6.6 APPENDICES TO EMPLOYER'S REQUIREMENTS

TABLE OF CONTENTS

POPULATION DATA

The last census for the whole country was done in 2001 and the data is given below.

D.S. Division :- …… (Part)

G.N. Division Name	G.N. Number	Total No. of Persons	
		20….	20….

D.S. Division :- ……

G.N. Division Name	G.N. Number	Total No. of Persons	
		20….	20….

D.S. Division :- ……

G.N. Division Name	G.N. Number	Total No. of Persons	
		20….	20….

D.S. Division: -……

G.N. Division Name	G.N. Number	Total No. of Persons	
		20…	20….

D.S. Division :- …….

G.N. Division Name	G.N. Number	Total No. of Persons	
		20….	20….

Appendix -2

RAW WATER QUALITY DETAILS (Sample Form)

SCHEME :

Parameter	Test Results of the Samples Collected on:										
									AVG	Max	Min
Odour											
Colour (Hezen)											
Turbidity (NTU)											
P^H											
Electrical Conductivity (µs/cm)											
Chloride (as Cl) (mg/l)											
Free Residual Chlorine as $Cl_{2\ (mg/l)}$											
Total Alkalinity (as $CaCO_3$) (mg/l)											
Free Ammonia (mg/l)											
Nitrate (as N) (mg/l)											
Nitrite (as N) (mg/l)											
Fluoride (as F) (mg/l)											
Total Phosphate (as PO_4) (mg/l)											
Total Residue (mg/l)											
Total Hardness (as $CaCO_3$) (mg/l)											
Calcium (as Ca) (mg/l)											

Parameter	Test Results of the Samples Collected on:										
									AVG	**Max**	**Min**
Total Iron (as Fe) (mg/l)											
Sulphate (as SO_4) (mg/l)											
Manganese (as Mn) (mg/l)											
TOC											
Total Nitrogen											
DO											
BOD											
COD (mg/l)											
Total Coliform (#/100ml)											
Fecal Streptococci											
E-Coli (#/100ml)											
Algae (Cells/ml)											
Heavy Metal Analysis of water											
Lead (as Pb) (mg/l)											
Cromium (as Cr)(mg/l)											
Cadmium (as Cd)(mg/l)											
Zinc (as Zn) (mg/l)											
Manganese (as Mn)											
Copper (as Cu) (mg/l)											

Names of the algae Species Present

Algae name	Count
Melosira dead filaments	1.13×10^4 cell/lit
Melosira sp	2.05×10^3 cell/lit

Sub – Dominant species of algae : Osciliroria sp, synedra sp

Appendix -3 ***Page 1***

<u>SUMMARY OF POPULATION PROJECTIONS</u>

Population Forecast

GND Number	GND Name	Population Forecast					
		2012	2015	2020	2025	2030	2035
TOTAL							

POPULATION FORECAST

Year / Area	Population Forecast					
	2012	**2015**	**2020**	**2025**	**2030**	**2035**

Appendix -4

LOCATION & SITE PLANS FOR PROPOSED STRUCTURES UNDER THIS PROJECT

Appendix -5

CAPACITY OF PROPOSED STORAGE RESERVOIRS AND LOCATION

Capacity of storage reservoirs and locations are listed below.

Location	Capacity (m3)	Type of Storage Reservoir (Ground Reservoir / Tower
Refer Annex – I Section 12		
Refer Annex – I Section 12		
…….		
…….		
…….		
…….		
…….		

Note: 1. Minimum shaft height shall be …….. m
2. This Table shall be prepared to suit the Project requirement

Appendix-6

DETAILS OF PROPOSED TREATED WATER TRANSMISSION NETWORK

From	To	Dia of Pipe (mm)	Material	Approx Length (km)
Water Treatment Plant	Ground Reservoir (…….m^3) (GPS co-ordinate; X = ……. Y = …….			
Ground Reservoir (……..m^3) (GPS co-ordinate; X = ……. Y = …….	Ground Reservoir (……..m^3) (GPS co-ordinate; X = ……. Y = …….			
Water Treatment Plant	Tower/Ground Reservoir			
Tower	……m^3 Ground Reservoir.			
……..m^3 Ground Reservoir.	Tower			
Ground Reservoir (……m^3)	Tower			

Note: 1. Please note that these lengths are approximate lengths and it could be varied with detailed drawings.
2. This Table shall be modified to suit the project requirement.

Appendix-7

DATA REQUIRED FOR THE COMPUTATION OF NET PRESENT VALUE OF THE PRODUCTION COST FOR FIRST 10 YEARS

Power Cost - Based on the Tariff of Ceylon Electricity Board with 10% Annual Increase. Latest tariff structure is attached as annex 5.8 -A.

Chemical Cost - Lime – Rs. 20/= per Kg.- 5% annual increase

Alum – Rs 18/= per Kg.- 5% annual increase

Gas Chlorine – Rs. 115.0 per Kg-5% annual increase

Staff Cost

Proposed O&M staff for head works as given below.

		Salary/Month/Person
Officer In Charge	(01 No.)	Rs. 43,454.00
Technical Officers	(03 Nos.)	Rs. 35,056.00
Clerks	(01 No.)	Rs. 35,056.00
Pipe Fitters	(01 No.)	Rs. 30,222.00
Mechanic	(1 No.)	Rs. 30,222.00
Electrician	(01 No.)	Rs. 30,222.00
Pump Operators	(04 Nos.)	Rs. 33,412.00
Plant Attendants	(04 Nos.)	Rs. 27,625.00
Unskilled Labourers	(04 Nos.)	Rs. 27,625.00

Bonus, ETF, EPF etc. 25% of cost.

Repair & Maintenance Cost

(i) Structures
(ii) Electro – Mechanical Equipment

Discounting rate for NPV 10% annually.

Note: 1. Cost of chemicals and salaries shall be the current prices, number of staff shall be modified to suit the project requirement.

Basis of Calculations of Production Cost

Production cost of water must include all costs to be incurred for pumping & treatment etc., from the point of intake upto the end of the treatment process, which is the clear water sump of the treatment works.

Appendix-8

ELECTRICITY BOARD TARIFF STRUCTURE

Include current Tariff System obtained from the Ceylon Electricity Board.

Appendix-9

DESIGN CRITERIA & SPECIFICATIONS
(SAMPLE FORM)

The design criteria to be used for the project

1	Planning horizon		**30 years**		
2	Population Growth Rate	Growth Rate	……. %		
3	Per Capita Demand / (lpcd)	Direct Connection	…….		
4	Non Revenue Water		20%		
5	Non Domestic Demand	Year	Up to and including ……	Up to and including …….	Up to end of Design horizon
		Commercial Demand Industrial Demand	…….% …….%	…….% …….%	…….% …….%
6	Maximum day/Average day ratio		1.25		
7	Peak hour/Average hour ratio		2.0		
8	Minimum Residual Pressure at the end of the distribution system		10 m		
9	Pipe Friction Factor	uPVC DI HDPE	130 120 130		
10	Pipe Material	Raw Water Transmission main	**DI** (minimum pressure class of PN 16) **or blue colour HDPE** (minimum pressure class of PE 100 SDR 11 PN 16) pipes.		
		Clear water Transmission main	**DI** (minimum pressure class of PN 16) **or blue colour HDPE** (minimum pressure class of PE 100 SDR 11 PN 16) pipes.		
		Distribution mains	**DI** (minimum pressure class of PN 16) **or blue colour HDPE** (shall be used diameters only from 63mm to 225mm with minimum pressure class of PE 100, SDR 21 PN 8 and for 250 mm or above diameters with minimum pressure class of PE 100, SDR 17 PN 10) **or uPVC** (shall be used diameters only from 63mm to 225mm with minimum pressure class PN_T 7) pipes.		
11	Above Ground Pipe lines	……..			
12	Minimum overall pump efficiency of Raw water & Treated water pumps	70%			
13	Swabbing Teas with necessary valves, fittings & chamber for transmission mains	At 2 km intervals as maximum distance in between two			
14	Section valves for transmission mains	At 2 km intervals as maximum distance in between two			
15	Junction valves for distribution system	For all out-going pipe lines at a junction.			
16	Air Valves	On transmission & distribution lines wherever necessary as per the specification			
17	Washout Valves	On transmission & distribution lines wherever necessary as per the specification.			

Appendix -10

SUPPLEMENTARY DESIGN CRITERIA & SPECIFICATIONS

1. General

1. The purpose of design guideline is to provide the Bidders scope of design, submittals and required design criteria design and to maintain the consistency of design which coincides with employer's policy.
2. All works shall be executed by following code, regulation, and related law
   - Structural Designs – BS standards
   - Applicable Law is Law of Democratic Socialist Republic of Sri Lanka
3. All equipments which are supposed to be applied to this project shall have more than one year's operation experiences.
4. All structures which contact water is required to have water proofing structure.
5. Underground structure is required to be checked against uplift water pressure.
6. Water treatment process is required to have an individual 2 (two) process system.
7. Contractor shall submit the preliminary design for the approval of the Engineer and shall not be allowed preceding the further works without the approval of Engineer.

2. Scope of Design

1. Scope of Design shall follow Sec. 8 employer's Requirement.
2. Scope of works includes all expenses to investigate site for design.

3. Design period

1. Bidding (outlined) design shall be submitted with bidding documents.
2. Detailed design shall be finished within 4 (four) months from commencement date.

3. Submittals lists of Design Documents

1. Bidding (outlined) design
   The Bidders shall follow sec. 5 Bidding Form attachment from form TEC -10.
2. Detailed Design
   Contractor is required to submit detailed design report as followings.

Item	Size	Quantity
Detailed Design Report	A4	20
Hydraulic Calculation Sheet	A3	5
Structural Calculation Sheet	A4	5
Capacity Calculation sheet	A4	5
Specification	A4	5
Site Survey Report (topographic, Geotechnical)	A4	5
Priced Bill of Quantities	A4	5
Breakdown of Bill of Quantities	A4	5
Drawings	A3	10
Drawings	A1	10

3. All items should be submitted by CD-ROM.
4. Drawings should be made by Auto CAD program.
5. Please include following under submittals with bid:
   a. Manufacture's literature for each type of equipment supplied/installed under the contract
6. All items should be made with individual bookbinding.

Appendix - 11

NATIONAL WATER SUPPLY & DRAINAGE BOARD

SLUDGE MANAGEMENT POLICY FOR WATER TREATMENT PLANTS

December 2012

Sludge Management Policy for Water Treatment Plants

1.0 Introduction

Considerable amount of wastewater is produced in water treatment plants due to backwashing of rapid sand filters and release of accumulated sludge in sedimentation tanks. Treatment of the wastewater emanating from the water treatment plants has not been practiced in the past as a policy even in large scale water treatment plants such as Ambatale, causing pollution of the downstream environment. In water treatment plants the amount and the concentration of wastewater produced will depend on the raw water quality which may differ seasonally.

The National Environmental Act Number 47 of 1980 and amended Act Number 56 of 1988 and the latest amendment on 1st February 2008 specifies the requirements of compliance to "Tolerance Limits for the Discharge of Industrial Waste Into Inland Surface Waters" to meet the identified 31 parameters. The compliance for water treatment plant effluent is of no exception. The new standards dictate discharge criteria for colour (maximum spectral adsorption coefficient) of

- $7m^{-1}$ for wavelength for yellow (436nm)
- $5m^{-1}$ wavelength for red range (525nm)
- $3m^{-1}$ blue range (620nm)

to be achieved in order to obtain or renewal of the Environmental Protection License for Emission or Disposal of Wastewater which will become mandatory for all water treatment plants in the near future. In addition, chemicals used in water treatment contain trace concentrations of heavy metals which will ultimately end up in the water bodies.

In larger capacity water treatment plants (>4500 m^3/d), it is advantageous to reuse the backwash water in order to conserve energy. The additional energy consumed for backwash water recovery pumping would be comparatively less than the equivalent for raw water pumping. Thus it would be prudent to adopt backwash water recovery in large water treatment plants.

2.0 Treatment of Wastewater from Water Treatment Plants

2.1 Sludge Thickening

Sludge thickening is defined as the removal of water from the sludge to aim at substantial reduction of sludge volume. For example if sludge with 0.8% dry solids (DS) can be thickened to 4% DS; a five fold decrease in sludge volume is achieved. The objective of thickening is to produce a sludge that is as thick as possible which can be pumped without difficulty and a relatively solid free liquid supernatant.

The major advantage of sludge thickening is the cost saving in sludge handling processes. The design and operation as well as the performance of several subsequent processes are positively affected by a higher solid content of the input sludge. Stabilization as well as dewatering processes is improved at higher sludge concentrations.

Gravity sludge thickening is the method commonly adopted. Slope of the bottom of the gravity thickeners should be carefully selected in order to facilitate flow of thickened sludge towards the centre/collection pit. Gravity thickeners, usually circular in shape and provided with pickets or rakes to improve dewatering of sludge. A dry solids content of 2-2.5% can be expected from gravity thickening.

Polymer dosing to enhance performance of thickening process can increase the dry solids content at least to 4% and it will improve the efficiency of dewatering processes such as sludge drying beds, centrifuge which would follow thereafter. The centrate resulting from dewatering should not be recycled back into the water treatment plant. Instead it can be sent back to the sludge regulation tank under gravity to undergo thickening process

The thickener supernatant can be discharged to the environment if it complies with the CEA regulations or else suitable pre-treatment should be provided. Progressive cavity pumps can be used to transfer the thick slurry to an appropriate sludge dewatering process depending on the hydraulic profile of the treatment plant.

2.2 Sludge Dewatering

The alternatives for sludge dewatering systems are described below. Guidance for selection of an appropriate system is given in Table 1.

Table 1: Comparison of Sludge Dewatering Systems

Treatment Process	Advantages	Disadvantages	Land Requirement	Cost Per Unit of Treated Water
Sludge Drying Beds	Low cost	Lateral Clogging Rain can impede the drying process	High	Low
Solar Sludge Drying Beds	DS content of 80-85% possible	Capital Cost is slightly increased due to UV Protected Polythene	Considerably lower than conventional drying beds	High
Sludge Lagoons	Low cost	Rain can impede the drying process	Low	Low
Filter Press	DS content of 20-30% possible	High capital & O&M cost Polymer dosing is required Sand and grit can damage the belt	Low	High
Centrifuge	DS content of 15-20% possible	High capital & O&M cost Polymer dosing is required	Low	High

The filtrate from the selected dewatering system should be returned to the sludge regulation tank.

2.2.1 Sludge Drying Beds

Sludge drying beds are most favoured when lands are available in close proximity to the water treatment works. Areas where strong sunlight is available with average annual rainfall lower than 2200mm are appropriate. Filtrate of the sludge drying beds can be directed under gravity to sludge regulation tank for subsequent thickening and should not be discharged to the environment. However in areas having higher rainfall (average annual rainfall between 3000 to 6000 mm) in order to achieve higher dry solid contents solar sludge drying beds having a roof cover of UV protected polythene can be utilized..

Past experience in water treatment plants in Sri Lanka reveals that sludge emanating from dissolved air floatation technique which contain considerable amount of algae retard the drying process of the sludge drying beds. In such situations it may be more appropriate to adopt mechanical dewatering techniques such as centrifuge with polymer dosing. Such process selection may have to be verified through research. User friendly arrangement to be provided to collect dried sludge from sludge drying beds

2.2.2 Sludge Lagoons

Lagoons may be the cheapest method of sludge dewatering but large land area is required compared to mechanical dewatering techniques. However, compared to conventional sludge drying beds, lagoons require considerably lesser land extent. Lagoons can be lined or unlined or can be provided with under drain arrangement for better dewatering requirements.

Unlined earthen sludge lagoons are more effective in dealing with large volumes of sludge from higher capacity water treatment plants. However due consideration should be given to the following during planning of the water treatment plant layout to locate sludge lagoons

- Fluctuation of groundwater table (seasonal high groundwater table should be sufficiently below the bottom of the lagoon preferable below 2.5 m)
- Underlying soil characteristics should be investigated to see its suitability, soil percolation rate between 25 to 150 mm/hr being preferred.
- Annual precipitation preferably to be below 3000mm
- Access ramps to be provided for dumper/tractor/mini loader to collect dried sludge from the lagoon and final disposal as outlined in section 2.5.

2.2.3 Mechanical Sludge Dewatering

Important operational parameters to be considered in evaluation of these systems are: ***energy consumption, required polymer dosage and separation efficiency***. Further, mechanical dewatering systems such as Belt Filter Presses, Filter Presses and Centrifuges should operate continuously as far as possible in order to reduce usage of treated water for the cleaning operation required at the end of each operation cycle and to optimize utilization of equipments. These equipments require

- high skilled maintenance staff
- suitable polyelectrolyte with dosing arrangement
- electrical power for operation of the equipment

Therefore the process is usually attractive only in large sludge dewatering facilities with incoming flow > $0.3m^3/s$ ($25{,}920m^3/day$). As such correct assessment of sludge generation and selection of the capacity of each unit is very important.

After mechanical dewatering, the sludge is generally directed through a conveyer into a skip or a hopper. The filtrate from mechanical dewatering facility can be directed back

to the sludge regulation tank. Most mechanical dewatering equipment can achieve 15-20% DS content but the actual performance needs to be verified from manufacturers.

Mechanical sludge dewatering is only recommended for

- major water treatment plants that generate large quantity of sludge
- treatments plants that do not have adequate land or
- areas that experience average annual rainfall in excess of 3000mm

2.3 Backwash Water Recovery

Backwash recovery is aimed to utilize water resources to its maximum potential, minimize energy consumption and thereby optimize production costs. The backwash recovery process should not cause any adverse impacts on the treated water quality. The possible health implications could be trace amounts of heavy metals that may be present in raw water or in water treatment chemicals as impurities, pathogenic microorganisms, algal toxins/THM which may be produced during physical/chemical processes of the treatment works or present in raw water.

In this context, reuse of thickener supernatant is not recommended as about 95% of the contaminants in raw water are removed from the sedimentation process and hence may contain pathogenic organisms such as C**ryptosporidium and Giardia Lamblia which is resistant to chlorination**. The presence of these organisms in major rivers in Sri Lanka has not been investigated as yet.

It is advantageous to reuse the backwash water in order to conserve energy by minimizing the utilization of low lift pumps and to recover 2-5% of water. Backwash water recovery has many advantages as indicated in Section 1. However, the introduction of backwash water recovery needs careful evaluation of the raw water quality, the proposed treatment process and the cost-benefits.

Therefore the recommended unit processes for backwash water recovery to be incorporated in the sludge treatment stream are as follows;

- ✓ Backwashed water is first directed to backwash recovery tank (minimum two tanks each having capacity at least to hold two backwashes) where it is allowed to settle for a selected time. After allowing for sedimentation, supernatant is gravity fed to backwash recirculation tank which is constructed with common wall to the backwash recovery tank to minimize construction cost as shown in Annex 1. The gravity feeding system should comprise of pontoon attachment at the surface of the inlet pipe (which needs to be covered with suitable mesh to prevent escaping of

floating debris) and the bottom end supported by a hinged bend in order to facilitate rotation of the pontoon attached inlet pipe as water level drops up to the sludge thickening zone of the backwash recovery tank.

Moving inlet pipe with pontoon with hinged bend (Kalatuwawa WTP: 1954)

- ✓ Backwash recirculation tank should be equipped with two wet well submersible pumps, one duty one standby, to pump the supernatant from backwash recovery tank to the raw water regulation tank. The submersible pumps should be equipped with float switches suitable for automatic operation and will be provided with guide rails and lifting chains to facilitate maintenance. The pumping rate should be decided by giving due consideration to the hydraulic capacity of the treatment units.

- ✓ After supernatant (clear water) in the backwash water recovery tank is completely transferred to backwash recirculation tank, the sludge from the backwash recovery tank is then pumped to sludge regulation tank using submersible wet well pumps similar to the operation of backwash recirculation pumps.

- ✓ Sludge emanating from the sedimentation tank can be directly sent to sludge regulation tank. The mixer equipped inside the sludge regulation tank will agitate and mix the sludge from sedimentation and backwash recovery tanks to achieve homogeneous concentration and to keep the sludge under suspension.

  Two wet well submersible pumps, one duty one standby, to be provided to lift sludge from the sludge regulation tank to the gravity thickener.

- ✓ From the gravity thickener, the sludge is directed to ultimate disposal which could be either sludge drying beds, sludge lagoons or mechanical dewatering facility preferably by utilizing progressive cavity pumps, one duty one standby operation.

2.4 Wastewater from Slow Sand Filters

During scraping operation of the biological layer called "schmutzdecke" of the slow sand filters, the removed sand can be washed using "hydro cyclone" and reused when "re-sanding" of the slow sand filters is required. The dirty water resulting from the hydro cyclone needs to be treated appropriately in line with the disposal standards. A sludge thickener can be used if the number of filters is higher and continuous type of treatment is needed as in larger scale water treatment plants. If the treatment plant is of small scale, it may be sufficient to have a roughing filter together with natural or constructed wetland to polish further to meet the discharge standards as this type of system may be suitable for intermittent operation as generally slow sand filters need to be cleaned once in two to three months depending on the raw water quality.

2.5 Disposal of sludge

The dried sludge resulting from different dewatering methods discussed above should be disposed in compliance to environmental regulations. The options available for disposal of sludge are as follows;

- Land Disposal
    - Forest
    - Land Reclamation
    - Landfill
- Incineration
- Melting
- Brick and roof tile construction (after mixing with other constituents to obtain the desired consistency)

Table 1: ***EU Council Directive 86/278/EEC for land application of Sludge***

Metal	Limiting Value (g/ha/year)	Limiting Value (mg/kg DS)
Cadmium, Cd	30	10
Copper, Cu	3000	1000
Nickel, Ni	900	300
Lead, Pb	2250	750
Zink, Zn	7500	2500
Mercury, Hg	30	10
Chromium, Cr	3000	1000

Note: Incineration and melting is extremely expensive and definitely not attractive to a country like Sri Lanka at least in the present context.

3 Recommendation

- Treatment of wastewater from water treatment plants has become mandatory in view of the requirements specified in the National Environment Act. The requirement of NWSDB to obtain a license from CEA to operate the treatment works will become mandatory in the near future.

- The treatment of wastewater from water treatment plants using conventional water treatment processes requires the following basic processes;

  - Backwash recovery system which includes backwash recovery tank, backwash recirculation tank, sludge regulation tank, sludge thickener, complete with equipment as stated in Section 2.3.

  - Sludge Disposal should be carried out using an appropriate method as outlined in Section 2.5.

  - If the raw water source is highly contaminated with algae, backwash water recovery should be revived in relation to physical/chemical treatment proposed and possibility of presence/development of algal toxins

APPENDIX 12 - ENTITLED ALLOWANCES ON FOREIGN TRAVELS & RELATED EXPENSES

Category of Countries

Category No.	Countries					Combined & Incidental Allowance
1st category	Afganistan Albania Algeria Azerbaijan Bahamas Balarus Barbados Belize Bhutan Bolivia Bosnia Botswana	Burundi Cambodia Canary Island Capevrde Cooks Island Domenica El Salvador Etihiyopiya Equatorial Gabon Gambia Gibraltar	Guam Kiribati Lao Peoples Dem.Rep. Lesothe Liechtenstein Nacedonia Rep. Malawi Malta Mauritania Mongolia Montenegro Myanmar	Nambia Nauru Netherlands Anti Nicaragua Palau Paraguay Samoa Sao Tome & Prince Serbia Sierra Leon Soloman Island Somalia	Tanzania Swaziland Tajikistan Tunisia Uganda Uzbekistan	US$ 200 + US$ 75
2nd category	Antigue Barbuda Armenia Argentina Bulgaria Bangaldesh Brunei Cameroon Coted Ivoria Costa Rica	Ecuador Fiji French Guiana Guyana Grenada Gerogia Guatemala Greenland	Guinea Bissaw Hawai Haiti Honduras Ireland Iraq Jamaica Korea Dem.Rep.	Liberia Mexico Micronesia Fed. Monaco Mozambique Papua new Guinea Suriname Yeman Rep.	Yogoslavia Tahiti Tonga Vanuatu	US$ 260 + US$ 75
3rd category	Baharain Chile Cyprus Egypt Arab Rep. Estonia Guinea Hungary Indinesia Iran Islamic Rep. Kenya	Kuwait Lithuania Madagascar Mauritius Malayasia Maldives Morocco Macedonia Rep Nepal Oman	Pakistan Panama Peru Pholippines Poland Quarter Romania Ruwada Saudi Arabia Solvenia	Sriyan Arab Rep. South Africa St.Lucia Sudan Thailand Togo Trinidad & Tobago Uruguay Ukrain Venezuela	Vietnam Zaire Zambia Zimbabwe	US$ 330 + US$ 75
4th category	Belgium Benin Burkina Faso Comoros Central African Rep. Colombia Congo	Croatia Cuba Czech Republic Dem.Rep.of Congo Djibouti Greece Iceland	India Ivory Coast Jordan Kazakhastan Latvia Lebanon Luxemburg	Mali New Caledonia Nigeria Portugal Slovak Rep. Spain Taiwan	Turkey United Arab Emirates	US$ 400 + US$ 75
5th category	Angola Australia Austria Brazil Canada Chad	China (Beijin) Denmark France Germany Finland Hongkong	Israel Italy Japan Libiya Netherland New Zealand	Niger Norway Russia Senagal Swedan Seychelles	Singapore South Korea Switzerland United Kingdom USA	US$ 530 + US$ 75

APPENDIX 13 - TOR FOR INDEPENDENT INSPECTION AGENCY (DI PIPES)

DI Pipes & Fittings

Activity		Test Performed	Results	Acceptability as per Specification
1.	**Physical Proportion**			
1.1	**Socket & Spigot Pipes**			
	Pipe wall thickness			
	External Diameter			
	Internal Diameter			
	Length of Pipe			
	Socket Length			
	Chamfering of Spigot end			
	C - Class			
	Grooves in the Socket.			
	Thickness of Internal Cement lining			
	Smoothness of Internal Cement lining.			
	External Zinc Coating.			
	Thickness & Weight of external Zinc Coating.			
	Compressive Strength of the Cement Lining.			
	Curing period of Pipes after Cement Lining.			
	Smoothness of external Bitumen Coating.			

	Activity	Test Performed	Results	Acceptability as per Specification
1.2	**<u>Flanged Pipes</u>** Flange thickness Flange diameters No. of bolt holes Length of pipe Wall Thickness of Pipe C – Class of Pipe Cleanliness of Flange Raised Face or Flat Face Smoothness of Raised Face/Flat Face Integrally casted or Factory Welded Condition of weld if welded. Thickness of Internal Cement lining Smoothness of Internal Cement Lining. External Zinc Coating. Thickness & Weight of external Zinc Coating Method of Application of Bitumen Coating. Compressive Strength of the Cement Lining Curing period of Pipes after Cement Lining. Smoothness of external Bitumen Coating			

	Activity	Test Performed	Results	Acceptability as per Specification
1.3	**Socketed Bends**			
	Socket Diameter			
	Length of Bend			
	C-Class of Bend			
	Wall Thickness of bend			
	Grooves in the Socket.			
	Thickness of Internal Cement lining			
	Smoothness of Internal Cement lining			
	External Zinc Coating			
	Thickness & Weight of external cement coating			
	Method of Application of Bitumen Coating			
	Compressive Strength of the Cement Lining			
	Curing period of Bends after Cement Lining			
	Smoothness of external Bitumen Coating.			
1.4	**Flanged Bends**			
	Flange Diameter			
	Length of Bend			
	Thickness of Flange			
	No. of Bolt holes			
	Wall Thickness of Pipe			
	Raised Face or Flat Face			
	Smoothness of Raise Face/ Flat Face			
	Integrally Casted /Factory welded condition of weld if welded			

	Activity	Test Performed	Results	Acceptability as per Specification
	C – class			
	Thickness of Internal Cement lining			
	Smoothness of Internal Cement lining			
	External Zinc Coating			
	Thickness & Weight of External Coating			
	Compressive Strength of the Cement Lining.			
	Method of Application of Bitumen Coating			
	Compressive Strength of the Cement Lining			
	Curing period of Bends after Cement			
	Smoothness of external Bitumen Coating.			
1.5	**<u>Tees</u>**			
	Socketed Tees			
	Length of Tees			
	Length of Branch			
	Diameter of Tee (all faces)			
	Wall Thickness of Tees			
	Wall Thickness of Branch			
	Condition of grooves in socket			
	C – Class			
	Thickness of Internal Cement lining			
	Smoothness of Internal Cement lining.			
	External Zinc Coating			

	Activity	Test Performed	Results	Acceptability as per Specification
	Thickness & Weight of External Zinc Coating Method of Application of Bitumen Coating Compressive Strength of the Cement Lining Curing period of Tees after Cement Lining Smoothness of external Bitumen coating.			
1.6	**<u>Flanged Tees</u>** Length of Tee Length of Branch Diameter of Tee (all Branches) Wall Thickness of Tee Diameter of Flanges (All faces) No of Bolt holes Flange thickness Integrally Casted or Factory Welded Condition of weld if welded Flanges of Raised Face or Flat Face Smoothness of Raised Face/ Flat Face C – Class Thickness of Internal Cement lining Smoothness of Internal Cement lining. External Zinc Coating Thickness & Weight of external Zinc Coating Method of Application of Bitumen Coating Compressive Strength of the Cement Lining Smoothness of external Bitumen coating.			

	Activity	Test Performed	Results	Acceptability as per Specification
2.	**Strength &Metalogical Properties**			
2.1	**<u>DI Pipes & Fittings</u>** 1. Method of Casting Metelogical Properties ……. Tensile Strength Hardness minimum Elongation Positive Internal Hydrostatic Pressure Negative Internal Pressure 2. Manufacturing Standards of Pipes & Fittings. 3. Lubricant make & seal type of designation of lubricant. 4. Manufacturing of lubricant 5. Manufacturing Standard of lubricant <u>Joint Rings/ Gaskets</u> 6. Materials of Joint Ring/ Gasket 7. Manufacturing Standards of Joint Ring/ Gasket 8. Hardness of materials of Joint Ring/ Gasket. 9. Seal Type designation of Joint Ring/ Gasket. <u>Gasket Nuts & Bolts.</u> 10. Materials of Nuts & Bolts Washers 11. Manufacturing Standard of Nuts & Bolts 12. Number of Washers/ Bolt.			

APPENDIX 14- PRE-SHIPMENT INSPECTION OF DI PIPES & FITTINGS BY NWSDB ENGINEERS - CHECK LIST

Name & Location of the Factory

Pipe : - ……
……

Fittings : -……
……

Valves : - ..……
..……

Couplings :- ……
……

Adaptors :-……
……

Flanged Pipes : -……
……

(Requirement - Pipes and fittings should be manufactured by same manufacturer or manufacturing group.)

Applicable Standards

Manufacturing Standards Of pipes & Fittings	:	(ISO 2531 : 2009/BSEN 545: 2010)	…….
Manufacturing Standards of Joint Rings	:	(BSEN 681-11996/ISO 4633:2015	…….
Quality Assurance Standards	:	(ISO 9001: 2015)	……

Parameters to be checked

Markings to casted on, painted or cold stamped
Mechanical Properties, Hardness, Elongation,
Hydrostatic Pressure Tests of pipes & fittings ready for supply
Wall Thickness
Length of straight pipes
Straightness
External Coating
Internal Coating
Testing of Welded Flanges
Chemical Composition of Pipes & Fittings (Composition of metals).
Condition of Pipes & Fittings

Warping or shrinkage
Surface or other defects detrimental to functionality : Satisfactory/Unsatisfactory
Handling of pipes, Fittings after production : Satisfactory/Unsatisfactory

Inspection Procedure

Witness testing a sample with Factory QC Team : Yes/No
Witness testing with Independent Inspection Agency : Yes/No

PRE-SHIPMENT INSPECTION OF DI PIPES & FITTINGS

CHECK LIST

Mark Yes or No in the Remarks Column as Appropriate Date of Inspection ……

Technical Specifications Clause No.	Description	Values as per Specifications	Satisfactory/ Unsatisfactory	Remarks
GENERAL				
Quality Assurance	Availability of Valid Quality Standard Certificates	ISO 9001:2015		
Independent Inspection	Availability of Inspection Agency. Certificate before Shipment	-		
Markings	Pipe Material (Ductile Iron)	-		
	Year of Manufacture (Last Two Digits)	-		
	Manufacturers Identification Mark/Name	-		
	Nominal Diameter in mm	-		
	Class Designation	-		
	Quality Standard & Product Conformity certificate	-		
	Client Identification	-		
	Socket Penetration Lines (2 Lines)	-		
	In case of Fittings, these marks shall appear on the body of each fitting together with its main characteristics such as angle of bend, pressure rating of flange etc.	-		
Material Characteristics				
	Mechanical Properties			
	Minimum Tensile Strength	420 N/mm^2		
	Minimum Bending Strength	Table B1 BSEN-545 : 2010		
	Modulus of Elasticity	14- 18 N/mm^2		
	Brinell hardness for pipes	230HB		
	Brinell hardness for fittings	250 HB		

PRE –SHIPMENT INSPECTION OF DI PIPES & FITTINGS - CHECK LIST

Test	**Hydrostatic Test**	
Bill No:	Item No. & Qty.	Sample size:
Description of Item : DI Pipes (SS/DF)	Class :	Dia x Length :
Tech Spec Clause No:	Reference Standard : BSEN545:2010 - Clause 6.5 & Table 15 ISO 2531:2009 - Clause 6.5 & Table 13	

Sample No	Item of Testing	Pressure class ("c" class)	Test Condition						Deviation	Tolerance Allowed	Comply ?	Remarks
			Flexible joints		Push-fit joints		Flanges & flanged joints					
			+ve int. pressure	-ve int. pressure	+ve ext. Pressure	Dynamic int. pressure	Flanged joints	Screwed & welded flanges				
1												
2												
3												
4												
5												
6												
7												
8												
9												
			Inspection & Testing Witnessed by									
			Name : 1.					Name : 2.				
			Signature: 1.					Signature: 2.				
			Date :									

PRE –SHIPMENT INSPECTION OF DI PIPES & FITTINGS - CHECK LIST

Test	Length of Straight Pipes and Fittings						
Bill No:		Item No. & Qty.				Sample size:	
Description of Item : DI Pipes (SS/DF) , Fittings		Class :				Dia x Length :	
Tech Spec Clause No:		Reference Standard : BSEN545:2010 – Clause 4.3.3 & Table 4,5,6,7 ISO 2531 :2009 - Clause 4.2.4 & Tables 4,5,6,7					
Sample No	Item of testing	Physical/Measured Value		Deviation	Tolerance Allowed	Comply? (Yes/No?)	Remarks
		Standard	Measured				
1							
2							
3							
4							
5							
6							
7							
8							
9							
Inspection & Testing Witnessed by							
Name : 1.					Name : 2.		
Signature: 1.					Signature: 2.		
Date :							

PRE –SHIPMENT INSPECTION OF DI PIPES & FITTINGS - CHECK LIST

Test **Straightness**							
Bill No: Item No. & Qty. Sample size: Description of Item : DI Pipes (SS/DF) Class : Dia x Length : Tech Spec Clause No: Reference Standard : BSEN545:2010 – Clause 4.3.4 ISO 2531 :2009 -Clause 4.2.5							
Sample No	Item of testing	Physical/Measured Value		Deviation	Tolerance Allowed	Comply? (Yes/No?)	Remarks
		Standard	Measured				
1							
2							
3							
4							
5							
6							
7							
8							
9							
Inspection & Testing Witnessed by							
Name : 1. Name : 2.							
Signature: 1. Signature: 2.							
Date :							

PRE –SHIPMENT INSPECTION OF DI PIPES & FITTINGS - CHECK LIST

Test	**Internal & External Diameter of Pipes & Fittings**						
Bill No:		Item No. & Qty.			Sample size:		
Description of Item : DI Pipes (SS/DF) , Fittings		Class :			Dia x Length :		
Tech Spec Clause No:		Reference Standard : BSEN545:2010 – Clause 4.3.2 ISO 2531 :2009 - Clause 4.2.2					
Sample No	Item of testing	Physical/Measured Value		Deviation	Tolerance Allowed	Comply (Yes/No?)	Remarks
		Standard	Measured				
1							
2							
3							
4							
5							
6							
7							
8							
9							
Inspection & Testing Witnessed by							
Name : 1.					Name : 2.		
Signature: 1.					Signature: 2.		
Date :							

PRE –SHIPMENT INSPECTION OF DI PIPES & FITTINGS - CHECK LIST

Test	**Wall Thickness of Pipes & Fittings**						
Bill No:		Item No. & Qty.			Sample size:		
Description of Item : DI Pipes (SS/DF), Fittings		Class :			Dia x Length :		
Tech Spec Clause No:		Reference Standard : BSEN545:2010 – Clause 4.3.1 ISO2531 :1998 – Clause 4.2.3					
Sample No	Item of testing	Physical/Measured Value		Deviation	Tolerance Allowed	Comply? (Yes/No?)	Remarks
		Standard	Measured				
1							
2							
3							
4							
5							
6							
7							
8							
9							
Inspection & Testing Witnessed by							
Name : 1.				Name : 2.			
Signature: 1.				Signature: 2.			
Date :							

PRE –SHIPMENT INSPECTION OF DI PIPES & FITTINGS - CHECK LIST

Test	Internal Coating (Strength & Thickness)						
Bill No:		Item No. & Qty.			Sample size:		
Description of Item : DI Pipes (SS/DF) , Fittings		Class :			Dia x Length :		
Tech Spec Clause No:		Reference Standard : BSEN545:2010 – Clause 4.5.3 & 4.6 ISO 2531 :2009 - Clause 4.4.2 & 4.5.2					
Sample No	Item of testing	Physical/Measured Value		Deviation	Tolerance Allowed	Comply? (Yes/No?)	Remarks
		Standard	Measured				
1							
2							
3							
4							
5							
6							
7							
8							
9							
Inspection & Testing Witnessed by							
Name : 1.				Name : 2.			
Signature: 1.				Signature: 2.			
Date :							

PRE –SHIPMENT INSPECTION OF DI PIPES & FITTINGS - CHECK LIST

Test	External Coating (Thickness of Zinc Mass & Paint coating)					
Bill No:		Item No. & Qty.			Sample size:	
Description of Item : DI Pipes (SS/DF), & Coating for fittings and Accessories		Class :			Dia x Length :	
Tech Spec Clause No: ISO 2531 :2009 - clause 4.4.1 & 4.5.1		Reference Standard : BSEN545:2010- clause 4.5.2 & 4.6				

Sample No	Item of testing	Physical/Measured Value		Deviation	Tolerance Allowed	Comply? (Yes/No?)	Remarks
		Standard	Measured				
1							
2							
3							
4							
5							
6							
7							
8							
9							
Inspection & Testing Witnessed by							
Name : 1.				Name : 2.			
Signature: 1.				Signature: 2.			
Date :							

PRE –SHIPMENT INSPECTION OF DI PIPES & FITTINGS -CHECK LIST

Test	Chemical Composition			
Bill No:		Item No. & Qty. :		Sample size:
Description of Item :		Class :		Dia x Length :
Tech Spec Clause No:		Reference Standard : BSEN545:2010& ISO 2531 :2009		
Sample No	Item of testing	Name of the Metal	Available %	Remarks
1		Fe		
		C		
		Zn		
		Cr		
		….		
		…..		
		…..		
Microscopic Inspection of DI sample : % of DI				
Inspection & Testing Witnessed by				
Name : 1.			Name : 2.	
Signature: 1.			Signature: 2.	
Date :				

INSPECTION OF DI PIPES & FITTINGS

CHECK LIST

Technical Specifications Clause No.	Description	Requirements as per Specifications	Satisfactory/ Unsatisfactory	Remarks
HANDLING OF PIPES AND FITTINGS AFTER PRODUCTION				
	Packing			
	Handling			
	Stacking			
	Inspection by Factory/Inspection Authority			
	Transport Arrangements within manufacturers Country			
	Shipping Arrangements			
	Freight Insurance Arrangements			
CONCLUSION AT THE END OF THE INSPECTION TOUR				
Total Process of Production, Testing, Packing, Handling, Insurance and Freight Arrangements Satisfactory				

Observations :

Signature 1 Signature 2

Name & Designation 1: Name & Designation 2:

Rubber rings / Gaskets

Physical Parameter

1. Dimensions :……..
2. Diameter :……..
3. Hardness :…….
4. Appearance :……..
5. Lot Numbers : ……..

Quality

1. Product Conformity certificate
2. ISO 9001:2015 certificate

Packing Arrangements

1. Inspection by Independent Inspection Agency : …….
2. Shipping Arrangements :……..

Sample No	Diameter	Thickness mm	Hardness	Appearance	Deviation	Tolerance allowable	Whether Comply	Remarks

Product conformity certificate available acceptable : ……..

(witness the original certificate)

ISO 9001:2008 Quality Management System certificate available and acceptable: ……..

(witness the original certificate)

APPENDIX 15 - TOR FOR INDEPENDENT INSPECTION AGENCY (PE PIPES)

PE pipes & Fittings

Activity		Test Performed	Results	Acceptability as per specification
1.	**Physical Proportion/properties**			
1.1	**Socket & Spigot Pipes**			
	Pipe wall thickness External Diameter Length of Pipe SDR category PE designation Elongation at Break for e $\leq$ 5 m 5m $\leq$ e $\leq$ 12 mm e > 12 m Melt Mass flow rate (MFR) Oxidation Induction time Ovalty Density Effect on water quality			
1.2	**Flanges**			
	Flange thickness Flange diameters No. of bolt holes Cleanliness of Flange Raised Face or Flat Face Smoothness of Raised Face/Flat Face Integrally casted or Factory Welded Condition of weld if welded Elongation at Break for e $\leq$ 5 m 5m $\leq$ e $\leq$ 12 mm e > 12 m Ovalty Melt Mass flow rate (MFR) Oxidation Induction time Density Effect on water quality			

	Activity	Test Performed	Results	Acceptability as per specification
1.3	**Bends**			
	Diameter Length of Bend SDR PE designation Wall thickness of bend Melt mass flow rate (MFR) Oxidation induction time Cohesive resistance Tensile strength Ovalty Density Effect on water quality			
1.4	**Tees**			
	Length of tees Length of Branch Diameter of tee (all faces) Wall thickness of Tees Wall thickness of Branch SDR PE Designation Melt mass flow rate (MFR) Oxidation induction time Density Ovalty Tensile strength Effect on water quality Cohesive resistance			
2.	**Strength & Mechanical Properties**			
2.1	**PE Pipes & Fittings**			
	Hydrostatic strength at 20 ^{0}C Hydrostatic strength at 80 ^{0}C Manufacturing Standards of Pipes & Fittings.			

Activity		Test Performed	Results	Acceptability as per specification
3.	**Accessories**			
3.1	**Steel flange converter**			
	Dimension Physical appearance Ovality			
3.2	**Slim flange assembly**			
	Dimension Physical appearance Ovality			
3.3	**Nuts & Bolts**			
	Dimensions **Tensile strength** i) yield stress or stress at permanent set limit of 0.2% ii) percentage elongation after fracture iii) stress under proof load iv) strength under wedge loading v) hardness thickness of galvanized coating Ovality			
4.	**Joint rings & Gaskets**			
	Appearance & finish Tensile strength Elongation of break Compression hardness Micro biological deterioration			
4.	**Material Characteristics**			
	Compound Density Carbon black content (black compound) % by mass Carbon Black dispersion (black compound) grade range			
5.	**Quality Assurance**			
5.1	**Raw Materials (R/M)** R/M received and kept separately in quarantine area on R/M test report received (Report Ref. No.) on			

Activity		Test Performed	Results	Acceptability as per specification
5.2	**Manufacture** Date and Time of commencement of batch Date and Time of completion of batch Date batch sent to quarantine area			
5.3	**Physical/Mechanical Checkings (by In-House Q/A Department and Laboratory)** a. Dimension and appearance checking b. Heat reversion test c. General test d. Batch test e. Tensile test			
5.4	Pipe sample sent for chemical test			
5.5	Pipes passed by inspector for release to general storage area			
5.6	General storage area for packing Wrapping/packing completed and labelled and separately stored, awaiting chemical test results for pipe.			
5.7	**Verification of Quality** Chemical tests results of pipe received.			
5.8	Separation of coils pipes not complying With BS			
5.9	Test certificate submitted for inspection agent/NWSDB's approval			
5.10	Purchaser's approval received for shipment			
5.11	**Containerisation & Final Approval** Pipe stocks loading in to container & passed by Q/A Department & Inspection Agent			
5.12	Final approval for transport & shipment			

APPENDIX 16 - PRE-SHIPMENT INSPECTION OF PE PIPES & FITTINGS BY THE EMPLOYER

CHECK LIST

Name & Location of the Factory

Pipe : - ……

……

Fittings : - ……

……

(Requirement - Pipes and fittings should be manufactured by same manufacturer or manufacturing group.)

Applicable Standards

Manufacturing Standards Of pipes & Fittings	:	(ISO 4427:2019 EN12201-1 TO 5):2011	
Manufacturing Standards of Joint Rings	:	(EN681-1:2011)	…….
Quality Management System	:	(ISO 9001: 2015)	……

Parameters to be checked

Markings
Mechanical Properties
Hydrostatic Pressure Tests of pipes & fittings
Wall Thickness
Length of straight pipes
Straightness
Testing of Flanges
Joint Rings
Chemical Composition of Pipes & Fittings
ConHDPEtion of Pipes & Fittings
Tolerances

Handling of pipes, Fittings after production : Satisfactory/Unsatisfactory

Inspection Procedure

Witness testing a sample with Factory QC Team	:	Yes/No
Witness testing with Independent Inspection Agency	:	Yes/No

PRE-SHIPMENT INSPECTION OF PE PIPES & FITTINGS

CHECK LIST

Mark Yes or No in the Remarks Column as Appropriate **Date of Inspection ……**

Technical Specifications Clause No.	Description	Values as per Specifications	Satisfactory/ Unsatisfactory	Remarks
GENERAL				
Quality Assurance	Availability of Valid Quality Standard Certificates	ISO 9001:2015		
Independent Inspection	Availability of Inspection Agency. Certificate before Shipment	-		
Markings		-		
		-		
		-		
		-		
		-		
		-		
		-		
		-		
		-		
Material Characteristics				
	Mechanical Properties			

PRE –SHIPMENT INSPECTION OF PE PIPES & FITTINGS - CHECK LIST

Test	Hydrostatic Test							
Bill No:		Item No. & Qty.			Sample size:			
Description of Item :)		Class :			HDPEa x Length :			
Tech Spec Clause No:		Reference Standard :						
Sample No	Item of Testing	Test results			Deviation	Tolerance Allowed	Comply?	Remarks
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Inspection & Testing Witnessed by								
Name								
Signature :				Date :				

PRE –SHIPMENT INSPECTION OF PE PIPES & FITTINGS- CHECK LIST

Test	Length of Straight Pipes and Fittings						
Bill No:		Item No. & Qty.				Sample size:	
Description of Item : PE Pipes (SS/DF) , Fittings		Class :				PEa x Length :	
Tech Spec Clause No:		Reference Standard :					
Sample No	Item of testing	Physical/Measured Value		Deviation	Tolerance Allowed	Comply? (Yes/No?)	Remarks
		Standard	Measured				
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
Inspection & Testing Witnessed by							
Name							
Signature		Date					

PRE –SHIPMENT INSPECTION OF PE PIPES & FITTINGS - CHECK LIST

Test	Wall Thickness of Pipes & Fittings						
Bill No:			Item No. & Qty.			Sample size:	
Description of Item : PE Pipes , Fittings			SDR:			PEa x Length :	
Tech Spec Clause No:			Reference Standard				
Sample No	Item of testing	Physical/Measured Value		Deviation	Tolerance Allowed	Comply?	Remarks
		Standard	Measured				
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
Inspection & Testing Witnessed by							
Name							
Signature			Date				

PRE –SHIPMENT INSPECTION OF PE PIPES & FITTINGS - CHECK LIST

Test	Chemical Composition						
Bill No:		Item No. & Qty.				Sample size:	
Description of Item : PE Pipes		SDR :				PEa x Length :	
Tech Spec Clause No:		Reference Standard					
Sample No	Item of testing	Physical/Measured Value		Deviation	Tolerance Allowed	Comply? (Yes/No?)	Remarks
		Standard	Measured				
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
Inspection & Testing Witnessed by							
Name							
Signature		Date					

INSPECTION OF PE PIPES & FITTINGS

CHECK LIST

Technical Specifications Clause No.	Description	Requirements as per Specifications	Satisfactory/ Unsatisfactory	Remarks
HANDLING OF PIPES AND FITTINGS AFTER PRODUCTION				
	Handling			
	Stacking			
	Inspection by Factory/Inspection Authority			
	Transport Arrangements within manufacturers Country			
	Shipping Arrangements			
	Freight Insurance Arrangements			
CONCLUSION AT THE END OF THE INSPECTION TOUR				
Total Process of Production, Testing, Handling, Insurance and Freight Arrangements Satisfactory				

Observations :

Signature 1 Signature 2

Name & Designation 1: Name & Designation 2:

APPENDIX 17 – PRE-QUALIFICATION OF MANUFACTURERS FOR SUPPLY & DELIVERY OF DI PIPES, FITTINGS , DI /CI VALVES ,DI MANHOLE COVERS AND PVC PIPES & FITTINGS

Note:
Pre-Qualified pipe manufacturer has been pre-qualified together with pipe fitting manufacturer and rubber ring manufacturer. Therefore, when selecting a pre-qualified pipe manufacturer, his relevant pipe fitting manufacturer and rubber ring manufacturer shall be selected.

When Bidding Document is prepared please include updated list of prequalified manufactures under this Appendix for

- *PVC pipes , fittings & rubber rings*
- *PE pipes & fittings*
- *DI pipes , fittings & rubber rings*
- *DI Valves*
- *DI Manhole covers*
- *DI Couplings, Flange Adaptors, Stepped Couplings and Dismantling joints for DI. Asbestos, GRP, PE & PVC Connection*