

PERFORMANCE SPECIFICATION AND PARAMETERS FOR PROPOSED 4,000 CMD SEWAGE & SEPTAGE TREATMENT PLANT

*Location: Materials Recovery Facility (MRF) Compound, Gov. Lim Avenue
(Magay), Zamboanga City*

February 8, 2018

Republic of the Philippines
ZAMBOANGA CITY WATER DISTRICT
Pilar Street, Zamboanga City



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Definition of Terms

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
FRP	Fiberglass Reinforced Polyester
UHW-PE	Ultra-High Molecular Weight Polyethylene
API	American Petroleum Institute
TDH	Total Dynamic Head
UV	Ultraviolet
RVAT	Reduce Voltage Auto Transformer Type
ACB	Air Circuit Breaker
MCCB	Molded Case Circuit Breaker
PFC	Power Factor Capacitor
MCC	Motor Control Center
MCB	Miniature Circuit Breaker
FLC	Full Load Current
O/L	Overload
RSC	Rigid Steel Conduit
uPVC	Unplasticized Polyvinyl Chloride
ELCB	Earth Leakage Circuit Breaker

References

ANSI/ASTM D4066	Nylon Standard
AISI 304/ASTN A276-98b 431	American Society of Testing and Materials
AISI A48-40B	Cast Iron Standard
AISI 4340	High Tensile Steel
AISI 9840	Alloy Steel
ASTM A153-73	Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A167-74	Stainless and Heat Resisting Chromium – Nickel Steel Plate, Sheet and Strip
ASTM A307-74	Carbon Steel Externally/Internally Threaded Standard Fasteners
ASTM A48/ASTM A126 Class B	Gray Iron Casting for valves, flanges, and fittings.
ASTM A743/AISI 303	Stainless Steel for General Application
ASTM B584/UNS C86700,C85800, C86200	Copper Alloy Sand Castings for General Application
ASTM B584-74	Copper-Alloy Sand Castings for General Applications
ASTM B62	Composition Bronze or Ounce Metal Castings
ASTM D3011	Polystyrene Standard
ASTM D3935	Polycarbonate Standard
ASTM D4181	Acetal Standard
AWWA C504-74	Rubber Seated Butterfly Valves
DIN 2532	Cast-Iron Flanges, Nominal Pressure 10 ISO 2084-1974 (e) Pipeline Flanges for General Use – Metric Series – Mating Dimensions
DIN 30677 T2	Internal and External Protection for Grey cast Iron Castings
ISO R261-73	IS General Purpose Metric Screw Threads – General Plan
B.P. 334	An Act to Enhance the Mobility of Disables Persons by Requiring Certain Buildings, Institutions, Establishments and Public
DA AO 26 s. 2007	Guidelines on Safe Reuse of Wastewater
DENR DAO 2016-08	Water Quality Guidelines and General Effluent Standards
DPWH Blue Book	Standard Specifications for Highways, Bridges and Airports (2013 edition)
IEC	Institute of Electromechanical Commission Fire Code of the Philippines

IEE	Institute of Electrical and Electronics Engineers
IEEE Pub. No. 142	Grounding of Industrial Power System
IEEE STD 141-1976	Protection and Coordination
IPCEA	Insulated Power Cable Engineering Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NPCP	National Plumbing Code of the Philippines
NSCP	National Structural Code of the Philippines (latest edition)
OSH	Occupational Safety and Health Standards 2017 edition
PD 1586	Philippine Environmental Impact Statement System
PD 856	Code on Sanitation of the Philippines
PEC	Philippine Electrical Code
PGBC	Philippine Green Building Code
PMEC	Philippine Mechanical Engineering Code
RA 9003	Ecological Solid Waste Management Act
RA 9275	Clean Water Act
Other applicable local ordinances	

RATIONALE

The Zamboanga City Water District is a premiere water district in the southwestern part of the Philippines. It has been established in April 1974 by virtue of Zamboanga City Council Resolution No. 446 in accordance with Presidential Decree 198. The resolution in effect transferred the ownership, management and operations of the existing waterworks and sewerage facilities from the former Zamboanga Waterworks and Sewerage System, which was then owned and managed by the local government to the Zamboanga City Water District.

Historically, the water and sewerage system in Zamboanga City was constructed during the period 1911 to 1913 under the United States Colonial Government with the Tumaga River as the source of water supply. The system was purposely built to serve the needs of the United States forces during that time. With the declaration of Philippine Independence in 1948, the system was taken over by the local government operating until 1974.

R.A. 9275 or the Philippine Clean Water Act of 2004 mandates water utilities in highly urbanized areas, in coordination with the local government units, to connect existing sewage lines to available sewerage systems. At present, there are only 887 service connections in the sewered area that are connected to the sewerage system. This system is composed of a sewerage line within the central business district and two (2) pumping stations with an outfall draining into the Basilan Straight. The remaining population are either using septic tanks or are directly discharging their wastes in the drainage system which is draining to the Cawa-Cawa Bay. In order to protect the coastal and inland waters of the city, it is imperative that the discharge of wastewater into water bodies must be in compliance with the effluent standards set by the Department of Environment and Natural Resources, through its line agency, the Environmental Management Bureau. Thus, in order that the sewage discharged into the Cawa-Cawa Bay comply with the said standards sets, a 4,000 cubic meter capacity Sewerage Treatment Plant (STP) will be constructed.

On April 21, 2014, ZCWD and the Local Government of Zamboanga City, entered into a Memorandum of Agreement for the use of the Materials Recovery Facility (MRF) compound for the construction of an underground STP. However, it is necessary that during the construction period, the MRF operations will not be hampered and that existing facilities and structures which will be affected during the construction will be restored.

In August of the same year, the United States Agency for International Development (USAID) through the Water Security for Resilient Economic Growth and Stability (Be Secure) Project began providing technical assistance to ZCWD in its water and sanitation projects, including this project. A Geotechnical Investigation was conducted at the proposed project site which found that the soil condition therein is potentially liquefiable in the event of strong ground motion (major earthquake). Thus, it was necessary to revise the earlier plan of constructing an underground facility because of this.

On August 1, 2016, an amended MOA was signed by the parties for an additional area in order that the facility may be constructed above ground and for the original MRF to be transferred and rebuilt at an area within the main public market recently vacated due to conflagration. Thus, from original area of 1,800.00 square meters, it has now been expanded to a total of 2,196.00 square meters.

It is hoped that with the implementation of this project, Zamboanga City will soon be compliant with the requirements of the Clean Water Act and ensure cleaner waters for the future generations of the city.

EXISTING SEWERAGE SYSTEM

The sewerage system has a total of 887 service connections and has an average flow rate of 4,000 cubic meters per day as of May 2017. It is among the few water service providers in the country which operates and maintains a sanitary sewer system. It was turned over to the water district in 1976 along with the transfer of the water supply system. The existing system has limited coverage but it provides a sanitary means of sewage collection from the high density commercial areas of the city. Outside the existing sewerage service areas, residents and other establishments rely on the on-site systems specifically septic tanks for wastewater treatment and disposal.

The sanitary system dates back to year 1933 when it was constructed during the American occupation. It covers an area of approximately 80 hectares covering most of the city's downtown area. The collection system consists of approximately 11,400 linear meters of vitrified clay pipes with lengths and sizes broken down as follows: 830 ln.m. of 100 mm Ø, 5390 ln.m. of 150 mm Ø, 4,960 ln.m. of 250 mmØ, and 220 ln.m. of 300 mmØ. Excluded are private lines of large establishments connected into the system.

The Magay Creek (Sucabon Creek) divides the sewer service area into the East and West catchment areas. Sewage flow from the East Catchment is conveyed by gravity to the East Pumping Station, which are then pumped to the West Pumping Station via two 200 mm Ø Cast Iron (CI) pressure pipes. Likewise, sewage flows generated from the West Catchment are collected in the receiving tanks of the West Pumping Station where together with the flows from the East Catchment are now being discharged into the Magay Creek.

All major mechanical and appurtenant equipment at the two sewage pump stations are the same original equipment installed in 1933.

SCOPE OF WORKS

1. GENERAL PROVISIONS

- 1.1. The Contractor should be able to design the process and construct a sewage and septage treatment plant (SSTP) capable of treating 4,000 cubic meter per day of sewage collected from the existing sewerage system of the Zamboanga City Water District that would meet the effluent quality requirements set under this specification. The capacity of the SSTP must be expandable to 6,000 cubic meters per day at any time when the full capacity of 4,000 cubic meters per day has been achieved. Furthermore, should also be able to treat 15 cum/day of septage .
- 1.2. An allotted area of 2,196.00 square meters at the Materials Recovery Facility (MRF) Compound, Gov. Lim Avenue (Magay), Zamboanga City will be used for this project. The construction of the facility must give due consideration to the soil quality of the project site based on the results of the geotechnical investigation attached herein.

2. BIDDING REQUIREMENTS

The contractor shall include in its bid offer all costs of maintaining the treatment plant such as the consumables, qualified personnel assigned on the site (on shift basis) who shall conduct sampling and carryout the tests. A complete record has to be maintained for all the tests carried out at regular intervals.

2.1. REQUIREMENTS UNDER R.A. 9184

The statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid referred to under Sec. 23.1 v. shall refer to ***“Design and build of wastewater treatment facility.”***

- 2.1.1. The Preliminary Conceptual Design Plans (PCDP) must show the complete assembly of the plant with all components, equipment, support structures and access facilities in accordance with Section 10.1 i. of Annex G of the Revised IRR of RA 9184. It shall include the architectural layout and the dimensions of the structure and facilities. It must be reflected in the Front, Rear, Left and Right Side Elevation.

2.1.2. The PDCP shall be supported with the Site Development Plan and perspective and aerial view relative to the location with respect to the boundary of the lot allocated for all the plant, structures and other facilities.

2.1.3. All plans/drawings submitted with the bid shall be in size A1 tracing paper.

2.2. GUIDELINES FOR ORAL PRESENTATION

2.2.1. Each presenting bidder will be given a maximum of two (2) hours for their oral presentation, 1 ½ hour of which will be allotted for the question and answer. The presence of the designer during the oral presentation is highly encouraged to be able to resolve any technical questions that may arise.

2.2.2. Presentation must focus on the process, structural and architectural layout and the technology offered. It should explain how the present system with a capacity of 4,000 cmd will be expanded to 6,000 cmd.

2.2.3. The presentation will use MS Powerpoint and should not exceed 30 minutes. An hour and a half (1 ½) will be allotted for questions and answers. The presenter-bidder is expected to provide the answers during this allotted time;

2.2.4. An electronic copy of the presentation may be submitted to the BAC during the day of the presentation;

2.2.5. The presentation materials may include but not limited to the following: company profile, design and specifications of the facility, construction approach and methods, facility features not specified in the SOW, green and climate resiliency features of the facility design, and others that may enhance the merits of the technical proposals. Maps may be used if needed.

2.3. OTHER TECHNICAL BIDDING REQUIREMENTS

In addition to the Eligibility, Technical and Financial Documents, the following shall be submitted during the post qualification:

- 1) Projection of the Monthly Operating Expenses for the next twenty-five (25) years and the replacement cost for the next twenty-five years using the 9% discount rate over the life of the project for 25 years.

- 2) In relation to the Projected Monthly Operating Expense computed for the next 25 years, the following shall also be submitted as a functional guarantee which shall form part of the contract:

b.1 Guaranteed Power Consumption

Power Usage	kW/m ³ wastewater		kW/day	
	0- 1.59 MLD	2-4 MLD	0- 1.59 MLD	2-4 MLD
Base Power (not influenced by inlet flow)				
Main process (liquid stream)				
Sludge Treatment				

b.2 Guaranteed Chemical Consumption

Chemical Usage	L/m ³ wastewater		L/day	
	0- 1.59 MLD	2-4 MLD	0-1 MLD	2-4 MLD
Main process (liquid stream)				
Sludge Treatment				

b.3 Guaranteed Sludge generation

Sludge generation	m ³ sludge/m ³ wastewater		m ³ sludge/day	
	0- 1.59 MLD	2-4MLD	0- 1 MLD	2-4 MLD
Sludge				

- 3) The following shall be the basis in the preparation of the following item:
- Electricity/Fuel = follow the rates of ZAMCELCO/DTI
 - Manpower = follow DOLE Standards for Region IX at the time of bid
 - Chemicals = DTI
- 4) The bidder should provide end-user certification or performance data stating that a similar sewage/wastewater treatment system being offered in the bid has been satisfactorily operating continuously; except during

plant shut-down for maintenance purposes or due to force majeure where the operation has to be stopped to prevent damage. It must show the compliance of the effluent discharged to the DENR Standards all throughout its operation excluding the testing period. Failure to comply with this requirement is a ground for technical disqualification.

2.4. CONCEPTUAL DESIGN

- 2.4.1. The treatment process must include the primary, secondary and tertiary treatment of the wastewater.
- 2.4.2. **Pre-treatment** shall include at the minimum screens, grit removal, flow equalization, oil and grease removal.
- 2.4.3. **Primary Treatment** shall include at the minimum primary settling basins, primary sedimentation tanks or primary clarifiers.
- 2.4.4. **Secondary treatment** shall be either a fixed film or attached growth systems, suspended-growth systems or a hybrid or combination thereof.
- 2.4.5. **Tertiary treatment** shall include disinfection or effluent polishing before finally discharging to the Magay Creek or reclamation for reuse.
- 2.4.6. **Sludge Treatment** may either be belt press, screw press, filter press, centrifuge or volute.
- 2.4.7. **Septage Acceptance Unit** capable of accepting, screening and pre-treating septage conveyed by vacuum trucks.

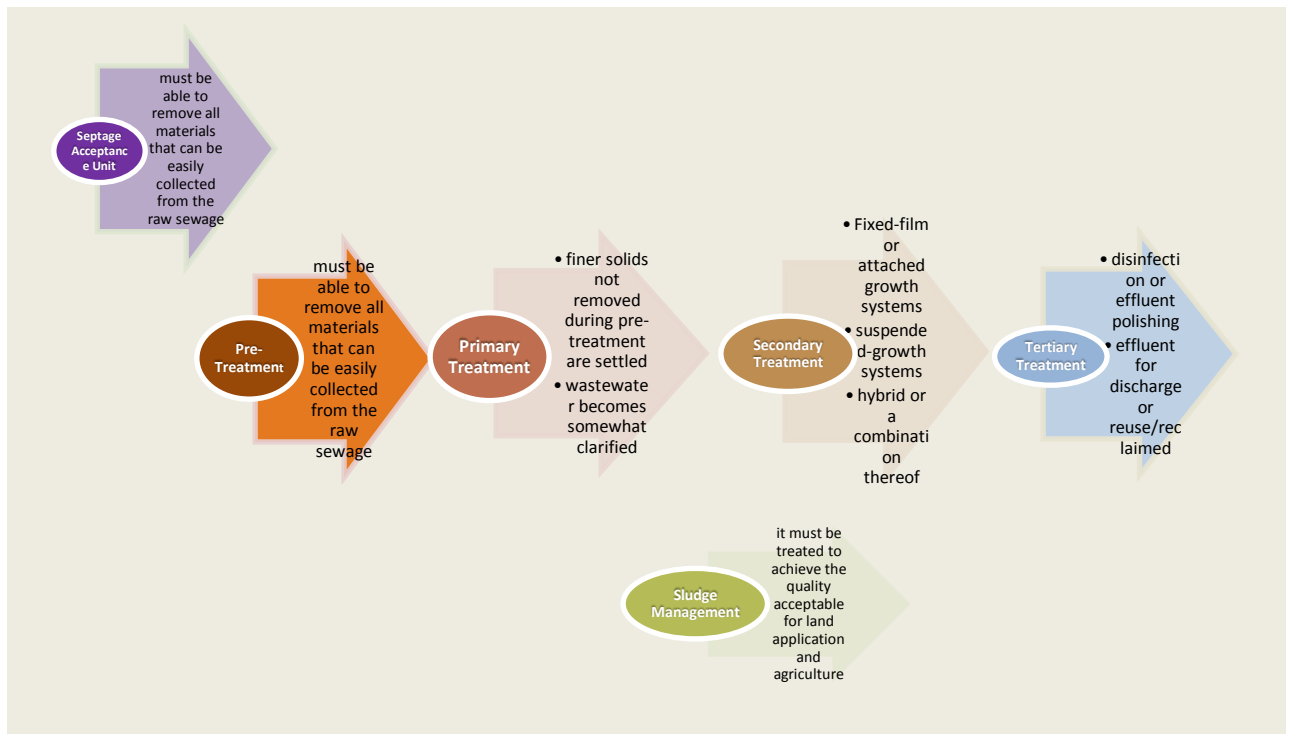


Figure 1 Conceptual Design for the Septage and Sewage Treatment Plant

2.4.8. The following facilities must also be included in the project:

- Guard House
- Administration Building (Office, Conference Room, Storage Room (for chemicals) and Laboratory)
- Control and Instrumentation Room
- Storage (for tools and for dried sludge)
- Perimeter Fence
- Perimeter/Plant Lighting
- Parking Space
- Equipment Lifting Facilities
- Generator Room
- Storage Tank for Recycled Water (capacity: 100 cubic meters)

2.4.9. In the event that there are other structures not stated in the above list but which are necessary to the complete and successful operation of the bidder's designed STP, the same shall be constructed with no additional cost to the ZCWD, notwithstanding the award of the contract.

2.4.10. In addition to the above facilities, the following support system must also be included:

- Potable Water Supply System
- Drainage System
- Service/Recycle Water Supply System
- Electrical, Control, Monitoring and Instrumentation System
- Generator System
- SCADA (Supervisory Control and Data Acquisition)
- Surveillance camera/Closed Circuit Television (CCTV) showing all critical areas of the STP
- Personal Protective Equipment (PPE) and other safety device in the plant per Occupational Safety and Health standards
- Force Main/Sewer Pipe connecting the West Pumping Station and the STP

2.4.11. In making the design, reference should be made to the list of codes and standards herein stated and such other applicable standards and guidelines, local or international.

2.5. PREPARATION OF BILL OF QUANTITIES, DETAILED ESTIMATES AND PAYMENT

2.5.1. In the preparation of the Bill of Quantities and Detailed Cost Estimates, which shall be categorized into major components, the detailed resources for each scope of work should be provided therein, to wit:

- 1) **NON-ENGINEERING WORKS** – this shall include but not limited to the Mobilization and Demobilization, fees and permits, Construction Safety and Health Program, Construction of Temporary Facilities.
- 2) **DESIGN AND CONSTRUCTION** – includes all civil works, electrical works, mechanical works, instrumentations and automations.
- 3) **TESTING & COMMISSIONING**
- 4) **PROCESS PROVING**

2.5.2. **PAYMENT** for each component of work shall be paid in the following manner:

1. **NON-ENGINEERING WORKS** – payment for non-engineering works shall be by progress billing the manner by which shall be in accordance with Sec. 5 of Annex E of the Revised IRR of RA 9184. No payment will be made unless all documentary requirements stated therein has been complied with.
2. **DESIGN AND CONSTRUCTION**- payment for the component on design and construction shall be by progress billing the manner by which

shall be in accordance with Sec. 5 of Annex E of the Revised IRR of RA 9184. No payment will be made unless all documentary requirements stated therein has been complied with.

For purposes of payment, the process modules and all other items that are integral to the complete and successful treatment of the wastewater shall be treated as one (1) lot. Thus, mere installation of the equipment will not be considered for payment unless all the required effluent parameters has been met and a commissioning certificate has been issued by the ZCWD.

- 3. TESTING AND COMMISSIONING-** Payment shall be made after submission of Completion/Commissioning Certificate issued by the authorized ZCWD officials along with the billing statement.
- 4. PROCESS PROVING-** Payment shall be made after submission of Final Acceptance Certificate issued by the authorized ZCWD officials along with the billing statement.

3. DESIGN REQUIREMENTS

3.1. GENERAL PROVISIONS

The Contractor shall be responsible for obtaining all necessary information as to risks, contingencies and other circumstances which may affect the works and shall prepare and submit all necessary documents specified by the procuring entity to meet all regulatory approvals as specified in the contract documents.

3.2. GEOTECHNICAL INVESTIGATION OF THE PROJECT SITE

Please refer to the attached GTI Report (Annex 5).

3.3. DESIGN PARAMETERS

3.3.1. GENERAL CONSIDERATIONS

- a) The SSTP shall be capable of treating 4,000 cubic meters per day of sewage collected from the existing ZCWD sewerage system. Its capacity must be expandable to up to 6,000 cubic meters per day.
- b) It shall treat sewage collected from the East and West Pumping Station collected from its current service area.
- c) In addition, the SSTP shall be capable of treating at least 15 cubic meters of septage collected from ZCWD concessionaires within the sewered area but are not connected to the sewerage system.
- d) **Project Duration:** The expected date of completion of this contract, which includes the design, build, testing and commissioning, is six hundred and ten (610) calendar days from the receipt of Notice to Proceed.
- e) The project shall be constructed within the allotted 2,196.00 square meter area as defined in the Memorandum of Agreement (see attached Annex). A copy of the said MOA will be furnished for the guidance of the winning bidder.
- f) The processes and facilities shall be designed to meet the performance requirements of the overall treatment plant. In particular, the interconnections between various equipment and processes, support system and other structures must be an integrated approach, which meets operational performance, flexibility, maintenance and reliability criteria.
- g) It is intended that this STP shall be suitable in every way for the service required, and the Contractor shall design and supply all materials, labor, equipment and do all work which may be reasonably implied as being required, at no additional cost to ZCWD.
- h) The overall architectural and structural design, as well as the landscaping of the STP should not only fit within the allotted area but must also be climate change resilient based on a 20 year projection and is environmentally sustainable.
- i) The winning bidder shall design an STP that will continuously treat sewage coming from the existing ZCWD sewerage network and septage collected from ZCWD concessionaires. They shall make the necessary verification as to the flow and quality of the sewage that will be treated. The design capacity of

the STP shall not be lower than 4,000 cubic meters per day, expandable to 6,000 cubic meters per day.

- j) In designing the STP, reference must be made to the Geotechnical Investigation of the project site. The result of this study is also attached in this document. The type of cement to be used must consider the presence of chloride, sulphate and organic soil in the project site.
- k) The tanks which will be constructed for the various stages in the treatment process must be so designed and constructed as to ensure its integrity and stability of the surrounding structures. Furthermore, it must be resilient from ground water or salt water intrusion.
- l) The design shall also ensure that there is applicable odor control in the STP. Odor must be controlled in such a way as it will not create a nuisance within the compound as well as to its neighbouring areas.
- m) Accumulated sewage from the East and West Pumping Station will be pumped from the West Pumping Station to the Sewage Treatment Plant. The construction of the connecting pipeline must be undertaken by the winning bidder. Attached is a reference design for the force main connected from the West Pumping Station to the STP (Annex 1)
- n) During low flow conditions, the treatment process must be able to cope with the diminished quality and quantity of the sewage. Otherwise, the bidder must specify the minimum flow and quality which the system can accommodate. The bidder must also specify the maximum flow which the system can accommodate during high flow events or sudden change in flow.
- o) Appropriate landscaping should be introduced to create an atmosphere of sanitation and eliminate the negative impression of sanitary facilities, like STPs. Waste receptacles, made of durable materials, must be properly labelled and strategically located at visible sites within the compound.
- p) Site development of the STP shall ensure climate change resiliency based on a 20 year projection. It must be so designed as to incorporate green innovations such as, but not limited to, the reuse of treated wastewater, use of solar panels for the perimeter and parking lighting. Landscaping must be such that the negative impressions of sanitary facilities will be eliminated and an ambiance of cleanliness and harmony with nature will be imbibed.

- q) Storm drainage shall be designed on the basis of a 20-year flood and storm surge projections. It shall include all necessary physical interventions/improvements, even outside the STP property boundaries, to ensure that storm water is conveyed to an acceptable existing to drainage system.
- r) Treated effluent from the STP shall be conveyed to the storm drainage system, provided that there is a means to monitor effluent quality prior to discharge to the drainage system or if not feasible, provide a separate effluent line both of which will drain to the Magay Creek.
- s) At the effluent drain, the contractor must provide a means of collecting effluent sample for regular effluent quality monitoring.
- t) The facility must be structurally designed in accordance with NSCP 2015 edition or its latest edition, and in a manner which allows it to withstand flooding and storm surges,. The table below shows the historical climatological extremes experienced in the city based on PAG-ASA records, which the contractor may use as basis for their design

Month	Temperature °C				Greatest Daily Rainfall (mm)		Highest Wind (mps)		
	High	Date	Low	Date	Amount	Date	SPD	DIR	Date
JAN	35.5	01-23-2002	15.8	01-22-1965	128.0	01-23-1916	22	NE	01-30-1982
FEB	35.5	02-28-2010	15.6	02-27-1905	156.5	02-26-1928	16	SSE	02-01-1988
MAR	36.0	03-26-2002	17.5	03-10-1911	79.6	03-21-2010	17	NN E	03-05-1972
APR	36.9	04-22-1987	16.7	04-07-1967	106.0	04-30-2004	14	W	04-22-1990
MAY	36.1	05-24-1987	20.7	05-11-1954	88.9	05-13-1990	20	NE	05-09-1978
JUN	36.0	06-05-2010	20.4	06-02-1904	123.5	06-20-2008	21	W	06-23-1984
JUL	35.2	07-07-1988	20.0	07-18-1958	140.4	07-09-1940	20	WS W	07-21-1989
AUG	35.7	08-31-1992	19.0	08-12-1917	136.6	08-29-1952	23	ENE	08-17-1988
SEP	35.8	09-02-2004	19.9	09-07-1911	193.2	09-29-1990	22	W	09-13-1986

OCT	36.0	10-01-1999	18.4	10-05-1955	199.1	10-09-2001	23	WSW	10-06-1984	
NOV	35.5	11-11-1988	18.5	11-11-1910	163.3	11-27-1955	22	W	11-07-1988	
DEC	35.2	12-13-2004	16.7	12-28-1950	161.0	12-02-1910	18	NE	12-22-1992	
ANN UAL	36.9	04-22-1987	15.6	02-27-1905	199.1	10-09-2001	23	ENE	08-17-1988	
Peri od of Reco rd	1903-2010				1902-2010			1950-2010		

- Reference: PAG-ASA Climatological Data as of 2010.

Table 1 Climatological Extremes Data in Zamboanga City as of 2010

	Observed baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MA M	JJA	SO N	DJ F	MA M	JJ A	SO N	DJ F	MA M	JJ A	SO N
Seasonal temperature increases (in °C) in 2020 and 2050 under medium-range emission scenario in provinces in Region 9												
ZAMBOANGA DEL NORTE	27.0	27.9	27.6	27.5	1.0	1.1	1.1	1.0	2.0	2.1	2.2	2.0
ZAMBOANGA DEL SUR	26.8	27.6	27.3	27.2	0.9	1.1	1.0	1.0	1.9	2.1	2.0	1.9
ZAMBOANGA SIBUGAY	27.1	27.9	27.5	27.5	1.0	1.0	1.0	1.0	2.0	2.0	1.9	2.0
Seasonal precipitation increases (in mm) in 2020 and 2050 under medium-range emission scenario in provinces in Region 9												
ZAMBOANGA DEL NORTE	324.5	279.7	599.1	718.1	11.0	3.2	-3.2	13.8	2.6	1.7	-0.7	5.4
ZAMBOANGA DEL SUR	294.5	298.7	593.5	663.2	11.2	2.2	-0.4	13.8	3.6	0.0	9.9	7.1

ZAMBOANGA SIBUGAY	284.1	290.5	597.2	674.1	9.9	6.6	6.5	14.8	4.8	10.3	22.0	8.9
Frequency of extreme events in 2020 and 2050 under medium-range emission scenario in provinces in Region 9												
		STATION S	No. of days w/ Tmax >35°C			No. of Dry Days			No. of days w/ Rainfall >150mm			
			OBS (1971-2000)	2020	2050	OBS	2020	2050	OB S	2020	2050	
ZAMBOANGA NORTE	DEL	Dipolog	217	2155	4004	7481	5384	5470	10	13	9	
ZAMBOANGA SUR	DEL	Zamboanga	54	114	714	8531	7058	6781	1	8	9	

Reference: Climate Change in the Philippines, February 2011, PAG-ASA

Table 2 Climate Projections in 2020 and 2050 in the Provinces in Region IX

Note: Zamboanga Sibugay, use values of Zamboanga City

OBS – Observed Baseline

- u) The contractor should also establish protocols for various scenarios when water level rises at the creek or in cases of sudden changes in and extreme weather conditions. A document which reflects these protocols must be submitted during commissioning.
- v) The process technology must be capable of addressing extreme cases of salt water intrusion. It must also take into consideration incidence of salt water intrusion by backflow in the outfall system.
- w) The system must be flexible to accommodate wastewater from commercial establishments draining to the sewerage system.
- x) The STP must be designed for a maximum total plant shutdown time of 4 hours per year for corrective maintenance.

- y) At least two process modules must be provided to allow the plant to operate with at least half the desired efficiency during equipment replacement or maintenance servicing. All process equipment, including those for which the whole STP is dependent for full operation, must be provided with standby. The overall plant power efficiency must be in tune to the frequent power outage in the city.
- z) It must have a disinfection unit capable of eliminating pathogenic microorganisms in the effluent prior to discharge. It must result to the wastewater being treated with a quality compliant with the standards for re-use.
- aa) A chlorine contact tank may be included to provide disinfection to meet the microbiological standards of DAO 2016-08 for Total Coliform and Fecal Coliform. Measures should be incorporated to eliminate residual e.coli in the re-use water.
- bb) It must be operated at minimum chemical addition, aeration and maintenance without compromising compliance to effluent limits.

3.3.2. CIVIL, STRUCTURAL AND ARCHITECTURAL

- a) Considering the soil bearing capacity of the project site based on the results of the Geotechnical Investigation, bored piling shall be the method employed in the installation of piles, unless a safer and more appropriate method may be used, Provided, that when the contractor recommends for a safer method other than bored piling, the contractor shall secure prior approval from ZCWD in writing. The contractor must exercise due diligence in the execution of this works considering the existing structures in the vicinity of the project site. Any damage to the neighbouring structures which may be incurred as a result of the piling activity, the contractor shall be held liable thereto.
- b) Sheet Piling shall be provided during excavation works. It shall comply with the standards set by the Department of Public Works and Highways.
- c) **Access and Support Facilities:** Access and Support facilities shall be provided by the contractor and designed in accordance with B.P. 334

National Building Code, the National Structural Code, and Occupational Safety and Health Standards. It shall include at the minimum the following:

- Walkways and Platforms
- Access Stairway or Ladder
- Handrails
- Lighting, Ventilation and Hoisting

- d) **Control Room:** Control room must be provided for centralized operations management and control of the STP. Location of the control room must be such that it overlooks the major areas of the overall facility. It must include a sufficient work station space for at least three staff, storage space for all plant data, drawings, manuals and records, at least two personal computers allocated to the plant control system complete with set of network servers and digital storage devices. It must include a computer network linked to the administration building network covering an additional work station complete with personal computer, an A3 laser printer, uninterruptible power supply and full suite of office software.

It must include adequate staff amenities, air conditioning, power, lighting, telecommunications, fire extinguishers, water supply and sewerage services for the building with suitable connection to emergency power generation to ensure safety.

- e) **Administration Building:** The total floor area for this structure shall be atleast 120 square meter. An administration building shall be provided which includes a covered front entrance, pantry, reception area, office for the managers, a conference room accommodating at least 10 people, first aid room with first aid kits, storage cabinets, wheeled stretcher and adequate doorways for rapid movement, records storage room, male and female amenities for office staff, change rooms with showers, lockers for 7 employees. It should include, but not limited to, the following:

- Storage room
- Electrical switch room –Rooms for air conditioning equipment and standby generator –Locker room complete with lockers for 7 personnel

The specifications herein indicated shall be without prejudice to applicable guidelines particularly the National Building Code, Mechanical Engineering Code, B.P. 334 and the Philippine Electrical Code.

- f) The offices shall be provided with telephone and LAN systems, in addition to equipment monitoring and control systems to be installed in the control room.
- g) It must include adequate air conditioning, power, lighting, water supply and sewerage services for the building with suitable connection to emergency power generation to ensure safety. It must comply with the guidelines under the Revised National Building Code on fire egress and the Fire Code of the Philippines.
- h) The building must be equipped with all necessary office equipment and furniture including computer network covering all office workstations complete with desktop personal computers, A3 laser printers, photocopiers, facsimile machines, internet connections, scanners, uninterruptible power supply and required office software.
- i) The entire facility must be equipped with wireless surveillance camera system capable of capturing the audio and video details of the 24 hours activities all throughout the year. Also, it can be viewed online by the ZCWD authorized user.
- j) **Toilet and Pantry:** Toilet and Pantry wastewater must be conveyed to the STP. Re-use water should be used for sanitary purposes. On the other hand, potable water should be used at the Pantry.
- k) **Laboratory:** A laboratory must be provided on-site to conduct regular monitoring of the following effluent parameters in compliance to Water Quality Guidelines and General Effluent Standards of 2016 of DENR Administrative Order No. 2016-08: (w/ instrumentation):
- BOD₅
 - TSS
 - Fecal Coliform
 - Nitrate
 - Phosphate
 - Ammonia
 - Surfactants
 - Oil and Grease
 - Moisture Content of Solids/Sludges
 - Microbiological Analyses
- l) All laboratory facilities and equipment shall be provided, including but not limited to, exhaust hood systems, chlorine dosing and laboratory safety and emergency facilities (shower, sprinkler, etc.). All such facilities and

equipment shall be in accordance to applicable standards. A certification to that effect must be presented. Laboratory design must be in accordance with the laboratory safety design guidelines.

- m) The Administration Building and Laboratory shall have a total floor area of at least 120.00 square meters.
- n) **Blower Room:** If the treatment facility requires a blower room, it must have a minimum floor area of 33.47 square meters.
- o) **Perimeter Fence:** The perimeter fence shall be of full masonry with a minimum height of at least 2.40 meters from finished floor line of the driveway.
- p) **Perimeter Lighting:** must be provided within the vicinity. The use of alternative power source (*i.e.* solar power) is encouraged whenever feasible
- q) **Guard House:** A security building shall be provided near the gate of the STP. It shall serve as a control for incoming and outgoing vehicles, staff and visitors, and a base for all security personnel. A telephone line system shall be installed therein. It shall have a minimum area of at least 3.00 square meters
- r) **Parking Space.** It must be able to accommodate at least 3 4-wheel vehicles, wherein 1 slot is allotted for PWDs.
- s) **Utilities:** Power and water supply facilities to be provided will include tapping/interconnection to nearest ZAMCELCO power line and water supply line. Continuous water supply storage shall be provided.
- t) A recycled water system using disinfected water from the STP system shall be provided. Pressure filters with automatic backwash shall be installed to improve water quality prior to distribution. Backwash shall be directed to the STP.
- s) Recycled water shall be used for watering landscape, truck/tanker washing, toilet flushing, and for specific processes that allow use of recycled water. The required pipe network for such purposes shall be provided.

- t) Recycled water outlets and exposed pipe segments shall have adequate labels and warnings. Pipes shall be of a specific color different from other pipes conveying different fluids/materials. Hose bibs for landscape watering shall be installed inside a lockable vault.
- u) Recycled water must be contained in a 100 cubic meter storage tank which will be situated in an area easily accessible to water tankers. This storage tank must not require pumping to convey recycled water in it. Hosing and fittings and other appurtenances for the conveyance and use of the reclaimed water shall be provided. Its quality must be compliant with the physical, chemical and bacteriological parameters under Department of Agriculture Administrative Order No. 35. Storage for recycled water with a capacity of at least 20 cubic meters per day for the internal use of the facility must be provided on-site. The remaining 80 cubic meters shall be made available to PPA and the City Government for their use.
- v) Back-up power shall be provided for the provision of the continuous operation of the facility. Diesel storage shall be sufficient to provide 48 hours of continuous operation. Fuel storage must comply with the Occupational Safety and Health guidelines (OSH yellowbook).
- w) **Genset Room:** The Genset room shall have a minimum area of at least 33.00 square meters. It must have acoustic enclosures to control noise levels to within acceptable limits.
- x) Hosing and fittings and other items for recycle water use shall be provided.
- y) **METALWORKS:** All submerged metalwork shall be stainless steel, Type 304, ASTM, A276.
- z) **WELDED CONSTRUCTION:** The Contractor shall comply with the current AWS D1.1 and AWS D14.1 (or equivalent) codes for procedures, appearance and quality of welds and welders.
- aa) **PRE-CAST CONCRETE MANHOLES:** Units which bed into bases shall be designed and manufactured so that the imposed vertical load are transmitted directly through the full wall thickness of the unit.
- bb) **MANHOLE STEP IRON (LADDER RUNGS):** All ladder rungs shall be cross cut serrated stainless steel A 304 of 20mm diameter.

- cc) **MISCELLANEOUS STEEL METAL WORKS:** All submerged metal works shall be fabricated of Type 304, ASTM A276 stainless steel.
- dd) All stainless steel metal work shall be supported with Type 304 stainless steel anchor bolts.
- ee) **PROTECTIVE COATINGS TO METAL WORK:** Protective coatings to metal works shall be in accordance with LWUA-ZCWD standards.
- ff) **COATING SYSTEM GENERAL:** The exposure class to be used for the galvanizing of the structural steelwork shall be Class D Environment.
- gg) **CONCRETE DIRECTLY IN CONTACT WITH SEWAGE:** For all concrete directly in contact with sewage, sludge and other corrosive substances, use cement which conforms to the requirements of ASTM C- and C-618. Design concrete mix as per ACI 211.1.
- hh) **TILES:** Ceramic tile for toilet walls shall be white glaze ceramic tile. Caps, inside and outside corners, and other moldings, as required, shall be provided. Ceramic tile for toilet floors shall be vitrified unglazed. Acid resistant vitrified tile shall be used in the laboratory. Portland Cement shall be standard brand per ASTM C-150. Tile adhesive and grout shall be of approved brand and quality
- ii) For floors, provide standard granite tile.
- jj) Tile shall be resistant to alkali and grease and oils .
- kk) **FINE AGGREGATE:** Shall consist of sand, stone screenings or other approved inert materials with similar characteristics or a combination thereof, having clean, hard, strong, sound, durable, uncoated grains, free from injurious amount of dust, lumps, soft or flaky particles, shale, alkali, organic matter, loam or other deleterious substances. The use of beach sand is strictly prohibited without the written consent of ZCWD.
- ll) Notwithstanding the above provision, the following shall be the minimum requirement for interior finishes of floor, wall and ceiling, exterior finishes and for doors and windows:

Room Designation	Interior Finishes		
	Floor	Wall	Ceiling

Administration Office	Granite tiles	Plain cement plaster painted finish	Painted finish cement fiber ceiling board with metal furring joist
Guard House	Granite tiles	Plain cement plaster, painted finish	Painted finish cement fiber ceiling board with metal furring joist
Screening and Degritting Room	Colored Hardened	Plain cement plaster painted finish	Painted finish, no ceiling, provide roof insulation
Genset Room	Elastomeric paint	Plain cement plaster painted finish	Painted finish, no ceiling, provide insulation
Pump/Blower Room	Colored Hardened	Plain cement plaster painted finish	Painted finish no ceiling, provide roof insulation
Laboratory	Granite tiles	Plain cement plaster painted finish	Painted finish cement fiber ceiling board with metal furring joist
T & B	Ceramic unglazed tiles	Ceramic glazed tiles	Painted finish cement fiber ceiling board with metal furring joist
Sludge storage	Colored hardened	Plain cement plaster painted finish	No ceiling bd., provide roof insulation

Table 3 Architectural Finish of Floors, Walls and Ceilings

Description	Exterior Finishes
Concrete and Masonry	Acrylic solvent base paint
Wooden Surfaces	Acrylic solvent base paint
Steel surfaces	Acrylic paint
Ceiling	Acrylic solvent base paint

Table 4 Exterior Finishes

ROOM DESIGNATION	DOOR	WINDOWS
Office	Solid Wooden	Alum. Frame Sliding Window, Corrosion resistant
Guard House	Panel Door	Steel casement
Genset Room	Steel door, corrosion resistant, sound proofed	Metal louver, corrosion resistant
Pump/blower room	Steel door, corrosion resistant, sound proofed	Metal louver, corrosion resistant
Laboratory	Solid wooden	Alum. Frame sliding window, corrosion resistant

T & B	PVC Door	Steel casement, corrosion resistant
Sludge storage room	Panel door	Steel casement, corrosion resistant

Table 5 Schedule of Doors and Windows

- mm) **METAL DOORS, WINDOWS AND FRAMES:** All work shall conform to ASTM, ANSI, Underwriter’s Laboratories, Inc. (UL) Standards and other standards where applicable.
- nn) All doors and windows shall have locking accessories for security purposes.
- oo) Frames for screens shall be of formed-steel and re-wireable.
- pp) Screen cloth shall be of aluminum, 18 x 16 mesh, securely fastened to the frames and held taut by removable plastic splines.
- qq) All windows and frames shall receive a prime and finish coat of paint.
- rr) Roller sheaves shall be of nylon having a groove of 1/16" radius.
- ss) **SOUND DOORS.** Sound door assemblies shall have a minimum STC rating of 47 db. The Contractor shall provide a certification by the door manufacturer stating that the STC rating is in accordance with ASTM E90 as conducted by a qualified acoustical products testing laboratory
- tt) **STEEL WORKS:** For roofing systems, it must be structurally sound and must comply with the provisions of the latest edition of the NSCP and its materials shall be

3.3.3. MECHANICAL

- a) Mechanical design and installations shall comply with the Philippine Mechanical Engineering Code;
- b) The scope of works to be provided under this contract shall be enumerated in Schedule of Quantities and Unit Prices.

- c) All valves shall withstand a hydrostatic test pressure of at least 150 psi and shall be of solenoid type.
- d) The Contractor shall be responsible for the design, selection and procurement of all valves required under this project.
- e) All valves shall be designed for a pressure rating of 16 bars and a test pressure of 1.5 times the pressure rating.
- f) All electro-mechanical installations must be elevated, unless they are meant to be submerged. This is to avoid the said electromechanical equipment from being submerged in case of flooding. Generator units must be movable from one place to another (trailer type).
- g) **Equipment:** Whenever possible and applicable, all equipment shall be installed indoors for security purposes and to avoid undue exposure to weather. All buildings/rooms shall have closed sides.
- h) **Flow Measurement:** Magnetic flow meters shall be installed in following locations:
- Influent to the STP;
 - Any other point necessary for the efficient control of operations of the proposed facilities;
- i) Flow meters displayed at the control station should show flow rate in lps, and total flow in liters. Display of flow rate and total flow shall also be displayed at each loading bay, visible to the vacuum tanker drivers and sludge acceptance operator. Resetting of total flow at each loading bay, by the sludge acceptance operator, should be possible. Flow meter data shall be stored, and processed to automatically generate daily and weekly load/flow reports.
- j) Fire sprinkler shall follow the National Fire Code of the Philippines.
- k) Wherever the supply and installation of submersible centrifugal pump is called for by a pay item in the Schedule of Quantities and Unit Prices, it shall be construed to include all its accessories and/or appurtenances for maintenance and safety use.

- l) **References:** This specification shall be read in conjunction with the applicable standards.

3.3.4. ELECTRICAL

- a) Designs and installations must comply with the Philippine Electrical Code, Mechanical Code and other applicable standards.
- b) The electrical/instrumentations control system shall include main and branch circuit breakers, starters, contactors, variable speed drives and reset buttons selector switches, push buttons and pilot lights, circuit control items for electrical control or liquid level control of the various plant components and all necessary wiring and conduits. All electrical/instrumentations controls shall be wired so that the plant equipment can be operated either manually or automatically using PLC to achieve the intended sequence of operation and for remote monitoring purposes and shall be enclosed in a steel type floor mounted cabinets. The system should be installed with Supervisory Control and Data Acquisition (SCADA) System. All electrical controls for all processes shall be at the Motor Control Centers and located in buildings. The Motor Control Center shall be air conditioned such that the control cabinets will not heat up.
- c) Electrical components of mechanical equipment and systems shall be provided as necessary for complete and operable systems. Interconnecting wires for factory wired-wired plant components shall be provided as an integral part of the plant.
- d) The electric power would be 400V 3Phase/ 220V Single Phase to be sourced from the Zamboanga City Electric Company (ZAMCELCO). The contractor should provide the transformers that must be able to take into consideration future load especially when the plant should be operating at 6000 cu.m. per day already. Fault current calculation and load coordination must be presented. The initial energization deposit fee shall be bourn also by the contractor.
- e) Electrical design and installation works shall adhere to the Philippine Electrical Code;

f) Reference codes and Standards listed in the prefaces to those Standards and Codes are applicable in respect of all materials and workmanship except where in conflict with the provisions of this specification;

g) **CODES AND REFERENCES**

This specification shall be read in conjunction with the applicable codes and references.

h) **TECHNICAL SPECIFICATION**

The following supply conditions apply:

Voltage:	13.2kV primary; 400V Three Phase / 220V Single Phase secondary
Frequency:	60 Hz
Phases:	3, 4 Wire
Neutral:	Earth Neutral Link at the star point of transformer
Control Voltage:	440 VAC or 230 VAC depending on the contractor's design

No other voltage shall be used unless approved in writing by ZCWD.

i) **CLIMATIC CONDITIONS**

Temperature :	Highest Maximum 45°C
Humidity :	Average annual range 72-95% RH non-condensing

j) **DEGREE OF PROTECTION**

j.1. The degree of protection as listed below shall refer to NEMA.

Switch Board :	NEMA 12
Control stations:	NEMA 12
Field Devices :	NEMA 3R

j.2. **PROTECTION FROM WATER**

All outdoor equipment shall be fitted with a cover to provide effective protection against rain;

- ❑ All enclosures housing electrical equipment must be capable of preventing water penetrating to live parts. Design must take into account the likelihood of deliberate hosing in some locations;
- ❑ Enclosures having doors or removable panels exceeding 0.4 m² in area should, where possible, be located indoors
- ❑ No electrical component is to be located where it will be permanently wet without authority from ZCWD;
- ❑ Thermostatically controlled low surface temperature heaters shall be provided where necessary to prevent condensation of water

k) CORROSION PROTECTION

- k.1. Carbon steel conduits, ducting, cable ladders, 'unistrut', etc are all to be hot dip galvanized, suitably plated or manufactured from non-corrodible material;
- k.2. Fixings such as screws, rivets, bolts, brackets, etc. are to be galvanized, suitably plated or manufactured from non-corrodible material;
- k.3. Cubicles and enclosures must be manufactured out of mild steel. Carbon steel or glass filled polyester construction is permissible where indicated by ZCWD;

l) LOW VOLTAGE SWITCH BOARD

- l.1. All equipment shall be designed, built, rated, tested and shall perform in accordance with the latest edition of the applicable Standards.
- l.2. The switchboard shall be free standing, totally enclosed, multi cubicle type, and shall be constructed in mild or as specified.
- l.3. All electrical cubicles and boxes shall be suitable for bottom cable entry and front access unless otherwise specified. Non- magnetic gland plated shall be supplied for all non stainless steel enclosures.
- l.4. All doors shall swing about a vertical axis.

- I.5. All enclosures mounted directly onto floors shall be supplied with a welded 75 mm RHS hot dip galvanized plinth. In wet process areas hot dip galvanized steel stands or legs shall be supplied.
- I.6. The heat generated within the cubicle shall not cause the air temperature around the equipment to rise above the rating of this equipment. Air to air heat exchanges may be used if required but not with refrigeration units.
- I.7. All control items shall be DIN rail mounted where possible.
- I.8. No inflammable or hygroscopic materials shall be used.
- I.9. In all cases, equipment shall be designed, rated, tested and shall perform in accordance with the latest edition of the applicable Standards
- I.10. No equipment shall be mounted on the sides, top or bottom of the cubicle (internal light exempted).
- I.11. All field wiring shall terminate via terminal rail blocks not connected directly to the control devices.
 - a. A minimum distance of 50 mm shall be allowed between cable ducting and equipment for the terminating of wires.
 - b. Conduit or cable entry shall not be made from the top.
 - c. Desired Starter

Below 7.5 kW	DOL
7.5 TO 11 Kw	Auto Transformer
15 kW and above	Soft Starter or Variable Speed Drive (depends on the process requirements)

- d. **Control Circuits:** The standard control voltage is 400V for three phase motors, and 220V for single phase motors. Contactor coils shall operate on 220 volts (phase to neutral) 60 Hz. Any other voltages shall not be used unless approved by ZCWD.

e. **Soft Starters**

Protection and Diagnostics : The SS shall incorporate, as standard the following protection features:

- Over voltage
- Under voltage
- Stall/jam
- Overload
- Under load
- Phase Unbalance
- Phase sequence
- Under Current
- Motor Thermistor
- Starter Over temperature
- Line Fault
- Power Loss
- Ground Fault

Fault diagnostics shall be indicated in descriptive text on the built-in LCD display. The exclusive use of fault codes shall be unacceptable. An auxiliary contact that is programmable for fault indication shall be provided.

Monitoring: The controller shall provide the following monitoring functions indicated through the built-in LCD display:

- Three phase line current
- Per phase current
- Phase-to-phase supply voltage
- Line voltages
- Apparent Power in KVA
- Power in kW
- kWh
- Running Horsepower
- Frequency
- Elapsed time
- Power Factor
- Motor Thermal capacity
- SS status

The SS must make available the following output signals for the external controller in addition to summary alarm voltage free contact.

- Run
- Start/Run
- Motor Current (4-20 mA)
- Motor Thermal Model (4-20 mA)
- Fault indication

The SS shall have RS485 as standard allowing the starter to be used in conjunction with the external control system. Through this link the SS must be able to be controlled and monitored.

- f. The bypass cabinet shall include a door-interlock input circuit breaker or fused disconnect switch, a UL rated isolation contactor, and a NEMA rated full-voltage starting contactor (both contactors electrically interlocked), a thermal overload relay to provide motor protection, and a control power transformer.

m) LOW VOLTAGE FREQUENCY DRIVE

- m.1. The VFD shall have an efficiency that shall exceed 90% at 50% speed and load. It must have been available in the market and in use for at least five (5) years.
- m.2. The VFD shall maintain the line power factor at no less than 0.95, regardless of speed and load.
- m.3. The VFD shall be capable of operating existing motor induction motor, regardless of manufacturer, with a horsepower and current rating as indicated.
- m.4. **Standard Operating Condition**

Ambient temperature range:	0 to 40 °C
Elevation:	up to 3300 ft
Atmosphere:	non condensing relative humidity to 95%
AC line Frequency Variation:	+/- 3%

a. Monitoring and Displays

The VFD's display shall be LCD type capable of displaying three (3) lines of text and indicators. The following are to be available for monitoring at minimum:

- Output Frequency
- Output Speed
- Output Torque
- Motor line current
- Motor per Phase Current
- Motor power in KW
- Motor power in KVA
- Power Factor
- Motor Voltage or output voltage
- Input voltage
- Elapse time meter
- Digital input/output status
- Kilowatt hour meter

VFD shall have the capability of communicating via an RS-232, RS-422 or RS-485 port. It shall have an integral Modbus communication capability and its parameters, fault log and diagnostic log shall be downloadable via the RS-232, RS-422 or RS-485 port.

b. Input/Output Features

- Two programmable analog inputs ((0-20mA/0-10V)
- One programmable analog outputs (0-20mA)
- Five programmable digital inputs (24VDC)
- Two programmable digital outputs (form C, dry contact relays). All programmable digital outputs can be programmed to give start and stop signal to other motor. Auto-change features capability of changing the starting order of other drives shall be available.
- System program providing built-in drive control or application specific configuration capability

c. Protective Functions

The VFD shall include the following protective features at minimum:

- Overcurrent
- Overvoltage
- Under voltage
- Ground/Earth fault

Inverter fault

- Phase loss
- Output phase loss
- Under temperature/Over temperature
- Motor overload/under load

d. Enclosure

All VFD components shall be factory mounted and wired on a dead front, grounded, NEMA-12 enclosure. If a free-standing enclosure is provided, it shall be suitable for wall mounting.

e. Control Functions

The operator shall be able to scroll through the keypad menu to choose between the following:

- Monitor
- Operate
- Parameter setup
- Actual parameter values
- Active Faults
- Fault History

The following setups and adjustments, at a minimum, are to be available:

- Start command from keypad, remote or communication port
- Speed command from keypad, remote or communication port
- Motor direction selection
- Maximum and minimum speed limits
- Acceleration and deceleration times, two settable ranges
- Multiple preset speed adjustments
- Catch a spinning motor start or normal start selection

Other features:

- VFD Automatic Control
- PID Utilization an internal or external set point
- Auto start functions: On/off, operable from a 4-20mA signal or from the PID outputs (from C, dry contact relays). Digital outputs can be programmed to give start and stop signal to other motor. Auto-change features capability of changing the starting order of other drives shall be available.

All drive setting adjustments and operation parameters shall be stored in a parameter log which lists allowable maximum and minimum points as well as the present set values. This parameter log shall be accessible via a RS-232, RS-422, or RS-485 serial port as well as on the keypad display.

f. Diagnostic Features and Fault Handling

The VFD shall include a comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

A "Fault Log" shall be accessible via a RS-232, RS-422, or RS-485 serial link as well as line on the keypad display. The "Fault Log" shall

record, store, display and output to a serial port upon demand, the following for the most recent events:

- Date and time of day
- Type of fault
- A historic log shall record, store and output to a RS-232, RS-422 or RS-485 serial link port upon demand.

g. Drive Options

Provide the following options to the VFD. All special features shall be factory mounted and wired within the VFD enclosure unless otherwise specified.

- Pressure transducer in the VFD to convert a 0-100 psi pneumatic signal to an electrical signal for automatic speed control.
- The VFD shall be provided with circuit breaker for disconnecting power supply. This will provide the ability to isolate the VFD for maintenance and service. All switches include handle operators, door interlocking and are pad lockable.

h. SOUND LEVELS : Transformer average sound levels shall not exceed 40 db based on ANSI and NEMA levels for self-cooled ratings.

m.5. Standards and Frame Sizes: All motors shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and ANSI.

m.6. Enclosure and Protection: Motors shall be totally enclosed fan cooled and waterproof. Motor fans shall be bidirectional. Motors shall be rated for continuous running at full rated load. (IP 56).

m.7. Thermistor: Thermistor to be fitted to all motors rated above 22 kW (30 Hp). It may be fitted to motors with variable speed drives (frequency converters). It shall be PTC type.

- m.8. **Rating:** Motor shall operate on a 400 Volts, 3 phase, 60 Hz power. Written approval is required for all motors which deviate from these requirements.
- m.9. **Starting:** Squirrel cage motors shall be suitable for direct on line starting however, all winding ends shall be brought out. Each motor shall be rated for the maximum frequency of starting. Starting or stall current shall not be greater than 7 times the motor full load current.
- m.10. **Noise:** Noise level shall not exceed 85 dB (A) at 1 M for all conditions.
- m.11. **Temperature:** Temperature rise to agree as per standard.
- m.12. **Insulation:** Shall be class 'F' for 'B' temperature rise

n) **MOTOR PROTECTION:** The circuit should employ an auto resetting overload.

o) **LIGHTING AND SMALL POWER**

o.1. **Distribution System:** The circuits for lighting and power outlets shall be from a 4600//220V, 3-phase, 4-wire system with the neutral directly grounded.

o.2. **Lighting Fixtures**

- Light Emitting Diode (LED) bulbs shall be AC220V, 60 Hz, and standard E27 screw base type.
- LED tube lamps shall be AC220V, 60 Hz. Comparable to a 20W and 40W fluorescent lamps. Plugs directly into fluorescent two (2) prong receptacle replaces standard T8/T10/T12 bi-pin socket fluorescent tube lights.
- High power LED lights use for outdoor, and low and high bay applications shall be AC220V, 60Hz.
- All LED lights and fixtures shall consist of the following
 - aluminum heat sink
 - cooled by free air with no moving parts
 - patented heat sink and optical diffuser

- solid state lamps
- high shock and vibration resistant
- mercury free
- no noise and no flickering
- rated IP65
- no maintenance cost
- long life span: 35,000 to 100,000 hrs
- color temperature range of 3200K to 7000+K
- luminaires must be rated for -40 oC to +50oC
- power factor of ≥ 0.90 or better and with built in power factor correction (PFC) function
- DUV tolerance of 0.001 ± 0.006
- Color Rendering Index (CRI): ≥ 65
- minimum efficiency of 85%

o.3. **Illumination Level** : The standard illumination levels shall be based on the latest edition of PEC.

o.4. **Indoor Lighting**: Lighting for offices, control room, rest rooms, etc. shall be provided by LED tube lamps, either directly mounted to the ceiling or by pendant suspension. For 6 meters above, high bay lighting or approved equivalent shall be used.

o.5. **Outdoor Lighting**

Lighting for outdoor shall be high power LED lamps mounted on steel structures or steel poles (hot dip galvanized).

Automatic switching circuits shall be provided for outdoor lighting.

Switching circuits shall have an “automatic-manual” changeover switch. Automatic sensors shall be of a solid state light sensitive type.

o.6. **Emergency Lighting**

Emergency lighting shall be provided where necessary in order to secure the minimum lighting required with respect to equipment maintenance and personnel safety.

- For emergency lighting, fixtures with built-in batteries shall be used with sufficient battery power to give one hour continuous running during power failures.
- Emergency lighting shall be arranged so as to immediately switch on automatically in the event of power failure.

o.7. Socket Outlets

- All outlets located outside the plant shall be rated to IP 56 except in offices and must be installed with ground fault circuit interrupter (GFCI) type.
- 1-phase 220 V – 2 flat pin + E

p) INSTRUMENTATION AND CONTROLS

p.1. General:

- Instrumentation for controlling and monitoring the process shall be of a robust design and manufactured by recognized supplier. The manufacturer shall be represented in the Philippines having both spare parts and engineering support.
- All field instrumentation and junction boxes shall be rated to IP65.
- Analogue signals shall be 4-20mA dc for transmission on a 2 wire system.
- Digital signals shall be of the 24V DC PNP type (unless otherwise specified or approved by ZCWD).
- Sensors installed to give signals for totalising shall give digital output pulses. The generation of pulses shall be integral within the unit together with calibration and output signal pulse rate and width adjustment. Conversion of analogue signals to pulses by either remote devices or software will not be accepted. These sensors are usually required to give both analogue and digital signals such as flow and volume, kW and kWh.

p.2. Flow and Level Transmitters

- Pressure and differential pressure transmitters shall be electronic solid state type instruments constructed from corrosion-resistant materials.
- Wetted parts shall be of stainless steel for level or ceramic for flow, body shall be of a non-corrosive material or alloy with screwed connections.
- Span and zero adjustments shall be continuously adjustable. The span and zero adjustment should be externally accessible.
- Accuracy of the instrument shall be $\pm 0.25\%$ of span repeatability $\pm 0.20\%$ of span.

p.3. Control Sensors and Equipment

- All field sensors shall be of industrial quality and entirely suitable for their intended purpose.
- All field sensors shall be constructed of a high impact none corrosive material or encased in stainless steel.
- Digital signals from sensors shall switch the DC control voltage in either a positive current driving mode (PNP type) or via clean contacts. Sensors having outputs of the PNP type shall be 3 wires, and have protection against short circuits, overloads and switching of inductive loads. All sensors are to have LED indication to show the operated state.
- Proximity switch or photocell shall have a terminal box attached to the body.

q) PROGRAMMABLE CONTROLLERS

- q.1. **General:** This specification has been developed to establish minimum requirements for a solid-state programmable controller designed to provide high reliability in industrial applications. The controller shall

be supplied with the CPU, input/output scanner, inputs, outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable programmable controller system.

q.2. **Service:** The supplier shall provide operating instruction manuals with adequate information pertaining to the following:

- System Specifications
- Electrical power requirements
- Application considerations
- Assembly and installation procedures
- Power up procedures
- Troubleshooting procedures
- Explanation of internal fault diagnostics
- Shut down procedures
- Recommended spare parts list

q.3. **Design Description**

- Programmable controller system shall be modular, field expandable design allowing the system to be compatible to the machine and/or process control application. The capability shall exist to allow for expansion of the system by the addition of hardware and/or user software.
- The logic processor, power supply, I/O scanner, and communication interface as well as input and output circuitry shall be of a modular design with interchangeability provided for all similar modules.
- The programmable controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant.
- Each input and output module shall be a self-contained unit housed within an enclosure. These input/output enclosures with their respective modules shall be field expandable.

r) **COLOR AND IDENTIFICATION**

r.1. **Color Coding :** The colors shall be:

- Logical states of devices monitored and controlled by the control system shall be differentiated with colors as follows:

Red:	Danger, stop, emergency stop. Measures required in emergency situations;
Yellow:	Caution, take action to avoid danger, avoid changes.
Green:	Safe start, on
Black, white, gray	Neutral, can be used for all purposes except those covered by red, e.g. reset, inching
Blue:	Special, must not be used for purposes covered by red, yellow, or green, e.g. thermal/light

- **Wires Color**

460 V 3-phase:	Red, White, Blue
230 V single phase:	Phase color, when switched – red
Earth:	Green/Yellow
Neutral:	Black
24 VDC	+ ve Brown -VE Violet

- Multicore cables and their cores do not have to be colored as above but must be uniquely identified at both ends.

r.2. **Label Colors:** Labels shall be engraved black lettering on a white background. Warning labels shall white lettering on a red background

s) **INSTALLATIONS**

s.1. **Mains/Power Cable:** Mains cables shall be THHN single core stranded copper cables at 90 °C temperature rating min. (unless otherwise specified or approved by ZCWD).

s.2. **Motor Cable:** Motor cables shall have a minimum cross section of 3.5 mm² and shall be a multicore or single core PVC insulated, PVC sheathed multi stranded copper cable at 75 °C temperature rating minimum. (Unless otherwise specified or approved by ZCWD).

- s.3. **Control Cable:** Control cables shall be PVC insulated multicore cables having multi stranded copper conductors with a minimum cross section area of 1.5 mm² min. All control cables shall be rated for a minimum of 600/1000 V and 75 °C.
- s.4. **Signal Cable:** General purpose signal cable 4-20 mA or any other signals for electronic devices shall be multicore, having stranded copper conductors with a minimum cross sectional area of 1.5 mm² (unless otherwise specified and approved by ZCWD) and be PVC insulated, overall screened, PVC outer sheath construction with a maximum working voltage of 220 VAC.
- t) **CONDUIT** shall be one size larger than is required by Regulation for the number of cables to be drawn in and not less than 20 mm. It shall be of the high impact, rigid, PVC pattern, resistant to ultra violet light.

3.3.5. PLUMBING

- a) The pipe material to be used for the sewer mains connecting the West Pumping Station and the STP shall be **HIGH DENSITY POLYETHYLENE:** High Density Polyethylene (HDPE) pipe. Medium-density polyethylene (MDPE) pipe shall not be allowed. The sizing of HDPE pipe shall be in accordance with ASTM F714 and shall be based upon the DIPS, outside diameter sizing system. The dimension ratio (DR) of pipe to be installed shall also be either shown on the drawings or as directed by the Engineer.
- a.1. Site storage shall be in accordance with manufacturer recommendations.
- a.2. Joints between mainline HDPE pipes shall be constructed by using butt fusion techniques in accordance with ASTM specification D2657. The recommendations of the pipe manufacturer shall govern the fusion process, including the specification of the ideal temperature for fusion. Fittings shall not be joined to mainline piping using heat fusion joining techniques.
- a.3. All standards shall be used the latest edition.

b) PIPE MATERIAL FOR WATER PIPES

b.1. For exposed pipes: Use steel pipes.

b.2. For buried pipes: Use PVC pipes.

3.3.6. PROCESS MODULES

- a) The STP will be operating on a continuous basis, i.e. 24 hours a day and 365 days per year. The design and construction of the facilities shall be based on the sewage volume and characteristics which must be determined by the contractor.
- b) The contractor shall be constructing the STP with an overall capacity of 4,000 cubic meters per day of sewage from the existing sewer network. However, tanks which will be constructed for various stages of the treatment must be so constructed as to allow future expansion of up to 2MLD. It must be so designed/constructed/supplied/installed such that all civil works and electro-mechanical facilities will meet the design capacity.
- c) The following provisions cover specific facilities but do not preclude the provision of other facilities that may be required in attaining the required STP performance requirements and efficiencies.
- d) Screens: Preliminary screens or bar racks should be included for the removal of inert and other floating solids and debris that may have entered the sewer lines, and desludging trucks in the case of septage.
- e) Grit, Scum and Oil and Grease Removal: A grit and oil and grease removal mechanism/system must be included in that system to prevent grit and oil and grease from entering the main treatment system and ensure smooth operation of the downstream processes.
- f) As necessary to maintain the desired efficiencies of the processes, scum, oil and grease collection equipment shall be provided. Two (2) day storage of scum, oil and grease shall be provided.
- g) Disposal of scum, oil and grease shall be the responsibility of ZCWD or its designated operator/contractor after the 1 year process proving period shall have lapsed. Until then, the contractor shall be responsible for the

disposal of scum, oil and grease in accordance to relevant environmental standards.

- h) The system must be able to accommodate sewage peak-flows and shock loadings by employing such methods that will equalize the sewage flow
- i) **Each major module in the treatment process must be connected to the SCADA system for a step by step monitoring of the treatment efficiency and for ease of detection in case of system failure.** It must be able to provide a complete overview of the entire system, that is user friendly, reliable, flexible, and communicates real time data with quick and easy access to critical information of the operating environment. It must be equipped with an appropriate SOFTWARE, the required personal computers for HMI (Human Machine Interface) monitoring, PLCs and RTUs Communication and Telemetry associated with the field instrumentations. It must be able log history/data storage which is easily retrievable.

3.4. SEPTAGE ACCEPTANCE AND SLUDGE MANAGEMENT

- 3.4.1. Septage Acceptance Unit must have the capability to partially treat septage from ZCWD concessionaires not connected to the sewerage system.
- 3.4.2. Septage Acceptance Unit shall have pre-treatment of waste water from the septic tanks received directly from the tanker trucks or septage truck collector.
- 3.4.3. The effluent (filtrate) quality from the pre-treatment of the septage acceptance unit should be equivalent or better than that of the sewage influent. The same shall be conveyed directly to the pre-treatment of the sewage treatment plant.
- 3.4.4. At least one (1) sludge dewatering unit, with sufficient capacity, is required in a complete system to perform the separation of mixed septic and wasted biological sludge from the plant process streams, and to produce a sludge cake with dry solids content of 20% to 25%.
- 3.4.5. Main machine parts including the dewatering unit must be stainless steel with a minimum grade of Type 316. Certain other small components like bearing,

etc. must be of an equivalent material with a proven reliability and durability under these particular operational conditions.

- 3.4.6. Each unit shall be completely covered and enclosed and incorporate all functions in each unit for a compact and complete system, in which the septage is treated for the separation and dewatering of solids.
- 3.4.7. Dewatered sludge shall be discharged via enclosed discharge chutes into enclosed inclined screw conveyors. It shall be accurately discharged in a collector system that will be automatically conveyed to the sludge storage facility.
- 3.4.8. The STP must be provided with a facility for loading of dewatered sludge to 5 m³ bulk haul trucks. At least one (1) hopper with a one-day capacity shall be installed for this purpose.
- 3.4.9. At the minimum, the septage acceptance must have a shed with a minimum floor area of 88.00 square meters.

3.5. DEMOLITION AND CONSTRUCTION OF MRF

- 3.5.1. The Materials Recovery Facility (MRF) is operated and managed by the local government thru the City Environment and Natural Resources (OCENR). As part of its commitment to the local government, and in order to give way to the construction of the STP at the project site, it is necessary that the facility be demolished at its present location and reconstructed at the vacated site due to conflagration within the main public market.
- 3.5.2. The specifications and dimensions in the design herein mentioned shall be without prejudice but must be compliant with the National Building Code, Fire Code, National Plumbing Code, Philippine Electrical Code, Philippine Mechanical Code and other applicable standards.
- 3.5.3. The MRF shall be demolished at its present site and reconstructed at a 660.00 square meter area (see attached location plan) within the main public market which was vacated due to conflagration.
- 3.5.4. The works shall include demolition of the MRF at its present site, the construction of its office building and shed in a 660 square meter area within the Zamboanga City Public Market, 10 meters from the mosque, previously identified and the transfer of the rotating digesters and other MRF equipment to the new

location. Attached in this document is a copy of the location and site development plan.

- 3.5.5. It shall also include the demolition of the office/storage building, restrooms and the shed at the existing site. At the MRF transfer site, a perimeter fence should be constructed with ingress facing the public market. The entrance must be wide enough to allow the entrance and exit of garbage trucks from the public market. A perimeter fence must also be constructed around the 660 square meter area. The storage room must have an area of 100 square meters while the office/supply room should have an area of 26 square meters while the restroom will have an area of 10.5 square meters (see attached reference drawing of the site development of the MRF).
- 3.5.6. **Perimeter Fence Specifications:** The perimeter fence may be at least a combination of concrete and interlink with a height of not less than 2.40m. However, the part facing the mosque must be made of masonry firewall. Finish grade line (finish pavement) inside the transfer site of the MRF shall be even plain finish with a capacity to carry a traffic load.
- 3.5.7. **Shed Specifications:** Shed Column/Post and roof frame shall be made of Steel and painted with Enamel Paint. Roof material shall be at least corrugated roof sheet painted with acrylic paint. Electrical wires must be provided for each of the Rotating Digesters from the top. All materials recovered from demolition shall be turned over to ZCWD.
- 3.5.8. **Office Room Specifications:** It shall be plastered finish painted with masonry paint, floor finish shall be a ceramic tile, ceiling shall be fibre cement board w/ metal furring ceiling joist. All windows shall be at least of jalousie glass.
- 3.5.9. **Storage Room Specifications:** It shall be plastered finish painted with masonry paint, plain cement floor finish, provide ventilation by means of grills or steel mesh matting.
- 3.5.10. **Leachate collection drainage** must also be provided from the composting area and drained to a three-chamber septic tank constructed on-site.
- 3.5.11. **Utilities:** The works identified herein includes the transfer of existing utilities (*i.e.* electricity and water), which includes incidental works necessary for the complete transfer of the MRF to its new location based on the contractor's inspection of the MRF prior to its demolition.

3.5.12. A provision for electrical supply overhead of each of the Rotating Digesters must be provided.

4. CONSTRUCTION REQUIREMENTS

4.1. GENERAL REQUIREMENTS

4.1.1. It shall be the responsibility of the contractor to secure all the necessary and applicable permits to undertake the project, including, but not limited to, building and fencing permits and excavation permits. No work shall commence unless said permits have been secured.

4.1.2. All works and installations shall be in accordance with the manufacturer's specifications and standards.

4.1.3. Shop drawings, manufacturer's literature and structural calculations that may be required elsewhere in this Section shall be submitted to ZCWD for review and approval. Shop drawings shall show details of the products and systems, and connections to adjoining materials. Schedules showing sizes, types, and locations of louvers and glass shall also be submitted for approval along with manufacturer's installation instructions.

4.1.4. All materials for the works herein involved shall be delivered, stored and handled so as to prevent damage of any nature. Materials that have been damaged shall be removed from the site and shall be replaced with good ones.

4.1.5. INSPECTION AND TESTING

- 1) The Contractor shall furnish copies of Contractor's inspection and quality control plan prior to the commencement of project implementation.
- 2) Materials and workmanship shall be subject to inspection.
- 3) Unless otherwise specified, at least three (3) samples of each material shall be submitted a minimum of fourteen (14) working days prior to ordering such material or equipment. Submission shall be in an orderly

sequence so that dependent materials or equipment can be assembled and reviewed without causing delay in the work. All samples shall be individually and indelibly labelled or tagged indicating thereon all specified physical characteristics and manufacturer's names for identification. Upon receiving approval, one set of samples will be stamped and dated by ZCWD and returned to the Contractor for safe keeping in the site office until completion of the work. Unless otherwise specified, all colors and textures of specified items shall be selected by ZCWD from the manufacturer's standard colors and standard product lines. All materials to be used under this contract shall be ISO certified and applicable for industrial applications under Class D environment.

- 4) The inspection will check as a minimum, equipment components, dimensions and quality of workmanship against certified drawings and data.
- 5) All materials must be inspected by the Inspection Committee or any authorized designated personnel of ZCWD prior to installation. Otherwise, the end user has the authority to remove and replace such item at the expense of the contractor.
- 6) Before delivery on site, the equipment for the different process modules must be inspected at the manufacturing plant. Expenses for at least 5 personnel must be to the cost of the contractor.
- 7) Before erection, the Contractor and the Manufacturer's representative shall jointly inspect the installed materials and equipment on site to determine compliance with the specifications and manufacturer's data.
- 8) Upon completion, and before final acceptance, the hoist, trolleys and monorails shall be given the rated load test specified in ASME B30.11

4.2. ENVIRONMENT, HEALTH AND SAFETY

- 4.2.1. ZCWD shall be responsible for the preparation of the Environmental Impact Assessment (EIA) Report and for the application of an Environmental Compliance Certificate (ECC) with the Environmental Management Bureau IX. However, the contractor shall be bound to implement the Environmental Management Plan (EMP) and the Environmental Monitoring Program (EMoP) applicable for the construction phase of the project, as well as those applicable during the operation phase must be implemented by the winning bidder until the one (1) year process proving period expires. They shall also be bound to comply with the conditions enumerated in the ECC.

- 4.2.2. Upon receipt of the Notice to Proceed, the contractor shall install on the entrance of the project site a billboard containing this message: *“Notice to the Public, This Project (name of the Project) of (Name of Proponent) has been issued an Environmental Compliance Certificate (ECC No. R09-1509-0066) by the Environmental Management Bureau of the Department of Environment and Natural Resources, Region IX, on (October 20, 2015).”*
- 4.2.3. A copy of the EMP, EMoP and ECC shall be furnished to the contractor.
- 4.2.4. During the construction period, the winning bidder must designate a Pollution Control Officer (PCO) for the project who shall ensure that the implementation of the Environmental Monitoring Program (EMoP) and the Environmental Management Plan (EMP) is strictly complied with. Said PCO should be duly accredited by the DENR-EMB and shall be working closely with the Corporate PCO of ZCWD to ensure the smooth implementation of the EMP and EMoP.
- 4.2.5. Odor control, malodorous gases produced from operation shall be contained, collected and treated. A bio-filter or soil filter odor treatment system is highly encouraged. However, if the odor control used is mechanical in nature, it must be able to resume normal operation after power interruption, even if unmanned, without causing damage to or undue shortening of the economic life of the electric motors.
- 4.2.6. The plant itself shall be free from discernible odor and noise which must meet DENR standards on noise levels (ambient and source-specific standards). Please refer to the standards being adopted by the DENR and DOLE on noise limits. In case of non-compliance, the Contractor shall make revisions of their design to meet the requirements without additional cost to ZCWD.

TIME	CLASS				
	AA	A	B	C	D
Daytime (0700Hr-700Hr)	50	60	65	70	75
Evening (1700Hr-100Hr)	45	50	60	65	70
Nighttime (2100Hr-500Hr)	40	45	55	60	60
Morning (0500Hr-700Hr)	45	50	60	65	70
Class AA – a section of contiguous area which requires quietness, such as areas within 100 meters from school sites, nursery schools, hospitals and special homes for the aged. Class A – a section or contiguous area which is primarily used for residential purposes. Class B – a section or contiguous area which is primarily a commercial area. Class C – a section primarily zoned or used as light industrial area. Class D – a section which is primarily reserved, zoned or used as a heavy industrial area					

Table 6 DENR Standards for Noise in General Areas

4.2.7. Occupational health and safety measures must be properly implemented. Engineering Control, Administrative controls and PPE must be implemented. Workers at the project site must be equipped with proper safety personal protective equipment (PPE) during project implementation. This shall also include all necessary PPE during operation of the STP which must be turned over to ZCWD.

4.2.8. Fire safety must be considered in the facility. All facilities must be provided with fire protection system as per the latest National Building Code and the National Fire Protection Association. At the very least, fire extinguishers must be easily accessible at strategic locations within the facility.

4.3. CIVIL WORKS

4.3.1. General Requirements

- 1) Structural design shall follow the National Structural Code of the Philippines (NSCP) 2015 edition, Philippine Green Building Code, B.P. 344 Accessibility Law and other renowned and globally accepted standards.
- 2) All civil works shall follow DPWH Blue Book Standards for construction requirements, material testing, method of measurement, and basis of payment.
- 3) The design for deep foundation shall be designed in accordance with the attached Geotechnical Investigation Result; use a methodology for deep foundation that will not damage the adjacent structure or else the contractor shall be held liable for any damages.

- 4) Architectural designs shall follow the latest edition of National Building Code of the Philippines and the Philippine Green Building Code.
- 5) Wastewater/water retaining structures shall be waterproof/leak-free.
- 6) Exposed surfaces shall have a smooth finish concrete and shall be painted with acrylic solvent based paint.
- 7) **LEVELS AND REFERENCE POINTS:** The Contractor shall preserve and keep accessible or free from sight obstruction the benchmark of the basic survey here.
- 8) **DRAWINGS**
 - 8.1. In addition to requirements specified elsewhere in this specification, the requirements of this section shall be applied harmoniously with the earlier provisions.
 - 8.2. The Contractor shall prepare detailed working drawings of the whole of the Works to be carried out in this Contract. All drawings shall be to an acceptable and professional standard. Poorly prepared or insufficiently detailed drawings will be rejected. Drawings which were not initialled or signed as having been checked by a responsible member of the Contractor's organization will also be rejected.
 - 8.3. Where appropriate, the drawing scale must be shown. The drawing shall also include a graphic scale to facilitate scaling when a sheet is reproduced at a different size to the original. Plant room layout drawings are to be prepared to a scale of 1:50 or larger. Equipment detail drawings shall be drawn at a scale of 1:20 or larger.
 - 8.4. All Drawings shall include the Manufacturer's detail or serial number of all plant/equipment so that sufficient information is available for the ordering of replacement parts.
 - 8.5. All drawings shall be created using CAD software that may be accessed with Autodesk AutoCAD version in 24" x 36" size tracing paper unless noted otherwise.
 - 8.6. Graphical symbols used on drawings shall comply with the symbols contained in the current version of the appropriate standard (PEC, NEC or IEC).
 - 8.7. Cross-references shall be marked on all schematic diagrams to show where a coil has its contacts and where contacts have their coils. This

referencing shall apply to all types of equipment shown on more than one drawing.

- 8.8. **“As Built”** Manufacturing Drawings/Information shall be supplied in loose-leaf binders with index to simplify location of a particular drawing. Immediately following final successful works testing/commissioning, the Contractor shall revise all appropriate drawings and incorporate any modifications found necessary as a result of the tests. The Contractor shall then forward three (3) white copies, one (1) reproducible copy, and an electronic copy on flash drive in CAD format that may be accessed with Autodesk AutoCAD, of all documentation and drawings applicable for the installation. The Contractor shall also submit three (3) clear copies of test certification applicable to the installation.
- 8.9. **Execution.** No site work, other than standard equipment or controls, will proceed until such drawings or specifications have been reviewed and marked as satisfactory or released. Approved code numbers are only for engineering review and prior for approval for construction drawing. The Contractor shall seek permission, clearances prior to approval of ZCWD to commence execution of works on-site
- 9) **SURVEYING AND SETTING OUT WORK:** The Drawings show the available survey information for the sites included in this Contract. Should the Contractor have any disagreement with this basic survey information and the relevant drawings, it shall inform ZCWD in writing not later than two (2) weeks after the Notice to Proceed. The Contractor shall perform all calculations, surveys and setting-out necessary to establish the accurate location of the structures as shown on the Drawings. The Contractor shall submit to ZCWD for review in advance of any setting-out work, a description of the methods and procedures it intends to use. The Contractor shall entrust the surveying works only to persons who, by their training and experience, have sufficient qualifications and knowledge to ensure proper fulfilment of the survey tasks assigned to them. For the

performance of the survey, the Contractor shall provide a sufficient number of reliable and accurate instruments.

10) **OTHER SPECIFICATIONS:**

10.1. **PAVEMENTS & LANDSCAPING**

Roads & Pavements: Aggregate sub base and base course and Portland cement concrete pavement materials and methods of construction shall be in accordance with referenced sections of the "Standard Specifications for Highways, Bridges, and Airports" published by the Department of Public Works and Highways (Revised 1988).

Landscaping Works

The Contractor shall furnish all plants, labor, materials, tools and equipment necessary for the performance of all landscaping complete to include springing, seeding, loaming, sodding, planting of trees, topsoil supply and spreading and all other incidentals which are deemed necessary in the completion of this work item. All unpaved areas shall be sodded. Border plants to be used shall be subject for approval of ZCWD

* List of plants and landscaping materials shall be submitted together with landscaping layout to be approved by ZCWD.

* Plants shall be subject to inspection and approval or rejection by ZCWD at place of growth and upon delivery to the site at any time before or during progress of the work based on the following criteria:

- Quality, size and variety;
- Ball and root condition;
- Quantity of stock; and
- Latent defects and injuries resulting from handling, disease and infestation.

* Plants approved at pre-planting inspection shall still be subject to rejection during planting if found to be unsatisfactory.

- * Rejected plants shall be identified in an obvious manner, removed from the site and replaced with acceptable equals.

□ **Maintenance of Landscape Planting Prior to Acceptance**

* **General**

- The Contractor shall be responsible for protecting, wearing and maintaining all planting and irrigation systems until final acceptance of all work under the contract.
- At time of acceptance of the complete project, the lawn shall be totally established with no bare spots, mowed a minimum of 4 times and grass is at least 40 mm to 50 mm in height.
- All maintenance works, including watering and protection of the landscaped area and its plants shall be undertaken by the contractor until final commissioning and turn-over over the project to ZCWD. Acceptance shall not be made unless ZCWD shall not be satisfied with it.

* **Final Inspection and Guarantee**

- Inspection of work of lawns and planting will be made at conclusion of maintenance.
- Final acceptance of the work prior to guarantee period of the contract will be accepted upon written approval by ZCWD , on the satisfactory completion of all work, including maintenance, but exclusive of the replacement of plant material.
- The Contractor shall replace, as soon as weather conditions permit, all dead plants, and all plants not in a vigorous, thriving condition noted at the end of the guarantee period.

- Plants used for replacement shall be of the same size and variety specified in the plant list. Plants shall be furnished, planted, staked and mulched as specified.
- All work done under this contract shall be left in good order to the satisfaction of ZCWD and the Contractor shall without additional expense, replace any trees, shrubs, etc., which develop defects or die.

11) **DRAINAGE SYSTEM**

- 11.1. Design for the drainage system should follow the standards of the DPWH Blue Book. The system's size should be adequate to drain any type of water.

12) **METAL DOORS, WINDOWS AND FRAMES**

- 12.1. **GENERAL:** All work shall be coordinated with appropriate related work to assure proper installation. Field conditions and dimensions shall be verified prior to fabrication.

13) **HOLLOW METAL DOORS, WINDOWS AND FRAMES**

13.1. **General**

- All work shall be shop-fabricated and shop assembled where possible. Temporary stiffeners, spacers, etc. necessary to facilitate handling and accurate erection shall be provided.
- After fabrication, all tool marks, and other surface imperfections shall be filled and ground smooth.
- Doors, windows and frames shall be chemically-treated to ensure maximum paint adhesion and shall have all exposed surfaces painted with a rust-inhibitive primer after fabrication.

- Doors and frames shall be reinforced and drilled or tapped for fully templated mortised hardware; and shall be reinforced with plates for surface-mounted hardware, meeting ANSI 115 requirements.

13.2. **Metal Doors**

- Metal doors shall be full flush design. Face sheets shall be not less than cold rolled stretcher-levelled 1.4 mm steel, hollow metal construction. All doors shall have flush seamless face sheets. The door top and bottom shall be internally reinforced by steel members welded in place. Tops of exterior doors shall be provided with flush weather tight tops.

- Door louvers for metal doors shall be of metal of the type which integrally frames the opening and can be securely attached. Louvers shall be of the "Z" blades type for exterior and interior use. Exterior louvered openings shall be provided with removable type insect screens. Door louvers shall be uniformly located in doors and be of sizes shown.

- Doors shall be rigid, and neat in appearance, free from warpage, or buckle. Corner bends shall be true and straight and of minimum radius for the gauge of metal used.

- Double doors shall be provided with a "T" type steel astragals.

13.3. **Metal Louver Windows** : Metal louver windows shall be of the same gage and of similar construction to door louvers for metal doors.

- 14) **SOUND DOORS**: Sound doors and frames shall be complete factory-built and laboratory tested assemblies, complete with perimeter compression seals and automatic door bottom seals at sill.

- 15) **STEEL-REINFORCED PVC DOOR AND WINDOW SYSTEM**: Materials and installation shall be in accordance with the following reference standards Manufacturer's printed recommendations, specifications and installation instructions.

- 16) **ALUMINUM SLIDING WINDOWS**

16.1. **Scope:** The work covered by this section consists of furnishing all equipment, materials, and labor in the fabrication and installation of aluminum sliding windows.

16.2. **Materials**

☐ **Weather-stripping:** Weather-stripping shall be vinyl and wool pile and shall form a continuous weather seal. They shall be installed snugly in integrally extruded keyways and shall not be loosened nor removed by operating the windows. Weather-stripping for the panels will be one-piece channel shaped gaskets.

☐ **Finish:** Exposed aluminum surfaces shall be powder coated, white. Surfaces shall be completely sealed requiring no further application additional coating or preservatives.

17) **WOOD DOORS**

17.1. **General:** Doors shall be of the quality and workmanship acceptable to the ZCWD. The Contractor shall guarantee finished doors against twisting, warping, crack and such other defects due to construction and installation for a period of one year after the final acceptance of the building.

17.2. **Solid Core, Hollow Core, Plywood Flush Type**

17.3. **Materials:** Where indicated, plywood flush doors shall be provided with louvers of sides shown. Louver blades shall be kiln-dried wood as indicated in the schedules. Louver blades shall be uniformly cut finished and fastened to frame in an approved manner. Sufficient reinforcement shall be provided for installation of door closers.

4.3.2. **Materials**

1) **INSTALLATION:** All installations must be done in accordance with the manufacturer's approved erection instructions and diagrams. All materials installed in the work shall match the approved samples.

2) **JOINT SEALANT:** Joint sealant for concrete shall be all approved one component joint sealing compound on Polyurethane base and shore

hardness of at least 35 after a 7 day curing period. The shore hardness shall be as defined in ASTM D2240.

- 3) **FLANGES OF PIPES:** Unless otherwise specified in the Contract Drawings, all flanges shall withstand a hydrostatic test pressure of 16 bars.

4) **GLAZING**

4.1. **General**

- Work Quality:** All work shall conform to the recommendations of the glass manufacturers.
- Accessories:** Glass and glazing systems shall be installed complete with all stops, blocks, channels, beads, sealants and glass to form a completely installed watertight installation.
- Warranty:** The Contractor shall guarantee that all work performed under this Section will be free from defects in materials and workmanship and will remain watertight for a period of within the warranty period. Upon receipt of written notice of defect or leakage within the guarantee period, the Contractor shall, at his expense, make necessary repairs or replacement of the defective work.
- Manufacturer's Label:** Each piece of glass shall bear the manufacturer's label showing grade, thickness and type of glass and all labels shall remain until the glass has been set and inspected.
- Certification of Glass Thickness and Grade.** When glass is not cut to size by the glass manufacturer, the Contractor shall furnish an affidavit stating the grade, thickness and type of glass and manufacturer of the glass furnished.

4.2. Glass Types

- Type A:** Tinted colored tempered float glass shall be heat-treated safety glass 6 mm minimum thickness used for exterior window wall lites. The glass color shall be bronze.
- Type B:** Clear tempered float glass shall be heat-tempered safety glass and shall not be less than 6 mm thick. This glass type shall be used for interior windows and window wall lites within 0.40 m of floor, entrance doors and door lites.
- Type C:** Mirrors shall be 6 mm select mirror glazing quality mirrors.

4.3. **Submittals:** Stock samples of glass along with manufacturer's literature and installation instructions shall be submitted to ZCWD for review and approval.

4.4. Execution

- Inspection:** Areas to receive glass and glazing shall be inspected and defects shall be reported to ZCWD. All glazing shall be done in accordance with the applicable Referenced Standards.
- Manufacturer's Recommendations:** Preparation work such as priming and cleaning shall be done with materials and procedures recommended by the manufacturer.
- Surfaces:** Surfaces shall be dry and free from dust, dirt and film. All priming shall be completed and thoroughly dried before glazing.
- Unfavorable Weather Conditions:** No work shall be performed in damp, foggy or rainy weather.
- Concealed edges:** Concealed edges of glass shall be clean, straight cut and free from chips and fissures. All glass shall be shop-cut and allowances shall be made for maximum grip on all edges. Nipping glass on the job will not be allowed. Glass shall be accurately cut to size of opening. Glass shall be set with equal bearing on entire width of pane. Large sheets of glass

shall be positioned with setting blocks. Glass shall not move or rattle.

- **Glazing Beads:** Glass in glazing beads or channels shall be in accordance with manufacturer's printed installation instructions. Materials shall not be stretched.
- **Stop Glazing:** Glass set with stop glazing shall be set on glazing tape. All voids around perimeter and between glass and stop shall be filled with glazing compound to provide a completely watertight installation. Tape and compound shall be trimmed flush to sight line.
- **Sealant:** Sealant shall be applied on inside glass surface below glazing bead. Void below vinyl to bottom of glazing reglet shall be filled to maintain weather tight seal.
- **Metal Glazing Beads:** Where metal glazing beads occur, the glass shall be set completely bedded in glazing compound. Metal glazing beads furnished by the manufacturer shall be installed in accordance with manufacturer's printed instructions. Compound shall be trimmed flush to sight line.
- **Identification for Safety:** Glass, glazing panels and glazing shall be protected by clear identification by indicating devices which indicate the presence of glass to other workers and materials handlers. Taping or marking on the glass which would cause a permanent stain shall not be used.
- **Workmanship:** Glass and glazing shall be left in perfect condition and ready for final cleaning.
- **Acceptance:** Prior to acceptance of the work, broken, defective or scratched glass shall be promptly replaced, and damaged glazing compound shall be repaired.

4.3.3. *Concrete and Formwork*

- 1) **SURFACE FINISHES PRODUCED WITHOUT FORMWORK:** Surfaces where people may step on shall be wood floated under light pressure to eliminate surface irregularities. Vertical surfaces and others not intended

as walkway or stepping board shall be steel-troweled under firm pressure to produce a dense, smooth, uniform, surface free from trowel marks.

2) **SURFACE FINISHES PRODUCED WITH FORMWORK:** Exposed surfaces shall be fair finish while those to be covered by soil can be rough finish.

3) **TILES**

3.1. All tiles shall be installed by competent tradesmen and in accordance with the best practices of the trade. Finished surfaces shall be produced in the true plans, free of damage, scratches, or otherwise faulty tile in all places solidly backed up and firmly secured. All tiling work shall be laid out so that field or pattern is exactly centered on the area to preclude the use of tiles less than full size; do any cutting along edges of area. Joints of uniform standard width and in true alignment shall be maintained throughout; completely fill with grouting or pointing mortar and finish smooth and flush with tile. Cut and drill without marring tile, smooth cut edges with a fine stone. Fit carefully around pipes, outlets and similar items so that cover plates or trim will cover the cut edges. Remove surplus mortar and grout from tile surfaces before these have set.

3.2. All tiles shall be delivered to the site in sealed containers with labels intact.

3.3. **Plain Cement Finish:** Mix mortar one (1) part Portland cement to two (2) parts sand.

3.4. **Granite Tiles**

Install flooring after all other trades, including painting, have been completed. All surfaces to receive resilient flooring finishes shall be dry, clean and smooth.

Inspection: Examine substrate and conditions under which flooring is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

4.3.4. *Demolition and Construction of Materials Recovery Facility*

In order to ensure that the winning bidder will limit their construction works within the prescribed area, a representative from the local government (City Engineer's Office, City Assessor's or City Legal Office) should be present during the verification survey/staking works of the project. Furthermore, constant coordination should be made with the Philippine Ports Authority, which is the property located at the southern portion of the MRF compound, and with the Office of the City Environment and Natural Resources, who operates the materials recovery facility

4.4. MECHANICAL WORKS

4.4.1. *Scope of Works*

This Specification establishes the mechanical features and minimum level of quality required for all permanent mechanical plant in this contract.

- 1) **Drawings and Information:** The following drawings and documents as a minimum shall be submitted for review:
 - 1.1. Pump mounting and general arrangement drawing, complete with parts and materials listing, dimensions and weight.
 - 1.2. Pump sectional drawings detailing all internal components and associated parts lists;
 - 1.3. Typical performance curves;
 - 1.4. Pump data sheet;
 - 1.5. Valve and actuator datasheets
- 2) Outline general arrangements showing overall dimensions and all pertinent details including equipment, valves and pipes including all supports and clamps/guides etc., and any requirements for access for installation and maintenance.

4.4.2. *Methodology in Executing the Extent of the Contract*

- 1) **Certification:** Prior to installation works, the Contractor shall submit three (3) clear copies of all Test Certificates (including results of tests) as required by the Contract.

4.4.3. *Product Specifications*

1) **Pump Sets**

- 1.1. Pumps, whether submersible or centrifugal, shall suit the duty requirement of the project.
- 1.2. The casing shall be of close-grained cast iron or approve equal, designed for maximum heat transfer to the surrounding liquid. The casing shall be fitted with renewable wear rings.
- 1.3. The pump shall be direct driven by a close-coupled electric motor.
- 1.4. The impeller shall be of stainless steel / bronze to the manufacturer's standard grade, preferably secured to the shaft by keying.
- 1.5. All seals shall be selected for a long service life. The choice of face material shall be suitable for the pumped media and to the recommendation of the seal manufacturer.
- 1.6. All bearings shall be heavy duty ball type grease packed and sealed-for-life and shall be designed with minimum life of L10, 100,000 hours at the guaranteed duty point.
- 1.7. The pump-set shall be fitted with a lifting handle designed for simple, safe and speedy removal of the pump-set using a permanently installed lifting chain and shackle.
- 1.8. Characteristic curves for the pump-set performance shall be submitted by the Contractor and appended to the completed data sheets.
- 1.9. The pump-set shall accommodate the variation in the water level or as required by the particular installation in the Water Treatment Plant.
- 1.10. Bolts and nuts required for fixing shall be stainless steel grade 304 complete with nylon washers to prevent galvanic reaction. It shall not be painted.

2) **Air Blowers**

- 2.1. Air Blowers shall be of manufacturer's standard. The maximum blower operating speed shall be 3450 RPM.
- 2.2. Characteristic curves for the air compressor performance shall be submitted by the Contractor and appended to the completed data sheets.
- 2.3. Bolts and nuts required for fixing shall be stainless steel grade 304 complete with nylon washers to prevent galvanic reaction. It shall not be painted.

3) **Pipe Work**

- 3.1. All pipework associated with pumping unit and associated fittings shall be flanged to PN 16 or greater.
- 3.2. All pipework design shall include sufficient flanges or unions to allow for the disconnection of the major items of plant without disturbing the main pipework. The contractor shall supply flexible couplings as necessary to achieve this requirement.
- 3.3. Flange gaskets shall be natural rubber or equivalent suitable for water application for the wash-down pump.
- 3.4. All pipework installed shall be adequately supported with pipe supports of an acceptable design. These supports shall allow for removal of any section of pipework for maintenance purposes. All pipe supports shall be fabricated from either concrete or hot dip galvanized mild steel; in either case adequate clamping and guides shall be designed and installed. Air, sludge piping & support under the tank shall be suitable and non-corrosive type.
- 3.5. The Contractor shall be responsible for the detailed design and dimensioning of the pipework.

4) **Valve Specification**

- 4.1. The Contractor shall submit for review a complete valve schedule including manual and actuated valves;
- 4.2. The Contractor shall submit the specifications of each valve for review before procurement;
- 4.3. Valve ends, mating dimensions and drilling shall be in accordance with ISO 7005-2, Table I, Class PN-16. The type and minimum thickness of flange shall conform to DIN 2532;
- 4.4. All manually actuated valves shall be clockwise closing and shall have the direction arrow to signify opening;
- 4.5. All manually operated and actuated valves shall be supplied with permanently installed hand wheels orientated in such a position as to allow easy operation. All hand wheels shall be manufactured from cast iron, or equivalent, and shall be located via a keyway onto the shaft. A locking nut shall secure the hand wheel to the shaft;
- 4.6. The composition, sampling and testing shall be in accordance with ASTM B62. All valves shall be coated over 100% of the interior of the valve by a powder epoxy coating. Where because of the nature of the item being coated, it would be impossible to use the powder epoxy method without causing damage to the item; the use of a liquid epoxy shall be permitted. The minimum dry coating thickness shall be 250 microns provided, however, that the thickness of coating in the grooves for valves or fittings designed to receive a rubber gasket shall be approximately 125 microns.
- 4.7. All valves must be motorized or pneumatic;
- 4.8. All valves shall include, but not be limited to, the following markings, which shall be raised and cast in a prominent position into the main valve body:
 - Manufacturer's name and address;
 - Identification and/or serial number;
 - Month and Year of manufacture;
 - Working and Test Pressure;
 - The direction of flow in the form of an arrow.

5) **GATE VALVES**

- 5.1. All Gate Valves AWWA C509. Shall be design suitable for water system. Valves shall be cast iron bodied with electrostatically applied epoxy resin(internal and external) Stem shall be stainless steel with stem sealing made of NBR/EPDM. Wedge shall be made of ductile iron and shall be core fully vulcanized with EPDM rubber with integral wedge nut of dezincification resistant brass. Bonnet bolts shall be made of stainless steel with bonnet gasket made of EPDM rubber.
- 5.2. The valve shall have a 50 mm square operating nut with the word "OPEN" and an arrow cast on showing that the valve opens by turning the operating nut counterclockwise with a maximum operating effort of 13kg push/pull (i.e. total 26kg).
- 5.3. For valves up to and including \varnothing 150mm the stem shall be sealed with a minimum of two (2) "O" ring seals, of which at least one (1) shall be above the stem collar and replaceable under full working water pressure while the valve is in the fully open position. Above this size, all gate valves shall be packed glands for stem sealing.
- 5.4. Manually hand wheel operated isolation and actuated valves shall be of the non-rising spindle type.

6) **BUTTERFLY VALVES**

- 6.1. All pump control valves shall be of the butterfly type, designed and manufactured in accordance to AWWA C504 Class 150 B or ISO 106311994 standards and in accordance with the following:
- The actual waterway diameter of any valve shall not be less than 95% the nominal diameter;
 - Each valve disc shall be ductile iron with no external ribs transverse to the direction of flow and shall be of material in accordance with AWWA C504 or ISO 185, 1083 or 5922. The disc shall seat at 90o to the axis of the pipeline.
 - The shafts shall be manufactured from stainless steel grade 304 or better, and designed for both torsional and shearing stress

when the valve is operated under its greatest dynamic or seating torque;

- Shafts seals of valve with exposed shaft to the water shall be designed to allow replacement or adjustments without removal of valve shaft or operator assembly. Rubber lined butterfly valves without any internal packing gland will be preferred;
 - The valve body and flanges shall be made either of cast-iron conforming to ASTM A-48 Class 40; or ductile Iron conforming to ASTM A-536 grade 65-45-12, fabricated from steel plate conforming to ASTM-A-36 or cast steel conforming to ASTM-A-27;
- 7) **CHECK VALVES:** All check valves shall be of the ball/swing type, and shall comply with the applicable AWWA standard. The seat ring shall be cast from 85-5-5-5 bronze or approved equal. The body seat ring shall be accurately threaded and screwed into a machine seat within the body. The face of the ring shall be machine finished;
- 8) **BALL AND PLUG VALVES:** All plug valves shall be of the ¼ turn operation type;
- 9) **AIR- VACUUM AND AIR-RELEASE VALVES**
- 9.1. **Air and Vacuum Valves:** Valves shall conform to ANSI/AWWA C512 – Air-Release/ Air Vacuum, and Combination Air Valves for Waterworks Service and the following: Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipeline are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.
- 9.2. **Air Release Valves:** Air-release valves shall vent accumulating air while system is in service and under pressure and be of the size

indicated and shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.

- 9.3. **Combination Air Valves:** Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. Valves shall have the same general characteristics.

10) Chlorine Dosing

- 10.1. Chlorine dosing shall be provided high quality metering pump & HDPE tank;
- 10.2. **Metering Pump:** The unit shall be weather proof motor and must be compatible for automation It shall be suitable to the system. It shall be 220 V, 60 Hz. Power shall be design above maximum requirement as per manufacture standard and it shall be in conjunction with flow and total dynamic head of the system;
- 10.3. **HDPE Tank:** The tank shall be UV stabilized to withstand prolong exposure to sunlight and shall be suitable for Chlorine operation. All of the Chlorine pipe work shall be suitably supported and restrained from excessive movement. All brackets shall be included within this Contract and shall be corrosion resistant. The tank should be installed onto smooth flat surface making sure that the whole base is fully supported. It shall be corrosion proof, durable, lightweight, high performance and high quality. The tank shall be provided with sight glass with appropriate volume level indicator on it. Sight glass shall be protected with stainless steel guard (tube type). Both end of sight glass shall be provided with gauge cock. Gooseneck type air vent with appropriate insect screen shall be provided. Tank shall be provided with drain;
- 10.4. **Pipes:** All of the Chlorine pipe work shall be suitably supported and restrained from excessive movement. All stainless steel brackets shall be included within this Contract and shall be corrosion resistant;

- 10.5. **Valves:** All gate valves (for isolation/control) and check valve (for isolation) shall be included within this scope of works and shall highlight their positions on the design drawings to be submitted for approval;
- 10.6. The Contractor shall submit the design of the said system for the approval of the ZCWD. All fittings and pipe work shall be from a suitable material suitably selected for a chlorine application and to endure external impact. Details of said coating and pipe work materials shall be for review by the ZCWD;

11) **Execution**

11.1. **Health and Safety**

- The Contractor may not start on site until approval of the Construction Health and Safety Program is attained from the Department of Labor and Employment. The contractor shall observe all Health and Safety Regulations of the Philippines throughout the course of his works;
- The Contractor shall ensure that prior to the commencement of site installation a method statement of installation of all plant noting specific health and safety issues shall be submitted in writing to both the Engineer and the Operational representative;

11.2. **Testing of Pump before Delivery**

- All equipment supplied under this Contract shall be tested for quality of workmanship at the manufacturer's premises. On delivery to site, the Engineer shall inspect all said plant and any equipment not complying with the specification shall be immediately rejected. The replacement costs of the same shall be the responsibility of the Contractor;
- Pump-sets shall be tested to ISO 2548, class C;
- The Contractor/Manufacturer shall conduct tests and furnish three (3) original certified copies or reports describing the procedures and results of tests in accordance to AWWA C504

and ISO 10631-1994 prior to deliver to the site.

11.3. Installation

- The Contractor shall install the entire pump as indicated in the manufacturer's drawings. All written instructions from the pump supplier shall also be observed;
- The fixing of all frames and brackets shall be with stainless steel expanding bolts with nylon washers unless otherwise noted;
- The Contractor shall be required to fabricate any piping and supports required to install the pumps, motors, and associated plant;
- The Contractor shall be responsible for providing all power requirements and special tools required to undertake the installation of the pump;
- SIGNAGE:** The Contractor shall be responsible for the provision of the following signs on the equipment to be used on the system;
- All items of equipment shall identified by permanent labels giving the item designation. All labels shall be in English, engraved black lettering on white background. All necessary warning labels to be engraved on approved material with white letters on a red background. Provide signage arrow for the piping system.

Example: Chlorine Tank – Engraved “CHLORINE TANK” & “CT-1”

11.4. Testing and Start-up

□ The pump installation shall be tested before commissioning commences. **All tests shall be performed in accordance with the manufacturer's instructions.** General testing shall include, but not be limited to, the following tests:

- * Security and integrity of all fixtures and fittings
- * Pressure testing of the installation to 1.5 x the working pressure of the system unless otherwise noted;
- * Prove to the satisfaction and approval of the Engineer that the pump shall be capable of the specified duty;
- * Check operation of all valves included with the installation;

□ **Specific Tests** to be performed on site shall be in accordance with the following:

* **Pump-sets;**

The Contractor shall perform the following tests as a minimum:

- Pipework leak test to closed valve conditions;
- Demonstrate the removal of the pump-set using the lifting davit, chain and guide rail(s) for submersible pump;
- Demonstration of running amps at the duty point;
- Demonstrate that the pump performance meets the specified duty;
- Undertake electrical testing in accordance with electrical specification;

□ The Contractor shall be responsible for providing all power requirements and special tools required to undertake the aforementioned. Furthermore if additional instrumentation (portable in nature) is required to undertake the testing described herein then it shall be the responsibility of the Contractor to provide the same;

□ Should any of the above test results (and others undertaken as detailed within the plant manufacturer's instructions) be not to the satisfaction of the ZCWD then rectification of the same shall be required and re-testing be performed until the ZCWD is satisfied with the said works. Any costs incurred for required

modification works and re-testing shall be to the account of the Contractor;

- After testing {re-testing} has been undertaken to the satisfaction of the ZCWD all ancillary items left on site shall be removed and the site tidied. Only after satisfactory inspection of the working area by the ZCWD shall final hand-over be complete;

4.5. ELECTRICAL WORKS

4.5.1. GENERAL

1) SPECIFIC CONDITIONS

- 1.1. The performance of the equipment and materials installed shall be as specified and the quality of the installation is in accordance with the specification and good trade practice;
- 1.2. The works shall be carried out in accordance with the requirements of all authorities having jurisdiction over the works and/or approval required therefrom. Such notice shall be provided and the application shall be prepared accompanied by such plans and information as may be called for and /or obtain such approvals;
- 1.3. All wiring and tests shall be carried out in strict accordance with the current edition of PEC part 1 and 2 including amendments and rulings;
- 1.4. If there is any conflict between Philippines Electrical Code Part 1 & II and other standard the most stringent rule shall apply;
- 1.5. All permit and electrical fees required for this work shall be obtained by and at the expense of the Contractor. The Contractor shall furnish and transmit to ZCWD, copies of Certificates of Inspection and Approval after completion of the work. The Contractor shall prepare all as-built plans and all other paperwork required by the approving authorities;

2) SPARE PARTS AND SPECIAL TOOLS

Where a machine is fitted with components of a specialized nature, such as electronic components, etc. for which spares are not already held at or are not held elsewhere Manila (ex. stock), or which cannot be replaced by other components dimensionally and functionally identical, which are held or available in Manila (ex. stock), then such spares shall be provided as part of the original equipment;

4.5.2. ***LOW VOLTAGE SWITCHBOARD***

- 1) It will be permissible to obtain access to live parts through a door or cover while the equipment is alive by defeating mechanical interlock or using special tools. Such interlock must be automatically restored on refastening the door or cover.
- 2) Any item of apparatus must be capable of being removed for replacement without requiring any other item to be removed first. Captive nuts or threaded steel shall be used so all apparatus can be replaced without removing the gear plates or other parts of the cubicle. Self-tapping screws are not acceptable.
- 3) **Construction**
 - 3.1. Main switchboards to be fabricated from at least 2mm mild steel. Control panels to be fabricated from at least 1.6 mm thick.
 - 3.2. All panels or doors supporting equipment in which large cutouts are required shall be constructed of at least 2.0 mm sheet steel.
 - 3.3. All joints shall be continuously welded and ground to be smooth finish.
 - 3.4. All doors and covers shall be provided with compressible Neoprene gaskets.
 - 3.5. Switchboard doors will be fitted with key lockable handles. Doors over 1500 mm high will be fitted with two door handles at top and bottom. A single handle and locking rods will not be accepted. Drawing pockets will be provided for each switchboard, mounted on the inside of the cabinet door.

- Doors are to be effectively earthed by 6 mm² insulated flexible copper bonding straps.
- Painting mild steel metalwork shall be as follows: After construction and all cut outs completed, the sheet metalwork shall be thoroughly rubbed down to a smooth blemish free surface free of all defects and rust. All metalwork shall be Zinc Chromate primed and passivated, undercoated, two topcoats of high gloss enamel paint “gray” exterior and white interior.
- The switchboard shall be so arranged that it may be readily extended in either direction. Each shipping section shall have provision for top lifting and lifting eyes or beams shall be provided.
- The manufacturer shall provide the internal fixings within the equipment necessary for the holding down bolts.
- Workmanship shall be of a high standard in all cases and the finished equipment shall present a neat and attractive appearance.
- All bolts, nuts, washers and spring washers used in the assembly of components and cubicles shall be of adequate size for the duty required and shall be Zinc plated to prevent corrosion. Cadmium plated components shall not be used.
- Cable ducting shall be so sized and arranged that the cables in the duct do not exert pressure on the lid or cause deformation of the duct.
- Cable ducts are to be dedicated to electrical cables only. Under no circumstances are pneumatic lines to run in these ducts.
- Any cables entering through the top of sides of an envelope shall pass through cable glands. Where circuits or sub mains exceeds 100 Amps and are single cored and gland plates shall be designed to prevent currents in the plates.

4) **Main Switchboards**

4.1. All main switchboards shall be of a type-tested design as defined in and of comparative type construction.

4.2. Main switchboards supplied directly from transformers shall have:

- One voltmeter with selector switch for phase and line voltage selection;
- One multi-function relay with the following minimum features:
 - * Phase relay;
 - * Over/Under voltage relay
 - * Phase unbalance relay
 - * Ground fault relay
 - * Under load current relay
 - * Overload relay

5) **Bus Bars**

5.1. **Phase Bars:**

- Bus Bars shall be hard drawn, high conductivity copper supported on approved insulation. The Bus Bar Assembly shall be rated based on short circuit calculation for 1 second minimum and have type tested certificates for an approved testing station.
- Main bus bars shall be rated for minimum of 25 % greater than the total loading on them.
- Connections for demountable or withdrawable switchgear shall be so arranged as to permit easy disconnection without disturbing the working condition of the bus bar or cable connections. The bus bar is to be pre-drilled to permit easy extension in either direction.
- Main connections and bus bars shall be arranged and identified in either by painting, PVC sleeving or other approved means.

5.2. **Earth Bars**

- This shall be installed in line with the standards;
- A suitable sized earth bar shall extend the length of the switchboard.

4.5.3. *MOTOR CONTROL CENTERS*

1) **General**

- 1.1. The work covered by this Specification includes the design and manufacture of motor control centre (MCC) equipment completely assembled.
- 1.2. The Vendor shall also provide technical assistance during the installation and placement in service of the equipment, if requested by the Purchaser.
- 1.3. All equipment shall be designed, built, rated, tested and shall perform in accordance with the latest editions of the applicable standard.
- 1.4. The standards and regulations of authorities having jurisdiction over the equipment particularly ZAMCELCO shall apply.
- 1.5. Where the stipulation of this Specifications, the data sheets and the drawings do not comply with the minimum requirements of the applicable regulations and standards; the latter shall prevail. Where the stipulations of this Specification, the data sheets and the drawings are more exacting than the minimum requirements, the former shall prevail.

2) **Service Conditions**

- 2.1. The MCC and all components therein, shall function in a satisfactory manner within the rated capacity under the service conditions specified regardless of whether or not all necessary specific performances are set forth in this Specification or in the applicable standards.

3) **Design Construction Details**

- 3.1. **General:** The MCC within this Specification shall be compartmentalized.
- 3.2. **Enclosure:** The MCC shall be constructed with suitably folded and stiffened corners and edges with an integral supporting structure, and shall be manufactured from mild steel as specified.
- 3.3. The MCC shall be free standing, front connected and front wired. The front of the MCC shall have doors supported with chrome plated pintle hinges. The door shall not extend more than 450 mm perpendicular to the MCC face. The door locking shall be designed to prevent opening when subjected to forces caused by an internal fault. Master locking system on all doors.
- 3.4. All openings shall be fitted with a suitable non distorting compressible seal, which shall engage onto the MCC panel's stiffened return surround on one side and the door's rear face within the stiffened return on the other side.
- 3.5. Each section of the MCC shall be supported on the identical 75 mm RHS hot dip galvanized plinth, fully braced and welded, turned outwards.
- 3.6. Gland plates shall be fitted to the top and the bottom of the MCC and at the incoming supply cable entry, this gland plate shall be 3.5 mm thickness aluminum, and all other gland plates shall be made out of the MCC construction material. All gland plates shall be gasketed and bolted.
- 3.7. Wiring diagram pockets shall be provided.

4) **Component Arrangement**

- 4.1. All electrical equipment shall wherever possible be mounted on DIN rails on metal mountings. If equipment has to be attached directly onto the mounting plate, they shall be secured by screws in the pre-tapped holes, self-tapping screws are not permitted.

- 4.2. All wiring shall wherever possible be wired in ducts. Cable ducting shall be so sized and arranged that the total number of cables and wires to be installed in the duct do not exert pressure on the lid or cause deformation of the duct. Signal wiring where possible be segregated from other wiring.
- 4.3. The minimum clearance between panel mounted equipment, cable looms, ducting, terminals and MCC framework or panels shall conform to PEC standards.

5) **Shipping**

- 5.1. The MCC shall be delivered on site in sections not later than 4months. Each section shall be suitably braced and have lifting points so that during a crane lift no distortion will take place. Assembly instruction shall accompany the equipment.

6) **Other**

- 6.1. Identification, test and inspections, drawings, wiring and approvals of MCCs shall agree with the relevant sections within this Specification.
- 6.2. Instrument cubicles shall be separate, the layout shall be approved by ZCWD.
- 6.3. All fields wiring to remote control panels or instrument shall be terminated into a terminal rail, not wired directly to devices.

4.5.4. DISTRIBUTION BOARDS/CONTROL PANELS

1) **Construction**

- 1.1. The enclosure shall be constructed as per section on Low Voltage switchboards.
- 1.2. The door seal shall be of high quality and a pressured catch handle shall be employed.

- 1.3. Exterior cables (power source cables as well as feeding cables) shall be directly connected to the MCCB or isolator. Adequate space for exterior wiring shall be provided.
- 1.4. A permanent connection diagram identifying the feeders shall be provided in holder fitted with a transparent cover inside the door on completion of construction.
- 1.5. Provision for spare space for future expansion shall be provided to accommodate additional load capacity of the STP of up to 6,000 cubic meters per day.
- 1.6. Grounding Bar shall be provided. The sectional area of the neutral bar shall be equal to the sectional area of the phase bar.

4.5.5. **COMPONENTS**

- 1) **General:** All switches shall be of the fault make load break suitably de-rated for their enclosure.
- 2) **Power Switches and Isolators:** Switches are to be rated for ACB. They are to be lockable and have operating indication of 'OFF' and 'ON'. Main cubicle switches shall be rated for at least the same fault level as the bus bars and shall be able to break the full load current or make onto a fault.
- 3) **Circuit Breakers**
 - 3.1. The main incoming terminals of the main switch shall be extended by copper 'take offs'. The unit shall be lockable in the 'service', 'test' and 'isolated' position and when the CB is 'Open/Off'.
 - 3.2. ACB's shall be of the withdrawable type and equipped for manual stored energy operation. They shall have shunt release coils. ACB's shall have at least two normally open and two normally closed spare

auxiliary contacts over and above those required for operation of the scheme as detailed on the drawings.

- 3.3. All main CBs shall have thermal, instantaneous overcurrent and earth fault protection with provision for single phasing, and delayed under voltage if required.
- 3.4. Branch Circuit protective devices shall be molded case circuit breakers providing complete circuit overcurrent protection by having inverse time and instantaneous tripping characteristics.
- 3.5. Circuit breaker for general purpose convenience outlet shall be ELCB type rated at 30mA.
- 3.6. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding alloy. A push-to-trip button on the front of circuit breaker shall be provided local manual means to exercise the trip mechanism.
- 3.7. Each molded case circuit breaker microprocessor-based tripping system shall consist of three current sensors, a trip unit, and a shunt trip.

4) **Feeder Protection Relay**

Protection relays with the following minimum protection:

- Instantaneous overcurrent relay
- Ground fault overcurrent with time delay
- Thermal overload relay
- Load unbalance, phase sequence overcurrent relay

5) **Motor Protection Relay:** Motor protection shall be provided as specified in Soft Starter Section.

6) **Metering.**

- 6.1. Three phase digital incoming metering shall be provided by a power quality meter. Metering shall include Ampere, Voltage, Wattage, Watthour, var (Reactive Volt ampere), VoltAmpere, Hertz, and Power Factor.
- 6.2. Four switch inputs shall be provided which can be programmed for relay activation, counters, logic, reset and alarms. Four output relays shall be provided which can be programmed to activate on alarms, set points, switch inputs, kWh pulse or communications control. These output relays shall also be able to use demand metering values of A, var, W and VA to control load shedding. PLC interface shall be provided via four isolated 4-20 mA outputs programmable from measured parameters.
- 6.3. Local user interface shall include a keypad and display for entering all set points and reading all measured values, and LED indicators for output relays, communication status and alarm status. An RS232 computer interface port shall be located on the front panel.
- 6.4. All metering shall be Solid state digital metering. Metering shall be panel mounted type.
- 6.5. Ammeter and run hour meter shall be provided to all motors.

7) **Pushbuttons**

- 7.1. Pushbuttons shall have a heavy duty oil tight rating, be of the mounting hole type and follow the color coding prescribed by applicable standards.
- 7.2. Pushbuttons should be of oil tight (hose proof) type.
- 7.3. Pushbuttons shall be shrouded to minimize the possibility of accidental operation.
- 7.4. All buttons shall be clearly labelled.

- 8) **Indication:** Indicator lights shall be of similar design as the pushbuttons of mounting hole type, and should also be hose proof. The lights shall be LED type.

9) **Starters**

- 9.1. Each starter is to have isolation, overcurrent and thermal protection, a contractor, control voltage C/B and terminals for output power and control cables.
- 9.2. The power wiring shall be red, white and blue. The minimum size of all power wiring shall be 3.5 mm².
- 9.3. The overcurrent and thermal protection shall be coordinated so that both motor and starter equipment is protected

10) **Thermal Protection**

- 10.1. The setting of the relay or starter will refer to the motor full load current.
- 10.2. Overload elements are required in all three phases. The overload shall be temperature compensated, and have differential single phasing protection.
- 10.3. Thermal overloads shall be fitted with two pairs of electrically separated auxiliary contacts for indication and tripping purposes. (2 x NO., 2 x NC).

11) **Contactors**

- 11.1. Utilization Category to be ACB.
- 11.2. Minimum rated current at duty specified is to be 9 amps.
- 11.3. All contactors shall be double air break with at least one auxiliary contact and provision for adding more.
- 11.4. Reversing contactors shall be incorporated electrically and mechanically interlocking where practical.
- 11.5. Contactors for power factor capacitor shall be provided with on delay relay.

- 12) **Control Relays:** All control relays shall be of the plug in type held by retaining clips. All contacts shall be rated for at least 5 amps. All relays

shall be in sealed enclosures with means for manual operation from the front. An indication to show relay operation is required.

- 13) **DC Power Supplies:** Dc power supplies shall have isolated outputs, have regulation to control the voltage within 0.5 % of the rated value over the full load range. The output ripple shall be within 0.2% peak to peak or less than 0.05% RMS. The output shall be protected against short circuits. The gear plate shall have a perforated steel cover mounted such that the cover can be removed while the unit is alive without the possibility of the cover touching live parts. The input and output terminals shall be of the type described under Terminals and shall be rated for clamping on the outgoing side, two cables each rated for the full current of the power supply. The power supplies shall not exceed the nominal voltage at power up more than 1.5 V.

- 14) **Timers:** All timers shall have electronic timing. They shall be multi voltage and shall accept 12 to 240 volts AC or DC without any wiring or switch changes. They shall be multi-function giving delayed on and true delayed off as selected from a function switch. The time range shall be adjustable between 0.6 seconds and 60 hours. A visible indication shall be given when the timer has timed out. The timer shall have an 11 pin circular plug in base. The output shall be voltage free contacts rate for a minimum of 5 amps inductive.

- 15) **Terminals**
 - 15.1. External wiring shall be terminated at terminal blocks within motor control centers and control panels.

 - 15.2. Terminal shall be of Polyamide spring assisted type or approved equivalent.

 - 15.3. Terminal blocks shall be rail mounted.

 - 15.4. Terminal blocks shall be segregated in groups by barriers of blank space to separate extra low voltage terminals from those of higher voltage. It is preferred that both terminals and cables be colored to

indicate voltages. This will improved safety and make fault finding easier.

- 15.5. No more than 2 wires may be terminated in any tunnel or clamp type terminal.
- 15.6. Approved insulated crimp lugs must be used to terminate multi-strand flexible cables. One cord only in each lug.
- 15.7. The use of plug in type strip terminals is not permitted.

16) Control Circuits

- 16.1. One leg of any coil, solenoid, relay, contactor, lamp or current consuming device, must be connected directly the earth or neutral side of the supply.
- 16.2. Where control circuits are not isolated automatically when the phase supplies are isolated or when multiple source supplies are used then prominent warning signs shall be displayed together with instructions for de-engaging these circuits.
- 16.3. Capacitor shall be properly selected to attain 80% power factor.
- 16.4. Group of motors fed in motor control center shall be provided with capacitor bank with automatic switching of controller for power factor correction.

Standard Type	IEC 831 or Approved Equal Dry type Design
Frequency	60Hz
Degree of protection	IP42
Execution	Indoor
Discharge Resistor	Permanently connected built-in discharge resistors are sized to ensure safe discharge of the capacitor to less than 50V in 1 min. after switch off

Losses 0.5 W/kvar

Max. ambient temperature	+50 °C
Min. ambient temperature	-25 °C

4.5.6. *SOFT STARTERS (SS)*

1) **General**

- 1.1. This section covers the general requirements applicable to the design, manufacture of Soft Starter Drive to provide ramp starting and stopping of AC motor rated as indicated in the drawing and its associated equipment and accessories completely assembled.
- 1.2. The supplier shall also provide technical assistance during the installation and placement in service of the equipment, if requested by the Purchaser.
- 1.3. All equipment shall be designed, built, rated, tested and shall perform in accordance with the latest editions of the applicable standards.
- 1.4. The controller shall provide a Soft start with selectable Kick start and a soft stop option.
- 1.5. The SS shall be selected to provide a successful start of the relevant connected load by being able to provide sufficient current so that the motor is able to develop the level of torque required.
- 1.6. The SS shall be equipped with Capacitor to improve the power factor to 80%.

2) **Operating Conditions**

- 2.1. The SS shall be capable of withstanding any combination of the following environmental conditions in which it must operate without causing electrical/mechanical damage or degradation of performance:

Ambient Temperature	Up to 40°C
Relative Humidity	Up to 90%

- 2.2. The SS shall be equipped with transient protection so that it will not cause damage to power components upon absorbing an electrical transient. By-pass internal run shall be available to prevent excessive heat built up within the enclosure. Motor protection shall not be lost during the by-pass mode.
- 2.3. The SS shall have built in cooling fans so that the ss can be forced air cooled to operate within the above rated environmental conditions. The ss shall be housed in a motor starter panel. Adequate ventilation must be allowed to ensure the internal temperature of the enclosure does not exceed 40 °c.
- 2.4. The SS shall be equipped with Auto/Off/Manual control switch. In the manual mode the SS will be controlled by local stop/start buttons. In the Auto mode the SS will be controlled by remote 2 wire system.
- 2.5. Digital parameter adjustment shall be provided through a built-in keypad. A built-in alphanumeric, backlit LCD display shall be provided for controller set-up, diagnostics, status, and monitoring. Analog potentiometer adjustment is not acceptable.
- 2.6. The SS shall have the following electrical characteristics:

Input Power	Voltage	400 V +/- 10%
	Frequency	60 Hz +/- 2 Hz
Output Power	Voltage	400 V +/- 10%
	Efficiency	99%

3) User Adjustment

- 3.1. The acceleration ramp time shall be adjustable from 0-30 seconds.
- 3.2. The initial torque setting shall be adjustable from 0-90% of locked rotor torque.
- 3.3. Current limit starting shall be adjustable from 50-600% of the motor's full load current.

- 3.4. A selectable kick start feature shall be available to provide a current pulse at 550% of the motor full load current rating. The time period shall be adjustable from 0.0 to 2.0 seconds.

4.5.7. LOW VOLTAGE FREQUENCY DRIVE

- 1) The VFD shall be able to start into a spinning motor. The VFD shall be able to determine the motor speed and resume operation without tripping.
- 2) Harmonics compliance shall be verified with onsite field measurements of both voltage and current harmonic distortion at the drive input terminals with and without the VFDs operating. A recording type Fluke or equivalent harmonic analyzer and total harmonic currents and voltages must utilized.

4.5.8. TRANSFORMERS

- 1) The transformer supplied and installed on site must be compliant with the requirements of the electric utility (ZAMCELCO).
- 2) **Tests:** The transformer which shall be used at the project site must be presented to the electric utility (ZAMCELCO) for testing.

4.5.9. EARTHING

- 1) The installation of copper earthing rods 3.0 meters long and a minimum of 15 mm in diameter with the required number to achieve a ground resistance of 5.0 Ohms or less. The earthing rods shall be arranged, driven into the ground and connected together etc to the manufacturer instructions. The earthing rods shall be connected together and wired to a new main earth bar via suitably sized copper cable(s).
- 2) All metallic conduits, cabinets and equipment shall be properly grounded and bonded by means of copper straps. The conduits of each system shall be grounded by connecting to the metallic water service pipe. All ground connections shall have clean contact surfaces and shall be tinned and seated while bolting. Unless otherwise specified, exposed ground cables shall be installed in conduit and connections made readily accessible for inspection. Connections shall not be made underground or concealed in floors and walls.
- 3) All ground connection shall be clamped and brazed or cad welded.

- 4) The following equipment shall be grounded:
 - Motors;
 - Secondary main distribution panel;
 - Panels;
 - All other equipment as required by the National or Philippine Electrical Code;
 - All grounding type receptacle outlets;
- 5) The resistance of the combined grounding system shall not exceed 5 ohms and shall be in accordance with the standards of the National Electrical Code, Philippine Electrical Code and all governing authorities having jurisdiction;
- 6) All earthing cables shall where possible include for green and yellow pvc sheaths.
- 7) The entire installation shall be free from improper grounds and from short circuits. Insulation and earth loop impedance tests shall be made in the presence of ZCWD. Each panel shall be tested with mains connected to the feeder, branches connected and switches closed, all equipment in place and permanently connected. Each individual power feeders shall be tested with the power equipment connected for proper and intended operation. In no case shall the insulation resistance be less than that allowed by the Regulation for Electrical Equipment of Buildings, failures shall be corrected in a manner satisfactory to ZCWD.
- 8) Above 5.0 kW both ends of each motor winding one to be brought out to the terminal box such that the motor is suitable for Star/Delta starting. Terminal boxes to be of adequate size and shall be easily accessible in the installed position. Cable entry to the terminal box shall be from at least two directions and terminating shall be in suitably robust terminals or studs.

4.5.10. LIGHTING AND SMALL POWER

General area lighting is to be located to allow access for relamping without the use of temporary scaffolding. Suitable means of access are ladders not exceeding 2.1 M in height, mobile work platforms or extension handles and lamp changer heads.

4.5.11. *INSTRUMENTATION AND CONTROLS*

All field sensor types to be approved by ZCWD.

4.5.12. *PROGRAMMABALE CONTROLLERS*

- 1) In cases where the programming is done by the supplier, the supplier shall provide a copy of all working programs on cd as well as a printed program listing.
- 2) The supplier shall have the capability to conduct on-site training programs at a location provided by the end-user.
- 3) Within the enclosure all I/O racks, processor racks, and power supplies shall be grounded to meet the manufacturer's specifications.
- 4) **Wiring and Terminal Identification:** All single cores including individual cores of multicore cable to be identified at each end with approved markers. The only exception to this requirements are short lengths not exceeding 100 mm which are used to connect between C/B's and contactors, or loops from one terminal on terminal strips or contact blocks – provide these short lengths are not loomed up or otherwise covered, one end only be numbered. Cable cores shall be identified at the rail terminals only. All terminals should be clearly marked on outgoing side of terminal and common type circuits shall be grouped logically i.e. power, control etc.

4.1. **MCC/Panel wiring:** At every termination the wire shall have crimped connection. The joining of any wire in the duct is expressly prohibited. All external connections (with the exception of the supply and local sub mains) shall be via terminals mounted on the mounting plate. All terminals shall be grouped in a logical order.

4.2. **Panel and Cubicle Wiring:** Wiring with the panels and cubicles shall be installed in an approved PVC wiring duct and any conductors not installed in these ducts shall be laced with PVC ties and strips in an approved manner. The total cross sectional area of wiring within ducts shall not be greater than 40% of the total cross sectional area of duct.

4.3. All wiring shall be stranded with minimum size of:

- 1.0 mm² for Electronics/Instrumentation signals;
- 1.5 mm² for control
- 2.5 mm² for Power and CT circuits

4.4. All ducts shall be terminated with suitable crimp lugs. No soldered or bare wires shall be used as terminations.

4.5. All wiring shall be rigidly supported and where against metal, protective insulation shall be provided. Wiring between hinged panels and fixed All wiring shall be rigidly supported and where against metal, protective insulation shall be provided. Wiring between hinged panels and fixed.

5) **Cables Identification**

5.1. All circuits are to be uniquely identified by an alphanumerical cable numbers as listed in the cable list, and cable cores shall be identified at the rail terminals only.

5.2. All sheathed cables shall be uniquely identified at each end by means of engraved or embossed labels firmly attached to the cable. For bottom entry this label should be attached just after it enters the enclosure in which it is terminated.

5.3. For top entry this label should be attached just before it enters the enclosures;

5.4. All power, control and instrumentation cabling shall be identified at all terminations by use of a durable type tag and approved by ZCWD.

6) **Item Identification and Equipment Labelling**

6.1. All electrical components shall have all terminals clearly and permanently marked. All items of equipment shall identified by permanent labels giving the item designation;

6.2. All labels shall be in English, engraved black lettering on white background. All necessary warning labels to be engraved on approved material with white letters on a red background;

- 6.3. Characters shall be legible for both the equipment label and electrical component, uppercase print type font, mechanically engraved;
- 6.4. Labels mounted inside electrical enclosures and switchboards may be mounted using approved double-sided adhesive tape, and shall not be attached to removable ducting tops;
- 6.5. Labels mounted outside electrical enclosures to be fixed with at least two screws, rivets or drive parts on the permanent structure to which the component is mounted, adjacent to the component and readily visible from in front of the component. Where ready access is not available in front of a component then additional labelling that is visible from a readily accessible position will be required, e.g. Solenoids, limit switches etc. positioned behind panels, under machinery etc. are to be identified also by labels mounted on external surfaces of the machine.
- 6.6. Instrumentation equipment may be identified by using cable the alphanumeric identification Tag approved by the ZCWD;

4.5.13. INSTALLATION

1) General

- 1.1. All field wiring to motors, control stations sensors and actuators shall be wired using cables. Conduit wire is not accepted. Single wires in conduit will not be accepted.
- 1.2. Connections of series of contacts such as emergency and motor stops, safety switches etc., are not to be looped in the field. All wiring is to be brought back to a common terminal rail. Indication of the device being operated is to be provided both locally to the device and at the approved area control station.

2) Cable Installation

- 2.1. Single core power cables to be clamped in Trefoil Arrangement;
- 2.2. Cables shall be securely braced with cable clamps or ties as required;
- 2.3. Vertical rises of cables shall be secured at intervals no less than 1 meters, to allow for cable expansion;

- 2.4. The arrangement of cables on ladder trays or brackets shall be such that where cables join or leave the ladder or brackets there is not unnecessary crossing or tangling of cables. Where cables are liable to mechanical or environmental damage they shall be protected in a suitable manner;
- 2.5. Where cables pass through fire rated walls or floors a fire barrier or fire rated sealing compound shall be used to seal the space after installation of the cables.
- 2.6. All cables, pipes and conduits shall be buried not less than 600 mm below finished ground level in the center of a 150 mm layer of sand. Underground cables, pipes and conduits shall be effectively protected with yellow PVC cable warning marker tape (or equivalent) covered above the run of services 150mm below the surface.
- 2.7. Cables shall not be cast directly into concrete;
- 2.8. All instrumentation/data cables shall be segregated from power cables by a minimum of 300mm and from control cables by a minimum of 50mm;

3) **Cable Protection**

- 3.1. Cables shall be fully protected from mechanical damage. The protection shall not allow liquids to enter or accumulate within the protection;
 - 3.2. All cables are to be protected where they pass through any openings, gaps, holes, or over edges of metalwork, ladders etc. The contractor shall ensure that surrounding surfaces are smooth and free of sharp edges etc., and that holes are bushed with close fitting plastic bushes;
- 4) **Cable Entrances:** All cable entrances to equipment and buildings shall be vermin proof and shall be firmly sealed to prevent ingress of weather and water.
 - 5) **Cable Glands:** Where cables terminate in cubicles or auxiliary equipment boxes, the cables shall be fitted with suitable cable glands. These cable glands shall grip the cable securely, seal on the outer sheath of cable and

be complete with locknuts. They shall for armored cable include provision for securely bonding the earth.

6) **Cable Terminations**

- 6.1. All terminations shall comply completely with the manufacturer's recommendation instructions.
- 6.2. Cables joints shall be made only in approved junction boxes.
- 6.3. All terminations of field cable cores shall be to individual terminal blocks mounted in a group adjacent to each other.
- 6.4. Connection of power cables shall be with crimp type lugs of the correct size for each size conductor together with electroplated bolts, nuts and lock nuts.
- 6.5. Connection of control and signals cables, except thermocouples, shall be with appropriate crimp pins or lugs.
- 6.6. Adjacent to motors (Aerators), motor cables shall terminate at a local isolator for the motor. The isolator shall be rated to ACB. Cabling between the isolator and the motor terminal box shall be enclosed in flexible conduit.
- 6.7. Cable or core termination shall under no circumstances be under mechanical stress due to lack of support of the cable or vibration.
- 6.8. The connection of cable screens shall fan out from the signals power supply, with the remote ends being insulated from earth. (Star connection) Screens on screened cables shall be insulated or sleeved and brought out as appropriate. Heat shrink sleeving shall then be fitted over the end of cable sheath.
- 6.9. All field sensors with moulded in leads shall be held by compression glands at the terminal boxes. Where leads are subject to mechanical damage, suitable sized loose flexible or rigid conduit shall be fitted over this lead and fixed to support in an appropriate manner.

- 6.10. The Contractor may be required to demonstrate his jointing technique, and, if in the opinion of ZCWD, the termination is faulty, the Contractor shall replace all other terminations so jointed at no extra cost.
- 6.11. Cables, conduits or ducting entering cubicles, junction boxes, motor terminal boxes or like, shall be from the bottom. (Unless otherwise specified or approved by ZCWD).

7) **Cable Support System**

- 7.1. Cable ladder racking, trays and ducting shall have a minimum of 20 percent spare capacity for ventilation.
- 7.2. All fixings to concrete or masonry shall be of the expansion type set in holes. Explosive powder-charged fixings shall not be used.
- 7.3. Fixings to structural steelwork shall be by clamping, not welding or drilling, except with the specific prior approval of the ZCWD.
- 7.4. Cable support systems shall be installed in accordance with the manufacturer recommendations to give a maximum between support deflection of 10 mm when carrying the final number of cables to be installed.
- 7.5. All steel supports, frames, hangers and the like shall be electroplated and in most areas hot dip galvanized.
- 7.6. All exposed threads on support systems, conduit and other places where the galvanizing finish has been removed shall be painted with galvanized paint. Use of spray can type of paints is prohibited.
- 7.7. All lengths of the cable support system shall be bonded to earth.
- 7.8. The Contractor shall submit to the Principal a layout of his proposed method of reticulation throughout the Plant showing positions of all cable ladder, tray or ducting system.

8) **Cable Ladders**

- 8.1. Cable ladders shall be hot dipped galvanized steel with welded rungs. They shall be completed with accessories including hot-dip galvanized hangers, brackets and cable clips.
- 8.2. The contractor shall supply and erect all cable ladders and all brackets and fabricated steelwork necessary to support the cable ladder and shall ensure that they are adequate in all respects for the loading imposed.
- 8.3. All changes in direction shall be made using purpose made slow radius bends and cranks as manufactured for this purpose.
- 8.4. Cable ladders installed outside the building shall be provided with cover.

9) **Cable Trays**

- 9.1. Cable trays shall be hot dipped galvanized steel and securely fixed.
- 9.2. Cable Trays installed outside the building shall be provided with cover.

10) **Conduits**

- 10.1. All exposed conduit, embedded in concrete, conduit in plant room and equipment area where exposed to damage shall be screwed galvanized conduit.
- 10.2. Where steel conduits are used, they shall not be utilized as the earth continuity conductor to plant and equipment.
- 10.3. All steel conduits shall be bonded to earth.
- 10.4. All conduit runs whether above ground or below shall utilize inspection boxes/draw pits at every change in direction or/and every 50 meters, to enable the cables to be routed through the conduits.
- 10.5. Where space allows, every conduit run shall include for a nylon draw rope to aid the pulling in of additional cables at a later date

11) **Flexible Conduit**

- 11.1. PVC coated gray color flexible conduits shall be used for the final connection to removable field apparatus such as motors, RTD probes and the like.
- 11.2. Conduit installed outside shall be stabilized against ultra violet light.
- 11.3. Where mounted on moving parts of machinery or where subject to mechanical damage the conduit shall be flexible PVC covered galvanized steel.
- 11.4. All flexible conduits shall be terminated in purpose built glands.

12) **Cable Junction and Equipment Boxes**

- 12.1. Boxes for equipment requiring more than 300 mm length of terminals shall be fitted with a door;
- 12.2. Reference shall be made to the section on SWITCHBOARDS for details on manufacture, equipment, wiring, labelling etc.;
- 12.3. In wet processing areas boxes shall be made of stainless steel. They shall be mounted at a normal working height with a minimum floor clearance of 300 mm;

4.6. PLUMBING REQUIREMENTS

Plumbing works shall follow the National Plumbing Code of the Philippines.

Sanitary design and construction shall abide by the Code on Sanitation of the Philippines;

TESTING AND DISINFECTION: Testing and disinfection of water pipes shall be in accordance with LWUA-ZCWD standards.

5. COMMISSIONING REQUIREMENTS

5.1. GENERAL REQUIREMENTS

5.1.1. The contractor shall supply all necessary manpower, apparatus and instruments necessary for the commissioning and carrying out of proving and performance testing on the plant. All fees or costs associated with testing, commissioning and proving operation of the facility for the specified period shall be borne by the Contractor. The plan for conducting the commissioning and proving tests shall be submitted to the ZCWD for its approval.

5.1.2. Aside from the in-house laboratory, all laboratory analysis of the final effluent conducted monthly must be analyzed by a third party laboratory duly accredited by the Environmental Management Bureau and submitted to ZCWD. All sampling activities must be conducted in the presence of ZCWD representatives for the whole duration of the commissioning period.

5.1.3. Commissioning shall comprise of a minimum of two (2) stages:

- 1) Testing and pre-commissioning by the Contractor on site of individual equipment and of integral system operation which has a period of 30 days; and
- 2) Final commissioning by the Contractor as directed by ZCWD for equipment and integral system operation in compliance with required standards to the satisfaction of ZCWD. This stage shall cover the trial run for a period of 30 days. During the trial run, weekly sampling must be taken and be tested with a DENR accredited laboratory. All weekly samples must pass all the parameters of the required effluent standards within the 30 day period trial run. If during the trial run, a sample did not comply with the required effluent standards, the same shall be repeated. At this instance, the 30-day period shall recommence. This stage of the commissioning shall only be considered to have been complied if all samples have passed the required effluent standards within the given period. All costs incurred for modification to meet the required effluent shall be to the account of the Contractor.

5.1.4. Commissioning of the project shall be for a total period of ninety (90) calendar days.

5.1.5. Final commissioning shall only be recommended pursuant to the following conditions to the satisfaction of ZCWD:

- 1) Satisfactory rectification of identified defects and missions;

- 2) Equipment and system performs satisfactorily as confirmed by the testing and pre-commissioning records; and
- 3) Operation and maintenance manuals satisfactorily complete.

5.1.6. A pre-requisite to practical completion shall be the completion of final commissioning to the satisfaction of ZCWD.

5.1.7. Prior to acceptance, the winning bidder must be able to expose the end user on the sewage/wastewater system being offered on actual site in any or all of its completed facilities. Expenses for at least five (5) personnel will be to the cost of the contractor.

5.1.8. All drawings shall be submitted in electronic file that may be accessed with CAD format file readable in Autodesk AutoCAD software with a printed copy on size A1 tracing paper.

5.1.9. A fully detailed parts listing including quantities, materials and manufacturer's part numbers (if applicable).

5.1.10. Immediately following successful final works/testing/commissioning, the "As-built" drawings of the STP, including the electrical installations and mechanical facilities should be forwarded to ZCWD incorporating any modifications necessary as a result of the test. It shall forward three (3) white copies, one (1) reproducible copy, and an electronic copy on flash drive, of all documentation and drawings applicable for the installation. It shall also submit three (3) clear copies of test certifications conducted on the various installations.

5.1.11. Each datasheet shall incorporate all relevant data associated with each specific valve which shall include but not be limited to:

- Principal dimensions;
- Any pertinent construction details;
- Materials used for all parts;
- Torque limits;
- Pressure rating;
- Connection detail;

5.1.12. **NAMEPLATES**

A nameplate shall be fitted in a prominent position on each equipment and valves giving the following minimum information:

- Manufacturer's name and address;
- Identification and/serial number;
- Month and year of manufacture;
- Working and Test Pressure;
- The direction of flow in the form of an arrow;
- Speed in rpm for equipment;

5.1.13. Outline of control protocol shall be submitted for electrical components with ratings;

5.1.14. A full set of any special tools required for the operation, maintenance, or repair work on electrical or instrumentation equipment shall be supplied.

5.2. COMMISSIONING WORKS

- 1) The ZCWD shall create a Project Monitoring Unit (PMU) and shall coordinate with the contractor's authorized representative to oversee the testing and commissioning phase;
- 2) Every equipment used for the plant shall undergo testing in order to ensure its conformity with the designed load. Should there be any defects, the same shall be rectified by the contractor at their own cost and within reasonable time which shall be decided upon by ZCWD;
- 3) The Contractor shall guarantee for a period of one (1) year for the failure of any part of the equipment. The Contractor shall replace certain part of the equipment in the event that it has failed to function during the guarantee period. However, if it is found that the failure is due to some other connected parts, the same shall also be rectified or replaced by the contractor to avoid such failure in the future. The guarantee for such replaced parts shall be extended for one (1) year from the date of last replacement;

5.3. OVERALL PERFORMANCE TESTING

5.3.1. The Contractor shall commission all plant and maintain the plant in a satisfactory operating condition for the whole of the commissioning period. After

the completion of the installation and successful preliminary testing by the Contractor, the Contractor shall give ZCWD seven (7) days' notice that the installation is ready for normal performance checking, forwarding a record of final preliminary test figures with the notification. On receipt of the notification, ZCWD PMU will witness repeat tests on the installation together with any additional tests they may be considered necessary to prove that the performance, efficiency and operation of the plant meet the requirements of this specification. The Certification of Practical Completion will only be issued after satisfactory completion of the Testing.

5.3.2. The Contractor shall be responsible for making all the necessary remedial measures within 90 calendar days after the first test period to bring the plant performance efficiency to the specified level at no additional cost to ZCWD; except when the cause of not meeting the specified level of efficiency is when the actual plant loading is more than the specified plant loading duly verified by the Contractor prior to construction. Failure of the Contractor to make the remedial measures shall authorize ZCWD to confiscate the Performance Security or Performance Guarantee bond as the case may be and to retain all monies due to the Contractor without prejudice to ZCWD's right to file a damage suit.

5.3.3. The testing work will include all tests and checks but it shall not be limited to the following:

- 1) Flushing and cleaning of water lines & piping works;
- 2) Testing the effectiveness and workability of electrical lines and water & sewer lines;
- 3) House cleaning of the work area in preparation of hand over to ZCWD;
- 4) Testing of submersible pumps, blowers and other plant equipment; and
- 5) Includes hydraulic testing for water tightness/seepage as per relevant code for all water/wastewater retaining structures;

5.4. MECHANICAL

5.4.1. The Contractor shall prepare detailed test plans and commissioning program for review and approval by ZCWD four (4) weeks prior to practical completion.

5.4.2. The plans shall include installation checks, checks of all safeties, operator variable equipment, performance and duties of all pumps and other mechanical equipment.

5.4.3. A complete list of all standard settings and adjustments necessary to variable plant shall be provided by the Contractor;

5.4.4. Pump Testing and Start-up

- 1) The pump installation shall be tested before commissioning commences. All tests shall be performed in accordance with the manufacturer's instructions;
- 2) Check operation of all valves included with the installation.

5.4.5. Minimum Tests Required

- 1) Pipe work leak test to closed valve conditions
- 2) Demonstrate the removal of the pump-set using the lifting davit, chain and guide rail(s) if pump is centrifugal
- 3) Demonstration of running amps at the duty point;
- 4) Demonstration that the pump performance meets the specified duty;
- 5) Undertake the electrical testing in accordance with electrical specification;

5.4.6. The Contractor shall be responsible for providing all power requirements and special tools required to undertake the aforementioned. Furthermore, if additional instrumentation (portable in nature) is required to undertake the testing described herein then it shall be the responsibility of the Contractor to provide the same. Should any of the above test results (and others undertaken as detailed within the plant manufacturer's instructions) be not compliant to the required standards then rectification of the same shall be required and re-testing be performed until the standards should have been satisfied with the said works. Any costs incurred for required modification works and re-testing shall be to the account of the Contractor. After testing has been undertaken all ancillary items left on site shall be removed and the site tidied. Only after satisfactory inspection of the working area by the ZCWD shall final hand-over be complete.

5.5. ELECTRICAL

5.5.1. The contractor is completely responsible for the satisfactory installation, testing and commissioning to the relevant standard and to the requirements of ZCWD.

5.5.2. ZCWD reserves the right to inspect at any time, the shop drawings, equipment, materials and installation called for in this Specification and on the drawings during manufacture, installation and commissioning.

5.5.3. **Testing**

1) **General:** Tests are to be pre-planned, scheduled, and carried in a safe and efficient manner. Notification will be given at least three (3) days in advance to carrying out any tests of the panels and field wiring so that a representative is able to plan witnessing of each test at the following stages:

- Equipment and cables support mounted within panel/in the field, but not wired;
- Fully wired and ready for test;

2) All test required by Statutory Authorities are to be carried out to prove that the systems operate in accordance with appropriate codes and regulations;

3) Works and field testing shall be witnessed by a company representative or the Engineer and all testing and results shall be recorded. The checklist (record sheets) shall be obtained from the Electrical Engineer;

4) **Field Inspection and Testing**

4.1. All plant provided under this contract shall be available for inspection and testing as required by ZCWD or his inspector, during manufacture. The costs of the tests including the provision of all necessary test equipment at the manufacturer's works shall be deemed included in the Contract Price;

4.2. Prior to starting any test the Contractor is required to check that the installation, electrical devices and instrumentation are strictly in accordance with the Specification, electrical and instrumentation drawings;

4.3. All AC test instruments shall have a minimum accuracy of +0.5%, all DC test instruments shall have a minimum accuracy of +0.1%.

- 4.4. All other test instrument (pneumatic and electronic calibrators, temperature calibrators etc.) shall have a minimum accuracy of +0.1%.
- 4.5. Each test instruments shall be calibrated in accordance with manufacturers' standards. The calibration certificates shall not be more than 3 month old and shall be presented to the Electrical Engineer prior commencing work.
- 4.6. Following completion of works and before the delivery, testing shall be performed by the contractor to ZCWD's satisfaction

5) **MCC and Switchgear Test**

5.1. Test shall include but not limited to:

- Cubicles shall be inspected to ensure that the quality of finish is to standard. The correct apparatus and labeling have been installed and the wiring has been carried out in a neat and correct manner.
- The equipment shall be carefully inspected to ensure that all electrical connections are tight, particular attention should be paid to bus bar connections and all clearances should be adequate.
- All wiring shall be checked against the schematic layout and all control switches relay contacts, timers, etc. checked for correct polarities and mode of operation.
- Operational tests of control, protection, relays and alarms equipment with all items of auxiliary equipment for mounting remote, temporarily wire-in for the tests.
- Where certain control interfaces are not available, simulated signals shall be used to test individual systems.
- Checking phase sequence and voltage levels;
- Sequential operational tests of all control circuits including interlocks;

- Insulation Test (Phase to phase, Phase to neutral and Phase to earth);
 - Checking the individual operation of all motors without load for rotation, bearing lubrication, noise, vibration and temperature rise
 - Recording the operating load current of all motors;
 - Measure and balance full load currents in each phase when the system is fully loaded;
- 6) **Cable Test:** Every cable shall be tested for insulation (Megger), continuity compliance and earth loop impedance. The results of all tests shall be detailed on a signed test certificate prior to submittal for review. The energization of each circuit shall not be allowed until the test certification has been reviewed by ZCWD;
- 7) **Transformer Test**
- 7.1. Transformer test must be done by the ZAMCELCO at the expense of the contractor and secure a positive test result.
- 8) **Instrument Checkout**
- 8.1. Each instrument, including transmitter, shall be identified and compared with the process diagrams to verify its function and operation.
- 8.2. Transmitting instruments containing or provided with protecting walls shall be verified to have compatible components suitable for the service and application intended.
- 8.3. Analytical instruments shall be verified to the service intended. Solutions and/or source elements shall not be installed until instrumentation is ready for re-wire operation in final calibration.
- 8.4. Spare parts furnished with instruments shall be checked, identified and stored with identification tags attached. Spare parts shall not be

used to complete initial installation and start-up without re-ordering to insure complete spare parts complements.

- 8.5. Damaged spare parts shall be returned immediately to vendor with corrective action requested.

9) **Instrument Inspection, Cleaning and Testing**

- 9.1. All instruments must be disconnected from the process piping and vessels during hydrostatic testing of the process lines. Instrument process piping shall be hydrostatically tested together with process piping and vessels.
 - 9.2. All interconnecting wires from panel to field mounted devices shall be tested by "ringing out". Wiring pairs shall be disconnected at the transmitter and the panel terminal blocks, joined in pairs at the transmitter, and tested from the panel termination. Individual leads shall be tested using ground return, or common, to verify continuity and identification.
 - 9.3. If any changes in connections are necessary, wires shall be retag accordingly.
 - 9.4. Signal wire polarities shall be verified by simulation of transmission signals.
 - 9.5. Ground connections and shielding terminations shall be checked against drawings or manufacturer's instructions. All control cable shielding shall be grounded at one end only, with reference at the receiver station (control panel).
 - 9.6. Equipment (case) grounds shall be in accordance with drawings and manufacturer's instructions.
 - 9.7. Indicator scales on all transmitters and receivers shall be checked for correct range and legend. Especially calibrated flow meters shall be verified as to scale range and information data sheets supplied.
- 10) **Calibration:** Electrical instrument calibration shall be performed on an individual instrument or combination of instruments as required completing the measurement or proving the loop functional. Factory

tested elements are not to be calibrated unless it is required for critical service and facility is available. Functional checks shall be performed in a manner to ascertain operational capability.

11) **Calibration Data Sheets:** Calibration data sheets shall be prepared and submitted for file reference for all critical measurements.

12) **Instrument for Environmental Protection**

12.1. Environmental protection shall be provided for all instrument equipment against damage upon receipt, storage and during installation;

12.2. Instruments located outdoors, and subject to severe ambient conditions including moisture and corrosion shall be protected by installation in a weatherproof housing or similar protective enclosure or shield.

12.3. The installation of protective housings, or enclosures shall not inhibit the functioning of the instrument or in any way detracted from the ability to perform routing service as required;

13) **Commissioning**

13.1. The contractor shall provide sufficient skilled staff, during the commissioning phase, to carry out necessary adjustments as they are identified. All settings and adjustments to equipment to be recorded;

13.2. All tests must be witnessed by ZCWD or Company Representative and carried out to ZCWD Representative's satisfaction.

14) **Training**

14.1. The contractor shall provide training as per prepared (specified) training program for the maintenance electricians so that they can efficiently maintain and fault find on the equipment. As the plant works shift the training shall be repeated so all personnel will be trained;

14.2. Commissioning shall not be completed until all training has been provided to ZCWD's satisfaction;

14.3. **System Test:** Each Panel Board shall be tested with the power equipment connected, circuit breakers closed and all load and fixtures permanently connected for their intended operation in the presence of ZCWD.

15) **Performance Test and Equipment Setting**

15.1. It shall be the responsibility of the Contractor to test the entire Electrical System for the proper operation. Setting of all protective relays, pilot devices, and auxiliary system shall conform to the operating requirements of the installation;

15.2. Performance tests shall be undertaken and recorded at the site to validate undertakings given in written warranties and performances levels specified in this Specification.

16) **Electrical Drawings**

16.1. **General**

- All drawings shall be created using AutoCAD;
- Graphical symbols used on drawings shall comply with the symbols contained in the current version of the appropriate standard. (PEC, NEC or IEC);
- Cross-references shall be marked on all schematic diagrams to show where a coil has its contacts and where contacts have their coils. This referencing shall apply to all types of equipment shown on more than one drawing;

16.2. **Drawing Sheets and Scales**

- All drawings shall be on sheet with sizes and borders complying with the "Preferred series of sheets, with filling margins".
- All electrical wiring and circuit diagrams as well as electrical layouts shall be in 24" x 36" size tracing paper;

17) **Post Contract Drawings and Documentations**

17.1. **General**

- The drawings shall be supplied in loose-leaf binders with index to simplify location of a particular drawing.
- No site work, other than standard equipment or controls, will proceed until such drawings or specifications have been reviewed and marked as satisfactory or released for construction.
- Three reproducible copies of the drawings, specifications or documentation shall be shipped with the equipment or immediately after the plant commissioning and personnel training unless otherwise specified.

17.2. **Document List**

- A document list shall be produce to show all documents being supplied under this Contract. This list shall show the document name, document number, paper size, latest revision number and highest sheet number used.

17.3. **Single Line and Block Diagrams**

- These are to describe the process control in simple terms using single line diagrams for instrumentation, controls, protection and control sequence;

17.4. **Plant Layout**

- Drawings shall show the location of all electrical equipment in relation to the plant.

17.5. **Equipment Layout Drawings**

- Cross section and other drawings shall show clearly the location, layout, labeling of the equipment mounted in switchgear, control boxes etc. and the location of cables supporting routing.

17.6. **Schematic Diagram**

- Drawings shall show in schematic form all wiring and electrical equipment supplied under this Contract, together with all other circuitry to which this equipment is interconnected. Any

relevant reference data supplied by the 'Engineer' shall be incorporated. Drawings shall be in Ladder diagram format.

17.7. Connection Diagrams/Termination Diagram

- Connection diagrams shall include all control panel and junction box connection diagrams and also interconnection diagrams.

17.8. Bill of Materials/Parts List

- All apparatus shall be listed in the Bill of Materials showing quantity, description, manufacturer and type, order number, installed location.

17.9. Cable Routing Diagrams or Cabling Lists

- Cable routing block diagram shall be supplied and shall show all cables involved in the contract together with cable identification number, cable type, length and connection positions. Cable lists may also be used.

5.6. FACILITIES AND EQUIPMENT FOR TURN-OVER

5.6.1. The specifications under this section does not preclude the contractor from providing more than what is specified if it sees that the items provided which are not specified herein are incidental and necessary for the smooth operation of the sewage treatment plant and in meeting the effluent requirements set.

5.6.2. The following facilities, equipment and process modules should be included, but not limited, to:

- Intake Structure
- Sludge Acceptance Unit with 15 cu.m./day capacity
- Screens/Bar Screens (coarse and fine screens with washing/dewatering)
- Grit Removal System (with washing and classifying and disposal)
- Oil and Grease Removal System
- Equalization Tank
- Biological Treatment System
- Effluent Disinfection System

- Excess Sludge Treatment System
- Final Effluent Outfall structure
- Support System:
 - ◆ Potable Water Supply System
 - ◆ Drainage System
 - ◆ Service/recycle Water Supply System
 - ◆ Chemical Dosing System (coagulants flocculating aid, acid/alkali)
 - ◆ Odor Control and Ventilation System
 - ◆ Acoustic enclosures/Noise Control
 - ◆ Effluent Pipe Line System
 - ◆ Electrical, Control, Monitoring and Instrumentation System
 - ◆ Generator System
 - ◆ SCADA (Supervisory Control and Data Acquisition)
 - ◆ CCTV/Surveillance Camera
 - ◆ Laboratory and its apparatuses
 - ◆ Personal Protective Equipment (PPE) and other safety devices in the plant
 - ◆ Force main/Sewer pipe connecting the West Pumping Station and the STP

5.6.3. The contractor is not precluded from substituting or omitting facilities, equipment or process modules it finds unnecessary and redundant provided that the substitute or the omitted facility, equipment or process module is necessary to meet the ultimate objective of the facility, equipment or process module substituted or omitted. Furthermore, its quality must not be lower than that standard required for such facility, equipment or process module (i.e. Coarse screens must have an opening of at least 6 mm (0.25 in) or larger and fine screens.

5.6.4. The following are minimum Office equipment for turn-over:

- 5 units office chairs and tables or its equivalent
- 2 units Desktop computers and printer
- 1 set sofa
- Airconditioning unit/facilities

5.6.5. These office equipment must be of standard quality with due consideration to ergonomics.

5.6.6. The following are the minimum Laboratory Equipment/Tools for turn-over:

- Benchtop pH Meter

- BOD Analyzer, 6 Placer
- BOD Incubator
- Waste Water Set up Spectrophotometer
- Laboratory Fume Cupboard
- Oil Free Vacuum Pump for TSS
- Desiccator
- Refrigerator
- Drying Oven
- Analytical Balance
- Oil and Grease Analyzer
- Laboratory Ware

5.6.7. It shall also include such laboratory equipment not mentioned herein but are necessary for the complete analysis of the abovementioned parameters. These laboratory equipments must be compliant with ISO, ASTM, WHO, ISL or other equivalent international standards in the absence of local standards. A certification to such effect must be presented.

5.6.8. There must be a Supply of Reagents **good for one whole year operation** that will be utilised after the Process Proving Period ,including the following at the minimum.

- 1Kit of COD 0-1500 mg/L O₂
- 1 Kit of Ammonia Vario HR Tube Test
- 1 Kit of Nitrate Vario Tube Test
- 1 Kit of Nitrite LR Vario Powder Pack
- 1 Kit of Nitrogen Vario Total HR Tube Test
- 1 Kit of Phosphate Vario Total HR Tube Test
- 1 Kit of Lovibond BOD Reagent (Potassium Hydroxide Solution 45%, 50 ml)
- 1 Kit of Nitrification Inhibitor (N-ATH), 50 ml

5.6.9. The reagents to be supplied/ utilized for this project must be available locally.

5.6.10. These should include such reagents as may be necessary to properly conduct wastewater analysis of the abovementioned parameters.

5.7. TRAINING

5.7.1. The supplier shall provide training program for the end-user designed to teach the end-users in the understanding and application of the programmable controller. The training program shall include training manuals and "hands-on" programming experience on a programmable controller of a type similar to that provided by the supplier.

5.7.2. The Contractor shall provide training as per prepared (specified) training program for the operation and maintenance staff so that they can efficiently maintain and fault find on the equipment.

5.7.3. Commissioning shall not be completed until all training has been provided to ZCWD's satisfaction.

5.7.4. Provide training with all the necessary equipment, manuals, videos, notes, and trained and experienced staff.

5.7.5. Training of ZCWD Staff and the Contractor staff during the commissioning process and during all commissioning and operational testing procedure.

5.7.6. **Demonstrations**

- 1) Prior to final inspection and after all commissioning tests have been completed, the operation of each of the system is to be demonstrated to not less than five (5) persons nominated by ZCWD.
- 2) These demonstrations shall cover all aspects of use, programming and operation of the plant and equipment and of maintenance procedures. They are to relate closely to the Operation and Maintenance Manuals.
- 3) Formal training sessions of a minimum total of 40 hours for each of the following training programs for ZCWD staff should be conducted. These training sessions shall be supported by formal session notes, which are complementary to the Operation and Maintenance Manual covering the following:

- 3.1. Management Skills
- 3.2. Operations Skills for Wastewater Treatment Plant, Pump Stations and all associated equipment
- 3.3. Occupational Health and Safety
- 3.4. Laboratory Skills
- 3.5. Electrical operations and programming

- 4) The Contractor is to allow for a period of up to five working days, which may be taken in two separate sections: the initial demonstrations with follow-up during the Defects Liability Period.

5.8. OPERATION AND MAINTENANCE MANUALS AND LIST OF SPARE PARTS

5.8.1. The contractor shall prepare and submit the Operations and Maintenance Manual for each equipment and for the whole STP.

5.8.2. The contractor shall provide the list of recommended spare parts.

5.8.3. All spare parts must be available locally or there must be equivalent replacement.

5.8.4. The contractor shall also include the Material Safety Data Sheet (MSDS) of all chemicals that will be used for the treatment process, including those that will be used for testing and analysis in the laboratory.

5.8.5. **Operation and Maintenance Manuals**

- 1) The Contractor shall send direct to the ZCWD, three (3) copies of the approved Operations and Maintenance Manuals. These manuals shall be in separate folders and shall provide all information needed for the safe efficient commissioning, operation, adjustment and maintenance of the plant.
- 2) The Contractor shall collate all the information relating to the enclosure(s) and its associated equipment. Two (2) draft copies of each manual shall be supplied prior to the despatch of the enclosure(s).
- 3) Any and all information which are not listed below but are necessary for the complete operation and maintenance of the facility shall be deemed included.
- 4) ***Operation Manual***

4.1. The Operations manual shall include:

- Index and references to enable the user to quickly find the relevant information.

- Electrical drawings which includes the following:
 - * Cover
 - * Index
 - * Single Line Diagram
 - * General Arrangement/Plant layout
 - * Equipment Layout
 - * AC Distribution Diagram
 - * DC Distribution Diagram
 - * Control Wiring Diagram
 - * Termination diagram
 - * Cable Schedule
 - * Parts List

4.2. Equipment manuals for various items necessary for the operator setting up and adjustment of process variables in accordance with the control philosophy.

4.3. A detailed written description of the control philosophy including descriptions of the action to be taken by operators, with respect to operator controlled devices, together with operator adjustable variables.

4.4. The Operation Manual shall provide the Plant Operator with the information required for successful start-up and Shut-Down Procedures, Operation of Manual Interface, Operation of Local Interface, Plant Considerations, Associated Document References.

5) ***Maintenance Manual***

5.1. The Maintenance manual shall include:

- Index and reference to enable the user to quickly find the relevant information;
- Schedule of drawings, showing title, revision, manufacturer's reference and purchaser's reference;
- Plant and parts list giving manufacturers name, address, catalogue number or re-ordering reference, and serial numbers of individual items;
- Setup, calibration, commissioning instructions for all items of plant, including operating characteristics of all protective devices;

- Commissioning data for all settings and tests performed;
- Fault finding and rectification instructions
- Results of all tests before delivery
- Results of all tests on site
- The Maintenance Manual will provide the Maintenance Technician with the information and references for Preventive, Corrective and Condition-Based Maintenance, Associated Documentation References, Preventive Maintenance Procedures, Condition-Based Maintenance Procedures, Corrective Maintenance Procedures and Fault Finding Techniques.
- List of abnormal operating conditions, their cause and remedy
- Recommended routine maintenance procedures
- Recommended list of spares

6) ***Plant Operation and Maintenance Manuals***

- 6.1. The Contractor shall furnish to ZCWD, at least thirty (30) days prior to the commencement of commissioning and testing of the equipment, seven (3) sets of technical manuals for all equipment supplied or installed. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, three ring, loose leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring shall not exceed 63 mm;
- 6.2. The manuals supplied shall cover the complete works and must be relevant to the actual equipment installed. The operation instruction manual shall be comprehensive and sufficiently detailed to ensure that the equipment can be competently and efficiently operated by ZCWD staff after commissioning and testing of the equipment have been completed. The maintenance manual shall be in sufficient detail to enable the overhaul and maintenance of all equipment to be effectively carried out by ZCWD maintenance staff;
- 6.3. All manuals shall be supplied with detailed indices, which will enable any specific item to be quickly and accurately located;
- 6.4. The operating instruction manual shall be prepared separately from the maintenance instruction manual and compiled such that reference to the maintenance instruction manual is not necessary for the implementation of the operating instruction manual;

6.5. Where manufacturer's standard manuals are supplied for any equipment, they shall be those applicable to the equipment installed and the relevant sections shall be clearly marked. Trouble shooting manuals of the manufacturer's equipment should also be furnished for future maintenance purposes;

6.6. Manuals shall include the following:

- A concise description of the equipment and the proposed method of control and operation;
- A detailed description of each piece of equipment complete with performance specification and mode of operation;
- Procedure to be followed for equipment start-up, operation and shut down;
- Procedures to be followed for installation, testing, maintenance and repair
- Fault-finding procedures for all equipment in the form of charts listing "fault", "possible causes", and "remedy".
- Instructions of dismantling, repair, re-assembly and adjustment of all equipment;
- Lubrication chart for all installed equipment, including lubrication schedules, lubricant SAE grade and type, including frequency of required lubrication;
- Complete list of equipment installed showing the manufacturer's name, manufacturer's nearest representative's address, telephone and telex or fax numbers;
- A comprehensive index of manuals supplied by equipment manufacturers, indicating the equipment type, number and manufacturer's name;
- A comprehensive routine maintenance schedule for all the equipment installed;
- Complete details of earthing system installed;
- Sufficient information to enable parts for any piece of equipment to be ordered from the manufacturer;
- Other manuals mentioned in each Section;

6.7. Drawings comprising of:

- General arrangement

- Sectional Arrangement
- Parts list
- Performance curves

5.8.6. All manuals submitted to ZCWD, which do not meet the requirement of this Section, will be returned to the Contractor for improvement and resubmission within fourteen (14) days.

5.8.7. **Tools:** A full set of any special tools required for the operation, maintenance, or repair work on electrical or instrumentation equipment shall be supplied.

5.8.8. **Spares:** A comprehensive set of spares is to be provided to maintain the electrical or instrumentation equipment for a period of not less than 24 months in operation.

5.8.9. **Spare Parts List:** The Contractor shall submit to ZCWD five (5) identical sets of spare parts lists for all equipment supplied or installed. The lists shall be headed by equipment name and numbers indicated in the as-built drawings and shall include the following:

- 1) Current list price of each spare part. It shall be limited to those spare parts which each manufacturer recommends to be maintained by ZCWD in the inventory, and
- 2) The name, address, and telephone numbers of the nearest suppliers of the parts listed;
- 3) The spare parts lists shall be bound in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 63 mm;

5.8.10. **Exemptions:** Where special conditions exist which would make compliance with these Specifications unusually difficult, then details should be submitted in writing to ZCWD, who may grant an exemption. Any such exemption granted shall be obtained in writing from ZCWD by the party seeking the exemption;

5.8.11. **Preferred Equipment:** Any items of equipment offered and not listed under 'Preferred Equipment' must be approved by ZCWD. Any such exemption granted shall be obtained in writing from ZCWD by the party supplying the equipment.

5.8.12. **Location of Equipment:** The location of all electrical equipment shall be such that it will allow both convenient and safe access for service, testing, calibration etc., without the use of temporary staging, ladders, the dismantling of other equipment or the removal of the component itself. No apparatus or terminal block shall be mounted within 250 mm vertically from the internal floor level.

5.8.13. **Minimum Records to be Provided**

- 1) For insulation and continuity testing for all cabling.
- 2) For distribution board and switchboard insulation test.
- 3) For TOL and other equipment settings.
- 4) For Earth Resistance Test.
- 5) For instrument configuration
- 6) Other records and procedures to be followed during testing and commissioning as appropriate for the equipment and/or system;
- 7) Testing and commissioning records shall be kept by the Contractor. Copies of these records shall be forwarded by the Contractor to ZCWD immediately on request. Copies of these records shall be incorporated in the Operations and Maintenance Manual.

6. PROCESS PROVING REQUIREMENTS

6.1. TREATMENT PLANT PERFORMANCE AND EFFLUENT REQUIREMENTS

6.1.1. The winning bidder must design a sewerage treatment plant for a flowrate of 4,000 cubic meters per day of sewage. The STP must be able to treat the present wastewater quality to within or above the acceptable effluent standards set by DENR-EMB for the type of receiving water body (Magay Creek) and which may be reused for beneficial purposes (washing, cleaning, and other general services use).

6.1.2. The winning bidder must conduct their own data gathering needed for the preparation of the design. Sampling and laboratory analysis of wastewater quality to determine design parameters must be made by the winning bidder at any EMB accredited laboratories.

6.1.3. The effluent quality discharged from the STP shall comply with the provisions of DENR Administrative Order No. 2016-08, May 24, 2016 Water Quality Guidelines and General Effluent Standards of 2016 for Class C Freshwater Body.

Parameters	Units	Effluent Limits
Ammonia as NH ₃ -N	Mg/l	0.5
BOD ₅	Mg/l	50
Nitrate as NO ₃ -N	Mg/l	14
Phosphate	Mg/l	1
Surfactants	Mg/l	15
Oil and Grease	Mg/l	5
Fecal Coliforms	MPN/100 ml	400

Table 7 Significant Effluent Quality Parameters for Sewerage (Operation of Sewer Systems or Sewage Treatment Plant Facilities that Collect, Treat and Dispose of Sewage)

- 6.1.4. Notwithstanding the above requirements, this project will require the STP to produce better effluent quality such that the **BOD5 should be 30 mg/l, COD should be 60 mg/l, Fecal Coliform of 200 MPNB/100 ml and Total Coliforms shall be 3,000 MPN/100 ml or better.**
- 6.1.5. The STP must be able to produce treated effluent with quality shall be that which permits water reclamation for beneficial purposes, such as but not limited to, general cleaning and agriculture in accordance with the standards implemented by the Department of Agriculture.
- 6.1.6. The system must be able to efficiently remove pollutants present in the wastewater to meet the above prescribed effluent quality.
- 6.1.7. The main treatment process of the STP shall be an aerated biological treatment system capable of removing carbonaceous BOD of up to 98%. It must be a highly efficient biological treatment unit which may be a stand-alone unit, a combination of two or more biological treatment processes or a hybrid system not limited to aerated biological treatment systems only (such as membrane bioreactor, upflow anaerobic sludge blanket (UASB) or its equivalent).
- 6.1.8. If the chlorination will be used as the method for disinfection, dechlorination of the effluent before final discharge will be necessary.
- 6.1.9. It must have a compact design which can be constructed above the ground within the 2,196.00 square meter area of the MRF compound.
- 6.1.10. The system must be complete in itself in terms of wastewater treatment efficiency but must be simple enough as to require less monitoring in operation. It must be easy to operate and maintain.

6.1.11. The STP which will use a compact aerated biological treatment system or its equivalent shall be designed within the limits of the parameters shown in the table below. Notwithstanding, the Contractor shall assume full responsibility for the appropriateness of all design parameters applied in the project.

6.1.12. Deviation from the minimum design parameters shall not be allowed.

Process Modification	Mean Cell Residence Time, (d)	F/M Ratio	Volumetric loading, (kg BOD ₅ /m ³ , d)	MLSS, (mg/l)	Q _r /Q
Conventional	3-15	0.2-0.4	0.3-0.7	1,000-3,000	0.25-0.75
Complete-mix	3-15	0.2-0.6	0.30-1.6	1,500-4,000	0.25-1.0
High-Rate Modified Aeration	0.2-0.5	1.2-2.0	1.20-2.40	200-1,000	1-1.5
Contact Stabilization	5-10	0.2-0.6	1.0-1.3	(1,000-3,000) ^a (6,000-10,000) ^b	0.5-1.50
Extended Aeration	20-40	0.01-0.1	0.1-0.3	2,000-5,000	0.5-1.50
Oxidation Ditch	15-30	0.04-0.1	0.1-0.3	3,000-5,000	0.75-1.50
Sequencing Batch Reactor (SBR)	10-30	0.04-0.1	0.1-0.3	2,000-5,000 ^c	N/A
MBR (Membrane Bioreactor)	5-20	0.1-0.4 (based on COD)	1.2-3.2* COD	5,000-20,000	N/A

Table 8 Design Parameters for Aerated Biological Processes

Legend:

a = contact unit

Q = secondary influent flow

b = solids stabilization

Q_r = return sludge flow

c = MLSS varies depending on the portion of the operating cycle

N/A = not applicable

F/M = Food to microorganism ration

Note:

The F/M can be expressed in kg BOD₅ applied/kg MLVSS.d or in lb BOD₅ applied /lb MLVSS.d

6.1.13. Secondary clarifiers shall be designed within the limits of the standard design parameters shown below:

Treatment Processes	Overflow Rate (m ³ /m ² .d)		Solid Loading (kg/m ² .h)		Depth (meter)
	Average	Peak	Average	Peak	
Settling following air activated-sludge (excluding extended aeration)	16.3-32.6	40.7-48.8	4-6	10	3.5-6.0
Settling following oxygen activated-sludge	16.3-32.6	40.7-48.8	5-7	10	3.5-6.0
Settling following extended aeration	8.1-16.3	24.4-32.6	1-5	7	3.5-6.0

Table 9 Design Parameters for Secondary Clarifier

6.1.14. Aeration tanks shall be designed within the limits of the standard design parameters shown below.

Design parameters	Aeration by Diffused Air	Mechanical Aeration
Maximum Sidewater Depth, m	7.5	7.5
Freeboard, m	0.30-0.60	1.0-1.5
Length to width ratio *	4:1-5:1	Per to the power rating
Width to depth ratio	1:1-22:1	1:1-2.2:1

Table 10 Design Parameters for Aeration Tanks

* - may be reduced to save cost for completely mixed system

6.1.15. The system designed must be flexible enough to allow future expansions where additional process modules may be necessary to accommodate additional loads, or future modification to upgrade performance efficiency. Where the STP will be designed with a capacity of 4,000 cubic meters per day, it must be expandable to 6,000 cmd.

6.1.16. The system must include a disinfection unit capable of eliminating pathogenic microorganisms in the effluent prior to discharge. It must result to the wastewater being treated with a quality compliant with the standards for re-use under Department of Agriculture Administrative Order No. 26.

6.1.17. It must be operated at minimum chemical addition, aeration and maintenance without compromising compliance to effluent limits.

- 6.1.18. Sludge treatment must be a complete system.
- 6.1.19. Chemical storage for a 20-day cycle must be available. Bundwalls and wash basins shall be provided in the storage room.
- 6.1.20. The contractor shall provide for the chemicals that will be used for the treatment of sewage and sludge. They shall provide the same during the testing period, during the one (1) year process proving period and until one (1) year after the facility has been completely turned over.

6.2. PROCESS PERFORMANCE TEST AND GUARANTEE

- 6.2.1. During the Process Proving Period, aside from the daily analysis of effluent by the in-house laboratory, all laboratory analysis of the final effluent conducted monthly must be analyzed by a third party laboratory duly accredited by the Environmental Management Bureau and submitted to ZCWD. All sampling activities must be conducted in the presence of ZCWD representatives for the whole duration of the process proving period.
- 6.2.2. Prior to acceptance of the STP, the Contractor shall, for ninety (90) consecutive days, demonstrate that the completed STP is capable of treating sewage in compliance with the provisions on Treatment Plant Performance Requirements/Efficiencies at the given initial plant loading and at an operation cost not more than ten percent (10%) of the bidder's quoted operation cost. The process proving period of one (1) year shall start upon passing the 90 days commissioning period.
- 6.2.3. After the commissioning period has been completed and accepted by ZCWD, the 1-year process proving period will commence. During this period, the contractor will operate the STP based on the guaranteed OPEX, which was submitted during the bidding, and should consistently pass the required effluent standard. The contractor therefore will operate the STP only within these periods – the 90-day commissioning period and the 1-year process proving period following commissioning until they have satisfied the requirements.
- 6.2.4. In case the effluent during monthly sampling period failed to pass the required standard and the actual operating cost is higher by ten percent (10%) than the quoted operation cost, the Contractor shall make some modification on the STP. The process /test shall be repeated until the operating cost shall equal the quoted operation cost or within the allowed variance and the effluent

standard has been met from which time the 1 year process proving period shall again be counted. Costs of all modifications shall be to the account of the Contractor.

If after such modification the computed actual annual operation cost during the process proving period (including but not limited to costs of labor, chemicals, electric energy) exceed the quoted operation cost and the given variance, the difference, extrapolated linearly up to 25 years using the average design plant loading and an inflation rate of five percent (5%) per annum and discounted to present value at a discounting rate of 9%, shall be charged to the Contractor's collectibles and to the Performance Bond if the former is not enough.

- 6.2.5. The variance in the OPEX costs will serve as the basis for the computation of the NPD. The Non-Performance Damages(NPD) shall be calculated as follows:

$$\text{NPD} = [\text{Actual OPEX} - \text{Guaranteed OPEX}] \times 10.83$$

These OPEX values represent figures taken during the 1-year proving period. The 10.83 is the computed factor which represents the cost of money over the life of the project – in this case a discount of 9% and over 25 years life of project.

6.3. CONSTRUCTION AND SHOP DRAWINGS

- 6.3.1. The drawings shall show the complete assembly of the plant with all components, equipment and parts, each with an assigned number corresponding to the plant spare parts list. The layout shall also indicate the relative location with respect to the boundary of the lot allocated for the plant.
- 6.3.2. The drawings shall also show construction details for each component, piece of equipment, support structures and access facilities.
- 6.3.3. The construction drawings shall be size A1 and shall show the complete construction and assembly of the plant with all components.

ANNEXES

Memorandum of Agreement with LGU

Reference Design and Drawings

Survey and Mapping

Utility Locations

Geotechnical Investigation Result

Physical and Chemical Analysis of Sewage

Sample Deed of Undertaking

PAG-ASA Climatological Data