FIJI ELECTRICITY AUTHORITY
TENDER NO MR 12/2015

SPECIFICATIONS FOR THE DESIGN, SUPPLY, FABRICATION AND INSTALLATION OF HFO FUEL TANKS AT KINOYA POWER STATION

JANUARY 2015

FIJI ELECTRICITY AUTHORITY

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GENERAL CONDITIONS OF CONTRACT

1.0 DEFINITIONS

In this contract, the following terms shall be interpreted as indicated: -

1.1 "Authority" or "Purchaser" means the Fiji Electricity Authority.

1.2 "Contract" means the agreement entered between the Authority and the Contractor as recorded in the Contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.

1.3 "Contract Price" means the price payable to the Contractor under the Contract for the full and proper performance of its contractual obligations.

1.4 "Goods" means all the equipment, which the Contractor is required to supply to the Authority under the Contract.

1.5 "Contractor" means the individual or firm carrying out works as defined under Scope of Works.

1.6 "Site" means the place where the equipment will be installed, as stated in the Schedules.

1.7 "Engineer" means the General Manager Generation of the Authority or his representative authorised in writing by him.

2.0 APPLICATION

These General Conditions shall have effect, subject to any express stipulation or condition at variance with these conditions that may be contained in the specification or may otherwise be incorporated in the contract.

3.0 STANDARDS

The Goods supplied under this Contract shall conform to international ISO / DIN standards for mechanical and IEC standards for electrical work.

4.0 CONTRACT AGREEMENT

Notwithstanding the formation of the contract by the Authority's acceptance of the Contractor's tender in writing, the Contractor and the Authority shall, within 30 days of such acceptance, enter into and execute a Contract Agreement.

5.0 PERFORMANCE BOND

5.1 Within 21 days after the Contractor's receipt of notification of award of the contract or upon contract signing and down payment, the Contractor shall furnish a performance bond to the Authority in the amount of 10% of the tendered price.

5.2 The proceeds of the performance bond shall be payable to the Authority as compensation for any loss resulting from the Contractor's failure to complete its performance obligations under the Contract.

5.3 The performance bond shall be denominated in the currency of the Contract or in another freely convertible currency acceptable to the Authority, and shall be in one of the following forms:

a) A performance bond issued by a surety acceptable to the Authority, and in the form provided in the Tender Documents.

b) A Bank Guarantee issued by a bank located in the Authority's country or abroad acceptable to the Authority, and in the form provided in the Tender Documents.

c) A cashier's cheque, certified cheque, irrevocable letter of Credit or Cash.

5.4 The Performance Bond will be discharged by the Authority not later than 90 days following the date of completion of the Contractor's performance obligations, including any warranty obligations under the Contract.

6.0 PROGRAMME TO BE FURNISHED

Within 20 days of the acceptance of his tender the Contractor shall submit to the Authority, for approval, a programme showing the order in which he proposes to carry out the works, including design, manufacture and delivery.

7.0 INSPECTION AND TESTS

The Authority's Engineer or his representative shall have the right to inspect and/or to witness test the Goods at the factory or place of manufacture, for their conformity to the Contract Specifications. The Authority shall notify the Contractor in writing of the identity of its Engineer(s) or representative(s) retained for these purposes. The contractor shall provide the authority with a detailed program for the inspections and/or witness tests and notice of at least 44 hours of notice when the materials, equipment, system is ready for inspection & testing. Nothing in this clause shall in any way release the Contractor from any warranty or other obligations under this Contract in delivering a fully functional plant as specified elsewhere in this document or the contractors' design and specifications.

8.0 PACKING

8.1 The Contractor shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to Fiji. Each component or item shall be suitably packaged & sealed to withstand tropical weather conditions. The packing shall be sufficient to withstand, rough handling during transit and exposure to extreme temperatures, salt,

high humidity and precipitation during transit and open storage.

8.2 The packing, labelling and documentation within and outside the package shall comply strictly with such special requirements as shall be expressly provided for in the Contract and, in any subsequent instructions ordered by the Authority.

8.3 Nothing in this clause and the contract documents shall in any way release the Contractor from any warranty or other obligations under this Contract in case of deterioration or damage until the entire plant and facility has been certified as complete by the Authority.

9.0 INSURANCE

The contractor shall provide for 100% insurance cover for the equipment supply, transport and contractor's personnel, including third-party liabilities and Contractors All Risk (CAR) insurance for the equipment scope and consequential damage insurance to existing facilities due to contractor activity/negligence. They shall include the Authority and their representatives as co-insured and hold them harmless from all liabilities and claims.

10.0 DELIVERY

Delivery for the complete Scope of Supply (Goods) shall be to Delivered Duty Unpaid (DDU) to Suva Port complete with auxiliary and ancillary equipment.

11.0 TRANSPORTATION

The Contractor is required under the Contract to deliver the Goods (complete equipment scope) Delivered Duty Unpaid (DDU), per Incoterms 2000, to the Suva Port, Suva, Fiji Islands. Costs associated with carriage and risk thereof shall be included in the Contract Price. Normal Port of Entry shall be Lautoka.

12.0 PAYMENT

12.1 Payment shall be on a percentage of completion basis up to 90% of contract sum till initial commissioning date, 5% retention till successful completion of site tests and final 5% retention after warranty period expires. Payment will be net 10 working days after receipt of invoice-milestone of completion against a mutually agreeable irrevocable Letter of Credit.

12.2 The Contractor's request for payment shall be made to the Authority in writing, accompanied by invoice(s) describing as appropriate, the Goods delivered and services performed together with shipping and other documents as may be required by the Authority. Payments shall be made promptly within ten (10) days, but no later than thirty (30) days of submission of an invoice/claim made by the Contractor, upon approval of the invoice.

12.3 In case there is any dispute on the percentage completion or the amount of work accomplished, the authority shall inform the contractor within 10 days for revision of the invoice.

13.0 PRICES

Prices charged by the Contractor for Goods delivered under the Contract shall not, with the exception of any price adjustments authorised under Clause 14, vary from the prices quoted by the Contractor in his bid. Contractor shall note that no price variation shall be effective unless and until it has been approved by the Authority in writing.

14.0 CHANGE ORDERS

14.1 The Authority may at any time, by written order given to the Contractor, make changes within the general scope of the Contract any one or more of the following :

a) Drawings, Designs or Specifications.
b) Where the goods that are to be furnished under the Contract needs to be modified by the Authority.
c) The method of shipment or packing.
d) The place of delivery.

14.2 If any such change causes an increase or decrease in the cost of, or the time required for the Contractor's performance of any part of the work under the Contract Price or Delivery Schedule, or both, the Contract shall accordingly be amended. Any claim by the Contractor for adjustment under this Clause must be issued to the Authority within thirty days from the date of the Contractor's receipt of the Authority's change order.

15.0 DELAYS IN THE SUPPLIER'S PERFORMANCE

15.1 Delivery of the Goods, installation & commissioning shall be made by the Contractor in accordance with time schedule specified by the Contractor in his tender. The preliminary schedule provided in the tender shall form the basis of the detailed program as indicated in item # 6.

15.2 An unexecuted prolonged delay by the Contractor in the performance of his delivery obligations shall render the Contractor liable for any or all of the following sanctions, damages, forfeiture of its performance security, and/or termination of the Contract for default.

15.3 If at any time during the performance of the Contract, the Contractor should encounter conditions impacting timely performance of the work. The Contractor shall immediately notify the Authority in writing of any delays, its likely duration and its cause(s). As soon as practicable after receipt of the Contractor's notice, the Authority shall evaluate the Contractor's case and determine if an extension in time for performance of the contract is justifiable. Any extension granted shall be ratified by both parties by an amendment to the Contract. Unless the extension and

changes in performance has been duly authorized by the Authority in writing, the delay shall be at the Contractors risk.

16.0 TERMINATION FOR DEFAULT

16.1 The Authority may, without prejudice to any other remedy for breach of Contract, by written notice of default sent to the Contractor, terminate this Contract on the following grounds :

a) If the Contractor fails to deliver any or all of the Goods within the time period(s) specified in the Contract, or any extension thereof granted by the Authority.

b) Fails to perform any other obligation(s) under the Contract.

c) If the Contractor fails to comply within a period of ten days (or any such period as the Authority may authorise in writing) after receipt of default notice from the Authority.

17.0 FORCE MAJEURE

Notwithstanding the provisions of Clause 15 & 16 the Contractor shall not be liable for forfeiture of its performance security, liquidated damages or termination for default if, and to the extent that, it's delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure.

In this Clause *Force Majeure* means any event or circumstance (whether arising from natural causes, human agency or otherwise) beyond the control of the Contractor including (in so far as beyond such control but without prejudice to the generality of the foregoing expression) strikes, lockouts or other labour disputes, riot, civil commotion, aircraft fire, flood, drought loss, delay at sea, breakdown or war.

18.0 LANGUAGE

The Contract shall be written in the English language. Subject to Clause 19, the language version of the Contract shall govern its interpretation. All literature, corresponding and other documents pertaining to the Contract which are exchanged by the parties shall be written in that same language.

19.0 APPLICABLE LAW

The Contract shall be interpreted in accordance with the laws of Fiji.

20.0 ARBITRATION

All questions or differences what so ever which may at any time hereafter arise between the parties hereto or their respective representatives attached to this agreement or the subject matter or construction hereof or the rights and duties of the parties hereunder, shall be referred to a single arbitrator if the parties agree or otherwise, to four arbitrators, one to be appointed by each party and in either case, in accordance with and subject to the provisions of the Arbitration Act Cap. 38 of the Laws of Fiji or of any statutory modification or re-enactment thereof for the time being in force. Such person to be an arbitrator will be nominated by the Fiji Institute of Engineers.

21.0 NOTICES

21.1 Any notice given by one party to the other, pursuant to this Contract shall be sent in writing or facsimile to the address specified for that purpose in the Contract.

21.2 A notice shall be effective when delivered or on the notice's effective date, whichever is later.

22.0 ACCEPTANCE OR REJECTION OF TENDER

The Authority shall not be bound to accept the lowest or any tender nor assign any reason for the rejection of a tender and reserves the right to waive any formality in the tender.

23.0 WARRANTY

23.1 The Contractor warrants that all Goods supplied, installed and commissioned under this Contract shall have no defect arising from material used, workmanship or from any act or omission of the Contractor, that may develop under normal use of the supplied Goods in the conditions prevailing in the country of final destination.

23.2 The Contractor shall clearly specify the Warranty period of the installed and commissioned Goods supplied under this contract and such period shall be referred to as the Warranty and shall not be any period less than 12 months or 8,000 machine operating hours, whichever comes first from the date of commissioning (Formal or Official acceptance of the completed installation by the Authority). The contractor shall ensure that the equipment supplied under this Contract shall operate within specified guaranteed performance levels during the warranty period.

23.3 The Authority shall promptly notify the Contractor in writing of any claims arising under this Warranty. Upon receipt of such notice, the Contractor shall, with all reasonable speed, repair or replace the defective Goods or parts thereof, including transport, duty, and local Fiji charges, without any cost to the Authority.

24 GENERAL CONDITIONS`

General conditions of this contract shall be governed by the Built & Turnkey of the Federation Internationale Des Ingenieurs Conseil (FIDIC) first edition 1995. (Copies can be obtained from FIDIC PO Box 86 CH 1000 Lausenne, 12 Switzerland. Fax 41-21-653 5432)

PART 1 INFORMATION TO TENDERERS

1. NAME AND ADDRESS OF PURCHASER

Fiji Electricity Authority
Private Mail Bag
Suva
FIJI

2. SCOPE OF WORKS

Refer to part section 2 - technical specifications.

3. CONDITIONS OF CONTRACT

The conditions of Contract included with this tender document in conjunction with General Conditions of Contract apply to this contract.

4. TENDER DOCUMENTS

I) Tender documents comprises of :

a) General Conditions of Contract
b) Information to tenderers
c) Condition of Tendering
d) Specifications
e) Schedules
f) Form of Tender
g) Price Schedule

5. CLOSING DATE OF TENDERS

The tender closes at Noon on Wednesday 25th February 2015.

6. ADDRESSEE AND ADDRESS FOR POSTED TENDERS

The Secretary - Tender Committee
Fiji Electricity Authority
Private Mail Bag
Suva
FIJI

7. ADDRESS AND PLACE OF DELIVERY FOR TENDERS

The Secretary - Tender Committee
Fiji Electricity Authority
Head Office
Suva, FIJI

PART 2 CONDITIONS OF TENDERING

For the design, supply, fabrication, installation and testing of a 1,300MT HFO fuel tank and associated piping and accessories at Kinoya Power Station sites

1. TENDER DOCUMENTS

I) One set of the Tender is provided electronically to prospective Tenderers and further copies of the documents will be provided by the Authority on request in writing from Tenderers.

ii) Tenders are to be submitted in the standard form of Tender provided and are to be accompanied by the full Tender documents with all Schedules duly completed together with all additional information and drawings required by the Specification. In addition to all information which the specification requires to be included with the Tender, Tenderers may also include any additional information which they consider necessary to explain and support their tender.

iii) iv) All Tenders are to remain open for acceptance for a period of 90 days from the date on closing of tender.

2. LODGEMENT OF TENDERS

2.1 Tender shall be submitted in **Duplicate** and complete in every respect including Tenderer's drawings and any technical literature the Tenderer

may wish to submit to explain his proposal. Where a Tenderer wishes to submit a conforming tender and an alternate tender(s), the conforming tender shall be clearly marked "Original" and the non conforming, "Alternate Tender".

2.2 The conforming tender, and where applicable, the alternate tender shall be delivered to the office of the Secretary, Fiji Electricity Authority Tender Committee, Head Office, Lautoka, Fiji on or before the time set for the closing of tenders or shall be posted to the above named, Private Mail Bag, Lautoka, Fiji, to arrive on the ordinary course of post not later than the prescribed deadline of the closing of the tender.

2.3 Each tender shall be sealed in an inner and outer envelope with :

The outer envelope bearing only the marking :

a) The Secretary
Fiji Electricity Authority Tender Committee
Private Mail Bag
Suva
FIJI

b) The inner envelope bearing the following identification only :

" TENDER FOR HFO TANK " and the words **DO NOT OPEN BEFORE 1400 HOURS** Wednesday, 25th February 2015
It must also indicate the name and address of the Tenderer.

2.4 Any tender received after the stipulated bid closing date and time will be returned unopened to the Tenderer.

3. TENDER PRICES

For the purpose of comparison, the tender prices shall be converted into Fijian Currency at the exchange rates prevailing as of the date of opening of Tenders.

4. All tenders will be opened at the Head Office of the Fiji Electricity Authority, 2 Marlow Street, Suva at 1400 hours 25/02/2015 by the Secretary, Fiji Electricity Authority Tender Committee in the presence of three other responsible officers.

5. ACCEPTANCE OF TENDERS

The Purchaser shall not be bound to accept the lowest or any tender. A Tender shall not be deemed to be accepted unless and until notice in writing is handed by the Purchaser to the Tenderer or is posted by the Purchaser to the Tenderer at the address appearing on his Tender.

6. ACCURACY

No alterations to the tenderer shall be made after the date for lodging tenders.

The Purchaser accepts no responsibility for the accuracy of any tender.

7. EXPLANATIONS

If the Tender needs any clarifications, he/she should make his inquiry in writing to :

Mr Tuvitu Delairewa
The Supply Chain Manager
Fiji Electricity Authority
Private Mail Bag
Suva
FIJI
Telephone : (679) 3311 133 Fax : (679) 3311882
e-mail: TDelairewa@fea.com.fj

All explanations to the clarifications shall be answered in writing.

SECTION TWO

1.0 INTRODUCTION

The Fiji Electricity Authority (hereinafter referred to as the "FEA or Authority") invite tenders for the design, supply, fabrication, installation and testing of HFO fuel tanks and associated piping at Kinoya Power Station sites as per specification.

2.0 TANK CAPACITY

The basic tank requirement at Kinoya Power Station are as follows:

- 1 x 1,300,000 litres storage tank
- 1 X 80,000 Litres Day Tank
- 1 x 50,000 Litres Buffer Tank
- 1 x 35,000 Sludge Tank

3.0 SCOPE OF SUPPLY

1. Fabricate and construct a 1,300M^3 vertical storage tank as per Wartsila drawing number WDAAA288223 or equivalent
2. Fabricate and construct a 80M^3 vertical day tank as per Wartsila drawing numberWDAAA387062 or equivalent
3. Fabricate and construct a 50M^3 buffer tank as per Wartsila drawing number WDAAA387062 or equivalent
4. Fabricate and construct a 35M^3 sludge tank as per Wartsila drawing number WDAAA288220 or equivalent
5. Supply of all schedule 40 pipes, flanges, pipe supports, clamps, bolts and nuts
6. Construct foundation for each tank and built a concrete bund wall as per Wartsila specification or equivalent
7. Install 2 x unloading pump unit. Pump to be installed parallel and should include all pipe-work, valves, non-returns and electrical, individual flameproof switch for each pump and emergency stop. The pump should be fitted with a variable speed drive. It should also include concrete base with a bend, that will be connected to the new platform for discharge to allow any leakage into the separator pit.

8 The pump size to be 125 x 100 – viton elastoners mechanical, mounted on a steel plate with motor driven, flameproof, 22kW, 4 pole, 1450rpm. Flow rate at 2400l/min @ 34 metres, 2100l/min @ 38 meters. NB. Pumps are to be designed for 5 hose manifold discharge.

9 The pump design condition is as follows:

Liquid	Heavy Fuel Oil
Viscosity at 50 deg C, mm^2/s	180
Density at 15 deg C – kg/m^3	900 – 991

10 Construct a shed to house the pumps and flow meter.
11 Fabrication and welding of all pipe works from Discharge Bay to the Storage Tank
12 Fabricate and welding of all pipe works between all tanks
13 Construct a concrete platform for discharge of trucks with bund
14 Install a flow meter for fuel unloading measurements with bypass valve
15 Supply and Installation of storage tank suction heater
16 Supply and install of storage tank, buffer tank and day tank level gauges and remote reading
17 Supply and install control panel and carry out control wiring of all monitoring equipment for all tanks.
18 Fabrication and welding of all pipe works from Tank Farm to Fuel Treatment House shall be as per Welding Standard EN 25817 and ISO 5817.
19 Supply and installation of fire fighting water supply hydrant to tie in to the existing system
20 Construct a 3-stage interceptor pit
21 Supply and Installation of electrical heaters in buffer and day tanks as per specification
22 Supply and Installation of Thermal insulation of buffer and day tanks to maintain temperature of fuel oil at 60 Deg C
23 Supply and Installation of Insulation of HFO pipes between Tanks
24 Supply and Installation of Storage, buffer and day tank monitoring equipment such as external level indicators, temperature gauges, and automatic filters etc
25 Carry out Hydro Testing of all Tanks and Certification

4 GEOTECHNICAL ASSESSMENT

The contractor must provide a full geotechnical assessment of the proposed tank site, design tank foundations accordingly and discuss fully with FEA before commencement of tank foundation work. The contractor must report of the findings and result of the investigation complete with design calculations for tank foundation performance integrity for approval by the FEA.

5.0 CONSTRUCTION OF FOUNDATION FOR VERTICAL CYLINDRICAL TANKS

The foundation construction for all the tanks shall be constructed using the Wartsila specification as detailed below as a reference and should incorporate requirements of internationally approved standards including any local regulatory codes.

WÄRTSILÄ DIESEL

INSTALLATION INSTRUCTIONS	Made	JOF	Page 1/3
	Approved	JAK	Doc.No. 4V99H0140
	Date	12.05.1995	Replaces

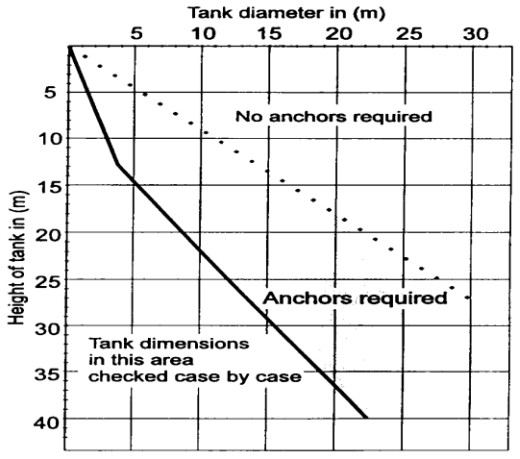
RECOMMENDATIONS FOR CONSTRUCTION OF FOUNDATIONS FOR VERTICAL CYLINDRICAL OIL TANKS

0. Introduction

The main purpose of a tank foundation is to transfer the load from the tank and its contents to the subsoil within the limited settlement range that the tank structure is able to withstand. Another purpose is to keep the tank bottom free from ground water and surface water.
Because of the wide variety of surface, subsurface and climate conditions, it is not practical to establish design data to cover all situations. The allowable soil bearing capacity is site dependent and thus the suitable foundation type to be used shall be decided for each individual case separately after careful consideration. National standards and regulations shall also be followed if such exist.

1. Foundations in general

High wind velocities may cause the tank to slide or overturn when the tank is empty and the seismic forces the tank to overturn when full. Fig.1 gives guidelines to the stability of the tank in regard to the ratio between the tank height and tank diameter at a chosen specific load case. Tanks above the dotted line need no anchors. Tanks in the dark area and below have to be anchored. Tanks below the thick line could be used but have to be anchored properly and need to be checked if they can withstand the wind loadings and the seismic forces.
It is recommended that the top of foundation shall be constructed to be at least 300 mm above the surrounding ground level. To prevent uplift (buoyancy) of the empty tanks, the top of the foundations should be raised in cases when the boundwall area (walls are higher than the top level of foundation) may be filled due to heavy rain etc.
The top of the fill (app. 80 mm) shall be made of clean sand (max. aggregate size 5 mm) which can be shaped to the proper contour.
To prevent corrosion at the tank bottom, caused by moisture from the foundation, a layer of sulphur free pitch or asphalt can be applied on the sand before the tank is placed. A geomembrane shall be placed between the topfill and underlaying coarse fill to prevent penetration at and into the ground in case of leakage.



The stability of the tank as a function of the tank dimensions for a wind velocity of 180 km/h (112 mph.) and 0.5 m fill of oil inside.
Fig. 1.

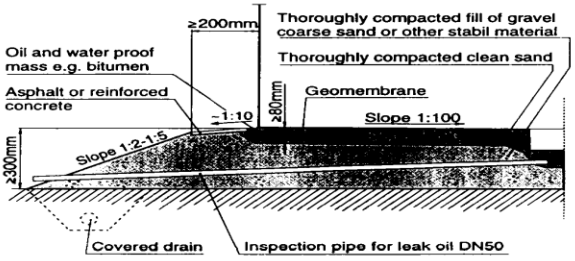


Fig. 2. Crushed stone ringwall

2. Foundations on soil or rock

Foundations for tanks that impose low loads on the foundations can consist of compacted crushed stones, screenings, fine gravel or similar materials placed directly on virgin soil. See figure 2.

The foundations for large tanks with high shell structure shall generally be made of concrete as shown in figure 3 and 4. A foundation of concrete ringwall provides a good distribution of loads, retains the fill more effectively and has some other advantages compared to the foundation soil bed type also.

Any unsuitable material under the tank foundation shall be removed and replaced by suitable fill and be thoroughly compacted.

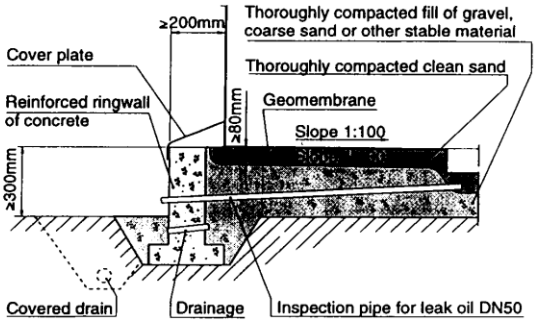


Fig.3. Concrete ringwall

3. Foundations on unstable soil or temporarily ground frost

Tank foundations, which shall be constructed on soils not having adequate load bearing capacity or when there is danger of excessive settlements of the foundation, shall be piled. See figures 6 - 7. Tank foundations placed on soil with temporary ground frost have to replace the material with a stabile fill of gravel or similar to a frostproof depth. See figure 5.

NOTE! Any unstable material must be removed and any replacement material must be thoroughly compacted.

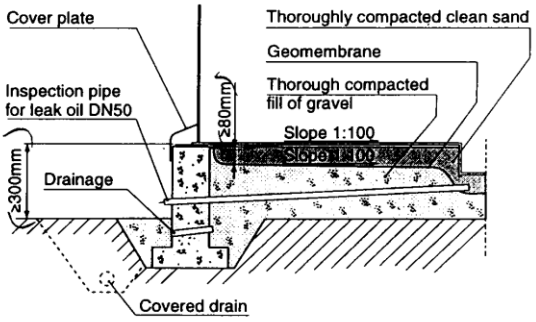


Fig.4. Concrete ringwall

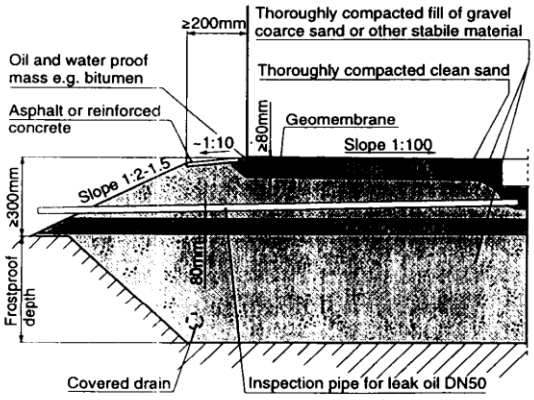


Fig.5. Foundation on replaced soil

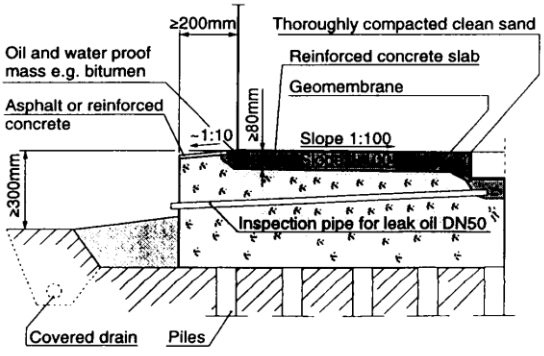


Fig.6. Piled foundation

2. STORAGE SYSTEM

2.1. General

In a power plant, oil of different grades is stored in tanks that differ in shape and size. The storage tanks are normally built in a tank yard. The main function for the tanks is to store and ensure fuel for the power plant. The fuel oil is also stored at the right temperature to ensure pumpability. The heating coils must therefore be rated to make this attainable.

In power plants with large storage tanks the heat losses are considerable and have to be noticed.

The tanks must be designed to fulfill the standards or other requirements set by local authorities.

2.2. Tank yard

The location of the tank yard depends on the site layout but the following parameters influence the design.

- access from road, rail, waterway
- terrain
- location of other buildings
- explosion and fire fighting regulations
- official regulations

Waste oil tanks, lube oil tanks and water tanks can sometimes be located in the tank yard. These tanks are discussed later in respective systems but they have to be remembered when planning the tank yard. Different grades of oils must always be stored in separate tanks.

The tanks shall not be placed in more than two rows. The bigger tank's diameter shall be used when calculating the minimum distance between the tanks. Every tank has a danger zone and a safety zone, these measurements are usually regulated by local authorities and have to be checked. In the table below some measures that can be used as guidelines are found.

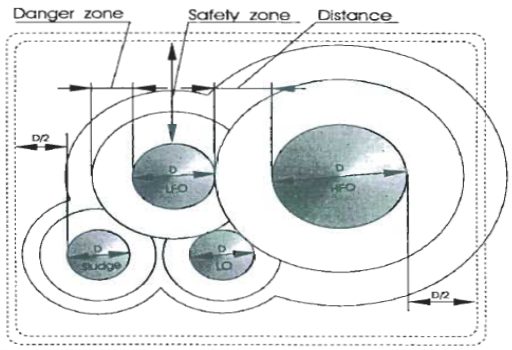


Figure 10. Tank yard

When a storage tank volume exceeds 15 m^3, a bank surrounding made of concrete or similar, is recommended. The banked volume must be at least as big as the volume of the biggest tank. The minimum distance from any tank to the bank wall is D/2 and is calculated from the nearest wall.

Tank Volume (m^3)	Danger Zone (m)	Safety Zone (m)	Distance (m)
< 3	> 1	> 1	> 1
3-15	D/2	3	D/2
15-200	D/2	5	D/2
200-500	D/2	10	D/2
500-1500	D/2	15	D/2
1500-3000	D/2	20	D/2
3000-5000	D/2	25	D/2
> 5000	D/2	30	D/2

2.2.1. Sizing of tanks

2.2.1.1 HFO and LFO tanks

The storage volume of a tank yard varies depending on the plant load (delivery quantity) and delivery intervals. The volume for HFO- or LFO tanks can be calculated according to formula:

$$V = P \cdot d \cdot a$$

V = Storage volume [m^3]
P = Plant load [MW]
d = Loading intervals [days]
a = factor, depending on engine type
see table below

a	Diesel engine
5.8	Vasa 22 and 32
5.3	Vasa 46

2.2.1.2 Sludge tank

See the treatment system under sludge quantities.

2.2.2. Number of storage tanks

A power plant can have one or several storage tanks depending on the available space, but two tanks are recommended. Then one tank in turn can act as a settling tank allowing water and dirt to settle at the bottom before using the fuel oil. The maintenance is also easier with two tanks since the plant can use fuel oil from the standby tank during the other tank is to be checked or cleaned.
The tank from which fuel is taken has to be heated while the other tank can be kept cold.

2.2.3. Type of tank

For storage systems two types of tanks are used, vertical cylindrical and horizontal cylindrical. The horizontal tank is used up to 100 m^3. The vertical tank is recommended for volumes over 100 m^3.

Tank dimensions H (height) and D (diameter) for a vertical tank be calculated according to formula:

H / D = 0.5 ... 4

One guideline is that a big tank has a smaller ratio than a small one.

Tank dimensions L (length) and D (diameter) for a horizontal tank:

L / D = 1 ... 5

2.3. Heating

Heavy fuel oil is very viscous and at low temperatures it doesn't flow at all, therefore heavy fuel oil has to be heated to 10° C above pour point to ensure pumpability. The fuel oil in the storage tanks has to be stored at this temperature. The heating devices have to be controlled by a thermostator to avoid the fuel from being heated above its flash-point. Because of heat losses it is recommended to insulate the storage tanks.

Recommended storage tank temperatures: (*See also fuel oil viscosity-temperature diagram 0.2.1 Viscosity and temperature*).

Fuel viscosity cSt at 50 °C	Storage tank temp.
180	37° C
380	40° C
500	43° C
600	46° C
700	48° C

2.3.1. Required tank heating

2.3.1.1 General

Normally the dimensions of the heating elements are based on the heat transfer required for increasing the temperature within a specified time, e.g. 1°C/ 5 h, and on the heat required to compensate for heat losses when maintaining the tank at storage temperature.

In addition, heat losses from the surface of the tank must be taken into consideration.

The diagrams on page 13, figure 11, gives an estimated theoretical value for the losses.

The total heat loss depends on factors as:

- tank volume
- tank type
- tank form, horizontal or vertical
- insulation thickness
- temperature difference between storage and ambient temperature
- average wind velocity

2.3.1.2 Sizing of tank heater coil

Formula for required output from the heating elements in order to increase the temperature in the tank within specified time:

$$P_R = \frac{V \cdot \rho \cdot c_p \cdot t}{y \cdot 3600}$$

P_R = Power required [kW]
V = tank volume [m^3]
ρ = density of fuel [kg/m^3]
c_p = specific heat value of fuel [kJ/kg°C]
t = temperature [°C]
y = hours [h]

Example:

- Storage tank:
  - horizontal type
  - height 15 m
  - diameter 5 m
  - volume ~ 300 m^3
  - insulated 30 mm
  - storage temperature 40° C

- Heavy fuel oil:
  - 380 cSt at 50° C
  - density ρ = 990 kg/m^3 at 15° C

- Ambient conditions:
  - average wind velocity 8 m/s
  - minimum ambient temp. = 0° C

Heating of fuel oil to storage temperature

Required power to heat the fuel oil 1° C in five hours:

$$P_R = \frac{v \cdot \rho 40 \cdot Cp_{40} \cdot t}{3600 \cdot y}$$

- the storage temperature for the fuel is 40° C
- the specific heat value at 40° C according to formula on page 4:

$$C_p = (53.4 + 0.0535 \cdot t) / \sqrt{\rho_{15°}}$$
$$C_p = 1.77 \text{ kJ/kg°C}$$

- the density for the fuel at 40°C

$$\rho_{40} = \rho_{15} - 0.64 \cdot (t_2 - t_1)$$
$$= 990 - 0.64 \cdot (40-15)$$
$$\rho_{40} = 974 \text{ kg/m}^3$$

- temperature rise 1°C/5 h

$$P_R = \frac{300 \cdot 974 \cdot 1.77 \cdot 1}{3600 \cdot 5}$$

P_R = 28.7 kW $\Rightarrow \approx$ 30 kW

Estimating of heat losses

See the diagrams on next page, Figure 11:

(A) Begin from part ①:
- horizontal tank type
- ratio L / D = 15 / 5 = 3
- tank volume = 300 m^3

(B) Find actual insulation thickness in part ② :
- go horizontally to the 30 mm line

(C) Find actual temperature diff. in part ③:
- go vertically to temp. diff. line 40° C

(D) Read heat losses from part ③:
- go horizontally
- $\Rightarrow P_{tank1\text{-}2\text{-}3}$ = 7.1 kW

(E) Read heat losses by the wind from the actual diagram:
- tank volume 300 m^3
- average wind velocity 8 m/s
- $\Rightarrow P_{wind}$ = 1.2 kW

Total heat losses = 7.1 kW + 1.2 kW = 8.3 kW

Required size of heating coil in the tank

- to heat the fuel oil 1°C / 5h requires 30 kW
- to compensate for heat losses requires 8.3 kW.

The right size for the heating coil is:

30 kW + 8.3 kW, or $\approx$ 40 kW.

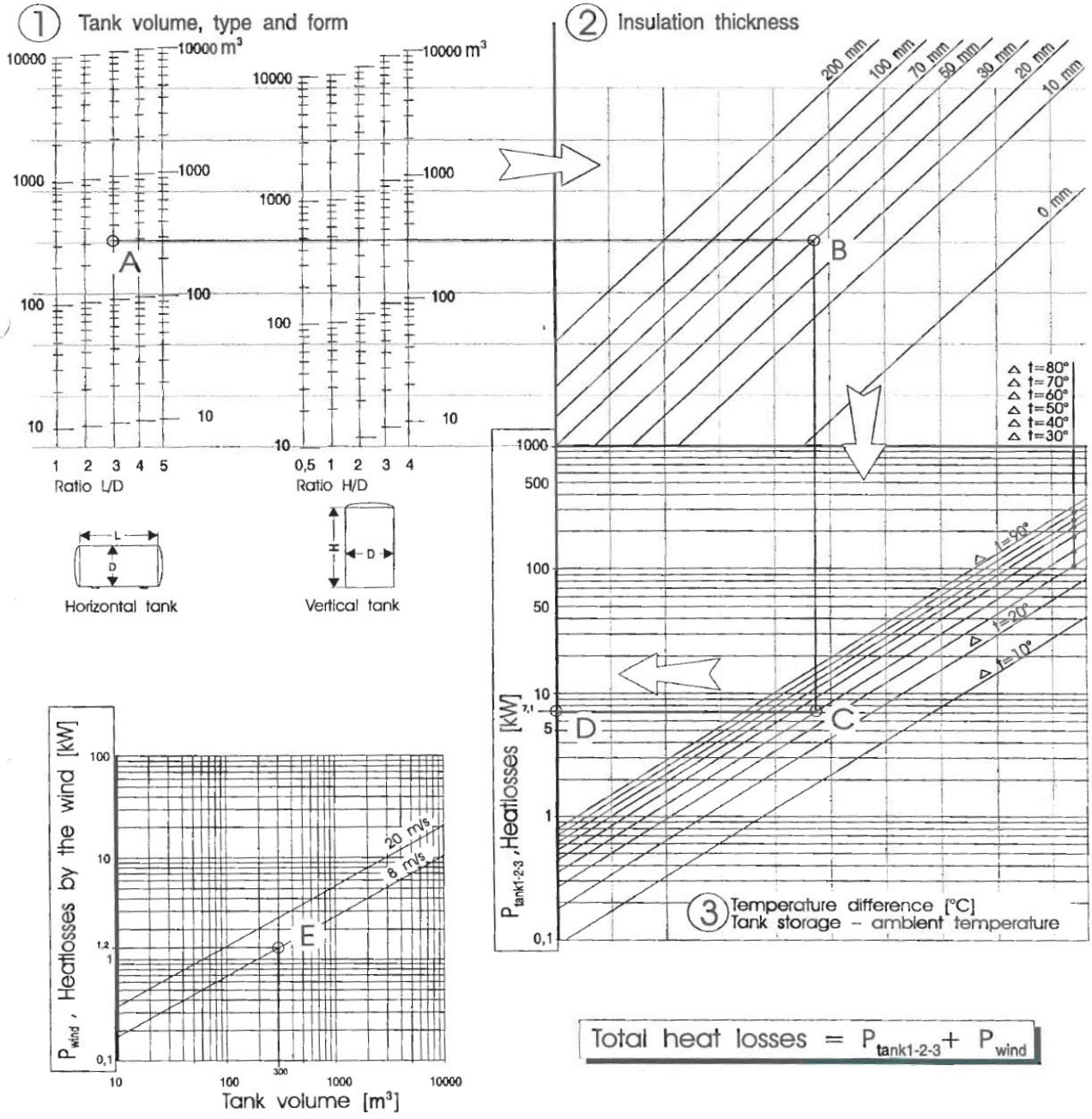


Figure 11. Diagrams for estimating of heat losses.

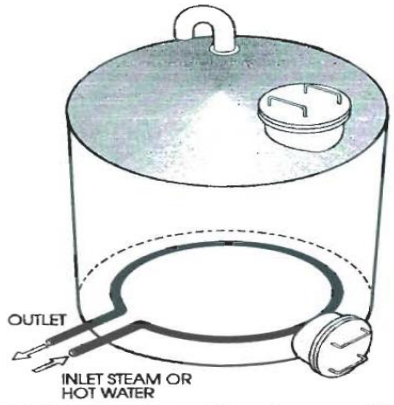


Figure 12. Heating by water, steam or thermal oil

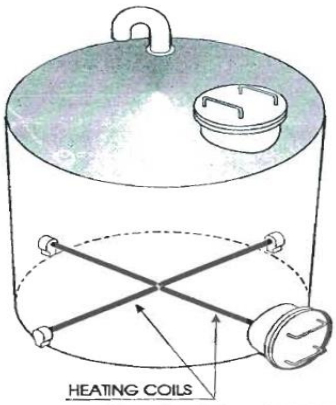


Figure 13. Heating by electrical heating coils

2.3.2. Heating coils

There are four different ways of heating a storage tank. The tanks can be heated by means of:

- water
- steam
- electricity
- thermal oil

When choosing heating method, the following must be considered:

- possible surplus steam capacity
- the evenness of local electricity supply
- hot water from the cooling system
- hot water or steam from the exhaust gas boilers

Two different methods are recommended to avoid that the storage tanks cool down:

- Heating of the entire tank
  The coils must be placed so that the heating of the fuel oil becomes even and the temperature reaches the calculated value in the entire tank.

- Heating of the entire tank and in addition heating of the suction area
  The suction heater has to rise the temperature of the fuel oil at least 10 °C above the pour point only around the fuel oil transfer pump suction area.

The viscosity of the fuel oil in the entire tank must be at least 3000 – 4000 cSt, enabling the flow of fuel oil to the suction area.

The required min. capacity of the suction heater is calculated according to formula:

$$P_R = \frac{q \cdot \rho \cdot c_p \cdot \Delta t}{3600} \cdot \eta$$

P_R = heat required [kW]
q = flow [m^3/h]
ρ = density of fuel at actual temp. [kg/m^3]
c_p = specific heat value at actual temp. & density [kJ/kg°C]
Δt = rising temperature [°C]
η = min. factor of safety 1.10 - 1.15 (10-15%)

To avoid carbon deposit on the heating coils and pipes the surface temperature must not be too high. The surface power of the heater element shall not be higher than about 1W/cm^2.

All suction-, steam-, electric-, thermal oil heaters or combinations, must be sized to reflect the required power under the most unfavorable conditions.

4. TREATMENT SYSTEM

4.1. General

The fuel oil treatment system comprises tanks and separators. The main function of these units is to supply sufficiently clean fuel. When operating on heavy fuel oil the dimensioning of the separator is important.

The tank location and ventilation must be planned accurately to avoid any danger of fire or explosion. Venting pipes from tanks placed inside building have to be extended to the outside and to a place where it is no danger of explosion.

Avoid placing tanks close to:
- open fire
- exhaust gas pipes
- exhaust gas silencers

or similar hot objects.

4.2. Tanks

In a standard HFO system three different tanks are used:
- HFO buffer tank
- HFO day tank
- LFO day tank.

The alternative HFO system has two different tanks:
- HFO day tank
- LFO day tank.

In the standard LFO system one tank is used:
- LFO day tank.

See diagram in general section

4.3. Number of tanks

The number of tanks vary from installation to installation. The standard installation is one buffer- and one day-tank. In installations with several engines, it is recommended to have double tanks or more to increase flexibility.

Another advantage with double tanks is the possibility of keeping different fuel deliveries separated from each other. Blending problems are in that way eliminated.

If problems with a bad fuel occurs, the other tanks immediately can take over and the problem fuel can be pumped back.

Double tanks enables maintenance on one tank system meanwhile using the other.

Several tanks are the only solution if different grades of fuel are used.

Note! Requirements by local authorities can sometimes be solved by using several tanks.

4.4. Buffer (settling) tank, HFO

The conventional settling tank was always an important item since excess water with sludge and abrasives could be removed in the tank by gravitational effects.

To give the settling process sufficient time, these tanks normally have a capacity equivalent to 24 hours fuel consumption.

The amount of sludge and abrasives removed by settlement is considerably less than the amount removed by the separator. Therefore smaller thanks, having only a buffering function, can be used in combination with a separator. The purpose of the tank is to provide fuel with constant temperature and static pressure to the separator.

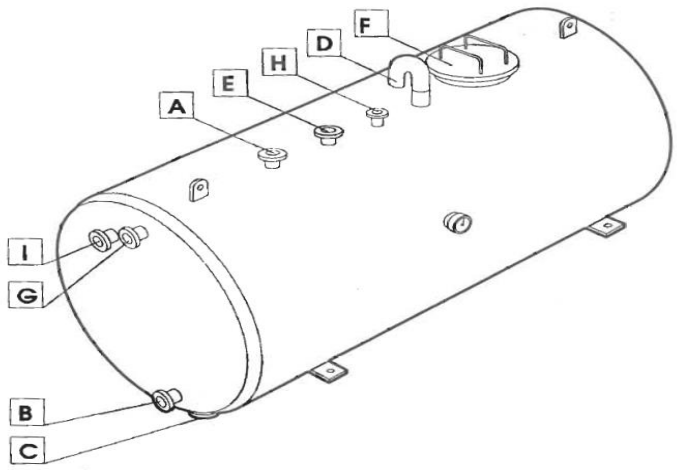


Figure 19. HFO buffer tank

The buffer tank has the following connections:

A = HFO filling
B = Suction to separator unit
C = Drain/emptying
D = Venting
E = Return from separator unit
F = Manhole
G = Overflow
H = Fuel from return fuel unit
I = Overflow from day tank

The buffer tank is dimensioned to ensure constant temperature and suction head in the separator. The temperature in the buffer tank shall be kept as constant as possible, min. 60° C or at least 10° C above the pour point of the actual fuel.

The minimum level of fuel in the buffer tank shall be kept as high as possible. In this way the static pressure will not vary too much.

The buffer tank shall ensure fuel supply for 3-8 hours when filled to maximum. The tank shall be designed to provide sludge and water rejecting effect.

4.5. Day tank

4.5.1. Day tank, HFO

The heavy fuel oil day tank is normally dimensioned to ensure fuel supply for about 8-12 operating hours when filled to maximum.

The tank shall be designed to keep water and dirt particles out of the suction pipe.

The day tank has to be placed at about 0.5 m above the buffer tank and has to be connected with an overflow line with constant slope back to the buffer tank.

The tank and pumps shall be placed where a positive static pressure of 0.3-0.5 bar is obtained on the suction side of the pumps.

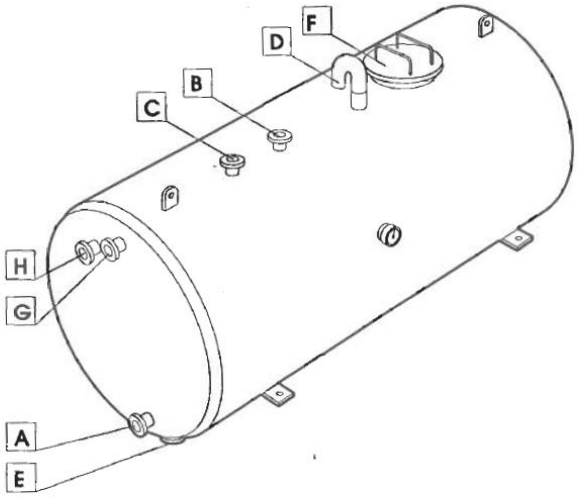


Figure 20. HFO day tank

The HFO day tank has the following connections:

A = Suction to booster unit
B = HFO filling
C = Return fuel from pipes
D = Venting
E = Drain/emptying
F = Manhole
G = Overflow
H = Overflow to buffer tank

4.5.1.1 Heating

The buffer and HFO day tank heaters shall only be dimensioned for the heat losses. The same formulas and diagrams can be used as for the storage tanks.

See storage tanks chapter 2.3 Heating.

4.5.2. Day tank, LFO in HFO installation

The day tank is normally dimensioned to ensure fuel supply for 4-5 operating hours when filled to maximum.

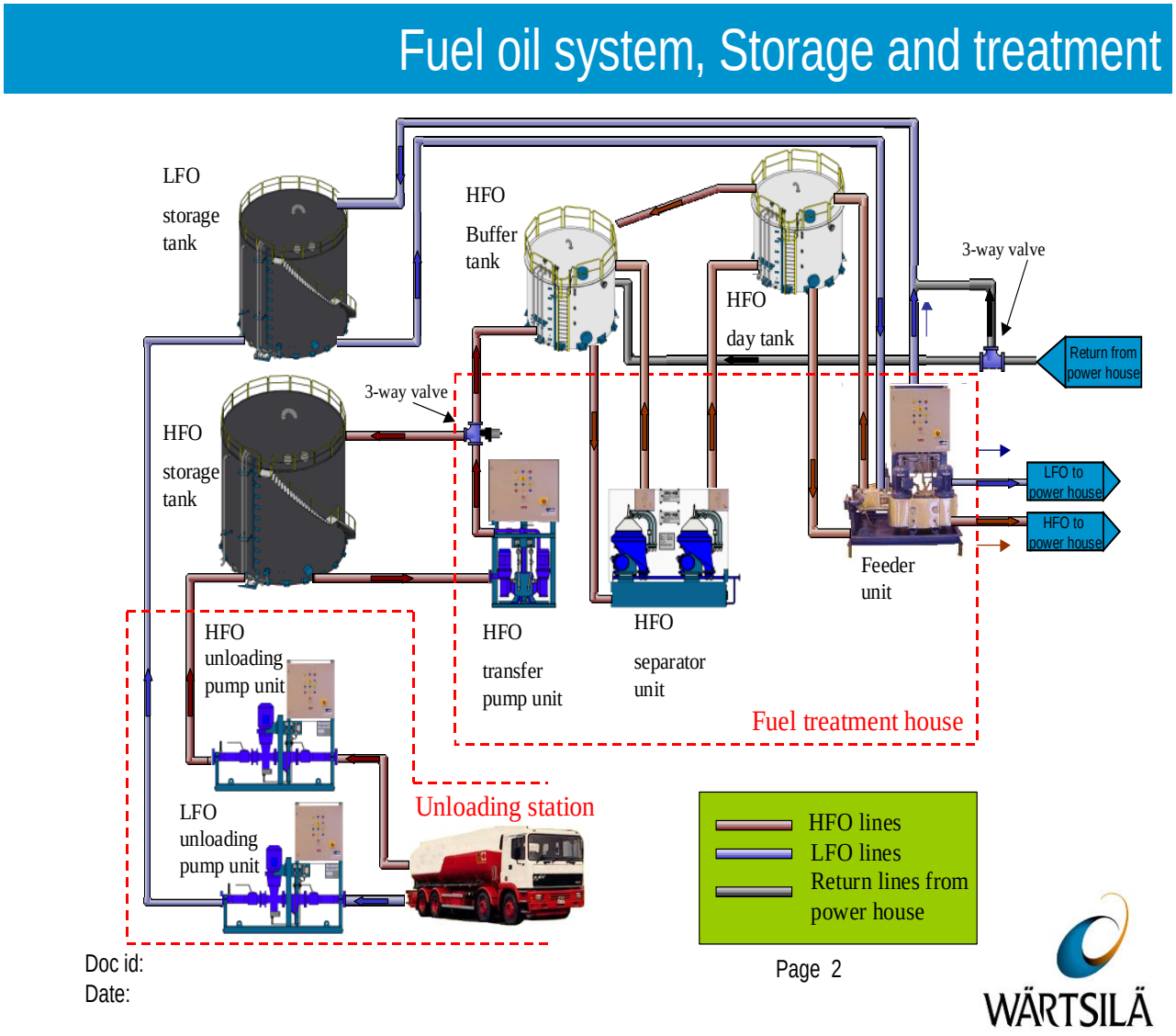
4.5.2.1 Heating

Usually there is no need of heating for the LFO day tank. In installations with arctic conditions, attention is to be paid to the pour point and the wax formations for the fuel.

For the LFO day tank the same formulas and diagrams can be used as for the storage tanks.

See storage tanks chapter 2.3 Heating.

6.0 TYPICAL HFO FUEL SYSTEM



7.0 MECHANICAL SPECIFICATIONS

7.1 Storage Tanks & Vessels

Scope

This section covers the general requirements for the design(fabrication design and drawings only), materials, fabrication, testing, and erection (if site fabricated) of vertical, cylindrical, closed top steel storage tanks in various sizes and capacities for internal pressure approximating to atmospheric pressures. FEA will require the entire design package to be reviewed by the appropriate Engine Manufacturer prior to approval for fabrication and site construction to commence. In addition, FEA expects that the design will integrate seamlessly to equipment supplied by others or Engine manufacturer such as HFO transfer pump unit, etc.

Codes and Standards

The design (fabrication design and drawings only) and manufacture of storage tanks shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable Standards. In particular, the equipment shall conform to the latest editions of the applicable standards mentioned in Section 6.

Design Requirements

General

Storage tanks shall be designed (fabrication design and drawings only) using largest course consistent with the optimum economic based on amount of welding.

Connections and Appurtenances

When connections and appurtenances are installed on tanks, the use of designs as specified in the applicable codes is required except that all alternate designs which provide equivalent strength, tightness and utility are permissible, if agreed to by Owner / Engineer

Flange facings shall be slip on, raised face type

Manhole necks, nozzle necks, reinforcing plates and shell plate openings, which have either sheared or oxygen-cut surfaces, shall have surfaces made uniform and smooth, with the corners rounded, except where such surfaces are fully covered by attachment welds.

Earthing Cleats

Each tank, when specified, shall be provided with drilled cleats welded to the tank for electrical grounding, Material of cleats shall be same as that of the shell.

Materials

All materials shall be of high grade, free from defects and imperfections, of recent manufacture, unused and of classifications and grades indicated below. Contractor, however, may offer substitute materials at the time of quotation. Any exception to the material specified shall be approved by Owner / Engineer before commencing manufacture.

- Shell, Bottom, Roof External & Internal Steel – DIN 5143
- Nozzle Necks – ASTM A 106 Gr B
- Nozzle flanges – ASTM A 105
- Blind flanges, Manhole Nozzles, Flanges and Covers – DIN 5143

- Bolts & Studs – ASTM A 307 / A 193 Gr B
- Nuts – ASTM A 194
- Gaskets - Compressed Non - Asbestos Fibre 1.5 Thick

Fabrication Drawings

Owner's/Engineer's approval of Contractors design and drawings constitutes certification of overall dimensions only, and does not relieve the Contractor of any responsibility with respect to design in accordance with the code requirements.

Fabrication

Prior to fabrication, the material shall be checked with its mill test certificate to ensure the correctness of the material for the intended purpose.

Basic lines for location of nozzles and other attachments shall be clearly shown on the storage tanks by means of center punching. These shall be located so as not to come or lap over shell longitudinal or circumferential seams.

Reinforcing pads around manhole and nozzle openings shall not come on or lap over longitudinal seams.

Nozzle and manhole necks shall be flush with the inside surface of the tank, unless otherwise specified.

Plate for tanks shall be straightened by pressing or other non-injurious methods prior to bending. Shell plates shall be shaped to suit the curvature of the storage tanks, prior to erection.

Handrails shall be provided around the roof of the storage tanks. Toe (skid) plate shall be provided.

Fabrication tolerances for test shall be conducted on tank bottom, shell and roof in accordance with applicable codes. The tanks, when filled with water, must be free from sweating, leaks, bulges and any other defects. The cost of all tests shall be deemed to have been included in the price quoted and no extra payment will be made for the tests.

Accessories to be provided for Tanks & Vessels

- Isolating Valves wherever required, for lines connected to the tanks & vessels
- Ladder
- Flame Arrestors for fuel oil tanks
- Instrumentation as required
- Goose neck with screen for air vent
- Earthing device
- Pressure safety relief valves for prevention of damage to downstream equipment.
- Water draw – off sump

Joint Efficiency

For all tanks and vessels, the Joint efficiency shall be 0.85 with 10 % Radiography.

Design and Test Pressures

The Design pressure and Test pressures shall be full water and in some cases as per applicable codes.

Painting

Painting of tanks and vessels shall be in accordance with painting specifications to suit site conditions. SSPC codes shall be followed.

6.2 Piping (Outside the building)

Codes and Standards

The design of pipelines, pipe assemblies, pipe fittings, flanges and components, valves and specialties and any other pressure retaining part in a piping system will be carried out in accordance with the applicable power piping codes (like ANSI B31.1).

The design of the piping systems will also meet the statutory requirements of the countries of manufacture and installation of the piping systems.

Not with standing the recommendations and stipulations of the codes and standards mentioned above, the requirements of this specification shall be deemed minimum and shall be complied with fully.

Basic Design & Erection Criteria

Pipelines will be designed adequately to meet the system requirements of flow, pressure drop, etc., under all operating modes of the plant.

It will be ensured that under no circumstance including mal operation or failure of the equipment or system, the safety of the plant, equipment or personnel is endangered by inadequate design of pipelines.

Piping systems will be so designed and conceived in such as manner as to maximize plant or equipment availability. Provisions of isolating valves, bypass, etc. are examples of this concept.

Design temperatures will be as per the recommendations of applicable codes.

A minimum corrosion allowance of 1 mm will be considered while selecting wall thickness of pipes for all systems Fuel oil piping shall be welded using gas tungsten arc welding process to avoid slag inclusion inside the piping.

Fuel oil piping including valves and specialties shall be cleaned by pickling.

Routing of Pipes

The piping shall be arranged to provide clearance for the removal of equipment requiring maintenance and for easy access to valves and other piping accessories required for operation and maintenance.

Overhead piping shall have a minimum vertical clearance of 2.3 meters above walkways and working areas and 6 meters above roadways.

Sufficient upstream and downstream lengths shall be provided for flow measuring devices, control valves, etc.

At all the screwed valves and screwed connections on equipment, unions shall be provided to facilitate disassembly.

The hangers and supports shall be spaced in accordance with the standard engineering practice as outlined in applicable codes and standards.

7.2 Valves

Design Requirements

All valves and specialties shall be so located that they are readily accessible for operation and maintenance.

Unless specified, valves of sizes 65 DN and above will have a cast steel body and valves of sizes 50 DN and below shall have a forged steel body.

Flow direction will be clearly embossed on the valve body for globe and check valves.

All steel valves of sizes 50 DN and below will have socket welding ends. In case of all end-welded valves, the stub ends of the valves must project from the valve body a sufficient amount to ensure that the welding process will not affect the valve seat. All valves for lubricating oil service shall be welded.

Valves that are required to be motor-operated will be provided with hand-operated equipment for closing and opening of the valves during power failure and shall have a suitable arrangement for decoupling effectively when the valves are being motor-operated.

The motors, gearing and disengaging hand-wheel will be adequate to open and close the valves under full unbalanced design pressures and will be completely assembled on the respective valves and shop-tested before shipment.

7.3 Strainers

Design and Construction Requirements of Water and Oil Strainers

The body material of strainer will conform to ASTM A 216 Grade WCB or equivalent for cast steel and ASTM A 105 or equivalent for forged steel. The screen material shall be of stainless steel of type 316.

The cover design will be of quick-opening, swing away, yoke type to facilitate quick and easy access to the basket.

The body will be fitted with a drain plug and a vent cock shall be provided on the top cover.

Duplex strainers will have mechanical interlocking to ensure that only one section is pressurized at a time. The manner of interlocking shall allow uninterrupted flow to be maintained during change-over from section to section.

Strainers shall have free straining area at least six times the cross sectional area of pipe.

Basket strainers, 150 mm NPS and larger shall be provided with legs for bolting to the floor.

End connections shall be Raised Face flange drilled to ANSI B16-5.

For steel strainers, bolts and studs shall conform to ASTM A 193 Grade B7 or equivalent and nuts to ASTM A 194 Gr. 2H or equivalent.

15 mm NPS connections for pressure gauges on the strainer body shall be provided for indication of inlet and outlet pressures.

Painting And Corrosion Protection

One coat of primer and two coats of enamel shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion, after release has been given for painting and before dispatch. The use of grease or oil, other than light grade mineral oil, for corrosion protection is prohibited.

7.5 Thermal Insulation

Scope

This section covers the technical requirements and essential particulars for the supply, application and finishing of the complete thermal insulation and its protective covering for pipes, valves, fittings including bends equipment, tanks and vessels, flues, ducts etc. The scope of the Contractor shall include, but not be limited to, the following items:

- Insulating materials of all types as specified/required.
- Finishing materials of all types including cement, protective coating, and sheathing, as specified / required.
- Angle irons, clamps, lugs etc. for supporting insulation on pipes and equipment.
- Wire mesh, lacing/binding wires, bands, straps, screws etc., as required.
- Weather hoods.
- Any other material as may be required for making the insulation complete.

General Design Requirements

All exposed portion of the plant, which operate at temperatures of 65deg.C and above during normal operation will be thermally insulated so that the temperature on the outer surface of the sheathing (aluminum/galvanized steel) does not exceed 60 deg.C based on an ambient temperature of 30deg.C.

The specified insulation thickness will not include the thickness of wire netting, finishing cement or any other finishing or weatherproofing application.

Piping and Equipment that are not insulated but have a surface temperature exceeding 50deg.C will be insulated for personnel protection.

7.6 Material Specification

Insulating Materials

Application density of insulating materials shall be as given below:

Material	Temperature	Density
Lightly bonded mineral (slag/rock) wool for tanks & Equipments	< 400°C	100 kg/m3
Mineral wool pipe sections for pipes	> 400°C	150 kg/m3

Insulating Cement

The insulating cement, when used shall have the same composition as that of the main insulating material to which it is applied. Also, it shall be capable of withstanding the same temperature.

Finishing Material

All insulation shall be protected by an outer covering of aluminium sheathing. The thickness of aluminium sheathing/galvanized steel to be used shall be as follows:

Pipes of 450mm (18 in.) and above over outside diameter of insulation.
1.219mm (18 SWG) for aluminium.

Pipes of 150mm (6 in.) and above over outside diameter of insulation but less than 450mm (18 in.)
0.914mm (20SWG) for aluminium

Pipes less than 150mm (6 in.) over outside diameter of insulation.
0.711mm (22SWG) for aluminium

Flues and ducts, not less than 1.0mm for aluminium and galvanized steel.

Binding and Lacing Wire

Binding or lacing wire shall be 20 SWG galvanized steel wire. Where interface temperature is 400deg.C or more, the binding wire shall be 20 SWG stainless steel wire.

Straps and Bands

All straps and bands shall be of galvanized steel. For securing aluminium sheathing material, stainless steel or anodised aluminium bands shall be used. Bands shall be 20mm (3/4 in) wide x 0.6mm (24 SWG) thick.

Screws

Screws shall be of self-tapping type and shall be of galvanized materials.

Application of Insulation-General

The insulation shall be applied to all surfaces when they are at ambient temperature. Ample provision shall be made for the maximum possible thermal movement and the insulation shall be applied in a manner, which will avoid breaking or telescoping due to alternate periods of expansion and contraction.

A single layer of insulation shall not be more than 75mm thick.

All surfaces to be insulated shall be clean and dry before the insulation is applied. The surfaces shall be cleaned of all foreign material such as scale, dirt, rust and paint, by the use of steel wire brushes and steel scrapers, where necessary.

Application of Insulation

All vertical pipes shall be provided with suitable insulation supports to prevent the insulation from collapsing due to its own weight. The insulation shall be applied starting from bottom above.

All equipment and vessel manholes, hatches, bolted or screwed cover plates, flanged ends, etc. shall have removable box type insulation, with same thickness of insulation as for adjacent surfaces. Insulation adjoining such equipment or vessel openings shall be tapered towards these openings to permit removal of bolts, screws, heads, covers or plates with no damage to adjacent surface insulation or cover.

The insulation applied to equipment shall be reinforced with 25 mm (1 inch) 20 SWG galvanized wire netting with hexagonal mesh. One course of wire netting shall be applied to the surface of the equipment, with an additional course per 40 mm of thickness. All irregularities of the surface shall be filled and leveled over with insulating cement insulating blocks or slag/rock/glass wool blanks as specified shall be applied over the dry cement surface and secured with annealed wire lacings.

Application-of Insulation-Valves and Fittings

All valves fittings and specialties shall be covered with the same type and thickness of insulation as specified for the adjoining pipe, with the special provisions and/or exceptions as listed below.

All valves and flanges shall be completely insulated with removable type of boxes fabricated from aluminium/galvanized steel sheets of same thicknesses as used on adjoining pipes. Pipe insulation adjoining flanges shall be beveled back to permit removal of the bolts and nuts. The insulation shall be applied after the finish has been applied over insulation on the adjacent piping.

Flanges on lines covered with the minimum thickness of insulation (lower temperature range) shall not be insulated. Flanges on all other lines shall be covered with provisions for making the insulation removable and replaceable.

Unions, expansion joints (metallic or rubber), safety valves, traps and safety valves on discharge lines shall not be insulated. However, trap discharge lines shall be insulated for personnel protection only.

Valves shall be insulated upon and including their bonnet flange.

Pipe hanger clamps shall be covered with insulation along with the pipe. When pipe hangers pass through insulation on piping outdoor, a metal hood packed with waterproof sealing material shall be supplied and installed. Care shall be taken to ensure that the upper bolts of hangers clamps are not insulated.

Pipes hoods shall be provided for insulated piping passing through roof slabs and walls.

Finishing and Weather Proofing

On all piping and equipment where slag/rock/glass wool blanket insulation is used a 12 mm thick finishing cement shall be applied in two layers of 6 mm each of dried thickness after a 25 mm (1 inch) 20 SWG galvanized wire netting with hexagonal mesh is stretched over the entire surface of insulating material and securely fastened down. The cement shall be hand-toweled over the wire netting to a smooth circular finish. The application of finishing cement shall be terminated, at the end of day's work, at an expansion joint.

All equipment and vessel manholes, hatches, bolted or screwed cover plates, flanged ends, etc. shall have removable box type insulation, with same thickness of insulation as for adjacent surfaces. Insulation adjoining such equipment or vessel openings shall be tapered towards these openings to permit removal of bolts, screws, heads, covers or plates with no damage to adjacent surface insulation or cover.

The insulation applied to equipment shall be reinforced with 25 mm (1 inch) 20 SWG galvanized wire netting with hexagonal mesh. One course of wire netting shall be applied to the surface of the equipment, with an additional course per 40 mm of thickness. All irregularities of the surface shall be filled and leveled over with insulating cement insulating blocks or slag/rock/glass wool blanks as specified shall be applied over the dry cement surface and secured with annealed wire lacings.

The finishing cement coating shall have the following properties:

- A light shower of rain, falling immediately after application should not wash off the cement.
- At any time, one week or more after application, it should not shatter if struck a sharp blow with a 0.7 kg. (1-1/2lb.) hammer. Such a blow may damage the insulation locally but should not cause large pieces to break away.
- When set, it should withstand prolonged exposure to the weather without additional protection.

Outdoors, the finishing cement shall be applied immediately after application of insulation. If this is not practicable, then the Contractor shall take adequate precautions to protect the insulation from weather e.g. by wrapping it with polythene sheet, roofing felt or other approved material.

Expansion Joints

Necessary expansion joints shall be provided to prevent cracking of rigid insulation and hard setting finishing cement layer. Expansion joints shall be provided at intervals. They shall also be fitted on both sides and within 1 metre of each bend and branch connections. At the expansion joint, there shall be complete cut through the insulation and the wheel metal covering shall be provided with sliding joints.

Measurement

Conversion factors for bends, fittings, valves and specialties etc., for measurement, shall be as per applicable codes.

Protection of Materials During Storage

The Contractor shall protect the insulating materials from weather at all times from delivery to finish. Decking and covering tarpaulins alone are not adequate for any length of time and shall not be allowed except in extreme emergencies and only for short period. Stacking of insulating materials directly on ground shall not be done.

Protection of Partially Complete Job

The Contractor shall take all precautions to complete application of finishing cement on exposed surfaces covered with insulation before closing the day's work.

Guarantees

In addition to the guarantees called for in the Owner's General Conditions of Contract for Supply and Erection, the Contractor shall also guarantee that if the specified maximum surface temperatures are exceeded on actual measurement, the Contractor shall either replace the insulation with a superior material or provide additional insulation thickness at the Owner’s/ Engineer's discretion and at no extra cost to the Owner.

Miscellaneous

Approval of the Owner/Engineer shall be obtained of samples of all insulating and sheathing materials and necessary test certificates of approved national laboratories, before dispatching these materials to Site. Insulation shall not be applied until specific release is given by the Owner.

Testing

Contractor shall demonstrate to the Owner the surface temperature of the insulation at site. Temperature shall be measured at the middle of one segment of piping run to be mutually agreed. These temperatures shall be taken as the representative temperature for that of piping. If the temperature is higher than the guaranteed, the whole length shall be replaced or additional thickness added to meet the surface temperature. Two measurements shall be taken at the measuring points (one at the top and the other at the bottom).

8.0

CIVIL SPECIFICATIONS

The following sections describe the general specifications to be followed for civil work

8.1 Site Installation

The Contractor shall submit design drawings for site installation. The design drawings shall be compatible with the general layout as shown in the preliminary drawings. The final

arrangement for site installation shall be mutually agreed upon with the Client's Representative prior to Contract signature, and shall include supply, furnishing, transport, erection and installation, operation and maintenance and removal of all plant and construction equipment and auxiliary equipment, materials, tools, all temporary installations such as workshops, offices with site communication facilities like telephone, fax, e-mail- with broadband connection and local site LAN, laboratories, stores, houses, canteens, first aid station and all other facilities required for Contractor's personnel and for the execution of the construction works and for the fulfillment of the Contractor's obligations as well as all necessary temporary installations in accordance with Health & Safety Regulations (public and/or FEA).

Site installation shall also include temporary hoarding/fencing site roads, maintenance, crossings, drainage, parking areas, storage areas, auxiliary buildings and structures, supply of electric power, drinking and industrial water supply, sewage disposal, waste disposal, medical facilities, construction workers and supervisors housing and community facilities, i.e. all works required for the safe and efficient execution of the works.

Site installations shall also include provision of water and electricity for the site offices of Customer's Representative for the duration of the Contract up to the issue of the Final Acceptance Certificate (FAC).

8.2 Earth Work

General

This chapter applies to all earth and rock work, as well as the de-watering required for establishing of structures, equipment foundation, and burying services in the ground.

Standards

Further to the standards listed under Section 6 above, following standards shall apply:

DIN	18300	-	General Technical Specifications for Building Works, Earth Works
DIN	1054	-	Subsoil; Permissible Loading of Subsoil
DIN	1055	-	Design Loads for Buildings
DIN	4017	-	Subsoil, Shear Failure Calculations
DIN	4018	-	Subsoil, Bearing Pressure Calculations
DIN	4019	-	Subsoil, Analysis of Settlements
DIN	4084	-	Subsoil, Calculation of Terrain Rupture and Slope Rupture

Excavations

Site Preparation

Prior to the commencement of excavations, the Contractor shall clear all areas of site, including the complete removal and disposal of all rubbish, trees, bushes and any other growing vegetation. All debris shall be removed to an approved location.

Dimensions of Excavations

Excavations shall be carried out to the widths, lengths, and depths as shown on the approved drawings. Over excavation shall be filled either by concrete, class C15, or by approved, cohesion less soil, backfilled and compacted as specified hereinafter.

Excavation for Foundation

The storage tanks shall be founded on bearing strata. The Contractor shall examine any unsuitable or weak ground found below foundation level, and report the same to the Client's

Representative... Should it be found necessary to reach a more suitable strata, the Contractor shall perform all additional excavation as directed by the Client's Representative at no extra cost prior to the concreting works. The bottom layer of excavation of 250 mm shall be removed manually, and the bottom of the excavation shall be leveled and well compacted.

If excavated material has been approved by the Client's Representative for re-use, it shall be stockpiled in approved locations.

Excavation in Rock

The contract price shall be deemed to cover the cost of excavation in any type of ground such as rock, paved areas etc. For (cable and pipe) trenches in rock, the Contractor shall provide a clearance of 200 mm minimum below and on each side of all pipes, cables, and ducts. After excavation, the Contractor shall fill up the area around the pipes and cables with fine material approved by the Client's Representative.

Shoring of Excavation

Where necessary, the sides of excavation shall be shored in a proper manner to prevent sliding of earth or settlement of any part of adjoining construction, as well as for the protection and safety of persons and traffic near the excavation. Calculations and working drawings for the proposed scheme to protect excavations shall be approved by the Client's Representative prior to the commencement of works.

Fill and Backfill Material

Material to be used as fill or backfill shall be cohesionless, well graded granular material and shall contain less than 10 % non-plastic silt. It shall be free from contamination and shall not be taken from areas falling into Class 5 of the BRE Digest 363 and shall have a grading curve close to the following:

Sieve	% Passing
75 mm	100
37.5 mm	85 – 100
10 mm	40 – 70
5 mm	25 – 45
600 µm	8 – 22
75 µm	0 –10
Note:	

Material shall not contain:

More than 1 gram/litre sulphates, measured as SO3 in 2: 1 water: soil extract
More than 0.05% chlorides as Cl.

Should the suitable excavated material not be sufficient for filling and backfilling, the Contractor shall deliver the quantity required from an approved source.

Prior to the commencement of the works the Contractor shall take samples from the proposed filling/backfilling material to be tested in respect of grain size distribution, sulphate and chloride content, maximum and minimum density, dry density, and optimum moisture content. The test results shall be submitted to the Client's Representative in the form of a comprehensive report for approval.

Filling for Make-up Ground and Site Leveling

Filling for make-up ground and site leveling shall be compacted as specified herein. Levels and embankments or other slopes shall be constructed and trimmed to a gradient of not less than two (2) horizontal: to (1) one vertical, or as shown on the approved drawings.

Compaction of Fill and Backfill

No backfill shall be executed until the work has been inspected, tested, and approved by the Client's Representative... Great care shall be applied during backfilling to ensure that the construction details are not damaged.

After having added the estimated amounts of water, the fill and backfill shall be compacted by vibratory steel wheeled roller with static weight of at least 5 tons. Portable vibratory steel rollers of the single drum self propelled type may be used for areas where the vibratory steel roller is impractical. A criss-cross pattern of rolling shall be carried out for a minimum of 10 passes on each layer.

After completing the compaction, the density in place shall be determined by the sand cone method in accordance with ASTM D1556. The maximum density and moisture content relationship for each type of soil shall be in accordance with BS 1377. For cohesion less soils the maximum and minimum index density as well as the relative density shall be in accordance with ASTM D4253 and D4254. The minimum required degree of compaction shall be 95 % of the maximum dry density. For cohesion less soil the relative density shall not be less than 75 %.

The density-in-situ test shall be carried out for each second layer of filling and backfilling, and on each layer for the filling of the supporting strata under foundations, trenches, etc. at a rate of one test per 2500 square meters of finished profile at each layer, with a minimum of three tests for each layer.

Soil Improvement

The Contractor shall ensure that the poor soil is completely removed and shall carry out trial pits for a depth of 1 meter minimum below the proposed level of the soil improvement for the Client's Representative's inspection.

Material for soil improvement shall be ideally cohesion less and containing less than 10 % non-plastic silt and shall be deposited in layers not exceeding 200 mm in un-compacted thickness and shall be compacted as specified herein. Each layer shall be tested and approved prior to progressing with additional layers. Prior to the commencement of the work the Contractor shall submit a detailed method statement for the soil improvement and a detailed analyses of the soil improvement material.

9.0 DURATION

The contractor shall detail below the duration of the construction of the tanks and provide a complete Project timeline using Microsoft Project

Description	DURATION (Weeks)
Geotechnical Survey & Report	
Site Preparation, Civil Works and Foundation Construction	
1,300KL Storage Tank	
80KL Day Tank	
50KL Buffer Tank	
35KL Sludge Tank	
Welding and Fabrication of Pipe works Between Tanks	
Hydro Testing of all Tanks	
Total (Weeks)	

10.0 PRICE SCHEDULE

ITEM	DESCRIPTION	TANK DESCRIPTION			
		1,300MT	80MT	50MT	35MT
1	Mobilize to site				
2	**GEOTECHNICAL SURVEY** Carry out Geotech survey and report				
2	**TANK FOUNDATION WORKS** 2.1 Excavation, backfilling and Compacting.				
	2.2 Form works, steel works and concrete pouring				
	2.3 Civil works – floor preparation, leak detection sump and well construction				
3	**TANK FLOOR WORKS** 3.1 Floor – Steel works • Preparation and welding of steel plates. • Installation of tank floor plates. • Quality Assurance (all relevant test as per API 650)				
4	**TANK STRAKES** 1.1 Preparation of strakes • Rolling of strakes • Welding of strakes 1.2 Installation of strakes • Quality Assurance (all relevant test as per API 650)				
5	**TANK SHELL ATTACHEMENTS & APPURTENANCES** 5.1 Preparation of all tank shell attachments and appurtenances 5.2 Installation of all tank shell attachments and appurtenances 5.3 Quality Assurance (all relevant test as per API 650)				
6	**ROOFING** 6.1 Preparation of Tank Roof plates and structure 6.2 Installation of Tank Roof 6.3 Quality Assurance (all relevant test as per API 650)				
7	**SAFETY STAIRWAY AND RAILINGS** 7.1 Preparation of safety stairway and railings 7.2 Installation of safety stairway and railings				
8	**PAINTING WORKS** 8.1 External surface preparation and tank appurtenances 8.2 Internal Surface preparation and tank appurtenances 8.3 Internal Painting (lining) and tank appurtenances 8.4 External painting of tank surface and tank appurtenances 8.5 Painting of safety stairway and railings				
9	**TESTING** 9.1 Tank Hydro testing. Quality Assurance (all relevant test as per API 650)				
10	**PIPE INSTALLATION** Supply of Piping's, valves, flanges, bolts and nuts from Discharge Bay to Storage tanks, buffer tanks, day tanks etc as per specification				
12	**METERS/CONTROL WIRING** Flow Meters, Level Gauges/meters, Control Wiring and Control Panel as per specification				
13	**HEATERS** Supply and Installation of Storage Tank Heater, Buffet tanks heater and Day tank heater as per specification				
14	**INSULATION** Supply and Installation of Insulation for Buffer Tank and Day Tank as per specification				
	LABOUR COST				

Note: Please note that a 15% Non Resident WithHolding tax will be charge for any On-shore labour services provided by an overseas contractor.

Submission of Tender

Two (2) hard copies of the tender bids in sealed envelope shall be deposited in the tender box located at the Supply Chain Office at the FEA Head Office, 2 Marlow Street, Suva, Fiji.

Courier charges for delivery of Tender Document must be paid by the bidders.

This tender closes at 4:00pm, on Wednesday 25th of February, 2015.

Each tender shall be sealed in an envelope with:

The envelope bearing only the following marking:

Tender- MR 12/2015 – Design, Fabrication, Supply and Installation of a 1,300MT HFO Fuel Tank at the FEA's Kinoya Power Station

The Secretary, Tender Committee
Fiji Electricity Authority

Supply Chain Office

Private Mail Bag, Suva

It must also indicate the name and address of the tenderer on the reverse of the envelope.

All late tenders, unmarked Envelopes and envelopes without bidder's name and address on the reverse of the envelope.

For further information or clarification please contact our Supply Chain Office on phone **(+679) 3224360 or (+679) 9991587.**