FUEL STORAGE AND RETICULATION SYSTEMS

INTRODUCTION

- The design of a fuel system is of critical importance:
  - Ensures safe storage and handling
  - Minimises disruptions to production
  - Minimises operating and maintenance costs
  - Maximises efficiency and minimises emissions

Safety and Legal Compliance

- Installations up to 200m³ (total) fall under SANS 10131:2004
- Installations above 200m³ to SANS 10089-1:2008
- Underground to SANS 10089-3
- Electrical to SANS 10089-2:2007
- Local bylaws
- OHSA
- Environmental Legislation (APPA, Etc)

SANS 10131 & 10089

- South African National Standards/Codes of Practice that set out requirements for fuel installations for Classes of fuel:
  - Class I A, B & C : Low flashpoint (<35°C)
    - Petrol, Solvents, LO2
  - Class II : Flashpoint >=38°C, <60.5°C
    - Paraffin, LO10
  - Class IIIA : Flashpoint >=60.5°C, <93°C
    - FO150, LSO
  - Class IIIB : Flashpoint >= 93°C
    - Marine Fuels IFO180, IFO350, CTF

SANS Codes (/2)

- Primary concerns of codes are
  - Tank design and location
  - Bund Size and Construction
  - Spacing (tank to: tank, bund, buildings, boundaries)
  - Specifications and layout of piping, valves, fittings and instrumentation
  - Pumps
  - Line and Outflow heaters
  - Operation and maintenance regimes
  - Electrical Equipment: type and installation
  - Fire Safety

Other design Considerations

- SANS sets out minimum requirements
- Local by-laws may specify more stringent standards based on risk in area
- Environmental issues such as sulphur, CO2, VOC's and other emissions, etc
- Health and Safety aspects

Purpose of a Fuel Storage and Reticulation System

- Provide safe and legally compliant means of storing and handling fuel
- Ensure sufficient storage to avoid supply disruptions
- Consistently supply fuel to the burner(s):
  - At the correct viscosity (temperature)
  - At the correct pressure
  - In sufficient volume
  - With minimum impurities

System Design

- Design considerations:
  - Tank Size
  - Location
  - Offloading equipment
  - Pumps
  - Heating
  - Filtration

Tanks

- Should conform to recognised code of practice API650, BS2654, etc
- Be of sufficient volume to ensure no supply disruption
  - Fuel consumption
  - Lead time to delivery
  - Distance from source
  - Available space on premises
  - Provision for "dead stock"
  - Supply risks (strikes, fire, etc)
- Rule of thumb is 10 days useable fuel on site

Fuel heating

- Outflow heater used to raise fuel temperature for pumpable viscosity
- Line heaters used to heat fuel to meet burner supply viscosity requirements
- Steam/Thermal Oil/Electrical heaters used

Fuel Heating

- Heater design critical to reduce carbonisation
- Carbonisation leads to:
  - Blockages
  - Accelerated pump, nozzle and burner component wear
  - Less effective heating

Fuel Heating

- Electric Heaters should:
  - Have a watt density of less than 1.2W/cm²
  - Be fitted with a relief valve
  - Have 2 x temperature controls
  - Have a duty cycle of no more than 70% at normal operating conditions
  - The flow rate through the heaters should be maximised

Fuel Heating

- Formula for calculating heating requirement is:

kW = (M x sh x dT) / (3600 x duty x eff)

m=mass of fuel in kg/hour

sh = specific heat of fuel in kJ/kg.K

dT = temperature rise required

duty = duty cycle of heater (70%)

eff = Thermal efficiency of system (~80%)

Pumps

- Pumps are selected to:
  - Supply fuel at the required pressure to the burner
  - Circulate the fuel (HFO systems)
- Must be suitable for fuel
  - Chemically compatible
  - Temperature rated
  - Pressure Rated

Pumps

- Types of pump:
  - Positive displacement
    - Gear, vane, progressive cavity
    - Good for cold start-up and very viscous fuels
    - Low speed operation best
  - Centrifugal
    - Good for light oils and HFO at temperature
    - Low maintenance, low cost

Pumps

- Size pumps to ensure minimum flow is:
  - Minimum 5 x Maximum offtake from **ring main**
  - Turbulent as possible given ring main size and length
- High flow advantageous for
  - Preventing coking in line heaters
  - Prevention of sludge in piping
  - Even temperature and pressure distribution throughout system

Filtration

- Size for flow rate
  - Open area (rule of thumb = 5 times for light oils, 15-20 for HFO)
- Aperture size
  - Select largest aperture size possible to extend time between cleaning
  - Note: ~150 micron is minimum for HFO at all but very low flow rates

Filtration

- Position filter after line heaters to filter carbon particles out
- Use end point filtration where possible:
  - Lower clean frequency
  - Smaller filter size
- Do not install strainers on the suction side of ring main pumps –cavitation will cause pump and heater damage

Piping and Fittings

- Select piping and fittings based on:
  - Required flow rate – maximise flow velocity
  - Pressure drop over system – long ring mains may require larger bore piping
  - Pressure and temperature rating
- Note: Galvanised piping and fittings are specifically disallowed in fuel installations

Piping

- For HFO installations:
  - Insulate and clad all piping
  - Route piping as close to burner takeoff
  - Design layout to avoid “dead legs” (low or no flow piping lengths)

Valves

- Valves on tank and within bunded area must be "of a fire safe" design and be manufactured from steel or cast steel. Cast iron casings are not permitted.
- Generally good to use ball valves as they are quick acting and provide a "double seal"
- Brass gate valves are not suitable for use in fuel installations

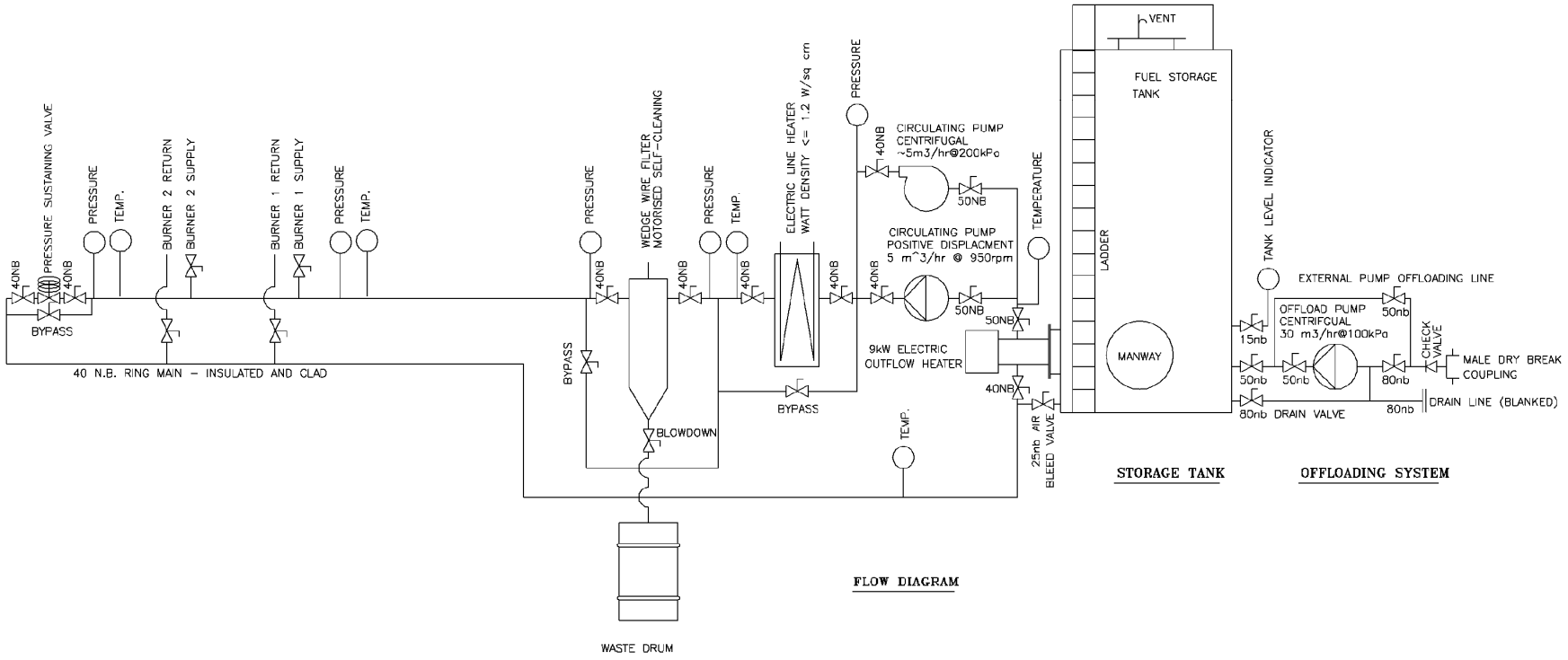
Instrumentation & Indicators

- Pressure and temperature gauges adequate for most installations
- Ensure temperature gauge and thermocouple probes are properly installed.
- Install adequate indication throughout the system
  - Pressure gauges before and after filters
  - Temp. gauges on return line

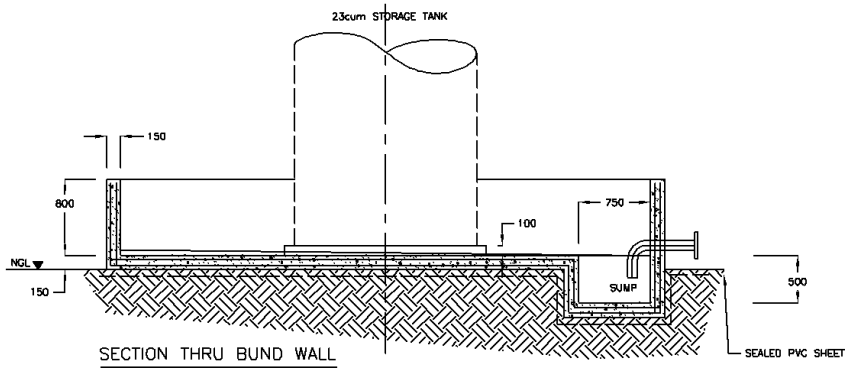
Electrical

- Area within bund and up to bund height is considered Zone 2 (spark-proof) for most fuel oil installations
- Sumps and areas around vent are Zone 1 (flameproof)
- Headspace of tank is Zone 0 (NB for level indicators, etc).

Typical HFO Installation



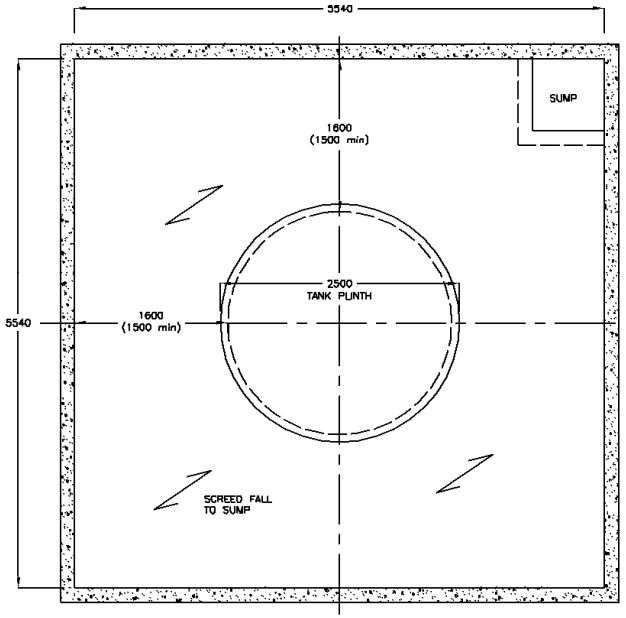
Typical Bund Area



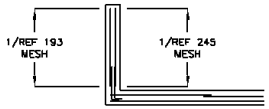
SECTION THRU BUND WALL

NOTES:

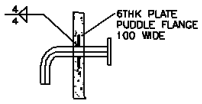
1. A structural engineer should be appointed to ensure that the structure has been built according to the design drawings and to sign the certificate of compliance
2. The engineer must ensure that the site has been levelled and compacted and has a soil bearing pressure capability of at least 100 kN/m^2 in accordance with SABS 1061-1980 cl 5.2.1
3. A sealed PVC plastic sheet should be laid under the slab to prevent any leakage of oil from below the slab and to provide a blinding layer for the concrete slab
4. The concrete should be at least 25 mPa and be well compacted, and have a maximum of 19mm aggregate
5. The bund volume is sized to contain >110% of the storage tank capacity.
6. Reinforcing mesh according to SABS 1024, Ref 193 5,6/5,6 diameter at 200/200 centres, Ref 245 6,3/6,3 diameter at 200/200 centres and be placed as detailed on this drawing.
7. Design of this reinforced concrete structure is according to SABS 0100
8. The wall to slab joint must be clean and scabbled to ensure a good
9. All reinforcing joints to be minimum 150mm overlap
10. Cover should be a minimum of 40mm



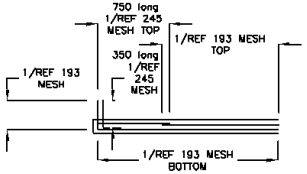
PLAN ON BUND



WALL REINFORCING DETAIL



WALL PENETRATION DETAIL



FLOOR SLAB REINFORCING AND STARTER BARS FOR WALL

REVISIONS:

REFINERS (PTY) LTD.
104 UMHLATUZANA ROAD, DURBAN 465-3103

SUBJECT	CUSTOMER INSTALLATIONS		
DESCRIPTION	TYPICAL 23cum TANK FOUNDATION AND BUND WALL DETAILS		
DATE	15/02/2007	DRAWN CF	SCALE NTS
DRAWING No.	4376	REV	REV 00

THE END