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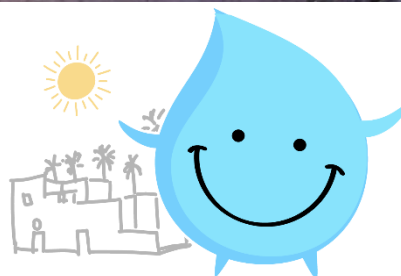


# Potable Water Management Programme in Upper Egypt – Phase 2

PWMP Supply, Civil and Installation Works for Supply Network  
Technical Specifications  
August 2023

Contract No.  
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**برنامج إدارة  
مياه الشرب  
في الصعيد مصر**

## Table of Contents

<b>1</b>	<b>GENERAL INSTRUCTIONS .....</b>	<b>2</b>
<b>2</b>	<b>PIPES AND ITS ACCESSORIES .....</b>	<b>2</b>
2.1	STORAGE AND TRANSPORTING .....	2
2.2	PIPES SPECIFICATIONS AND ITS ACCESSORIES.....	2
2.2.1	<i>The UPVC pipes PN 10- Main option for water distribution network .....</i>	<i>2</i>
2.2.2	<i>HDPE Pipes (Main option for Transmission/feeder Lines) .....</i>	<i>3</i>
2.2.3	<i>Steel pipes (main option for areas that plastic pipes are not fit):.....</i>	<i>5</i>
2.2.4	<i>Ductile cast iron pipes and installments (DI) .....</i>	<i>8</i>
2.3	SPECIAL PARTS .....	8
2.4	VALVES SPECIFICATIONS .....	9
2.4.1	<i>Gate Valves .....</i>	<i>9</i>
2.4.2	<i>Butterfly Valves .....</i>	<i>9</i>
2.4.3	<i>Air Valves.....</i>	<i>10</i>
2.4.4	<i>Non-Return Valve:.....</i>	<i>10</i>
2.5	VALVES TEST ON FACTORIES .....	10
2.6	ASSEMBLY AND DISASSEMBLY TOOLS (MECHANIC CONNECTIONS) .....	11
2.7	SURFACE BOX UNITS.....	11
2.8	COVER AND FRAMES .....	11
2.9	FIRE HYDRANTS .....	12
2.10	SERVICES CONNECTIONS .....	13
2.11	NETWORK SPECIFICATIONS .....	13
2.12	FLOWMETER .....	14
2.13	PRESSURE GAUGE.....	15
2.14	MULTI-LOGGER .....	15
<b>3</b>	<b>CONVENTIONAL WORKS .....</b>	<b>15</b>
3.1	GENERAL .....	15
3.2	TRANSPORTATION AND SHORTAGE .....	15
3.3	LINES PATHS .....	16
3.4	PIPES TRENCHES AND ITS INSTALLATION.....	17
3.4.1	<i>Preparing the site.....</i>	<i>17</i>
3.4.2	<i>Open Trenches .....</i>	<i>17</i>
3.4.3	<i>Layout Plan and Division: .....</i>	<i>17</i>
3.4.4	<i>Laying the Foundation of Trench Bottom: .....</i>	<i>18</i>
3.4.5	<i>Trench's Width: .....</i>	<i>18</i>
3.4.6	<i>Remove Waste from the Site:.....</i>	<i>18</i>
3.4.7	<i>Excess excavation:.....</i>	<i>19</i>
3.4.8	<i>Dewatering:.....</i>	<i>19</i>
3.4.9	<i>Refixing the trench after Dewatering: .....</i>	<i>19</i>
3.4.10	<i>Below Pipe and Trenches Backfilling: .....</i>	<i>19</i>
3.4.11	<i>Pipe Installation.....</i>	<i>22</i>
3.4.12	<i>Backfilling the Trenches: .....</i>	<i>24</i>
3.4.13	<i>Return to Original .....</i>	<i>25</i>
3.4.14	<i>Valves Chambers:.....</i>	<i>27</i>
3.4.15	<i>Inspection and Test .....</i>	<i>27</i>
3.4.16	<i>Water Lines .....</i>	<i>28</i>
3.4.17	<i>Waterlines Wash and Disinfection.....</i>	<i>28</i>
<b>4</b>	<b>OCCUPATIONAL HEALTH &amp; SAFETY &amp; ENVIRONMENTAL REQUIREMENTS.....</b>	<b>29</b>
4.1	OCCUPATIONAL HEALTH & SAFETY .....	29
4.2	ENVIRONMENT .....	35
4.3	ENFORCEMENT AND PENALTIES.....	36

**Technical specifications of water networks and conventional works**

**1 General instructions**

- (1) All services, facilities and works provided under the Project must fully comply with the applicable Egyptian regulations, norms and standards. If there are no or no sufficiently specific Egyptian regulations, norms and standards, the applicable EU regulations, norms and standards shall be applied as guidelines, including ISO norms. The Bidder / Contractor is responsible to study, to make himself familiar, and to apply as deemed necessary the applicable regulatory framework and standards. This also applies to health and safety requirements. The international transports of goods and equipment must comply with the pertinent regulation and standards of the countries on the transport route. Deviations from the applicable regulations, norms and standards must be explicitly stated in the Bid.
- (2) The contractor shall consider the national and religious holidays when preparing the proposal.
- (3) The contractor shall apply specific protection methods throughout the works of excavation, backfilling, supporting trenches, protecting of separated and attached buildings (if any), and all other facilities works.
- (4) All required conditions for work execution have been included on the prices provided at the bill of quantities (BOQ), therefore, the contractor shall not claim for any additional variation in concerning of the same.
- (5) The contractor shall study water, sanitary, electricity, gas lines intersecting with the project track and apply all necessary prevention procedures to ensure that the project will not affect those lines. The contractor shall submit all proposed amendment drawings to project consultant for reviewing and approval before execution the same.

**2 Pipes and its Accessories**

**2.1 Storage and Transporting**

The contractor shall prepare proper store to storage the plastic pipes. Manufacturing and storage specifications shall be applied as per ministry regulations. The store shall be covered to keep the pipes out of direct sunlight. Furthermore, the contractor shall apply all necessary precautions and manufacturing instructions and recommendations related to transfer and storage of pipes in order to prevent any dents or bends on the same. Also, the contractor shall be responsible for secure and protect any pipes may be storage or held on the site.

The pipes shall not drag or pull along the ground to prevent any distortion or torsion may occur. The vehicles used to transport the pipes, shall be furnished and do not include any sharp tools or equipment in order to protect the same, furthermore, long and chunky belts, metal chains and hooks shall be used to tie all pipe packages.

The pipes shall be stored in the shape of a pyramid, which, its height shall not be more than 1 M. The pipes shall put on non-slip supports to prevent sliding of pipes. The distance between each non-slip supports shall not be less than 1 M. Also, the stocked pipes may be tied in wooden frames in order to be on the same level, each package shall put over each other, so its height shall not be more than 3 M.

**2.2 Pipes Specifications and its Accessories**

**2.2.1 The UPVC pipes PN 10- Main option for water distribution network**

The UPVC Pipes shall be supply as per drawings, BOQ and the following specifications; DIN 8061 – 8062 (Part 1, ES 848, ES 1717)-19532 (water pipes), and Egyptian Standards: Es: 848

The contractor shall provide all issued information, catalogs, manuals, instructions and recommendation by manufacturer to be approved by the employer.

The contractor shall, on his own expenses, execute all the below mentioned tests for plastic pipes on factory in the presence of owner representative, supervisor of the contract works. Any pipes did not successfully pass those tests, shall not be supplied.

- Wear Test.
- Tensile, Shrinkage and Expansion Test.
- Impact Test.
- Water Absorption Test.
- Lengths and Thickness Measuring and Visual Inspection.
- Hydrostatic Pressure Test.
- The UPVC Pipes shall be produced according to Ministerial Decree No. 277 of 2000 as amended, and additions issued on Ministerial Decree No. 14 of 2002, as amended. The contractor shall issue Conformity Certificate of the above-mentioned standards and specification, from the manufacturer and submitted to employer.

### 2.2.2 HDPE Pipes (Main option for Transmission/feeder Lines)

The HDPE Pipes manufacturing from PE-100 according to German Standards and related international specifications as; ISO 4427, EN 12201, ISO 12176, ISO 21307 DIN 8074, DIN 8075- ES 1832, DIN 19533, and Ministerial Decree No. 277 of 2000, its attachment No. 4 of 2002, as amended.

#### HDPE Pipe Thickness (grade: PE-100)

The wall thickness shall not be less than the provided in the below table. The thickness shall be measure from both ends of the pipe, provided that three readings shall be taken from each end, then the minimum average of pipe wall thickness shall be recorded. The outside diameter or wall thickness shall be within the limits of tolerance.

#### Less Thickness of High Resistant Polyethylene Pipes

Outer Diameter	Working pressure of 6 bar		Working pressure of 10 bar		Working pressure of 12.5 bar		Working pressure of 16 bar	
	Thickness	internal diameter (ID)	Thickness	internal diameter (ID)	Thickness	internal diameter (ID)	Thickness	internal diameter (ID)
(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
110	4.2	101.6	6.6	96.8	8.1	93.8	10	90
125	4.8	115.4	7.4	110.2	9.2	106.6	11.4	102.2
140	5.4	129.2	8.3	123.4	10.3	119.4	12.7	114.6
160	6.2	147.6	9.5	141	11.8	136.4	14.6	130.8
180	6.9	166.2	10.7	158.6	13.3	153.4	16.4	147.2
200	7.7	184.6	11.9	176.2	14.7	170.6	18.2	163.6
225	8.6	207.8	13.4	198.2	16.6	191.8	20.5	184
250	9.6	230.8	14.8	220.4	18.4	213.2	22.7	204.6
280	10.7	258.6	16.6	246.8	20.6	238.8	25.4	229.2
315	12.1	290.8	18.7	277.8	23.2	268.6	28.6	257.8
355	13.6	327.8	21.1	312.8	26.1	302.8	32.2	290.6
400	15.3	369.4	23.7	352.6	29.4	341.2	36.3	327.4
450	17.2	415.6	26.7	396.6	23.1	383.8	40.9	368.2
500	19.1	461.8	29.7	440.6	36.8	426.4	45.4	409.2
560	12.4	517.2	33.2	493.6	41.2	477.6	50.8	458.4
630	24.1	581.8	37.4	555.2	46.3	537.4	57.2	515.6

#### Internal pressure of pipes

The pipes shall be designed by maximum working pressure of 10 bar according to BOQ. The pressure test on site shall be 1.5 of working pressure and as per standard specifications. The contractor shall prepare all testing tools and equipments of working pressure in site on its own expense.

**The required HDPE Pipes Tests:**

The following tests shall be conducted on factory, and a certificate of the same shall be submitted to the supervisor to be approved before supplying. The test shall be according to German specifications; DIN 8074 and 8075 or ISO.

**1- Material Tests:**

- Collapse Flow Rate Test
- Density Test
- Moisture Test

**2- The Final Product Tests**

- Tensile Test.
- Hydrostatic Pressure Test (according to the Ministerial Decree No. 14 of 2002, as amended.)
- Measuring of product dimension changes in high temperature.

Generally, all required tests are provided on the following table as per the Ministerial Decrees;

1- dimensions, weights and lengths		
A- Pressure pipes		DIN 8074 & 8075
B- sewage pipes		DIN 8074 & 8075
2- Visual Inspection		
A- Pressure pipes		DIN 8074
B- sewage pipes	Pressure	DIN EN 12666
3- Density	Density	DIN ISO 1183
4- Melt elements	Flowing	DIN ISO 1133
5- Tensile Strength	Tensile	DIN ISO 527
6- Elongation Percentage	Tensile	DIN ISO 527
7- Flexural Strength	Flexural	DIN ISO 178
8- Flexibility Standards	Flexibility and Tensile	DIN ISO 527
9- Hardness Test	Hardness	DIN ISO 2039
10- Resilience of Shocks.		DIN 53453
11- Coefficient of Expansion		ASTM D696
12- Hydrostatic Pressure		
A- for sanitary and sewage lines	Pressure	DIN EN 12666
B- for water lines		DIN EN 12201

**3- Site Test:**

The pipe shall be tested for an interval less than 500 m pipe length, furthermore, the test pressure shall be 1.5 of working pressure at the lowest point.

**Limits of Tolerances:**

**- Tolerances on outer diameters**

The following equations shall be used to calculate the allowed Tolerances on outer diameters;

- For pipes up to 400m outer diameter ( $d_o$ ) =  $0.009 \times d_o$  rounded to nearest 0.1.
- For pipes 450 up to 630 outer diameter =  $0.004 \times d_o + 2\text{mm}$  rounded to nearest 0.1.

**- Thickness of the pipes**

The following equations shall be used to calculate the allowed tolerances on pipes thickness;  
 Tolerance= 0.1 S + 0.2mm rounded to nearest 0.1mm, where S is the min. thickness of the pipe according to DIN 8074.

**Limits of tolerance on outer diameters and thickness  
 of HDPE Pipe (grade: PE-100) and working pressure 10 Bar**

<b>Outer diameter (mm)</b>	110	160	200	225	250	280	315	355	400	450	500	560	630
<b>Tolerance on outer diameter (mm)</b>	1.0 + zero	1.5 + zero	1.8 + zero	2.1 + zero	2.3 + zero	2.6 + zero	2.9 + zero	3.2 + zero	3.6 + zero	3.8 + zero	4.0 + zero	4.3 + zero	4.6 + zero
<b>Nominal diameter (ND)</b>	101.6	147.6	184.6	207.8	230.8	258.6	290.8	327.8	369.4	415.6	461.8	517.4	518.8
<b>Thickness (mm)</b>	4.2	6.2	7.7	8.6	9.6	10.7	12.1	13.6	15.3	17.2	19.1	21.4	24.8
<b>Tolerance on thickness (mm)</b>	0.6 + zero	0.9 + zero	1.0 + zero	1.1 + zero	1.2 + zero	1.3 + zero	1.5 + zero	1.6 + zero	1.8 + zero	2.0 + zero	2.2 + zero	2.4 + zero	2.7 + zero

**Pipes Connection**

Pipes shall be connected by one of the following methods;

- 1- Butt welding; is accomplished by heating up the two ends of pipes with special electrical welding equipment. The two pipes shall have the same thickness.
- 2- Electrofusion welding; is welding used a fitting with implanted metal coils which is placed around two ends of pipes to be joined, this coil used for pipes with 355 mm diameter.

In case of joining the pipes with special types of flanges or any other pipe with different material types, or valves, Polyethylene pipes shall be used with flanges. Subject to coating all flanges and other metal materials by mastic then covered with belts of same mastic type, so the overlap shall not be less than 10% of the belt width or 30 mm, whichever is greater.

**HDPE Pipe requirements**

- Pipes shall be supplied from brand has big and good reputation at pipe industry, and has great experience on manufacturing, and installation according to the state-of-the-art technology and practical experiences.
- The contractor shall agree with the manufacturer that its technical representative shall be at site in order to train the workers to transporting, laying, joining, testing, and repairing (when necessary). The technical representative shall have enough experience to solve execution problems, and be specialized on installing, joining HDPE Pipe.
- Technical representative shall be at site at the time of testing the pipes until obtaining the approval of the pipeline, so he shall be at the disposal of the engineer during this duration. The technical representative shall be at site at the time of installing and joining the pipelines.

**2.2.3 Steel pipes (main option for areas that plastic pipes are not fit):**

All required technical specifications to supply spirally welded and coated seamless steel as per the following American standards;

APIS Spec 5L	American Petroleum Institute Specifications for Line Pipes, AWWA-C200
AWWA C203	Coal-Tar Protective Coatings and Lining for Steel Water Pipe Lines

AWWA C210–C200	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe Lines The Viking Johnson Pipe Joining System Impressed Current Cathodic Protection
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The related ministerial decrees of manufacturing, testing, securing, and coating pipes and its accessories, which its internal diameter is between 168 mm and 1626 mm, and length between 6 M and 12M.

The following tests shall be conducted on factory, and a certificate of the same shall be submitted to the supervisor to be approved before supplying:

1- Mechanical Properties (Tensile Properties)	APIS Spec 5L – AWWA C200,ES601m859
2- Chemical Analysis (determination of steel components)	APIS Spec 5L- AWWA C200,ES601m859
3-dimensions, weights and lengths	
4- welding	
5- Hydrostatic Pressure	APIS Spec 5L- AWWA C200,ES601m859
6- Protective coating tests	APIS Spec 5L- AWWA C200,ES601m859
A- Protection by Bitumen-coating	APIS Spec 5L- AWWA C200,ES601m859
B- Protection by epoxy-coating	AWWA C203-15
	AWWA C210-15

### Working pressure

Working pressure of pipes is 10 bar – testing pressure at site is 16 bar - testing pressure at factory is 20 bar.

### - Sizes and Weights of Pipes

The pipes shall be supplied as per the above-mentioned diameters and the weights shall be determined as follows;

$$- NW = (OD - THK) \times THK \times 0.0246615$$

Whereas;

- NW= Nominal weight in kilogram
- OD = Outer Diameter / mm.
- THK = Wall Thickness / mm.

0,0246615 Coefficient has been provided as per the specific weight of steel which is 7.85 kg / dm.

### - Limits of Tolerance

#### A- Thickness Tolerance

The allowed thickness tolerance shall be as follows;

- Unlimited increased in Tolerance
- Decrease in Tolerance shall be up to 1.5

#### B- Weight Tolerance

The allowed thickness tolerance shall be as follows;

- ± 15% for each pipe
- ± 10% for each package of pipes, its weight not less than 10 ton

### Test of Welding Works

The contractor shall conduct all welding test required by the consultant, furthermore, he may asks for conducting tests with X-Ray and submitting the result with his technical report to the entity. The

tests cost shall depend on nominal weight of pipes. In case of non-conformity of the same, the contractor shall rewelding and retesting of pipes on its own cost with no additional expenses on the entity.

**- Outer Diameter Tolerance**

The allowed outer diameter tolerance shall be  $\pm 3,5$  mm

**- Special Marks:**

Each pipe shall have the following specific marks;

- Manufacturer name and its logo.
- Outer diameter by inches and mm.
- Thickness by mm.

Those marks shall be applied by manual coating or seal of manufacturer.

**Cathodic Protection of steel pipes**

The contractor shall conduct full Cathodic Protection of steel pipes on the line up to 0.85 volt (protection degree) according to Cu/Cu 501 by Impressed Current system. The contractor shall, on its own expenses, execute all site's measures and studies of grounding throughout the pipe line, so it shall take the same into account upon applying Cathodic Protection for the pipe line. Furthermore, the contractor shall bear the full responsibility of Cathodic Protection, which included on its prices, as of design, supplying, executing, manufacturing, installing, testing and delivering the line in proper way of Cathodic Protection. After the Cathodic Protection system operates successfully and become stable, the contractor shall offer his recommendations of maintenance the same.

So, the contractor shall install protection system against electric currents, which generate protection current by (Impressed Current System) comply with the grounding and the kind of pipes internal coating. The protection system efficiency shall be determined by measuring lines voltage on different points.

**The Material of Cathodic Protection**

All material used on steel pipes cathodic protection works shall be according to NACE general industry standards. Silicon Iron Anodes or bars shall be used on soil salinity, in addition to this anode with current intensity of 10 amps and has all required shapes and measures. Each anode shall be sheathed PVC insulated and have suitable material around the same for backfilling, whether was graphite powder or coke breeze. Provided that; the carbon shall not be less than 95% and the grounding degree of backfilling around the anode shall be specified Electrical Resistivity, so it shall not be more than 50 M/cm at dry condition before integration and adding lime for transformer and rectifier. The used transformers shall be as per I.E.C. system or similar which has stable, continuous, connectable to any Alternating current (AC) with 415 volt, whether was single or three phase with 50 HZ. The transformers kind shall be cooled by oil.

The system shall have main transformer and Rectifier, both of them put it on welded and coated flexible steel box against any weather conditions, which may be used and install in open areas and spaces. D.C. Output voltage shall not exceed 48 volt in order to reduce circuit resistance. transformer and Rectifier shall have all connections required for efficacy installation, operation, and maintenance. Rectifier power shall be enough to cover all pipe line needs for 25 years as its life services.



### **Bonding station**

If the surveying, done by the Contractor on site, is proved that either another line is crossed over the line mentioned herein or if there are stray currents on the site, the Contractor shall supply and install a bonding station for this purpose. Concerning the coating works components (Flange Insulation Kits) (Gasket Sleeve Washer ...Etc), they shall be materials of high compressive strength and of good dielectric, as well as, they shall be installed between the flanges of ordinary pipes; provided that these materials shall have the features of Electric Resistance 600LB ANSI-N 5016. In addition, the test shall be conducted to ensure that the resistance is at least  $5 \times 10 \Omega$  by using Megger when the voltage is 1000 V.

The Contractor shall submit the calculation sheet and the studies on which cathodic protection system of the pipeline is based. The tests shall be conducted on site before accepting the cathodic protection system whereas they shall prove the following:

- The electrical cables are installed in a correct manner.
- All connections and cathodic protection tools shall be provided according the above-mentioned specifications, operation conditions, and pipeline that shown in this study and the diameters suitable for this type.
- These pipes are necessary for nominal diameters (300 mm. 250 mm, 200 mm. and 150mm).

### **2.2.4 Ductile cast iron pipes and installments (DI)**

Ductile cast iron pipes and installments (DI) for water works (used for crossings and valve chambers) the pipes and Ductile cast iron parts shall be supply as per drawings, BOQ and the following; DIN EN 545- DIN 30674- EN 545- ISO 2531- DIN 28603- ISO 4179- DIN 1164 PART 1, and the related Egyptian standards.

The contractor shall provide all issued information, catalogs, manuals, instructions and recommendation by manufacturer to be approved by the employer.

The contractor shall, on its own expenses, conduct all test of Ductile cast iron on factory, at the present of owner and supervisor Engineer. Furthermore, any pipes did not pass the following tests shall not be accepted;

- Variation of dimensions, weights and lengths in accordance with DIN EN 545.
- Tensile Strength in accordance with DIN 50154
- Hydrostatic Pressure in accordance with DIN 50104
- Hardness (conduct on raw materials and products) in accordance with DIN 50351
- Visual Inspection in accordance with ISO 2531
- Leveling (to determined distortion percentage) in accordance with DIN EN 545
- German authority tests such as explosion, pressure, and longitudinal curvature in accordance with DVGW.
- Protective internal layers of cement mortar tests in accordance with DIN 1164.
- External layers of cement mortar tests in accordance with ISO 8197.
- Tests conduct on pipes in accordance with ISO 2531- EN 545.
- Pipes shall produce according to Ministerial Decree No. 277 of 2000 as amended, and additions issued on Ministerial Decree No. 14 of 2002, as amended. The contractor shall issue Conformity Certificate of the above-mentioned standards and specification, from the manufacturer and submitted to employer.

### **2.3 Special parts**

Excluding the uPVC pipes with which Ductile iron cast parts used, all the special parts are made of the same pipes material in order to bear the same operational pressure of pipes. These parts shall be undertaken to the same compression tests of the pipes at the site, with the pipe lines test, and

factory. The internal and external protective works shall be implemented on these parts according to the specialized mistrial orders.

## **2.4 Valves Specifications**

All the valves shall be from the type of valves most often used, which is in line with the Egyptian Standards M. No. 971/ 1969 or its equivalent from the international standards. They also shall be horizontal or vertical installed.

### **2.4.1 Gate Valves**

Diameters to 300 mm, pressure operational test: 10 Bar, site test: 16 Bar, manufacturer test 20 Bar. The gate valves shall be one of manual valves using the hand-wheel. It shall meet the following specification:

- This kind of valves shall be from the kind that directly runs by hoop or elongation columns, according to their installation position. The rotation shall be in clockwise direction.
- The stuffing box, body and cover shall be made of high- quality Ductile cast iron, GGG50.
- All the stems shall be manufactured inside the valve body.
- All the bases and friction rings shall be made of high- quality and high-voltage bronze alloy.
- The valves columns shall be made of anti- rust steel. The steering column shall be made of a stress-resistant material.
- The stress-resistant shall have a suitable depth to ensure not replacing the pads at frequent intervals.
- The flanges shall be automated and punched according to the Egyptian Standards No. 10.
- The hoop shall be made of high- quality cast iron. It shall also have an arrow showing the direction to turn the hand-wheel to open/ close the valve.
- The gate valves shall be used in the pipes; which diameters are less than 300 mm.

### **2.4.2 Butterfly Valves**

- They shall be manufactured according to the British Standard BS 5155 FOR PN 10.
- They shall be used for pipes of 300 mmdiameters and more, and the pressure of its working test: 10 Bar, site test: 16 Bar and manufacturer test: 20 Bar.
- They shall be produced by certified companies to ensure that they meet the latest international standards. The valve body shall be made of the high- quality Ductile cast iron, GGG50. The valve column shall be a one piece of anti- rust steel. The bearings shall be sealant and self-lubricating and made of protective gasket, EDM or NBR.
- The rubber material shall cover the body of the pipes, with diameters less than or equal to 600 mm, and disc of pipes, with diameters more than 600 mm.
- The valves shall have a diameter of 300 mm or more and hoop of cast iron with two arrows showing the direction to turn the hand-wheel to open/ close the valve by manual change gear with an indicator to show the valve position (opening/ closing).
- The valves shall be provided with holes for inspection. In addition, the filter shall be installed in the valve body at its designated place, taking into consideration that the material of metal, in such places, allows making these openings, in terms of design.
- The gates must be reinforced and made of the same metal, which the valve body made.
- The flanges shall be mechanically punched according to the Egyptian Standards M No. 10.
- The valve components shall meet these standards, At least, or its equivalent:
  - Body and Disc –GGG50                    -D.C.I. to BS 4772 or ISO 2531
  - Shaft   -Stainless Steel to BS 97pt4
  - Sealing Ring & Seat                    -Gunmetal to BS 1400 Grade LG2.

### **2.4.3 Air Valves**

The air valves shall include a comprehensive system to minimize the influence of the water hammer. They shall perform automatically to reduce the sudden high pressure or the high pressure that follows closing the valves thanks to the high speed of air escape or rewelding the separated water column.

The valves, that are unable to perform its function (reducing pressure) within fraction of the first second followed by closing the valves, shall be rejected.

The area of intake and output ports shall be equal to the valve nominal diameter. The manufacturing of the valves shall be matched in terms of its raw materials and its functions to prevent any dent, seal or loses due to be subject to a pressure, which is twice as the pressure of running.

To handle the high pressures, the valve shall be provided with safety means to drop it without causing any explosions or any other malfunction. Such mean shall be easy to replaced and reinstalled. The valve's components shall be in line with the following specifications at least or otherwise equivalent. The valves shall be two- metal balls covered by the gasket, and meet the following specifications:

- Body C.I (GGG-50)
- Balls: Steel covered with rubber
- The valves have two chambers

The valve shall be provided with a lock valve meets the said specifications.

### **2.4.4 Non-Return Valve:**

These valves shall be made of cast iron, which is individual type or extended type with non-return gates. The close specifications shall meet the terms of hydraulic calculations. These valves shall protect the system from shocks, arising from the movement of return water or arising from the sudden shutdown in general.

- The friction rings made of guns steel, that can be replaced, and panels, that can be disassembled in order to facilitate the inspection process and withdraw the non-return gates.
- The non-return gates shall be made of GGG50 cast-iron. Their seats are shall be made of bronze, that bear high stress, at a proper angle for the pipe axis.
- There shall be control means in order to prevent the excessive return of gates.
- The valves shall be supported by anti- rust steel hinges or bushes made of bronze bear high stress.
- The non-return gates are protected, using pins or pads, at the direction of the valve's columns.
- These valves shall handle the operational pressure not less than 10 kg / cm<sup>2</sup>.

### **2.5 Valves Test on Factories**

Before supplying any of the valves, the contractor shall supply a certificate of origin from the company (Manufacturer), specifying the required tests described below. Such hydrostatic tests on valves shall be undertaken at the manufacturer as follows:

#### 1- Gate Valves:

- Open position – 16 kg/ cm<sup>2</sup>
- Close position - 12 kg/ cm<sup>2</sup> (the tests shall be done on the both side of the plug)

#### 2- Butterfly Valve:

- Open position – 16 kg/ cm<sup>2</sup>
- Close position - 12 kg/ cm<sup>2</sup>

#### 3- Air Valve:

- Open position – 16 kg/ cm<sup>2</sup>

## **2.6 Assembly and Disassembly Tools (Mechanic Connections)**

The pipes works shall include a sufficient number of the relevant assembly tools to facilitate the processes of assembling and disassembling the valves in the pipeline. These tools shall not be used in putting the weight of the pipes on them. They are placed next to the valves according to the drawings and the engineer instructions. They are made from the Ductile cast iron GGG 50.

## **2.7 Surface Box Units**

Regarding valves less than 300 mm, each valve shall be supplied with its full surface box unit. For making the process above the surface possible, these units are cylindrical-shaped and made of the cast iron. They shall be robust to bear the heavy movements over them. They shall be supplied with their parts, including the binoculars with its cover, elongation column and the cover of valve column (and the basic part placed above the valve underground).

## **2.8 Cover and Frames**

They shall be supplied according to the Egyptian Code. One of these types shall be selected so as the bill of quantities:

### **1- Cast Iron Cover:**

It shall be made of the gray cast iron. It shall be placed firmly within frames at the same level in order to avoid any instability between the cover and frames, in case of heavy loads. In addition, it shall bear the load capacity 30 ton. The weight of both the cover and frames shall not be less than 285 kg and the diameter of the cover shall not be less than 600 mm. The writings on the cover shall be made according to the drawings or the engineer instructions.

### **2- GRC Cover:**

- The covers are made of glass fiber reinforced concrete (GRC) to bear the vehicles' loads up to 40 tons under the Egyptian Standards M No. 4207 and according to the drawings. Regarding the covers placed at the chambers on either side of the road with dimension not more than 0.50 m from the platform, the road breaking of such covers shall be 25 tons. Regarding the covers placed on the road, the road breaking of such covers shall be 40 tons. Regarding the covers placed on the inspection chambers, the road breaking of such covers shall be 10 tons.
- The density of concrete shall be for bearing such loads. The mixture shall be made of portland cement, sand, polymer, binders and some special chemical substances. The metal frame shall be 1 to 1.5 mm thick.
- The inner reinforcement system of covers shall be made of glass fibers.
- Before the implementation, the mixing ratio and all the diameters and dimensions, according to the technical specifications of GRC covers, shall be submitted after getting approved by the supervisory body.
- The concrete surface shall be totally smooth to avoid the wear due to the car's friction. A proper substance shall be added to the concrete mixture in order to increase its resistance against the wear, provided that they must be submitted to the supervisory body before the implementation.
- The covers shall be coated with the isolated epoxy.
- The covers shall have the resistance against acids, alkalis and gases (if any). Its material shall meet the specifications of Water Company, NOPWASD and the standard specifications.
- The said covers shall be placed on the relevant piston rings. The supplier shall take into account the matching of covers and piston ring measures with the road level.

- The back of concrete shall be sealed with the project name and year of manufacturing.
- These covers shall be manufactured according to the following specifications:
  - o chemicals of concrete: ASTM C494
  - o colored substances of concrete: ASTM C979
  - o sulphate resisting cement: BC 1014
  - o To determine the properties of reinforcement with the glass fibers BC 6432
- the following tests on the covers shall be done:
  - o Slump test, bag test, bucket test and physical rest.
  - o Specific Weight 1.9 : 2.1 ton/ mm<sup>3</sup>
  - o Elastic Modulus 10 : 20 kN/mm<sup>2</sup>
  - o Tensile Strength 8 : 11 N/mm<sup>2</sup>
  - o Modulus of Rupture 21 : 31 N/mm<sup>2</sup>
  - o Shear strength among lyrics 3 : 5 N/ mm<sup>2</sup>
  - o Yield Strength 7: 11 N/ mm<sup>2</sup>
  - o Compressive Strength 50: 80 N/ mm<sup>2</sup>

### **3- GRP Covers:**

- The external and internal layers of covers are made of the reinforced fiberglass, including the tissue, resin epoxy, fibers and the waterproofing substances. The middle layer shall be made of relevant filler and resin epoxy.
- A cast iron piston ring shall be placed in order to place the cover. Moreover, some locks shall be installed on the covers (without making disturbing in the road) to be safeguarded such from theft.
- These covers shall bear loads weighting 40 tons. In addition, they shall have all the chemical and mechanical characteristics described in item (GRC Cover).

### **4- Marmox Covers:**

- The marmox covers shall be made of the same materials, of which the GRC covers made, tissues of fiberglass, as well as, the marmox that gives high robustness to the cover. This type of covers do not need to an external metal frame.
- These covers shall bear the loads and have the chemical and mechanical characteristics described in item (GRC Cover).

### **5- Resin Covers:**

- These covers shall be made of the same materials, of which the GRC covers made, and the resin materials.
- These covers shall bear the loads and have the chemical and mechanical characteristics described in item (GRC Cover).

### **Marking:**

All pipelines, valves and the other installation shall be dully marked with the factories names, manufacture year and nominal diameter. It is preferred that these data are put during the manufacture process.

## **2.9 Fire Hydrants**

The underground fire hydrants shall be placed according to the drawings of distribution network across streets. The above ground pillar-type hydrants shall be placed in the water pump station (if exist) with height 1.10 m or according to the Civil Defense requirements. Their bodies shall be made of the cast iron. The process screws shape shall be one part of high-resistance copper alloy. The

diameter of tap shall be 63 mm or according to the Civil Defense requirements. The above ground pillar-type hydrants shall be surrounded with red- coated front fence of pipes diameter 75 mm to be protected. They also shall be installed on concrete blocks. They shall bear pressure not less than 10 Bar. They shall be placed on cast iron tees with diameter 75 mm or according to the Civil Defense requirements.

### **2.10 Services Connections**

The required connections for the lands and real- estates shall be made to the water line extensions. A gate valve and connection shall be installed in the place of the connection between the sublinear and service connection. On each connection, a flowmeter shall be installed (if asked from the Contractor) on the raiser line of the building. It is preferred that the meters are installed on straight connection with diameter not less than 10 x the diameter of the connection. Meter diameter must be equal to the diameter of service connection.

### **2.11 Network Specifications**

- 1- The contract includes the loading, transporting and unloading of pipes, gaskets and all the other supplies. The Contractor shall disposal the required vehicles and loading and unloading equipment, including the labor and winches.
- 2- The contractor shall be fully responsible for all the supplied tools. Therefore, it shall take all the precautions and necessary actions for protecting the pipes and machines during the processes of loading, transmitting, unloading and assembling. In addition, it shall test the lines before delivering them to the Owner.
- 3- The contractor shall review the distance of transporting and determine the ways which are used. It also shall take all the precautions to ensure that the matters shall be arrived safe to the site.
- 4- The instructions of pipes manufacturer shall be followed during the processes of transmitting, unloading, assembling and welding.
- 5- The quantities set out in the contract are estimated quantities. The contractor shall review the quantities of the pipes and other devises by its own method. Then, it shall submit a report on this equipment to the body engineer for being approved.
- 6- According the timeline, the contractor shall appoint the required staff of skillful and trained labor on the assembling works.
- 7- The contractor shall disposal the required equipment for unloading and assembling the pipes in line with the proposed timeline. It shall also supply, on his own account, the required lubricants or soaps for assembling works, provided that it shall submit a sample of the used lubricants or soaps to the supervisor engineer, before supplying, for being approved.
- 8- The pipelines shall be implemented in straight lines. Thus, the plans shall be made accurately before starting the work, as the contractor, solely, is liable for the same.
- 9- The depths of excavation works shall be carried out according to the drawings, taking into consideration the basic pit width and maintaining the inclinations. The width of the excavation must be large enough and more than the external diameter of the pipe according to the enclosed drawings and Egyptian Code. In the expected sits, the digs shall be large enough in line with the pipe head for the assembling works.
- 10- The subgrades of pipes shall be made of clean sand approved by the supervisor engineer. If it is countered by solid layer, such layer shall be removed and replaced by sand layer, with the same thickness, without prejudice to the borings report and recommendations. The contractor shall obtain an approval on the sand sample before supplying. All of these procedures shall be taken in the case of the replacement layer, if necessary.

- 11- The backfilling works shall be carried out by clean sand above the pipe surface with 30 cm or until the ground surface (if the soil of the excavation is unfit to the backfilling works). It shall be avoided to drop any blocks, rocks or stones. The backfilling works shall be carried out by solids- free clean sand, according to the approved sample by the supervisor engineer, above layers not more than 25 cm thick. The backfilling works shall include water spraying and heavy tamping to reach compact ratio not less than 95% by proctor compaction test. Three samples (collected from the right side, left side and above the pipe with 250 m of the pipe) shall be taken to the laboratory. The backfilling shall be carried out until the relevant level of restoring the matter to its original condition.
- 12- Before carrying out the excavation works, the contractor shall clean the site and area, within the project limits, from the wastes, grass, trees roots (if any) or any old basics, as well as, settle the site according to the levels described in drawings.
- 13- The recommendations and instructions of the supervisor engineer shall be followed in order to determine the required subgrade thickness.
- 14- The excavation and dewatering (if any) works in the subgrade of pipes shall be made according to the drawings. Thus, the excavation sides shall be shored, whether by wood or metal blinds if necessary. The supervisor engineer shall approve, firstly, the methods of excavation sides shoring and the dewatering.
- 15- The width of breaking the asphalt of the streets shall be approved by the supervisor engineer, as the necessary procedures shall be taken for road resurfacing again. Only the contractor shall have the liability for breaking width more than the required. There are no extra costs for the same shall be paid to it.
- 16- The internal and external layer of pipes shall be made in line with the soil type according to the soils and borings report pursuant to Ministerial Act No. 277/ 2000 as amended and added by the Ministerial Act No. 14/ 2002.
- 17- The contractor shall inspect the levels, on the ground, and use the guided borings, if necessary, in order to ensure the soil stress in some areas The recommendations of the approved borings report shall be taken into account, except the case are in contravention of them. In such cases, they shall be referred to the consultant- in- charge.
- 18- The contractor shall be ultimately responsible for avoiding any damage in any networks cross or parallel the new pipes. To avoid such crossings, the contractor shall make all the adjustments, including the pipeline routes or the levels of new pipes, and submit the proposal to the consultant for being approved or make suspending or temporary adjusting route for the current networks, provide that these adjustments do not affect the residents, such as: disconnection due to these adjustments.

## **2.12 Flowmeter**

Electromagnetic flowmeter with the ability to send readings remotely as follow:

- DN 400 mm- 700 mm PN16
- EPDM liner and Hastelloy Electrodes, corrosion-resistant coating of category C4
- IP68/NEMA 6P enclosure. Sensor can be buried
- Power supply -115-230 V AC - 11-30 V DC or 11-24 V AC
- Down to 0.2 % maximum uncertainty
- Bi-directional measurement

## 2.13 Pressure Gauge

50mm DIAMETER, DIAPHRAGM TYPE, PRESSURE RANGE 0:25 BAR, IP67, OPERATING TEMPERATURE -10:+50 DEGREE, HUMIDITY 90%, ST. ST. CASE, ST.ST 316 ELECTRODES AND METERING TUBES.

## 2.14 Multi-Logger

- At least 30 days memory Readings.
- Fully sealed & submersible, IP68.
- At least 4 Alarm per logger.
- DataGate S/W for Windows (برنامج تشغيل متواءم مع نظام ويندوز)
- Internal channel with pressure transducer: 0-20 Bar
- At least two input channels: 4-20 mA (Flow channel) – (Pressure channel).
- Power: Lithium-ion cell operational for 5 years under normal operating conditions (working for 24 hours per day).
- Site ID: up to 50 characters
- The ability to download data via USB/RS232
- And everything necessary to complete the process of installation, operation and testing
- Remote data transfer of flow & pressure to AWSC central server

## 3 Conventional Works

### 3.1 General

All materials, supplied by the Contractor, shall be stored in a proper place for storage under the Engineer's consent. The Contractor shall do all necessary tests, at its own expense, to ensure that the pipes, connections, and valves are matched for the contract's specifications, under its responsibility. In addition, the Engineer or its representative shall have the right to attend these tests, with no liability concerning these materials.

The Contractor shall permit the Engineer, in time, to enter any location of inspection or testing, and in any case, the Contractor shall provide the equipment in good and clean condition and the well-known marks are clear and the storage shall be as agreed on, to be approved by the Engineer.

The Contractor shall put up a building, is able to be locked and surrounding by a barrier, for delivery and shortage the pipes, connections, and valves whether are purchased abroad or locally manufactured or that are required to be supplied.

The Contractor shall commit to the Engineer's instructions; concerning the disposal of pipes, connections, and valves, in which any fault may be noticed, or repairing them or replacing them.

The valves shall be covered in the storehouse until it's required for installation, under special care to protect mechanical and complementary parts. Concerning the pips and connections, they shall be placed on wooden pillars at least 75 mm above the ground, and it's necessary to protect any paintings or protective coverage.

As for pips, they shall be arranged on shelves for more than 3 m, under the approval of supervising engineer, while the connections and valves, they may not be arranged above each other.

After finishing these works, the Contractor shall collect all additional supplied pipes, connections, and valves from the site.

### 3.2 Transportation and Shortage

- 1) When storing the pipes, subject of the works, it shall be arranged on sequence layers, separated from each other by wooden blocks, with appropriate measurements for the



- length of the pipes, free of nails and solid objects, to avoid any scratches or damages in the protective layer of the pipes when rolling on them.
- 2) The layers shall not be exceeded four layers.
  - 3) When loading or discharging the pipes at work sites, all necessary actions shall be taken to ensure that the pipes shall not be damaged or buckled by using a truck, and not being manually unloaded or not being rolled.
  - 4) When loading or discharging the pipes, it's necessary to use tracks or wire of leather with at least 30 cm width, by which the pipes shall be packed to be linked with the track's hook to lift and download the pipe.
  - 5) When discharging the pipes by and along with the drilling at the work site, it's necessary to be sequenced one after another with an appropriate distance between each group of pipes and another to ease traffic.
  - 6) The rubber rings of the pipes' fittings shall be kept in a cool and dry place, away from direct sunlight, in order not to be damaged by temperature and light.
  - 7) The manufacturer's instructions of transportation and loading or discharging and storing shall be followed.

### **3.3 Lines Paths**

- 1) Before commencing in works, the Engineer shall deliver the Contractor the roads and paths by which the pipes will be installed, according to the drawings of the contract.
- 2) The Contractor shall be liable for determining the works sites of drilling to avoid any damages, and it shall be liable for any damages happened to these works and repair them, at its own expense.
- 3) The Contractor shall be liable for preparing the appropriate length and width of the path to be implemented and the Engineer shall approve this path, whereas the drilling, pipes transporting, installing, cars and tracks transporting shall be easily done from and to the site.
- 4) Cleaning and preparing the works path are free.
- 5) The Contractor shall clean the roads as its original state, while works progress and after passing the tests.
- 6) The Contractor shall be liable for obtaining all required permits by the concerned authorities by Owner's help, while the Owner shall bear the costs of building permits.
- 7) All costs of implementing the occupational safety and health requirements shall be at Contractor's expense and the contractor, after winning the tender, shall submit a plan of maintaining the occupational safety and health as well as an implementation plan without obstructing traffic, for the consultant to review and approve it before the implementation, which includes but not limited to:
  - Keep a safe distance to protect people from falling.
  - Put a caution tape around the work area.
  - Coordinate with the traffic administration to change the paths of cars and pedestrians.
  - Establish areas specialized for pedestrians for their interest, and take all necessary measures and required actions to protect pedestrians.
  - Drilling sides shoring by a sound engineering method approved by a soil consultant to protect the workers.
  - etc.

### **3.4 Pipes Trenches and its Installation**

#### **Definitions**

The following terms shall have the meaning mentioned after each one:

#### **Surface Layer:**

It refers to any surface material, including the green layer suitable for cultivation or growing grass.

#### **Wide-Scale Drilling:**

It refers to open-pit drilling (without using force in drilling trenches) according to the specified drawing standards or to the general standards after finishing the drilling.

#### **Basis and Trenches Drilling:**

It refers to the drilling under the standards and limits specified in the drawings and pipes and otherwise.

#### **Excessive Drilling:**

It refers to the drilling outside the limits of wide-scale drilling and the trenches drilling or the emergency drilling.

#### **3.4.1 Preparing the site**

The Contractor, before starting in trenches' drilling, shall make the longitudinal budgets for the track, register the land heights, and determine the sites of the trenches required for digging, as well as, prepare the site for work by cleaning and removing all objects that hinder the progress, as the Engineer deems necessary. However, the Contractor shall bear the costs of these measures, taking into consideration the health, insurance, and general interest while cleaning works.

The Contractor shall have the borders for drilling and road crushing permitted by the Employer before starting works.

#### **3.4.2 Open Trenches**

The trenches drilling works shall be executed under a safe proper way and according to the required measures to save people's lives and facilities, as well as, the blast materials shall not be used for drilling.

The operations of drilling shall be executed; provided that not causing any obstacles to the people during the works progress. Therefore, it is necessary to limit the operations by shortening the distance of the work area for each crew according to the approval of the Engineer. Moreover, the equipment of trenches drilling and drilling sides shoring shall normally be within 60 m in front of the place of pipes or even shall put on a distance that ensure the possible safety. It's necessary that any part of the trenches shall be covered after doing the pipes test, however, the potholes shall be buried immediately or within 24 h at least. After the crew of extending the pipes finished its work, it shall return the main roads to its original state every day, as well as, the traffic shall not be suspended more than one intersection road at the same time, without the Engineer's consent.

#### **3.4.3 Layout Plan and Division:**

The layout plan of pipelines tracks and setting its calibration and standards shall be done according to the planning guidebook, and the pipes layout shall be horizontal and vertical as well as the maximum deviation of the connections, according to the section of the pipes installation.

**3.4.4 Laying the Foundation of Trench Bottom:**

The trench bottom shall be coherent, well-compacted, balanced, free of mud and fixed enough, thus, it will not be affected by the worker's feet while installing and testing the pipes and backfilling, in addition to, the Contractor shall be responsible for doing all balance works, with no additional costs.

**3.4.5 Trench's Width:**

The trench shall be in a proper width to install pipes, specified parts and accessories easily, whereas the trench width shall be according to the table shown below.

The trench width shall be regarding the longitudinal sectors of the pipes as stated in the following table:

Outer Diameter (mm)	Width of Base Layer (m)	Width of Asphalt Return (m)
110	0.65	0.96
160	0.65	0.95
225	0.75	1.05
280	0.85	1.15
355	0.9	1.2
450	1.10	1.35
560	1.20	1.50
710	1.35	1.70

In case that the pipes of small diameters that has not longitudinal profile, the excavation depth shall be taken into consideration, whereas the backfilling depth above the upper top of the pipe shall not less than 1.00 m.

The bottom of the trench shall be excavated regularly without any solid or rocky protrusions at the bottom, while if such these solid and rocky protrusions are found at the bottom of the trench, the required depth of excavation shall be increased 15 cm, whereas it will be backfilled by a layer of sand to form a flat surface on which the pipe body will be based. All costs of these works shall be under the cost of supplying and installing pipes, special parts and accessories installing.

The excavated trash shall be removed away from the edges of the trench by at least 1 m, and it's not permitted to suspend the traffic as well as fully maintain the progress of other facilities that may be found in the trenches, such as power cables, water pipes, sewers, telephones, etc., by doing all necessary actions to keep it in a good condition at the Contractor's expense and under its responsibility. Moreover, the Contractor shall coordinate with governmental authorities and companies that may have works or pipes or cables on the roads in which the trenches drilling shall be done, as well as, it shall commit to the instructions relating to this matter.

In case of rocky lands, it's prohibited to use explosive materials but use the proper cutting machines prepared for such cases, whereas before installing, it's necessary to remove the rocks and prepare the trench. The Contractor shall set up sides shoring of the trenches, if required, to maintain proper workflow and preserve the neighboring buildings. In addition to, it shall make barriers to prevent people from falling in trenches, put warning signs during the day and in night and implement the laws and instructions of health and traffic regarding this matter.

**3.4.6 Remove Waste from the Site:**

Excess waste of the drilling shall be removed away from the work site, under the contractor's knowledge and at its own expense, unless otherwise permitted, such as breaking concrete or pipes or rocky materials that are unneeded to use in backfilling the trenches and also foreign materials that will not be used again. Moreover, the Contractor shall remove all these materials, according to

the Engineer's instructions and disposal it in the place owned by the Contractor and set up for this purpose and or any other place determined by the Engineer.

The materials that are removed in the place owned by the Contractor and set up for this purpose, will be the Contractor's property, while those materials that removed in such place determined by the Engineer, will be the Owner's property.

#### **3.4.7 Excess excavation:**

It means excavation outside the area of pipe installation. The Contractor, at its own expense, shall remove and dispose of the excavation waste; provided that backfilling the excavated place by sand or any other approved material, whereas, it shall be compacted according to the specifications, in case that, the excavated waste does not fit for backfilling.

#### **3.4.8 Dewatering:**

The contractor shall provide the necessary means and equipment for the process of removing and draining water from the excavated trenches and executing any work under the purpose of making pipe bedding or installing the pipes and its accessories in a correct manner.

The Contractor shall have the right to choose any suitable way to deal with groundwater, sewage or surface water at work sites; provided that obtaining the Engineer's approval. In addition to, the Contractor shall ensure the validity and safety of all equipment, devices, and materials required for these works and shall provide the necessary details to control the level of groundwater if required, to obtain the Engineer's approval.

The trenches shall be maintained in a dry condition permanently until the pipes are installed, tested and being ensured that it accessed the required degree of protection against hydrostatic pressures, floating, or other possibilities, as required.

Surface water shall be stopped from entering the areas of drilling or trenches, as much as possible, while maintaining the surrounding properties in a good condition. In addition, the Contractor shall maintain the drainpipe that it uses and be responsible for cleaning it and ensuring it is free of any type of deposits.

#### **3.4.9 Refixing the trench after Dewatering:**

If the Engineer deems that the bottom of the trench, after the process of dewatering, is not suitable for pipes workability, the Contractor shall drill below the level of the invert of the pipe to any depth that required by the Engineer.

Then, the backfill shall be made to the level of the trench required to be spread into the entire width of the trench in layers that are not exceeding 25 cm and compact each layer well, according to the approval of the Engineer, as well as, the sand replacement at the bottom may be replaced completely or partly by any other granular materials or concrete or according to the soil borings' report.

#### **3.4.10 Below Pipe and Trenches Backfilling:**

##### **3.4.10.1 Bottom Trenches Replacement and Pipe Basis**

The trenches shall be excavated to the depth required to put the basis layer as per drawings and soil report.

According to the Engineer's instructions, the soft soil below the level of the excavation shall be drilled to specific levels according to the instructions with the removal of the materials resulting in. Concerning the soil, it shall be returned to the specified level using the agreed materials for

backfilling with compacting in layers that are not exceeding 25 cm or according to the soil borings' report.

### 3.4.10.2 Filling Materials

#### **The Surrounding Areas of the Concrete Works**

In narrow lanes and passageways in which it may be impossible to drill to sufficient depths to verify the consistency of the backfill layers, it is necessary to implement a regular concrete coverage of B15 on the top of the pipe with a thickness of 200 mm. The required concrete around and below the pipe, which is considered as a basis, shall be executed according to the instructions of the Engineer and shall be built by plain concrete B15 with proper thickness.

#### **Sand Replacement**

In general, the replacement shall be in accordance with the standards indicated in the drawings and bill of quantities. The replacement materials shall be clean dried sand, taking into consideration the following distributions of crystals size:

Sieve No.	Sieve Size (mm)	Size (% of Weight)
15	9.510	100
19	4.760	90/100
22	2.830	75/100
26	1.410	55/90
30	0.707	35/59
34	0.354	8/30
38	0.177	0/10

### 3.4.10.3 Concrete encasement

Concrete encasement shall not be placed on, unless the Engineer accepted.

The width shown in the drawings will be considered the maximum width. side support by replacement materials are necessary for the structural stability of the pipes, with putting and compacting the replacement materials.

The bottom of the trench shall be established by the replacement materials as previously explained. The concrete required for doing so, shall be from the class B15. It will be protected, treated and left in an appropriate manner and no backfilling will be done until the pressure strength of the concrete will be at least 10 N / mm<sup>2</sup> cubes.

After laying on the pipes, the concrete will be carefully placed only on one side of the pipeline, making sure that no voids are left under the pipes. Then it is gradually increased on both sides of the pipes to the required level, with taking into consideration to avoid floating the pipes.

Trench pillars shall be pulled in steps to limit casing damage to pipes and replacement.

The concrete will be carefully placed and gently shaken to avoid causing damage to the pipes.

When the pipes are temporarily established on solid blocks to leave a space between the pipes and the structure level of the trench to have cement replacement, the blocks will include a layer of pressure materials that work as a gasket in order to ensure that the full tolerance of the pipe by the concrete replacement and to avoid the pipeline moving between the loading blocks.

Once it is possible, a protective layer shall be applied carefully and gently with a depth of at least 300 mm with compact using agreed backfill materials on the upper of the pipe or fittings with concrete and manually combined into 150 mm layers that are measured before stacking manually

or mechanically until the pipes cover will be 300 mm. The last 150 mm consists of the general backfilling materials with leaving the piping connections uncovered until the pressure tests are successfully completed.

The trench will be backfilled after having the approval of the Engineer.

#### 3.4.10.4 Cover and Sand Replacement

- 1) The replacement shall be laid and combined carefully until the actual invert of the pipe, and the surface shall be leveled to the correct gradation.
- 2) After laying the pipes, the replacement will be increased to the upper of the pipe from both sides until it reaches the required level by well-compacted layers whose thickness is not exceeded 25 cm or according to the soil borings' report. It's necessary to be care while ensuring that the replacement are compacted below and on the sides of the pipes and the sides of the trench.
- 3) Then the replacement shall be raised above the level of the upper of the pipe by 300 mm, compacted with the width of the entire trench and at the end, it is backfilled with the appropriate materials.
- 4) Before laying the replacement, the trench pillars shall be pulled gradually to prevent the misarranging the placement of the replacement materials.

#### 3.4.10.5 Pipe Trench Backfilling

1) In general, the backfilling materials of the pipe trenches will be clean, coarse sand, according to the following distributions of sand:

Sieve No.	Sieve Size (mm)	Size (% of Weight)
15	9.510	100
19	4.760	90/100
22	2.830	75/100
26	1.410	55/90
30	0.707	35/59
34	0.354	8/30
38	0.177	0/10

Backfill materials will be placed and compacted into layers, whereas the thickness shall not exceed 250 mm, and compact will be carried out to ensure that a 95% proctor value have been already obtained.

Pipe trench backfill will not be carried out unless the Engineer approved.

Trench pillars will be carefully removed during the backfilling process, but removing these pillars shall not acquit the Contractor from being responsible for the safety and stability of these works, as well as, the safety of the facilities existing next to these trenches.

The Contractor shall pass all the buildings existing next to the drilling and classify the buildings to high-risk, dangerous and medium-risk, and providing it with all methods of monitoring high-risk and dangerous buildings during the implementation of the trenches.

The Contractor shall be responsible for knowing the requirements of the Road Authority with regard to backfilling rates to comply with these requirements, whether they are mentioned herein or not.

### **3.4.11 Pipe Installation**

- 1) The prices and categories of pipes shall include leveling the ends of pipes, cutting off the appendages, such parts and so on. Noting that the net lengths of the installed pipes already shall be paid.
- 2) The pipes shall be handled carefully during the placement process, and they will be moved by lifting, while the traction, rolling or landing will not be used suddenly. In addition, using the appropriate lifting methods according to the recommendations of the Manufacturer. No wires is allowed to pass through the pipes. When pipes with inner lining or a protective outer coverage are used, the lifting tools shall be of materials that do not harm the lining or the outer coverage.
- 3) The minimum horizontal distance between the draining lines and the existing water lines is determined according to the width of drain holes located next to the water pipes or according to what is stated in the tender drawings. All pipes shall be placed in a straight line and up to the limit specified in the drawings, except if the Engineer issues other instructions.
- 4) Unless otherwise specified by the Engineer or indicated on drawings, the pipes shall be installed with a minimum coverage over the upper of the pipe with a distance of at least 1000 mm above the ground surface.
- 5) The Contractor shall ensure that all pipes will not be floated during the implementation of uPVC pipelines.
- 6) All connections shall be of type of appropriate protection. When using the appropriate connections, the pipes shall be laid and connected according to the Manufacturer's instructions.
- 7) The required pipes and fittings shall be installed in other facilities in the places that determined by the drawings or according to the instructions of the Engineer.
- 8) All steel works and all similar installations shall be executed according to the details shown in the drawings and according to the instructions of the Engineer.
- 9) The Contractor shall keep the internal parts of pipelines clean and free of water, dust, stones or any foreign materials during the installation process. The end of all pipes and fittings shall be securely closed by a wooden seal or by other approved method.
- 10) During the placement process, a brush of appropriate diameter must be passed through the pipe to remove any foreign matter from inside the pipes.
- 11) The placement of pipelines inside the trenches shall be arranged regarding the drilling and backfilling process of the trenches to ensure that the whole process is completed as soon as possible.
- 12) Metal strips shall be added on the top of the pipeline executed through the pipeline path as shown in the drawings of the typical sectors for pipe implementation and at the distances stated by the Manufacturer's recommendations. These strips shall be of the type that is easily identifiable with all types of sensors that are in the Egyptian market and the water and wastewater company in the governorate.

#### **3.4.11.1 Water Supply Pipes**

The item of pipes shown in the bill of quantities is a type of the linear meter of pipes; furthermore, it is calculated according to the actual length of the pipes branches that are executed measuring on its centerline with the required depth of the project drawings or the approved executive drawings. The item includes the following:

- 1- Drilling trenches for pipes according to the specifications including breaking all types of paving materials; provided that excavation shall be in the manner specified in the final report prepared by

the Geotechnical Engineer, including any type of soil such as rocky soil, and according to the standards indicated in the project drawings or the approved executive drawings. In addition, the excess loose materials that are not required for backfilling shall be removed within at least 24 hours; starting the date of extracting it from the excavation and if necessary, the soil shall be transferred temporarily for backfilling, if required in writing. Moreover, this category shall include the suspension of pipes and cables which are in the ground, maintenance and return it to its original, as well as, protecting the trenches, fencing them, and making the necessary actions to protect the trenches. It includes also establishing crossings over the trenches, and draining water from them, if any, in the manner specified in the final report prepared by the Geotechnical Engineer, provided that it shall carefully observe the recommendation mentioned in the technical report regarding instructions in case of the groundwater while drilling, (keep it at its normal level or reduce to any level, or withdraw completely). The way of excavation and dewatering of the groundwater, specified in the technical report, shall be followed to ensure not to cause any damage the neighboring buildings or any other facilities, works located in work area, whether during the implementation process or after the completion, and to implement the downgrade pipelines perfectly and ensure its safety after implementation and operation.

2- Supply pipes and do all necessary tests, according to the specifications, before transferring to the work site.

3- Install pipes in straight lines, according to the required inclination and the customary industrial principles, concerning the specifications, and while installing the uPVC Plastic, the following points shall be taken into consideration:

- Using pin vise during installation diameters exceeded 200 mm.
- Taking into consideration, the installation of rubber rings in a proper manner and put the ring correctly by using a special foam material.
- The rubber ring and the inner surface of the head pipe bore, as well as the end of the pipe shall be cleaned well by the cleaning agent, approved by the pipe manufacturer, then shall be dried thoroughly immediately before installation, and the rubber ring shall be in the same shape as stated in the pipe catalog provided by the manufacturer.
- The end of the pipe and the inner surface of the head pipe bore, before tightening the fitting, shall be covered with the liquid soap approved by the pipe manufacturer. In addition, to facilitate the installation process, a small amount of the same liquid shall be placed on the edge of the rubber ring circularly; provided that the head and the end of the pipe shall be placed on a straight line and combined in one movement to complete the installation process.
- If the pipe is installed by adhesive, the following shall be taken into consideration:
  - A) A circular mark shall be put to determine the interference distance between the head and the end.
  - B) The end of the pipe shall be polished by an appropriate tool, especially in the case of cutting pipes at the work site.
  - C) The head and end of the pipe shall be cleaned well by a clean piece of cloth.
  - D) The adhesive shall be applied by a clean brush suitable for the diameter of the pipe, in one direction on the pipe's end and inside the head.
  - E) The end shall be installed into the head of the pipe, according to the entire interference distance specified by the mark on the end of the pipe, taking into consideration the movement of the pipe in a circular direction.
  - F) The line operation shall be tested 24 hours after the completion of welding process.

4- The pipelines on site shall be tested after the installation and according to the specifications.



5- After doing the pipes test successfully and permitting the contractor to backfill, the pipes shall be covered, and backfilled, according to the conditions, specifications and drawings.

6- If the washout pipes are linked to an existing sewage manhole, the openings shall be made for the branch pipelines in the manhole and other works with which these pipes are connected, and be well applied with cement and sand type (B35) to connect the branches, including cut and reshape the tendencies of the bottom sewerage completely according to the specifications and drawings.

#### **3.4.12 Backfilling the Trenches:**

##### **3.4.12.1 General**

Unless otherwise mentioned, the trenches and around the chamber rooms shall be gradually backfilled along with the work progress, after installation and after 24 h of successful testing and approval of the test, unless otherwise stated in the drawings and bill of quantities.

##### **3.4.12.2 Backfill Materials**

Backfill materials for trenches shall be fine, clean, and sifted sand free of any organic or foreign materials, stones, or cobbles.

##### **3.4.12.3 Backfilling of Trenches**

The trenches shall be backfilled by the materials above mentioned and according to the depths of the invert of the pipe, unless otherwise stated in the drawings and bill of quantities, measuring from the surface of the earth and according to the instructions of the companies that produced the pipes. Moreover, the trenches of the pipes will also be backfilled after the approval of the Engineer, so the Engineer shall have the right to check any pipes that have been laid before backfilling. The backfilling shall be on, around, and on the top the pipe, using clean fine sand above the body of the pipe with thickness of layer as described in the geotechnical soil report. The backfill shall be done on layers not exceeding 250 mm per layer, along with spraying and compacting carefully.

The rest of the trench shall be backfilled by fine sand or by the excavated soil approved by the Engineer in layers; the thickness of each one is not exceeding 250 mm, with compaction and spraying.

In the case of mechanically backfilling, the inclined plane used to lower the material shall be lowered before starting the backfill and the direct backfill shall not be used without the inclined plane, as long as, more than 600 mm height above the ground surface. In any conditions, it is not permitted to drop heavy or sharp pieces directly into the trench above the previously backfill materials and in such case, the Contractor shall be responsible for any damage caused to the pipes.

The materials used for backfilling shall be compacted to a density of 95%, according to what is mentioned in ASTM-D2049 or 1557 ASTM-d; provided that the moisture content, during the compaction, is as low as possible. In the case of the thickness of the backfill layer above the pipe is up to 1000 mm, vibrators for compaction shall be used. While, in the case of pre-backfilling above the pipe with at least 1000 mm thickness, the mandala (manual compactor) shall be used and the process of using the mandala shall be only executed after having the Engineer's approval.

The initial backfilling of trenches drilling shall only be carried out if necessary, and in the case of installing pipes within testing duration, unless otherwise the Engineer required.

The Engineer shall test the compaction randomly to find out the degree of its density, and the Contractor must provide all necessary arrangements for drilling to carry out these tests and bear all costs related to drilling, backfilling, and compacting, and other costs related testing the compaction shall be paid by the Contractor. In addition, the potholes resulted in this test, the Contractor shall be responsible for backfilling them by similar materials and reaching the required density level.

If the materials used in backfill fail to reach the required density, it will be the direct reason for rejecting the parts of backfill tests. However, if the tests indicate that the required density of backfill materials has been achieved, it shall not relieve the Contractor from repairing any damage that resulting from land collapse later, as well as, the Contractor shall not have extra duration or additional compensation against the test or replacement the backfill that required by the Engineer.

#### **3.4.12.4 Backfill Layer Collapse**

If the backfilling layer or the buildings next to the backfilling area collapse, during the warranty duration and according to the general conditions, it shall be considered as a result of bad compaction and using incorrect methods. Therefore, the Contractor shall repair the damage, at its own expense, and the facilities that have been damaged as a result of this collapse shall be restored to its original, at contractor's expense as well. If the Contractor rejects to repair the damage, it shall be carried out at its expense without notifying it, whereas the costs shall be deducted from the Contractor's dues.

#### **3.4.12.5 Maintenance of the pipeline trench backfilling**

The Contractor shall be responsible for backfilling the pipe trench with the materials specified in the specifications and for its maintenance throughout the duration of the contract. If (the Employer) is forced to do any emergency maintenance to the trenches stated in the contract, the costs of such maintenance shall be deducted from the Contractor's dues.

### **3.4.13 Return to Original**

#### **3.4.13.1 General**

- 1) Agricultural lands, fields, parks, sports arenas, paved areas, and tunnels shall be repaired according to the specifications mentioned in this chapter.
- 2) The roads shall be returned to the original, according to the specifications mentioned in this document.

#### **3.4.13.2 Agricultural Lands, Green Areas, Sports Arenas, Paved Areas, etc.**

The specific categories of pipe works shall include the removal of topsoil and plant materials carefully before drilling the trenches to the specified depth for the entire width of the trench and the width of the work area.

Topsoil shall be kept separately until reused.

The area shall be returned to its original permanently after finishing the works, by returning the topsoil to the required thickness with supplying additional topsoil, if required, with scattering, leveling, and treatment the surface by appropriate fertilizers to achieve the standard level that is accepted by the Engineer and Owner.

#### **3.4.13.3 Gardens, Fences, Walls, and Bush Fences**

The Contractor shall ensure that it will remove all obstacles and that the finishing levels of each garden, except in the case of a separate measurement, include, according to its estimate, all emergency conditions and it shall responsible for returning it to the final image that is accepted by the Owner or Tenant.

When the temporary removal of fences, walls and bush fences is necessary to ease the performance of the works, the Contractor shall repair any damage in the fences or walls and return to its original condition, at its own expense.

Fences and walls shall be restored to its original condition, while the bush fence shall be replaced by similar and protected plants on both sides by laying a fence of thick wire.

#### **3.4.13.4 Roads and Temporary Return to Original Condition**

The agreed basic materials shall be put and combined to a 95% density (Proctor) at the top of all trenches on the roads. If the 200 mm additional layer of these basic materials is put and compacted, however it's resulted in the collapse of the sides of the trench backfill, the costs of the temporary repair shall include in the categories of pipe works.

#### **3.4.13.5 Paved Roads - Permanent Repair**

The paved parts, that have already been existed, will be cut in straight lines up to 300 mm from each side of the pipe trench or as stated in the drilling width table that mentioned in the specifications. All broken pavements will be removed and cut into squares, and the paving will be replaced with materials similar or better than those already consisted of. In addition, the permanent paving of roads will be executed according to the Owner's consent, or it will not be less than the specifications mentioned in the specifications of the foundation layers of road works. The top layer of the temporary paving will be removed to reveal the inner part of the compacted steel, which will be laid on it and leveled, if required.

Before performing permanent paving, the Contractor shall be responsible for renewing all ground floors or any other facilities that may be damaged due to the existing works and return it to its original condition, at its own expense.

#### **3.4.13.6 Crosswalk - Return to Original Condition**

It will be considered that the Contractor shall take in its consideration while setting prices, the paving for both sides of roads and paths, whereas the damage caused by the temporary works, is resulted in the need for such materials. The surface shall be similar to that already existed and according the approval of the Owner.

#### **3.4.13.7 Stairs and Flat Stairs - Permanent Repairs**

The scope of these works include the removal of steps and flat stairs of cement completely from the site and re-establishment again using B25 concrete after finishing the part of pipeline works.

#### **3.4.13.8 Top soil**

- 1) When having the topsoil from the piles existed on the site, they shall be used only after a suitable duration to make them suitable for usage again and upon prior permission issued by the Engineer.
- 2) In case that it's necessary to have the soil from external sources, a sample shall be submitted to be approved by the Engineer before supplying the rest required quantities.

#### **3.4.13.9 Surface Final Grading**

Upon completing the external works by completing and settling the backfilling, all areas that are exposed to these works must be settled in line with the heights, inclinations and specified levels. It is allowed to use the grader or any other mechanical equipment to determine the final settlement and inclinations. The contractor must also verify the ground levels, after settling the street with its entire width according to the basic levels of the ground surface, which are approved by the engineer and the employer. The contractor shall obligate to bring or remove any extra backfilling materials in order to carry out the required levels approved by the engineer. It shall also complete these works,

using the proper methods approved by the engineer. In addition, the contractor shall receive the costs of the settlement works according to the bill of quantities.

#### **3.4.14 Valves Chambers:**

These chambers shall be made of reinforced concrete according to the attached drawings. They shall be made in the manner that does not impede the maintenance works after installing them.

Ingredients in Concrete:

##### **1- Plain Concrete (B15):**

- gravel	0.80 m <sup>3</sup>
- sand	0.40 m <sup>3</sup>
- cement	250 kg

##### **2- Reinforced Concrete (B20):**

- gravel	0.80 m <sup>3</sup>
- sand	0.40 m <sup>3</sup>
- sulfate-resistant cement	400 kg/ m <sup>3</sup> [Risk limit: 370 kg/ m <sup>3</sup> ]

The compressive strength of concrete shall be as required in project drawings. The compressive strength test shall be undertaken in line with standard ASTM V 39/ ASTM C 31 and in the following manner: 9 standard cylinders or cubes are prepared for each 20 cubic meters or 100 m<sup>2</sup> of the casted surface area, as they are collected from the same pouring on the same day. Whereas 3 samples are tested after 7 days, 3 samples are tested after 28 days and 3 samples will be kept as reserve for being tested if necessary. Additional test samples can be poured to monitor works progress.

Sika or similar material shall be added to the reinforced concrete and painting the walls of the external chambers adjacent to the backfilling, as two sides shall be painted with bitumen. Meanwhile, the internal walls are painted with 2 cm thick with cement mortar. The ratio of such cement mortar shall be 350 kg of cement per cubic meter of sand, with adding the sika or similar material to the mortar to prevent the dropout into the chambers. Regarding the chambers' ceiling, they shall be made of reinforced concrete (pre-poured concrete or site-poured concrete) with the same previous ratio to bear a tractor load of 20 tons. Their ceilings shall have one or more gray cast iron cover. A step ladder, whose steps made of cast iron according to the drawings, shall be placed across the wall and in front of any of the holes.

The stairs, made of wrought-iron with 25 mm diameter, shall be supplied, placed and painted in accordance with the drawings and specifications. The width of each step shall be 30 cm. Their ends of length 35 cm shall be placed, as the length of part connected to the wall is 20 cm. Before placing the stairs in their places, they must be covered with a lead cover of 3 cm thickness in a manner prevent the leak gases from iron. The category includes providing the cement mortar via such stairs with cement mortar (B35) according to the specifications and drawings and under the industry standards.

#### **3.4.15 Inspection and Test**

##### **3.4.15.1 General**

1- All the valves and pipes lines shall be inspected and tested, as the contract shall include their costs to the total price. Any found defects shall be cured, then, the test shall be undertaken, at the own expenses of the contractor, until achieving satisfied results.

2- All the tests shall be witnessed by the engineer. The results of these tests shall be recorded in an approved test record. Such records shall be signed by both the engineer and contractor, as the engineer has the right to have a copy of the same.

### **3.4.16 Water Lines**

According to the Egyptian Code, both the transmission lines and water supplies shall be subjected to an internal compression test. The supports shall be made on the pipeline during such test. The test shall be made in two phases:

- a- First phase: the transmission lines and water supplies segments of 500 to 1500 m by testing pressure equal to one and half of operational pressure; diameter of 200 mm shall be subjected to duration of 3 hours, diameter more than 200 mm shall be subjected to 24 hours under the operational pressure.
- b- Second phase: the full pressure test under the operational pressure plus 2 bars for ½ hour at least according to the engineer approval.

The contractor shall provide all the required equipment, labor and materials to carry out the tests on water lines, including calibration of pressure meters, which must be approved by the engineer. The pipelines must be tested as described above, once it becomes possible after completing the pipeline sectors, becoming more rigid and partially backfilling and detecting the connections. The contractor shall perform the tests under the supervision of the engineer.

The self-supporting and free- connection pipes must be supported at the ends of pipes, elbows, reducers, and extensions against the forces generated by the internal pressure. The measures of the supportive concrete cement shall be as the drawings. The pressure test shall not be applied to the closed valves.

The total pressure test shall be carried out, with leaving parts of exposed connections among the tests.

After accepting the results of the final tests, the engineer shall issue a certificate to the contractor; providing that the transmission lines have been passed the tests. The issuance of this certificate is not considered as a disclaimer of the contractor's liabilities prescribed in the contract concerning repairing any defects may appear.

### **3.4.17 Waterlines Wash and Disinfection**

#### **3.4.17.1 Wash**

- After completion of installation, tests and backfilling process, according to the previous items, the washing works shall be started by closing all the connections, service connections and fire hydrants and opening all the valves on the line routes and the washout valve, which is connected to the nearest watercourse or public stream.
- The pipes shall be washed by constant watering of relevant pressure until ensuring that all the impurities and sediment, in the pipes due to the construction works, are removed.

#### **3.4.17.2 Disinfection**

- After completing the washing, the washout valves and the water supply are closed. In addition, at the point of injection that is at the lowest point compared to the line, whenever possible, the network to be disinfected must fill with disinfected clean water, which contains 10 ppm chlorine.
- For 24 hours, the chlorinated water shall be retained in the network, after ensuring that chlorine is reached to the ends of the network.
- After such period, the specialized laboratories shall collect samples from the retained water in the network, thus, analyze them to find out the amount of remaining chlorine in the

network, that must not be less than 1 ppm. If the result is less than such ratio, the disinfection process shall be repeated.

- After the laboratory professionals decide that the line or the network has been disinfected by the presence of the remaining chlorine within the required limits, the network shall be drained from the retained disinfected water. The network shall be washed again with clean water to ensure that it is fully clean by measuring the amount of remaining chlorine in the washout water that must be similar to the chlorine concentration in the network.
- Then, the network is entered to service.

#### **4 Occupational Health & Safety & Environmental Requirements**

##### **4.1 Occupational Health & Safety**

The contractor shall, throughout the period of implementation of this contract and until the completion of the implementation of all activities at the site, comply with the following occupational safety and health instructions and requirements. The responsibility for implementing these instructions lies on the contractor and subcontractors, and they bear jointly all the consequences of failure to implement these preventive requirements, especially the responsibility for securing the site against fire accidents, death, collapse of trenches and serious accidents. The contractor must notify at least one week before the start of implementation to notify the competent Manpower Directorate with a statement that includes the name of the establishment or contractor Original - name of the subcontractor - type of operation - implementation time - number of employees - implementation sites. The contractor must surround the work sites with external fencing, appropriate lighting, and with the appointment of adequate night guards in line with the law, norms and standards in Egypt.

##### Safety conditions related to the use of heavy equipment:

1. Heavy equipment must be licensed to be used and equipped with appropriate safety means
2. Dangerous moving parts of equipment and vehicles must be protected
3. Lanes of movement and traffic for cars and heavy equipment must be marked at the site and warning tapes and signs must be placed.

##### Safety conditions related to the use of scaffolding:

4. The design, installation and use of scaffolding must comply with safety requirements
5. The base of the scaffold must be on flat ground and compacted to prevent its movement
6. The scaffold boards must be free of any protrusions that obstruct traffic and work on them
7. All scaffolding must be fastened and fixed in a good way to ensure its stability and using parts that conform to specifications
8. If the height of the building exceeds two floors, the scaffolding used must be made of iron or aluminum and its corners must be reinforced diagonally
9. In the case of using aluminum, it must be ensured that it does not mix with harmful substances of aluminum such as lime, liquid cement, and sea water
10. Workers installing the scaffolding must be provided with the necessary personal protective equipment, especially protective equipment to prevent falls
11. The weights assessed on the scaffolding must not be exceeded and the changing weather conditions must be taken into account during the execution of the works

Safety conditions related to welding and cutting works:

12. Adequate ventilation must be provided in the places of welding or cutting works, whether workers, equipment, or materials to be welded or cut.
13. The quality of the insulating materials for the wiring and additional equipment must be ensured, the integrity of all electrical connections must be ensured, and the presence and efficiency of the gearthing must be ensured.
14. It is be forbidden to carry out welding and cutting work near flammable materials.
15. Oxygen cylinders must be properly handled and transported and stored horizontally in a safe, dry, ventilated and storage place.
16. Gas leak detection must be carried out periodically.
17. There must be non-smoking boards in storage areas.
18. The status of gas cylinder must be clearly specified (full/empty)
19. Cutting or welding work must be carried out by specialized technicians equipped with personal protective equipment.
20. Welding processes must be effectively isolated to ensure that no harm is caused to workers and people present on site by exposure to harmful radiation or flying particles resulting from the welding process.

Safety conditions related to the use of stairs:

21. The length of the ladder must be suitable for the work to be accomplished, and when installing the ladder, it must protrude 1 meter above the place of work
22. The ladder must be placed at the base of 25% of a meter at its base for every one meter of its vertical height.
23. Connect the stairs near their fulcrum to prevent them from moving on the sides, and if this is not possible, there must be someone to hold the ladder at its base.
24. The ladder must be in good condition and its steps intact and complete.

Safety conditions related to the storage of chemicals and flammable materials:

25. Flammable liquids are stored away from areas where there is a fire hazard, and it is forbidden to store chemicals or oxidizing agents nearby, and warning signs must be placed.
26. The storage of these materials and liquids shall be limited to the extent necessary for the need for on-site work only.
27. Oxidizing substances are considered sources of oxygen, so it is forbidden to store them with flammable materials, even if they are slow to ignite, and therefore they must be separated from other materials.

Safety conditions related to the cleanliness of the site:

28. The contractor shall provide sufficient numbers of garbage bins to be placed in suitable places and must empty them at the end of the daily work.
29. All workplaces must be cleaned after the end of daily work by the workers in the same place and throw garbage and waste in the boxes designated for them.

30. It is forbidden to empty paint or suspicious materials in cesspools or waste bins, but they must be placed in special boxes that are tightly glued in preparation for proper disposal.

Conditions related to the safety of equipment and personnel:

31. Machinery and equipment workers must apply the technical rules required to be observed for the safety of machinery and equipment.
32. Employees must wear personal protective equipment.
33. The site must be provided with safety signs and signs indicating existing hazards and ways to avoid them.
34. Barriers must be lit at night to avoid falling by potholes.
35. Staff housing must be prepared within the site.
36. A qualified individual responsible for occupational safety and health of the site is required.
37. An assessment of the various work risks at the site and the determination of the degree of severity, probability and preventive measures taken according to the outputs and result of the assessment are required.
38. The work permit system is required to ensure that the requirements and preventive measures are applied to secure employees.
39. The condition of the equipment must be inspected on a daily basis to ensure good condition and suitability for use.
40. The use of rudimentary/non-conforming equipment is not permitted.
41. Be sure to have means of protection against falls.

Safety conditions related to electrical works:

42. All necessary preventive precautions must be taken and measuring devices provided to avoid the dangers resulting from electrical installations and electrical equipment in terms of proportionality of electrical loads or good insulation and to be under continuous monitoring and to take the necessary precautions to secure equipment, transformers and generators to avoid their risks.

Safety conditions related to excavation work:

43. The necessary tests must be done for the soil to classify it and determine its properties and type (rocky - sand - clay) and the following must be done:
- a. The accumulation of soil raised from the pit on both sides of the pit must be prevented, but the excavation material must be kept away to a distance of at least 60 cm from the edge of the pit so as not to fall into the pit and cause injury to the workers inside.
  - b. The height of the excavation output on both sides of the hole must not exceed one and a half times the distance between the excavation output and the hole, i.e. (not more than 90 cm).
  - c. Before starting work, make sure that there are no pedestrians near the place.
  - d. The trench side supporting structure shall be installed, changing, or removed by workers with experience in the field and under the supervision of a specialist.



- e. The construction of the shoring system is required when the depth of the pit reaches about one and a half meters and deeper.
  - f. The excavators must install the supports and then proceed in stages until the full depth is reached.
  - g. The correct stages of work for excavation and installation of supports must be followed, as well as when dismantling vertical and horizontal supports and backfilling the pits.
  - h. The process of backfilling the pits must be done well, moistened with water, and tamped before starting to remove the side supporting structure in successive stages.
44. The appropriate technical support method for trench shoulders (longitudinal excavation) must be tested, approved and provided in the light of the classification of soil when digging trenches with a depth of more than 1.5 meters by a qualified person or entity and according to the sound engineering methods based on Article 209 of the Labor Law 12 of 2003 and Article 1 of Chapter II of Resolution 211 of 2003, and standard specifications and Egyptian Code No. 102 of 2010 and related regulations.
45. An approved design and layout must be submitted by a competent and approved engineering authority when the excavation depth exceeds 6 meters or in the presence of neighboring facilities and high groundwater.
46. At least one copy of the support system design must be left at the execution site.
47. Trenches and pits must be evaluated at the start of work daily before allowing the workers to enter the trench and completing their work.
48. Pits must be re-evaluated when changing site conditions such as rainfall, soil difference or digging depth, increase equipment and materials or running pumps near excavation.
49. The sides of the excavation must be constantly inspected for cracks or signs of slippage on the sides of the trench.
50. The support boards of the vertical sides of the excavation must be inspected and inspected continuously to ensure their integrity and stability and note any curvatures or disintegration by them.
51. It is necessary to determine the services and facilities under the ground and below the excavation site with precision (water, drainage, gas lines and power cables, etc.) or above the ground surface (trees and walls of electricity poles) before starting work and providing the protection required for it and ways to support it and work to prevent its collapse or fall on employment due to engineering drawings for the site or for excavation test pits.
52. Supports or prefabricated trench boxes must be extended to a height of at least 30 cm above the ground.
53. Wooden formwork to support the sides of the excavation must be done using wooden planks made of Musky wood for side support and bonty wood for side beams "Wilm" and wood veins for 2 side-supporting beam "Dakm" with a section area of not less than 10×10 cm<sup>2</sup> or the use of ready-made metal jacks instead of wooden beams or the system of "metal standing - metal curtain - Dakma" according to the nature and depth of excavation.
54. Heavy loads such as tools, machinery and materials must be kept away at least 1.5 meters from the pits / trenches.

55. When it rains, the pit must be cleared of labor immediately and work must not be allowed to be restarted after the rain stops until after inspection of the site from the person in charge to ensure the integrity of the trench and give permission to enter and resume work.
56. Groundwater must be dewatered, if necessary, by the correct technical methods and under the supervision of a specialist in this field to avoid soil instability or preventing groundwater above the ground from seeping into the pit or pooling at the bottom of the trench.
57. The manufacturer's recommendations for assembly and installation must be followed or removed from the pit or ditch.
58. Labor-friendly transit corridors or bridges must be provided.
59. Spaces, if any, between the vertical supports, the soil and the sides of the trench must be blocked to prevent partial collapses.
60. Workers must be evacuated from the bottom of the pit or trench while removing supports or trench boxes and barriers.
61. Pit or trench air must be tested by a qualified person on site, regarding oxygen content or harmful gases, and the necessary means of control must be provided to ensure the provision of breathable air in them by providing the necessary means of ventilation, such as a device with ventilation for wells with the removal of ignition sources. Emergency equipment management for rescuing individuals such as self-respirators such as a breathing compressor with a hose, mask, and self-respirators with air cylinders and a triple punch device and safety ropes and parachute safety belts so that they are in reach when there are, or bad proportional conditions occur in the trench or in anticipation of any emergency incidents.
62. Eliminate the danger of walls, and other obstacles that constitute a danger to workers at any time while they are carrying out excavation work or to workers and passers-by who are near a construction site, before starting the earthworks.
63. Medical aid means and supplies must be provided near the workplace with the development of an emergency plan for cases of injuries on site.
64. All inspection and inspection procedures must be documented with daily reports and preserved.
65. The buildings adjacent to the excavation works must be strengthened if there is a possibility that they will be affected by these works, and the structure supports must be made before the beginning of excavation on the side of the executing contractor and training is carried out by engineering methods in coordination with the relevant authorities reality on its project scale.

Requirements related to traffic safety in the work area:

66. A sign board must be placed in a public area next to the construction site.
67. A copy of the excavation permit must be added.
68. The excavation areas on the way are divided into early warning area, transition zone, work area, and end of work area.

69. The output of excavation or equipment must not deviate from the permissible width in the corridors.
70. Night lighting and the placement of illuminated arrows, reflective phosphorescent signs and flash lighting must be placed at the entrances to the "beginning and end" of the construction site so that the night lighting is normal, colored and flashing bulbs on both sides of the excavation site or traffic diversion, provided that its capacity is not less than 15 watts depending on the degree of road lighting and the spacing between them does not exceed 2 meters.
71. Safe bridges suitable for crossing by the pedestrians must be installed so that the distance between each two bridges does not exceed 100 meters in the case of populated sites and 200 meters for uninhabited places, taking into account special cases such as the presence of entrances to public buildings and services.
72. Banners and flashing lights such as flashers, movable light tray must be placed at the entrances to the construction site.
73. Strong metal or concrete barriers must be provided along the trench to prevent the approach of mobile equipment and cranes or nearby traffic to the excavation area ,also plastic barriers "ANew Jersey" with reflective colors and phosphorous reflective cones on site could be used
74. Vehicles must be equipped with lights to distinguish them remotely if there is night work on site.
75. Dust and excavation products must be sprayed with water during work to prevent them from obscuring the vision.
76. The contractor is obliged to remove dust and excavation products at the end of the working day, and not to be placed next to the trench, and to maintain the cleanliness of the site.

Requirements related to concrete pouring works:

77. Safety belts must be worn in high places.
78. In the case of working with the concrete pump at height, a scaffold is required and checked before work and the safety belt is attached to an appropriate suspension point.
79. A jar of pure water is required to wash the face and eyes if any type of cement reaches the eye from under the protective glasses.
80. Laying warning strips for places of formwork.
81. 2 workers are required, if a concrete vibrator is used.
82. Employees must wear rubber boots while leveling the concrete surface.
83. The workers on the concrete pump must be trained technical workers.
84. Equipment must be inspected before work and washed after work.

Safety and protection precautions for workers:

85. The age of the worker must be at least 18 years and not more than 50 years, and such workers must have good health.
86. Prohibition of the use of child labour

87. Educating workers about the culture and traditions of the people of the project area
88. Workers must be qualified for the assigned work.
89. Workers must undergo training in the work assigned to them before commencing their work.
90. Adequate precautions must be taken to avoid workers from falls, collapses, or other hazards.
91. All employees must wear reflective jackets.
92. Ladders or safe means must be provided for the entry of workers in and out of the trench, provided that the stairs extend to a height of one meter above the ground and that the stairs are within 8 meters from the position of the workers under the trench.
93. The contractor must provide all necessary precautions to protect the bodies of workers from various work hazards by providing them with personal protective equipment and safety devices and equipment such as (protective suits, helmets, gloves, goggles, safety shoes, protective masks and masks, acoustic gas measuring devices, reflective traffic jackets, respirators, fire extinguishers, safety cords, safety belts, suspension hooks, earmuffs... etc.).
94. Determining places designated for workers' accommodation in crowded areas.

All the information and requirements received do not exempt the contractor from the need to comply with the laws, regulations, and regulations in force in the Arab Republic of Egypt, which are related to the occupational health and safety.

#### **4.2 Environment**

The contractor shall, throughout the period of implementation of this contract and until the completion of the implementation of all activities at the site, comply with the following:

1. Environmental laws, norms and standards of the Arab Republic of Egypt and the Egyptian Environmental Affairs Agency, especially Law No. 4 of 1994, as amended by Law 9 of 2009, as well as the legislation of the Ministry of Water Resources and Irrigation to protect the internal aquatic environment, canals, and drains (Law 48 of 1982 and Law 12 of 1984). As well as the general and special guidelines of the Environmental Affairs Agency related to the work of water and sanitation projects.
2. Preserving all individuals on the site while they are in the project area (either they are working in the project or not ) and to comply with the requirements of occupational safety and industrial security and to emphasize the commitment of individuals working on the site to personal protection means. During implementation, the contractor shall commit to providing first aid means at the site, as well as an appropriate means of transportation to the nearest hospital for any injuries that may occur at the site.
3. Applying the requirements of civil defense and providing the necessary equipment to fight fire at the project site, whether in closed places or in open places.
4. Avoid and work to prevent pollution or discharge of any solid or liquid waste, whether in surface water or groundwater, as well as on the surface of the soil.

5. Ensure the safety of the equipment used in the construction and the compatibility of the exhausts coming out of it with the maximum emission limits specified in the Environmental Law.
6. Obtaining the approval of the Egyptian Environmental Affairs Agency (EEAA ) and the necessary permit and full coordination with the EEAA when working in or near environmentally sensitive areas such as nature reserves.
7. Obtaining the necessary permits from the competent authorities in the event of work in or near archaeological and historical areas. If any archaeological monuments are discovered, work is stopped, and the competent authorities are informed, and work is not resumed except with permission from these authorities.
8. Do what is necessary to restore the nature and environment of the region to its original condition.

All the information and requirements received do not exempt the contractor from the need to comply with the laws, regulations, and regulations in force in the Arab Republic of Egypt, which are related to the environment.

#### **4.3 Enforcement and Penalties**

No separate invoices or payments will be made for any of the items mentioned in this part of the EHS -requirements unless included in the price tables. The cost of any item mentioned in this part of the EHS- requirements is included and distributed among the items listed in the table of quantities. All items to be provided by the Contractor to the Project Manager for occupational health and safety purposes remain part of the contract.

A penalty in the amount stated in the contract will be applied for each contractor that will violate the EHS requirements if the corrective measures are not taken in line with the contract. Further measures apply as specified in the contract.