STATE OF KUWAIT

MINISTRY OF INFORMATION

SPECIFICATIONS FOR UNDERGROUND STORAGE TANKS

AT JUELIAA STATION

General Conditions

1. **General Conditions**:

1.1 This is a Turnkey project includes design, supply, installation, testing, commissioning and handing over to full satisfaction of the MOI's Engineer. Fiberglass Underground Storage Tanks at Julaia Station.

1.2 All tenderers wishing to participate in this tender must visit the site to have full idea about all works before submitting their offers as no variation claims shall be entertained.

1.3 Specifications described hereunder are brief and therefore the tenderer shall include all equipment material, labor and whatever required for the entire installations and to ensure best workmanship and operating conditions to the satisfaction of the MOI Engineer whether detailed under the specifications or not, any additional works which may deem necessary to complete the work shall be made by the contractor without any right of variation claims of cost or time.

1.4 The Contractor shall take all necessary precautions not to damage any exiting services and must fix any damage done by him during the course of installation of equipment, at no extra cost.

1.5 The Contractor shall ensure that all mechanical, electrical and civil works shall be supervised by qualified engineers of the respective specialization and experience and all installations shall be made with special companies working in the Air Conditioning field and approved from the Engineering Services Department before the installation works start.

1.6 The contractor shall ensure cleanliness and safety of the site throughout the execution of the project and shall remove all waste materials. Scrap materials are not allowed to accumulate in the work site. Short intervals cleaning up are required to avoid mishap, accident or inconvenience to site users.

1.7 The contractor shall guarantee and maintain all the works for a period of two years including supply to the spare parts, guarantee and maintenance shall start from the date of handing over of the project.

1.8 All work must conform to the codes and standards established by the Ministry of Public Works, the Municipality, KNPC, and KFF, KFD Codes and standards.

1.9 All components, materials, and design drawings must receive approval from a certified engineering office & MOI engineer before installation.

Scope of Work

Design, supply, installation, testing, commissioning with two years guarantee and maintenance the following:

1. Design, supply, installation, testing, commissioning and handing over to full satisfaction of the MOI Engineers in perfect condition with two years guarantee and maintenance.

2. Supply and install an underground fuel storage tanks with a capacity of 25,000 liters & ensuring to meet all the requirements in the specifications section, and approved by KFF and KNPC.

3. Replace the existing concrete tank storage room with a new structure, ensuring that the design is approved by a certified engineering office. The new tank room must be able to support the weight of a fully-loaded tank and must receive approval from the Ministry of Public Works, the municipality, KFF, and KNPC.

4. Conduct a full inspection of the area beneath the concrete structure and provide a detailed installation plan for the MOI engineer.

5. Supply and install a new 1000-Liter fuel tank inside the generator room including all pipes & valves, and dismantle the old existing tank.

6. Supply and install a new 1-hp pump and replacing the old pump inside the generator room including all pipes & valves related to it.

7. All tasks related to replacing and connecting the existing fuel pipes, valves must be completed to finalize the work.

8. Contractor must prepare temporary plan for this project and approved by ministry engineers.

9. Dismantle and relocate the existing old temporary and the old underground tanks.

10. Supply and install a new valve, gauges for the new tank.

11. Two-years guarantee and maintenance of all works.

12. The contractor is committed to carrying out renovations to the existing bases including concreate, reinforced steel, and special materials.

13. The contractor is obligated to undertake the work of suppling and pouring reinforced concreate in the event that old bases are dilapidated or if their sizes or designs do not match the dimension and requirement of the old equipment. The contractor must carry out the necessary new design and work for the bases in accordance with the requirement of the equipment factory and the approval of the Ministry supervision engineers.

Detailed Technical Specification

SECTION 15550

Underground Storage Tanks for Fuel

Part 1 General

1.01 Quality Assurance

A. Governing Standard

1. ASTM Specification D4021
2. National Fire Protection Assoc. (NFPA 30) Flammable and Combustible Liquids Code and (NFPA 31) Standards for installation of Oil Burning Equipment.
3. Military Specification MIL-T-5277A, dated July 6, 1978 Tanks, Storage, Underground, Reinforced Plastic. Underground Fuel Storage Tanks should be UL listed.
4. Submittals:

    a. Shop Drawing : Contractors shall submit 3 copies of shop drawings for each tank. Drawings shall include all critical dimensions and show locations of all fittings and accessories, i.e., man-ways, ladders, hold-down straps, heating coils, etc. Materials of construction shall be in accordance with section 1.01 of this specification.
    b. Catalogue Data : Contractors shall submit 3 copies of manufacturer's literature. One of them should be original.
    c. Installation Instructions : Contractors shall submit 3 copies of manufacturer's latest installation instructions. One of them should be original.
    d. Calibration charts: Contractors shall submit 3 copies of manufacturer's latest calibration charts.

Part II Products

2.01 Underground Storage Tanks for Fuel

A. Loading Conditions – Tanks shall meet the following design criteria:

1. External Hydrostatic Pressure. Buried in ground with 2 meters of overburden over the top of the tank. The hole fully flooded and a safety factor of 2:1 against general buckling.
2. Surface loads: When installed according to manufacturer's installation instruction tanks will withstand surface H-20 axle loads (14500 Kg/axle).
3. Internal Load: Tanks shall withstand 3-5 psi air pressure test with 5 to 1 safety factors. Test prior to installation since this design condition is to test for leakage.
4. Tanks shall be designed to support accessory equipment such as heating coils, ladders, drops tubes, etc. when installed according to manufacturer's recommendation and limitations.

B. Product Storage Requirements:

1. All tanks must be vented. Tanks are designed for operation at atmospheric pressure only, except for use with vapor recovery system provided the pressure or vacuum does not exceed 1 psi.

2. Tanks shall be capable of storing liquids with specific gravity up to 1.5.
3. Maximum temperature. Tanks shall be capable of storing gasoline, gasohol (90% gasoline and 10% ethanol mixture) jet fuel, diesel fuel or potable water at ambient underground temperature, fuel oil at temperatures not to exceed 65^0C at the tank interior surface.
4. Tanks shall be chemically inert to petroleum products.

2.2 Provide the following underground tanks:

1. 25000 LIT

3. Specification for GRP tanks.

3.1 Scope

1. The specification covers the general technical requirements for reinforced plastic tanks to be used for underground storage of fuel products, to feed Diesel generators.
2. When submitting offers, the manufacturer shall clearly state and give reasons for any deviation from or non-compliance with this specification. Failure to do so will be interpreted to mean that tanks supplied by the manufacturer fully complies with this specification.

3.2 Codes and Standards

The design materials, manufacturing and testing of the reinforced tanks shall comply with the requirements of latest edition of the following standards:

1. ASTM - American Society of Testing & Materials such as ASTM D 4021 Standard specification for Reinforced polyester underground petroleum storage tank.
2. UL 1316 - Standard for reinforced plastic underground storage tanks for petroleum products.
3. NS 1545: Norwegian standard for GFRP petroleum products storage tanks.
4. NFPA 30: Flammable and combustible liquids code.
5. NFPA 30 A: Code for Automation and Marine service station.
6. NFPA 31: Standard for installation of Burning Equipment

The manufacturer should submit the necessary documents that show he is U. L. or KEWA listed.

3.3 Document submittals

1. The manufacturer along with his offer shall submit one copy of the following documents and drawings.
    a. Description of the manufacturing process. details of manufacturing process
    b. Machines, materials for manufacturing to be used, along with catalogues as well as quality control and inspection procedures being applied by the manufacturer. In addition, process of manufacturing external ribs and fixing them with the Tank shall be submitted.
    c. Typical shop drawing of the tank. The drawing shall show the critical dimension and location of all ribs, end caps, fittings and accessories.
    d. Manufacturer's latest tank installation instructions.
    e. Copy of the latest calibration chart.
    f. A list of all accessories with their specifications and details.
    g. Number of similar type of tanks manufactured by the tenderer with the name of the clients.
    h. Detail of manufacturing and installation of piping sump & necessary fittings.

Warranty.

i. Method of transportation, handling & storage.
j. List of raw materials used in the production of tank for shell and end caps.

2. Within four (4) weeks of receipt of order, the manufacturer shall submit 6 copies of the following drawing/documents for Owner's approval.

   a. Shop fabrication drawing showing all the relevant dimensions and location of accessories.
   b. Installation instructions.

3.4 Climatic Conditions

1. The GRP tanks during their storage and services period are likely to encounter the following environmental conditions:

a.	Ambient temperature:	Max	Min
	Under shade	50°C	3°C
	Direct sun	85°C	
b.	Relative humidity	5% to 100%	
c.	Occasional sandstorm with wind speed up to 45 meters/sec.		

2. The tanks might be stored in open area, for a period of two years, before they are installed underground. Hence, during this period, tank materials properties should not get affected or changed and tank should be kept vented.

3. Manufacturer shall provide sufficient protection to avoid damage and ingress of dust... etc. during the transit / storage period of the tank.

3.5 Design Conditions & Requirements

1. Tank Capacity & Dimensional Requirement

1.1 The nominal capacity of the tank shall be 25000 lit .
1.2 The minimum capacity of the tank shall be 25000 + 5% of the nominal capacity.
1.3 The maximum dia of the tank shall not be more than 2.50 meters.
1.4 The maximum overall length of the tank shall not be more than 10.85 meters.
1.5 Minimum 26 nos. of circular solid ribs shall be provided on each tank and equally spaced.
1.6 The thickness of the tank shell and end caps shall not be less than 9mm.

3.6 Product Storage Requirements

1. Tanks will be normally operated with internal pressure approximately equal to the atmospheric pressure. However, accidentally the internal pressure can increase to 5 PSIG. Hence, the tanks shall be capable to withstand an internal pressure of 5 PSIG.
2. Tanks shall be capable to withstand an internal negative pressure of -2.5 PSIG.
3. Tanks shall be capable of storing liquid with specific gravity up to 0.95.
4. Tanks shall be capable of storing gasoline, 90.5 gasoline and 9.5% Oxinal - 50%, gasoline with 5% methanol and minimum 2.5% co-solvent. The blend may contain a maximum concentration up to 3.7 oxygen by weight, gasoline with up to 20% (by volume) of methyl tertiary butyl ether (MTBE), diesel fuel and kerosene at temperatures not to exceed 150 F at the tank interior surface.
5. The tanks shall be chemically inert to petroleum products.
6. Tanks shall be capable of storing alcohol blend fuel and meet the requirement of UL.

3.7 Tank Loading Conditions

The tanks shall meet the following design criteria

1. Earth Load

The tank shall be designed to withstand fully compacted earth load of 2 meters cover on the top of the tank or as specified in ASTM D 4021 (latest edition).

2. Surface Loads

The tank shall be designed to withstand total external load of fully compacted earth load of 2 meters cover on the top of the tank and a concentrated load of 10,168 kg. When applied at the surface of the cover.

3. External Hydrostatic Pressure

The tank shall be designed to withstand external hydrostatic pressure, when the empty tank is fully submerged in water, with 2 meters cover on the top of the tank.

4. Inter Loads

Tank shall withstand pressure test of 5 PSI with factor of safety 5:1.

5. Tank shall be designed to support accessories such as submersible pumps and piping sump.

3.8 Tank Fabrication Materials

1. Resin

The resin used shall be a commercial grade, corrosion - resistant and inert to the petroleum products to be stored and shall be chemical resistant glass having a coupling agent that will provide a suitable bond with resin. The resin shall contain no pigment, dyes colorants or filler, except as follows:

a. A thixotropic agent that does not interfere with visual inspection of laminate quality may be added for viscosity control.

b. Antimony compounds or other fire retardant agents may be added to halogenated resins for improved fire resistance.

3.9 Reinforcing Materials

Reinforcing materials shall be commercial grade "E" type glass in the form of mat, continuous roving, chopped roving or roving fabrics or combination of these having a coupling agent that will provide suitable bond between the glass reinforcement and the

resin. The resulting reinforced plastic material must meet the requirements of this specification.

The tenderer shall furnish the details of material composition of structural laminates; he intends to use, to fabricate the tanks.

3.10 Tank Manufacturing Process

1. One piece tank cylinders, tank heads, man ways and nozzles shall be produced from glass-reinforced plastic, with the construction process of either contact molding, compression molding, filament winding etc. or combination of these processes.
2. The horizontal cylindrical tank and tank head shall be jointed together to form complete tank. The assembly joints type shall be overlay type and the construction shall be done as per the details shown on Fig. No.2 attached to this specification.
3. The manufacturer shall provide adequate number of external ribs around the cylindrical section of the tank, in order to make the tank shell structurally stable and to withstand the tank loading conditions described under para G. of this specification.
4. The manufacturer should submit detailed drawings of the external ribs and the process of manufacturing and fixing them along with his offer.
5. The manufacturer is also required to submit with his offer details of manufacturing process machines and equipment to be used to make tanks and piping sumps ...etc. along with catalogues. In addition, all the steps to be followed during manufacturing process shall be defined.

3.11 Accessories

1. Flanged Man ways

a. The tanks shall be equipped with 2 no. of 600mm I.D. flanged man ways. The tentative location of the flanged man ways are shown on the attached Fig. 1. The exact locations of the man ways will be finalized by the tank supplier in consultation with owner before starting the tank fabrication.

b. The thickness of the FRP man ways flange and steel cover flange shall not be less than 20mm. The tank supplier will check this thickness and increase it, if found inadequate to meet the service conditions.

2. Nozzle Openings

a. Nozzle openings on man way cover for pumps suction piping shall be made as per the locations shown on drawing.

b. Nozzle openings on man way cover for filling pipe, dip pipe and gauging...etc. shall be made as per the locations shown on drawings.

c. The vent and spare nozzles openings shall be made as per the locations shown on drawing.

d. The nozzles for gauging pipe, dip pipe and filling pipe shall be attached to the man way cover as per the details shown on drawing.

e. The spare & vent nozzle shall be attached to tank as per the details shown on drawings.

f. The filling and dip pipes shall be attached to the bottom of tank as per the details shown on drawings.

g. The filling and dip pipes shall have 8mm dia holes with centre to centre of 100mm. and cover the entire length of pipes inside the tank.

h. The filling/dip pipes and nozzle necks material shall be carbon steel seamless to ASTM A 53, Gr. B.

i. The tank supplier shall supply all the gaskets, plugs, bolts and nuts, vent coupling socket etc.

j. All the gaskets shall be of oil resistance type and their material shall be compressed asbestos flat ring 1/8" thick to ANSI B 16.5.

3. Piping Sump

The piping sump shall be constructed of (A proven material for long term performance) and features a 30 years structural and corrosion warranty which can minimize piping sump deformation during back-filling to ensure liquid tight seals at side and bottom penetrations. Sump body and neck shall be assembled by built - joint overlay and the bonding resin system shall be the same materials as used for the tank.
Tanks and piping sumps shall be shipped together. The piping sump is installed on top of the man way according to the drawing. The entire assembly is attached to the tank prior to shipment taken as a guidance. However, the detailed drawings of manufacturing and installation of piping sump should be submitted by the manufacturer along with his offer. Structural calculations shall be submitted for Owner's approval to determine thickness of buried sump shell.

4. Anchor Straps

Tank manufacturer shall design, fabricate and supply FRP anchor straps. The anchor straps, shall be strong enough to withstand a buoyancy load of the tank when fully submerged in water. The number of anchor straps and location shall be decided by the manufacturer and approved by owner.

The tank anchor system (strap, cables, turn buckles ...etc.) should have the strength of at least 1 1/2 times the maximum up lift force of the empty tank without back-fill in place.

5. Lifting Lugs

Each tank shall be provided with "hook-on" type device for lifting a tank. All lifting lugs must meet or exceed a load rating in accordance with Clause 8.10 of ASTM D 4021.

6. Deflection Plates

A tank shall have a deflection plate at least (1.35mm) thick. The deflection plate shall be at least (229mm) wide and at least one square feet in area under each opening as specified in drawing Fig. No. 10, the opening shall be marked to indicate that. Dipstick measurements shall be made only at that location.

7. Overfill prevention valves

a) Underground storage tanks

This Overfill Prevention Valve is designed to prevent the overfill of underground storage tanks by providing a positive shut-off of product delivery. It should be suitable for use on tight fill gravity drop applications. The shut-off valve is an integral part of the drop tube used for gravity filling. It should allow easy installation (without breaking concrete) and requiring no special manholes.

It should be a two-stage shut-off valve. When the liquid level rises to about 95% of tank capacity, the valve mechanism should be released, closing automatically with the flow. This reduces the flow rate to approximately 5 gpm through a bypass valve. The operator may then stop the filling process and disconnect and drain the delivery hose. As long as the liquid exceeds the 95% level, the valve will close automatically each time delivery is attempted.

If the delivery is not stopped and the liquid rises to about 98% of tank capacity, the bypass valve closes completely. No additional liquid can flow into the tank until the level drops below a reset point.

b) Electronic Product Line Leak Detection

1. A single line leak detector is required for each line to be monitored.
2. The product line shall be tested by the electronic line leak detector at the actual pumping pressure, or higher, of the submersible pump.
3. The system shall perform tests automatically and on demand.
4. The product line leak detector shall be capable of performing a leak test equivalent to 3.0 GPH @ 10 PSI, after the dispenser is shut off. The system shall be capable of performing a leak test equivalent to 0.1 GPH @ 150% of pumping pressure (0.08 GPH at operating pressure) automatically, on demand or at a programmed time.
5. The product line leak detector shall be capable of shutting down the submersible pump automatically when a 3.0 GPH failure has been detected. Submersible pump shutdown shall be a programmable option on occurrence of a 0.2 or 0.1 GPH failure.
6. The line leak detector shall be programmable to include a leak test schedule, selectable test rates, lockout times, and a selectable shutdown leak rate (3.0, 0.2 or 0.1 GPH).
7. The line leak detector shall be capable of performing a self-test to verify proper operation, or shall be fail safe in operation.
8. The line leak detector assembly shall be suitable to operate in an NFPA 70, class 1, class 1, division 1, group D environment and shall meet the intent of article 500 of the National Electrical Code (NEC), as published by the NFP.

c) Mechanical Line Leak Detection Device

The Line Leak Detection Device is a three position, pressure-sensing, piston operated valve. It is designed to continuously monitor the piping between the discharge of the submersible pump and the solenoid valve in a service station dispenser.

When the submersible pump is turned on after the system pressure has dropped significantly below the normal static system pressure, 3 GPH (at 10 psi) is metered through the Device into the piping system. If a leak is present that equals or exceeds this amount, as much product escapes from the system as is metered through the Device. Under this condition, pressure cannot build up in the piping system. When a nozzle is opened, a poppet in the Device moves to a position that restricts the flow to less than 3 GPM. This is the indication to the operator that a leak is present. If there are no leaks, pressure rapidly builds in the system forcing the Device to open to the full-flow position. For a system with no leaks, it takes approximately two in three seconds for a complete test. No further line testing takes place until the line pressure drops significantly below the normal static system pressure with the pump off.

Such a Detector should be capable of detecting 3GPH line leaks at 10 PSI (11.4 LPH at 0.68 Bar).

Once in open position, the Device remains open during product delivery to pressures as slow as 1 PSI. Therefore, it should never close when several nozzles are open.

Device signals a line leak by allowing less than 3 GPM restricted flow rate, at leak sizes 3 GPH or greater. Leaks of less than 3 GPH are indicated by the Leak Detector taking longer than 2 to 3 seconds to open. Time required to make a line test should not exceed 2 to 3 second when no line leak exists.

Device should suit the product, i.e. Gasoline, kerosene or Gas Oil flowing through the pipes.

The device should be UL listed and suitable for mounting on all commercially competitive pump brands.

3.12 Marking

1. Each tank shall be marked with the following information:
   a) ASTM Designation of the tank.
   b) Owner's Name
   c) Owner's tank serial No.
   d) Contract No.
   e) Maximum test pressure 5 PSI.
   f) Keep tank vented.
   g) Do not roll or drop tank.
   h) Installation instructions.
   i) The tanks should be labelled by U. L. or KEWA Le. The manufacture is regularly inspected by that testing agency as part of their follow-up service for each tank.
2. All required markings should be permanent, such as paint or paper labels embedded in clear resin on the outside surface of the tank.

3.13 Testing

Requirement for the testing of underground tanks which can be performed as follows :

a) At the time of the delivery of the tank to the site
b) In hole prior to covering
c) After installation but prior to completing the backfilling
d) After the paving and all piping has been installed

Notes

1. Since the damage can occur to tanks at any stage of construction, specific testing requirements would be dictated by the degree of control the owner must exercise. Any damage to the exterior coating should be repaired using material of similar nature.
2. Testing should comply with NFPA Code 30.
3. As a minimum, it is recommended that all tanks be tested with air pressure prior to installation. PRESSURE MUST NOT EXCEED 5 POUNDS PER SQUARE INCH (PSI) for 60 minutes. All fittings, seams and visible dents should be soaped during this period and inspected for bubbling.

3.14 Inspection and Testing

1. All the tanks shall be subject to inspection and tests as specified in the ASTM D 4021 code. The inspection and testing of the tank shall be witnessed by owner's Engineer and / or his authorized representative or organizations.

2. Test Condition

Test shall be conducted at ambient temperature without any special controls on temperature or humidity, unless otherwise specified in the test method reference.

3. The inspection and testing of tanks shall be carried out in accordance with the requirements of ASTM D 4021 code (latest edition) and the manufacturer shall submit test procedures for Owner's approval. The scope of inspection and testing shall include but not be limited to the following.

a) Visual Examination

Each tank component shall be examined for dimensional requirements, hardness and workmanship.

b) Leakage Test

Each tank shall be tested in accordance with clause 8.8 of ASTM D 4021 to determine its conformance with clause 6.8 of ASTM D 4021.

c) Negative Pressure Test

Each tank shall be tested in accordance with clause 8.11 of ASTM D 4021 to determine its conformance with clause 6.11 of ASTM D 4021.

d) Hydrostatic Test

Each tank shall be tested in accordance with clauses 8.5.2.1 of ASTM D 4021.

e) Lifting Lug Strength Test

Test a tank with the lifting lug installed in accordance with clauses 8.10 of ASTM D 4021.

f) Chemical Resistance

The testing procedure for measuring chemical resistance shall conform to practice C 581 in clauses 8.13 of ASTM D 4021.

g) Water Load Test

As one of test requirement of UL 1316, a tank shall be placed in a sand bed, so that approximately one eighth of the tank diameter is buried and filled to capacity with water for one hour. The tank shall not be damaged.

h) Composition Control

Control on glass, resin, fillers and additive shall be maintained for all manufacturing processes and for each portion of tank fabrication. Manufacturer shall maintain records of these control checks and shall make them available for Owner's Engineer or his authorized representative for scrutiny. Proper composition shall be shown by glass usage check, by glass and resin appricate rate checks or in" accordance with the material composition *tests* in clause 8.12.1 of ASTM D 4021.

i) Prototype Test

One tank from each order shall be subjected to prototype tests in accordance with ASTM D 4021 and the test shall be witnessed by Owner's Engineer and/or authorized inspecting authority.

4. The following mechanical tests shall be carried out to determine the properties of a laminate and to verify the material properties. The tests shall be carried out it accordance with ASTM codes.

    a. Ultimate tensile loading
    b. Ultimate compressive unit loading
    c. Lap shear strength
    d. Chemical resistance
    e. Impact resistance
    f. Surface hardness
    g. Material composition

    Samples for tests when possible, shall be taken from waste areas such as man way opening

5. All the expenses for carrying out the physical, chemical and other tests and inspections... etc. shall be borne by the tank manufacturer.

6. The manufacturer shall also carry out tests on each tank after unloading the tanks at installation site in Kuwait as specified in Article 3 (a) & (b) above.

4. Installation of GRP Thanks

4 .1

a) It should be noted that one of the significant causes of leaks in underground-reinforced plastic (GRP) tanks is improper handling and installation of the tanks. To ensure that the (GRP) tanks are not damaged during the handling and installation, extra precaution should be taken in accordance with the standard practices and procedures of (GRP) tanks installation.

b) *Care in Handling* of *GRP Tanks*

To avoid damage to the (GRP) tanks, during transportation or installation, the tanks shall not be dropped, dragged or handled with sharp objects and, except for minimal movement necessary for inspections and testing, should not be rolled. If the tank coating or shell is damaged, it shall be repaired in accordance with manufacturer's instructions.

c) *Unloading, Lifting and Lowering*

The GRP tanks shall be carefully lifted or lowered by use of lifting Lugs provided by the manufacturer. Under no circumstances the use of chains or cables around the tank shall be permitted. Tanks shall be maneuvered with guidelines attached to each end of the tank. If the tanks must be relocated on the job site during installation, they should be lifted rather than rolled. Before any attempt is made to move the tanks, it shall be established that hoisting equipment has sufficient capacity and boom length to lift and lower tanks without dragging and dropping.

d) *Storage*

Tanks stored temporarily at the installation, site shall be located away from areas of activities where the coating or structure of the tanks could .be damaged. Efforts shall be made to ensure that stored tanks do not interfere with the normal construction activities. The tanks shall be placed in a location that will minimize the need for further movement prior to installation.

e) Pre-Installation inspection

All tanks shall be physically inspected before installing the tank into the tank pit, to ensure that no damage to the tanks has occurred during transportation and handling etc.

When possible, damage coating etc. shall be repaired at installation site with manufacturer supplied materials and in accordance with the manufacturer's instructions.

If significant damage, such as denting, puncturing or cracking has occurred the tank shall be either repaired by the manufacturer or replaced.

Before a tank is installed, its inside dia. shall be measured by the contractor for compensation with post installation measurements and future reference.

f) Excavation

The excavation for underground tanks shall be made with due care. The excavation shall provide adequate space for tanks, piping and associated equipment and for the replacement and compaction of backfill materials, particularly under the circumference of the tank shell ends. The scope of excavation shall be determined considering the soil conditions, depth or the excavation and safety considerations.

The total depth of the tank excavation shall be determined considering the tank diameter, bedding thickness, hold down pad, depth of cover and slope of piping. To provide a firm foundation, at least one foot of backfill material shall be extended beyond the perimeter of the tank. The excavation shall be deep enough to provide a backfill depth of at least 12 inches below the bottom of the tank, with or without a hold down pad.

g) Minimum / Maximum Cover Depth

The cover on the top of the tanks shall be at least 1100mm. and shall consist of a pea gravel filling material.

To avoid excessive soil pressure on tanks, the maximum burial depth measured from the top of the tanks shall not exceed 2 meter.

h) Placement of Tank in the Chamber

Prepare the concrete bed/slab for placing the tanks in the chamber. On the concrete slab/bed shall be spread suitable backfill material, such as pea gravel or crushed stone that meets the requirements of ASTM C333. The backfill bed shall be 12" deep on the top of the concrete slab, properly graded, leveled and the compacted. Then place the tanks on the backfill bed, maintaining proper distances, clearances between the tanks and around the tanks ends. The tanks shall be lowered in the chamber by using the lifting straps provided by the tank manufacturer.

Take utmost care not to damage the tanks, while placing them in the concrete chamber.

Do not place the tanks directly on the concrete bed or on a hold down pad. Care shall be taken to prevent any impact between the tank and the hold down pad or bed from the tank is lowered on to the pad or moved into the excavation.

i) Anchorage

After lowering the tank in the chamber, align the Centre line co-ordinate of the tank. The tank shall be anchored to the hold down clamps embedded in the concrete bed. In order to ensure proper anchoring, the tanks, shall be firmly secured with properly sized strap. Turn buckle of the straps shall be used to tighten the straps around anchoring of the tanks.

j) Backfilling

General

Careful placement and compaction of approved backfill materials is essential to protect
The failure of underground GRP tanks. During the backfilling, take proper precautions to avoid the following to happen, which could adversely affect the structural integrity and coatings of tanks.

1. Use of incorrect backfill material.
2. Inadequate or improper placement or compaction.
3. Rocks and debris left in excavation.
4. Voids under the perimeter of the tanks.

K) Backfill Materials

Backfill material should be dean, washed, well granulated, free flowing, inert material. Crushed rock or pea gravel. It should be free from debris, rock or organic material, all of which could damage the tank or adversely affect compaction.

Pea gravel: Natural rounded particles with a minimum dia. of 1/8" and maximum size of 3/4" shall be used.

Crushed rock or gravel: Washed and free flowing angular particles between 1/8" to 1/2" size shall be used.

I) Compaction

Compaction of bedding and backfill materials should be adequate to ensure support of tank and to prevent movement or settlement. If the mechanical compaction is employed, then the care shall be taken to protect the tank from damage. Pea gravel and crushed rock are relatively self compacting. However, to prevent voids, all materials shall be forced under the lower quadrant of the tank.

4.2 Installation Instructions & Assistance

Along with his offer, tank manufacturer shall furnish his detailed tank installation instructions. Tank installation instruction shall include the details of precautions to be taken for handling the tanks, anchoring of tank, Le. type & size of anchor bolts, turn buckles, eye bolts and wire ropes etc. and recommended back - fill materials and their compaction method.

Tank manufacturer shall be responsible to guide and assist Owner's staff in the proper installation of tanks supplied by the manufacturer. For this purpose, the tank manufacturer shall make available to Owner the services of a professional tank installation Engineer. The tank installation Engineer shall be qualified and experienced and his CV shall be submitted to Owner for approval.

It is obligatory on the part of the manufacturer to send his tank installation Engineer at Owner's Filling Stations during the tank installation and he shall be responsible to certify that the tanks have been installed as per the manufacturers installation requirements.

The presence of Manufacturer representative at the job site does not relieve his responsibility to follow the published installation instructions.

4.5 Method of Transportation, Handling & Storage

The tank manufacturer shall submit with his offer the mode of transportation of tanks and other accessories viz by ship or by road ... etc. and the method of loading and unloading the tanks.

The tank shall be lifted from the trailer by means of lifting lugs and are to be stored on a level surface free from sharp, protrusions and well supported to prevent local damage to the tank. During transportation, tanks must be secured with straps to prevent any damages and to avoid overturning.

When the tanks are unloaded, set tanks on smooth ground, free of rocks and foreign objects and recheck by a visual inspection and examination for possible cracks. No persons are allowed to stand on tank while tank is being lifted *I* unloaded from trailers.

Unloading activities should be done very carefully to avoid any damages to tank shell. Therefore, the wooden saddles shall be strong to support the tank during transportation and to put it under tanks during unloading operations.

1.5 Piping:

- All pipes between tanks and pump island area shall be reinforced pipes.
- The pipes shall be as specified below.

1.5.1 Selection

a) Schedule 40 steel pipe, either galvanized or wrapped black iron pipe is recommended for all underground piping; and schedule 40 galvanized steel pipe should be used for above-ground vent piping. Piping with a 2 1/2" diameter is generally used. As a minimum, coupling and fittings should be 150 Ib malleable iron.

b) Delivery piping from tanks to dispensers should be sized according to the recommendation of the pump manufacturer. In determining size, consideration must be given to the length of runs, flow rates and number of dispensers to be served.

c) Siphons may be used to equalize product levels in two tanks storing the same project. (Supper) materials for siphons may be galvanized iron, seamless black iron or approved non-metallic. It is recommended that siphon piping be the same size as the suction and/or delivery lines to the dispensers.

d) Each tank should be vented through adequately sized piping. This necessary to prevent the build up of excessive pressure, or the blow-back of vapour or liquid at the fill opening, while the tank is being filled. The maximum rate of fill can be limited by the diameter of the vent line 2 1/2" diameter vents (in lengths up to 4.0 M) should be adequate for flow rates incurred using 3" delivery equipment.

4.6 Installation

Product lines should run in a single trench between the tank area and the pump island area. Similarly, vent lines between the tank area and the building or other structure to which the. above-ground vent lines are attached, should be placed in a single trench.

a) Before any underground lines are laid, the trench or ditch for such piping should receive a minimum 15 cms. Deep bed of well-compacted non-corrosive material, such as clean, washed sand. All trenches should be wide enough to permit at least 15 cms. or such protection around al! Underground lines. This applies to metallic piping. Bedding and the covering backfill should be of the same material. This will be helpful for grading the lines, and in providing corrosion protection for any adaptor fittings used with non-metallic piping.

b) The actual of pipe runs should be noted on as-built drawings, if there is a change from installation drawings. Photographs of underground piping are desirable as part of the permanent record of piping locations.

c) Piping should be arranged so that lines do not cross over underground tanks.

d) Underground product lines should have a uniform slope of not less than 1 percent toward

the tank. Product lines should be at least 60 cms. below the finished surface. Underground piping requires careful attention to the tightness of joints and pipe fittings. A pipe certified for petroleum service is to be used for galvanised or black iron pipe fittings.

e) Possible breakage of underground piping and vent lines, or the loosening of pipe fittings resulting in product leaks, will be minimised through the use of flexible connectors. These should be installed in lines at points where the piping connects with the underground tanks, and where the piping ends at the pump islands.

f) Occasionally, it is necessary or advisable to install more than one storage tank for a given grade of product. Such multiple tanks may be interconnected through a siphon connection. This permits the equalisation of the product in the connected tanks. However, a siphon system will give reliable service only if care is taken to see that all joints in the siphon manifold are tight.

g) Vent piping should be at least 60 cms. below the forecourt beginning from the point where it rises vertically (or 40 cms. in no-load areas), and slope uniformly towards the tank. The slope should be no less than 1 percent, and the piping laid so as to avoid sags or traps in the line in which liquid can collect.

h) Vent piping above-ground should be located, or protected and anchored, so as to prevent damage from traffic and other sources of potential dar'1a;e. 'lent outlets should be located so as to prevent flammable vapours from entering building openings or reaching hazardous areas. Vent outlets must discharge upwards, and the discharge point must not be less than 4.0 M above adjacent ground.

4.7 Testing

It is essential that, during testing of piping, the piping be disconnected from the tanks, pumps dispensers. Failure to disconnect the piping from the tanks could result in the damage of tanks and product loss. The piping should then be subjected to an air test of 1 1/2 times the working pressure but not less than 50 psi, and the pressure maintained for a minimum of 60 minutes, with only a minimal change. Leaks may be detected all joints, while the system is under pressure

a) After all piping has been tested and found to be tight, all expose threads of galvanized pipe should be coated with a coal tar product or tape film. This prevents the formation of an electrolytic cell between the galvanized fitting and the threaded area where the protective galvanized layer has been removed. Where sacrifical tank anode cathodic protection systems are installed a separate protection provided for steel piping. When remote pumps are used, an insulating fitting should be installed in the electrical conduit at the pump.

b) All piping must be covered with the same material used in the bedding. Depth of such material should not be less than 15 cms.

c) K.N.P.C. Recommended Testing Method.

The three classes of pressure test to prove the pipeline during construction are:

a. Air and bubble test
b. Air pressure test
c. Hydrostatic pressure test

1. Air Pressure Test

Each section of line or the completed pipeline, should be tested with air at an internal pressure of not less than 80 Ibf sq. in (5.6 kgf / sq. cms) which should be maintained for 24 hours without appreciable loss. In assessing any change in pressure" temperature changes over the 24 hours should be taken into consideration.

2. Hydrostatic Pressure Test

The completed pipeline of each completed section, as convenient, or as necessary, due to static pressure, should be filled with water. The pressure in the line or section should then be raised to one and a half times the maximum working pressure in the line or section or to a pressure that will result in a hoop stress (based upon the specified minimum wall thickness) equal to 90 percent of the specified minimum yield strength of the pipeline material at any point in the line, whichever is the less. This pressure should be maintained for 24 hours without pressure changes which cannot be accounted for by changes in temperature.

Note: Safety during tests

All testing of pipelines after construction should be done with due regard for the safety of persons and property. When air or gas is used, persons not working on the testing area during the period in which the hoop stress is first raised above 50 percent of the specified minimum yield to the maximum test stress and until the pressure is reduced to the maximum operating pressure.

4.8 General Practice for piping

The following information and details are a general practice use for K.N.PC. Filling Stations.

a) Filling pipe

a. Each tank should have a filling pipe not less than 3" in diameter.
b. The filling pipe should be carried down inside the tank leaving 15 cms. gap between filling pipe and tank bottom.
c. The filling pipe should have 1 % slope towards the tank.
d. The filling pipe (centre line) should normally be below the forecourt level at least 60 cms. as shown in Fig. (24)
e. Pipes and fittings should be suitably protected against corrosion by coldtar coating and/or densotape wrapping.
f. Where different petroleum products are kept in two or more tanks, the upper end of each filling pipe should be clearly marked with the umber of the tank to which it is connected and indicated by the product colour.
g. All practicable steps shall be taken to ensure that no light, fire, flame or smoking is permitted within 4.0 m. of any opening to petroleum storage tank.

b) Filling points

a. The dispensing from tanker to filling point is done on premises not open to the public.
b. The distance between the filling point M.H. and public road should not be less than 8.0 meters.
c. The location of filling point M.H. should be such that the parked tanker shall not obstruct the vehicular traffic.
d. The maximum distance between the filling point M.H. and the tanker discharging point should be 3.00 meters.

e. The size of the M.H. for each filling point should be 60 cms. x 60 cms. clear opening with medium or heavy duty M.H. cover and frame including necessary handle.

f. On the surface of the underground tank where the filling pipe is connected a ball valve should be fixed.

g. The location of the tanker filling point M.H. should be at the right side of the tanker.

h. On the beginning of tanker filling point M.H. a 4" kamlock and adaptor should be fixed to the tight joining with tanker hose (if used by KNPC tanker).

i. Provide a Bronze Ball valve below the kamlock and adaptor on the tanker filling point M.H. if no spill container is used in the Filling Point.

c) Feeding pipes (supply pipes)

The following recommendation are made in respect of product lines between the tank and Dispenser.

a. Feeding pipes should be sized according to the recommendations of the Dispenser manufacturers. In determining the size, consideration must be given to the length of runs, flow-rates

d) Vent pipe

a. Each tank or tank compartment should have a vent pipe not less than 2 1/2" in diameter.

b. The upper end of the vent pipe should discharge upwards in the open air out of each and be at least 4.0 m. above forecourt level and should not be located within 1.5 m. of opening windows other openings.

c. The open and should be provided with a vent cap to prevent the entry of birds, leaves, etc.

d. Vent piping should be at least 60 cms. Below the forecourt surface beginning from the point where it rises vertically, and slope uniformly towards the tank. The slope should be not less than 1 percent and the piping laid so as to avoid sags or traps in the line in which vapours can collect.

e. Vent piping above ground should be located or protected and anchored, so as to prevent damage from traffic and other sources of potential damage.

f. The vent pipe should be painted to indicate the product in the tank and to prevent from rust.

g. The distance of the vent pipe from the public road should be at least 4.00 M.

h. Electrical fittings within 1.5 M. in any direction of the vent discharge point should be Division 1 Standards. Elsewhere, within 1.5 M. of the vent riser pipe, division 2 fittings should be used.

i. Vent pipes should be instaiied no closer than 1.5 M. from a boundary except where this is a solid wall extending for 1.5 M. beyond the vent discharge point in every direction and down to ground level. This wall should .be considered as the limit of the classified area.

j. The vent pipe should have steel supports with the necessity base plate clamps.

END OF SECTION