Construction of Water Transmission Pipeline
For Jericho Agro-Industrial Park (JAIP)

ITB No.: ITB-2021-PAL-150345

Particular Specifications

September 2021

Design by
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1 GENERAL PRELIMINARIES

1.1 MOBILIZATION/DEMOBILIZATION

1.1.1 Definition and Scope of Mobilization

The project is to construct a High Density Polyethylene (HDPE) water transmission pipeline of 225mm outer diameter of about 1km length from the new Jericho well site to existing water tanks complex of Jericho municipality and about 5.38km length from the complex to the Jericho Agro-Industrial Park (JAIP) area. The works include also other complementary works such as isolation valves, control valves, air valves, washouts, concrete encasement, sleeve pipes, reinstatement works, all as listed in the Bills of Quantities.

As required for the proper performance and completion of the Work, mobilization shall include, but not limited to, the following principal items:

1. Provide and furnish field offices for the Contractor and Engineer as specified in the UNDP Health and Safety Manual.
2. Move onto the site all the Contractor’s plant and equipment required for the first month’s operation.
3. Install temporary construction power, wiring, and lighting facilities as specified in the UNDP Health and Safety Manual.
4. Establish a fire protection plan and safety program including personnel protective equipment (PPE), first aid kits, etc. as specified in the UNDP Health and Safety Manual.
5. Provide all the requirements in line with the UNDP Health and Safety Manual and maintaining the requirements throughout all the project implementations until the completion of the Works.
6. Provide on-site sanitary facilities and potable water facilities as specified in the UNDP Health and Safety Manual.
7. Arrange for and erect the Contractor’s work and storage yard, employee’s parking facilities, and temporary fencing as specified in the UNDP Health and Safety Manual.
8. Submit all required insurance certificates and bonds.
9. Obtain all required permits.
10. Mobilize and demobilize all equipment and materials in accordance with all local laws related to transportation and safety.
11. Post all required notices.
12. Have the Contractor’s Project Manager and/or superintendent at the job site full time and the other required staff.
13. Submit a detailed construction schedule acceptable to the Engineer.
14. Erect all required Project signboards.
15. Locate and flag the limits of construction and clearing.
16. Satisfy the Engineer that responsive and responsible progress on the Contract Work is under way.

1.1.2 Payment for Mobilization

The Contractor’s attention is directed to the condition that no payment for mobilization, or the part thereof, will be approved for payment under the Agreement until all mobilization items listed above have been satisfactorily completed. The full payment of the Lump sum for Mobilization will be paid after satisfactory completion of mobilization components, according to the related item in the Bill of Quantities.

1.1.3 Demobilization

As required for the proper performance and completion of the Work, demobilization shall include, but not limited to, the following principal items:

1. Remove the Contractor’s field offices and trailer used for storage.
2. Remove all temporary power and utility lines.
3. Remove temporary fencing, roadways and parking areas.
4. All areas disturbed during construction are organized turned back as before construction per the Contract Documents.
5. Remove contract signs.
6. Meet with the Engineer or Owner on site and have the site approved and acceptable as is.

1.1.4 Payment for Demobilization

Payment for demobilization will be made in the final application for payment. The full payment of the Lump sum for Demobilization will be paid after satisfactory completion of demobilization components, according to the related item in the Bill of Quantities.

1.2 ENVIRONMENTAL AND SOCIAL PROTECTION

The Contractor shall make every reasonable endeavour both by means of temporary works and by the use of particular plant or silencing devices to ensure that the level of noise or pollution resulting from the execution of the works does not constitute a nuisance.

The Contractor shall take all such precautions as may be necessary in the conduct of the work to avoid water pollution, air pollution, noise pollution harmful to health, spreading of plant diseases and pests or damage to natural resources or the environment, all as is consistent with good practice and as required by applicable laws, ordinances and regulations or lawful orders.
or authority having jurisdiction, as well as required by the Environmental and Social Management Plan (ESMP) established by the Employer.

End of Section
2 SUBMITTALS

2.1 GENERAL

Inquiries: Direct to Engineer regarding procedure, purpose, or extent of Submittal. 
Timeliness: Schedule and make submissions in accordance with requirements of individual 
Specification sections and in such sequence as to cause no delay in Work.

2.1.1 Identification of Submittals
Complete, sign, and transmit with each Submittal package, one Transmittal of Contractor's 
Submittal Form (see below). Identify each Submittal with the following numbering and 
tracking system:
- Sequentially number each Submittal.
- Resubmission of a Submittal will have original number with sequential alphabetic suffix.
  - Format: Orderly, indexed with labelled tab dividers.
  - Show date of submission.
  - Show Project title and owner's contract identification and contract number.
  - Show names of Contractor, Sub Contractor (if any) and manufacturer as appropriate.
  - Identify, as applicable, Contract Document section and paragraph to which Submittal 
    applies.
  - Identify Submittal type; submit only one type in each Submittal package.
  - Identify and indicate each deviation or variation from Contract Documents.
- Resubmissions: Clearly identify each correction or change made.

2.1.2 Incomplete Submittal Submissions
Engineer will return the entire Submittal for Contractor's revision/correction and resubmission. 
Submittals which do not clearly bear Contractor's specific written indication of Contractor 
review and approval of Submittal or which are transmitted with an unsigned or uncertified 
submission form or as may otherwise be required will be returned to Contractor not reviewed.

2.1.3 Engineer’s Review
Engineer will act upon Contractor's Submittal and transmit response to Contractor not later 
than 30 days after receipt, unless otherwise specified. Resubmittals will be subject to the same 
review time.

2.1.4 Schedule Delays
No adjustment of Contract Times or Price will be allowed due to Engineer's review of 
Submittals, unless all of the following criteria are met:
Contractor has notified Engineer in writing that timely review of Submittal in question is critical to progress of Work, and has received Engineer's written acceptance to reflect such on current accepted submissions and progress schedule. Written agreement by the Engineer to reduce Submittal review time will be made only for unusual and Contractor-justified reasons. Acceptance of a progress schedule containing Submittal review times less than specified or less than agreed to in writing by Engineer will not constitute Engineer's acceptance of the review times.

Engineer has failed to review and return first submission of a Submittal within agreed time indicated on current accepted schedule of submissions or, if no time is indicated thereon, within 30 days after receipt. Contractor demonstrates that delay in progress of Work is directly attributable to Engineer's failure to return Submittal within time indicated and accepted by Engineer. *No adjustment of Contract Times or Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmission of Submittals, including multiple resubmissions.*

### 2.1.5 Copies
- Shop Drawings and Product Data: Five and one reproducible, except copyrighted documents.
- Samples: Two unless otherwise specified in individual Specification sections.

### 2.1.6 General
Submit to Engineer as required by individual Specification sections.

### 2.1.7 Identify and Indicate
- Pertinent Drawing sheet(s) and detail number(s), products, units and assemblies, and system or equipment identification or tag numbers.
- Critical field dimensions and relationships to other critical features of Work.
- Samples: Source, location, date taken, and by whom.
- Each deviation or variation from Contract Documents.
- Design Data: When specified, provide Project-specific information as required and as necessary to clearly show calculations, dimensions, logic and assumptions, and referenced standards and codes upon which design is based.
2.1.8 Preparation

- Format: Whenever possible, schedule for and combine Shop Drawings and Samples required for submission in each Specification section or chapter into a single Submittal package. Also combine product data for like items into a single Submittal package.

- Present in a clear and thorough manner and of sufficient detail to show kind, size, arrangement, and function of components, materials, and devices and compliance with Contract Documents. Identify details by reference to sheet and detail, and schedule or room numbers shown on Drawings.

- Reproducible Copy:
  - Preferred Minimum Sheet Size: A4 and A3, suitable for photocopying.

- Piping Systems: Drawn to scale.

- Product Data: Clearly mark each copy to identify pertinent products or models and show performance characteristics and capacities, dimensions and clearances required, wiring or piping diagrams and controls, and external connections, anchorages, and supports required.

- Equipment and Component Titles: Identical to title shown on Drawings.

- Manufacturer's standard schematic drawings and diagrams as follows:
  - Modify to delete information that is not applicable to Work.
  - Supplement standard information to provide information specifically applicable to Work.

2.1.9 Shop Drawing Disposition

Engineer will review, mark, and stamp as appropriate and distribute marked-up copies as noted:

- Approved as Submitted (for incorporation in Work):
  - One copy furnished Owner.
  - One copy furnished Resident Project Representative.
  - One copy retained in Engineer's file.
  - Remaining copies returned to Contractor appropriately annotated.
  - Contractor may begin to implement activities to incorporate specific product(s) or Work covered by Submittal.

- Approved as Noted (for incorporation in Work):
  - One copy furnished Owner.
2.1.10 Sample Disposition

Same as Shop Drawing disposition; samples will not be returned.

2.2 ADMINISTRATIVE SUBMITTALS

2.2.1 Copies
Submit four copies.

2.2.2 Description
Submittals that are not Shop Drawings or Samples, or that do not reflect quality of product or method of construction. May include, but not limited to those Submittals identified below.

2.2.3 Applications for Payment (and Cash Allowance Data and Values)
Meet requirements of General Conditions and MEASUREMENT AND PAYMENT IN GENERAL TECHNICAL SPECIFICATIONS.
2.2.4 **Progress Reports and Quantity Charts**
As may be required in, Project Control / Procedures.

2.2.5 **Schedules**
- **Progress Schedule(s):** Meet the requirements of Project Control / Procedures.
- **Schedule of Submittal Submissions:**
  - Prepare and submit, preliminary list of submissions grouped by Contract Document article/paragraph number or Specification section number, with identification, numbering and tracking system as specified under Paragraph Identification of Submittals and as approved by Engineer.
  - Include only the following required submissions:
    - Shop Drawings and Samples.
    - Training plans (if required by other sections).
    - Test procedures.
    - Operation and maintenance manuals (if required by other sections).
    - Record documents.
    - Specifically required certificates, warranties, and service agreements.
  - Coordinate with progress schedule and prepare submissions to show for each Submittal, at a minimum, the following:
    - Estimated submission date to Engineer.
    - Specifically requested and clearly identified Engineer review time if shorter than that set forth herein, with justification for such request and critical dates Submittals will be needed from Engineer.
    - For first 6-month period from the date the Contract Times commence or following any update or adjustment of the submissions, the estimated submission date shall be week, month, and year; for submissions beyond 6-month time period, show closest month and year.
  - Submit to Engineer monthly (i) updated list if changes have occurred, otherwise submit a written communication confirming existing list, and (ii) adjusted submissions reflecting submission activity planned for forthcoming 6-month time period and beyond. Coordinate with progress schedule updates.

2.2.6 **Submittals Required by Laws, Regulations, and Governing Agencies**
- Submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
• Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

2.2.7 Disposition
Engineer will review, stamp, and indicate requirements for resubmission or acceptance on Submittal as follows:

■ Accepted:
  • Acceptance will indicate that Submittal conforms to intent of Contract Documents as to form and substance.
  • Contractor may proceed to perform Submittal related Work.
  • One copy furnished Owner.
  • One copy furnished Resident Project Representative.
  • One copy retained in Engineer's file.
  • Remaining copies returned to Contractor appropriately annotated.

■ Rejected as Noted:
  • One copy retained in Engineer's file.
  • Remaining copies returned to Contractor appropriately annotated.
  • Contractor shall revise/correct or develop replacement and resubmit.

2.3 QUALITY CONTROL SUBMITTALS

2.3.1 Certificates
■ Manufacturer's Certificate of Compliance.
■ Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in the individual Specification sections.
■ Manufacturer's Certificate of Proper Installation.

2.3.2 Statements of Qualification
Evidence of qualification, certification, or registration. As required in these Contract Documents to verify qualifications of professional land surveyors, Engineers, materials testing laboratories, specialty Sub Contractors, trades, specialists, consultants, installers, and other professionals.

2.3.3 Field Samples
Provide as required by individual Specifications and as may be required by Engineer during progress of Work:
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- Written Test Reports of Each Test and Inspection: As a minimum, include the following:
  - Date of test and date issued, Project title and number, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
  - Date and time of sampling or inspection and record of temperature and weather conditions.
  - Identification of product, Specification section, location of Sample, test or inspection in the Project, type of inspection or test with referenced standard or code, certified results of test.
  - Compliance with Contract Documents, or identifying corrective action necessary to bring materials and equipment into compliance.
  - Provide an interpretation of test results, when requested by ENGINEER.

2.3.4 Disposition

Engineer will review, stamp, and indicate requirements for resubmission or acceptance on Submittal as follows:

- Accepted:
  - Acceptance will indicate that Submittal conforms to intent of Contract Documents as to form and substance.
  - Contractor may proceed to perform Submittal related Work.
  - One copy furnished Owner.
  - One copy furnished Resident Project Representative.
  - One copy retained in Engineer's file.
  - Remaining copies returned to Contractor appropriately annotated.

- Rejected as Noted:
  - One copy retained in Engineer's file.
  - Remaining copies returned to Contractor appropriately annotated.
  - Contractor shall revise/correct or develop replacement and resubmit.

2.4 CONTRACT CLOSEOUT SUBMITTAL

2.4.1 Record/As-Built Drawings

Throughout the project, maintain a current complete set of project drawings with all variations plainly marked. Each month, or as otherwise agreed, submit to Engineer a current listing and description of each variation incorporated into the work since the preceding submittal. Contractor will prepare a set of Contract Drawings, with all changes marked in red and including all variations made in materials, locations, and dimensions of the work. The
Contractor shall certify that these drawings represent the actual "as built" condition of the project.

After approval of the Engineer to these drawings, the Contractor will rely upon these drawings in the preparation of Record Drawings of the Work.

The Contractor shall submit to the Engineer three sets of the final record drawings on paper form in addition to one copy of digital form on Auto Cad format at least version 14.

### 2.4.2 General Guidelines for AutoCAD As-Built Drawings

1. As-built drawings must be prepared and certified by a licensed surveyor.
2. The Palestinian Coordinate System shall be used. The Benchmarks (absolute benchmarks) to be used shall be declared by the surveyor and be documented by photos (to be supplied to the Employer).
3. Surveyor’s seal on all sheets signed and dated.
4. As-built drawings shall be drawn to 1/500 scale on A2 sheets.
5. Cover Sheet shall include:
   a) Project title and number.
   b) Contractor’s name and address.
   c) Logos as per Engineer’s instructions.
6. Key plan.
7. Provide a quantity sheet showing final or As-built quantities.
8. Drawing sheets numbered in sequence.
9. As-built drawings to be submitted in AutoCAD (.dwg) format.
10. Provide a draft copy with an AutoCAD file.
11. After checking the draft one, the Contractor shall provide the Engineer with (3) copies of the final as-built drawings.
12. Draw all the details in each chamber/manhole/cabinet.
13. The Engineer will provide the contractor with an AutoCAD (.dwg) format file which contains the names of all layers.
14. All features depicted in the as-built drawings must be surveyed after construction and before backfilling. The Engineer’s surveyor will spot check all coordinates to ensure accuracy.
TRANSMITTAL OF CONTRACTOR’S SUBMITTAL FORM

TRANSMITTAL OF CONTRACTOR’S SUBMITTAL

(ATTACH TO EACH SUBMITTAL)  TO DATE: ___________________________

TO: ___________________________

Submittal No.: ___________________________

New Submittal  Resubmittal

____________________________________

Previous Submittal No.: _______________

Project: ___________________________

____________________________________

Contract No.: _______________________

Specification Section No.: ____________

(Cover only one section with each transmittal)

FROM: ___________________________

Contractor

____________________________________

Schedule Date of Submittal: ____________

____________________________________

SUBMITTAL TYPE:

Shop Drawing  Quality Control

Administrative  Contract Closeout

Sample  "Or-

Equal"/Substitute

The following items are hereby submitted:

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<tr>
<th>Number of Copies</th>
<th>Description of Item Submitted (Type, Size, Model Number, Etc.)</th>
<th>Spec. Para. No.</th>
<th>Drawing or Brochure Number</th>
<th>Contains Variation to Contract</th>
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Center for Engineering and Planning (CEP)
Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: ________________________________________________
Contractor (Authorized Signature)

End of Section
3 HDPE PIPES

3.1 GENERAL

3.1.1 Potable Water Certification

All pipes, coating, and lining materials shall be certified for potable water use and shall contain no ingredients that may migrate into water in amounts that are considered to be toxic or otherwise dangerous for health. The Contractor is prohibited to import or to use any of the “Acryl amide and N-Methyl acryl amide Grouts” or any other toxic or poisonous materials or sub materials used in piping, kinds of concrete or in soil in any kind of usage.

The contractor is required to submit certificates from third party recognized by the governmental tender’s doctorate, (Bureau VERITAS, Lloyds, SGS, and WRAS or any other accredited certified third party organizations) that the components of the network must not be of any way toxic to the water being conveyed and can be fully used for the distribution of potable water to a temperature up to 50°C. The Certificates should be submitted for the following materials:

-Cement mortar.
- Bituminous paint.
- Epoxy polyurethane varnish.
- Epoxy powder.
- EPDM Sealing Rings and Rubber Gaskets.
- Lubricating paste.

3.1.2 Quantities of Pipes, Valves, Fittings and Specials

Before ordering the pipes, the Contractor shall make a proper survey of the Pipelines and shall make sure of the necessary lengths of each kind of pipes, adapters, fittings, valves, and specials necessary to complete the works. The Contractor shall have no claims for extra or deficit amounts that he orders based on BOQ.

3.1.3 Fittings

Fittings unless otherwise specified shall be furnished with a type of joint compatible with the pipe system at the supplier’s option. Any adapters necessary to joint fittings to the adjacent pipes, even of different materials, shall be provided by the Contractor at no extra cost.
3.1.4 Toxic Materials

The Contractor is prohibited to import or to use any of the “Acryl amide and N-Methyl acryl amide Grouts” or any other toxic or poisonous materials or sub materials used in piping, kinds of concrete or in soil in any kind of usage. Any Contractor required to be licensed in writing by the Employer, otherwise, the Contractor shall be subject to legal pursuance.

3.1.5 Country of Origin of Materials

The Contractor shall be specific as to the country of origin and manufacturing firm of the materials he intends to supply under the Contract, and shall submit all relative catalogues to the Engineer. Prior to confirming the import of any materials, the contractor shall obtain the written approval of the Engineer.

3.2 HDPE Pipes

HDPE pipes shall comply to ISO 4427 or EN 12201 Plastic pipe systems for water supply or equivalent. HDPE pipes shall satisfy the following standards: PS 196-1, 2, 5 or ISO 4427-1, 2, 5 or EN 12201-1, 2, 5. HDPE fittings shall satisfy the following standards: PS 196-1, 3, 5 or ISO 4427-1, 3, 5 or EN 12201-1, 3, 5.

Electro fusion and butt welded fittings shall comply to EN 12201-3. Compression fittings shall comply to ISO 17885 or equivalent. On request the documentation of HDPE pipes and fittings’ quality is to be submitted by the contractor through working certifications according to EN 10204-3.1. HDPE Pipes Electro fusion fittings, butt welding fittings, and compression fittings should be colored all through –out as per standards.

The manufacturer/s of HDPE pipes and fittings shall have implemented a quality management system according to DIN ISO 9001.

HDPE pipes shall be jointed by butt-fusion or electro-fusion welded fittings.

Electro-fusion fittings should have the electrical resistance totally integrated in the fitting’s body and PIN connectors diameters shall be 4.7 and/or 4 mm and comply with the relevant provisions of ISO 121762:2000.

Materials in contact with or likely to come into contact with potable water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odor and cloudiness or discoloration of the water. Concentration of substances, chemicals and biological agents leached from materials in contact with potable water, and measurements of the relevant organic/physical parameters shall not exceed the maximum values recommended by the World Health Organization (WHO, 1984) or as required by the EEC, Council Directive.
1980, whichever is in each case is the more stringent.

The melt flow rate (MFR) for the raw material shall not be less than 1.0 g/10 min. tested at 190° C/5 kg. When measured according to the ISO 1133 test method Evidence of nominal value of (MFR) for raw material shall be provided. The nominal value is the average value indicated by the pipe manufacturer as a standard value for his production.

The MFR for raw material and for extruded pipe should be measured. Change of MFR by processing shall be less than 20% for the tested values. In addition, the MFR measured on the extruded pipe can deviate by ±30% from the nominal value.

- Solution flow rate must be 0.200 to 0.500 gram/10 minutes under 190 C and 5 kg load.
- The stretching at the time of breaking must not be lower than 600% when measured according to the ISO 6259 test method
- Break resistance at flow point must be higher than 19 MPa, when measured according to ISO 6259 test method.

### 3.2.1 Factory Testing of Pipes

Tests for determining the resistance of pipes to a constant internal pressure and the bursting time of these pipes are required and should comply with DIN 8075 or ISO/1167.

Two types of tests are required:

- **Acceptance test**, carried out at a temperature of 20°C (1 hour-test). This allows a fast verification of the conformity of a batch of pipes to a specified type. At least one sample test for each size shall be carried out for every batch of pipes delivered to the site. Maximum batch size for the purposes of this clause is to be 10 km.

- **Quality test** (170 hr-tests) carried out at an elevated temperature as a nature of the pipes tested. It is a test for the material type and should be carried out for each dimension of pipes as follows:

  - When a change is made in composition or method of manufacture of the pipe.
  - Not less than one test every twelve months.
  - At least one test for each lot not greater than 20 km in length delivered to the site.
  - At least one test for each size of pipes.

The above tests allow evaluation of the standard of production and the pipe material used. The pipe material shall be of type PE 100 or PE 100+ and shall meet the following minimum requirements:
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<table>
<thead>
<tr>
<th>Acceptance Test</th>
<th>Quality Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature 20°C</td>
<td>Temperature 80°C</td>
</tr>
<tr>
<td>Time 1 hour</td>
<td>Time 170 hours</td>
</tr>
<tr>
<td>Induced stress 19 N/mm²</td>
<td>Induced stress 4 N/mm²</td>
</tr>
</tbody>
</table>

If the pipe leaks or ruptures during the period stipulated for the acceptance test, it will be rejected.
When the pipe eventually fails during the acceptance test it shall show a ductile failure of the pipe wall (displaying visible yield deformation at failure.) A brittle or other shattering, cracking, splitting, or weeping pipe shall not be acceptable.

Failure of the wall during the quality test shall be a brittle failure.

3.2.2 Storage

The Contractor shall ensure that during transport, handling and storage, each item (pipe and fitting) is free from damage prior to installation. Damaged pipes and fittings shall be discarded. The protection of the pipe ends is particularly important. Pipes and fittings should never be dropped to the ground. They should be unloaded from the transport either by hand or using slings and lifting equipment.

Pipes shall be cut by an approved method which provides a clean square cut of the pipe and lining (if applicable) without damage. All cut or trimmed ends shall cleaned before the pipes are laid.
Polyethylene pipe, tubing and fittings should be stored according to the manufacturer’s recommendations.
Also the following general points should be taken into consideration:

- Contact with burrs or sharp metal edges on racks, etc., should be avoided.
- The ends of pipes should be protected from damage to avoid the risk of unsatisfactory jointing.
- The pipes and fittings should be stored under cover and protected from direct sunlight including when stacked at the places of delivery.
- The Contractor shall take all measures such as providing covers of suitable size and durability to protect the pipes and fittings from direct sunlight.
- Coils may be stored either on edge or stacked flat one on top of the other, but in either case they should not be allowed to come into contact with hot water or steam pipes and should be kept away from hot surfaces. To avoid damage coils should not be dragged over rough ground
- Pipes and fittings should be stored at less than 23°C.
If, due to unsatisfactory storage or handling, a pipe is damaged or kinked, the damaged portion should be cut out completely at the Contractor’s expense.

### 3.2.3 Marking of pipes and fittings

All HDPE pipes shall be indelibly marked at maximum intervals of one meter. The fittings shall be indelibly marked or labelled.

The marking shall show at least the following information:

- Manufacturer’s name and/or trade mark.
- Dimensions (nominal diameter, wall thickness).
- Material, material class (e.g. PE 100+) and
- Pressure class e.g. (PN10) or (PN16)
- Production period (date).
- “Water”, to indicate that pipes or fittings are intended for potable water.
- Serial number.
- Batch number.
- Standard number
- SDR

The HDPE pipes and fittings shall be rejected, if the above information for marking is not shown clearly on each piece.

### 3.2.4 HDPE Joints and Fittings

Jointing of the pipes shall be either mechanical or push fit. Jointing shall be made of Acetyl or ABS or gunmetal.

The mechanical jointing shall consist of tightening the pipe by means of screwed connections with compression push in such a way that water tightness is fully secured by means of elastomer “O” ring and PVC grip ring or equivalent material for “O” ring.

Push fit jointing shall consist of a PVC grip ring and nitrile elastancer “O” ring or equivalent material for “O” ring.

HDPE couplings and fittings shall be designed for a nominal working pressure of 16 bars and temperature of 40°C and shall be suitable for the HDPE pipes supplied. The Contractor shall liaise with the Engineer and the Employer to ensure that the fittings supplied under another contract are compatible with the pipes which the Contractor will supply.

The Tapping tees supplied shall be such as to ensure ease of assembly with an integrated moulded nut, retained in the body of the fitting to prevent loss or damage. The cutter and sleeve shall be of corrosion-free metal with the cutting area free of the heating coils. The unit shall be complete with a plug and sealing-ring for permanent and reliable sealing when under pressure to PN 16. The electro-fusion of the tapping tee shall be as described above.
Tapping tees shall comply with DIN 3543, part 4 and DIN 3544, part 1 and shall be sealed with an electro-fused end cap.

### 3.2.5 Testing of fittings and joints

The dimensions of the mechanical fittings and joints shall be chosen so that assemblies fulfil the requirements of the performance tests for the assembled joints mentioned below. The HDPE pipes and fittings, accessories and specials are recommended to be furnished by single manufacturer. HDPE Pipes and fittings shall be compatible. An official letter signed by the manufacturer shall be submitted to ensure the compatibility between the pipes and fittings. The Contractor shall provide certificates from an authorized third party demonstrating that the assembled joints comply with the following tests (performance tests):

- ISO 3458 Assembled joints between fittings and polyethylene pipes: test of leak proof less under internal pressure.
- ISO 3459: Polyethylene pressure pipes joints assembled with mechanical fittings: test of internal pressure.
- ISO 3501: Assembled joints between fittings and polyethylene pressure pipes: test of resistance to pull out.
- ISO 3503: Assembled joints between fittings and polyethylene pressure pipes: test of leak proof less under internal pressure when subjected to bending.

### 3.3 TESTING -GENERAL

The Contractor shall provide a sufficient quantity of gauges, pumps, stop ends, pipes and connections and all things necessary and suitable for the pressure testing of all pipes. The Contractor shall also provide all necessary temporary works in connection with the test, and shall remove the same on successful completion of the test. All tests shall be done in the presence of the Engineer’s Representative and in accordance with the relevant standards for the pipe material under test the results shall be signed by the Contractor and handed to the Engineer’s Representative who shall prepare the necessary test reports.

Should any test fail, the Contractor shall (after repairing and making good any leaks), carry out at his own expense further tests all as described above until such tests meet the requirements contained herein.

The results of the tests, specifying the layout of sections of system, pipes and fittings tested including all relevant data of testing as weather, time, duration, filling time, pressure, etc., shall be produced in the form of a report by the contractor and signed by the contractor and the Engineer’s Representative. This report shall not relieve the Contractor of his responsibility for care and maintenance of the system until the date of final acceptance of the completed work.
The contractor shall make the water tests for the isolation of each zone in the contract as in drawings and shall provide all needed and necessary fittings or equipments for these tests. The contractor shall give note to the engineer 14 days before doing the test in order to have the employer's approval and shall make all the coordination required with the other contractors, if any.
4 VALVES

4.1 GENERAL

All valves and accessories are recommended to be furnished by a single manufacturer and should be subjected to the Engineers approval before ordering the valves. Valves shall be compatible with pipes and fittings specified in these Specifications. Compatibility should be the Contractor’s responsibility at his own expense, and should be approved by a third party accredited by PSI certified Testing Laboratory. Two copies of manufacturing and installation manuals shall be provided at time of materials delivering.

All valves shall be supplied according to the latest editions of standards and references specified in these Specifications. Valves shall be fabricated according to Standards and References specified in these specifications or shall be equivalent and compatible to these standards and references subjected to third party accredited testing laboratory.

The type and size of valve to be used at any location shall be as indicated on the Contract Documents or specified herein and shall be rated to at least the same pressure as the pipeline in which they are to be installed. All valves shall be designed to avoid cavitation and vibration in all positions, to minimize head loss in the open positions and to seal the water passage when completely shut.

All operating spindles and gears shall be provided with adequate points for lubrication. Unless otherwise specified, all valves shall be closed in a clockwise direction. Head loss curves through the valves for throttled flow conditions shall be provided for all valve sizes.

Bolts, nuts, rubber seals (joint rings), gaskets, and flanges shall be in accordance with standards specified in GTS.

Valves’ manufacturers shall have a minimum 5 years’ experience in the manufacturing of similar products.

The following brands or equally approved are accepted:

- Vales General: Talis Group, Henry Bratt, VAG, PAM, ARI, DVD.
- Brass/copper alloy valves: Sagiv, NTM, Giacomini, Itap.
- Couplings, dismantling joints, flexible joints and adaptors: Talis-Uni-Joint, BELGICAST, PAM, Viking Johnson, Witzenmann,
- Hydraulic Control Valves: Bermad, Talis-Raphael, Erhard, Bayard and Cla-Val.
- Water Meters: Siemens, ABB, Euromag, Endress+ Houser
- Pressure Gauges: Ashcroft, Wika, Bourdon, Kobold.

4.2 SUBMITTALS

The contractor shall submit the following:

- Assembly drawings.
• Manufacturer Valid quality certifications ISO or equivalent.
• Certified copies of Manufacturer quality control Test results and reports.
• Assembly shop drawings.
• Instruction manuals.
• Catalogues.
• With every consignment of valves, accessories and specials delivered under this Contract, the Contractor shall furnish a certificate worded as follows:

“This is to certify that the valves, accessories and specials delivered in this consignment comply with the required specifications and Standards”.

4.3 MARKING OF VALVES AND WATER METERS

The valves and water meters shall be clearly labelled and marked with the following information:

■ Valves:
  • Class or Pressure rating.
  • Nominal Diameter
  • Arrow showing the flow directions (for valves designed for one-way flow only).
  • Name or trade mark of the manufacturer.
  • Date of manufacturing.

■ Water Meter:
  • Pressure rating.
  • Nominal diameter.
  • Meter class.
  • Arrow showing the flow direction.
  • Serial number.
  • Name or trade mark of the manufacturer.

4.4 VALVE COATINGS

Unless otherwise indicated in the Tender Documents for an alternative coating system, the internal and external surfaces of valves shall be prepared and coated with epoxy paint. The final coat shall be applied to external surfaces after installing the valves. All coats/materials in contact with water shall be certified for drinking water as per NSF-61 or WRAS or equivalent.

4.5 WORKS TESTS

All valves shall be hydrostatically tested at the place of manufacture. The Contractor shall supply a certificate stating that the valves supplied have satisfactorily passed the specified tests and comply in all respects with these Specifications or BOQ.
All valves shall be subjected to pressure test in accordance with ISO 5208 and shall be drop tight.

4.6 PACKING

All valves shall be securely packed in crates or boxes for protection against damage during transit, and shall be accompanied by the materials necessary to secure all flanges to adjacent pipe work. These materials shall also be suitably packed and shall be stored away from sunlight at all times.

4.7 MATERIAL, PRESSURE RATING AND EQUIPMENT

- All valves and appurtenances shall be of the size shown on the Drawings and as far as possible all equipment of the same type shall be from one manufacturer.
- All valves and appurtenances shall have the name of the maker, flow directional arrows, and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
- All buried valves shall open left (counter clockwise). Insofar as possible, all valves shall open counter clockwise.
- All valves installed at the inflow and outflow side of the water reservoir shall be PN 16 bar rating.

4.8 FLANGED JOINTS GASKETS

The joints shall withstand under the same pressures mentioned for the pipes. The dimension of the gaskets shall be such that, when jointed in accordance with manufacturer’s instructions, the joint shall provide a positive seal for the range of pressures likely to occur in the pipeline. The dimensions and tolerances of the flanges of pipes and fittings shall comply with ISO 7005 and/or EN 1092, to insure interconnection between all flanged components like pipes, fittings, valves, …etc. of the same DN and PN and adequate joint performance. Gaskets shall be 2-3 mm thick and shall be reinforced compressed fibres or EPDM suitable for drinking water, in one piece, full-cut with holes to pass the bolts. Segmented, straight joint or interlocking gaskets shall not be accepted. Blind flanges shall be casketed covering the entire inside face with the gasket cemented to the blind flange. The dimensional size shall be kept to the full face of the flange to suit the flange bolting.

4.9 NUTS, BOLTS, SCREWS, GLANDS AND WASHERS

Nuts, bolts, screws, washers generally shall be of austenitic stainless steel 316 Grade A4 -70 as per ISO 3506, DIN 267-11 or ISO 4017. Nuts, bolts and screws shall have coarse metric threads. Bolting for pipes and fittings shall comply with the approved standard. Bolt lengths shall be sufficient to ensure that nuts are full-threaded when tightened in their final position. At least two washers shall be provided with each nut and bolt set.
bolts and nuts shall be supplied with two washers per bolt, and the bolt length shall be such that after the joints are made up, the bolts shall protrude through the nut by at least 1.30 times bolt size (Not more than 40% of bolt size).

4.10 GATE VALVES AND APPURTENANCES

4.10.1 General

- Ductile Iron Gate valves for water shall meet the requirements of ISO 7259, ISO 5996 or EN 1171. Steel gate valves should comply with ISO 6002 or EN 1984.
- The flanged gate valves shall be face to face doubled flanged, ductile iron, resilient seated for rated pressure up to 25 bar and metal seated for PN 40 valves, wedge gate and non-rising stem suitable for use in drinking water systems and buried/non-buried service.
- Face to-face and centre-to-centre dimensions of flanged valves shall comply with EN 558-1 and EN 558-2, respectively. The required basic series are:
  - Long valve: ISO 5752, EN 558-1 basic series 15.
  - Short valve: ISO 5752, EN 558-1 basic series 14.
- Standard flange drilling and dimension is according to EN 1092-2.
- Stuffing boxes shall be the "O-Ring" type.

4.10.2 Gate Valve Characteristics

- Gate and stem
  - The gate of valve shall be of the Wedge resilient seated type for nominal rated pressure up to 25 bar.
    - The gate sealing in the body shall be ensured by the rubber compression.
    - The gate shall be ductile iron, fully encapsulated in EPDM leaving no exposed metal surface.
    - The resilient material shall have a nominal thickness of minimum 4mm on the seating areas, and minimum 1.5mm on the other non-seating areas.
  - The gate of valve shall be of the Wedge metal seated type for nominal rated pressure of 40 bars and above. The body seat shall be of copper alloy; the wedge seat shall be of copper alloy or stainless-steel welded overlay.
  - The wedge shall be combined with guide rails and integrated wedge shoes to secure a smooth operation of the valve and low operating torques.
  - The valve stem shall be stainless steel BS EN 10088-1: 1.4021 (grade AISI 420) or equal.

- Stem and bonnet sealing
  - Non-rising type shall be used.
  - The stem threads shall be rolled in a cold pressing process.
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- The stem shall be provided by triple sealing system (EPDM or NBR) as follows:
- Stem ‘O’ ring seal arrangement shall be suitable for replacement under pressure.
- Bonnet sealing: EPDM O-ring between cap and bonnet, EPDM gasket between bonnet and body.

■ Bolts Sealing

- The Bolts which are used to secure bonnet to valve body are further protected with Plastic Seal/ Wax to provide extra sealing and protection
- The bonnet bolts are encircled by the bonnet gasket, countersunk in the bonnet and finally sealed with Plastic Seal/ Wax to prevent corrosion.

■ Valve Closing:

- The valves shall be closed by turning the stem in a clockwise direction.
- Each valve shall be supplied with a stem cap secured to the valve stem by a stainless-steel headed setscrew or a hand wheel. The stem cap or hand wheel shall be marked with an arrow to indicate the clockwise closing direction of the valve.
- Stem caps shall be designed to be the first component of the valve to break under both of the following situations:
  - Gradually increasing closing torque is applied to the top end of the stem cap when the valve is in a fully open position; and
  - Gradually increasing opening torque is applied to the top end of the stem cap when the valve is in a fully closed position.
- Hand wheel shall be of grey cast iron with epoxy coating according to BS EN 14901 or ductile iron.

4.10.3 Gate Valves and Appurtenances for Buried Service

- Valves shall be steel body, or ductile, bronze- mounted, double disc, parallel seat; non-rising stem type fitted with "O-Ring" seals. The operating nuts shall be 50mm (2in) square.
- Valves shall be equipped either with hand-wheel or the spindle as specified in the Drawings or BOQ.
- Tapping sleeves shall have cadmium-plated low alloy steel nuts and bolts. Sleeves shall be of cast iron, designated for working pressures not less than 30 bars (435 psi). Lead gaskets shall be provided for the full area of the sleeve flanges.
- Tapping valves shall conform to the requirements specified above for gate valves except that one end shall be flanged and one mechanical. Tapping valves shall be provided with an oversized opening to permit the use of full-sized cutters.
- Valve boxes shall be provided for each buried valve. They shall be cast iron, of heavy pattern, adjustable type and provided with cast iron cover. The upper section of each box shall have a bottom flange of sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve. Boxes
shall have barrels of not less than 130mm (5in) in diameter and be of length adapted to pipe cover.

- Valve boxes shall be adjustable, with a lap of at least 150mm (6in) when in the most extended position. Covers shall have lettering indicating the type of service.
- Tee handled gate wrenches of suitable length shall be furnished to operate all valves with valve boxes. Valves greater than 300mm in diameter supposed to be actuator operated or fixed in a horizontal position should be fitted with mechanical gear on the wedge working in machined gunmetal channel in the body.

### 4.10.4 Gate Valves for Non-Buried Service

- Gate valves, shall have flanged, screwed, or solder ends as required; and shall be bronze/ductile iron, solid wedge, rising-stem-type gate valves or non-rising-stem type as specified in the Tender Documents.
- Bronze gate rings shall be fitted into grooves of dovetail or similar shape in the gates. For grooves or other shapes, the rings shall be firmly attached to the gates with bronze rivets.
- Hand wheels shall turn counter clockwise to open the valves. Hand wheels shall be of ample size and shall have an arrow and the word OPEN cast thereon to indicate the direction of opening.
- The design of the valves shall permit packing the valves without undue leakage while they are wide open and in service.

### 4.11 CHECK VALVES (NON-RETURN VALVES)

#### 4.11.1 General

- Check valves shall be swing type and shall meet the material requirements of AWWA C508 or BS EN 1074-3 or ISO 5781.
- Standard flange drilling and dimension is according to EN 1092-2.
- The valves shall be iron body, bronze mounted, single disc. The Ductile iron check valves should comply with EN 12334.

#### 4.11.2 Characteristics

- Body, disc, cap/cover, lever and weight arm shall be of cast grey or cast ductile iron (Grey cast iron: EN 1561- GJL-250 or ductile cast iron: EN 1563- EN GJS 400-15 or 500-7. The disc shall be of grey/ductile cast iron or carbon steel to EN 10083-1 or ASTM A216-WCB with EPDM or NBR seals. The shaft shall be stainless steel BS EN 10088-1:1.4021 or ASTM 420 – S42010 or equal.
- When there is no flow through the line the disc shall hang lightly against its seat in...
practically a vertical position. When open, the disc shall swing clear of the waterway.

- Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers.
- Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm, outside lever and counter weight. Valves shall be also equipped with non-slam dampener (spring or hydraulic dampener).

### 4.12 QUICK CONNECT COUPLINGS

Couplings shall be of the cam and groove type consisting of a male adapter conforming to Specification ISO 6150, ISO 2861, ISO 7241-1, ISO 16028. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leak-proof under working pressures. Each adapter shall be furnished with a dust cap complete with security chain of corrosion resistant material.

### 4.13 FLEXIBLE COUPLINGS/CONNECTORS

Furnish/Install moulded double arch spherical connector/expansion joints(s). The moulded spherical body must be manufactured using multiple piles of nylon tire cord fabric bonded within the EPDM elastomeric or reinforced rubber bellows. Floating flanges shall be zinc-coated plate steel and must have drilled bolt holes in accordance with pump flanges standard (EN 1092-1). The floating flanges shall be complete with stainless steel AISI 316 tie rods (external restraints) of the same size as of flange bolts to absorb reaction force from internal pressure.

### 4.14 DOUBLE FLANGED, RESTRAINED DISMANTLING JOINTS

- The adaptor body and end rings shall be constructed of Ductile iron to BS EN 1563-EN-GJS-450-10, Spigot body: Steel to BS 10225:2004, Flange (follower): Steel to BS EN l0025:2004 Grade S275.
- Dismantling joints are to be assembled between two flanges.
- Dismantling joints shall consist of two single flanged sleeves, one loose flange, one gasket and the bolts and nuts required to tighten the coupling and compress the gasket.
- One sleeve shall be able to slide into the other sleeve by at least 50mm.
- Sealing shall be achieved by compression of the gasket by the loose flange.
- Dismantling joints shall be able to restrained axial thrust forces under the nominal working pressures indicated in the design drawings and bill of quantities.
- The metal parts (except bolts and fittings), from internal and external shall have epoxy powder coating.
- The Adaptor and accessories shall be internally and externally coated with a factory applied Epoxy coating.
- Average thickness of Epoxy powder coating is 300 microns with no Spot thickness less than 250 microns.
• The Protective coating comprises chemical treatment of the iron surface followed by electro-deposition of a blue Epoxy resin suitable for Drinking water, resulting in a regular thickness of coating.
• All the bolts, nuts, washers, fixing rods and accessories shall be stainless steel 316 type A4.
• Dismantling Joints of PN 16 shall be 25% restrained, higher ratings shall be fully restrained unless otherwise stated in the Bill of Quantity.

4.15 PRESSURE GAUGES

Pressure gauges shall be manufactured in accordance with ISO 5171 or EN 837-1,2,3 and shall be furnished and installed where indicated in accordance with Tender Documents requirements. The gauges shall be 4" diameter, liquid filled, bottom connected, equipped with while laminated dials and black graduations and shall have shatterproof glass. The measuring element shall be stainless steel bourdon tube with welded stress- relieved joints with stainless steel rotary geared movement. Where gauge taps are not available in the pump’s suction or discharge nozzle, the necessary taps in the adjacent piping shall be made for installation of gauge connections.

Provide an accuracy of plus and minus 1/2-percent range to 150 percent of the working pressure or vacuum of the pipe or vessel to which the gauge is connected.

4.16 FLAP VALVES

Flap valves to be used in the overflow system discharge lines shall be as specified or as per Contract Drawings and, shall be flanged end.

4.17 AIR RELEASE VALVES

Air release valves shall be of combination 3 function type with ductile cast iron bodies, the inlet flange shall be fitted and drilled in accordance with EN 1074-4. The valves shall be adequately sized for the release of air from the pipeline (or other container) without restriction of rate of filling or flow due to backpressure. Air shall be allowed to enter at a rate sufficient to prevent excessive reduction of pressure in the pipe during pipeline emptying. The “aero kinetic” type shall be provided; air valves with internal operating linkages shall be avoided.

Valves shall be designed to prevent the operating elements being in contact with the pipeline liquid by approved means such as the provision of an auxiliary float and chamber sufficiently large to isolate the orifice valves and seats throughout the rated operational range.

Air valves shall be fitted with a separate isolating ball or gate valve and gearing shall be provided, where necessary, to facilitate operation.

In applications where the pipeline characteristics may lead to liquid column separation with consequent possibility of surge conditions, a vented non-return valve shall be provided which allows air to enter freely on separation but controls expulsion of air as the liquid column rejoins (non-slam type).

All air release valves and associated isolating valves shall be works tested and capable of withstanding the same test pressure as the pipeline or vessel on which they operate. All materials used in the manufacture of the valve shall conform to EN 1074-4.
4.18 BALL VALVES

Large full-bore type with BSP threading. Body, bonnet and ball constructed of Chrome/nickel plated brass CW617N and complete with PTFE seals, NBR O-ring, steel PVC coated lever. The valves shall be suitable for drinking water. The threaded valves shall be rated for as per drawings and bill of quantities. The valves shall be marked and tested according to EN 331.

4.19 HYDRAULIC CONTROL VALVES

Hydraulic Control valves should comply with ISO 6263 or EN 1074-5. The valves shall be hydraulically operated, diaphragm actuated for ratings up to 25 bar and piston actuated for rating of 40 bar and more. The valves may be single or double chamber type according to approved manufacturer recommendations. The valve body and actuator shall be heavily constructed ductile cast iron as per EN 1563 (EN GJS 400-15, EN JS 1030-GGG 40 grade at least) and shall be of globe or Y or sigma pattern type. Valve internals and trim including stem, springs, seat rings, bolts, nuts, washers of S.S. Valves up to PN 25, shall be hydraulically operated diaphragm actuated, diaphragm and seals shall be constructed of Nylon Reinforced Buna-N or NBR Nylon fabric-reinforced material. PN 40 valves shall be hydraulically operated/ piston actuated, body shall be constructed of Carbon steel EN 10083-1 (ASTM A-216 WCB). The pilots and control loop (tubing and fittings) shall be constructed of S.S 316 or copper alloy. All control valves shall be equipped with indicating rod. The most appropriate type of port/plug shall be selected by the approved manufacturer in order to fit the operating system hydraulic conditions. Prior to shipment of the valves the manufacturer shall factory test the valves under the pressure and flow conditions specified by tender documents or as directed by the Engineer. The manufacturer shall submit to the Engineer with certified copies of the factory test results. The valves shall be factory calibrated at the prescribed design control parameters as stated by tender documents or as directed by the Engineer. Valve sizing calculations shall be carried out by the manufacturer against the system design parameters and enclosed to the valve's submittal. Control valves shall be installed where indicated on the Drawings. Valves shall be rated as specified in the Contract Tender Documents.

4.19.1 Float Control Valve

The valve shall be double chambered of a float type mentioned on design drawings and BoQ (on/off, bi-level, modulating, etc.). The valve shall allow full open at Pre-set low level and to shut-off at pre-set high level regardless of the valve differential pressure. All necessary repairs shall be possible without removing the valve from the line. Level float valve shall be installed on the rising main, in concrete chamber or above the ground. The valve shall operate through a remote float control installed in the water storage or balancing tank, and/or as shown on Drawings. The remote float control shall be connected to the main valve through copper/PE tubes to control the valve opening such that when float rises gradually with water surface the main valve
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will close gradually until it is tightly closed when water level reaches the specified high-water level in the two parts of the tank.

4.19.2 Altitude Valves:

Altitude valve shall be the pilot control type, which controls high level in the reservoir, the pilot control system and valve trim shall be bronze. Altitude valve shall stay open as long as the water level of the reservoir is below a pre-set level. As the water level rises the valve gradually closes.

The altitude control valve should be of one-way flow with an automatic control valve designed to control the high-water level in reservoirs and tanks without the need for external control devices such as floats, etc. Control valve should be rated at 16 bars and factory tested at 25 bars unless otherwise indicated. It should be pilot controlled, hydraulically operated, diaphragm actuated globe valve in either the oblique (Y) or angle pattern design. Valve differential pressure powers the diaphragm actuator open or closed.

The lower control chamber shall be connected through a fixed orifice to the downstream pressure, which serves to cushion the closing of the valve. The upper control chamber, which operates on a three-way control principal, has pressure applied from or pressure vented through the three-way altitude pilot.

The altitude pilot senses reservoir or tank pressure head. It closes at a pre-set pressure head and opens on decreasing pressure head.

The closing and opening of the pilot alternatively pressurize or vents the pressure in the upper control chamber causing the main valve to close or open thus maintaining a constant pressure head in the reservoir or tank.

When the head pressure falls below the pilot setting the pilot opens, pressure in the upper control chamber decreases and the main valve opens to refill the reservoir or tank. When the head reaches the set point of the pilot the pilot closes, pressure in the upper chamber increases and the main valve closes to stop flow into the tank or reservoir. The altitude pilot shall have an adjusting screw to pre-set the desired head pressure.

4.19.3 Flow Control Valves

The valve shall be set to maintain a constant rate of flow regardless of fluctuations in upstream pressure. Rate of flow shall be adjustable at any time. Valve shall be installed in concrete chamber as shown on Drawings. Rate of flow shall be set as specified in the Tender Documents. The selected orifice plate shall cover the flow operational range mentioned in design drawings and schedules. Constant down-stream pressure type shall be provided at the inlets of balancing/storage tanks.

All flow control valve chambers shall be provided with bypass loop and water meter of type and sizes indicated unless otherwise indicated on design drawings.

4.19.4 Pressure Relief (Sustaining) Valves and Surge Anticipating Valves

Pressure relief / Surge Anticipating valves shall be in accordance with ISO 6264 and shall be installed on the plant water lines as shown on the Drawings.
The valve body shall be of angle or Y pattern. Valve internals and trim including stem, springs, seat rings, bolts, nuts, washers of S.S. The pilot and control loop (tubing and fittings) shall be constructed of S.S 316. Valves up to PN 25, shall be hydraulically operated diaphragm actuated, diaphragm and seals shall be constructed of Nylon Reinforced Buna-N or NBR Nylon fabric-reinforced material. PN 40 valves shall be hydraulically operated/ piston actuated, body shall be constructed of Carbon steel EN 10083-1 (ASTM A-216 WCB) with S.S 316 actuator assembly. The pilots and control loop (tubing and fittings) shall be constructed of S.S 316. The pressure sustaining valves shall maintain a minimum pre-set upstream pressure in the pipeline regardless of fluctuating flow or down-stream pressure.

The pressure relief valve shall be equipped with high pressure pilot adjusted at the factory to hold closed against the normal operating system pressure. When the system pressure exceeds this setting, the relief Valve shall open immediately to relieve the pressure rise, but closes slowly at an adjustable rate as the system pressure returns to normal.

The surge anticipating valve shall be equipped with low pressure pilot that senses the initial pressure drop caused at the beginning of surge and opens the valve in order to absorb the inertia caused by returning water column. Should the relief rate be insufficient and the pressure exceeds the setting high pressure, the high-pressure pilot immediately opens and further valve opening is activated in order to release the high pressure until the pressure is maintained to the normal system pressure. When the pressure stabilizes, both pilots close and the main valve starts to close. The valve shall be equipped with flow stem in order to limit the relief flow to prevent column separation and preserve closing pressure.

Prior to shipment of the valves the manufacturer shall factory test the valves under the pressure and flow conditions specified above. The manufacturer shall submit to the Engineer with certified copies of the factory test results.

The valves shall be factory calibrated at the prescribed high pressure (for relief valve) and prescribed low/high pressures for the surge anticipating valves.

Usually, Low pressure anticipating pilot is set @80% of static pressure; high pressure relief pilot is set @ 1-2 bar above maximum system pressure.

Valve sizing calculations shall be carried out by the manufacturer against the system design parameters and enclosed to the valve’s submittal.

Control valves shall be installed where indicated on the Drawings. Valves shall be rated as specified in bill of quantity and drawings.

4.19.5 Pressure Reducing Valves

Pressure reducing valves shall comply with ISO 5781 or EN 1567. Pressure reducing valves shall be factory tested. Outlet pressure shall be easily field adjustable over the pressure ranges and meet the criteria noted on the Drawings.

All pressure reducing valves shall have flanged connections, or shall have unions mounted in the pipe on each side of the valve.

Strainers for installation upstream of pressure reducing valves are specified elsewhere. The pressure reducing valve manufacturer shall specify the screen mesh or size of perforations that are required to protect the reducing valve. The valve supplier shall furnish both valve and strainer.

a) Pressure Reducing Valves 50mm and Larger:

• Valves 50mm and larger for pressure reducing shall be flanged diaphragm actuated
cast-iron “Y” pattern body and replaceable bronze valve seat. The valve shall be external pilot operated, diaphragm type single seat with seat base equal to size of valve. The valve shall be supplied with an internal spring to assist in closing the valve and keeping the valve seated when the inlet and outlet pressure differential is near zero. The valve shall also be supplied with a “V” port-throttling plug for effective control of the outlet pressure as recommended by the manufacturer. High pressure reduction valves shall be equipped with anti-cavitation trim.

- The valve shall be packed with material acceptable to the Engineer to ensure tight closure and prevent metal to metal friction and sticking. The valve shall be furnished with indicator rod, to show position of opening of the piston, and pet cocks for attachment to valve body for receiving gauges for testing purposes.
- The pilot valve, controlling operation of the main valve, shall be easily accessible and so arranged to allow for its removal from the main valve, while the main valve is under pressure. The pilot valve shall be easily adjustable without removal of the springs, weights or use of special tools. The control piping on the valves shall have strainers to prevent plugging of control mechanisms.
- The design shall be such that repairs and dismantling internally of main valve may be made without its removal from the line.
- The unit shall be flanged. The valve body shall be constructed of cast iron.
- The valve shall maintain pre-adjusted downstream pressure for varying rates of flow through the positioning of the diaphragm by the pilot without causing water hammer or waste of water and without cavitation.

b) Pressure Reducing Valves Smaller than 50mm:

- Threaded Pressure reducing valves smaller than 50mm shall be constructed of direct acting type and constructed of bronze and brass body; renewable stainless-steel seat and flexible diaphragm of suitable material. Outlet pressure shall be easily field adjustable over the pressure ranges tabulated on the Drawings

4.20 STRAINERS

Strainers will be made of ductile iron or cast iron. Strainer body will be coated with an epoxy powder minimum thickness 120 microns. Screen shall be made of stainless steel. For maintenance purposes, covers shall be provided to allow ample access to inspection, cleaning and servicing. A drain bend at the bottom of the body, fitted with a stopcock shall be incorporated. Due to particularly hard conditions of service – high speed, high-pressure, presence of solid elements in the network – bidders are requested to pay particular attention to the quality of the protection provided by the strainers to the regulation valves and meters placed downstream. Head loss shall not be more than 0.1 bars, when clean, at the nominal flow rate of the control valve or water meter protected by the strainer box.
4.21 ELECTROMAGNETIC FLOW METERS

- Magnetic flow meter systems shall be the low frequency electromagnetic induction type which produces a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flow meter system. Each magnetic flow metering system shall include the installation and furnishing a metering tube, signal cable, transmitter, flow meter grounding rings, transmitter enclosures, antennas, external batteries and all related items. The meter shall be compatible to the approved control and SCADA systems according to drawings and specifications.

- Flow meters located on transmission pipelines shall be battery powered, the convertor shall have weather proof IP 68 housing. The flow meters at well site shall have IP66 convertors and AC main powered (230VAC or 12/24 VAC-DC).

1. The metering tube shall have:
   a) Pressure ratings as indicated and in accordance with the requirements of piping specifications.
   b) The manufacturer shall provide the recommended size of the water meter based on system flow range.
   c) Polyurethane or Butyl hard Rubber Liner, conforming FDA and/or WRAS.
   d) EN1092-1 Flanges, rating as indicated on drawings and bill of quantities.
   e) Electrodes shall be 316 stainless steel or Higher grade (Hastelloy C)
   f) Metering tube housing rated for IP66 or better. Metering tube housing rated for IP 68, suitable for continuous submergence in up to 3 meters of water, if installed in a below grade vault or any other area with reasonable potential for submergence.
   g) Epoxy protective coating.
   h) Grounding rings shall be 316 stainless steel. Grounding rings shall be designed to protect and shield the liner's edge interface from abrasion at the meter end.

The magnetic meters shall be marked CE and are manufactured according to the following standards:
   a) 2014/35/EU - EN 61010-1:2013 (LVD)
   b) 2014/30/EU - EN 61326-1:2013 (EMC)
   c) OIML R49-1:2013
   d) European directive 2014/32/EU (MID)
   e) 2014/34/UE - IEC 60079 - 0, IEC 60079 - 18 (ATEX - IECEx) Separate version
   f) EN ISO 15609-1 and EN ISO 15614-1
   g) Ebonite conforms to the norms WRAS, FDA

2. The microprocessor-based signal converter/transmitter shall have:
   a) DC pulse technique to drive flux-producing coils.
   b) Six-digit LCD displays for flow rate, percent of span, and tantalization.
   c) An operator interface with keypad which responds to English text entry.
   d) Automatic range change.
e) Capable of measuring flow in both directions.

f) Programmable parameters including meter size, full scale Q, magnetic field frequency, primary constant, time constant.

g) Data retention for a minimum of 5 years without auxiliary power from main source or battery.

h) Self-diagnostics and automatic data checking.

i) Protected terminals and fuses in a separate compartment which isolates field connection from electronics.

j) Ambient temperature operating limits of -20 to 60 degrees C.

Calibration and Performance

1. Calibration: Each flow metering system shall be calibrated on a hydraulic bench equipped with a reference weighting system and SIT certified. The flow metering system shall conform to the following:
   a) Accuracy: \( \pm 0.25\% \) Maximum.
   b) \( Q_3/Q_1 \): 125 at least.
   c) Repeatability: 0.1%.
   d) Environmental Limits: - 10 to +60º C.
   e) Power requirements: external battery with 6 years life.

2. The flow meter shall be furnished with the following accessories:
   a) Furnish remote mount flow transmitter with a sufficient cable.
   b) Provide stainless steel stanchions for mounting of remote transmitter no less than 4 feet above grade.
   c) Provide manufacturer digital calibration verification unit with necessary accessories to interface with the furnished magnetic flow meter.

3. GSM/GPRS Communications:
   a) Where indicated on the drawings or the Instrument Device Schedule, the magnetic flow meter shall be battery operated with 6 years’ useful life at least and main powered operated on 230 or 12/24 volts ac/dc, 50 Hz and capable of GSM/GPRS communications using commercially available cellular data service.
   b) The meter shall be equipped with EEPROM memory to prevent data loss.
   c) GSM/GPRS communications hardware shall allow the meter to transmit real-time flow rate, totalized flow, and time-stamped stored process data over a third-party cellular network to the Client’s facilities identified on the drawings. The communications hardware shall be integral to either the flow meter or signal converter.
   d) A high gain remote antenna shall be supplied with the meter that will allow data to be transmitted via GSM/GPRS technology.
e) Installation of GSM/GPRS-capable magnetic flow meters shall be coordinated with the cellular service provider as specified.

4. GSM/GPRS Coordination.

Where GSM/GPRS communications are employed, the System Supplier shall coordinate with the GSM/GPRS cellular service provider for the following:

a) Coverage of GSM/GPRS service acceptable to the Engineer at all designated locations.

b) Antenna, transmitting requirements, and any other requirements.

c) Setting up the instrument for signal/data transmission over the cellular network.

5. PRODUCTS:

GENERAL, the following paragraphs provide minimum device requirements. The Drawings and Instrument Device Schedule shall be used to determine any additional instrument options, requirements, or service conditions.

- **Interconnecting Cable.**
  - For instruments where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided.
  - The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter.
  - Length of cable shall be a minimum of three meters or as indicated on the Drawings or in the Instrument Device Schedule.
  - The interconnecting cable shall be provided in the length necessary for installation.
  - Splices shall not be allowed in the installed cable.

- **Programming Device.**
  - For instruments that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each Client facility (quantity required shall be as indicated in the Instrumentation and Control System section).
  - The programming device shall include appropriate operation manuals and shall be included in the training requirements.
  - For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

- **Configuration Software/Serial Interface.**
  - Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link.
  - As a minimum, an appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer.
- One licensed copy of the diagnostic/interface software shall be provided for each Client facility (quantity required shall be as indicated in the Instrumentation and Control System section).
- Software shall be capable of running under the Windows XP operating system.
- If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

6. Field Services:

   a) Manufacturer's field services shall be provided for installation, programming, commissioning, field calibration, start up, and training as specified in the Instrumentation and Control System section.
   b) Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. The System Supplier shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

   End of Section
5 MATERIALS

5.1 MANHOLE COVERS

Manhole cover shall be Cast Iron, according to EN124 Standard or equivalent, class D400 (40 tons of resistance minimum).
This compliance will be certified by an Authorized and Independent Third Party, and the cover will be so badge with the logo of the Third Party (such as “NF”, granted by AFAQ/AFNOR Certification).

It will have to be cast by a manufacture complying to the ISO 9001: 2000 Standard

Frame will have to be moulded with wide anchoring holes, at least 16, to allow effective and durable bedding.

Frame will have at least 18 strong ribs, to provide mastered frame profile capable to withstand traffic stresses

The frame height will be of 100 mm minimum, with a good settlement of the manhole and a right behaviour under traffic stresses.
The clear opening of the frame will be of minimum 600 mm

A sound-proofing gasket in composite material (such as PE+PP) will be installed on the frame to support abrasion and crushing when in function. It will be clamped on the frame, with a specific shape to avoid it moves out from the frame.

For an ergonomic opening and lifting once unlocked, the cover will be hinged, with an integrally cast-iron hinge. This hinge will be integral part of the cover, so it resists as well as the cover to corrosion, vandalism and traffic impact.
The cover when opened will have to stay in 130 °position to avoid any accidental self-closure on workers.
The cover will be round shape, unless otherwise mentioned and shall be none ventilated

An elastic spring bar, cast integrally with the cover, will be active that is to say designed to bring a permanent tension between that spring bar, and the cover positioning lugs. It so will provide a remarkable dynamic stability of the cover thanks to 3 points of contact. Furthermore, the spring bar keeps the cover held against the gasket, preventing from rocking.
The elastic spring bar will be such that it will be automatically closed by any load (traffic or pedestrian) when coming over the cover.
This spring bar will nevertheless be flexible enough to open by itself when over pressure in the network, and will so avoid any damage in the network (shaft and pipes).

The unlocking of the cover will be allowed by lever effect in the opening box, located on the side of the frame, and will be permitted with usual tools such as pickaxe or bar. It will be potentially opened via a single operation.

An optional locking mechanism to prevent from any intrusion in the network will be foreseen on the cast cover, thanks to a punch able recessed area.

An anti-theft device of cast iron, will be installed in the frame hinge box, to avoid releasing the cover out of the frame.

5.2 BASE COURSE

Base course sieve analysis, specifications and requirement are as shown in the below tables:

<table>
<thead>
<tr>
<th>Class</th>
<th>Sieve No.</th>
<th>2&quot;</th>
<th>1 1/2&quot;</th>
<th>1&quot;</th>
<th>3/4&quot;</th>
<th>1/2&quot;</th>
<th>3/8&quot;</th>
<th>#4</th>
<th>#10</th>
<th>#40</th>
<th>#200</th>
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<tbody>
<tr>
<td>A</td>
<td>%</td>
<td>100</td>
<td>100</td>
<td>75-100</td>
<td>60-90</td>
<td>45-80</td>
<td>40-70</td>
<td>30-65</td>
<td>20-40</td>
<td>8-20</td>
<td>5-10</td>
</tr>
<tr>
<td>B</td>
<td>passing</td>
<td>100</td>
<td>70-100</td>
<td>55-85</td>
<td>55-80</td>
<td>-</td>
<td>40-70</td>
<td>30-60</td>
<td>20-50</td>
<td>10-30</td>
<td>5-12</td>
</tr>
</tbody>
</table>

Class A: Granular fill Class A to be used as shown in standard details and drawings according to AASHTO T180, T191, or ASTM D 1557, ASTM D1556 or equivalent. Tests shall be carried on the contractor’s own expense.

Class B, to be used as shown in standard details and drawings according to AASHTO T180, T191, or ASTM D 1557, ASTM D1556 or equivalent. Plate bearing test, for bearing capacity and settlement evaluation to be done according to AASHTO T 235 or ASTM D 1194 or equivalent. Tests shall be carried on the contractor’s own expense.
5.3 **BEDDING MATERIAL (SEMSEM)**

SEMSEM Shall be from approved source; sound, from durable stone, free from any foreign materials and structural defects. Also, it shall conform to the ASTM Standards. Sieves openings for SEMSEM are summarized in the below table.

**Sieves Openings for SEMSEM**

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>9.5</th>
<th>4.75</th>
<th>2.36</th>
<th>1.18</th>
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<tbody>
<tr>
<td>Lower Limit</td>
<td>90</td>
<td>30</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Upper Limit</td>
<td>100</td>
<td>75</td>
<td>25</td>
<td>3</td>
</tr>
</tbody>
</table>