

CHAPTER 2 AIR CONDITIONING AND VENTILATION

2.1 GENERAL

2.1.1 SCOPE

The Contractors works covered by this Specification comprises the supply, installation, commissioning, testing, placing into services and maintenance of the Air-conditioning and mechanical services including:

(1) Air Conditioning

Packaged air conditioners consisting of indoor evaporators and fans with outdoor condensing units and single package air conditioning units. Located as shown on the contract drawings.

(2) Ventilation

Mechanical exhaust systems shall be installed to garage, electrical room and kitchen space where shown on the contract drawings.

2.1.2 ASSOCIATED BUILDING WORK

The Contractor will provide the following items of work for the Mechanical Contractor.

- Opening or fixing of sleeves to openings in external and internal walls, floors, walls and ceilings, etc. to accommodate ducts, pipes, etc...
- Built in fixing inserts required for the attachment of brackets, etc...
- Concrete ducts for the piping and cables of outdoor condensing units.
- Concrete pads for mounting external equipment.
- Carriers and risers for passage of refrigerant pipework and cables.
- Access panels to concealed equipment.
- Flashing upstands for all roof penetrations, including primary support members for roof mounted equipment.

2.1.3 DESIGN CONDITIONS

The packaged air conditioning units and FCU(Fand Coil Unit) have been sized to the following limits at full load. No control of RH(Room Humidity) is required to be installed.

- | | | | | | |
|--------------|------|----|--------|----|--|
| (1) External | | | | | |
| Summer | 34°C | DB | 28.2°C | WB | |
| Winter | -2°C | DB | -3°C | WB | |
| (2) Internal | | | | | |
| Summer | 26°C | | DB+2°C | | |

Winter

22°C

DB+2°C

(3) Supply Air

Supply air quantities on the drawings are nominal only and dependent on the final packaged equipment selected and the manufacturer.

2.1.4 DESIGN STANDARDS

The installation shall be carried out in accordance with Chinese Standard Codes, JIS or equivalent.

Where specific standards or codes are referred to in the Bill of Quantities or the Specifications, or the drawings, other authoritative standards that ensure an equal or higher quality than the standards mentioned will also be acceptable. It will be incumbent on the Contractor to verify the equal or higher quality and to submit comparative standards (both specified and proposed standards) for review.

For any items not included in the above, the Sub-contractor shall use the appropriate Standards.

2.1.5 DIMENSIONS

The Contractor shall check all relevant dimensions on site and notify the Engineer of any discrepancies before proceeding with the works.

Under no circumstances shall dimensions be scaled from drawings. Use figured dimensions only.

The layout of equipment as shown on the Drawings shall be taken as diagrammatic only and all measurements and other information required to carry out the works specified shall be obtained by the Sub-contractor on site. No claims for extras arising from failure to obtain measurements and other information on site will be allowed.

Should any dispute arise as to the number of items or interpretation of plans or specification, such disputes shall be referred to the Engineer whose decision shall be final and binding on all parties concerned.

2.1.6 MATERIALS AND WORKMANSHIP

Unless otherwise specified, all materials and goods required for the project shall be new, the best of their respective kinds, conforming with the relevant standard specification and codes.

The Engineer reserves the right to inspect the work in progress and all materials to be used and in the event of any dispute regarding the quality of materials or workmanship. The Engineer reserves the right to order the removal or replacement of any material or goods which in his opinion is not satisfactory or does not comply with the specification. The Engineer shall give to the Contractor notice in writing of any defects in the works carried out by the Contractor. The Contractor shall then at his own expense and with all speed make good the defects so specified.

The Contractor shall provide and retain on site at all times copies of the relevant codes. Workmanship shall be the best practices of the trades.

2.1.7 INSURANCE

The Contractor shall take out and maintain during the Contract any insurance as applicable or proportional to this section of the work.

The Contractor shall submit evidence, before commencing work, that the required insurance policies have been effected.

2.1.8 WARRANTY

The Contractor warrants that the completed works and every part thereof and all materials, articles and goods used or incorporated therein, or supplied by the Contractor in performance, or purported performance of this Contract, whether purchased by the contractor under patent or trade name or otherwise, shall comply with the quality, nature, description and conditions specified, or shall otherwise be fit for the purpose for which they are required. The contractor shall be liable for breach of this warranty notwithstanding that the Project Manager or Engineer may have accepted the works, or any part thereof, as satisfactorily executed or otherwise.

2.1.9 GUARANTEES AND MAINTENANCE

The Contractor shall provide a comprehensive guarantee for twelve (12) months from the date of completion against faulty workmanship or materials. The Contractor shall ensure that equipment supplied by the manufacturer is also extended to cover the above period.

2.1.10 CONSTRUCTION DRAWINGS

The Constructor shall prepare and submit for approval prior to manufacture or installation Five (5) complete sets of shop drawings. All drawings shall be prepared generally in accordance with the drawings supplied with this specification, except where variations to the shop drawings are endorsed by the Client.

All shop drawings shall be on the same size drawing sheet and shall be to a scale not less than 1:50 and larger if necessary. All duct sizes shall be drawn overall external airway dimensions.

Construction drawings shall cover the following:-

- All structural penetrations including full dimensions to enable blockout and sleeve placement by others.
- Ductwork and pipework layouts including details of construction, supports, fixings.
- Electrical schematic layout.

Approval of drawings will not in any way relieve the contractor of his responsibility for errors or omissions and interference or from the necessity of furnishing such workmanship or materials as may be required for the completion of these works in accordance with this specification.

2.1.11 AS-BUILT CONSTRUCTED DRAWINGS

Provide (3) three bound sets of "As-Built" drawings and forward to the Engineer within (3) three weeks after completion. Final acceptance of this contract will not be given until receipt of these documents.

The As-Built drawings shall be a true and accurate representation of the actual installation and shall include the following:-

- Complete equipment layout drawings with full identification of each and every item of equipment.
- Complete piping layout showing the actual size and location of all refrigeration pipes applicable to the system.
- Complete control wiring diagram showing all electrical controls, relays cut outs, timing devices, fuses, etc. which shall be clearly identified as to the type of function.

"As-Built" drawings upon final issue by the contractor shall be of a uniform size and neatly bound into sets, with front and back covers. The front cover shall be titled.

2.1.12 MAINTENANCE AND OPERATING INSTRUCTIONS

On completion of a satisfactory performance test the contractor shall supply (3) three copies of Maintenance and Operating instructions bound together in a manual form.

These manuals shall include clear and precise instructions for the operation of the systems as a whole, complete details of recommended preventative maintenance with

recommended lubricants to be used, and the normal running period between applications, and all other information needed to keep the system in good order and condition.

The setting of all controls and protection devices shall be stated. Where proprietary equipment is installed the manufacturer's operating and maintenance instructions shall be included.

One copy of each instruction manual shall be left on site. One instruction manual shall be issued to the Engineer prior to final inspection and commissioning, for inspection.

2.2 MATERIALS AND EQUIPMENT

2.2.1 GENERAL

The Mechanical Services contractor shall supply and install all necessary equipment and components as herein described.

2.2.2 AIR CONDITIONING SYSTEM

The air cooled packaged units shall be of a factory assembled horizontal discharge type, and suitable for outdoor applications.

All condensate shall be drained as shown on contract drawings.

The condensers shall be fully compatible to the fan coil units in refrigerant and capacity.

The compressor shall be a Hermetically sealed compressor operating on R22 refrigerant.

The Condenser fans shall be direct drive, propeller type with blades.

All Condensing units shall be mounted on anti vibration mounts and bolted to the structure in accordance with the Manufacturer's recommendation.

Electrical panel should install loss phase protection.

2.2.3 MECHANICAL VENTILATION

Ventilation shall be provided to garage, electrical room and kitchen space by wall, or roof mounted exhaust fans and duct systems where shown on the contract drawings.

a) Exhaust Fans

Duct mounted fans shall be of axial flow form suitable for connection to ductwork systems as required.

The roof mounted units shall comprise centrifugal, or axial flow fans housed in a compact base fitted with back draft dampers.

The manufacturer shall ensure that all fans are adequate to withstand the pressures developed by the fan for the specified duty.

All fans shall be fitted with anti vibration mounts between fan and upstand.

b) Connections to ductworks

Fans shall be isolated from the ductwork system by means of flexible connections, the flexible connection shall be made with fire retardant materials.

Connection shall be such that the fabric can be removed without disturbing fan or ductwork, and the fan and ductwork are separated by not less than 100 mm.

c) Fan Motors

The motor power on a continuous maximum rating shall not be less than the sum of the fan limit load power at the specified speed. The motor shall be suitable for 220 volt and or 380 volt operation as indicated in the equipment schedule.

d) Fan Control

Fan on/off control shall be by switches as where shown on the design drawings.

2.2.4 DUCTWORK AND GRILLES

a) General

This part of the specification details the materials to be used and the methods to be employed in the fabrication and installation of ductwork associated with mechanical services.

The drawings indicate the extent and general arrangement of the ducting system. Details of departures from the contract drawings which are deemed necessary by the Sub-contractor shall be submitted to the Engineer for approval.

The drawings indicate the sizes of ducts in millimeters and the manner in which the various systems are to be installed. They do not, however, purport to show offsets and transitions which must be coordinated with other trades, measured on site or ascertained from Architectural drawings.

All ductwork systems shall be complete with transitions, bends, tees, supports, dampers, offsets, flexible connection, take offs and similar fittings necessary for the full operation of the air ventilation system and shall be fully detailed on the construction drawings.

All ductwork sizes are shown with clear internal dimensions of the air passage. In the case of rectangular ducting the first dimension indicates the size of duct in view on the particular plan or elevation, and the spiral duct in diameters. The fire dampers shall fully comply with relevant Standard.

All sheet metal ductwork shall be fabricated from full size galvanized sheet steel specifically manufactured for roll forming such as "Galvabond" or approved equivalent. Galvanizing shall remain unbroken after fabrication and installation.

b) **General Ductwork Construction (Small Systems)**

Ductwork shall be machine folded and free from waves and buckles. Rectangular ducts shall not have a Long/Short side ratio of greater than 4:1 unless shown otherwise.

Longitudinal corner Joints between two sides shall be made using Pittsburgh or Snap-Lock seams.

Sheet metal joints shall be "drive slip" and "plain slip" type restricted to duct sizes. S-slip sheet metal joints shall not be employed on internally insulated ductwork.

c) **Exhaust Air Grilles**

All exhaust air grilles shall be of an approved type, and selected for efficient air distribution and low noise levels.

All internal parts of outlets, such as volume controllers shall be finished matte black. External finishes shall be colored to match adjacent services.

2.3 INSTALLATION

2.3.1 DUCTWORK INSTALLATION

- a) **Ductwork Joints**
Sheet metal joints shall be sealed with a liquid or mastic sealant, applied with an injection gun. The use of adhesive tape will not be accepted.
- b) **Supports**
Ductwork or ductwork supports shall not be used for support to other services, ceiling systems, or light fittings.

Supports shall be installed at right angles to the center line of the duct, and generally at transverse joints whenever the specified spacing intervals match the length of duct sections.

At horizontal changes in duct direction one or more supports shall be symmetrically located at the center of the bend.

Supports shall be installed at duct ends, branches, diffusers, and plenums.

Vertical ductwork shall be supported from joints or stiffeners.

- c) **Hangers**
Hangers may be fixed to the building structure by the following:-

Steel - by steel bolts, nuts and washers and with clamps if appropriate.

Concrete or masonry - by steel expanding bolts in drilled holes.

Explosion power fasteners shall not be used.

2.3.2 PIPEWORK

- a) **General**
This section of the specification details the materials to be used and methods to be employed in the fabrication and in the installation of piped services associated with the mechanical services.

The Contractor shall install refrigerant pipes chilled and hot water pipes and

condensate pipes for the air cooled condensers and fan coil units, complete with insulation as described in this section of the specification.

All refrigerant pipes shall be located as indicated on the mechanical drawings.

Unless an alternative standard of material is required by the Local and/or Statutory Authority having jurisdiction over installation, the pipework shall comply with the following clauses.

Copper piping shall be hard drawn for pressures up to 1379 kPa. Copper piping shall be used on all liquid and suction pipes.

b) Pipework Construction

Unless shown otherwise, all permanent pipe joints shall be brazed or silver soldered. Flared unions, screwed joints, capillary fittings and compression fittings shall be used on non permanent fittings and connection to the unit.

All refrigerant pipes shall be de-hydrated and end capped.

Copper pipe bends shall have a center line radius of not less than 1.5 times the nominal diameter of the pipe.

Branch connections shall be made with factory produced tee-pieces, pipe to pipe branches shall only be employed on the approval of the Engineer.

c) Pipework Installation

All pipework shall be installed in workmanship manner. Pipe runs shall be straight, true, aligned and graded as required.

All pipework shall be supported by hangers, clips or rollers in suitable placed steel brackets, so designed and located to prevent any undue stress being applied to connected equipment.

The exact location of supports shall be determined to suit conditions on site but as far as possible they shall be located adjacent to valves, bends, branches, and joints at intervals to meet relevant standard.

Where groups of pipes are suspended from a concrete slab "Unitstrut" or equal inserts shall be used to aid the suspension, and at no time shall suspended pipework be closer than 100 mm to the ceiling over.

All supports and fixings subject to weather, condensation or other moist conditions under normal services shall be painted with a protective coating.

Provide a sleeve for all pipes passing through walls or floors. Clearance between pipe or pipe insulation and sleeve shall be adequate for installation and shall be tightly packed with fire retardant material.

d) Pipework Insulation

All liquid, suction, chilled and hot water pipes and condensate drain pipes shall be insulated as described in this section. All pipe bends, tees, valves, flare unions and fittings shall be insulated with a similar material to pipework.

The thickness of the insulation of the pipework, valves and fittings shall be as follows:-

PIPE	PIPE SIZE	INSULATION THICKNESS
Refrigerant, Condensate	0- 32	25 mm
Chilled and hot water	0- 25	30 mm
	32- 200	40 mm

All pipes shall be insulated with rigid molded sectional closed cell expanded polystyrene, or rigid fiberglass. All insulated pipework shall be provided with an approved vapour barrier of "Sisalation 450" adhesive bonded to the insulation. All insulation shall have a Thermal Conductivity of 0.036 W/m deg C and a density of not less than 17.5KG/M³. All insulation joints shall be of the lapped construction with vapour barrier joints lapped a minimum of 25 mm and sealed with tape.

Chilled and hot water pipes shall use glass wool insulation not less than 40 kg/m³.

Where pipework is exposed to the weather, install a further sheathing of 0.3 mm thick stainless sheet steel, rolled to diameter of the insulation and lapped 10 mm at the seam, popped riveted with blind rivets to pipework and fittings. Alternative protection where pipework runs at groups level shall be as shown on the drawings.

e) Testing of Pipework

Each pipework system shall be tested as a whole. Care shall be taken to avoid excessive tests pressures. Any equipment or instrument not capable of withstanding the test pressure shall be isolated during such tests.

Any leaks in screwed fittings shall be corrected by re-making the joint. In a welding joint by cutting out and re-welding.

All joints in the system must be tested. The test pressure shall be the gauge pressure recorded at the highest point of each system. Each system shall satisfactorily withstand test pressure of 1.5 times the design pressure and be

absolutely tight and drip-proof or gas leak after 24 hours. The gauges used for the test shall have a current certificate of calibration.

The Contractor shall give a minimum of 48 hours notice to the Engineer that the system is ready for test. Make available to the Engineer facilities to enable him to inspect and test any item of equipment, necessary to ensure procedures are taken.

All valves and fittings shall be the standard products of approved manufacture. All valves shall be entirely suitable and correctly sized for each application and unless otherwise shown shall be of the pipeline size. Valves shall be selected to suit the operating characteristics of the system.

All valves, controls and accessories shall be installed in positions readily accessible for operation and maintenance.

The connection between each valve and adjacent lines shall be made with flare or flange connection to permit the removal of the valve.

2.3.3 ASSOCIATED ELECTRICAL WORK

a) General

This section of the specification details the material and equipment to be used and the method to be employed in the electrical installation associated with mechanical services.

The Electrical Services Contractor shall provide an isolator switch adjacent to the air cooled condensers to enable the final connection only to be carried out by this sub-contractor. Power supplies for the exhaust and outdoor air fans shall be provided at an isolator adjacent to the fans or as nominated on the design drawings.

The Mechanical Services Contractor shall be responsible for carrying out the field wiring between the air cooled condenser, the fan coil unit and remote control panels. The remote control switches supplied by the manufacture of the air conditioning units shall be neatly mounted as indicated on the contract drawings.

The controls and power supply cables from the indoor fan coil units to the remote control panels and exhaust fans to switch cables shall be concealed. Remote control panels for the ceiling cassette type units shall be supplied standard with each unit and shall include instantaneous temperature display and adjustment.

b) Standards

Certificates or proof of compliance with the relevant standards shall be provided by the contractor within 14 days when requested by the Engineer. The materials and

equipment will not be accepted if certificates or proof of compliance are not provided when requested.

c) Cables and cable installation

Unless specified otherwise, all wiring shall be carried out with the loop in and loop out system and any intermediate joints shall only be made in enclosed junction boxes. Tee connections shall only be employed at specified terminal blocks and connected to equipment terminals.

Wiring shall generally be concealed under floors, in wall cavities, in false ceilings and roof spaces. Cables directly embedded in concrete, plastic etc. will not be accepted. They shall be enclosed in P.V.C. Conduit at all times.

Wiring installed in false ceilings or roof spaces shall be fixed to the underside of the floor or roof structure above at 100 mm intervals. In the event of this structure not being suitable, cable trays shall be employed to achieve continuity of fixing. Wiring shall not be laid on or supported from the false ceiling.

Wiring to the remote control switches shall be concealed.

The remote control switch location shall be neatly mounted to the wall.



CHAPTER 3 PLUMBING WORK

3.1 GENERAL

3.1.1 SCOPE OF WORKS

WATER SUPPLY AND SANITARY DRAINAGE: Hot and cold water service and mains supply to point of connection including rainwater downspouts; sanitary drainage and trade waste drainage including soil and waste piping systems to the point of connection to the drainage system; and associated pipework, reticulation, accessories, fixtures and fittings and associated apparatus.

3.1.2 STANDARDS

REFERENCE DOCUMENTS: The following standards of the latest edition are referred to in this section:-

The installation shall be carried out in accordance with Chinese Standard Codes, JIS or equivalent.

Where specific standards or codes are referred to in the Bills of Quantities or the Specifications or the drawings, other authoritative standards that ensure an equal or higher quality than the standards mentioned will also be acceptable. It will be incumbent on the Contractor to verify the equal or higher quality and to submit comparative standards (both specified and proposed standards) for review.

STEEL PIPE

Steel Tubes

COPPER PIPE

Copper pipe

Capillary fittings for copper pipe

Copper fittings for waste

POLYETHYLENE PIPE

Polyethylene pressure pipe

Polyethylene fittings

Polyethylene pipe installation

Plastic waste fittings

UPVC PIPE

UPVC soil & waste fittings

UPVC pressure pipes

UPVC rubber ring joint

UPVC pipe installation

Solvent cement

Plastic waste fittings

MISCELLANEOUS

Paint colors
Plugs for fixtures
Stainless steel material
Basins
Vitreous China
Stainless steel sinks and drainers
Vitreous china WC's
Laundry troughs
Toilet seat of molded plastic
Pipeline identification
Flushing cisterns
Copper alloy taps
Copper alloy gate valves
Fire hose reel installation

3.1.3 AUTHORITIES AND APPROVALS - PLUMBING

AUTHORITIES: Authorities whose requirements apply to the work of this section include:

- the Provincial Building Board or Town Building Authority
- the Provincial Health Division
- the Fire Fighting Service, Department of Civil Aviation

APPROVALS: Documents evidencing approval of such authorities shall be surrendered before the Certificate of practical Completion is issued.

WORKS BY AUTHORITY: If the responsible authority elects to perform or supply part of the works, make the necessary arrangements and pay any fees.

3.1.4 DRAWINGS AND DIMENSIONS

DIAGRAMMATIC LAYOUTS: Drawings showing pipework layouts are diagrammatic only. Before commencing work, verify the exact positions of fixtures, appliances and the like to which the pipework is to be connected.

AS-BUILT DRAWINGS: If requested provide 'As-built' drawings showing the locations of pipes and fittings, including the depth of underground pipework, positions of control valves, and the like. Give co-ordinate dimensions where applicable. Do not use scaled dimensions. Use given dimensions only.

3.1.5 SUPERVISION

PERSONNEL: Work shall be done by under the direct supervision of appropriately licensed tradesmen.

3.1.6 INSPECTION

Give sufficient notice so that inspection may be made at the following stage:

- Trenches excavated and ready for pipe laying
- Work ready for specified testing
- Underground or enclosed work ready to be covered up or concealed
- At any other stage as required

3.1.7 EXISTING SERVICES.

ALTERATIONS: Deal with existing services as necessary to complete the work specified in this section. Take precautions when altering metallic service pipework that may form part of an electrical earth electrode and ensure that a continuous path to earth is maintained at all times.

INTERRUPTIONS: Obtain approval before interrupting an existing service, and perform the work in accordance with an approved program so that the duration and number of interruptions is reduced to a minimum.

3.2 TESTING

3.2.1 TESTING

TESTS: Supply apparatus and materials necessary, and carry out tests required by the regulatory authorities in the presence of the authorized representatives and where specified, the Engineer.

CONCEALED WORK: Do not cover or conceal underground or enclosed work until it has been inspected and tested to approval. Leave pipe joints exposed to enable observation during the tests.

REJECTION: Pipework which fails required test, or which vibrates or is noisy because of insufficient support or loose fittings, is liable to be rejected.

UPVC PIPEWORK: Ensure solvent cement joints have been cured for at least 24 hours before testing.

3.3 WORKMANSHIP

3.3.1 INSTALLATION

GENERALLY: Arrange and install pipework in straight lines and uniform grades with proper supports that prevent sagging or vibration but allow thermal and other necessary movement. Provide bends and sets as required, and sufficient unions, flanges and isolating valves for satisfactory removal of piping and fittings for maintenance. Keep the number of joints to a minimum.

DISSIMILAR METALS: Avoid contact between dissimilar metals which are likely to generate electrolytic, galvanic or other corrosive action. Make junctions between such metals with special fittings manufactured in suitable compatible material.

CHANGES OF DIRECTION: Use bends where practicable in preference to elbow. Use elbows where pipes are led up or along walls and then through to fixtures.

JOINTS: Fit joints tightly, seal and make leakproof, with no internal projections, burr or obstructions.

CONCEALED PIPEWORK: Arrange pipework runs to be horizontally parallel to each other and to adjacent building members. Leave 25 mm clear space between pipes, and 50 mm between pipes and electric wiring. Take off branches at right angles for water supply and with appropriate bends for waste piping. Provide suitable removable access covers to allow servicing of drainage inspection openings.

STUD WALLS: Pipework may be run inside timber or metal stud walls providing that no framing member will lose more than one third of its cross-sectional area without prior approval.

3.3.2 ACCESSIBILITY

CONCEALMENT: Where practicable, conceal pipework so that it is accessible within ducts or non-habitable enclosed spaces and does not appear on external walls. If concealment is not practicable and if required, pipework and accessories shall be chrome plated copper and located only where approved.

ENCLOSED PIPEWORK: If pipework is proposed to be enclosed in an inaccessible location, obtain prior approval and if required record the actual locations on As-built drawings.

SANITARY PIPEWORK: Locate pipe fittings requiring maintenance access including inspection openings, cleaning points and the like, in accessible positions.

3.3.3 UNDERGROUND WATER PIPES

TRENCHES: General open-trench excavation and backfilling is specified in SERVICE TRENCHES-SITWORKS.

BEDDING Trim trench bottom to provide continuous, uniform and adequate support to the pipe. Bed the pipe in sand or selected excavated material free from hard or sharp objects or lumps and fill to 150 mm above the top of the pipe.

MINIMUM COVER: Unless over-ridden by regulatory requirements provide minimum cover over pipes of:

- 450 mm for pipes not subject to vehicular loading
- 600 mm for pipes subject to vehicular loading

SHARED TRENCHES: Where water pipes are laid in the same trench as a stormwater or sewer drain they shall be located on a shelf excavated at one side of the trench not less than 50 mm wide and at least 100 mm above the highest part of the drain.

PIPEWORK UNDER SLABS: Protect pipework under concrete floor slabs by supporting on compacted underlay material 150 mm thick, and provide compacted overlay and side support of sand or clean excavated material to not less than 150 mm above the top of the pipe.

3.3.4 CLEANING OUT

REQUIREMENT: Remove all foreign matter and flush out the system to provide clean water at outlets.

3.3.5 SLEEVES AND CHASES

SLEEVES: If required, where pipes pass through concrete walls, floors, beams and columns provide purpose-made metal or plastic sleeves with min. 5 mm clearance around all pipes, packed with gunned silicone rubber joint sealer (self extinguishing grade).

CHASES: Where possible form chases as concrete is being poured. Where necessary cut chases with a power saw unless otherwise approved. Do not chase reinforced concrete work without approval. Keep size of chases the minimum necessary.

PIPE ENCASED IN CONCRETE: Provide a minimum cover of 25 mm and lay in continuous lengths without fittings unless the fittings are permanently accessible. Provide approved flexible waterproof wrapping to allow for thermal movement.

3.3.6 CAPPING OFF

During construction, temporarily seal open ends of pipes and valves to prevent the entry of foreign matter into pipe systems. Provide purpose made covers of copper, pressed steel or rigid plastic. Do not use rags, paper or wood plugs.

3.3.7 BACKFLOW & CROSS CONNECTION PREVENTION

Install the water systems so as to prevent non-potable liquids, solids or gases from being introduced into the potable water supply through cross connections or by backflow, in accordance with the Chinese Plumbing Standard.

3.4 FASTENINGS

3.4.1 SUPPORTS

Provide supports including hangers, saddles, bolted clips and the like, sufficient to secure the pipework to adjacent surfaces and to support it at joints, at changes of direction, and at intervals suitable to the size and type of pipe and as necessary to prevent sagging of pipework. Make provision for adjustment of gradient as required. Clips for wall mounting shall be screwed, not nailed to supports.

SUPPORT MATERIALS: The same material as the pipe or galvanized or non-ferrous bonded PVC or fiberglass woven tape sleeves to separate dissimilar metals. Provide fixings of compatible material.

3.4.2 COVER PLATES

Where pipelines emerge from wall, floor or ceiling surfaces, provide cover plates of non-ferrous metal finished to match the pipe. Cover plate diameter shall be nominally 50 mm larger than the pipe.

3.5 PIPEWORK

3.5.1 PIPING MATERIAL

SELECTION: Acceptable piping materials are listed below for various building applications. The use of alternative materials will require prior approval.

INTERNAL WATER SUPPLY:

- exposed to view
- concealed

COPPER-chrome plate finish
COPPER, POLYBUTYLENE

EXTERNAL WATER SUPPLY:

- exposed to vandalism
- underground
- within concrete

GALVANIZED STEEL
COPPER, POLYETHYLENE
COPPER

SANITARY DRAINAGE:

- all locations

CAST IRON, GALVANIZED STEEL
PIPE

TRADE WASTE DRAINAGE

- in ground

REINFORCED CONCRETE PIPE

3.5.2 PIPING SIZES

Unless otherwise indicated on the drawings or required by the relevant authorities, pipework shall be sized as follows:

Water Supply	Nominal diameter (mm)
• Connections serving less than 10 water fittings	20
• Connections serving 10 or more water fittings	25
• Internal lines	20
Soil/Waste	
• Waste from hand basins	40
• Waste from other fittings	50
• Waste vents	50/80/100
• Soil pipes	100
• Terminal vent pipes	100

3.5.3 GALVANIZED STEEL PIPING

Galvanized steel tubes shall be to medium grade with screwed joints. Galvanized steel tubes and accessories shall not be used underground or in concrete slabs except for standpipes.

3.5.4 COPPER PIPING

Copper piping shall be to relevant standard - Type for Water Supply
- Type for Sanitary Plumbing

Fittings shall be de-zincification resistant if required by the relevant authorities.

- Capillary fittings:
- Compression fittings:

Jointing shall use capillary fittings or compression fittings. Make slip joints using a proper tool, soften and expand the pipe to form a slip joint of not less than the following lengths:

Nominal pipe size (mm)	Length of slip joint (mm)
• 15 - 20	10
• 25 - 32	12
• 40 - 65	16
• 80 - 100	20

3.5.5 POLYETHYLENE PIPING

Pipe, fittings and Installation shall be to relevant standards.

3.5.6 UNPLASTICISED POLYVINYL CHLORIDE (UPVC)

Pipe, fittings and Installation shall be to relevant standards.

3.5.7 PIPE FINISHES

All exposed pipes (except chrome plated pipes) in front of a painted surface shall be painted. Colors to match adjacent wall surface unless identification colors are required. Paint systems description refer PAINTING Section, also APPLICATION-PAINTING.

IDENTIFICATION: If required by the authorities apply flow direction arrows and identification colors by means of tape or paint.

3.5.8 PIPEWORK INSULATION

Water supply, drainage, fire fighting and hot water pipes shall be insulated as described in this section.

The thickness of the insulation of the pipework, valves and fittings shall be as follows: -

PIPE	PIPE SIZE	INSULATION THICKNESS
Water supply drainage fire fighting	0 - 80	20 mm
	100 - 150	25 mm
	200	40 mm
Hot water	0 - 25	25 mm
	32 - 50	30 mm
	65 - 150	40 mm

All pipes shall be insulated with rigid molded sectional closed cell expanded polystyrene, or rigid fiberglass. All insulated pipework shall be provided with an approved vapour barrier of "Sisalation 450" adhesive bonded to the insulation. All insulation shall have a Thermal conductivity of 0.036 W/m deg C and a density of not less than 17.5KG/M³. All insulation joints shall be of the lapped construction with vapour barrier joints lapped a minimum of 25 mm and sealed with tape.

All pipes shall use glass wool insulation not less than 40 kg/m³.

Where pipework is exposed to the weather, install a further sheathing of 0.3 mm thick stainless sheet steel, rolled to diameter of the insulation and lapped 10 mm at the seam, popped riveted with blind rivets to the pipework and fittings. Alternative protection where pipework runs at groups level shall be as shown on the drawings.

3.6 VALVES

3.6.1 ACCESSORIES

Provide each fixture with the accessories, including tapes, valves, and the like, necessary for proper functioning compatible with the fixtures they serve, and of types as shown on the drawings or specified.

3.6.2 TAPS AND COCKS

Copper ally taps shall be easy clean type pillar or bib cocks as appropriate in chrome plate finish. External laundry tub and standpipes shall have brass hosecocks.

Provide chrome plated brass wall extension pieces for bib taps to allow taps to discharge properly into bowls or fittings. Tap Heads shall be star type chrome plate brass, unless specified otherwise. Provide purpose made chrome plate flanges or cover plates and bed in sealant for a neat waterproof seal between tapes and their mounting surface.

3.6.3 VALVES

Gate and non-return valves shall be of copper alloy to relevant Standards. Full bore gate type with screwed connections. Valve spindles shall be non-rising type. Install valves with spindles in a vertical position where practicable.

Conceal valves wherever possible in ducts or non habitable spaces provided that they shall be accessible as specified in ACCESSIBILITY - PLUMBING. Valves in visible positions shall be finished to match that of adjoining visible pipework.

3.6.4 VALVE ACCESS

Provide access shaft and lid for access to underground gate valves. Lid shall be 150 thick 300 x 300 concrete lid.

150 mm diameter UPVC pipe flush with ground surface and extending down and slotted over service line shall be provided to give clear access to the valve wheel or spindle. Surround top 100 mm of shaft with a 300 x 300 concrete collar with top surface trowelled level.

3.6.5 SHOWER

Install either dual shower bib taps and mixing box or proprietary shower mixer valve, where both hot and cold water supplies are available to the shower, as specified.

Shower head shall be arm mounted swivel type 100 mm chrome plated head, mounted, 1,800 mm above floor level unless specified otherwise.

3.7 MAINS WATER SUPPLY

3.7.1 MAINS CONNECTION

Connect the water supply system to the supply main through a stop valve and a meter, if required. Provide underground connection from the meter to the building.

RISER: The supply riser from the underground connection, shall be protected above ground from vandalism by either concealment (i.e. inside a duct or wall) or encasement in a protective sleeve consisting of galvanized steel pipe extending up to 2,000 mm above ground level.

STOP VALVE: Provide access shaft as for VALVE ACCESS - PLUMBING.
ved precast concrete box.

3.8 FIRE SERVICES.

3.8.1 FIRE HOSE REELS & SPRINKLERS - PLUMBING

Install fire hydrants, hose reels according to the drawings, to the manufacturer's recommendations, and the requirements of Plumbing Standard.

IDENTIFICATION OF PIPEWORK: Provide distinguishing coat of full gloss enamel paint system color bright red.

3.9 HOT WATER

3.9.1 HOT WATER UNIT

Electric Hot Water Unit shall be packaged proprietary automatic water heater including the connections, controls and fittings necessary for the proper functioning of the unit.

INSTALLATION: To comply with the supplier's recommendations.

HOT TAPS: For sink, basin, shower or other specified fittings with hot and cold taps, ensure the hot tap is installed on the left or above the cold tap. Clearly and permanently mark tap with an "H" or "Hot" or by a red marker.

LAGGING: Lag all hot water distribution pipes with approved performed, flexible vermin proof, closed cell foamed elastomeric pipe lagging where exposed to external air movement or passing through masonry work. Size lagging to match pipe diameter and with a nominal wall thickness of 10 mm.

3.10 STANDPIPES

DRAINAGE: Unless indicated otherwise on the drawings fall slab to an open earth drain to discharge where directed.

3.11 SANITARY PLUMBING

3.11.1 SOIL AND WASTE SYSTEMS

Install pipework and sanitary fixtures in accordance with relevant Standard, as specified and shown on the drawings, or as required.

Copper fittings, UPVC fittings shall be to relevant Standard, and shall have fire collars fitted where required.

Hydrostatic or air test of a pressure and duration as required by the regulatory authorities shall be conducted.

SIZES: Refer to 3.5.2 Piping Sizes.

FINISHES: Refer to 3.5.8 Piping Finishes.

3.11.2 BRANCHES

When a branch line enters a vertical pipe, the branch fittings shall be wholly outside the vertical pipe so that the internal bore is maintained at all places.

3.11.3 TRAPS

Loose ring P trap and S trap - fitted to all wastes. Diameter to match the waste pipe.

Material of traps shall match material of connecting pipework.

In visible location finish traps to match adjoining visible pipework.

3.11.4 FLOOR TRAPS, RISERS AND GRATES

Provide traps and inlet risers of the same material as the outlet pipework.

Grates shall be screw in type, either UPVC or chrome plate finish cooper.

3.11.5 CONNECTION TO SEWER DRAIN

Connect discharge and vent pipes to disconnector gully level inlets or appropriate drain fittings.

3.11.6 TRADE WASTE DRAINAGE

Provide grates, traps pipework, coalescing Plate Separator and holding tank and connect to disconnector traps.

3.12 SANITARY FIXTURES

3.12.1 Fixtures

Install fixtures as specified in the Schedule of Sanitary Fittings or indicated on the drawings in accordance with the manufacturer's recommendations and the appropriate standards and regulations.

NOTE: WHERE A PARTICULAR PROPRIETARY ITEM IS NOT SPECIFIED, THE FIXTURES SHALL BE AS FOLLOWS:

WATER SUPPLY: Provide suitable water supply, cocks and taps. Refer to 3.6.2 Taps & Cocks.

MATERIALS:

- Vitreous China
- Stainless steel
- Fabrication
- Fixtures subject to corrosive action in service shall be stainless steel, welded with molybdenum type electrodes.
- Enameled Pressed Steel
- Alternative Materials may only be used with approval.

FINISHES:

Unless specified otherwise

- Vitreous China and enamel fittings **WHITE.**
- All stainless steel **BRIGHT.**

PLUGS: To relevant Standard

3.12.2 SHOWER TRAYS

Shower Trays shall be minimum 100 mm deep single seamless unit, 1.2 mm stainless steel or pressed steel vitreous enamel. Apron front with flanged back and sides to accept sheet or tile wall linings. Size to properly fit the recess indicated on the drawings.

3.12.3 WALL BASINS

Wall Basins shall be to Vitreous China, pressed stainless steel or pressed steel vitreous enameled to the size indicated. Basin shall be complete with recess for soap and suitable for the number and type of taps required.

Supports shall be proprietary concealed wall mounting bracket system.

Height shall be set at rim 750 mm above finished floor level.

3.12.4 VANITY BASINS

REQUIREMENT: As for wall basins and shall be self rimming.

SUPPORT: Securely fix to vanity unit top and bed on approved white, silicon sealant.

3.12.5 WASH TROUGHS

1.2 mm stainless steel wash trough. Length as indicated on drawings with minimum 250 mm wide x 200 mm deep trough, 150 mm high, back upstand to accommodate bib cocks, 25 mm wide front and end rims turned down and in. Install to ensure sufficient falls to waste pipe to prevent ponding.

SUPPORTS: Stainless steel concealed wall mounting brackets.

HEIGHT: Rim 750 mm above finished floor level.

3.12.6 SINK/DRAINERS

Sink/Drainers shall be 1.2 mm stainless steel, to the size and bowl/draining configuration indicated on the drawings. Unless flat rim type is specifically noted the unit shall be aproned on front and exposed sides with minimum 100 mm upstands to back and sides abutting walls. Drainers shall be grooved self draining type, installed to prevent any ponding.

Where flat rim i.e. bench inset type is specified, install according to manufacturer's recommendations. Seal rim in bedding on a continuous bed of silicon sealant. Neatly finish by fillet of approved color sealant between rim and bench top.

Height shall be as indicated on the sink bench drawings, otherwise at 900 mm above finished floor level.

3.12.7 WATER CLOSETS

Pedestal pan shall be floor mounted vitreous china to with "S" trap as indicated or as appropriate.

Pedestal shall be fixed to floor by;

- Brass screw to timber floor
- Cement mortar bed and approved plug or expansion type fixing to concrete floor

Pedestal seat shall be non-rigid molded plastic. Recessed underside and matching cover flap, standard hinged. Color white, or as otherwise specified.

Pedestal pan cistern shall be to relevant Standard. Molded white plastic, low level-push button. Capacity 11 liter nominal for mains water.

3.12.8 URINALS

Unless otherwise specified provide wall mounted automatic flushed, vitreous china individual stall type. Top or back inlet as appropriate with integral flushing rim and chrome plate flushing spreader and "dome" waste grate connector.

3.12.9 THERMOSTATIC MIXING VALVE

Supply and install a thermostatic mixing valve to disabled area complete with locking device and cover plate for access.

3.12.10 COALESCING PLATE SEPARATOR

Supply and install a coalescing plate separator complete with pump and fittings required to complete the installation.

3.13 WASTE WATER TREATMENT

3.13.1 OILY WASTE DRAINAGE

Oily waste drainage discharged from maintenance building shall be treated as separate to oil and water by a holding tank with coarser.

The separated waste water shall be drain into the sewer waste drainage line.

CHAPTER 4 ELECTRICAL WORK

4.1 GENERAL

4.1.1 GENERAL

The work covered in this section comprises the supply, installation, testing, commissioning and guarantee for a period of twelve (12) months of the complete electrical services installation as described in detail in the following clauses or shown on the drawings, and in conformity with the specification applicable to the work.

The complete installation shall be tested to ensure that all systems function satisfactorily and comply with the detailed requirements of this specification and any statutory authority having jurisdiction over the installation.

The installation shall be commissioned with all systems set into operation and demonstrated to the nominated occupants of the completed building. The Client is to be instructed as to the function of all equipment, the method of operation and the day-to-day maintenance requirements.

The installation shall be maintained for the defects liability period of twelve (12) months in first class working condition, periodical testing being carried out as specified, all faults rectified and any defective equipment replaced. A comprehensive operations and maintenance manual (3 copies) shall be provided not less than seven (7) days before practical completion of the installation. As 'Installed Drawing' (3 sets) plus an Auto Cad Disk giving the precise details of all controls, electrical circuitry, pipe work and duct work, etc. shall be provided not later than thirty (30) days after practical completion of the installation.

4.1.2 SCOPE

The work under this section of the contract shall comprise the complete electrical installation and all other associated works necessary to place the electrical installation in full working order in accordance with this specification and details shown on the contract drawings.

A general description of the work is as follows:

- a) Supply and installation of general purpose outlet (GPO) indicated on the drawings.
- b) Supply and installation of light fittings indicated on the drawings and specified herein.
- c) Supply and installation of all exit and emergency lighting, indicated on the drawing and specified herein.

- d) Supply and installation of telephone cable and conduit to points as indicated on the drawings.
- e) Wiring isolation switch, and control panel for exhaust fans, air-conditioning unit and pump supplied and installed by contractor.
- f) Public Address system.
- g) Emergency alarm system

All other work whether specifically mentioned or not, necessary to provide a completely operative installation in accordance with the intentions of the specification and drawings.

4.1.3 ELECTRICITY SUPPLY

The electricity supply is 380/220V 3 phase 50 Hz.

All equipment selected shall be suitable for operation on the above voltage and frequency.

4.1.4 BALANCE OF LOAD

The Contractor shall, as far as possible, balance the load on the distribution boards and also on the complete installation over the individual phases of the supply.

4.1.5 EARTHING

The complete installation shall be earthed to approval in accordance with the Chinese Standards, JIS or equivalent. Wiring Rules and the requirements of the Supply Authority.

4.1.6 SEGREGATION OF SERVICES

All wiring associated with other services such as Telephone, TV, computer and alarm systems shall be segregated as required under the Code.

4.1.7 DANGER SIGNS AND LABELS

Danger signs and labels of an appropriate size shall be fitted in areas and on equipment where dangerous conditions exist.

4.1.8 GUARANTEES

The Contractor shall guarantee that all equipment used in this installation complies fully with the intent and meaning of this specification and all relevant standards, as well as the requirements of all authorities having jurisdiction over such work and equipment.

The Contractor shall, where called for and where applicable, provide confirmation of such capacities, ratings and duties as well as overall performance. Any such items found

wanting in this respect shall be replaced entirely, or rectified to the Engineer's satisfaction at the expense of the contractor.

The Contractor shall guarantee all equipment and work against faulty workmanship and materials for a period of twelve (12) months from the date of practical completion. If tenderers include in their tender equipment that which is covered by a lesser guarantee, they shall allow for and include the cost of extending that guarantee to the whole of the defects liability period.

4.1.9 ADJUSTMENT

The Contractor shall carry out at his own expense all necessary tests and adjustments to the plant and equipment to attain the specified performances and conditions of operation prior to the occupation of the building. However, if for any seasonal or other agreed reasons some adjustments and tests cannot be completed at this time, they shall be carried out during the period of twelve (12) months after the date of practical completion.

The latter adjustments will have to be made while the building is occupied. The Contractor shall allow for any additional costs that may be involved in carrying out these adjustments at the convenience of the Client, outside normal working hours if necessary.

4.1.10 DEFECTS LIABILITY PERIOD

During the defects liability period any equipment requiring regular routine servicing shall be served by the Contractor at no additional cost to the Client. The Contractor shall be entirely responsible for performing all regular inspections and servicing during the defects liability period in accordance with the maintenance and operating instructions provided by him as required by the specification. The contractor shall prepare and utilize a schedule of maintenance procedures and duties which, following the performance of such procedures and duties shall be signed by the authorized representative of the Client. Service visits shall be carried out at intervals of not longer than three (3) months.

Where materials, equipment and/or workmanship are replaced during the defects liability period, such material, equipment and/or workmanship shall carry a further defects liability period equal to the originally specified defects liability period, but shall not be subject to maintenance and servicing by the Contractor beyond the date of expiry of the contract defects liability period.

4.1.11 STANDARDS AND APPROVAL

Where specific standards or codes are referred to in the Bills of Quantities or the Specifications or the drawings, other authoritative standards that ensure an equal or higher quality than the standards mentioned will also be acceptable. It will be incumbent on the

Contractor to verify the equal or higher quality and to submit comparative standards (both specified and proposed standards) for review.

The work of the electrical services installation shall be completed to the satisfaction of the Engineer. Workmanship and materials shall be the best of their respective kinds in regard to quality, quantity, duty, performance and arrangement.

All work shall comply in all respects with the relevant rules and regulations of statutory authorities having jurisdiction over this installation.

The installation shall be in accordance with the particular requirements of the local supply authority.

4.1.12 SHOP DRAWING

After the date of notification of acceptance of the tender, the contractor shall commence the preparation of necessary working drawings so as to meet the time schedule with due regard to the time required for the examination by the Engineer and for the time required for possible alteration and resubmission.

The Contractor shall, on the shop drawings submitted for approval, or by covering letter, indicate clearly any equipment or material that does not comply with either the specification, the tender drawings, or the accepted tender and shall indicate the reasons for non-compliance. In the absence of such statement the Engineer shall assume that drawings are in accordance with the specification, the tender drawings and/or the accepted tender.

The Engineer's permission to use shop drawings will not relieve the Contractor of responsibility for any deviation from the requirements of the contract documents, unless such deviation has been approved in writing by the Engineer.

The Engineer's permission shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings. No work requiring shop drawings shall be commenced until permission to use such drawings has been given.

4.1.13 INSTALLATION, FEES AND NOTICES

Each item of equipment shall be installed completely in accordance with the requirements and recommendations of the manufacturer or his licensed representative, subject to the requirements of all statutory authorities having jurisdiction, unless specified directions to the contrary are given with the approval of the Engineer.

The inspecting authorities requirements in regard to testing and giving notice, paying of fees and similar items shall be met in all regards in carrying out the works of this contract. All relevant test and approval certificates shall be handed to the Engineer at the completion of the works of the contract.

All fittings, apparatus or accessories shall be tested as required under the Electricity Act and the Contractor shall pay all fees associated with these tests.

4.1.14 REJECTION OF PLANT

If the complete plant or any portion thereof be defective or fails to fulfill the requirements of this contract, such plant shall be made good or shall be liable to rejection in accordance with the conditions of contract.

4.2 SWITCHBOARDS

4.2.1 DISTRIBUTION SECTION

a) General

Supply and install the distribution section complete with circuit breakers generally in accordance with the following requirements.

The general schematic of the distribution section shall be as indicated on the drawings.

b) Construction

The distribution board shall be of the dead front, multi-pole totally enclosed type, recess mounted, containing moulded case circuit breakers and other equipment that may be required as indicated on the drawings.

It shall be constructed from 1.6 mm zinc coated steel. The finish shall be Electrical Orange Color to Chinese Standards, JIS or equivalent, applied by baked enamel and red oxide undercoat method.

Escutcheons shall be fixed to the panelboard box by fastening screws to allow easy access to the panelboard interior.

The doors shall be of the dished type constructed from 1.6 mm zinc coated steel and the finish shall be the same as for the panelboard. The doors shall be fitted with locks, keyed alike, and two keys supplied per panelboard. The doors shall be easily removable and shall cover the escutcheon screws.

Multiple size knockouts shall be provided top and bottom of the distribution board.

Neutral size knockouts shall be provided top and bottom of the distribution board.

Neutral and earth bars of adequate size shall be fitted.

The board shall be securely bolted into position using a minimum of four (4) bolts.

c) Busbars

The busbar and tee-offs shall be made of high conductivity, hard drawn copper and shall be fully insulated and color coded. The busbar system shall be Type Tested at a fault level of as stated on the schematic drawings.

Tongues shall be provided for all future circuits where circuit breakers are not installed.

d) Circuit Breakers

Circuit breakers shall be of the clip-on type and interconnected with a three phase busbar system which must not rely on the circuit breaker terminals for support. The circuit breakers shall be to Chinese Standard, JIS C 8370 or equivalent for fault capacities of 10 KA or more and to Chinese Standard, JIS C 8370 or equivalent for miniature overcurrent circuit breakers up to 100A current rating and less than 10KA fault capacity.

Construction shall allow for complete interchangeability of single or multi-pole breakers without alteration to busbar connection or breaker mounting fixture. A separate fit-out tray assembly shall be provided to mount breakers and busbar supports.

Earth leakage devices to Chinese Standard, JIS C 8374 or equivalent shall be provided integral with circuit breaker protection operation.

Circuit breakers shall be Email Quicklag or equal approved and shall incorporate both thermal or magnetic protection.

e) Power Switches

Manual power switches for isolating as scheduled or indicated on the drawings shall be fuse switch units fitted with links or alternatively double air-break, rotary operation flush mounted type.

The handles of rotary operation switches shall be of the level type designed to give a marked and positive indication of switched position.

f) Contactors

Supply and install contactors to Chinese Standard, JIS C 8325 or equivalent controlling the lighting as indicated on the drawings.

The contactors shall be similar to Sprecher and Schuh and shall be fitted with minimum 20 amp contacts to AC3 rating.

g) Motor starters

Motor starters shall be provided with thermal overload relays single-phase protective relays and reverse sequence protect relays. Thermal overload relays shall have thermal characteristics suitable for associated motor and its starting characteristics, and suitably compensated for ambient air temperature variations.

h) Schedule

A mechanical schedule of circuits shall be provided at all distribution boards.

4.2.2 DISTRIBUTION BOARDS

Distribution boards shall be of the totally enclosed metal clad type complete with the equipment indicated on the drawings.

The distribution boards are to be constructed to fit in the space allocated. A general arrangement of the distribution boards is shown on the contract drawings. All distribution boards shall have hinged lockable door with seal to Chinese Standard, JIS or equivalent and internal hinged escutcheon panel.

Provide and install for each distribution board an approved typewritten circuit schedule. The schedule shall be protected by plastic or glass and fixed in a suitable frame adjustment to the distribution boards.

The distribution boards shall be painted with primer and two (2) coats of orange color enamel.

Provide distribution board labeling to Chinese Standard, JIS or equivalent.

Marking shall include labels for each switchboard control, circuit designations and ratings, fuses fitted to fuse holders, current limiting fuses, warnings notices for operational and maintenance personnel and the like.

Three (3) copies of dimensioned layout drawing for the distribution boards shall be submitted for approval before manufacture begins.

4.3 ELECTRICAL ACCESSORIES

4.3.1 CONDUITS

All conduits shall comply with the requirements of the relevant Chinese Standard Specifications. No conduit less than 20 mm diameter shall be used without prior approval.

Flexible conduit shall be used to connect conduit runs to free standing equipment and equipment subject to vibration.

Arrange the building-in of conduits and inserts as the work proceeds.

All conduits shall be heavy duty UPVC to Chinese Standard, JIS C 8430 or equivalent or metal where specifically indicated. Conduits shall be laid to straight and symmetrical lines with easy sets of bends. Bends or sets must be made without altering the section of the conduit. Where it is not practicable to set the conduit, spring bends shall be used. PVC conduit shall be joined using the manufacturer's recommended solvent and following closely his printed instructions.

Conduits cast-in situ shall be securely fixed to the steel reinforcement with heavy binding wiring to prevent the movement of the conduit during the pouring and vibrating of the concrete.

Conduits installed in screeds and chases shall be secured at intervals not exceeding 1.5 m with approved fixings. Conduit stub-ups through concrete surfaces and foundations shall be adequately braced to prevent shifting during pouring.

Obtain approval to run surface mounted conduit.

Surface mounted conduits, if approved, shall be fastened at intervals not exceeding 1.0 m. Where conduits enter distribution boards and accessories of any kind, the conduit shall be secured at each side of the entry.

The conduits, particularly in cavity walls etc., shall be arranged such that, under no circumstances, will they aid the passage of moisture into the building.

The wiring of a particular section shall not be carried out until the completion and final fixing of conduits in that section.

All conduit runs where cast into the concrete slab shall be looped at their terminal points to adjacent conduit runs in order that alternative paths can be provided should conduit blockages be encountered.

All conduit systems shall be installed to form a "draw-in" type wiring installation.

Conduits and accessories shall be fully assembled complete with draw-in wires before the drawing in of cables.

4.4 LIGHTING FIXTURES

4.4.1 STANDARDS

All fittings shall be constructed in accordance with the details of this clause. Where any fitting is referred to by a supplier's catalogue number this does not necessarily mean that the firm's product is required. Alternative supplier's products will be considered provided they comply with the standards specified in respect to design, type and quality.

All lighting fixtures shall comply with Chinese Standard, JIS C 8105 or equivalent.

4.4.2 SAMPLE FITTINGS

The Contractor shall deliver to the Engineer a sample of each fitting.

Approval of each sample fitting shall be obtained before commencing manufacture.

Sample fittings must be clearly labeled with the manufacturer's name and type number.

Failure to comply with this requirement may mean rejection of the fitting.

4.4.3 GUARANTEE

Obtain from the manufacturer a guarantee that all equipment is warranted against faulty design or faulty workmanship for the defects liability period. Replace any equipment which proves defective in normal operation during that period without cost to the principal.

All lamps and/or tubes which fail within the defects liability period shall be replaced and installed at no cost. Such replacements shall be carried out at times to be arranged with the Client.

4.4.4 GENERAL

Supply and install lighting fixtures as scheduled on the drawings

All fittings shall be of a standard manufacture and shall comply with the latest codes and their amendments.

The light fittings indicated by catalogue numbers are the preferred manufacture, however alternatives may be submitted for consideration.

All fitting shall be supplied complete with lamps and/or tubes and their associated control equipment ready for installation.

The installation of all light fittings shall be carried out in a workmanlike manner, so that they may be removed without undue difficulty for the purpose of maintenance and servicing.

Provide all necessary support brackets and fixings which may be required for light fittings.

4.4.5 FLUORESCENT LIGHTING FIXTURES

a) General

Except where specified or shown as being aluminum, metalware or fluorescent lighting fixtures, reflectors, channels etc. shall be constructed from zinc-anneal sheet not less than 0.8 mm thickness. All corners and joints exposed to normal view shall be welded, ground smooth and filed where necessary before painting.

Fittings shall have closed ends unless otherwise specified or detailed. Where a diffuser is specified the diffuser shall be for the full length and width of the fitting.

After fabrication, metal surfaces shall be thoroughly cleaned back to the parent metal and all dust, moisture, grease or oil shall be removed by an approved de-greasing process.

The metalware shall be primed and given one coat of hot sprayed enamel on both sides and stoved. Total thickness of paint build up shall be not less than 0.5 mm. Finish color shall be to approval on all surfaces.

b) Fluorescent tubes

Fittings shall be supplied complete with energy saving tubes and any associated equipment ready wired for installation.

Fluorescent lamps shall be 'white' with an apparent color temperature of 4200K.

c) Ballasts

All ballasts shall comply with Chinese Standard, JIS C 8108 or equivalent.

d) Capacitors

Power factor correction capacitors shall be supplied with all fluorescent and high discharge fittings.

They shall be designed for continuous operation and shall effect power factor correction not less than 0.8 lagging.

e) Wiring

All wiring within the light fitting shall be suitably temperature rated and neatly secured within the casing.

Terminal blocks shall be provided for all fittings and all fittings shall be individually fused.

f) Location and method of fixing auxiliary equipment

All auxiliary gear shall be securely fixed to the fitting body, not to the gear tray cover. The gear mounting screws shall be non-rotating type, either square headed or spot welded so as to allow auxiliaries to be changed without demounting the fitting.

g) Starters

Starters shall have radio interference suppression condensers. They shall be readily accessible by removal of the diffuser only and may be changed without removal of the tubes. All starters shall be matched to suit the tubes they control.

h) Diffusers

Diffusers shall be fitted to light fittings as scheduled on the drawing.

i) Lamps

All fluorescent fittings shall be fitted with standard color 26 mm energy saver tubes.

Incandescent and HID lamps shall be as specified on the schedule of fittings.

All fittings shall have approved lamp holders suitable for the fitting and duty and shall be resistant to tracking.

All fittings shall be complete with lamps or tubes as applicable.

j) High intensity discharge fittings

All HID fittings shall comply generally with all requirements of previous clauses of this section where applicable.

k) Ventilation

All fittings shall be well ventilated so that components do not exceed the makers recommended operating temperatures during continuous fitting operation.

- l) Fusing of Lighting Fixtures
All fluorescent fittings shall be fused.

4.4.6 SCHEDULE OF TYPE OF LIGHTING FIXTURES

Refer to the Schedule of Lighting Fixtures or the legends on the drawings which form a part of this specification for details of the types of Lighting Fixtures to be supplied and installed.

4.4.7 EXIT SIGNS

Supply and install the emergency exit signs in the position indicated on the drawings. The units shall be complete with lamps, control gear, diffuser, batteries, etc. basically as specified below.

- a) Electronic control gear
The control gear shall consist of a battery charger, automatic switching circuitry, low voltage cutout, mains initiation circuitry, a two power transistor inverter.

Performance of the control gear shall be of a standard to fully comply with Chinese Standard or equivalent.

- b) Battery
The battery pack shall consist of resealable nickel cadmium cells.
- c) Thermal isolation
Adequate thermal isolation shall be provided between the battery and the heat generating parts.
- d) Control/monitors
A test switch and LED monitor shall be fitted to each luminaire.
- e) Diffuser
The diffuser shall be injection molded and dished out from the luminaire to provide a downward component of light.

The legend, including arrows if required, shall be silk screened and fully comply with the requirements of Chinese Standard or equivalent.

4.4.8 EMERGENCY LIGHTING

- a) General
Where indicated on the drawings supply and install emergency battery power packs to operate the fluorescent tube.
- b) Power pack
The fluorescent power pack shall comply with Chinese Standard or equivalent.
- c) Inverter and indicators
The inverter shall operate both switched and rapid start luminaries. It shall be capable of maintaining the specified lamps. The inverter shall be equipped with a low voltage cutout, short circuit proof charger, and require mains power to activate circuits after installation. There shall be an indicator to signify mains supply and charger functioning. The lamp shall be removable from the luminaries without damage to circuitry.
- d) Battery
The Battery shall consist of the required number of nickel cadmium cells. Each cell shall be high temperature to 60 degrees celsius and constructed with polypropylene (electrolyte) separators. Cells will be interconnected with soldered tabs and battery shall be connected to the inverter by plug and socket.
- e) Installation
The fluorescent power pack shall be installed in the luminary with the battery as far as practicable for the ballast, as space will allow.
- f) Fittings
The type and make and fitting shall be indicated on the drawing schedule.

4.5 WIRING AND FIXINGS

4.5.1 METHOD OF WIRING

All wiring shall be concealed in the walls, floors or ceilings unless otherwise specified or shown on the drawings.

Generally where there are no false ceilings wiring shall be run in rigid PVC conduits cast into the concrete slab. The conduits in this case shall be kept above the bottom layer of re-enforcement shell. Deep or extended type junction boxes shall be used.

Wiring within stud walls, roof and ceiling spaces shall be consist of crosslinked polyethylene insulated power cable (XLPE power cable, IEC 502) in PVC conduit as scheduled on the drawings and specified herein.

Wiring within concrete slabs, chased in masonry and brick walls or exposed on the surface shall be in conductors as specified and enclosed in rigid PVC conduit.

In blockwork and concrete walls, wall boxes for switches and GPO's shall be of the deep or extended type.

Carry out wiring on the loop-in system. Jointing of cables and use of connectors will only be permitted at outlets.

Wiring shall not be run through light fillings and the like; wiring shall enter and leave at one point.

All lighting fittings shall be switched and arranged as indicated on the drawings.

The circuit zones for wiring the lighting fittings associated with each distribution board shall be as indicated on the drawings. Accessories shall be squarely fixed to wall boxes, skirtings, architraves etc., using approved screws with plastic head covers or chrome plated screws to suit the fittings concerned.

Due consideration shall be given to the height of tiling, brick course, or other special wall finishes and outlets shall not be mounted across the junction of different finishes.

Where practicable, switches at the one location shall be grouped under one plate.

The locations of light and power outlets shown on the contract drawings are diagrammatic and shall be confirmed with the Engineer prior to installation.

Light switches shall be installed at a height of approximately 1.00 m above floor level unless otherwise indicated on the contract drawings.

Common neutrals shall not be used on single phase circuits unless otherwise specified.

Separate earth wires shall be run for all circuits and shall originate at the switchboard concerned and run in same conduit.

All point to point wiring shall be undertaken using the circuit schedules.

Wiring in the landscaped areas shall consist of XLPE power cables installed in non-metallic conduits.

Secure accessible XLPE power cables by approved strap clips.

Run XLPE power cables in a neat and regular manner, concealed except where otherwise noted.

Protect exposed XLPE power cables liable to mechanical damage with approved metal cover strips or steel conduit.

4.5.2 WIRING

All wires and cables except where otherwise specified shall be PVC insulated wire in conduit or XLPE power cables. XLPE power cables wiring shall not be run where exposed to view throughout the installation.

4.5.3 BRACKETS AND FIXINGS

To allow implementation and installation of works, the Contractor shall supply and fix in position all brackets, troughs, trays, supporting racks as required for the running of wiring and equipment in general.

4.5.4 LABELING

All labels shall be engraved Traffolyte type which shall be firmly fixed to the boards in an approved manner by means of chrome plated metal thread screws.

All GPO's switches and permanently connected equipment shall be fitted with circuit identification. The identification shall indicate the circuit's origin as well as the circuit number and phase color.

4.5.5 FIXINGS

All nuts, screws, bolts, washers, clamps shall be cadmium or zinc plated.

Where plugs are necessary for the fixing of equipment, conduit and other fittings to floors, walls or ceilings approved metal plastic expansion devices shall be used.

4.5.6 LIGHTNING PROTECTION

Lightning protection shall be provided by a protection system integral with the roof on top of the Buildings shown on the Drawings and earthing wire bonded to the steel structure. The earthing to ground shall be by earth copper plate. The tested earthing resistance shall not to exceed four ohms.

4.6 MANUALLY OPERATED ELECTRIC FIRE ALARM SYSTEM

4.6.1 GENERAL

The Manually Operated Electric Fire Alarm System shall be provided as generally indicated on the accompanying drawings. However, the final installed system shall conform in all respects to the requirements of all relevant Authorities. The drawings indicate the approximate extent of the system, however, the Contractor shall provide the system protection to suit the building, fitting and services at no additional cost the Builder.

4.6.2 INSTALLERS STATEMENT

The Contractor shall provide an installers statement and certificate in the form set out in Chinese Standard or equivalent, before the date of practical completion.

4.6.3 FIRE INDICATOR PANELS

The fire indicator panel shall be contained within a robust, painted metal enclosure including a battery charger and standby batteries and shall comply with Chinese Standard or equivalent.

The power supply shall have primary inputs of 220 volts.

All alarm and indicators shall be indelibly labeled indicating the function of the particular indicator. (Label to be engraved perspex or similar, screw fixed).

The FIP shall be fitted with a spare parts section to contain the log book and spare parts to included the following:

A log book and operating instructions shall be provided inside the indicator panel. The operating instructions shall provide, in a condensed form, with particulars of the installation and a brief description and explanation of the sequence of the system and control panel.

The finish color of the fire indicator panel shall be selected and advised by the Engineer.

4.6.4 SHOP DRAWINGS

The contractor shall provide shop drawings showing information related to this installation. Five (5) sets shall be submitted. After the date of practical completion this contractor shall update drawings to an "As built" condition and issue four (4) prints and one (1) sepia.

4.6.5 DETECTORS-MECHANICAL SERVICES

All detectors shall be fitted with a light emitting diode which shall face the likely path of approach by fire brigade or fire alarm personnel. A faulty self indicating device shall not render the detector inoperative under fire conditions.

Each detector head shall be readily removable and replaceable without damaging the surrounding surfaces or causing changes to the wiring configuration.

Any sensitivity adjustments to individual detectors shall be carried out in the workshop only.

Smoke Detector:

Smoke detectors to comply with Chinese Standard or equivalent

Selection to be in accordance with Chinese Standard or equivalent

Where smoke detectors are mounted in air return duct of the Mechanical Services, they shall be provided with approved air sampling device. The location of sampling device in return air ducts shall be determined on site.

All detectors shall be approved by the Local Fire Brigade and other relevant Authorities.

4.6.6 MANUAL CALL POINTS

A "Break Glass" manual call point shall be provided in the main fire indicator board door or adjacent and as shown on accompanying drawings.

The manual call points shall comply with Chinese Standard or equivalent.

All manual call points shall be recessed unless noted otherwise. Provide a stainless steel surround to these manual call points.

4.6.7 ALARM BELL

Supply and install, where indicated on the drawings a fire alarm of an approved type and manufacture. The bell shall comply with Chinese Standard or equivalent and be:

- Weatherproof
- Undergoing type, minimum size 150 dia, and shall be suitable for operation from the systems battery supply;
- Mounted direct onto the wall with a back conduit entry;
- Painted red with words "Fire Alarm" painted in a contrasting color.

4.6.8 EMERGENCY WARNING SYSTEM

Emergency warning shall be provided by a system of fire warning speakers positioned around the building.

The system of fire warning speakers shall be powered by the fire indicator panel. The Contractor shall supply all equipment (e.g. amplifiers, batteries, connections, etc.) required to make the system work.

The actuation of the Manually Operated Electric Alarm System shall comply with Chinese Standard or equivalent.

4.6.9 WIRING AND INSTALLATION

All wiring for this installation shall be carried out by this Contractor. Wiring Rules Chinese Standard, JIS or equivalent.

4.6.11 CONDUITS

Where required, provide conduit to Chinese Standard, JIS or equivalent.

Run surface conduits square with building elements. Minimum size of all conditions to be 20mm nominal diameter with inspection fittings and draw-in boxes throughout to ensure a complete draw-in system is provided.

4.6.12 TESTING AND COMMISSIONING

In-situ test all equipment in the presence of the Engineer and Local Fire Brigade after completion of the installation work to determine the satisfactory operation of the system.

Replace without cost any item of equipment that does not operate within the limits of the applicable standards and codes.

4.6.13 MECHANICAL SERVICE

Smoke detectors with air sampling devices shall be installed in the return air duct of the air handling systems.

Should the Manually Operated Electric Fire Alarm Systems operate in the building, then the FIP shall cause the air handling system to shut down.

All wiring between the FIP and mechanical services switchboard (MSSB) shall be carried out as part of the Manually Operated Electric Fire Alarm System. Cutting of holes in

ductwork, internal wiring (MSSB) between and (MSSB) and mechanical service equipment shall be carried out as par of the Mechanical Services.

4.7 PUBLIC ADDRESS SYSTEM

4.7.1 SCOPE

The Public Address system shall consist of an amplifier with switching capabilities to enable announcements to be made from several points as shown on the drawings and provide high quality sound reproduction in all areas of the building.

4.7.2 STANDARDS

The system shall comply with the Chinese Standard or equivalent

4.7.3 AMPLIFIER AND CONTROL EQUIPMENT

Supply and install a power amplifier within the fire night-duty room suitable for public address throughout the building. Controls shall include input gain control, tone control, ON / OFF switch, treble tone control low cut-out switch. Provide central switching system unit complete with volume control for each zone capable of adjustment to provide the required sound pressure levels and means of locking this adjustment once the required sound pressure levels have been pre-set. The system shall incorporate volume feedback control and automatic switching of microphone inputs so that not more than one microphone can be operated at a time. Microphone shall be uni-directional hand held unit with built in ON / OFF switch, LED speech priority indicator.

4.7.4 LOUDSPEAKERS

Suitable for duty required and shall be matched to amplifier equipment supplied.

4.7.5 WIRING AND INSULATION

All wiring for this installation shall be carried out by the Contractor, and shall be in accordance with Chinese Standard, JIS or equivalent.

4.8 MISCELLANEOUS

4.8.1 GENERAL

All conduit and cables to power and telephone outlets shall be fully concealed in walls or in floor channeling. Co-ordinate with the supplier of furniture where outlets are built into fixtures.

4.8.2 TOILET EXHAUST FANS

Toilet exhaust fans shall be wired to turn on the light switch with over-run timer.

4.8.3 PAINTING

All exposed metallic materials, wiring ducts, etc., including those mounted in service cupboards, riser ducts, ceiling spaces, shall, unless otherwise directed, be painted to approval after erection with two (2) coats of best quality enamel or lacquer of colors selected by the Engineer.

Prior to painting these two (2) coats and between the coats, any blemishes to previous work shall be filled and rubbed smooth. Paint is to be ready mixed and used straight from the original containers without thinning.

Preparation of surfaces, priming of previously unpainted work and application of paint shall be strictly as recommended by the paint manufacturer.

All painting shall be done by an approved firm of painting contractors employing men skilled in the trade.

The painting finish on all fittings and equipment supplied under this contract shall be left in a perfect condition. Any blemishes shall be repaired and, if necessary, the equipment repainted to the satisfaction of the Engineer.

4.8.4 CLEAN UP AND FINISH

Remove all packing and waste associated with the work as the job progresses.

On completion, ensure that all fittings and equipment installed under this contract are clean and left in a workmanlike condition to the complete satisfaction of the Engineer.

4.8.5 AS-BUILT DRAWINGS, OPERATING AND MAINTENANCE MANUAL AND INSTRUCTIONS

As-built drawings, operating and maintenance manuals and instructions shall be provided. These documents shall include instruction to cover every action necessary for the efficient operation and maintenance of the plant and equipment supplied.

A preliminary submission of the manual having been made previously in time to permit adequate checking and, if necessary, correction.

Particular attention is to be paid to the following:-

- (1) List of Light fittings and equipment containing each item installed with maker's name and address, serial number and name plate data.
- (2) Operating instructions for the correct starting, operating, etc. for each system. Instructions for adjusting all controls and cut out settings. These shall include instructions for actions to be taken in event of abnormal or emergency conditions.
- (3) Maintenance Instructions setting out in detail all requirements for preventative maintenance of the equipment supplied. This shall be arranged in sections and recommended daily, weekly, monthly and annual maintenance. Provide for each section a check sheet for recording maintenance done.
- (4) Particular items
In particular the following items shall be covered and described in full.
 1. Main Switchboard
 2. General Schematic of the Light and Power including all circuitry
 3. Distribution Switchboards
 4. Accessories

4.8.6 SCHEDULE OF TECHNICAL DATA - ELECTRICAL SERVICES

In accordance with the equipment the tenderer proposes to use and upon which his tender is based, two copies of these schedules dully filled in, shall be provided by the tenderer. Tenderers shall include additional information where called for in duplicate. Tenders wherein the schedule of technical data is not completed may be rejected.

These schedules are of a limited nature only and the tenderer may be called upon to supply additional information. Upon entering into a contract, the successful tenderer is required to submit for approval details of all equipment he proposes to use. The completed schedule will be used to assess the merits of tenders received and the fact that the schedule will become part of the contract documents will not absolve the Contractor from complying the performance and warranty provisions of this specification.

5.1 MEASUREMENT AND PAYMENT

Each work item shall be measured in the unit for each Item No. as shown in the Bill of Quantities. The work quantities shall be calculated in conformity with the lines, grades, grading sections, cross sections, and dimensions as shown in the Drawings or as directed by the Engineer.

Measurement for payment for the lump sum payment items shall be by the lump sum for the full set of the subject equipment and machinery. Lump sum payment items are indicated by the abbreviation "LS" in the Unit column of the Bill of Quantities.

Payment for each item shall be made at the contract unit price or the contract lump sum price as indicated in the Bill of Quantities. This price shall be full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete the item in accordance with the Drawings, the Specification, and the terms of Contract.

The works items to be covered by the section of the Specification are as shown in the Bill of Quantities.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

SCIENCE AND TECHNOLOGY COMMISSION OF
SHANGHAI MUNICIPAL PEOPLE'S GOVERNMENT,
PEOPLE'S REPUBLIC OF CHINA

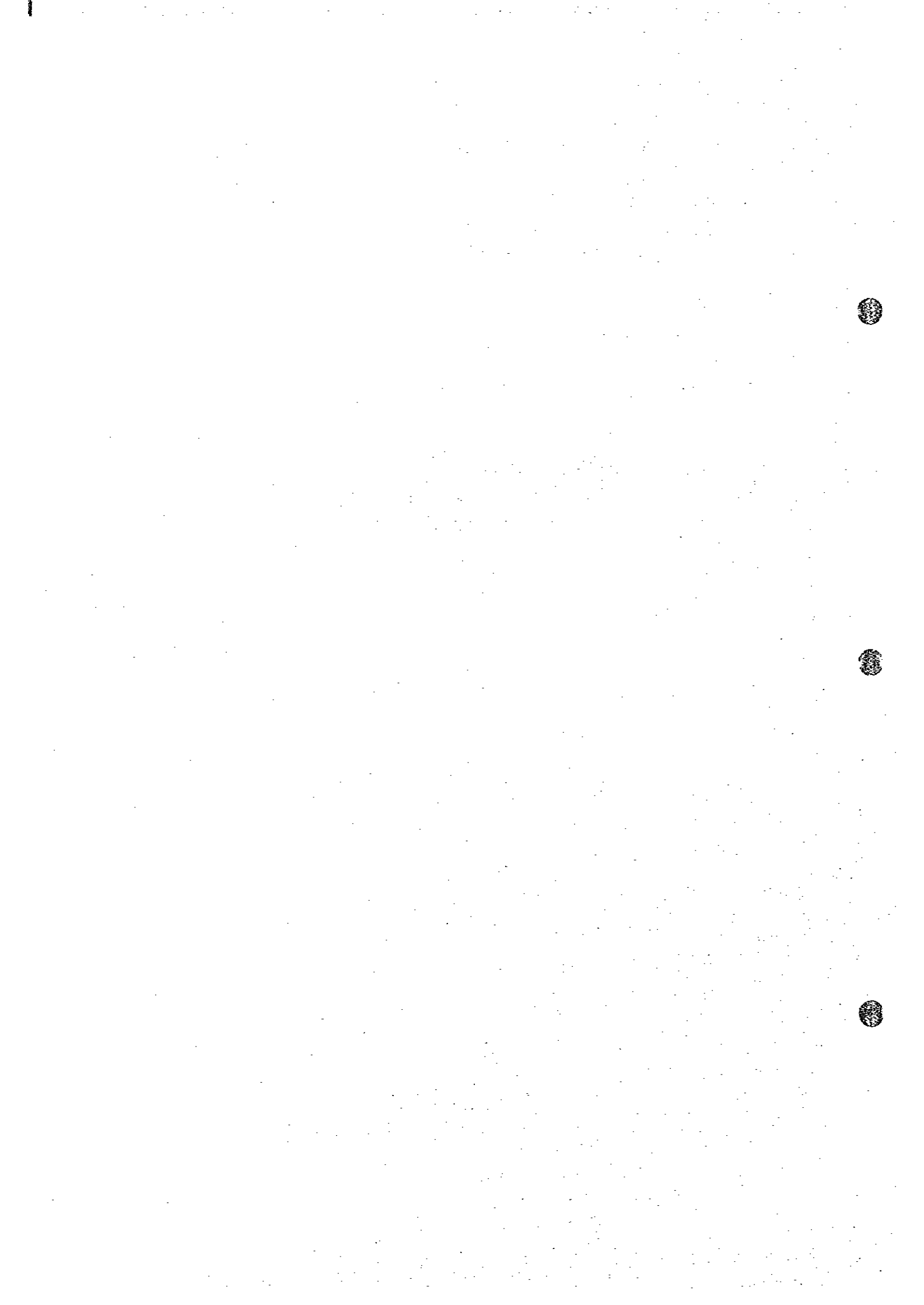
**DETAILED DESIGN
OF
SHANGHAI PUDONG INTERNATIONAL
AIRPORT
FINAL REPORT**

**VOLUME III
TENDER DOCUMENT**

**PART IV-3
SPECIFICATION
FOR
FUEL SUPPLY SYSTEM**

SEPTEMBER 1997

**NIPPON KOEI CO., LTD.
NIKKEN SEKKEI LTD.**



PART IV: TECHNICAL SPECIFICATION

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CHAPTER 1. GENERAL

1.1 GENERAL

This specification covers the technical requirements for the aircraft fuel supply system for Shanghai Pudong International Airport (first stage construction).

1.2 DRAWINGS AND SPECIFICATION

This Specification which forms a part of the Contract Documents, is divided into 14 chapters:

Chapter 1	General
Chapter 2	Description of Work
Chapter 3	Design Conditions
Chapter 4	Equipment
Chapter 5	Piping
Chapter 6	Electrical Work
Chapter 7	Instrument and Control
Chapter 8	Surface treatment Work
Chapter 9	Welding and Inspection
Chapter 10	Pipe Cleaning and Test
Chapter 11	Training Spare Parts and Special Tools
Chapter 12	Commissioning
Chapter 13	Civil Work
Chapter 14	Building Work

The drawings which forms part of the Contract Document are incorporated follows:

<u>Drawing Nos.</u>	
F01 to F08	General
F11 to F12	Plot Plan
F21 to F25	Tanks
F31 to F38	Piping
E01 to E11	Electrical Work
B01 to B13	Civil Work
A01 to A10	Building Work

The Specification and Drawings shall be read in conjunction with the several documents forming the Contract and shall be taken as mutually explanatory of one another. The Engineer shall explain any ambiguities or discrepancies as provided for in the Condition of Contract.

CHAPTER 2. DESCRIPTION OF WORK

2.1 SUMMARY OF AIRCRAFT FUEL SUPPLY SYSTEM

In the Shanghai Pudong International Airport to be newly constructed in the Pudong region of Shanghai, one 4,000m long runway and related facilities will be constructed. The number of anticipated passengers will be about 20 million per year, and take-off/landings are expected to be 126,000 per year in 2005.

The aircraft fuel in the new International Airport will be unloaded from the berth at the mouth of the Chang Jiang River, and stored in tanks in the terminal depot. The fuel will be transported from these tanks to the new airport fuel supply system by pipeline. The transportation capacity per pipeline is 360m³/h, and the bore diameter of the pipeline is 12".

The fuel supply system consists of one fuel storage depot, one fuel supply depot and one fuel hydrant facility.

In the fuel storage depot, six storage tanks of 10,000m³ capacity each will be installed in the Phase-I Project. The area for the tanks for future increase in fuel demand will be prearranged in the north of the depot site. The total area of the depot including the future expansion area will be about 270,000m².

The fuel storage depot will be equipped with: the storage tanks; fuel receiving facility; fuel pumping facility; ancillary facility; fire fighting facility; water supply and oily water treatment facility; and buildings.

In the fuel supply depot, a refueler loading facility, a servicer parking area, a refueler maintenance shop, and a test facility will be provided.

The hydrant facility will be provided to supply fuel to 47 spots in Phase-I project. The diameter of two main pipelines will be 24". The maximum fuel supply flow rate will be 2,000 m³/h. Ten hydrant pumps of 200m³/h capacity each will be installed.

Each of the piping system, the electrical system and instrumentation control system will be duplexed in consideration of future trouble and maintenance. Thus, due consideration is given to enabling the aircraft fuel supply system to be operable in case of trouble of one system.

The fuel supply flow rate will be controlled by the number of pumps in operation. The DCS system will be adopted for instrumentation control, and signals will be optically

transmitted.

2.2 SCOPE OF WORK

The Scope of Work for Fuel supply system shall be as follows;

- (a) Construction of the facilities shown on the P&I Diagrams (Drawing No.F-02, F-03, F-04, F-05, F-06, F-07 and F-08) including equipment installation, piping work, civil work, electrical work, instrument & control work, building work, steel structure work and painting work.
- (b) Detailed design, equipment procurement, inspection and transportation for all facilities.
- (c) Oil flushing work, test and commissioning.
- (d) Construction management.
- (e) Construction, maintenance and removal of all temporary facilities.
- (f) All licensing applications necessary for this construction work.
- (g) Witnessed inspections at fabrication shops by the Engineer.
- (h) Training of the Employer's operators at fabrication shop.
- (i) Field training of the Employer's operators on site.
- (j) Preparation of spare parts lists, purchasing and deliveries to site.
- (k) Purchase and delivery to site of special tools.
- (l) Preparation of operation and maintenance manuals
- (m) As-built drawings

CHAPTER 3. DESIGN CONDITIONS

3.1 TARGET YEAR

The Phase I Project: Year 2005
Annual Fueling: 756,000ton / year

3.2 APPLICABLE LAWS/REGULATION AND STANDARDS

ASTM (American Society for Testing and Materials)
ANSI (American National Standards Institute)
API (American Petroleum Institute)
NFPA (National Fire Protection Association USA)
IEC (International Electrochemical Commission)
JIS (Japanese Industrial Standards)

Chinese National Code
Chinese Industrial Standard
Chinese Fire Service law

3.3 FUEL CONDITIONS

- (a) Standard: According to the Chinese standard GB 6537-86 (equivalent of ASTM D1655)
- (b) Fuel name: RP3 (Jet A-1)
- (c) Density (20°C): 0.775 - 0.83g/cm³ (design value: 0.78)
- (d) Flash point: 38 deg c or higher
- (e) Viscosity (20): 1.25mm²/s
- (f) Viscosity (-20): 8mm²/s (design value 4mm²/s)
- (g) Electric conductivity: 50-350 Ps/m
- (h) Vapor pressure: 0.0007MPa

3.4 CLIMATIC CONDITIONS

(The values shown in the final report on basic design of Shanghai Pudong International Airport were used.)

Place: Observatory records of the Shanghai Chuan Sha Observatory

(a) Wind velocity:	Max. 33.1m/s (maximum value between 1915 and 1990)
(b) Atmospheric temp.:	Average temperature 15.5deg C Highest temperature 38.0 deg C Lowest temperature -9.6 deg C
(c) Rainfall:	Yearly average rainfall 1109.4mm Number of yearly average Rainfall days 130.9 days
(d) Snowfall:	Max. snow depth 15cm Number of 5-cm or higher Depth snowfall days 5 days (1977 Record)
(e) Earthquake: seismic	Basic seismic intensity 7 (on Chinese seismic scale) 5 (on Japanese scale)
(f) Lightning:	Number of yearly average lightning days 29.1 days

3.5 SOIL CONDITIONS

Soil conditions conformed to the "Soil Data" separately prepared.

3.6 FUEL RECEIVING FLOW RATE

Maximum flow Rate: 360m³/h

3.7 FUEL STORAGE CAPACITY

Six 10,000m³-capacity tanks will be installed. The total fuel storage capacity will be 60,000m³.

3.8 HYDRANT FLOW RATE

Maximum Flow Rate: 2,000m³/h (at 2 Lines).

3.9 LOADING FLOW RATE: 80m³/h (Each Spot).

(For Refueler loading)

3.10 POWER RECEIVING CONDITIONS

Receiving point: Electric room within fuel storage depot
Receiving voltage: 3-phase 10KV and 3-phase 400V
Receiving line: Two lines

3.11 WATER RECEIVING CONDITIONS

The line was branched from the main city water line buried under the trunk road north of the fuel farm.

3.12 OILY WATER DISCHARGE CRITERIA

The Chinese discharge criteria for fuel oil in water is 10ppm or under.

3.13 EMERGENCY CONSIDERATION

The following shall be incorporated into the Contractor's detail design for safety operation of the fuel supply system.

The fuel supply pump shall be stopped automatically by a "low-low" level signal from the fuel storage tanks and emergency signals in the fuel supply system.

Emergency stop buttons shall be located at the strategic places such as control room, fuel pumping shed ,test facility, each header pit at the apron side and fueling spots on the apron (one stop button - two fueling spots or two stop buttons - three spots.)

The new fuel supply header shall be equipped with a 24" motorized emergency shutdown valve (ESV) at the boundary limit of Fuel Storage Depot.

Tank over-fill protection shall be provided as stated in Para.4.2.

Inlet and outlet valves of Fuel storage tanks shall be motorized, and these valves shall be interlocked as specified in Para. 4.2.

A pressure gauge shall be provided just downstream of the 24" ESV so as to check if oil leakage occurs in the fuel hydrant pipeline. Check will be periodically undertaken while the fuel hydrant pipeline is not in service.

As specified in Para.4.6 fire fighting facilities and fire extinguishers shall be provided.

CHAPTER 4. SPECIFICATIONS

4.1 FUEL RECEIVING FACILITIES

4.1.1 CONSTITUENTS

Fuel Receiving Facility shall consist of the following major constituents:

- (a) Receiving Filter
- (b) Receiving Filter Separator

4.1.2 SPECIFICATION

4.1.2.1 RECEIVING FILTER

- (a) Quantity: 1 set
- (b) Design Data
 - Design Flowrate: 360m³/h
 - Design Pressure: 1MPa
 - Body Material: Carbon Steel
 - Screen Material: 304 Stainless steel (200 mesh)

4.1.2.2 RECEIVING FILTER SEPARATOR

- (a) Applicable Codes and Standards
 - API 1581-1989
 - Specifications and Qualification Procedures for Aviation Jet Fuel Filter/ Separators.
- (b) Quantity: 1 set
- (c) Design Data
 - Design Flowrate: 360m³/h
 - Performance: API 1581 Group II Class B
 - Body Material : Carbon Steel
 - Accessories
 - Air eliminator
 - Differential pressure gauge
 - Safety valve
 - Water level indicator
 - Water slug control valve (with flow limiters)

Automatic water drain valve

4.2 FUEL STORAGE FACILITY

4.2.1 CONSTITUENTS

Fuel Receiving Facility shall consist of the following major constituents:

- Fuel Storage Tank
- Tank Level Gauge System

4.2.2 FUEL STORAGE TANK

(a) Applicable code and standard

- | | |
|---------|--|
| - API: | American Petroleum Institute API 650 |
| - ANSI: | American National Standard Institute |
| - JIS: | Japanese Industrial Standards |
| - ASTM: | The American Society for Testing Materials |

(b) Quantity: 6

(c) Design Data

Tank size:	Inside Diameter 38,282 mm
Height:	14,000 mm
Tank Capacity:	Nominal 10,000 m ³
Content Name:	RP3 (JET-A-1)
Flash point:	Above 38 deg C
Storage temp:	30 deg.C
Sp. Gr:	0.83 at 30 deg.C
Design pressure:	+ATM/ -ATM
Design metal temp:	31Deg.C
Lowest one day mean ambient temp:	23Deg.C
Pumping rates:	In 2,000 m ³ /h Out 2,000 m ³ /h
Corrosion allowance:	0 mm
Design code:	API 650
Material:	ASTM 283, Gr. C or Equivalent
Roof design	
Design code:	API 650
Fixed roof type:	Dome
Roof column:	No
Materials roof:	ASTM 283 Gr. C or Equivalent
Structure:	ASTM 36 or Equivalent
Bottom design	
Slope:	Apex. down 5 %
Material; Annular plates:	ASTM 283 Gr.C or Equivalent
Bottom plate:	ASTM 283 Gr. C or Equivalent
Joint Type:	Annular plates BUTT welding
Bottom plate:	Lap welding

(d) Internal coating: Epoxy resin (Refer to Surface treatment works)

(e) Auxiliaries - Two 20" floating suction pipe with swivel joint.

Materials for floating suction pipe and float shall be aluminum or stainless steel.
Pressure and vacuum valves

Necessary manhole and nozzles
Necessary sampling nozzles
Necessary stainless check wire for floating suction pipe.
Necessary flexible tube between tank and piping
Necessary air foam chamber 2 set.

Necessary water drencher ring.
Necessary instrumentation
level switch
level indicator
Average type thermometer
(Refer to Instrumentation)
Refer to Dwg. No.FD-21

- (f) Erection, Welding, inspection and Test.
(Refer to Welding and Inspection)

4.2.2 TANK LEVEL GAUGE SYSTEM

Each Fuel Storage Tank shall be equipped with remote readout level indicator and temperature indicator. Remote level indicator shall be installed in the control room at the tank site. In addition, each tank shall be equipped with one "high-high" level switch and one "low-low" level switch which are independent from the tank level gauge. Both tank nozzles for inlet (pipeline receiving) and outlet (fuel supply pump suction) shall be equipped with optical signal control type motor operated valves which can be operated and monitored for status at Control Rooms as well as at the Site. The motor operated valves mentioned above shall be interlocked in the following three ways in order to avoid serious operation:

Inlet and outlet valves shall not open simultaneously.

For each tank, inlet and outlet valves shall not open when tank "high-high" and "low-low" alarms are on.

During emergency alarm inside Fuel Storage Yard, both inlet and outlet valves shall not open.

When the liquid level of a tank increases above the "high-high" level, the receiving shut down system shall actuate and pipeline fuel receiving shall stop automatically by closing ESV(Emergency Shut off Valve). On the other hand, when the liquid level in a tank falls below the "low-low" level, the shut down system shall actuate to stop Fuel supply pumps and also close ESV on the Fuel supply header line.

Level indicate on CRT display which installed in control room shall accept from the transmitter and indicate level in storage tank individually.

The indicator shall have level signal transmission capability to the CPU for volume calculation.

4.3 FUEL PUMPING FACILITY

4.3.1 CONSTITUENTS

Fuel Pumping Facility shall consist of the following major constituents:

Hydrant Pump

Pump Control System included VVVF, Flow Instrument, Pressure Instrument, Control valve, Pump

Minimum Flow Control System and Emergency Shutdown System.

Analysis guidance for each tank in order to inform operators which tank is ready for analysis or acceptable for discharge.

4.3.2 HYDRANT PUMP

(a) Applicable codes and standards API610 Centrifugal Pumps for General Refinery Service ASTM American Society for Testing Materials

(b) Numbers:

ITEM No.	Quantity	Capacity
P-201,210	10	200m ³ /hx1.15Mpa
P-211,212	2	50m ³ /hx1.15Mpa

Operating Condition

Pumping Temp: 38Deg.C

Design Temp: 55Deg.C

Differential head: 130m

Discharge pressure: 1.01Mpa

Suction pressure: 0.01MPa

Differential pressure: 1.0MPa

(d) Construction

Pump type: Centrifugal Vertical

Number of stages: Single

Impeller type: Closed

Nozzle

Suction: ANSI150#RF End

Discharge: ANSI150#RF Top

Vent: ANSI150#RF with Valve

Drain: ANSI150#RF with Valve

Flushing: ANSI150#RF

Corr. allow: 3.2mm

Bearing Type radia/thrust: Ball/Ball
 Lubrication type: Oil ring
 Coupling type/guard: Flexible/Non-spark
 API plan: Flush/aux. Seal 11/61
 Flushing fluid: Self liquid
 Materials(API material class S-1)
 Casing: Carbon steel
 Impeller: CI
 Shaft: Carbon steel
 Shaft sleeve: 12% Chrome hardned

(e) Test and Inspection

The pump shall be inspected in accordance with API610.
 Shop test items : Performance test, NPSH test and Hydraulic test.

4.3.3 FILTER

(a) Applicable codes and standards

- API Publication 1581 Third Edition, Specifications and Qualification procedures for Aviation Jet Fuel Filter/Separators
- ASME Boiler and Pressure Vessel Code, Sec.VIII

(b) Quantity

ITEM No.	Quantity
FS-201..210	10
FS-211,212	2

(c) Operation Condition

Operation Temp: -9Deg.C +38Deg.C

Max. Operation Pressure: 1.5MPa

Operation flow rate

Item No.	Q'Ty	Flow rate(m ³ /h)
FS-201..210	10	200
FS-211,212	2	50

Performance	
API 1581 Group II Class B	
Total solids content:	0.26 mg/l
Free water content:	15 ppm
Media migration:	10 fibers/l

(d) Specification

- Materials

Vessel: Carbon steel.

All metal parts in contact with the fuel, including sensing lines, shall be free from zinc, copper, and cadmium and their alloys.

- Connection

Flange connection: ANSI 150# RF

- Internal coating

Vessels shall be internally coated with epoxy coating approved in accordance with MIL-C5541C or an equivalent

(e) Accessories

Cover Lift

Air Eliminator

Pressure Relief Valve

Differential pressure Gauge

Water Level indicator

Automatic Water Drain

Water Slug Control Valve(with flow limiters)

(f) Testing

Vessel shall be hydrostatically tested in accordance with ASME cod sec.VIII

4.3.4 PUMP CONTROL SYSTEM

The hydrant system is controlled by two principal methods: control of the first pump starting method used for VVVF(Variable Voltage Variable Frequency) system and the number of running pumps. VVVF control and sequence control are conducted by the control station of DCS.

2. Automatic or manual operation can be selected for each pump.

Automatic: When automatic operation is selected, the pump is incorporated into automatic operation mode.

Manual: When manual operation is selected, the pump is disengaged from automatic operation mode.

Pump operation order selection function

The pump operation order can be automatically set by selecting the pump which starts first.

-7. Analysis guidance function

Analysis guidance can be indicated for each tank in order to inform operators which tank is ready for analysis or acceptable for discharge.

-8. Pump jump operation function

On the occasion of various pump malfunctions or when manual operation mode is selected, pumps will be automatically disengaged from the control of the number of running pumps.

-9. Emergency stop and emergency stop reset function

When any emergency stop item is detected, pumps in discharge operation will be stopped automatically.

When a "tank level low" signal is detected, the tank discharge valve will also be closed. Emergency stop reset will not be allowed until the cause of emergency stop is cleared

These pumps shall be controlled by Distributed Control System (DCS).

4.4 FUEL HYDRANT FACILITY

Fuel Hydrant Facility shall consist of the following major constituents:

Hydrant Pit and Hydrant Valve

Fuel Piping

4.4.1 HYDRANT PIT AND HYDRANT VALVE

(1) Applicable codes and standards

API: American Petroleum Institute

ANSI: American National Standard Institute

ASTM: The American Society for Testing Materials API, ASTM, ANSI

(2) Hydrant Pit

- Size of hydrant pit Standard 18" API pit
- Design load on hydrant pit 40 ton
- Size of base flange 6" ANSI Class 300 # flange
- Manufacturers Pit shall be a manufactured by DABICO Inc.,
or approved equal.

Equipment into the pit Hydrant valve with accessory, block valve (ball
valve or butterfly valve) for hydrant valve
maintenance, 6" x 4" reducer adapter.

(a) Hydrant valve

- Flow rate 1000 Ugpm (227m³/h)
- Size 4" with quick release mechanism without pressure
control mechanism.
- Temperature of fuel Normal 30
- Pressure rating Max. pressure 17 kg/cm²
- Fuel JET A-1
- Pressure drop of Max. 1.1 kg/cm² at 1000 gpm at valve and adapter

(b) Operation time

Opening time shall be adjust from 5 to 10
secondsadjustable closing time (from deadman
release) all not be exceed 5 seconds.

Block valve Ball valve or Butterfly valve for hydrant valve
maintenance and test.

- Adapter 4" API Adapter.
- Manufacturers Valve shall be a manufactured by
JC-CARTER CO., or approved equal.

(c) Scope of Contractor's supply

- | | |
|------------------------|---|
| - Hydrant pits with 6" | 85 sets of standards 18" API pit
ANSI B 16.5 class 300 base flange |
| - Hydrant pit valves | 85 sets of 4" pit valve without
with filter pressure control mechanism |
| - Adapter | 85 sets of 4" API adapter |
| - Other hydrant pit | 85 sets including wit internal parts 4" ball or
butterfly valve. |

(d) Spare parts

Recommended spare parts for two year's operation shall be provided by the Contractor approved by Engineer.

4.5 ANCILLARY FACILITY

Fuel Pumping Facility shall consist of the following major constituents:

- Slop Oil facility
- Drain Recovering Facility
- Hydrant Servicer Test Facility
- Hydrant Valve Test Facility
- Refueler Loading Facility
- Fueling Vehicle

4.5.1 SLOP OIL FACILITY

(a) Constituents

Slop Oil Facility shall consist of the following major constituents:

- Two 100m³ slop tanks
- Two 60m³/h slop lorry loading pumps
- Two 60m³/h filter separator

(b) Slop Tank

1) Applicable code and standard

- API: American Petroleum Institute API 650
- ANSI: American National Standard Institute
- JIS: Japanese Industrial Standards
- ASTM: The American Society for Testing Materials

2) Quantity: 2

3) Design Data

- Tank Type: vertical cylindrical
- Tank size:
- Tank Capacity: 100m³ Content: JET A-1
- Design pressure: ATM
- Pumping rates: in 120m³/h
out 120m³/h

(c) Slop lorry loading pumps

1) Applicable codes and standards API 610

2) Numbers: 2

3) Operating Condition

- Design capacity: 60m³/h
- Dif.pressure: 0.5Mpa
- Other condition: refer to pra.4.3

(d) Filter separator

1) Applicable Codes and Standards

API 1581-1989
Specifications and Qualification Procedures for Aviation Jet
Fuel Filter/Separators.

2) Quantity: 1 set

(e) Design Data

- Design Flowrate: 60m³/h
- Performance: API 1581 Group II Class B
- Body Material: Carbon Steel
- Accessories: Air eliminator
Differential pressure gauge
Safety valve
Water level indicator
Water slug control valve (with flow limiters)
Automatic water drain valve

4.5.2 DRAIN RECOVERING FACILITY

(a) Constituents

Drain Recovering Facility shall consist of the following major constituents:
One 20m³ underground horizontal drum
One 5m³ underground horizontal drum

(b) Design Data

- Tank Type: horizontal cylindrical drum
- Tank size:
- Tank Capacity: 20m³ and 5m³
- Content: JET A-1
- Design pressure: ATM

4.5.2.1 HYDRANT SERVICER TEST FACILITY

Test facility shall be provided to permit meter proving of servicer and refurler against a master meter. pressure control testing of servicer and refueler by using a pressure gauge. The followings shall be included. Two sets of grounding unit assemblies which can simulate the actual refueling conditions for aircraft. Each grounding unit assembly shall include two 2-1/2" self-sealing spring loaded

- Accuracy: Plus/minus 0.1%
- Type: Removable type

4.5.3 HYDRANT VALVE TEST FACILITY

Test facility shall be provided for hydrant valve.
testing open/close time
testing operation of hydrant valve

4.5.4 REFUELER LOADING FACILITY

Refueler Loading Facility shall consist of the following major constituents:
Loading Filter Separator
Batch Control System
Loading

4.5.4.1 NUMBER OF REFUELER LOADING POINTS

Two refueler loading points shall be provided in the refueler loading stations.

4.5.4.2 LOADING FILTER SEPARATOR

(a) Applicable Codes and Standards

API 1581-1989
Specifications and Qualification Procedures for Aviation Jet Fuel Filter/
Separators.

(b) Quantity: 2 set

(c) Design Data

- Design Flowrate: 80m³/h
- Performance: API 1581 Group II Class B
- Body Material: Carbon Steel
- Accessories: Air eliminator
Differential pressure gauge
Safety valve
Water level indicator
Water slug control valve (with flow limiters)
Automatic water drain valve

4.5.4.3 BATCH CONTROL SYSTEM

4.5.5 LOADING CONTROL

Loading control shall be the mechanical predetermined batch system. The regulator equipped with a local flow meter, preset counter, and temperature compensation function shall be installed at each loading station. Loading quantity shall be controlled automatically by the batch controller with a two stage control.

4.5.5.1 SPECIFICATION

The set stop valve shall be designed to operate the flow meter equipped with a set stop counter.

- | | |
|-------------------|---|
| a. Quantity: | 2 |
| b. Flow Rate: | 80kl/h maximum
5 kl/h minimum |
| c. Flange Rating: | 150# |
| d. Maximum | Operating Pressure:8.2 kg/cm ² |

This valve shall be closed and opened in two stage. "see SECTION 1-4 Instrumentation".

4.5.5.2 LOADING HOSE

Type-Soft wall aviation hose with reusable male coupling on each end, coupling guaranteed not to part from hose at specified minimum burst pressure; the hose shall be of type C grade 2 and meets BS3185 specification.

Size 2.1/2" and 2" of 25 meters long each for reel hose 2 off 3" of 5 meters long for deck hose

Number required One of each 2.1/2" and 2" of 25 metres long 2 off 2" of 5 metres long.

4.6 FIRE FIGHTING FACILITY

4.6.1 SYSTEM CONSTITUENTS

Fire fighting system consists of the following systems and major equipment.

4.6.1.1 FIRE WATER SYSTEM

Fire water storage system (water Pond)

Fire water pump

Fire water piping network

Isolation valves

Water hydrants

Hose cabinets (including water nozzle/hoses)

Fire water spray system for tank

4.6.1.2 AIR FOAM SYSTEM

Fixed for system (including pressure proportioning system)

Foam hydrants

Fire truck connection

Hose cabinets (included foam nozzle/hoses)

4.6.1.3 FIRE EXTINGUISHERS

Wheeled type dry chemical extinguishers

Portable type dry chemical extinguishers

Portable type Halon 1301 extinguishers

Refer to DWG. No. F-38

4.6.2 GENERAL DESCRIPTION

4.6.2.1 FIRE WATER SYSTEM

Fire water pump capacity shall be designed based on the Chinese law. The distribution system shall maintain system pressure by jockey pump at all times. Fire water main piping in the plant shall be installed along the road and the isolation valves shall be installed at strategic points on the piping networks so that fire water can be sent through other piping routes in the case of breakage of a portion of the piping. Fire water piping shall be installed above the ground except around road crossing or where it may impede access for operation and maintenance. Fire water storage capacity shall be designed based on Six (6) hours duration time of the fire water pump capacity.

4.6.2.2 AIR FOAM SYSTEM

10000m³ fuel storage tank shall be provided with fixed air foam system (bottom injection).

4.6.2.3 FIRE EXTINGUISHERS

Fire extinguishers shall be installed or located at strategic points throughout the plant area.

4.7 WATER SUPPLY AND OILY WATER FACILITY

Refer to the drawing No.F-35, F-36 and F-38

4.8 FUELING VEHICLE

This specification describes the components parts and details required to manufacture a hydrant servicer. The servicer shall be capable of delivering fuel through 2 (two) underwing nozzles from deck hoses and through 2 (two) underwing nozzles at 1200 GPM from reel hoses and shall be used to refuel all kinds of jet aircraft B737 to B747.

4.8.1 TRUCK CHASSIS

The engine shall be a diesel engine and shall have a 4 forward speed and 1 reserve speed gearbox, an operating hour indicator is required. An air compressor with relevant air reservoir to be provided. Steering must be left-hand and power steering to be provided. The voltage of the electrical system for the vehicle must be 12 volt (single pole). A master battery cut-off switch located inside the vehicle cabin should be

provided. Engine exhaust pipe must be installed forward and be equipped with muffler and spark arrester. The vehicle should be fitted with an interlock system to prevent the vehicle moving, unless refuelling nozzles, input hose and input hose coupling are correctly stowed or positioned for transport and/or movement. Airfield obstruction light to be provided on roof of cab or highest point. Reflectors required on side or rear.

4.8.2 PLATORM

As the unit is also used to refuel Jumbo-Jet aircraft, it is also necessary that the unit be provided with a refueling platform. forward mounted just behind cab, fixed or elevated with permanently erected handrails. Hydraulically operated scissor type lift platforms; operating controls located on platform. underwing nozzles from de

4.8.3 INPUT HOSE

Type - Soft wall aviation hose with reusable 4" male coupling on each end; Couplings guaranteed not to part from hose at specified minimum burst pressure; The hose shall be of type C grade 2 and meets BS3158 specification. Carrying handles and dolly wheel carriage shall be provided.

Size: 4" ID of 12 metres long, tested to 30 bars

Number required: 1

4.8.4 INPUT HOSE COUPLING

Type - Dry Break, automatic pressure control and deadman control plus dual setting excess flow control, quick coupling, non selective with dust cap and trolley, 4" female connection for the input hose.

Size: 4"

Designed working pressure: 250 psi

Make: Avery Hardoll CC8500/E/R/T

Number required: 1

4.8.5 FILTER

Type - Horizontal, shall be for 1200 GPM for aviation turbine fuel (kerosene type), complete with one complete set of cartidges.

The free end of elements shall be firmly supported against vibration. Access to the elements for inspection and replacement shall be provided by a removable cover at other end; the cover to be secured by swing bolts.

Fitings and accessories shall be furnished as follows :

- a. Air eliminator, connected to the highest point, piped through a check valve and sight flow indicator to a slop tank.
- b. Pressure Differential Gauge calibrated 0-28 PSI.
- c. 1/2" ball valve drain from the sump.
Number required :1

4.8.6 METER

Type -Positive Displacement with counter reading Decalitres, totaliser, mechanical rate of flow indicator, preset counter and slow closing preset valve.
Counter Head should be located adjacent to the control panel, and as such easily visible to the operator.

Capacity :	1300 GPM.
calibration :	Decalitres
Accuracy :	+/- 0.1 % over the normal operating range
Designed working pressure :	250 PSI
Number required :	1

4.8.7 HOSE REELS

Type - Top Wind, aluminum fabrication, direct rewind hydraulic motor, with 90 deg inlet single swivel c/w pneumatic brake with air cylinder and switch.

Size:	to hold 25 meter of 2.1/2" dia hose
Designed working pressure:	125 PSI
Number required:	2

4.8.8 DELIVERY HOSE

Type - Soft wall aviation hose with reusable male coupling on each end, coupling guaranteed not to part from hose at specified minimum burst pressure; the hose shall be of type C grade 2 and meets BS3185 specification.

Size : 2.1/2" and 2" of 25 metres long each for reel hose 2 off 3" of 5 metres long for deck hose

Number required : one of each 2.1/2" and 2" of 25 metres long 2 off 3" of 5 metres long.

4.8.9 VENTURI

6" venturi with flanged connections should be installed before deck hoses and 4" venturi before reel hoses to provide compensated signals to pressure control valve

4.8.10 SHOCK ALLEVIATOR

A shock alleviator of seal air cushion type should be installed at the input manifold immediately upstream of the venturi.

4.8.11 UNDERWING PRESSURE FUELLING NOZZLES

Type - Quick disconnect with BSPT inlet, 100 mesh screen, stick handles, rising curve regulator and surge control, dust cap, grounding wire and clip.

Size: 2.1/2"

Make: Avery Hadrol model HU.3204/B50/C22/Y
model HU.3295/B50/C22/Y

Number required : 2 off each 2.1/2" and 3" BSPT connection

4.8.12 STATIC WIRE/GROUNDING WIRE REEL

Type - Spring rewinding with latch to accommodate 15 metres of 3/32" plastic covered multicored copper wire with alligator clip.

Number required : 1 (one)

4.8.13 FIRE EXTINGUISHER

Type - Dry chemical cartridge expelled, corrosion and water resistant, quick release bracket mounted.

Number required : 2 (two) of 20 lbs capacity.

In additional : one BCF of 2 lbs in the cabin.

4.8.14 INSTRUMENT PANEL

A conveniently located instrument panel is to be provided, equipped with high quality weatherproof gauges and controls. Night illumination lights (flame proof) are to be fitted for panel face and meter counter.

Panel to include : filter differential pressure gauge, hydrant input pressure gauge, hose deck and hose reel inlet pressure gauge, air reference pressure gauge, air reference pressure regulator control, flow rate selector is to be provided. A flow scheme should be installed conveniently on the instrument panel.

4.8.15 SAMPLE POINTS AND SLOP TANK

Sample and rain cocks shall be conveniently grouped and permit sampling form (quick action valve) Filter separator sump, inlet manifold and hose reel inlet. Drain points to be provided at all low points in the pipe work. All drain valves must have quick release dust cap (camlock type) secured by chain.

A sample box for stowage of 6 (six) samples bottles 1000 cc should be provided.

4.8.16 PIPING

- a. All piping shall have a design working pressure or 250 psi.
- b. Upstream piping of the filter shall be seamless steel pipe.
- c. Downstream piping of the filter shall be seamless steel pipe.
- d. All welded joints shall be butt welded, all welds to have full penet% ck hoses and through Refueler

This specification describes the components and details required to manufacture two kinds of refueler. Each one shall be equipped with a tank, pump, filter separator, flow meter etc.

4.8.16.1 47m3 REFUELER

- | | |
|------------------|--|
| - Type: | Trailer bottom loading type |
| - Quantity: | 4 |
| - Tank Capacity: | 47 m3, |
| - Tank Material: | Aluminum Alloy |
| - Pump: | centrifugal, self priming
400 G.P.M |

a. **Truck Chassis**

- (1) The engine shall be a diesel engine and shall have a 4 speed forward and 1 reverse speed gearbox. An operating hour indicator is required.
- (2) An air compressor with relevant air reservoir is to be provided.
- (3) Steering must be left-hand and power steering is to be provided.
- (4) The voltage of the electrical system for the vehicle must be 12 volt (single pole).
- (5) A master battery cut-off switch located inside the vehicle cabin should be provided.
- (6) The engine exhaust pipe must be installed forward and be equipped with a muffler and spark arrester.
- (7) The vehicle should be fitted with an interlock system to prevent the vehicle moving, unless refuelling nozzles, input hose and input hose coupling are correctly stowed or positioned for transport and/or movement.
- (8) An airfield obstruction light is to be provided on the cab roof or highest point.
- (9) Reflectors are required on the side or rear.

b. **Platform**

The platform shall be provided for refuelers.

Type-forward mounted just behind cab, fixed or elevated with permanently erected handrails. Hydraulically operated scissors type lift platforms; operating controls to be located on platform.

Number required : 1 (one)

c. Meter

Type-Positive Displacement with counter reading Decalitres, totaliser, mechanical rate of flow indicator, preset counter and slow closing preset valve.

Counter Head should be located adjacent to the control panel, and as such easily visible to the operator.

Capacity: 400 GPM. calibration : Decalitres

Accuracy: +/- 0.1 % over the normal operating range

Design working pressure : 100 PSI

Number required: 1 (one)

d. Filter/water separator

Type - Horizontal, for 400 GPM of aviation turbine fuel (kerosene type), complete with one complete set of cartridges.

The free end of elements shall be firmly supported against vibration. Access to the elements for inspection and replacement shall be provided by a removable cover at the other end; the cover is to be secured by swing bolts.

The following fittings and accessories shall be furnished as follows :

- (1) Air eliminator, connected to the highest point, piped through a check valve and sight flow indicator to a slop tank.
- (2) Pressure Differential Gauge calibrated at 0-28 PSI, piston type.
- (3) 1/2" ball valve drain from the sump.

Number required: 1 (one)

e. Hose Reels

Type: Top Wind, aluminum fabrication, direct rewind hydraulic motor, with 90 deg. inlet single swivel c/w pneumatic brake with air cylinder and switch.

Size: to hold 25 meter of 2-1/2" dia hose

Designed working pressure: 125 PSI

Number required: 2 (two)

Delivery Hoses

Type: Soft wall aviation hose with reusable male coupling on each end, coupling guaranteed not to part from hose at specified minimum burst pressure; the hose shall be type C grade 2 and meets BS3158 specification.

Size: 2 of 2-1/2" x 25 meters long for reel hose
2 of 2-1/2" x 4 meters long for Deck hose

f. Venturi

6" venturi with flanged connections should be installed before deck hoses and 4" venturi before reel hoses to provide compensated signals to pressure control valve.

g. Shock Alleviator

A shock alleviator of the seal air cushion type should be installed at the input manifold immediately upstream of the venturi.

h. Underwing Pressure Fueling Nozzles

Type: Quick disconnect with BSPT inlet, 100 mesh screen stick handles, rising curve regulator and surge control, dust cap, grounding wire and clip.
Avery Hardroll or equivalent
model HU.3204/B50/C22/Y or equivalent
model HU.3295/B50/C22/Y or equivalent.

Size: -1/2"

Number required: 2 of both 2-1/2" and 3" BSPT connection.

i. Static Wire/Grounding Wire Reel

Type: Spring rewinding with latch to accommodate 15 meters of 3/32" plastic covered stranded copper wire with alligator clip.

Number required: 1 (one)

Fire Extinguisher

Type: Dry chemical cartridge expelled, corrosion and water resistant, quick release bracket mounted.

Number required : 2 (two) of 20 lbs capacity

In addition : one BCF of 2 lbs capacity in the cabin.

j. Instrument Panel

A conveniently located instrument panel equipped with high quality weatherproof gauges and controls, is to be provided. Night illumination lights (flame proof) are to be fitted to panel face and meter counter.

Panel to include : filter differential pressure gauge, hydrant input pressure gauge, hose deck and hose reel inlet pressure gauge, air reference pressure gauge, air reference pressure regulator control, flow rate selector. A flow scheme should be installed in a convenient location on the instrument panel.

k. Sample Points and Slop Tank

Sample and drain cocks shall be conveniently grouped and permit sampling from (quick action valve) Filter separator sump, inlet manifold and hose reel inlet. Drain points are to be provided at all low points in the pipe work. All drain valves must have a quick release dust cap (camlock type) secured by chain. A sample box for storage of 6 (six) samples bottles 1000 cc should be provided.

l. Piping

- (1) All piping shall have a design working pressure of 250 psi.
- (2) Upstream piping of the filter shall be seamless steel pipe.
- (3) Downstream piping of the filter shall be seamless steel pipe.

(4) All welded joints shall be butt welded, with all welds having full penetration.

CHAPTER 5. PIPING

5.1 GENWEAL

This specification broadly covers the general requirements of the piping. The scope includes but is not limited to, the items described thereunder. Any item which is not specifically indicated, but it shall be considered necessary for safe and efficient operation of the facilities, shall be included.

5.2 CODES AND STANDARDS

ANSI: American National Standards Institute

ASTM: American Society for Testing and Materials

API: American Petroleum Institute

MSS: Manufactures Standardization Society

Others: Manufacturers standards or codes, which are approved by the Engineer.

5.3 PIPING MATERIAL

5.3.1 FUEL OIL AND HSD

PIPE

(Aboveground)	1/2" - 1-1/2"	SCH 80 Seamless ASTM A 53 Gr. A	ANSI B 36.10
	2" - 4"	SCH 40 Seamless ASTM A 53 Gr. A	ANSI B 36.10
	6" - 16"	SCH 40 Seamless ASTM A 53 Gr. A Internal Surface; Epoxy resin coating	ANSI B 36.10
	18" - 30"	SCH 40 Seamless ASTM A 53 Gr. A Internal Surface; Epoxy resin coating	ANSI B 36.10
(Underground)	1/2" - 1-1/2"	SCH 80 Seamless	ANSI B 36.10

		ASTM A 53 Gr. A External surface; Polyethylene lining	
	2" - 4"	SCH 40 Seamless ASTM A 53 Gr. A External surface; Polyethylene lining	ANSI B 36.10
	6" - 16"	SCH 40 Seamless ASTM A 53 Gr. A Internal Surface; Epoxy resin coating External surface; Polyethylene lining	ANSI B 36.10
	18" - 30"	12.7mm Seam ASTM A 53 Gr. B Internal Surface; Epoxy resin coating External surface; Polyethylene lining	ANSI B 36.10
FITTING			
(Aboveground)	1/2" - 1-1/2"	3000# SW ASTM A 105	ANSI B 16.11
	2" - 4"	SCH 40 BW ASTM A 234 Gr. WPB	ANSI B16.9

	6" - 16"	SCH 40 BW ASTM A 234 Gr.WPB Internal surface; Epoxy resin coating	ANSI B16.9
	18" - 30"	12.7mm BW ASTM A 234 Gr.WPB Internal surface; Epoxy resin coating	ANSI B16.9
(Underground)	1/2" - 1-1/2"	3000# SW ASTM A 105 External surface; Shrink tube.	ANSI B 16.11
	2" - 4"	SCH 40 BW ASTM A 234 Gr.WPB External surface; Shrink tube.	ANSI B16.9
	6" - 16"	SCH 40 BW ASTM A 234 Gr.WPB Internal surface; Epoxy resin coating External surface; Shrink tube	ANSI B16.9
	18" - 30"	12.7mm BW ASTM A 234 Gr.WPB Internal surface; Epoxy resin coating External surface; Shrink tube	ANSI B16.9
FLANGE	1/2" - 1-1/2"	ANSI 150# RF SW ASTM A 105	ANSI B 16.5
	2" - 30"	ANSI 150# RF SO ASTM A 105	ANSI B 16.5

GASKET	1/2" - 20"	ANSI 150# RF Asbestos sheet	ANSI B 16.21
BOLT		Stud bolt ; ASTM A 193 Gr. B7	ANSI B 1.1
NUT		Heavy nut ; ASTM A 194 Gr. 2H	ANSI B 1.1
GATE VALVE	1/2" - 1-1/2"	800# SW API ST'D 602 Compact design BB BG OS&Y BODY: TRIM : SEAT :	ASTM A 105 13%Cr STL
	2" - 12"	ANSI 150# RF API ST'D 600 Cl, 150 BB BG OS&Y BODY: TRIM:	ASTM A 216 Gr. WCB 13%Cr
	14" - 24"	ANSI 150# RF API ST'D 600 Cl, 150 BB BG OS&Y BODY: TRIM:	ASTM A 216 Gr. WCB 13%Cr
GLOBE VALVE	1/2" - 1-1/2"	800# SW API ST'D 602 Compact design BB BG OS&Y BODY: TRIM: SEAT:	Modify ASTM A 105 13%Cr STL
	2" - 16"	ANSI 150# RF BB BG OS&Y BODY: TRIM:	API ST'D 600 Cl, 150 Modify ASTM A 216 Gr. WCB 13%Cr
	1/2" - 1-1/2"	800# SW Compact design	API ST'D 602 Modify

		BC piston lift	
		BODY :	ASTM A 105
		TRIM :	13%Cr
		AT :	STL
	2" - 20"	ANSI 150# RF	API ST'D 600
		BC SWING	CL.150 Modify
		BODY:	ASTM A 216
			Gr. WCB
		TRIM :	13%Cr
BALL VALVE	1/2" - 1-1/2"	ANSI 150# RF	API ST'D 6D
		Side entry BG	
		Non metal seal,	
		Full bore	
		Fire safe type	
		BODY:	ASTM A 105
		BALL:	SUS 304 or Gr. CF8
		SEAT:	Teflon
	2" - 4"	ANSI 150# RF	API STD 6D
		Side Entry BG	
		Non metal seal,	
		Full bore	
		Fire safe type	
		BODY:	ASTM A 216 Gr. WCB
		BALL:	ASTM A 351 Gr. CF8
		SEAT:	Teflon
TWIN SEAL VALVE	12" - 24"	ANSI 150#	
		BODY	ASTM A 216 Gr. WCB
		PLUGASTM A 216 Gr.	Side Handle
		SEAT:	ASTM A 536
		O-RING :	VITON
STRAINER			
Connection ANSI 150#			
Material		BODY:	ASTM A 53 Gr.A or B
			SCH 40 or ASTM A 216
			Gr.WCB
		FLANGE:	ASTM A 105 or A 106
			Gr.WCB

	GASKET: ELEMENT:	CAF SUS 304
FLEXIBLE METAL TUBE Connection Material	ANSI 150# FLANGE: TUBE: BRAID: PIPE:	ASTM A 105 SUS 304 SUS 304 ASTM A 53 Gr. A SCH40
EXPANSION JOINT 8" & 20" Universal Connection Material	ANSI 150# RF FLANGE : PIPE : TUBE :	ASTM A 105 ASTM A 53 Gr. A SCH40 SUS 304

5.3.2 FIRE FIGHTING WATER AND AIR FOAM

PIPE (Aboveground)	1/2" - 1-1/2"	ST'D W ERW	ANSI B 36.10 ASTM A 120 Galvanized
	2" - 14"	ST'D W ERW	ANSI B 36.10 ASTM A 120 Galvanized
(Underground)	1/2" - 1-1/2"	ST'D W ERW	ANSI B 36.10 ASTM A 120 Galvanized Polyethylene tape
	2" - 14"	ST'D W ERW	ANSI B 36.10 ASTM A 120 Galvanized Polyethylene tape
FITTING (Aboveground)	1/2" - 1-1/2"	2000# NPT	ANSI B 16.3 ASTM A 338 Galvanized
	2" - 14"	SCH 40 BW	ANSI B16.9 ASTM A 234 Gr. WPB Galvanized
(Underground)	1/2" - 1-1/2"	2000# NPT	ANSI B 16.3 ASTM A 338 Galvanized Polyethylene tape

	2" - 14"	SCH 40 BW	ANSI B16.9 ASTM A 234 Gr.WPB Galvanized Polyethylene tape
FLANGE	1/2" - 1-1/2"	ANSI 150# RF NPT	ANSI B 16.5 ASTM A 105 Galvanized
	2" - 14"	ANSI 150# RF SO	ANSI B 16.5 ASTM A 105 Galvanized
GASKET	1/2" - 14"	ASNI 150# RF	ANSI B 16.21 Asbestos sheet
BOLT	1/2" - 14"	MACHINE BOLT:	ANSI B 1.1 W/Hexagon ASTM A 307 Gr. B
NUT	1/2" - 10"	HEAVY NUT ;	ANSI B 1.1 ASTM A 563 Gr. A
GATE VALVE	1/2" - 1-1/2"	800# NPT Compact design BB BG OS&Y BODY : TRIM : SEAT :	API ST'D 602 ASTM A 105 13%Cr STL
	2" - 14"	ANSI 150# RF BB BG OS&Y BODY: TRIM:	API ST'D 600 Cl, 150 ASTM A 216 Gr. WCB 13%Cr
GLOBE VALVE	1/2" - 1-1/2"	800# NPT Compact Design BB BG OS&Y BODY: TRIM: SEAT:	API ST'D 600 Modify ASTM A 216 Gr.WCB 13%Cr STL
	2" - 10"	ANSI 150# RF BB BG OS&Y	API ST'D 600 Cl 150 Modify

		BODY:	ASTM A 105
		TRIM :	13%Cr
CHECK VALVE 1/2" - 1-1/2"		800# NPT	API ST'D 602
		BC Piston Lift	Modify
		BODY:	ASTM A 105
		TRIM:	13%Cr
		SEAT:	STL
	2" - 14"	ANSI 150# RF	API ST'D 600
		BC Swing	CI 150 Modify
		BODY:	ASTM 216
			Gr. WCB
		TRIM:	13%Cr
STRAINER		ANSI 150#	
Connection		BODY:	ASTM A 53 Gr.A or B
Material			SCH 40 or ASTM A 216
			Gr. WCB Galvanized
		FLANGE:	ASTM A 105 or A 216
			Gr. WCB Galvanized
		GASKET:	CAF
		ELEMENT:	SUS 304
FLEXIBLE		ANSI 150#	
METAL TUBE		FLANGE:	ASTM A 105
Connection		TUBE:	SUS 304
Material		BRAID:	SUS 304
		PIPE:	ASTM A 53 Gr. A SCH40
			Galvanized

5.3.3 SERVICE WATER

PIPE			
(Aboveground)	1/2" - 1-1/2"	ST'D W ERW	ANSI B 36.10
			ASTM A 120 Galvanized
(Underground)	1/2" - 1-1/2"	ST'D W ERW	ANSI B 36.10
			ASTM A 120 Galvanized
			Polyethylene tape

FITTING (Aboveground)	1/2" - 1-1/2"	2000# NPT	ANSI B 16.3 ASTM A 338 Galvanized
(Underground)	1/2" - 1-1/2"	2000# NPT	ANSI B 16.3 ASTM A 338 Galvanized Polyethylene tape
FLANGE	1/2" - 1-1/2"	ANSI 150# FF NPT	ANSI B 16.5 ASTM A 105 Galvanized
GASKET	1/2" - 1-1/2"	ANSI 150# FF	ANSI B 16.21 Asbestos sheet
BOLT	1/2" - 1-1/2"	MACHINE BOLT:	ANSI B 1.1 W/Hexagon ASTM A 307 Gr. B
NUT	1/2" - 1-1/2"	HEAVY NUT;	ANSI B 1.1 ASTM A 563 Gr. A
GATE VALVE & GLOBE VALVE	1/2" - 1-1/2"	ANSI 150 NPT SBSGISS BODY: TRIM:	MSS-SP-30 ASTM B62 ASTM B62
CHECK VALVE	1/2" - 1-1/2"	ANSI 150# NPT BODY: TRIM:	MSS-SP-80 SC Piston Lift ASTM B62 ASTM B62

5.4 PIPING LAYOUT

Refer to DWG. Nos. F-31, F-32, F-33, F-34, F-35, F-36, F-37 and F-38.

These Drawings define the minimum requirements for fuel supply system piping design. The Contractor shall execute the necessary detailed designs and submit these for the approval of the Engineer prior to the commencement of the Works.

CHAPTER 6. ELECTRICAL WORK

6.1 GENERAL

The specification broadly covers the general requirements for electrical equipment and facilities. The scope includes but not limited to the equipment and/or system described thereunder. Any item which is not specifically mentioned but considered necessary for safe and efficient operation of the facilities shall be included.

6.1.1 CODES AND STANDARDS

The electrical equipment, materials and installation shall confirm to the requirements of the latest edition of the following codes and standards.

- a) IEC (International Electrotechnical Commission)
- b) NEC (National Electricity Code)
- c) Other international recognized codes and standards

6.2 AREA CLASSIFICATION

Hazardous area classification and electrical installation within the hazardous locations shall be in accordance with the relevant codes and standards indicate above. Refer to drawing DWG3-E02 showing preliminary area classification.

- Zone1 : - No electrical equipment installed
- Zone2 : - Motors
 - Local motor control station
 - Lighting fixtures and receptacles in fuel pump shelter and refueler loading shelter
- Unclassified : - Lighting fixtures except the above, and inside of building
 - Transformers, switchgear, motor control center, panel, and other equipment of installed inside the buildings.

6.3 DESIGN BASIS

6.3.1 Electrical power supply and distribution

- a) Refer drawing DGW3-E01 "One line diagram" regarding the electrical system.

- b) All electrical power for normal operation shall be supplied from the local power grid.
- c) The electrical system of the local grid is as follows :
 - Voltage : 10,000 V, 3 phase, 3 wire
 - Frequency : 50 Hz
- d) The high voltage switchgear, main transformer, low voltage switchgear and motor control centers shall be rated to supply the total capacity for the load of fuel supply system..
- e) VVVF (Variable Voltage Variable frequency) controller shall be considered for the hydrant pump which is run first of group of these pumps.
 The hydrant pumps shall have two (2) groups.
- f) Full voltage motor starting method shall be considered as a standard. However, reduced voltage starting method may be considered for large motor starting.
- g) An uninterruptible power supply (UPS) system shall be provided to supply 220 Volt A.C. single phase power for the DCS systems.
- h) Electrical system for each service shall be as listed below;

Description	System	Distribution (Hz)	Frequency Voltage	System Voltage (V)	Equipment Rated (V)
From local power grid	Incoming power	3 ph, 3W	50	10,000	-
	Electric motors	3 ph, 3W	50	400	380
	Lighting and Socket outlet	3 ph, 4W	50	400/230	380/220
	Instrument Supply	1 ph, 2W	50	230	220
	Electric motor control circuit	1 ph, 2W	50	230	220
	Switchgear control	DC	-	110	110
	Space heater	1 ph, 2W	50	230	220

6.3.2 CCTV SYSTEM

The CCTV systems shall be provided to monitor where around the tank area, pump area and gate independent camera system.

The CCTV system shall be monitored at control room in substation 2nd floor.

6.3.3 LIGHTING

- a) Suitable illumination shall be provided to facilitate normal operation and maintenance activities, and to ensure the safety of work personnel.
- b) The Lighting power shall be supplied from 3ph, 4W, 400/230 V lighting panels, which shall be fed from motor control center.
- c) For outdoor illumination, flood lights and street lights shall be installed at suitable locations to provide the required levels of illumination. Pole mounted high pressure sodium vapor or mercury vapor fixture shall be used.
- d) The illumination system design shall ensure uniform illumination, avoiding dark spots.
- e) High-pressure mercury vapor lamp shall be provided for pump station shed.
- f) Fluorescent lighting fixture shall be provided inside of building.
- g) The illumination level at each location shall be as follows :
 - Tank area : 30 Lux
 - Pump area : 100 Lux
 - Road : 30 Lux
 - Inside of building : 150 ~ 300 Lux

6.3.4 GROUNDING

The following facilities/equipment shall be grounded :

- Metallic non-current carrying parts of electrical equipment, enclosures etc.
- Vessels, piping, and structures subject to potential and current flow due to lightning or other abnormal conditions.
- The resistance value of grounding shall be as follow:
 - Lightning less than 3 ohms
 - Equipment less than 5 ohms

6.3.5 CATHODIC PROTECTION

The undergrounding pipeline shall be provided the cathodic protection. The cathodic system shall be impressed current type.

6.3.6 OTHER

Fire alarm system, telephone system and lighting in the buildings for the fuel storage and supply depot shall be provided.

6.4 TECHNICAL SPECIFICATION

6.4.1 10KV SWITCHBOARD

- a) The switchboards shall be metal-clad consisting of vacuum circuit breakers. The switchboards shall be of single busbar design.
- b) Busbar systems shall be totally enclosed air insulated with solid or heat-shrinkable insulation.
- c) The metal-enclosed switchgear assembly shall consist of free-standing, vertical steel structures.
- d) The circuit breaker shall be of an electrically operated vacuum type.

6.4.2 LOW VOLTAGE SWITCHGEAR

- a) The switchgear shall comprise a metal-enclosed switchgear assembly built of circuit breakers of the draw-out type, which shall be readily interchangeable with others of the same rating.
- b) The metal-enclosed switchgear assembly shall consist of free-standing, vertical steel structures.
- c) The switchgear assembly shall be provided with a common ground bus.
- d) The rating of the neutral bus shall be 50% of the phase bus rating, unless otherwise specified.
- e) Metal-enclosed switchgear assemblies shall be adequately vented, and shall be designed to prevent the entrance of small animals, spiders and small insects. Degree of protection shall be IP 30 as per IEC recommendation.

- f) Circuit breakers shall be of an electrically operated air break type.

6.4.4 LOW VOLTAGE MOTOR CONTROL CENTERS

- a) Motor control center shall be of indoor use type and each motor controller unit shall comprise molded case circuit breaker and magnetic contactor with thermal overload relay.
- b) Each unit shall be of draw-out type.
- c) Full voltage, direct-on-the-line starters shall be standard unless otherwise specified.
- d) Degree of protection of external enclosure shall be IP 30 as per IEC

6.4.5 VVVF CONTROL PANEL

- a) The VVVF control panel shall comprise a metal enclosed assembly built of solid state rectifier and inverter.
- b) The VVVF control panel shall be equipped motor circuit exchanger.
- c) Degree of protection of external enclosure shall be IP 30 as per IEC

6.4.6 POWER TRANSFORMER

- a) Power transformer shall be dry type, self cooled, indoor type unless otherwise specified.
- b) An externally operated no-voltage (off-circuit) primary tap changer shall be provided with 2.5% and 5% full capacity taps above rated voltage and with 2.5% and 5% reduced capacity taps below rated voltage.
- c) Tanks shall have sufficient strength to prevent distortion occurring when the transformer is lifted, jacked up, or transported, and joint seams and fittings shall be sufficiently strong and well protected to prevent leakage of oil under these conditions.
- d) The transformer shall be provided with an air filled terminal chamber with conduit entrance. The terminal chamber for the cable entrance shall be arranged to permit disconnection of the cable without disturbing the actual cable termination and seal.

- e) A control circuit terminal box incorporating conduit entry shall be provided. All control and alarm devices on the transformer shall be wired to terminal blocks located within this terminal box using rigid steel conduits.

6.4.7 ELECTRIC MOTORS

- a) Electric motors shall generally be of the induction type with squirrel cage rotor.
- b) Electric motors shall, in general, be totally enclosed and fan-cooled, and shall have enclosure of minimum IP 44 as per IEC recommendation.
- c) Electric motor characteristics such as torque, speed, kind of rating, etc. shall be coordinated with the operation of the driven machine.
- d) Winding insulation shall be minimum class E.
- e) Contractor shall provide the following vendor's information for each motor.
- manufacturer, type
 - rated voltage, and speed
 - efficiency at 3/4 and 4/4 full load
 - power factor at 3/4 and 4/4 full load
 - normal and maximum torque and ratio of starting torque to normal torque
 - normal current and ratio of starting current to normal current
 - temperature rise in windings, core, and bearings
 - details of lubrication
- f) Electric motor characteristics such as torque, speed, kind of rating, etc. shall be coordinated with the VVVF controller.

6.4.8 UNINTERRUPTIBLE POWER SUPPLY SYSTEM (UPS)

- a) An uninterruptible power supply system (UPS) shall be provided for DCS and essential instruments.
- b) UPS shall be of solid-state type with a static transfer switch to AC alternate power upon inverter failure.
- c) Battery bank shall consist of Ni-Cd or sealed type lead acid batteries mounted in steel enclosure, and shall be sized for 30 minutes service minimum in case of normal power failure.

6.4.9 DC POWER SUPPLY SYSTEM

- a) A DC power supply system shall be provided for 10KV switchgear control.
- b) Battery bank shall consist of Ni-Cd or sealed type lead acid batteries mounted in steel enclosure, and shall be sized for 1 hour service minimum in case of normal power failure.

6.4.10 CCTV SYSTEM

- a) The CCTV system shall be provided to monitor around the tank area, pump area and gate.
- b) CCTV system shall consist of the following:
 - CCTV camera : Outdoor fixed type, weather proof enclosure
 - CCTV monitor : 21 inch color
 - Monitor divider : four divided on monitor

6.4.11 CABLE AND CABLE INSTALLATION

- a) The power cable for direct buried shall be PVC insulated, galvanized steel wire armored. PVC sheathed cable in accordance with IEC or equivalent.
- b) For other power cable on site use shall be PVC insulated, PVC sheathed cable
- c) Control cable shall be of similar type to power cable.
- d) Except for factory assembled and wired equipment, the following minimum sizes shall be used.
 - Power circuits : 2.5 mm²
 - Motor control circuits : 2.5 mm²
 - Lighting branch and receptacle circuits : 2.5 mm²
- e) Cable or wire for the ancillary facility in the buildings shall be installed in conduit, on cable tray, cable or cable pit.
- f) In general, direct buried cable system shall be applied for unpaved areas, except road crossings, where cables shall be protected by concrete-encased pipes.

6.4.12 GROUNDING AND LIGHTNING PROTECTION

- a) Grounding network shall be made of:

- Common grid of 70 mm², stranded copper cable, buried 50 cm deep.
 - Grounding rods installed in ground well with concrete cover.
 - Equipment-grounding conductors connected to main grid.
- b) Underground grounding conductor connection shall be made by thermit welding.
 - c) The aircraft and services shall be effectively earthed against electrostatic conditions.
 - d) Lightning protection shall be covered the hydrant pump area, refueller loading area and related buildings.
 - e) Lightning protection system shall be provided each building.

6.4.13 CATHODIC PROTECTION

- a) Galvanic anode for cathodic protection system shall be applied to the underground pipeline for the fuel supply system.
- b) The galvanic anodes in the protection system shall generally consist of magnesium, zinc or aluminum.
- c) The design and materials for the cathodic protection system shall comply with the following applicable codes and standards.

For design

BS : British Standards, Code of Practice for Cathodic Protection,
CP1021; 1973

For materials

JIS : Japanese Industrial Standard

IEC : Standards of International Electro-technical Commission

NEC : National Electrical Code of National Fire Protection Association

- d) Design Condition

- Pipe coating resistance : 5,000 (ohm m²)

CHAPTER 7. INSTRUMENT AND CONTROL

7.1 GENERAL

This specification covers the general requirements of instrumentation . The scope includes, but is not limited to the instruments and/or instrumentation described thereunder. Any items which are not specifically indicated, but are considered necessary for safe and efficient operation of the facilities, shall be included.

7.1.1 CODE AND STANDARD

API RP550 Part I is applied as a general philosophy to the instrument engineering in this project.

- a) Control valve sizing : Vendor's standard
- b) Electrical : IEC
- c) Flow (Orifice) : ISO 5167

7.1.2 INSTRUMENTATION AND CONTROL PHILOSOPHY

- a) The design of the control system shall consider the principle of "Fail safe" operation for all system.
- b) A distributed control system (DCS) shall be applied for the hydrant monitor and control system.
- c) Explosion proof enclosure or intrinsic safe barriers shall be provided for all instruments located in hazardous areas.
- d) Lightning arester shall be provided for all local mounted electronic transmitters.
- e) DCS power source shall be considered an UPS (Uninterruptible Power Supply).

7.2 TECHNICAL SPECIFICATION

7.2.1 TANK GAUGING SYSTEM

- a) Displacement or float type transmitter shall be provided in each fuel storage tank. The transmitter shall have local indicator and optic signal transmitted type.

- b) Multi-element type average temperature bulbs shall be installed on the tanks. Elements shall be automatically selected by level transmitter corresponding to the level.
- c) Level indicate on CRT display shall be installed in the control house, also it can be monitored at office building.

Output signal : Optical
 Enclosure : Intrinsically
 Average temperature : RTD
 Monitor : Color CRT

7.2.2 PRESSURE INSTRUMENT

- a) The measuring element shall generally be made of 316 stainless steel. The case of gage shall be weatherproof.

Type : Bourdon tube 100dia
 Case material : ADC

- b) Low displacement type optic signal transmitter shall generally be applied. Pressure element shall be 316 stainless steel.

Output signal : Optical
 Enclosure : Intrinsically
 Material : 304SS/316L

7.2.3 FLOW INSTRUMENT

- a) For the measurement of flow, the principle of turbine type measurement shall be applied. The measurement for minor flow and major flow shall be measured separately system on the pipe line.

Material : CS/304SS
 Output signal : Pulse
 Enclosure : Flameproof
 Material : C.S/316LSS

- b) Positive displacement type shall be used as refueller loading.

7.2.4 TEMPERATURE INSTRUMENT

- a) Resistance bulbs shall be used for temperature measure optic signal transmission. The resistance bulbs shall be used with protection well.

Output signal : Electrical
Enclosure : Flameproof
Material : 304SS

- b) Bi-metallic thermometers shall generally be used at local indicator. The resistance bulbs shall be used with protection well

Type : Bi-metallic , 100 dia, with well
Material : ADC/304SS

7.2.5 CONTROL VALVE

- a) Control valves shall be sized at least 120% of anticipated maximum flow rate at the permissible pressure drop for the flow rate.

b) Valve actuator shall normally be motor operated type.

Actuator type : 3phase, 50Hz, 380V
Control signal : Optic
Enclosure : Flameproof

7.2.6 DCS (DISTRIBUTED CONTROL SYSTEM)

The monitor and control system principally consists of two operator stations and a process control station. The operator station functions as a man-machine interface (for monitor and operation use), including a printer for process historical message and alarm message output and document preparation, and a color copier for CRT display screen recording. The process control station is used for sequence control and loop control. This monitor control system shall have redundant system configuration, and the quantities of components will be as follows:

a) Operator station : 2 sets
Configuration : Desk type
CRT : 20 inch color (1024 X 768 dots), touch screen
function provided
MPU : 32 bits
Main memory : 32 MB
Auxiliary memory : 1.2 GB
Control LAN : Ethernet

b) Accessories : Printer : 2 sets (one for alarm recording, the other
for document preparation)
Color copier : 1 set

c) Process control station : 2 panels (duplex)

d) Control LAN : Ethernet

Signal relay panel : 1 panel (Locker type)

7.2.7 LORRY BATCH CONTROL SYSTEM

The lorry loading system shall apply the automatic batch control system.

Type of batch-counter : Electrical remote setting
Enclosure : Flameproof
Shut-off valve : Ball type, 2 step opening

7.2.8 FLIGHT INFORMATION SYSTEM

Flight information system shall be provided to link with the airport LAN system. This system consist of monitoring station and LAN cable between fuel storage depot, fuel supply depot and passenger building. Design of this system is out of scope work of this project, however, the cable installation work shall be included.

7.2.9 CABLE

The direct buried control cable shall be PVC insulated, galvanized steel wire armored . Signal cable shall be used single pair twisted minimum 1.5mm^2 stranded copper wires with heat resistant PVC insulation over each conductor.

Multi pair cable shall consist of suitably identified twisted pair minimum 1.0mm^2 stranded copper wires with PVC insulation over each conductor.

Optic fiber cable shall be used single core and/or double core 0.9 mm diameter nylon and polyethylene sheathed, steel corrugate armored.

7.2.10 IMPULSE TUBING/PIPING

- a) Tubing shall be seamless type, nominal diameter 12 mm O.D x 1.5 mm wall thickness, fully annealed type 316 stainless steel to ASTM 269 or equivalent.
- b) Thread connections are normally used for the final connection to the instruments.
- c) Compression fittings shall be 316 stainless steel to ASTM A276 or equivalent.