SPESIFIKASI

CADANGAN KONTRAK PERKHIDMATAN KERJA-KERJA SERVIS DAN PENYELENGGARAAN SISTEM BEKALAN AIR UNTUK TEMPOH SATU (1) TAHUN DI UiTM CAWANGAN PULAU PINANG.

SCOPE OF WORK

1.0 The Contractor shall inspect and service all machinery and equipment comprising the complete **Water Supply System and Ancillary Equipment** at the above premises **once every three (3) months** except where otherwise instructed by Resident Engineer.

The Contractor **shall also provide** emergency repair during normal working hours and overtime hours if required to do so by the Resident Engineer.

At each such monthly inspection and service of the complete Water Supply System and Ancillary Equipment, the work detailed below must be followed:-

1.1 Pump House.

a) Cut grass inside and outside boundary (1m) and collect into plastic bags for off site disposal for every two (2) Weeks.

b) Clean and clear rubbish, plants, leaf, rubbish in the valve chamber sump.

c) Clear all the rubbish, leafs, dead tree branches and others unwanted materials off site as required.

d) Clean, clear and sweep floors, ceiling walls from spider webs and dust as required.

e) Check and report of any cracks, settlement or leak from roof and walls as required.

f) Check if the fire extinguisher is still valid or expired as required.

g) To make sure the control room and the front gate of the pump house are locked before leaving the site.

1.2 Control Panel Starter Board

a) Inspect and check the routine operation of Control Panel Starter Board and ancillary electrical apparatus for every three (3) months.

i) Check and clean electrical contactors and relays or renew as necessary.
ii) Check and clean all cable.
iii) Check all the electrical component and make it function properly.
iv) Simulate the function of the Control Panel Board.
v) Check the earthing reading.
vi) Clean all the Control Board with special tool.

Motor and Water Pump

a) Inspect and check the routine operation of Motor, Water Pump and ancillary electrical apparatus for every three (3) months.

i) Check all motor and bearings with SPM meter for impending failure and lubricate with grease as necessary.
ii) Check lubrication oil and refill as necessary.
iii) Check the reading of operating temperature.
iv) Check, adjust and lubricate all bearings, bush, mechanical seal, flexible joint, gland and other moving parts as necessary.
v) Check and clean safety valve if necessary.
vi) Check and clean motor insulation.
vii) Check all the electrical component and make it function properly.

1.3 Gate Valve and Check Valve

a) Inspect and check the routine operation of Gate Valve and Check Valve for every three (3) months.

i) Check condition of gate valves and check valves
ii) Report if gate valves and check valves is not operational as necessary.
iii) Lubricate gate valves / tighten bolts / nuts to stop leaks.
iv) Lubricate check valves / tighten bolts / nuts to stop leaks.
v) Report if leak persist for gasket replacement as necessary.
vi) Check and make sure that all gate valve are operational (close and open)
vii) Check and report condition of leak pipes
viii) Tighten bolts and nuts to stop leak at joints as necessary.

1.4 One-Way Flow Altitude Control Valve and Pressure Reducing Valve

a) Inspect and check the routine operation of One-Way Flow Altitude Control Valve and Pressure Reducing Valve for every three (3) months.

i) Check condition of valve.
ii) Lubricate valves / tighten bolts / nuts to stop leaks
iii) Report if leak persist for gasket replacement as necessary.
iv) Check and make sure that valve are operational (close and open)
v) Report if valve is not operational as necessary.

1.5 Water Tank and Reservoir

a) Inspect and check all the water tank and reservoir once a year.

i) Check and report the status of water tank and reservoir.
ii) Check all pipe and check that water flows freely.

iii) Check, service and clean all accessories and make it function properly.
iv) Check, service and clean outside and inside the water tank and reservoir.
v) Check and clean all the water tank and reservoir area.
vi) Inspect, check and submit water quality report.
vii) Test the water on pH level, colour and odour.

2.0 It understood that the Contractor is not required to furnish replacement parts and supplies, not to supply labour to replace worn or broken parts or to repair damage to the equipment due to causes beyond the Contractor's control. Additional material and labour required will be furnished by the Contractor at normal selling prices as quoted in Annex A.

3.0 The maintenance service furnished hereunder shall not include the normal function of starting and stopping the equipment described above which function include the opening and closing of valves, dampers or regulator normally installed to protect the equipment against damages not shall include the defrosting of evaporators.

4.0 Any repair and supplies, deemed necessary and recommended by the Contractor for efficient operation of the installation are to be authorized by the Resident Engineer. Unless these recommendations are accepted and authorization is given to perform this service, the Contractor will no proceed.

5.0 In the event the Contractor is required to make emergency calls occasioned by the improper operation of the equipment or due to damage caused by floods, lightning, fire, elements rebellions, riots, strikes, labour troubles, civil commotion of any kind or due to failure to follow the Contractor's control, the Contractor shall be reimbursed for the expense incurred in making the emergency call in question, in accordance with the current established the emergency call in question, in accordance with the current established rates for performing such services.

6.0 The Contractor shall not be held liable for any loss or damage due to delay in furnishing labour or material caused by reason of strikes or labour troubles affecting his employees who perform the service herein agreed or by unusual delays in procuring supplies or for any other cause beyond his control.

7.0 In addition to the above maintenance checklist, the contractor shall perform the following work **once every twelve months:**

7.1 Inspect the whole system

7.2 Touch up and rusty parts of all equipment with paint anti-corrosion paint depending on its situation.

7.3 Give quotation on further repair work if necessary.

8.0 The Contractor shall supply the following consumable materials as and when required:

8.1 All oils and greases required for lubrication of air blower compressor, fan bearings, motor bearings, pivots and other moving parts.

8.2 All cotton waste soap detergent and other cleaning materials required for cleaning purposes.

8.3 Maintenance log books to be kept in every sewage treatment plants and all relevant equipment as indicated by Resident Engineer.

8.4 Bolt, nut, washers and shims used to fasten panels for switchboards and equipment in service. The cost of these consumable materials shall not be charged for separately by the Contractor, but shall be included in the fixed monthly rate quoted by the Contractor for the service and maintenance of the complete equipment as stated above.

9.0 The Contractor shall repair defects in the complete **Water Supply System and Ancillary Equipment** on the instructions of the Resident Engineer.

10.0 Insurans / EPF and SOCSO will be responsibility of the Contractor.

11.0 All workers and supervisors shall be easily identified in full company uniforms.

12.0 The Contractor is responsible in submitting the monthly quality and attendance report to the Resident Engineer. Failure to comply with this provision shall render the Contractor in breach of his obligation and the Resident Engineer shall have the right to deduct any monies due to Contractor for the numbers of buildings the Contractor has failed to submit the report.

13.0 All the workers must be in permanent employment of the Contractor. The Contractor should employed at least one (1) technical staff who registered with Jabatan Bekalan Air (JBA) for pipe work and Jabatan Bekalan Elektrik & Gas (JBEG) for electrical work.

14.0 The Contractor shall provide each of its staff with security passes approved by the Employer.

15.0 The Contractor will allowed to store his belonging and tools meant for use within UiTM but the Employer bear no responsibility regarding their safety in whatever respect at any time.

16.0 All works, whether general servicing or repair work can only be started when the Resident Engineer or his officers will arrange the supervision to be done by the department concerned should other matters arise simultaneously.

17.0 All defective parts already replaced, must be produced to the Resident Engineer or his officers before further action are taken.

18.0 Commencing and completion of works will only be recognized as done instructions and certifications are recorded in writing.

19.0 The Employer will use the time frame below as guidance to deduct monies due to Contractor, should the Resident Engineer feels that Contractor deliberately delaying works:

19.1	Electrical faults (replacement of fuses, Contactors, carbon brushes, isolators)	4 hours

19.2	Water pipe faults	1 day
19.3	Technical repair on pump, viz. : remachine Shaft, bearing replacement c/w insulation Where applicable.	7 days
19.4	Motor rewinding of all capacities	4 days

Time frame above is effective the time, a written instruction is issued by the Resident Engineer or his officers.

Failure to comply within the time frame above mentioned, a fined will be imposed on the eventual claim of the job concerned and the rate deducted if 15% per no. of day or hour of delay which ever is applicable.

Examption of fine above mentioned can be granted by the Resident Engineer or his officers if enough justification can be produced by the Contractor.

20.0 The Contractor shall be deemed to have visited and examined all the Sewerage Treatment Plant satisfies himself as to the local conditions, accessibility, the full extent and character of the operation, supply and conditions effecting labour and materials, transportation of labour, materials, equipment etc. and the execution of the contract generally as no claim on the ground of want of knowledge in this respect shall be entertained.

21.0 The Contractor shall at all times have in their employment sufficient numbers of competent employer to effectively perform this contract. The Contractor shsll comply only skilled workmen to ensure the proper and efficient execution of the work.

The Resident Engineer shall be at liberty to object to and require the Contractor to remove forth with from the buildings, compounds or any site any person employed by the Contractor, who in the opinion of the Resident Engineer as misbehaved himself / herself or is incompetent or negligent in the proper performance of his / her duties or whose employment is otherwise considered by the Resident Engineer to be undesirable.

Any person do removed from the works shall be replaced as soon as practicable but not later than one wekk by a competent substitute approved by the Resident Engineer.

The Contractor shall, before the commencement of the contract, provide the Resident Engineer with a list of names of the engineering staff employed for the contract.

The Contractor must encourage his staff to behave in the best manner and at all times maintain good relations with the Employer staff.

During the fasting month of Ramadhan, all the staff must fast except those who have the right not to. They must however restrain from eating in the public areas. Anybody found drinking, smoking or breaching these rules shall a removed from site immediately.

22.0 The Contractor may provide his technical staff with uniforms approved by the Resident Engineer.

The Contractor shall endure that his staff are neatly and tidily attired at all times.

All uniforms shall carry the name of the company. No tee-shirts, slippers shall be worn by the staff at any time.

23.0 The Contractor shall supply all the necessary equipment, machines, instruments, tools any materials, for the efficient execution of the work including specialized tools.

The Contractor shall be required to state the brand of products which he intends to use, as in the schedule of rates.

24.0 The Resident Engineer reserves the absolute right to engage other contractors to execute works and/or services which in his opinion are specialized in nature or in which the Contractor has failed to perform in accordance to the specifications. In such an event the Resident Engineer reserves the right to deduct money due to the Contractor as provided for in the contract.

25.0 All water and electricity required for the works shall be provided free of charge. The Contractor shall exercise every effort to prevent the abuse of this privilege and to economize in the use of water and electricity and to ensure that all rules and regulations applicable to the use of same are strictly complied with by his technical staff.

The Contractor must ensure that his staff switch off all lights and turn off taps as soon as their work is completed.

Proper connections must be made to power point accordance in to the prevailing rules and safety precautions. The Contractor shall be made liable for damages to electrical circuits and installations of designated buildings.

26.0 The Contractor shall compensate persons of the Employer against claims for damages attributed to the negligence of the company in the performing their duties.

27.0 For the security reasons, the Contractor shall provide the Resident Engineer with particulars of his staff engaged from time to time i.e.:

27.1 Name
27.2 Address
27.3 Identity Card Number
27.4 Citizenship
27.5 Sex and Age

The Resident Engineer shall have the right to instruct the Contractor to remove any of his employees who in opinion of the Resident Engineer is considered to undesirable of unfit for employment in the buildings or compound for security reasons.

Appropriate security passes as provided by the Employer shall be worn by all technical workers, all the times.

28.0 The Contractor must remove all rubbish arising from the repair work all defective parts replaced must be shown to Resident Engineer or his officers before permission to bring them out is granted.

29.0 The Contractor shall at all times observe and comply with all prevailing laws and regulations relating to safety law and there after in force and shall bear all costs connected with the compliance of same.

The Contractor shall be responsible to take all safety precautions to eliminate danger to his workmen, the general public and property of others.

30.0 The Contractor must immediately notify the Resident Engineer of any damages or accident occuring in their areas of work.

Any claims arising from such accidents, be it affecting person or properties or furniture will be responsibility of the Contractor if such accidents can be ascertained to have caused through the negligence of the Contractor.

31.0 Should the Contractor be found to have committed any irregularities such as using inferior materials and workmanship or creating, nuisance in the buildings to the inconvenience of the Resident Engineer or the public, the Resident Engineer reserves the right to charge the Contractor the cost of making good to any inconvenience caused and for the investigation and administrative expenses incurred by the Resident Engineer.

Thereafter, the irregular works shall be made good to the satisfaction of the Resident Engineer at the Contractor expenses.

32.0 Servicing and the maintenance as herein provided shall be furnished by the Contractor from …… to …… inclusive for the sum Ringgit Malaysia …… …… (RM: ……) per two yers, which sum shall be paid every one (1) month after inspection and service have been performed and a report there on has been submitted to the Resident Engineer.

33.0 This contract shall remain effective until …… Unless terminated by either party giving one (1) month notice to the other.

The Contractor shall provided a service and maintenance record book for the complete Water Supply System and ancillary equipment being serviced and maintained by him.

The Contractor shall also keep an aaccurate detailed record in duplicate of all service, maintenance and repair work carried out by him on the complete Water Supply System and accillary equipment. This record shall be in the form of a maintenance/repair sheet and shall countersigned by a responsible Employer officer where the plant is located each time the plant is serviced. This record shall be forwarded to the Resident Engineer together with the bill.

In addition a full report of the maintenance carried out and the condition of the plant should be forwarded to the Resident Engineer every month.

34.0 The team Resident Engineer (or the initials ‘RE’) shall be deemed to include any person or persons who may be deputed by the Resident Engineer to act on his behalf.

35.0 This contract should not be sub-let either wholly or in part without the written permission of the Resident Engineer.

36.0 Injury to persons – The Contractor shall indemnify government in respect of any liability, loss, claim for proceedings whatsoever whether arising at common law or by the statue in respect of personal injuries to or death of any person whatsoever arising out of or in the course of caused by the execution of the works unless due to any act or neglect of government or its servants.

Injury to property – The Contractor shall be liable for and shall indemnify government in respect of any liability, loss, claim or proceedings and of any injury or damage whatsoever arising out of or in the cause of or by reason the execution of the works to any immovable or movable property due to any negligence, omission or default of himself, his agent or his servants or any authorized sub-contractor or to any circumstances within his control.

37.0 Default – If the Contractor shall make default in any of the following respects, namely :-

37.1 Without reasonable cause suspends the service maintenance required hereunder;

37.2 Fail to proceed with the service and maintenance with reasonable delinquency, if any such default shall continue for 14 days after a notice sent by registered post to the Contractor form the Resident Engineer, the Resident Engineer may there upon by notice send by the registered post determine this contract.

Bankruptcy or Assignment – If the Contractor commits an act of bankruptcy or becomes insolvent or compounds with or makes any assignment of the benefits of his creditors the Resident Engineer may be a notice sent by registered post determine this contract.

38.0 The proper Stamp Duty, if any, on this contract will be done by Contractor.

39.0 The Contractor shall furnish servicing and maintenance as herein provided on the Water Supply System located at as attached

……

40.0 To provide sufficient Two (2) manpower (Full Time) to be stationed in order to carry out the above mentioned works to monitor such that all systems are always in good working condition through at the contract period and shall consist of the following:

41.0 Provide one foreman and two skill workers to stationed in UiTM all the time during normal working hours.The contractor shall also provide qualified skill workers for 'stand by' (without any claim on that Extra working hours) during special functioning or emergency at UiTM if required to do so by the Resident Engineer.
Note : During Contract Period.

SPESIFIKASI

CADANGAN KONTRAK PERKHIDMATAN KERJA-KERJA SERVIS DAN PENYELENGGARAAN SISTEM BEKALAN AIR UNTUK TEMPOH SATU (1) TAHUN DI UNIVERSITI TEKNOLOGI MARA (UiTM) CAWANGAN PULAU PINANG.

JADUAL SERVIS DAN PENYELENGGARAAN

1. PAM

Bil.	Keterangan Kerja	Setiap Tiga (3) Bulan	Tahunan
1.	Periksa dan servis gegalas pam	x	
2.	Periksa dan servis kedap (seal) mekanikal	x	
3.	Periksa dan servis aci (shaft) pam	x	
4.	Periksa dan servis perumah (housing) pam	x	
5.	Periksa dan servis 'gland packing'	x	
6.	Periksa dan service getah 'coupling' dan penjajarannya	x	
7.	Periksa dan servis tapak asas (base plate)	x	
8.	Periksa dan servis 'plinth' pam	x	
9.	Periksa dan servis tolok tekanan (pressure gauge)	x	
10.	Periksa bacaan suhu dan bunyi semasa pam operasi	x	
11.	Periksa dan servis minyak dan gris, tambah jika perlu	x	
12.	Periksa dan ketatkan semua skru, bolt dan nut	x	
13.	Periksa dan cuci penapis air (strainer)	x	
14.	Lakukan ujian gegaran (Vibration Test)		x
15.	Kerja-kerja mengecat pam, paip dan aksessori		x

2. MOTOR

Bil.	Keterangan Kerja	Setiap Tiga (3) Bulan	Tahunan
1.	Periksa dan servis gegalas motor	x	
2.	Periksa dan servis penebat pendawaian fasa motor	x	
3.	Periksa dan servis aci (shaft) motor dan penjajarannya	x	
4.	Periksa dan servis perumah (housing) motor	x	
5.	Periksa bacaan suhu dan bunyi semasa motor beroperasi	x	
6.	Periksa dan pastikan motor mencapai kuasa maksima dalam tempoh 30 saat selepas dihidupkan	x	
7.	Kerja-kerja mengecat motor dan aksessori		x

3. INJAP DAN TOLOK

Bil.	Keterangan Kerja	Setiap Tiga (3) Bulan	Tahunan
1.	Periksa dan servis injap pepintu (gate valve)	x	
2.	Periksa dan servis injap sehala (check valve)	x	
3.	Periksa 'flexible rubber coupling'	x	
4.	Periksa dan servis injap ampung bebola (Float ball valve)	x	
5.	Periksa dan servis tolok tekanan (pressure gauge)	x	
6.	Periksa dan servis 'one-way flow altitude control valve'	x	
7.	Periksa dan servis 'surge anticipating relief valve'	x	
8.	Sapukan minyak / gris pada alatan atau injap yang diperlukan	x	
9.	Periksa dan servis kesemua skru, bolt dan nut	x	
10.	Kerja-kerja mengecat valve		x

4. PANEL KAWALAN (SWITCHBOARD)

Bil.	Keterangan Kerja	Setiap Tiga (3) Bulan	Tahunan
1.	Periksa dan servis Isolator on / off	x	
2.	Periksa dan servis push button / start / stop	x	
3.	Periksa dan servis Amp. Dan volt meter, coil transformer dan lampu penunjuk	x	
4.	Periksa dan servis pam boleh berfungsi secara manual	x	
5.	Periksa dan servis pam boleh berfungsi secara automatik	x	
6.	Periksa dan servis 'overload relay'	x	
7.	Periksa dan servis 'auto control relay'	x	
8.	Periksa dan servis 'auto transformer'	x	
9.	Periksa dan servis fius kuasa dan fius kawalan	x	
10.	Periksa dan servis 'selector switch'	x	
11.	Periksa dan servis 'timer relay'	x	
12.	Periksa dan servis 'contactor'	x	
13.	Periksa dan servis sistem automatik kawalan aras air	x	
14.	Periksa dan servis sistem automatik pam berfungsi seperti pelarasan sedia ada	x	
15.	Periksa dan servis semua sambungan, terminal dan pendawaian berada di dalam keadaan yang baik.	x	
16.	Lakukan ujian beban penuh (Full Load Test)		x

5. PAIP

Bil.	Keterangan Kerja	Setiap Tiga (3) Bulan	Tahunan
1.	Periksa kebocoran pada semua sambungan	x	
2.	Periksa dan servis saluran buangan air (drain pipe) dari tersumbat	x	
3.	Periksa keadaan fizikal paip dan jika perlu dicat atau diganti baru	x	
4.	Cuci (Flush) paip-paip di dalam sistem	x	

6. RUMAH PAM

Bil.	Keterangan Kerja	Setiap Tiga (3) Bulan	Tahunan
1.	Sapu dan bersihkan kawasan dalam dan luar rumah pam	x	
2.	Pastikan tiada air yang bertakung di dalam rumah pam	x	
3.	Pastikan pintu rumah pam berfungsi (ditutup dan dikunci)	x	
4.	Pastikan system lampu di dalam rumah pam berfungsi	x	
5.	Pastikan system pengudaraan (ventilation) berfungsi dengan baik	x	
6.	Pastikan bahagian dalam rumah pam dicat semula		x

7. KAWASAN

Bil.	Keterangan Kerja	Setiap Dua (2) Minggu	Tahunan
1.	Memotong rumput di sekitar kawasan rumah pam dan satu (1) meter daripada pagar rumah pam	x	
2.	Membersihkan sampah, daun kering dan tumbuhan yang menjalar di sekitar kawasan rumah pam	x	

8. TANGKI AIR (SEDUTAN & BEKALAN)

Bil.	Keterangan Kerja	Tahunan
1.	Periksa keadaan tangki dari kebocoran dan kekaratan	x
2.	Periksa keadaan tiang sesokong tangki dari kekaratan	x
3.	Periksa keadaan getah 'lining' tangki dari kebocoran	x
4.	Periksa keadaan aksessori tangki dalam keadaan baik	x
5.	Periksa keadaan semua injap tangki dalam keadaan baik	x
6.	Periksa keadaan penutup tangki air	x
7.	Periksa dan cuci penapis air (strainer)	x
8.	Cuci dan bersihkan dalam dan luar tangki	x

9. TANGKI AIR UTAMA (SEDUTAN & RESERVOIR)

Bil.	Keterangan Kerja	Tahunan
1.	Periksa keadaan reservoir dari kebocoran	x
2.	Periksa dan pastikan struktur binaan reservoir berada dalam keadaan baik	x
3.	Periksa dan pastikan penunjuk paras air berfungsi	x
4.	Periksa keadaan aksessori reservoir dalam keadaan baik	x
5.	Periksa keadaan semua injap reservoir dalam keadaan baik	x
6.	Periksa dan cuci penapis air (strainer)	x
7.	Cuci dan bersihkan dalam dan luar reservoir	x
8.	Menyediakan laporan kualiti air (pH, warna & bau)	x

TECHNICAL SPECIFICATION FOR WATER SUPPLY SYSTEM

SPESIFIKASI

TECHNICAL SPECIFICATION

1.0 PIPING DETAILS

Galvanised Iron Pipes

Piping shall be galvanized wrought steel to B.S. 1387 – 1957 Class 'C' screwed and socket. Pipes of 100mm (4") dia. and above shall have flange connections to B.S. 10 and for less than 100mm (4") dia. pipe shall be screwed and socket.

All pipe fittings shall be malleable iron or galvanized wrought iron and steam quality, long radius and conform to the following standards:-

a) B.S. 143 malleable cast iron pipe fittings.

b) B.S. 1256 malleable cast iron and cast copper alloy pipe fittings.

c) B.S. 1740 wrought pipe fittings iron and steel (screwed BSP thread)

All flanges fittings shall be factory welded and no welding shall be carried out at the site. All flange connections shall have their mating faces machined to a true surface square with the center line pipe axis +/- 3 degrees deflection from the cross-sectional axis of the pipe. Suitable gaskets shall be provided for leak proof connections.

All tubing shall be cut with pipe cutters, accurately to dimensions determined on site and worked into position without springing or forcing. Pipe thread shall be cut with threaded dies and ends reamed before assembly. All screwed and socket pipe joints shall be made using Teflon or an approved propriety jointing compound and fire hemp. Any threaded tubing exposed after jointing shall be pinted to prevent corrosion.

The Contractor shall ensure that all joints are tight and rip-proof. Pipe sleeves shall be provided where pipes pierce through floors, ceiling or walls.

Pipes run underground shall be laid at least 900mm (36") below the surface and adequate provision for protection against vehicle movements and corrosion shall be taken. The buried pipe work shall be primed with one coat of Denso paste. Denso tapes of 150mm (6'0 width shall then be used to wrap spirally round the pipe work with 75mm (3") overlap. After the wrapping, the insulated pipe shall be carefully laid on a sand bed completely free of stones, backfill with sand around and over the pipe to a minimum depth of 75mm (3"). The next layer of backfill shall then be 300mm (12") deep of material free of stones, etc. the trench shall then be filled with available material.

All excavation, backfill of underground pipe work shall be done by the Contractor. The work shall be supervised for aligment, levels and protection to the piping.

Piping shall be installed in accordance with good commercial practice. Care should be taken to avoid possible restrictions due to foreign matter, faulty fabrication or improper insulation.

Pipe Work, Accessories and Fittings

a) Vibration isolators shall be of wire and fibre moulded high pressure rubber type. The flange shall be integral with the fittings and shall be clamped in place using split steel flanges for sizes 50mm (2") dia. and above. For sized below 50mm (2") dia., a similar hose shall be used except that hose clips sealed with mastic shall be used for connection.

b) Stainers shall be "Y or angle type of bronze body constructed and fitted with perforated monel metal screens. Screens shall be 60 mesh. Strainers shall be installed with easy access for maintenance and clearing and screens be easily removable.

c) Pressure gauges shall be minimum 100mm (4") dia. dial face type and having ranges suitable for the service pressure encountered. Pressure gauges shall be supplied and fitted at the discharge side of each pump. They shall be designed for pipe mounting and be calibrated in bar. All pressure gauges shall be of the Bourdon tube and complete with a red pre-setting indicator. All pressure gauges shall be provided with suitable gauge cocks.

d) All valves, etc. shall be suitable for the working and the test pressure of the system concerned. Valve flanges shall be in accordance with B.S. Tables as specified for their respective service pipe work.

Valve spindles shall be adequately lubricated with graphite and all glands shall be freshly packed before installation.

All valves, etc. for the cold water supply services installation shall be comply and approved by the Local Authorities.

All valves over 50mm (2") dia. shall be have flanged ends. Valves up to and including 50mm (2") dia. may have screwed ends shall not used where the working pressure exceeds 8.62 bar (125 p.s.i.). All flanges shall be drilled to B.S. 10.

Gate valves up to and including 50mm (2") dia. shall be screwed end, bronze or brass body, broze inside screw spindle integral seats and bronze or brass valves. For sizes above and including 50mm (2") dia. shall be resilient seat type and flanged ends, ductile iron body and ductile iron gate is totally vulcanised with EPDM rubber internally and externally. All bolts are counter sunk and close with hot melt. Stainless steel stem with 12mm thread lead compliance to BS 5163 type B to maintain good load distribution so easy operation.

Check valves shall be non-slamming type. These shall be of gun metal with screwed connection for sizes up to and including 50mm (2") dia. For sizes above 50mm (2") dia. shall be flanged cast steel type with bronze disc. All check valve above 50mm (2") dia. shall be of the butterfly type.

The Contractor is required to select these valves in relation to the velocity of the water in the pipe. In all cases the valve is required to operate silently on reversal of

water flow and the valves of the double or articulate clack type or spring assisted type shall be fitted.

2.0 PUMPSET DETAILS

VARIABLE SPEED HYDRO BOOSTER SET

The Contractor shall furnish and install fully packaged Variable Speed Hydro Booster set capable of providing constant pressure head at the required capacity automatically, the specified system requirement Igpm and ft Head operation.

The Contractor shall supply equal numbers of variable frequency drive (VFD) for each of pump set supplied. VFD units must be protected against external environment by installing in the electrical control panel, mounted together with the pump controller unit. The design shall incorporate microprocessor pump controller unit capable of maintaining constant water pressure at the discharge pipeline by varying the pump speed.

The Hydro Booster system shall consist of two (2) units Stainless Steel Vertical Multi Stage in line Centrifugal pump coupled in parallel with standard fitted TEFC 2 pole 3/50/415V motor. Hydro Booster set shall generally incorporated with Electronic Pump Controller cabinet, frequency inverters, a diaphragm tank, pressure transmitter, flow switches and common suction/discharge manifolds with isolating and non-return valves mounted common base frame. Pump-motor units and Electronic Controller unit shall be the same manufacturer to ensure system compatibility. Each pump provided must incorporate with individual frequency converter drive unit to ensure constant pressure head operating conditions to minimize system pressure fluctuations. All Hydro Booster system is fsctory assembled and tested, pre-set according to UiTM engineer requirement. The system should ready to connect at site.

System Description

The pumping system shall be capable of delivering set constant pressure according to the system demand pattern. The constant system pressure shall be maintain by variable speed drive control by micro-computer controller designed to ensure smooth operating conditions of pump set to meet system flow requirement. A pressure transmitter shall detect the pressure at the delivery manifold and providing the necessary feedback signals to the electronic controller built integrally in the electrical panal. The electronic pump controller unit shall command the performance of various pump units to continuously maintaining the set pressure head as determined.

a) Pressure Input

A pressure sensor shall be mounted at the discharge manifold with output value of 4 – 20 mA.

b) Controller and electrical panel

The controller shall be capable of the following functions: operation, display, faults, reading, control and monitoring of set operating condition.

Main components mounted on the electrical control panel are VFD units (each pump), micro-processor pump controller, MCB, main control CPU board, electric leakage relay and other electrical items suitable for the control and monitoring of

variable speed pump system. The controller shall be capable to suit with any Building Automation System (BAS) software.
The controller shall display the following items:

- Discharge pressure (digital display)
- Pump operating ampere (digital display)
- Voltage (digital display)
- Pump operating frequency (digital display)
- Operating condition (running pump)
- Operating mode (Auto or manual)
- System interlock
- Failure display for low discharge pressure, inverter trip, shortage/full storage tank.

The controller shall also enable the pump to automatically change over to next pump in the event that if one pump fail. Also if pump failed or inverter failure, another pump will start automatically and back-up operation to ensure uninterrupted water supply.

To controller shall provide protection and display for the following faults:

- Low discharge pressure
- VFD fault or Inverter trip
- Shortage/full storage tank

To ensure smooth operating conditions and compatibility, controller unit must be manufactured by the same pump manufacturer by the same pump manufacturer and offers the necessary warranty, parts replacement and after-sales service.

Pump and Motor

The pump shall be centrifugal type, with major components such as pump casing, impeller and pump shaft made of stainless steel. Sealing shall be mechanical shaft sealing. The pump impeller and shaft shall be dynamics balanced to provide quiet and vibration-free operation.

The motor shall be foot mounted and coupled to pump without the risk of misalignment. Aluminium motor frame shall be used. The motor shall be the standard total enclosed fan cooled squirrel cage type with protection class of IP 55 suitable for 3/50/415V operation.

Pump controller shall be manufactured by similar pump manufacturer to ensure system compatibility and optimal system operations.

The packaged Hydro Booster unit shall be tested and assembled by a single pump manufacturer and provided with a Certificate of Authenticity to ensure genuine used of electronic/electrical components and availability of service parts.

Base frame & Common Pipe work

Galvanized pipe work enable easy connection to all commonly used pipe fittings. The pipe work is sized suitable for maximum hydraulic unit capacity. Check valve and suitable gate valves are fitted for optimal system operation.

Diaphragm Pressure Tank

A pre-charged diaphragm tank is fitted to the discharge pipe with a compatible Butyl-rubber diaphragm. Generally this tank serves basis functions of supplying water at a very low flow and minimising effect of water hammering.

Pressure Transmitter

1 – 5V to transmit control signals to the Hydro Booster Controller, located at the discharge side.

Frequency Converter

Constant water pressure is achieved due to variable speed drive make possible by the use of frequency converters. To ensure highly reliable system, each pump is equip with frequency converter unit, thus ensure optimal operation of pumping system.

Flow Switch

Flow switch is used to enhance system operation by receiving signal to cut-out pump operation during low-flow or no-flow condition. Thus can be used as dry running protection device.

3.0 ELECTRICAL DETAILS.

This section of the specification covers the electrical equipment and services necessary for the efficient, safe and satisfactory operation of the various plant detailed elsewhere in the specifications, including:-

All motors, starters and isolating switches and fuse switches.

All pumping plant switchboards, control panel with fuse switches, isolators, remote push buttons, selector switches, indicator light, etc.

All control equipment, control and power wiring and associated conduit work unless otherwise stated.

The whole of the work shall be carried out in accordance with this specification, the regulations of local electricity supply authorities and such further instructions as may be given during the progress of work and to the satisfaction of the Engineer.

Cable Tray

Cable trays where required shall be of the perforated type and constructed of not less than 15 gauge galvanized mild steels supported at maximum 2 meters interval by mild steel hangers fixed to the walls, floors or ceiling in an approved manner.

The hangers shall be painted with a primer and two coats of approved colour.

Pumping Plants Switchboard

The pumping plant switchboard shall be of the self contained, metal clad cubicle type with flush hinged doors for front access. Doors shall be provided with car type lockable handles. The switchboard shall be suitable for wall mounting.

The switchboard shall be built up from completely enclosed units housing isolating switches, indicating lamps, motor starter, meters, sealing glands, relay and other necessary items of equipment whether specified hereinafter or not, suitable either for indoor or outdoor service, in an ambient temperature of of up to C with 100% R.H. at maximum temperature permitted by the relevant a.s. specification to which reference is made herein for operation on a 415/240 volt, 3 phase 50 cycles per second system operating with solidly earthed neutral.

Special attention shall be given to insulation and finish of all items and no linseed oil varnish, fibre or hygroscopic material shall be used in any position and all components shall have a tropical finish including electrotinning of non-ferrous parts and Vacuum impregnation of operating coils.

All items of equipment of similar design and deminsions shall be, wherever possible made to jig and be fully interchangeable with each other and care shall be taken to ensure that all parts fit accurately. The switchboard shall be factory assembled and tested before delivery to site.

The cubicles framework shall be fabricated from rolled steel angle sections and shall be self supporting when assembled. The cubicle roof, side panels and doors shall be of not less than No. 14 s.w.g. sheet steel with turned edges to the fronts panels and so formed as to provide a clean flush and neat appearance and rigid construction with welded cross-struts.

Excavation, Reinstatement and Laying of Cables

When cable trenches are opened, all cables shall be laid and the tranches shall be backfilled within 24 hours. At all times safety precautions shall be taken and arrangements made to prevent damage to cables.

The excavation shall be kept free of water and properly stored up. Other services uncovered shall be adequately supported by slings or other means and protected.

The front, top and back of all cubicle shall be finished as specified with and plates and heads of any external fixing bolts or set screw similarly finished except those steel parts normally left bright which shall be cadmium plated and operating parts finished semi-gloss black.

The exterior of each cubical shall be of matt white finish and shall be dust, insect and vermin proof. The exterior of each of equipment shall be clearly marked to show the

phases and to this end coloured plastic discs screwed to fixed components or identification by means of coloured PVC sleaving shall be employed. Plastic tape will not be permitted.

Wire and Cables

All cables shall be confirm to the appropriate Institution of Electrical Engineer Standards and to cable Manufacturers Association Insulation Standards for operation at 250 volts to earth, 415 volts phase to phase. The insulation for cables run in conduit or trunking shall be at operating temperature.

Cables shall be 98% conductivity copper and shall be large enough to be protected by the fuses or circuit breaker ahead of time. Conductors for motor circuit shall be sized in accordance with regulation.

Every connection at a cable termination shall be made by means of a terminal, soldering socket or compression type socket, shall securely contain and anchor all the wires of the conductor and shall not impose any appreciable mechanical strain on the terminal or socket.

Cable carrying different potential shall be not be run the same conduit or boxes without barriers.

Cable colour shall be comply with the regulations.

No cable used shall be of smaller size than 31.036.

Current-carrying capacities and associated voltage drops for twin and multicore armoured p.v.c.- insulated cables (copper conductors)

Coductor cross-sectional area	Installation method E, F and G (Clipped direct)				Installation method K (Defined conditions)			
	One twin cable single phase a.c. or d.c.		One three or four core cable three phase		One twin cable single phase a.c. or d.c.		One three or four core cable three phase	
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre
mm²	A	mV	A	mV	A	mV	A	mV
1.5	20	29	18	25	-	-	-	-
2.5	29	18	24	16	-	-	-	-
4	37	12	31	9.6	-	-	-	-
6	48	7.4	41	6.3	50	7.3	42	6.3
10	66	4.3	56	3.8	69	4.3	58	3.8
16	86	2.7	73	2.3	90	2.7	77	2.3
25	115	1.8	97	1.6	121	1.8	102	1.6
35	142	1.3	119	1.1	149	1.3	125	1.1
50	168	0.92	147	0.81	180	0.92	155	0.81
		a.c d.c				a.c d.c		
70	209	0.65 0.64	180	0.57	220	0.65 0.64	190	0.57
95	257	0.48 0.46	219	0.42	270	0.48 0.46	230	0.42
120	295	0.40 0.36	257	0.34	310	0.40 0.36	270	0.34
150	337	0.32 0.25	295	0.29	355	0.32 0.25	310	0.29
185	390	0.29 0.23	333	0.24	410	0.29 0.23	350	0.24
240	461	0.25 0.18	399	0.20	485	0.24 0.18	420	0.20
300	523	0.23 0.14	451	0.18	550	0.23 0.14	475	0.18
400	589	0.22 0.11	523	0.17	620	0.22 0.11	550	0.17

Current-carrying capacities and associated voltage drops for twin and multicore armoured p.v.c.- insulated cables (copper conductors)

Conductor cross-sectional area	Installation method A to C (Enclosed)				Installation method E to H (Clipped direct)				Installation method K (Defined condition)			
	One twin cable, with or without protective conductor, single phase a.c. or d.c.		One three-core cable, with or without protective conductor, or one four-core cable three-phase		One twin cable, with or without protective conductor, single-phase a.c. or d.c.		One three-core cable, with or without protective conductor, or one four-core cable three-phase		One twin cable, with or without protective conductor, single-phase a.c. or d.c.		One three-core cable, with or without protective conductor, or one four-core cable three-phase	
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre
mm²	A	mV	A	mV	A	mV	A	mV	A	mV	A	mV
1.0	14	42	12	37	16	42	13	37	-	-	-	-
1.5	18	28	16	24	20	28	17	24	-	-	-	-
2.5	24	17	21	15	28	17	24	15	-	-	-	-
4	32	11	29	9.2	36	11	32	9.2	-	-	-	-
6	40	7.1	36	6.2	46	7.1	40	6.2	-	-	-	-
10	53	4.2	49	3.7	64	4.2	54	3.7	-	-	-	-
16	70	2.7	62	2.3	85	2.7	71	2.3	-	-	-	-
25	79	1.8	70	1.6	108	1.8	90	1.6	114	1.8	95	1.6
35	98	1.3	86	1.1	132	1.3	115	1.1	139	1.3	122	1.1
50	-	-	-	-	163	0.92	140	0.81	172	0.92	148	0.81
						a.c d.c				a.c d.c		
70	-	-	-	-	207	0.65 0.64	176	0.57	218	0.65 0.64	186	0.57
95	-	-	-	-	251	0.48 0.46	215	0.42	265	0.48 0.46	227	0.42
120	-	-	-	-	290	0.40 0.36	251	0.34	306	0.40 0.36	265	0.34
150	-	-	-	-	330	0.32 0.25	287	0.29	348	0.32 0.25	302	0.29
185	-	-	-	-	380	0.29 0.23	330	0.24	400	0.29 0.23	348	0.24
240	-	-	-	-	450	0.25 0.18	392	0.20	474	0.25 0.18	413	0.20
300	-	-	-	-	520	0.23 0.14	450	0.18	548	0.23 0.14	474	0.18
400	-	-	-	-	600	0.22 0.11	520	0.17	632	0.22 0.11	548	0.17

Current-carrying capacities and associated voltage drops for single-core p.v.c.- insulated cables, non-armoured, with or without sheath (copper conductors)

Conductor cross-sectional area	Installation method A to C (Enclosed)					Installation method E to H (Clipped direct)				Installation method K (Defined condition)			
	2 cables, single-phase a.c. or d.c.			3 or 4 cables, three-phase a.c.		2 cables, single-phase a.c. or d.c.		3 or 4 cables, three-phase a.c.					
	Current carrying capacity	Volt drop per ampere per metre		Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre		
											Single-phase	d.c.	Three-phase
mm²	A	mV		A	mV	A	mV	A	mV	A	mV	A	mV
1.0	14	42		12	37	17	42	16	37	-	-	-	-
1.5	18	28		16	24	21	28	20	24	-	-	-	-
2.5	24	17		21	15	30	17	26	15	-	-	-	-
4	32	11		29	9.2	40	11	36	9.2	-	-	-	-
6	41	7.1		37	6.2	50	7.1	45	6.2	-	-	-	-
10	55	4.2		51	3.7	68	4.2	61	3.7	-	-	-	-
16	74	2.7		66	2.3	90	2.7	81	2.3	-	-	-	-
25	97	1.7		87	1.5	118	1.7	106	1.5	-	-	-	-
35	119	1.3		106	1.1	145	1.3	130	1.1	-	-	-	-
		a.c	d.c				a.c	d.c					
50	145	0.97	0.91	125	0.84	173	0.93	0.91	160	0.82	195	0.95	0.91	0.85
70	185	0.71	0.63	160	0.62	220	0.65	0.63	200	0.59	240	0.68	0.63	0.62
95	230	0.56	0.45	195	0.48	270	0.48	0.45	240	0.45	300	0.52	0.45	0.49
120	260	0.48	0.36	220	0.42	310	0.40	0.36	280	0.38	350	0.44	0.36	0.43
150	-	-	-	-	-	355	0.34	0.29	320	0.34	410	0.39	0.29	0.39
185	-	-	-	-	-	405	0.29	0.24	365	0.30	470	0.35	0.24	0.36
240	-	-	-	-	-	480	0.24	0.18	430	0.27	560	0.36	0.18	0.38
300	-	-	-	-	-	560	0.22	0.14	500	0.25	660	0.33	0.14	0.35
400	-	-	-	-	-	680	0.20	0.12	610	0.24	800	0.30	0.12	0.33
500	-	-	-	-	-	800	0.18	0.086	710	0.23	910	0.28	0.086	0.31
630	-	-	-	-	-	910	0.17	0.068	820	0.22	1040	0.26	0.068	0.30

Mineral Insulated Cables

All cabling between the pumps shall be 4 x 2.5mm² / 1 core mineral-insulated (MI) copper cables.

Mineral Insulated copper sheathed cable shall be designed and manufactured in accordance with B.S. 6207 Part 1 or in accordance with I.E.C., Publication 22S1966.

Installation of Mineral Insulated Cables

The Contractor shall provide necessary tools for installing M.I. cables and these shall be produced for inspection prior to commencement of work :-

a) Sheath cutter (universal size).

b) Stripping tools – side cutter, fork, rotary stripper / pot wrench.

c) Pipe grips.

d) Crimping tools.

M.I. cable shall be securely fixed to suitable perforated galvanized cable tray held to steel brackets hung from the slab at suitable intervals or held to steel brackets fixed to wall.

Insulation and continuity test shall be carried out before and after M.I. cables is installed using a 500 volt 'Megger'. The reading of the megger should be infinity and no value will be accepted. Blow lamp may be used for drying out cut cables ends. It is essential to keep hands and all materials, particularly the compound, perfectly dry and clean when terminating M.I. cables. The length of tails shall be kept to a minimum.

Dirt and matalic particles in the compound and any loose traces of dielectric left at the face of the sheath after stripping shall be carefully removed before cold sealing compound is forced down one side of the pot and up the other. Sealing compound shall be over filling in order to avoid trapping air at the base of the pot and to ensure that when the sealing disc is entered before crimpling, a completely solid insulation barrier is effected.

The minimum bending radius shall be not less than six times the cable diameter and saddle spacing shall be not less than 50 times of the cable diameter and not greater than 2 feet 6 inches whichever is the less.

Experienced electricians shall be engaged for the termination of M.I. cables. They shall be fully instructed and experienced in all stages of the operation.

Conduit Work

All conduit work shall run and buried into the wall. Final finishing of wall surface shall be made good to superintending officer satisfaction.

Minimum sizes of ½ in. diameter rigid conduit shall be used throughout except where describe otherwise elsewhere in the specification. All conduits shall be heavy gauge rigid steel galvanized outside with inside finish as Standard Regulation.

Junction, switch and socket outlet boxes for use in exposed conduit installation shall be of approved type for such installation.

All bends, offsets or elbows must be so made that conduit is not injured or flattened. Not more than two right angle bends shall be installed between boxes. Where conduits are to be concealed and the protecting coating is injured, same shall be provided with a coat of corrosion resisting paint before they are covered from view.

Where runs extend to equipment subject to vibration such as at motors, the final connection shall be made with flexible galvanized conduit, unless otherwise called for. The brass adapters shall be brazed to the flexible conduit. A separate earth wire shall be provided in the flexible conduit. Where shall be provided, the flexible conduit shall be adequately supported.

The entire coduit system and boxes shall be finished through, cleaned out of plaster, rubbish etc. and dry before pulling in conductors.

All work shall be executed in a workmanlike manner and shall present a neat appearance upon completion.

Motors

All electric motors shall conform to appropriate British Standards Specifications and I.E.E. Regulation and to the requirement of Tenaga Elektrik Negara. Unless otherwise specified motors shall be furnished with Class 'E' insulation to B.S. 2757.

Motor ½ Hp and under, shall be suitable for operation from 240 volts, single phase, 50 cycles per second mains and motor larger than ½ Hp shall suitable for operation from 415 volts, 3 phase, 50 cycles per second mains, unless otherwise specified. The motor shall be of the induction type with a squirrel cage motor, unless otherwise specified.

All motors shall be designed for 40ºC and shall be suitable for hard continuous service and shall be free vibration and excessive noise.

All motors with belt drive shall have slide rails or equivalent to permit belt tightening and shall be complete with belt guard.

Motor Starters

Motor starter shall be in accordance with B.S. 587 and equipped with overload, single-chasing and under-voltage protection where remote control is required, starters shall be of contractors type with coils wound for 240 volts 50 cycle operation.

STARTER TYPE

a)	Up to 3 Hp motors	-	Direct On Line (D.O.L.)
b)	3 Hp to 10 Hp motors	-	Star Delta / Auto Transformer
c)	10 Hp motor and above	-	Auto Trans / Resistance Starter

All starter shall be of automatic type complete with START / STOP push buttons auxiliary contacts as required, HAND / OFF / AUTO Selector switch and provision for remote control as required.

Equipment Earthing

Equipment earthing shall be provided by means of a separate copper earth continuity conductor for trunking, conduit and flexible conduit.

Connection at equipment shall be either securely bolted or by means of exothermic type welding process.

All earth-continuity conductors, the metal work at the point of electrical contact shall be thoroughly cleaned of paint or surface corrosion to ensure good electrical contact is made.

All items of equipment shall be appropriately labelled to indicate the service. Labels shall also be provided to identify all items of equipment, circuits, cables and where applicable

current rating of fuses and setting of relays. Label on the exterior of equipment shall be clear Perspex, engraved, filled flush with black (or red as suitable) filling and the back painted the same colour as the equipment. Labels shall be attached by means of machine screws and nuts or machine screws driven into drilled and tapped holes.

4.0 PAINTING DETAILS

Painting and Protection

All pipe work, metal work, machinery, valve etc. supplied and installed under this contract shall be painted to colours approved by the engineer.

Before any painting is carried out, contractor shall ensure that the surface to be painted is clean, free of grease and rust as recommended by the pain manufacturer. If necessary, degreasing and derusting shall be employed.

Each coat of paint shall be supplied by brush or paint roller when thoroughly dry, smoothed with suitable abravise paper or cloth before the next coat applied.

No painting or drying should be carried out direct sunlight and due care be taken during dusty or wet condition.

Should any corrosion, or sign of faulty painting technique became apparent during the maintenance period the contractor will be required to remove the defective paint work or component part at his own cost and retreat and/or repaint it as direct and to the satisfaction of the engineer.

Contractor must be painting at one time every year. Cost of material and labour must be responsible by contractor.

Procedure of Painting

The painting shall be carried out as following:-

All pipe work and associated hangers, brackets, sleeves, etc. shall be painted as follows:-

Primer coat (Gray green Chromate Metal Primer)

Undercoat

Top coat hard matt finish paint.

All screw heads, wing nuts and other means of fixing shall be painted at the time of installation and refinished after the final testing and commissioning is complete.

All manufactured item that are delivered in a painted condition, whether under or finish coated shall be prepared as mentioned above and then repaints as before. Special care shall be taken with the painting of the underside of pumps, bases, etc. a layer of bituminous material of roofing felt shall be laid on the base before the item is installed and then trimmed to size.

All cuts of galvanized steel or sheet metal work shall be prepared as mentioned above and paint 2 coats of zinc chrome paint.

All item that are considered liable to oil grease splashes shall be finished painted using 2 coats of the appropriate oil proof paint.

All item subjected to corrosive air or other hazardous condition shall be specially treated and painted with suitable anti corrosive paint as recommended by the manufacturers.

A schedule of paints colours to be used in the various service will be issued to the contractor as the work progresses on site.

5.0 WATER TANK DETAIL

Fiberglass Reinforced Plastic (FRP) water tank should be cylindrical shape for purpose of providing non-varying load distribution and the belt-like reinforcement that encircles the tank is to secure a strong structure as well as for easy handling. The tank should constructed using highly controlled "Hand Lay-Up Pyramid Module Method". System adapted is a Monocoque Structure System and Thermosetting Process with minor secondary reinforcement using pre-fab liners coupled with laminates and grouts to the required thickness. The fabricated tank should installed on a platform to ensure ample water pressure for the water supply system. Large tank should fitted with ladder for easy maintenance. The tank are manufactured should accordance with SIRIM MS 1241 : 1991 or British Standard BS 4994 – 1987 and BS 7491 Part 2: 1992. the material used must from the highest quality such as a food grade resin which safe for drinking water. The composite of Orthopthalic Polyster Resin s as matrix, 'E' Glass Fiber as reinforcement, MEKP as catalyst and NPG UV Stabilised as gelcoat.

Fibreglass Reinforced Polyester (FRP) panel tank type. The panel should be easily assembled by bolting them together. The panel are designed to meet highest standards of sanitary storage of potable water. The panel should rust free and non-corrodable properties greatly extend the life span of the tank and minimise maintenance. The panel also should made from non-toxic substance and will not contaminate water. The stainless steel and other non-corroding material for internal and external supporting system ensure the panel are securely mounted in position. The tanks should installed on a steel skid base and concrete foundation.