New Delhi Municipal Council

(NDMC)

BIDDING DOCUMENT

for the

Selection of Contractor for Implementation of Continuous (24 x 7) Pressurised Water Supply in NDMC and Operation & Maintenance of the System for the Period of Five Years

(Following single stage two envelope bidding procedure)

Section 6.23
Part I (Vol-2) – Detailed Technical Specifications

Issued on: __/___/2016

Invitation for Bids No.: NDMC/TENDER NO. _____

Employer: New Delhi Municipal Council

State : New Delhi

Country: India

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Section 6.23

CONSTRUCTION REQUIREMENTS : DETAILED TECHNICAL SPECIFICATION

Selection of Contractor for Implementation of Continuous (24 x 7) Pressurised Water Supply in NDMC and Operation & Maintenance of the System for the Period of Five Years

APPLICABLE CODES & SPECIFICATIONS

The following specifications, standards and codes are made a part of the specification. All standards, tentative specifications, CPWD latest specifications, codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions in hard & soft copy in two sets while performing the work one copy should hand over to NDMC /NDMC before starting the work.

Where reference is made in the Specification to a British Standard Specification (hereinafter abbreviated to 'BS') issued by the British Standards Institution of 2, Park street, London W.I., or to an Indian Standard Specification (I.S.) issued by the Bureau of Indian Standards, (earlier known as Indian Standard Institution), Manak Bhavan, 9 Bahadur shah Zafar Marg, New Delhi 110 002, or American Society for Testing and materials (ASTM) issued by ASTM 1916 Race Street, Philadelphia, P.A., 19103, U.S.A. or American national Standards Institute (ANSI) issued by ANSI 1430, Broadway, New York, N.Y., 10018, U.S.A. or to any other equivalent Standard it shall be to the latest revision of that Standard at the Tender opening date.

The Contractor may propose, at no extra cost to the Employer, the use of any relevant authoritative internationally recognized Reference Standard and seek approval of the Engineer-in-charge before adopting the same.

All details, materials and equipment supplied and workmanship performed shall comply with the specified Standards. If Bidder offers equipment to other Standards, the equipment/material should be equal or superior to those specified and full details of the difference shall be supplied and approval is sought from the Engineer-in-charge.

Certain specifications issued by national or other widely recognized bodies are referred to in this specification. In referring to the Standard Specifications the following abbreviations are used:

- IS : Indian Standard
- ANSI : American National Standards Institute

- API : American Petroleum Institute
- ASME : American Society of Mechanical Engineers
- ASTM : American Society of Testing and Materials
- AWS : American Welding Society
- AWWA : American Water Works Association
- ISO : International Organisation for Standardisation
- DIN : Deutsche Institute fur Nuremburg
- BS : British Standard
- IEC : International Electro-technical Commission
- IEE : Institution of Electrical Engineers
- IEEE : Institute of Electrical and Electronic Engineers
- NEMA : National Electrical Manufacturers Association
- AGMA : American Gear Manufacturer's Association

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

1. IS : 2062 Steel for general structural purposes.
2. IS : 808 Dimensions for hot rolled steel beam, column, channel and angle sections.
3. IS : 814 Covered Electrodes for manual Metal Arc Welding of carbon and C-Mn steel.
4. BS EN 499 Welding Consumables. Covered Electrodes for Manual Metal Arc Welding of Non Alloy and Fine Grain Steel. Classification
5. AWS : A-5.1 Specification for Mild Steel Covered Arc Welding Electrodes.
6. IS : 3613 Acceptance Tests for Wire Flux combinations for Submerged - Arc Welding.
7. AWS : A-5.17 Specification for Bare Mild Steel Electrodes and Fluxes for Submerged Arc Welding.

IS : 1367 - Technical Supply Conditions for Threaded Fasteners

8. IS : 1367 Technical Supply Conditions for Threaded Fasteners (Parts 1 to 3).
9. IS : 2016 Plain Washers.
10. IS : 2074 Ready Mixed Paint, Red Oxide Zinc Chrome and Priming.
11. IS : 102 Ready Mixed Paint, Brushing, Red Lead, nonsetting, Priming.
12. IS : 1786 High Strength Deformed Steel Bars and Wires for Concrete Reinforcement
13. IS : 432 Specification for Mild Steel & (Part-I) Medium Tensile bars and hard drawn steel wire for concrete reinforcement : mild Steel & Medium tensile steel bars.
14. IS.432 Specification for mild steel & (Part-II) Medium Tensile steel bars and hard drawn steel wires for concrete reinforcement : Hard drawn steel wire
15. IS : 269 Specification for Ordinary and Low heat portland cement
16. IS : 8041 Specification for Rapid hardening Portland Cement
17. IS : 383 Specification for coarse and fine aggregate from natural source for concrete

18. IS :12330 Specification for Sulphate Resisting Portland Cement
19. IS : 456 Code of practice for plain and reinforced concrete
20. IS : 800 Code of practice for General Construction in Steel.
21. IS : 816 Code of practice for use of Metal Arc Welding for General Construction in mild steel.
22. IS : 4353 Submerged Arc Welding of Mild Steel & Low Alloy Steels – Recommendations.
23. IS : 817 Code of practice for Training and Testing of Metal Arc Welders.
24. IS : 1182 Recommended practice for Radiographic examination of Fusion - Welded Butt Joints in steel plants
25. IS : 2595 Code of Practice for Radiographic Testing.
26. IS : 3658 Code of Practice for Liquid Penetrant Flaw Detection
27. IS : 5334 Code of practice for Magnetic Particle Flaw Detection of welds.
28. ASTM E 94 Guide for Radiographic Testing
29. ASTM E 709 Guide for Magnetic Particle Examination.
30. ASTM E 165 Test Method for Liquid Penetrant Examination.
31. IS : 3600 Methods of Testing Fusion Welded Joints and weld metal in steel (Parts 1 to 9)
32. IS : 4853 Recommended Practice for Radiographic Inspection of Fusion Welded Butt Joints in Steel Pipes.
33. IS : 3589 Seamless or Electrically welded steel pipes for Water Gas and Sewage (168.3 to 2032 Outside Diameter)
34. IS : 6631 Steel pipes for Hydraulic Purposes
35. IS : 7343 Code of practice for ultrasonic Testing of Ferrous Welded Pipes and Tubular Products
36. IS : 2598 Safety Code for Industrial Radiographic Practice
37. IS : 5822 Code of Practice for Laying of Electrically Welded steel pipes for water supply
38. IS : 1608 Mechanical testing of Metals.
39. IS : 9595 Metal Arc welding of Carbon and Carbon-Manganese Steels.
40. IS : 2825 Code of unfired Pressure Vessels
41. IS:5504 & IS:3589 Code for SW PIPES (SAW)
42. IS:10748 Requirement for Weldable Hot Rolled Carbon Steel Strip in Coils.
43. IS 10234 : Recommendation for radiography for general pipeline welding.
44. API-1104 Welding of pipeline & related facilities
45. IS: 3370
46. IS:456 IS:10262 and SP:23 for design mix
47. Any other relevant code

General civil Engineering works

DESIGN & DRAWING SUBMISSION

Specific attention is invited to the stipulations in respect of Contractor's design, drawings and engineering documents in Specification Section 1. The programme for submission of designs, drawings, etc. shall be based on the following general order, which need to be adjusted to fit particular circumstances:

- Basic design criteria
- Outline design calculations
- General civil works drawings
- Detailed structural design drawings
- Detailed civil works drawings
- Detailed structural drawings
- Detailed architectural drawings
- Civil works working drawings
- Structural working drawings
- Architectural working drawings

Fabrication or shop drawings of all structural steel works supplemented by a Bill of Materials of Structurel shall be submitted to the Engineer for information only. Bar bending schedules for all reinforced cement concrete (RCC) Structures indicating requirements of weights of reinforcing bars of different diameters shall be prepared by the Contractor and submitted to the Engineer for information only. The accuracy and correctness of all such drawings shall be the sole responsibility of the Contractor and any / loss damage incurred by the Corporation in respect of any mistake or discrepancy or anomaly shall be entirely borne by the Contractor. All the civil works drawings shall have the following information mentioned therein for the information of the Engineer**:**

2. Quantity of concrete, masonry in m3 units (concrete blocks, brick or rubble) covered under that drawing. In the case of concrete, quantities for different grades of concrete shall be given. In case of masonry, quantity for different proportions of cement mortar shall be given.

3. Schedule of plate inserts, pipe inserts, anchor bolts, etc. with sizes numbers and tonnage.

Complete detailed design calculations of foundations and superstructure together with general arrangement drawings and explanatory sketches shall be submitted to NDMC/PMC. Separate calculations for foundations or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by NDMC/PMC.

The design considerations described hereunder establish the minimum basic requirements of plain and reinforced concrete structures, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance of the functions for which the same is being constructed. The Contractor shall also take care to check the stability of partly completed structures.

DESIGN GUIDES AND CRITERIA

Complete detailed design calculations of foundations and superstructure together with general arrangement drawings with explanatory sketches shall be submitted to the Engineer. Separate calculations for foundation or superstructures submitted independently of each other shall be deemed to be incomplete and will not be accepted or checked by the Engineer. The design

considerations described here under establish the minimum basic requirements of plain and reinforced concrete structures, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance of the functions for which the same is being constructed. The Contractor shall also take care to check the stability of partly completed structures.

STANDARDS

All designs shall be based on the latest Indian Standard (I.S.) Specifications or Codes of Practice. The design standards adopted shall follow the best modern engineering practice in the field based on any other international standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by the Engineer. In case of any variation or contradiction between the provisions of the I.S. Standards or Codes and the specifications given along with the submitted Tender document, the provisions given in this specification shall be followed. All reinforced concrete structural design shall generally conform to the following publications of the Indian Standards Institution:

(i) IS: 456 : Code of Practice for plain and reinforced concrete

(ii) IS: 875 : Code of Practice for structural safety of buildings, loading standards

(iii) IS: 3370 : Code of Practice for concrete structures for (Part I to IV) storage of liquids

(iv) IS: 1893 : Criteria for earthquake resistant design of Structures

(v) IS: 2974 : Code of Practice for design and construction (Part I to V) of machine foundations

(vi) IS:2470 : Design of Septic Tanks (Part I and II)

All structural steel design shall generally conform to the following publications of the Indian Standard Institution

(i) IS:800 : Code of Practice for use of structural steel in general building construction

(ii) IS:806 : Code of Practice for use of steel tubes in generalbuilding construction

DESIGN LOADING

All buildings and structures shall be designed to resist the worst combination of the following loads / stresses under test and working conditions; these include dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, dynamic loads, impact load and other specific loads.

Dead Load

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipment and other items of machinery. The following minimum loads shall be considered in design of structures

Weight of water	9.81 kN/m^3
Weight of soil (irrespective of strata available at site and type of soil used for filling etc). However, for checking stability against uplift, actual weight of soil as determined by field test shall be considered.	20.00 kN/m^3

Weight of plain concrete	24.00 kN/m^3
Weight of reinforced concrete	25.00 kN/m^3
Weight of brickwork (exclusive of plaster)	22.00 N/m^2 per mm thickness of brickwork
Weight of plaster to masonry surface	18.00 N/m^2 per mm thickness
Weight of granolithic terrazzo finish or rendering screed, etc	**6.23.5** /m^2 per mm thickness

Live Load

Live loads shall be in general as per I.S. 875. However, the following minimum loads shall be considered in the design of structures:

Live load on roofs (accessible)	1.50 kN/m^2
(Non-accessible)	0.75 kN/m^2
Live load on floors supporting equipment such as pumps, blowers, compressors, valves, etc.	10.00 kN/m^2
Live load on all other floors walkways, stairways and platforms	5.00 kN/m^2

In the absence of any suitable provisions for live loads in I.S. Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of NDMC/PMC prior to starting the design work. Apart from the specified live loads or any other load due to material stored, any other equipment load or possible overloading during maintenance or erection / construction shall be considered and shall be partial or full whichever causes the most critical condition. Wind loads shall be as per I.S. 875.

Earthquake Load

This shall be computed as per I.S. 1893 considering ZONE IV parameters. An importance factor appropriate to the type of structure shall be considered for design of all the structures.

Dynamic Load

Dynamic loads due to working of items such as pumps, blowers, compressors, switch gears, travelling cranes, etc. shall be considered in the design of structures as per manufacturer's data.

JOINTS

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be designed to suit the structure. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both right angle directions for all walls and rafts. Expansion joints of suitable gap at suitable intervals not more than 30 m shall be provided in all walls, floors and roof slabs of water retaining structures. Construction joints shall be provided at right angles to the general direction of the member. The locations of construction joints shall be decided on convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 2-m height. PVC water-stops of 150 mm width shall be used for walls and 230 mm width for base slabs. Expansion joints for non-liquid retaining structures shall be provided as per IS 346.23.

DESIGN CONDITIONS FOR UNDERGROUND OR PARTLY UNDERGROUND LIQUID RETAINING STRUCTURES

All underground or partly underground liquid containing structures shall be designed for the following conditions:

i. Liquid depth to be considered up to full height of wall and no relief due to soil pressure from other side to be considered. The wall shall be designed as cantilever bottom fixed and top free.

ii. Structure empty condition (i.e., empty of liquid, any material, etc.)**:** full earth pressure with saturation and surcharge pressure wherever applicable, to be considered.

iii. Partition wall between dry sump and wet sump **:** to be designed for full liquid depth up to full height of wall.

iv. Partition wall between two compartments **:** to be designed as one compartment empty and other full for both the directions.

v. Structures shall be designed for uplift in empty conditions with no live load with the appropriate water table.

vi. Walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilization and dynamic water loads.

vii. Underground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures from below to base slab. A minimum factor of 1.2 shall be ensured against uplift or floatation.

Contractor may carry out detailed soil analysis & based on actual S.B.C. structure shall have to be designed.

FOUNDATIONS

(i) The minimum depth of foundations for all structures, equipment, buildings and frame foundations and load bearing walls shall be as per IS 1904.

(ii) Maximum safe bearing capacity of soil strata shall be taken as indicated in geo-technical reports. (iii) Care shall be taken to avoid the foundations of adjacent buildings or structure foundations, either existing or not within the scope of this Contract. Suitable adjustments in depth, location and sizes may have to be made depending on site conditions. No extra claims for such adjustments shall be accepted by NDMC/PMC.

1. DESIGN REQUIREMENTS

The following are the design requirements for all reinforced or plain concrete structures:

a) All binding and leveling concrete shall be a minimum 100 mm thick in concrete grade 1:3:6.

b) All structural reinforced concrete for water retaining structures shall be of a minimum M30grade with a maximum 20 mm aggregate size for footings and base slabs and with a maximum 20 mm aggregate size for all other structural members. The structures shall be

designed as per IS : 3370 (Part I-IV).

For non water retaining structures the concrete shall be of M 25 grade. The concrete will be designed mix.

c) The reinforced concrete for water retaining structures shall have a minimum cement content of 420 kg/m^3 with a maximum 20 mm size aggregate and 330 kg/m^3 with a maximum 40 mm size aggregate as per IS : 3370 (Part I-IV).

d) The minimum reinforcement for water retaining structures in each direction should be 0.35% of cross section. The minimum clear cover to all reinforcement including stirrups and links shall be 50 mm for all water retaining structures.

e) Where ever space is available, structures shall have a minimum 1 metre wide, 100 mm thick plinth protection paving in M15 grade concrete or stone slabs/tiles. All plinth protection shall be supported on well compacted strata.

f) Any structure or pipeline crossing below roads shall be designed matching classification of road (anything from Class A to AA of IRC loading)

i) Approved quality water proofing compound (chloride free) shall be added during concreting of all liquid containing structure in the proportions specified by manufacturer or 2 % by weight of cement whichever is higher. The wall and floor panels shall be poured in sequential order with a minimum time gap of 4 days.

The following thickness of the members to be designed shall not be less than the following for different reinforced concrete members, irrespective of design thickness:

i. Walls for liquid retaining structures : 200 mm at top and 1000mm at bottom

ii. Roof slabs for liquid retaining structures : 150 mm (other than flat slabs) Flat slam <200mm

iii. Bottom slabs for liquid retaining structures: 500 mm(Raft)

iv. Floor slabs including roof slabs, walkways, canopy slabs : 150 mm v. Walls of cables / pipe trenches, underground pits etc. : 125 mm

vi. Column inside the reservoir shall be circular in shape with 400mm diameter. For other structures, these can be square in shape.

vii. Beam for the reservoir shall be 300 mm x 450 mm viii. Depth of column footings : 500 mm

ix. Parapets, : 100 mm wide and 45cm high on the top of reservoir

x. Precast trench cover : 75 mm

xi. Sun shades 75mm thick and 75 cm projection.

2. MATERIALS IN GENERAL

The term "materials" shall mean all materials, goods and articles of every kind whether RAW, processed or manufactured and equipment and plant of every kind to be supplied by the Contractor for incorporation in the Works. Except as may be otherwise specified for particular parts of the works the provision of clauses in "Materials and Workmanship" shall apply to materials and workmanship for any part of the works.

All materials shall be new and of the kinds and qualities described in the Contract and shall be at least equal to approved samples. As soon as practicable after receiving the order to commence the Works, the Contractor shall inform NDMC/PMC of the names of the suppliers from whom he proposes to obtain any materials but he shall not place any order without the approval of NDMC/PMC which may be withheld until samples have been submitted and satisfactorily

tested. The Contractor shall thereafter keep NDMC/PMC informed of orders for and delivery dates of all materials. Materials shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination failing which such damaged materials will be rejected and shall not be used on any part of the Works under this contract.

3. SAMPLES AND TESTS OF MATERIALS

The Contractor shall submit samples of such materials as may be required by NDMC/PMC and shall carry out the specified tests directed by NDMC/PMC at the Site, at the supplier's premises or at a laboratory approved by NDMC/PMC. NDMC may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by NDMC. The Contractor shall give NDMC seven days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the supplier's premises or at a laboratory approved by NDMC. Representative of NDMC shall attend the test at the appointed place within seven days of the said date on which the materials are expected to be ready for testing or inspection according to the Contractor, failing which the test may proceed in his absence unless instructed by NDMC to carry out such a test on a mutually agreed date in his presence. The Contractor shall in any case submit to NDMC's Representative within seven days of every test such number of certified copies (minimum six) of the test results as NDMC/PMC may require. Approval by NDMC as to the placing of orders for materials or as to samples or tests shall not prejudice any of NDMC's powers under the Contract. The provisions of this clause shall also apply fully to materials supplied under any nominated sub-contract.

4. STANDARDS

Materials and workmanship shall comply with the relevant Indian Standards (with amendments) current on the date of submission of the tender. All the governing items, materials, goods and equipments shall bear ISO-9001-2000 certification. Where the relevant standard provides for the furnishing of a certificate to NDMC/PMC, at his request, stating that the materials supplied comply in all respects with the standard, the Contractor shall obtain the certificate and forward it to NDMC/PMC. The specifications, standards and codes listed below are considered to be part of this Bid specification. All standards, specifications, codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of discrepancy between the Bid Specification and the Standards referred to herein, the Bid Specification shall govern.

a) Materials

IS : 269 Specification for 33 grade ordinary Portland cement

IS : 383 Specification for coarse and fine aggregates from natural sources for concrete

IS : 428 Specification for distemper, oil emulsion, colour as required

IS : 432 Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (Parts 1 & 2)

IS : 455 Specification for Portland slag cement

IS : 458 Specification for precast concrete pipes(with and without reinforcement)

IS : 650 Specification for standard sand for testing of cement

IS : 651 Specification for salt glazed stoneware pipes and fittings

IS : 777 Specification for glazed earthenware tiles

IS : 808 Specification for dimensions for hot rolled steel beam, column, channel and angle sections

IS : 814 Specification for covered electrodes for manual metal arc welding of Carbon and Carbon Manganese steel

IS : 1003 Specification for timber paneled and glazed shutters(Parts 1 & 2) IS : 1038 Specification for steel doors, windows and ventilators

IS : 1077 Specification for common burnt clay building bricks

IS : 1398 Specification for packing paper, water proof, bitumen laminated

IS : 1489 Specification for Portland pozzolana cement (Parts 1&2)

IS : 1566 Specification for hard drawn steel wire fabric for concrete reinforcement

IS :1580 Specification for bituminous compounds for water proofing and caulking purposes

IS : 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement

IS : 1852 Specification for rolling and cutting tolerances for hot rolled steel products

IS : 1948 Specification for aluminium doors, windows and ventilators

IS : 1977 Specification for structural steel (ordinary quality)

IS : 2062 Specification for steel for general structural purposes

IS : 2185 Specification for concrete masonry units (Parts 1 & 2)

IS : 2202 Specification for wooden flush door shutters (Parts 1 & 2)

IS : 2645 Specification for integral cement water proofing compounds

IS : 2750 Specification for steel scaffoldings

IS : 2835 Specification for flat transparent sheet glass

IS : 3384 Specification for bitumen primer for use in waterproofing and damp roofing

IS : 3502 Specification for steel chequerred plates

IS : 4021 Specification for timber door, window and ventilator frames

IS : 4350 Specification for concrete porous pipes for under drainage

IS : 4351 Specification for steel door frames

IS : 4990 Specification for plywood for concrete shuttering work

IS : 8112 Specification for 43 grade ordinary Portland cement

IS : 9862 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and chlorine resisting

IS : 10262 Recommended guidelines for concrete mix design

IS : 12269 Specification for 53 grade ordinary Portland cement

IS : 12330 Specification for sulphate resisting Portland cement

IS : 12709 Glass fibre reinforced plastics (GRP) pipes, joints and fittings for use for potable water supply

b) Tests

IS : 516 Method of test for strength of concrete

IS: 1182 Recommended practice for radiographic examination of fusion welded butt joints in steel plates

IS : 1199 Methods of sampling and analysis of concrete

IS : 2386 Methods of test for aggregates for concrete(Parts 1 to 8) IS : 2720 Methods of test for soils (Parts 1 to 39)

IS : 3025 Methods for sampling and test (physical and chemical) for water and wastewater (Parts 1 to 44)

IS : 3495 Method of test for burnt clay building bricks(Parts 1 to 4)

IS : 3613 Acceptance tests for wire flux combination for submerged arc welding

IS : 4020 Methods of tests for wooden flush doors Type tests

IS : 4031 Methods of physical tests for hydraulic cement (Parts 1 to 15)

IS : 5807 Method of test for clear finishes for wooden furniture (Parts 1 to 6)

IS : 7318 Approval tests for welders when welding procedure approval is not required (Parts 1 and 2)

c) Codes of Practice

IS : 456 Code of practice for plain and reinforced concrete

IS : 783 Code of practice for laying of concrete pipes

IS : 800 Code of practice for general construction in steel

IS : 806 Code of practice for use of steel tubes in general building construction

IS : 816 Code of practice for use of metal arc welding for general construction in mild steel

IS : 817 Code of practice for training and testing of metal arc welders

IS: 875 Code of practice for design loads (other than earthquake) for building structures(Parts 1 to 5)

IS: 1081 Code of practice for fixing and glazing of metal (steel and aluminum) doors, windows and ventilators

d) Construction Safety

IS : 3696 Safety code for scaffolds and ladder (Parts 1 & 2) IS : 3764 Safety code for Excavation work

IS : 7205 Safety code for erection of structural steel work

ORIENTATION

The works shall be laid out within the confines of the Site in order to interface to the existing infrastructure of roadways and inlet and outlet pipe work.

BUILDINGS AND STRUCTURES

- All the building and structure works shall generally comply with the following NDMC requirements unless otherwise specified elsewhere.
- All building framework shall be of reinforced concrete framework.
- All external walls of the pump house shall be in 230 mm thick brick masonry built cement mortar in 1:4.
- All internal partition walls except for toilets shall be in 230 mm thick brick masonry built in cement mortar 1:4 .
- All internal masonry surfaces finish shall have 12 mm thick plain faced cement plaster in cement mortar (1:4). Over this, one coat of primer and two coats of dry distemper of approved quality and shade shall be provided.
- All external masonry surfaces shall be finished with grit wash in ordinary cement followed by cement paint of approved shade. External surface of reservoir above ground level shall be finished with one coat of primer and two coats of waterproof cement based paint of approved quality and shade.
- Toilet areas, walls and ceilings, shall have one coat of primer and two coats of plastic emulsion paint.
- For pumping station foundation and plinth will be in M30 grade concrete where as all external wall for super structure will be 230 mm thick in Brick masonry in C.M. 1:4.
- Toilet floor slab shall be filled with brickbat coba (broken bricks in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company.
- The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.
- The flooring in all areas shall be in 600 mm x 450 mm x 20-mm thick polished kota stone placed in C.M. to give overall thickness of 50mm.
- Toilet areas shall have 450 mm x 450 mm x 25 mm thick polished marble Kota stone tiles placed in cement mortar or lime mortar to give an overall thickness of 50 mm. 2200 mm high ceramic tile (size 200 mm x 200 mm x 6 mm thick) dado placed in cement mortar shall also be provided in these areas. In W.C. areas, the flooring and 2200 mm high dado shall be provided with 200 mm x 200 mm x 6 mm thick coloured ceramic tiles.
- Staircase in annexe shall have 25 mm thick chequered mosaic tiles for treads and 25 mm

thick plain mosaic tiles of approved shade for risers set in cement mortar or lime mortar to give an overall thickness of 50 mm.

- Stairways shall be provided to permit access between different levels within buildings. All roof tops and overhead tanks shall be made accessible with ladder provision. Vertical ladders fitted with landing point extensions will be permitted where considered appropriate by the NDMC to access areas not frequently visited.
- All floor cutouts and cable ducts, etc. shall be covered with pre-cast concrete covers in outdoor areas and mild steel chequered plates of adequate thickness in indoor areas. All uncovered openings shall be protected with G.I. hand railing of 32 NB (M).
- All staircases shall be provided with 32 NB (M) galvanised M.S. pipe hand railing for protection.
- The reinforced concrete roofs shall be casted with its slope towards end as well as made waterproof by application of an approved roof polythene / bitumen membrane. The finished roof surface shall have adequate slope to drain quickly the rainwater and also the runoff from the green area to R.W down take inlet points. A suitable filter media shall be provided before the outlet to avoid flowing of earth from the roof top.
- For roofing drainage, PVC rainwater down takes with PVC. bell mouth and C.I. grating at top shall be provided. For roof areas up to 100 sq.m adequate no. 100 mm diameter down take pipes shall be provided.
- Top surfaces of chajjas and canopies shall be made waterproof by providing a screed layer of adequate slope or application of an approved roof membrane and sloped to drain the rain water. Chajjas, canopies and roof projections shall have drip moulds.
- Building plinth shall be minimum 300 mm above average finished ground level around building.
- All doors, windows, rolling shutters shall have lintels above. Chajja protection to lintels on external walls shall be such as to prevent the rain water splashing into the building.
- All windows and ventilators shall have 25 mm thick marble stone sills bedded in cement mortar (1:3)
- Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of Factory Act.
- All rooms in the buildings shall be provided with appropriate sign boards indicating the function of the rooms involved.
- Wherever equipment and machinery are to be moved for inspection, servicing, replacement etc., suitable movable gantry in the form of EOT crane shall be provided. Minimum capacity of 3 tonnes or more as required shall be provided.
- The design of buildings shall be suitable for the climatic conditions existing on site. Buildings shall as far as is possible permit the entry of natural light.
- Emergency exit doorways with Signboards shall be provided from all buildings in order to

comply with local and international regulations.

- Stairways and paved areas shall be provided at the exit points.
- Toilet blocks in pump house buildings shall be provided with a sink with one drinking water taps of 15 mm size with adequate inlet and outlet connections.
- The side walls of buildings shall, comprise at least 15% ventilated brickwork or louvers.

Ventilated brickwork or louvers shall not be used where the ingress of driven rain could affect equipment or stored materials.

ROADWAYS, & PATHWAYS

The entire area of plot left after construction of reservoirs, storm water drain etc shall be Developed as per provisions contained in BQ. Otherwise it shall be developed as green.

SITE DRAINAGE

The contractor shall provide a site drainage system which shall comprise of the Storm Water

Drainage and its connection with the trunk drain by constructing suitable closed drains

TESTING

Test Cubes

i) The strength of concrete, either in assessing the suitability of the trial mixes or when placed in the works shall be determined from 150mm cubes made, cured, stored, transported and tested in accordance with IS-516: 1959 and as specified.

ii) Test cubes shall be made under the direct supervision of the competent person appointed by the contractor to supervise all stages of the preparation and placing of concrete. They shall be made by the contractor in the presence of the Engineer and generally from concrete taken at the point of discharge from the mixer and the contractor shall provide suitable facilities in the form of a hut or other covered protection as agreed with or directed by the Engineer for the storing and curing of the test cubes during the first 24 hours after making them and until they are dispatched to the testing laboratory.

iii) Test cubes shall be marked and dated in such a manner that the trade and the part of the works in which the concrete they represent has been placed can be readily identified.

iv) Testing shall be done in the field laboratory with due approval of Engineer or whenever so desired and directed by the Engineer, testing of 10% of all such samples may be carried out in approved laboratory and the results shall be submitted promptly by the contractor to the Engineer.

v) Method of sampling of cubes for concrete at plant and at sites, their frequency and strength as well as standard of acceptance of designed concrete mix, shall be as laid down in revised CPWD specifications 2002 and IS:456.

All sampling & testing of various materials as well as for quality control shall be as per CPWD specificities & IS:456.

GENERAL

Specifications

Specifications for various materials required for cement concrete/RCC, their mixing, transportation to site of work, placement, curing, finishing etc. for design mix/ ready mix concrete, its strength, acceptance criteria, requirements of durability etc. shall be as per IS:456 and revised CPWD specifications 2009 and the same shall prevail. All requirements as contained therein shall be complied with.

Supervision

All concreting work shall be done under strict supervision of qualified and experienced representatives of the Contractor as well as those of the Engineer. The contractor's supervisors who are in-charge of concreting work shall be experienced & skilled in this class of work and shall personally superintend all the concreting operations at all stages.

Special Attention shall be paid to the following

a) Proportioning, mixing and quality testing of the materials with particular control on the water cement ratio.

b) Laying of material in place and thorough compaction of the concrete to ensure solidity and freedom from voids and honeycombing.

c) Proper curing for the requisite period.

d) Reinforcement positions are not disturbed during concreting and consolidation by vibration.

Quality Control

The Engineer reserves the right to make changes in the mix proportions including the increased cement content or/and a change in the Contractor's control procedure, should the quality control during progress of the works prove to be inadequate in his opinion and the contractor shall carry out the same. Any extra cost due to change in mix proportions shall be deemed to have been included in relevant item rates.

All the concrete work shall be true to level, plumb and square within the acceptable tolerance. The corners, edges and rises in all cases shall be unbroken and finished properly and carefully. A quality assurance plan shall be submitted for approval before any work is commenced.

SUBMITTALS

6.23.7.23.1 Materials Reports

Prior to start of delivery of materials required for cement concrete the following shall be submitted by the Contractor to the Engineer for approval.

i) Recommended suppliers and/or sources of all ingredients for making concrete including cement, fine and coarse aggregates, water and additives including samples thereof.

ii) Quality Inspection Plan to ensure continuing quality control of ingredients by periodic sampling, testing and reporting to the Engineer on the quality of materials being supplied.

Mix Design

i) The Contractor shall design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements as specified.

ii) Well in advance to commencement of concreting work the contractor shall submit the proposal of mix design and test results from approved laboratory thereof as a report for the approval of the Engineer.

PLANT AND EQUIPMENT

The contractor shall submit his proposed programme, methods and details of plant and equipment to be used for batching, mixing of concrete and transportation of concrete to the site, well in advance prior to start of work.

Certificates

i) With each mix design, the Contractor shall submit laboratory test reports on concrete cubes and as well as on ingredients along with manufacturer's certificates attesting that ingredients have been taken from materials to be used at the actual construction work and conforms to specifications for approval of the Engineer.

ii) In case the source, brand or characteristic properties of the ingredients are required to be varied during the term of the contract, a revised laboratory mix design report shall be submitted to the Engineer.

Reports for Inspection and Testing

During manufacture and concreting operations, the contractor shall conduct inspection and testing as per CPWD Specifications and all reports thereon shall be submitted in a summary form to the Engineer.

Schedules

The Contractor shall prepare working schedules for dates and quantity, location of pouring of concrete for each item of work and submit same to the Engineer at least 48 hours before commencement of such work.

Manufactured Items

Articles manufactured by reputed firms and approved by the Engineer-in-Charge shall only be used. Only articles classified as "First quality" by the manufacturers unless otherwise specified or which bear ISI certification marks shall be used. In case articles bearing ISI certification marks are not available, the quality of samples brought by the contractor shall be judged by the standards laid down in the relevant CPWD specifications. For items not covered by CPWD specifications relevant ISI standards shall apply.

Existing Structure/Services.

Some of the existing above/below ground structures, services, etc. as called for in the tender/directed by Engineer-in-Charge may be required to be dismantled. Some of the existing services like sewer/over flow pipe lines shall require to be diverted. These existing structures services shall be dismantled with extreme care to minimize damage to the materials being dismantled and absolutely avoiding any structural damage to the work not to be dismantled and to work already executed. The dismantled materials shall be stacked within the premises as directed by Engineer-in-Charge. Unserviceable dismantled materials shall be disposed off outside the site by the contractor at no extra cost to Owner. Contractor shall take adequate precaution including providing temporary support measures etc. to the existing below or above ground structures, services, cables, pipes etc. at no extra cost to Owner. Should any damage occur to such structures the same shall be made good by contractor at no extra cost of Owner.

Bench Mark

The contractor shall establish at his own cost, at suitable points, additional reference points/lines, bench marks as may be necessary. The contractor shall remain responsible for the sufficiency and accuracy of all bench marks and reference lines. The temporary bench marks shall be connected with permanent standard bench marks.

It shall be the responsibility of the contractor to verify the correctness of the TBM and other related levels given in the working drawings before start of the work.

Royalty for Surplus Earth:

In case excavated good earth (excluding building rubbish) after fulfilling the requirement for site, is found surplus, the same shall be issued to the contractor at a rate of Rs.8/- per cum. The carriage of earth/ malba from one site to another site, where NDMC has interest, under the awarded contract is payable as per BOQ.

The measurements of works shall be based on CPWD specifications after deduction for voids.

In case the good earth is not allowed to be disposed off or carted by the department or by any other agency the contractor shall not have any claim for deleting/ reducing of the item from the scope of work at any stage. Supporting documents of having the earth disposed at the defined destination shall be attached with each running bill.

The contractor shall be responsible for the security /watch & ward of the material obtained during excavation, the dismantling and demolishing or otherwise, the same shall be utilized or sold by the department. If the department desires that the material including excavated surplus earth requires to be carted to any other NDMC land at shorter/longer lead other than mentioned above, the same shall be done by the contractor and will be paid as per actual lead accordingly.

CLEARANCE OF SITE

The site shall be cleared off all malba/ debris etc. After completion of work and shall ensure removal of temporary structure erected for execution of works, hutments put up by his labourer at site, if any before handing over site to the department in workable condition. No final payment for the work shall be made to the contractor till full satisfaction of the engineer-in-charge.

SLOGAN & LOGO

The contractor shall provide boards of suitable size within the pump house to display

- Lay out of the pumping station.
- Safety rules to be followed in the shape of Dos & Donts.
- General features of the installation

ITEM WISE TECHNICAL SPECIFICATION

6.23.1 ITEM NO.1 ESTABLISHMENT OF DISTRICT METER AREAS

A] Creation & Establishment of DMA's (Scope of work for 30% payment of Item No. 1):-

1. General Scope of Woks:-

The scope of work to be executed as a part of this item are establishment of the DMA/ zones / subzones by measuring the inflow, outflow, pressure, water consumption, consumer meter replacement, water quality etc. with all necessary work to facilitate the work within the scheduled period as mentioned. The Contractor need to provide all the necessary manpower, materials, equipment's etc. for implementation of the services listed below. The detailed scope is as per section 6 of employer requirement for DMA establishment, hydraulic modeling consumer survey, etc.

- Validation of the Network like boundaries, pipeline network, valves, washout etc.
- Customer awareness & Conservation programs for 30,000 connection consumers in the all DMA's.
- Consumer survey: number of current consumers: location of 30,000 connection consumers in the all DMA's.
- Flow and pressure measurements by installing flow and pressure measuring devices.
- Review of existing functioning of the area with valves, supply hours, and updating of map.
- Updating of the network map: GIS map of the network. The cost of tracing equipment's, all the trial pits required for validation of the network etc.
- Develop a Record Plan for each DMA zone which will include a schematic diagram of the feeder and distribution network including sizes and materials, inflow meters location, boundary valves, other valves, major consumers etc.
- Establishment of the consumption in each of the DMA's zones
- Establishment of baseline UFW levels using the flow data from the DMA meters and the consumption assessed
- Condition assessment of pipe & make repair, rehabilitation plan. .
- Assessment of the non-leakage components of the UFW.
- Assessment of the various baseline levels in the zones like Initial water Balance & Zero Pressure Test

2. Detailed Scope of Works:-

The detailed Scope of Works is described as below;

The Contractor shall size the DMAs based on good industry practice, taking into account the water distribution system configuration, continuity of adequate supplies to all consumers, ease of, establishment and maintenance. Each DMA shall, generally, contain about 500 to 2,000 service connections; the contractor shall propose the actual number.

DMA's and sub-DMA of service area boundaries are not currently based on hydraulic boundaries but are defined purely for administrative purposes based on BPS command area wise. For future technical, operational reasons, the divisional, sub-divisional and service area administrative boundaries are to be progressively adjusted to coincide with the hydraulic boundaries of the new DMAs. This will require some areas of jurisdiction to be transferred between divisions and also between sub-divisions and service areas. DMAs will therefore be designed to take into account the following principles:

1. **Create hydraulically isolated Service Station Areas.** Each Service Station Area (or Water Supply Zone) will be supplied from a service reservoir or be directly tapped from a transmission or trunk main, and will be comprised of several DMAs isolated hydraulically from adjacent areas.
2. **Number of connections within the DMA to be about 2,000.** The size of a DMA is a compromise between the cost of establishing and operating the DMAs, and the reductions in water loss and leakage that can be achieved. The larger the size of the DMA the lower will be the water loss reductions achieved and, conversely, the smaller the DMA the Water loss reductions achieved will increase but the costs and manpower requirements will also increase. After a DMA is established it is likely that the number of connections in it will increase due to the formalisation of illegal connections, if any.
3. **Ease of creating hydraulic boundaries.** DMA boundaries will be based on existing topographical boundaries as well as the ease of creating hydraulic boundaries within the existing distribution network. This will minimise installation work (new/replacement valves, district meters, new cross connections, etc.) and establishment costs, keeping changes to supply characteristics and disruption to existing consumers to a minimum, as well as reducing road works' requirements, etc.

The Contractor shall develop a detailed method statement and specification for undertaking the design of the DMAs. This shall be reviewed and approved by the Engineer-in charge.

Electronic water meters shall measure the DMA inflow and outflow, with pressure monitored by pressure transducers, and all flow and pressure data recorded by the integral loggers. The number of water meters shall be kept to a minimum commensurate with best practice.

The Contractor shall undertake a pipeline mapping survey to confirm the accuracy of the distribution network drawings available with NDMC. Pipeline routes and diameter/material type, where access to the pipeline is possible, valve type and locations, and pipe connectivity shall be marked and updated in the drawings. This information further updated in GIS base map of NDMC project area distribution system. The Contractor shall develop a strategy to undertake pipeline mapping surveys, and also pipe condition and corrosion assessment surveys, and shall submit it to the Engineer- in - charge for review and approval The Contractor shall also describe the extent to which such surveys will utilizes trial holes, surface detection techniques, including ground probing radar, non- destructive testing or any latest technologies available for the same etc.

The detailed investigations shall provide a comprehensive overview of the operation and performance of the DMA, specifically to determine the extent and severity of any inadequate levels of service measured against the stated criteria for water quality, customer complaints, pressure, interruption to supply (pipe bursts) and leakage.

If unknown mains are identified by the Contractor during the pipeline mapping survey, or during other work activities, and do not appear to be in service, the Contractor shall investigate and test the mains in consultation with the Engineer-in charge to bring them back into service. The Contractor shall up-date distribution system records and the GIS map, and incorporate the restored main into the network analysis and model.

The Contractor shall update the GIS system of NDMC regularly throughout the contract period as details, of the distribution network are verified during surveys, leaks are repaired, new pipes and fittings are installed or existing assets are replaced, and as pipe replacement proceeds. All findings and system asset changes shall be incorporated into the GIS system. The contractor shall provide a terminal of equivalent or better specification to the existing terminal for his own use at Central Office Space or any place provided by NDMC. At the end of the contract the terminal will be handed over to NDMC.

Where illegal connections are identified during the mapping work, house to house surveys, or at any other time, the Contractor shall report the details to the Engineer-in charge for reporting to NDMC for further action to formalise or disconnect the consumer.

The Contractor shall undertake house to house surveys to record the number of residents, all water supply sources on the premises, including alternative private supplies such as a borehole or well, in addition to legal and illegal connections, and shall report details of private supplies and illegal connections to NDMC. As part of the survey, all consumer meters and meter chambers, as well as service pipes, shall be inspected for satisfactory operation and location, and checked against NDMC records. As a priority action, all leaking and non-operating meters shall be replaced with new and meeting the relevant clauses of this Specification. Where existing meters are installed incorrectly, or the meter chamber has poor access or is not clearly visible, the contractor shall replace the existing installation as approved by the Engineer-in - charge. The Contractor shall remove and replace all previously installed Non AMR or AMR compatible meters and replace with Fully AMR meters. Only those AMR meter which are recently been installed by NDMC in separate contract shall be checked for its accuracy, if required and re-installed. The Contractor shall be responsible for procuring the new fully AMR meters and ultimately returning existing meters removed to the Employer's store.

The maintenance and accuracy testing of new meters procured and installed by the Contractor rests with the Contractor until completion of the contract period, irrespective of the date of meter installation. He shall replace all defective, leaky and non-operative meters with new meters at no cost. Defective meters shall be repaired/ tested for accuracy as specified in the specifications and can then be re-used.

Mains crossing the DMA boundary that are to be retained but their flows not measured shall have an isolating boundary valve installed. Mains crossing the DMA boundary that are not considered to be essential for maintaining flows between DMAs under emergency, or similar, conditions shall be linked inside the DMA to form pipe loops and the mains layout altered to avoid dead-ends, where practical, and to maintain hydraulic performance.

Circulating valves, i.e. those valves that are closed in order to remove all loops from within the DMA thus producing a tree-like mains layout, shall be identified and new valves installed where necessary.

The size and extent of areas within the DMA that can be progressively isolated in order to identify leakage levels across the DMA shall be determined to minimise the need for step valves commensurate with best step-testing practice. New step valves shall be installed where necessary.

On completion of the design the Contractor shall prepare the DMA Design Report in both hard and soft copies and submit it to the Engineer for approval.

All consumer revenue meters and DMA meters, together with their associated permanently installed pressure monitoring transducers, shall be procured under the contract. However, all other monitoring and all location and leak detection equipment shall be supplied, repaired/replaced, and maintained in good order by the Contractor who will retain ownership of them throughout the contract period.

The Contractor shall provide, operate, repair/replace, and maintain in good order, all necessary monitoring and recording equipment required to undertake the contract efficiently, including all pipe and valve locators, temporary flow meters, pressure gauges, pressure/level transducers, data loggers and all leak detection equipment, etc. At the start of the contract, and before any fieldwork commences, the Contractor shall provide recent calibration certificates for all such equipment. Re-calibration certificates, as appropriate, shall be provided by the Contractor at no cost during the Contract as required by the Engineer-in charge.

When undertaking activities at night (such as surveys, step tests and leakage detection activities), the Contractor shall take special precautions to protect personnel from traffic and other hazards by providing protective reflective jackets or vests, using temporary workmen warning road signs, providing adequate illumination, and having lookout personnel as needed.

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 pressurised 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.

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

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 Al size. Five copies (paper) and two digital on CD Of each DMA shall be issued to the Engineer-in charge.

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:

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

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.

B] Water Loss (NRW) detection / reduction and management services (Scope of work for 50% payment of Item No. 1) :-

1. General Scope of Works:-

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 in selected DMA's. 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):

Cost under this item includes for;

1. All leaks detection methods, technology & equipment's, manpower etc. No separate payments on account of leak detection in network.

2. All items , equipment's , services other than bills of quantity

a. 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 tec. 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).

b. 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.

c. 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;

d. Detecting illegal connections: Should the Contractor find illegal connections he shall report them to the Employer.

e. 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.

2. Detailed Scope of Works:-

The detailed Scope of Works is described as below;

Determination of Initial and Target NRW Levels.

After completion of the establishment of DMA's, and preferably prior to any leak detection work being undertaken, the Contractor shall determine the initial leakage level in each DMA, as well as the initial hours of supply/day and Average Zonal Pressure (AZP). Leakage shall be expressed in terms of the number of connections within the DMA, i.e. litres / connection / hour.

Leakage shall be evaluated from flow measurements taken at the DMA supply flow meters when demand in the DMA is at a minimum. This will generally be between the hours of 01.00 and 04.00. From this minimum night flow, deductions shall be made for metered consumption by large water users during the evaluation period and legitimate use by the remaining consumers to make allowance for toilet flushing, etc. The net night flow (leakage) in litres / connection / hour so determined shall have a pressure correction factor applied to allow for the variation in diurnal pressures in the DMA since the night flow is measured when DMA pressures are highest and, therefore, unrepresentative of the average DMA pressure on which the leakage level should be based. The pressure correction factor to be applied in each DMA shall be agreed with the Engineer-in charge and shall be based on relevant DMA pressure data, as well as other data, obtained by the Contractor. This pressure correction is applicable during determination of initial leakage levels.

Where it proves impossible for an adequate water supply to the DMA to be made available by NDMC for a sufficient length of time to undertake the above procedure, alternative approaches should be implemented. All approach that has been successfully implemented in the region for intermittent water supply networks is the mobile tanker and pump method. Short sections of main are temporarily

isolated from the rest of the network, are pressurised and then tested using the meter on the pump. If all consumer connections are also temporarily isolated or capped off to eliminate any legitimate consumer consumption the rate of water pumped into the test section is a direct measure of the actual leakage and any consumption through unknown (illegal) connections. A pressure correction factor shall be applied to allow for the difference between the test pressure and the pressure during normal periods of supply.

Before start of the test, segregate the pipe lines into groupes according to diameter, age, connection density, etc. Suitable groups may be established and the results shall be analysied to arrive the leakage levels in the DMA.

After recording the initial rate of leakage and the test pressure, leakage detection activities can then be immediately undertaken to locate leaks for later investigation and repair. Subsequent repetition of the -test will provide the new level of leakage and the reduction achieved.

The Contractor shall investigate and rectify any contamination reported in the DMA when once the DMA has been proved and the initial levels of leakage and water in the DMA have been agreed, as such contamination will have entered the distribution network through leaks. The Contractor shall take any necessary steps to remove all contaminated water, disinfect any affected mains or pipe work, and test the water for acceptable quality, as agreed with the Engineer-in charge.

Target NRW Levels

The contractor shall carry out leak detection, repair of leak, accounting of non leak component until the water loss level has achieve target NRW levels as specified in section 8 schedules of the Contract document. Once the target NRW level is accepted for the DMA, it is the responsibility of the contractor to maintain it to the acceptable level and never let it fall below the target level.

The contractor can use the latest technology/facility available. for identifying details of underground utilities and leakage detection from water pipes .

Leak Detection and Repair

After determining initial water loss levels the Contractor shall undertake leak detection and repair activities until achievement of the target water loss levels as per Schedule 6 of the contract document by repeating the leakage evaluation procedures carried out to determine the baseline leakage. The Contractor shall develop a strategy for undertaking leakage detection activities in view of the physical conditions likely to be encountered in the Contract area, for instance intermittent water supply at low pressure and limited options for distribution system management or temporary additional water supply fed to the area. At an early stage in the contract, the Contractor's work plan for leak detection and repair shall be developed and issued to the Engineer-in charge for approval prior to commencing associated activities. These activities shall be carried out in accordance with best international industry practice in terms of leak detection methods and equipment, and repair materials and methods employed. This shall be demonstrated in the work plan.

Where the Engineer-in charge has approved an excavation to repair a leak based on the leak detection results provided by the Contractor, and the excavation proves to be "dry", i.e no leak could be found on the pipe; in the excavation, then the Contractor shall be paid for the abortive work undertaken. Payment for excavations to expose and repair a leak shall be paid for under the relevant item in the Bill of Quantities.

Any leaks repaired by the Contractor and that are subsequently found to be leaking will be repaired by the Contractor at no cost.

Visible leaks identified at any time during the contract shall be measured and then repaired. This is essential to minimise complaints from the public and improve water availability. The size of such leaks shall be taken into account when assessing leakage and UFW levels.

Leaks found in locations where both sides of the road are bordered by restricted land or open fields, and there is no reasonable benchmark to locate them, then the leak location shall be identified by triangulation from permanent benchmarks.

The location of all leaks repaired shall be entered by the Contractor onto the NDMC integrated GIS system.

The performance of the contractor in reducing water loss will be evaluated and the payment for his performance will payable on completion of water Loss Reduction and commissioning of DMA's. Formula to derive the DMA Fees as per performance is detailed out in Schedule 5 : Contract Payment Terms of the bid document.

Cost under this item excludes:-

1. All repairs to be carried out for leak reduction as per bill of quantity.

2. Item covered under bills of quantity (item 2 to 190)

C] Achieving continuous (24 x 7) pressurized water supply in DMA (Scope of work for 20% payment of Item No. 1) :-

Achieving and maintaining continuous (24 x 7) pressurised water supply in respective DMA, maintain minimum positive 17 m of water column at consumer end of DMA, monitoring for flow and pressure data including logging and data transfer to the central server. Establishment of the Target NRW 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.

As soon as the target NRW level in each DMA is achieved and the Contractor shall able to achieve and maintain 24 x 7 Pressurised water supply in each DMA based on the 7 days monitoring period, the performance of the contractor will be evaluated and payment for his performance after certification of the same from Engineer-in Charge will be released.

6.23.2 ITEM NO.2: EXCAVATION

Earth work in excavation by mechanical means (Hydraulic excavator) in all kind of soil

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.3 ITEM NO.3: EXCAVATION

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.4 ITEM NO.4: EXCAVATION

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.5 ITEM NO.5, 5.1 TO 5.4 : EXCAVATING TRENCHES OF REQUIRED WIDTH FOR PIPES IN ALL KIND OF SOIL

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.6 ITEM NO.6, 6.1 TO 6.4 : EXCAVATING TRENCHES OF REQUIRED WIDTH FOR PIPES IN ORDINARY ROCK

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.7 ITEM NO.7, 7.1 TO 7.4 : EXCAVATING TRENCHES OF REQUIRED WIDTH FOR PIPES IN ORDINARY ROCK

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.8 ITEM NO.8, 8.1 TO 8.3: OPEN TIMBERING IN TRENCHES

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.9 ITEM NO.9, 9.1 TO 9.3: EXTRA RATE FOR QUANTITIES OF WORKS, EXECUTED :IN OR UNDER WATER AND / OR LIQUID MUD IN OPEN TIMBERING IN TRENCHES

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.10 ITEM NO.10, 10.1 TO 10.11 ,: PROVIDING PUSH-ON-JOINTS TO CENTRIFUGALLY (SPUN) CAST IRON PIPES OR DUCTILE IRON PIPES

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.11 ITEM NO.11, 11.1 TO 11.11 : PROVIDING & LAYING DUCTILE IRON PIPE

General :-The specification pertains to ductile iron spigot and socket spun pipes (suitable for jointing with rubber gaskets) with ISI make and in standard length and of classes mentioned in the bill of quantities confirming to IS -8329/ISO 2531 with all upto date amendments and revision inclusive of all taxes, transportation loading, unloading from the railway wagons, carting to site of work, stacking at site of work (F.O.R.) site of work including all the taxes and duties. Ductile Iron pipe manufacturer must have ISI licence for the entire range of DI pipes required for this tender as on date of submission of tender.

Material :-The material shall confirm IS 1387 of 1993 (second revision) for General

requirements for supply of metallurgical materials.

Manufacture :-The Ductile iron pipes shall be manufactured disconfirming the procedure laid down in clause 7 of IS 8329-2000.

Mechanical test :-Shall confirm clause10 J IS: 8329-2000

Hydraulic test :-Shall confirm clause 10 J IS: 8329-2000

Cement motor lining :-Shall confirm Annex B of IS: 8329-2000

Rubber gasket :-Rubber gasket used for jointing shall be of EPDM Rubber gasket and physical properties of gasket material shall confirmed to IS: 5382-1985.

Test Reports :-The contractor shall have to produce the original copy of **manufacturer's test certificate & third party inspection certificate** from organisation such as DGS & D, SGS, EIL, RITES or any other agency authorized by NDMC for quality and strength of D.I pipes.

Stacking Pipes:-All pipes shall be stacked as per manufacturer's recommendations unless otherwise directed by the Engineer.

The maximum number of layers in any stack of pipes shall be as follows:

Nominal Diameter	**No. of Layers in Stack**	**Nominal Diameter**	**No. of Layers in Stack**
200	12	600	4
250	10	700	3
300	8	800 & 900	2

Transportation of Pipes at Site:-After pipes, fittings and valves will be delivered to and off-loaded at temporary stores/ go-down, the Contractor shall make all arrangements for subsequent transport and handling on or about the site to the point of installation, including where necessary any movement into and out of temporary storage.

The Contractor has to transport the pipes and other materials from manufacturers to the site of laying as indicated by the Engineer. Pipes should be handled with care to avoid damage to the surface and the socket and spigot ends, deformation or bending. Pipes shall not be dragged along the ground or the loading bed of a vehicle. Pipes shall be transported on flat bed vehicles/trailers. The bed shall be smooth and free from any sharp objects.

The transportation and handling of pipes shall be made as per IS: 12288. Handling instructions of the manufacturers of the pipes shall be followed. All precautions set out shall be taken to prevent damage to the protective coating, damage of the jointing surfaces or the ends of the pipes.

Loading & Unloading :-Pipes shall be loaded and un-loaded manually or by suitable mechanical means without causing any damage to the stacked pipes.

Cranes or chain pulley block or other suitable handling and lifting equipment shall be used for loading and un-loading of heavy pipes. Where 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. Pipes shall not be thrown directly on the ground or inside the trench.

When using mechanical handling equipment, it is necessary to employ sufficient personnel to carry out the operation efficiently ensuring safety. The pipes should be lifted smoothly without any jerking motion and pipe movement should be controlled by the use of guide ropes in order to prevent damage caused by pipes bumping together or against surrounding objects.

Rolling or dragging pipes along the ground or over other pipes already stacked shall be avoided.

Support of Pipe on Transit & Storage :-The pipe should be given adequate support at all times. The pipes shall rests uniformly on the vehicle bed in their entire length during transportation. Whatever method and means of transportation is used, it is essential that the pipes are carefully placed and firmly secured against uncontrolled movement during transportation to the satisfaction of Engineer.

Stocking of Materials :-The Contractor shall remain responsible for the safe custody of all kinds of materials received by him till consumption of the same in the works. The materials must be stored in a protected temporary store near the site of work and shall not be removed without specific permission of the Engineer. Temporary stores shall be built by the Contractor at location as directed by the Engineer at the Contractor's cost.

A stock register shall be maintained by the Contractor and the day to day receipt, consumed and balance of such materials shall be recorded therein. This register shall be produced by the Contractor to the Engineer or his representative whenever required for verification of stock. The Engineer shall have free access to the temporary stores/go-down of the Contractor at any time and without any prior intimation.

Materials supplied for a particular work or part thereof shall not be used elsewhere without permission from the Engineer.

Temporary Storage:-The Contractor shall take into temporary protective storage all pipes and valves not required for immediate installation in the works. The Contractor shall provide proper and adequate storage facilities to protect all the materials and equipments against damage from any cause whatsoever and in case of any such damage/theft, the Contractor shall be held responsible.

Pipe should be stored on a reasonably flat surface free from stones and sharp projections so that the pipe is supported throughout its length. In storage, pipe racks should provide continuous support and sharp corners of metal racks should be avoided. Pipes should not be stacked in large piles. Socket and Spigot pipes should be stacked in layer with sockets placed in alternate ends of the stack to avoid lop sided stacks.

Pipes should not be stored inside another pipe. On no account the pipes should be stored in stressed or bent condition or near the sources of heat. Pipes should not be stacked more than 2

m high and pipes of different sizes and classes should be stacked separately. The ends of the pipes should be protected from abrasion. The pipes should be protected from excessive heat at all times. Their storage facility should be well ventilated.

Valves shall be stored under cover until they are required for installation and particular care shall be taken for the protection of any associated mechanical equipment.

The period between taking delivery of pipe and the completion of its installation shall be kept to a minimum and generally, the pipes shall be laid within four weeks from the date of their dispatch from the manufacturer / store.

Any period during which the pipes are strung out along the pipeline or placed alongside the works awaiting installation shall also be kept to a minimum and if this period exceeds one month pipes shall be raised at least 75 mm from the ground on timber bearers. Jointing parts and materials shall in any case be stored under cover as for valves.

LOWERING, LAYING, JOINTING D.I.PIPES :-

The DI pipes will be transported to the site of work where actually they are to be laid and jointed. All necessary steps shall be taken to prevent damage to pipes during transport, loading, unloading, operations etc. Only approved method for conveyance loading and unloading, stacking operations etc. Only approved method for conveyance loading unloading, stacking operations such as winch and chain pulley block tripod, etc. may be adopted. The DI / C.I. pipe should be laid as per IS 12288 and as given below.

Laying of Pipes Under Ground :-

The pipes should be lowered into the trench with tackle suitable for weight of pipe. Either a well designed set of shear legs or mobile crane shall be used for lowering of pipe into the trench. When lifting gear is used the positioning of the sling to ensure proper balance should be checked when the pipe is just clear of the ground. The pipe should be clearly cleaned of any debris inside the pipe either before or just after joint is made. When the laying is not in progress the temporary end closure should be securely fitted to the open end of pipe line.

On gradient of 1:15 or steeper, precautions should be taken to ensure that The spigot of the pipe being laid does not move into or out of socket of the laid pipe during jointing operation. As soon as the joint assembly is completed. The pipe should be held in position while the trench is back filled over the barrel of pipe.

The designed anchorage shall be provided to resist the thrust developed by internal pressure at bends, tees and other specials etc. The cement concrete block should be casted in situ to resist the thrust designed taking into account the maximum pressure the main is to carry in service or on test and the safe bearing pressure of the surrounding soil.

Cutting and Chamfering to D.I. Pipes :-

This item shall be executed for use of cut pipes in required length only when directed by Engineer in charge and after obtaining the permission from him. The burn left after cutting should be trimmed off by light grinding or by filing method. The chamfering of pipes shall conform to IS 12288 — 1987.

The chamfering shall be suitable for push on joints / mechanical joint without damaging the

rubber gasket. The pipe after chamfering should be so smooth that enables to pushed in gasket for push on jointing. This item includes cost of all labour and tools required for executing the complete item.

Jointing of Pipes :-

The DI pipes should be jointed either with flexible joints / SBR rubber gasket joints or by rigid flanged joints. The pipes shall be jointed by the rubber gaskets (SBR) except where there are specials / valves to be jointed to the pipeline. The SBR rubber gasket of suitable size required for laying of CI pipes shall have to be procured by the contractor at his own cost. The SBR ring should confirm to IS 12820/1989.

Before assembling the joint the spigot of one pipe and the interior of the socket of the. adjacent pipe should be thoroughly cleaned. The insertion of the gasket can be facilitated by the prior application of a thin film of lubricant to the bulb seating the inside the socket.

The rubber gasket should be wiped clean, flexed and then placed in the socket with the bulb towards the back of the socket. The groove in the gasket must be located in the retaining heel in the socket and the retaining heel of the gasket firmly embedded in its seating:

It is necessary to ensure that the SBR gasket fits evenly around the whole circumferences removing any bulges which prevent the proper entry of the spigot end. In the larger diameter this operation may be assisted by forming a second loop in the gasket opposite the first then pressing the loop flat one after the other.

A thin film of lubricant should be applied to the inside surface of the gasket which will be in contact with the entering spigot. In addition a thin film of lubricant may be applied to the outside surface of the entering spigot for a distance of 25 cms from the spigot end.

The pipe to be jointed should be supported centrally by the tackle used for laying and balance just clear of the trench bottom. The spigot of the pipe must be aligned and entered carefully into the adjacent socket until it makes contact with the gasket. Finally assembly of the joint is completed from this position.

Joint assembly is completed by forcing the spigot end of the entering pipe through the gasket, which is thus compressed until the spigot end reached the total depth of the socket, if the assembly is not completed with the application of reasonable force, the spigot should be removed and the position of the gasket examined.

For joints 200 mm and above rack and level tackle may be used for completing assembly wherever found necessary at the cost of contractor.

The rack is placed on the socket with the hooked end of the rack extending over the spigot of the entering pipe. The tumble on the end of the 3.2 mtrs. Long socket rope is placed over the hook bolt on the rack, which should be in its lowest position, with nut of the top of the thread. The plain end of the rope is passed round the body of the pipe looped through the rope adjuster on the side of the rack housing, wedge inserted and the rope draw tight, this pulls the wedge home thus securing the rope. The tackle is then tamped firmly to the pipe by tightening the nut on the work bolt once the length of the rope is correctly set, it is not necessary to loosen the wedge adjuster for subsequent joints unless the diameter of pipes being jointed in change. The thimble secured to one end of 6.1 m. wire rope is not loosed over the hook at the end of rack and the free end carried to the socket end of the pipe to be jointed.

A special hook and rope adjuster is then fitted on to this rope and securely located in convenient position by means of the wedge. Once the position of the hook and rope adjuster has been thus set subsequent assembly of pipe of similar length should be subsequently jointed.

Backfilling

Pipe trenches shall be backfilled after completion and acceptance of field hydraulic tests and repair of coating as required and/or as directed. The work shall be done in accordance with IS: 12288.

Backfilling of trenches shall be done as specified below with watering and compacting in layers under "Optimum Moisture Content" conditions to achieve required density of refilling and strength after compaction. For the purpose of backfilling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench to its top:

Zone A: From the bottom of the trench to the level of the centre line of the pipe	Backfilling by hand with sand, fine gravel or other approved material placed in layers of 150 mm and compacted by tamping. The back-filling material shall be deposited in the trench for its full width of each side of the pipe, specials and appurtenances simultaneously. Special care shall be taken to avoid damage of the pipe and the coating or movement of
Zone B: From the level of the centre line of the pipe to a level 300 mm above the top of the pipe	Backfilling and compaction shall be done by hand or approved mechanical methods in layers of 150 mm, special coating or moving or moving of the pipe.
Zone C: From a level 300 mm above the pipe to the top of the trench.	Back-filling shall be done by hand or approved mechanical methods in 150 mm layers after compacting and carried to the level necessary to allow for the temporary restoration of road and path surfaces, and also for hard core (if and where ordered) on roads or to such level as will leave the requisite space for the top soil, road surface etc. to be reinstated as directed by

Where the excavation is made through permanent pavements, curbs, paved footpaths, or where such structures are undercut by the excavation, the entire back-fill to the sub-grade of the structures shall be made with sand in accordance with IS:12288.

The excavated material may be used for back-fill in the following cases, provided it complies with IS: 12288 Clause 4.11.1:

a) In Zone C: In cases where settlement is unimportant the back-fill shall be neatly rounded over the trench to a sufficient height to allow for settlement to the required level.

b) In any zone, when the type of back-fill material is not indicated or specified. Provided

that such material consists of loam, clay, sand, fine gravel of other materials which are suitable for back-filling in the opinion of the Engineer.

All excavations shall be backfilled to the level of the original ground surfaces unless otherwise shown on the drawings or ordered by the Engineer, and in accordance with the requirements of the specification. The material used for backfill, the amount thereof and the manner of depositing and compacting shall be subject to the approval of the Engineer, but the Contractor will be held responsible for any displacement of pipe or other structures, any damage to their surfaces, or any instability of pipes and structures caused by improper depositing of backfill materials.

Trenches shall be backfilled with selected material placed in layers not exceeding 150 mm in thickness after compacting, wetted and compacted to a density of not less than 90 percent of the maximum dry density at optimum moisture content for zones A, B and C of the surrounding material. Any deficiency in the quantity of material for backfilling the trenches shall be supplied by the contractor at his expense. Water for compaction shall be arranged by the contractor at his cost.

The contractor shall at his expense make good any settlement of the trench backfill occurring after backfilling and until the expiry of the defects liability period.

On completion of pressure and leakage tests exposed joints shall be covered with approved selected backfill placed above the top of the pipe and joints in accordance with the requirements of the above specifications. The contractor shall not use backfilling for disposal of refuse or unsuitable soil.

Laying to Curves

Where flexible jointed pipes are to be laid to curves, the deflection at each joint shall not exceed 75% of the maximum allowable values as per the recommendations of the pipe manufacturer. For sharper curves made bevel pipes, bevel adopters and standard bends shall be provided.

Anchor/Thrust Blocks

The contractor shall provide anchor/thrust blocks at all bends, at dead ends and at all other places both below and above ground as directed by the Engineer. Anchor blocks shall be in cement concrete as per dimensions given in the approved drawings. The grade of concrete as specified in the relevant sections of the specification shall be strictly followed. Shuttering shall be as required and to the satisfaction of the Engineer.

The thrust faces of all blocks shall be placed directly against the undisturbed faces of excavations and the shape and size of the blocks shall be as shown on the drawings or as otherwise determined by the Engineer having regard to the nature of the ground and the load or thrust to be encountered. The concrete shall be placed around the fitting in such a way that the coupling are not covered or fixed by it to allow for flexibility and to provide access to the collars for replacing when necessary.

Before casting concrete, bituminous felt shall be wrapped around the fitting at the interface between concrete and fitting. Where required, anchor clamps shall be cast into the anchor blocks.

Hydraulic Test of DI Pipeline :-

1. DI pipes and Fittings:

2. All the Pipes, specials and fitting of DI shall be supplied and tested as per relevant IS.

3. codes and specifications

4. The Following code shall be used for

a. Factory Test Pressure: as per IS 8329 b. Site Test Pressure: as per IS 8329

Suitable section as directed by the Engineer in charge shall be taken for such testing from time to time during progress of the work and satisfactory test given for that section. All testing apparatus, gauges, connections, etc. and water required for testing shall be arranged by the contractor at his cost. The NDMC does not undertake any responsibility to supply water for testing which the contractor has to arrange by paying the required charges directly. The NDMC shall have the right to recover such charges from his bills if complaints are received that contractor has not paid the charges thereof. If there is delay in testing, the contractor shall refill the trenches for the time being and reopen them at time of testing at his own cost failure of which shall entitle the NDMC to do the refilling and reopening of trenches at the risk and cost to the contractor. If the trenches are filled due to any reason whatsoever before testing, the contractor shall have to open them for testing at no extra cost.

1.0] Satisfactory hydraulic test shall be recorded when the section under test shall withstand the pressure as specified by the Engineer in charge for about 15 minutes without operating the test pump. The test pressure being maintained at the specified figures during that 15 minutes interval.

1.2] The field test pressure to be imposed should be not less than the maximum of following.

a) 1.5 times the maximum sustained operating pressure (with minimum design pressure as 6.0 kg/sqcm) in the pipeline.

b) 1.5 times the maximum static pressure (with minimum design pressure as 6.0 kg/sqcm) in the pipeline in the pipe line

c) Sum of maximum sustained operating pressure and maximum surge pressure.

d) Sum of maximum pipe line static pressure and maximum surge pressure,

The testing conditions for the pipelines are summarized as follows:

- Pre test and saturation period with addition of make-up water

  Pressure : Test pressure

  Duration : 24 hrs for DI pipes with cement mortar lining

- Pressure test with addition of make-up water

  Pressure : Test pressure

  Duration : 3 hrs

The pipeline shall be filled slowly from the lowest point in such a manner as to allow expulsion of air through air release valves at highest points. The following filling rates are recommended:

Size (mm)	100	150	200	250	300	400	500	600
Filling rate	0.3	0.7	1.5	2.0	3.0	6.0	9.0	6.23.0

After filling, the pipeline shall be pressurised to the specified operating pressure and left for a period of time to achieve stable conditions. The pipeline shall then be pressurized upto the full test pressure and the section under test completely closed off. Care shall be taken to ensure that the pipeline is free of air. For this if required or if asked by the Engineer, water release test shall be carried out. The hydraulic test shall be maintained for a period of not less than 10 minutes to reveal any defect in the pipes, joints and anchorages.

If the test is not satisfactory, the fault shall be found and rectified. In case fault can not be identified easily, the section under test shall be sub-divided and each part tested separately.

If it is required to test a section of a pipe line with a free end, it is necessary to provide temporary support against the considerable end thrust development by the application of the test pressure. The end support can be provided by inserting a wooden beam or similar strong material in a short trench excavated at right angle to the main trench and inserting suitable packing between the support and pipe end.

Leakage Test for DI/MS Pipeline

Test criteria for permissible losses in DI pipes shall be as under

Q = 1 litre per km per length per 10mm diameter of pipe per 30mtr test pressure per 24 hrs.

All pressure testing at site should be carried out hydrostatically. The pipes shall be accepted to have passed the pressure test satisfactorily, if the quantity of water required to restore the test pressure does not exceed the amount 'Q' , calculated by the above formula.

If it is required to test a section of a pipeline with a free end, it is necessary to provide temporary support against the considerable end thrust developed by the application of the test pressure. The end support can be provided by inserting a wooden beam or similar strong material in a short trench excavated at right angle to the main trench and inserting suitable packing between the support and the pipe end.

No section of the pipe work shall be accepted by the Engineer until all requirements of the test have been obtained.

On completion of a satisfactory test any temporary anchor blocks shall be broken out and stop ends removed. Backfilling of the pipeline shall be completed.

During testing if any joints are found leaking they shall be repaired and / or redone by the contractor at his cost till the test is found satisfactory. Similarly, any pipes collars, specials, show hair cracks, leaks etc. during testing the contractor shall replace them with sound pipes and specials etc. free of cost. The hydraulic test shall be given in presence of the

Engineer in Charge.

Cleaning Out after Testing

On completion of a satisfactory test any temporary anchor blocks shall be broken out and stop ends removed. Backfilling of the pipeline shall be completed.

All pipes or joints which are proved to be in any way defective shall be replaced or remade and re-tested as often as may be necessary until a satisfactory test shall have been obtained. Any work which fails or is proved by test to be unsatisfactory in any way shall be redone by the contractor.

After the completed pipeline is tested, approved, backfilled and the Contractor has removed all temporary works and has reconnected any parts temporarily removed from the pipeline, the Contractor shall finally clean out the whole pipeline and flush it through with water.

Disinfection

After cleaning out, disinfection shall be performed in the following manner: after flushing the pipes the system shall be drained completely, all valves shall be closed carefully and the system filled with a strong chlorine solution of about 50 ppm free chlorine. This solution shall remain in the system for a period as directed but not exceeding 24 hours uninterruptedly. Chlorine residual tests shall be done at various points by an orthotolidine reagent with a colour scale. The disinfection process shall be repeated until the chlorine residual is not less than 10 ppm at all sampling points. After disinfection the entire pipeline shall be rinsed with potable water till the chlorine residual is less than 4 ppm at various points of testing. Rates of disinfection are deemed to be included in the BOQ item. Contractor will not paid separately for this activity.

After completion of disinfection and rinsing the results shall be reported by the Contractor in writing and signed by the Contractor and the Engineer.

The Contractor shall provide at his own expense such sampling points as the Engineer may direct if permanent points are not available or suitably located.

Water for Testing and Cleaning

The Contractor shall provide all water required for testing, cleaning and disinfection of the pipeline at his own cost and shall use only potable water. Contractor shall also bear the cost of chemical required for disinfection.

Disposal of water after testing, disinfection and cleaning shall be arranged by the Contractor with prior approval from the Engineer. The disposal shall be done in such a manner as will not cause any harm to any standing crop, cultivated land, damage to roads or structures, cause submergence and/or nuisance to any public or vehicular traffic.

6.23.12 ITEM NO.12,12.1,12.2: PROVIDING AND LAYING D.I. SPECIALS OF CLASS K-12 SUITABLE FOR PUSH-ON JOINTING

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

Test Reports :-The contractor shall have to produce the original copy of **manufacturer's test**

certificate & third party inspection certificate from organization such as DGS & D, SGS, EIL, RITES or any other agency authorized by NDMC for quality and strength of D.I specials.

6.23.13 ITEM NO.13, 13.1, 13.2 : PROVIDING AND LAYING D.I. SPECIALS OF CLASS K-12 SUITABLE FOR MECHANICAL JOINTING

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

Test Reports :-The contractor shall have to produce the original copy of **manufacturer's test certificate & third party inspection certificate** from organization such as DGS & D, SGS, EIL, RITES or any other agency authorized by NDMC for quality and strength of D.I specials.

6.23.14 ITEM NO.14, 14.1 TO 14.6: PROVIDING AND FIXING G.I. PIPES COMPLETE WITH G.I. FITTINGS

Item includes:- Providing and fixing G.I. pipes complete with G.I. fittings including trenching and refilling etc.

Specification :- **Pipes-Galvanised Iron**

The pipes (tubes) shall be galvanized mild steel hot finished seamless (HFS) or welded (ERW) HRIW or HFW screwed and socketed conforming to the requirements of IS 1239 Part-I for medium grade. They shall be of the diameter (nominal bore) specified in the description of the item, the sockets shall be designated by the respective nominal bores of the pipes for which they are intended.

Galvanizing shall conform to IS 4736 : The zinc coating shall be uniform adherent, reasonably smooth and free from such imperfections as flux, ash and dross inclusions, bare batches, black

spots, pimples, lumping runs, rust stains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanized in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the tube.

The dimensions and weights of pipes and sockets and tolerances shall be as prescribed in Appendix 'C' of CPWD Specification.

All screwed tubes and sockets shall have pipe threads conforming to the requirements of IS Screwed tubes shall have taper threads while the sockets shall have parallel threads.

All tubes shall withstand a test pressure of 50 Kg/sq.cm without showing defects of any kind. Fittings : The fittings shall be of mild steel tubular or wrought steel fittings conforming to IS 1239 (Part-2) or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended Pipe shall be supplied from the NDMC approved list of the firms after **third party inspection** by SGS, RITES or any other agency approved by NDMC inspection charges shall be borne by the contractor.

The different activities under this item shall be executed as per specifications given above and also refer the CPWD Specifications for works.

6.23.15 ITEM NO.15, 15.1 TO 15.10: PROVIDING AND MAKING FLANGED JOINT

The suitable C.I./D.I/ M.S. specials required for making flanged connection shall be procured

by the contractor including all required jointing material i.e. nut bolt and rubber sheet of required thickness etc. The contractor shall have to fix these specials at required places as directed by Engineer in charge. The contractor shall have to employ a fitter for making these flanged joints. The nut bolts shall be tightened enough to make the joint water tight. The satisfactory hydraulic testing shall have to be given by the contractor for these joints. Any leakages if found during testing will have to be rectified by the contractor at his cost. This item shall be carried out as described in Section Ba-V3 of PWD standard book of specifications (Red Book).

This includes the Cost of all jointing materials such as rubber packing of approved quality nut bolts of required size and length as approved by Engineer in charge and cost of all labour for Jointing in required position and alignment. No material shall be supplied by the NDMC.

6.23.16 ITEM NO.16, 16.1 TO 16.10: PROVIDING CUTTING C.I, D.I PIPE

Specifications:- This item shall be executed for use of cut pipes in required length only when directed by Engineer in charge and after obtaining the permission from him. The burn left after cutting should be trimmed off by light grinding or by filing method. The chamfering of pipes shall conform to IS 12288 — 1987.

The chamfering shall be suitable for push on joints / mechanical joint without damaging the rubber gasket. The pipe after chamfering should be so smooth that enables to pushed in gasket for push on jointing. This item includes cost of all labour and tools required for executing the complete item.

6.23.17 ITEM NO.17: LEAD CAULKED JOINTS WITH PIG LEAD

This type of lead caulking is generally done in providing joints in gas water and sewer lines wherever it is practicable to use cast lead caulking, but not in case of wet conditions.

The approximate depth and weights of pig lead for various diameters of C.I. pipes and specials shall be as given in Table

Lead for Different Sizes of Pipes

Nominal size of pipe mm.	*Lead per joint Kg.*	*Depth of lead joint mm*
(1)	*(2)*	*(3)*
80	1.8	45
100	2.2	45
125	2.6	45
150	3.4	50
200	5.0	50
250	6.1	50
300	7.2	55
350	8.4	55
400	9.5	55
450	14.0	55
500	15.0	60
600	19.0	60
700	22.0	60
750	25.0	60

Note: 1. The quantity of lead given in the table is on average basis and a variation of 10 per cent is permissible.

2. Before pipes are jointed on large scale, three or four sample joints shall be made and the average consumption of lead per joint shall be got approved by the Engineer-in-Charge. Only required quantity of spun yarn shall be put so as to give

the specified depth of lead in the joint.

6.23.18 ITEM NO.18:- SUPPLYING PIG LEAD

The material i.e. pig lead, shall be of standard quality to the satisfaction of Engineer in charge.

The different activities under this item shall be executed as per specifications given above and also refer the CPWD Specifications for works.

6.23.19 ITEM NO.19:- FILLING AVAILABLE EXCAVATED EARTH

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.20 ITEM NO.20, 20.1 TO 20.3 : PROVIDING AND LAYING IN POSITION CEMENT CONCRETE

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.21 ITEM NO.21, 21.1 TO 21.4 : CENTERING AND SHUTTERING

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.22 ITEM No.22: Brick work with common burnt clay F.P.S. (non modular) bricks

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.23 ITEM NO.23: PROVIDING AND LAYING IN POSITION SPECIFIED GRADE OF REINFORCED CEMENT CONCRETE

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.24 ITEM NO.24: 12 MM CEMENT PLASTER

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.25 ITEM NO.25: STEEL REINFORCEMENT FOR R.C.C. WORK

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.26 ITEM NO.26: STRUCTURAL STEEL WORK

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.27 ITEM NO.27: WELDING BY GAS OR ELECTRIC PLANT

WELDING :-

General :-

1] Before aligning, assembling and welding, the special's, faces shall be cleaned by scrapping with wire brushes or by any other method approved by the Engineer-in-charge.

2] Welding on field shall conform to IS:816 (Code of practice for use of metal arc welding for general construction hereunder shall have precedence).

3] Welders shall be experienced and approved to do the welding at all locations. Welding shall not be done by helpers, contractors shall remove such welders from the job whose work is not found to be satisfactory. The Engineer-in-charge may ask them to do test welding before approving their employment on the job.

Gousing :-

M.S. Pipes / specials of diameter larger than 500 mm shall be welded with required number of runs from inside and a sealing run from outside. External sealing run shall be done only after internal welding is completed. Before starting the external welding the weld material in the joint shall be cleaned by gousing with gas flame. Gousing shall be done before rectification of any defective welding wherever necessary and as directed by the Engineer-in-charge. Gousing shall not be paid for separately and the rate for welding includes the cost of gousing.

Electrodes :-

Welding electrodes to be used for welding in this contract shall conform to the Indian Standard Specifications IS:814 (Part-II) latest (Specifications for covered electrodes for metal arc welding of mild steel)

The contractor shall use standard electrodes depending on the thickness of the plates to be welded and the type of joint. The contractor shall also use standard current and A.C. voltage required for the machine as per manufacturer directions.

Types of Welded Joints :-

The circumferential joints of the pipes shall be butt welded with required number of runs externally and internally. Pipes below 500 mm dia shall be welded only externally.

All fillet welds shall have a throat thickness not less than 0.7 times the thickness of the pipes to be welded.

Welding Procedure :-

All parts of pipes, specials shall be free from all loose scale, slag, rust, paint and any other foreign materials,, it shall be removed with wire brush and left clean and dry. All scale and slag shall be removed from each run of weld when that run is completed.

The different activities under this item shall be executed as per specifications given above and also refer the CPWD Specifications for works 2009 for works.

6.23.28 ITEM NO.28:- HIRE CHARGES OF PUMP

The item includes dewatering during excavation for the work under water other than specified in Item No: 1 excavation for pipe line, wherever necessary. All machinery, piping, fuel, lubricating oil, electrical connection charges etc. required for pumping machinery including labour and running charges are to be born by the contractor.

This item is operative only when dewatering operations are actually required to be done during execution of construction work at Nallah , river crossing. Necessary written permission from the competent authority is necessary before starting of work

Specifications :-

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification .

6.23.29 ITEM NO.29: SAFETY FOOT REST

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification.

6.23.30 ITEM NO.30: DISINFECTING C.I./M.S/D.I/HDPE WATER MAINS:-

Disinfection shall be performed in the following manner: after flushing the pipes the system shall be drained completely, all valves shall be closed carefully and the system filled with a strong chlorine solution of about 50 ppm free chlorine. This solution shall remain in the system for a period as directed but not exceeding 24 hours uninterruptedly. Chlorine residual tests shall be done at various points by an orthotolidine reagent with a colour scale. The disinfection process shall be repeated until the chlorine residual is not less than 10 ppm at all sampling points. After disinfection the entire pipeline shall be rinsed with potable water till the chlorine residual is less than 4 ppm at various points of testing.

After completion of disinfection and rinsing the results shall be reported by the Contractor in writing and signed by the Contractor and the Engineer.

The Contractor shall provide at his own expense such sampling points as the Engineer may direct if permanent points are not available or suitably located.

The different activities under this item shall be executed as per specifications given above and also refer the CPWD Specifications for works.

6.23.31 ITEM NO.31: DEMOLISHING RCC WORK

Specifications:-

The different activities under this item shall be executed as per the corresponding specifications detailed in general specifications given in the CPWD Specifications for works for this item .

6.23.32 ITEM NO.32: DEMOLISHING BRICK WORK

Specifications:-

The different activities under this item shall be executed as per the corresponding specifications detailed in general specifications given in the CPWD Specifications for works

for this item .

6.23.33 ITEM NO.33, 33.1 TO 33.2: DEMOLISHING CEMENT CONCRETE WORK

Specifications:-

The different activities under this item shall be executed as per the corresponding specifications detailed in general specifications given in the CPWD Specifications for works

for this item .

6.23.34 ITEM NO.34, 34.1 TO 34.3: PROVIDING AND LAYING NON-PRESSURE NP2 CLASS R.C.C PIPES

Item includes:-

1.0] Providing, laying & jointing of pipes of service connections & casing pipe(including cost of pipes & specials)

Specification

RCC. Pipe

The contractor shall supply the required diameter & length of pipe at his cost. The pipes shall be accepted after the **third party inspection by SGS, RITES or any other agency authorized by NDMC,** the charges for the same shall be borne by the contractor. The detailed specification for pipes shall be conforming to IS specification as as per IS-458-1988.

i) The dimension and reinforcement should be as per IS-458-1988.

ii) The laying and jointing of RCC pipes as per IS-783-1985. The joint used for jointing shall be rigid collar/ spigot & socket joints.

iii) Perfect alignment of two joining pipes is necessary before jointing.

6.23.35 ITEM NO.35,:- DISPOSAL OF BUILDING RUBBISH/MALBA/SIMILAR UNSERVICEABLE

Specifications:-

The different activities under this item shall be executed as per the corresponding specifications detailed in general specifications given in the CPWD Specifications for works for this item .

6.23.36 ITEM NO.36, 36.1 TO 36.7 :- SUPPLY OF M.S PIPE

M.S. Pipes

Providing, fabricating, testing, painting, supplying and installation of M.S. Pipes & Specials of specified ID / OD & specified wall thickness conforming to IS 3589-2001/5504. Pipes shall be flanged with slip-on-boss flanged available open confirming to IS 6392-1971.

Pipes shall be made from steel plates / HRC coils conforming to relevant IS 2062 grade B, Fe410 or strips by SAW butt welding longitudinally or spirally. The weld shall be continuous. Prior to welding, edges of plates or strips may be prepared suitably where required by the process of manufacture.

A General

All pipes and specials shall be manufactured out of new mild steel plates/steel strips/coils, which shall be free from any cracks, surface flaws, laminations, excessive pitting or any other defects. The pipes shall be mill manufactured of either plate welded or spiral welded variety with longitudinal or spiral welds confirming to respective standards from a mill which can establish with authenticity having supplied similar pipes in the last 3 years which shall be truly cylindrical, and straight in axis. The process of manufacture shall be as per clause 7.3 of IS:

3589. The ends shall be accurately cut and prepared for welding. *No site-fabricated pipes are*

allowed. The external circumference of the pipe pieces, which are to be fixed adjacent to flange adopter with fixed outer diameter shall not deviate from theoretical by more than 1 mm. The pipe shall be rolled to the extent it is truly cylindrical. The external longitudinal/spiral welding of the pipe shall be ground smooth flush with surface to the satisfaction of the Employer or his Representative. Nothing extra cost shall be charged by the Contractor for grinding work. The approved vendors for supply of M.S. plate sheets / HR coils for fabrication of pipes shall be **SAIL, TISCO, ESSAR, JINDAL & ISPAT** Industries Ltd.

B Design

While designing the Steel Cylinder, it will be seen that no tension is taken by the cement mortar lining / coating. The thickness of the steel plate provided shall be such that it will be able to cater to the maximum of the following loading/pressures as given below: -

a) Class AA loading due to moving traffic + Weight of soil above the top of the pipe + Self-Weight of the pipe and Water load in the pipe + Internal pressure + Surge pressures.

b) Pressure rating of pipe is not less than 12 kg/cm^2.

c) The thickness of MS plate for the pipe shall be maximum of designed thickness plus corrosion allowance of 2 mm or the thickness indicated in the table. For sizes not specifically mentioned in the said Code, the minimum preferred thickness for the next higher size shall be applicable.

Finished ID Of	Thickness	Toleran
400mm	6mm	No
500mm	6mm	
900mm	9mm	allowed

C Fabrication Specifications

a. The Contractor shall get the fabrication work done in a duly valid licensed factory of his own or that from an approved nominated manufacturer. This factory meant for fabrication of pipes, specials etc. shall have arrangements for testing all sorts of materials as per requirements of IS codes, etc. & machining as well as lining by centrifugal process, out-coating etc. for completing the work under the present contract within the contract period, the factory shall be equipped with adequate number of various equipments and plants as per requirement of IS 3589

b. The factory shall have adequate area and shall also have stacking yard for the stacking of plates, structural, fabricated pipes and scrap etc. At the time of submitting the bid, the Contractor shall submit lists of equipment's available with him for this work and balance, which shall be arranged/purchased by the bidder on receipt of Letter of Intent and also list of trained personal along with experience in the job and their qualifications etc.

c. Each pipe shall be hydrostatically tested in the plant/mill and subjected to ultrasonic and radiographic testing of weld seam and body of the pipe

D Standard Specification for Welding

a. All components of a standard shell, either straight or bent etc. shall be welded, wherever possible by use of automatic are welding machine by Submerged Arc welding process with alternating current. Hand welding shall not be permitted except for sealing runs and such other minor works at the discretion of the Employer or his Representative. The strength of the joint shall be at least equal to that of the parent material.

b. The Contractor shall use electrodes either of Advani-Orlecon (over code-S), D&H (Medio) make (SFA 5.1 AWS E-6013) or other equivalent approved make if the above makes are not available, and the size depending on the thickness of plate and the type of joint as approved by the Engineer-in-charge. The Contractor shall also use standard current and are voltage required for the machine in use with such modifications as may be found necessary after experimental welding. For this purpose, samples of welded joints shall be prepared and tested in the presence of the Employer or his representative. The values once determined shall be maintained throughout the work and if any modifications are to be made, a written permission of the Employer or his Representative shall be obtained. In the case of thin sheets electric arc welding may not give satisfactory results and gas welding shall be resorted to Gas welding shall be subjected to the same specifications and tests as those for electric welds. Welding shall be carried out inside as well as outside. The ends of pipes shall be beveled for butt joints.

c. Joints: As per clause 17,1(a) of IS 3589.

E Tolerance

a) Tolerance for pipes in respect of diameter and straightness shall be in accordance with IS: 3589 **however, negative tolerance in pipe wall thickness is not permissible.**

b) The shell in the completed work shall be almost fully round. The difference between maximum and minimum inside diameters at any cross section shall not exceed 1% of the

nominal diameter of the cross section under consideration subject to a maximum of 5 mm in circumference only.

c) Machined parts shall be within the limits specified by IS 3589-2001.

d) Straight pipes shall have their faces perpendicular to the axis of the section with a maximum deviation of 2 mm on either side of the plane.

e) For the shell thickness, following tolerances are acceptable: (+) 10% and no negative Tolerance on pipes wall thickness. Permissible tolerance for specials for diameter arm length and angular deviation shall be in accordance with IS 3589 - 2001.

F Shop Testing

After fabrication, but before application of lining and protective coatings all pipes and specials shall be subjected to a shop hydraulic test as per clause 10 of IS : 3589. Standard lengths of pipes shall be directly subjected to test and non-standard pipe and elbows can be tested as standard pipe before being cut to size.

II. Cleaning, Epoxy Painting/ Coating of M.S. Pipes and Specials

Surface Cleaning:-All the surfaces of steel pipes and specials to be painted shall be blast cleaned to Sa 2½ Swedish Standard SIS 055900 (equivalent to IS:1477-Part-I, Class-B i.e. near white) to remove all rust, mill scale etc. Earlier to sand blasting oil and grease shall be removed by applying a suitable metal cleaning solution (quality, make and properties of the cleaning solution to be clarified by the Bidder at the time of submission of the bid) and wiping the clean rags. Also the bidder shall remove all foreign matter, which cannot be removed even by blasting to the satisfaction of the Employer.

III. Priming Coat

The blast-cleaned surface shall then be provided immediately a priming coat of following specifications in the fabrication shop. “One Coat of Zinc Anode 304 inorganic Silicate coating by airless spray (not by brush) to achieve a dry film thickness of 75 to 80 microns”.

Each lot of paint i.e. primer supplied shall also be accompanied with the certified copies of the results of the test carried out by the manufacturer. If any sample of primer and/or paint is not conforming to the specifications, the entire consignment to which the sample may pertain shall be rejected. Only those primers and painting materials that have been approved by the Employer/owner in writing shall be used for this work. Therefore, the Bidder shall also clarify the following in respect of primer and the paint in his bid,

i. Base

ii. Catalyst

iii. Shade,

iv. Characteristics

v. Pod life

vi. Mixing ration

vii. Viscosity

viii. Drying time.

IV. Intermediate Coat

This shall be applied at fabrication shop and shall be of the following specifications, "Apply one coat of high build Micaceous iron oxide coating by airless spray to achieve a dry film thickness of 100 microns" – MAKE – Asian, Shalimar, Berger, Godlac Nerolac and Johnson & Nicholson.

The bidder shall also clarify the following in respect of paint to be used as intermediate coat

(i) Shade,

(ii) Characteristics,

(iii) Shell life,

(iv) Drying time,

(v) Finish,

(vi) Colour,

(vii) Toxicity

In addition to above the Bidder should also enclose with the bid results of the tests of the manufacturer in respect of the following:

I. Stripping test,

II. Flexibility and adhesion of 96 hours of drying

III. Protection against corrosion under conditions of condensation

IV. Impact test

V. Resistance to heat

VI. Flash point

VII. Weigh per 10 litres

Paint shall be applied only to dry, freshly cleaned surfaces, free from dust, rust, scales, grease or other substances which might affect the adhesion or the durability of the coating. In no case the paint shall be applied during rainy or misty weather.

All paints shall be applied by skilled workmen in a workmanship manner and the average coverage shall be equal to that recommended for first class work by the manufacturer on M.S. Steel pipes.

The primer coat and the intermediate coat shall be uniform in thickness and free from floods, runs, sags, drips or bare spots. Any bares pots noticed shall be recoated with an additional application of the primer and the intermediate coat.

Application of the paint under very strong sun or in the early morning in winter shall be avoided. All paintings shall be done at mean temperature recommended by the manufacturers. If during inspection any portion is found rusted, the same shall be removed by emery paper and recoated to the original specifications. When one coat is applied, the date of application of this coat should be written on either end of the section. Before application of the paint, it shall properly stirred so as to get a good mix.

The painting shall be done by cross brushing i.e. one coat shall be given vertically and another coat horizontally so as to get required uniform thickness and to avoid sagging.

V. Finish Coat

a) This coat shall be given at erection site and shall be of the following specifications. "Apply one coat of Catalyzed Epoxy Resin suitably pigmented of 75 microns dry film thickness" – Make : Asian, Shalimar, Berger, Godlac Nerolac and Johnson & Nicholson.

b) Total film thickness of all the coats shall be 250 microns.

c) Over the finishing coat, a coat of POLYURETHENE EPOXY FINISH shall also be applied of 30- micron thickness. (Reference BS:5493 Standard) Make : Asian, Shalimar, Berger, Godlac nerolac and Johnson & Necholson.

d) No coating shall be applied closer than 100 mm from ends of pipes and specials and this coating shall be done after field welding. The exposed steel surfaces shall be protected by rust preventive application, which shall not interfere with the field welding.

e) Machined finished surfaces shall be effectively coated with white lead to prevent rust during loading / unloading and transport of pipes and specials from the fabrication shop to the site of erection to preserve the shop applied paint in the best practical condition.

f) After erection of the M.S. Pipeline on site above ground, all rust, damaged area and site weld portion of the pipeline shall be cleaned to near white and shall be painted with one coat of primer and two coats of paints as explained earlier. Over the two paints coats a coat of 30-micron thickness POLYURETHENE EPOXY FINISH shall also be provided. All paintings shall be done on clean dry surfaces so that there is proper adhesion of different coats with each other.

g) Thickness of each layer of paint shall be measured using elcometer or other standard measuring devices to be provided by the Bidder at his own cost. If the thickness is found to be less than the specified, the outer surface of the pipe shall be re-surfaced to bring the same to the original specified thickness.

h) The bidder shall also check adhesion properties of the paints applied and submit necessary reports as asked by the Employer or his representative.

i) If, at any time during inspections, it is found that the procedure of applying paint is not as per standards laid down, all such painting work shall be rejected and rectified by the Bidder at his own cost as per direction of the Employer or his representative.

a) **Epoxy Inner Lining for carrier pipes laid with trench-less method**

Wherever permitted, the inner lining of food grade epoxy will be applied after achieving cleaning as per clause 6.7.3 II. The thickness of various coats shall be as under:

- Primer : 150-170 micron
- Intermediate Coat : 150-170 micron
- Sealing Coat : 150-170 micron

The total thickness (DFT) shall not be less than 450 micron.

K MARKING

The component parts of the pipes shall be carefully marked as per IS Codes for identification in the field in such a way that these could be located on the field.

6.23.37 ITEM NO.37, 37.1 TO 37.4 : SUPPLY OF M.S PIPE 12 MM THICK FOR TRENCHLESS AS CASING PIPE

Supply of MS pipe of MS plate of 12 mm thick including painting with epoxy paint inside and bitumenous paint for trenches less laying.

For detailed specification please refer item no 36 above.

6.23.38 ITEM NO.38, 38.1 TO 38.7 : SUPPLY OF M.S SPECIAL

Specials – Fabrication

Generals

Specials, such as tees, Y-pieces, bends (single or composite), tapers, tees, blank flanges and gap pieces, collars etc. shall necessarily be in steel and shall be manufactured as per IS : 7322 standards and applicable codes and tested in the same manner as the pipes. Small branches, single piece bends etc. may be fabricated at the site. Care shall be taken to ensure that the fabricated fittings have at least the same strength as the pipeline to which they are to be joined and tested.

A. Bends

i. Bends shall be fabricated taking into account the vertical and horizontal angles for each case as per the IS code.

ii. The bends shall have welded joints and the upstream and downstream ends of each bend shall have a straight piece of variable lengths as required at site.

iii. Bends shall be designed with deflection angle of maximum 10 deg between segments.

STEEL FLANGES

The flanges and their dimensions of drilling, wherever not specified, shall be in accordance with IS:6392 – 1971 or its latest revision. The flanges shall be slip on boss type NP 1N/mm2. Prior to welding flange, the contractor shall have to obtain approval of Engineer for all sizes and types of flange drawings.

6.23.39 ITEM NO.39, 39.1 TO 39.3 : PROVIDING POLYETHYLENE HDPE PIPE

Providing and supplying in standard length ISI mark High **Density Polyethylene(HDPE) anti rodent pipes suitable for (HDD) – horizontal direction drilling work)** & suitable for potable water as per IS specification 4984/1995 including all local and central taxes, insurance, transportation, freight charges, octroi, inspection charges, loading& unloading, conveyance to departmental stores or site of work and including cost of jointing material etc., complete.

The item shall be covering manufacturing, supplying and delivery of HDPE pipes having material grade PE100 bearing IS4984/1995 and its latest version or amendments. The HDPE pipes shall be supplied in standard length or as per NDMC requirements.

Raw material

Raw material used to manufacture the HDPE pipes shall be virgin compounded or Natural black PE 100 resin confirming to ISO4427:2007 .The carbon black content in the material shall be within 2.5± 0.5% and the dispersion of carbon black shall be satisfactory when tested as per ISO2530.

The pipe shall generally meet the specification as per latest revisions and amendment of IS:4984 and IS:7328 unless otherwise mentioned. The PE100 black compound proposed to be used for manufacturing of the pipes should also comply with the following norms certified by the raw material manufacturer from an independent third party laboratory like Exova (formerly Bodycote), KIWA etc which should be submitted by the pipe supplier.

a) The raw material should have certification as per ISO 9080:2003 and ISO 12162 by an independent international testing laboratory for having passed 10,000 hour long term hydrostatic strength (LTHS) test extrapolated to 50 years to show that the resin has a minimum MRS of over 10 MPa. Certification as per ISo 13477:2008- Determination of resistance to rapid crack propagation (RCP)- small –scale steady state test (S4 test)

The resin should have been certified by the an independent laboratory of international repute for having passed 10,000 hour long term hydrostatic strength (LTHS) test extrapolated to 50 years to show that the resin has a minimum MRS of over 10MPa. Internal certificate of any resin manufacturer will not be acceptable.

a) Certificate for having passed the full scale rapid crack propagation test as per ISO 13478.

Quality assurance certificate

Quality assurance certificate, for the raw material proposed to be used for the project (HDPE / MDPE, electro fusion fitting, compression fitting), from one of the certifying agencies such as Bodycoat or Slevan or Advantica or any other internationally reputed organization shall be submitted after finalization of vendors and after award of contract.

The pipe supplier should have adequate manufacturing / test facilities for all the HDPE pipes

being supplied. The manufacturing system of the supplier also should have been certified under ISO 9000/ISO 14001. The manufacturing / test facilities should preferably include oxidation induction test equipment, Environmental Stress crack resistance test equipment and thickness/ weight control through wall thickness monitoring or feeder control systems. Adequate facilities for checking of critical raw materials specifications should also available at the premises of the pipe manufacturer.

The bidder should submit the above raw material certificates after finalization of vendors and after award of contract

Pressure Rating

The pressure rating of HDPE pipes and specials shall be of PN 10 confirming to clause 3.3 of IS 4984.

Density and MFR

The specified density shall be between 940.0 kg/m^3 and 958.4 kg/m3 (both inclusive) when determined at 27 degree C according to procedure prescribed in IS 7328 the value of the density shall also not differ from the nominal value by more than 3 kg/m3 as per 5.2.1.1 of IS 7328. The MFR of the material shall be between 0.2g/10 min to 1.10 g/10 min (both inclusive) when tested at 190 degree C with nominal load of 5 kg as determined by method prescribed in IS 2530. The MFR of the material shall also be within ±20% of the value declared by the manufacturer.

Colour of pipes

The Colour of the HDPE pipe shall be confirming to clause 4 of IS4984:1995 or clause 3.1.2, 3.1.3 and 3.2.

Reworked material

As per the provision of clause 5.4 of IS4984:1995, addition of not more than 10 percent of the manufacturer's own reworked material resulting from the manufacture of pipes is permissible. No other reworked or recycled material shall be used. The material to be used shall be clean and should be derived from the same resin as used for the relevant production.

Dimensions

The pipe dimensions shall be as per latest revisions and amendment of Clause 6 of IS4984:1995. The pipes up to diameters 125mm shall be supplied in coils of 50/100m length. The coils shall be as per the provisions of clause 6.5 of IS4984:1995. Pipe beyond 125mm shall be supplied in straight lengths of minimum 6/12m as per Engineers instructions.

The internal diameter, wall thickness, length and other dimensions of pipes shall be as per relevant tables of IS: 4984 for different class of pipes. Each pipe shall be of uniform thickness throughout its length.

The wall thickness of the PE100, PN 6 pipes shall be as per the table given below:

Nominal Dia of HDPE	Wall Thickness (mm)	
	Minimum	Maximum
63	4.7	5.4

75	5.6	6.4
110	8.1	9.2
160	11.8	13.2
200	14.8	16.5

The dimension tolerances shall be as per IS: 4984.

Performance requirements

The pipe supplied should have passed the acceptance tests as per clause 9.2 of IS4984:1995. The manufacturer should provide the test certificates for the tests conducted, as required in clause 9.2 of IS4984:1995 along with the supply of pipes. These tests can be performed in the in-house laboratory of the pipe manufacturer or at an approved laboratory.

Marking

As per the provisions of IS4984:1995, each straight length of the pipe shall be clearly marked in inedible ink/ paint on either end and for coils at every 5m the following information:

a. The manufacturer's name and/ trade mark

b. Designation of the pipe as per IS (PE 100 & PN10)

c. Lot number/ Batch number

The words "NDMC WATER Project

BIS License

The pipe manufacturer who is going to supply the pipe for the project has to have a valid BIS license to do so for the kind of pipes required for this project. The bidders shall submit this valid license after finalization of vendors and after award of contract.

Third Party Inspection

The pipes shall be accepted successful after the third party inspection by SGS, RITES or any other agency authorized by NDMC, the charges for the same shall be borne by the contractor.

6.23.40 ITEM NO.40, 40.1 TO 40.3 :- LOWERING LAYING & JOINTING HDPE PIPES

Welding Procedure

Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634 part II. Method of jointing between the pipes to pipes and pipes to specials shall be with fusion welding using automatic or semi automatic, hydraulically operated, superior quality fusion machines which will ensure good quality fusion welding of HDPE pipes. Electrofusion coupler fittings will be carried out for smaller diameters of PE pipes (up to 110mm). & above 110 mm dia. Welding procedure need to be follow.

METHOD OF FUSION

Method of jointing between the pipes to pipes and pipes to specials shall be with fusion welding using automatic or semi automatic, hydraulically operated, superior quality heat fusion machines which will ensure good quality heat fusion welding of HDPE pipes The most widely

used method for joining individual lengths of large diameter polyethylene pipe (>75mm) is by heat fusion of the pipe ends This technique produces a permanent, economical and flow-efficient joint. Field-site heat-welding may be made readily by trained operators using specially developed heat fusion machines. The Fusion Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634 part- II

GENERAL GUIDELINES FOR FUSION-WELDING:

The welding area has to be protected from unfavorable welding conditions such as moisture, wind, dirt, excessive surface temperature and low temperatures < 5 degree C and intensive UV radiation. If the pipe is exposed to such UV radiation, the pipe ends are to be thoroughly scrapped (by planning tool) before the welding procedure is adopted.

Heating Pressure 0.15 N/sq. mm

Welding Temperature 200-220 deg. C

The seven steps involved in making a heat fusion joint are:

a) Securely fasten the components to be joined

b) Square cut the surface of the pipe end

c) Face the pipe ends

d) Align the pipe profile

e) Melt the pipe interfaces

f) Join the two profiles together

g) Hold under pressure and release

Heat fusion cycle and parameters are given in Annex A in ISO 11414 – the contractors are requested to follow this guideline for a good weld.

Caution: An additional 10 to 60 minutes cooling time may be required (depending on pipe size) after removing the pipe from the fusion equipment before subjecting the pipe for bending, burying, pressure testing or similar handling.

BEAD REMOVAL:

In some pipe system usage, the bead from the heat fusion process may be undesirable. Inside beads may create minor flow turbulence of liquids or may become an obstacle on which solids in the fluids may become lodged. Furthermore, outside beads may be a hindrance to relining operations. Equipments are available to remove the bead. The bead removal shall not affect the performance of the pipe and the weld However, it must be noted that the friction factor ('c' value; 'k' value) as given elsewhere in the manual takes cognizance of the inside bead. Hence the bead does not effect the design parameters for flow rates in PE pipes.

FUSION EQUIPMENT

The Contractor should have automatic superior quality fusion welding machines with hydraulic jacks, surface cleaning planner, and digitally controlled heating mirror and hydraulic power pack for doing the installation.

The contractor is cautioned for the proper procurement of the welding equipment and the Inspection agencies shall necessarily be assured that the welding contracting company has the proper machine for a good field weld.

The heat fusion equipment shall incorporate a facility for supporting the heating plate and planning tool (necessary to square cut the pipe end) when in use. The machine shall be robust enough to stand normal field use.

The design of the heat fusion machine shall allow the heating plate to be removed and the pipe ends closed after heating, without damaging the heating surfaces, within a time frame of maximum of 6 secs upto d<250mm and 12 secs for d>250mm.

The clamp alignment system shall be such that there shall be perfect axial alignment of the pipe surface – during heating and during pressurizing the pipe ends after heating, is assured.

The guide elements of the machine shall be such that the gap between the pipe ends shall not exceed 0.25mm for d<250mm and 0.5mm d>250mm Heat-welding machines shall have a locking system to hold the fusion force is to be ensured in all the systems.

All the systems shall be protected against over pressure. It shall be capable of maintaining the required interface force on the pipe or fittings end as long as necessary. There shall be a display of the pressure applied.

TRAINED MANPOWER FOR FUSION WELDING:

Only trained and technically qualified for the welding method are to be employed for the welding operation. It is necessary that the manufacturer certified person need only be authorized for heat welding.

These persons shall carry at all the time in the field during site work, a valid and authentic certificate that the person performing welding has been so trained.

LAYING HDPE pipe

a) After trench is excavated to the specified depth the bottom of the trench has to be cleared of all stones or pieces of rock & leveled up properly. A layer of ordinary soil of not less than 5 cm. is to be used for leveling the trench to ensure that cable when laid will follow a straight alignment

b) When trenches are excavated up to specified depth, properly dressed and leveled, joint measurement of trench shall be taken by representative of Contractor and Site Engineer. Measurement shall be recorded in measurement book with their signature. Trenches for which measurements are recorded in measurement book shall be considered as approved trenches.

c) HDPE Pipe shall be laid only in approved trenches. The contractor shall exercise due care to ensure that the HDPE Pipe/ is not subjected to any damage or strain.

d) The HDPE Pipe shall be laid in RCC spun pipes as casing pipes, at road crossings and through G.I. Pipes on culverts and bridges and also in exceptional cases where the depth of the trench is less than specified depth as per direction of Engineer-In-Charge..

e) Water present in the trench at the time of laying the HDPE Pipe shall be pumped out

by the contractor before lowering in the pipes to ensure that no mud or water gets into the pipes.

f) At road crossings, one extra HDPE Pipe of same diameter with NP3 RCC spun pipe as casing pipe as per direction of Site Engineer.

g) In case of nallahs, which are dry for nine months in a year, the HDPE Pipe shall be laid within the RCC pipe The RCC pipes shall be extended 2 mtrs. Beyond the bed of nallah on either side.

h) The following construction practices are applicable in general:

i) Wherever GI pipes are used, rubber bushes shall be used at the two ends of the GI pipes to protect the damages of HDPE Pipe.

ii) Wherever RCC pipes are used, two ends must be properly sealed to bar entry of rodents.

iii) On Rail bridges and crossings, the HDPE Pipe shall be encased in suitable cast iron/RC pipes as prescribed by the Railway Authorities.

iv) Unloading of PLB HDPE Coil from truck should be done with help of Wooden / Metallic planks and coil can also be dropped from floor of truck on sand or soft soil bed.

Field Hydraulic Test

a. The Sectional Hydraulic Test shall be carried out after the pipeline section to be tested has been laid jointed and backfilled to a depth sufficient to prevent floatation, but leaving the joints exposed which are to be tested. The sections to be tested shall be to the approval of the PMC and shall not be longer than 2000 m or 500 m when either the pipeline is laid adjacent to or underneath the carriageway or when section includes an air valve chamber. The joints between each tested section shall be left exposed until the pipeline has passed the test on completion.

b. Each length of the pipeline to be tested shall be capped or blanked off at each end and securely strutted or restrained to withstand the forces which will be exerted when the test pressure is applied. Air valves already fitted shall be permitted to function during the test

c. Proposals for testing where thrusts on structures are involved, even where thrust flanges on the piping are installed, shall be with the prior approval of the PMC.

d. The length under test shall be filled making certain that all air is displaced through an air valve or any other appropriate mechanism. The test length shall then remain under constant moderate pressure, 10 to 20m head of water, for a period of several hours until the pressure can be maintained without additional pumping.

e. The pressure shall then be slowly increased at a maximum rate of 1 bar per minute to the full test pressure and pumping discontinued for 3 hours or until the pressure has dropped by 10m, whichever occurs earlier. Thereafter pumping shall be resumed and continued until the test pressure has been restored. The quantity of water pumped to restore the pressure, which is called make up water, shall be the measure of thermal expansion or leakage from discontinuation of pumping until its

resumption. The makeup water shall be as below:

OD of pipeline (mm)	Litres per 1000 m of the pipe length tested		
	One hour test	Two hour test	Three hour test
63	9	14	24
110	16	31	50
160	37	74	112
200	50	87	124
315	136	285	422
400	174	347	521

f. The maximum allowable test pressure shall be 1.5 times the system design pressure or pipe rating whichever is higher

g. Notwithstanding the satisfactory completion of the hydraulic test, if there is any discernible leakage of water from any pipe or joint, the Contractor shall, at his own cost, replace the pipe, repair the pipe or re-make the joint and repeat the hydraulic test with cost including the cost of water. Water used for hydrostatic test shall be clean and potable.

h. Pipelines shall be tested as above except where the PMC issues such instructions as are necessary for testing parts of the Works that have been designed for stresses limited by considerations other than those applying to the pipeline systems.

i. Test pressures are to be measured in kg/cm2 at the centre of the blank flange situated at the lowest end of the pipeline under test. Unless otherwise specified the test pressure shall be as stated below.

6.23.41 ITEM NO.41, 41.1 TO 41.22 : ELECTROFUSION FITTINGS FOR HDPE PIPES

All the electrofusion fittings included in this document should be designed for use in water distribution systems and be manufactured/supplied by manufacturers having ISO 9001: 2000 certification for their quality systems. The products should comply with the following specific requirements.

1. The products shall comply with the requirements of BS EN 12201-3: 2003, BS EN 1555-3 or ISO 8085-3.

2. All the fittings shall be of SDR 11 rating.

   The product group used for drinking water applications should have undergone type test by WRc-NSF, U.K according to BS 6920 in any of their Certified Laboratories like WRc – NSF/DVGW/KIWA/SPGN and certificate of Compliance to be produced for the following parameters:

   a. Odour & Flavour of Water

b. Appearance of Water

c. Growth of Micro Organism

d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)

e. Extraction of Metals

3. All the products shall be manufactured by injection moulding using virgin compounded PE 80 (MDPE) polymer having a melt flow rate between 0.5 – 1.1 grams/10 minutes and shall be compatible for fusing on either PE 80 or PE 100 distribution mains manufactured according to the relevant national or international standards. The polymer used should comply with the requirements of BS 3412 and/or BS EN12201-1.

4. The fittings intended for water distribution applications shall be coloured blue for the clear identification of the services.

5. All the electrofusion products should be individually packed so that they can be used instantaneously at site without additional cleaning process. The protective packing should be transparent to allow easy identification of the fittings without opening the bags.

6. The electro fusion products should be with only a single heating coil to fully electrofuse the fitting to the adjoining pipe or pipe component as applicable. The heating coils shall be terminated at terminal pins of 4.0 or 4.7 millimetre diameter, protected with terminal shrouds. Each terminal shroud should be additionally protected with polyethylene shroud caps.

7. No heating element shall be exposed and all coils are to be integral part of the body of the fitting. The insertion of the heating element in the fitting should be part of the injection moulding process and coils inserted after the injection moulding process or attached to the body of the fitting as a separate embedded pad etc. are strictly not acceptable.

8. The pipe fixation shall be achieved by external clamping devices and integral fixation devices are not acceptable.

9. The brand name, size, raw material grade, SDR rating and batch identification are to be embedded as part of the injection moulding process. Each fitting should also be supplied with a barcode sticker for fusion parameters attached to the body for setting the fusion parameters on an automatic fusion control box. The barcode sticker should also include the fusion and cooling time applicable for the fitting for the manual setting of a manual fusion control box.

10. The fittings should be V-regulated type designed to fuse at a fusion voltage of 40 volts AC.

11. The heating elements should be designed for fusion at any ambient temperatures between -5 to +40 degree centigrade at a constant fusion time i.e. without any compensation of fusion time for different ambient temperatures.

12. A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of each fitting near the

terminals. The fusion indicators should not allow the escape of the molten polymer through them during or after the fusion process.

13. All the sockets in the electrofusion fittings should include a method of tapping controlling the pipe penetration (pipe positioner/stopper).

The contractor shall supply the required dia of special at his cost. **The Electrofusion fittings special shall be accepted after the third party inspection by SGS, RITES or any other agency authorized by NDMC,** the charges for the same shall be **borne** by the contractor.

6.23.42 ITEM NO.42, 42.1 TO 42.12 : D.I BUTTERFLY VALVE

Manufacturing, supply and delivery DI D/F Resilient Seated Vacuum tight Butterfly Valve suitable for bidirectional flow with Body and disc made of DI GGG40. Disk shall conform to double eccentric with specially designed (Dove tail Shape) pressure supported sealing system made of EPDM approved by DVGW Clause W270. The Body seat shall be fusion bonded nickel chromium weld overlay / SG iron /SS AISI 316 and micro finished. Closed Disk Eye with dry shaft design made of Stainless steel with 13% chromium of grade 1.4021 connected with Medium free bearing of Bronze with double O-ring sealing of EPDM. The shaft shall be connected to the disc by riveted pin or taper pin with lock. The Valve shall be compatible for Buried application without chamber. The Coating and the rubber parts shall comply with DVGW and KTW standards. The gearbox shall be with self-locking, fully enclosed, maintenance-free lubricated for life, worm gear including mechanical position indicator. The Valve shall be according to EN593/IS 5163, the face-to-face length shall be EN 588-1, basic series 14/BS 5155(Long Body)/ IS13095 (Long Body) and drilling according to EN 1092-2/IS 6418. Epoxy Powder or liquid Epoxy coating with minimum thickness of 250 micron applied inside and outside of both body and disc. it is a resi-coat powder approved for drinking water application, applied through fusion bonding technology process by dipping the shot-blasted casted components heated up to 200 deg C).

1.4.4.1 Material of Construction:

Body	Ductile iron to EN-JS 1030 (GGG-40)
Disc, Retainer Ring	Ductile iron to EN-JS 1030 (GGG-40)
Shaft	Stainless Steel 420 with 13% chromium (1.4021)
Shaft Bearing Bushes	Bronze
Seat	Integral Ni-Cr weld overlay, (Ni > 67% Cr = 19.5 %) microfinished
Disc Sealing& 'O' rings	EPDM Rubber [W 270 Clause]
Surface Protection	Epoxy powder coating or epoxy liquid lacquer min. 250 microns thickness, colour RAL 5005 Blue

Note:

1) For sizes above DN1200 the coating minimum thickness will be 150 microns applied inside and outside of the body and disc.

valve shall be supplied from the approved list of the manufacturer by NDMC (like VAG, AVK, SINGER, IVC or any other approved make by NDMC) after third party inspection authorized by NDMC. Inspection charges shall be borne by the contractor.

Electric Actuator

Actuators shall be suitable for the medium, climatic, environmental and pressure conditions of the system in which they are to be fitted. Actuators shall be provided with:

(a) AC Electric Motor.

(b) Reduction gear unit.

(c) Torque switch mechanism.

(d) Limit switch mechanism complete with set of limit switches and additional two spare sets for suitable position.

(e) Hand wheel, for manual operation.

(f) Valve position indicator.

(g) Hand-auto lever with suitable locking arrangement.

(h) 10 W single phase space heater in the switch compartment.

(i) Blinking light throughout the valve operation.

(j) Junction box for terminating power and control cables.

(k) With additional accessories for integrating with PLC system.

The actuator shall be suitable for operation on 415V, 3 phase, 50 Hz power supply. The motor winding insulation shall conform to class B as per relevant BS and motor shall be protected by suitable thermal overload relays. The actuator shall be capable of producing not less than 1 1/2 times the required operator torque at the required time cycle of valve operation. The transmission shaft connecting the actuator to the valve shall be provided with 2 bearings one at actuator end and one at valve end with universal couplings at suitable places. The required numbers of switch/contacts meet requirements for PLC system. The electric motor shall be of the squirrel cage type as per IS 325 with insulation to IS 1271

Class B. The windings shall be impregnated to render them non-hygroscopic and oil resistant. All internal metal parts shall be painted. The motor shall be rated for 15 minutes. They shall also be suitable for operating on the specified electric supply and shall satisfactorily open and close the valve under variations of electric supply specified.

Motor shall be protected by suitable overload protection device. The reversing contactor starter and local controls shall be integral with the valve actuator. The starter shall comprise mechanically and electrically interlocked reversing contactors of appropriate rating fed from a 110 Volt control transformer. The common connection of the contactor coils at the transformer shall be grounded. HRC cartridge type primary and secondary fuses shall be provided.

Local control shall comprise pushbuttons for open, close and stop operations and a Lockable Local/Remote/off selector switch. The control schematics shall be subject to approval. Internal wiring shall be of 650/1100 volt grade PVC insulated stranded copper conductor of minimum

1.5 sq. mm for control circuits and of minimum 4 sqmm copper for the power circuit. Each wire shall be number identified at each end. The terminals shall be of stud type.

Cable entries shall be suitable for PVC insulated/ sheathed, armoured cables. A separate terminal box shall be provided for the heater. A separate terminal box shall be provided for cabling to control circuits.

The actuator enclosure shall be fully weatherproof and hose proof to IP 67 and shall be fitted with an anti-condensation heater, which shall be switched off when the motor is running. The torque switch mechanism shall function as follows to stop the motor on closing or opening of the valve, or upon actuation by the torque when the valve disc is restricted in its attempt to open or close.

The torque switch in the closing direction shall interrupt the control circuit if mechanical overload occurs during the closing cycle or when the valve is fully closed.

The torque switch in the opening direction shall interrupt the control circuit if mechanical overload occurs during the opening cycle or when the valve is fully open.

The mechanism shall facilitate adjustment of the torque at which the switches are required to operate. Non-adjustable limit switches shall stop the motor and give indication when the disc has attained the fully open or closed position.

The adjustable limit switches shall have control rated 2A, 48 V DC for specified system interlock, at the desired value position in both the opening and closing directions.

Motor Operator shall be provided with clearly visible local valve position indicators mounted on the operator assembly to give an indication whether the valve is fully open, fully closed or in an intermediate position.

Settings and emergency operation shall be possible with the use of a hand wheel. The Hand wheel shall be of stainless steel and the drive mechanically independent of the motor drive and any gearing should limit the operating torque at the hand wheel to less than 15 kg and be such as to permit emergency manual operation in a reasonable time. During electric operation the hand wheel shall not rotate.

Actuators shall be adjusted at the manufacturer's works to ensure that they provide the correct, fully, open position and fully closed position. Mechanical adjustable stops shall be provided to prevent over-travel of the valve in the open and closed positions.

The contractor shall supply the required dia of valves at his cost. **The valves shall be accepted after the third party inspection by SGS, RITES or any other agency authorized by NDMC,** the charges for the same shall be **borne** by the contractor

6.23.43 ITEM NO.43, 43.1 TO 43.5 : D.I RESILIENT SEATED SLUICE VALVE

Specifications:-

Manufacturing, supply and delivery of DI D/F non-rising spindle soft seated glandless Gate Valves with body and bonnet of Ductile cast iron of grade GGG-40, wedge with fully encapsulated EPDM rubber W-270 (approved for drinking water) and seals of NBR. The valves should be with replaceable stem nut and replaceable sliding shoes. Valve stems shall be of single piece thread rolled. Valve shall have 3 "O" rings of NBR for stem sealing. Gate valve shall be compatible for burried applications without valve chamber. Face-to-face dimensions as per

BS 5163-89/IS 14846-PD/EN 558F4 and flange connections as per IS 1538, Maximum Valve operating torque should be at least 40% less than the torque as stated in the standard EN 1074. Electrostatic epoxy powder/liquid coating (EP-P) inside and outside color blue RAL 5005 with minimum coating thickness of 250 microns. The EPDM rubber & Epoxy Powder should be approved by W 270. (EP-P > it is a resi-coat powder approved for drinking water application, applied through fusion bonding technology process by dipping the shot- blasted casted components heated up to 200 deg C).

Material of Construction:

Body, Bonnet	ıctile Iron GGG 40 (EN-JS- 1030) / Spheroidal Graphite Iron IS: 1865 Gr 400/12
Wedge (fully rubber encapsulated)	ıctile Iron GGG 40 (EN-JS- 1030) / Spheroidal Graphite Iron IS:1865 Gr 400/12 encapsulated with EPDM rubber - W270 approved grade.
Spindle/Stem	SS: IS: 6603 12Cr13/22Cr 13;AISI 410/AISI 420
Stem Nut	Brass
Bonnet Gasket	EPDM rubber - W270 approved grade
Internal Fasteners	Stainless Steel SS316/304
Stem Sealing	Toroidal NBR sealing rings (Min 03 'O' Rings)
Coating	Inside & Outside epoxy powder coated; DFT minimum 250 micron, shade RAL 5005 (BLUE)

Valve shall be supplied from the NDMC approved list (like VAG, AVK, SINGER, IVC or any other approved make by NDMC)) of the firms after third party inspection by SGS, RITES or any other agency approved by NDMC inspection charges shall be borne by the contractor

6.23.44 ITEM NO.44, 44.1 TO 44.5 : AIR VALVE SINGLE CHAMBER COMPACT DESIGN

Manufacturing, supply and delivery of single chamber, double orifice DI Air Valve with Triple function (Venting, admitting and venting during operation), Tamper proof in one piece construction (Both Large and small orifice housed in the housing itself), with capacity to handle air up to sonic velocity (300 m/s), with flange dimension acc. To EN 1092-2/ IS 1538. Body and cover in ductile cast iron of grade GGG 40. All internal parts such as float, shell etc & all cover bolts of austenitic alloy steel and DN 50 float of HOSTAFLON and gaskets and seals of EPDM approved for anti bacterial which is mandatory for drinking water, with Electrostatic epoxy powder coating (EP-P) inside and outside color blue RAL 5005 with minimum coating thickness of 250 microns. The EPDM rubber & Epoxy Powder should be approved by W 270. (EP-P it is a resi-coat powder approved for drinking water application, applied through fusion bonding technology process by dipping the shot-blasted casted components heated up to 200 deg C).

Material of Construction

Body	Ductile iron to EN-JS 1030 (GGG-40)
Bonnet/Cover	Ductile iron to EN-JS 1030 (GGG-40)

Float	Stainless steel (ASTM A240 Grade 316 Ti/AISI 316 Ti);
Shell Body	Stainless Steel(ASTM A240 Grade 321/AISI 321)
Shut off Device & Ring	Stainless Steel(ASTM A240 Grade 321/AISI 321)
Gasket & Seal	EPDM Rubber [Grade- W 270]
Lead Screws	Stainless Steel (ASTM A194 Grade 303/AISI 303)/
Cylindrical Screw	Stainless Steel(AISI 304/A2-70)
Surface Protection	Electro static epoxy powder coating min. 250 microns

Valve shall be supplied from the NDMC approved list (like VAG, AVK, SINGER, IVC or any other approved make by NDMC) of the firms after third party inspection by SGS, RITES or any other agency approved by NDMC inspection charges shall be borne by the contractor

6.23.45 ITEM NO.45, 45.1 TO 45.11 : FIXING SLUICE VALVE/BUTTERFLY VALVE/ AIR VALVE/PRV/ALTITUDE VALVE

The valves shall be installed in accordance with IS:2685. While installing the contractor shall ensure that all grit and foreign matters are removed from inside of the valves and all the four faces are thoroughly cleaned and coated with a thin layer of mineral grease. The valves shall be installed with spindle vertical. The location of valves shall be as per drawing. All sluice valves shall be installed on concrete bases. The length of the operating stem shall be properly adjusted depending upon the depth of the valve below operating level. This shall be done to the satisfaction of the Engineer.

6.23.46 ITEM NO.46, 46.1 TO 46.10 : ELECTROMAGNETIC FLOW METER

Providing and fixing Full Bore Electromagnetic Flow Meters.

Item includes:-

1. Excavation for fixing Flow meters in all types of soils & surfaces in all types of site conditions including drainage, dewatering, etc.

2. Providing installing Electromagnetic Flow Meters with cost of accessories required.(Flow Meter are to be fixed for measurement of water flowing in & out of the distribution.

1] General Technical Specification & Conditions for Electromagnetic (Full bore) :-

NDMC has provided the size of pipe is indicative. The actual size, O.D.I.D., thickness shall be measured by Manufacture before supply of meter, any deviation and delay or damage cost due to non-fitting of meter shall be borne by Manufacture. The liquidity damage due to delay in fitting for wrong selection of fittings and accessories lies with Manufacture.

1.1 If there is any problem with ovality of pipes after the pipes are cut, the contractor as per the relevant standards shall jack up the pipes and the jointing work shall be carried

out.

1.2 The Manufacture will have a full system of local offices in India and full service capability in the Metro-cities throughout the country. Full contact details for key personnel, both national and local shall be furnished on request. The supplier shall provide evidence of at least five years involvement in the manufacturing of meters worldwide.

1.3 The sensor / transmitter cables shall be capable of withstanding the climatic condition as applicable at site and should be weatherproof. The cable shall be installed in a suitable uPVC duct to minimize the risk of damage during excavations for other works. All the cable laid at a minimum depth of 0.5 m below the ground. Maximum length between the sensor & the transmitter shall not be more than that recommended by the meter Manufacture.

1.4 The transmitter shall operate so as to avoid loss of data in the event of temporary loss of electrical power supply and contractor shall include of provision of maintenance free battery back up facility (8 hours duration) to cater for temporary loss of such power supply. The contractor must allow for normal variations in mains electrical power parameters to be expected at site.

1.5 All the data loggers should be of the same type & make. i.e. they should be compatible for all the meters supplied as part of this bid. The logger should be suitable for local conditions. Each signal transmitter should be provided with a appropriate dual channel flow & pressure logger of type approved by the client, with a data storage capacity of 120 days at 5 minutes logging interval. Logger shall be supplied with compatible communication leads from transmitters to loggers & loggers to portable download devices (hand held units / laptops) & GSM / WAP Mobile phone.

1.6 The loggers shall receive a compatible pulse or continuous output as appropriate from the transmitter. Appropriate software, of Windows type or similar software approved shall be included for downloading the flow on to a portable download device. The loggers shall have integral maintenance free batteries with a minimum of 10 years life, on continuous operation and rated not worse than IP68 protection. Pressure transducer should be of appropriate type with a pressure range of 5 m to 150 m with an accuracy of not less than + 1%. The logging interval should have a range of 1 second to 24 hrs.

1.7 The portable devices shall be compatible to the logger & flow meters for the purpose of retrieving data and resetting the data loggers / meter as part of this contract. The portable download devices should be simple to operate, robust in construction. The portable download devices should be compatible for downloading the data to a desktop or laptop computers. Supply of portable download devices also includes supply of necessary programming and communication leads for connection with data logger and desktop / laptop computers. All the necessary software for downloading of data from logger to portable devices & software for download of data from portable devices to laptop / desktop computers to be provided by the contractor.

1.8 The flow meter shall be supplied with compatible features for “Gateway for Remote Monitoring of flow meter via Web Browsers”. The system should enable remote monitoring, remote diagnosis and remote configuration of connected HART sensors/actuators, either via telephone lines (analogue and ISDN), Ethernet TCP/IP and mobile communications (GSM). The measured data shall be web-compatible.

1.9 Seprate Control Panel Unit to accommodate flow transmitter and all other accessories including data logger shall be provided by Contractor. Thickness of control panel shall not be less than 2 mm.

1.10 All safety precaution with lighting protection shall be provided to all the flow meters, the failure / damage to flow meter for any reason for the warranty and period of annual maintenance contract shall be with Manufacture, hence, cost of insurance against all failure / damage (if any) shall be borne by Manufacture no additional payment will be made.

Minimum Technical Specification for Electromagnetic Flow Meter		
Flow Sensor		
Type	:	Pulse DC Excitation, (Bi-directional)
System	:	Separate with cable output
Power Supply	:	240 V AC, 50 Hz
End Connection	:	Flanges of Carbon Steel
Flange Rating	:	As per Operating Pressure
Electrode		SS 316
Electrode Type	:	Round Head Electrodes
Meter Tube	:	SS 304
Liner	:	Hard Rubber, EPDM
Coil Housing	:	SS 304 with fully welded construction
Protection category	:	IP 68
connection/ junction box	:	SS 304
Earthing	:	Groundering Rings
Accuracy	:	0.5 % of MV inclusive of linearity, repeatability, Pressure effects and hystersis
		1-3 m/s velocity

Flow Transmitter / Converter		
Model	:	Microprocessor based, Modular design,
Type	:	remote mounting
Display Language	:	English
Display	:	Two line back lit LCD for indication of actual flow rate, forward, reverse and sum totalizer with softkeys
Output	:	4-20 mA, HART for flow and pressure separately. Additional output for pulse and status
Protection category	:	IP 68
Enclosure	:	Diecast aluminium with plyurethane finish with glass window
Programming	:	From Front facia through keyboard / optical pin programming
Power Supply	:	240 V AC, 50 Hz
Battery Back up	:	lithium batteries, replaceable, suitable life
Memory retention	:	8-10 years, non volatile
Cable Gland	:	1/2" NPT, 4 glands double compression type
Mounting	:	Wall mounted with long cables
Separation	:	100 meters max. without boosters
Interface	:	HART
Power failure mode	:	Provision of RAM/ PROM to store paramter entered and measured flow data during power failure
Terminal	:	Shock - Hazard- protected push lock terminal
Error Identification	:	0/3.6/22 mA
Empty Pipe detection	:	Facility required
Interchangeability	:	Fully interchangeable with all the flow sensors

Flow Indicator & Totalizer	:	Internal, 5 mm high, LED display with 6 digit LCD, Totalizer and display in Single Unit
Loggers & data acquisition	:	Data logger shall be the dual channel type, one flow channel and one pressure channel. The loggers shall have a data storage capacity of 360 days @ 15 min logging intervals. It should have maintenance free batteries with min 5 years life @ 15 min interval and IP 68 protection. Data can be exported to PC / Laptop / Palm tap via GSM / USB.

6.23.47 ITEM NO.47, 47.1 TO 47.7 : AMR BULK WATER METER

Item includes providing and fixing Woltman type AMR bulk water meter, Cast Iron Body (FG 260) magnetic drive, dry dial, hermetically sealed register of IP68 (Totalizer of meter made of copper can /suitable anti corrosive metallic material required to maintain IP68 protection class) protection class with removable mechanism and be fitted with a low mass rotor which is parallel to the direction of water flow and exhibits dynamic thrust relief, conforming to ISO 4064 with valid CE mark mentioning notified body number on meter dial for each size, along with MlD / OIML/EEC certification from a recognized International laboratory,

The meters must have protection rating of IP68 or higher.

The meters must be tamper proof and hermetically sealed with lockable plastic seals with copper wire provided by the water meter supplier. The bulk water meter shall not measure flow of air, if any. Recommendations shall be provided for ensuring such measurement.

The meter casing shall be Cast Iron/bronze and body shall be bronze/brass and shall be flanged at both ends. The meter body and cover shall be made from highest quality material ensuring resistance to corrosion. Meter body and cover are epoxy powder coated for protection from any environment.

The meter parts coming in contact with water shall not create hazard and must be corrosion proof to withstand upto 2 ppm of residual chlorine in water.

The meters shall withstand maximum working pressure upto 1.6 MPa and conform to testing as per ISO:4064 and latest revision.

The functional working pressure shall be as per the working pressure available in the pipeline.

The meter shall include the following accessories suitable for flanged connection:

Set of short pipes, dismantling Joints & adaptors with flange connection.

Cast Iron strainer with stainless steel strainer element at inlet of same size.

The length of meters shall be as per ISO 4064.

The meters shall have protective devices which can be sealed in such a way that before and after the water meter has been correctly installed, there is no possibility of dismantling or altering the water meter or its adjustments device without damaging the protection characteristics.

The meters shall have the following meteorological characteristics: Class 'B' as per ISO 4064. Imported water meters shall be MlD / OIML/EEC certified.

During Transportation for supply, the water meters shall be packed in containers or boxes containing meters as per manufacturer's recommended practice.

The meters shall have analogue / digital indicating device. The meters shall be designed to withstand accidental reversal of flow without causing any deterioration / damage to the water meters.

The water meters shall be designed for easy installation, easy disassembly and re-assembly without the application of special tools / gadgets.

The water meters shall be designed for intermittent flow. The installation consisting of flanged adapters, short pipe with flange, strainer, water meter shall be housed in a covered chamber. Mandatory straightening length at both upstream and downstream of the water meter as per standard practice of shall be provided.

The water meter shall be marked with the following identification :Size, class and type of water meter, ISO No., Year of Manufacture, serial no. make of water meter, country of manufacturer, Purchaser's name, direction of flow, rate of nominal flow and working pressure.

The Employer will depute Third Party Inspection Agency to the meter manufacturing facility of the manufacturer to inspect the meter as per QAP approved by Engineer In charge. Inspection charges and all other charges shall be borne by the contractor.

Supply shall be made strictly as per the sample meters including the weight as approved by the Board after testing at National Physical Laboratory or at Fluid Control Research Institute, Kerala.

Minimum three meters shall be sent for testing at FCRI from each batch of supplied meters before installation at site

Sr.No	**Item Description**	**Bid Requirement**
1.	Type	bulk meter of MlD / OIML/EEC mark removable mechanism type
2.	Size & Quantity	40 mm to 300 mm as per contract specifications
3	Class of Accuracy	Class B
4	Manufacturing Standard	ISO 4064 with all amendments

5	Testing Standard	ISO 4064
6	Pipeline / Watermeter orientation	Horizontal
7	Tamper proof watermeter	To be provided
8	Material of Construction	Body : Cast Iron Construction
9	Protection	IP68 or higher.
10	Flow Conditions :	
	Maximum Flow	As per ISO 4064
	Nominal Flow	As per ISO 4064
	Minimum flow	As per ISO 4064
11	Pressure loss at nominal flow	As per ISO 4064
12	Reverse flow	Reverse flow
13	Accessories :	
	Y type strainer	To be provided
14	Meter shall be equipped with RF based AMR technology, directly fitted on the water meter & wireless	To be provided

AMR SYSTEM

1. The water meters shall have the anti – magnetic properties / immunity, as specified in ISO: 4064 – 2005, when tested with 400 gauss magnet. The AMR system shall remain unaffected with application of 4000 gauss magnet. As specified in ISO: 4064 – 2005.

2. The remote readings of AMR water meter should be obtainable by 'Walk by' methods.

3. The AMR trans-receivers shall be wireless and have IP 68 protection class i.e. no ingress of water after submerging AMR water meter for 48 hours under 3 meters of water column.

4. AMR shall be obtainable even under submerged conditions.

5. Remote readings of different water meters shall be obtained with single command. The remote readings shall have instant reading facility. The remote readings and dial readings of water meters shall match at all the times.

6. All A. M. R. readings shall show the date and time of the reading recorded.

7. The AMR system shall have facility to record the reverse flow in water meters readings and it shall show the quantum & period of reverse flow on the Hand Held Device (HHU) i.e. AMR reading device and on computer screen.

8. The AMR system shall have the facility to record the abnormalities like application of external magnetic effect, very high consumptions, water leakages etc. along with necessary alarms in HHU and in software.

9. The battery life of AMR water meter shall not be less than 7 (seven) years from successful installation of said AMR water meter along with its AMR system, the battery life shall be calculated by considering the monthly remote reading. During remote reading the battery life of AMR water meter shall be displayed / indicated on HHU.

10. The AMR device of the water meter shall be tamper proof.

11. If the AMR communication frequency is using / operating on paid frequency band, then the AMR water meter manufacturer has to produce the valid copy of license issued by Govt. of India / Deptt. of Telecom (DOT), for using the said operating frequency band. The cost of the same will be presumed as included in the quoted rates.

12. If the AMR communication frequency is using / operating on free frequency band, then the AMR water meter manufacturer has to produce the valid copy of license issued by Govt. of India /Deptt. of Telecom (DOT), stating that the said operating frequency lies in the free band.

13. The AMR water meter shall not get affected for its AMR functioning due to High Tension or High Voltage line concentration.

14. All the time electronic index of the water meter shall match with mechanical index.

15. All water meters shall be fitted with RF based wireless remote transreceivers for A.M.R. reading. It shall be either inbuilt or directly fitted on the water meter without wires.

16. The water meters fitted with A.M.R. shall have the facility to transmit reading in submerged condition & the remote readings should be obtained outside the meter chamber, with water meter in submerged condition & lid of the chamber closed.

17. The manufacturer shall specify the frequency of the AMR operating system & shall possess the necessary license of said operating frequency, issued by Government of India (GOI) / Department of Telecom (DOT). In case, if he claims frequency of the operation in the free band, necessary documents / clearance from GOI / DOT shall be submitted, along with the offer. However, the NDMC reserves the right for acceptance of offered frequency & Power subjected to the guidelines issued by DOT / WPC.

18. AMR system should be compatible for up gradation to fixed net work if required in future.

Lab Testing:

The lab testing shall include following tests as per ISO:4064:2005 standards . The same will be conducted at FCRI, Palghat.

i. Accuracy testing of water meters at Qn.

ii. Accuracy testing of water meter at Qn after clamping the magnet on the water meter.

iii. IP 68 testing of water meter& AMR system.

iv. Remote reading of water meter in dry i.e. open air condition.

v. Remote reading of water meter in submerged condition i.e. under water, with under variable water depth conditions.

vi. Remote reading with different tamper alarms for back flows, magnet and physical damage, etc.

vii. Response time of AMR reading on HHU.

viii. Visual inspection of AMR water meter and its AMR system along with its software.

ix. Real Index test i.e. all the time electronic index of the water meter shall match with mechanical index.

x. Demonstration of uploading of readings from hand held unit to PC and vice versa.

xi. Life cycle and endurance test.

These tests should be performed in the in-house laboratory of the meter manufacturer. The Employer will depute Third Party Inspection Agency to the meter manufacturing facility of the manufacturer to inspect the meter as per QAP approved by Engineer In charge. inspection charges and all other charges shall be borne by the contractor.

6.23.48 ITEM NO.48: SUPPLY OF HAND HELD UNIT TO CAPTURE THE DATA LOGGED FROM METERS

1. The hand held device or reading device shall have the sufficient memory(minimum 4000 reading data) for storage of maximum data / reading along with sufficient power back up.

2. The HHU shall have the onsite search facility, to locate the exact physical location of water meter in particular area and to obtain the corresponding details of it.

3. The HHU should be adjustable back light, sun light readable, colour display and touch screen.

4. The HHU shall have minimum 64 MB flash memory and 128 MB RAM.

5. The battery of HHU device shall give power back up for at least 5 hours continuously.

6. The unit must be able to withstand three foot drop on concrete.

7. The handheld must be ergonomically designed to be comfortable for handheld meter reading.

8. There must be audible beep when indicating key has been pressed, there must also be an auto repeat function on keys and a rapid response between keying and seeing results on the screen.

9. The handheld must come with an integrated intelligent fast charge capability that allows full charge within 5 hours.

10. The hand-held must have integration with Global Positioning System (GPS) for route monitoring and configuration.

11. The read-out device should be connected to the Hand held device and needs to be USB powered.

12. The quantity of HHU in BOQ has been considered @ 1 HHU on every 25000 AMR water meters which may vary at the time installation based on capacity of HHU and location/cluster size of meters .Bidders has to quote item rate for HHU.

6.23.49 ITEM NO.49: SUPPLY & INSTALLATION OF SOFTWARE REQUIRED FOR AMR METER

SOFTWARE

1. The software shall give output, at least in the CSV (Comma Separated Value) format .

2. The Route Management software must be capable of running on a standard PC compatible with minimum Pentium processor; in addition the software must run under Windows95, Windows XP Professional, Windows Vista, Windows 7 and / or latest version of windows operating system.

3. The software shall allow the PC operator to review and edit any account in Route Manager database. Also, the PC operator shall be able to generate route and activity reports.

4. The software shall alert the meter reader for unread accounts in that route.

6. The software shall enable the user to specify the data to be exported from the database for transferring to billing system.

7. The software shall take routes from an existing database for loading into a reading device.

8. The software shall select the routes to be read, and assignment of routes to a reading device and dynamic updating of routes and sub-routes to be enabled.

9. The software shall upload routes from the reading device.

10. The software shall post the reading from the reading device onto appropriate accounts within the database.

11. Software shall be able to set meter status on the fly like, meter not okay, reading not reliable, meter maintenance required etc

12. Software should have a radio configuration tool which can enable/disable meter, set / read meter status

6.23.50 ITEM NO.50, 50.1 TO 50.4: PROVIDING AND FIXING FULLY AMR DOMESTIC WATER

SPECIFICATIONS

Meter shall be manufactured as per ISO 4064 standards & have European Economic Council (EEC) or International Organization of Legal Metrology (OIML)/MID pattern approvals & shall

bear EEC marking on dial of water meter for each size.

1. The water meters of domestic sizes shall be equipped with RF based AMR technology, directly fitted on the water meter & wireless, , multi-jet, inferential type, dry dial, MID approved water meters .

2. Water meters of each size should have been duly tested and passed as per the relevant standards and specifications from Fluid Control Research Institute (FCRI) Kerala for performance test supported with test certificate.

Applicable Standards:

Water meter straight reading means – 15mm size domestic water meters, inferential type, multi jet, magnetically coupled, having dry dial, Class 'B' standard with EEC/OIML/MID certification mark shall be with protection class of IP-68.

The meters shall be supplied complete with GI fittings, brass nuts and brass nipples. Strainer & sealing shall be provided as per relevant IS provision.

Material of construction:

a) The manufacturer shall provide specific details of materials used for various parts of the meter which must meet the specifications for the material of construction of the individual parts of the meters as per IS 779:1994 (latest amendments) or ISO 4064: 1993.

b) The body of the meter shall be of either Brass or Bronze. The firm shall specifically mention in the offer, the metal used in manufacturing. Material that come in contact with the water supply shall withstand 2 ppm (parts per million) of chlorine residual in the water supply and shall be resistant to corrosion.

c) The water meter and accessories shall be manufactured from materials of adequate strength and durability. The materials, which come in contact with the potable water, shall not create a toxic hazard, shall not support microbial growth, and shall not give rise to unpleasant taste or discoloration in the water supply. However, the spindle and bearings inside the hydraulic chamber shall be made of polished stainless steel with hard metal tip/ sapphire.

d) The internal pressure cup shall be made of low-ferrous brass not exceeding 0.02% Fe contents / Engineering plastic. Furthermore the internal pressure cup should overlap the meter body. The lower case of the meter shall be painted with thermal painting externally. The painting materials should be safe for human uses and not affect human health (Health certificates should be included in the bidding documents). The painting colour shall be decided in consultation with the department after order of award.

i) Variation in weight of the meter will be permissible to ± 5% of the weight indicated by the bidder in his technical bid.

f) Each meter should be supplied in separate individual box with its accessories and test Certificates and guarantee card for free repair/ replacement for duration of 5 years. The no. of individual boxes of meters shall not exceed 30 nos in each cartoon.

g) Supply shall be made strictly as per the sample meters including the weight as approved by the Board after testing at National Physical Laboratory or at Fluid Control

Research Institute, Kerala.

h) Minimum three meters shall be sent for testing at FCRI from each batch of supplied meters before installation at site.

i) Markings On The Body Of The Meter:

(a) Marking on dial/ cap.

i. Class "B"

ii. Multijet/ Model

iii. Magnetic Type

vi. ISO: 4064-1993.

v. MID/OIML Code No.

vi. Make/Brand

vii. Sl.No. / Year of Manufacture.

viii. NDMC

(b) Embossing/ engraved on meter body.

i. 15 mm

ii. Direction of flow of water on both sides of the body of meter.

The Totalizer and Totalizer Shield :-

The totalizer shall be designed in such a way that if the totalizer protective glass is broken for a reason or another the totalizer cannot be removed from its place. The totalizer protective cover shall be made of sturdy glass and shall have a thickness of not less than 5mm and shall pass specified tests. Sturdy glass is defined as the ability of the counter protection glass to withstand, without damage, a free fall of a metal ball weighing 27.2 grams from a vertical distance of not less than 70 cm or sturdy Engineering plastic window subject to clear visibility till end of contract period guaranteed by bidder may be allowed.

Totalizer :-

A] It shall be of straight reading type

B] The totalizer shall register in cubic meter units

C] The totalizer reading should be less than 1KL

D] The totalizer shall consist of a row of minimum five on-line consecutive digits to read at least 99,999 m3.

E] Another three digits or pointers shall register flows in litres and be of a Different colour.

F] The totalizer should be of closed type.

G] The totalizer must be suitable for test on an electronic test bench.

H] Totaliser shall be made of copper CAN having 5mm thickness mineral glass or any other Suitable material required to maintain IP 68 protection class.

I] Meter will be provided with monolithic seal with copper wire.

AMR SYSTEM

1. The water meters shall have the anti – magnetic properties / immunity, as specified in ISO: 4064 – 2005, when tested with 400 gauss magnet is mandatory. For AMR system resistivity against application of magnate is not required

2. The remote reading of AMR water meter needs two way communications without affecting battery life and reading perforations throughout O&M period.

3. The remote readings of AMR water meter should be obtainable by either 'Walk by' or 'Drive by' methods.

4. The AMR trans-receivers shall be wireless and have IP 68 protection class i.e. no ingress of water after submerging AMR water meter for 48 hours under 3 meters of water column.

5. The AMR trans-receivers shall be used (RF End units/ Wireless RF transmitter/Receiver) for communication and remote reading. If the water meter & AMR trans-receivers are independent units then they must be from the same manufacturer

6. AMR shall be obtainable even under submerged conditions.

7. Remote readings of different water meters shall be obtained with single command. The remote readings shall have instant reading facility. The remote readings and dial readings of water meters shall match at all the times.

8. All A. M. R. readings shall show the date and time of the reading recorded.

9. The AMR system shall have facility to detect the reverse flow in water meters readings on the Hand Held Device (HHU) i.e. AMR reading device and on computer screen.

10. The AMR system shall have the facility to record the abnormalities like application of very high consumptions, water leakages etc. along with necessary alarms in HHU and in software

11. The battery life of AMR water meter shall not be less than 7 (seven) years from successful installation of said AMR water meter along with its AMR system, the battery life shall be calculated by considering the monthly remote reading. During remote reading the battery life of AMR water meter shall be displayed / indicated on HHU.

10. If the AMR communication frequency is using / operating on paid frequency band, then the AMR water meter manufacturer has to produce the valid copy of license issued by Govt. of India / Deptt. of Telecom (DOT), for using the said operating frequency band. The cost of the same will be presumed as included in the quoted rates.

12. The technically qualified bidders shall obtain license for using frequency band to conduct the demo in the area of demonstration. The bidder will have to start the demonstration within 10 days of submission of bids and hence they would be allowed to produce the certificate till such time.

13. The AMR water meter shall not get affected for its AMR functioning due to High Tension or High Voltage line concentration.

14. All the time electronic index of the water meter shall match with mechanical index.

15. All water meter shall be fitted with RF based wireless remote trans receivers for AMR reading. It shall be either inbuilt or directly fitted on the water meter without wires.

16. The water meters fitted with A.M.R. shall have the facility to transmit reading in maximum submerged condition (as specified for IP-68 compliance)& the remote readings should be obtained outside the meter chamber, with water meter in submerged condition & lid of the chamber closed.

17. The manufacturer shall specify the frequency of the AMR operating system & shall possess the necessary license of said operating frequency, as per norms of Department of telecommunication, Govt. Of India issued by Government of India (GOI) / Department of Telecom (DOT). In case, if he claims frequency of the operation in the free band, necessary documents / clearance from GOI / DOT shall be submitted, along with the offer. However, the Utility reserves the right for acceptance of offered frequency & Power subjected to the guidelines issued by DOT / WPC.

18. AMR system should be compatible for up gradation to fixed net work if required in future.

Lab Testing:

The lab testing shall include following tests as per ISO:4064:2005 standards . The same will be conducted at FCRI, Palghat.

i. Accuracy testing of water meters at Qn.

ii. Accuracy testing of water meter at Qn after clamping the magnet on the water meter.

iii. IP 68 testing of water meter& AMR system.

iv. Remote reading of water meter in dry i.e. open air condition.

v. Remote reading of water meter in submerged condition i.e. under water, with under variable water depth conditions.

vi. Remote reading with different tamper alarms for back flows, magnet and physical damage, etc.

vii. Response time of AMR reading on HHU.

viii. Visual inspection of AMR water meter and its AMR system along with its software.

ix. Real Index test i.e. all the time electronic index of the water meter shall match with mechanical index.

x. Demonstration of uploading of readings from hand held unit to PC and vice versa.

xi. Life cycle and endurance test.

These tests should be performed in the in-house laboratory of the meter manufacturer. The Employer will depute Third Party Inspection Agency to the meter manufacturing facility of the manufacturer to inspect the meter as per QAP approved by Engineer In charge. Inspection charges and all other charges shall be borne by the contractor.

6.23.51 ITEM NO.51, 51.1 TO 51.4: PROVIDING AND FIXING BALL VALVE

Specifications:-

The ball valve shall be of standard make with body made up of gun metal/brass/stainless steel with stainless steel ball. The work should be carried out as per standard specifications and as directed by Engineer-in-charge The different activities under this item shall be executed as per the corresponding specifications detailed in general specifications given in the CPWD Specifications for works 2009 for works for this item.

Valve shall be supplied from the NDMC approved list of the firms after third party inspection by SGS, RITES or any other agency approved by NDMC inspection charges shall be borne by the contractor.

6.23.52 ITEM NO.52, 52.1 TO 52.6: PROVIDING ,LOWERING, LAYING & JOINTING NDPE PIPE

Item includes providing, lowering, laying & jointing of MDPE pipe

MDPE pipes

These specifications are for MDPE Blue PE 80 Pipes anti rodent & suitable for Moling method for House Service Connections.

Raw Material

Raw material used to Manufacture MDPE Blue Pipes shall be Virgin Natural Resin PE 80 containing those anti – oxidants, UV Stabilisers & Pigments necessary for Manufacturing of pipes. The Density of Pipes shall be in the Range 0.926 to 0.940 g/cm3 confirming to ISO 4984 & ISO 4427 Standard. The PE 80 Resin shall have MRS of 8 Mpa.

Effects on Water Quality :

The MDPE PE 80 Blue Pipes shall confirm to ISO 4984 & ISO 4427for conveyance of Water for Human Consumption. Also the pipes intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGM/KIWA/SPGN/WRc-NSF and certificate of compliance to be produced for the following parameters

a. Odour & Flavour of Water b. Appearance of Water

b. Growth of Micro Organism

c. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)

d. Extraction of Metals.

Pressure Rating:

The Pressure rating of MDPE Blue PE 80 Pipes shall be confirming to clause4.1 of ISO 4984 of ISO 4427 : 1996.

Colour of Pipes:

The Colour of MDPE PE 80 Pipes shall be BLUE confirming to clause 3.2 of ISO 4984 of ISO 4427 : 1996.

Dimensions:

The pipe dimensions shall be as per latest revisions clause 4.1 of ISO 4984 of ISO 4427 : 1996 and pipes upto diameters 32 mm shall be supplied in Coils of 300 mtrs. The internal diameter, wall thickness, length and other dimensions of pipes shall be as per relevant tables of ISO 4427:1996. Each pipe shall be of uniform thickness throughout its length.

The wall thickness of the PE 100 Pipes shall be as per the table given below:

Nominal Dia of MDPE Pipe (mm)	PR rating	Wall thickness	
		Minimu	Maximu
20	PN 16	2.3	2.8
25	PN 12.5	2.3	2.8
32	PN 12.5	3.0	3.5

The dimension tolerances shall be as per ISO 4427

Performance requirements

The Pipe supplied should have passed the acceptance test as per ISO 4427. The manufacturer should provide the test certificates for the following tests.

1. Melt Flow Rate
2. Density,
3. Oxidation and Induction test,
4. Hydrostatic Test ,
5. Pigment dispersion Test,
6. Longitudinal Reversion Test.

These tests should be performed in the in-house laboratory of the pipe manufacturer. The Employer will depute Third Party Inspection Agency to the pipe manufacturing facility of the manufacturer to inspect the pipes as per QAP approved by Engineer In charge. Inspection charges and all other charges shall be borne by the contractor.

6.23.53 ITEM NO.53, 53.1 TO 53.3: PROVIDING & FIXING D.I STRAP SADDLE

The item includes providing and fixing of D.I. saddle with strap, reducing brass bush for C.I. & D.I. pipes.

Specifications-

1) Main Saddle body & D washer made up of ductile iron. 2) Strap made up of non-corrosive material SS304 as per require pipe diameter. 3) Fastener and locking arrangement made up of non-corrosive material SS304 for tightening. 4) Rubber bush made up of EPDM/Nitrile material for leak proof joint and firm grip.

The Employer will depute Third Party Inspection Agency to the saddle manufacturing facility of the manufacturer to inspect the saddle as per QAP approved by Engineer In charge. Inspection charges and all other charges shall be borne by the contractor.

6.23.54 ITEM NO.54, 54.1 TO 54.8: PROVIDING & FIXING FERRULE TAPPING TEE/SADDLE ON HDPE PIPE

Specifications for Electro Fusion Ferrule Tapping Tee

a. All saddles shall be injection moulded from recognised top quality virgin PE 100 resin. The raw material used shall be from the positive list of the PE100+ Association, which is available from www.pe100plus.net.

b. All Ferrule Tapping Tee shall conform to the requirements of EN 12201-3 / ISO 4427 and be suitable to be used in conjunction with pressure pipes from polyethylene manufactured to the appropriate ISO and CEN standards.

c. The heating coils contained in each individual saddle should be so designed that only one complete process cycle is necessary to fully electrofuse the fitting to the adjoining pipe or pipeline component as applicable.

d. No heating element may be exposed and all coils are to be fully imbedded into the body of the fitting for protection purposes.

e. The pipe fixation device shall be an integral/external part of the the Ferrule Tapping Tee

f. An individual data carrier card in compliance with ISO 7810 and ISO 7811 containing a magnetic strip and an appropriate barcode as well as manual setting information for data transfer purposes must be supplied with each fitting. The data carrier card must also contain a traceability barcode. This barcode must contain the following information about the product: batch number, production facility, the manufacturer of the raw material, the MRS and the MFI.

g. All fittings must have moulded-in identification and appropriate product information. h. Process voltage of all saddles must not exceed a maximum of 40 volts.

i. Insulated contact heads for the terminal pins are to be provided.

j. Terminal pin size shall be 4.0 mm in diameter.

k. A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of saddle near/ adjacent to terminal.

l. The design of the fusion indicators must prevent the escape of fusion melt.

m. The branch spigot and internal cutter size should be of similar size of tapping dia.

n. The branch spigot of tapping tees must be long enough to allow a second joint if necessary or to attach a compression fitting.

o. Safe tapping into mains must be possible under the defined allowable maximum water pressure according to the respective pipe series and ambient temperature.

p. Tapping saddle cutter is to be designed to seal-off the central passageway in uppermost position.

q. The cutter design must fully contain the cut-out coupon and not produce shavings

r. It must be possible to permanently seal-off the top of the saddle with an electrofusion cap in the mains sizes from nominal diameter 63 mm and above.

s. An upper-stop in the neck of the saddle shall prevent the removing of the drill after tapping

The outer neck of the saddle shall be provided with a rubber-sealing ring

6.23.55 ITEM NO.55, 55.1 TO 55.15: MAKING CROSS CONNECTION TO EXISTING DISTRBUTION MAIN

This item, includes cost of all labour required for excavation for this job work in all strata including dewatering (Also dewatering by Pump if necessary) cutting of existing M.S. / C.I. / D.I. pipe jointing to the existing distribution mains of M.S. /C.I. by welding method or by any other method i.e. Flanged joint lead joint or mechanical joint etc. This item also includes labour cost for lowering laying carting of materials required and refilling the trenches for this job work.

The item includes cost of jointing material i.e. welding or nut bolts rubber packing or pig lead etc. However the cost of specials required for connection is not included in this item. The same shall be procured by the contractor and it will be paid under the respective items of BOQ.

The permission required from NDMC for cutting of existing pipe line and making cross connection to existing one shall be the responsibility of the Contractor.

6.23.56 ITEM NO.56, 56.1 TO 56.2: INSTALLATION OF HDPE PIPE BY HDD METHOD

Item includes :- Providing and installation of HDPE pipe (PE 100) , PN 10) by Horizontal Directional Drilling (HDD) method including preparation and setting up the plant and equipment, preparing new pipe work material, installing new pipe work, hydro/ pneumatic testing and commissioning pipe work or making the system ready for commissioning by HDD Operation including, all related civil and mechanical work like excavation, shoring/ strutting, etc., drilling, stringing, reaming and pulling back the new pipe work on the designed bore path alignment, proper disposal of drilling fluid all inclusive as per Ind STT:101-2007 code of Practice for Horizontal Directional drilling Technique suiting Indian Conditions.

Description

This pipe installation method is called Horizontal Directional Drilling (HDD). This method is defined as a steerable technique for the installation of pipes, conduits, and cables in an arc shape using a surface launched drilling rig. This method requires the execution of a pilot bore which is then enlarged with the use of a reamer prior to installation of the product pipe. Depending on the diameter of the product pipe, multiple enlargements may be required. The excavation is performed by the mechanical action of a fluid assisted cutting head.

Allowable forces

In case of HDPE pipe, an extra 1.8 m section of the pipe must be pulled out of the borehole to check for any sign of stress or damage.

Allowable pulling force for all diameters shall be determined depending on the pipe size, wall thickness, manufacturer, field conditions, pull distance, manhole integrity, bearing capacity of soils, adjacent infrastructure, related equipment, cable strength, and all other related considerations.

Construction

Minimum Allowable Depths

The minimum allowable installation depth of cover of a HDD installed pipe under the road and shoulder surface is correlated to the pipe diameter. Table 2. summarizes the minimum allowable depths:

Table 2 -- Minimum Allowable Depth

Pipe Diameters	Depth of Cover
Small (< 100 mm)	1.0 m
Mini (100 – 300 mm)	1.3 m
Medium (325- 600 mm)	1.5 m
Large (> 600 mm)	2.5 m

To help with future locating of installed pipes, installation of a trace wire on plastic pipes and submission of an as- built (both plan and profile) for all installations are required.

In locations where the road surface is super elevated, the minimum depth of the bore shall be measured from the lowest side of the pavement surface.

Equipment

Equipment used for this method varies greatly. However, the basic operations of boring and pulling the pipe into position are essential. Please refer to the specific operator's manual for more information.

Method

(a) The ends of each section of HDPE pipe shall be inspected and cleaned as necessary to be free of debris immediately prior to joining the pipes by means of thermal butt fusion/electro fusion.

The Polyethylene pipe shall be of the same type, grade, and class of the polyethylene compound used in the process. This process provides joint weld strength equal to or greater than the tensile strength of the pipe.

(b) The handling of the joined pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp or jagged objects. Sections of the pipes with cuts

and gouges exceeding 10 percent of the pipe wall thickness or kinked sections shall be removed and the ends rejoined.

(c) HDPE Pipes shall be stored on level ground, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation, bending, or warping of the bottom layers of pipes under anticipated temperature condition.

(d) Sufficient space shall be allocated to fabricate and layout the product pipeline into one continuous pipe length, thus enabling the pull back to be conducted during a single operation. If space considerations are discovered that make this impossible, the permit applicant shall obtain specific alternative instructions from the owner's Engineer.

(e) Sufficient space is required on the rig side of the machine to safely set up and perform the operation.

(f) The drill path alignment shall be as straight as possible to minimize the frictional resistance during pullback and maximize the length of the pipe that can be installed during a single pull.

(g) The radius of curvature is determined by the rig. The minimum radius of curvature of HDD path should be 1,200 times the nominal diameter of the pipe to be installed.

(h) The required piping shall be assembled in a manner that does not obstruct adjacent roadways or public activities. The HDD operator shall erect temporary fencing around the entry and exit pipe staging areas.

(i) Several pre-reams may be employed to gradually enlarge the hole to the desired diameter and reduce road surface heaving potential. No backream diameter increase shall exceed 37.5 mm. Furthermore, during the final pullback, the pull back rate shall not exceed 3 m per minute.

(j) The pipe shall be sealed at both ends with a cap or a plug to prevent water, drilling fluids and other foreign materials from entering the pipe as it is being pulled back.

(k) Pipe rollers, skates or other protective devices shall be used to prevent damage to the pipe, eliminate ground drag, reduce pulling force, and reduce the stress on the pipe and joints.

(l) The drilling fluid in the annular region outside of the pipe shall not be removed after installation, and remain in place to provide support for the pipe and neighboring soil.

(m) Should the drilling operation be unsuccessful, the contractor shall ensure the backfill of any void(s) with flowable fill.

(n) Entry penetration angles are limited by equipment capabilities. However, according to most HDD drilling rigs' design, the best entry angle should be between 100 and 120.

(o) Exit angles should generally range from 50 (for large diameter steel pipelines) to 120. However, when high exit angles are encountered or designed, the pipe must be supported in an elevated position during the pull back operation to prohibit the pipe from bending, deforming, kinking, or even breaking.

Drilling Site

(a) Location

A minimum distance of 6 m, from the edge of the paved shoulder or curb to the face of any equipment, and supplies, shall be maintained in areas posted at 50 kmph or less; otherwise, a minimum distance of 9 m shall be maintained.

(b) Protection

- At discretion of owner's Engineer/Inspector, traffic barriers shall be installed adjacent to machine site locations according to the owner's plans and current Standard Specifications for such Construction. Temporary beam guardrail shall also be installed according to the current Standard Specifications for Construction.

- Fencing barriers shall be installed adjacent to equipment and supplies with suitable fencing and plastic drums to prohibit pedestrian access to the work site. Equipment shall not be used as fencing to protect access pits.

Overcut Allowance

The overcut diameter shall not exceed the outside diameter (OD) of the pipe by more than 37.5 mm, to ensure excessive voids are not created resulting in post installation settlement.

Watertight Joints

Water tight pipe joints are required to ensure the integrity of the roadbed. Pipe shall be constructed to prevent water leakage or earth infiltration throughout its entire length. A watertight specification refer the HDPE specification & hydraulic testing should be given as per the technical specification of HDPE pipe given in contract.

Drilling Fluids

(a) Drilling fluid shall be used during drilling and back reaming operations. Using water exclusively may cause a collapse of the borehole while in unconsolidated soils, and may also cause soil swelling while in clay soils. Either case may significantly impede the installation of the pipe.

(b) Excess drilling fluid shall be contained within a lined pit or containment pond, or trailer-mounted portable tank, until removed from the site.

(c) All drilling fluids shall not enter the streets, manholes, sanitary and storm sewers, and other drainage systems, including streams and rivers.

d) Any damage to any highway or non- highway facility caused by escaping drilling fluid, or the directional drilling operation, shall be immediately restored by the HDD operator.

Pipe Locating and Tracking

(a) During construction, continuous monitoring and plotting of pilot drill progress shall be undertaken to ensure compliance with the proposed installation alignment and allow for appropriate course corrections to be undertaken.

Monitoring shall be accomplished by manual plotting based on location and depth readings provided by the locating/tracking system or by computer generated bore logs which map the bore path based on information provided by the locating/tracking system. Readings or plot points shall be undertaken on every drill rod.

(b) Pipe installed by the HDD method shall be located in plan as shown on the drawings, and shall be no shallower than shown on the Drawings unless otherwise approved. The Contractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 9 m. This "as built" plan and profile shall be updated as the pilot bore is advanced. The HDD operator shall at all times provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure. The HDD operator shall grant the Engineer/ Inspector access to all data and readout pertaining to the position of the bore head, the fluid pressures, and flows.

Settlement/Heaving Monitoring

(a) This method shall be performed in a manner that will minimize the movement of the ground in front of, above, and surrounding the boring operation; and will minimize subsidence of the surface above and in the vicinity of the boring.

(b) Potential settlement shall be monitored at each edge of right of way, each shoulder point, each edge of pavement, the edge of each lane (or centerline for two lane roads), and otherwise at 15 m intervals along the pipe centerline.

(c) A survey shall be performed 1 day prior to initiating this operation at each required monitoring location. A similar survey shall then be performed at each location, on a daily basis, until the permitted activity has received a final inspection. This survey establishes the preexisting and post construction conditions, and the amount of settlement. All survey readings shall be recorded to the nearest one-hundredth (0.01) of a meter. Whenever possible, trenchless pipe installations shall <u>not</u> be installed directly under a pavement crack. Digital photographs of the pavement conditions shall also be taken prior and after the pipe installation.

(d) All operations shall stop immediately whenever monitored points indicate a vertical change in elevation of 12 mm or more, or any surface disruption is observed. The Contractor shall then immediately report the amount of settlement to the owner's Engineer/ Inspector.

Ground Water Control

Dewatering is not an issue with this method of installing pipe.

Boring Failure

(a) Should anything prevent completion of this operation, the remainder of the pipe shall be constructed by methods approved by the Engineer in charge.

(b) Abandonment of any component of the installation shall only be allowed as approved by the owner's Engineer in charge.

Contamination

When an area of contaminated ground is encountered, all operations shall stop immediately, and shall not proceed until approved by the Engineer in charge. Any slurry shall be tested for contamination and disposed of in a manner, which meets locally applicable requirements.

Bulkhead

Pipe ends shall be temporarily sealed with a cap until the connection is made permanent, to

prevent water or earth infiltration.

Work Site Restoration

(a) Access pits and excavations shall be backfilled with suitable material, and in a method approved by the Engineer in charge.

(b) The disturbed grass-surface area shall be top soiled, seeded, fertilized, mulched, and anchored according the tender Specifications for construction. Slopes steeper than 1-on-3, shall be sodded. If a final site restoration is not completed within 5 days after completion of the operation, the installation of temporary soil erosion and sedimentation control measures shall be required.

(c) Upon completion of the work, the contractor shall remove and properly dispose of all excess materials and equipment from the work site.

(d) The permit, including the surety requirements, shall remain in effect for a minimum of one year after completing the work to monitor for settlements of the pavement and/or slope.

6.23.57 ITEM NO.57, 57.1 TO 57.2: INSTALLATION OF STEEL PIPE BY HDD METHOD

Item includes :- Installation of steel product pipe by HDD method including preparing and setting up the plant and equipment, preparing new pipe work material, installing new pipe-work and commissioning system or making the system ready for commissioning by HDD operation including , all releated civil and mechanical works like excvation, shoring/strutting etc. drilling, stringing, reaming, and pulling back the new pipe- work on the designed bore path alignment, proper disposal of drilling fluid and restoration of site after completion all inclusive as per InSTT:101-2007: code of practice for horizontal directional Technique suiting Indian Condition. (in all kind of soil)

For detailed specification please refer item no 56 above.

6.23.58 ITEM NO.58: CONDUCTING GROUND PENETRATING RADAR SURVEY

This item included investigation for detecting poison & alignments of under ground pipe lines, cables & existing utility , wherever adopting advance technology (given in Ind STT(Indian society for trenchless Technology) - with necessary excavation & refilling , and making the surface good after done with, as directed.

Specifications :-

The specifications for the instruments & technology used for detecting under ground pipe lines shall be as per vender specifications.

6.23.59 ITEM NO.59: PROVDING AND FIXING WATER METRE BOX

The item includes

1.0] Excavation in all types of soils including dewatering required.

2.0] Providing & fixing of water meter box of suitable size in concrete.

1) PP Water meter protection box - with UV resistant material and positive locking arrangement with only one metallic part for locking (SS 304 Spring) ensuring weather-proof

feature. 2) Components for constraining the box to the pipe and avoiding the entry of Mud/Sludge/Reptile are made up Poly Propylene. 3) Water meter protection box should withstand a dead load of 150Kg for 1 hour and should not show any signs of deflection, deformation or cracking.

Sr No	Description	MOC
1	Water Meter Box cover	PPGF
2	Water Meter Box Body	PPGF
3	Pipe Holder	PP
4	Locking Plate	PP
5	Locking Screw	Delrin
6	Locking Pin	Delrin
7	Spring	SS
8	Key for Lock	PP

6.23.60 ITEM NO.60: DOUBLE FLANGE DUCTILE IRON FLANGE ADOPTER

Specifications :-

The different activities under this item shall be executed as per the corresponding specifications of item no. 10 & 11.

6.23.61 ITEM NO.61, 61.1 TO 61.8 : CARRYING OUT VOLUMETRIC TEST OF WATER METER

Item includes:-

1.0] Removing new/old meter

2.0] Taking that meter to NDMC testing lab or test bench of operator & test the meter, in presence of consumer.

3.0] Obtaining test certificate from test lab.

4.0] Fixing the meters at its original place.

Specifications :-

The different activities under this item shall be executed as per the standard specifications for meter as given in IS.

6.23.62 ITEM NO.62: CARRYING OUT INTERNAL WATER AUDIT TEST OF CONSUMER PREMISES

Item includes:-

1.0] After completing HSC, if Engineer-in-charge feels or after billing for one month found excessive billing from normal, in that case required internal water audit leak test of consumer premises for checking leakages in the existing piping system, leakages of u/g tank & overhead storage tank of consumer concealed water piping, leaking taps, defective float valves etc. shall be carried out by Contractor & if any leakages found it should be brought on notice of the consumer & give him the required suggestion to solve the problem in writing. Contractor shall maintain list of higher consumption consumer regularly conduct internal water audit/leak test for such consumer.

Process :-

Finding out visible leaks, with closing all known tabs and checking the consumption during supply hours of one hour and identifying the leakages & creating inspection check list report. And provide check list to the consumer for further repairing work. This item only includes identification of leakages.

The repairs cost will be borne by the consumer itself with its own arrangement.

2.0] All equipment's should be used to detect the leak etc. complete

6.23.63 ITEM NO.63: PROVDING AND INSTALLING BLACK M.S PIPE

Item includes:-

1.0] Providing & laying MS. Black pipe as casing pipe as per relevant IS for MDPE pipe during crossing any drainage

The different activities under this item shall be executed as per the corresponding specifications detailed in general specifications given in the CPWD Specifications for works 2009 for works for this item.

6.23.64 ITEM NO.64, 64.1 TO 64.3 : PROVDING AND FIXING METAL INSERTED ELBOW /ADOPTER

Item includes:-

1.0] Providing and fixing Metal Inserted Elbow/adaptor as per relevant IS for MDPE pipe to G.I pipe

6.23.65 ITEM NO.65,65.1 TO 65.4: PROVDING AND FIXING PICO DIAPHRAGM PRESSURE RELIEF VALVE

ITEM INCLUDES :- Providing Valve of approved make from NDMC

The Pressure Reducing Valve shall reduce higher pressure to lower preset downstream pressure regardless of fluctuating demand or varying upstream pressure head.

Main Valve:

The main valve shall be a center guided, diaphragm actuated globe valve of either oblique (Y) or angle pattern, design. The body shall have a replaceable, raised, stainless steel seat ring. The valve shall have an unobstructed flow path with no stem guides, bearings, or supporting ribs. The body and cover shall be ductile iron. All external bolts, nuts, and studs. shall be Duplex coated. All valve components shall be accessible and serviceable without removing the valve from the pipeline.

Actuator: The actuator assembly shall be double chambered with an inherent separating partition between the lower surface of the diaphragm and the main valve. The entire actuator assembly (seal disk to top cover) shall be removable from the valve as an integral unit. The stainless steel valve shaft shall be center guided by a bearing in the separating partition. The replaceable radial seal disk shall include a resilient seal and shall be capable of accepting a V-Port Throttling Plug by bolting.

Control System: The control system shall consist of a 2-Way adjustable, direct acting, pressure reducing pilot valve, a needle valve, isolating cock valves, and a filter. All fittings shall be forged brass or stainless steel. The assembled valve shall be hydraulically tested and factory adjusted to customer requirements. The required numbers of switch/contacts meet requirements for PLC system.

Quality Assurance: The valve manufacturer shall be certified according to the ISO 9001 Quality Assurance Standard. The main valve shall be certified as a complete drinking water valve.

Material of construction :

Body, Cover & Stem Cap in Ductile Iron ASTM A 536 65/45/12. Stem, Seat Ring, Spring of SS: 316. Diaphragm, Seals, O-Rings EPDM/Buna N. The Valve body will be straight type and not Y type. The SS: 316 Seat Rings shall be guaranteed for life of the Valves for potable water use only. The Valve shall have removable Stem Cap for in line inspection and easy maintenance. The painting shall be NSF 61 fusion bonded epoxy coating safe for drinking water. All external fasteners shall be SS: 304.

The valves shall be accepted after the third party inspection by SGS, RITES or any other agency authorized by NDMC, the charges for the same shall be **borne** by the contractor.

6.23.66 ITEM NO.66: DESIGNING, PROVIDING AND CONSTRUCTING CHLORINATORS VACCUM TYPE

Item includes:-

Designing, Providing. and constructing chlorinators vacuum type 2 Nos. each having capacity of 10 Kg/Hr. as per obligatory provision and detailed specification with necessary provision of chlorinator room having floor area not less than 30 Sq .m including automatic residual chlorine controller with actuator and residual chlorine analyser including cost of chlorine cylinder, piping valves measuring and controlling equipment's, safety devices, alarm facility, lifting equipments, etc. complete. as per I.S .-10553(Part/It) 1982 The tonner room

should have 3 MT capacity crane for loading and unloading facility. Tonner storage should distinctly isolated and should be for minimum 10 Tonners space and arrangement as per gas laws 1981 and factory act shall be provided, and all other matching amenities be provided, 5

MT gantry shall be provided for full length of Tonner room at 6 m height from floor level, as per detailed Specification

6.23.67 ITEM NO.67: CUTTING BITUMINOUS ROAD

Item includes :-The Contractor and it's sub-contractors shall obtain permission from concerned road authorities for carrying out works such as excavation on the existing roads. The Contractor shall be responsible for establishing and maintaining temporary road diversion for the duration of the road works. The road shall be kept clean at all times during the road works period and the work shall be carried out in such a manner to minimize the disruption to other users of the road.

While the execution of any work is in progress in any street or thoroughfare, the Contractor at his own cost shall have adequate provision for the passage of traffic, for securing safe access to all premises approached from such street or thoroughfare, and for any drainage, water supply, or means of lighting or any other utility services which may be interrupted to reason of execution of the work.

1. Whenever it may be necessary to stop the traffic in any street or thorough fare, permission must first be obtained from the concerned authorities and the Contractor shall put up such barriers and adopt such other measures or take precautions as may be necessary for regulation of traffic. The work shall in such cases be executed night and day or for as long a period as practicable if so ordered by the NDMC /PMC, and with such speed and vigour as he may require, so that the traffic may be impeded for as short a time as possible. The Contractor shall remove the barriers as soon as necessary and shall be taken by the Contractor to cause the least obstruction to traffic during the progress of the work.

2. The Contractor shall supply and erect signboards at his own cost at locations. The layout and dimensions of the signboard and their construction shall be as approved in the Implementation Plan and the lettering in both Hindi and English shall be black on white background. Contractor shall take care of signboard and replace it in case of loss, damage, theft etc.

Barricading and safety signs

During cutting of roads statutory safety signs and barricading shall be adequately provided. All signs shall be positioned at highly visible points. Special attention shall be given to areas designated hazardous. Any accidents due to improper warning, barricading by the Contractor shall be the risk of the Contractor.

Clearance and reinstatement of site after completion of the Works

It includes taking out soling metalling i/c sorting, screening and stacking with in 50m lead as direct by NDMC /PMC On completion of the works, the Contractor shall clear any temporary works and temporary access roads and trench shall be refilled by proper refilling practice & well level & compactied with suitable instruments & excess material should be dispose at suitable place as instructed by engineer in charge so it will not cause any problem to traffic or daily routine of work and to satisfaction of the NDMC /PMC.

6.23.68 ITEM NO.68: PROVIDING & FIXING GUN METAL FERRULE OF IS-2692

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification ,the sample & make of ferrule should be approved from the Engineer in charge .

6.23.69 ITEM NO.69, 69.1 TO 69.6 : INSTALLATION OF LDPE /MDPE PIPE BY MOLING

The Scope of works generally envisaged under Trenchless tender include but not limited to the following: Installation of LDPE/MDPE duct/pipe by Moling method including making of entry and exit pits , all related civil works like excavation, shoring/strutting, maintaining the pits, backfilling the pits after pipe installation etc. and restoration of site after completion but excluding the cost of the duct/pipe.

- Interpretation and verification of all data in respect of hydrological and geotechnical surveys. Carrying out all additional surveys required for connecting data related to design and construction of the crossings.
- Design and Engineering of crossing to meet the technical parameters of the Crossing and specifications.
- All underground utilities shall be identified and mapped and shall be submitted before start of work. The mapping shall include both horizontal as well as vertical position of underground utility and structures/ obstructions.

- Performing all engineering and design calculations to verify suitability of pipe thickness proposed for installation in accordance with requirements of application codes/ standard for owner's review and approval.
- Preparation of all detailed construction/Installation drawing and methodology for trenchless and look up for NDMC approval.
- Submission of QA/QC Procedure for NDMC approval.
- Procurement and inspection of all materials and consumables required for or in connection with execution of the crossing other than those specially undertaken to be supplied by the NDMC.
- Mobilizing equipment, manpower and other resources etc, site preparation including arranging of additional land required for pipeline/fabrication, stringing, placement of equipment and preparation of pipeline connecting area and access to work site.
- Setting out works including establishing the location of extremity points (i.e. entry and exit locations of drilled portion of the pipeline to be laid by trenchless techniques, etc) on ground including carrying out of pre-construction survey and collection of all necessary data.
- Preparation of pipe string, installation of the carrier pipe string below the river/water course bed or at the designated crossing location prepared by single trenchless operation to the correct profile as per the drawing approved by the NDMC.
- Disposal of drilling fluid returns and cutting produced from drilling operation from worksite including arranging disposal site at contractors cost and initiative.
- Submission of daily log activities with all relevant details connected with trenchless operations for installing pipeline as required by Engineer in Charge.
- Final cleanup & restoration of ROW including de-mobilization
- Submission of as built drawings,
- All other works, which are not specifically indicated above, but required for successful completion of the trenchless work, associated mainline work and allied works, drawings, construction methodology & details engineering calculation etc.

Impact moling is a technique using a compacting device that is forced through the soil typically from an entry shaft to an exit shaft by applying a static thrust force, a rotary force and/or dynamic impact energy; the soil along the alignment is displaced rather than being removed. Impact moling is divided into three methods, the push rod method, the rotary method, and the percussion method. The push rod method utilizes a machine that pushes or pulls a solid rod or pipe through the soil to create the borehole by displacing the soil without rotation or impact. The rotary method combines the rotating drill rod and the compaction effect developed from utilizing a compaction bit. The percussion method or the impact moling method utilizes piercing tool that is self-propelled by a pneumatic or hydraulic power source

6.23.70 ITEM NO.70, 70.1 TO 70.3 : PROVIDING AND FIXING PIPE ENDS AND SLIP ON FLANGE

Item include:- providing and fixing slip on flange HDPE Stub ends shall be square ended conforming to IS: 8008 Part I & VII Specifications. Stub ends will be welded on the pipe. Flange will be of slip on flange type as described below.

Slip-on flanges shall be metallic flanges covered by epoxy coating or plastic powder coating. Slip-on-flanges shall be conforming to standard mating relevant flange of valves, pipes etc. Nominal pressure rating of flanges will be **PN 16**

6.23.71 ITEM NO.71, 71.1 TO 71.11 : LOWERING LAYING IN POSITION TO CORRECT LINE AND LEVEL INCLUDING M. S. PIPES AND SPECIAL

General

After having carried out excavation of trenches as is explained in these specifications elsewhere the loose materials from the sides or the edges of the trench shall be prevented from falling inside the trench. Properly designed bedding as per site conditions for resting of the pipes shell then be provided before starting with the laying. The excavation of trenches for laying of M.S. pipe shall be as per Clause 4.2.1 of IS: 5822. Design of bedding with respect to installation condition shall be submitted by the Contractor for approval by the Employer Unless specified otherwise, the M.S. pipeline shall be buried with minimum cover of 1.0 meter above socket top as shown on drawings to be submitted by the Contractor and approved by the Employer. No material shall be erected unless it has been previously passed by the employer or his Representative.

Lowering and Jointing

Before pipes are lowered the trenches shall be examined as per Clause 4.2 & 4.2.1 of IS:5822. Also pipe handling and inspection shall be done as per Clause 5.1 to 5.2.5. Pipe laying below ground shall be as per Clauses 8.1.1 to 8.1.2.1 and pipe laying above ground shall be as per Clause 8.3.1 of IS:5822. Jointing of pipes shall be beveled but joint as per 17. (a) of IS 3589.

Welding

Unless specified otherwise all M.S. pipes and specials shall have butt-welded joint. Where shown on drawings, flanged joints or collar sleeve collar. Collar sleeve joints shall be provided.

The welding of pipes in the field should comply with IS: 816. Electrodes for welding should comply with IS:814. The welded joints shall be tested in accordance with IS: 3600 (Part-1) and other relevant Codes. One test specimen taken from at least one field joint out of 10 shall be subjected to test as per Clause 6.2, 6.2.1, 6.2.2 and 6.3 of IS:5822 i.e. the Contractor shall carry out all test for welding as are described under Clause 6 of IS:5822.

Saddle Supports

Unless otherwise specified pipeline shall be laid underground. However in certain reaches it shall be on steel saddle supports, over the proposed bridge, spaced at suitable intervals. The material and construction of Steel structures such as saddles, anchor blocks, crossings etc. associated with the work of pipeline shall conform with the relevant I.S. Codes, good engineering practice and as directed by the Employer or his Representative. The pipes to be laid at saddle supports shall be erected at mean temperature. Saddle supports shall either be sliding type or fixed type, detailed design and drawings including fabrication drawing for which shall be supplied by the Contractor. In case of sliding support, the pipe shall be allowed to slide freely over the plate embedded in the saddle. Alternatively to achieve fixity, the pipe shall be anchored by providing suitable anchor bases with steel clamps. The rate for laying the pipe on saddle support shall be included in laying, aligning, welding, provision of rigging screws with screw eyes etc. all complete in the Contract of Contractor.

Below the pipes in the above alignment, the Contractor shall provide necessary bedding/ saddle supports at his own cost required as per structural designs, which shall be got approved from the Employer or his Representative.

Hydraulic Test of MS Pipeline :-

1. MS pipes and Fittings:

2. All the Pipes, specials and fitting of DI shall be supplied and tested as per relevant IS codes and specifications

a. Factory Test Pressure: as per IS 3589

b. Site Test Pressure: as per IS 5822

Suitable section as directed by the Engineer in charge shall be taken for such testing from time to time during progress of the work and satisfactory test given for that section. All testing apparatus, gauges, connections, etc. and water required for testing shall be arranged by the contractor at his cost. The NDMC does not undertake any responsibility to supply water for testing which the contractor has to arrange by paying the required charges directly. The NDMC shall have the right to recover such charges from his bills if complaints are received that contractor has not paid the charges thereof. If there is delay in testing, the contractor shall refill the trenches for the time being and reopen them at time of testing at his own cost failure of which shall entitle the NDMC to do the refilling and reopening of trenches at the risk and cost to the contractor. If the trenches are filled due to any reason whatsoever before testing, the contractor shall have to open them for testing at no extra cost.

1.1] The field test pressure to be imposed should be not less than the maximum of following.

a) 1.5 times the maximum sustained operating pressure in the pipeline.

b) 1.5 times the maximum static pressure (with minimum design pressure as 6.0 kg/sqcm) in the pipeline in the pipe line

c) Sum of maximum sustained operating pressure and maximum surge pressure.

d) Sum of maximum pipe line static pressure and maximum surge pressure,

The testing conditions for the pipelines are summarized as follows:

- Pre test and saturation period with addition of make-up water

  Pressure : Test pressure

  Duration : 24 hrs for M.S pipes

- Pressure test with addition of make-up water

  Pressure : Test pressure

  Duration : 3 hrs

After filling, the pipeline shall be pressurised to the specified operating pressure and left for a period of time to achieve stable conditions. The pipeline shall then be pressurized upto the full test pressure and the section under test completely closed off. Care shall be taken to ensure that the pipeline is free of air. For this if required or if asked by the Engineer, water release test shall be carried out..

If the test is not satisfactory, the fault shall be found and rectified. In case fault cannot be identified easily, the section under test shall be sub-divided and each part tested separately.

If it is required to test a section of a pipe line with a free end, it is necessary to provide temporary support against the considerable end thrust development by the application of the test pressure. The end support can be provided by inserting a wooden beam or similar strong material in a short trench excavated at right angle to the main trench and inserting suitable packing between the support and pipe end.

Leakage Test for MS Pipeline

Test criteria for permissible losses in M.S pipes shall be as under

Q = 1 litre per km per length per 10mm diameter of pipe per 30mtr test pressure per 24 hrs. All pressure testing at site should be carried out hydrostatically. The pipes shall be accepted to have passed the pressure test satisfactorily, if the quantity of water required to restore the test pressure does not exceed the amount 'Q' , calculated by the above formula.

If it is required to test a section of a pipeline with a free end, it is necessary to provide temporary support against the considerable end thrust developed by the application of the test pressure. The end support can be provided by inserting a wooden beam or similar strong material in a short trench excavated at right angle to the main trench and inserting suitable packing between the support and the pipe end.

No section of the pipe work shall be accepted by the Engineer until all requirements of the test have been obtained.

On completion of a satisfactory test any temporary anchor blocks shall be broken out and stop ends removed. Backfilling of the pipeline shall be completed.

During testing if any joints are found leaking they shall be repaired and / or redone by the contractor at his cost till the test is found satisfactory. Similarly, any pipes collars, specials, show hair cracks, leaks etc. during testing the contractor shall replace them with sound pipes and specials etc. free of cost. The hydraulic test shall be given in presence of the Engineer in Charge.

Cleaning Out after Testing

On completion of a satisfactory test any temporary anchor blocks shall be broken out and stop ends removed. Backfilling of the pipeline shall be completed.

All pipes or joints which are proved to be in any way defective shall be replaced or remade and re-tested as often as may be necessary until a satisfactory test shall have been obtained. Any work which fails or is proved by test to be unsatisfactory in any way shall be redone by the contractor.

After the completed pipeline is tested, approved, backfilled and the Contractor has removed all temporary works and has reconnected any parts temporarily removed from the pipeline, the Contractor shall finally clean out the whole pipeline and flush it through with water.

Disinfection

After cleaning out, disinfection shall be performed in the following manner: after flushing the pipes the system shall be drained completely, all valves shall be closed carefully and the system filled with a strong chlorine solution of about 50 ppm free chlorine. This solution shall remain in the system for a period as directed but not exceeding 24 hours

uninterruptedly. Chlorine residual tests shall be done at various points by an orthotolidine reagent with a colour scale. The disinfection process shall be repeated until the chlorine residual is not less than 10 ppm at all sampling points. After disinfection the entire pipeline shall be rinsed with potable water till the chlorine residual is less than 4 ppm at various points of testing. Contractor will not paid separately for this activity.

After completion of disinfection and rinsing the results shall be reported by the Contractor in writing and signed by the Contractor and the Engineer.

The Contractor shall provide at his own expense such sampling points as the Engineer may direct if permanent points are not available or suitably located.

Water for Testing and Cleaning

The Contractor shall provide all water required for testing, cleaning and disinfection of the pipeline at his own cost and shall use only potable water. Contractor shall also bear the cost of chemical required for disinfection.

Disposal of water after testing, disinfection and cleaning shall be arranged by the Contractor with prior approval from the Engineer. The disposal shall be done in such a manner as will not cause any harm to any standing crop, cultivated land, damage to roads or structures, cause submergence and/or nuisance to any public or vehicular traffic.

6.23.72 ITEM No.72, 72.1 to 72.11 :- DISMENTALING JOINT

Providing, erecting and commissioning D.I . Dismantling joint as per requirement and Department's approved drawing and specifications, including machining and rubber rings and suitable for 16 kg/cm2 working pressure with required flanges of suitable size with nut bolts etc complete.

Flange norm / drilling :- ISO2531 / EN1092 raised face – reduced bore (RF-RB), other norms / drillings,

Body :- GGG-50, S235 to EN10025 and / or S275 to EN10025

Gasket :- EPDM to EN-681 (WRAS approved)

Bolts, nuts & washers :- Hot dip galvanized (stainless steel AIS316-A4)

Coating:- powder, Resicoat RT9000 R4 epoxy (blue coloured-RAL 5015), 305 microns (WRAS approved)

6.23.73 ITEM No.73:- CONSTRUCTION OF MASONARY CHAMBER 90X90X100 CM

Specifications :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD specifications

6.23.74 ITEM No.74:- CONSTRUCTION OF MASONARY CHAMBER 120X120X100 CM

Specifications :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD specifications

6.23.75 ITEM No.75:- REINFORCED CEMENT CONCRETE WORK JOINT

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.76 ITEM No.76:- FINISHING WITH EPOXY PAINT (TWO OR MORE COATS)

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.77 ITEM No.77:- PROVIDING AND APPLYING ZINC EPOXY PRIMER

Item includes:- Providing and applying 2 component Zinc epoxy Primer at 40 micron thickness in a single coat using brush on the cleaned reinforcement bar as a passivation layer including necessary tools and tackles for mixing the parts and all consumables, etc., complete

The primer shall be a single-component zinc epoxy primer. An unbroken 40 microns thick coating shall be capable of providing a protective barrier to further corrosive elements attacking the steel. It shall be a suitable viscosity to enable the coating to penetrate imperfections and pits within the surface of corrosion-damaged steel bars. The formulation of the primer shall be such that drying occurs to allow the application of the repair mortar to proceed after 20 - 45 min. at 35°C or after 50 min. to 1 hour at 20°C. It shall be fully compatible with the Renderoc system of concrete repair.

PROPERTIES

Recommended thickness per coat:40 microns (dry)

Application thickness per coat:120 microns (wet)

6.23.78 ITEM No.78:- PROVIDING AND FIXING SHEAR ANCHOR OF 10/12 MM DIA.

Item includes:-Providing & Fixing Shear anchors of 10/12 mm dia of sufficient length by drilling in the concrete for all Microconcrete jacketing works at 500 mm c/c and grouting by high strength, quick setting polyester resin grout including cutting, bending of steel, all tools tackles, etc., complete

6.23.79 ITEM No.79:- PROVIDING AND APPLYING SITE MIX POLYMER

Item includes:- Providing and applying site mix polymer modified mortar in 1:3 cement mortar with 20%,polymer by weight of cement on the spalled portions of beams, slab soffits, etc., up to 40 mm thickness in 2 to 3 layers. The mortar shall develop compressive strength up to 15

Mpa in 3 days. The rate shall include necessary surface preparation, removing rust from rebar and cleaning, profiling of concrete.

6.23.80 ITEM No.80:-PROVIDING& APPLYING FREE FLOW, SELF COMPACTING MICROCONCRETE

Item includes:- Providing & applying free flow, self compacting Microconcrete into the watertight shuttering for columns, beams jacketing at pre decided thickness admixed with 6 mm down pre washed cleaned stone aggrgates in the ratio of 1:0.5 as per manufacturer's specifications. The cost of providing the shuttering shall be paid separately.

6.23.81 ITEM No.81:- PROVIDING AND CARRYING INJECTION GROUTING

Item includes:- Material:
Grout shall be prepared by using webercret / or Roff supercrete / Polyalk WP or equivalent with cement in proportion 1:3.5 (1 part of Chemical and 3.5 part of cement by weight) along with50ml plasticizer (Roff plast 320 / Sun polycrete NCT / or equivalent) with proper water for injectable consistency as approved by engineer in-charge.

Workmanship:

Before undertaking the work the contractor shall clean the complete surface to the satisfaction of engineer in-charge and shall give demo the methodology & product selected to the employer’s representative. After satisfactory demonstration contractor will adopt injecting method including drilling of suitable diameter drill in the surface to be treated like slab, beam, column, pillars, deckslab, retaining wall, basement, underground & elevated water storage reservoir, concrete & brick wall, crack portion of structure etc. Holes @ 2 to 4 Nos. /sq.m or as directed by Engineer in-charge shall drilled. Injection of the grout using caps & nozzle, grouting machinery and necessary scaffolding, tool & tackles shall be carried out. After completion of work needful testing shall be undertaken to the satisfaction of Engineer in-charge.

6.23.82 ITEM No.82:- P/ A POLYMER MODIFIED CEMENTITIOUS

Item includes:- P/ A polymer modified cementitious compound for surface leveling up to 5 mm thickness on the rough surface on walls, slab bottom, etc., before application of Polyurea, wherever required, including all tools & tackles, etc., complete.

6.23.83 ITEM No.83:- PROVIDING & APPLYING 95 % SOLIDS, FLEXIBLE, ELASTOMERIC,

Item includes:- Providing & applying 95 % solids, flexible, elastomeric, UV stable, 2 component, waterproof, highly tough, odour free, chemical resistant, fast setting, negligible wastage, colour stable, Polyaspartic Sanitile 985 PA Coating, tensile strength 2920 psi, at 0.5 mm thick polyaspartic system over the substrate, brush applied as per manufacturer's specifications including all necessary tools, tackles, primer application, surface preparation, filling of cracks with suitable compound, solvent for overlaps, all transportation, etc., complete.

6.23.84 ITEM No.84:- PROVIDING AND FIXING STAINLESS STEEL (GRADE 304) RAILING

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.85 ITEM No.85:- EXTRA OF EVERY ADDITIONAL LIFT IN EXCAVATION

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.86 ITEM No.86, 86.1 to 86.3 :- EARTH WORK IN EXCAVATION

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.87 ITEM No.87:- SUPPLYING AND FILLING IN PLINTH WITH JAMUNA SAND

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification**.**

6.23.88 ITEM No.88:- SURFACE DRESSING OF THE GROUND

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification**.**

6.23.89 ITEM No.89, 89.1 to 89.2 :- PROVIDING AND LAYING IN POSITION MACHINE BATCHED, MACHINE MIXED DESIGN MIX M-25

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.90 ITEM No.90:- ADD OR DEDUCT FOR PROVIDING RICHER OR LEANER

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.91 ITEM No.91:- BRICK WORK WITH COMMON BURNT CLAY F.P.S IN FOUNDATION AND PLINTH

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.92 ITEM No.92:- BRICK WORK WITH COMMON BURNT CLAY F.P.S IN SUPERSTRUCTURE ABOVE PLINTH LEVEL UP TO FLOOR V LEVEL

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.93 ITEM No.93:- 52 MM THICK CEMENT CONCRETE FLOORING

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.94 ITEM No.94:- PROVIDING AND FIXING GLASS STRIPS IN JOINTS

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification

6.23.95 ITEM No.95:- PAINTING TOP OF ROOFS WITH BITUMEN OF APPROVED QUALITY

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification

6.23.96 ITEM No.96:- MAKING KHURRAS

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification

6.23.97 ITEM No.97:- PROVIDING GOLA

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.98 ITEM No.98:- PROVIDING AND FIXING ON WALL FACE UNPLASTICISED RIGID PVC RAIN WATER PIPES

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.99 ITEM No.99:- PROVIDING AND FIXING M.S. HOLDER BAT CLAMPS

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.100 ITEM No.100:- 15 MM CEMENT PLASTER

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.101 ITEM No.101:- 6 MM CEMENT PLASTER TO CEILING

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.102 ITEM No.102:- ROUGH CAST PLASTER UPTO 10 M HEIGHT

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.103 ITEM No.103:- WHITE WASHING

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.104 ITEM No.104:- DISTEMPERING WITH DRY DISTEMPER

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.105 ITEM No.105:- FINISHING WALLS WITH WATER PROOFING CEMENT PAINT

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.106 ITEM No.106:- PROVIDING AND FIXING BRASS STOP COCK

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.107 ITEM No.107:- PROVIDING AND FIXING WHITE VITREOUS CHINA PEDESTAL TYPE WATER CLOSET

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.108 ITEM No.108:- PROVIDING AND FIXING WHITE VITREOUS CHINA FLAT BACK OR WALL CORNER TYPE LIPPED FRONT URINAL BASIN

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.109 ITEM No.109:- PROVIDING AND FIXING WHITE VITREOUS CHINA PEDESTAL

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.110 ITEM No.110:- PROVIDING AND FIXING MIRROR

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.111 ITEM No.111:- PROVIDING AND FIXING SOIL, WASTE AND VENT PIPES

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.112 ITEM No.112:- PROVIDING AND FIXING PTMT LIQUID SOAP CONTAINER

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.113 ITEM No.113:- PROVIDING AND FIXING PTMT TOWEL RAIL

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.114 ITEM No.114:- PROVIDING, LAYING AND JOINTING GLAZED STONEWARE PIPES

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.115 ITEM No.115:- PROVIDING AND FIXING SQUARE-MOUTH S.W. GULLY TRAP

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.116 ITEM No.116:- MANUFACTURING, SUPPLYING AND FIXING RETRO REFLECTIVE SIGN BOARD

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.117 ITEM No.117:- PROVIDING AND FIXING STAINLESS STEEL (GRADE 304) RAILING MADE OF HOLLOW TUBES

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.118 ITEM No.118:- 30 MM THICK GLASS FIBRE REINFORCED PLASTIC (FRP) PANELLED DOOR SHUTTER

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.119 ITEM No.119:- SUPPLYING AND FIXING ROLLING SHUTTERS

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.120 ITEM No.120:- PROVIDING AND FIXING BALL BEARING FOR ROLLING SHUTTERS

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.121 ITEM No.121:- EXTRA FOR PROVIDING MECHANICAL DEVICE CHAIN AND CRANK OPERATION

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.122 ITEM No.122:- PROVIDING AND FIXING CIRCULAR/ HEXAGONAL CAST IRON OR M.S. SHEET BOX FOR CEILING FAN

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.123 ITEM No.123:- PROVIDING AND FIXING FIBER GLASS REINFORCED PLASTIC (FRP) DOOR FRAMES

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.124 ITEM No.124:- PROVIDING AND FIXING GLAZING IN ALUMINIUM DOOR, WINDOW, VENTILATOR SHUTTERS

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.125 ITEM No.125:- PROVIDING AND FIXING ON WALL FACE UNPLASTICISED-PVC MOULDED FITTINGS/ACCESSORIES

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.126 ITEM No.126:- PROVIDING AND FIXING TO THE INLET MOUTH OF RAIN WATER PIPE

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.127 ITEM No.127:- PROVIDING & FIXING UNPLASTICISED -PVC PIPE CLIPS

Specification :- The different activities under this item shall be executed as per the corresponding specifications given in CPWD Specification.

6.23.128 ITEM No.128:- PROVIDING AND INSTALLATION OF WATER FOUNTAIN/KIOSK

item includes all civil, mechanical **& automation work required to install & start working of kiosks including all tools & tackles.**

Electro Contact has engineered a systems based on RFID technology. Water is delivered from the electronic water fountain by inserting an electronic "key" in the water fountain. Removing the key stops the flow of water and the quantity of water delivered is substracted from the credit in the key .

The system is powered from a solar panel which makes it self sustainable and very easy to install.

Technical description

The water fountain is housed in a rugged metal cabinet designed to handle open space installation. The solar panel is mounted in the top section, and can be rotated every 90 to be oriented southwards.

The cabinet face holds

-the controller, whose LCD display is visible through a window

-the slot to insert the electronic key

-the water outlet.
Inside components
electronic controller with LCD display, RFID key reader with a slot to insert the key, hydraulic circuit : valve, flowmeter and solenoid valve on a removable board, sealed battery, solar panel, Solar panel, Key reader, Controller and display, flowmeter, Solenoid valve, Battery Stop valve, Hydraulic circuit, RFID key

Maintenance e and installation

All inside components are mounted on supports which allow for fast assembly and disassembly with standard tools.
The fountain can be equipped with one or two sets of equipment to serve one or two users simultaneously. The top structure containing the solar panel can be positioned horizontally every 90 degrees for best sun exposure. The vertical angle of the solar panel is fixed, the required angle must be specified with the order.
The door-is- fitted at the -back of the cabinet .. It is equipped with an electric lock which is activated by a special "maintenance" electronic key or an infrared remote controller.
The metal cabinet is designed to be mounted atop a concrete base 50cm high. This arrangement prevents water spill on the water fountain. A metal frame is furnished, to be incorporated on top of the concrete base.
The water fountain is then bolted to the frame, which allows for quick mount .

The water pipe should be routed inside the concrete structure to the water inlet of the hydraulic circuit.
There is a provision to mount a mechanical water meter if required (support furnished) .

Other components of the system Besides the water fountain, the system is made of the following
components :

- electronic key with RFID transponder
- handheld electronic payment terminal (TPE) to charge credit in the keys
- infrared remote controller to open the water fountain, set some parameters (such as time and dace, identification) and read the amount of water delivered on a daily basis.
- PC software to download data from the TPE, set parameters in the TPE and initialize keys.

Technical Specification for Mechanical & Electrical works

BOOSTER PUMPING STATION

The bidders are to design the pump sets along with other installations. However, the minimum requirement shall consist of the following.

a) Dry well where pumps/ motors along with suction & delivery pipes, Sluice Valves, Non

Return Valves shall be installed.

b) Loading/ unloading bay with suitable ramp/rolling shutter for erection and maintenance.

c) RCC staircases at one end shall be provided for access up to walk way. Necessary openings/ inspection manholes shall be provided suitably on the roof of reservoir/ sump with PVC encapsulated steps for getting down.

d) One MS step ladder-connecting roof of reservoir/ sump to roof of PH shall be provided.

e) 8 mm thick MS chequered plates over channels, cable trenches & drains in HT Room, Metering room, transformer rooms. MCC room & Pump house etc shall be provided.

f) Provision to be made for drawing overhead electric wire between EOT crane pedestal and roof level for providing power supply to EOT crane.

g) The sluice valves on the inlet to the reservoir, suction/ delivery of pumps shall be Actuator operated.

ANNEXE BUILDING

The Transformer/ HT/ Power Supply Company room/ Metering room in the annexe building will be provided with ramps and rolling shutters of suitable size. The building shall have suitable access roads/pavements and entrance as shown in the layout plan.

MECHANICAL EQUIPMENT SUPPLY AND INSTALLATION

SCOPE

Engineering, manufacturing, shop testing, supply, unloading at site, storing, shifting, installation and testing & commissioning of mechanical equipment's , pipes, cables and ancillary equipments.

a) Trial run for a period of 3 months after completion / testing & satisfactory commissioning of BPS.

- The parameters and detailed specifications of equipment are indicated in the technical specification.
- All items mentioned in these specifications shall be complete in all respect and any item not explicitly mentioned but essential for satisfactory operation of the system shall be deemed to have been included by the Tenderers.
- The contract for work is complete in all respect for the equipment, electrical and water supply materials, labour, workmanship including the provision of all consumable, construction equipment, tools and tackles measuring and testing devices. The contractor shall have to make his own arrangements for all materials required for due performance of the contract.
- All works shall be carried out as per specification and approved drawings.
- The Contractor shall supply, deliver at site, unload, store including watch & ward for save custody of the material till the time of erection, erect, test and commission the various equipments on turnkey basis in accordance with the requirements of enquiry specifications and statutory requirements. The work covered in this contract shall include, but not limited to the following in each pumping station:

PARTICULARS

• Horizontal centrifugal pump set single stage (pump, coupling, coupling guard, Base plate & foundation bolts) Pumps as shown in GA drawings of each pump house.
• Squirrel cage induction motor for pumps with necessary emergency push button near motor.
• Sluice valves (PN-1.6) ○ Electrically operated (Actuator) on delivery of pump ○ Electrically operated (Actuator) on suction of pump ○ Manually operated delivery main ○ Electrically operated (Actuator) on inlet to UGR
• Non Return Valves
Air Release valve with Isolating sluice valve 100 mm for rising mains.
MS. flanged puddle pipes & bends etc, in 2 Nos overflow chambers including insertion sheets, bolts, nuts & washers etc, as shown in GA drawing.
MS. flanged suction pipe of pump including C.I. flanged specials & fittings (Bell mouth, short pieces, bends, puddle pipes, eccentric tapers), insertion sheets, bolts, nuts & washers etc, including connection with suction of pumps etc, as shown in GA drawing.

MS flanged pipe inside Inlet chamber as inlet to underground reservoirs including C.I. flanged specials & fittings (puddle pipes, bends, short pieces, flanges drilled/ blank etc), insertion sheets, bolts, nuts & washers etc, as shown in GA drawing.
• M.S. pipe outside Inlet chamber including flanged specials & fittings MS flanges, bolts, nuts & washers etc as per site requirements, as inlet to UGR as shown in GA Drawing.
MS flanged pipe in delivery piping of main pumps including MS flanged specials & fittings (Bends, puddle pipes, concentric tapers etc). MS dismantling joints, MS flanges drilled, insertion sheets, bolts, nuts & washers etc, including connection with delivery of pumps & MS header as shown in GA drawing
MS flanged pipe for common header & delivery mains laid including M.S. specials & fittings, (puddle pipes, tees, bends, etc,) M.S. dismantling joints, MS flanges drilled /blank, insertion sheets, bolts, nuts & washers etc, as shown in plan of GA drawing
• D.I. Sluice Gates for controlling water from UGR to Sump
• Electric Operated Traveling Crane with Double Girder Gantry
• Sump Pumps over dewatering pit with associated piping fittings, valves, mounting flanges/ frame, float operated start/ stop limit switch etc.
Dewatering pump (portable submersible type) with associated 60 meter flexible hose & the cable of 4 core 6 sq.mm 60 meter length, push button station & DOL starters
• Fire Extinguishers, CO_2 Type ○ for Transformer Room, HT panel room. ○ Fire Extinguishers, CO_2 Type for Panel Rooms and Pump House ○ Fire extinguisher water CO_2 type (hose pipe) ○ Fire Buckets with stand.
• Local level indicator float & chord type for sump
• Ultra Sonic Level indicator for sump

• Pressure gauges for local indication
• Compound gauges 150 mm
• Ceiling Fans
• Wall mounted Air circulators heavy duty
• Exhaust Fans: • For Pump House, • Transformer Rooms, HT Panel Room and MCC Room • b) For Toilet
• Power Transformers, 500 KVA DYn, 11 / 0.433 KV dry type.
• 11 KV Switchgear Panel (5 Panels)
433 V switchgear 800Amps panels as required along with DB with the provision of the following.

(A) DOL starters with single phase preventor, phase sequence corrector for actuating sluice valves.
• (a) Sluice Valves.
• (i) 350 mm on delivery of pumps
• Soft Starter for Squirrel Cage Induction Motors for main pumps.
• Local push button station for sump pump motors.
• Local push button station for Vacuum pump motors
Indoor Lighting System including distribution boards, PVC conduits, Copper lighting wires, Modular switches & receptacles, CFL & T5 tube light fittings etc.
• External Lighting System including fixtures, wires, cables, poles, distribution boards, Conduit.
Automatic power factor correction panel with power capacitor bank suitable for improvement of power factor of the entire system to 0.9 lagging up to unity no load & on load.
• 30 V DC Battery and Battery Charger
• Power (HT 11 KV LT and Control Cables including GI pipe for road crossing as required.
• Cable Trays with covers.
• Chequered sheets 8 mm thick x width as required for cable ducts and drains
• Earthing System as per IER/ IS specification
• Electromagnetic Full Flow water Meter based on GSM technology
Chequered rubber mats 1 metre wide, with 25 mm thick laid along the entire length of 11 KV switchgear panel, 433 V switch gear, Automatic power factor correction panel battery charger.

- b) Electric Motor for main pump

In addition to the above, the following services are also included in the scope of the contractor.

A) Painting of the plant equipment supplied and erected by the contractor.

B) Preparation of mechanical and electrical schematic/ single line diagram, detailed electrical layout, piping layout drawing showing supports, operational platforms, level of pipes, operating hand wheels and actuators for the valves, construction drawings of panels, wiring lighting layout etc.

C) (i) The following Civil works will remain part of civil works and shall be measured in civil work

(a)Foundation for pump motor set

(b) Valve chambers

(c) RCC/PCC Thrust Block

(d) PCC for supporting bend in Inlet Chamber.

(e) PCC/RCC Pillars with Saddles on suction / delivery pipes and other places wherever required as per the direction of Engineer-in-Charge.

(f) Operating platform for suction & delivery valves.

- *(ii) GROUTING* OF *PUDDLE PIPES AND ACCESSORIES FOR SLUICE GATE SHALL BE DONE BY CIVIL BUT WILL NOT BE MEASURED IN CIVIL WORK.*

(iii) The following Civil works will remain part of E&M works.

(a) Earth works for laying pipe within the plot of the BPS
(b) Grouting of pump motor set on casted foundation.
(c) Foundation of panels (Grouting of foundation bolts) supports etc.

(d) Chasing in wall, ceiling or making hole in RCC floor/ceiling or brick wall for pipe/bus duct/cable tray/wiring including making good.

(e) Earth work for laying cables including bricks for protection.
(f) Laying G.I. pipes in road & plinth protection etc.
(g) Any other Civil work not mentioned above but required in connection with the Installation of the system"

D) Any other item not explicitly mentioned but essential for satisfactory operation of the system without any extra charge.

Exclusions: The following works are excluded from the scope of this contract. a) Incoming H.T. Cable up to BSES H.T. Panel & Metering panel.

Note: In case of E&M equipments, pipe, cable etc, sizes/ quantities/ numbers/ lengths/ diameter/ area/ thickness etc., are tentative and minimum. However, the contractor has to supply, install and commission all E&M equipments, pipe, cable etc, as per site requirements without any extra charges. The number of internal & external lighting fixtures and poles are however firm in quantities as specified and shown on drawings. This supersedes all other clauses mentioned elsewhere, if any. In case of any discrepancy, the same should be pointed out by the bidder during the evaluation of tender before opening the price bid otherwise it will be deemed to have been taken care of by the bidder.

MECHANICAL EQUIPMENTS AND SYSTEM

SCOPE

This section shall cover the manufacture, supply, installation, testing & commissioning of complete

Mechanical Equipment with indicating and measuring equipments.

6.23.129 ITEM No.127:- DESIGNING, PROVIDING ERECTING, COMMISSIONING AND GIVING TEST AND TRIAL OF HORIZONTAL SPLIT CASING CENTRIFUGAL PUMPS

HORIZONTAL CENTRIFUGAL PUMPS variable frequency drive pump

Item includes :- Designing, providing erecting, commissioning and giving test and trial of horizontal split casing centrifugal pumps capable of discharging 57.87 Lps. Against total head of 42 mts suitable for Electric motor of 1500 RPM for VFD Drive with coupling, base plate & accessories. Pressure gauges, coupling guard, MS companion flanges, foundation bolts etc..

a) Design Requirements

a) The pump shall be capable of developing the required total head at rated capacity for continuous operation **for Electric motor of 1500 RPM for VFD Drive**. The pumps shall operate satisfactorily at any point on the Q- H characteristic curve over a range of (-) 30% to (+) 10% capacity.

b) The total head capacity curve shall be continuously rising towards the shut off. The shut off head shall be at least 125% of the total head. The pump should deliver at least 125% of its rated capacity at 75% of the specified total head.

c) The required NPSH at duty point shall be atleast 1.0M less than the available NPSH.

d) Pumps shall run smoothly without undue noise and vibration. The velocity of vibration shall be within 4.5 mm/sec. The noise level shall be limited to 85 dBA at a distance of 1.8 M.

e) The power rating of the pump motor shall be the larger of the following:

i) The maximum power required by the pump in the entire operating range.

ii) 115% of the power required at the duty point. Power requirement shall be worked out considering 1% negative tolerance on quoted figure of efficiency.

b) Features of Construction

a) Pumps of a particular category shall be identical and shall be suitable of parallel operation with equal load sharing. Components of identical pump shall be interchangeable.

b) Impeller shall be enclosed type, securely keyed to the shaft. Means shall be provided to prevent loosening during operation including rotation in reverse direction.

c) Pump shall be provided with renewable type casing ring.

d) The first critical speed of the pump rotor shall be at least 30 percent above the operating speed.

e) Pump shall be furnished complete with flexible coupling.

f) Coupling guard, bolted to the base plate shall be furnished.

g) The base plate for pump and motor shall be common. Suitable holes shall be complete with nuts and washers.

h) Suction and discharge connections shall be flanged.

i) Pump impeller shall be dynamically and statically balanced.

j) All accessories required for proper and safe operation shall be furnished with the pump.

c) Materials of Construction

a)	Casing :	Cast Iron to IS: 210 GR FG 260	
b)	Impeller	:	Stain Less steel SS CF8M
c)	Casing Rings	:	Zinc free Bronze
d)	Shaft	:	Stain Less Steel -SS 431
e)	Shaft Sleeve	:	Not Required
F)	Seal	:	Stain less Steel SS 304
g)	Base Plate	:	MS fabricated

Factory Testing:

The Factory testing shall include all tests as per IS standards. The same will be conducted at factory in presence of NDMC official, third party agency, PMC representative.

These tests should be performed in the factory of manufacturer. The Employer, Third Party Inspection Agency and PMC representative for pumps testing at manufacturing facility of the manufacturer to inspect the pumps as per QAP approved by Engineer In charge. Inspection charges and all other charges shall be borne by the contractor.

6.23.130 ITEM No.130:- DESIGNING, PROVIDING ERECTING, COMMISSIONING AND GIVING TEST AND TRIAL OF HORIZONTAL SPLIT CASING CENTRIFUGAL PUMPS

Item includes :- Designing, providing erecting, commissioning and giving test and trial of horizontal split casing centrifugal pumps capable of discharging 57.87 Lps. Against total head of 35 mts suitable for Electric motor of 1500 RPM for VFD Drive with coupling, base plate & accessories. Pressure gauges, copling guard,MS companion flanges, foundation bolts etc. .

For detailed specification please refer item no 127 above.

6.23.131 ITEM No.131:- DESIGNING, PROVIDING, ERECTING, COMMISSIONING PN-1.6, ISI MARK CI D/F REFLUX VALVES (NON-RETURN VALVES)

Item includes :- Designing, Providing, Erecting, commissioning PN-1.6, ISI mark CI D/F reflux valves (non-return valves) of following dia including all taxes (Central and Local), railway freight, inspection charges unloding from railway wagon, loading into truck, transportation upto departmental stroes/ site, unloading, stacking etc. complete. Reflux valves as per I.S.5312 Part I (1984) a) 250 mm diameter.

Design Requirements

a) The valves shall generally conform to IS: 5312 Part 1 (Single Door Type) for sizes up to 600 mm dia. Valves shall be suitable non-slam characteristics

b) Valves shall be suitable for mounting on horizontal pipeline.

c) Valves shall be designed for a nominal pressure PN 1.0 MPa.

Features of construction

a) The non-slam characteristics shall be achieved either by suitable disposition of weight on door and the hydraulic passages or by dashpot arrangement. Valves with external counter weights will not be acceptable.

b) Valves of 500 mm and above shall be provided with supporting foot.

c) No by-pass is required for the valve.

d) Nominal size of the valve and direction of flow shall be cast on the body of the valve.

Materials of construction (NRV- Single Door)

BODY/ DOOR	-	*CAST IRON IS: 210 GR. FG 200*
BODY RING/ DOOR RING	-	*BRONZE TO IS: 318 GR. LTB 2*
Hinge Pin/ Stub Pin	-	Stainless Steel AISI 410/ 431
Disc	-	CI IS: 210m GR. FG 200
Disc arm (Hinge - Integral)	-	CI, IS 210 Gr. FG 200
Door Seat ring	-	LTB IS : 318, LTB 2
Cover Bolts	-	C.S. IS 1363 CL 4.6/CL 4.0

Cover plug	-	CI, IS 210, Gr. FG 200
Cover Gasket	-	MS Compressed fibre board.

Note : The way of achieving non slam characteristic shall be explained.

6.23.132 ITEM No.132:- PROVIDING, FABRICATING AND FIXING EXPANSION JOINTS

Item includes:- Providing, fabricating and fixing expansion joints for pipelines as per the drawing. The rate to include machining the strakes and steel ring as shown in the drawing and welding on either automatic welding machine or manually, Rate includes plates and flats required for expansion joint and all other materials such as synthetic rubber, rubber ring, etc. complete. including packing as per specifications, grease, bolts and nuts, etc. including local handling, all types of taxes and duties etc. complete. a) 400 mm diameter

6.23.133 ITEM No.133:- ELECTRIC OPERATED TRAVELLING CRANE

Crane

a) The crane bridge shall consist of a double bridge girder of adequate size.
b) The duty classification shall be class 1 Heavy duty.
c) The design standard shall be as per IS: 3177, IS 807 & IS: 3938. d)The operation shall be pendent operated.

Main Hoist

a) The main speed shall be 3 meter per minute. b) Motor.
   (i) The main hoist motor shall be Squirrel Cage, 6 pole, 1000 RPM, class F insulation, TEFC with degree of protection IP 55.
   (ii) The motor shall be capable of 150 starts per hour.
   (iii) The cyclic duration factor shall be 40%.
   (iv) The motor shall be of suitable KW/HP for 3 Tons crane.

c) Brake: The type of Brake shall be AC EM.
d) Limit Switch: The type shall be Snap type.
e) Coupling: Coupling shall be Direct Mounting type .
f) Wire Rope.
   (i) The dia of the wire rope shall be 13 mm, GR 80 IS 6216.
   (ii) Construction shall be 6 x 36/37
   (iii) No. of fall shall be 4.
   (iv) The breaking strength shall be 170 to 180 Kg/mm^2
   (v) Factor of safety shall be 6.
g) Hook
   (i) The hook shall `C' shank type.
   (ii) The hook shall be of forged steel IS: 8610.

Gross Travel.

a) The main speed shall be 15 meter per minute.

b) Motor.

(i) The CT motor shall be Squirrel cage, 6pole 1000 RPM, class F Insulation, TEFC with degree of protection IP55.

(ii) The motor shall be capable of 150 starts per hour.

(iii) The cyclic duration factor shall be 40%.

(iv) The motor shall be of suitable HP/KW for 5 ton crane. c) Brake: the brakes shall be AC EM

d) Coupling: Coupling shall be direct mounting type.

e) Limit Switch: Limit Switches shall be 2 way lever type. f) Wheels

(i) The cross Travel wheels shall be of suitable dia double flanged & tread.

(ii) The cross travel wheels shall be of forged steel/ EN8 BS:970.

(h) DSL: DSL shall be festoon type.

Long Travel

a) The main speed shall be 15 meter per minute. b) Motor

(i) The LT motor shall be Squirrel cage, 6 pole, 1000 RPM, class F Insulation, TEFC with degree of protection IP:55.

(ii) The motor shall be capable of 150 starts per hour. (iii) The cyclic duration factor shall be 40%.

(iv) The motor shall be of suitable HP/KW for 5 Ton Crane. c) Brakes: The type of brake shall be AC EM.

d) Limit Switch: The type of Limit switch shall be 2 way lever type.

e) Coupling: Coupling shall be flexible type. f) Wheels:

(i) The long travel wheels shall be of suitable dia double flanged & tread. (ii) The LT wheels shall be of forged steel/EN 8 BS: 970.

g) Rail : The rail size shall be 50 x 50 mm

h) Buffer : LT Buffer shall be of Rubber. i) DSL : DSL shall be Festoon type.

6.23.134 ITEM No.134:- DOWN SHOP LEAD SYSTEM FOR ABOVE CRANE

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.135 ITEM No.135:- PROVIDING ERECTING AND FIXING SQUARE BAR

The different activities under this item shall be executed as per the corresponding

specifications detailed in CPWD specification for works.

6.23.136 ITEM No.136:- PROVIDING STRUCTURAL STEEL WORK IN SINGLE STANCHIONS COMPOSED OF RSJ

For detailed specification please refer item no- 26 above

Technical Specification for Electrical works

Scope

This section shall cover the design, manufacture, supply, installation, testing, commissioning of complete Electrical Equipments and their installation for proposed Booster Pumping Station.

Power Transformers. H.T. Switchgears

L.T. Switchgear & Distribution Board. Squirrel Cage Induction Motors.

Soft Starter

Bus Duct

Automatic power factor correction panel

H.T. and L.T Cables and their laying

Cable Trays

Battery Charger

Lighting of various Buildings and Outdoor

Ceiling Fan

Exhaust Fan.

Air Circulators Wall mounted type. Push Button Station

Wiring Earthing etc. Rubber mats.

Completeness of Tender

The tender shall be complete in all respects. The contractor will have to make his own arrangements for the safe storage, protection, necessary lighting, water, tools and tackles, scaffolding, ladder, sand and all such accessories which are required for the completeness of the work. The contractor shall make his own arrangement of temporary electric connection for lighting etc. through the appropriate agency during execution/testing. The contractor shall be responsible for getting clearance from Chief Electrical Inspector.

Standardization

As far as possible, components to be utilised in the manufacture of equipment, supplied under this contract, should be of consistent specified standard. The equipment supplied along with its accessories shall be of approved make for the use in electrical installations.

Compliance to Indian Electrical Rules

The equipment supplied as well as the installation work carried out shall comply in all respects with

Indian Electricity Act and Indian Electricity Rules (1956) as amended upto date.

Codes and Regulations

The work shall be governed by the electrical drawings and these specifications, in conformity with relevant Indian Standard Codes and Regulations issued by the Bureau of Indian Standards from time to time.

Statutory Regulations Inspection and Testing

It will be the Contractor's responsibility to prepare and submit drawings, test certificates and any other information that may be required by the Power Supply Company authorities for release Electric Connection for commissioning and operation of the equipment's. The contractor shall assist in explaining his drawings and will co-operate with the NDMC for approval to the drawings, for the works that are being executed. Necessary fees as required will have to be paid by the contractor for seeking clearance from Power Supply Company, Chief Electrical Inspector Delhi Administration and Department of Industries, Govt. of Delhi, NCR etc. or any other agency.

Competency of Electrical staff

Accepted norms of good workmanship is required. The electrical works shall be done by qualified and trained staff having sufficient competency in electrical works. The staff handling the works shall further be under the overall supervision of contractors having Electrical Contractors License from the Government of Delhi or Other states approved for execution of such works.

Material

All material used shall be new and conform to the relevant specifications or standards. Reconditioned parts/Equipments shall not be accepted.

Makes of Equipments

Makes for major items are indicated in the Schedule of Makes. Where makes are not indicated, necessary approval will have to be obtained from NDMC.

Working Conditions

It will be the Contractor's responsibility to acquaint himself with the local prevailing conditions of temperature, humidity, rainfall, dust and other conditions. All the equipments supplied shall be suitable for satisfactory operation under such abnormal conditions as prevalent.

Conformity to Specification

The work is to be executed in accordance to the electrical drawings, these specifications and the relevant I.S. Codes. In case of ambiguity the following orders shall prevail which shall be treated as final: -

a) As detailed in the nomenclature of the item in the Bill Quantities read with drawings.

b) The particular specifications of the item as per details.

c) The relevant I. S. Codes, I.S. Specifications and B.S. Standards as applicable to such equipment and type of works.

The work shall be executed neatly and in conformity with good workmanship, under the strict directions and surveillance of Engineer-in- Charge of NDMC.

Approval of Materials

All materials used on the work shall be new and of the best quality available, conforming to the relevant specifications and as per the good Engineering practices. Prior approval should be obtained in writing from the Engineer-in- Charge for all materials proposed to be used, if necessary, approved sample duly identified and labeled shall be deposited with the Engineer-in-Charge of NDMC for future comparison.

Safety Precautions

The contractor shall take all reasonable safety precautions during construction and testing of the works. Particular attention shall be paid to the following:

a) Precautions to prevent any conductor or apparatus, becoming accidentally or inadvertently charged, when persons are on the work. The Engineer-in- Charge should be well informed and his approval be sought for doing such works on the line or electrical system.

b) Prior to the electrical installation (or part thereof) being connected to the main supply, the contractor shall ensure that all main switches controlling the equipment are in 'OFF', position and locked, so that un-commissioned or incomplete circuits could not be inadvertently get energized, even the completed circuit should not be used without the consent of Engineer-in-Charge.

c) During testing and commissioning or at any other time, when live conductors may be temporarily exposed, (e.g. control panel doors are open) the Contractor shall provide danger boards and warning signs to prevent any possibility of accident or electrical shock to the staff executing the work.

Training to Staff of NDMC

The contractor shall educate the operating personnel of the NDMC for operation and maintenance of the installation. He shall demonstrate and explain the procedure to NDMC's operating staff as per the recommendations of the manufacture's guidelines.

Handing Over

The contractor shall hand over the complete installations etc to the NDMC's representative, in a clean and perfect working condition after completion of the contract period. Any area in which has been in the possession of the contractor , shall be thoroughly cleaned of all debris, trash and unwanted materials, cleaned and handed over in a perfectly finished almost identical to the original conditions. The worn-out parts shall be replaced with genuine spares. Reconditioned spares shall not be acceptable.

Deviation and ordering material

The contractor must quote exactly as per specifications and bill of quantities and drawing. Deviation, if any, must be clearly mentioned separately.

The bill of quantities shall not be used as a basis for ordering materials. The contractor shall be responsible for assessing the quantities of materials to be ordered which are required for completing the work; any variation in quantities shall not be made the basis for extra claim of payment.

General Design Criteria

All electrical equipment will be rated for 50°C designed ambient temperatures. The installation will generally conform to Indian Standards / IEC.

The following assumptions shall be made to arrive at the load

a)	Load Factor		
i)	Main motor	:	0.9
iii)	Lighting load	:	1.0
b)	Diversity Factor		
i)	Main motor	:	1.0
iii)	Lighting load	:	1.2

c) Power factor of Motors shall be as per manufacturer's catalogue

d) Efficiency of Motors shall be as per manufacturer's catalogue

Energy efficient, high performance motors are proposed for main pump motors for optimum utilization of energy.

Protections:

The following protections are proposed for switchboard, motors and Lighting

3 pole MCCB up to 100A of 25kA at Hasanpur and 3 poles 125A of 25kA at Talkatora for Motors & 200 A at Hasanpur & 400 A at Talkatora DT for panel.

All LV power cables up to 35 sq mm shall have stranded aluminium conductors and above that, it shall be stranded aluminium conductor. Power cables shall be XLPE / PVC insulated.

The illumination levels for various areas shall be considered as follows:

Area	Illumination level (Lux)
Pump House	150

Moulded Case Circuit Breaker (MCCB) shall be provided at the Main Incomer and Pump control Panel.

Compliance to Standards:

The electrical safety and clearances will be maintained as per Indian Electricity Rules and CBIP

guidelines. The equipment selection and electrical installation will generally conform to the latest edition of Indian Standards (IS) and the International Electro-technical Commission (IEC).

6.23.137 ITEM No.137:- PROVIDING AND FIXING MAIN INCOMER AND PUMP CONTROL PANEL

Item includes :- Main incomer and pump control panel (Talkatore DT) as per SLD and as given below

1. Supplying and erecting contactor L&T make ML-4 or suitable from MN series for motor starter suitable from 60 HP to 75 HP.
2. Providing & erecting 3 Pole MCCB upto 125A of 25kA SC rating, thermal and magnetic setting with provided leads on iron frame/laminated board as per specification No. SW-SWR/MCCB
3. Supplying & erecting Bank of polypropylene condensers with the standard of 10, 10,10 &20 Kvar unit of power factor correction on 3 phase, 50Hz, 400 volts..
4. VFD (variable frequency drives) 35KW, 440 volt.
5. Providing & erecting 3 Pole MCCB of 400A. capacity with S.C. rating 50 kA thermal and magnetic setting with provided leads on iron frame/laminated board as per specification no. SW-SWR/MCCB
6. Sheet metal enclosurer, busbar, indication & metering, insulator single &three Phase Plug point, Contactor & MCB for Capacitor, Energy Meter.etc

General Constructional Features

Sheet steel used for fabrication of switchboards, control cabinets, marshaling boxes, etc shall be cold rolled.

All panels, cabinets, kiosks and boards shall comprise rigid welded structural frames made of structural steel sections or of pressed and formed cold rolled sheet steel of thickness not less than 2 mm. The frames shall be enclosed by sheet steel of at least 2 mm thickness. Stiffeners shall be provided wherever necessary.

All doors, removable covers, gland plates, etc. shall be of at least 1.6 mm thickness and shall be gasketed all-round the perimeter.

All doors shall be supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.

All floor mounted panels/boards shall be provided with a channel base frame. Total height of all floor mounted cubicles/panels shall not be greater than 2300 mm. Where steel pedestals for mounting of boards/panels are specified, the total height including that of the pedestal shall exceed 2300 mm.

Switchboard/control cabinet/panel shall be dust and vermin proof. Degree of protection of the

enclosure shall be IP 54 for indoor installations and IP 55 for outdoor installations.

LV Switchboard

Separate, segregated metal clad compartments shall be provided for main and auxiliary bus bars, each feeder and cable alleys. Metal clad cubicles/modules shall be provided with hinged doors in the front, with facility for padlocking door handles. More than one module may be arranged in the same vertical section.
The fixed type module shall have all the circuit components mounted in the compartment, with bolted type power and control connections. It shall be possible to remove all circuit components after removing the connections and the component fixing bolts.

Instruments, relays and control devices shall be mounted flush on hinged door of the cubicles. Switchboard shall be complete with inter-panel wiring.

Each switchboard shall also be fitted with a label indicating its title. Each cubicle shall be fitted with a label on the front and rear of the cubicle. Each relay, instrument, switch, fuse, contactor and MCCB/MCB shall be provided with a separate label.

One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchboard except for the horizontal busbar compartment. However, each shipping sections shall have metal sheets at both ends.

After isolation of the power and control connections of a circuit, it shall be possible to carry out maintenance in a compartment safely, with the busbars and adjacent circuits alive.

The current rating of outgoing feeders of any switchboard shall not be less than 10% of that of the incoming feeder. Deviation from this requirement shall be subject to the approval of the Engineer.

Busbars
The phase and neutral busbars shall be of rating indicated in the corresponding one line diagram. Busbars shall be of aluminium and shall be provided with minimum clearances as specified.

All busbars and bus taps shall be insulated with close fitting sleeve of hard, smooth, dust and dirt free, heat shrunk PVC insulation of high dielectric strength, to provide a permanent non-ageing and non-tracking protection, impervious to water, tropical conditions and fungi. The insulation shall be non-inflammable and bself extinguishing type and in fast colours to indicate phases. The dielectric strength and properties shall hold good for the temperature range of 0 to 95 degree centigrade. If the insulating sleeve is not coloured, bus bars shall be colour coded with coloured PVC tape at suitable intervals.

Busbar joints shall be of the bolted type. Spring washers shall be provided to ensure good

contact at the joints. Busbars shall be thoroughly cleaned at the joints and suitable contact grease shall be applied just before making a joint.

Direct access to, or accidental contact with busbars and primary connections shall not be possible. All apertures and slots shall be protected by baffles to prevent accidental shorting of busbars due to insertion of maintenance tools.

Sequence of red, yellow and blue phases and neutral for four-pole equipment shall be left to right and top to bottom, for horizontal and vertical layouts respectively.

Moulded Case Circuit Breaker (MCCB)

a) MCCBs shall be of the air break, quick make, quick break and trip free type and shall be totally enclosed in a heat resistant, moulded, insulating material housing.
b) MCCBs shall have an ultimate short circuit capacity not less than the prospective short circuit current at the point of installation.
c) MCCBs shall have a service short circuit breaking capacity equal to the ultimate short-circuit capacity.
d) Each pole of MCCB shall be fitted with a bi-metallic thermal element for inverse time delay protection and a magnetic element for short circuit protection. Alternatively, they shall be fitted with a solid state protection system. Such a protection system shall be fully self-contained, needing no separate power supply to operate the circuit breaker tripping mechanism. Thermal element shall be adjustable. Adjustments shall be made simultaneously on all poles from a common facility. Thermal elements shall be ambient temperature compensated.
e) The MCCBs shall be provided with the following features.

Common trip bar for simultaneous tripping of all poles Shrouded terminals

Time for clearing short circuit current of 20 msec.

2 NO + 2 NC auxiliary contacts

Miniature Circuit Breaker (MCB)

a) MCB shall be hand operated, air break, quick make, quick break type.
b) Operating mechanisms shall be mechanically trip-free from the operating knob to prevent the contacts being held closed under overload or short circuit conditions.
c) Each pole shall be fitted with a bi-metallic element for overload protection and a magnetic element for short-circuit protection. Multiple pole MCBs shall be mechanically linked such that tripping of one pole simultaneously trips all the other poles. The magnetic element tripping current classification shall be of the type suitable for the connected load. Where this is not specified, it shall be Type C.
d) The short circuit rating shall be not less than that of the system to which they are connected.

Contactors

The power contactors used in the switchboard shall be of, air break, single throw, triple pole, electromagnetic type. Contactors shall be suitable for uninterrupted duty and rated for Class AC3 duty in accordance with the latest edition of IS 13947.

Operating coils of all contactors shall be suitable for operation on 240 V, single phase, 50 Hz supply. Contactors shall be provided with at least two pairs of NO and NC auxiliary contacts. Contactors shall not drop out at voltages down to 70 % of coil rated voltage. Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable settings. The hand reset button shall be flush with the front door of the control module, and shall be suitable for resetting the overload relay with the module door closed. Relays shall be either direct connected or CT operated.

Overload relay and reset button shall be independent of the "Start" and "Stop" push buttons. All contactor shall all be provided with single phasing preventer (SPP).

Motor starters shall be complete with auxiliary relays, timers and necessary indications.

Instrument Transformers

Current transformer (CT) shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block.

CT shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit current.

CT core laminations shall be of high grade silicon steel. Identification labels giving type, ratio, output and serial numbers shall be provided.

Relays

All relays shall be accessible from the front for setting and resetting. Access to setting devices shall be possible only after the front covers of the relays are removed. Resetting facilities shall however be accessible external to the relay case.

Control and Selector Switches

Control and selector switches shall be of the rotary type, having enclosed contacts, which are accessible by the removal of the cover. Control and selector switches for instruments shall be flush mounted on the front of the panels and desks.

All control switches shall be of the spring return to normal type and shall have momentary contacts. Selector switches shall be of the stay-put, maintained contact type.

Indicating Instruments & Meters

Electrical indicating instruments shall be 110 mm square with 240 º scale. Taut band type of instruments is preferred. Taut band moving coil instruments for use on AC systems shall incorporate built-in transducers.

Instrument dials shall be white with black numbers and lettering. Normal maximum meter

reading shall be of the order of 60 % normal full scale deflection. Ammeters for motor feeders shall have suppressed scale to show current from full load up to six times the full load current.

Watt hour meters shall be of the induction type and shall be provided with reverse running stops.
Instruments shall have an accuracy of Class 1.0.

Indicating lamps
Indicating lamps shall be of the cluster LED type, with low watt consumption. Indicating lamp shall be of the double contact, bayonet cap type rated for operation at either 240 V AC or at the specified DC system voltage as applicable. Lamps shall be provided with translucent lamp covers. Bulbs and lenses shall be interchangeable and easily replaceable from the front.

Push Buttons
"Start" and "Stop" push buttons shall be coloured green and red respectively. Stop Push Button shall be lockable stay-put type with Mushroom head.

Space Heaters
Adequately rated anti-condensation space heaters shall be provided, one for each control panel, for each switchboard and for each marshalling kiosk.

Space heater shall be of the industrial strip continuous duty type, rated for operation on a 240 V, 1 phase, 50 Hz, AC system.

Each space heater shall be provided with a single pole MCB with overload and short circuit release, a neutral link and a control thermostat to cut off the heaters at 450 C.

Cubicle Lighting/Receptacle
Each control panel, control cabinet, marshalling box, etc. shall be provided with interior lighting by means of a 20 W fluorescent tube lighting fixture. A MCB shall be provided for the lighting circuit. The lighting fixture shall be suitable for operation from a 240 V, 1 ph, 50 Hz, AC supply.

A 240 V, 1 phase, AC receptacle (socket) plug point shall be provided in the interior of each panel with a MCB for connection of hand lamp.

Safety Arrangements
All terminals, connections and other components, which may be “live” when front access door is open, shall be adequately screened. It shall not be possible to obtain access to an adjacent cubicle or module when any door is opened. Components within the cubicles shall be labelled to facilitate testing.

Power and Control Cable Terminations
Equipment terminal blocks for power connections shall be complete with adequate phase segregating insulating barriers, shrouds and suitable crimping type of lugs for terminating the

cables. Double compression type cable glands shall be provided for all power and control cables.

Earthing connectors between cable armour and earth shall be routed outside the cable gland in an approved manner. Gland insulation shall be capable of withstanding a high voltage test of 3000 V for one minute.

Wiring for Control and Protective Circuits

All wiring for control, protection and indication circuits shall be carried out with 650 V grade, PVC insulated cable with stranded, tinned copper conductor of minimum 1.5 sq. mm size. The size of conductor for CT circuits shall be minimum 2.5 sq. mm.

All wiring shall be run on the sides of panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel. All wiring shall be taken to terminal blocks without joints or tees in their runs.

All wiring shall be colour coded as given below. Instrument Transformer: Red, Yellow or Blue determined by the circuit phase with which the wire is associated

A C phase wire: White

A C neutral: Black

D C circuits: Grey

Earth connections: Green

Engraved core identification ferrules, marked to correspond with the wiring diagram, shall be fitted to each wire and each core of multicore cables terminated on the panels. Ferrules shall fit tightly on wires, without falling off when the wire is removed. Ferrules shall be of yellow colour with black lettering.

All wires forming part of a tripping circuit shall be provided with an additional red ferrule marked 'T'. Each wire shall be identified by a letter to denote its function followed by a number to denote its identity, at both ends. Unused core of multicore cables shall be ferruled U1, U2 etc., at both ends, and connected to spare terminals. Spare auxiliary contacts of electrical equipment shall be wired to terminal blocks.

Control Wiring Terminal Blocks

Terminal blocks shall be of the 650 V grade and stud type. Brass stud of at least 6 mm dia. with fine threads shall be used and securely locked within the mounting base to prevent turning. Each terminal shall comprise two threaded studs, with a link between them, washers, and matching nuts and locknuts for each stud. Connections to the terminals shall be at the front.

Terminals shall be numbered for identification, grouped according to function. Engraved ‘black

on-white' labels shall be provided on the terminal blocks describing the function of the circuit.

Terminals for circuits with voltage exceeding 110 V shall be shrouded. Terminal blocks at different voltages shall be segregated into groups and distinctively labelled.

Terminals used for connecting current transformer secondary leads shall be 'disconnecting and shorting' type with a facility grounding the secondary.

Terminal blocks shall be arranged with 100 mm clearance, between any two sets. Separate terminal stems shall be provided for internal and external wiring respectively.

All wiring shall be terminated on terminal blocks, using crimping type lugs or claw type of **terminations**

Test Terminal Blocks

Test terminal blocks, if any, shall be provided for secondary injection and testing of relays. A suitable metering block shall be provided where specified for the connection of a portable precision instrument to be operated when required for specific plant testing purposes.

Earthing of Switchboards/Panels

Each switchboard, control panel, etc. shall be provided with an earth busbar running along its entire length. The earth busbar shall be located at the bottom of the board/panel.

Earth busbars shall be of copper and shall be rated to carry the rated symmetrical short circuit current of the associated board/panel for one second, unless otherwise specified. Earth busbars shall be properly supported to withstand stresses induced by the momentary short circuit current of value equal to the momentary short circuit rating of the associated switchboard/panel.

Positive connection of the frames of all the equipment mounted in the switchboard to the earth busbar shall be maintained through insulated conductors of size equal to the earth busbar or the load current carrying conductor, whichever is smaller.

All instrument and relay cases shall be connected to earth busbar by means of 650 V grade, green colored, PVC insulated, stranded, tinned copper, 2.5 sq. mm conductor looped through the case earth terminals.

Applicable Standards

The following standards and codes of practice shall be applicable. These shall be the latest editions including all official amendments and revisions. The standards referred to therein shall also be applicable.

Air break switches, MCCBs, etc. for voltage not exceeding 1000 V AC or 1200 V DC: IS 13947
Current transformer : IS 2705 / IEC 60044

Voltage transformer : IS 3156 / IEC 44, 60186

Electrical Relays : IS 3231, 3842 / IEC 60255

Contactors for voltage not exceeding 1000 V AC : IS 13947 / IEC 60947

Control Switches : IS 6875 / IEC 60947

High Voltage Fuses : IS 9385 / IEC 60282

Low voltage Fuse : IS 13703 / IEC 60269

Electrical direct acting indicating instruments : IS 1248 / IEC60051

AC electricity meters of : IS 722, 8530 / IEC 60145,

of induction type for voltage IEC 60211

greater than 1000 volts

Porcelain post insulators for system with nominal voltages greater than 1000 volts : IS 2544

Specification for copper rods and bars for electrical purposes : IS 613

Specification for low voltage switchgear and control gear : IS 13947 / IEC 60947

Degree of protection provided : IS 13947 / IEC 60947

Marking and arrangement for switchgear, busbars,

main connections and auxiliary wiring : IS 5578 / IS 11353

Code of practice for selection, installation and maintenance,

of switchgear and control gear : IS 10118

Miniature Circuit Breakers : IS 8828 / IEC 60898

Control Switches/ Push buttons : IS 6875

Technical Particulars

The specific technical particulars of switchboard shall be as given below:

Description Particulars

1. Rated voltage, Phases and Frequency 415 V, 3 Ph, 50 Hz
2. Type of Construction Single front, fixed type (except for CB)
3. Maximum system voltage 476 V
4. One minute Power Frequency withstand voltage

a) Power circuit 3000 V (rms)
b) Control Circuit 2000 V (rms)
c) Auxiliary circuit connection to secondary of CTs 2000 V (rms)

5. Current rating of busbars over design ambient temperature of 50oC (*)
6. Short circuit withstand for main and auxiliary busbars (1 sec.) (*)

7. Maximum temperature of main and auxiliary busbars at continuous rated current rating under site design ambient temperature of 50oC 85oC

8. Colour finish shade as per IS:5

a) Interior Glossy white

b) Exterior Light grey, semi-glossy, shade 631 of IS 5

9. Earthing bus material and size Copper, 25 x 6 mm

10. Clearances in air of live parts 25.4 mm

11. Power contactors

    a) Contactor rated duty AC3

    b) Utilization category Uninterrupted

12. Motor Starters For motor < 5 kW – DOL
    For motor > 5 kW <50

    kW – Star-Delta

13. Type of Mounting Floor

14. Cable Entry Bottom /Top. Based on Layout.

(*) size to be worked out by the contractor based on approved calculations submitted by contractor

Tests

The following routine tests shall be carried out on the assembled switchboard/panel during inspection at the manufacturer's works in addition to other tests.

- One minute power-frequency voltage dry withstand tests on the main circuits
- One minute power-frequency voltage dry withstand tests on the auxiliary circuits

LT CAPACITOR BANK:

General:

The capacitor bank will be complete with all parts that are necessary or essential for efficient operation. Such parts will be deemed to be within the scope of supply whether specifically mentioned or not. It will be complete with the required capacitors along with the supporting post insulators, steel rack assembly, copper bus bars, copper connecting strips, foundation channels, fuses, fuse clips, etc. The steel rack assembly will be hot dip galvanised.

The capacitor bank may comprise of suitable number of single phase units in series parallel combination. However, the number of parallel units in each of the series racks will be such that failure of one unit will not create an over voltage on the units in parallel with it, which will result in the failure of the parallel units. The assembly of the banks will be such that it provides sufficient ventilation for each unit.

Each capacitor case and the cubicle will be earthed to a separate earth bus.

Capacitor will conform to IS 13925. Capacitors will be of APP type. Each unit will satisfactorily operate at 135 % of rated kVAR including factors of overvoltage, harmonic currents and manufacturing tolerance. The units will be capable of continuously withstanding satisfactorily any over voltage up to a maximum of 10 % above the rated voltage, excluding transients.

Each capacitor unit/bank will be fitted with directly connected continuously rated, low loss discharge device to discharge the capacitors to reduce the voltage to 50 volts within one minute upon disconnection, in accordance with the provisions of the latest edition of IS:13925.

Unit Protection:

Each capacitor unit will be individually protected by a HRC fuse suitably rated for load current and interrupting capacity, so that only the faulty capacitor unit will be disconnected without causing the bank to be disconnected.

An operated fuse will give visual indication so that it may be detected during periodic inspection. The fuse breaking time will co-ordinate with the pressure built up within the unit to avoid explosion.

Mounting of the individual fuse should be internal to the capacitor case.

Tests and Test Reports:

All tests will be conducted in accordance with the latest edition of IS: 13925 and as applicable for the controls. Type test certificates for similar capacitor units will be furnished.

Drawing:

A general arrangement drawing showing overall dimension of capacitor banks/housing, details of housing, sizing calculation for capacitor and reactor based on the finally procured motor details, bill of material, sectional view foundation arrangement, weight etc. will be submitted for approval after the award of contract.

Technical Particulars:

The following are the technical details for the LT Capacitor Bank

Capacitor bank having all polypropylene condensers with the standard capacities of 1,2,3,5,7,10, 15,20 and 25 kVAR unit of power factor correction for operation on 3 phase, 50 Hz, 415 V+/10% with externally discharge resistances, earthing terminals and build on angle iron on channel iron frame work and provided with terminals cover box complete erected and tested.

The specific technical particulars of capacitors will be as given in the table below.

Sr.No.	Description	Particulars
		LV

Sr.No.	Description	Particulars
		LV
1	Rated Capacity	1,2,3,5,7,10, 15,20 and 25 kVAR
2	Type of Capacitor	APP
3	Rated voltage, frequency and phases	415V, 3 Phase, 50 Hz
4	Insulation level	3 kV (rms)
5	Capacitor bank connection	Delta
6	Control	Manual
7	Capacitor Bank Enclosure	
a)	Type	Sheet Metal
b)	Colour finish / shade	Light grey, semi glossy, shade 631 of IS 5

Variable Frequency Drive (VFD)

The scope of work includes supply and installation of Variable Frequency Drive (VFD) for motor with the required wiring harness. The provision for sheet and metal enclosure should be made. Also a external potentiometer should be provided for the VFD. The provision of cables, cable terminations, power supply, etc. is to be done with the necessary cabling required.

Variable Frequency Drive			
	Rating Details		
Sr. No	Parameters	Description	
a.	Motor Rating HP	40 hp	47 hp
b.	Motor Rating kW	30 kW	35 kW
c.	Rated output capacity (kVA)	37.5	43.75
d.	Rated Input Voltage	Three-phase 415 V AC ±10%, 50Hz ± 5%	
e.	Rated Output Voltage	Corresponds to Input Voltage	

Variable Frequency Drive			
	Rating Details		
Sr. No	Parameters	Description	
	Control System	Sinusoidal Pulse Width Modulation, carrier frequency 1kHz - 12kHz	
	Output Frequency Resolution	0.1 Hz	
	Overload Capacity	150% of rated current for 1 minute	
	Torque Characteristics	Includes auto-torque boost, auto-slip compensation, starting torque 125% @ 0.5Hz/150% @ 5.0Hz	
	Braking Torque	20% without dynamic braking resistor, 125% with optional braking resistor	
	DC Braking	Operation frequency 50-0Hz, 0-100% rated current. Start time 0.0-5.0 seconds. Stop time 0.0-0 25.0 seconds	
	Acceleration/Deceleration Time	0.1 to 600 seconds (linear or non-linear acceleration/deceleration)	
	Voltage/Frequency Pattern	V/F pattern should be adjustable. Settings should be available for Constant Torque - low and high starting torque,	
		Variable Torque - low and high starting torque, and user configured	
	Stall Prevention Level	20 to 200% or rated current	
	Enclosure Rating	Protected chassis, IP20	
	Ambient Temperature	-10° to 50°C (14°F to 122°F)	
	Storage Temperature	20° to 60 °C (-4°F to 140°F) - during short-term transportation period	
	Ambient Humidity	20 to 90% RH (non-condensing)	
	Vibration	9.8 m/s^2 (1G), less than 10Hz, 5.9 m/s2 (0.6G) 10 to 50 Hz	

6.23.138 ITEM No.138:- PROVIDING AND FIXING MAIN INCOMER AND PUMP CONTROL PANEL

Item includes :- Main incomer and pump control panel (Talkatore BPS) as per SLD and as given below

1. Supplying and erecting contactor L&T make ML-4 or suitable from MN series for motor starter suitable from 60 HP to 75 HP.
2. Providing & erecting 3 Pole MCCB upto 125A of 25kA SC rating, thermal and magnetic setting with provided leads on iron frame/laminated board as per specification No. SW-SWR/MCCB
3. Supplying & erecting Bank of polypropylene condensers with the standard of 10 x 3 Kvar unit of power factor correction on 3 phase, 50Hz, 400 volts
4. VFD (variable frequency drives) 35KW, 440 volt.
5. Providing & erecting 3 Pole MCCB of 250A. capacity with S.C. rating 50 kAthermal and magnetic setting with provided leads on iron frame/laminatedboard as per specification no. SW-SWR/MCCB.
6. Sheet metal enclosurer, busbar, indication & metering, insulator single &three Phase Plug point, Contactor & MCB for Capacitor, Energy Meter... etc.

For detailed specification please refer item no- 135 above

6.23.139 ITEM No.139:- PROVIDING AND FIXING MAIN INCOMER AND PUMP CONTROL PANEL

Item includes :- Main incomer and pump control panel (Talkatore BPS) as per SLD and as given below

1. Supplying and erecting contactor L&T make ML-4 or suitable from MN series for motor starter suitable from 60 HP to 75 HP.
2. Providing & erecting 3 Pole MCCB upto 100A of 25kA SC rating, thermal and magnetic setting with provided leads on iron frame/laminated board as per specification No. SW-SWR/MCCB
3. Supplying & erecting Bank of polypropylene condensers with the standard of 10 x 3 Kvar unit of power factor correction on 3 phase, 50Hz, 400 volts
4. VFD (variable frequency drives) 30KW, 440 volt.
5. Providing & erecting 3 Pole MCCB of 250A. capacity with S.C. rating 50 kAthermal and magnetic setting with provided leads on iron frame/laminatedboard as per specification no. SW-SWR/MCCB.
6. Sheet metal enclosurer, busbar, indication & metering, insulator single &three Phase Plug point, Contactor & MCB for Capacitor, Energy Meter... etc.

For detailed specification please refer item no- 135 above

6.23.140 ITEM No.140:- CABLES ALUMINUM CONDUCTOR THREE CORE

CABLING SYSTEM

General

The cabling system covers the supply of cables, supports and associated accessories, hardware and their installation. It shall be the responsibility of the contractor to complete the cabling system in all respects.

Installation of Cables

The Contractor shall install, test and commission the cables in the specification in accordance with the approved drawings, and instructions issued by Engineer's Representative. Cables shall be laid directly buried in earth, on cable racks, in built up trenches and supports, on trays, in conduits and ducts or bare on walls, ceiling etc. as per approved drawings. Contractor's scope of work includes unloading, laying, fixing, jointing, bending, and termination of the cables. The Contractor shall also supply the necessary materials and equipment required for jointing and termination or the cables.

After pulling the cable, the Contractor shall record cable identification with date pulled neatly with waterproof ink in linen tags / aluminium tags and shall securely attach such identification tags. Identification tags shall be attached to each end of each cable with non-corrosive wire. The said wire must be non-ferrous material on single conductor power cable. Tags may further be required at intervals on long runs of cables on cable trays and in pull boxes. Cable and joint markers and RCC warning covers shall be provided wherever required.

Sharp bends and kinks in cables shall be avoided. The bending radii for various types of cables shall not be less than 15 times the overall diameter of the cable.

Cables laid in ground shall be laid on a 75 mm riddled earth bed. The cables shall then be covered on top and at their sides with riddled earth of depth of about 150 mm. This should be then filled up to a depth of about 100 mm above the top of uppermost cable to provide bedding for the protective cable covers which shall be placed centrally over the cables. The RCC covers shall have one hole at each end, to tie them to each other with GI wires to prevent displacement. The trench should be then backfilled with the excavated soil and well rammed in successive layers of not more than 300 mm thick, with the trenches being watered to improve consolidation wherever necessary. To allow for subsidence, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench should be provided.

In each cable run, some extra length shall be kept at a suitable point to enable one or two ‘straight through joints’ to be made, should the cable develop a fault at a latter date.

At cable terminal points, where the conductor and cable insulation will be terminated, terminations shall be made in a neat, skilful and approved manner by specially trained staff.

Terminations shall be made by the Contractor for each type of wire or cable in accordance with instructions issued by cable manufacturers or the Engineer's Representative.

Cable seals shall be examined to ascertain if they are intact and that cable ends are not damaged. If the seals are found to be broken the cable ends shall not be jointed until after due examination and testing under supervision of the Engineer's Representative. Before jointing is commenced, insulation resistance of both sections of cables to be jointed shall be checked by megger.

Metal sheath and armour of the cable shall be bonded to the earthing system of the station. The size of conductor for bonding shall be appropriate with the system fault current.

All cables shall be tested for insulation resistance before jointing. After jointing is completed, all cables shall be tested again by a 1000 volt megger.

Cable core shall be tested for

- Continuity;
- Absence of cross phasing;
- Insulation resistance to earth; and
- Insulation resistance between conductors.

Contractor shall furnish testing kits and instruments required for field testing.

CABLES:

1.1 kV Power Cables:

Power cable used in 415 V systems will be 1.1 kV grade 3.5 cores or 3 cores as applicable aluminum conductor XLPE insulated PVC sheathed galvanized flat steel armoured type conforming to IS: 7098.

Cables will be of sizes rated to carry full load current continuous at 0.85 PF or to withstand short circuit current of 35 kA for 1 second duration whichever is greater, but will not be less than size specified in subsequent clause.

Control cables for d.c. Supply, circuit breaker, relays, indication, annunciation and protection: 650/1100V grade cable of adequate number of cores, of suitable size, copper conductor, PVC sheathed, armoured will be provided as required and approved by the Engineer. All above cable for purpose of work are designated as 'Control Cables' and include all required cables not specifically stipulated.

Complete wiring diagram showing terminal block number, ferrule number and unit, with earthing point will be submitted for prior approval before execution.

General Requirements:

IS 1554, 7098, 8130, 5831, 3975, IEC 60183, 60227, 60502, 60885

Cable Schedule:

The sizes for the cables stated in the schedule are the minimum acceptable size. The Concessionaire may offer alternative sizes subject to approval from Engineer-In-Charge

Sr.No	From	To	Grade	Cores	Size Sq.mm
1	Supply	Incomer	415 V	3 Core (Al)	35
2	Panel	Motor 30 kW	415 V	3 Core (Al)	35
3	Panel	Motor 35 kW	415 V	3 Core (Al)	35

Technical Data Sheet:

Sl.	Description	Particulars
1.0	Voltage grade of cable	
2.0	Permissible voltage variation	+ 10%
3.0	Permissible frequency variation	+ 5%
4.0	Material of conductor	Aluminium, H4-grade, Class-2
5.0	Type of conductor	Stranded
6.0	Material of insulation	Extruded PVC/XLPE
7.0	Material of inner sheath	Extruded thermoplastic or unvulcanized rubber
8.0	Material of armour	Galvanized steel
9.0	Material of outer sheath	Extruded PVC, Type-ST 2
10.0	Core identification	Required

- **Cable Termination:**

Necessary number of cable glands will be supplied for terminating auxiliary power and control cables. Glands will be of heavy duty brass castings, machine finished and complete with check nut, washers, neoprene compression ring etc.

Cable lugs for all power and control cable connections will be supplied. The lugs will be tinned

copper/aluminium depending on cable conductor and of solderless crimping type

All necessary materials required for terminating the power cables such as tapes, fillers, binding wires, armour clamps, brass glands etc. will be supplied.

6.23.141 ITEM No.141:- SUPPLYING & ERECTING SIEMENS TYPE BRASS CABLE GLANDS

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.142 ITEM No.142:- MOTORS (35KW) SUPPLYING & ERECTING AND GIVING TEST AND TRAIL 1500 RPM SQUIRREL CAGE INVERTOR DUTY INDUCTION

Item includes :- Motors (35KW) Supplying & erecting and giving test and trail 1500 RPM squirrel cage invertor duty induction motor continuous rating suitable for operation at 415volts

MOTORS Specification-:

Motor-: Motor shall be induction motor with inverter's duty, 1500 RPM; it shall be operated at 415 volt, +-5%.

Supplying & erecting and giving test and trail 1500 RPM squirrel cage invertor duty induction motor continuous rating suitable for operation at 415volts

General:

The Contractor will provide 35 kW, 415 V invertor duty squirrel cage motors of approved make for driving pumps. The motors will conform to I.S. 325. The Concessionaire will have to supply winding data of motor duly signed by manufacturer.

The motor will be suitable for voltage variations for ±10%, frequency variation of ±5% and combined variation of ±10% and speed 1500 RPM (Synchronous). The Torque speed and current- speed characteristic of the motors will be suitable to accelerate the driven equipment to full speed without exceeding the limit of starting current at 6 times full load current.

Design:

1. The rated power of the motor will be at least 10% above the maximum power required over entire head range of pump. However, output rating of motor will not be less than 900 kW.
2. The starting time and locked rotor withstand time under hot condition will have suitable discrimination for proper selection of protection relay.

3. The locked rotor withstand time under hot condition and at 110% rated voltage will be more by at least 3 second than the starting time with driven equipment coupled and at 85% rated voltage.

The motors will be suitable for restricted operation at following conditions,

1. Accelerating the driven equipment from stand still to full speed within duration of 1 minute or less at 65% of rated voltage.

2. Operation on load at 75% of rated voltage for 5 minutes.

3. Two starts in quick succession from cold condition.

4. One hot restart at maximum steady state temperature over ambient temperature of 48 deg. C.

Three starts per hours equally spaced over the duration after attaining thermal equilibrium.

The winding insulation system shall be rated Class F. System components such as slot liners, wedges, and phase separators shall be Class F or class H and the whole insulation system to be of non-hygroscopic materials. Inter-phase insulation paper shall be used.

Triple coat magnet wire or advanced design magnet wire shall be used. Wound stators with insulating materials in position shall be oven baked to drive-off residual moisture, then dipped in Class H varnish and baked again to cure the varnish. A minimum of two dip and bake cycles is required.

The full load temperature rise (of the windings) when the motor is operated on sine wave power shall be measured by resistance and shall be within Class B allowable limits.

The entire insulation system shall be capable of withstanding the 1600V spikes experienced with dV/dt IGBT waveforms as defined in NEMA MG1 –1993, Part 31.

Construction:

The motor will be foot mounted, vertical solid shaft. The rotor will be statistically and dynamically balanced. Critical speed will not be in the range of 80% to 120% of the motor speed.

The motors will be screen protected, drip proof construction with degree of enclosure protection conforming to IP-23 or superior and having heavy duty friction bearings, grease lubricated type.

The cable box will be phase segregated and with degree of protection conforming to IP 54. The terminal box will be suitable for termination of power cable as per size in cable schedule. The fault withstand capacity of the cable box will not be less than the fault level as specified. Motor

should have separate phase segregated neutral terminal box suitable for connecting fully rated power cable

Single-row, radial or maximum capacity, deep-groove vacuum-degassed steel ball bearings will be used. The bearing system shall be designed to accept radial and thrust loading and permit motor operation in any position. Ball bearings on direct drive motors shall have AFBMA B-10 minimum life of 40-50,000 hours. The ball bearings shall have an internal clearance equivalent to a Class C3 AFBMA fit.

Accessories:

Accessories as under will be provided,

1. Shaft mounted cooling fan of cast iron / aluminium or mild steel and dynamically balanced.

2. Space heater, operating on 1 phase 240 V 50 Hz supply incorporating necessary interlocking to ensure that space heat is 'Off' when motor is running and 'on' when motor is idle with separate terminal box conforming to IP 54 protection on motor frame.

3. Resistance temperature detector, for detecting temperature of winding with terminals brought to separate terminal box for high temperature alarm and higher temperature trip, and indication on scanner in vacuum contactor panel.

4. Bearing temperature detector for both bearing and wired to scanner in vacuum contactor panel.

Testing:

All the motors will be tested in presence of third party agency approved by the department and Engineer-in –charge or his representative at manufacturer's works. The typed tested motor will be used for performance test of pumps at manufacturer's works. The scope of testing is as follows:

1. Review of raw materials test certificates and quality control procedure.

2. All the motors will be offered for routine test and one motor will be offered for type test at full load.

6.23.143 ITEM No.143:- MOTORS (30KW) SUPPLYING & ERECTING AND GIVING TEST AND TRAIL 1500 RPM SQUIRREL CAGE INVERTOR DUTY INDUCTION

Item includes:- Motors (30KW) Supplying & erecting and giving test and trail 1500 RPM squirrel cage invertor duty induction motor continuous rating suitable for operation at 415volts

For detailed specification please refer item no- 140 above .

6.23.144 ITEM No.144:- SUPPLYING AND ERECTING EARTHING SYSTEM WITH PIPE

a) The earth station shall be used for street light pole earthing. Minimum 2 earthings shall be provided. Both the earthings will be connected with 25 x 3 mm G.I. strip laid in ground along the route of underground cable of street lighting. From this strip, each pole shall be earthed with 8 SWG G.I. wire.
b) The earth electrode shall be 2.5 M long 50 mm dia class "A", Galvanised steel pipe.
c) The earth resistance shall be maintained with a suitable soil treatment.
d) The resistance of each earth station should not exceed 1 ohms.
e) The earth lead shall be fixed to the pipe with a nut and safety set screws. The clamp shall be permanently accessible.
f) The earthing grid and the earthing conductor shall be hot dip galvanised iron strips of the size.
g) G.I. pipe with funnel of approved quality shall be used for watering the earth electrode\station.
h) The block masonry chamber with Cast Iron hinged cover shall be provided for housing the above referred funnel and pipe.
i) The hardware and other consumables for earthing installation shall be hot dip galvanised iron material as shown on the drawing.

Installation and Connection

a) The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case, less than 2.5m below finished ground level.
b) The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 m from outer face of the respective building wall/column.
c) The plate electrode shall be installed vertically and shall be surrounded with 150 mm thick layers of Charcoal dust, Salt and sand mixture.
d) 20 mm dia G.I. pipe for watering, shall run from top edge of the plate/pipe electrode to the mid level of block masonry chamber.
e) Top of the pipe shall be provided with G.I. funnel and screen for watering the earth/ground through the pipe.
f) The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber.
g) The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.
h) Construction of the earthing station shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard (IS: 3043).
i) The earth conductors (Strips/Wires copper/Hot dip G.I.) inside the building shall properly be clamped/supported on the wall with galvanised clamps and Mild Steel Zinc Passivated screws / bolts. The conductors outside the building shall be laid atleast 600 mm below the finished ground level.

j) The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly finished.
k) Over lapping of earth conductors during straight through joints, where required, shall be of minimum 75 mm long.
l) The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

Earth Leads and Connections

a) Earth lead shall be bare copper or galvanised steel as specified. Copper lead shall have a phosphor content of not over 0.15%. Galvanised steel buried in the ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is atleast 8 mm away from the wall surface.
b) The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

Equipment Earthing

All apparatus and equipment transmitting or utilising power shall be earthed in the following manner. Copper /G.I. earth strips/wires shall be used unless otherwise indicated.

6.23.145 ITEM No.145:- SUPPLYING AND ERECTING G.I. STRIPS EARTHING SYSTEM

For detailed specification please refer item no- 142 above .

6.23.146 ITEM No.146:- SUPPLYING & ERECTING 2X28W T-5 ENERGY EFFICIENT RETROFIT/ STAND ALONE FLUORESCENT TUBE LIGHT FITTING

LIGHTING SYSTEM

Lighting Fixtures

The lighting fixtures offered shall comply with the following requirements and typical drawing.

a) The fixtures shall be suitable for operation on a nominal supply of 240 V, single phase, 50 Hz, AC with a voltage variation of + 10 %.
b) All lighting fixtures shall be supplied complete with lamps and all necessary accessories such as ballast, capacitor, etc. for their satisfactory operation.
c) Starter of the fluorescent light fixture shall be replaceable without disturbing the reflector or lamps and without the use of any tool.
d) e) Lamp holders for fluorescent tubes shall be of the spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in insulation value, contact resistance or lamp holding quality.
f) Lighting fixture reflectors shall generally be manufactured from steel or aluminium sheet of

not less than 20 SWG thickness.

g) Each fixture shall be complete with a four way terminal block for connection and looping of incoming and outgoing cables. Each terminal shall be able to accept two 2.5 mm2 copper stranded conductors.

h) Each lighting fixture shall be provided with an earthing terminal suitable for connecting 16 SWG copper stranded conductor.

i) All metal or metal enclosed parts of the housing shall be bonded and connected to the earth terminal to ensure satisfactory earthing continuity throughout the fixture.

j) All reflectors and louvers shall be finished to the same standard as the fixture housing.

k) 1200mm sweep ceiling fans shall be provided in areas such as offices, etc. as indicated in the drawings. Adequate ventilation arrangements shall be made for enclosed areas where ceiling fans are not proposed to be installed or cannot be provided. Power supply for the ceiling fans shall be derived from lighting circuits. Ceiling fans shall be complete with all accessories. Regulators shall be conventional resistance type.

l) 450mm heavy duty exhaust fans shall be provided as directed. The fans shall have built in power factor capacitor, supports for mounting / fixing and cowls to prevent entry of birds. Power supply to the exhaust fans shall be from a 5A switched socket supplied from the lighting panels.

Type of Lumminaire at various areas

No.	**Area/Structure**	**Type of Fixtures**	**Type of Luminaire.**
1.	Pump House Room	Energy efficient fluorescent tube light fitting indoor, box type, complete with electronic ballast and lamp holders duly wired suitable for **1 x 28 W, T5** energy efficient tubular fluorescent lamps of pre-heated cathode type to be operated on 230V, 50 Hz AC supply and shall confirm IS : 10322 -5, Section 1]/1985 [Reaffirmed 2005]. The fitting shall be made from 0.50 mm thick CRCA Steel Sheet duly stove enamelled or powder coated after phospho-chromate treatment and shall be in white colour both on exterior as well as on lamp compartment. Reflector to be made up of high purity pre-anodised aluminium sheet	

Receptacle units

Receptacle units of 5/15 A rating with switches shall be supplied. The units shall be suitable for mounting flush on GS sheet boxes. The receptacle shall be suitable for 240V, 1-Phase, (or 415 V, 3-Phase), 50 Hz AC supply.

LIGHTING SYSTEM INSTALLATION

The Contractor shall supply, install, test and commission the complete system of lighting and receptacles in accordance with the approved lighting drawings and documents and in accordance with relevant Indian Standards, codes of practice, Indian Electricity rules and safety codes in the locality where the equipment/system is to be installed. Nothing in this specification shall be construed to relieve the contractor of this responsibility.

Installation of Lighting Panel, Lighting fixtures & Receptacles. The scope of installation work shall include mounting of lighting panel, lighting fixtures and receptacles at locations as per the approved drawings. All work associated with installation such as providing and fixing of wooden blocks, ball sockets, hooks, etc., as required, drilling holes in walls, ceilings, etc., or any civil work including scaffolding, provision of ladders, etc., together with supply of hardware shall form part of the Contractor's work. All work items necessary for completing earthing connections shall be included in the scope of work.

6.23.147 ITEM No.147:- SUPPLYING & ERECTING S WIRING

Wiring

The work shall comprise wiring in heavy gauge (minimum 16 SWG) 20 mm MS conduits, fixed and supported at intervals of 300 mm on walls, ceiling etc.; installation of light control switches and receptacles housed in GS boxes; earthing with 16 SWG copper wire run along the conduit and clamped to it at every 300 mm; and termination of cables/wires at lighting panels, light control switches, receptacles, lighting fixtures etc., as required. The minimum size of conduit shall be 20 mm. Space factor (ratio of total wire area to internal conduit area) shall be 40 %.

Supply of all the items of work detailed above including 650 V grade, 2.5/4 sq. mm stranded copper conductor PVC insulated cables; 5 / 15A switches; GS conduits and accessories (such as junction boxes, tees, elbows, etc); 16 SWG GS boxes complete with gasket, knockouts for conduit entries, earthing terminal with bolts, nuts and washers; 16 SWG aluminium earthing wire; flexible conduit etc. shall be included in the Contractor's scope. All work necessary for fixing boxes, conduits etc., together with supply of necessary accessories hardware, shall also be included in the Contractor's work.

All light control switches and receptacle units (connected on the same phase) at one location (such as room entrance), shall be housed in one common GS sheet steel box.

Receptacle and lighting fixtures shall be fed from different circuits and wiring for the same shall be done in different conduits. The maximum load on any circuit shall not exceed 1800 Watts.

Wires belonging to different phases shall not be run in the same conduit. However, more than one circuit on the same phase can be run in the same conduit. For every phase wire, a separate

neutral wire shall be run. Neutral wire for different phases shall not be looped.

Size of wire chosen shall be such as to limit the voltage drop to within 3 %. Minimum area of conductor shall be 1.5 sq mm stranded copper for lighting and 2.5 sq mm / 4 sq mm for 5A / 15A receptacle circuits respectively, and current density shall not exceed 2.5 A/sq mm. Generally, not more than 8 to 10 lighting points shall be wired in one circuit. For calculating connected loads of various circuits, a multiplying factor of 1.25 shall be assumed on the rated lamp wattage for sodium vapour and fluorescent lamp fixtures to take into account the losses in the ballast. A loading of 100 watts and 500 watts shall be assumed for each, single phase 5 amps and 15 amps receptacles respectively.

Estimation for point wiring (Electrical)

Wiring of all lighting fixtures, fans and receptacles and earthing wiring shall be on point wiring basis. Insulated green coloured earthing wire shall also be run in conduits. Indian TNS type of distribution (as per IS 3043) shall be followed. Neutral of the circuits shall not be looped.

Mains wiring up to switchboards

Mains wiring consist of wiring from lighting panel to first point of switch board (where provided) of the circuit. Where no switchboard is provided (switching is directly from MCB on the lighting panel), no “mains wiring” is applicable.

Mains wiring work shall consist of supply, installation and testing commissioning of wiring with 4 sq mm copper PVC wires and their terminations including supply of 19/25 mm (16G) GI conduits with all accessories (e.g. bends, reducers, coupler, junction boxes, 16 SWG green copper wire for earthing, etc.) from lighting panel to first point of the circuit (switches for control are excluded).

The mains wiring shall be classified into the following lengths:

Short point – from 0 to 5m

Medium Point – 5 to 10m

Long Point – 10 to 20m

Extra long point – more than 20m

Point wiring for lighting and fans

Primary point (GI) shall consist of supply, installation and testing commissioning of lighting system / fan system including supply of 19/25 mm (16G) GI conduits with all accessories (e.g.

bends, reducers, couplers, switches for control, junction boxes, 16 SWG green copper wire for earthing, etc.) with 1.5 sq. mm. copper PVC wires and their termination etc.

The point wiring for lighting and fans shall be classified into the following lengths:

i. Short point – from 0 to 5m

ii. Medium Point – 5 to 10m

iii. Long Point – 10 to 20m

iv. Extra long point – more than 20m

Applicable Standards

All standards and codes of practice referred to below shall be the latest edition including all official amendments and revisions.

Industrial luminaries with metal reflector	:	IS 1777
Ballast for fluorescent lamp	:	IS 1534
3 pin plugs & sockets	:	IS 1293
General safety requirements for luminaries	:	IS 1913
Luminaires for street lighting	:	IS 10322
Fitting for rigid steel conduits for electrical wiring	:	IS 2667
Code of practice for interior illumination	:	IS 3646 & IS 6665
Switches for domestic & similar purposes	:	IS 3854
Electric ceiling type fans & regulator	:	IS 374
Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts)	:	IS 732

Tests and Test Reports

Type tests, acceptance tests and routine tests for the lighting fixtures, accessories and receptacles covered by this specification shall be carried out as per the relevant standard.

Manufacturer's type and routine test certificates shall be submitted for tests conducted as per

relevant standards for the fixtures, accessories and receptacles.

The following routine tests shall be conducted as per the relevant Indian Standards.

- Each fixture shall be tested at 1500 Volts (rms), 50 Hz, AC for one minute and no flash over or breakdown shall occur between current carrying parts and ground.

- Insulation resistance of each fixture shall be tested at 500 V DC and the insulation resistance so measured shall not be less than 2 mega-ohms between all current carrying parts and ground.

- All luminaires provided with glass covers shall be subjected to thermal shock-proof test. A test shall be conducted to ensure that the cover glass will withstand sudden variation in surface temperature due to rainfall or splashing water when the lighting fixture is lit. The cover glass shall be heated in an oven to attain a steady temperature of 100^0 C and then plunged into cold water. No crack should develop.

- Contractor shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards.

6.23.148 ITEM No.148:- SUPPLYING & ERECTING 20 MM DIA ISI MARKED STEEL CONDUIT

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.149 ITEM No.149:- SUPPLYING & ERECTING 6 AMPS TO 32 AMPS RATINGS SPN MCB

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.150 ITEM No.150:- SUPPLYING & ERECTING 25 AMPS RATING 2 POLE RCCB

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.151 ITEM No.151:- SUPPLYING & ERECTING 2+4 WAY, SPN, SINGLE DOOR MCB DB

The different activities under this item shall be executed as per the corresponding specifications detailed in CPWD specification for works.

6.23.152 ITEM No.152:- SUPPLYING WIRING FOR LIGHT POINT/FAN POINT/EXHAUST FAN POINT/CALL BELL POINT

WIRING

Type Of Wiring

Concealed conduit wiring is to be done in the loop in and loop out system without any jointing in non metallic pvc conduits. Phase wires shall be looped in switch control points and neutral shall be looped at out-let points.

Point Wiring

point wiring shall include all works necessary to complete wiring of a switch circuit of any length from the tapping point on the distribution circuit to the following via the switch:

A) Ceiling rose and connector (in the case of ceiling/exhaust fan points).
B) Back plate (in case of fluorescent fitting with down rods, etc).
C) Socket outlet (in the case of socket outlet points).
D) The following shall be deemed to be included in the point wiring:
   i) modular type switch
   ii) ceiling rose or connector as required.
   iii) any special or suitable round block for neatly housing the connector and covering the fan hook in case of fan point.
   iv) wooden box, bushed conduit, porcelain tubing where cable passes through wall etc.
E) Conduit up to 1.5 m from floor.
F) Earth wire from three-pin socket outlet point/fan regulator to common earth including earth dolley except the earth wire from the first tapping point of live wire to the distribution board.
G) All wood or metal blocks, boards and boxes, sunk on surface type, including those required for mounting fan regulator but excluding those under the main and distribution switch gear.
H) All fixing accessories such as clips, rails, screws, phil pugs, wooden plugs, etc. As required.
I) Connections to ceiling rose, connector socket outlet, lamp holder, switch and fan regular etc.
J) Looping the same switch board and inter connections between points on the same circuit.
K) Providing fish wire in conduits while recessed conduit work is undertaken.
L) In rooms where the number of light points, ceiling fan & exhaust fan points are more than 9 nos, two circuits with two different phases shall be made and where the number of points are more than 18 nos, 3 circuits with 3 different phases shall be made. These circuits shall be terminated in separate switch board i.e. 2/3 phases shall not be terminated in one switch board. Each switch board shall have a 6 amps socket outlet with a switch. Wiring shall be

done in such a way so that alternate light fitting is wired from different phase and on/off arrangement of alternate lighting can be done. However in rooms where the number of light points, ceiling fan & exhaust fan points are 9 nos or less, only one circuit may by drawn & wiring done including that of one 6 amps socket outlet with a switch on the switch board.

Circuit Wiring

Circuit wiring shall mean the length or wiring from the distribution board upto the ist nearest tapping point of the circuit, measured along the run of the conduit for the maximum number of points or load or a circuit.

Sub-Mains

Sub-mains wiring shall mean the length of wiring from the main/distribution switchgear to another main/distribution switchgear measured along the run of wiring. Such wiring shall be measured on linear basis.

Distribution Board And Load On Circuit

A triple pole and neutral distribution board of required amperage and ways will be fixed on a suitable place for wiring the light points, exhaust fans, ceiling fans, 6a sockets 16a sockets, 20 a sockets, & 32 amps sockets. Number of ways of the distribution board shall be worked out as under:

A) 1 no 32 a socket in one 3 phase & neutral circuit controlled by a tp mcb of 32 a.
B) 2 nos. 16a sockets in one circuit controlled by a spmcb of 16a.
C) 1 no 20 amps socket in one circuit
D) Light points, 6a socket ceiling fan and exhaust fans may be wired on a common circuit. Such circuit shall have 10 points of light, ceiling/ exhaust fan and 6 amps socket outlets or a load of 800 watts, whichever is less. It shall, however, be ensured that in one switchboard, wiring of one circuit is only provided. The amperage of the distribution board will be worked out from the total load of all the points.
E) Light points/ ceiling fans/ exhaust fans/ 16a receptacles and building lights as shown in drawing will be considered as firm, whereas 5a receptacles will be 1 no. In each switchboard.
F) Air circulators will be plugged in 6 amps socket outlet provided on the switch board.

Size Of Conductor

Single core pvc insulated stranded copper conductors shall be used for wiring as under.

(a)	2 runs of 1.5 sq.mm	-	For light points, ceiling fan points, exhaust fan points & 6 amps receptacle

			units.
(b)	2 runs of 4 sq.mm	-	For 16 amps receptacles units.
(c)	2 runs of 6 sq.mm	-	For 20 amps receptacle units.
(d)	4 runs of 6 sq.mm	-	For 32 amps receptacle units.

Non Metallic Pvc Conduit Wiring

Maximum permissible number of 1100 volts grade single core.
Copper cables that may be drawn in pvc conduits shall be as under :

Size of cable	**Size of conduit**				
	19 mm	**25 mm**	**32 mm**	**40 mm**	**50 mm**
1.5 sq.mm	6	10	14	-	-
2.5 sq.mm	5	10	14	-	-
4.0 sq.mm	3	6	10	14	-
6.0 sq.mm	2	5	8	11	-
10 sq.mm	-	4	7	9	-
16 sq.mm	-	2	4	5	12

Conduit Laying

The layout of conduit shall be such that any condensation or sweating inside the conduit is drained out. Suitable precautions shall be taken to prevent entry of insects inside the conduits. For concealed wiring, non metallic pvc conduit will be used & for surface wiring gi conduits are to be used.

Non Metallic PVC Conduit Wiring

In this system of wiring, no bare or twist joints shall be made in through run of cables. If the length of final circuit/sub-main is more than the length of the standard coil, joints shall be made by means of approved mechanical connectors in suitable and approved junction boxes.

PVC conduit pipes shall be fixed by heavy gauge saddles secured to suitable wood plug or other approved manner at an interval of not more than one metre.

Time switch shall be provided for street light and gate lights.

Push button stations

These shall be pedestal mounted type and shall be mounted near the sump pumps & vacuum pumps.

A)

i) of the momentary contact, push to actuate type rated to carry 10a at 230 volts ac inductive breaking.

ii) fitted with self reset, 2 no and 2 nc contact.

iii) provided with internal escutcheon plates marked with its functions.

B) 'start', 'open', 'close' push buttons shall be green in colour.

C) Stop push buttons shall be red in colour.

D) All other push buttons shall be black in colour.

D) 'emergency' stop push button shall be lockable in the pushed position type and shall be shrouded to prevent accidental operation. Key shall not be required for the operation of the push buttons.

6.23.153 ITEM No.153:- SUPPLY, DELIVERY, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF PRESSURE MEASURING INSTRUMENTS

Pressure gauges shall comply with BS EN 837-1:1998.and BS1780. Pressure gauges and transmitters shall have over range protection up to 1.5 times the maximum line pressure and shall be capable of withstanding full line pressure on any side with the other side vented to atmosphere without damage or effect on the calibration. No plastic material shall be used in their construction. Internal parts shall be of stainless steel, bronze or approved corrosion-resistant material. Where necessary, a special diaphragm shall be used to segregate the gauge tube from corrosive fluid media.. In chlorine applications, the diaphragm shall be in silver or tantalum. The minimum diameter for any pressure gauge shall be 150 mm unless specified otherwise or where the gauge forms part of a standard item of equipment.

Where compensation of more than 2% of the instrument span is needed for the difference in level between the instrument and the tapping point, the reading shall be suitably adjusted and the amount of compensation shall be marked on the dial. The zero and span of a pressure transmitter shall not change by more than 0.1% of the span per 0C change in ambient temperature. After application for 10 minutes of pressure at 130% of maximum pressure, the change in zero and span shall not exceed 0.1% of the span.

Pressure transmitters shall have accuracy typically better than 0.25% of span, depending on the application and shall be protected to BS EN 60529:1992, IP 65 standard or higher. For transmitters installed in locations liable to flooding or underwater applications, they shall be to IP 68 standard and shall operate up a to maximum submergence of 20 meters of water.

Pressure transmitters shall provide a 4 to 20mA d.c. output proportional to the pressure range at a maximum load of 750 ohms.

Differential Pressure Transmitter:

Differential Pressure transmitters shall have pressure dampeners.

The specifications for pressure transmitter shall be as follows,

a. **Type :** 2 wire type

b. **Housing :** IP 68

c. **Output :** 4-20mA

d. **Supply :** 24 VDC

e. **Local Display:** LCD.

f. **Accuracy :** Better than 0.5 % of range

The specific Technical specification is as below;

Function	:	Transmit & indicate
Mounting	:	In Line
Connection	:	½ " NPT
Service	:	Clear water
Damping	:	Adjustable
Turn on time	:	<2.5 sec.
Pressure Range	:	0-7 meter or As per requirement
Enclosure Class	:	Weather proof (NEMA 4 and IP 65)
Intrinsically safe	:	Yes
Accuracy	:	± 0.075%
Turn down ratio	:	25:1
Response time	:	250 mSec or less
Operating Temp.	:	0 to 55 ^{o}C
Humidity	:	5 to 95 % Rh, Non condensing
Transmitter		
Type	:	SMART microprocessor based
Power supply	:	16 to 48 V DC (Nominal 24 VDC)
Out put	:	4-20 mA
Span and zero adjustment	:	Provided
Indicator	:	LCD display with front facia capability for programming
Range setting switches	:	provided
Element		
Sensor	:	Piezoresestive
Load resistance	:	Max 600 Ohm.

Zero Elevation/ Suppression	:	Provided
Accessories	:	2 way manifold- 01 No. per Transmitter
Material	:	316 SS
Accessories		Mounting bracket, chequears plate etc.
Reputed make		Siemens/E& H/Kronhe Marshall/Emerson/ABB or Equivalent

6.23.154 ITEM No.154:- SUPPLY, DELIVERY, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF LEVEL MEASUREMENT SYSTEMS

Level Monitoring system

Function : Transmit and indicate
Range : 0-7 m (as per site condition)
M.O.C : SS316
Power : 24 V DC
Accuracy : 0.20 %
Resolution : 0.10 %
Display : 3 ¼ digit
Calibration : Zero and span internal
Output : 4 – 20 mA 600 ohms. 0.1 % resolution
Housing : Weather proof (IP-68)
Design : suitable for water application
Response time : 250 msecs or less
Remote Indicator : 4½ digit LCD display with front facia capability for programming in any engineering units
Process connection : 1- 1/2" NPT /BSP or as per Manufacturer Standard
Lightning protection : to be provided externally at RTU end
Operating Temperature : 0 to 55^0C
Humidity : 5 to 95% (suitable for outdoor)

Accessories
Mounting bracket
SS Tag plate to be provided
Reputed Make:- Siemens/E& H/Kronhe Marshall/Emerson/ABB or Equivalent

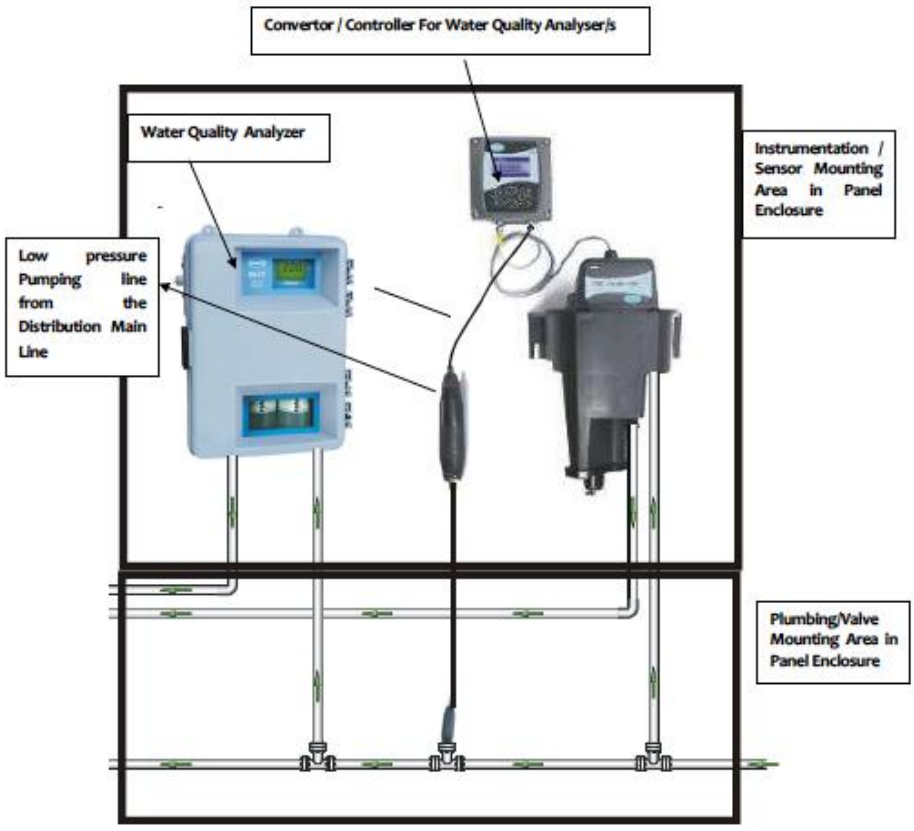
6.23.155 ITEM No.155:-SUPPLY, DELIVERY, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF CHLORINE RESIDUAL MEASURING INSTRUMENTS

The Analyzer shall operate on Analysis Method like DPD Colorimetric principal. The application is for Drinking Water Residual Chlorine analysis.

Following specifications as a minimum shall be applicable in the basic Instrument model offered as chlorine analyser. The analyser shall be provided with all the necessary accessories required to operate the Instrument once unpacked and installed at site.

a. Range : 0.1 to 5 mg / Lit free or total residual chlorine, with automatic colour / turbidity compensation

b. Programming : The instrument shall be freely programmable using Menus & Key pad.
c. Sensor Operating Pressure : 1 Bar
d. Sensor Op Temp. : 45 Deg. C.
e. Response Time: < 120 Sec.
f. Min. Detection Limit : 0.035 mg/L
g. Cycle Time: One complete sample analysis every 2-1/2 minutes . The output shall be retained at the same value until next sampling is carried out.
h. Accuracy: 0.5 % of range or 0.035 mg/L as Cl2, whichever is greater
i. Supply: 230 VAC +/- 10%, 100 VA Max.
j. Output: 4-20 mA. Output shall be Programmable and shall be isolated from the ground.
Additionally Potential Free Contact output (230 V, 5 A Rating) for sample concentration shall be available.
k. Load : <= 500 ohm
l. Display: 4 & ½ Digit LCD
m. Repeatability: Better than 0.2% of range
n. Enclosure: IP62 Min. & Housing shall be in ABS plastic.
o. Accessories: All the required accessories shall be built in to the system offered and no external accessories shall be required to operate the instrument in the normal fashion.
p. Certification: The offered instrument shall be at least CE approved and UL listed.
The instrument shall work continuously at remote place without any requirement of calibration etc. at least for a period of 30 days, from the previous maintenance date. The instrument shall be Tamperproof or pass word protected to prevent unauthorised handling of the same.
Reputed Make:- Siemens/E& H/Kronhe Marshall/Emerson/ABB or Equivalent



Typical Physical G.A Drawing for Water Quality Analyser/s Installation in Enclosure at Field Stations

6.23.156 ITEM No.156:- SUPPLY, DELIVERY, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF RPM MEASURING INSTRUMENTS

Type	:	**Microprocessor based**
Duty	:	Under + Over Speed
Supply Voltage	:	230 VAC
Enclosure	:	Cast Aluminum
Protection grade	:	IP-65
Initial time delay	:	1-20 Sec.
Digital Display	:	7 Segment, 4 digit, 0.5"LED display
Speed range	:	1-9999 RPM
Output	:	RS-485 / 4-20 mA HART

Accuracy	:	+/- 1 RPM
Sensor	:	
Supply voltage	:	12 VDC
Enclosure	:	Nickel plated brass tube
Protection grade	:	IP-67
Probe size	:	M30 X 1.5 P X 65 L
Sensing distance	:	9 mm ± 10 % (effective): 15 mm ± 10 % (Nominal)
Mounting	:	Non flush

6.23.157 ITEM No.157:- SUPPLY, DELIVERY, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF ENERGY MEASURING (POWER ANALYSER) INSTRUMENTS

Power Analyzer

Measurement Parameters	:	VLN , V1, V2, V3, VLL, V12, V23, V31, A, A1, A2, A3 W, W1, W2, W3 VAR, VAR 1, VAR 2, VAR 3 VA, VA 1, VA 2, VA 3 PF, PF 1, PF 2, PF 3 Frequency F
Sensing / Measurement	:	True RMS, 1 sec update time, 4 Quadrant Power & Energy
Accuracy (Wh)	:	Class 1.0 as per IEC 62052-11, 62053-21
Input Voltage	:	4 Voltage inputs V1, V2, V3, VN, 110 or 415 VL-L nominal (Range 80 to 600 VL-L
Aux. Supply (control power)	:	44 to 300 V ac / dc (3 VA Max)
Input Current	:	Current Inputs A1, A2, A3, 20 mA to 6 A (field Configurable)
Overload	:	10 A Max Continuous
Frequency	:	45 to 65 Hz

Resolution	:	RMS 4 Digit
Communication	:	RS-485 Modbus RTU Protocol
Isolation	:	2000 volts AC for one minute between communication & other circuits
Demand	:	Integration period multiple of 5 minutes from 5 to 30 minutes 15 sec. update time
Safety	:	Measurement category III, Pollution Degree 2, Protection against shock by double insulation at user accessible area
Pumping Hours	:	Measurement Possible
Reputed Make:-		Conzerve/HPL Socomec/Scheider/ L & T or any other equivalent

6.23.158 ITEM No.158:- Supply, delivery, installation, testing, Training and commissioning of PLC based Control Panles

Access doors or panels shall have heavy duty hinges and approved latching or fastening means to allow access. Fabrication shall be of 2mm thick, steel, suitably braced internally for structural rigidity and strength. The final finish shall be smooth, free of runs, and uniform in tone and thickness. Control panel enclosures shall be rated IP55.

All wiring shall be numbered in accordance with the numbering system used on the wiring/ connection diagrams. Wiring and connection diagrams shall conform to ISA S5.4 Instrument loop diagrams and shall be submitted as part of the shop drawings for approval of the Engineer.

All wiring shall terminate in a master terminal board, rigid type and numbered. The master terminal board shall have a minimum of 25 percent spares. Terminal blocks shall be barrier type with the appropriate voltage rating (600 Volts minimum). They shall be the raised channel mounted type rail mounting (marshalling).

Wire and tube markers shall be the sleeve type with heat impressed letters and numbers. DIN rail mounted terminal strips shall be provided for the purpose of connecting all control and signal wiring. Direct interlock wiring between equipment will not be allowed. Only one side of a terminal block row shall be used for terminal wiring. The field wiring side of the terminal shall not be within 150 mm of the side panel or adjacent terminal.

Nameplates shall be provided and mounted on each RTU enclosure. The nameplates shall be approximately 25mm x 75mm constructed of black and white laminated, phenolic material having

engraved letters approximately 6 mm high, extending through the black face into the white layer. Nameplates shall be attached to panels by self tapping Type 316 stainless steel screws.

All components shall be mounted in a manner that will permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components shall be mounted on plates on the inside of the panels in such a manner that allows for removal of the components without removal of the plate. Components shall not be mounted directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration.

Components mounting shall be oriented in accordance with industries standard practices. All internal components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjustment to (not on) each component identifying the component in accordance with the drawing specifications and supplier's data.

Control Panel requirements for in-plant SCADA System:-

a) Programmable Logic Controller (PLC) based Instrument Control Panel {ICP} shall be provided at control room of water pumping stations at Hasanpur, Talkatora, BPS locations and Master Control Room locations covered under scope of project with manual override facility.

b) Technical Particulars

a)	Service	For pure water pumping
(b)	Type	Free standing type
(c)	Construction	Prefabricated and modular construction
(d)	Sheet Material	Cold rolled sheet steel
(e)	Internal Lighting	Required
(f)	Cable Entry	From bottom
(g)	Access	Front and Rear

The following instruments shall be mounted on front fascia of the ICPs for the control of pumping station:

1. Auto/ Manual/ Off selector switch for each pump
2. Auto / Semi Auto/ Manual1 selector switch for the each pumping station.
3. Level measuring system of raw and pure water sump for automatic operations.
4. Digital indicators for the following:
    - Level in each compartment / sump
    - Pressure in Pure water pumping main

- Position of BFVs in discharge of Pure water pump.
- Position of BFV in the pumping main

5. Digital flow indicator for flow in pumping main of pure Water
6. Alarm annunciator,
7. Operator Interface Unit (OIU) of the PLC system
8. Temperature Scanners for motor winding and bearing temperatures and pump bearing temperatures of each raw / pure water pump.
9. Electronic microprocessor based power meter shall be used for each motor, incomer & other major loads to provide complete details of different electrical parameters. Suitable CT/ PT is required to wire the power meter. These meters shall communicate and integrate with local in-plant SCADA.
10. Status of different protection relays used should be monitored. Whenever the protection relays trip required alarms should be generated.
11. Pump start & stop operation will be automatically done in required sequence & all safety requirements shall be monitored continuously. Only single push button command is required to be given for start or stop of the pump.
12. For automated operation of pump start or stop discharge BFV shall be fitted with electric/ pneumatic actuators. It is responsibility of the contractor to integrate these actuators with local SCADA system.
13. A common shrouded mushroom type emergency stop pushbutton for emergency system stop for pure water pump.

The above is the minimum requirement Any other instrument required for proper monitoring and control of the pumping station shall be provided on the ICP. Contractor should note this carefully.

6.23.159 ITEM NO. 159:- Supply, delivery, installation, testing, training and commissioning of GPRS / GSM based Data Logger

Providing supplying, fixing and commissioning GPRS/ GSM Data logger with internal battery having (3 years battery life) dual channel for flow and pressure logging with internal pressure transducer, PC software, PC connection cable, Infra-red reading head, pressure hose, instruction manual etc. complete as directed by the Engineer-in-charge.

The contractor shall supply the required GPRS enabled Data logger to be installed at remote locations within DMAs . The GPRS Data LOGGER shall be accepted after the third party inspection by SGS, RITES or any other agency authorized by NDMC, the charges for the same shall be borne by the contractor. Equipments / Instrumentation Shall be provided as per Approved Make of NDMC.
The minimum technical specifications of the instruments shall be as follows;

Sensor Input Options	Digital	One or two bi-directional pulse input for Flow Reed switch contact closure type or other non powered sensors including Kent LRP, PD10 with ext battery box, Aquamag/Magmaster. Two single-directional pulse inputs for Flow logging, via a single 4 pin mil connector (optional) Up to 64 pulses per second.
	Analogue	Internal Pressure Transducer (optional). External pressure (optional). 4-20 ma (optional) 0-20 bar / 0-200 metres head / 0-300 psig, 0.1% repeatability / 0.1% accuracy optional Please note that the logger is calibrated to 10bar as standard. 20bar calibration must be specified at time of order if required.
Logger Features	Memory	Primary recording 179,760 readings. Can be programmed to read continuously (cyclic mode) or for a specific period of time (block).
	Frequency	Variable sample rate 1 to 59 mins, then 1 to 24hrs (please note that this may affect battery life and communications cost).
	Alarms	Minimum or maximum duration-triggered threshold alarm per channel. 16 Alarms per logger. Each alarm out comment field 16 characters. Can be programmed to auto dial up to 4 telephone numbers on alarm with telemetry option (i.e. 1 per alarm).
	Logger ID	Up to 7 alphanumeric characters. Also readable factory set serial number in firmware.
	Clock	On board 24 hour real time clock with date facility.
	Count and Event Logging	Count and Event logging modes independent for both recordings
Communication	Serial	RS232 by Infra-Red reading head for connection to PDA hand held programming and data collection unit, laptop, or desktop PC using 9600 Baud.
	Internal Cellular modem	GPRS to FTP site using HWM DataGate or customer specific FTP. SMS Back Up* SMS to HWM DataGate or customer modem. Multiple messages per day. Quad band modem supplying 850/900/1800/1900MHz bands. GPRS can send data down to every 15 mins, with appropriate battery pack
	Dimensions / Weight	110H (130H with int pressure sensor) x 150W x 105D mm. Weight 590 grams (1.3lb)
	Construction	Tough ABS plastic enclosure (colour Blue).
	Operating Temp	-20 to +70°C (-5 to +160°F)
	Ingress protection	IP68 submersible
	Power	Lithium Thionyl-Chloride cell operational for 5 years under standard operating conditions *, complete with low battery alarm

6.23.160 ITEM No.160:- SUPPLY, DELIVERY, INSTALLATION, TESTING FOR INTERFACING OF VALVE ACTUATORS & EXISTING FLOW METERS

Flow meters

At BPS / UGRs / MBRs Inlet and Outlet Water pumping Locations, there are existing flow meters installed. It is responsibility of the contractor to acquire flow data from the meter and integrate it with telemetry / SCADA system and all the required accessories like sensors, transmitters, cables, power points etc. to be provided to interface with the meter and communicate the data with Central Server Station. Consent from NDMC is required before taking up such work.

It is the responsibility of contractor to provide complete interfacing required to receive the data from such existing flow meter.

Valve Actuators

At BPS / UGRs / MBRs Inlet and Outlet Water pumping Locations or any other locations within distribution system, there are existing valve actuators installed. It is responsibility of the

contractor to interface with the telemetry system and control the valve through telemetry / SCADA system. It is inclusive all the required accessories like sensors, transmitters, cables, power points etc. to be provided to interface with the valve actuators and communicate the data with Central Server Station. Consent from NDMC is required before taking up such work.

It is the responsibility of contractor to provide complete interfacing required to receive the data from such valve actuators.

6.23.161 ITEM No.161:- Supply, delivery, erection, installation, testing and commissioning of all required communication interface, SCADA interfaces, telemetry interfaces, RTUs / PLC hardwares, controls,

General Description of Proposed System

The Telemetry / SCADA specified herein shall be designed, manufactured, installed, tested and shall provide along with the following functions:

- To provide central monitoring system and Master Control Centre to collect, store, control and monitor the Water Distribution Management System (WDMS) for all BPS/ UGRss/ GSRs covering proposed pumping station locations of Hasanpur & Talkatora and tapping points of bulk supply from DJB.
- To monitor Real-time water distribution & management process
- To perform calculations based on sensor and manual operator data inputs.
- Store and retrieve all the information of each locations.
- Compile and prepare daily, weekly and monthly reports for water & energy and as directed by engineer in charge.
- Provide mimic / graphic display to indicate water supply and distribution system through extensive graphics support, which also reduces the learning curve of an average operator. All the data logged at central server shall be analysed through representation of this data in various meaningful user defined graphs, trends and customized analytical requirements of the system.

All the required field instruments to measure flow, level and pressure, residual chlorine shall be provided, calibrated, tested and installed. The signals from the field instruments both existing and newly proposed instrumentation shall be wired to the PLCs / RTU's with necessary programming etc. Complete for further communication and data integration with Central SCADA Server software.

The system shall be open system architecture utilizing standard operating and communication systems like GPRS or radio telemetry. The system supplier shall provide documentation of successful field performance of the proposed system, including hardware and software applications. Unproven or proprietary systems shall not be acceptable.

The SCADA / Monitoring Requirements

Contractor shall be responsible to provide the following;

a) Layout drawings for each piece of equipment fabricated or assembled by the Contractor, showing the position of each component with required clearance where applicable, and with overall dimensions.

b) Wiring diagrams indicating each component of the system and all wiring and cabling thereto, showing manufacturers, types, duties, ranges and nomenclature, referencing the P&I diagram where applicable, with inputs, output, cable wiring and terminal identifications clearly marked.

c) PLC/ RTU IO instrumentation drawings, cable along with sizings and cable layout trenches as per site condition.

d) Communication details / protocol details for all communicating instruments viz. PLC, GPRS telemetry, SCADA, etc. shall be provided.

e) Mimic video displays in the form of hard copies or photographs which are clearly legible and are notated to indicate dynamic data and control pick points where applicable.

f) Control video displays in the form of hard copies or photographs which are clearly legible and are notated to indicate dynamic data and control pick points.

g) Complete input and output list giving type, circuit number, tag name, short description, outstation, database reference, associated field device, range (if applicable), critical/non-critical alarm status and the like.

h) Description of quality control methods and approvals.

i) Calibration certificates for all the instruments along with test procedures.

j) Detailed works and acceptance test procedures.

k) Programme for manufacture, delivery, installation, interfacing and commissioning.

RTUs / PLCs General Specifications

Based and requirements as stated above and system architecture defined in Section 6, Contractor shall be responsible to supply, install, commission the RTU's / PLC's as per the General Requirements as below:-

1. RTUs / PLC enclosures shall be corrosion resistant welded for outdoor locations. Enclosures shall be fabricated from a minimum of 14 gauge cold rolled steel with a baked enamel finish in the manufacturer's standard color.

2. RTUs / PLC protected from lightning or other transient voltages by a power arrestor.

3. Condensation protection shall be provided to RTUs / PLC. Enclosure shall have arrangements to prevent condensation build-up.

4. All power supplies required for operation shall be provided. Power supplies shall be sized to have a minimum of 40% spare capacity providing increased reliability and allowing for the addition of future equipment.

5. All wiring shall be in complete conformance with the standards as specified in general specifications. All wiring neatly tied and fastened and for ease of servicing and maintenance, all wiring shall be color coded and uniquely numbered.

6. Battery Back up system for RTUs / PLCs shall be provided and working in conjunction with the unit's power supply, shall be an intelligent battery back up system including voltage converter, battery health logic module, charger and sufficiently sized battery. Battery system shall provide a seamless switchover to battery upon detection of main power supply failure. Once main power is restored, the unit shall provide seamless switchback to normal power source and recharge the battery. Battery health logic module shall individually monitor main power supply, battery and converter voltages for low voltage conditions, and provide low voltage cutoff to protect battery from an unrecoverable depletion.

7. Battery system shall be of sufficient capacity to provide a minimum of four (4) hours of backup in the event of a failure of the main power source. To avoid battery damage and erroneous data transmissions when operating on battery, should the battery voltage drop below 10.8 V, the PLC shall be inhibited from operation. Recovery shall be automatic upon restoration of normal power. The intelligent battery back up system shall be able to source 5 Amps allowing operation of mission critical components including; sensors, local alarm and communication equipment during a power failure condition.

8. All RTUs / PLCs shall be SMART and shall have real time multitasking soft-ware and powerful communication Capabilities.

9. It shall be comprising of CPU and signal conditioning ends for analog and digital signals.

10. It shall have a LCD display for indicating local data. Matrix keyboard shall also be provided for interface.

11. All RTUs / PLCs signals, status signals, alarm and process variable data shall be transmitted and received between the central location and the remote locations via the radio telemetry system. The system shall convert commands, alarms and variable analog data to digital blocks and transmit this information between the Central and the multiple remote locations.

12. RTUs / PLCs shall be furnished completely configured and tested for providing the specified communication, monitoring, display, input/output, annunciation, etc. for the Central Monitoring System and computational and other control requirements for operation of the in-plant SCADA system (pumping station). Any additional components required for operation, whether specifically referenced herein or not, shall be provided.

13. RTUs / PLCs system shall be based on a robust, field proven, current technology hardware platform allowing utilization of the latest advances in technology and

permitting the most open programming and communication architectures. The PLC system shall be modular and scalable to be efficiently applied at each of the specified sites within the system.

14. RTUs / PLCs shall store field /system parameters including, logic configuration, set points, time delays, alarm and event data, counters and totalizers, etc.. in field programmable non-volatile memory. Sufficient non-volatile memory must be provided to protect at least 8,000 variables. The PLC shall also provide enough protected memory for time stamped data logging.

RTUs / PLCs allow telemetry operations over radio frequency communication media as well as GPRS media affording the most efficient and reliable operation. Telemetry System communication architecture can be based on any one or a combination of these communication media.

RTU Specifications:-

The Remote Terminal Units (RTUs) shall be micro-processor based units of modern field proven design. RTUs must be modular in design to allow expansion of any count communications and I/O interfaces and capable of a variety of data transfer methods using various communications media as above.

THE RTU's MUST AS A MINIMUM HAVE THE FOLLOWING FEATURES:-

A. GENERAL

1) The RTU programming shall language used shall be windows based..
2) Input / output modules shall be furnished to accommodate all process and data controls plus any additional modules not mentioned but required to carryout any additional necessary for operation of the facility, shall be supplied and implemented by the contractor.
3) Flexible backplane arrangement that allows distribution of RTU modules within a single enclosure, or distributed between field enclosures. Each individual module shall be coded and encased in a protective housing isolating the internal circuits from handling by human hands. Each module shall have LED displays for status indication. The complete RTU, including RF stage, shall be of industrial grade capable of operating in harsh environments especially temperature.
4) The RTU shall be auto-configuring at startup whereupon the contents and slot location is automatically identified to the programming software when it is initialised. The RTU shall auto-execute a self-diagnostic upon initialization. Diagnostic results shall be available to the programming software via local computer and/or remotely via radio interrogation.
5) Processor modules shall have 32 bit processors with a minimum of 512kB RAM (for data storage), 512kB flash RAM (for firmware/program storage) and have a minimum of 2

communications ports each. The RTU applications programs and firmware shall be remotely downloadable via the communications network. It shall also be possible to add communications functionality (eg. additional protocols) to the RTUs without visiting site. Applications programs (site database and logic program/s) shall be able to be uploaded from the RTUs.

B. DATA TRANSFER

The RTUs proposed MUST support a number of data transfer philosophies that include,

1. ***Standard polling*** – where the master station **continuously** requests some/all real-time data values.
2. ***Exception Reporting*** – where the RTU initiates messages.
3. ***Time tagged data uploads*** – where the master station requests data that has been logged based on its priority/class. All data is logged in an event log buffer with a time stamp of 1mS resolution (system wide accuracy of 10mS or better).
4. ***Dynamic message routing*** – RTUs must be able to 'learn' of changes to network routing and dynamically change message routes.
5. ***Peer to peer communications*** – allowing RTUs to communicate with each other rather than simply with a master station.
6. ***Store and forward communications*** – allowing RTUs to 'pass on' messages for other RTUs. This is used to extend the coverage of point to multipoint style networks and also allows linear communications paths (where RTUs are typically ' daisy chained').
7. ***Transparent port connections*** – allowing RTUs to 'connect' ports between remote locations for the transfer of non-RTU data/messages. This requires the RTU to receive and package a non-RTU message within a RTU message packet for transfer to another RTU location for output (the output message is stripped of the RTU message headers, CRC etc).

C. POWER SUPPLIES

The RTU power supply shall accept AC or DC input and provide all necessary power to support the RTU operation. The power supply outputs shall be fully isolated from the input power source and include both monitoring and control of the various outputs to allow advanced power management functionality. The power supply shall be able to run from its standby battery for a minimum of 6 hours.

Battery Backup shall maintain operation of fully configured RTU, radio, I/O power for a minimal of 6 hours assuming a radio transmission every 10 minutes. The battery charging system shall provide maximum battery capacity and life.

D. COMMUNICATIONS EXPANSION MODULES

The RTU shall support up to 16 communications ports and allow additional ports to be added using communications expansion modules.

E. BACKPLANES

Backplanes shall allow distribution of RTU modules within a single enclosure, or distributed between field enclosures.

F. DATA LOGGING

The RTU shall have data logging capability of any I/O or register data value. The event log entry shall be time tagged with a 1 mS resolution time stamp and each entry shall include the following parameters:

- year, month, day, hour, minute, second, millisecond,
- RTU ID, data ID, data priority (0-7), data user type (0-31)
- data value, (2 bytes)

The event log capacity shall be configurable in the RTU memory setup, with a minimum capability of 50,000 event logs before any data is overwritten. The RTU logic shall allow the packing/archiving of 'old data' using the data priority field to mark data older than a specified period as deleted.

The RTU event logs shall be retrievable using any/all arguments of;

- date/time,
- priority,
- user type,
- RTU/data ID

G. LOCAL COMMUNICATIONS

The RTU shall support a number of device drivers that allow communications with local devices such as meters, PLCs, and other intelligent electronic devices (IEDs). These interfaces will typically operate on any of the RTU communications ports using data transfer protocols such as DNP3, MODBUS, HART, etc.. The RTU logic must allow the generation of ASCII command strings and the parsing of ASCII responses for development of simple ASCII interfaces. The RTU shall allow the use of multiple protocols per communications port.

H. NETWORK COMMUNICATIONS

The RTU shall be capable of communications within a network of greater than 1000 RTUs using industry standard SCADA protocols. The RTU shall be configurable to manage network communications in slave mode, master mode or as a data concentrator (where a data concentrator operates in both slave and master modes). The RTUs shall maintain 'images' of network data received from other RTUs to allow reference of such data (and its communications status) to be included in the RTU logic.

I. RTU DIAGNOSTICS

The RTU shall have in-built diagnostics that allow local and remote interrogation of diagnostic information. Basic diagnostic information shall be presented to the user via the module LEDs and advanced diagnostic information via the RTU programming and configuration interface program.

The advanced diagnostic information for I/O modules should include the health/presence of each RTU module and the current state/value of each I/O channel (including power supply I/O data). Diagnostic information specific to the processor module and RTU in general should include the scan rate of I/O and logic, the current time and date, the RTU firmware version, firmware options

(ie. protocols, application extensions etc), list error status flags. Communications statistics should be accessible for each RTU in the network that include the number of message successes, message fails and fails since last success.

The RTU shall have port monitoring capability that allows local and remote capture of messages to/from any RTU port for display in the programming and configuration interface.

J. SPARE CAPACITY

Each RTU shall be sized to accommodate all of the I/O listed in the scope of works and include an additional 20% spare installed I/O capacity. There shall be at least 2 backplane slots spare in the offered solution for RTUs with up to 24 modules and at least 4 backplane slots spare for RTUs with greater than 24 modules.

K.SECURITY

The RTU shall have two types of security, one for the programming and configuration interface and the other for the RTU ports.

L. Programming and Configuration Interface - User Security

The programming and configuration interface shall support at least six levels of user access that can be configured by a system administrator. These should include as a minimum,

1. Unlimited Access	Allows unlimited access, can read and write all RTU arameters including configuration parameters. RTU parameters include :- Local Registers,Network Registers, System Registers, Hardware (I/O) Registers, Event Logs, and Logic Program/s.
2. Read All, Write All (except config.)	Allows reading and writing of all RTU parameters, except for System Registers and Ladder Logic. Thus reconfiguring an RTU is not possible from this access level.
3. Read All, Limited Write Access	Allows reading all RTU parameters. Writing is limited to some Local Registers. No other parameters can be written at this access level.
4. Read-Only Access	Allows reading all RTU parameters. No parameters can be written at this access level.
5. Limited Read Access only	This access level allows reading some Local Registers. No parameters can be written.
6. No Access	No RTU parameters can be read or written. This access level is useful only for RTU port configuration.

Whenever the interface program is started, the user should be prompted to enter a username and password. This is checked against the User Database, to verify the password, and to provide the authorized access level. Alternatively, the user can select 'View-Only' mode.

M. RTU Security

Each RTU Communication Port shall have a configurable access level. The default access level can be any of the 6 levels (0-5) specified above to control read and write access to that port.

Thus, if a RTU port has default access level 4, then only some of the local data registers can be read via that port (eg. in energy delivery applications this functionality allows the energy vendor to allow the customer access to 'some' of the RTU data).

Minimum Technical Specifications for RTU:-

Type		Microprocessor / Micro-controller based			
Input Supply		12 – 14.5 V-DC			
Input / Output		DI	DO	AI	
		8	8	8	
		Expandable up to any count using I/O expansion Module			
Analog to Digital Converter		24 Bit ADC			
Over all Cycle time		100 mSec.			
Update Time		>1 Second			
Display		Graphics display			
Key-pad		4 Key-pad with Membrane Keys			
Microprocessor		32 Bit ARM			
Embedded Software		Special Purpose Embedded Software			
Communication Ports		RS- 232	RS-485	USB	Ethernet
		2 Nos.	1 No.	2 No.	1 No.
Program Memory (Flash)		512 KB flash			
Storage Memory		4 MB flash, Expandable to 8MB			
Removable Memory		16 GB Flash using SD acard / USB host			
Data Transfer Rate		115200 bps			
Data Retrieval		Via RS-232 Port Using Laptop / P.C. with software			
Enclosure		Standard wall mount / din rail mount			
Operating Temperature		0 to 60 Degree Celsius			
Storage Temperature		-25 to 80 Degree Celsius			
Relative Humidity		0-90% Non Condensing			
Atmosphere requirement		Free from corrosive gases and excessive dust			
Cooling method		Self cooling			
Design Type		Modular in design			
Communication Protocol		Proprietary ASCII Protocol / Modbus protocol			
Station ID		Programmable			
Settings for sensor		Programmable			
Reset Facility		Yes			
Time synchronization		Using inbuilt GPS receiver			

PLCs Specifications:-

Programmable Logic Controller (PLC) used for interfacing the local sensors and equipments shall have modular in design and from the reputed manufacturers. All modules of the PLC like Processor, Power Supplies and Input-Output (I/O) Modules shall be of same product family. Hybrid modules of different makes should not be combined to build the system.

Following are minimum but not limited to specifications for the PLC.

Make	Allen Bradley/Messung/ SCHNIDER/ SIEMENS/ MITSUBHISHI/ or any other Equivalent
Type	Microprocessor based Modular
Processor type	32 Bit or Higher
Processor I/O Capacity	1024 I/Os Minimum expandable up to 2048 I/O
User program Memory flash EPROM and ROM	512 KB or Higher
Plug in memory	SD memory suitable to store 1 year data at 15 min interval
Cycle time per instruction	Bit 0.05us, word -0.06 us, Float –point -0.5 us Or better
Communication Ports	RS-232 serial, RS-485, Ethernet TCP/IP , Device Net, SDI-12
Protocol	Programming - Modbus, RTU, ASCII, CS31MASTER, SDD
Power Supply	As required by processor and I/O modules
I/O module density	Digital 16/24/32 channels, Analog 4/8/16, channels

At BPS pumping stations the non-redundant Processor with suitable power supply and communication interfaces shall be used while designing the system. The processor should be capable of handling minimum 2048 hard wired / wireless I/O's in addition to the internal process and functions.

At Master Control Room located at Central Station and other two locations of Hasanpur & Talkatora, PLC should have redundant CUP and Power supply system for smooth and break free running of the system. CPU at Master station having capacity of handling remote I/O ' s in addition to the internal process and functions

The program memory of the processor be of NV type shall have internal battery backup. The processor should continue functioning as defined the process logic after power restoration and should not require any manual intervention.

Communication between the I/O modules and Processor should be smooth and without any interruption. The process signals will be “hold previous good” during hot-swapping of any I/O module.

The power supply module for the processor and I/O should be suitable to provide smooth power to the all instrumentation in the PLC panel and shall be working on UPS backed 230 V AC power supply.

I/O Modules:

The proposed I/O modules should be have identical Channel density and shall be from the same product family as that of processor. The I/O modules should be hot swappable.

While defining the channel density of the I/O modules, I/O requirement for each location shall be taken into consideration. In addition to the required I/O at each location, 10 % spare I/O’s shall be provided in each panel.

Human Machine Interface (HMI): The panels requiring local display and control of the process shall be provided with the suitable color touch-screen HMI mounted on the front panel and interfaced with the PLC processor. The HMI software should be designed in such a way that it will cater to the local monitoring and control requirements.

All analog input channels shall be provided with the surge protection and signal conditioning devices as may be required. The Digital Output Channels shall be provided with the interposing relay to avoid the high voltage surges.

PLC panels should be provided with required space heathers, ventilation and fan arrangements, Electrical Service socket and earthing arrangements and shall be wired as per the relevant standards and norms adopted for such panels in the industry.

PLC Control Panel:
The Panel shall be stand alone, floor mounting type with IP 55 protection and shall house PLC, HMI-7inch colour touch screen, 24 VDC, 5 A, SMPS, Modem / Router, Relay boards, MCBs for Incoming Power (DP), PLC Power, I/C & O/G for24 VDC supply, service socket, 2 additional DP MCBs for auxiliary supply.
PLC Panel for filter bed shall be pedestal desktop type panel only for ease of operation. Necessary UPS/ Power back arrangement shall be provided with PLC’s to avoid any data loss.

PLCs for Local SCADA system (pumping station)

The PLC system shall have I/O resources to support a wide variety of control operation of water pumping. Each PLC shall be supplied with the required I/O to meet the specified requirements.

Control Modes

i) Control Logic

The pure water pumping station comprises of duty and standby pumps. Programmable Logic Controller (PLC) based control system shall be provided for automatic and semi-automatic operation of pumping station. The Contractor shall design and size the PLC system, its memory, inputs/ outputs etc. considering the requirements of pumping station i.e. considering additional pumps (may be required to

add in future) and associated equipment and instruments. However, the program to be loaded in the PLC shall be suitable for the operation of specified no. of pumps. In the event of failure of automatic controls or by operator choice, it shall be possible to operate the pumping station independent of the PLC function. The control system should be designed to recover fully to a normal operational state on restoration of power, following a power failure without manual intervention. This requirement includes recovery from the H.T. failure as well as the control system power failure.

“Remote”/”local” selector switch shall be provided on the switchgear panel for each pump.

“Auto”/off / Manual” selector switch shall be provided for selection of operation mode for each pump on the Instrument Control Panel.

“Auto / Semi Auto / Manual” selector switch for the pumping station operations.

On the Local SCADA System operator station, a facility shall be provided for selecting various combinations of working and standby pumps.

More combinations shall be provided to cover all the required combinations.

ii) Manual Control Mode

In this mode, the raw / pure water pumps and valves shall be operated manually from the local PC based SCADA system. The control commands shall be routed through the PLC. The PLC shall prevent simultaneous starts or stops of the pumps and shall carry out automatically any start up or shut down routines necessary in order to start or stop a pump.

iii) Local Control Mode

In the 'Local' mode, the pumps shall be operated through pushbuttons provided on the Switchgear Panel. The pumps shall be operated independent of the PLC function. The motorized valves shall be operated through pushbuttons provided on the valve actuator.

- The pumps shall stop automatically if the level in the raw water & pure water sump is at 'low low' level in order to prevent dry running of the pumps in all the control modes.
- If any one compartment of the pure water reservoir is taken for maintenance, the pure water pumps connected to the other compartment of the reservoir shall be selected manually for level signals for control purpose.

I/O Schedule

The PLC shall be capable of having following minimum specifications

- Digital Inputs: 48 Nos (24 VDC)
- Digital outputs:24 Nos (24 VDC Transistor/ Relay)
- Analog Inputs: 16 Nos (Min.12 Bit resolution)
- Analog Outputs : 8 Nos (Min 12 Bit resolution)
- Communication ports: 3 Nos. One for HMI, One for Connecting various parameters through MODBUS and one for MODEM/ Router.

6.23.162 Item No. 162 :- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING AND COMMISSIONING OF LIGHTING / SURGE PROTECTION SYSTEM

Both lighting and Surge protection shall be provided to protect all electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be provided. Field instruments (regardless of location outdoors), shall be protected by isolation transformers and surge suppressors. Individual field instruments shall be protected by gas tube surge suppressers.

Technical Specifications are as under;

LIGHTENING/ SURGE PROTECTION UNIT FOR R.F. SIGNAL		
Frequency Range	:	1.5 Mhz to 400 Mhz
Surge	:	50KA-IEC 100-4-5 8/20micro sec.
Turn on	:	600 VDC $\pm$ 20 % 2.5ns for 2kV
VSWR	:	$\leq$ 1.2:1 @1.5 Mhz to 400 Mhz
Max power	:	VHF 375 Watt
Operating Temp.	:	50 ^{o}C
Storage Temp.	:	-45 ^{o}C to 85 ^{o}C
Relative Humidity	:	90 % at 40 ^{o}C
Vibration	:	1G at 5 Hz. to 100 Hz.

SURGE PROTECTION DEVICES 4-20 mA.		
For Transmitters at RTU / PLC End		
Technology	:	Gas filled Discharge Tube (GTD)
Total Surge Current (8/20 micro sec)	:	10 kA
Nomonal Discharge current I_n (8/20 micro sec)	:	5kA
Nominal Current I_N (40oC)	:	300mA.
resistance per path	:	3,7 Ohm
Response time	:	<1 n sec.
Ambient Temp	:	-40 to 85^{o} C
Humidity	:	5-95 % RH Non Condensing
Mounting	:	Din rail
Max operating voltage	:	30 VDC
Degree of protection	:	IP-20
For field mounted Transmitters at Transmitter End		
Max Surge Current	:	10 kA
Working voltage	:	40 VDC Max
Resistance in series	:	2.2 ohm
Response time	:	< 100 n sec.
Ambient Temp	:	-40 to 85^{o} C
Humidity	:	5-95 % RH Non Condensing
Mounting	:	Direct screw connection
Degree of protection	:	IP-67

6.23.163 Item No. 163:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING AND COMMISSIONING OF INSTRUMENTATION CABLE WITH ALL REQUIRED ACCESSORIES

All cabling required for connecting all field instrument, sensors, transmitters, PLC etc. shall be provided by contractor. This item shall be executed as per specific requirement supported with justification with prior consent and approval of the Engineer.

Specifications for cables:-

1. All conduit and cable entering control panels shall be gland sealed to prevent the intrusion of gas and moisture.

2. All signal cables for carrying 4-20 Ma , 0-5 V, low level transducer outputs, etc shall be copper PVC insulated twisted pairs, individually screened with tinned copper drain wire, overall screened, steel wire armoured and overall PVC sheath. The twisted pairs shall be constructed with 24-30 twists per metre.

3. The rated working voltage shall be 100 V rms and the maximum working voltage shall be 600 V rms. The continuous current rating shall be at least 5. Insulation between conductors and earth shall not be less than 10 Mega Ohms at 500 Volts.

4. Screening shall provide a minimum of 95% coverage of Copper braid or Mylar backed Aluminium foil. Individual shields in multi core cables shall be insulated from each other and from the overall shield and armoring.

5. Strict segregation shall be followed with not more than one type of signal run in any multi core cable. The different types of signals shall be segregated from each other and shall be contained in separate cables.

Application		**For connecting sensors and transmitters**
Type		Copper, PVC insulated, Shielded with aluminum polyester tape with tinned copper drain wire, Twisted pair, overall shielded with aluminum polyester tape with tinned copper drain wire PVC inners heated GI wire (0.90mm) Armored, PVC sheathed cable as per IS- 5308
No of pairs		1 pair X 1 X 1 Sqmm / 1 pair X2 X 1 Sqmm / 1 pair X 3 X 1 Sq. mm
Working Voltage		100-600 Vrms
Application		**For providing power to field equipments**
Type		PVC insulated PVC sheathed copper conductor armoured cable1.1 KV grade as per IS 1554
No. of core		2/3/2004

Gauge		1.5 Sq.mm
Working Voltage		1100 Vrms
Application		**For providing power to in house equipments**
Type		copper flexible, unarmored, PVC insulated
No. of core		3
Gauge		1.5 Sq.mm
Working Voltage		1100 Vrms

6.23.164 ITEM No.164:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF WIRLESS TELEMETRY

Either Radio telemetry or GPRS as a communication media shall be used to communicate with nos. locations of BPS / UGRs / GSR/ remote locations of DMA's and 2 nos. proposed locations of Water pumping stations at Hasanpur and Talkatora and one central server station for monitoring & SCADA purpose.

The contractor is expected to personality visit and inspect all these remote location covered under this contract before tendering.

GPS site surveys at all locations for determining communication parameters and tower heights at all locations of BPS / UGR / GSR and proposed pumping station including Central Station shall be borne by Contractor.

Unless otherwise specified following are the minimum & must requirements of the radio Wireless communication system:-

1. The System shall monitor all the remote locations (24 Hrs.)
2. High speed retrieve, store data from remote sites (24 Hrs.)
3. Analyse, process, print, display etc. all the field variables & data.
4. Alarm & report generation
5. The System shall support remote maintenance of radio units
6. The System shall operate up to 30 to 35 Kms.
7. The System is equipped with surge suppressors to protect it from unavoidable lightning conditions.
8. The System shall support high level of security mechanisms such as DES for end to end connectivity to avoid any breaches due to Interference or hacking.
9. Only licensed communication frequency band should be provided for communication.
10. Necessary Frequency Liasoning and Royalty charges for the complete O & M period shall be borned by the contractor only.

11. Remote Radio Telemetry System shall use powerful radio transceivers to seamlessly connect Central monitoring location with remote sites.
12. Radio Telemetry System shall use rugged, high speed intelligent, radio modems that are designed for seamless communications and capable of wireless communications of up to 30 Kms.
13. Contractor shall be responsible to provide the proper antennas and self supported MS tubular Tower (triangular shape) of suitable height (apprx. 30 m height) depending upon the site location and as approved by NDMC engineer- in charge for clear communication between all described BPS/ UGR / GSR, Pump House location and Central Tower at NDMC Head office to ensure powerful telemetry functionality including all other integrals required to achieve this functionality. **Contractor shall be fully responsible to give and achieve the reliable and satisfactory low cost Central Monitoring / SCADA system**. Contractor should note this carefully Built-in error correction assures accurate data transfer between radio telemetry systems.
14. Steel structures (towers) required for the work shall be certified by civil structural engineer or as directed by engineer in charge. Necessary N.O.C. wherever required while executing the work shall be provided and same shall be approved by engineer in charge.
15. Remote Radio Telemetry System Software shall have an easy to use, intuitive interface. The built-in address book should allows to quickly set up radio telemetry system monitoring sites with a unique identifier and name.

Unless otherwise specified following are the minimum & must Technical Specifications for the Wireless Communication system :-

For BPS / Pumping Stations / Pure water Pumping System/ DMA locations:

RF Modem

1. A single control room should communicate with proposed remote locations
2. System should be capable of communicating faithfully over the distances of 30-35 Kms in a city area like New Delhi Municipal Council Boundary.
3. Output Wattage of Wireless Data communication System should be 1-25 watt software programmable with or without RF amplifier.
4. Wireless Data communication System should have Online/ OPC enabled local as well as remote diagnostics feature. Without disturbing communication (to provide information about Supply Voltage to the Wireless equipment; Temperature; Radiated and Reflected RF power, RSSI signal level)
5. Radio modem Modulation Type should have all : 2 FSK , 4 FSK , 8 FSK , 16 FSK
6. Should work with or without RTS/CTS handshaking signals.
7. RF Connector : SMA Female Type
8. Temperature range: -30 to +60 Celsius.
9. Equipment should have: Class 1, Div 2, FCC, CE approvals.
10. Reputed Make – Calamp / Elpro / siemens/ messung / or any other Equivalent
11. Radio communication should support Non line of site communication
12. Radio Modem should have built in Dynamic routing feature
13. Radio Modem should be able to program for Bridge or Router Mode

14. It should have built in store and forward feature .
15. Radio Modem should support : most of the industries Ethernet protocols.
16. Radio modem should be able to operate in Star or Mesh Topology .
17. Same radio modem should work as a Master , Repeater and Remote .
18. Should have min 8 Channels
19. Duty cycle : 100 %

Type	:	VHF data modem with transreceiver
Data Interface	:	RS-232 standard / Ethernet
Frequency Range	:	VHF : 136-174 MHz
Channel Bandwidth	:	6.25, 12.50, 25.00 KHz selectable
Operating mode	:	Simplex or Half duplex
Communication Protocol	:	Support all protocols (Transperent)
Data Encryption	:	AES encryption
Operating Temperature	:	-30^0C to $+60^0$C
Supply Voltage	:	10.00 to 30.00 VDC
Current Drain @ 25^{o}C	:	480 mA (Rx) and 4.6A (Tx) @ 10 V
Cold Start	:	15 Sec
Approvals And Certifications	:	FCC , IC , UL (Pending)
RF Power Output	:	1 – 25 Watt Software Adjustable
Frequency Tolerance	:	$\pm$1.0 PPM
FM Hum And Noise	:	Less Than -45 dB @ 25 KHz
Duty Cycle	:	100%
Receiving Sensitivity	:	-116dBm @ 8kbps at 10-6 BER
Selectivity	:	> Than 75dB at 25 KHz
Data Rates	:	32 kbps @ 25 kHz
Modulation	:	4 FSK
Remote Diagnostic features	:	Yes
Programming	:	User Programmable with selectable modes
Indication LED	:	Power, Status, LAN link, LAN Activity, Rx, Tx.

GPRS Modem/ Router:

The device shall act as REMOTE MANAGEMENT DEVICE.

This shall have facility to connect PLC with central SCADA server PC at central location office through GPRS or PSTN.

The PSTN / Broad band with dynamic IP connection or SIM card with GPRS enabled with Dynamic IP be created. The connection will be provided based on best available connectivity at each BPS or DMA location. The Contractor shall provide connectivity device which will be able to incorporate any connection. The specifications for the device shall match following. Remote Maintenance PLC point to Point RAS or Internet remote access: and any PLC / device / equipment with TCP/IP

Remote Service : Data acquisition (Tag names) in MODBUS/RTU, MODBUS/TCP 'Tag names' enable alarm management, Basic programming, custom Web pages, reporting, Data Logging: Internal data base for data logging 21.000 points. Retrieval of the data base with files transferred by FTP put or email attachment.

- Alarms: 'Tag name' database: 128Kb. Alarm Notification by email, SMS, FTP put and/or SNMP trap.

- Available standard limits to configure: Very Low, Low, High, Very High + Dead zone and activation delay.
- Alarm summary and historian available in HTTP and via FTP files transfer.
- Alarm cycle management: ALM, RTN, ACQ and END.
- MMI HTTP: System and user defined Web site.
- SNMP: 'Tag Name' read/write
- FTP: Whole set of parameters are available in files
- Callback: Call back on user request or on amount of rings
- Direct or Internet call back (supports dynamic DNS)
- Firewall IP filtering
- Script Dedicated application to be programmed with the Basic language.
- Router IP forwarding, NAT, port forwarding and routing tables.
- Internet RAS connection (PPP), PAP/CHAP security. Data compression, ISP connection
- (Internet Service Provider) primary et secondary, supports DNS.
- Synchronization Embedded real-time clock, manual setup via http or automatic NTP setup
- File Management FTP client and server for configuration and data transfer.
- Web Site Security: DAA and session control. HTML standard supports the entire PDA browsers.
- SSI technology (Server Side Include) and BASIC scripted ASP (Active Server Pages).
- Maintenance SNMP V1 with MIB2 and/or via FTP files
- Material ARM processor @75Mhz, 8Mb SDRAM, 8Mb Flash, Din Rail Mounting
- Power supply 12 - 24VDC +/-20%, SELV; consumption: 3-6 watts
- 1x SUBD9 serial port: RS232, RS422 or RS485, 1,5kV isolation
- 1x RJ45 Ethernet 10/100 baseTx; 1,5kV isolation
- 1x digital input: 0/24VDC; 3,5kV isolation
- 1x digital output: open collector 200mA@30VDC; 3,5 kV isolation
- Embedded modem: PSTN or GSM/GPRS
- GPRS Modem should support 2G & 3G
- GPRS Modem should have Hardware Watch Dog
- Reputed Makes : siemens/ messung / Mitsubhishi/ ACTL / Cisco or any other Equivalent
- GPRS Solution should have Hardware based Network Manager at control centre to handle GPRS connections and should support min 300 VPN connections and should work without any software at control centre
- Operating Temperature range: 0° to 50°C, 80% humidity (no condensation

6.23.165 ITEM No.165:- PROVIDING FABRICATED SELF SUPPORTED TRIANGULAR SHAPE MS TUBULAR TOWER

Contractor shall be responsible for Supply, delivery, erection, installation, testing, training and commissioning of towers for Central Monitoring / SCADA system with proper Towers/ Antennas /subscriber module / reflector disk at each location and central location and all necessary accessories inclusive of all liscence fees at all locations of BPS/ UGR/ and Proposed Pumping stations at Talkatora & Hasanpur reservoirs. It is inclusive of all required equipments, Towers, Antennas, subscriber module, disk, pedestal for tower base, lightning arrestors, cables, structure

required for mounting viz: poles, platforms, railings, furnitures etc and all required installation hardwares complete and as directed by Engineer-in –charge

Providing Fabricated self supported triangular shape MS tubular Tower of suitable height from ground , providing matched pedestal for tower base, providing aluminium earthing wire upto nearest earth terminal, providing GI lightening arrestor at pump House locations of Hasanpur and Talkatora and At Central Location (NDMC Head office)

6.23.166 Item No. 166 :- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF LOCAL SCADA SYSTEM

Local (in-plant) SCADA system with control at Master Control Centre shall be provided for following locations:-

1) Pure Water pumping Station at Hasanpur

2) Pure Water Pumping Station at Talkatora

3) BPS locations of Benagli Market, Bharati Nagar, Harijab Basti, Jor Bagh, Mandir marg, Moti Bagh, Nataji Nagar, North Avenue, Rajdoot Marg, Sardar Patel Marg, Sarojinai Nagar, Shivaji Stadium, South Avenue, Tilak Marg, Ninay Marg

The contractor is expected to personality visit and inspect all these remote location covered under this contract before tendering.

The Contractor shall supply and install all necessary cables and connectors including power point connections / arrangements etc. for proper functioning of the system.

Unless otherwise specified following are the minimum requirements of the system:-

- To automate, supervise & control all the pumping operations
- Supervisory control of pumping parameters at local as well as at Master Control Centre central location with data transfer.
- All the control functions and control parameters at ICP.
- HMI for Opertaor

6.23.167 Item No. 167:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF LOCAL SCADA PC CONSOL FOR RUNNING SCADA SOFTWARE

SCADA PC Consol

The local SCADA System shall be located in the control room of pump house. Control panel board shall be provided to mount all instruments and house all components of the

instrumentation and control systems to execute control functions for the pumping operation and PC based software for dynamic viewing of the plant process and operations. It will offer all required supervisory control functions as well as provide GUI for plant personnel. The system shall have all the facilities such as communication ports and modules for interfacing, data recording and display with the Central Monitoring System at control room of proposed Central Monitoring System at NDMC Head office. Contractor shall provide all the required furniture for the PCs & system at each location with air-conditioning unit.

SCADA Pc configuration:-

Processor	:	Intel Core i7 or equivalent latest
Make	:	Industrial Grade Reputed Make
Chipset	:	Intel
RAM	:	16GB DDR
Cache	:	8MB Total Cache
Optical drive	:	Combo drive
HDD	:	1 TB SATA
Ports	:	Display Port – 1 VGA
		USB 2.0 - 6 Nos.
		Serial port - 1 Rear
		Parallel port – 1 Rear
		Ethernet network - 1 Rear
		Stereo Line –In 1 Rear
		Stereo Line – Out - 1 rear
Ethernet	:	Gigabit LAN
Power supply	:	power Supply - 280 W
Keyboard	:	standard Keyboard
Mouse	:	Optical Mouse
Monitor	:	55" LCD/ LED
Operating Software	:	Windows -8

The Contractor shall supply and install all necessary cables and connectors etc.

6.23.168 ITEM No.168:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF SCADA SOFTWARES

SCADA Server & Softwares

The contractor shall supply all programming (PLCs) and SCADA software's necessary to provide a fully debugged Pumping Operation and control for water distribution management system (WDMS) /IMIS along with control operation of valves actuators remote SCADA. SCADA System shall communicate with field PLC through RF/ GPRS for data, information & Control. The software required shall consist of those programs necessary for the system to efficiently perform the functions specified herein, plus enable convenient and efficient preparation of new programs. The system shall be capable of operating in a foreground/background mode. The contractor shall assume complete responsibility for the successful operation of all software and application programs provided as part of the system. All programs can be completely debugged and operable prior to delivery of the system. The NDMC shall not be required to expend any programming effort in order to achieve a fully operational system.

The central processor shall be provided with self-test diagnostic routines, which are automatically executed every time the processor is powered up or the bootstrap routine is initiated. The Contractor shall supply and install all necessary cables and connectors etc.

It is under the scope of this contract that the contractor shall provide the web enabled facility/ cloud server facility for server data of whole Central monitoring System including internet facility and necessary communications. NDMC users can be able to access this data with user name and password facility. Contractor shall maintain the website through entire operation & maintenance period and store the data up to the complete contract period.

Operating system, database software, monitoring & display software, pump house resource planning software etc. and all other required peripherals shall be provided under this contract for achieving required functionality of the Local SCADA system at each location.

SCADA softwares shall be of reputed make likes Wonderware/ Intelution/ Ellipse/ Rockwell Automation/ Schneider or any equivalent

End User Interface

There shall be three levels of End user Interface

j) Central Monitoring Station

The Central Monitoring Station shall have the following main components

1. Screens to display the layout schematic of the system as per actual configuration on the field
2. Online and historical trends plotted with respect to benchmark graphs. The benchmarks are to be arrived at using practical data over a reasonable period of time
3. Settings screen for important parameters like timing, pressure and flow, residual chlorine etc.
4. User login and authentication screens
5. Dashboards of important KPIs as specified by the Engineer in Charge
6. Bar graphs as per Engineer-in-charge to be plotted against Benchmark levels

Cloud based web Pages

1. Important Data to be uploaded to the cloud using state of the art protocols like IOT drivers etc. and viewed using Http protocol. Any software/hardware/drivers required for the same shall be provided by Contractor
2. This shall be only in view mode and no changes shall be possible in this method
3. It should be possible to add a link to these webpages on the NDMC website. The link to be added by the customer using the services of the service provider/agency maintaining the website of NDMC.

Apps

1. Apps for IOS and android devices to be developed by the contractor
2. Apps to be downloadable by users/citizens if required
3. Screens of the apps to be developed as per Engineer in Charge
4. No Changes to be possible using the apps.

6.23.169 ITEM No.169:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF CENTRAL MONITORING SYSTEM

Space for Central Monitoring / SCADA System Control Room will be provided by NDMC at Main Administrative building and all the required furniture and other accessories shall be in Contractor scope. All the equipment, cables, electrical boards / points, instrumentation and all required hardwares and softwares to be provided for the system shall be from a standard line of equipment manufactured and supported by a manufacturer approved by the NDMC Engineer. Contractor should supply install & commission the system with specific project plan for effective and successful monitoring system including all necessary hardwares and softwares (not covered in price bid under specific item).

Control Room Furniture

In addition to the control system equipment, the Contractor shall provide furniture to complement or match both the colour and styling of the equipment. Control room furniture shall comply with relevant IEC standards for ergonomic design. Details of the control room furniture shall be submitted to the Engineer for approval.

The Contractor shall provide fabric-covered upholstered swivel-type adjustable arm chars with casters, a rigid and lockable steel cupboard for the storage of operating and maintenance manuals, drawings, logger paper, charts, disks and the like.

The visual display unit consoles or VDU desk shall incorporate suitable nos. drawer unit with drawers for operators use and for standard files.

Large Video Display System

The LVS shall be designed for continuous operation, i.e. 24 hours per day. Viewing distance for the display screen & viewer shall be small.

The LVS system should have following technical specification General Specification of Video wall.

1. The product should be from OEM which has installations worldwide and should be of international repute.
2. The OEM should have their own manufacturing unit in India. The Indian Manufacturing unit should be certified for the following quality management System ISO 9001: 2008, ISO 14001: 2004
3. The cubes, controllers and the associated software should be from the same manufacturer to ensure seamless integration.
4. The system shall be complete with display wall with 50" each Diagonal Laser based Rear projection system preferably 3.5 meter x 2 meter with multiple unit or as system desired. Screen to screen gap should be ≤ 0.2 mm.
   Each cube should have minimum specification as below:

Cube

1. Resolution: 1920 x 1080 DMD resolution of chip.
2. Light Source type: Laser light source,
3. Brightness of each projection engine : Minimum 2000 lumens
4. Brightness Uniformity: ≥ 97% and control should be IP based and IR remote control should also be provided for quick access.
5. Input terminals – 1X-Digital DVI, 1X-HDMI, 1X-Analog Dsub-15, 1X-Analog RGBHV
6. Cooling : Inside cube should be by means of a heat pipe only. Pump based cooling involving hazardous liquids is not acceptable.
7. Cube Size: 50" with Rear Maintenance.

Video Wall Controller

1. Controller: Controller to control Video wall in a matrix (3.5 x 2) outputs, inputs along with software's.
2. Processor: Single Quad Core Intel (R) Core™ i7 Quad Core 3.4 GHz Processor) or better and supports 64-bit Operating System Windows 8 with RAM capacity of 16 GB or more with HDD 1000 GB or more.
3. Net Working: Dual Port Gigabit Ethemet.
4. Power Supply: 1+1 (Redundant Hot Swappable).
5. Inputs: Minimum 6 DVI
6. Outputs: 6 DVI outputs

Video Wall Management

1. Display and Scaling: Display multiple sources anywhere on display up to any size.
2. Input Management: All input sources can be displayed on the video wall in freely resizable and movable windows and should have and load desktop layouts from Local or remote machines.

3. It should be able to provide an error message in three sections a) Problem area b) Error Module location c) Error Module image.
4. Provide video wall status including Source, light source, temperature, fan and power information.
5. Should provide a virtual remote on the screen to control the video wall.
6. Input sources can be scheduled in “daily”, “periodically” or “sequentially” mode per user convenience.
7. System should have a quick monitor area to access critical functions of the video wall.

Monitoring system instruments earthing

Monitoring system instruments and all related equipment earths shall be electrically bonded to the instrumentation earthing system or be provided with a separate independent isolated earth terminal bonded directly to the main station earth terminal in accordance with BS 6739.

6.23.170 ITEM No.170:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING, AND COMMISSIONING OF CENTRAL SERVER PC

General:-

The central processor(s) shall be of industrial quality and of proven high reliability suitable for continuous operation (24hrs.).

The processor shall be furnished with a real-time calendar clock with battery back-up which provides the current time and date during system boot-up with no operator action required.

The processor shall contain sufficient memory for all requirements described herein, including future requirements, and 30% spare capacity when all application programmes are loaded and operating,. The central processor shall be equipped with storage facilities consisting of:

- Random access memory (RAM) for the storage of all current data (real-time database);
- Large capacity, fast access, mass storage magnetic (hard) disks for on-line data storage;
- High density cartridge or streaming tape drive or optical disk system, with removable media, for off-line archiving of data;
- CD DVD Read/Writer, for off-line archiving of data;

Additional high capacity fixed and removable storage media, shall be provided for data back-up.

At least 50% of the hard disk shall remain unused and available for other uses after all database, program, historical and working files required by the system are resident.

The operating system and application software shall reside on the hard disk. Upon power-up, power restoration after power failure or warm start, the system shall automatically load and become fully operational without the need for operator action.

Minimum Server configurations:

	:	System x 3650 Server or latest version
Type	:	2U Rack Mount
Processor	:	Xeon 8 Core E5-2630V3 90W 2.4 GHZ /1866MHZ/20MB INTEL
Chipset	:	Intel
RAM	:	2x16 GB RAM ECC DDR
cache		L2 8 M B or higher
Raid support	:	Support Raid 0,1 & 10
Optical drive	:	DVD Writer (Sony or any OEM)
HDD	:	5x1TB 2.5" inch 7.2k RPM6Gbps SATA Hot plug Hard Drive
Ports	:	4 USB, 1 KBD,1 MOUSE, 1 Parallel & 2 Serial
Ethernet	:	Four integrated RJ-45 Gigabit Ethernet 1000 BASE-T ports
Power supply	:	550 watt redundant power supply
Cooling fan	:	Yes
Keyboard	:	standard Keyboard
Mouse	:	Optical Mouse
Monitor	:	55” LCD / LED (make standard)
OS	:	WINDOWS SERVER 2012

It is under the scope of this contract that the contractor shall provide the web enabled facility/ cloud server facility for server data of whole Central monitoring System including internet facility and necessary communications. NDMC users can be able to access this data with user name and password facility. Contractor shall maintain the website through entire operation & maintenance period and store the data up to the complete contract period.

6.23.171 ITEM No.171:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING, TRAINING AND COMMISSIONING OF PCS, SOFTWARES, KEYBOARDS, PRINTERS ETC

Minimum configuration for PCs are as under:-

Processor		Intel Core i7 or equivalent latest
Make		Industrial Grade Reputed Make
Chipset		Intel
RAM		16 GB DDR
Cache		8MB Total Cache
Optical drive		Combo drive
HDD		1TB SATA
Ports		Display Port – 1 VGA
		USB 4.0 - 6 Nos.
		Serial port - 1 Rear
		Parallel port – 1 Rear
		Ethernet network - 1 Rear
		Stereo Line –In 1 Rear
		Stereo Line – Out - 1 rear
Ethernet		Gigabit LAN
Power supply		power Supply - 280 W
Keyboard		wireless Keyboard
Mouse		wireless Mouse
Monitor		55" LCD/LED
Operating Software		Windows -10

System Softwares

The contractor shall supply all programming necessary to provide a fully debugged operating system. The software required shall consist of those programs necessary for the system to efficiently perform the functions specified herein, plus enable convenient and efficient preparation of new programs. The system shall be capable of operating in a foreground/background mode. The contractor shall assume complete responsibility for the successful operation of all software and application programs provided as part of the system. All

programs can be completely debugged and operable prior to delivery of the system. The NDMC shall not be required to expend any programming effort in order to achieve a fully operational system.

The overall operating software package shall be modular, primarily comprised of an integrated group of proven, standard software modules. Individual standard modules shall be designed such that adoption to this system's specific needs shall be accomplished through entry of definitive data in stored parameter tables. The system software shall be of standard product. No programming shall be required beyond configuration and minor customisation. The system software shall be designed to provide a disturbed database.

All of the programs are to be generalised in nature such that the NDMC may later add new functions. The scheduling and initiation of future application programs and the servicing of their input and output requirements, including construction of new printing formats and other system interfaces, shall be accomplished without recompiling of application software.

Specifics for the system are given as a guide, however manufacturer's standard offerings that can accomplish all of the specified functions will be considered. The system shall be capable of accepting process control operational directives in a conversational mode. Data validation shall be performed on operator inputs and reject illegal entries.

System parameters such as data, time, set points, alarm limits, loop tuning constants, etc., shall be entered or modified via the operator's terminal. Any input, which modifies the system, shall be logged on the logging printer with data and previous value.

Software Licensing - The computer system supplier shall include all necessary licensing for operation of all software on all computer systems provided. All packaged and system software licenses shall be registered by the Contractor in the name of the New Delhi Municipal Council.

The supplier shall also update all software packages with the latest versions and patches until the expiration of the warranty and/ or Operation & maintenance period i.e. for. The software shall include development key for the owner.

a) Operating System

The Operating System software shall be the latest version of Microsoft Windows to provide system resource allocation and management in a Real-Time, multi user environment.

The Operating System shall provide an orderly shutdown on loss of power or low voltage and automatically restart the system, including processor and peripherals, upon restoration of power without operator intervention. The power failure protection shall protect against loss of program and/or work in progress at the time of occurrence.

b) OIS User Interface

The operator shall be capable of to access displays via a printing device and/ or soft key menus with a choice of function keys, cursor, control keys, or any key on the key NDMC. Supported pointing devices shall include a mouse, touch screen, light pen or trackball.

The system shall support operator access to multiple displays at one time, including split screens where the operator may view more than one process area at a time. In addition, the system shall support unlimited use of pop-up displays for additional help or diagnostic information.

Access to all displays and to all command functions shall be based on the opeartor's security level to protect against unauthorised use. The security level shall be established during the operator sign-on procedure.

Visibility and operation of command buttons, symbols etc shall be controllable based up on the operator's security level.

The operator shall be able to have access to context sensitive help at any time during operation of the system.

The operator shall be able to access multiple data sources/ items with a single tag name.

c) Programmer's console

For systems, which require it for modifications or additions to be made to the operating system or application programmes, a programmer's terminal shall be provided of the type recommended by the system software and hardware manufacturers.

d) Diagnostic capability

The system shall be provided with the capability to diagnose hardware malfunctions in the central station and related peripheral equipment. Diagnostic programmes shall be password-protected to prevent unauthorized use. The diagnostic procedures shall be able to be performed by operations personnel with a minimum of training. Software routines shall be provided which can isolate a single problem to the circuit board level. The routines shall be menu-driven to allow for ease of use. Complete documentation of diagnostic procedures shall be provided as part of the system documentation.

Keyboard

Unless otherwise specified, keyboards shall be equipped with upper and lower case alphanumeric keys as well as a minimum of 10 function keys. Each key shall be clearly and permanently labeled to show its purpose.

Standard editing keys such as tab, insert, delete and backspace shall be provided.

Cursor control shall be available for the keyboard giving right, left, up, and down movements.

Keyboards located in the process area shall be protected from dust and splashed water.

Certain keys shall be programmable. A minimum of 8 keystroke-sequences, apart from the standard functions, shall be a available after project completion for assignment of programmable functions.

Contractors proposing alternative keyboards shall submit full details for approval.

Key boards for use in program modifications shall be of the standard QWERTY configuration with separate 10-key pad for numeric input.

Cursor-positioning device

Cursor-positioning devices shall be of the mouse or track-ball type or otherwise approved by the engineer. Two select buttons shall be provided as a minimum.

Printer Requirements

Two types of printers shall be supplied for reports, alarms and events as detailed below. It shall be possible to configure any text based output from the master station to either of these printers.

It shall be possible to add additional printers if required. Additional printers shall be capable of being assigned the functions of alarm/event logging, or report printing/ Scanning of documents.

a) Printer Connections

Alarm / Event printers, shall offer at a minimum of 100 characters per second, upper and lower case ASCII character set with true descenders, a minimum of 132 characters per line, and a self-test facility capable of printing automatically the entire character set.

The minimum size of printer buffers shall be 4k characters.

Each printer type shall connect to the system using the standard interfaces such as RS232 / Ethernet with both RTS/CTS control signal and XON/XOFF data transfer control methods supported.

All printer types shall be of a low noise type or shall be provided with acoustic hoods to ensure the ambient noise level never exceeds 30dBA.

Printer types shall be provided with all necessary cables and connectors. Should a printer be off-line when an output is ready, the control system shall send a message to the operator.

b) Alarm/Event printers

The alarm/event printer shall be a dot matrix/ laser printer with a minimum of four colours available. Alarms shall be highlighted by coloured printing (i.e. plant alarms red/system alarms orange/return to normal green) while events and alarm acceptance shall be printed in black. This printer shall be located in the Control Room in a self-contained printer stand. The Contractor shall supply and install all necessary cables and connectors etc.

c) Report colour printers

The report colour printer shall be an A4 printer capable of producing high quality text and graphical reports for plant and management purposes and full colour high quality prints of screen display mimics, trends etc. In text mode the printer shall be capable of up to 7 pages per minute for text and 1 minute per page for graphics. The resolution shall be 600 by 600 dpi for colour and 600 by 600 dpi for black as a minimum. The printer shall be capable of receiving and printing data formatted for an Hewlett Packard printer. It shall be located in the control room of each location. The Contractor shall supply and install all necessary cables, and connectors etc.

6.23.172 ITEM No.172:- SUPPLY, DELIVERY, ERECTION, TESTING AND COMMISSIONING OF UNINTERRUPTED POWER SUPPLY

The monitoring system processor(s), VDUs, logging printer and communications equipment shall be powered through an uninterruptible power supply (UPS) via a dedicated distribution system. The UPS shall provide for full functioning of this equipment for minimum of one hour in the event of a power failure. UPS capacity shall be over-sized in terms of rating and power duration by 50% to provide for future additional equipment.

The Uninterruptible Power Supply system shall consists of a regulated rectifier to operate from commercial AC power, a battery to store emergency power, and an all – static inverter to convert DC power from the rectifier or battery to high quality AC.

The power supply system shall normally operate from the existing commercial power. When commercial power failure occurs, the battery shall immediately and without switching, take over as the source of power to the inverter which shall continue to provide high quality AC power to the equipment.

Unless otherwise specified, it is under the scope of this contract that the contractor to provide / arrange necessary power point required while executing the work.

The UPS shall be a minimum of minimum following Spcifications:-

Make		Transtech /Emerson/ Schnider / APC or equivalent
Type	:	On Line
Input	:	230 VAC +/- 15 %
Output	:	230 VAC +/- 1 %
Power factor	:	0.8 Lag
Power capacity	:	1.00 KVA- 2 KVA -5 KVA As per requirement of site and system
Frequency	:	50 Hz +/- 0.5 Hz.
Wave form	:	Pure sine wave
Total Harmonic Distortion	:	< 4 % on linear load
Inverter	:	IGBT based high freq PWM
Inverter efficiency	:	> 85 %
Duty	:	Continuous
Transfer time	:	Zero secs.

Battery Voltage	:	48 – 360 VDC as per requirement
Battery Type	:	Sealed Maintenance Free
Operating Temp	:	0-45^{o} C
Humidity	:	Up to 95 % RH
Protection	:	Out put high / Out put Low/ Out put Short Ckt/ Batt. Low Trip
Alarm	:	Battery Low
Indicators	:	Mains ON, Inverter ON, Battery Low, Fault
Metering	:	Out put voltage

Exact sizing shall be the responsibility of the system suppliers based on total load requirements of equipments proposed. The Contractor shall supply and install all necessary cables, and connectors etc.

The system batteries shall be sized to sustain operation for a minimum of 360 minutes. The system batteries shall be of the gelsel or Nicad type and shall reside in the same enclosure as the UPS.

6.23.173 ITEM No.173:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING AND COMMISSIONING OF AIR CONDITIONING UNIT FOR CENTRAL CONTROL ROOM

Window type room air conditioner of 2 ton capacity shall be provided at the Central Control Room for monitoring system. The air conditioner shall be sized to maintain a temperature of 24 + 1 degree Celsius, 50 % relative humidity inside at all time. Air conditioner and its part shall be constructed with the strength and rigidity adequate for normal conditions of handling, transport and usage. AC shall be of reputed brand.

The Contractor shall supply and install all necessary cables, and connectors etc.

6.23.174 ITEM No.174:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING AND COMMISSIONING OF OUTDOOR DISPLAY MONITORS

It is intended to display the information related with water quality parameters like pH, Turbidity, conductivity, chlorine, flow etc. at various display points as specified by NDMC within each DMA's of project area for the citizens. The information of effluent water quality parameters of upcoming / under tendering STP's like TSS, pH, BOD, COD, flow etc. shall also be integrated and displayed on these display points locations which may increase or decrease as per the actual requirement of NDMC. The

Contractor is expected to provide outdoor video display monitors as per specification below which will have GPRS communication / interfacing facility with Central Control Station for remote data display.

Contractor shall provide Industrial-grade Sunlight Readable LCD TFT monitors or outdoor LED's of 32" (minimum size) designed for use throughout a wide range of harsh outdoor applications which shall withstand the effects of severe environments such as water, dust and dirt intrusion. Outdoor display unit shall perform well beyond ordinary 'commercial' type monitors. The monitors shall be an ideal solution for high-ambient lighting conditions such as outdoor information kiosks, transport stations, NDMC parks / gardens / premises or any other information terminals specified by NDMC.

The monitor display shall achieve minimum 1500 nits (cd/m²) of brightness in an outdoor environment where strong ambient or direct sunlight may be present. The display panel shall features a **1080P HD** resolution (minimum) for exceptional picture clarity and video quality and shall be engineered with extended operational temperatures ranging from -40°C to +60°C (-40°F to +140°F) as well as wide viewing angles and a variety of mounting options including ceiling, wall and portrait orientations. Enclosure shall be of IP 65 with all required accessories for protection etc. complete.

Outdoor video display monitors shall be provided with GPRS modem / router / datalogger which will have compatibility to interface with display panel and communicate with Central Control Station for remote data and information display. The display content will be either a text data or any video graphic / mimic display or any informative display as per NDMC requirement. All protection enclosures, locking arrangments, cabinets and structure required for mounting, platforms, railings, cables, with all required hardware etc. complete shall be provided to establish the display system.

6.23.175 ITEM No.175:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING AND COMMISSIONING OF PH MEASURING SYSTEM

Following specifications as a minimum shall be applicable in the basic Instrument model offered as pH Measuring System. The pH analyser shall be provided with all the necessary accessories required to operate the Instrument once unpacked and installed at site.

Type	:	Microprocessor based
Mounting	:	Field Mount
Measuring Range	:	0 to 14 pH
Power Supply	:	230 AC
Out put	:	4 to 20 mA. DC 1 for pH/ Orp
Display		2 line LCD display
Area classification		Safe
Temperature compensation	:	Automatic
Enclosure Class	:	IP-67
Accuracy	:	+/- 0.01 pH
Repeatability	:	+/- 0.2 % of the measuring range
Resolution	:	0.01 pH
pH Sensor	:	

Service	:	Clear water
Measuring Range	:	-2-14 pH
Mounting	:	NPT ¾" Threaded – sensor 2 x M20 supply & pulse output
Temperature sensor	:	PT 100/NTC
communication	:	HART
Electrode Length	:	23mm+Electrode Guard
Maximum Pressure	:	10 bar
Operating Temperature	:	110 ^{O}C
Reference Diapharm	:	PTFE
Reference System	:	Double chamber reference system
Membrane / Diaphragm	:	Lead free Glass / PTFE
Display	:	2 line Dot matrix 10 characters per line LCD Display, programmable along with conversion factor
Diagnostics	:	analyzer should continuously monitors itself and the sensor(s) for problematic conditions. The display flash Fault and/or Warning when these conditions occur.
Keypad	:	3 Buttons keypad & magnetic pin programming for user friendly menu interface
Field mounting Housing	:	Polycarbonate / Die cast Aluminium
Electrode Holder	:	
Holder type	:	Flow thru chamber
MOC	:	SS
Holder connection		Clamps / Flange

Taping from the water pipeline and installation of necessary Isolation valves required to make sample available to the analyzers shall be in scope of Contractor.

6.23.176 ITEM No.176:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING AND COMMISSIONING OF CONDUCTIVITY MEASURING SYSTEM

Following specifications as a minimum shall be applicable in the basic Instrument model offered as Conductivity Measuring System. The analyser shall be provided with all the necessary accessories required to operate the Instrument once unpacked and installed at site.

Type	:	Microprocessor based
Mounting	:	Field mounting
Measuring range	:	0-20 µS/cm
Resolution	:	0.01 µS/cm

Accuracy		+/- .5%
Response time	:	Less than 7 sec
Power Supply	:	230 AC
communication	:	HART
Output	:	4 to 20 mA DC freely programmable
Display		2 line Dot matrix 10 characters per line LCD Display, programmable along with conversion factor
Diagnostics	:	analyzer should continuously monitors itself and the sensor(s) for problematic conditions. The display flash Fault and/or Warning when these conditions occur.
Keypad	:	3 Buttons keypad & magnetic pin programming for user friendly menu inteface
Area Classification	:	Safe
Enclosure Class	:	IP-67
Conductivity Sensor:	:	
Service	:	Clear Water
Cell Constant	:	1/CM
Technology	:	Two electrode Graphite Technology
Measuring range	:	0-20 µS/cm
Maximum Pressure	:	2.5 bar at 135 deg C
Operating Temperature	:	-20 to 150 degC
Mounting	:	1 x 1/2 " NPT – Sensor 2 x M20 – supply & pulse output
Temp Sensor	:	PT 100
Electrode material	:	SS 316 L
Field Mounting Housing	:	Poly carbonate
Housing Panel	:	M.S. Powder coated
Max Relative humidity	:	90% non condensing
Electrode Holder	:	
Holder type	:	Flow thru chamber/ direct
MOC	:	SS/PP
Holder connection		1/2'" inlet & outlet tappings

Taping from the water pipeline and installation of necessary Isolation valves required to make sample available to the analyzers shall be in scope of Contractor.

6.23.177 ITEM No.177:- SUPPLY, DELIVERY, ERECTION, INSTALLATION, TESTING AND COMMISSIONING OF TURBIDITY MEASURING SYSTEM

Following specifications as a minimum shall be applicable in the basic Instrument model offered as Turbidity Measuring System. The analyser shall be provided with all the necessary accessories required to operate the Instrument once unpacked and installed at site.

Type	:	Microprocessor Based
Measuring Principal	:	ISO 7027, 90^{o} Scattered light, Infra red (Nephelometric)
Measuring Range		0 – 40 NTU (clear water)
Cleaning	:	Ultrasonic Cleaning System
Temperature rating		1 – 50 deg C
Cleaning	:	Built – in Self cleaning type
Flow rate	:	0.1 to 1 Lit/min
Protection Class	:	IP66/ NEMA 4X
Display resolution	:	0.0001 NTU (below 10 NTU)
Display	:	High contrast LCD provided live measurement readouts in large digits and shows up to four additional process variables
Diagnostics	:	analyzer should continuously monitors itself and the sensor(s) for problematic conditions. The display flash Fault and/or Warning when these conditions occur.
Output	:	4-20 mA
Power supply	:	230 VAC @ 50/60Hz
Response Time	:	Less than 5 sec
Accuracy	:	<10 NTU : 0.0001 NTU <40NTU: +/-2% of reading or +/_ 0.02 NTU which ever is greater.
Repeatability	:	+/- 1 % of the reading
Outputs	:	1 x 4 -20mA current output, Bidirectional RS485 modbus, 2 x relay freely programmable
Material		
Enclosure	:	Polycarbonate
Sample Cuvette	:	Borosillicate Glass
Flow through Fittings	:	Polypropylene /ss
Inlet tube	:	Stainless Steel

Necessary Flow through chamber with ½'' NPT process connection shall be provided for real time readings.

6.23.178 ITEM No.178:- REPLACEMENT OF EXISTING PUMPS AND MOTORS AT VARIOUS BPS LOCATION.

Item includes:- Replacement of existing Pumps and Motors : Supply & delivery at site brand

new and fixing and commissioning , best efficient approved make centrifugal pump conforming to the latest ISS 1520 & ISS 5120 including cost of motor, pump, panel boards, VFD drives, suction, delivery piping on the pump side, electrical cabling, including all accesories and civil, electrical & mechanical work etc.(including dismantling old pumps)

For detailed specification for pumps please refer item no- 127 above head and flow of pumps should be as per the BOQ given as per location wise

For detailed specification for VFD drives please refer item no- 127 above head and flow of pumps should be as per the BOQ given as per location wise

For detailed specification for VFD drives please refer item no- 135 above head and flow of pumps should be as per the BOQ given as per location wise

For detailed specification for motor please refer item no- 140 above head and flow of pumps should be as per the BOQ given as per location wise

6.23.179 ITEM No.179:- ROAD RESTORATION OF BITUMINOUS CONCRETE SURFACE

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.180 ITEM No.180:- ROAD RESTORATION OF CEMENT CONCRETE ROAD

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.181 ITEM No.181:- ADDITIONAL CHARGES FOR TRENCH LESS CUTTING

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.182 ITEM No.182:- RESTORATION OF CHEQUERRED TILES/RCC SLAB/CC SLAB ON WALKWAY/ FOOTPATHS

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.183 ITEM No.183:- 'RESTORATION OF RED/WHITE SAND STONE ON FOOTPATH/ WALKWAY

ETC

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.184 ITEM No.184:- RESTORATION OF 'BRICK ON EDGE FLOORING ETC

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.185 ITEM No.185:- RESTORATION OF 'INTERLOCKING FOOTPATH/WALKWAY

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.186 ITEM No.186:- RESTORATION OF 'D.Q. STONE FLOORING AS PER NDMC RESTORATION SPECIFICATION

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.187 ITEM No.187:- RESTORATION OF ''A) KATCHA/GREEN OF ROAD BERM/NON IRRIGATED

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.188 ITEM No.188:- RESTORATION OF B) IRRIGATED DEVLOPED /GREEN MAINTAINED AREAS

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.189 ITEM No.189:- 'RESTORATION OF ''C)LANDSCAPING GREENS INCLUDING FLOWER BEDS

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.190 ITEM No.190:- RESTORATION OF ''''GRANITE OF ANY COLOUR AND SHADE FOOTPATH WALKWAY

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.191 ITEM No.191:- RESTORATION OF '"G.R.C./ULTRA TILES FOOTPATH /WALKWAYS

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration

6.23.192 ITEM No.192:- ADDITIONAL CHARGES FOR TRENCHLESS CUTTING WITH HAND MOOLING

The different activities under this item shall be executed as per the corresponding specifications of NDMC /CPWD Road restoration.

6.23.193 ITEM No.193:- OPERATION & MAINTENANCE SERVICES FOR THE PERIOD OF FIVE YEARS

Contractors shall comply to the O & M services obligations specified in Section 6 : Employers Requirement. However, following are the minimum obligations covered under the scope of Operation and Maintenance of Contractor.

1. Maintaining the minimum personnel as specified in contract during the previous month.
2. Compliance with the obligations under the Contract.
3. Providing and maintain continuous pressurised water supply to the respective water districts or DMA's specified in the project area
   a. Providing water supply to the Consumers at the minimum service levels as specified under Schedule-7 of PCC without further deterioration
   b. Water Demand Management in DMA's
   c. Emergency water supply
   d. Network Operations, repairs and Management
   e. O & M of assets within Established DMA's
   f. O & M Hasanpur & Talkatora Pumping and all BPS
   g. Flow and pressure monitoring
   h. Repair of leaks and bursts and valves
   i. New Connections as per directives and approval by NDMC
   j. Consumer Services including attending to complaints received through NDMC and their resolution
   k. O & M of SCADA Web Server and monitoring System of project area with web enabled facility
   l. O & M of telemetry system including Integrated GIS system and WDMS system
   m. O & M of PLCS , Flow Meters, Chlorine Analysers, level, pressure, pH, turbidity etc.
   n. Information management and reporting
   o. O & M of existing and new instrumentation of project area
   p. Consumer services like complaint resolution, water awareness & conservation programmers, campaign, media co-ordination, and society meetings etc.