chain pulley block, rope etc necessary for laying DI specials in line & level.

Codes of practice

IS:8329 Centrifugally cast (spun) Ductile Iron pressure pipe for water, gas and Sewage.

IS:3764 Excavation Work - Code of Safety.

IS:12288 Code of Practice for use and laying of Ductile iron pipes

2.6 SLUICE VALVES.

For Valves of Diameter upto 250mm, DI Resilient Sluice Valves should be used: Features required for Sluice valves suitable to water work application for continuous operation up to 70 degree Celsius are as follows or otherwise the standard BS 5163/EN 1074-1&2 Ductile Iron / Spheroidal Graphite (S.G.) Iron Double flanged resilient seated Sluice Valves Full bore in accordance with BS 5163/EN 1074-1&2 of PN-10 /16 rated, with Body and Bonnet of Ductile Iron confirming to GGG-50/40 or IS 1865 Gr. (SG 500/7 or SG 400/15), Wedge of WRAS or DVGW approved EPDM rubber (approved for drinking water), Integral Wedge nut, Shaft of S.S. AISI 420, O rings of NBR. Body & Bonnet coated with electro statically applied epoxy powder coating to DIN 30677-2 & GSK guidelines or equivalent to GSK Guide line. Blue colour RAL 5005/5017 with a coating thickness of 250 microns both inside & outside. Sluice valve shall be compatible for buried applications without valve chamber. Face-to-face dimensions as per BS 5163/EN558 and Flange drilling as per IS 1538. 100% tight shut-off. Manual operation by Hand wheel at present but it should be upgradable for Motorized operation by Electrical Actuator suitable for SCADA system.

The contractor shall provide C.I. cap as per I.S. and Hand wheel for valve.

a) Testing

All Sluice valves must undergo hydraulic testing to BS 5163/EN 1074-1&2

- Seat test 1.1 x PN rating
- Body test 1.5 x PN rating

b) Materials

Summary of materials used are as follows:

ITEM	COMPONENT	MATERIAL	GRADE	STANDARAD
1	Body, Bonnet	Ductile Iron	500-7 or 400-15	BS EN5163/ IS1865
2	Wedge core	Ductile Iron	500-7 or 400-15	BS EN5163/ IS1865
3	Wedge nut	Brass	CZ 132	BS 2872/4
4	Rubber (vulcanised on wedge)	EPDM	EUW 70	WRA Sor DVGW Approved
5	Stem	Stainless steel	A276-420	EN 10088-1
6	Stem collar	Dezincif. res. Brass	CZ 132	BS 2872/4
7	Bonnet bolts	Stainless steel	A2	ISO 3506
8	Bonnet gasket	EPDM	EUW 70	WRAS or DVGW Approved
9	O-ring	NBR	-	-
10	Dust seal ring	NBR	-	-
11	Hand wheel	Grey cast iron	250	EN 1561
12	Actuator (Rotork/Auma)	Mfg. Std.	-	-

c) Markings and labeling

Valves shall have the following marking in raised letters: -

- a. The nominal size (i.e. DN)
- b. The nominal pressure designation (i.e. PN)
- c. The body material identification (i.e. GGG)
- d. The manufactures name/trademark
- e. Year of manufacturing
- f. Direction of closing markings (i.e. in cast direction arrow)
- g. Traceable serial number for each valve, - either as engraved tag plate or bar code labeling of aluminum or equivalent durable material.

d) Certification

- a. Manufacture or supplier is requested to provide a copy of the certificate and testing report from recognized certification body.
- b. The Manufacture's quality system ISO 9001:2008 certified by authorized body and copy of certification submitted on request.
- c. Manufacture should give minimum 10 Years of Warranty.
- d. The contractor shall also produce third party inspection test certificate of 'TATA', EIL or CEIL & RITES. The third party inspection charge will be borne by the contractor.
- e. The contractor shall provide manufacturer's test certificate fulfilling quality of valves as per relevant Indian standard.

The rate of item covers cost of supply of valves inclusive of all taxes, duties insurance, loading, unloading, carting etc. complete. The rate shall be on number basis.

2.7 BUTTERFLY VALVE

- Butterfly valve shall be as per IS 13095/BS EN 593. Valve shall be suitable for mounting in any position.
- When the valve is fully closed, the seal shall seat firmly so as to prevent leakage.
- All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.
- All valve, spindles and hand wheels shall be positioned to give good access for operational personnel.
- The time from fully open to fully closed position and vice versa shall be limited to about 5 minutes. The valve shall be suitable for controlling flows by throttling.
- Valves shall be provided with enclosed gear arrangement for ease of operation. Hand wheel manual over-ride shall be provided. The operation gear shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N (for manual hand wheel operation).
- All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels. Hand wheels shall be provided with an integral locking device to prevent operation by unauthorised persons.
- Materials of Construction:
 Body : Cast steel (Conforming to ASTM A216 Gr WCB)
 Disc : Cast steel (Conforming to ASTM A216 Gr WCB)
 Shaft : Stainless Steel (BS 970 431 S29)
 Seat Ring : Stainless Steel : ASTM A 743 CF8

Bearing : Teflon

Size of valves and pressure rating shall be as per Bill of Quantities. Location of valves shall be as per contract drawings.

The contractor shall provide test certificates for materials, strength and leakage shall in accordance with BS EN 593 or relevant international standards.

2.8 Pressure Reducing Valve Set

The pilot controlled Pressure Reducing Valves shall reduce higher upstream pressure to lower, preset, constant downstream pressure regardless of fluctuating demand or varying upstream pressure. The desired downstream pressure shall be easy to set at site, by turning the pilot adjusting screw.

Main Valve

The PRV Main Valve units should conform to the following minimum requirements:

- The main valve shall be diaphragm actuated Straight pattern design.
- The valve shall have an unobstructed flow path, with no stem guides, bearings, or supporting ribs.
- The valve body shall consist of a replaceable, in line & on site raised, stainless steel seat ring.
- The actuator assembly shall be double chambered, center guided by a bearing in the separating partition.
- The diaphragm shall not be used as a sealing surface.
- The replaceable radial seal disk assembly shall include a resilient seal and a V-Port throttling plug.
- The valve shall consist of a visual valve position indicator for observing its seal disk opening level.
- Valve flange shall be with flats for vertical support.

Construction Materials

The main valve construction material shall be:

- Body, cover and separating partition: Ductile Iron
- Seat ring, seal disk (closure), shaft, spring, diaphragm washers: Stainless Steel
- Bearing: Bronze
- Diaphragm: Nylon Fabric reinforced Synthetic Rubber
- Seals: Synthetic Rubber
- Bolts and nuts: Stainless Steel

Coating

Valve body, cover and separating partition shall have a protective fusion bonded epoxy coating. Coating color shall be Blue or any other colour as approved by Engineer in charge and its thickness shall be 250-350 μ .

Control System

The valve shall be controlled in a 2-way system without a water bleed to the atmosphere.

- The complete valve shall be capable of accepting a Multi-Setting Pneumatic Controlled (MSPC) unit, without removing the pilot from the valve or changing the tubing.
- The pilot body shall be stainless steel/ Brass, pilot setting range shall be 1.0-18.0 bar.
- The control system shall be equipped with isolating cock valves on upstream, downstream, and control chamber ports, a one-way flow control device and an external "Y" shape filter. Washing the filter shall not require isolating the main valve.
- All tubing and tube fittings shall be Stainless Steel with Compression connection.
- Internal spring of the pilot to be of Either Galvanised steel /stainless steel make that comply with water standards.
- The PRV Springs to be provided with the PRV must be of middle weight strength.

Service

All valve components shall be accessible and serviceable without removing the valve from the pipeline. The entire actuator assembly (seal disk to top cover) shall be removable from the valve as one integral unit.

Hydraulic Test and Calibration

Prior to shipment, the valve shall undergo a complete functional test performed under dynamic conditions.

Approvals and Certifications

- The valve manufacturer quality shall be certified to ISO 9001-2000.
- The main valve shall be certified for use with drinking water by a reputable authority.

2.9 Lowering & Laying of Valves.

Loading at store and unloading at site of works shall be done carefully using suitable mechanical handling devices such as crane, chain pulley etc. The chambers for housing the valves shall have stable and firm foundations. The chamber and top roof cover with removable lid shall be provided so that it shall be possible to remove or replace or recondition the valves seats and to remove the parts without removing the valves from the pipe work. For this, suitable flange adapters may be provided. Butterfly valves shall have high nitrile rubber seats, preferably metal reinforced, unless otherwise specified and shall be installed in the pipe work in such a manner that they can be removed from the line for dismantling and replacement of rubber seats.

Where the valves are required to be operated electrically, actuators shall be sized to guarantee valves closures at maximum possible differential pressure across the valve. Each actuator shall be supplied with installation, instructions and wiring diagrams and sufficient spare parts.

Valves used on pipeline shall be straight, through type, and non chokable. Each valve or its operation equipment shall bear an approved name plate stating its function. All operation spindles, gears and head stocks shall be provided with adequate points for lubrications.

The tightening of nut and bolts shall be done smoothly in such a way that no excessive strain occurs on any one side. The nuts shall be tightened on diametrically opposite site at a time.

2.10 DISMANTLING DEAD PIPE LINE OF G.I./ A.C PIPE INCLUDING COST OF NECESSARY EXCAVATION AND REFILLING OF TRENCHES, BREAKING THE JOINTS, LIFTING THE PIPES AND STACKING TO THE PLACE AS DIRECTED BY ENGINEER-IN-CHARGE

WITH ALL LEADS AND LIFTS INCLUDING CLEANING THE SURFACE ETC. COMPLETE.

2.11 DISMANTLING FOLLOWING OLD CAST IRON SOCKET AND SPIGOT PIPE CLASS 'LA', 'A', & 'B' INCLUDING BREAKING LEAD CAULKED JOINTS, MELTING OF LEAD AND MAKING IT IN TO BLOCKS INCLUDING STACKING OF PIPES AT SITE LEAD UP TO 50 METERS

2.12 Dismantling of Old Cast Iron socket and spigot class, including cost of necessary excavation, refilling, lifting the pipes and stacking it to the store or to the place as directed by the Engineer-In-Charge. The Rate shall be Quoted in Rmt.

2.13 PROVIDING AND CONSTRUCTING BRICK MASONRY VALVE CHAMBER AND FLOW METER CHAMBER WITH 15CM THICK 1:3:6 PROPORTION PCC BEDDING EXCLUDING EXCAVATION, BRICK MASONRY IN C.M. 1:5 PROPORTION 12MM THICK CEMENT PLASTER IN CM 1:4 PROPORTION ON BOTH SIDES WITH PROVIDING AND FIXING C.I. MANHOLE FRAME AND COVER IN RCC 1:2:4 COPING OR RCC 1:2:4 PROPORTION X 15CM THICK SLAB, ETC COMPLETE AS DIRECTED BY ENGINEER-IN-CHARGE. (NOTE :- WALL THICKNESS : 0.23 M FOR DEPTH OF 1.2M AND 0.35 M FOR BALANCE DEPTH EXCEEDING 1.2M).

- Additional excavation required to be done shall be carried out as per instruction of Engineer-in-charge. For foundation chamber, 15 cm thick PCC Grade M-25 shall be provided; 20 cm thick RCC walls of Grade M-25.
- 12 mm thick cement plaster in CM 1:4 shall be provided on inside of walls.
- 20 mm dia. MS bar steps shall be provided and fixed in wall at 30 cm c/c for facilitating access into the chamber. First step should be at a depth of 0.5 m from top and last step should be 0.5 m above bottom.
- Chamber shall be covered with 150 mm thick RCC of Grade M-25 pre-cast or cast-in-situ slab in two parts with keyholes to insert key for operation.
- Reinforcement for the cover slab shall be provided considering heavy traffic load.(70R Loading)
- Curing of concrete, RCC etc. shall be done using chemical or water for 14 days.
- 12 mm dia. MS bar handles, minimum two nos., shall be provided to each piece of slab during the time of casting of slab.
- Sides of chamber shall be refilled properly with selected excavated earth.
- All the above items shall be carried out in manner as per prevailing sound engineering practices and instruction of Engineer-in-charge.
- FRP Covers of capacity 2.5 Tonne with double seal & with a closed bottom High strength plastic alloy socket keyhole lifting arrangement. The closed keyhole does not allow mosquito breeding to happen in the chamber, doesn't allow foreign particles to enter the chamber and eliminates/reduces the foul smell from the chamber. The High strength plastic alloy socket keyhole lifting arrangement protects the FRP surface from damage due to multiple lifting operations over the years.
- If any chamber comes under road carriage way, chamber should be separately designed comprising RCC walls of Grade M-25.

2.14 INTERCONNECTION OF EXISTING PIPE LINE.

The contractor shall bring required tools at site of work for cutting the existing pipeline. The pipe shall be cut as per instructions of the Engineer-In-Charge. The pipe should be cut in such a way that it may not damage the existing pipe and develop extended crack in the

pipe. The lining of DI pipe shall not be damaged. The materials, debris and waste obtained shall be deposited in stores of the corporation. For dewatering from excavated pit, the contractor shall provide pumping equipment, machinery, fuel, labour, temporary platform and proper disposal of water to nearby storm water drain or drainage manhole as far as possible as per the instructions and requirement to the satisfaction of engineer-in-charge.

The Contractor will be responsible for all above activities along with providing, supplying, fitting and fixing of specials to the Existing as well as Proposed Pipe Lines that are deemed to be necessary for the successful execution of the above said work.

The Rate shall be as per No. of Joints executed.

2.15 HOUSE SERVICE CONNECTIONS

- Supply, laying, testing and commissioning of PE-AL-PE material Plot connections with all necessary fittings of approved make.
- Connecting the DI pipeline from main road to the individual house service connection using PE-AL-PE material of potable type ensuring continuous water supply and in line with the technical specifications.
- All the removed GI of the existing Service Connections (If any) shall be submitted to the RMC store at no extra cost.
- Polyethelene – Aluminium - Polyethelene (PE-AL-PE) Composite Pressure Pipes conforming to IS – 15450 - 2004 U.V. stabilized with carbon black having thermal stability for hot & cold water supply, capable to withstand temperature up to 80°C
- Necessary restoration works to be carried out after providing connection as per the instruction of Engineer in charge.
- The Plot connection shall be of potable type and shall be amicable to fixing of water meters. After that necessary excavation shall be done on new laid line, a hole of a said dia. shall be made by requisite tools and make thread on it. A ferulle shall be fixed with jute & whitener etc. on the top of pipe and after transfer the connection both the pipe shall be filled with earth in layer of 9 inch, necessary watering and ramming shall be done properly. Refer drawing No. TCE.10596A-CV-6169-WS-30021.

2.16 FERRULE CONNECTION :

GENERAL : The item includes making ferrule connection with existing D.I. water supply line including fittings and fixtures.

MATERIAL : The ferrule shall be of GM or brass Conforming to IS-2692/1984 (Reaffirmed 2005), tested to 21.00 kg/sq.cm. & shall be of diameter as specified in the schedule. It shall be fitted with screwed plug or valve capable of completely shutting off water supply. Coupling shall be casted in one piece with cast iron bell mouth cover.

FIXING : The ferrule shall be fixed to the water supply pipe line of specified diameter without protruding inside including making hole in the water main and covering with cast iron bell mouth cover. The ferrule shall be fitted water tight.

DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till completion of the work.

TESTING : Ferrule shall be tested under the testing clause of pipe line. The testing shall be done along with the testing of pipe line.

THE RATE INCLUDES FOR : 1. Ferrule, coupling and cast iron bell mouth cover. 2. Boring hole in the water main and fixing ferrule. 3. Dewatering the trench or pit till completion of work. 4. All necessary labour, materials use of tools.

2.17 THRUST BLOCK.

Anchorage in the form of a thrust block at each deflection in the horizontal and/or in vertical alignment of the pipeline shall be provided as per the design requirements to resist any unbalanced pressure at the bends. Gravity type thrust blocks shall be provided at horizontal and vertical deflections in the pipeline, which shall be designed according to the test pressure and the soil conditions at the site of the thrust block. Before designing the thrust blocks the Contractor shall assess the stability of the soil considering erosion due to wind and water. The general guidelines to be followed for providing and designing of thrust blocks shall be as under:

- The thrust blocks may not be required for bend angles up to 5%. However, necessary calculations shall be submitted by the Contractor for approval by Employer to establish that the thrust shall be taken care by pipe itself and that it is safe not to have the thrust block.
- The thrust shall be designed according to the field test pressure of the pipe.
- For above ground pipelines, thrust blocks shall be designed to take 100% thrust.
- For buried pipelines, thrust blocks on continuous pipe line sections shall be designed considering 50% thrust to be taken by block and balance by pipe as per CPHEEO manual.
- For buried pipelines, thrust blocks near valve chambers and/or any other dismantling joints shall be designed to take 100% thrust.
- In rock the passive pressure of rock shall be considered for thrust block design
- The thrust blocks shall be of concrete M25, cast in-situ, with minimum surface reinforcement of 5 kg/m². No formwork is required to be used for construction of thrust blocks in buried conditions, unless desired by the Contractor. The calculations for the dimensioning and the shape of the thrust blocks shall be approved by the Employer.
- Anchor blocks shall also be located wherever there is a transition between above ground and buried pipelines. All such anchor blocks shall have flexible joints at either end to allow for small amounts of settlement to occur.
- The Contractor shall construct the thrust blocks as early in the program of work as is practical, and at least six months prior to installation of the above ground pipeline in order to reduce the risk of settlement imposing additional loads on the pipeline supports. All thrust blocks are to be completed on each section before the sectional hydraulic testing is conducted.
- Where possible, the base of the thrust block shall be cast against solid rock in order to prevent any settlement. Any material overlying the rock shall be excavated and replaced with class M20 mass concrete. In the event of no rock being encountered, the base of the thrust block shall be cast against undisturbed ground. Any ground, which in the Employer opinion is unsuitable, shall be excavated and replaced with class M20 mass concrete.

2.18 Full bore Electromagnetic flow meter:

- Full bore type Electromagnetic flow meter shall be provided as per approved P&IDs. The flow meter shall consist of flow sensor (i.e. flow tube), flow transmitter/ flow computing unit and remote flow indicator cum integrator. The electromagnetic flow meter shall be manufactured as per BS EN ISO 6817 standard (Measurement of conductive liquid flow in closed conduits, method using electromagnetic flow meters).
- The flow tube flanges and transmitter housing shall be properly earthed.
- Flow tube shall have waterproof construction (IP 68) and shall be suitable for installation on underground pipe lines buried directly in the soil and also suitable for above ground pipelines.
- The transmitter of the flow meter shall be SMART type microprocessor based using digital technology having facilities for configuration of engineering units, flow range and features of memory and self diagnosis. The transmitter shall be mounted separate from the flow tube, connected by a cable. The flow transmitter and flow computation/ evaluation unit shall be mounted in a field mounted metallic field enclosure / cabinet.
- The electromagnetic flow meter shall have bi-directional measurement feature and with accuracy better or equal to + 0.5% of measured value inclusive of linearity, repeatability, pressure effect etc.
- Flow transmitter/ flow computing unit should be microprocessor based having digital display with flow-rate indications and integrated flow values with the configuration facility from the front facia.
- Material of construction of the wetted parts of flow meters shall be suitable for functioning on treated / raw and chlorinated water applications. Flow tube shall be rugged in construction and shall be suitable for continuous operation. Flowmeters shall be suitable for the water turbidity at site during various seasons.
- The flow meter shall be installed in such a way that it always remains filled with water. To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow meter shall be provided, as required by the flowmeter manufacturer. The flow tube shall be installed at a location free from flow turbulence. In order to achieve the same, the flow tubes shall be installed in the pipe section such that straight lengths of pipe without bends or tee connection shall be minimum 5 diameters on upstream and 3 diameters on downstream side. The Contractor shall finalize the exact location of flow transducers in consultation with Employer.
- The flow meter output signals shall contain the data for flow-rate and integrated flow readings. The output signal of the flowmeter will be connected to panel mounted Flow Indicator
- The meter shall be MID approved and OIML compliant.
- Technical Particulars

a)	General		
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i.	Service	:	At the ESR output and at the DMA
ii.	Overall accuracy of measurement loop	:	±0.2 % of measured value
iii.	Quantity	:	As per DMA Requirement
iv.	Internal diameter of pipe	:	As per DMA Requirement
v.	Suitable concrete chamber for enclosing flow meter.	:	As per DMA Requirement
b)	Flow tube		
i.	Type	:	In line full bore electromagnetic
ii.	Size of flow tube	:	Same as pipe size
iii.	Weather Protection Class	:	IP 68
iv.	Range	:	Bidder to state
v.	Surge protection devices (SPD) between flow tube and flow transmitter	:	Required for protection from lightning surges
vi.	Electrode material	:	Hastelloy C /SS
vii.	Flow tube Lining	:	PTFE/HARD RUBBER
c)	Flow Transmitter Unit		
i.	Type	:	Pulse o/p Based with GSM/GPRS Connectivity.
ii.	Type of display	:	8 digit LCD for totalized flow in m3/Hr.
iii.	Input	:	From flow tube
iv.	Output	:	Pulse o/p Based with GSM/GPRS Connectivity.
v.	Power Supply	:	Battery Operated, Battery Life Min 10 Years,
vi.	Zero and Span Adjustment	:	Required
vii.	Weather Protection Class	:	IP 67
viii.	Battery backup for totalised flow	:	Required
ix.	Facility for on line diagnosis	:	Required
d)	Data Logger Unit		
i.	Operation	:	Receive Pulse from EMF & PT and Transfer the same through GSM Network
ii.	Polling Time	:	Every 15 Min from Flow Meter & Pressure Transmitter
iii.	Transmit Time	:	Every 24 Hrs. Once in a form of CSV File

iv.	Display	:	
		:	8 Digits LCD Display
		:	
v.	Power Supply	:	Battery Operated
vi.	Battery Backup	:	10 Years
vii.	Application Software	:	Suitable for Displaying water consumption detail
		:	
viii.	- Provision for Meter non functionality and tampering notification	:	To be provided
		:	

2.19 Technical specification for Transmitter- Pressure:

- Pressure measuring system shall consist of a pressure sensor/transducer/ transmitter and panel mounted digital pressure indicator and any other items required for completing the measuring system. Where the transmitter is subject to pressure pulsations and/or vibration, it shall be provided with snubber.
 - The pressure transmitters shall be designed for operation over 130 % of full range.
- Technical Particulars

i.	Service	:	At the DMA and at the outlet of ESR
ii.	Accuracy of measuring loop	:	± 0.2% of reading or better
iii.	Type	:	Capacitive/piezoelectric / Silicon resonance
iv.	Material of sensor and other wetted parts	:	SS 316
v.	Transmitter type	:	SMART type, 2-wire indicating type with LCD display for pressure MWC or kg/cm ²
vi.	Range	:	Range to be finalised during detailed engineering without any cost implication
vii.	Zero and span adjustment	:	Required
viii.	Output signal	:	4-20mA DC isolated with HART protocol (version 6 or above) proportional to pressure-2nos.
ix.	Enclosure material	:	Die cast aluminium / non-corrosive

x.	Enclosure protection class	:	IP 65
xi.	Ports for in situ calibration	:	Required
xii.	Over range protection	:	130 % of full range
xiii.	Process connection	:	As per process requirement
xiv.	Accessories	:	<ul style="list-style-type: none"> • Diaphragm seal assembly with SS 316 diaphragm(as applicable) • 3 way isolation valve • Impulse tubing, fittings • Snubber • All other installation hardware

2.20 Technical Specification-Multijet type Domestic GSM/ GPRS Water Meter

Technical Specification:

- All meters to be offered under the terms of the Tender and Specification must be of a Multijet/ Volumetric type and must be fitted with liquid filled sealed counters to ensure readability.
- The Meter will be as per Latest Version of IS-779:1994 with its latest version & ISO 4064:1993 with its latest version
- The meters will be Dry dial type, inferential type, horizontal, magnetically coupled.
- Class-B type meters to be supplied.
- Meters which have external calibrating devices are not acceptable.
- Meter should have IP-68 protection class copper can register with 5 mm tempered mineral glass cover.
- Meters to be installed at horizontal, vertical or inclined planes.
- The meters will be fitted with an internal return flow restrictor.
- Successful life cycle test certificate from FCRI is to be provided.
- The meter to be supplied with brass nuts and nipples with complete accessories.

Specification of GSM/GPRS Unit

Power supply	
Power supply	Inbuilt battery
Battery Life	5 years*
Power consumption Standby mode Communication	Less than 18uA 550mA
Battery Management	Built-in 1. Battery Voltage Monitoring 2. Battery usage monitoring
Signal Inputs	

Signal Inputs	Serial Interface
Baud Rate	Configurable
Parameters	
Flow Units	Total Flow: m ³
Real Time Clock	Built-in
Memory	
Memory	2K bytes
Parameters Stored	1. Date/Time 2. Total Flow 3. System Flags 4. System Leak Records 5. Tamper Records 6. Dry events
Memory Type	Non-Volatile memory
Memory Retention	100 years
Environmental	
Max. Operating Temperature:	70 °C
Storage Temperature	0 – 80 °C
Humidity	0 – 80 non condensing
Housing:	ABS plastic
Communication Options:	
GSM Modem	
Operating Voltage	3.8V DC
Maximum Current Consumption	2A peak
Frequency bands	Dual Band
Transmit power	Class 4 (2W) at GSM 850 and E-GSM Class 1 (1W) at DCS and PCS
GPRS	GPRS multislot class 10 Multislot class 2 support PBCCH Support Coding schemes CS1 to CS4
Voice Features	Not used
SMS	SMS, MT, MO and SMS CB
Data / Fax	Not used
SIM Interface	1.8V / 2.9V interface
Communication protocol	Proprietary protocol over TCPIP, FTP over GPRS

Scheme for Bulk Flowmeter, Pressure Transmitter Data Reading

From Bulk Electromagnetic Flow Meter and Pressure Transmitter the Flow & Pressure Data will be fed to Central SCADA system. The Data from that Datalogger unit to SCADA will be transmitted through SMS (CSV Format) through GSM/GPRS Connectivity (1 SMS per Day)

Water consumption detail to be calculated from Bulk EMF cumulative for each DMA area.

Warranty

All the supplied smart water meters, their peripherals and equipment, etc., must have a written warranty from the manufacturer covering not less than 10 years from the date of commissioning.

Maintenance liability

All the installed smart water meters, their peripherals and equipment etc. will be subject to a defect liability period of 10 year beginning from the successful commissioning date. This means that if there is a malfunction or breakdown within the period the supplier will be responsible for making good the same by repair/ replacement at his cost.

When there is a malfunction the bidder, It is expected that the problem will be resolved within 48 hours of the supplier receiving the information. In case a spare part has to be imported then the repair should similarly take not more than 21 days.

The supplier should do a classification of what malfunction/breakdown to be given 48 hours or 21 days. This should be in his tender. The list must be exhaustive and include all elements and how they can be detected.

Spare parts

The supplier must show prove that spares for all the supplied/installed items are available and that they will continue to be produced for the next 10 years at the least. It will be preferable for the spares to be within the country, and full explanation given of their availability.

In case the spares are overseas, full contacts, i.e. email, website, postal address and office telephone must be given and tested for workability. The language of communication must be ENGLISH.

Weatherproof

The equipment to be supplied will be installed and used in unfavourable weather conditions, such as in water, very humid, exposed to any external conditions etc. it is therefore required to supply equipment with all units of build standard to IP 68.

2.21 Specifications of Programmable Logic Controller(PLC):**DESIGN AND CONSTRUCTION REQUIREMENTS**

PLC H/W & S/W shall be from the same family and should be sourced from approved Vendors only. Programmable logic controller (PLC) shall be microprocessor based with 32 bit or other suitable processor and be fully programmable and capable of performing control relay logic, including timing, counting, sequencing, and interlocking to provide the required functionality. The PLC shall be high performance processors suitable for real time process application. High inherent reliability, self checking, error-recovery and trouble-shooting features shall be some of the features of PLC.

The PLC shall have a modular / modular chassis design which allows for ease of future expansion. The processor module shall be easily removed from the I/O chassis for service

or repair. The I/O chassis shall have slots for installing I/O cards, communications, or other special function modules. All I/O cards and modules shall be capable of being installed in any open slot in the chassis or shall be DIN rail mounted. Module and channel level diagnostics should be standard feature.

The PLC shall have a suitable power supply and can be easily serviced or replaceable. The system shall be capable of being powered on 120VAC / 230VAC / 24V DC as per mfr. Std..

The PLC shall be rated to operate from 0 to 60 Degrees C, with a humidity rating of 5 to 95% (non-condensing). All module circuit boards shall be encased and protected such that, when properly installed, they are not exposed to accidental contact by personnel or other objects.

The PLC shall be of high quality and reliability with replacement processors, power supplies, chassis, I/O and specialty modules that are readily available on an urgent or emergency basis. All PLC products shall be fully supported and spares shall be available for purchase for up to ten (10) years from the date of the original system purchase.

User memory	8 MB
I/O memory	0.98 MB
Optional nonvolatile memory	1 GB
Digital I/O, max	128,000
Analog I/O, max	4000
Total I/O, max	128,000
Power dissipation	2.5 W
Thermal dissipation	8.5 BTU/hr
Isolation voltage	30V (continuous), basic insulation type, USB port to backplane Type tested at 500V AC for 60S
USB port(1)	USB 2.0, full speed (12 Mbps)
Module location	Chassis-based, any slot
Wire category(2)	3 - on USB ports
North American	T4A
IECEX temperature	T4
ATEX temperature	T4
Enclosure type	None (open-style)

Temperature, operating	-25 °C < Ta < +70 °C (-13 °F < Ta < +158 °F)
IEC 60068-2-1 (Test Ad, Operating Cold),	surrounding air temperature range is
IEC 60068-2-2 (Test Bd, Operating Dry Heat),	-25 °C < Ta < +60 °C (-13 °F < Ta < +140 °F)
IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	
Temperature, nonoperating	

IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40...+85 °C (-40...+185 °F)
Temperature, surrounding air, max	70 °C (158 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5...95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10...500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g (45 g with SD card installed)
Emissions	IEC 61000-6-4
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80...2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz

Standards: c-UL-us ,CE, RCM, EX, KC, ECA , IECEx

2.22 Technical specifications for receiving indicators mounted at ICP/LCP:

All indicators/controllers shall be electronic (microprocessor based) type programmable indicator and shall be mounted on the control panel located in the control room.

Multiplying factors, shall be specified on manufacturer's nameplate, if applicable.

Specifications, as applicable are as follows:

Process Indicator:

Type : Microprocessor based, programmable

Input : 4-20 mA

Display : 4 ½ Digit, 7 Segment LED display

Display Units : % or Engg. Units, user programmable at site
Alarm Setpoint : Two nos., pot. free relay contact rated at 5A
@230V AC resistive load, adj. over entire range
Transmitter Supply : Required, 24V DC @30mA
Retransmission Output: Required, 4-20 mA in 600 ohm load
Accuracy : + 0.25% of FSD
Terminals : suitable for up to 2.5 sq.mm. wires
Mounting : panel flush mounting
Power : 230 V AC, 50 Hz
Comm. Port : RS-485 Serial Port (Modbus)

Flow Indicator cum totaliser shall also have following in addition to above:

Totalising Counts/Hr : User Programmable at site

Totaliser Display : 8 Digit Digital Display with Battery Backup to retain totalized data in the event of power failure for a minimum period of 24 hours.

2.23 Technical specification of panel:

General

Control panels shall be prefabricated type. Control Panel shall be CNC machine prefabricated out of CRCA sheet steel of thickness not less than 2 mm, modular in construction, properly reinforced, powder coated and having rigid frame structure. Internal mounting plate including the gland plate shall be 3 mm thick. The control panel shall have dimensions as per system requirement. However, the control panel height shall not exceed 2200 mm.

The exterior corners and edges shall be rounded to give a smooth overall appearance with projections kept to a minimum.

Lifting lugs shall be provided for installation purposes and shall be replaced with corrosion resistant bolts after installation.

a) Control Panel shall be completely metal enclosed and shall be dust, moisture and vermin proof.

Panel enclosures shall provide a degree of protection not less than IP 54 in accordance with IS: 13947Part-I.

Control Panel shall be freestanding type. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation.

Metal sills in the form of metal channels properly drilled shall be furnished along with anchor bolts and necessary hardware for mounting the control panels.

Cable entries to the panels shall be from the bottom Control panels shall be provided with louvers along with washable micron filters AIRIN – AIROUT fans will be provided.

All equipments on front of panel shall be mounted flush or semi-flush. In case of semi-flush mounting, only flange or bezel shall be visible from the front. Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment.

Equipment mounted inside the panel shall be so located that terminals and adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible.

(c) Earthing for Instruments:

The panel shall be equipped with an earth bus securely fixed along the inside base of panel.

All metallic cases of instruments and other panel mounted equipment shall be connected to the instrument earth bus.

Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken shall not be permitted. However, looping of earth connections between equipment to create alternative paths to earth bus shall be provided.

A separate instrument earth bus will be created which will be floating and all the cable shields will be terminated onto this bus. This bus will be connected to an electronic earth pit.

(d) Frame Earthing

All metal parts other than those forming part of an electrical circuit shall be connected to a copper earth bar run along the inside bottom of the panel. The minimum section of the earth bar shall be 25 mm x 3 mm. A 15 mm diameter hole is to be provided at each end of the bar. Connection of the earth bar to the station earth shall be carried out by Contractor.

(e) Space Heater

Strip type space heaters of adequate capacity shall be provided inside control panels to prevent moisture condensation on the wiring and panel mounted equipment when the panel is not in operation. The heaters shall operate on 230 V AC. Heaters inside the panels shall not be mounted close to the wiring or any panel mounted equipment. The operation of heaters shall be controlled by thermostats.

(f) Interior Lighting and Receptacle

Each panel shall be provided with either a CFL lighting fixture rated for 11 watt, 230V, 1 phase, 50 Hz supply for the interior illumination of the panel during maintenance. The illumination lamp shall be operated by door switch or manual switch. Each panel section shall be provided with separate lighting.

Each panel shall be provided with 230V, 1 phase, 50 Hz, combined 5 amps and 15 amps, 3 pin receptacle with a switch and neon. The receptacle with switch shall be mounted inside the panel at a convenient location. If the panel has front and rear doors then maintenance socket shall be provided at both locations.

(g) Voltage Level and Power Supply Units

Generally, voltage levels for control schemes and power supply for instruments in the panels, shall be limited to 24 V DC. In case the instruments require power supply other than 24 V DC, Contractor shall provide necessary transformers, converters, inverters and other associated hardware required to generate the requisite power supply. The power supply distribution board for panel mounted and field mounted instruments shall be provided. Power supply to all the instruments mounted outside the control panel shall be provided from the power supply units in the control panel.

The power supply to all the instruments shall be without interruption and shall be continued even in case of failure of 230 V A.C. power supply. UPS sizing should take this into consideration.

(h) Labels

All the equipment mounted on the front facia of control panel as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved. The labels shall be mounted directly below the respective equipment. Also the panel shall be provided at the top with a label engraved with panel designation.

(i) Switches and Miniature Circuit Breakers (MCBs)

Each control panel shall be provided with necessary arrangement for receiving, distributing, isolating and protecting of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with Miniature Circuit Breakers (MCBs). Potential circuits for relaying and metering also shall be protected by MCBs. All Important MCBs will be provided with an auxiliary contact to be used for providing MCB tripped alarm.

(j) Intra-panel (i.e. Panel Internal) Wiring

Connections within a panel, between panel mounted devices and terminal blocks or between two panels mounted devices will be made by 660 volt grade, stranded copper conductor insulated with PVC and designed for a minimum conductor temperature of 90 degrees centigrade. The wires shall be shielded, where necessary. Panels shall be supplied completely wired internally, with a colour coding scheme decided mutually between the Purchaser and the Contractor, to equipment and terminal blocks and ready for external cable connections at the terminal blocks.

Wires within the panel shall be continuous i.e. without splicing and shall comprise stranded copper conductors. Internal wiring or wiring between the two assemblies shall be commensurate with mechanical safety.

Wire termination shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules, marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire disconnected from terminal blocks. The ferrule system shall adopt single tube printed arrangement so that all the characters remain on one line always & hence easily readable

(k) Terminal Blocks

Terminal blocks for power connection shall be 660V grade, 10 amps rated, one-piece moulded, complete with stud type terminals, washers, nuts and lock nuts and identification markings. Markings on the terminal strips shall correspond to wire numbers on the wiring diagrams. All control output terminals will be fused type and all other input signal terminals will be clip on shrouded type. Spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks as required.

There shall be a clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be 250 mm.

Panel internal wiring shall not be looped directly from instrument to instrument. The same shall be looped through the panel terminal block only.

If accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker or positive and negative wires, these wires shall not be terminated on adjacent terminal blocks.

(l) Cable Supports

All external cables shall present a neat appearance and shall be suitably braced, placed in troughing clipped or laced to prevent effects of vibration.

(m) Terminal/ Identification

Every terminal and test plug shall be uniquely identified within the terminal cabinet by means of a terminal number. Appropriate labels shall be used to permit quick and unambiguous identification of each terminal and test plug.

(n) Painting of System Cabinet/ Control Desk

All sheet steelwork shall be phosphated in accordance with the following procedure:

The pre treatment shall be hot process with running water for rinsing

Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.

Rust and scale shall be removed by trickling with clean water followed by final rinsing with dilute dichromate solution.

The control panel shall be powder coated. Thickness of coating of minimum 60 microns. QA test certificate shall be furnished for thickness, adhesion and hardening of powder coating.

2.24 Technical specification for DATA ACQUISITION SYSTEM AND COMMAND CENTER:

General Activities

Within the framework of the Contractor's responsibilities given in this document, the Contractor shall carry out the following activities. However, these shall not limit the requirement for other activities which otherwise are required as per term and conditions of Contract or to fulfil the Contractor's responsibilities or are essential as per good industrial practices. The Contractor shall be responsible for, but not limited to, the following:

a) Providing the Centralized monitoring system & SCADA for RMC.

b) Providing the required staff, but not less than the minimum as specified in this document

c) Providing all required consumables and spare parts/ instruments required for functioning of plant and equipment.

d) Maintenance of instrumentation (all field instruments) & control system, software's, PCs, control room, radio telemetry system, UPS, A.C. etc. and all other works constructed in this Contract.

e) Periodic calibration check of all supplied instrumentation and controls from reputed agencies and submitting the same document to RMC engineers during the period of operation and maintenance.

f) Reporting;

☐ Repair history of all mechanical, electrical and instrumentation control equipment in and pure water pumping stations, water transmission mains;

☐ Daily log of operations of all the important instrumentation & equipment

☐ Daily start-stop operation of pumps with every hour readings for operating voltage, amperage and power factor;

☐ Hourly readings of pressure, flow rate and integrated quantity of water;

☐ Hourly levels of sumps;

☐ Daily list of alarms with time tag;

☐ Logbook format and the data to be included in the logbook shall be decided during commissioning in consultation with RMC;

☐ Last periodic maintenance done for all equipment/buildings of the system;

g) Providing required instrument spares and maintaining adequate inventory of required

accessories or equipment itself for repair of system so that the all instrumentation and control equipments, software and communication system can work efficiently for the proper functioning of Central Monitoring System as per the guarantees given or minimum required efficiencies asked under this Contract, without any additional costs to department.

- h) Prior approval to the changes required to be carried out during O&M shall be obtained by the contractor from the RMC engineer. The required changes shall be reported to RMC well in time necessary drawing and literature for any changes shall be submitted to the employer's representative.
- i) The Contractor shall be solely responsible for the safety and security of the goods in the store and will be responsible for any loss or damages in stores for any reason. He may opt for insurance cover against the value of the goods to be stored without any additional costs on the Department.
- j) Daily patrolling of each location, to identify and report the damages / defects if any.
- k) Periodic routine maintenance of structures/control room / chambers of each location of and others built in the Contract. Such maintenance must ensure adequate cleanliness, ventilation, illumination and structural safety. In addition to this, the general hygienic standards must be maintained and adequate plantation, horticultural activities must be taken up to maintain the total environment of the campus / building / room pleasant.
- l) Providing adequate manpower for monitoring / watch and ward of each location of, pumping stations, OHT's etc.
- m) Providing four wheeler vehicle as specified & as approved by engineer-in-charge for transportation facilities between various locations.
- n) Updating and periodic submissions of the operation and maintenance manual as defined in specifications for O&M works. The Contractor shall take up all periodic maintenance works provided in the approved O&M manual.
- o) Submission of Daily report (Water audit / Energy Audit / Water Balance).
- p) Insurance: The Contractor shall, without limiting his or the Employer's obligations and responsibilities, insure;
 - ☐ The work together with material and plant for incorporation therein, to the full replacement cost (term "cost" in this context shall include profit).
 - ☐ The Contractor's equipment and other things brought onto site by the Contractor, for a sum sufficient to provide for their replacement at the site.
 - ☐ The insurance shall be in the joint names of the Contractor and the Employer at the Contractor's cost and shall cover the Employer and the Contractor against all losses or damages from whatsoever cause arising from the start of the O&M until the date of completion of O&M in respect of the facility or any section or part thereof as the case may be.
 - ☐ Any amount not insured or not recovered from the insurer shall be borne by the Contractor

2.25 Emergency Action Plan

The Contractor shall provide Emergency Plan of Action, as per the following:

- (i) The RMC may, at its election, intercede and take, or direct the Contractor to take, any and all actions reasonably necessary to respond to an Emergency.
- (ii) The Contractor shall, upon learning of an Emergency or the probable occurrence of

an Emergency, (1) immediately provide oral notice to the RMC or its Authorized Representative of the same and (2) as soon as possible, but no later than twelve (12) hours, provide Notice to the RMC or its Authorized Representative of such event or probable event; provided however, if Applicable Law shall provide for a more expeditious oral or written notice of any Emergency to the RMC, the Contractor shall so comply by providing such notice to the RMC or its Authorized Representative.

(iii) The RMC and Contractor or their Authorized Representatives shall coordinate with each another prior to, during and after the occurrence of an Emergency including 1) the planning and implementation of actions designed to prevent or mitigate damage to the System and the environment and (2) the attendance of all meetings related to such planning and implementation.

(iv) The Contractor shall **interact / liaison** and cooperate with appropriate departments of the public entities comprising the RMC and other jurisdictions.

(v) The Contractor shall supply standby employees from normal system staff ready to address an Emergency in an expeditious manner.

(vi) Response Times and Emergencies:-

The Contractor commits itself to a high standard of effective response. To indicate commitment, the Contractor shall establish 'Standards of Service' which shall define the Contractor's response to any emergency with the intention of minimizing the possible impact of an emergency or failure on the output of the Facilities. These standards shall be agreed with the SMC and would typically include:

Situation	Response	Target Time
To any alarm or non-conformity during normal work time, or when the Facilities are being manned.	Any threat to public or personal health.	Immediate
	To attend to and assess the required action and the resources needed to effect remedial action. Effect first call repairs where possible	Immediate
	If the problem requires further resources, to have remedial work on site rectifying the problem	2 Hours
To any alarm Or non-conformity occurring outside normal Operating hours or when Facilities are unmanned	Any threat to public or personal health.	Immediate
	To attend to and assess the required action and the resources needed to effect remedial action.	1 Hours
	Effect first call repairs where possible If the problem requires further resources, to have remedial work on site rectifying the problem	2 Hours

A dedicated problem solving team shall be appointed by the Contractor and this team shall have the responsibility of tracking problems through to a satisfactory outcome.

Major events that threaten public, employee or process safety or security shall be managed directly by an Contractor's Representative, who shall have full authority to utilise

whatever resources he considers fit to rectify any emergency situations. In performing these duties, this manager shall have full responsibility for ensuring proper and adequate communications with the RMC and other relevant bodies.

FUNCTIONAL REQUIREMENTS:

The system is provided with Supervisory Control and Data Acquisition (**SCADA**) with Graphical Users Interface (**GUI**) based Man-Machine Interface capable of acquisition of operational and monitoring data from the field stations, validate and consolidate the same, present the same in graphical form, extract trending information, analyze data in real time and apply analytic tools to recommend logical decision for implementation.

The SCADA shall be capable of displaying following information dynamically.

1. Overall view of the water distribution network with dynamic mimic display of status of measured values of the individual Data on daily and monthly basis and event logging.
2. Generate Control Command Signal based on sequential and discrete control operation. Sequence of control operation is on the basis of select acknowledge and execution logic.
3. Man-Machine Interface shall be provided to generate clear graphical representation of the whole of the pipe line water transmission system, alarm management system, storage of data base for trending, daily / monthly / yearly reporting etc.
4. Software program shall be such that any person without any prior knowledge of software shall be capable to operate the system. Program shall be window based menu driven for ease of operation. The user interface shall be through GUI.
5. Printers loggers shall be provided for periodical print out of the parameters alarms events etc. Also to provide print out of data of thirty (30) minutes pre & post occurrence of events.
6. The SCADA shall be provided with an adequate storage system for data. The data and all operational parameters shall make available online at least one (1) month data, which can be recalled and processed on demand. Provision shall be made to download the data on appropriate storage devices for permanent storage for archiving.
7. Computer based SCADA is aimed at achieving efficiency, equitable distribution and uninterrupted water supply management. Automation will also lead to manpower utilization, saving of power, timely service offered to consumers.
8. Operator Console at Central Monitoring Station:

This shall be server class computer of latest specifications available in the market at the time of execution. Vendor shall submit the indicative specification with the bid for approval.

The SCADA system shall be of open architecture type and it should not be monopolized. GSM/GPRS connectivity to be provided at SCADA system for connection with ICC.

Specification Web Server:

Make: DELL / HP / IBM / Any Approved Make

Quantity: As Per Requirement

Type: Workstation type

Processor: Dual / Quad core Intel Xeon 64-bit Processor with min 2 GHZ or higher

Memory: At least 4 GB DDR2 or higher expandable up-to 32 GB. (Memory may be more based on systems architecture and requirement) or higher

Form factor: Tower I/O Interfaces: PS/2 or USB Mouse port, minimum 1 serial and 1 parallel port., USB port

Mouse: Scroll Mouse with Pad (External mouse)
Key Board: Standard keyboard for Workstation
HDD: 2 TB SATA or higher
Optical Drives: DVD + /- RW
PCI slots: Minimum 3 (Supplier shall ensure that sufficient PCI slots shall be available for mounting PLC to PC communication cards and LAN Ethernet card.
Monitor: 20" TFT flat panel square colored monitor. The make of monitor shall be same as that of PC.
Graphics Card: 128 MB(Min.) Dual DVI or Dual VGA
OS: Latest Microsoft OS with original Microsoft CD media compatible with PLC & HMI software
Data Storage: One additional external hard-disk of 1 TB capacity to be supplied with each work station.

Specification of Engineering/Operator Work Station:

Make: DELL / HP / Any Approved
Quantity: As per Requirement.
Type: Work Station.
Processor: Intel Core I5 Processor with min 2.5 GHZ, 1066 FSB (minimum) or higher
Memory: At least 4 GB expandable up-to 8 GB or higher
Memory Slot: Minimum 2
Screen: Minimum 52" diagonal LCD / TFT Display
Graphics Card: 512 MB or higher
Mouse: Scroll Mouse with Pad (External mouse)
Key Board: Standard Full keyboard
HDD: Minimum 500 GB
Optical Drives: 8x DVD + /- RW
Network: Intel Gigabyte Network Connection (10 / 100 / 1000)
OS: Microsoft Windows - XP / Latest with original Microsoft CD media.
Communication: Integrated Gigabit LAN Ethernet.
Accessories: Audio Stereo Speaker, Audio Jack, Internal Bluetooth card, Audio jacks, RJ-45, RJ- 11 ports, Webcam.
USB Port: Minimum two USB ports for external connection.
Other Software: MS – Office latest student version and Antivirus.

2.26 Laying Of Cables

A distance of minimum 300mm shall be maintained between the cables carrying low voltage AC and DC signals and a distance of minimum 600mm shall be maintained between cables carrying

HT and LT signals. In outdoor areas, the cables shall be directly buried. Each instrumentation and power supply cable shall be terminated to individual panel/ terminal box. Identification of each cable shall be by proper ferrules at each junction as per cable schedule to be prepared by Contractor.

Cables shall be laid in accordance with layout drawings and cable schedule which shall be prepared by Contractor and submitted for Employer's Representatives approval.

All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient amount for the final connection of the cable to the terminals on either end. Various

cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. A loop of 1 meter shall be left near each field instrument before terminating the cable.

Cables shall be complete uncut lengths from one termination to the other.

All cables shall be identified close to their termination point by cable numbers as per cable interconnection schedules. Identification tags shall be securely fastened to the cables at both the ends.

Cable shall be rigidly supported on structural steel and masonry, using individually cast or malleable iron galvanized clips, multiple cable supports or cable trays.

Cables And Cable Carrier System

LV(Low voltage) CABLES :

LV Power Cables shall be 1100V grade, single/multi core, stranded aluminum conductor, XLPE insulated with PVC inner sheath, armored and outer sheath made of FRLS PVC compound, generally conforming to IS 1554 Part-I (for PVC) and IS 7098(for XLPE). Copper cables shall be used for all cables sizes up to and including 6 sq mm.

CONTROL CABLES :

Control cables shall be 1100V grade, multi core, minimum 1.5sq.mm cross section, stranded copper conductor, PVC insulated, PVC inner sheathed/galvanised steel wire armoured, overall FRLS PVC outer sheathed generally conforming to IS 1150 Part-I.

INSTRUMENTATION CABLES:

The instrumentation cables shall be Annealed, tinned stranded copper conductor, 0.5 sq mm, twisted into pairs, overall screened for digital signals, individual and overall screened for low level analog signals, individual triplet and overall screened, PVC insulated, inner PVC sheathed, GS wire armoured and overall sheathed with FRLS PVC.

LT Cables Standards

Standard Description

IS 7098 XLPE insulated electric Cables.

IS 8130 Conductors for insulated electric cables.

IS 5831 PVC insulation and sheath of electric cables.

IS 3975 Mild steel wires, strips and tapes for armouring of cables.

IS 1753 ALLUMINIUM conductors for insulated cables.

INDICATIVE VENDOR LIST

S.No.	Item/equipment	List of Makes of various equipment
1	Sluice Valve / Reflux Valve/	Fouress/ IVC/ Kirloskar/ IVI/Calsens/ LP Valves
2	Butterfly valve	
3	Air valve	Fouress/ IVC/ Kirloskar/ IVI/ ARI/ LP Valves
4	Electromagnetic Flow meter 350 mm dia and above	ABB/ Siemens/ Endress & Houser/ Krohne Marshall
5	Electromagnetic Flow meter	ABB/ Siemens/ Endress & Houser/Krohne Marshal/ Mikamachi
6	DI pipes	Jindal, TATA Metallic.
7	Reinforcement Steel	SAIL, VIZAG STEEL, TATA TISCO.
8	Cement	ACC, Ambuja, Lafarge, Ultratech.
9	Pressure Gauge	AN Instruments, Altop Industries limited, Mazgaon Instrument, Precision industries (MASS, Ashcroft, Heise), Gauges Bourdon (India) Ltd., WIKA Instruments India Pvt. Ltd., Goa Instruments Industries Pvt. Ltd., M Guru Controls Pvt. Ltd., Pyro Electric Instruments Pvt. Ltd., Walchandnagar Industries Ltd., Baumer Technologies India Pvt. Ltd.
10	Pressure Switch	Baumer Technologies India Pvt. Ltd., Chemtrols, Dag Process Instruments, Gauges Bourdon (India) Ltd., Indfos Industries Ltd., Orion Instruments, Precision industries (MASS, Ashcroft, Heise), Switzer Instrument Ltd., Sherman International Pvt. Ltd., Varma Trafag Ind. Pvt. Ltd., WIKA Instruments India Pvt. Ltd.
11	Differential Pressure Gauge	Gauges Bourdon (India) Ltd., AN Instruments, Baumer Technologies India Pvt. Ltd.,
12	Differential Pressure Switch	Indfos Industries Ltd. Switzer Instrument Ltd., Varma Trafag Ind. Pvt. Ltd., Baumer Technologies India Pvt. Ltd., Gauges Bourdon (India) Ltd.,
13	Pressure Transmitter	Foxboro (Schneider electric), Nivo Controls Pvt. Ltd., Honeywell
14	Differential Pressure Transmitter	Baumer Technologies India Pvt. Ltd., Honeywell
15	Electromagnetic Flowmeter	Instrumentation Engineers Limited, Foxboro (Schneider electric), Honeywell Automation India Ltd., Manas Microsystems Pvt. Ltd., Nivo Controls Pvt. Ltd., Siemens Ltd., Toshbro Controls Pvt. Ltd. (Nivo controls), Yokogawa India Ltd., ABB Instrumentation Limited, Endress+Hauser (India) Pvt Ltd, Krohne Marshall
16	Pressure Reducing Valve	Bermad, Fouress, IVC, IVI
17	Programmable Logic	Siemens Ltd., Schneider Electric India Pvt. Ltd.,

	Controller	Yokogawa India Ltd., ABB Instrumentation Limited, GE Fanuc Systems Pvt. Ltd. [GE Intelligent Platforms], Honeywell Automation India Ltd., Mitsubishi electric India Pvt. Ltd., Rockwell Automation India Pvt Ltd,
18	Domestic water meter	Itron, Zenner, ARAD, Belan, Honeywell
19	PE-AL-PE Pipe	Jindal, KiTEC.
20	Instrumentation Cable	Associated Cables Pvt. Ltd., Associated Flexibles & Wires Pvt. Ltd., Chandresh cables Limited(Avocab), Belden, Cords India Ltd., Delton Cables, Finolex cables Limited, GEMSCAB, Helukable India Pvt. Ltd., Kerpen cables, LAPP India Pvt. Ltd., Nicco Corporation Limited, POLYCAB WIRES PVT. LTD., RPG Cables (a division of KEC International Limited), TCL Cables Ltd., TC Communications Pvt, LTD., Thermo Cables Ltd., Udey Pyrocables Pvt. Ltd., Universal Cables
21	Control Cable	Associated Cables Pvt. Ltd., Associated Flexibles & Wires Pvt. Ltd., Chandresh cables Limited(Avocab), Belden, Cords India Ltd., Delton Cables, Finolex cables Limited, GEMSCAB, Helukable India Pvt. Ltd., Kerpen cables, LAPP India Pvt. Ltd., Nicco Corporation Limited, POLYCAB WIRES PVT. LTD., RPG Cables (a division of KEC International Limited), TCL Cables Ltd., TC Communications Pvt, LTD., Thermo Cables Ltd., Udey Pyrocables Pvt. Ltd., Universal Cables
22	Control Panel	Rittal, Eldon CS enclosures Pvt. Ltd., Enclotek Ready Panels Ltd, Kaysons Techno Equipments Pvt. Ltd, Manshu Comtel Pvt Ltd, Positronics Pvt. Ltd., Pyrotech Controls (I) Pvt. Ltd.
23	Ethernet switches	Allied Telesis, AGC Networks Limited, Harting India Pvt. Ltd. Phoenix Contacts (India) Pvt. Ltd., Siemens Ltd., Schneider Electric India Pvt. Ltd.

Notes:

The following guidelines are to be noted with regard to use of materials in the work:

- The contractor shall produce samples of the materials for approval of the Engineer-In-Charge (EIC). The materials of the makes, out of the above as approved by the EIC shall be used on the work.
- In respect of materials for which approved makes are not specified above, the make/brand will be decided by the EIC.
- Before bulk purchase of quantities of materials, it is the responsibility of the Contractor to get the samples of materials approved from consultant and EIC.
- All cost towards the testing shall be borne by the contractor.
- For all the material of approved brands necessary testing as per IS standards shall be done by the agency and no extra payment shall be paid for that.