SECTION 3 - TECHNICAL SPECIFICATIONS

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3.1 SWIMMING POOL SYSTEM

3.1.1 GENERAL

The whole of the water supply plumbing and installation shall be executed by a licensed plumber with valid and relevant license issued by relevant state water authority / Suruhanjaya Perkhidmatan Air Negara (SPAN).The contractor shall at his own cost be responsible for employing the licensed plumber, and shall be responsible for all work performed by the licensed plumber.

The contractor shall at his own cost be responsible to appoint qualified person who are recognized by SPAN for the submission, supervision, construction and certification of the completed works.

All water supply plumbing and installation shall be executed in accordance with the relevant state water supply rules and to the approval of the state water authority / SPAN notwithstanding any approval given by the Superintendent Officer (S.O).

The Contractor shall submit method statement of installation recommended by manufacturer.

All pipes, fittings and equipment used for water supply plumbing and installation shall be of the type and make approved by the relevant state water authority / SPAN / S.O.

The standards stated in this specification shall comply with their latest edition issued or relevant standards approved by SPAN.

Pool Water Circuits

The pool water treatment plant shall consists of the following aspects: -

a) water circulation;
b) filtration;
c) pH control and chemical treatment;
d) disinfection

Water Turnover Rate

Unless otherwise specified, the pool water turnover rate shall be not less than once in every 8 hours in the case of an outdoor swimming pool as required, or revised turnover rate by JKR Malaysia

Water Balancing

In the case that 1 circuit is used to serve more than 1 pool, water balancing for each pool is important to maintain the turnover rate and the water level of each pool. The use of level sensors, flow meters, surge or balance tank and automatic control system to maintain the water balancing shall be facilitated. Refer to the Particular Specification for the water balancing methodology to be used.

3.1.2 PIPEWORK (MATERIAL PIPES STANDARDS)

3.1.2.1 General

Pipe work for water circulation plumbing shall be to the dimensions shown in the Tender Drawings or as specified hereinafter and shall be complete with all bends, tees, valves, gauges, sockets, plugs, reducers, brackets, supports and other accessories to complete the installation. Pipes and fittings shall be cleaned and free from manufacturing burrs and site debris.

3.1.2.2 Standards

The following standards in their latest edition shall apply: -

Item	Standard
ABS Pipes	MS 1419 : Part 1 :1997 - Pipes MS 1419 : Part 2 :1997 – Fittings MS 1419 : Part 3 :1997- Solvent
Stainless Steel	ASTMA312, BS EN 10312 : 2002
HDPE Pipe Class PN 15	MS 1058 : Part 2, 2002
uPVC Pressure Pipes	MS 628, MS 762, JIS K 6741

3.1.3 PIPE INSTALLATION

3.1.3.1 Internal Piping

All installation shall be done according to the drawings and pipe manufacturer's recommendation. Licensed Plumber shall be competent in various type of installation. Special care shall be taken in the arrangement of piping to ensure a neat finishing and alignment.

Services pipes and distribution pipes except those buried under ground level shall be concealed in wall, ceilings, boxed up or laid within the common trench, services ducts, etc provided where possible. All work shall be executed in such a manner so as to avoid cutting into finished work in walls, aprons, beam, etc. where practicable as the work proceeds. Pipe work to be buried or concealed shall not be covered or plastered before they are examined, tested and approved by the state water authority / SPAN, notwithstanding any approval given by S.O.

Installation of valves and fittings shall be grouped where this will not affect their operation, to reduce the number of joints to a minimum.

All necessary isolating valves, check valves and other fittings as required are as shown in the Tender Drawings. Every section of major branch supply piping shall be controlled by a stop valve at the point of connection to the supply.

The pipes shall be adequately protected against damage during transit. Each delivery of pipes shall be accompanied by the manufacturer's testing certificate.

3.1.3.2 Threaded Joints

Threaded end connections for ABS/PE/PB pipes shall have tapered thread forms complying with AS 1722.1 or equivalent approved standard in accordance with manufacturer's instruction.

Where threaded joint is to be made between ABS/PE/PB pipes and metal, the ABS/PE/PB pipes should be the male component of the joint.

All screwed joints shall be made by using Teflon tape or approved jointing compound.

3.1.3.3 Flanged Joints

Flanging or other suitable methods used shall be in accordance with the manufacturer's instructions and comply with the relevant state water authority / SPAN / S.O.

3.1.3.4 Bends

Bends of all piping shall have a radius of not less than 5 times the diameter and shall be of standard type.

3.1.4 PIPE SUPPORTS

Pipe supports, hangers, anchors, guides etc. shall be supplied and installed for proper support. Vertical riser shall be supported at each floor with galvanized iron (G.I) riser clamps or other material to S.O approval. Horizontal pipe runs shall be supported on hangers of split ring adjustable type or clevis type. Where pipelines run along walls, columns or ceilings, brackets or clamps may be used.

Piping at all equipment, valve positions and at main junctions, shall be adequately supported to prevent any distortion or transmission of strain to connected equipment or valves. Where pipe lines run in a common group, they shall be supported from a common hanger bar as indicated in the Tender Drawings.

Pipe supports and hangers shall be spaced at intervals not exceeding the following:-

3.1.4.1 Horizontal Position

Pipe Size (mm)	Recommended Maximum Spacing of Support (m)	
	Non-metal	Metal
10	0.6	1.5
15	0.7	1.5
20	0.7	1.5
25	0.75	1.8
32	1.0	2.1
40	1.0	2.4
50	1.0	2.4
80	1.3	3.0
100	1.5	3.7
150	1.8	4.3
200	1.9	4.9

***Water temperature should not exceed 60^{O}C**

3.1.4.2 Vertical Position

Pipe Size (mm)	Recommended Maximum Spacing of Support (m)	
	Non-metal	Metal
10	0.7	NA
15	0.9	3.0
20	1.0	3.0
25	1.0	3.0
32	1.2	3.7
40	1.2	3.7
50	1.3	4.6
80	1.6	4.6
100	1.9	5.5
150	2.1	NA
200	2.4	NA

***Water temperature should not exceed 60^{O}C**

Vertical pipes shall be supported at least at the top and bottom of each riser, at each floor level, and at each isolating valve.

3.1.5 PIPE SLEEVE AND COVER PLATE

Where pipes are required to be laid through structural beams or slabs, G.I/ uPVC pipe sleeves shall be provided as indicated in the Tender Drawing. All pipes shall be properly secured in place with brackets.

All exposed piping within occupied rooms shall be boxed up to S.O approval.

Where pipe past through fire break walls or other partitions, clearance between pipes and sleeves shall be tightly pegged with suitable fire rated material to form a sound and fire barrier.

3.1.6 VALVES AND FITTINGS

All valves and fittings necessary for the correct control, operation and maintenance of all services shall be provided and installed to the satisfaction of the S.O. Samples shall be submitted for S.O approval before installation. Valves shall be installed where they are easily accessible for maintenance and operating purposes.

Each valve shall be of the same nominal size as the line in which it is installed, except for control, pressure reducing and similar valves which shall be correctly sized for the duty concerned. Connection between each valve and adjacent piping or equipment shall be made either flange or treaded joints may be applicable.

Before installation, every valve shall be blown out with air to remove any foreign matter lodged in the valve.

All valves shall be of SPAN approved, manufactured and generally constructed in accordance with relevant standard. All valves shall be suitable for system operating pressure.

3.1.6.1 Ball Float Valve

Equilibrium ball valves to BS 1212-1:1990 & BS1212-2:1990 shall be provided to the water tanks.

Fresh water ball valves up to 50 mm shall be bronze with copper ball float to BS1968:1953. Fresh water ball valves 65 mm and above shall be cast iron with nickel alloy working parts and copper ball float.

Salt or pool water ball valves up to 50 mm shall be bronze,65 mm and above shall have cast iron body and stainless steel or zinc free bronze trimming with construction entirely suitable for use with sea water. Ball float shall be in stainless steel or in zinc free bronze or rubber lined to prevent corrosion.

3.1.6.2 Isolation/Gate/Butterfly Valves

Butterfly Valves

Butterfly valves shall have resilient seats which are (in-the-field) replaceable with moulded-in O-rings to serve as a flange gasket. For sizes of 50 mm diameter to 150 mm diameter inclusive, a notched plate handle shall be provided for the control of the valve and indication of disk position. For sizes of 300 mm diameter and above, gear actuator shall be used. All butterfly valves shall be capable of bubble tight shut off. Butterfly valves shall comply with the recognized international standards.

(a) The manufacturer shall provide independent laboratory tests such as Underwriters Laboratory or Factory Mutual Research for pressure rating. All testing records and data shall be submitted to the Architect for approval.

(b) Bodies shall be made of ductile iron grade 400-18, completely coated with polyamide or products having equivalent functions or performance against corrosion, suitable for the temperature range of 0°C to 50°C. The valve shall provide dead end service at maximum rating.

(c) The shafts stems and discs shall be made of stainless steel to 316.

(d) The control handles and the gear operators shall be suitable for locking in any position. The micro switches shall be built in the actuators and factory adjusted at full or partly open and full closure. Manufacturer shall provide certificate of factory adjustment.

(e) Valve electric operators shall be mounted on valves and tested at factory.

(f) The valves shall have marking tag in accordance with ISO5209:1977 standard.

(g) The valves body and seat must be designed for the maximum working pressure of at least 10 bar.

(h) The Contractor is to ensure that the valve disc can protrude into the pipework on either side of the valve without damaging the disc or the lining on the pipes. Pipework either side of the valve shall be so designed that the valve can be removed even when jammed in the fully open position.

(i) Where specified for manual operation valves shall be provided with hand wheels fitted with reduction gearing to enable one man to operate the valve, in a reasonable time, when it is subjected to the maximum unbalance pressure.

(j) Grooved ends butterfly valves shall be bubble tight closing to ISO 5208:1993 standards, enabling quick assembly with mechanical grooved coupling on ISO standard pipes.

Isolating Valves

Pool Water and Non-Fresh Water Application

(i) Up to and including 50 mm bore:

PVC diaphragm valves to BS EN 13397:2002 with reinforced spindle, rising stem. All parts of the valve shall be suitable for use with salt water equivalent to seawater. Ends of the valves shall be suitable for flanged connection to PVC pipe flanges.

(ii) Above 50 mm bore

Full way gate valves shall be constructed of cast iron body with zinc free bronze trim, bolted cast iron bonnet, malleable iron hand wheel, zinc free bronze stuffing box, gland, thrust, plate, yoke, wedge, seat and yoke sleeve with nickel alloy faces, stainless steel spindle with outside screw of rising stem or of inside screw of non-rising stem, whichever is specified, gunmetal nuts, and graphited packing compressed fibre packing.

Fresh Water Application

i) Up to and including 50 mm bore

Full way gate valve of bronze body construction to BSEN 12288:2003 wedge and valve seat shall be in bronze, non-rising spindle and screw collar in high tensile bronze. Valves shall have screwed female ends for taper treads to BS EN 10226-1:2004.

ii) Above 50 mm bore

Full way gate valve of bronze body construction to BSEN 12288:2003 bolted bonnet, wedge and valve seat in bronze, rising or non-rising spindle and screw collar in high tensile bronze. Valves shall have flanged connection to BS EN 1092-1:2002, BS EN 1092-2:1997 and BS EN 1515-1:2000.

3.1.6.3 Strainers

Pool specific hair and lint strainer with removable stainless steel basket shall be supplied and installed where shown in the drawings. The body shall be in AISI304 and strainer basket in AISI316. Inlet and outlet size shall suit the pipeline size.

3.1.6.4 Pressure Gauges

Dial type with 3-way gauge cock shall be supplied and installed where indicated in the drawings.

Pressure gauges shall be minimum 100 mm diameter dial face type and having ranges suitable for the service pressure encountered. The maximum range of the gauge should be double the operating pressure.

The gauges shall be industrial type shock proof, oil filled, stainless steel casing and IP 65 Ingress Protection Rating.

3.1.6.5 Pressure Reducing Valve (PRV)

Air Vent and pressure reducing valve shall be installed at 30 meters intervals along downpipes in order to restrict the pressure sustained by the fittings to prevent water hammer and other effect.

3.1.6.6 Regulating Valves

Regulating valves in fresh water systems shall have gunmetal body to BS EN 12288:2003 with screwed female connections for sizes up to 50 mm bore, and shall be of flanged connections for size above 50 mm.

Regulating valves in salt water system shall be similar materials as the cast iron gate valves and suitable for use with sea water. Valves shall have parabolic shaped discs to

give a "straight line" characteristic of water flow to spindle lift. All valves shall be lock-shield type.

3.1.6.7 Motorized Control Valves and Solenoid Valves

(a) For pool water application, valve suitable for sea water application is required.

(b) Motorized valves shall be of the modulating type with a turn down ratio of at least 50 to 1. Valve bodies shall be cast gunmetal, brass cast iron or as otherwise indicated. Seat and inner valve material shall be brass, stainless steel or as otherwise indicated. Valve sizes 50 mm and smaller shall be screwed and supplied with union fittings. Valve sizes 65 mm and larger shall be flanged. Valves shall be of the straight-through type as required by the sequence or shown on the Drawings. Valves actuator shall be equipped with manual opener to allow manual positioning of valve in the absence of control power. Valves shall have authority of at least 0.5 (50%) and shall have suitable actuator to close against full pump head. Valve body shall be rated for differential pressure stroke less than 20 mm.

(c) For valves that are incorporated within the system or units, they shall fit for the purpose and applications.

(d) Valves schedules for all valves modulations/on-off shall be submitted detailing the maximum allowed and actual pressure drops, authority, turndown ratio, maximum pressure the actuator will close against and other valve data.

3.1.6.8 Check Valves

(a) The body of the check valves shall be made of cast iron to BS EN 1561:1997 and ISO 185:2005 while the flaps/discs shall be made of bronze to ISO 197-4:1983 or ductile cast iron. The discs of swing check valves shall be of light construction and pivot on a spindle secured by 2 phosphor-bronzed hangers. Each valve shall be fitted with a stop to prevent undue movement of the flap and shall be as silent as possible in operation.

(b) The discs of lift check valves shall be provided with means of guiding the discs and preventing components from becoming detached in services.

(c) Recoil check valves with size 100 mm and above should have removable cover on top of the outlet body casing to facilitate inspection of bearings and movement door.

(d) Silent check valves shall have large bearing surfaces, functions equally well in all positions, drop-tight seating, and stainless-steel trim.

(e) For chemical handling, ball type UPVC check valves at 50 mm diameter or below may be used. B1.10.8 Stainless Steel Valves and Accessories

Where stated in the specification, valves and accessories for use with ozone or ozonated water such as valves and accessories for reaction tanks, carbon filter tanks, etc. shall be made of stainless steel materials to Grade 316 (BS EN10088-3:2005). This includes body, stem, disc, cover and spring of gate valves, check valves, globe valves and other accessories as specified in the particular specification. The gasket shall be made of PTFE. Butterfly valves shall be in accordance with the requirements of clause B 1.10.3 of this General Specification.

3.1.6.9 Cocks

(a) Cocks, taps and other accessories shall be of the type and working pressure suitable for the applied system and shall be supported by valid documents with approval from the appropriate authority. They shall be in accordance with the appropriate ISO Standard with marks.

(b) Bodies of cocks of up to and including 50 mm size shall be of cast gunmetal or bronze; approved valves having hot-pressed bodies may be offered as an alternative. For carbon and reactions tanks, size of drain cock shall be 50 mm and above which shall be of UPVC cocks with UPVC pipes below union end.

(c) Except otherwise specified all cocks that convey ozonized or chemical fluid shall be chemical resistant types.

3.1.6.10 Non-Return Valves

Where shown on the accompanying drawings, non-slam-type non-return valves shall be supplied and fitted.

Valves shall be selected 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 if necessary valves of the double or articulated clack type or the spring assisted type shall be fitted.

3.1.6.11 Water Meter

Suitable water meter approved by SPAN shall be supplied and installed as required.

3.1.7 SAND FILTER

3.1.7.1 **General**

Sand filter shall be air scoured sand pressure type. Each sand filter shall comprise a steel electrically welded shell complete with supported nozzle, balance tank, adequate strength stainless steel nozzle plate and filtering media supports, internal distribution and draw-off trough, flanged inlet and outlet, wash-in, drain and air connections, adequately sized "McNeil" type manholes (minimum 4 nos. for each filter), filter supporting feet, necessary filtering media and sundry accessories. The design and position of manholes shall be convenient for maintenance staff entering the shell to service, replace internal parts and repaint the internal surface wherever necessary. For each horizontal filter, two numbers of 250 mm diameter hand doors complete with shell fixing bolts shall be provided along the longitudinal side just above the nozzle plates. For each vertical filter, two numbers of 250 mm diameter hand doors complete with shell fixing bolts shall be provided on the opposite sides just above the nozzle plates. Sight glasses shall also be provided just above the level of filtering media. Detailed Drawings with design stress calculation of sand filters construction (at least 2 times above design working pressure) including the tank, nozzles, tank supports and sand filter bed & supports shall be submitted to the Architect for approval. Special attention shall be given to the methods of supports for the nozzle plates. These shall have adequate supports so that no bending of any of the support members will occur.

The tanks shall be treated as follows: -

(a) Interior Surface

i) Surface Preparation: -

Blast cleaning shall be carried out in accordance with BS EN ISO12944-1:1998 to BS EN ISO 12944-8:1998 and BS EN ISO14713:1999. The quality of blast-cleaning shall be to second quality as given in BS 7079-0:1990 "Preparation of steel substrates before application of paints and related products".

ii) Coating System: -

Primer: one coat of heavy duty epoxy paints up to a dry film thickness of 80 microns. It should be epoxy orange primer or approved.

Undercoat: one coat heavy duty epoxy paint with light yellow finish. It should have a dry film thickness up to 100 microns, and epoxy white primer (undercoat) or

approved.

Finish: two coats of heavy duty epoxy paint with blue finish. It should have a dry film thickness up to 30 microns per coat and epoxy sky blue or approved.

(b) Exterior Surface (unexposed)

Before placing the filter tank in position on the concrete plinths, the areas that will be in contact with the concrete shall be wire brushed and applied a thick coat of bitumen. For horizontal tank, the tank shall be laid on a pack of bituminous felt such that the interface between concrete and filter tank is adequately protected against corrosion for all times. Any bitumen between remaining on the exposed areas outside the interface shall be cleared off in preparation for the protection described below.

(c) Exterior Surface (exposed)

On completion of filter tank fabrication, wire brush the whole of the external surface thoroughly to remove all scale rust, dirt and grease. The outer surfaces and attachments shall be treated as follow:-

Primer: as for interior;

Undercoat: one coat of good qualities undercoat paint of colour consistent with finishing coat; and

Finish: one coat of good quality heavy duty epoxy green paint or approved.

(e) Tank Assembly

Factory assembled, pressure tested and certified filter tanks to be offered as practical as possible. Unless, in view of the actual difficult site conditions and to the approved of the Architect, the tanks may be shipped in small plates formed and ready for electrical welding on Site. Finished filter tanks shall be subjected to a pressure test for 6 hours of not less than 2 times the design working pressure or 600 kPa whichever is higher, in the presence of a Registered Professional Engineer (Mechanical) appointed by the Contractor and the S.O's representative on site.

(f) Test Certificates

Test certificates and other testing documentation as required by any relevant authorities shall be submitted to the S.O for each filter tank. Detailed design report of the filter tank regarding its strength shall also be submitted to the S.O for approval before fabrication.

3.1.7.2 Filter Support

All horizontal filter tanks shall be designed to rest on concrete supports embracing the lower portion of the tank at the support position without legs. Provide anchor fixing bolts for fixing the tanks/vessels after putting in place on the concrete supports. Submit full details of dimensions and operating weights of all tanks/vessels and the exact position and construction details of the concrete supports to the S.O for approval prior to manufacture or ordering.

3.1.7.3 Filter Tank Accessories

Each filter tank shall be equipped with automatic and bulk air release valves, water control valves, wash water sight glasses, inlet and outlet pressure gauges, differential pressure sensor (for auto-control backwash) for filtering and backwashing operations, flow meters and associated panels, drain pipe and valves, draw-off cocks for taking samples of raw

and filtered water and can be individually manually back washed. To allow efficient distribution of water in the filter, the inlet and outlet distribution pipe shall be designed to cross the whole length of the filter for horizontal tank and cross the whole diameter of the filter for vertical tank.

One set of flow meter shall be provided on the inlet to each filter. A sight glass shall be provided at the backwash discharge pipe of each filter.

3.1.7.4 Filter Bed

Filter bed shall consist of at least two but preferably more layers of filter media, each having a different particle size properly supported by a suitable under drain. Where nozzles are provided as a form of under drain, they shall be completely manufactured from poly-propylene or UPVC screwed into a high quality heavy gauge steel plate and shall not have any metal screws or holding bolts. The steel plate shall have adequate support and must be strong enough to withstand the weight of the filter bed plus the water pressure differential across the bed when dirty. A margin should be provided to take the additional pressure in the event that any other filter is temporarily valved off. Manufacturer's fully dimensioned shop drawings together with details of the nozzles and filter media must be submitted for approval prior to fabrication. 10% spare nozzles shall be provided for each filter tank.

3.1.7.5 Filtering Media

The filtering media shall consist of accurately and even graded quartz sand with at least one layer of 0.4 to 0.8 mm grain and one layer of 0.71 to 1.25 mm grain. The depth of sand shall be sized according to the plant capacity and the manufacturer's recommendation for low to medium filtering rate. 0.3 mm water free board shall be provided above the sand.

3.1.8 POOL DISINFECTION SYSTEM

3.1.8.1 Metering Pump For Hypochlorite

The hypochlorite metering pump shall be of the positive displacement type with a mechanically actuated diaphragm. The pump shall be constructed with plastic and complete with clear plastic moulded cartridge-type check valves to facilitate service and provide integral sight flow indication (Conventional threaded valves and external sight flow indicators are not acceptable.) The pumping diaphragm shall be fabric-reinforced elastomer with an imbedded steel backing plate to ensure accurate repeatability for each stroke. The output capacity for the chemical pump shall be manually infinitely controlled from 0-100% via a built-in control knob. The pump shall be complete with suction hose and accessories.

3.1.8.2 Hypochlorite Storage Tank

The hypochlorite storage tank shall be constructed from reinforced concrete, reinforced fibreglass or high density polyethylene or equivalent materials. The tank shall be designed for ambient temperature and atmospheric pressure and suitable for indoor/outdoor installations. The size of the tank shall be based on the numbers of working days, operating hours, circulation flow rate and chemical dosing concentration. The tank shall be complete with outlets, valves, overflows to drain and accessories. Level indication such as level glass tube shall be provided. The flanged connections for the inlet and outlet from the air dilution blower shall be provided. Safe level control for start-stop operation of electro-hypochlorite generator, overflow alarm, low storage level alarm, stop operation of metering pump induced by low storage level alarm and disable metering pump signal shall be provided.

3.1.8.3 Hydrogen Gas Detection System & Air Vent

Hydrogen gas detection system shall be provided in sodium hypochlorite tank

room. The required performance of the hydrogen gas detector shall be as follows: -

(a) Measurement Range: 0-100% of lower explosion limit of hydrogen (i.e. 4%) with initial alarm set to be 0.05% of hydrogen in air.
(b) Life Expectancy : 5 years
(c) Operating Temperature:-5°C to +40°C (±10 %.)
(d) Humidity : 0-99% RH

The air vent for the hydrogen gas shall be installed with the air flow sensor which would provide actuation for the standby blower via a control panel in case of the failure of the primary blower. The automatic air vent shall incorporate with no built-in valve and the discharge pipe shall be run to the nearest agreed terminal with mesh outlet in accordance with the Architect's instruction. The system completion shall be incorporated with explosive-proof type extraction fan and its accessories in accordance with FSD statutory requirement.

3.1.8.4 Chemical Cleaning System

An acid cleaning system shall be complete with recirculation pumps, fibreglass or PE chemical storage tank and other accessories to clean the electrolytic cell in a convenient manner. All pipework connected shall be constructed of materials suitable for chemical resistance.

3.1.8.5 Automatic pH and Chlorine Controller

The automatic chlorine and pH controller shall be installed to monitor and control the concentration of free chlorine and pH level within the specified range stated in the Particular Specification. The automatic chlorine and pH controller shall be either installed at the return water pipe from the pool or be complete with the pH and ORP sensors at numerous sampling water return points at regular intervals around pool for the measurement purpose. Standby pump with auto changeover shall be incorporated to ensure system reliability. Alarm shall be provided upon failure of pump.

3.1.9 PUMPING SYSTEM

3.1.9.1 Filtration Water Pump System

Filtration water pump sets shall be installed to pump water from a ground level or above level suction tank (balancing tank) pass thru sand/cartridge/D.E filters and to pool tank (elevated tank).

The system shall comprise but not limited to the following components;
a) Pump
b) Controller and devices
c) Pipes, fittings, valves and strainers
d) Support base

The system shall be provided with minimum two (2) numbers filtration pumps as shown in the drawings. These shall comprise of two (2) numbers electrically driven pump sets for duty and standby operation. The duty and standby pump set shall be alternated to maintain even wear and tear.

Pumps provided shall be single/multi-stage centrifugal type pumps. The pumps shall operate at constant/variable speed with the pump motor coupled directly to the pump and the whole mounted on a common base plate bolted onto a concrete plinth.

The pumps shall be selected to suit the type of service encountered. End covers, body rings, bearing housing and casing generally be of cast iron constructions or strong single piece glass filled thermoplastic. Impeller shall be of bronze or gunmetal and shafts of stainless steel. For pump speed of 2,900 rpm, the impeller shall be of stainless steel grade 316, shaft of stainless steel and the casing of high grade close grained cast iron or stainless

steel. The pumps shall be selected to operate at near maximum efficiency at the duty pointed specified.

The pump seal shall be integral with the casing and shall be of mechanical seal type. The mechanical seal material shall be silicon carbide, carbon or ceramic type and suitable for fluid media operation. The pumps shall be fitted with air cocks and two lubricators/nipples at suction and delivery branch flange. Proper drainage shall be provided for all points around the pump set mounting.

The plinth shall be provided to suit the manufacturer's requirements and shall raise the pumps to at least 6 inch (150mm). Mounting of the pump sets to the plinth shall be complete with vibration isolators.

The pump set shall be end flooded suction centrifugal pump with strainer and vertical discharge.

(a) Materials of Construction

Unless otherwise specified, the materials of construction of the pumps shall be as follows: -

Description	**Material**
Casing	Bronze to BS EN 1982:1999 or Cast iron to BS EN 1561:1997
Impeller	Bronze to BS EN 1982:1999
Shaft	Stainless steel to BS EN 10088-3:2005
Sleeves	Stainless steel same as shaft or cast bronze
Wearing rings	Copper-tin alloy to BS EN 1982:1999

(b) Standards

i) Stuffing Boxes and Drain Piping:

Stuffing Boxes shall have material same as the casing. Housing of cast iron stuffing boxes shall comply with ISO 185:2005 or BS EN 1561:1997 and shall be of ample length with bronze lined gland and neck bush, fitted with approved packing and lantern ring water seal. Drain outlet and piping to remove gland leakage shall be provided. Alternatively, a mechanical seal may be offered. The mechanical seal shall be of leak free operation. The mechanical seal shall be the product of a specialist proprietor and the materials used shall be suitable for the pumped liquid.

ii) For vertical in-line pump, suction and discharge flanges shall be of equal size. The impeller shall be dynamically balanced. The shaft shall have stainless steel/bronze sleeves keyed to prevent rotation and secured against axial thrust. For multi-stage pump, each stage/section shall be interchangeable.

Motors shall be 50 Hz, 415 volts TEFC squirrel induction motor with class F insulation and IP 55 enclosure.

3.1.9.2 Submersible Pump

(a) Materials of Construction of Submersible Pump

Unless otherwise specified, the materials for submersible non-clog pump shall be as follows:-

Description	Material
Casing	Cast iron to BS EN 1561:1997
Impeller	Cast iron to BS EN 1561:1997 or stainless steel to BS EN 10293:2005 grade 316
Shaft	Stainless steel to BS EN 10088-3:2005
Double Mechanical seals	Silicon Carbide; Carbon or ceramic faces
Discharge elbow	Cast iron to BS EN 1561:1997

(b) General Requirements

All bolts, nuts and fasteners shall be of stainless steel and electric cable entry shall be of watertight construction.

Materials for sump pumps shall be suitable for the pumping fluid being conveyed, such as, neither reacting to any parts in the pump by its fluid nor changing the content of the fluid by the pump. The sump pumps shall operate automatically by float level control. The guide bars for wet sump installation shall be of stainless steel to Grade 316.

Cable supports shall be of stainless steel. A safety provision shall be incorporated for automatic electrical disconnection of the supply in case of cable entry seal failure. Pumps for flammable zones shall be equipped with flameproof submersible motor in compliance with BS EN 60079-0:2006, BS EN 60079-1:2004 and IP 68 of BS EN 60529:1992.

3.1.9.3 Centrifugal Pump

(a) Driving Arrangement

The horizontal pump and motor shall be direct coupled and mounted on a substantial machined bedplate; accurately aligned, and fitted with guards. The whole assembly including the bedplate shall be designed and supplied by the pump manufacturer. Coupling with spacer shall be used for end suction pump so that the impeller may be dismantled from the motor side for servicing without neither disrupting the pipe-work nor dismounting the motor. For vertical pump, the driving motor and the pump shall be factory aligned before shipment.

(b) Stand-by Pumps Arrangement

Where stand-by pumps are specified with automatic changeover provision, the changeover shall be initiated by means of flow sensing devices of an approved pattern. The necessary non-return valves shall be incorporated in the pipe-work to interconnect such pumps.

3.1.9.4 Pump Base Plate

When pump base-plate is necessary, the base-plate should be proprietary made with the pump. The material of the base-plate shall be same as the pump.

3.1.9.5 Pump Vibration Connectors

Vibration connectors shall be fitted to the inlet and outlet connections of other vibrating equipment as deemed necessary.

Vibration connectors shall be full line size of the equipment connection and fitted as close to the source of vibration as is practicable.

Vibration connectors shall be provided with end restraint to counteract the pressure thrust should the piping be subjected to longitudinal movement.

Manufacturers' recommendations on restraints, pressure, and temperature limits shall be strictly followed during the installation.

3.1.9.6 Flexible Rubber Connectors

Flexible connector shall consist of a single or twin-sphere body manufactured with reinforced rubber, the ends of which are raised and wire reinforced to form the cuffs for sealing purposes. The cuffs shall be backed by floating steel flanges.

The rubber body shall be reinforced by multi-layered nylon tire cord fabric.

The rubber membranes shall have an indelible identification system to clearly identify the model and hence the suitability for the application and working conditions and have the date of manufacture moulded into the cover to ensure that no units that have exceeded the recommended shelf life are used.

Straight connectors shall be of the twin-sphere construction whilst elbow connectors shall be of the single-sphere construction.

Straight connectors connected to resiliently supported equipment shall be equipped with rods to prevent excessive elongation of the connectors if the system operating pressure is in excess of the value recommended by the manufacturer.

Acoustical control rods assembly shall consist of not less than 4 large triangle anchor plates, 2 control rods with large wedged-on end fittings and 13 mm thick acoustical washer bushings of sufficiently large load bearing area to isolate the end fittings, axially and laterally.

3.1.9.7 Automatic Switches And Controls

Single tank

The automatic controls shall be of no-float type using stainless steel electrodes provided at (i) Suction tank and (ii) Storage/elevated tank; and shall be able to perform the following automatic actions: -

a) When the water level drops below L.W.L. in the Storage/elevated tank, the pump shall be switched on and shall remain until the water level reaches T.W.L.

b) When the water level in the Storage/elevated tank reaches T.W.L. the pump shall be switched off and shall be prevented from being switched on again until the water level falls to L.W.L.

c) When the water level is at or below the L.W.L. in the suction tank, the pump shall be switched off and shall be prevented from being switched on again until the water level rises to T.W.L.

d) The L.W.L. and T.W.L. in the suction tank and Storage/elevated tank shall be provided subjected to the S.O approval.

An auto-manual change-over switch shall be provided. Each pump shall have a pressure gauge fitted on the delivery branch with shut-off cock. Flexible coupling shall be provided at the suction and delivery pipes to prevent transmission of Vibration.

Multiple tank

Each pump shall be automatically activated by water level sensors/pressure of no float electrode type located in the gravity tanks which are set at predetermined levels.

This control arrangement shall not prevent any individual pump to operate should any one

of the pumps in the set fail to function. For multiple gravity tank installation, each independent tank shall be fitted with its own no float electrodes. Pneumatic pumping systems with pressure switch controls may be considered as an alternative to the above system.

The operation of all automatic control equipment shall be so arranged that on power failure and / or partial or complete shut down during routine maintenance or repair, all systems and components shall 'fail safe'.

Water Level Control - Pressurized Mains System

All water tanks shall be incorporated with no float type high and low water level sensors, electrode, electrical solenoid on-off valve, and by pass line with normally closed valve. The electrical solenoid valve shall open on low water level and close on high water level.

3.1.10 WATER PUMP INSTALLATION REQUIREMENTS

3.1.13.1 General

The installation details should be in accordance with the instruction prepared by the manufacturer.

Pumps at 5 kW motor capacity and above shall be "Type-tested" in accordance with the requirements of BS EN ISO 9906:2000 or approved equal. Test certificate for each pump shall be issued and signed by the manufacturer and submitted for checking. The certificate shall clearly record the pump model, serial number and the materials of the casing, shaft and impeller. Any certification with requirements not in strict compliance with BS EN ISO 9906:2000 shall be submitted to the Architect for approval prior to pump ordering.

Each pump or each batch of pumps shall also be provided with a certificate on their place of manufacture. The certificate shall be issued by a recognized Chamber of Commerce of the place of manufacture concerned. A certification issued by an organization other than the recognized Chamber of Commerce shall be submitted to the Architect for approval prior to pump ordering.

Pumps and their drives shall be segregated such that failure of pump seals shall not result in damage to the drive motors. The pump shall be stored in a dry space when they are delivered to site. Special rust preventive measures to protect the internal parts shall be applied if it must be stored for an extended period of time. Such provisions shall be removed completely before final installation and the bearings shall then be re-lubricated.

Plant Room Location
The Contractor shall check and assure that adequate working space must be provided to access for maintenance and sufficient headroom to lift the parts for repair is provided. For large pump, a hoist with travelling crane or other facility shall be provided over the pump location.

For an open loop system, the location of pump should be sited so that it will use the shortest and most direct suction and smallest vertical lift. Where possible, the pump centreline should be placed below the level of the liquid in the suction tank.

Pump Foundation
The foundation shall be of sufficient size and rigidity to properly support the full area of the pump base-plate, to absorb any normal strains and to maintain correct alignment for the pump assembly.

Space between the pump unit and the foundation bolts shall be allowed in accordance with the manufacturer's recommendation.

For vertical pump, the foundation shall be of sufficient size and rigidity to properly support the full base area of the pump. The foundation shall be surrounded by 50 mm thick cork and housed in a 150-mm thick concrete plinth. The cork shall enclose the 4 sides and the bottom of the foundation to isolate vibration generated by the pump to the floor structure.

The cork and the concrete plinth and foundation shall be filled up with bitumen.

For horizontal pump, an inertia block shall be provided, with minimum mass of concrete not less than 2.5 times the mass of the pump assembly and with at least 150 mm thick and 150 mm wider than the pump base-plate. Unless otherwise specified, the pump base shall be mounted on the raised housekeeping plinth using appropriate anti-vibration spring mountings. Each spring shall be individually selected according to load distribution and shall have an additional free travel equal to one half of the rated deflection. Spring mounts shall have a levelling bolt and shall be mounted to the concrete inertia block via height saving brackets that allows a base clearance of 50 mm. When the horizontal pump motor size is less than 5.5 kW and the pump is located in a pump room which is not susceptible to structural bond noise, the use of inertia block may not be necessary subject to S.O's approval.

Pump Alignment

The pump unit shall be accurately aligned in accordance with the manufacturer's instructions prior to operation. The alignment shall be rechecked after the suction and discharge piping have been bolted to the pump to test the effect of piping strains. The pump and driver alignment shall be rechecked and adjusted correctly within ±0.05 mm tolerance.

Support for Piping

Suction and delivery pipes shall be supported independently of the pump. The connecting pipes to a pump shall not strain the pump. Pipes installation shall match up to the respective flanges without being strained into position. The faces of the coupling shall be checked with a straight edge to make sure that they are parallel and concentric.

Connection Piping to Pump

(a) Suction Piping

The suction piping shall be properly installed for a satisfactory pump operation. This shall be achieved by keeping as direct and as short as practicably possible with a minimum number of bends, and by avoiding air pockets forming. Concentric reducers shall not be used on suction branch.

The size of the suction pipe shall be larger than the pump inlet and when applicable eccentric reducer may be used. If the source of supply is located below the pump centreline, the reducer shall be installed straight side up. If the source of supply is above the pump, the straight side of the reducer shall be at the bottom.

A straight section piping at least 4 to 6 diameters long at the pump inlet with long radius bend shall be used for suction pipeline installation to create less friction and provide more uniform flow distribution as deemed necessary.

(b) Delivery Piping

Unless otherwise specified, the size of the delivery pipe shall be at least one size larger than the pump delivery. The check valve shall be installed between the pump and the gate valve. The gate valve should be installed close to the pump discharge for pump priming and repairing.

Air release valves shall be installed at the highest points on each rise to allow accumulated air or vapor or other gases to escape from the pipe.

Adequate support and anchorage shall be provided if the pipes are laid above or below ground. For this purpose, it is acceptable to have thrust blocks in either corner type or puddle flange type that are designed to absorb reactions or turning forces to ensure no mechanical and hydraulic forces are imposed on the pump.

(c) Pipe Flanges

Pipe flanges shall match with the sizes of pump flanges with full-face gaskets.

(d) Expansion Joints

Expansion joints shall be installed in suction and delivery pipelines to avoid transmitting any piping strains. A suitable pipe anchor shall be installed between the expansion joint and the pump.

If expansion joints are not specified, expansion loops that are formed by looping the pipe shall be provided to prevent the transmission of strains to the pump.

(e) Intake

The installation work shall be carried out properly to prevent air being entrained as bubble within the water. The intake pipe shall run well below the sump tank level. High level entry into the sump should be avoided as air may be entrained by the falling jet.

Vortex inhibitor shall be installed inside the water tank to prevent air being drawn from bottom of vortex into the intake. No chemical or brine tank suction requires vortex inhibitor.

Flushing Strainer
The suction strainer shall be installed as close as practicably possible to the pump. This suction pipe strainer should not be used for flushing the pipe. A temporary strainer fitted with a finer mesh than the permanent strainer should be used for flushing all piping and cleaning thoroughly all possible mill scale and other foreign matter. The temporary strainer shall be removed afterwards.

Venting Valves for Pump-set
Venting valves shall be installed at one or more points of the pump-casing waterway to provide a means to escape for air or vapor trapped in the casing. These valves shall be connected so as not to endanger the operation staff in handling toxic, inflammable or corrosive liquid.

Drains for Pump-set
All drain and drip connections shall be piped to a point where the leakage can be disposed of or collected for reuse if specified.

Instrumentation
Each pump installation shall include pressure gauges and a gauge cock to measure the system pressures and pressure drop.

All measuring and isolation instruments, such as pressure gauge, check valve, globe valve, gate valve and strainer, etc., or as specified in the Particular Specification shall be installed properly to maintain a close check on control on the performance and condition of the pumps.

Instruments shall be mounted in a suitable location so that they can be easily observed.

The vessel shall constructed of welded mild steel plate to ASME Section VIII for unfired vessel and shall be epoxy coated inside and painted outside. The vessel shall comply to the requirements of the local authorities.

The vessel shall be fitted with pressure switches and gauges, lifting lugs, gauges, safety valves and air valve, drain cock and inspection opening.

3.1.11 CONTROL SYSTEM

3.1.11.1 Scope of Work

a) The scope of work shall include, but not be limited to the design, supply, delivery, installation, testing & commissioning and maintenance during the Defects Liability Period of the control system including all the associated hardware, software, accessories, instrumentation and all the ancillary equipment & devices as specified in the Particular Specification and Drawings and as necessary for the satisfactory operation and maintenance of the swimming pool water circulation, filtration and disinfection plants and systems.

b) The Contractor shall supply, install and terminate the interconnecting wirings among

various control panels, equipment, pumps, valves, meters, and devices installed under this Contract. Manual override to automatic control shall be provided on local control panels of all equipment and pumps, unless such is not desirable for reason of safe operation.

c) The control points under the control system shall include but not be limited to the points indicated in the Control Point Schedule in the Appendix to this Section of General Specification. Local control panels for disinfection equipment shall be as specified in Section B3 of this General Specification. The Contractor shall advise any additional points that are needed to provide the desired functions as specified, and include these points in the installation.

3.1.11.2 Functions

a) The control system shall serve to enable the entire swimming pool water circulation, filtration and disinfection installations to function as specified in the Particular Specification, Drawings, and this General Specification unless otherwise indicated. The functions of each equipment, pump, valve, meter and device of the installation shall include its start, stop, modulating operation wherever appropriate, and indications of start, stop and fault. The functions shall also include the sequenced start, stop and modulating operation of each equipment, pump, valve, meter and device whenever such sequence is required for the proper operation of the entire installation; and the sequence shall, other than for a single equipment, pump, valve, meter, and device, include the operation of all other equipment, pumps, valves, meters, devices affected by the operation of the said equipment, pump, valve, meter and device.

b) The Contractor shall be responsible for the design and determination of the exact numbers of I/O points for the control system to provide the operation & maintenance functions of the entire swimming pool installation. The functions will be indicated in the Particular Specification or shown on Drawings.

c) Control facilities shall be provided to maintain the required pool surface water levels through control of valves and pumps.

d) The Contractor shall allow 20% additional I/O points and wiring to facilitate the I/O in the control system for future extension.

3.1.11.3 Operation Voltage

a) The control system shall be operated on single-phase mains voltage or on extra low voltage such as 12V or 24 V. Where a particular manufacturer's system is offered and accepted, the installation shall be installed to comply with that manufacturer's recommended technical details and methods of installation.

3.1.11.4 Sensors and Controllers

a) The sensors shall be placed in transparent chambers, one chamber for each sensor, at various locations as shown on the Drawings and the flow rate shall be adjusted to meet with manufacturer's recommendation. For chamber installed on the return water pipe and sampling lines, y-type strainer shall be provided. The sensors shall detect and sense the return water of the pools in the sampling lines, in return water, after mixing chambers, after reaction tanks and before discharge to pool. Allow for all necessary equipment, piping and accessories to provide the control and indication functions including running of pipes and/or wiring to the sensors.

b) All indication on controller shall be of LED type. Dial reading gauge is not acceptable. Measurement of chlorine and ozone level shall be made by redox potential philosophy or chemical means. Sensors shall be able to measure the chemical concentration as ppm. Running life of all sensors shall be of at least 1 year with no maintenance.

c) Indicator meters for pool water quality shall be suitable for analogue input.

d) The pH sensors and controllers shall be set at settings specified in this specification, with measurable range adjustable from 2-12. The residual free chlorine sensors and controllers shall be set at settings specified in this specification, with measurable range adjustable from 0.0-10.0 ppm, 0.0-5.0 ppm and 0.0-2.0 ppm with selection. The ozone sensors and controllers shall be able to be set at 0.4 ppm after reaction tank and 0.1 ppm before discharge to pool with measurable range adjustable from 0.0-3.0 ppm. All sensors and indication on controllers shall be able to give measurement down to 2 places after decimal point i.e. 0.01.

e) Extra output signals shall be provided to transit the temperature signals and chemical levels such as residual chlorine and ozone concentration and pH value to the supervisory control panel if such panel is specified.

f) Sensors shall also be included to measure ozone concentration in gas after ozone generator.

g) Elements sensing liquid temperature in pipework shall be: -
   i. provided with means for withdrawal for calibration, servicing, etc., without the need for draining the system;
   ii. positioned so that the active part of the element is wholly within the liquid;
   iii. positioned so that the element is not less than 10 pipe diameters downstream from a point of mixing, unless otherwise recommended by the manufacturer;
   iv. positioned so that sufficient length of flexible conduit can be allowed to permit complete withdrawal of the element; and
   v. positioned downstream from the valve, after the pumps, for the control of mixed flow temperature using mixing valves.

h) Elements sensing liquid flow in pipework shall be positioned so that: -
   i. the element is mounted in a section of pipe where there is a straight run of at least 5 diameters on each side of the flow switch;
   ii. the element is mounted so that the terminals or wire leads are easily accessible for wiring; and
   iii. the element must not be subjected to water hammering. If a fast-closing valve is located downstream of the element, a suitable water hammer arrester must be used.

i) Sensing elements shall in all cases be installed in accordance with the manufacturer's latest recommendations and instructions.

j) For sensors exposed to view, the precise location shall be approved by the Architect.

k) All sensors shall be arranged to give convenient access for servicing.

l) Suitable support and easy access facilities shall be equipped for all sensors, monitoring and measuring equipment. Suitable protection guard against damage shall be provided for equipment exposed to public contact. Temperature setting scales shall be clearly marked in °C.

3.1.11.5 Control Panels

Generally, the operation of the pump set shall be automatic with manual override as follows: -

a) Pump should be running 24 hours per day. The pumps are controlled by a timer for this operation.
b) Pump only STOP when either low level (L1) in suction tank is activated

c) Alarm will have activated either when the suction tank is in low level
d) The pump sets shall start ALTERNATIVELY where specified.

3.1.12 ANCILLARY INSTALLATIONS

3.1.12.1 Underwater Lighting Installation

Underwater lighting system shall comprise water proof and vandal proof light fittings, submersible cables, watertight junction boxes with neoprene gaskets, steel conduit and accessories, PVC cables, isolation transformers, RCCB, etc. as indicated on the Drawings and in compliance with BS 7671:2001.

The submersible light fittings shall be made of cast bronze or equivalent and complete with 12 V/24 V lamp bulbs. It shall be of IP 68, BS EN 60529:1992 and suitable for operation at the water depth as indicated on the Drawings. Light fittings shall be installed tilting upward at an angle about 10° to the vertical. The whole light fitting shall be easily demountable in water for bringing up the fitting to deck surface for lamp replacement. A flexible water tight conduit shall be provided connecting the light fitting with power supply system.

The colour lens or fittings shall be made of cast tampered glass, convex and heat resistance. The lens shall be mounted on neoprene gaskets. The whole frame of the light fitting shall be smooth with no sharp corner. It shall be installed in recessed position. The whole light fitting shall also be easily demountable in water for bringing up the fitting to deck surface for lamp replacement.

The isolation transformers shall be double wound, single phase, rated at appropriate kVA and housed in a metal enclosure outside pool areas. Tapping shall be provided on the secondary winding to give the suitable voltage ratios for supply of 12 V/24 V system. The primary winding and the secondary winding shall be so constructed that there is no possibility of any connection between the windings. The transformers shall be tested to BS EN 60076-1:1997, BS EN 600762:1997, BS EN 60076-3:2001, BS EN 60076-5:2006 and BS IEC60076-8:1997 where applicable by a recognized independent body.

The secondary winding and the circuits connected to it shall not be connected to earth. Separate insulated earthing wire from each lighting fitting shall be brought back to the residual current devices or RCCB. In case of any short circuit fault, the RCCB shall operate to trip the supply.

A 24-hour programmed timer switch shall be provided and serve to control the "ON" and "OFF" operation of the underwater lighting system. Also, an overriding facility shall be provided.

3.1.12.2 Water Testing Equipment

Water testing equipment shall be able to determine the chlorine residual and pH value of the pool water. The equipment shall be of portable type and suitable for field testing. For residual free chlorine testing, plain D.P.D. tablets and colour disc shall be provided. For pH value testing, phenol red solution and colour disc covering range of 6.8 - 8.4 shall be provided. The equipment shall be contained in a robust portable case suitable for carrying out field tests.

3.1.12.3 Portable Pool Cleaning Equipment

The cleaner shall be completely self-contained, with chassis & casing, removable filter, self-contained removable bag, pump & motor, mechanical drive system, control system, vacuum head, power cord, hand-held control box, etc. and operate without the need for piping connection.

The cleaner shall be of submersible type that can clean the bottom of pool without draining of any pool water, and perform cleaning by sucking up dirt and debris while roving both the bottoms and walls. It shall be fully automatic with driving wheels, and able to run in straight

and parallel paths and in free-form-shape pool. It shall have the ability to avoid being caught when meeting obstacles, through the provisions and profiles of its wings, flaps & shoes, and operate quietly with constant and balanced water flow. The cleaner shall be complete with a cart for free moving between storage and pool. All materials of the cleaner shall be resistant to swimming pool water.

The removable filter shall be of cartridge type with porosity not greater than 20 microns, which could be cleaned with an ordinary hose. The pump motor shall operate on 220 V AC, 50 Hz, and the length of power supply cord shall be 31 m minimum. The Contractor shall advise the Architect the type of power socket for connection before ordering. The cleaner shall be complete with a wireless remote control system such that it can move around in the pool by operating a hand-held control box.

Other necessary pool cleaning accessories shall include:

a) Algae Brush
b) Pool Broom
c) Leaf Scoop

3.1.12.4 Lifting Facilities

The Contractor shall check and ensure that all the equipment in the filtration plant rooms are well arranged and can be easily accessed for maintenance and operation. If there is any equipment that cannot be easily removed for maintenance, the Contractor shall propose eyebolts, lifting I-beams, chain hoists, access openings and other lifting facilities for use during servicing and maintenance of the installed equipment for approval by the S.O, as builder's works requirements will be carried out in the Building Part of this Contract. The Contractor shall allow for sufficient maintenance lifting facilities in the builder's works requirements for proper servicing and maintenance of all equipment on Drawings so that they can be incorporated in the Building Part of this Contract at early stage of project. The Contractor shall be responsible to carry out and bear all cost for the provision of access openings, maintenance and lifting facilities if additional numbers of them are found required during acceptance of the installation by the S.O.

The Contractor shall supply and install electric driven lifting chain hoists for handling of large pump motors.

The Contractor shall supply and install electric driven lifting facilities to lift and transfer the automatic swimming pool cleaner from storage to pool and vice versa should it be over a certain weight beyond a single operator's lifting capability.

The lifting height of the hoists shall suit the site condition, loading limit of I-beams and eyebolts and weight of the equipment/chemicals. They will provide normal operating purpose such as maintenance, delivery and relocation of materials and equipment. I-beams and eyebolts will be provided in the Building Part of this Contract.

The Contractor shall select and order chain hoists that can be mounted on the I-beam installed. Details of hoists shall be submitted to Architect for approval before ordering.

33.1.12.5 Supporting Chemical Treatment

Chemical treatment, other than disinfection purpose, of the pool water shall comprise of dosing of aluminium sulphate (alum) to the raw water to form floc and dosing of hydrochloric acid (HCL) solution to correct alkalinity imparted to water by disinfectants and soda ash (NaOH) to correct the acidity. Centralised preparation and storage tanks shall be provided which shall be designed with a capacity to store for 16 to 24 hours of continuous operation for at least 4 days.

Each chemical dosing system shall have 2 tanks, each can be operated independently while the other is in service. Both tanks are connected and would be used together under normal situation.

The chemical tanks of dosing systems shall be used as combined preparation and storage type and shall be made from reinforced fibreglass or high-density polyethylene, or equal and approved. Each tank shall be complete with outlets, valves, overflows to drains and accessories. Level indication such as level glass tube shall also be provided for all tanks. For alum dosing system, stainless steel with rubber lining is also acceptable and each tank shall be complete with stainless steel dissolving tray and electric stirrers.

The Contractor shall be responsible to supply and install pipings from make up tank to provide water supply for the chemical tanks where required for the normal operation of the system.

Individual chemical metering pumps shall be provided to inject the chemical solutions into the filtration plant. The chemical dosing pumps shall be plastic diaphragm variable output type complete with totally enclosed fractional horsepower motor. The pumps shall also have facilities for manually adjusted stroke length from 30% to 100% and stroke rates. Starters for the chemical pumps shall be of the direct on-line push button type with no volt release and magnetic overload protection. Each group of pumps for corresponding pool shall have 2 duty pumps and 1 standby pump, both having same characteristics, with selector switch enabling the choosing of any one of the pumps as the lead, bag or standby pump. Electrical supply and control facilities shall be such that all pumps can operate simultaneously under manual mode.

For alum system, 1 of the duty pump shall operate continuously when the carbon filters are in operation. The maximum dosing rate shall be 2.5 ppm of alum in main flow of water with 1 duty pump or as indicated in the Particular Specification. Initially, the stroke length shall be set to give 1 ppm of alum in main flow of water. The second duty pump is used to raise the alum level manually if required.

All level electrodes used for chemical dosing system shall be of corrosion resistant type suitable for submersing in the chemicals being used or measured.

It should be noted the HCL room is classified as Dangerous Goods stores. All equipment and devices installed in this room shall comply with FSD's requirements. All electrical equipment used shall be of flammable proof and explosion proof type where required by FSD.

Clear and concise notices and instructions on the operation procedures for the chemical dosing system shall be posted by Contractor besides the equipment of the systems. Warning notices shall also be posted to warn operators in handling the chemicals. The notices and instructions shall be made from permanent materials with easily reading characters in red, in both English and Bahasa Melayu.

The Contractor shall provide 2 sets of safety plastic gloves, face mask, goggle, footwear and 1 set of plastic protective clothing for handling of chemicals in chemical storage room.

3.1.13 CLEANING, PAINTING AND IDENTIFICATION

3.1.13.1 General

All surfaces, unless otherwise specified, shall be finished in accordance to the requirements in this section. All surfaces, other than those indicated to be left self finished such as stainless steel, PVC, anodized aluminium, shall be finished in first class paint work. All metallic surfaces shall be wire-brushed and cleaned to make it free from rust, scale, dirt and grease prior to painting. All work shall be carried out by qualified tradesmen.

Water based paints with reduced volatile and preservative content or paints with reduced solvent content formulated for minimal Volatile Organic Compound (VOC) emissions complying with reputable international standards and the General Specification for Building, 2007 Edition shall be used in occupied areas and renovated areas without good natural ventilation. In addition, all paints shall contain no mercury, lead, hexavalent chromium or cadmium compounds.

All painting works shall be completed and left in ventilated environment for at least 1 week, or the curing period recommended by the paint manufacturer whichever is longer, before occupation or handover of the renovated area to minimize VOC exposure.

All surfaces shall be painted and finished as specified in the Particular Specification to meet and match the aesthetic architectural design as required.

3.1.13.2 Cleaning of Pipework

All pipes, fittings, etc. shall be kept closed against moisture and foreign matters when stored on site.

All pipes, fittings, valves and accessories shall be thoroughly cleaned internally and externally before their installation and again where necessary before closing up.

After installation and before putting into service all pipework including fittings, valves shall be thoroughly cleaned internally.

3.1.13.3 Pipeline and Machineries Painting and Identification

All pumping equipment shall be factory painted according to the manufacturer's recommendations.

All thermoplastic pipes, fittings, valves, etc. exposed directly to sunlight shall be painted with water based exterior-grade latex paint.

All surfaces to be painted shall be first thoroughly cleaned to remove dirt, scales, grease spots etc. Surface shall be completely dry before painting.

The final external treatment for insulated pipes shall be as indicated in the Particular Specification or as directed on site by the S.O.

Pipes concealed in false ceiling need not be painted, unless otherwise specified in the Particular Specification but appropriate colour code identifications shall be applied.

Insulated pipes running in visual positions shall be plastered or otherwise finished as specified. They shall be painted in the appropriate identifying colour or as directed by the Architect in another colour plus identifying colour code bands.

Uninsulated pipes running in visual areas shall be painted in the appropriate colour throughout or painted in another colour as directed by the Architect but identified with appropriate colour code bands.

Unless specified in the Particular Specification or Drawings, painting shall not be applied to piping of UPVC, polyethylene, ABS and stainless steel.

The direction of flow of fluid shall be indicated by an arrow over the basic identification colour and painted white or black in order to contrast clearly with the basic identification colour.

Valves may be painted in the same colour as the associated pipework. However, if the pipeline is part of the fire services installation and has been coded only with the safety colour, the valves involved shall be fully painted "safety-red".

All surfaces shall have minimum one coat primer and two coats finish subject to S.O approval.

<u>Pipework Identification</u>

All pipes installed shall be identified in accordance with their relevant standards.

<u>Labels for Valves and Controls</u>

All control valves, relays, switches and instrumentation shall be identified by black or white engraved laminated plastic labels, securely attached to the item of equipment, or when such equipment is installed on or within panels or cubicle, the labels shall be located immediately below the equipment.

Directional arrows shall be painted on the pipework in the plant rooms, tank room and vertical risers.

3.1.14 ELECTRICAL MOTORS AND STARTERS

3.1.14.1 General

All electric motors shall be totally enclosed, fan cooled (TEFC) IP 55 and fully tropicalised and shall be furnished with Class `F' insulation to BSS 2757:1986 and BS 5000:Pt 99:1973 and suitable for operation on single and three phase 50 Hz. power supply.

All electric motors shall be furnished with isolator gears and starter gears which shall be fully tropicalised and comply with BSS 587:1954 incorporating amendments PD 3628: Jan 1960.

Thermal overload protection devices in all phases, over-current protection devices, and under-voltage releases shall be furnished and incorporated in the circuits of all electric motors.

The electric motor shall be totally enclosed fan cooled squirrel cage-induction motor, of sufficient capacity to efficiently fulfill the pump horsepower requirements. The continuous maximum motor rating shall be to B.S. 2613 and shall have minimum overload factor of 15% in excess of the power requirements at maximum discharge and minimum total head condition.

The pump motor shall be flanged motor and suitable for horizontal operation. Stator frames, end shields and terminal box and cover shall be cast iron or other approved material. Fan and fan bowl shall be corrosion protected material.

The motor winding shall be insulated to B.S. 2757, class ‘F’. The motor shall be suitable of 415V, 3 phase, 50Hz power supply. All electrical works pertaining to the motor installation shall be provided. The motor shall be suitable earthed and provided with overload trip protection. All supply cabling shall be PVC insulated cable runs in conduit or trunking of PVC/SWA/PVC type.

The AC motors shall also comply to the following:-

(a) Single phase AC motors shall not exceed 1 hp and if over ½ hp shall be fitted with a suitable starter designed to limit the starting current and including a no-volt release.

(b) Three phase AC motors up to and including 10 hp may be of the squirrel cage type. Up to 3 hp direct on lime starting may be used, and above 3 hp direct on line starting may be used, and above 3 hp a star-delta or auto transformer starter shall be provided and a no-volt release provided.

All motors from 2 hp shall have a power factor of not less than 0.9 at 80% load.

13.1.14.2 Electrical Switchboard

The Contractor shall supply and install a metal wall mounted switchboard which shall house all circuit breakers, starters, contactors, relays, selector switches, voltmeter and ammeter. The metal switchboard shall be fabricated from pressed steel sheets of not less than 16 SWG and shall be of rigidly structural construction with all joints neatly and finished flush and all bare edges turned over or lipped.

The doors of the metal switchboard shall be fabricated from pressed steel sheet of not less than 16 SWG and shall be rigidly reinforced on the inside with all edges finished

round. The doors shall be fitted with a handle such that it cannot be opened unless that isolator switches or handles are turned to the OFF position thereby cutting off the power supplly to the electrical mechanisms on the inside to the metal switchboard. Felt or rubber insert gaskets shall be incorporated in the frames of the metal switchboard to ensure dust-proof locking arrangement. The doors of the metal switchboard shall be fitted on the inside with shelve for storing spare cartridge fuses and contacts and electrical circuits diagrams.

All contactors, starters, relays and controllers shall be fitted on insulated panels. All incoming and outgoing circuits and wiring shall be brought to the contactors, starters, relays and controllers via insulated terminal strips mounted within the cubicle and all wiring between terminal strips and equipment inside the control panels shall be neatly run and taped strictly in accordance with the requirements of the Tenaga Nasional Berhad.

The complete control panel unit shall house the following functions:

(i) R-Y-B “on” indicator
(ii) Pump Run indicator
(iii) Pump Fail indicator
(iv) Pump Start Push Button
(v) Pump Stop Push Button
(vi) Ammeter, Voltmeter, MCCB and TPN Isolator
(viii) Auto Off Manual Key Selector Switch
(ix) Ammeter and Voltmeter Selector Switch
(x) Water Tank High Level (Suction and Storage Tank)
(xi) Low Level Indicator (Suction and Storage Tank)
(xii) Other as specified
(xiii) Alarm Bell

---------- END OF SECTION 3.1 ----------