15. APPENDICES

15.1. Emergency Plan

PROCEDURE NUMBER : PR/SFF/SDH/SAF/017

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TITLE
EMERGENCY PLAN SALDANHA OIL JETTY

PURPOSE
The purpose of this emergency procedure is to define the emergency procedure to be followed in case of an emergency on the oil jetty in Saldanha Port, operated by SFF for tanker loading and offloading purposes

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WORKFLOW, RECORDS AND PROCEDURES			
INTERNAL AUDIT			

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1. PURPOSE AND SCOPE

The purpose and scope of this emergency procedure is to define the emergency procedure to be followed in case of an emergency on the oil Jetty in Saldanha Port, operated by SFF for tanker loading and offloading purposes.

The procedure aims to ensure that all possible emergencies during the loading and offloading of crude oil tankers are dealt with in a responsible and correct manner to ensure that there will be no loss of product or harm to people, equipment and the environment.

The requirements for emergency planning contained in the International Safety Guide for Oil Tankers and Terminals (ISGOTT) revision 5 (Chapter 20) was used as a basis for this document.

2. OBJECTIVES

The objective of this document is to establish the procedures to be followed in the event of an emergency, on the oil jetty in Saldanha Port, which is operated by SFF.

3. REFERENCES

NO.	DOC NO.	TITLE
1	ISGOTT (Revision 5)	International Safety Guide for Oil Tankers and Terminals
2		Oil Jetty Risk Assessment

4. DEFINITIONS

4.1. SFF

Strategic Fuel Fund

4.2. TNPA

Transnet National Port Authority of South Africa

4.3. TPT

Transnet Port Terminals

4.4. MPT

Transnet Multipurpose Terminals

4.5. ISGOTT

International Safety Guide for Oil Tankers and Terminals – Revision 5

4.6. Emergency

An emergency is a serious, unexpected, and often dangerous situation requiring immediate action.

4.7. Emergency Plan

An emergency plan is a document containing all procedures necessary for immediate implementation in the event of an emergency.

4.8. Local Emergency

A local emergency is an emergency of minor consequences for life and property that can be dealt with locally, e.g. at the jetty or on-board a tanker, by the available staff (competent persons), with or without assistance. Such an emergency does not normally influence the operations in other parts of the terminal or port.

4.9. Terminal Emergency

A terminal emergency is one that is more complex or of a larger size or scope that requires an emergency plan to be initiated. It influences operations in the whole terminal, or has the potential to do so, may affect more than one tanker and may influence the port environment.

4.10. Major Emergency

A major emergency is one that is similar to a terminal emergency, but is of such a size and scope, and of such serious consequences for life and property, that the whole terminal and the neighbouring port environment is involved, and / or greatly endangered.

4.11. Partial Loss

A partial loss occurs when only part of the facility is out of service as a result of emergency or other circumstances.

4.12. Total Loss

A total loss occurs when the whole facility is out of service due to emergency or other circumstances.

4.13. Competent Person

A competent person is a person who has been adequately trained to undertake the tasks that they are required to perform within their job description and assigned or designated responsibilities. It includes demonstration of the ability to apply knowledge and skills.

4.14. Product Spill

A product spill is a non-continuous discharge of product, as a result of an incident, caused by the malfunction of equipment or human error.

4.15. Incident

An incident is an unplanned event that could or does result in loss to people, property, process or the environment.

4.16. Sabotage

Sabotage is a malicious attempt to damage the facility by means of placing bombs, setting fire to, fire missiles, etc., with the intent to cause damage or disrupt the normal activities and proceedings of the facility.

4.17. Security

Security means SFF Security performing duties at the oil jetty.

TNPA Security is excluded from this definition, as they will operate strictly under the control of TNPA, and will receive notification of emergency and subsequent instructions only from TNPA in the event of an emergency on the oil jetty.

4.18. Assembly Point

An assembly point is a point of assembly for all personnel, visitors and contractors in the event of an emergency.

4.19. OPC

Oil Pollution Control

5. KEYWORDS

Oil jetty = SFF Oil Terminal in Saldanha Port

6. EMERGENCY PLAN

6.1. Potential Emergencies

The following potential emergencies have been identified during loading / off-loading operations at the Oil Jetty:

- Fire or explosion at the oil jetty and on or around the tanker
- Major escape of flammable and / or toxic vapours, gases or chemicals
- Collisions, both ship-shore or ship-ship
- A tanker drifting away or breaking away from the jetty
- Major port incidents involving tankers, tugs, boats, etc.
- Meteorological hazards, such as floods, wind storms, heavy electrical storms, etc.
- Attack, sabotage and threat against tankers or the terminal
- Oil spillages into the harbour or land environment, either from the tanker or the pipeline
- Persons falling into the sea, either from the tanker or from the jetty
- Industrial action

RISK ASSESSMENT

HIRA FORM

AREA:	**SALDANHA TERMINAL**	**TEAM MEMBERS**		
SUB-AREA:	**OIL JETTY**	**ARS Petro**	**SS Dlalisa**	
ACTIVITY/FUNCTION:	**EMERGENCY SCENARIOS**	**CC Ellis**	**JCP Lubbe**	
DATE:	**ANY**	**CA Booysen**	**SM Ross**	

1. What is the hazard? **2. Where is the hazard** **3. How often is it observed?** **4. What activity is taking place?**	**1. What is the risk?** **2. Who can be harmed?** **3. What losses can we have?**	**1. What controls are in place and Are they adequately controlled?** **2. What additional controls can be implemented to control the risk?**	**CONSEQUENCE**	**EXPOSURE**	**PROBABILITY**	**RISK RESULT**
SCENARIO: **Local Emergency – Fire (landside)**	1. Damage to property. 2. Injuries to personnel. 3. Harm to environment	1.Proper PPE 2.Trained personnel to fight fire 3. SFF Emergency procedure/s in place 4. TNPA Emergency procedure in place 5. Fire equipment in place.	7	0.5	6	21
Terminal or Major Emergency: Gas Release or Fire – Landside	1. Total damage of SFF property. 2. Fatalities. 3. Harm to environment 4. Business interruptions.	1.Proper PPE 3.Trained personnel to fight fire 4. SFF Emergency procedure/s in place 5.TNPA Emergency procedure in place	40	0.5	6	120

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1. What is the hazard? 2. Where is the hazard 3. How often is it observed? 4. What activity is taking place?	1. What is the risk? 2. Who can be harmed? 3. What losses can we have?	1. What controls are in place and Are they adequately controlled? 2. What additional controls can be implemented to control the risk?	CONSEQUENCE	EXPOSURE	PROBABILITY	RISK RESULT
	5. Damage of neighbouring companies properties. 6. Other company's business interruptions. 7. Injuries and fatalities to other personnel other than SFF.	6.Assistance from WCDM and SBM 7. Emergency and fire equipment in place such as gas masks, fire equipment etc.				
Fire or Gas Release – Shipside	1. Total damage of SFF property. 2. Fatalities. 3. Harm to environment 4. Business interruptions. 5. Damage of neighbouring companies properties. 6. Other company's business interruptions. 7. Injuries and fatalities to other personnel other than SFF.	1.PTW 2.Proper PPE 3.Trained personnel 4. Risk assessment 5. SFF Emergency procedure/s in place 6.TNPA Emergency procedure in place 7. Ship to be removing immediately. 8. Emergency and fire equipment in place such as gas masks, fire equipment etc. on ship.	100	0.5	6	300
Bomb Threat – Via Telephone	1. Business interruptions. 2. Panic amongst personnel and others. 2. Possible injuries and fatalities when bomb not found and explode. 3. Possible damage to property when bomb not found and explode. 4. Possible harm to environment when bomb not found and explode.	1.Proper PPE 2.Trained SAPS personnel to counter incident 3. SFF Emergency procedure/s in place 4.TNPA Emergency procedure in place 5. SAPS Emergency procedures in place	7	0.5	6	21
Terminal or Major Emergency - Oil Spillage	1. Serious harm to the environment. 2. Public outcry. 3. Damage to SFF reputation.	1.Proper PPE 2.Trained personnel to do clean up/s 3. SFF Emergency procedure/s in place	100	0.5	6	300

1. What is the hazard? 2. Where is the hazard 3. How often is it observed? 4. What activity is taking place?	1. What is the risk? 2. Who can be harmed? 3. What losses can we have?	1. What controls are in place and Are they adequately controlled? 2. What additional controls can be implemented to control the risk?	CONSEQUENCE	EXPOSURE	PROBABILITY	RISK RESULT
	4. Possible cancellation of operating license by TNPA. 5. Fines issued by SAMSA and other authorities.	4.TNPA Emergency procedure in place (Spill Tech procedures in place)				
Local Emergency – Minor Spill on Jetty	1. Possible pollution of sea life. 2. Possible injuries when personnel slip and fall in oil spillage. 3. Possible gas inhalation coming from the crude oil.	1.Proper PPE 2.Trained personnel to do clean ups 3. SFF Emergency procedure/s in place 4.TNPA Emergency procedure in place	3	1	6	18
Industrial Action	1. Possible damage to SFF property. 2. Possible fatalities to people. 3. Possible injuries to personnel and others 3. Harm to environment. 3. Business interruptions. 5. Damage of neighbouring companies properties. 6. Other company's business interruptions.	1. SFF Emergency procedure/s in place 2. TNPA Emergency procedure in place 3. SAPS Emergency procedures in place	3	0.5	6	9
Collisions: Ship-Shore and Ship-Ship	1. Major damage to property. 2. Possible business interruptions. 3. Major explosion and fires. 4. Major gas releases. 5. Major oil spillages. 6. Extreme harm to the environment.	1. SFF Emergency procedure/s in place 2.TNPA Emergency procedure in place 3. Assistance needed from Marine experts	100	0.5	6	300
Meteorological Emergencies	1. Major damage to property 2. Possible injuries and fatalities. 3. Major damage to the environment.	1. SFF Emergency procedure/s in place 2. TNPA Emergency procedure in place 3. Possible abandoning of area for the	100	0.5	6	300

1. What is the hazard? **2. Where is the hazard** **3. How often is it observed?** **4. What activity is taking place?**	**1. What is the risk?** **2. Who can be harmed?** **3. What losses can we have?**	**1. What controls are in place and Are they adequately controlled?** **2. What additional controls can be implemented to control the risk?**	**CONSEQUENCE**	**EXPOSURE**	**PROBABILITY**	**RISK RESULT**
	4. Possible business interruptions 5. Fire caused by lightning	safety of personnel				
Persons falling into the sea, either from the tanker or from the jetty	1. Possible injuries. 2. Drowning if not wearing life jacket/s	1. TNPA and SFF emergency procedure caters that personnel must wear their life jackets when 2 m from the edge of the jetty. 2. Enforce disciplinary action for the safety of persons own safety if needed.	3	0.5	6	9

6.2. Specific Actions to be taken by those on location to raise alarms

Any person who becomes aware of an emergency situation will raise the alarm.

Where possible (Land-side), the appropriate alarm for the situation will be raised by the person becoming aware of the emergency situation.

If personnel on-board the ships become aware of an emergency situation, radio contact will be used to make all appropriate persons aware of the emergency situation. Persons with access to the alarm system will then activate the appropriate alarm.

If an emergency occurs on-board, the ship's alarm will be sounded in a long, continuous blast.

6.3. Climate

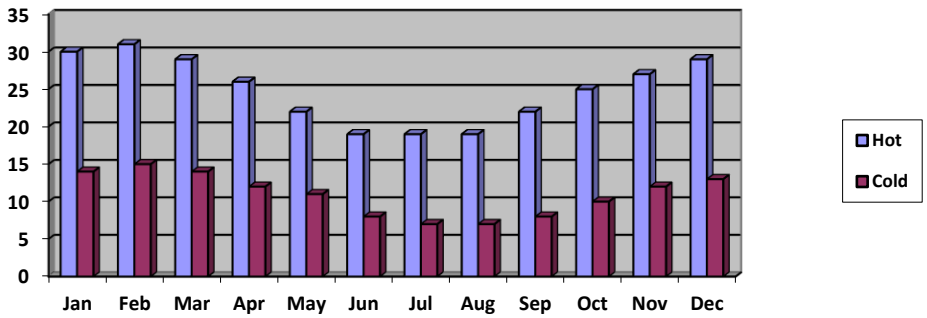
The port operates under open sea conditions. Wind and swell are always factors to be taken into consideration.

Winter months are May, June July and August. The wind blows predominantly from a North-Easterly direction, with rain at times.

Summer months are November, December, January and February. The wind is predominantly from a South Easterly direction in the mornings, swing to a South Westerly direction in the afternoons.

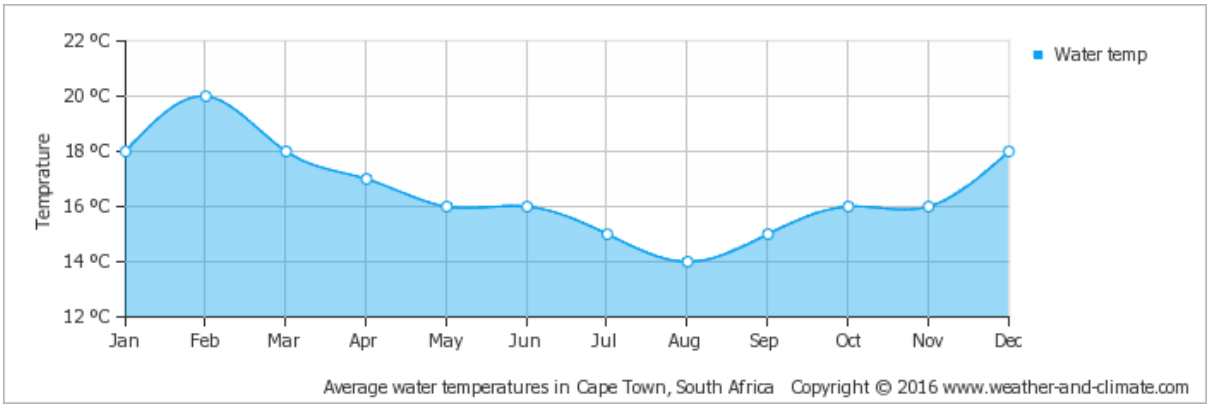
The swells in winter can be very heavy. At high tide the swell can be >7m at the entrance channel. The result is that breaking lines can be experienced when ships are berthed at the jetty. Ships may have to be taken off berth and go to anchor, either in the bay or outside at sea.

Mean Maximum and Minimum Temperatures per Month

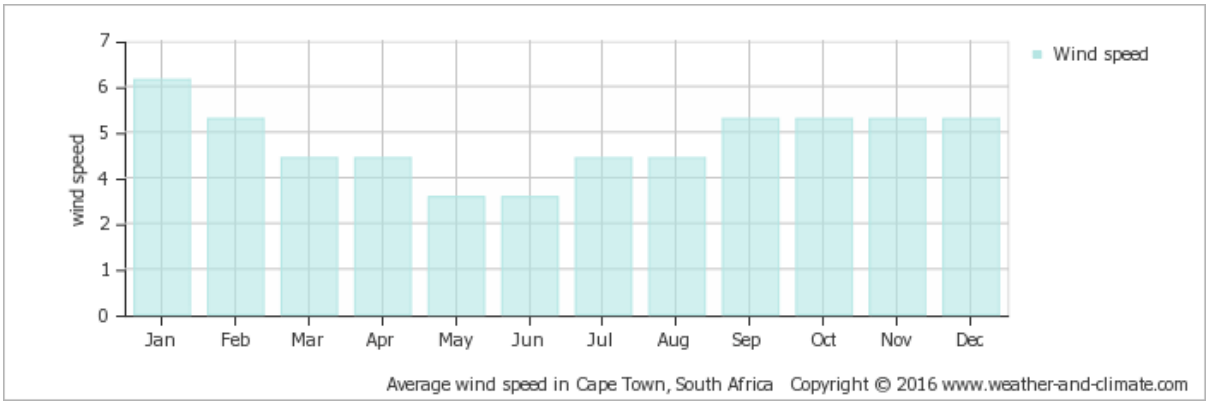


Maximum temperatures may exceed 40°C, while minimum temperatures may be below freezing.

Average Water Temperature per Month



Average Wind Speed per Month (m/s)



6.4. Joint Operations Centre

In the case of terminal or major emergencies, a Joint Operational Centre (JOC) will be established under the control of TNPA Emergency Services.

The JOC will be established either in the TNPA Bayview building, or at the TNPA Fire Department. TNPA Emergency Services will inform about the location and contact telephone number for the duration of any emergencies.

Potential personnel manning the JOC include, as required:

- Representatives from TNPA (including management)

  The Harbour Master and Vessel Control Officer will be part of this management team and the commander at the incident scene must provide last mentioned with the following information:

- Nature and extend of the emergency.
- Nature of the vessel/s involved and locations thereof.
- Nature of assistance required or not.
- According to this information the Harbour Master and Vessel Control Officer will make their final decision whether to remove the vessel/s from the key side or not.
- Details related to the cargo in/on ship.

- Representatives from SFF (including management)
- Representatives from applicable fire response teams:

  TNPA
  SFF
  West Coast District Municipality
  SA Navy Fire Department Saldanha Naval Base
  SA Air force Fire department Langebaanweg

- Representatives from the South African Police Services
- Representatives from the Saldanha Municipal Traffic Department
- A responsible crew member form the ship
- An information officer
- Representatives from the SAPS Water Wing

6.5. Incident Command Centre

If required, an incident command centre may be established in the security building at the entrance to the Oil Jetty to establish an on-site command centre for emergency services. If this is deemed to be too dangerous, the incident command centre may be established at OPC

The Incident Command Centre will be manned by:

TNPA Emergency Services
SFF Emergency Services
Representatives from other emergency services, as applicable

6.6. Communication Systems

6.6.1. Alarms

- Oil Jetty Fire & explosion alarm:

  SFF Alarm: 6 alarm blasts of 3 seconds each
  TNPA Alarm: To be confirmed
  Ships Alarm: 1 long blast: 30 seconds

- Other emergencies:

  SFF Alarm: 2 X 15 second alarm blasts. (Gas alarm).
  1 long blast: 30 seconds (Evacuation).
  TNPA Alarm: To be confirmed

6.6.2. Telephone Numbers

SFF	
SFF Control Centre	022 703 6200
SFF Security	022 703 6200
SFF Management	022 703 6202
Ambulance: Paramedic Services	0861 22 55 99
TNPA	
Fire Department	022 703 4338 073 185 7205
Clinic	0703 4486
Environmental Department	022 703 5450 071 850 3477
Risk Management	022 703 5450 071 850 3477
Port Control	022 703 5310 022 714 1726
Security	022 703 4326/7 073 197 7730
Harbour Master	022 703 5481
TPT	022 703 4457
MPT (SHEQ Department)	022 703 4238
Outside Emergency Numbers	
Hospital: Provincial	022 709 7200
Hospital: Private	022 719 1030

Ambulance: ER 24	010 205 314 509
Ambulance Service: ER 24 (Direct – Shane Fascio: West Metro Base Manager)	083 232 7410
West Coast District Municipality Fire Department	022 713 3700
SAPS Saldanha	022 714 8334

6.6.3. Radio Communication

- Emergency channel: Ship / Shore: UHF/VHF Channel 12

  SFF stop operations command to Ship Master: STOP CARGO, repeated 3 times

- TNPA Radio Communications

- SFF Radio Communications: UHF/VHF Channel 1

6.6.4. Communication Discipline

Each entity will use its own designated radio channel for communication.

In case of an emergency, SFF will be responsible to keep a communication log for all communications on Channel 1.

Once a JOC has been established, a TNPA designated person will keep a communication log of all applicable communications.

The primary communication responsibility with all outside emergency services and other areas of the port will be the responsibility of TNPA.

Media communication will only take place via the TNPA information officer, or other TNPA designated person.

6.6.5. Rescue Launches

Rescue launches will be launched as required by TNPA Emergency Services, including launches from OPC.

6.6.6. Initial Action to Contain and overcome the Incident

PLEASE NOTE THAT TNPA FIRE DEPARTMENT MUST BE NOTIFIED OF ALL INCIDENTS.

SITUATION UNDER CONTROL OR THE END OF THE EMERGENCY SITUATION MAY ONLY BE DECLARED BY SFF TERMINAL MANAGER – FOR THE OIL JETTY PART AND THE PORT HARBOUR / CAPTAIN TO DECLARE THE ENTIRE JETTY SAFE.

6.6.7. Local Emergencies - General

- The person becoming aware of the incident will assess the situation
- If possible, a competent person will take action to contain and control the situation
- If successful, notify TNPA Emergency Services and initiate the FSS Incident Reporting procedure
- If not successful or possible, the incident is escalated to a terminal emergency – sound the appropriate alarm and notify the SFF Control Centre
- Follow instructions for terminal and major emergencies

6.6.8. Local Emergency – Fire (landside)

- Sound the fire alarm
- Establish the magnitude and the wind direction
- Notify:

  TNPA Emergency Services
  Loading Master
  SFF Control Centre
  SFF Security
  SFF Management

- If a competent fire fighter is available, an attempt can be made to put out the fire with a fire extinguisher
- If it is not possible, the incident is escalated to a terminal emergency and the TNPA fire department will take control of the situation

6.6.9. Terminal or Major Emergency: Gas Release or Fire – Landside

- Sound the appropriate alarm
- Start evacuation of all personnel
- Notify:

  TNPA Emergency Services
  SFF Control Centre
  SFF Security
  SFF Management

- Primary response: TNPA Fire Department who will notify other response units if needed
- SFF Fire Department on standby at OPC, waiting for instructions from TNPA Fire Department
- TNPA Fire Department remains in control of the situation until the situation is declared over

6.6.10. Fire or Gas Release – Shipside

- Ships will sound a long, continuous alarm
- Evacuation
- Loading Master: Quick disengage of loading arms and stop operations
- Notify:

  TNPA Emergency Services
  SFF Control Centre
  SFF Security
  SFF Client

- Ship Master to remain in control of the emergency on board
- Follow all instructions issued by the Ship Master

6.6.11. Evacuation

See attached evacuation map

During an evacuation of the jetty all personnel will move to a safe assembly point, depending on the wind direction (assembly points at OV2 – outside security gate Langebaan side, at the berthing crew offices- outside security gate Saldanha side, and at Caisson 25 at the far end of the jetty, from where personnel will be picked up by rescue boats)

6.6.12. Bomb Threat – Via Telephone

- Person taking call will follow procedure to obtain as much information as possible from person making the threat
- As soon as it is appropriate, sound the evacuation alarm (continuous 30 second)
- Notify:

  TNPA Emergency Services

SFF Control Centre
SFF Security
SFF Management

- Stop operations and disengage loading arms

6.6.13. Terminal or Major Emergency - Oil Spillage

- Stop loading / off-loading operations
- Notify :

  TNPA Emergency Services
  SFF Control Centre

- Situation will be controlled by the Pollution Officer
- TNPA will notify appropriate emergency services

6.6.14. Local Emergency – Minor Spill on Jetty

- Establish:

  Location

  Magnitude
  Product
  Danger of fire
  Actual or potential injuries
  Possibility of environmental pollution

- Competent person to clean up spillage using provided spill clean-up kit on jetty
- Report incident to:

  TNPA Emergency Services
  SFF Control Centre

- Start normal SFF incident reporting procedure

6.6.15. Industrial Action

- Inform:

  TNPA Emergency Services
  SFF Security Department
  SFF Control Centre
  SFF Emergency Controller

SFF Shift Supervisor
SAPS Saldanha
Loading Master

- Await instructions from SFF Shift Supervisor

6.6.16. Persons falling into the sea, either from the tanker or from the jetty

- Inform:

  TNPA Emergency services
  SFF Control Centre

- Fall from tanker – seaside: Ship Master in control, may request assistance from TNPA Emergency Services

- Fall from jetty: Assist using life buoys which are available on all accessible caissons

- If necessary, direct rescue crew towards the person in distress so that the person can be rescued.

- Report the incident using the normal incident reporting procedure (SFF)

6.6.17. Collisions: Ship-Shore and Ship-Ship

- Notify:

  TNPA Emergency Services
  SFF Control Centre

- If the tanker being loaded or off-loaded is involved, stop operations and decouple loading arms

- TNPA Emergency Services will take further control of the situation

6.6.18. Tanker Drifting Away or Breaking Away from the Jetty

- Notify:

  TNPA Emergency Services
  SFF Control Centre

- Stop loading / off-loading operations immediately and disengage loading arms using quick release

- TNPA Emergency Services will take further control of the situation

6.6.19. Meteorological Emergencies

- Possible scenarios:

  Strong wind
  Wind speed less than 5km/hr (loading operations only)
  Heavy electrical storm
  High swell (more than 2m)

- Stop loading / off-loading operations

- Notify:

  TNPA Emergency Services
  SFF Control Centre
  Client

- Resume operations when weather conditions permit

- With all emergency situations SFF Association will issue clearly identifiable, high visible vest with wording "EMERGENCY TEAM MEMBER" to emergency crews.

6.6.20. Injuries during emergencies

TNPA personnel:

- TNPA first aiders will pay attention to TNPA personnel who suffers from a minor injury, on incident scene and refer them to their clinic, on site if necessary.

- In the event of a serious injury they will inform their Central Control Room who will request an ambulance for assistance.

- In the event of a fatality, they will notify local SAPS and cordon off the area for investigation by SAPS.

SFF Personnel:

- SFF first aiders will pay attention to SFF personnel who suffers from a minor injury, on incident scene and take injured to a hospital, if necessary.

- In the event of a serious injury they will inform their Central Control Room who will request an ambulance from "South African Paramedic Services" for assistance.

- In the event of a fatality, they will notify local SAPS and cordon off the area for investigation by SAPS.

7. PROCEDURES FOR MOBILIZING THE RESOURCES OF TNPA AND SFF AS REQUIRED BY THE INCIDENT

7.1. Evacuation for Oil Jetty in Case of Emergencies

7.1.1. TNPA Flowchart – Ship Fires

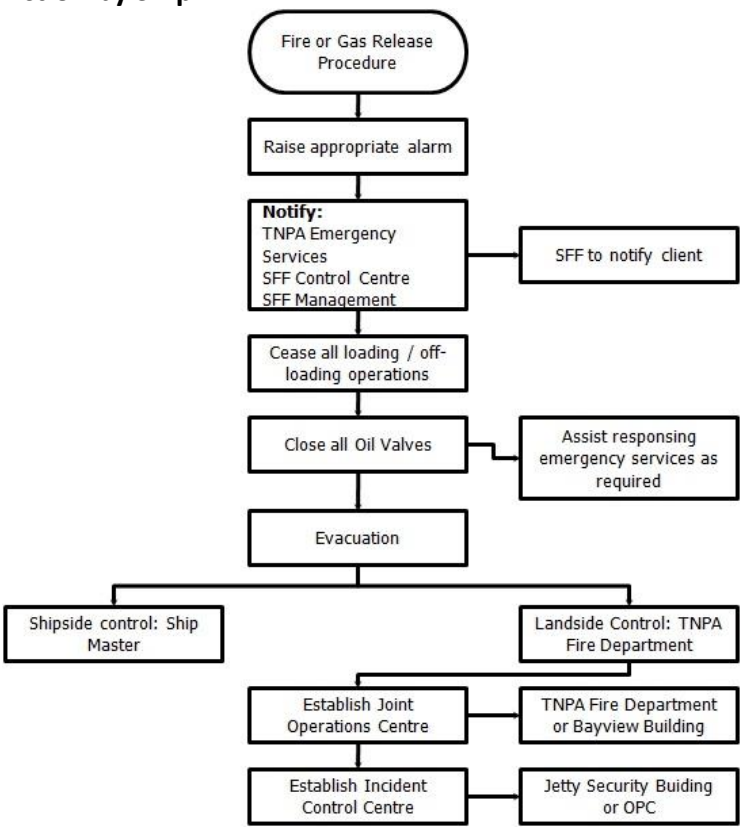
NPA must liaise with the client / vessel and take charge of the situation and hand over to the local authority upon their arrival

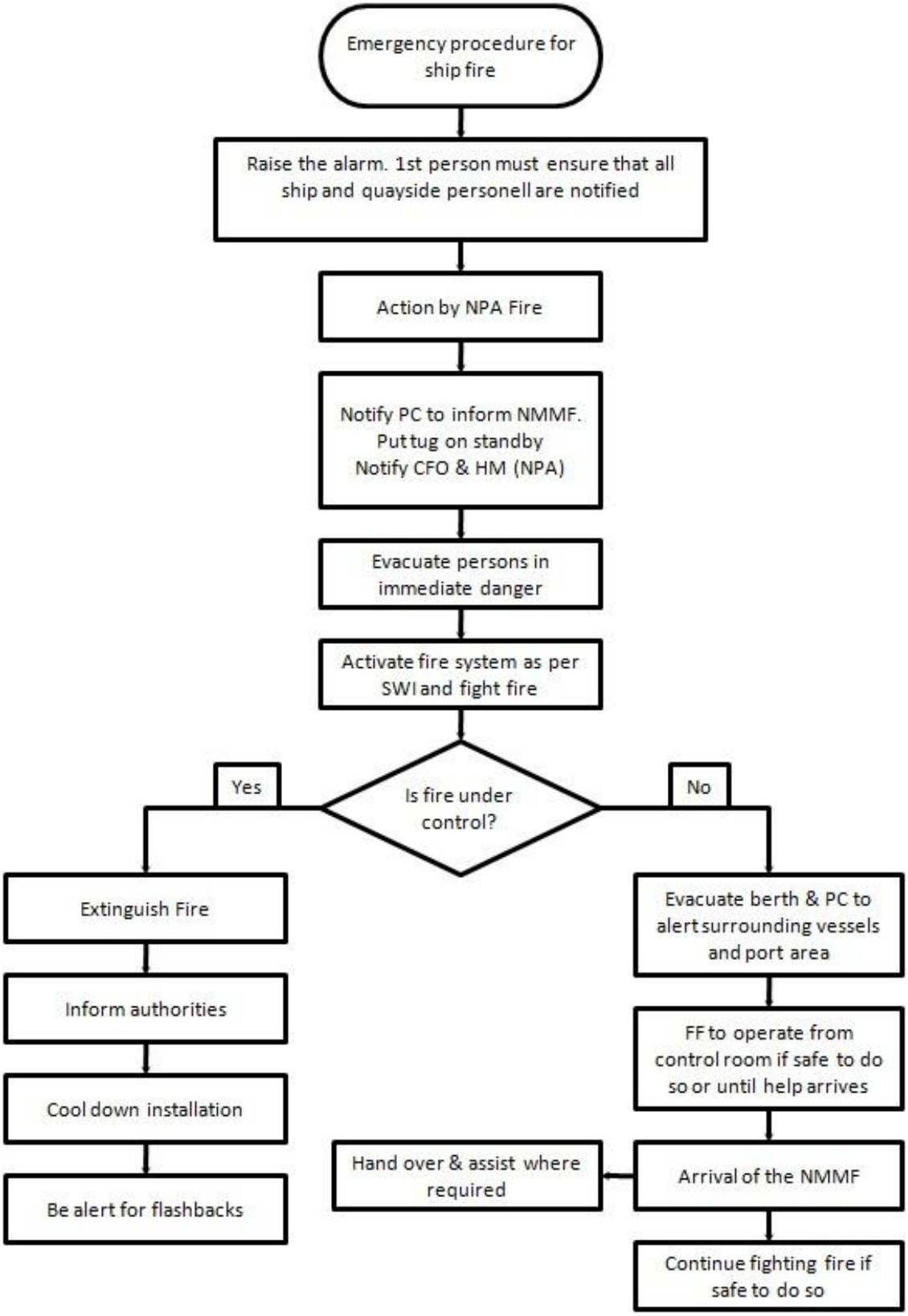
FF = Fire Fighter PC = Port Control SWI = Safe Working Instruction

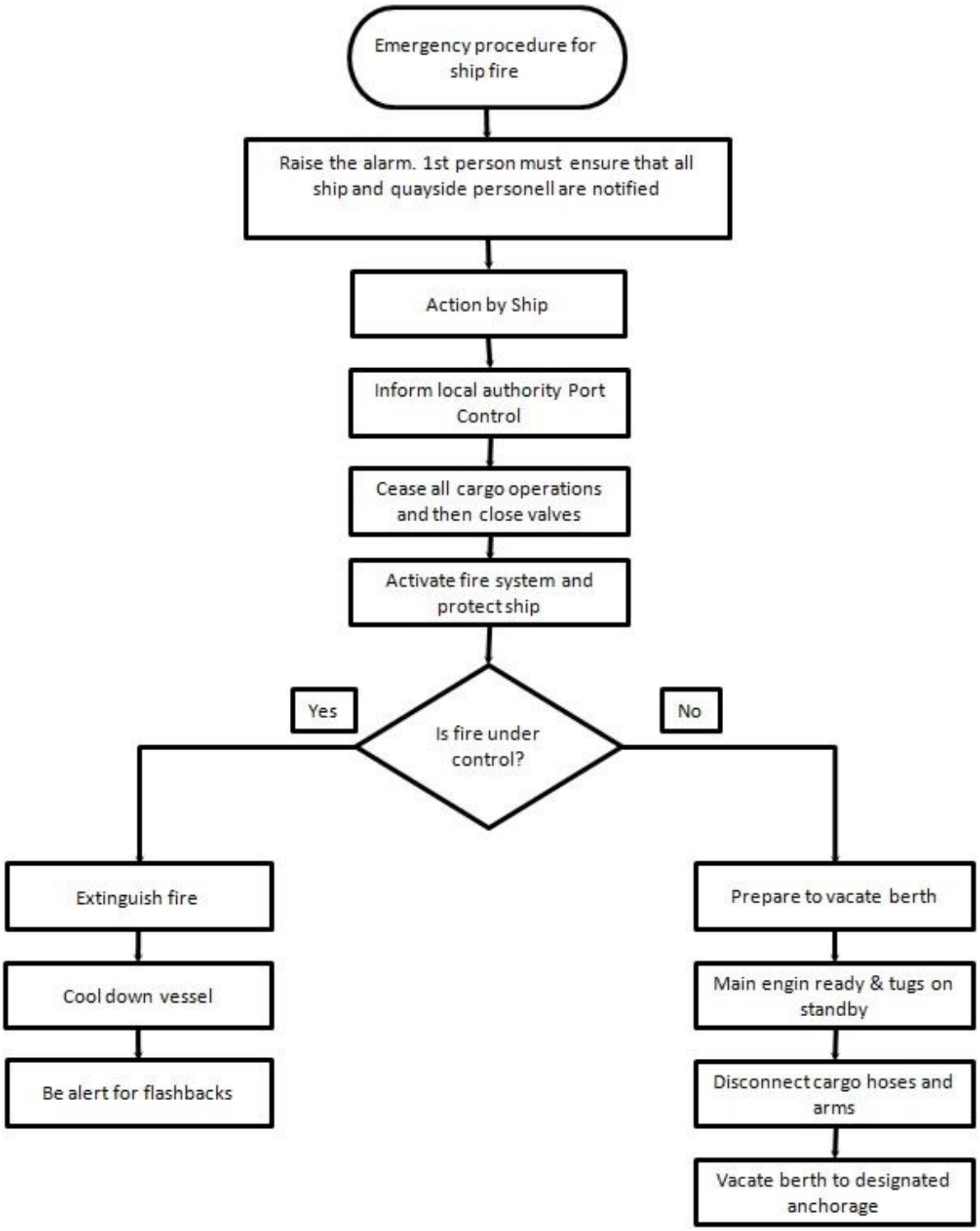
CFO = Chief Fire Officer HM = Harbour Master

7.1.2. Action by NPA Fire Department

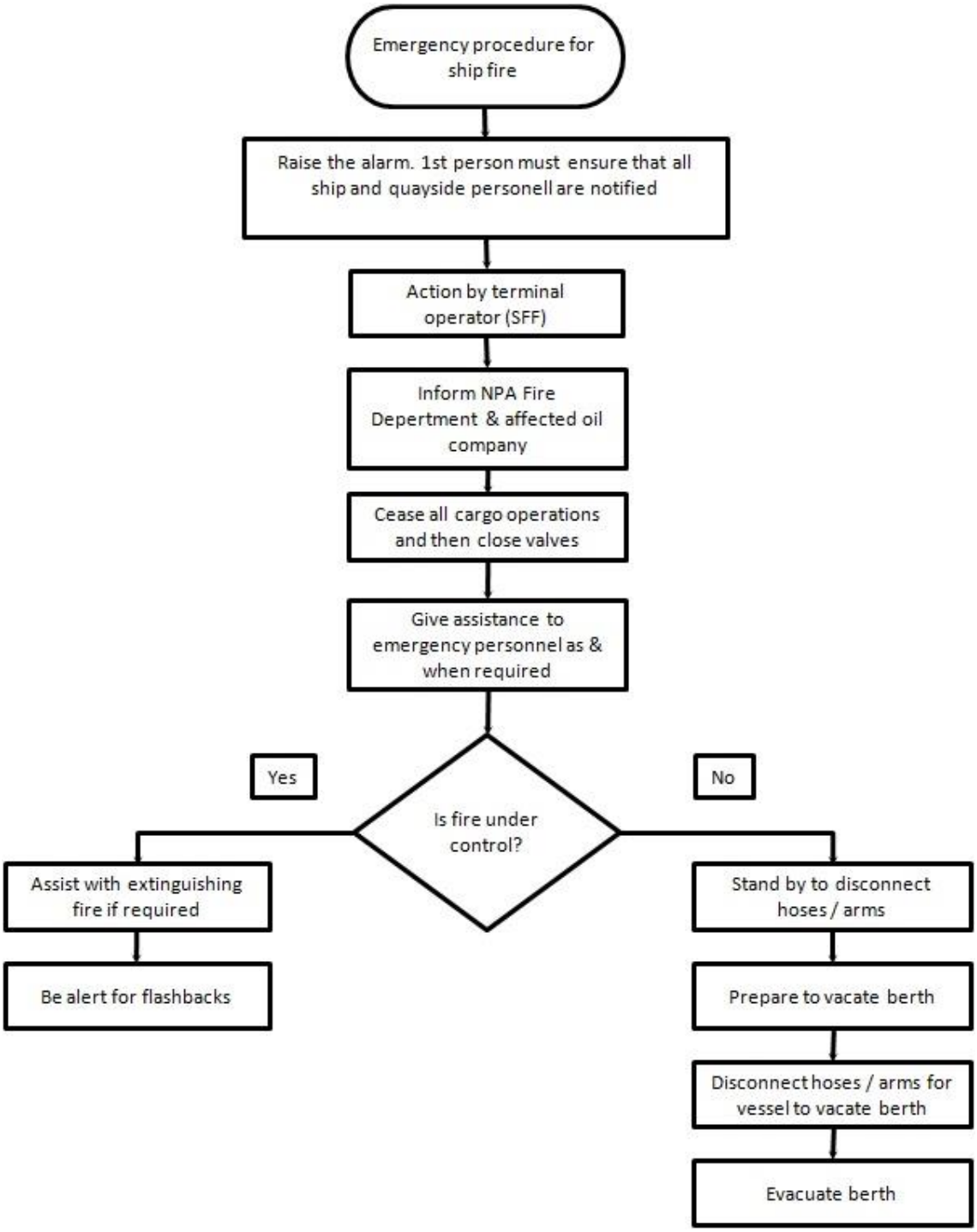
7.1.3. Action by Ship




Emergency procedure for ship fire
Raise the alarm. 1st person must ensure that all ship and quayside personell are notified
Action by NPA Fire
Notify PC to inform NMMF. Put tug on standby Notify CFO & HM (NPA)
Evacuate persons in immediate danger
Activate fire system as per SWI and fight fire
Is fire under control?
Yes
No
Extinguish Fire
Inform authorities
Cool down installation
Be alert for flashbacks
Evacuate berth & PC to alert surrounding vessels and port area
FF to operate from control room if safe to do so or until help arrives
Arrival of the NMMF
Hand over & assist where required
Continue fighting fire if safe to do so


Emergency procedure for ship fire
Raise the alarm. 1st person must ensure that all ship and quayside personell are notified
Action by Ship
Inform local authority Port Control
Cease all cargo operations and then close valves
Activate fire system and protect ship
Is fire under control?
Yes
No
Extinguish fire
Cool down vessel
Be alert for flashbacks
Prepare to vacate berth
Main engin ready & tugs on standby
Disconnect cargo hoses and arms
Vacate berth to designated anchorage

7.1.4. Action by Terminal Operator (SFF)



7.2. Control Points, Standby Points and Assembly Points

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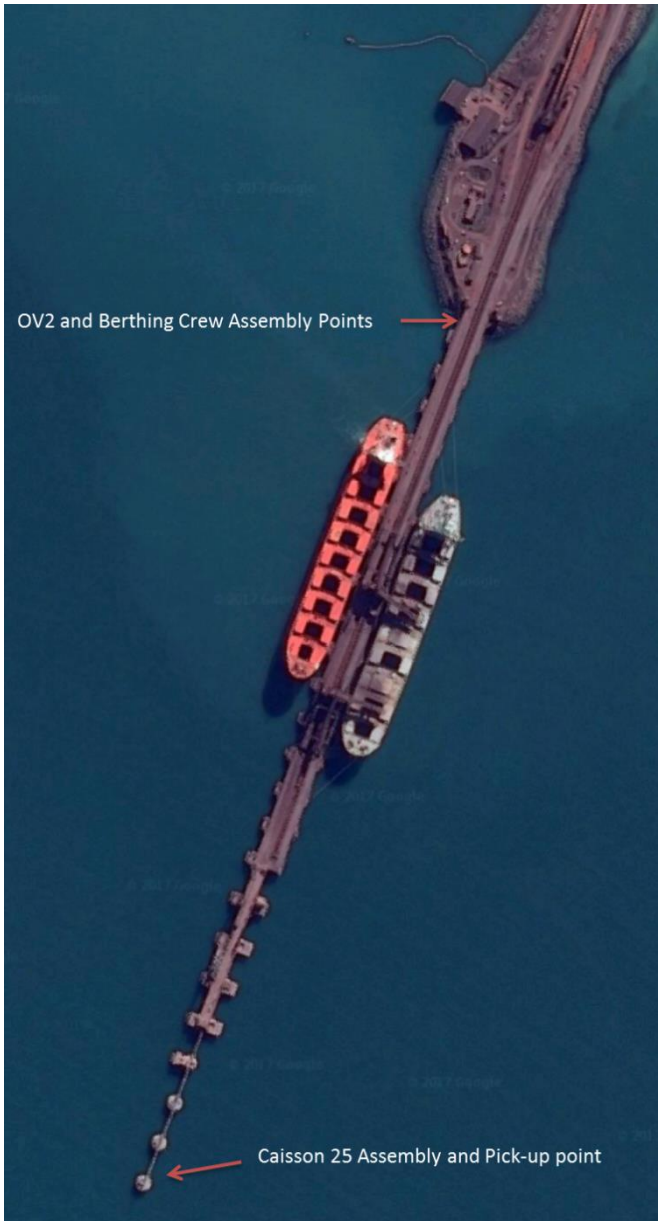
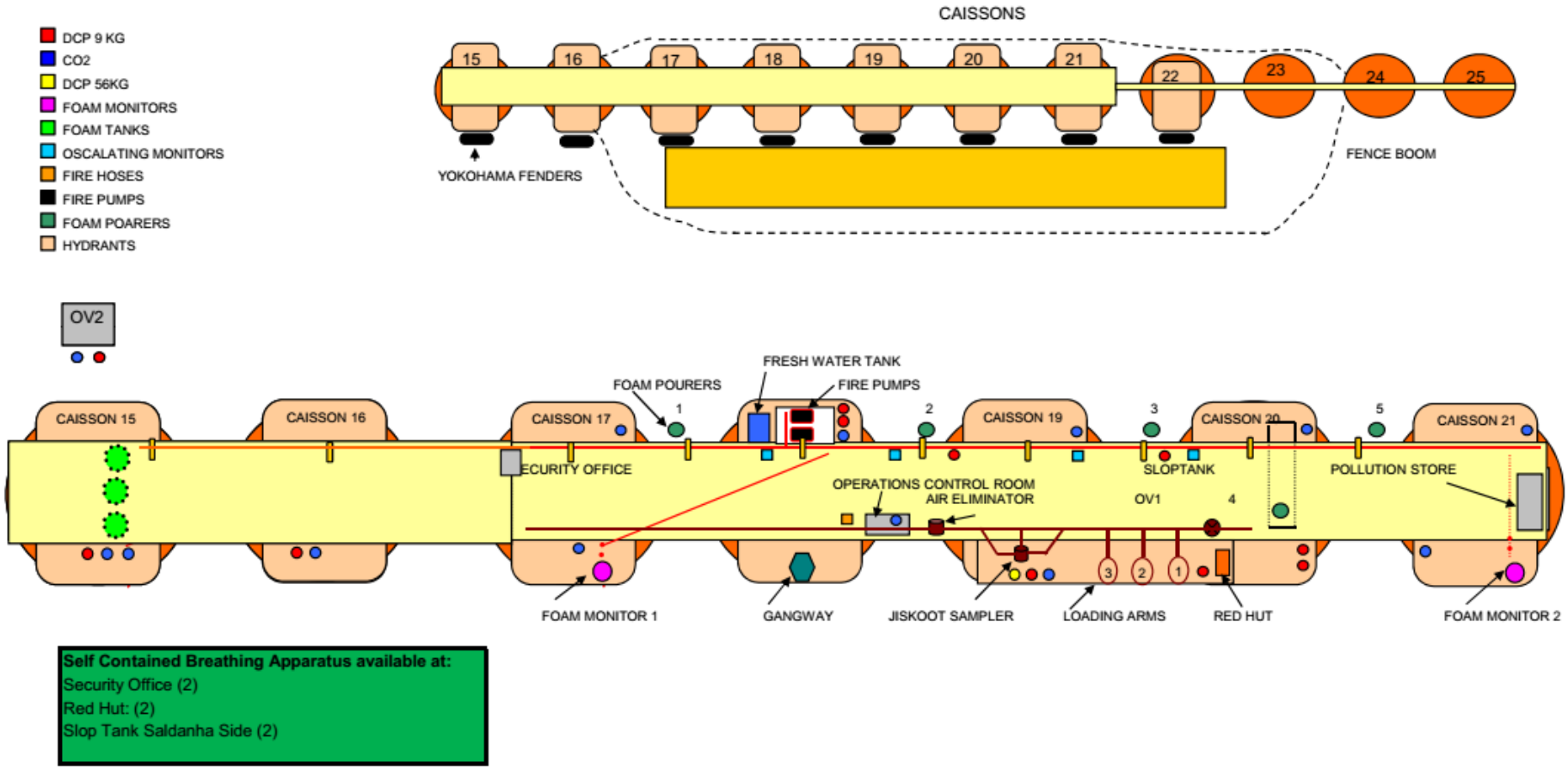


The decision of which assembly point to be used in case of an emergency depends on the type of emergency and the wind direction. TNPA Emergency Services will launch rescue craft when the evacuation alarm is sounded, unless all personnel are accounted for at the OV2 and Berthing Crew Assembly Points.

7.3. Jetty Lay-out and Emergency Equipment



8. MATERIAL SAFETY DATA SHEETS (MSDS)

8.1. Crude Oil

Material safety data sheets for crude oil is available on-board the tanker for each batch of oil.

For loading purposes, SFF will provide the necessary MSDS for the batch to be loaded.

JOINT TRAINING AND EMERGENCY DRILL ACTIVITIES:

SFF Association and TNPA Departments will do emergency drills twice a year. These drill and training activities will follow with discussions to improve the quality of mentioned drills and to determine the "short falls" of each entity.

The following service providers may be invited to take part in the drill:

- SBM Saldanha bay Municipal Fire Services.
- WCDM West Coast District Municipal Fire Services.
- SAPS South African Police Services.
- SADF South African Defence Force - (Fire Services)
- SA NAVY Fire Services
- Spill Tech Oil Pollution Control Services
- Local Hospitals
- SAMSA
- South African Paramedic Services.
- Namakwa Sands

NAME LIST OF KEY ROLE PLAYERS WITH THEIR ALTERNATES

Emergency Controllers	Operations	Mechanical	Mech-Assistants	Electrical	Elec-Assistants	Safety & Security	Warehouse
STRAUSS D		LOVE B	HAUZAMER J	TSIU TW	CLOETE CP	ROSS S	SWARTZ A
C BOOYSEN	CLOETE D	CUPIDO E	BOTHA WJ	MASUPA TF	SIKADI S	PETRO A	AC WHITE
MSHUDULU K	DLADLISA S	ELLIS C	ARLOW C		GROTESQUE F	LUBBE J	KAPTEIN F

NAME LIST DURING AND AFTER OFFICE HOURS – EMERGENCY PERSONNEL – SFF WHO MUST BE CALLED FOR AN EMERGENCY

According to current weeks standby list - (Starting Wednesday morning 08:00am till Wednesday morning the following week 08:00am)

Name	Designation	Office Hours	After Hours
K Mshudulu	Emergency Controller	022 703 6233	071 328 9673
DJ Strauss	Emergency Controller	022 703 6217	078 829 3909
CA Booysen	Emergency Controller	022 703 6218	082 978 6487
DHP Cloete	Shift Supervisor	022 703 6205	082 870 8924
SS Dlalisa	Shift Supervisor	022 703 6215	083 531 8619
B Love	Mechanical Fitter	022 703 6235	083 370 7257
EB Cupido	Mechanical Fitter	022 703 6235	073 439 2273
CC Ellis	Mechanical Supervisor	022 703 6218	082 895 7930
J Hauzamer	Mechanical Assistant	022 703 6235	078 342 0909
C Arlow	Mechanical Assistant	022 703 6235	083 661 7555
TW Tsiu	Electrician	022 703 6213	082 685 4956
TF Masupa	Electrician	022 703 6213	073 541 1605
C Cloete	Electrical Assistants	022 703 6213	083 491 2480
S Sikade	Electrical Assistants	022 703 6213	083 967 1830
F Grotesque	Electrical Assistants	022 703 6213	073 510 8414
S Ross	Fire, Safety & Security	022 703 6211	082 707 6332
ARS Petro	Fire, Safety & Security	022 703 6214	072 044 5766
JCP Lubbe	Fire, Safety & Security	022 703 6207	083 461 4210
F Kaptein	Warehouse	022 703 6212	073 200 8956
A Swartz	Warehouse	022 703 6208	073 577 1942
AC White	Warehouse	022 703 6219	072 901 2687

7.1.4 Action by Terminal Operator (SFF)

- Person discovering the emergency immediately report to SFF Operations Control Room.

- Operations control Room reports to Terminal Manager who will activate the JOC.
- Security Department will activate call out procedure on the request of the Emergency Controller.
- During Day time:
    - Fire / Safety Officer will establish a Fire Team and depart to the Oil Jetty.
    - Electrical and Mechanical Departments will send representatives down to the Oil Jetty to isolate Slop Tank and Maintenance to monitor Fire Pumps.
    - Fire / Safety Officer and Fire team will stop at OPC and be on Standby for TNPA Fire Services.
    - Operator at the Oil Jetty will activate the needed emergency alarm.
    - Operator at Oil Jetty will stop any activity and close any valves that need to be closed.
    - Evacuate personnel if needed
    - Operator will start and monitor the Fire Pumps and begin with firefighting in the event of a small fire otherwise wait for assistance.
    - Operations, Electrical Security Departments will do the necessary at the Terminal.
    - Fire / Safety Officer will respond to incident scene and assist TNPA, on their request, until incident is under control.
    - SFF Emergency Controller will declare end of the incident at the Oil Jetty
- After Hours:
    - Person discovering the emergency immediately report to SFF Operations Control Room.
    - Operations control Room reports to Emergency Controller who will activate the JOC if needed.
    - Security Department will activate call out procedure on the request of the Emergency Controller.
    - Operator at the Oil Jetty will activate the needed emergency alarm.

- Operator at Oil Jetty will stop any activity and close any valves that need to be closed.
- Evacuate personnel if needed
- Operator will start and monitor the Fire Pumps and begin with firefighting in the event of a small fire otherwise wait for assistance.
- Operations and Security Departments will do the necessary at the Terminal.
- Fire / Safety Officer will respond to incident scene and assist TNPA, on their request, until incident is under control.

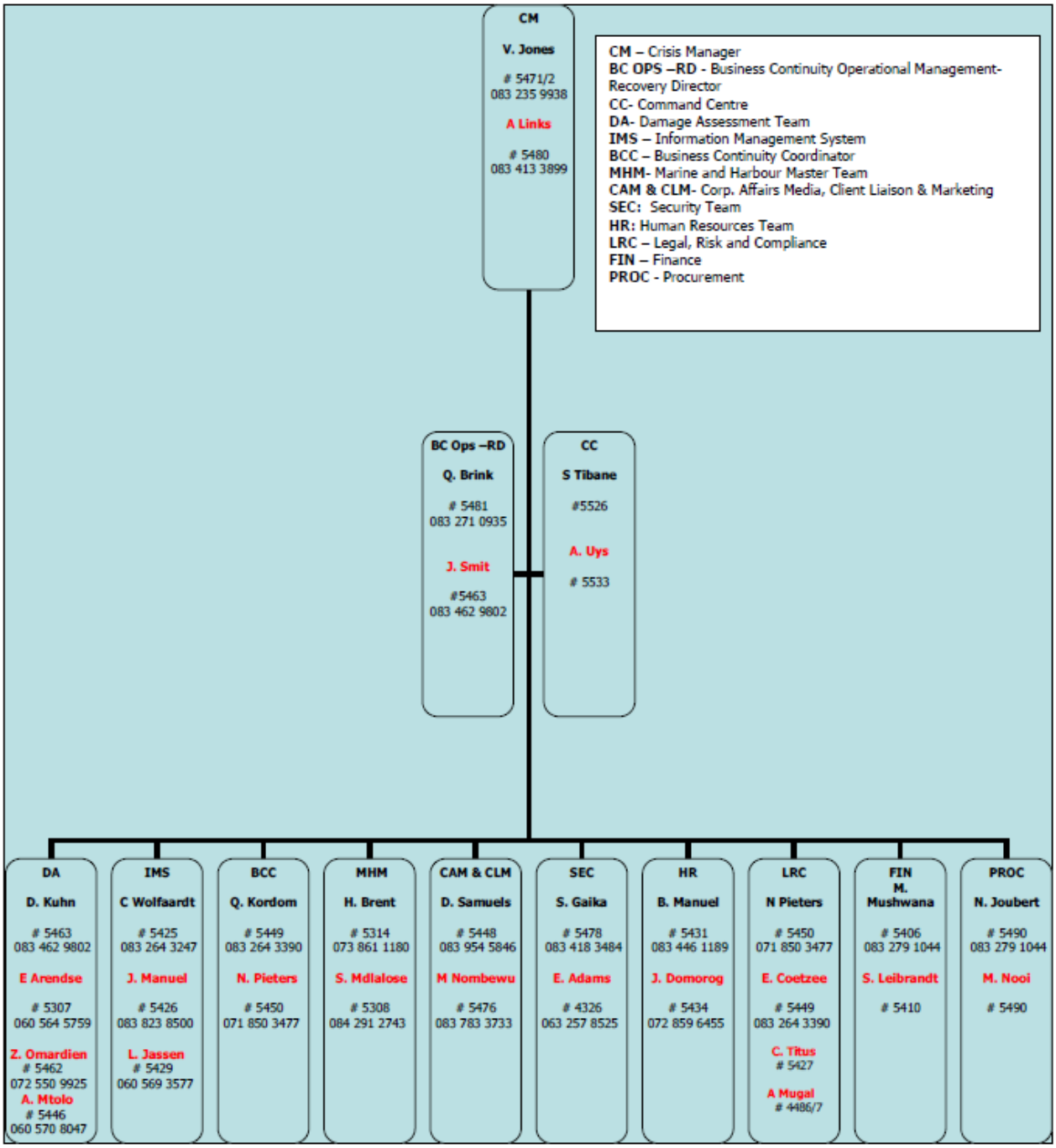
PERSONNEL OVERALL RESPONSIBLE FOR DEALING WITH THE EMERGENCY

NAME	DESIGNATION	DEPARTMENT
K Mshudulu	Terminal Manager (Act).	Management
DJ Strauss	Maintenance Engineer	Management
CA Booysen	Electrical Systems Technician	Electrical
ARS Petro	Fire / Safety Officer	SHEQ
SM Ross	Environmentalist	SHEQ
JCP Lubbe	Security Supervisor	SHEQ

TRANSNET

national ports authority

Port of Saldanha
Business Continuity Management
Crisis Team Structure 2017/2018
Legend: Alternates in **Red**
All internal Telephone numbers starts with 022 703



CONTROLLED

2019/03/23

PROCEDURE NUMBER : **PR/MGT/SDH/SAF/001**

REVISION : **04**

ORIGINAL DATE : **2012/08/31**

AUTHORISED BY	**Khayalethu Mshudulu** **TERMINAL MANAGER, SALDANHA**	
ORIGINATOR	**J Lubbe**	**SECURITY SUPERVISOR**
RECOMMENDED BY	**A Petro**	**FIRE/SAFETY OFFICIAL**
APPROVED BY	**Khayalethu Mshudulu**	**TERMINAL MANAGER, SALDANHA**

TITLE
EMERGENCY PLAN SFF SALDANHA TERMINAL

PURPOSE
To safely store and distribute strategic- clients crude stocks on a commercial basis in inground concrete storage tanks at SFF Saldanha Terminal with emergrncy plans incase a incident occur.

CONTROLLED

2019/03/23

DOCUMENT CONTROL		DOCUMENT NO: **PR/MGT/SDH/SAF/001**
DOCUMENT REVISION CONTROL		
PAGE NUMBER/S	CHANGE LOCATED	DATE OF ISSUE

ROUTING SLIP FOR LAST REVISION NUMBER			
ROLE	NAME	POSITION	REVIEW DATE
REVIEWER 1	**S Ross**	**Environmental Officer**	
REVIEWER 2			
REVIEWER 3			
REVIEWER 4			
REVIEWER 5			
REVIEWER 6			
REVIEWER 7			
REVIEWER 8			
REVIEWER 9			
REVIEWER 10			
QUALITY			
WORKFLOW, RECORDS AND PROCEDURES			
INTERNAL AUDIT			

CONTROLLED

2019/03/23

TABLE OF CONTENTS

1. PURPOSE AND SCOPE

The Saldanha Terminal consists of Storage Tanks storing Crude oil for the Caltex Refinery prior to distribution by pipeline as well as storing Crude oil on behalve of the government and third parties.The purpose and scope is to ensure that all possible emergencies are dealt with in a responsible and correct manner to ensure no loss of product and harm to people and equipment.

2. OBJECTIVES

The objectives of the procedure are to formulate a series of actions to be taken in case of an emergency event or situation and to account for responsibilities.

3. REFERENCES

NO.	DOC NO.	TITLE
Available on Public drive; SFF Procedures; Security		
1		BCP Plans V2011 02
2	BST/PR/SDH/001	SFF Saldanha Terminal Contingency Plan
3	WI/SFF/SDH/QAL/001	Incident Reporting System
4	RF Fuggel & MA Rabie	Environmental Management in South Africa
5	BST/PR/SDH/001	Environmental Management System {EMS}

4. DEFINITIONS

4.1 Unit Emergency

Any leak, fire or accident that effects only that specific Unit / Area / Tank and has or will have no effect on anyone of the neighbouring tanks and can be handled by personnel at that specific Unit / Area / Tank.

4.2 Complex Emergency

Any leak, fire or accident that effects one or more than one tank or unit and can or will have an effect on the neighbouring tanks / unit and cannot be dealt with by personnel of the Saldanha Terminal.

4.3 Area Emergency

Any emergency resulting from fire, leaks, pollution or accident that will result in the evacuation of the areas surrounding the tanks.

4.4 Partial Loss

Means that only a part of the facility is out of service due to unforeseen circumstances.

4.5 Total Loss

Means that the whole of the facility is out of service due to unforeseen circumstances.

4.6 Product Spill

Is a non-continuous discharge of product, which normally occurs as result of an incident, caused by the malfunction of equipment or human error at the Jetty Loading Facility at the Oil Jetty?

4.7 Operation Related

Incidents caused by human error or equipment failure.

4.8 Sabotage

Malicious attempt to damage the facility by means of placing of bombs, setting fire to, fire missile etc with the intent to cause damage or interrupt the normal proceedings at the facility.

4.9 Security

SFF Saldanha Security performing duties at the Tank farm and Oil Jetty.

4.10 Assembly point

A point of assembly for all personnel in event of an emergency.

5. KEYWORDS

Loading arms

6. RESPONSIBILITIES

The Terminal is managed as a commercial facility and therefore all 6 crude oil tanks are available for storage of crude oil on behalf of third parties. Currently ChevronSA is renting tank 1 from where the oil is transferred to Cape Town by pipeline. Two tanks are used for the storage of strategic stocks on behalf of the Government. The other tanks are available to client renting tank space for commercial reasons.

7. PROCEDURE STATEMENTS

The following may cater for the following events:

- Fire
- Bomb Threat
- Explosion
- Spillage
- Strikes / Blockage of roads / Sit in's
- Vehicle hi-jacking

7.1 Fire

When a fire is discovered, during normal working hours, the following actions must be taken:

7.1.1. Establish

- The location of the fire (Tank number, Valve station, Road tanker etc.)
- Product that is burning.
- Magnitude of the fire.
- Wind direction.

7.1.2 Alarming

- Via Radio - Introduce base radio system.
- Telephone.

7.1.3 Complex emergency

- Sounding alarm at Saldanha Terminal.
- Long blasts for fire.

7.1.4 Report to

- Terminal Control Room.
- Terminal Manager, Saldanha or Sub-ordinate.
- Saldanha Terminal Security Control Room.

7.1.5 The following divisions at SFF Strategic Fuel Fund must immediately be informed

- Fire Department.
- Security Department.
- Saldanha Shift Supervisor

Fire Department will inform.

- Saldanha Munisipality Fire department for standby.

Security Department will inform.

- Control Security Officer.
- Security Supervisor.
- Saldanha Environmental Department.

Terminal Personnel must fight the fire as far as possible. If out of control await the arrival of the Saldanha Municipality Fire department

7.1.6 If the fire is out of control

- Sound evacuation alarm. (Alarm with a 5 second interval)
- Stop all operational activities.
- Evacuate all personnel to assembly points outside buildings at main Gates.
- Roll - call will be held.
- Terminal manager will decide on a safe place for further evacuation to an evacuation point.
- If the fire is out of control the Security Department will activate the JOC and call-out the Emergency Controller.

7.1.7 Responsibilities of Security Officers on duty: in respect of emergency gates.

- Open emergency Gate on command.(Contractors gate)
- Keep emergency Gate escape routes free from vehicles after evacuations.
- Allow access to all emergency vehicles.

- Allow access to all emergency personnel.
- Keep general public, bystanders.
- Press as far away from the premises as possible.
- No information must be released to the press.

7.1.8 During evacuation personnel must:

- Keep calm and don't panic.
- Take all personal belongings with you.
- Help all injured personnel.
- Evacuate fast and orderly.
- Do not allow any unauthorized personnel to enter the premises without the permission of the Terminal Manager, the Emergency Controller, Fire /Safety Official or Security Supervisor remain at the evacuation point until roll call was held and further instructions was given.

7.1.9 If a fire is established after hours:

- Security Official will inform SFF Saldanha Terminal Operation Control Room and Security Control Room immediately.

Security Official will inform:

- The Terminal Manager, Saldanha.
- Fire /Safety Official.
- Security Supervisor.
- The above-mentioned departments will perform call-out procedures as during normal hours. Rest of actions as per Fire Emergency Procedure.

7.2 Telephone bomb threat - explosive devices

7.2.1 On receiving of a telephone bomb threat the receiver must:

- Keep calm and don't panic
- Keeps the caller talking as long as possible?
- Gather as much information as possible.
- Try to establish:
- Location of device
- Colour of device
- Shape and size of device

- The time, the device was set for (to go off) - Why the device was planted.
- Record the time of the call.
- Listen to:
- Background noises
- Nationality
- Male - Female

7.2.2 After the call the receiver must:

- Complete the telephone bomb threat form.
- Report immediately to Security Control room: (See attached telephone list)

7.2.3 Inform

- Security Supervisor.
- Terminal Manager, Saldanha.
- Explosive Expert.
- SAPS Dog Unit.
- Saldanha Fire /Safety Department.

7.2.4 Responsibilities: Terminal personnel

- Search own area for any unknown objects or devices.
- If any is found.
- Do not touch.
- Do not move.
- Cordon area off.
- Evacuate all personnel or contractors from area.
- Do not use portable radio to report the found device. It could activate the device.
- Await further instructions from experts on arrival.
- If necessary to evacuate, evacuate according to the evacuation procedures as described in the evacuation of a major fire.

7.3 Explosion

When an explosion at anyone of the areas occurs the personnel must establish:

- The location of the explosion.
- Magnitude of the explosion.
- Fire - Initiated by the explosion / Fire Hazard.
- Spillage of product.

- Injuries or death of personnel.
- Possible cause of the explosion.
- Effect on other oil companies.

Report immediately to Security Department at Saldanha

7.3.1 Responsibilities of Security

On receiving the call the Control Room operator will

- Activate the Saldanha JOC
- Inform:
- Terminal Manager, Saldanha.
- Security Supervisor.
- Saldanha Fire /Safety Department.
- Saldanha Emergency Controller.
- SAPS Saldanha
- Border Police.
- Saldanha Environmental Department.

7.3.2 Responsibilities of security guards

- Man the Emergency (Contractors) Gate.
- Allow access for all emergency vehicles.
- Keep emergency exits free from any other vehicles.
- Allow access for all Emergency Teams / Personnel.
- Keep all curious people and press away from the premises.
- Do not release any information to the press.
- Responsibilities of Terminal personnel
- Stop all operational work
- Contain fire / spillage as far as possible.
- Treat injured personnel if any.
- Assist emergency teams.
- If situation is out of control - evacuate to assembly point for roll call
- Await further instructions.

7.4 Spillage

7.4.1. When a spillage occurs the following must be established

- Location of spillage.

- Magnitude or spillage.
- Product that is spilled.
- Danger or fire.
- Any injured personnel.
- Are personnel out of danger?
- Possibility or environmental pollution.

7.4.2 Responsibilities - Terminal personnel

- Activate own Emergency Actions.
- Inform operator at Saldanha Terminal control room who will:
- Inform Saldanha Fire Department.
- Inform Security Supervisor.
- Inform Terminal Manager.

7.4.3 Fire /Safety department will:

- Be on standby
- Safety Department

7.4.4 Security department will:

- Inform Terminal Manager, Saldanha.
- Security Supervisor
- Environmental Resposible Person.

7.4.5 Responsibilities – Control Security Officers.

After Hours:

- Inform report to Saldanha Terminal.
- Control Room Operator.
- Allow access for all emergency vehicles and personnel
- Open emergency Gates
- Keep gates free from other vehicles.

7.5 Strikes / lock outs

7.5.1 Strikes

It is most unlikely that Tank Farm personnel will initiate strikes. If a strike occurs the following actions must be taken: Inform Security immediately

Security will inform:

- Security Supervisor.
- SAPS Saldanha.
- Border Police
- Shift Supervisor
- Fire /Safety Department.
- Security officers to close all Gates.
- Allow no access - only Emergency Response Teams.
- Man all posts (Emergency Gates)
- Do not get involved / argue with strikers or leaders of riot group.
- Keep a low profile.
- Do not aggravate the situation.
- Observe the situation and keep record in occurrence book.
- Await further instructions from Security Supervisor.

7.5.2 Blockage of access roads

If the road to the Terminal is blockaded, the first person to notice the blockade or the person to whose attention it was brought, will immediately: Phone Security and phone the Terminal Manager.

Security will notify the Security Supervisor, which in turn will notify the SAPS with the request to remove the blockade. If the blockade cannot be removed, or the road is too dangerous for use and will be for a period of time, alternative routes will be used.

7.6 Hi-jacking of vehicles

The possibility of vehicles being hi-jacked is a big concern and although the possibility in this area is very low it is important to follow the following steps and gather the necessary information: The driver of the vehicle must not try to defend himself or his vehicle during a hi-jack. It could lead to serious injury or death. He must try to gather the following information:

- Number of hi - jackers.
- Description of hi - jackers.
- Age.
- Clothing.
- Fire Arms used.
- Nationality - etc

- Location that hi-jack took place.
- Time of hi-jack.
- Vehicle use by hi-jackers.
- Colour.
- Model.
- Registration number.

The driver must report the information as soon as possible to:

- Nearest SAPS.
- Company Manager.
- SFF Saldanha Security.

It will be important that vehicles are equipped with satellite tracings or drivers issued with cell phones.

7.7 Evacuations

7.7.1 Terminal Emergency

If an emergency occurs during office hours,
the Terminal Manager, Saldanha or in his absence, his delegate should decide whether evacuation is necessary and evacuate the people to a safe designated area or assembly point. If the emergency occurs after hours, it will be the responsibility of the Saldanha Control Security Officers to evacuate the people to a safe designated area or assembly point.

If it is necessary to evacuate Security at the tank farm, they should be moved to a place higher up in the road from where they can:

- Let emergency vehicles through
- Keep all people away who do not have a vital interest in the procedures of combating the emergency

A plan of assembly points is attached here to.

7.7.2 Complex emergency

If a complex emergency occurs during office hours,
the Terminal Manager, Salanha or their delegates in their absence should decide the necessity to evacuate. Further steps to be taken as

for a Complex emergency. Evacuation in case of an area emergency will means the evacuation of all personnel to a point.

7.7.3 Area emergency

As described under definitions an Area Emergency may result in the evacuation of the area surrounding the Terminal. This decision will rest with the Emergency Coordinator in the JOC in the Security Building at SFF Saldanha. Up to 1 000 m around the Terminal may be effected depending on the extent of the emergency especially in event of fire.

The Emergency Controller will instruct the Security "OPS" room to notify the following places to evacuate, taking into account the extent of the emergency.

8. RECORDS

None

15.2. Material Safety Data Sheets

Date of Issue: 17/01/2003

SAFETY DATA SHEET

Crude Oil

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of substance/preparation

Crude Oil

Application

Refinery feedstock

For specific application advice see appropriate Technical Data Sheet or consult your BP representative

Company Identification

BP Oil International Limited
Chertsey Road
Sunbury on Thames
Middlesex, TW16 7BP

Emergency Telephone Number

+44 (0) 20 7496 5555

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Composition

Crude Oil: complex hydrocarbon mixture comprising mainly of aliphatic, naphthenic and aromatic hydrocarbons. It may also contain gases, sulphur and nitrogen compounds.

EINECS No. : 232-298-5, CAS-No.: 8002-05-9

Hazardous Components

Polycyclic aromatic hydrocarbons will be present, some of which have been shown by experimental studies to induce skin cancer.

The following components, considered by various legislative authorities to be hazardous, may be present:
Benzene, EINECS No. 200-753-7, CAS No. 71-43-2
Hydrogen sulphide CAS No. 7783-06-4, EINECS No. 231-977-3

3. HAZARDS IDENTIFICATION

Extremely flammable.

May cause cancer, classified as a category 2 carcinogen.

Contains Benzene. Prolonged or repeated exposure to benzene can cause anaemia and other blood diseases, including leukaemia.

This material may contain significant quantities of polycyclic aromatic hydrocarbons (PCAs), some of which have been shown by experimental studies to induce skin cancer.

Vapours containing hydrogen sulphide may accumulate during storage or transport and may also be vented during filling of tanks. Hydrogen sulphide has a typical "bad egg" smell but at high concentrations the sense of smell is rapidly lost, therefore do not rely on sense of smell for detecting hydrogen sulphide. Use specially designed measuring instruments for determining its concentration.

Harmful if swallowed - aspiration hazard. (If viscosity <7 cSt at 40°C)

Vapours may cause drowsiness and dizziness.

Repeated exposure may cause skin dryness or cracking.

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

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4. FIRST-AID MEASURES

Eyes

Wash eye thoroughly with copious quantities of water, ensuring eyelids are held open. Obtain medical advice if any pain or redness develops or persists.

Skin

Wash skin thoroughly with soap and water as soon as reasonably practicable. Remove heavily contaminated clothing and wash underlying skin.

Product can be removed from the skin using warmed medicinal paraffin. Never use gasoline or kerosine to remove product from skin or clothing.

In extreme situations of saturation with this product, drench with water, remove clothing as soon as possible and wash skin with soap and water. Seek medical advice if skin becomes red, swollen or painful.

Ingestion

If contamination of the mouth occurs, wash out thoroughly with water.

Except as a deliberate act, the ingestion of large amounts of product is unlikely. If it should occur, do not induce vomiting; obtain medical advice.

Inhalation

If exposure to vapour, mists or fumes causes drowsiness, headache, blurred vision or irritation of the eyes, nose or throat, remove immediately to fresh air. Keep patient warm and at rest. If any symptoms persist obtain medical advice.

Unconscious casualties must be placed in the recovery position. Monitor breathing and pulse rate and if breathing has failed, or is deemed inadequate, respiration must be assisted, preferably by the mouth to mouth method. Administer external cardiac massage if necessary. Seek medical attention immediately.

EXPOSURE TO HYDROGEN SULPHIDE:

Casualties suffering ill effects as a result of exposure to hydrogen sulphide should be immediately removed to fresh air and medical assistance obtained without delay.

It is advisable that all who are engaged in operations in which contact with H_2S may reasonably be anticipated, should be trained in the techniques of emergency resuscitation and in the care of an unconscious patient.

Medical Advice

Inhalation of hydrogen sulphide may cause central respiratory depression leading to coma and death. It is irritant to the respiratory tract causing chemical pneumonitis and pulmonary oedema. The onset of pulmonary oedema may be delayed for 24 to 48 hours. Treat with oxygen and ventilate as appropriate. Administer broncho-dilators if indicated and consider administration of corticosteroids. Keep casualty under surveillance for 48 hours in case pulmonary oedema develops.

If ingested, do not induce vomiting. Drinking milk or medicinal paraffin may be beneficial.

Aspiration of the product is unlikely to occur except as the result of ingestion, followed by vomiting or regurgitation in a partially or totally unconscious individual, when immediate effects are most likely to result from the aspiration of acidic stomach contents. If it should occur, transport casualty immediately to hospital.

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5. FIRE-FIGHTING MEASURES

For major fires call the Fire Service. Ensure an escape path is always available from any fire.
There is a danger of flashback if sparks or hot surfaces ignite vapour.
Use foam, dry powder or water fog. DO NOT USE water jets.
Fires in confined spaces should be dealt with by trained personnel wearing approved breathing apparatus.
Any spillage should be regarded as a potential fire risk.

Combustion Products

Toxic fumes may be evolved on burning or exposure to heat.
See Stability and Reactivity, Section 10 of this Safety Data Sheet.

6. ACCIDENTAL RELEASE MEASURES

As this product has a very low flash point any spillage or leak is a severe fire and/or explosion hazard.
Isolate spillage from all ignition sources including road traffic.
Ensure good ventilation.
Evacuate all non essential personnel from the immediate area.
Wear protective clothing. See Exposure Controls/Personal Protection, section 8, of this Safety Data Sheet.
Spilled material may make surfaces slippery.
Recovery of large spillages should be effected by specialist personnel.
It is advised that stocks of suitable absorbent material should be held in quantities sufficient to deal with any spillage which may be reasonably anticipated.
Large and uncontained spillages should be smothered with foam to reduce the risk of ignition.
The foam blanket should be maintained until the area is declared safe.
Protect drains from potential spills to minimise contamination. Do not wash product into drainage system.
Vapour is heavier than air and may travel to remote sources of ignition (eg. along drainage systems, in basements etc.).
If spillage has occurred in a confined space, ensure adequate ventilation and check that a safe, breathable atmosphere is present before entry.
In the case of spillage on water, prevent the spread of product by the use of suitable barrier equipment. Recover product from the surface. Protect environmentally sensitive areas and water supplies.
Any spillage which results in pollution at sea must be treated in accordance with the guidelines in MARPOL 73/78 Annex 1.
In the event of spillages contact the appropriate authorities.

7. HANDLING AND STORAGE

Storage Conditions

Do not enter storage tanks without breathing apparatus unless the tank has been well ventilated and the tank atmosphere has been shown to contain hydrocarbon vapour concentrations of less than 1% of the lower flammability limit and an oxygen concentration of at least 20% volume.
Always have sufficient people standing by outside the tank with appropriate breathing apparatus and equipment to effect a quick rescue.
Confined spaces contaminated with hydrogen sulphide must always be considered as constituting potentially life threatening environments. Entry into such spaces must never be undertaken except under extreme emergency when no alternative is possible and then only by trained operators wearing air-supplied breathing apparatus of an approved type and following procedures strictly in accordance with the Statutory Regulations governing such entry. Please see the comments in Section 8 (Exposure Controls/Personal Protection) of this data sheet.

Handling Precautions

Ensure good ventilation and avoid as far as reasonably practicable the inhalation and contact with vapours, mists or fumes which may be generated during use. If such vapour, mists or fumes are generated, their concentration in the workplace air should be controlled to the lowest reasonably practicable level.
Avoid contact with skin and observe good personal hygiene.
Avoid contact with eyes. If splashing is likely to occur wear a full face visor or chemical goggles as appropriate.
Do not siphon product by mouth.
Whilst using do not eat, drink or smoke.

Fire Prevention

Light hydrocarbon vapours can build up in the headspace of tanks. These can cause flammability/explosion hazards even at temperatures below the normal flash point (note: flash point must not be regarded as a reliable indicator of the potential flammability of vapour in tank headspaces). Tank headspaces should always be regarded as potentially flammable and care should be taken to avoid static electrical discharge and all ignition sources during filling, ullaging and sampling from storage tanks.

When the product is pumped (e.g. during filling, discharge or ullaging) and when sampling, there is a risk of static discharge. Ensure equipment used is properly earthed or bonded to the tank structure.

Explosive air/vapour mixtures may form at ambient temperature.

Product contaminated rags, paper or material used to absorb spillages, represent a fire hazard, and should not be allowed to accumulate. Dispose of safely immediately after use.

Empty containers represent a fire hazard as they may contain some remaining flammable product and vapour. Never cut, weld, solder or braze empty containers.

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8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits

There is no appropriate occupational exposure limit for this material.

Comply with current local occupational exposure limit. Where not established, the following limits are recommended.

Hydrogen sulphide
ACGIH (USA): TLV 10 ppm (8 hr TWA); 15ppm (15 min STEL)

Benzene
ACGIH (USA): TLV 0.5ppm (8hr TWA); 2.5 ppm (15min STEL)
A1 - Confirmed human carcinogen
Skin Notation - Can be absorbed through skin

Protective Clothing

Wear face visor or goggles in circumstances where eye contact can accidentally occur.

If skin contact is likely, wear impervious protective clothing and/or gloves.

Protective clothing should be regularly inspected and maintained; overalls should be dry-cleaned, laundered and preferably starched after use.

Respiratory Protection

If operations are such that the excessive generation of vapour, mist or fume may be anticipated, to which operators may unavoidably be exposed, then suitable approved respiratory equipment should be worn. Note: Approved air-supplied breathing apparatus must be worn where there may be potential for inhalation of hydrogen sulphide gas.

The use of respiratory equipment must be strictly in accordance with the manufacturers' instructions and any statutory requirements governing its selection and use.

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9. PHYSICAL AND CHEMICAL PROPERTIES

Typical Values

Grades:			Crude Oil
	Test Method	**Units**	
Physical state			liquid
Colour			brown
Odour			pungent
Density @ 15°C	ASTM D 1298	**kg/m³**	750 - 1000
Kinematic viscosity @ 40°C	ASTM D 445	**mm²/s**	<7 to viscous liquid
Boiling point/range	ASTM D 86	**°C**	-10 to 800
Flash point (PMC)	ASTM D 93	**°C**	-50 to 100
Explosion limits		**%**	0.6 - 8.0

Vapour pressure	ASTM D 323	**kPa**	40 - 700

10. STABILITY AND REACTIVITY

Stable at ambient temperatures.
Hazardous polymerisation reactions will not occur.

Conditions to Avoid

Sources of ignition

Materials to Avoid

Avoid contact with strong oxidizing agents.

Hazardous Decomposition Products

Thermal decomposition products will vary with conditions.
Incomplete combustion will generate smoke, carbon dioxide and hazardous gases, including carbon monoxide.

11. TOXICOLOGICAL INFORMATION

Eyes

Unlikely to cause more than transient stinging or redness if accidental eye contact occurs.

Skin

Unlikely to cause harm to the skin on brief or occasional contact but prolonged or repeated exposure may lead to dermatitis.
As with all such products containing potentially harmful levels of PCAs, prolonged or repeated skin contact may eventually result in dermatitis or more serious irreversible skin disorders including cancer.

Ingestion

Unlikely to cause harm if accidentally swallowed in small doses, though larger quantities may cause nausea and diarrhoea.
Lower viscosity crude oils may injure the lungs if aspiration occurs, eg. during vomiting

Inhalation

Likely to be irritating to the respiratory tract if high concentrations of mists or vapour are inhaled.
May cause nausea, dizziness, headaches and drowsiness if high concentrations of vapour are inhaled.
May be toxic by inhalation when hydrogen sulphide is present in the vapour.
ABUSE:
Under normal conditions of use the product is not hazardous; however, abuse involving deliberate inhalation of very high concentrations of vapour, even for short periods, can produce unconsciousness and/or result in a sudden fatality.

Carcinogenicity/Chronic Toxicity

Exposure to benzene may result in affects to the hematopoietic system causing blood disorders including anaemia and leukaemia.
Benzene is classified by EEC as a category 1 carcinogen - substances known to be carcinogenic to man.
IARC assessment: benzene - carcinogenic to humans (Group 1)

12. ECOLOGICAL INFORMATION

Mobility

Spillages may penetrate the soil causing ground water contamination.

Persistence and degradability

This product is inherently biodegradable.

Bioaccumulative potential

There is no evidence to suggest bioaccumulation will occur.

Aquatic toxicity

Harmful to aquatic organisms.

Spills may form a film on water surfaces causing physical damage to organisms. Oxygen transfer could also be impaired. May cause long-term adverse effects in the aquatic environment.

13. DISPOSAL CONSIDERATIONS

Dispose of via an authorised person/ licensed waste disposal contractor in accordance with local regulations.

14. TRANSPORT INFORMATION

This information is provided for guidance only. The current legislative text for each mode of transport should be referred to for definitive information.

** NOTE**, Transport Requirements depend on flash point, initial boiling point and vapour pressure.

Flash Point (closed cup) less than 23°C, initial boiling point less than or equal to 35°C, vapour pressure at 50°C greater than 110 kPa
ADR/RID: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group I, Classification Code F1, Hazard Identification No. 33
UN: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group I
IATA/ICAO: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group I
IMO: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group I
EMERGENCY ACTION CODE: Flammable liquid, 3WE

Flash Point (closed-cup) less than 23°C, initial boiling point greater than 35°C, vapour pressure at 50°C less than 175 kPa
ADR/RID: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group II, Classification Code F1, Hazard Identification No. 33
UN: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group II
IATA/ICAO: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group II
IMO: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group II
EMERGENCY ACTION CODE: Flammable liquid, 3WE

Flash Point (closed-cup) equal to or greater than 23°C but less than or equal to 61°C
ADR/RID: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group III, Classification Code F1, Hazard Identification No. 30
UN: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group III
IATA/ICAO: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group III
IMO: Petroleum Crude Oil, UN No. 1267, Flammable liquids, Class 3, Packing Group III
EMERGENCY ACTION CODE: Flammable liquid, 3W

Flash Point (closed-cup) above 61°C
Not classified as hazardous for transport (ADR, RID, UN , IMO, IATA/ICAO).

15. REGULATORY INFORMATION

EU Category of Danger

Extremely flammable or Highly Flammable or Flammable or unclassified for flammability (dependent on flash point and initial boiling point)
Carcinogenic category 2
Harmful (If viscosity <7 cSt at 40°C)
Dangerous for the environment

EU Labelling

Symbol:
Flame (for extremely flammable or highly flammable only)
Skull and crossbones

Indication of danger:
EXTREMELY FLAMMABLE, or HIGHLY FLAMMABLE, or no indication of danger for flammability (dependent on flash point and initial boiling point)

Risk (R) Phrases:

R12 Extremely flammable, or R11 Highly flammable, or R10 Flammable, or no risk phrase for flammability (dependent on flash point and initial boiling point)
R45 May cause cancer
R65 Also Harmful: may cause lung damage if swallowed. (If viscosity <7 cSt at 40°C)
R67 Vapours may cause drowsiness and dizziness.
R66 Repeated exposure may cause skin dryness or cracking
R52/53 Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Safety (S) Phrases:

S53 Avoid exposure - obtain special instructions before use.
S45 In case of accident or if you feel unwell, seek medical advice immediately (show label where possible)
S43 In case of fire, use foam/dry powder/CO2. Never use water jets.
S62 If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label. (If viscosity <7 cSt at 40°C)
S61 Avoid release to the environment. Refer to special instructions/safety data sheets.

The label must carry the following additional information: "EC Label", Substance name, EINECS No.
Substance Name: Crude oil , EINECS No: 232-298-5
For non-fuel use only - "Restricted to professional users. Attention - Avoid exposure - obtain special instructions before use." must be marked on packaging.

16. OTHER INFORMATION

Compiled by:

Product Stewardship Group
BP Oil Technology Centre
Chertsey Road
Sunbury-on-Thames
Middlesex, TW16 7LN

This data sheet and the health, safety and environmental information it contains is considered to be accurate as of the date specified below. We have reviewed any information contained herein which we received from sources outside the BP Group of Companies. However, no warranty or representation, express or implied is made as to the accuracy or completeness of the data and information contained in this data sheet.

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SHEET REVISIONS

DATE	SECTIONS
25/09/98	1, 3, 8, 14, 15
01/12/2002	14
16/01/2003	3, 15

SHEET NO: STI2201
ISSUE DATE: 16/01/2003
REVISION OF SHEET DATED: 01/12/2002

15.3. Designs and Drawings Crude Oil Installations

15.4. Design and Drawings LPG Installations

BVI CONSULTING ENGINEERS (PTY) LTD

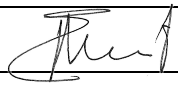
PRE-FEASIBILITY STUDY FOR THE CONSTRUCTION OF A LPG STORAGE FACILITY AT THE OIL JETTY IN THE PORT OF SALDANHA

PRE-FEASIBILITY DESIGN PACKAGE

Client: SFF

Approval

The following Signatories approve this Plan:

NAME	ROLE	SIGNATURE	DATE
C GOKALDAS	BVi Process Lead		26/09/2018
M WILLIAMS	BVi LPG Specialist		26/09/2018
E MARITZ	BVi Engineering Lead		03/10/2018
M XABA	SFF Project Manager		

Revision History

REV	DATE	DESCRIPTION	AFFECTED PAGES	ORIGINATOR
A	20/07/2018	ISSUE FOR DISCUSSION	ALL	T de Meillon
1-0	26/09/2018	ISSUE FOR APPROVAL	ALL	T de Meillon

TABLE OF CONTENTS

1 ABBREVIATIONS AND ACRONYMS

The following acronyms are applicable to this document: For more details, please consult the Glossary.

ACRONYM	DESCRIPTION
ANSI	American National Standards Institute
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
BLEVE	Boiling Liquid Expanding Vapour Explosion
BS	British Standard
C3	Propane
C4	Butane
CRS	Client Requirement Specification
DIN	Deutsches Institute für Normung
EEMUA	Engineering Equipment and Materials Users Association
EN	European National
ESD	Emergency Shutdown System
GAs	General arrangements
GVM	Gross Vehicle Mass
HAZOP	Hazards and operability
I/O	Input/Output
IP	Institute of Petroleum
ISGOTT	International Safety Guide for Oil Tankers and Terminals
ISO	International Standards Organization
LPG	Liquefied Petroleum Gas
LV	Low Voltage
MCC	Motor Control Centre.
MV	Medium Voltage
NiCad	Nickel Cadmium
NFPA	National Fire Protection Association
P&ID	Piping and instrumentation diagrams
PCMS	Plant Control and Monitoring System
PLC	Programmable Logic Controller
PFD	Process flow diagrams
PVC	Polyvinyl Carbon
RIO	Remote Input/Output

ACRONYM	DESCRIPTION
RMU	Ring Main Unit
SANS	South African National Standard
SFF	Strategic Fuel Foundation
SIGTTO	Society of International Gas Tanker and Terminal Operators Ltd.
SLD	Single Line Diagram
TNPA	Transnet National Port Authority
UPS	Uninterruptable Power Supply
VLGC	Very Large Gas Carrier

2 PROJECT DESCRIPTION

The SFF LPG pre-feasibility study entails the study of an 8,000-metric ton LPG storage facility to be located at the existing SFF oil storage facility in Saldanha. The facility should consider the receipt of product via the existing oil jetty, storage of LPG and truck loading operations for a loading gantry to be located at the Saldanha oil terminal.

Figure 1 depicts the port of Saldanha and the existing jetty to be used for receipt of LPG cargoes. The proposed LPG terminal infrastructure shall be combined into the existing operational oil jetty infrastructure. The LPG terminal shall be designed to receive and supply via cargo carrier, store 8,000 metric ton of LPG product in pressurised vessels.

A truck loading gantry shall be incorporated into the study, the truck loading gantry shall have a minimum of 2 bays. The final number of dispensing bays and configuration of the loading gantry for the truck loading shall be determined during the development of the design.

A rail loading facility and provision for cylinder filling will be not be considered in the study.

A weigh bridge shall track the weight of product entering and leaving the terminal. The terminal will also cater for single truck off-loading back to the terminal storage.

The loading of product will be achieved via the existing oil jetty which is located approximately 9 km away. The project will use the existing servitudes for the product lines which would be used to deliver product from the jetty to the terminal via a dedicated pipeline for this purpose.

It is anticipated that LPG vessels will be moored on the Langebaan side of the jetty and the pre-feasibility study will consider cargo receipt from this side of the jetty. The pre-feasibility study will consider the use of existing infrastructure that is available at the SFF terminal, these include, fire-fighting systems, electrical, control and instrumentation as well as operational staff required to run the facility.

The project scope does not include the further down line corporate customer and consumer distribution of the product.

Figure 2 displays an aerial view of the existing oil terminal jetty located at the port of Saldanha.

The design of the facility will also provide an indication of further LPG storage potential for the site in case future expansion could be considered.

Figure 1: Port of Saldanha Bay

Figure 2: Aerial View of Existing SFF Oil Jetty

2.1 SFF CONCEPT DESIGN

SFF has completed a concept study for the proposed LPG terminal which is depicted in Figure 3. The provided SFF conceptual design will be used as the basis for the pre-feasibility study.

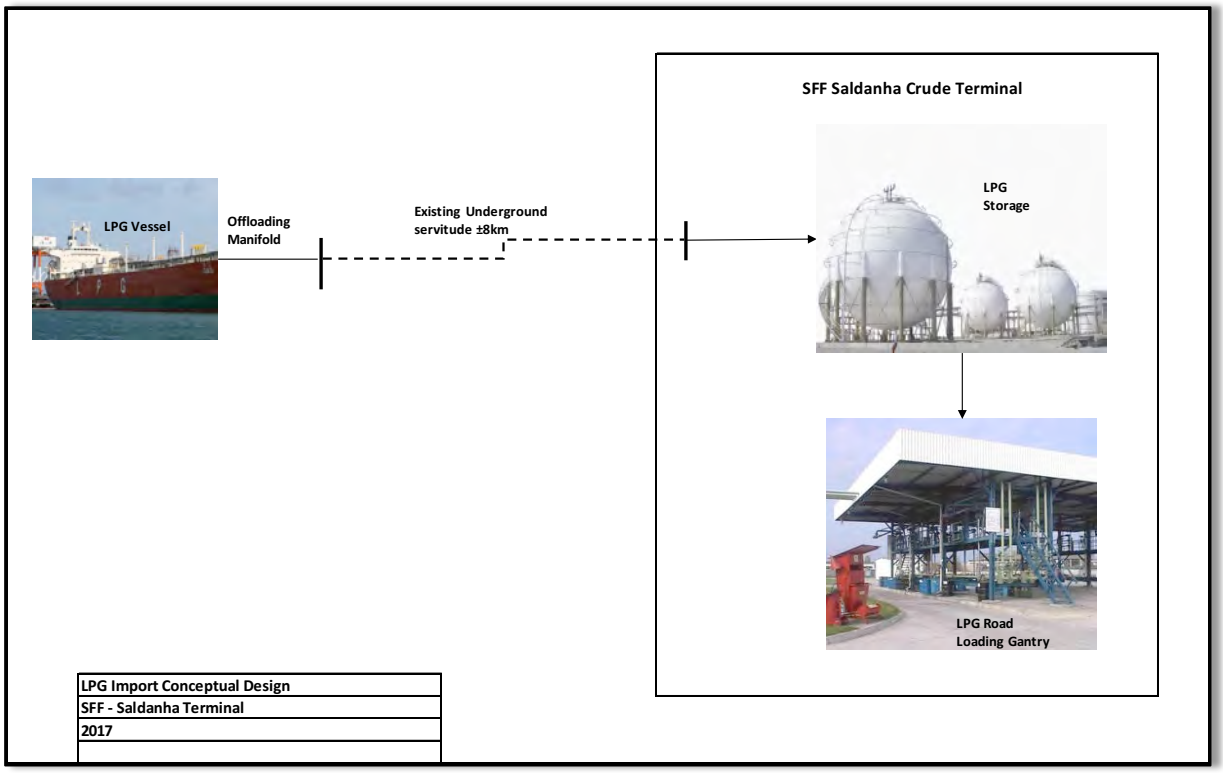


Figure 3: SFF Conceptual Design

3 FUNCTIONAL REQUIREMENTS

The facility is to be designed to received LPG product via gas carriers. The terminal will have an initial capacity of 8,000 metric tons with potential for future expansion. Although the port of Saldanha can support the berthing and mooring of very large gas carriers (VLGCs) which have a capacity of up to 45,000 metric tons of LPG, the facility will only be able to receive cargoes in accordance with its maximum capacity which will for the initial pre-feasibility be 8,000 metric tons.

The design alternatives will address the various LPG storage technology options for the project considering the site location, constructability as well as the economics of construction. The pre-feasibility study will consider the recommended option as a basis for the project.

The facility will also provide for the ability to load gas carriers via the same product receiving infrastructure thereby allowing for flexibility of operations through the project lifespan.

The facility will have an initial maximum requirement to distribute 8,000 metric tonnes of LPG per month via road tankers. The typical road tanker sizes of 25-27 metric ton capacity will be utilised as a basis of the design of the loading facilities.

Transfer metering will be installed which will allow for an indication of LPG transfer volumes during import and export mode, Tank surveying will be the primary means of custody transfer. Road tanker custody transfer will be achieved by means of a weigh bridge.

4 SITE LOCATION AND METEOROLOGICAL DATA

4.1 SITE LOCATION

SFF identified two areas for consideration for the location of the LPG Terminal. The first is located on the located on the Eastern side of the existing oil storage terminal (refer the area in blue in Figure 4). The second is located on the South Eastern side of the existing oil storage terminal (refer the area in red in Figure 4). The positives and negatives of each were evaluated and are provided below.

Table 1: Bullet storage considerations

Red Site	Blue Site
Advantages	
Close proximity to current site services	Brownfields
Will result in shorter pipeline , communication, etc. routes	
Will result in easier road tanker access	
Disadvantages	
Some greenfield areas (could be avoided)	Earmarked for future Crude Oil tank expansion
	Further from site Services
	Will result in shorter pipeline, communication, etc. routes
	Will result in easier road tanker access

Based on the above it is proposed that the LPG facility is to be located on the South Eastern side of the existing oil storage terminal (refer Figure 4, red site). The proposed area is within the existing oil terminal boundary and therefore may facilitate the use of shared infrastructure across the two operations. The proposed area is approximately 11 hectares. The co-ordinates are provided in **Error! Reference source not found.**.

Table 2: SFF LPG Site co-ordinates (Red site)

Location	S	E
A	33°0'57.48	18°2'56.37
B	33°0'49.01	18°3'09.50
C	33°0'53.07	18°3'16.24
D	33°1'01.64	18°3'09.81

Figure 4: Proposed Terminal Location

4.2 ACCESS TO TERMINAL

The existing SFF oil terminal entrance is located on the north western border of the facility. The pre-feasibility study will consider the use of this access point and the implications on existing operations. The study will consider the tanker routes as well as any risks associated with the movement of LPG tankers on the existing terminal.

The study will consider alternate access points and optimisation of the movement of road tankers to reduce the risks of incidents and impacts on existing terminal and future LPG terminal operations.

4.3 LPG IMPORT AND EXPORT FROM JETTY TO LPG TERMINAL

A newly constructed dedicated LPG product line will deliver product from the existing oil jetty to the new LPG terminal. The LPG line from the jetty is to be located within the existing crude oil pipeline servitudes which connects the jetty to the oil terminal. Refer to Annexure B for pipeline servitude and Annexure C for the jetty area plot plan.

4.4 SITE DESIGN CONDITIONS

All equipment shall be designed to safely and reliably operate within the ambient conditions listed in *Table 3* below;

Table 3: Environmental Parameters

Parameter	Value	Unit
Average ambient temperature	19.5	º9
Average Barometric pressure	101.70	kPa
Average Relative Humidity	67	%
Maximum Air Temperature	32.1	º2
Minimum Air Temperature	8.7	º.
Maximum Rainfall in 24 hours	295	mm
Mean Yearly Relative Humidity (Maximum)	79	%
Mean Yearly Relative Humidity (Minimum)	60	%
Maximum Wind Velocity / Gusts	33.8	km/hr
Minimum Wind Velocity / Gusts	9.6	km/hr
Site Elevation	5 to 6	meters ASL

5 STANDARDS, CODES, REGULATIONS, LEGISLATION & GUIDELINES

5.1 MINIMUM TERMS OF REFERENCE

The minimum terms of reference shall be South African National Standards, South African Regulations and Legislation. Unfortunately the primary LPG Standard of South Africa, i.e., "SANS 10087 - The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500L" does not provide sufficient relevant detail for larger LPG Storage Terminals and a broader reference to International Standards, Codes, Regulations, Guidelines and trends shall be required.

5.2 REFERENCE STANDARDS, CODES, REGULATIONS, LEGISLATION & GUIDELINES

Table 4: Reference Standards, Codes, Regulations and Guidelines

Reference	Description
API-6D	Specification of pipeline valves
API RP 505 / RP500	Recommended practice for classification of locations for electrical installations at petroleum facilities classified as class I, division 1 and division 2
API 526	Specification for flanged pressure relief valves
API 607	Certified fire safe ball Valves
API RP 752	American Petroleum Institute - Management of hazards associated with location of process plant buildings
API 1104	Welding of pipelines and related facilities
API 2510:2011	Design and construction of Liquefied Petroleum (LP) Gas installations
API 2510A:2010	Fire protection considerations for the design and operation of LPG storage facilities
API 2003	Recommended practice for protection against ignitions arising out of static lightning and stray currents
ASME B1.20.1	Pipe threads, general purpose, inch
ASME B16.5	Pipe flanges and pipe fittings NPS ½ through NPS 24 metric/Inch standard
ASME B16.9	Factory made wrought butt weld fittings
ASME B16.20	Metallic gasket for pipe flanges: Ring-Joint, Spiral Wound, and Jacketed
ASME B31.3	Process piping
ASME B16.47	Large diameter steel flanges NPS 26 through NPS 60 metric/Inch standard
ASTM A105	Standard specification for carbon steel forgings for piping applications
ASTM A106	Standard specification for seamless carbon steel pipe for High-Temperature Service
ASTM A193 B7	Standard specification for Alloy-Steel and Stainless Steel bolting for high temperature or high pressure Service and other special purpose applications
ASTM A194 H2	Standard specification for Carbon and Alloy Steel nuts for bolts for high pressure or high temperature service, or both
ASTM A234	Standard specification for piping fittings of wrought Carbon Steel and Alloy Steel for moderate and high temperature service
ASTM F436	Standard specification for hardened Steel washers
EEMUA Publication No. 190:2000	Guide for the design, construction and use of mounded horizontal cylindrical steel vessels for pressurized storage of LPG at ambient temperatures
EN13345	Unfired pressure vessels
IP-15	Institute of petroleum Part 15: Classification
ISGOTT	International safety guide for Oil Tankers and Terminals
ISO 12944-Part 5:2007	Paints and varnishes - corrosion protection of steel structures by protective paint systems Part 5: Protective paint systems
NFPA 15:2012	Standard for water spray fixed systems for fire protection
NFPA 30:2015	Flammable and combustible liquids code
NFPA 58:2014	LP gas code
NFPA 59:2015	Utility LP gas plant code
NFPA 70:2014	Electrical code

PD 5500:2012	Specification for unfired fusion welded pressure vessels
SANS 121:2000 SABS ISO 1461:2000	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
SANS 347:2012	Standard specification for categorization and conformity assessment criteria for all pressure equipment
SANS 1128-1:2010	Fire-fighting equipment Part 1: Components of underground and above-ground hydrant systems.
SANS 1128-2:2010	Fire-fighting equipment Part 2: Hose couplings, connectors, and branch pipe nozzle connections
SANS 1186-1:2008	Symbolic safety signs Part 1: Standard signs and general requirements.
SANS 1774:2007	Liquefied petroleum gases
SANS 3000-1:2009	Railway safety management National Railway Safety Regulator
SANS 10086-1:2003	The installation, inspection and maintenance of equipment used in explosive atmospheres
SANS 10089-2:2007	The petroleum industry Part 2: Electrical and other installations in the distribution and marketing sector
SANS 10087-3:2008	The handling, storage, distribution, and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500L
SANS 10087-4: 2011	The handling, storage, distribution and maintenance of LP gas in domestic, commercial and industrial installations Part 4: The transportation of LP gas including the design, construction, inspection, fittings, filling, maintenance and repair of LP gas bulk vehicles and rail tank cars
SANS 10108:2014	The classification of hazardous locations and the selection of apparatus for use in such locations
SANS 10111:2011	Engineering drawing
SANS 10121:1977	Cathodic protection of buried and submerged structures
SANS 10123:2014	The control of undesirable static electricity
SANS 10140:2003	Identification of Colour Markings Part 3: Contents of pipelines
SANS 10142-1:2012	The wiring of premises Part 1: Low-voltage installations
SANS 10160:	Basis of structural design and actions for buildings and industrial structures
SANS 10228:2012	The identification and classification of dangerous goods for transport by road and rail modes
SANS 10263-0:2003	The warehousing of dangerous goods - enclosed storage areas and covered and uncovered outdoor storage yards
SANS 10400:1990	The application of the National Building Regulations
SANS 10400 T: 2011	The application of the National Building Regulations Part T: Fire protection
SANS 60079-0/ IEC 60079-0	Explosive atmospheres Part 0: Equipment -General Requirements
SANS 60079-1/ IEC 60079-1	Explosive atmospheres -Part 1: Equipment by flame proof protection “d”
SANS 60079-7/ IEC 60079-7	Electrical apparatus for explosive gas atmospheres Part 7: Increased safety "e"
SANS 60079-10/ IEC 60079-10	Electrical apparatus for explosive gas atmospheres Part 10: Classification of hazardous areas
SANS 60079-11/ IEC 60079-11	Electrical apparatus for explosive gas atmospheres Part 11: Intrinsic safety "i"
Shell M.Eng 30:06:10:11 – 2003	Equipment in LPG installations
Shell M.Eng 30:06:10:12 - 2003	Pressurised bulk storage installations for LPG
Shell M.Eng 30:06:10:13 – 2004	LPG bulk transfer and transportation
Shell M.Eng 30:06:10:20 - 2006	ESD Systems for loading and discharging refrigerated and pressurised LNG and LPG carriers
SIGTTO	Society of International Gas Tanker & Terminal Operators
Engineering Profession Act, 2000 (Act No. 46 of 2000)	
Environmental Conservation Act, Act 73 of 1989	
Fire Brigade Act, Act 99 of 1987	
Government Notice No. 37305 of 07 February 2014 Construction Regulations	
Government Notice No. R. 1593 of 12 August 1988 Facilities Regulations	

Government Gazette No. 34995, Notice number 79, Regulation number 9672 Pressure Equipment Regulation	
Hazardous Substance Act, Act, Act 15 of 1973Regulations for Hazardous Chemicals substances, R1179 Aug 1995	
The National Building Regulations and Building Standards Act, Act No.103 of 1977	
National Disaster Management Act, Act 57 of 2002	
National Environmental Management Act, Act 107 of 1998	
National Ports Act, Act 12 of 2005	
National Railways Regulator Act, Act 16 of 2002	
Regulations for Hazardous Chemicals substances, R1179 Aug 1995Environmental Conservation Act, Act 73 of 1989	
The Occupational Health and Safety Act, 1993 (OSHA, ACT 85 OF 1993)	
Trade Metrology Act, Act No. 77 of 1973	
CONTROL	
SANS 60044 1 to 14	Instrument Transformers
SANS 62040 1 to 3	Uninterruptable Power Supplies
SANS 62099	Fibre Optic Wardlength Switches
SANS 62103	Electronic Equipment for use in Power Installations
SOFTWARE	
SANS 9126	Software Engineering
LIGHTING	
SANS 10389 1 to 3	Exterior Lighting
SANS 10114 1 to 2	Interior Lighting
SOFTWARE/INFORMATION TECHNOLOGY	
SANS 9127	Information Processing
SANS 10340 1	Fibre Optic Cables on Buildings
SANS 14598 1 to 6	Software Product Evaluation
SANS 14756	Measurement of Rating- Software Systems
SANS 14764	Software Maintenance
SANS 15939	Software Measurement Processes
SANS 16642	Terminology on Computer Applications
SANS 18019	User Documentation for Computer Software
SANS 61930	Fibre Optic Terminology
SANS 61931	Fibre Optic Graphical Symbology
SANS 9003	Guidelines for IS09001 for Computer Software
ELECTRICAL	
SANS 1019	Standard Voltages, Currents and Insulations Levels for Electricity Supply
SANS 1804 1 to 4	Low Voltage Induction Motors
SANS 10131	Lightning Protection of buried and submerged structures
SANS 10121	Cathodic Protection of buried and submerged structures
SANS 10123	Control of undesirable static electricity
SANS 10142 Part 1	Wiring of Premises-Low Voltages Installations
SANS 10198 1 to 14	Selection, Handling , Installation of Power Cables not exceeding 33KV
SANS 10199	Design and Installation of Earth Electrodes
SANS 10292	Earthing of Low Voltage Distribution Systems
SANS 50091 1 & 2	Uninterruptable Power Supplies
SANS 60034 1 to 26	Rotating Electrical Machines
SANS 60079 1 to 27	Electric Apparatus for Explosive Gas Atmospheres
SANS 60529	Degrees of Protection provided by Enclosures
SANS 60947	Switchgear, Controlgear, Low Voltage
SANS 61000 1 to 6	Electromagnetic Compatibility (EMC)
SANS 61024 1 to 2	Protection of Structures against Lightning
SANS 61312 1 to 4	Protection Against Lightning Electromagnetic Impulse

6 PRODUCT SPECIFICATION

6.1 LPG CHARACTERISTICS

SANS 1774:2007 Edition 1.3 Liquefied Petroleum Gases regulates the requirements of LPG as per Table 5.

Table 5: SANS 1774:2007 Properties of LPG

Property	Requirements			Test Method
	LPG Mixture	Propane	Butane	
Total acetylene (mol % max)	2.0	2.0	2.0	IP 264
Total C2 hydrocarbons content (mol % max)	8.0	8.0	-	
Total ethylene content (mol % max)	1.0	1.0	-	
Total dienes content (mol % max)	10.0	-	10.0	
Total C4 and higher hydrocarbons content (mol % max)	-	10.0	-	
Total C5 and higher hydrocarbons content (calculated as n-pentane) (mol % max)	2.0	2.0	2.0	
Vapour pressure (at 37.8°C kPa (gauge))	750 – 1,050	1,100 – 1,410	480 max.	ASTM D1267 IP 410 IP432
Corrosion copper strip (1h @ 37.8°C) Classification max	1	1	1	ASTM D1838
Free water content	None	None	None	
Total Sulfur content (mg/kg max)	200	200	200	ASTM D2784 ASTM D3246 ASTM D5453 IP 243
Residual matter a) residual on evaporation (ml/100ml max) b) oil stain observation (using 1.5ml of solvent-residue mixture)	0.005 No oil ring shall persist when assessed in terms of 9.2.2 of ASTM D2158/7.7 of IP 317	0.005	0.005	ASTM D2158 IP 317
Odorization ethyl mercaptan (µL/L min)	15	15	15	ASTM D5305
Density (at 20°C Kg/m^3 min)	500	-	-	

The composition of South African grade LPG varies and can technically be compliant as high as a propane rich ratio of 70/30 Propane (C3) / Butane (C4) by mass. The higher C3 mass is favoured due to its pricing advantage over C4. Above 70% C3 the vapour pressure of the LPG mix exceeds compliance.

However, the terminal shall be designed around **100% C3** storage to ensure not only flexibility but for future redundant cost recovery. C3 develops a much higher ambient vapour pressure over that of C4 and such pressure vessels and systems are designed for the higher developed pressures associated with C3.

6.2 CHARACTERISTICS OF BUTANE AND PROPANE

The Characteristics of Butane and Propane considered for the design is given in

Table 6.

Table 6: Characteristics of Butane and Propane

Characteristics	Butane	Propane
Molecular Formula	C4H10	C3H8
Molecular Weight	58.122 g/mol	44.096 g/mol
Solid Phase		
Melting Point	-138.29°C	-187.68°C
Latent Heat of Fusion (1.013 Bar at melting point)	80.193 kJ/kg	79.917 kJ/kg
Liquid Phase		
Liquid Density (1.013 Bar at boiling point)	601.26kg/m^3	580.88kg/m^3
Liquid/gas equivalent (1.013 bar and 15°C)	236.4 vol/vol	305.9 vol/vol
Boiling Point (1.013 bar)	-0.49°C	-42.11°C
Latent heat of vapourisation (1.013 Bar at boiling point)	385.71kJ/kg	425.59kJ/kg
Vapour pressure at 21°C	2.155 bar	8.587 bar
Critical Point		
Critical temperature	138.26°C	96.74°C
Critical pressure	37.96 bar	42.51 bar
Critical density	228 kg/m^3	220.48 kg/m^3
Triple Point		
Triple point temperature	-187.62°C	-187.62°C
Triple point pressure	6.736E-06 bar	1.724E-09 bar
Gaseous Phase		
Gas density (1.013 Bar at boiling point)	2.7093 kg/m^3	2.417 kg/m^3
Gas density (1.013 bar and 15°C)	2.5436 kg/m^3	1.8999 kg/m^3
Compressibility Factor (Z) (1.013 bar and 15°C)	0.96616	0.98194
Specific gravity	2.08	1.55
Specific volume (1.013 bar and 25°C)	0.4084m^3/kg	0.546m^3/kg
Heat capacity at constant pressure (Cp) (1.013 bar and 25°C)	0.1006kJ/(mol.K)	7.430001E-02kJ/(mol.K)
Heat capacity at constant volume (Cv) (1.013 bar and 25°C)	0.0911 kJ/(mol.K)	0.654 kJ/(mol.K)
Ratio of specific heats (Gamma: Cp/Cv) (1.013 bar and 25°C)	1.1052	1.1364
Viscosity (1.013 bar and 0°C)	6.769E-05 Poise	7.4692E-05 Poise
Thermal conductivity (1.013 bar and 0°C)	14.189 mW/(mK)	15.65 mW/(mK)
Other		
Solubility in water (1.013 bar and 20°C)	0.035 vol/vol	0.039 vol/vol
Autoignition temperature	470°C	405°C
Major Hazard	Fire	Fire
Toxicity	800ppm	2,500ppm
Flammability in air (STP conditions)	1.5 – 8.5 vol%	2.2 – 9.5% vol%

UN Number	UN1011	UN1978

Vapour pressure curves for pure butane, propane and mixtures thereof are displayed below; the curves indicate the anticipated pressure of storage at various temperatures. By way of example, the vapour pressure curve for butane (*Figure 5*) indicates that at a temperature of 20°C, the anticipated pressure of a vessel containing pure butane would be approximately 2 bar gauge. The curves for both components as well as mixtures thereof indicate increasing pressure with increasing temperature (*Figure 5*, *Figure 6* and *Figure 7*).

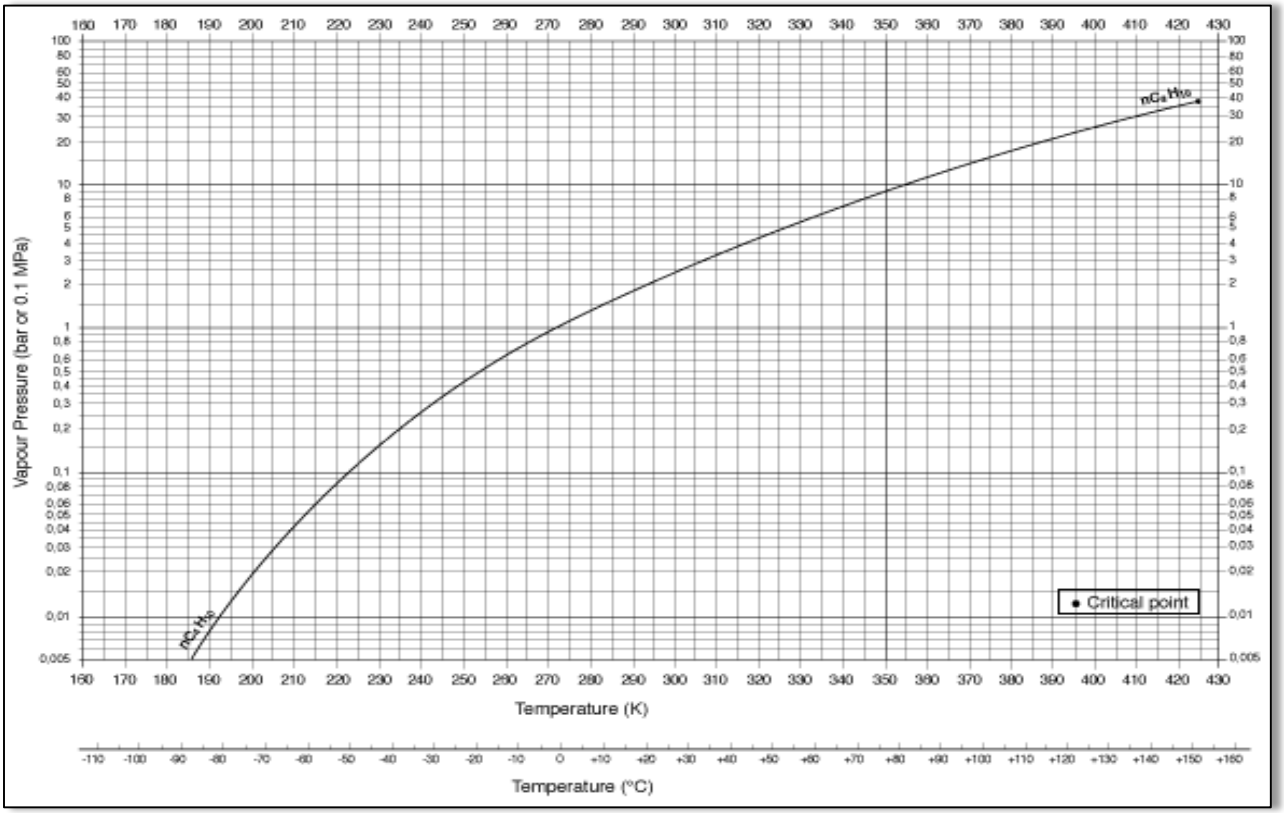


Figure 5: Butane pressure vs. temperature graph

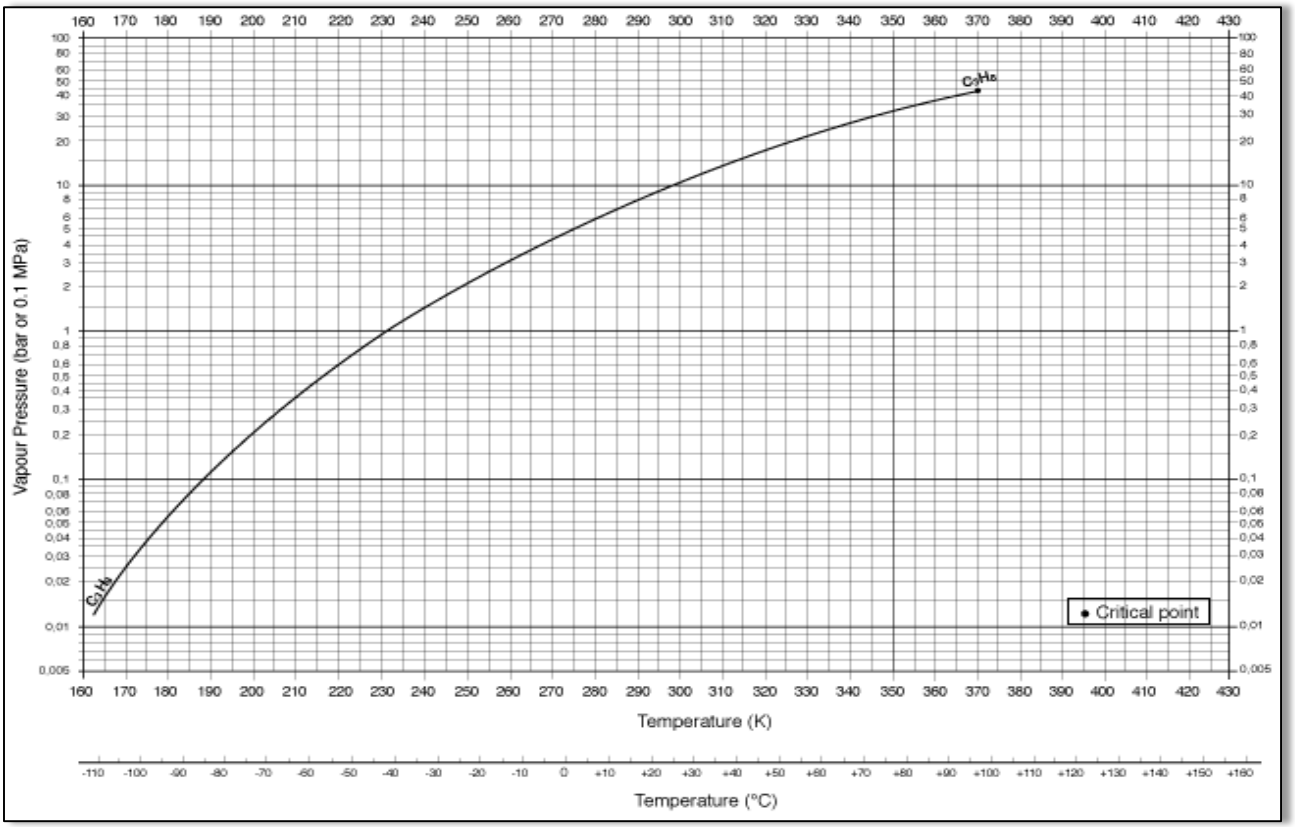


Figure 6:Propane pressure vs. temperature graph

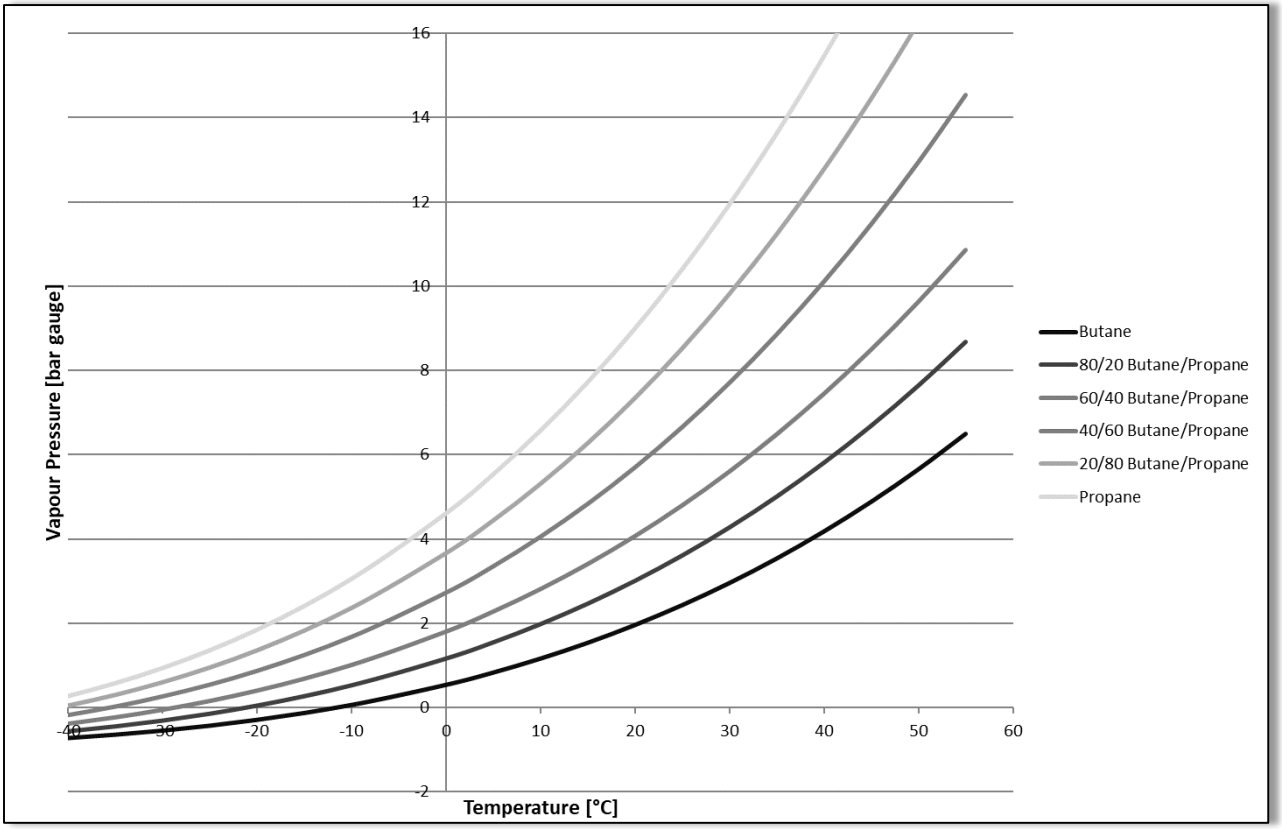


Figure 7: LPG Mixture pressure vs. temperature graph

6.3 LPG ODORIZING (STENCHING)

The terminal design shall cater for Mercaptan Injection operations as per the required >15ppm; the following operations shall be considered;

Operation 1 – If a marine vessel cargo has not been odorized it shall be dosed into the imported LPG stream but shall also allow for dosing of exported product if necessary.

Ethyl Mercaptan shall be used as a stanching agent. Chemical properties of Ethyl Mercaptan are indicated in Table 7 below;

Table 7: Ethyl Mercaptan Properties at 20°C

Molecular Formula	C2-H6-S
Boiling Point	35.1°C
Density	845kg/m^3
Vapour Pressure	56Kpa
Viscosity	0,316cP
Flash Point	-48.3°C
Autoignition	289.9°C
Flammability Range	2.8 to 18 % in air
ID Number	UN2363

7 LPG TRANSFER DESIGN PHILOSOPHY

The design shall provide the following LPG transfer functions:

- Road Tanker loading at 60m^3/hr per gantry.
- Export loading 400m^3/hr
- Inter tank transfer

The design will allow for the following transfer operations simultaneously without impeding or interruption of each of the individual operations:

- LPG import transfer shall operate independently or whilst any other transfer operation/s, is taking place (except export).
- LPG export transfer shall operate independently or whilst any other transfer operation/s, is taking place (except import).
- LPG road tanker single or multiple gantry loading operations.
- LPG storage vessel to storage vessel transfer. (stand-alone operation)

The design shall also allow for the following transfer operations;

- LPG import directly to road tanker loading operations.
- LPG pipeline liquid evacuation and vapour recovery with return to storage tank.
- LPG mixing of propane and butane when stored individually to mix storage tank, road tanker loading, or export.

8 PROCESS DESIGN

A typical overview schematic of the LPG terminal facility is graphically represented in Figure 8;

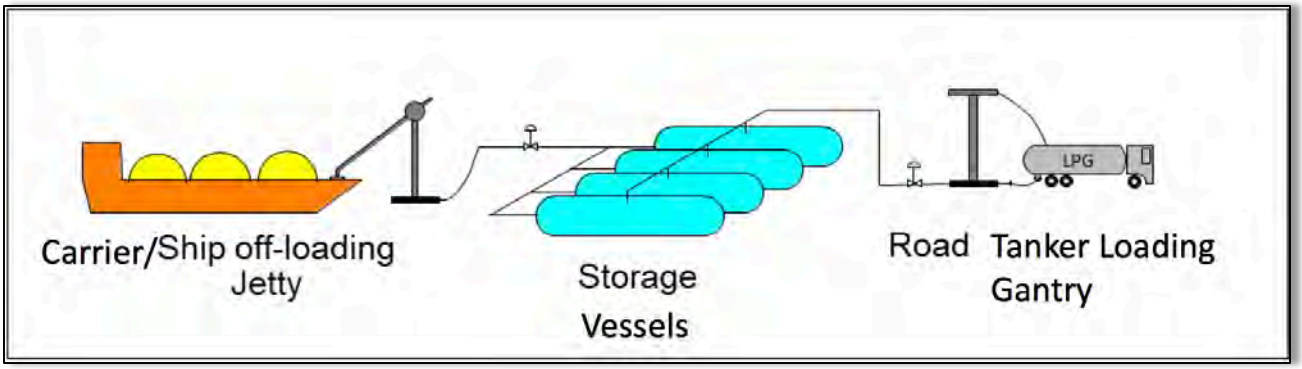


Figure 8: Schematic Overview of the LPG Terminal

8.1 FUNCTIONAL BLOCK FLOW DIAGRAM

The terminal functions are allocated to several main systems/components as listed below and illustrated in Figure 9.

- LPG receiving jetty;
- LPG receiving terminal;
- LPG conveyance to storage vessels;
- LPG storage vessels;
- LPG transfer house and odorization system;
- LPG truck loading gantry;
- Plant administration and master control centre;
- Fire protection system;
- Weigh bridge;
- Waste water management system;

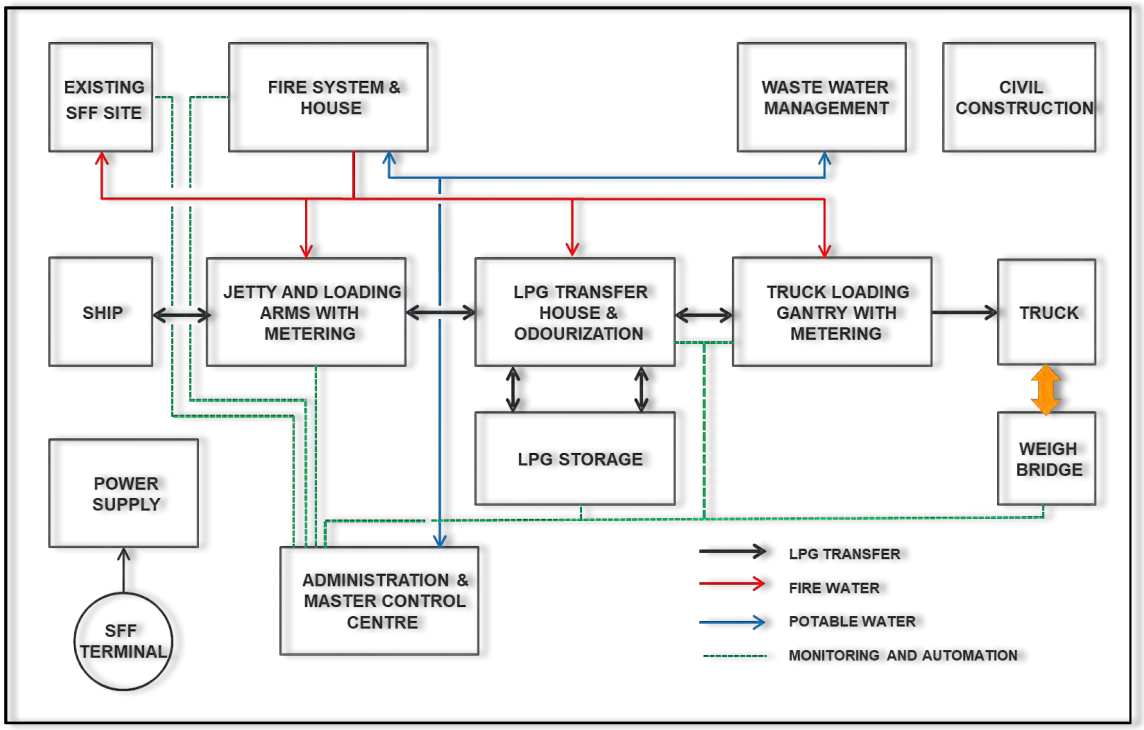


Figure 9: LPG Terminal Block Flow Diagram

8.2 MAJOR EQUIPMENT SELECTION

The design of the terminal will require the upfront selection of key equipment. For the facility under consideration the critical component includes the capacity, type and design of the LPG product storage vessels. Other equipment and balance of plant equipment have limited cost impacts and are therefore not considered in the selection of the major equipment for the terminal.

8.2.1 Storage Capacity of Individual LPG Vessels

The design basis calls for a terminal capacity of 8,000-metric tonnes. While the capacity requirements could be fulfilled by the construction of a single storage vessel of 8,000-metric ton capacity, the terminal flexibility of operation would be significantly reduced if a single vessel is selected. The use of a single storage vessel would not permit for the storage of different mixtures of LPG and the terminal would be restricted in terms of managing product qualities. Maintenance and inspection of the vessel will also constrain the storage of LPG.

In consideration of multiple vessels to allow for terminal flexibility, the increase in the number of vessels results in a larger terminal footprint and requirement for separation distances between vessels as well as other forms of storage infrastructure. A further consideration in the selection of the number of vessels is the additional requirements for pipework, valves and instrumentation which should be fitted to each vessel.

Based on the initial 8,000-metric ton terminal capacity and operational flexibility requirements, it is recommended that the use of two equal sized (approx. 4,000 metric ton) storage vessels be considered for the project. The design will also consider the allocation of plot space for the future seamless integration of additional capacity for the terminal.

8.2.2 Storage Type – Refrigerated vs Ambient

There are several options in respect to the type of LPG storage as listed below:

A. Fully Refrigerated – a low temperature (-40°C) and low-pressure (≤ 20kPa) storage operation that only becomes feasible at volumes of ≥80,000m^3 (approx. 40,000 metric tons) due to the economics of construction and operation. The process control, operation and maintenance are the most complex of the different storage types and together with the economic factors, we have therefore discounted from the pre-feasibility study.

B. Semi Refrigerated – similar to the fully refrigerated option, however a higher temperature (-5°C to +5°C) and low pressure (≤ 600kPa) storage operation and is a consideration where volumes are below 80,000m^3 (approx. 40,000 metric tons). The process control, operation and maintenance are far more simple means of storing LPG than fully refrigerated storage. This option shall also be discounted from the pre-feasibility study as it does not provide any significant benefits over a Pressurised / Ambient system (described in C below), furthermore, the costs of construction are greater for no additional benefit.
C. Pressurised / Ambient – A pressurised or an ambient system is the most common form of LPG storage. Pressurised storage is the least complex means of storing LPG and the least costly and have therefore been identified for use in this project. This option will be considered with a chiller pack as described below.

For vessels with capacity greater than 2,000m^3 (approx. 1,000 metric tons), an industrial chiller pack can be considered to alleviate the wasted ullage space required for liquid expansion at higher ambient temperatures. The liquid expansion at these higher temperatures reduces the available useful storage by more than 10% and effectively increases the cost of storage. The chiller pack reduces the storage temperature to between +5°C to +10°C and provides useful storage of up to 98% of the vessel volume.

Due to the simplicity of operation as well as the capacity of the terminal, the pressurised/ ambient storage option is recommended for the project, furthermore the pre-feasibility study will include a chiller unit due to benefit of increase in storage capacity.

8.2.3 Storage Design – Mounded vs Aboveground

Mounded storage refers to a vessel containment scheme that is buried, this may include the storage being covered by means of soil, sand or other suitable material.

The major considerations of mounded storage include:

- A significant reduction in risk due to accidental collision;
- A stable and consistent temperature operating envelope due to natural insulation;
- A reduction in the required safety distance between the vessel and surrounding infrastructure;
- Very limited and in some cases no fire protection requirements;
- Optimised use of land, higher storage volume per land area required.

Aboveground storage vessels are exposed to the elements and surroundings. The considerations of aboveground storage include:

- Reduced construction complexity in comparison to mounded storage;
- Construction cost benefits over mounded storage;
- This type of storage requires large volumes of firewater, based on storage spheres, the requirement of SANS 10087 – Part 3 calls for 10 litres per square meter per minute (10l/m^2/min). This would result in a water requirement in excess of 2.3 million litres. This again raises the cost of the storage.

A further option includes aboveground storage with passive fire protection. This option makes use of a pyro-coat scheme. The storage vessels are coated with a fire protective coating that provides an approximately 2-hour fire protective system. The aboveground storage with passive fire protection may be considered in the event of prohibitive geotechnical and other site-specific conditions associated with the mounded solution, and the costs vs risks warrant a higher risk profile. This is not expected to be the case for the SFF facility.

The recommended option for the SFF pre-feasibility study is the mounded storage design, the key justification for this selection is due to:

- The firewater requirements of an aboveground installation and considering the water conservation requirements of the Western Cape this factor alone motivates our recommendation of mounded storage over an aboveground storage vessel.
- The mounded design provides an intrinsically passive safe environment that significantly reduces the risk profile, reduces safety distances and consequent land size requirements, and removes the possibility of a “BLEVE” (Boiling Liquid Expanding Vapour Explosion) which in all LPG Terminal QRSA is the primary prevention focus.

8.2.4 Storage Design – Bullets vs. Spheres

Bullet storage is a term used to describe traditional horizontal style storage vessels. The major advantages and disadvantages are tabulated below.

Table 8: Bullet storage considerations

Advantages	**Disadvantages**
Workshop construction provides for less construction man-hours and shorter completion dates.	The storage size per m^2 is greater than what can be achieved with Spheres.
Provides for a less complex construction when incorporated as part of a mounded design.	Incremental building is more complex when increasing mounded bullet storage for future expansion.
The vessels provide for a higher redundancy recovery as they can be removed and relocated in the future.	Transportation is more complex and costly

Sphere storage is a term used to describe spherical style storage vessels. The major advantages and disadvantages are tabulated below.

Table 9: Sphere storage considerations

Advantages	**Disadvantages**
Greater vessel capacity per size of land utilisation	The environment of construction is less controlled (as opposed to workshop facility) and can interrupt construction timeline.
Construction on site removes the need for a viable transport route that is required for workshop construction.	The quality control of site build vessels is more difficult in a site environment.
Provides for a less complex construction when incorporated as part of a mounded design.	The vessels do not have a high redundancy recovery as they can't be moved and relocated in the future.
Allows for a greater ease of incremental building to increase storage at any time in the future.	

While both options provide for a suitable solution, the recommended option for the SFF terminal is the use of Sphere storage. The primary reasons for the selection of Spheres are:

- Local bullet workshop fabricator costs are extremely uncompetitive, when compared to global market pricing schedules and could be a project stopper;
- The bullet fabrication option would prevent significant labour opportunities from realising in an area of high unemployment;
- Storage capacity per hectare of land utilization is maximised with the sphere solution;
- The ease of incremental building for expansion over bullet-mounded schemes.

Sphere construction mitigates extremely uncompetitive local bullet fabrication costs and provides a compromised approach to construction where materials and local labour could be successfully managed for the benefit of local employment and a far greater economic viability for SFF.

8.2.5 Jetty Offloading Design – Loading arms vs. flexible hoses

The two most popular methods to load or off-load LPG are loading arms or flexible hoses The major advantages and disadvantages of loading arms compared to flexible hoses are tabulated below.

Table 10: Loading arms advantages vs. flexible hoses

Advantages of Loading Arms	Advantages of Hoses
Superior performance.	Less costly
Better durability and reliability	More flexibility
Higher throughput	Lighter
Low Maintenance	
Long life	
Few spare parts	
Less risk of spillages and trips, and better safety	
Don’t require hydrostatic testing	

It is recommended that Loading arms are considered.

8.3 PROCESS FLOW DIAGRAM

8.3.1 Process Flow Development

The Process Flow Diagram (PFD) or flowsheet, identifies all the equipment items and the process streams. For the SFF LPG terminal, the operational requirements set out in the Client Requirement Specification (CRS) and the design basis have been used to prepare the process flow diagram.

A staged approach was employed to develop the process flow diagram for this prefeasibility study, the approach is summarised in Figure 10.

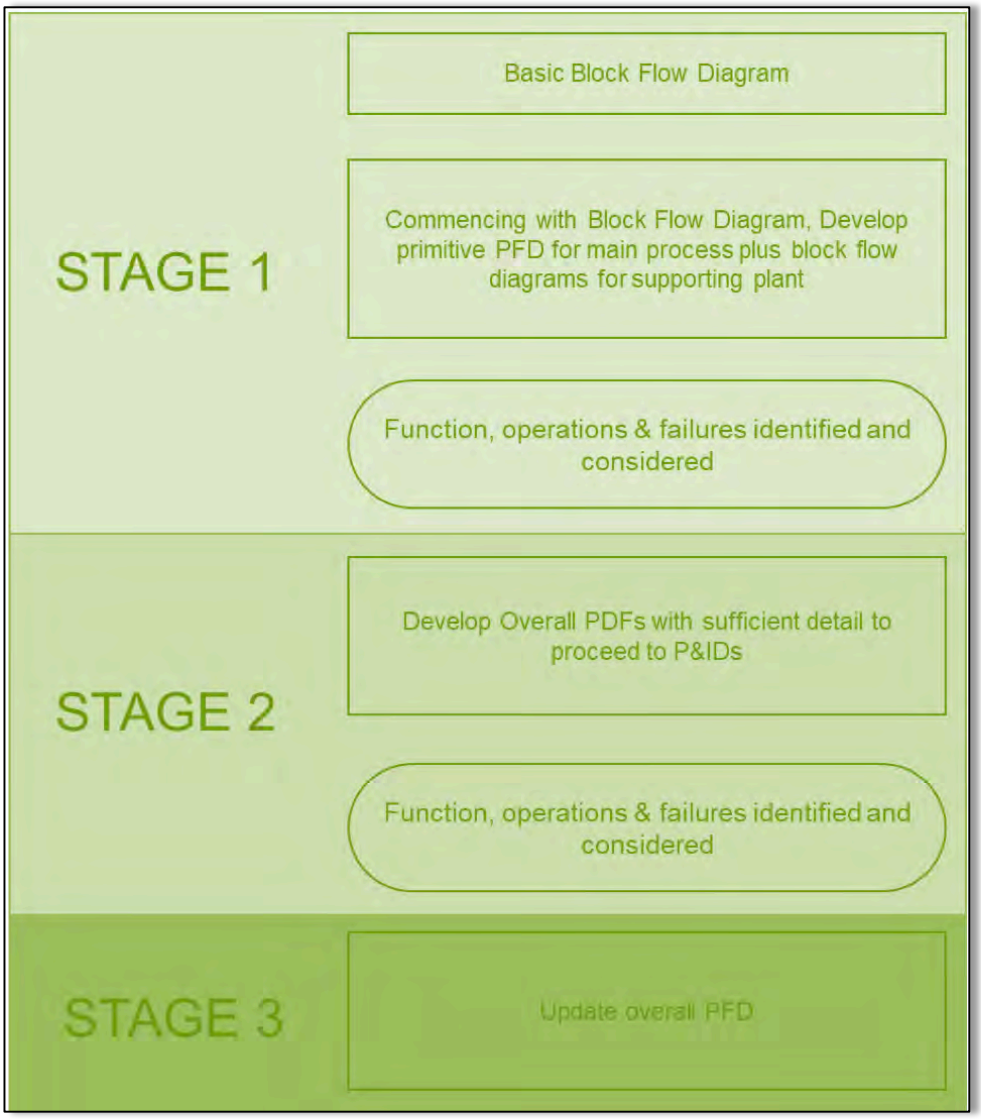


Figure 10: Approach to PFD Development

The above structured approach to the development of the PFD resulted in the draft PDF which is displayed in Figure 11 (Also available as addendum to the process design package).

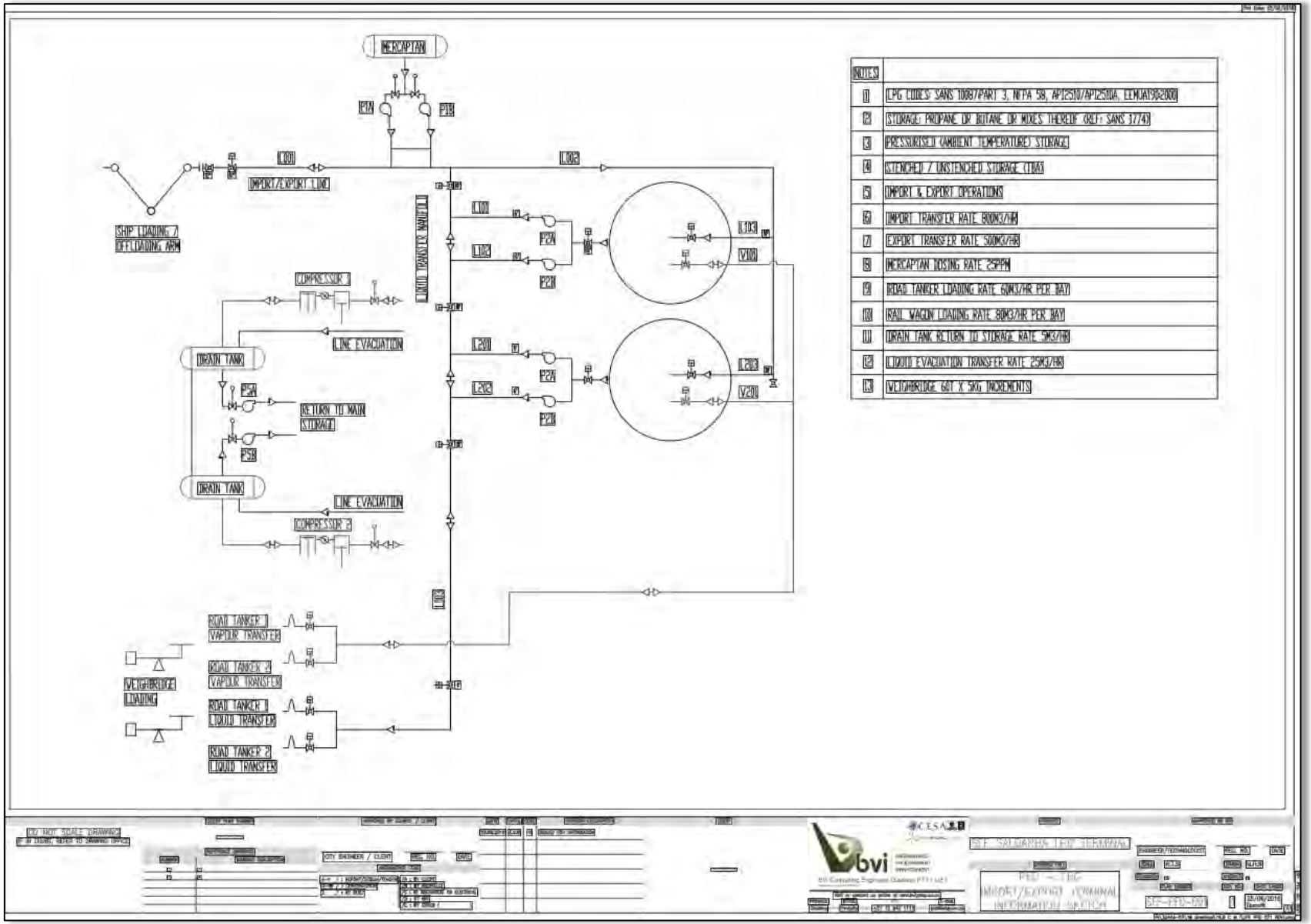


Figure 11: PFD (See Addendum for Full Scale Drawing)

8.3.2 Process Flow Description and Operational Description

The PFD indicates critical equipment and main values which will be required to ensure terminal operations are in accordance with the desired modes of operation.

The overall PFD displayed in Figure 11 depicts all major terminal components relating to the import/export, storage and distribution of LPG. The PFD is read from left to right and is described further below.

8.3.2.1 Import/Export Operations

Import of product is defined as the flow of product from cargo carrier on the jetty to the storage vessels at the LPG terminal on the SFF site. Export is defined as the flow of product in the opposite direction.

Cargo carrier loading/offloading is accomplished via the import/export line. During import operations, the cargo carrier product pumps will be used to deliver product from the cargo carrier storage to terminal storage, the delivery of product into the terminal storage is depicted by the liquid line indicated at the centre of each tank.

For cargo carrier export operations, both sets of terminal pumps (P2A/P2B) will be used to deliver product from the terminal storage to the cargo carrier. The terminal will not be capable of simultaneous import/export operations as there will only be a single line for import and export operations and flow will be in a single direction for all operations. The terminal will be capable of simultaneous road tanker loading and cargo carrier export.

8.3.2.2 Odorization

The PFD indicates odorization prior to storage. Un-stenched product will be subjected to the injection of a mercaptan to ensure that only stenched product is stored at the terminal. The PFD indicates the configuration of the odorization system which will be used during import operations.

8.3.2.3 Storage

The PFD indicates two spheres for storage with an option for expansion of the facility by the addition of spheres. The PFD displays the possible future addition of a single sphere however the limitation would be governed by the available site area and multiple additional spheres could be installed for future expansion. For expansion considerations, reference is made to the proposed site layout. The LPG storage shall normally be at a chilled condition of +5°C to +10°C. This provides for increased fill levels based on the lower thermal expansion of the stored contents and faster transfer times to road tankers and cargo carrier export. The chiller unit shall comprise of two air cooled glycol closed loop commercial chiller pack system, each chiller will be fitted to a storage vessel and will recirculate product to ensure stable operating temperatures. Vessel to Vessel transfer is also provisioned via the use of either vessel liquid discharge pumps (P2A/P2B), during this operation the vessel pressures are equalised after which transfer can commence.

8.3.2.4 Road Tanker Loading

The PFD indicates liquid and vapour connections to the road tanker loading area. Transfer is achieved via the pumps (P2A/P2B) from storage vessel to road tanker. Before the transfer can commence, the vapour and liquid lines are connected to the applicable road tanker and the pressure of the tanker and storage are equalised through the vapour connection. Pumping of product then commences and vapour that is displaced from the road tanker is recovered back to storage via the vapour lines. The custody transfer of product is achieved by the inclusion of two 60-ton weigh bridges which constantly monitor the road tanker weight to deliver the desired quantity of product.

8.3.2.5 Product Recovery System - Line Evacuation

The PFD also indicates the product recovery system which will be utilised in the event of product recovery from various transfer lines and road tankers.

Product recovery from lines will be achieved by allowing the lines to drain liquid into the drain tanks, thereafter the drain tank compressors will be employed to draw down the line pressure and recover product. All product collected in the drain tank will then be pumped back to storage.

Product recovery from road tankers may be required from time to time, this will be facilitated via the use of the mandatory on board pump located on the road tanker. The road tanker will pump product at approximately 16m^3/hr to the storage vessel. Once the discharge of liquid is complete the drain tank compressors will be used to draw down the road tanker pressure and recover product.

8.4 MATERIAL BALANCE

Material and Energy Balances are given for each of the various operating cases and design modes. For the purposes of the SFF material and energy balances, the product specifications for propane has been indicated due to the higher vapour pressure of this component when compared to butane or any anticipated product mixtures.

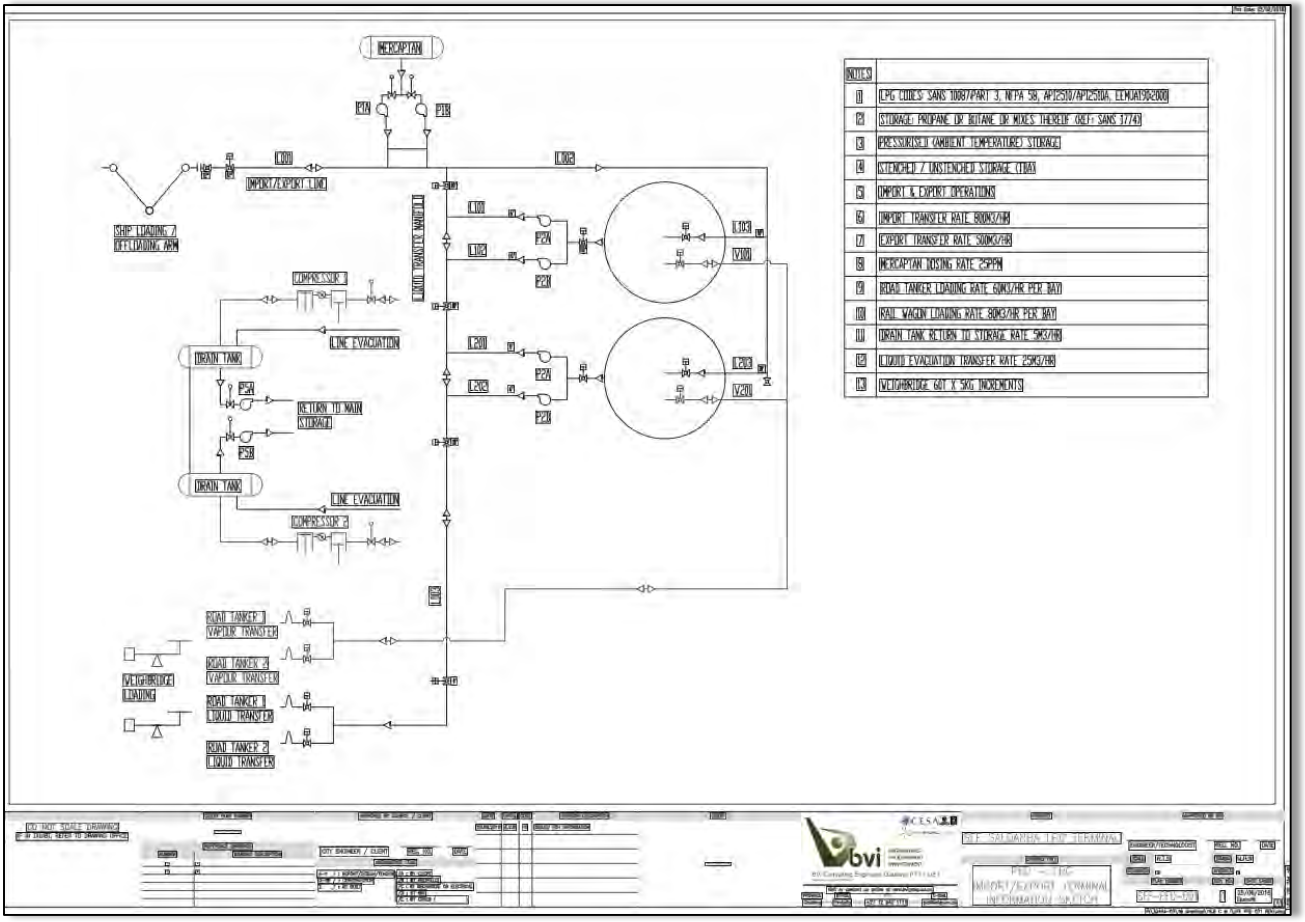


Figure 12: Material Flow Diagram (see addendum for full drawing)

The Material Balance values per stream condition is provided in **Table 11**.

Table 11: Material Balance values per stream condition

Stream Number	L001	L002	L101/L102	L103	V101/ V201
Max Pressure [barg]	14	14	12	14	12
Min Pressure [barg]	8	8	8	8	5
Max Temperature [°C]	30	30	30	30	30
Min Temperature [°C]	0	0	5	5	5
Max Mass Flow [Tons/hr]	630	630	105	630	1
Min Mass Flow [Tons/hr]	158	158	11	11	0
Max Volumetric Flow [m3/hr] liquids, [Nm3/hr] vapour	1200	1200	200	1200	453
Min Volumetric Flow [m3/hr] liquids, [Nm3/hr] vapour	300	300	20	20	0

8.5 PIPING AND INSTRUMENTATION DIAGRAMS

A Piping and Instrumentation Diagram (P&ID) shows the piping and vessels in the process flow, together with the instrumentation and control devices. The P&ID's developed for the LNG facility is discussed below.

8.5.1 Berth Line and Odorization

The P&ID for the berth line is given in Figure 13 and indicates the various line sizes and equipment associated with the berth line, the line also incorporates a two way by pass arrangement which incorporates the product non-return valves. The by-pass arrangement allows for the use of the line for import and export purposes.

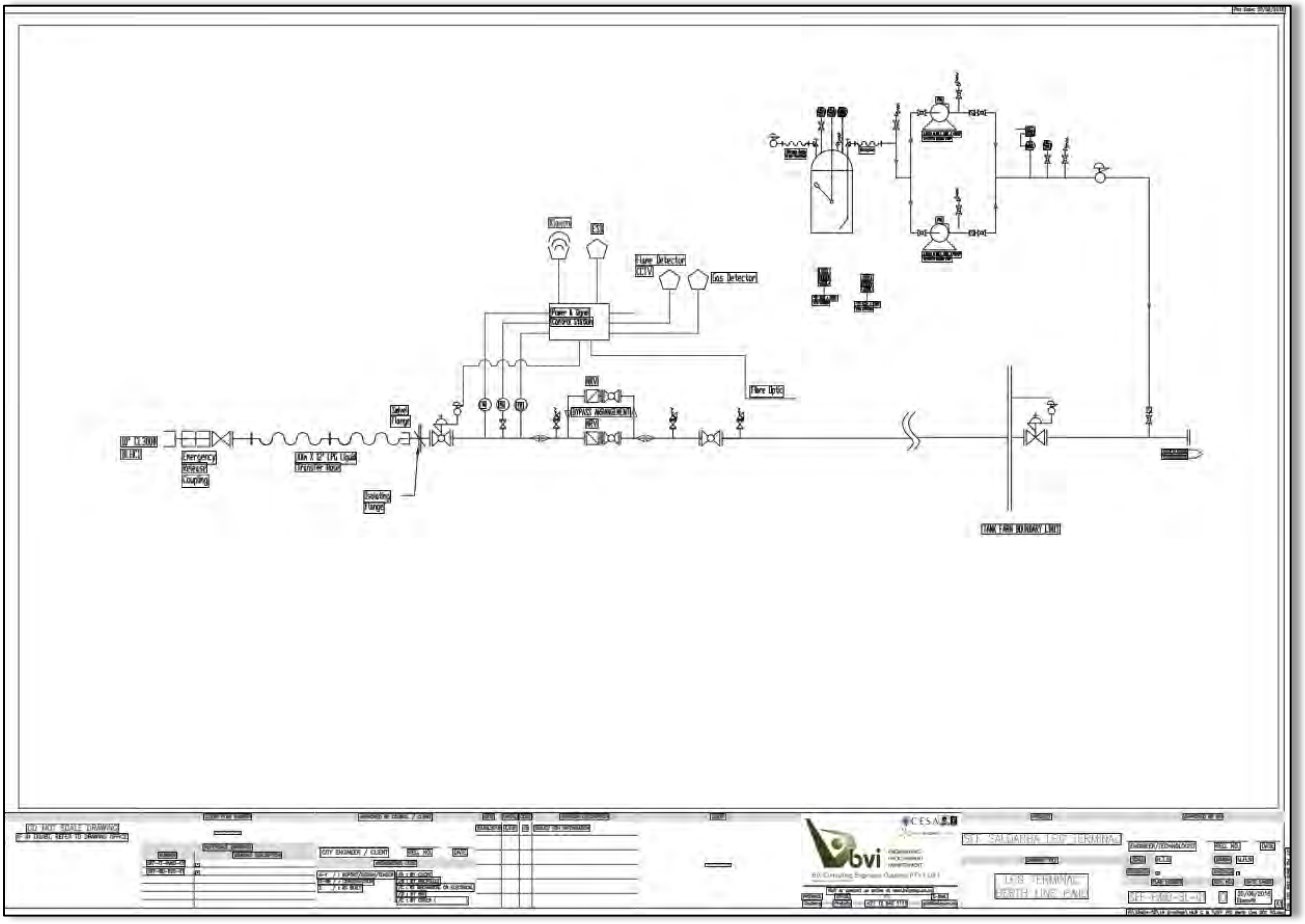


Figure 13: Berth line and Odorization P&ID (See addendum for full drawing)

Odorization equipment will be located on the terminal side to minimise operations on the jetty. Where lines may contain trapped liquid product, Pressure Relief Valves are installed to ensure pipeline operation within design conditions.

Custody transfer will be managed by appointed surveyors, whereby the appointed surveyor will record the cargo carrier inventory prior to discharge and after transfer completion. The storage vessels situated at the LNG terminal will be fitted with Servo gauges for accurate inventory measurement and custody transfer confirmation.

The LPG berth line will also be fitted with a Coriolis meter which will be used to monitor flow during operations, however, due to meter certification this meter will not be used for custody transfer. The storage vessel survey gauging will be the primary means of custody transfer measurement.

8.5.2 Tank Farm

The tank farm P&ID (Figure 14) displays the two storage spheres and associated equipment. Each storage sphere is fitted with the following connections:

- 1 x 12" liquid receipt connection

- 1 x 4” emergency liquid recovery connection
- 1 x 10” liquid export connection
- 1 x 4” liquid minimum flow connection
- 1 x 6” vapour vent header connection (compressor discharge)
- 1 x 4” vapour transfer connection (compressor suction)

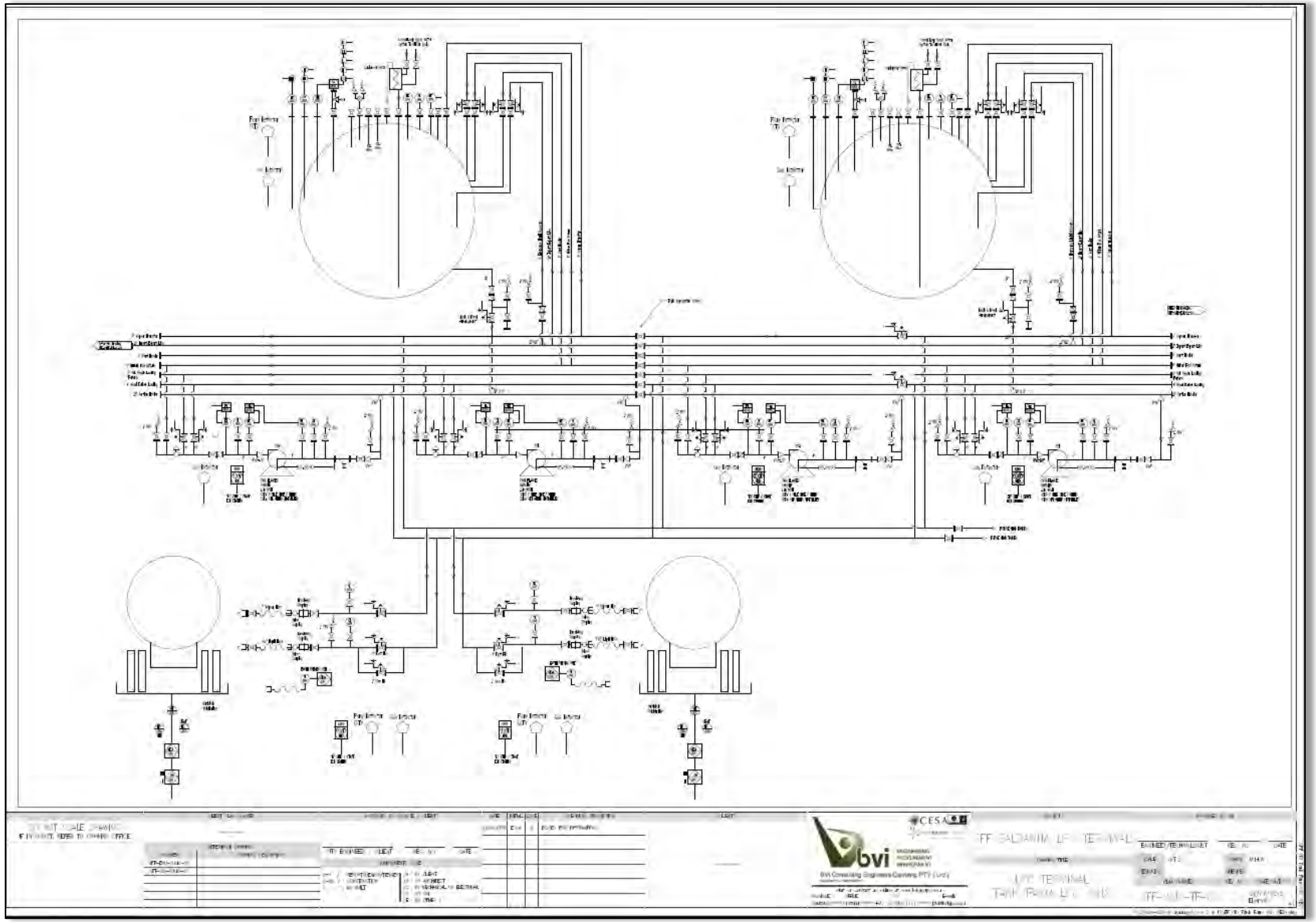


Figure 14: Tank Farm P&ID (See addendum for full drawing)

The vessels are also fitted with the necessary inspection man holes, tank gauging equipment as well as temperature and pressure monitoring equipment. The vessel over pressure protection provisions are catered for by the inclusion of Pressure Relief Valves.

8.5.2.1 Import Operations

During import operations, the vessel lined up to receive product will be isolated from all the liquid and vapour connections. The 12" liquid import line will then be opened to enable the receipt of product. During operations, the 12" liquid import line will be filled with product and liquid will be pumped via the cargo carrier pumps to the storage vessel.

After the receiving vessel has been filled to a certain level, the cargo carrier pumps will be stopped. The liquid line will be emptied by means of a vapour push. The cargo carrier will utilise on board compressors to achieve the vapour push. The current SFF facility is located roughly 10km from the jetty and the 12" liquid import /export line will contain an approximate volume of 820 cubic meters of product. Considering that each storage vessel will have a volume of 8181 cubic meters, the tank filling during liquid pumping will be limited to ensure that sufficient storage space is available for the receipt of the liquid in the import line.

The line will then be emptied by means of the vapour push. Once the vapour push is complete, and a custody transfer surveyor has confirmed quantity and quality of product, the cargo carrier may disconnect.

8.5.2.2 Export Operations

During export operations, both vessel pumps can be utilised to increase transfer rates. A maximum of 400m^3/hr can be achieved with the use of both pumps (P2A/P2B). The vessel under export mode will be lined up such that the liquid export connection is opened to the suction header. The liquid export pumps will draw product off the suction header and discharge product into the export line via the 12" import/export line.

During export operations, the facility can simultaneously dispense product to road tankers by closing of the tanker segregation valves on the 10" suction header line.

Liquid export pumps will be stopped once the vessel under export mode has been emptied. Thereafter the import/export line would require a vapour push to ensure no liquid product remains in the line. For the SFF terminal pre-feasibility study, vapour push from the LNG terminal to the cargo carrier has not been considered as the facility is not anticipated to perform export operations, however the integration of a vapour push compressor can be incorporated in future and the facility layout and piping systems will provide for this potential future requirement. The vapour push required to remove liquid from the import/export line will therefore be performed by cargo carrier vapour compressors and the liquid remaining in the import/export line will be transferred back to storage.

The implication of the above will result in export capacity being limited to approximately 95% of terminal storage capacity.

8.5.2.3 Inter-tank Transfer

To allow for product flexibility, inventory management and maintenance/inspections requirements, the terminal supports inter-tank transfer operations. Inter-tank transfer is achieved as follows:

- The vessel that is to be evacuated shall be lined with its liquid export connection opened to the 10" suction header.
- The vessel vapour connections (6" vent header) will be opened to allow for pressure equalisation between the tanks.
- The receiving vessel will be lined up to allow for product receipt via the minimum flow liquid line.
- Once the tank pressures have been equalised and the required vessel line ups confirmed, the discharging vessel pump will be started to commence liquid product transfer.
- Upon completion of the liquid discharge, the vessel to be evacuated will be connected to the drain tanker compressor to draw down the tank pressure and recover vapour product.

8.5.2.4 Road Tanker Transfer System

During road tanker filling, the dispensing storage vessel will be lined up with the liquid export connection opened to the suction header line. The pump used for transfer operations will be lined up so as to discharge product into the 4" road tanker loading line.

The tanker vapour space will be equalised with the storage vessel through the vapour connections situated at the loading bay. The vapour lines will connect to the storage vessel via the 4" vapour transfer connection. The liquid loading line will be connected to the road tanker via a 2" connection with suitable dry-break coupling to ensure minimum product loss in case of disconnection.

The liquid delivery line is also fitted with two flow regulators which enable the control of road tanker filling rate. These control valves are utilised to manage the start and completion of transfer with liquid loading rates lowered during road tanker top off.

The transfer pump in operation will be started up once all valve alignment and road tanker connections have been made. Transfer rates of 60 m^3/hr will be supported per road tanker bay. This transfer rate can be accomplished using a single transfer pump. Once the road tanker has reached a fill weight of 100 kg lower than the set point, the loading valve shall auto set to final slow fill transfer to maintain accuracy of loading. On the loading value being reached the loading valves shall close and if there are no other road tankers being loaded the pumps will stop.

8.5.2.5 Road Tanker Product Recovery

In the event of a road tanker requiring product recovery, the road tankers mandatory pump will be used to discharge product back to storage. The road tanker vapour connection to storage will be opened to allow for tanker – storage pressure equalisation. This will be achieved by the use of the vapour transfer line. The road tanker will commence product transfer via its on-board pump and liquid will be transferred back to the terminal storage via the minimum flow return line. Once liquid transfer is complete, the vapour space of the road tanker can be evacuated using the terminal drain tank compressor. The compressor will draw the vapours off the road tanker via the 4” vapour transfer connection and dispense compressed vapour back to the terminal storage tanks.

8.5.2.6 Product Chilling

The use of product chilling allows for the terminal to maximise on the quantity of product that can be held in the vessels. Each vessel will be connected to a chiller unit which will be sized to maintain product temperatures between +5 to +10°C. The chillers will be connected to the vapour space of the vessel and flow will be induced by the vessel vapour pressure. The chiller unit will decondense the vapours and return the liquid to the vessel. Each unit will be located in a safe zone and will be based on a water-glycol intermediate configuration.

8.5.3 Line Evacuation and Drain Tank

The Drain Tank and line evacuation P&ID is given in Figure 15. Line evacuation will be achieved by initially draining liquid into the drain tanks. Thereafter, the compression of vapour from the line into the drain tank vapour space will enable the reduction of the vapour line pressure to safe levels at which time venting can take place. The compressed vapours drawn from the line will be directed back to storage.

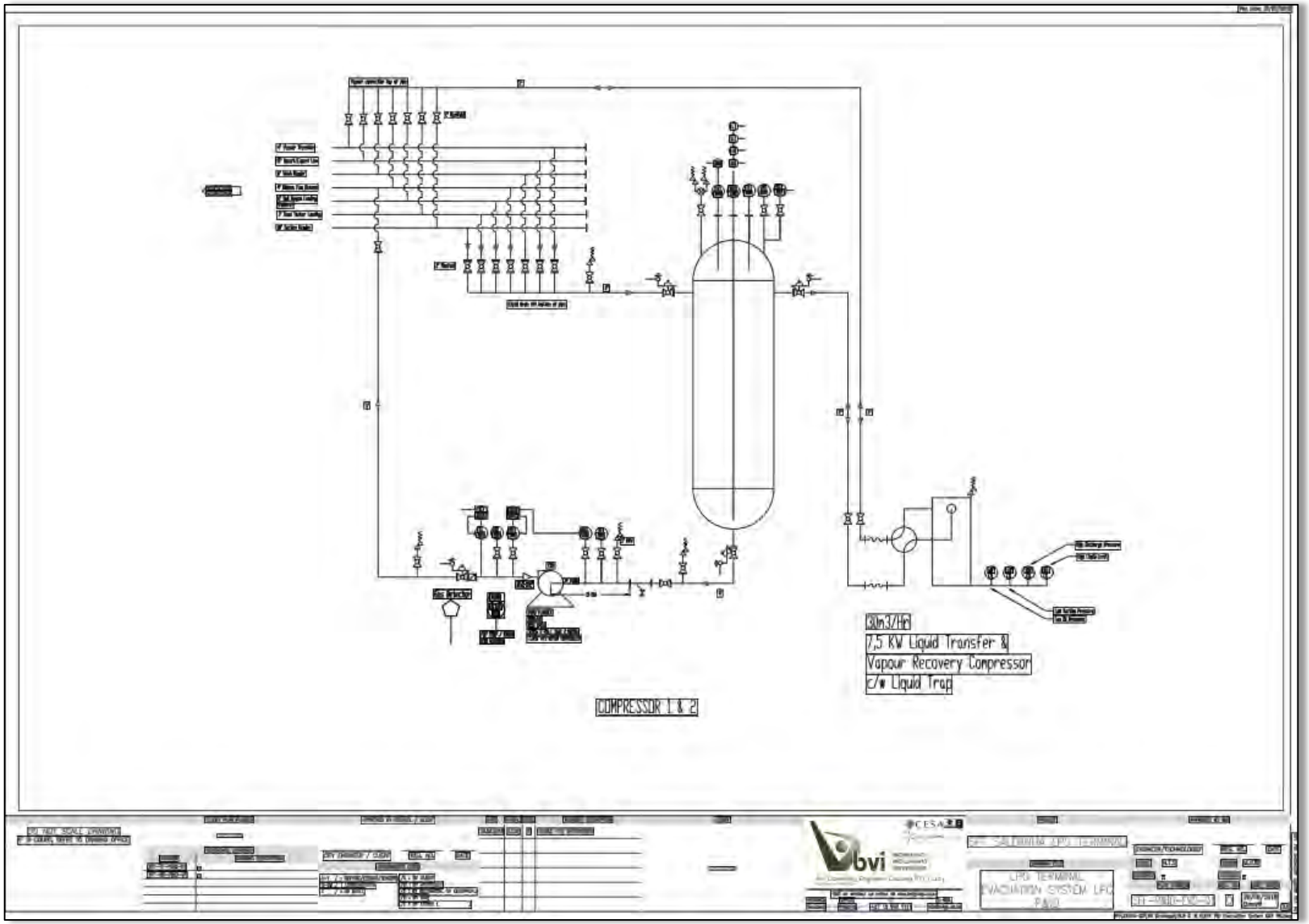


Figure 15: Drain Tank and line evacuation (See addendum for full drawing)

9 MARINE CONSIDERATIONS

9.1 BERTHING LOCATION

The berthing location will be responsibility of the SFF and will be informed by the CSIR study of berthing. The project can accommodate berthing of vessels on either side of the jetty and the exact equipment configuration and design should be carried out at the Feasibility stage of the project.

9.2 BERTHING LIMITATIONS

TNPA Web Site - Transnet National Port Authority (TNPA) Port of Saldanha Berth Details published on their web site Ref:http://www.transnetnationalportsauthority.net/OurPorts/Saldanah/Pages/Berths.aspx

Table 12: Berthing information

Berth	Speciality	Length	No. of Berths	Max. Draft	Max. DWT
Tanker	Oil Terminal Berth 1	365m	1	21.25m	320 000

Based on the information above all LPG Vessels including VLGC's would have no berthing limitations.

9.2.1 Marine Cargo Vessel Manifold Height

The Vessel Off - Loading / Loading design shall take into account the vessel information in Table 13.

Table 13: Vessel information

Vessel Category	Cargo Capacity	Elevation Relative to Sea	
		Not Greater Than at Min Operating Draught In Metres	Not Less Than at Max Operating Draught In Metres
A1	<6000m^3	10	2
A2	6001 – 15 000m^3	10	2
A3	15001 – 25 000m^3	12	4
A4	25001 – 50000m^3	16	6
B1	50001 – 70000m^3	16	6
B2	70001m3 – 85000m^3	18	8
B3	> 85001m^3	18	8

9.2.2 Marine Cargo Vessel Manifold Sizes

The Vessel Off - Loading / Loading design shall take into account the Marine Cargo Vessel Manifold Sizes in Table 14.

Table 14: Marine Cargo Vessel Manifold Sizes

Vessel Category	Diameter in Inches – Spec CL300#	
	Liquid	Vapour
A1	6	4
A2	8	6
A3	10	8
A4	12	8
B1	14	10
B2	14	10
B3	16	12

9.2.3 Marine Cargo Vessel Manifold Position

- Positioned as near as possible to the centre of the Vessel Starboard and Port but never shall be more than 4m away from the centre.
- General configuration of Liquid and Vapour layout connections are proposed as per Figure 16.

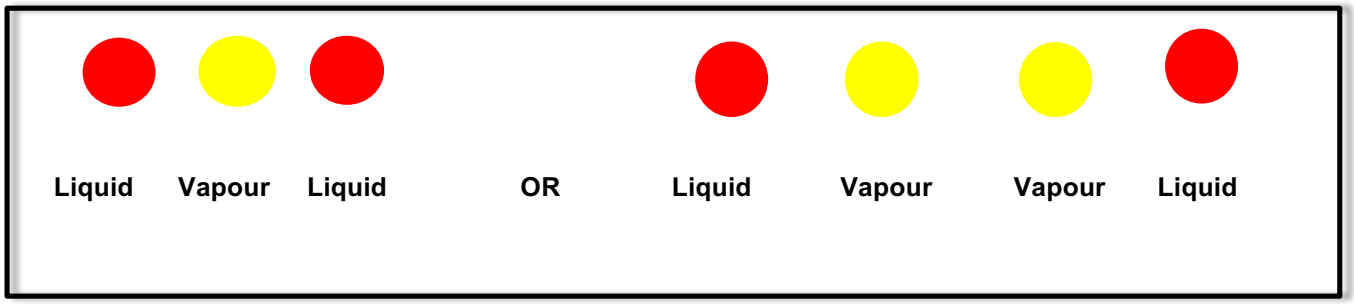


Figure 16: Manifold positions

10 CIVIL DESIGN

10.1 SITE SELECTION CRITERIA

The site selection criteria is discussed in Section 4.1.

10.2 GEOTECHNICAL INVESTIGATIONS (DESKTOP)

A geotechnical desktop summary of the area is provided in Appendix A. According to this study the site in question is predominantly overlain with collapsible aeolian dune sands and calcretized limestone outcrops only in certain areas. Once the project is elevated to the next stage a more detailed geotechnical investigation and testing of the in-situ soils is be required. The founding solutions proposals for both the tank mound structures & buildings in this report can only be confirmed on receipt of the more detailed geotechnical report.

10.3 PRELIMINARY DESIGN OF BERTHING STRUCTURES

All mooring infrastructure is available on the Saldanha side of the Jetty. If mooring will be conducted on the Langebaan side of the Jetty, fixed mooring points will have to be constructed. Fenders and Gangways, similar to the Saldanha side will have to be constructed. Electrical and I&C connections will also be required.

The infrastructure and systems that will be required to be constructed on the Jetty for LNG off-loading will be limited to the be loading arms or flexible hoses (refer Section 8.2.5 for a comparison between these) and 12" LPG supply pipeline.

Based on the small pipeline diameter comparative to the jetty size, and minimal clearance requirement, a suitable route for the 12" LPG supply pipeline could be found. It is not anticipated that any Jetty upgrades will be required for the routing of the pipeline. It can be mounted on the side of the jetty, on top of the current pipelines, or be mounted under the jetty. The actual routing will be confirmed during the feasibility design.

10.4 JETTY STRUCTURAL INTEGRITY

No structural integrity risks are identified with vessels berthing on the Langebaan side of the Jetty.

The only additional weight added to the existing jetty is the 12 inch LPG supply pipeline and Loading arms or flexible hoses. The critical load case will be when the pipe is being hydrostatically pressure tested. In this states the linear mass of the pipeline will approximately be 1.2kN/m. The existing jetty structure will comfortably accommodate this nominal additional mass.

If Loading arms will be used, the following additional forces are expected on the Jetty structure:

- Weight: 400 kN
- Bending Moment: 980 kN.m

As part of the design phase the effect of these additional forces on the jetty will have to be analysed to determine if the structure is adequate in strength. It is highly probable that the existing jetty was originally design for these magnitude of forces.

10.5 BUILDING/SITE BLOCK LAYOUT

The proposed site layout is indicated in Figure 17 below. The site is divided into two security zones. The high security zone will be for restricted access to the storage tanks and equipment by authorised personnel only. The other security zone will give access to the trucks for loading of the LPG.

The layout considers provision for an initial two tank configuration with potential expansion for an additional two tanks of similar capacity. Suitable provisions are made in the high security zone for a Control room, Admin and stores building, ablution facilities and small workshop.

The truck loading side of the facility also includes the drivers waiting area, ablution facilities as well as an admin front office for the processing of tanker documentation prior and post loading operation.

Figure 17 Proposed general site layout

10.5.1 Access to the site

The proposed access to the site will be from the existing gravel road, which intersects with the Road MR559. It is proposed that the gravel road be upgraded to a 7,4 m wide bituminous surfaced road up to the access to the new facility and that the road be re-aligned to provide a safer intersection with Road MR559. The new access road to the facility is also proposed to be a 7,4 m wide bituminous surfaced road.

Figure 18: Site Access

10.5.2 Traffic movement in the site

The traffic movement modelling on the site is based on the truck specifications indicated in the figure below.

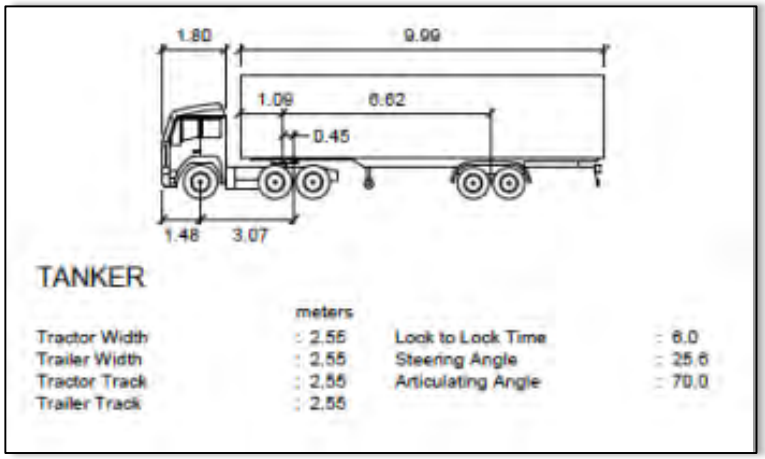


Figure 19: Proposed design truck

Trucks enter and exits the site through one gate with security checkpoint as indicated in Figure 20 below. Passenger and light delivery vehicles will also enter and exits the site via this security gate. A separate parking area has been provided for these vehicles. A parking / waiting area has been provided for 6 trucks, with one through lane to the gas loading area. Provision has been made for 2 weigh bridge loading bays, with option for expansion to 4 bays. It is proposed that the area that will be used by the trucks be a concrete pavement. The parking area for the passenger and light delivery vehicles can be constructed with concrete segmented paving blocks.

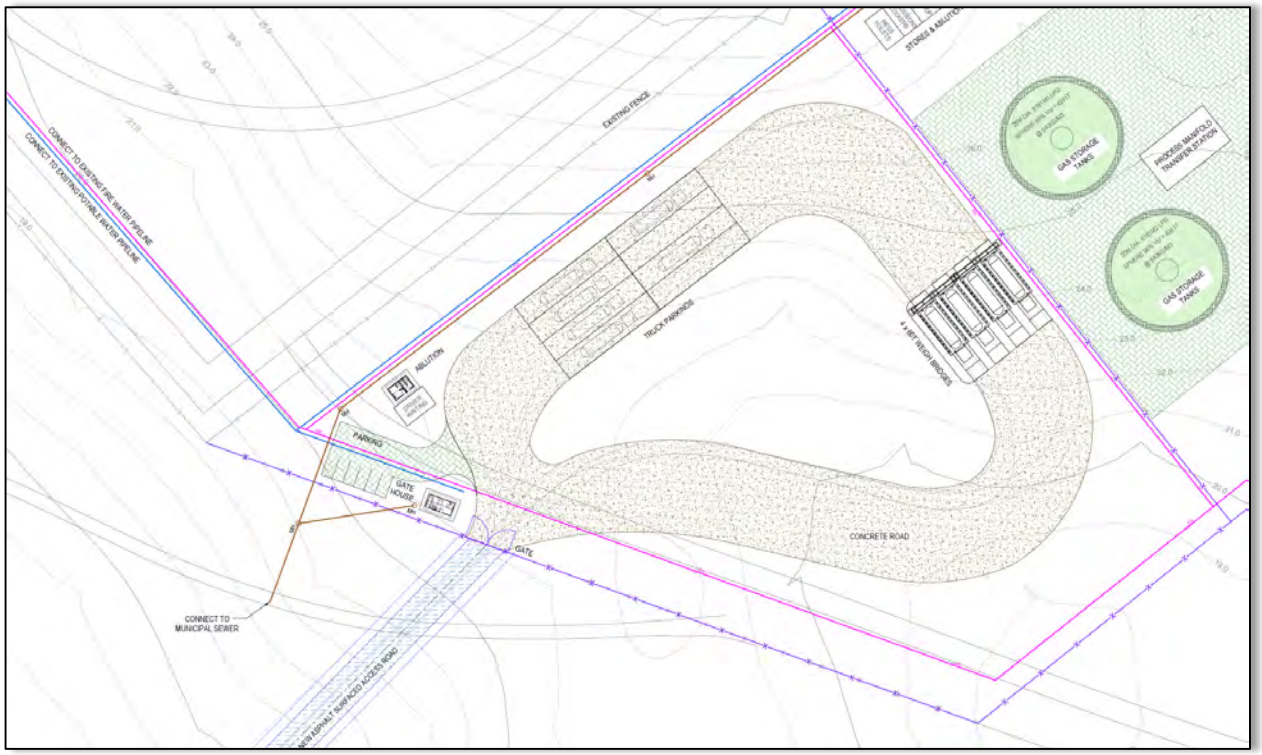


Figure 20: Truck entrance

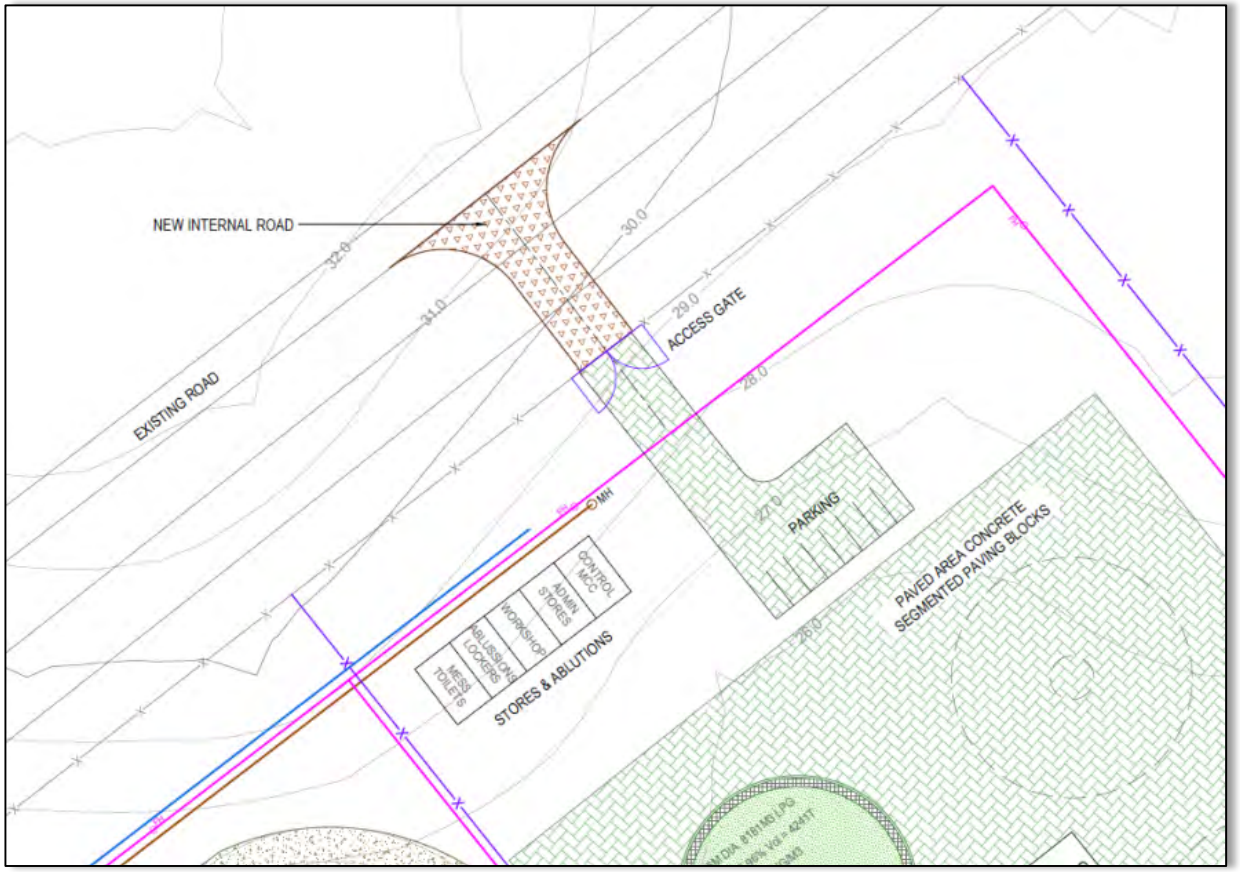


Figure 21: Personnel entrance

A separate entrance and parking area has been allowed for the personnel as indicated in Figure 20. This area will be restricted for personnel only. Access will be from the existing internal road around the strategic oil storage facility. It is proposed that this access road be constructed with concrete segmented paving blocks.

10.5.3 Stormwater control

It is assumed that all stormwater can be classified as clean stormwater which can be discharged into the environment. All drainage will be surfaced drainage via the roads and surface bed areas. The unpaved areas will be landscaped to accommodate any stormwater run-off created.

10.5.4 Mass earthworks and platform

Due to existing slope of the site it is proposed to construct a platform on the site as indicated in Figure 22, 1 below. Currently a single platform is proposed with a slight slope southern direction to facilitate the accommodation of stormwater. The bulk of the platform may possibly be constructed by means of a cut to fill operation using the material on site, with better quality imported material being used for underneath the structures and for the roads and parking layerworks. Further geotechnical investigations will be required to confirm the characteristics of the material on the site. A detailed topographical survey will also be required to do a more detailed design of the platform. This design can be incorporated at the FEED or feasibility stage of the project.

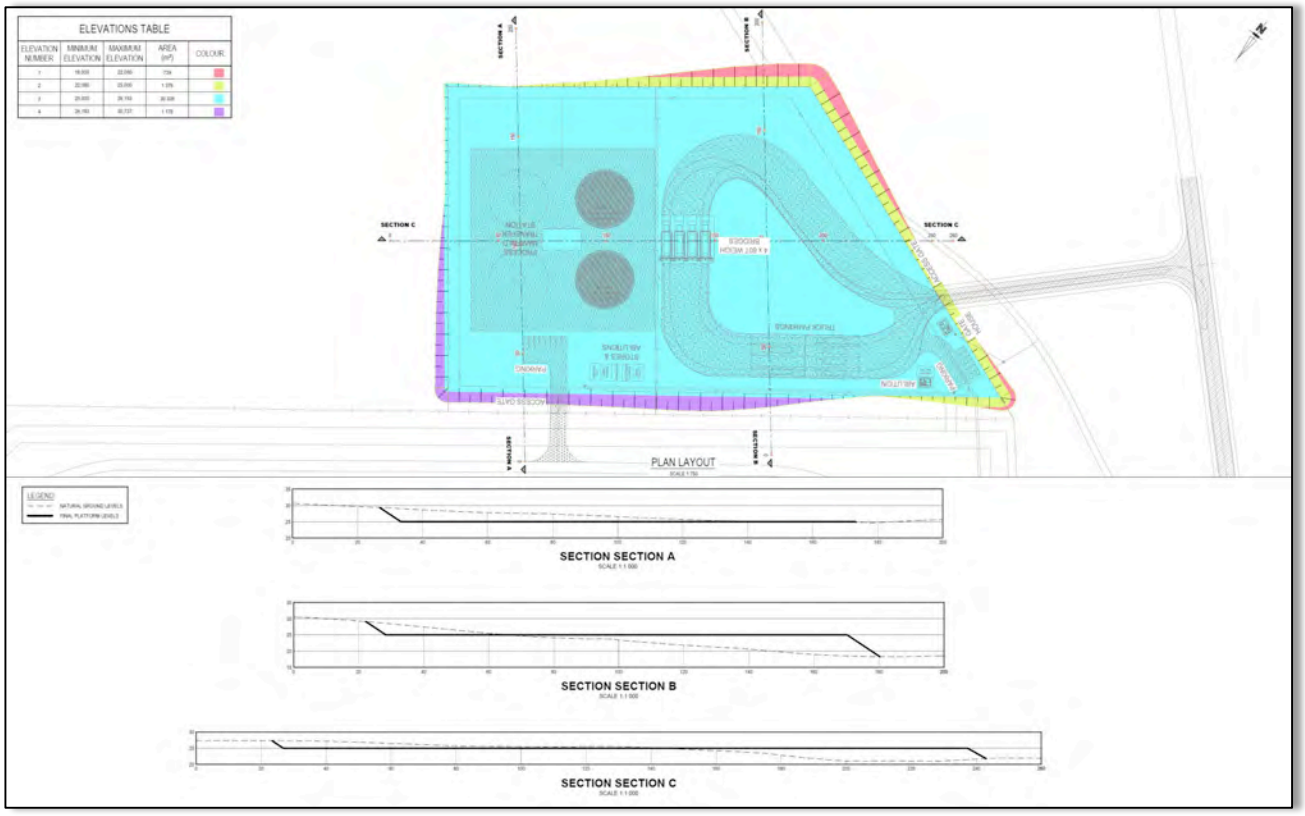


Figure 22: Proposed platform

10.5.5 Fire water supply

It is proposed that the supply for water for the fire protection is from the existing system at the strategic fuel storage facility, as indicated in Figure 23 below. A ring network with fire hydrants and hose reels will be provided around the facility. Any additional equipment, such as deluge systems can be connected to the ring network.

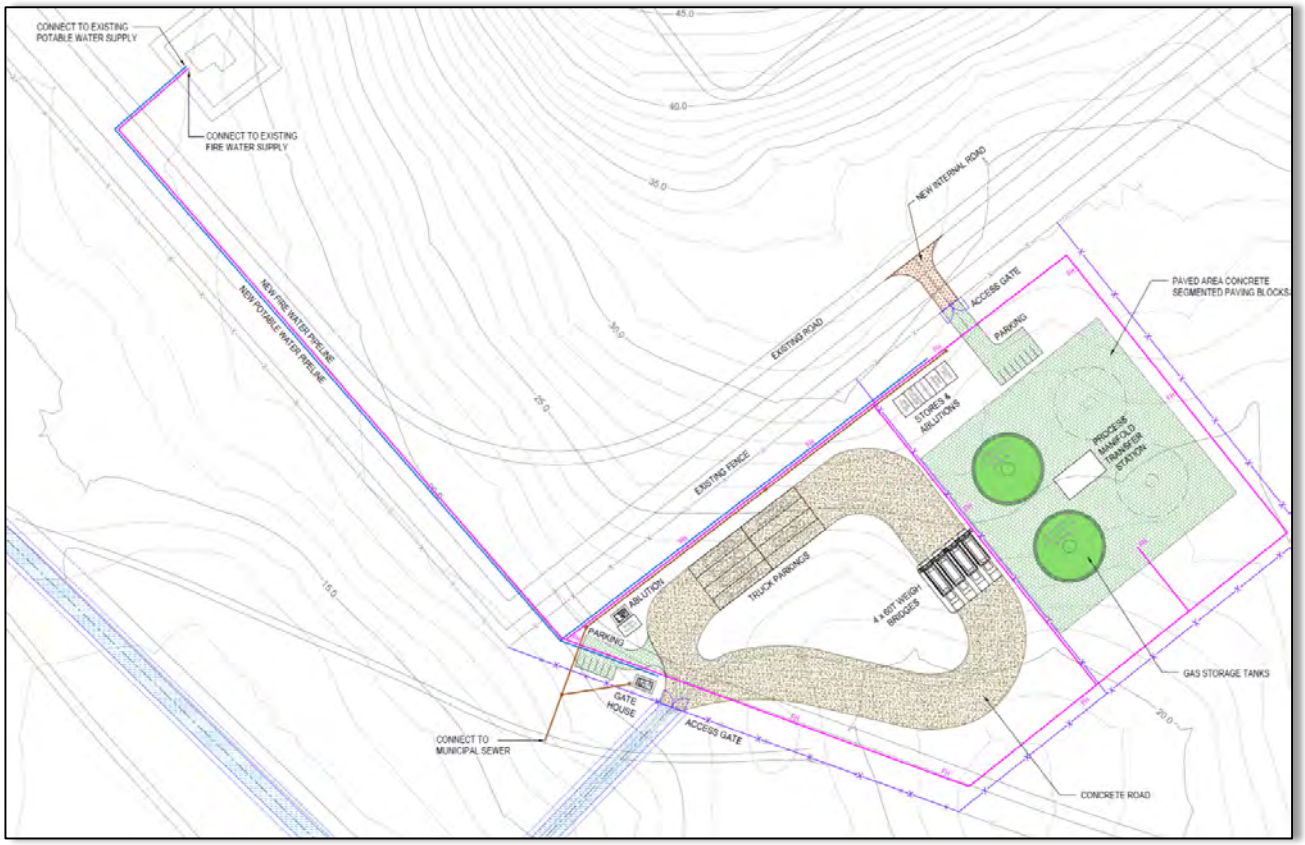


Figure 23: Fire water supply and distribution

10.5.6 Potable water supply

It is proposed that the potable water supply is from the existing potable water network of the bulk fuel storage facility, as indicated in Figure 23 and Figure 24. The potable water will be supplied to the gatehouse, the ablution facility for the truck drivers and the ablution facility for the personnel.

10.5.7 Sewer

The sewer of the gatehouse, the ablution facility for the truck drivers and the ablution facility for the personnel will drain to the nearest municipal sewer network, or alternatively to a conservancy tank, as indicated in Figure 24.

Figure 24: Potable water and sewer networks

10.5.8 Mound Structures Design

The proposed mound is a sealed dry concrete cylindrical structure with an approximate radius of 15m and a height of 30m. The outer structural skin will be an in-situ reinforced concrete wall with compacted soil/sand filling between the wall and spherical tank. The mound roof is finished off with a pumpable soilcrete cap with a gravel top to serve as additional insulation and protection. A spiral staircase will provide access to the top and a reinforced concrete tunnel to the liquid discharge connection at the bottom. The tunnel will also be utilised for the reticulation of services. A graphical representation of the structure is give in the figure below.

Figure 25: The mound structure design

10.5.8.1 *Foundation solution*

According to the geotechnical desktop study provided in Appendix A, the site geology consist mainly of dune type sand. Under the critical load condition being the hydrostatic testing of the tank, the structure will exert a soil bearing pressure of 500 kPa. This pressure is far greater than the predicted allowable soil bearing pressure. We therefore recommend a pile foundation solution with a reinforced concrete in-situ capping slab to be cast over the top. The piles are estimate to be 900mm diameter and spaced at 2.5m. The capping slab will be approximately 1.5m in depth. A geotechnical survey shall be carried out during the feasibility stage of the project, this survey will confirm the expected geotechnical soil conditions and foundation solution proposed.

10.5.8.2 *Outer reinforced concrete wall*

The outer reinforced concrete wall is estimated to be 300mm in width and could be constructed using slip-formwork. The design of this wall is highly dependable on the fill material's characteristics and it is recommended that a soil be selected with a large internal friction angle.

A minimum measurement of the containment fill between the sphere walls and the inside of the mounded wall shall be calculated based on the requirements of the reinforced concrete wall geogrid retainment system.

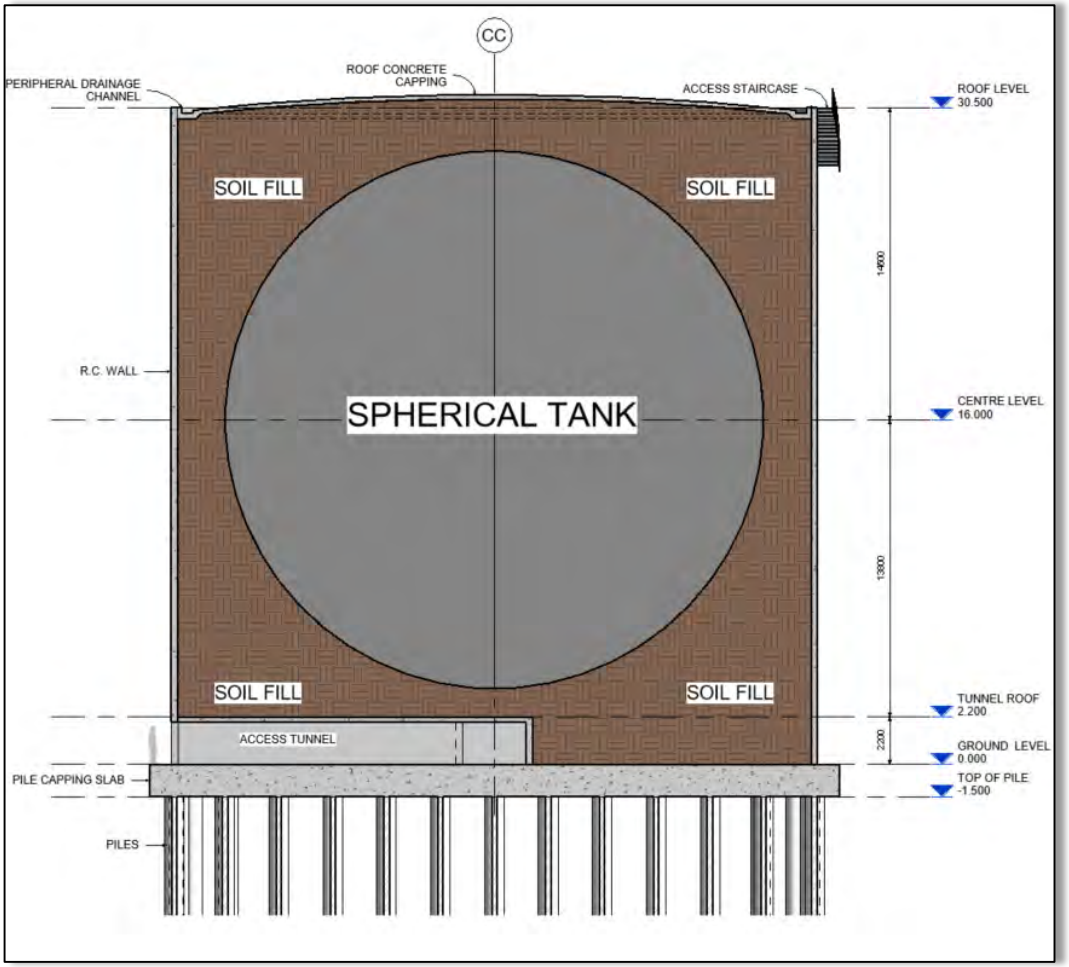


Figure 26: The mound structure design

10.5.8.3 *Roof & drainage*

The top of the mound is to be capped with a soilcrete mix with a nominal slope to drain all surface water to the peripheral storm water channels. Additional sub-surfaced drainage will be installed to eliminate any unwanted subsoil water pressure acting against the outer walls.

10.5.9 Buildings Design

The proposed building structures will consist of masonry walls and timber truss roofs with a concealed fixing type sheeting e.g. Klip-Lok, or similar. Based on the geotechnical desk top study, provided in Appendix A, the foundation solution is expected to be concrete raft.

10.5.10 Loading Gantry and Weigh Bridge Design

As stated in section 10.5.2 provision has been made for 2 Weigh Bridge loading bays. Due to the collapsible nature of the sites geology and the weigh bridge's sensitivity towards differential settlement, the recommended foundation solution is a concrete raft. With a truck's gross weight of 60 tons and an estimated raft size of 5x22m, a maximum soil bearing pressure of 25 kPa is expected. This is generally regarded as acceptable for collapsible sands, but will be confirmed with the detailed geotechnical investigation in the next stage.

A typical weighbridge design considered is shown in Figure 27.

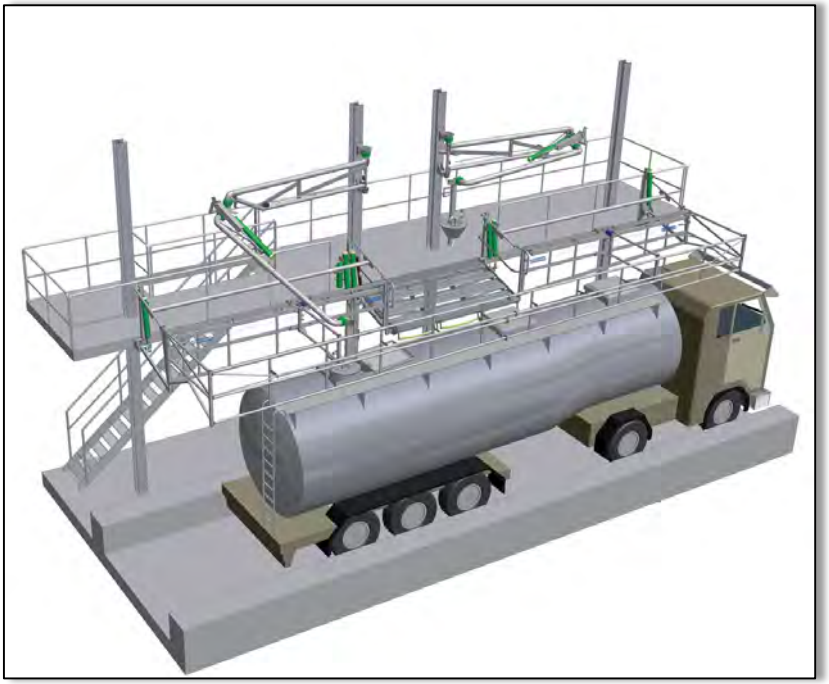


Figure 27: A conceptual Loading Gantry and Weigh Bridge Design[1]

11 MECHANICAL DESIGN

11.1 PIPING DESIGN SPECIFICATION

This section should be read in conjunction with the Process Design Pack. The major piping design considerations will be discussed in the sections below to ensure that the piping design complies with the major national and international design codes and manufacturing practices.

11.1.1 Design Standards

The design will comply to the piping design standards provided in Section 5.

11.1.2 Design Pressure

From the LPG properties table provided in Section 6.1 it is clear that the internal working pressure for the pipeline will be in the range of 750 – 1050kPa, (7.5 -10.5bar). However, from NFPA 058 (2001) it states that LPG systems that can be isolated and that requires hydrostatic relief valves, shall have a minimum design pressure of 24bar. (Refer NFPA 058 section 2.4.1.4)

11.1.3 Piping and Fittings Design code

Referring to API 2510.2001(Design and construction of LPG Installations), Piping will be designed according to ASME B31.3; except that piping that falls under the exclusion provided in 300.1.3(e) of ASME 31.3, shall be constructed in accordance with ASME B31.4.

All fittings, reducers and bends shall be weld prepared “Butt-Welding Fittings” and shall conform to ASME B16.9

Refer to Table 15 below for the detailed piping design specification.

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[1] http://www.atmarine.fi/ckfinder/userfiles/files/kanon_brochure_ENG.pdf

Table 15: Detailed Piping design specification

Material	< 2" (50NB) and below – ASTM A106 Grade B – SCH80
	Pipes larger than 2" (50NB) - ASTM A106 Grade B - SCH40
Bends	45 and 90deg LR ASTM A234 WPB SCH40 (Buttweld fitting)
Fittings	Tees and reducers to ASTM A234 WPB SCH 40 (Buttweld fittings)
	Pipe branches to be design in accordance with ASME B31.3 and will be reinforced with pipe collars where required
Ends	Flanged ANSI class 300 slip on raised face
	Max length of spool 150NB and below – 6m
	Max length of spool 200NB and above – 9m
	Pipe spool to have max of 1 bend
Gaskets	Self-centering or confined type gaskets, resistant to LPG. Gaskets shall be selected to withstand rated pressure.
Bolts	SANS 135 Grade 8.8 (High tensile)
Pressure rating	30 Bar

11.2 FLANGES

Flanges shall be ANSI class 300 based on the minimum design pressure requirement of 24bar and shall be slip-on flanges welded both inside and outside in accordance with API 2510.2001 section 8.3.4

11.3 VALVES

Valves and other fittings shall be made of steel with steel trim in accordance with SANS 10087-3. Cast iron or malleable iron shall not be used as a suitable material of construction for valves.

Valves will have a minimum pressure rating of class 300.

A self-resetting hydrostatic relief valve shall be fitted to relief the pressure that may build up through thermal expansion of the liquid gas, where the gas may be trapped between two isolating valves in the LPG pipeline.

11.4 EARTHING AND PROTECTION AGAINST STATIC ELECTRICITY

The piping needs to be earthed and protected against static electricity build-up as per SANS 10089.Storage Vessels. Storage spheres shall provide the required capacity of 8000t as per the following design criteria:

Design Element	**Design Detail**
Design Code	PD5500:2012

Pressure Equipment Categorization & Conformity	SANS 347:2012 PER
Product	LPG
Density	510-560KG/M3
Design Pressure	1560 Kpa
Test Pressure	1.25 Design Pressure
Design Temperature	-40°C to +38°C
Joint Efficiency	1.0
Post Weld Heat Treatment	No
Dimensions	25m Diameter (+-5% by Volume)
Plate Thickness	≤ 40mm
Corrosion Allowance	1.5mm
Surface Area	1963.5M2
Volume	8181m3 (± 5%)
Ullage	2% at 10°C
Capacity	4'329'000KG (± 5%) @ 10°C @ 540KG/M3
Nozzles	
Nozzle Design Rating	ANSI B16.5 Class 300#
Manway with davit arm & swing away assembly	2 x Manways of at least 30"
Liquid Receipt	1 x 10"
Recovered Liquids	1 x 2"
Compressor Suction	1 x 4"
Compressor Discharge	1 x 6"
Condenser Liquids	1 x 2"
Condenser Vapours	1 x 8"
Level Transmitter	1 x 6" with Stilling Well
Temperature Transmitter	1 x 3" with Stilling Well
High Level Transmitter	1 x 2"

Pressure Transmitter	1 x 2”
Pressure Relief Valve	2 x 8”
Liquid Out – Pump Suction	1 x 10”
Spare Nozzles	4 x 2”
Safety Distances	
Storage to property line	15m
Storage to operational buildings	15m
Storage to loading point	15m
Electrical Hazard Category – Zone 2	≤ 5m

12 ELECTRICAL AND INSTRUMENTATION DESIGN

12.1 SPECIFICATIONS

In addition to the requirements of Section 4, the Electrical, Control and Instrumentation installations shall comply with the latest revisions of the listed Standard Specifications, Standards and Statutory Requirements and Regulations as provided in Section 5.

12.2 VOLTAGE SYSTEM SPECIFICATION

The electrical equipment, other than items employing special converting equipment, shall be designed for one or other of the supplies detailed below with allowance of +7.5% and -10% on voltage and ±2,5% on frequency.

- Primary distribution voltage – 11kV, 3-wire, 50Hz at a fault level of 25kA;
- Low voltage – 400V, 4-wire, 50Hz at a fault level of 15kA;
- Lighting and power – 230V, 3-wire. 50Hz at a fault level of 10kA;
- Control voltage supplies drives >150m- 24Vdc;
- Instrument supplies – 24Vdc and 220Vac.

12.3 ELECTRICAL SYSTEMS

12.3.1 LGP Terminal

12.3.1.1 *Bulk Supply*

Bulk electrical supply to the new LPG facility will be supplied from an existing 11kV cable ring on the SFF premises.

In order to derive the point of supply, an 11kV, 3-Way, RMU (Ring Main Unit) of Isolator/Breaker/Isolator configuration will be cut into the existing cable ring between Tanks 5 and 6. Refer to the LPG Terminal Electrical Site Lay-out, Figure 28 (Drawing 33454-00-372-01-01 Rev A) and LPG Terminal Electrical Single Line Diagram, Figure 29 (Drw 33454-00-000-00-00 Rev00 and 33454-00-423-01-01 RevA).

The primary electrical supply to the LPG Terminal shall be by means of 3-core, cross linked polyethylene insulated, copper tape screened, PVC bedded, galvanized steel wire armoured, PVC sheathed (XLPE) cable with copper conductors, rated at 6,35kV/11kV and a 70mm^2 PVC insulated copper earth wire.

A Miniature Substation rated at 11kV/400V, 500kVA will be placed in close vicinity to the facilities at the LPG terminal to provide power at 400Vac.

The Miniature substation will be divided into 3 sections as follows:

- MV Section housing an 11kV Fused Switch rated 630A;
- Transformer section;
- LV Section housing 400V supply breakers to various loads.

The proposed lay-out of major electrical equipment is indicated in Figure 28.

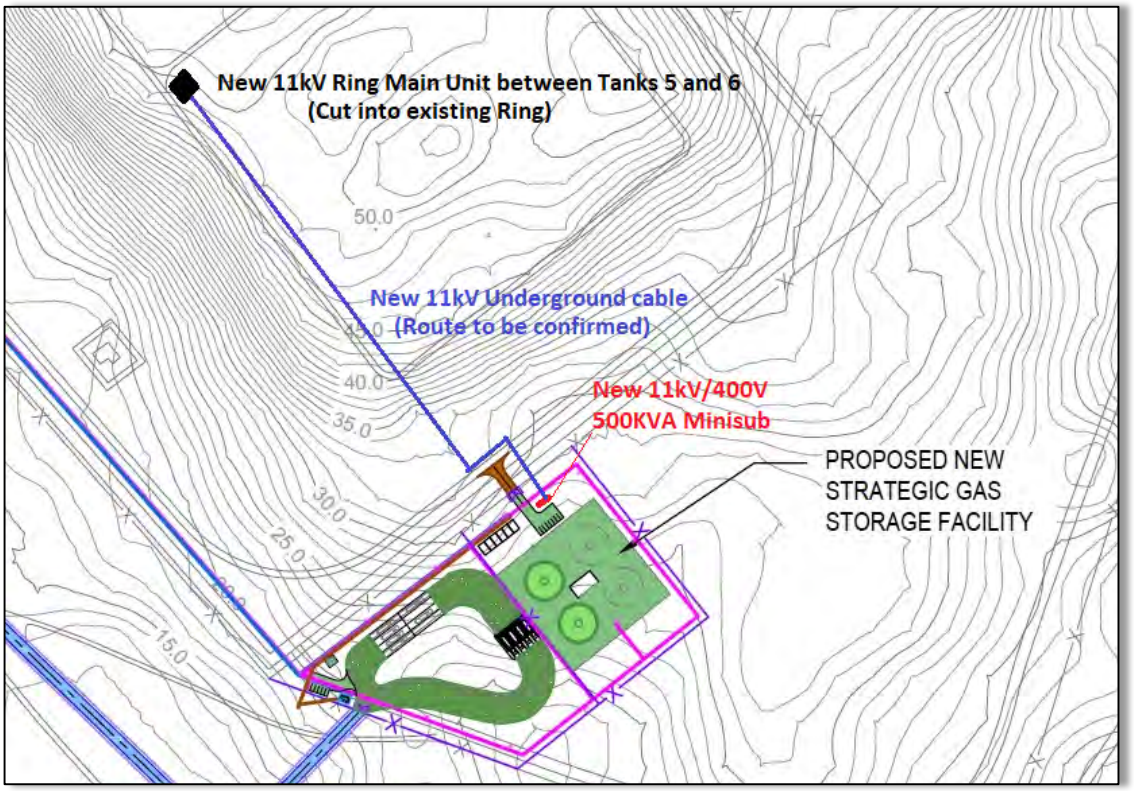

Figure 28: LGP Terminal – Major Electrical Equipment Lay-out

The high level electrical SLD (Single Line Diagram) is depicted in Figure 29.

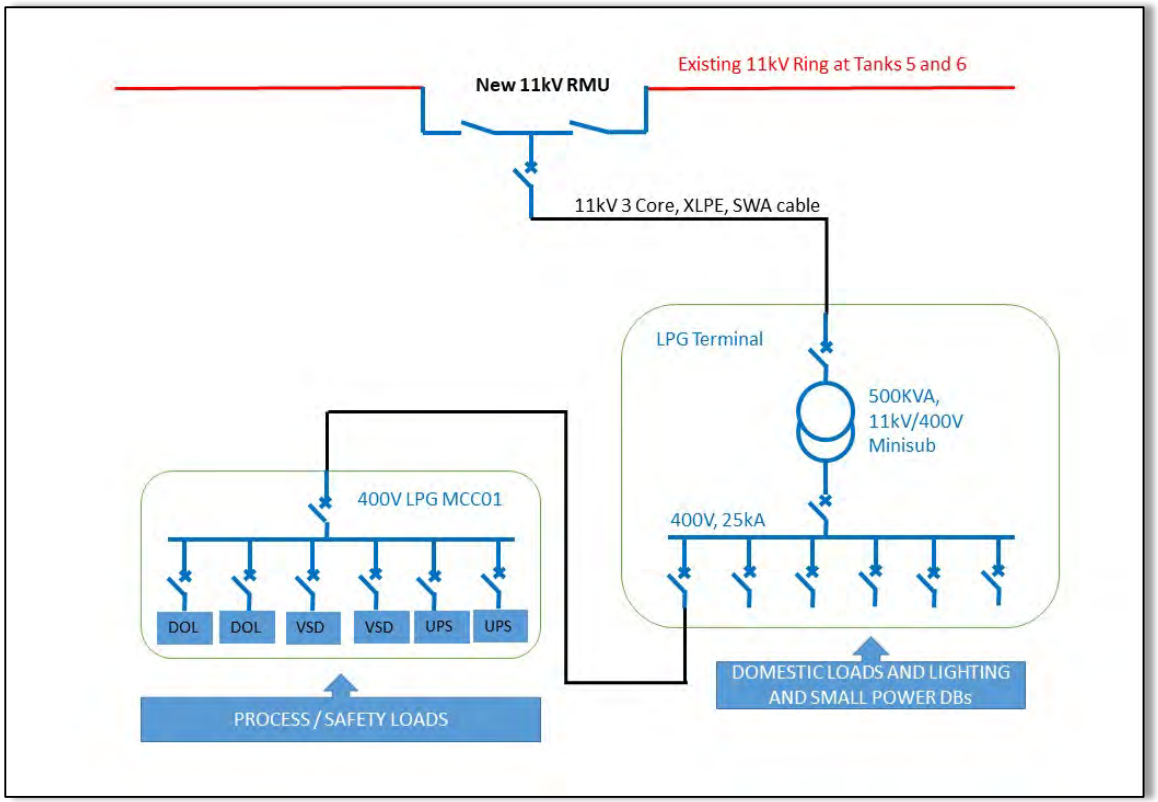

Figure 29: High Level Electrical SLD for LPG Terminal

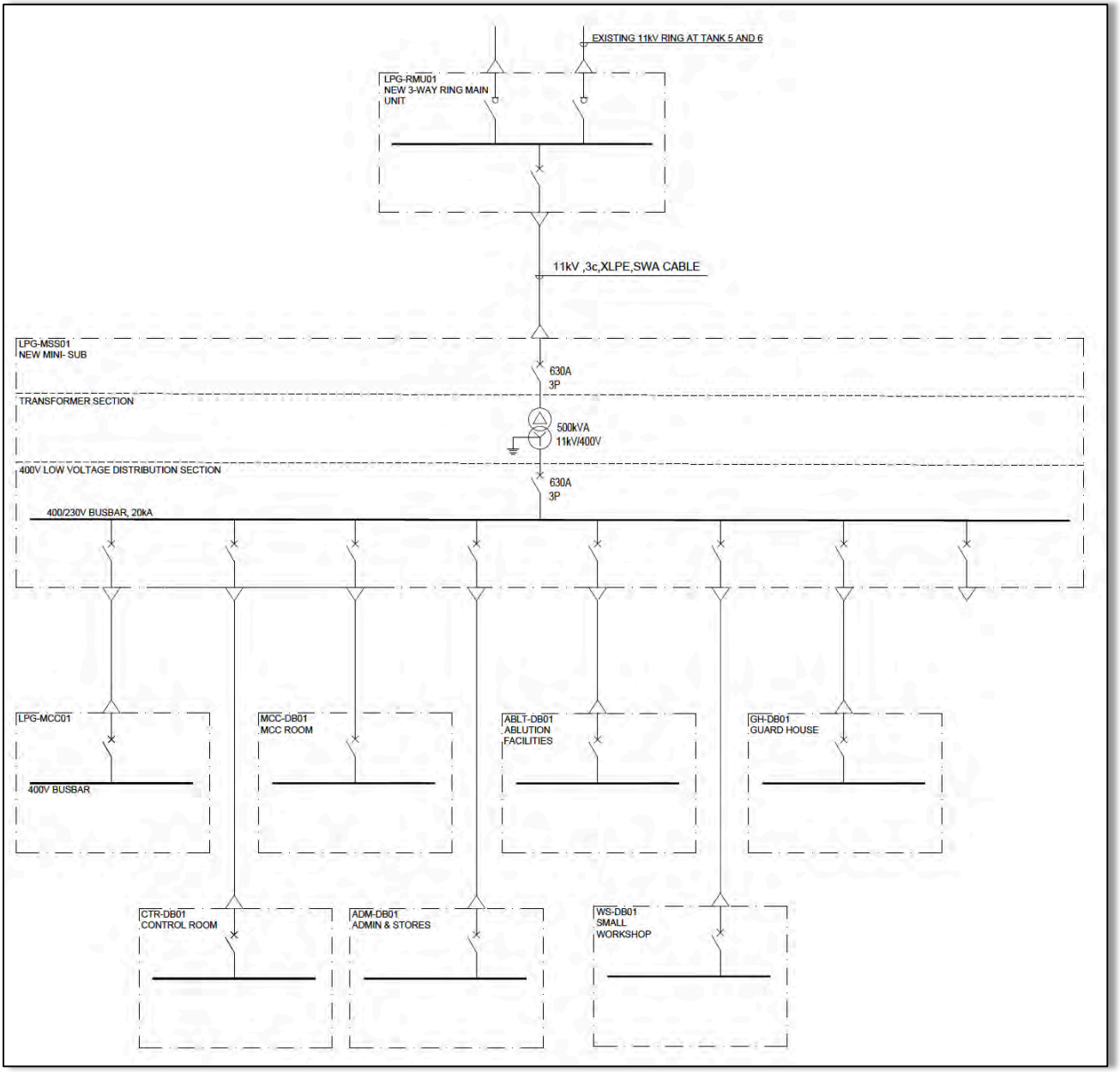

Figure 30: LPG Terminal 11KV Reticulation Single Line Diagram

12.3.1.2 *Emergency Supply*

The existing 11kV ring from which power will be derived for the LPG Terminal is supply with emergency back-up power from an existing diesel generator plant. No additional provision is made for emergency back-up power at the LPG Terminal.

12.3.1.3 *Uninterruptable Control Supply*

Control and Safety System requiring uninterruptable supply for safe shutdown and monitoring of critical systems will be supplied with power via a two redundant UPS's (Uninterruptable Power Supplies) rated at 230V, 5KVA. Each unit is rated for full load operation.

These units will be provided with a Static Bypass as well as a Manual Maintenance Bypass for the complete system. The UPS will be equipped with individual battery banks (NiCad Cells) suitably rated to provide 30 min back up to all connected systems in the event of a total power failure.

The system shall consist of two redundant units each with a rectifier, charger, battery, inverter, static-bypass switch, and be totally automatic in operation except for a manual system bypass switch.

It shall have two separate sources of mains input: A normal supply to the rectifier, etc., and a reserve supply connection which can be either automatically selected by the static-bypass switch or manually selected by the system bypass switch.

All loads shall be permanently connected to the common output, via an appropriately rated circuit breaker, and shall be normally supplied through the rectifier to invertor chain, with automatic changeover through the static-bypass switch to the reserve supply and back again, in a no-break manner with frequency synchronisation. Similarly, manual bypass shall also put the loads onto the reserve supply.

The UPS shall operate in conjunction with either one or more static constant voltage transformers, or, one or more active power line conditioners in the bypass line to provide a certain measure of clean power to the load when the UPS is unavailable.

The constant voltage transformer(s) or power line conditioner(s) are part of the UPS supply, and the UPS supplier shall ensure that this system configuration will work without any detrimental effects due to inductive loading, surge effects, etc.

The following facilities / systems will be fed with power at 230Vac directly from the UPS system:

- PCMS (Plant Control and Monitoring System) incorporating:
    - PLC (Programmable Logic Controller) Panel;
    - RIO (Remote Input/Output) Panel;
    - SCADA PC;
    - Server / Historian;
- ESD (Emergency Shutdown System);
- VBS (Vehicle Booking System);
- Electronic Instrumentation;
- MCC Control Supply;
- Fire Control Panel.

12.3.1.4 *400V Normal Supply*

The following facilities / systems will be fed with power at 400Vac or 230Vac directly from the miniature substation:

- Lighting and Small Power Distribution Board in the building complex:
    - Control room;
    - MCC room;
    - Admin and stores;
    - Ablution facilities;
    - Small workshop;
    - Driver Waiting Area.
- Guard house;
- The LPG Terminal MCC (Motor Control Centre).

The estimated electrical load for the LPG facility is 280kVA.

12.3.1.5 *400V LPG MCC*

A single 400V Motor Control Centre will be installed at the LPG Terminal. The MCC shall be supplied delivered and installed in accordance with the applicable standards and the single line diagrams.

The MCC shall consist of epoxy powder coated mild steel enclosed, floor standing, front entry, compartmented multi-tier, fixed pattern design, to IP44 standard, with suitably rated bus bars and provision for extension on both sides.

The panels shall be of radial bus type with two incomers and a bus coupler.

Switchgear shall be in accordance with the list of electrical preferred equipment and shall be rated to protect the supplied circuit cable and shall be rated 400V and 25kA.

All circuit breakers shall be equipped with thermal curve overload protection as well as magnetic curve short circuit protection devices. Circuit breakers shall also be of the current limiting type.

All low voltage motor starters shall be “direct on line” type starters with circuit breaker protection, with Class 10 tripping and Type 2 coordination characteristics. The motor protection relay/control devices will offer the following facilities:

- Field Bus type interface (PROFIBUS) with the PLC.
- Programmable with regards to motor data and protection requirement.
- Non-volatile memory for the retention of program data and operating history.
- Control of the starter contactor.
- Interface with the field control devices (start/stop stations).
- Remote emergency stop.
- Extensive motor protection.
- Residual current earth leakage protection.
- Transmission of electrical data of motor performance to the SCADA.
- Condition monitoring of the motor (above 90kW).

Each incomer breaker shall be equipped with the following:

- 3 x MD Ammeters.
- 1 x Voltmeter with selector a switch.
- Metering current transformers.

DOL motor starter equipment and instrumentation:

- Triple pole MCB.
- Triple pole contactor.
- Motor control device.
- Earth fault toroid.
- Single pole control voltage MCB for the motor protection/control device.
- Double pole control voltage MCB for control circuit.
- Door mounted operating handle with interlock.
- Run and trip in indicator lamps.
- Panel door mounted maintenance/test/sequence selector switch.
- Panel door mounted 76mm x 76mm ammeter.

VSD and Soft Starter equipment and instrumentation:

- Triple pole MCB.
- Triple pole contactor.
- VSD module or Soft Starter module (If physical size can be accommodated).
- By-pass contactor in the case of a soft starter.
- Door mounted operating handle with interlock.
- Run and trip in indicator lamps.
- Panel door mounted Human Machine Interface (HMI) unit.

Feeder equipment and instrumentation:

- Triple pole MCB.
- Earth fault relay.
- Door mounted operating handle with interlock.

12.3.1.6 *MCC Room*

The construction of the MCC room shall conform to the following criteria:

- The MCC room shall be provided with a single leaf escape door of corrosion proofed mild steel;
- The MCC room shall also be provided with a 3000mm wide double leaf equipment door of corrosion proofed mild steel;
- All single leaf and first opening leaf on double leave doors shall be equipped with an emergency release mechanism to be operated from the inside of the substation only;
- Door seals shall be fitted and a filtered vent shall be provided to regulate the internal pressure;

- Emergency and general lighting shall be installed as required by the regulations. Socket outlets and light switches shall be installed. The conduit installation for the light switches and socket outlets shall be of flush mounted galvanized steel conduit. The control of the lighting shall be automated;
- Cable ducts with covers and sleeves shall be provided in the floors from the switchgear and motor control panels to the transformer bays. Cable ducts and sleeves shall be vermin proof;
- All combustible material, including cables, must be protected to prevent the propagation of fires;
- The MCC room shall be equipped with a cooling system in the form of a split air-conditioning units to ensure that the temperature inside the substation does not rise above 25^{o}C;
- Air pressurization units with pulsed self-cleaning air filtration filters shall be installed to limit the ingress of dust into the substation buildings Positive pressure of at least 60Pa shall be maintained inside the substation;
- The MCC room shall be equipped with a Vesda Laserfocus fire detection system linked to the Fire Detection System and reported to the control room. The system shall be in accordance with the supplier's specification, i.e. one detector per 250m^{2};

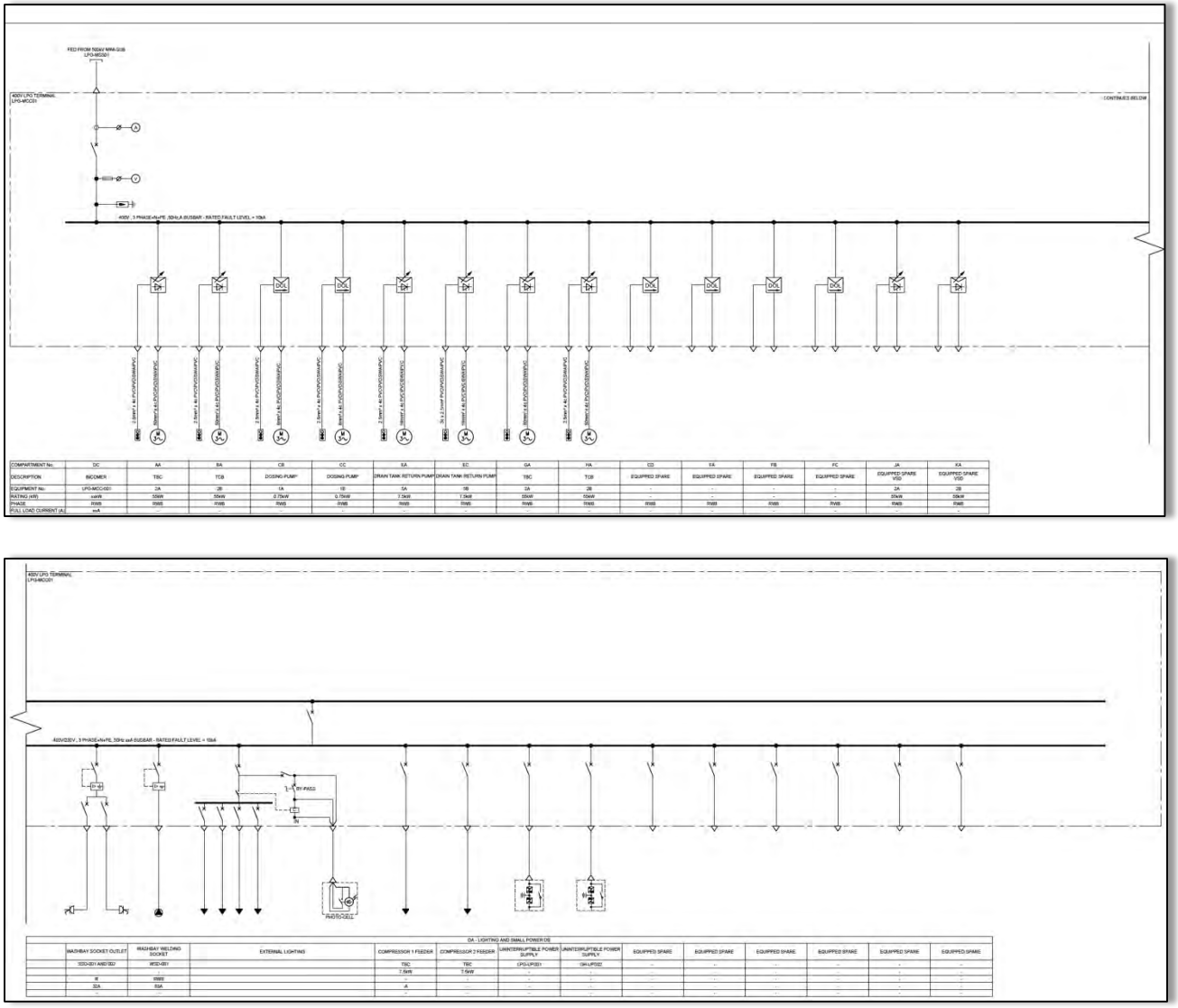

Figure 31: LPG Terminal 400V Motor Control Centre Single Line Diagram

12.3.2 JETTY

12.3.2.1 *Bulk Supply*

Bulk electrical supply to the new LPG facility will be supplied from an existing 400V Distribution Board.

12.3.2.2 *Equipment Location*

The UPSs, PLC and RIO panels required at the jetty will be installed inside the existing Main Electrical Building at Caisson 19. This building is classified as a ZONE 01 as per SANS 1018.

12.3.2.3 *Uninterruptable Control Supply*

Control and Safety System requiring uninterruptable supply for safe shutdown and monitoring of critical systems will be supplied with power via a two redundant UPS's (Uninterruptable Power Supplies) rated at 230V, 2.5KVA. Each unit is rated for full load operation.

These units will be provided with a Static Bypass as well as a Manual Maintenance Bypass for the complete system. The UPS will be equipped with individual battery banks (NiCad Cells) suitably rated to provide 30 min back up to all connected systems in the event of a total power failure.

The system shall consist of two redundant units each with a rectifier, charger, battery, inverter, static-bypass switch, and be totally automatic in operation except for a manual system bypass switch.

It shall have two separate sources of mains input: A normal supply to the rectifier, etc., and a reserve supply connection which can be either automatically selected by the static-bypass switch or manually selected by the system bypass switch.

All loads shall be permanently connected to the common output, via an appropriately rated circuit breaker, and shall be normally supplied through the rectifier to invertor chain, with automatic changeover through the static-bypass switch to the reserve supply and back again, in a no-break manner with frequency synchronisation. Similarly, manual bypass shall also put the loads onto the reserve supply.

The UPS shall operate in conjunction with either one or more static constant voltage transformers, or, one or more active power line conditioners in the bypass line to provide a certain measure of clean power to the load when the UPS is unavailable.

The constant voltage transformer(s) or power line conditioner(s) are part of the UPS supply, and the UPS supplier shall ensure that this system configuration will work without any detrimental effects due to inductive loading, surge effects, etc.

The following facilities / systems will be fed with power at 230Vac directly from the UPS system:

- PCMS incorporating:
  - PLC Panel;
  - RIO Panel;
- ESD;
- Electronic Instrumentation;

The UPSs will be installed in a ZONE 01 classified area.

12.3.3 Low Voltage Motors and Cabling

All motor cabling shall be 600/1000V PVC/PVC/SWA/PVC cable with copper conductors. For motor cabling with conductors up to 70mm^2, the 4th core shall be used to connect the motor to the earthing system. For larger motor supply cables, a 95mm^2 PVC insulated copper earth cable shall be installed.

The local control station shall be an epoxy powder coated 3CR12 enclosure, to IP65, with a sloped roof and shall be equipped as follows:

- Load-break 3-pole isolator;
- Early break, late make auxiliary contacts;
- Start button;
- Stop button with lock-out facility;
- Door mounted operating handle with interlock.
- A minimum cable size of 4mm^2 will be used for power cable, and 7 or 12 core 2.5mm^2 for control cable.
-
- Instrumentation cable will be either PVC/OAM/PVC/APL or PVC/I/OAM/PVC-APL for digital and analogue signals respectively. These cables will have a voltage grade of 300/500V.

12.3.3.1 *Cable racking and routing*

Cable racks will be of proprietary manufacture, factory made, ladder type, sectional construction and clamped to steelwork by hook-bolts or bolted to mild steel plates welded to structural members.
Cable racks and supporting brackets will be of substantial design and will allow for a 20% spare capacity.

Cable racks will generally be installed vertically inside the terminal area and routing shall take cognisance of the need for accesses.

Cable racks and supporting brackets shall be made of galvanised steel in accordance with an approved corrosion protection specification.

All cables are installed on cable racks or inside backfilled cable trenches.

Power cables up to 16 mm² and control cables on racks may be run double banked. Cables above this size will be run in single layers and clamped individually.

Cable dropouts to equipment will be provided with substantial angle-iron supports.

Conduit shall not be used unless in and around substation area.

Cables will enter at the bottom of all equipment, remote control switches, plugs, substations, light switches, motors, etc.

Cables will be strapped by means of SS304 strap and buckle system with PVC covers. PVC type straps will not be used where exposed to the sun.

Cables connected to motors will be looped before entering the terminal box of the motor. The loop will be long enough so that should the motor be replaced with a motor with the terminal box on the opposite side, the cable will be able to reach the new position of the box.

12.3.4 LIGHTING AND SMALL POWER

Lighting and utility distribution boards shall be installed inside the building structures and MCC and Control Rooms as required. The purpose of these distribution boards is to supply lighting circuits and utility power circuits in those areas.

The distribution boards shall be epoxy powder coated 3CR12 enclosures, to IP54. All circuit breakers shall have lock-out facilities and shall be indexed on the legend plate.

Weatherproof, switched socket outlets to IP65 shall be installed throughout the LPG terminal in safe locations for maintenance purposes.

Area lighting shall be provided by suitable LED fittings arranged on masts and installed under canopies throughout the facility to provide the agreed lux levels for security and maintenance purposes.

Emergency lighting in buildings are supplied via self-contained, battery back-up luminaries only.

Emergency lighting systems are designed to comply with statutory requirements. In general, emergency lighting is for the safe evacuation of personnel from operating areas after the occurrence of a failure of the normal power system.

12.3.5 EARTHING AND LIGHTNING PROTECTION

The Feasibility Design for this project will include a complete risk analysis as input to the earthing system design as required in SANS 62305-1:2011.

For purposes of this study, an allowance is made for the earthing and lightning protection system using the following principles.

A site-wide earthing system consisting of underground copper conductors and earth electrodes are installed between all buildings and structures.

The site wide earthing conductor consists of a 70mm² BCEW buried 600mm deep in trenches which follow the electrical cable servitudes. The earth electrodes used for this system is 16mm copper coated mild steel rods, 3 meters in length in accordance with SANS 1063.

All metallic equipment and service lines including cable racks, pipe racks, conveyor systems piping, tanks etc. are bonded to the site-wide earth conductor. This equipment is connected to the site-wide earthing system by means of bonding conductors with a minimum size of 35mm².

An Individual earth mat will be installed at the LPG Minisub.

The electrical earthing system employed at the plant is TN-S in line with IEC 60364-1 and/or SANS 10142:1.

Electrical Earthing is accomplished by the installation of separate bare copper earth wires with all feeder cables between main and sub-distribution boards. The earth wires sizes are selected as per the requirements of SANS 10142 which recommends the maximum lengths allowed for any particular feeder breaker size.

Earthing terminals and/or earthing bars in Distribution Boards are solidly bonded to the main earthing system. Main earthing conductors subject to damage or abuse are encased in 20mm minimum diameter tubing.

The following ohmic values are set for the design:

- 1 Ohm for the MV substations
- Overall resistance of 10 Ohm for remainder of systems

The power, data, communications and instrumentation installations shall also be referred the same main earthing system directly.

12.3.6 Active Cathodic Protection System (ACPS)

An Impressed current cathodic protection system is allowed for at the LPG terminal.

The ACPS will provide protection to the mounded storage tanks, underground pipeline as well as the earthing system.

The system will consist of:

- Rectifier;
- Cabling and connections to the various protected structures;
- High-silicone cast iron or graphite anodes placed strategically throughout the facility and along the pipeline. A detailed lay-out of this system will be produced during the Feasibility Design.

13 CONTROL AND INSTRUMENTATION

13.1 C&I FUNCTIONAL OVERVIEW

The overall Control System consists of two distinct separate functions as follows:

- PCMS
- EDS

The control systems and the safety systems shall be segregated by a purpose made SIL2 rated controllers adhering to industry safety standards e.g. IEC 61508, IEC 61511, etc.

The control panel will be segregated with “non-IS” and “IS” being in separate cabinets.

A functional design specification shall be completed with detailed descriptions of the functionality of the operational plant and how the software logic achieves the requirements during the project Feasibility Study. Cause and Effect drawings shall define the operational functions of the sub systems that control and protect different areas of the plant.

For purposes of this concept study the proposed hardware configuration is presented to enable costing of the systems for concept purposes.

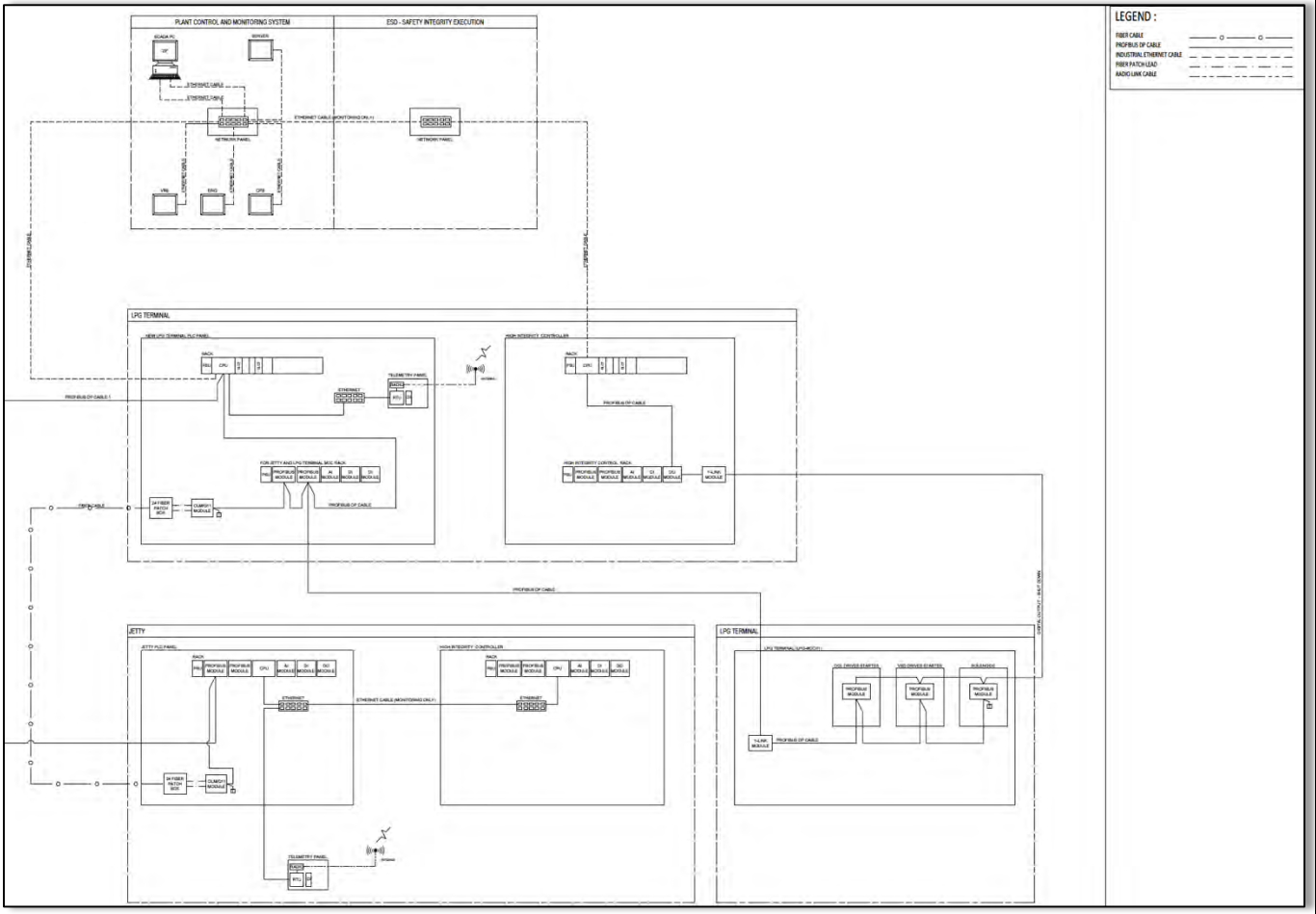

Figure 32: PCMS and EDS System Communication

The Plant Control and Monitoring System will control and monitor the following functions / systems:

13.1.1 Jetty

A Control Station is provided on the Jetty to provide the following functions:

- Operate electrical isolating flanges;
- Operate Fire Safe, Fail Safe, Nitrogen (or Instrument Air) Operated, Flow Control Valves;
- Monitor Coriolis Flow Meter providing flow, temperature, and density monitoring;
- Monitor Pressure Transmitter;

The Control Station will contain a segregated Emergency Shutdown System in a separate cubicle to take care of the following functions:

- Monitor Fire detection / CCTV combination monitoring at berth.
- Shut off the LGP flow in the event of fire (Flame detector);
- Shut off the LPG flow on detection of LPG at the Gas Detector;
- Shut off the LPG flow when the manual ESD button located at the operations is activated;
- Shut off the LGP flow on command from the PCMS;
- Any shut-down is reported to the PCMS.

13.1.2 LPG Terminal

A Main Control Room is provided at the LPG Terminal. The control system incorporates the following functions:

- SCADA system as MMI (Man-Machine-Interface) to monitor and control LPG Terminal and Jetty operations;
- PCMS to monitor and control the following systems:
    - Ethyl Mercaptan injection;

  - Tank Farm Operations including Loading Gantries;
  - LPG Chiller Plant;
  - Storage Spheres;
  - Transfer Pumps;
  - Pipeline Evacuation System;
- Vehicle Booking System.

The Control Station will contain a segregated Emergency Shutdown System in a separate cubicle to take care of the following functions:

- Monitor Fire detection / CCTV combinations located throughout the LPG Terminal.
- Shut off the LGP flow in the event of fire (Flame detector);
- Shut off the LPG flow on detection of LPG at the Gas Detector;
- Shut off the LPG flow when the manual ESD button located at the operations is activated;
- Shut off the LGP flow on command from the PCMS;
- Any shut-down is reported to the PCMS.

13.1.3 Nitrogen

A Nitrogen system is provided as follows:

- Maintenance use for purging and small pipe low pressure testing.
- Fail Safe Valve Operation;
- Mercaptan Priming;
- Purity ≥ 95%;
- Pressure 1000Kpa;
- Storage TBA;

13.1.4 Instrument Air

An Instrument Air System is provided as follows:

- Fail Safe Valve Operation;
- Pressure 600Kpa;
- Dry Air -5°C dew point;
- Oil Free;
- Storage TBA;

13.2 C&I ARCHITECTURE AND HARDWARE

The PLC will interface with the motor control centres, instruments and other proprietary control systems, e.g. VSD's, soft starters, etc. via Profibus-DP communication channels for control and monitoring functions.

The PLC's will also receive status and command signals from the various pushbuttons, controllers, selectors, limits, levels, temperature, and pressure switches and other instruments in accordance with the programme logic and commands and/or verifies the MCC component status.

All essential safety circuits for no-volt, emergency stop and over-travel conditions shall be hard wired and operate independent of the PLC system via the ESD system. All faults, however, shall be monitored by the PLC and displayed on SCADA and the local operating panel.

All interlocking and PID controls will be implemented via software in the PLC's.

13.2.1 PLC Cabinet and Remote I/O Panels

The PLC cabinets and Remote I/O panels shall be in accordance with the following requirements:

- Free standing steel enclosure, front and rear access with bottom cable entry;
- PLC (Type to be selected during Feasibility Study) remote I/O modules with integral 24Vpower supply;
- Industrial Ethernet communication processor;
- Profibus-DP Communication processor;
- Diagnosis repeater for Profibus-DP if required;
- Auxiliary 24V 10Adc power supply for instrument loops;

- Digital input expansion cards/modules;
- Digital output expansion cards/modules;
- Analogue input expansion cards/modules;
- Analogue output expansion cards/modules;
- Distribution panel with circuit breakers for local panel 220Vac.distribution;
- 220V dedicated switched socket outlet inside cabinet;
- Man Machine Interface module;
- PLC programming software;
- PLC programming cable;
- Programming of PLC in accordance with the operating philosophy;
- Programming of motor control devices;
- Programming of MMI module;

13.2.2 SCADA

Programming of the SCADA and PLC shall be in accordance with the existing program structure and philosophy of the total plant automation program.
Two desk top PC's each with two screens shall be provided at two locations e.g. local control room of the LPG Terminal and the main control room of the overall terminal. The systems shall be fully redundant and means if one fails all systems including history of alarms, set points, trends, etc. shall still be available and will shall fill once the 2nd system returns to operation.

The SCADA will monitor the following:

- MCC Switchgear Volts, Amps, Hz, KWH, Running Hours, etc.;
- LPG Tank Levels, Stock Management, Pressures, Temperatures, Density, Valve Positions Open/Closed %;
- LPG Tank Servo Calibration Check;
- LPG Berth Line Flow Rates, Pressures, Density, Temperature Valve Positions Open/Closed %, N2 Pressure or Instrument Air;
- LPG Pumps Flow Rates, Differential Pressures, Volts, Amps, RPM, Hz, KWH, Running Hours, Differential Pressures, Valve Open/Closed;
- Mercaptan Dosing Pumps Flow Rate, Volts, Amps, RPM, Hz, KWH, Running Hours, Stock Management, Valve Open/Closed;
- LPG Transfer Lines Flow Rates, Suction & Discharge Pressures, Temperature;
- LPG Road Tanker Gantry Flow Rate, Pressures, Temperatures, Weighbridge Totalizer, "Weigh-In" & "Weigh-Out", Earth Bonding;
- LPG Rail Wagon Gantry Flow Rate, Pressures, Temperatures, Weighbridge Totalizer, "Weigh-In" & "Weigh-Out", Earth Bonding;
- Weighbridge axle loading, overall loading totals;
- Gas Detectors LEL;
- Flame Detectors / CCTV;
- Firefighting, Reservoir Level, Pumps Running Hours, Electric Pump Volts, Amps, Hz, KWH, Deluge Valves Open/Closed;
- Instrument Air System, Pressure, Moisture, Running Hours, Volts, Amps, Hz, KWH, Open/Close Valves;
- Trends;
- Cause & Effect;
- Event Logs;
- Historical Data Base;

13.2.3 Industrial field bus and communication network

The field bus communication protocol (Profibus-DP) will be used to communicate to the motor control devices in the motor control panels, and the remote I/O stations.

The following requirements will be met:

- Profibus-DP communication to the 400V switchboards and motor control panels and other communication link modules;

- Industrial Ethernet communication via optic fibre link to the Jetty Control Panel;
- Industrial Ethernet communication via the existing SFF Wireless links to the Jetty Control Panel as a back-up system;
- Profibus-DP communication via fibre optic cables to the remote I/O panels within the LPG Terminal area if required;
- Industrial Ethernet communication to VBS;
- SAP or other administration system handshake (TBC);

13.2.4 Proposed C&I Architecture

Figure 33 indicates the proposed C&I architecture.

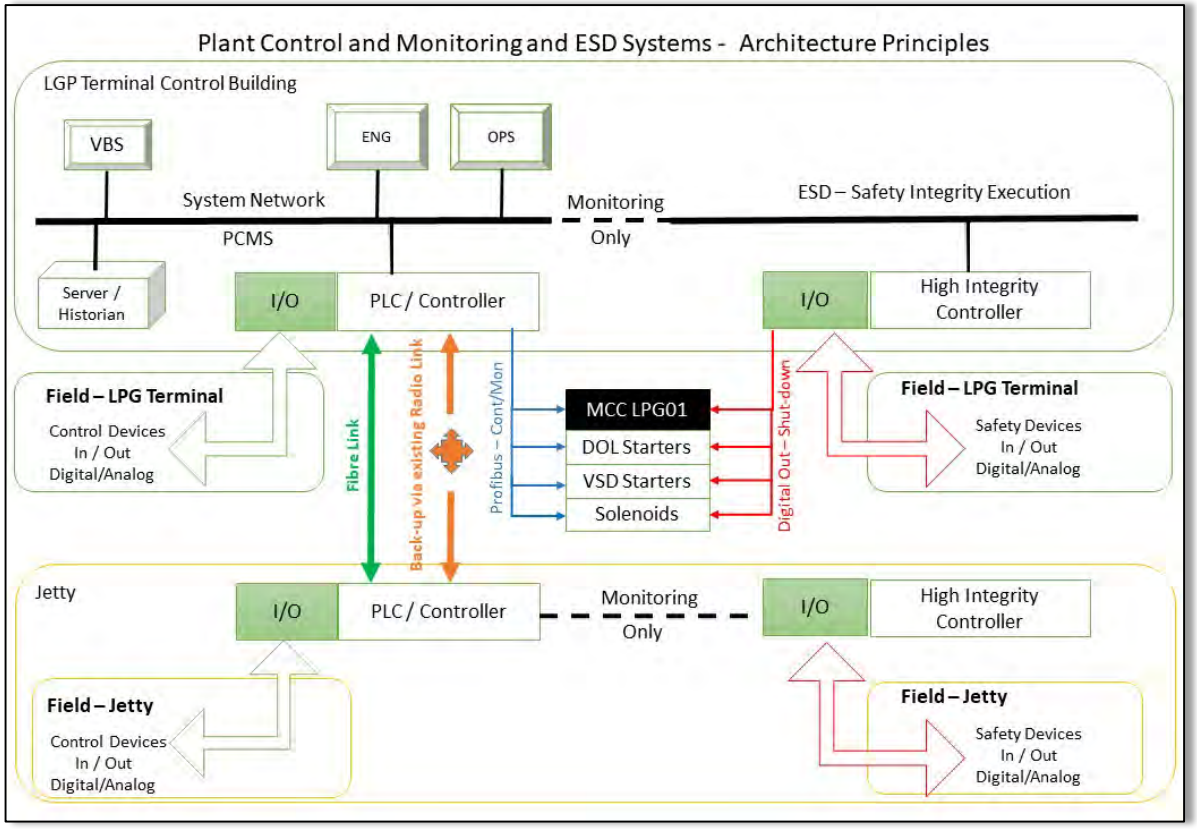

Figure 33: Proposed C&I Architecture

13.2.5 Fire Protection Operation

A risk analysis indicates that it is unlikely that all protected areas shall require activation at the same time and the ability to activate each area independently ensures that firewater is utilised in the area that it is needed.

The independence of activation also prevents unnecessary water loss during the regular testing regime.

The independent activations are as follows:

- Road Gantry Deluge – Local ESD activation at the road gantry area stops the operations supplying LPG to the road tanker loading gantry and/or Mercaptan dosing pump if gantry dosing is taking place. Liquid and vapour flow control valves at the gantry close, siren sounds, opening the road tanker gantry firewater deluge valve, and in turn commences the firewater supply start up sequence.

  Auto ESD activation will be by means of gas detector surpassing pre-set LEL set-points or IR flame detector identifying a fire and on local or remote activation of the ESD will set into motion the shutdown of transfer pumps, closing of valves, sounding of siren, opening of the deluge valve and commences the firewater supply start up sequence.

The remote activations are as follows:

- Master ESD's – shall be positioned at strategic places. The master ESD's operate all deluge valves. The master ESD shall be positioned at the following places;
    - Security Entrance Gate
    - Security Exit Gate
    - Control Room
- SCADA – The control room operator can select deluge activation on SCADA screen and commence the firewater start up sequence.

Security Access or Exit Gate - The fire control panel can be initiated to activate the deluge and firewater starts up sequence.

14 KEY LINE/SYSTEM SPECIFICATIONS

14.1 BERTH LINE

The berth line shall be both aboveground and belowground and a single liquid transfer line providing for import and export from marine vessel to shore storage and vice versa with sufficient capacity to accommodate future growth.

The berth line design shall incorporate the following:

- Option of loading arm or loading hoses.
- Emergency Release Coupling
- Electrical isolating flanges between Marine Cargo Vessel and shore.
- ASTM A333 Grade 6 Sch40 Low Temperature Service Seamless Carbon Steel Piping.
- ASTM CL300# Flanges
- Fire Safe, Fail Safe, Nitrogen (or Instrument Air) Operated, Flow Control Valves providing auto and manual isolation at berth and at entry to shore side storage tank manifold.
- Coriolis Flow Meter providing flow, temperature, and density monitoring.
- Pressure Transmitter.
- Flow Control Valve/s providing auto and manual isolation at berth and at entry to shore side storage tank manifold.
- Local pressure indicator with block and bleed at berth and at shore side storage tank manifold.
- Local ESD Station at berth.
- Pig launch / receive stations at berth and at end point of shore side tank storage manifold.
- Fire detection / CCTV combination monitoring at berth.
- Modbus integration with a SIL 2 rated PCMS, SCADA monitoring with segregated Emergency Shutdown Systems.

14.1.1 Loading arms

Loading arms could be supplied by a supplier like EMCO Wheaton, B0034 Marine Loading Arm[2].

Typical specifications include:

- Material: carbon steel, low temperature steel and stainless steel.
- Swivel joints: welded-in or flanged.
- Seals: Buna-N, Viton, PTFE or any other specific material depending on application.
- Pressure rates: PN 10 to PN 40 or alternative international standards.
- Temperature range: -50 °C to +200 °C.
- Flow rate: 4 000 m^3/h
- Height: 8 000mm

Typical Accessories include:

- Vacuum Breaker

[2] http://www.peksay.info/marine/pdf/B0034_e.pdf

- Working Envelope Warning System
- Insulating Flange
- Nitrogen Purge Line
- Purge Line
- Hydrolic. Operation
- Drainage Connections
- Manual Quick Coupler
- Vapour Return Line
- Emergency Release System
- Hydrolic Quick Coupler

14.1.2 Transfer Pumps

The transfer pumps and pump monitoring shall be as follows;

- 2 x Low NPSH Multistage centrifugal LPG transfer pumps for Road Tanker Loading and Ship Export
- 200m^3/Hr
- 75KW VFD Drive Motor Control per pump
- ANSI CL300# Rating
- Differential pressure transmitter monitoring suction and discharge pressures per pump
- Pitot Tube flow monitoring per pump
- Auto minimum flow valve arrangement per pump
- Local pressure indicator with double block and bleed assembly
- Local lock and turn ESD control is locally provided
- Local Stop/Start Station per pump
- Modbus integration with a SIL 2 rated PCMS, SCADA monitoring with segregated Emergency Shutdown Systems

14.1.3 Pump Discharge Lines

The pump discharge lines will be connected into a common manifold and will provide a piping network to all transfer operations.

Design Reference	**Detail**
Design Pressure	17 bar
Operating Pressure	8 – 12 bar
Design Temperature	-20°C to +65°C
Operating Temperature	+5°C to +30°C
Flange Rating	CL300#

The Pump discharge lines shall comprise the of the following:

- ASTM A106 GrB Sch40 Seamless Carbon Steel Pipe
- Fail Safe Spring Return Fire Safe air operated Flow Control Valves
- Fire Safe manual operated Isolation Valves
- Local pressure indicators complete with block and bleed assembly
- Thermal Relief Valve/s piped away to vent header
- Modbus integration with a SIL 2 rated PCMS, SCADA monitoring with segregated Emergency Shutdown Systems.

14.1.4 Injection System

The Ethyl Mercaptan injection system will comprise of the following:

- Ethyl Mercaptan Small Bulk Container + 1500KG
- Dosing Pump with an adjustable 10:1 turndown ratio

- Stainless Steel instrument tubing and fittings.
- Stainless Steel Fire Safe Full Weld Isolating Valves
- Coriolis Meter providing flow, temperature and density monitoring
- Pressure transmitter monitoring
- Local pressure indicators complete with block and bleed assy.
- Local lock and turn ESD control is locally provided.
- 100% redundancy is provided.
- The dosing system will be confined within a bunded area with sufficient volume to hold full SBC leakage.
- Modbus integration with a SIL 2 rated PCMS, SCADA monitoring with segregated Emergency Shutdown Systems.

14.2 FIRE FIGHTING SYSTEMS

The design approach provides a superior firewater system with sufficient redundancy.

14.2.1 Deluge Fire Fighting Systems

Protection shall be provided by deluge systems at road tanker operations in combination with strategically placed fixed monitors and hydrants.

- Deluge systems for road tanker and rail wagon gantries.
- Strategically placed monitors and hydrants with lay flat hoses and cabinets. Sufficient water run off provision shall be provided to accommodate maximum deluge or hydrant discharge plus recorded rain fall volumes.
- A separate and dedicated fire control panel mounted in security access or exit gate to monitor the ESD System, monitoring and activation of deluge systems, and monitoring of firewater pump.
- Modbus integration with a SIL 2 rated PCMS, SCADA monitoring with segregated Emergency Shutdown Systems.

The benefit of both the mounded and passive protected storage is an immediate reduction in firewater provision where no firewater is required for the storage. The existing firewater system shall be integrated providing for the following;

Design Reference	Detail
Deluge Road Tanker Volume	10L/m^2 (surface area)/min = 67,200Litres/hr/Road Tanker
Monitors / Hydrants	1600L/min 30m Reach @ 10 bar

14.2.2 Additional Fire Fighting Systems

- 9kg and 50kg Dry Powder Fire extinguishers.
- Infra-Red Fire detection / CCTV combination units strategically placed to monitor, berth operations, road tanker operations, transfer pump station, and top of storage valve stations.
- Gas detector units strategically placed to monitor road tanker gantries, berth operations, pump transfer stations, and top of storage valve station.
- Modbus integration with a SIL 2 rated PCMS, SCADA monitoring with segregated Emergency Shutdown Systems.

14.2.3 Passive Fire Protection Coating

A high-density spray applied fire resistive material for the protection of the pressure vessel offers substantial physical advantages of outstanding thermal performance and long term durability that meets and exceeds industry expectations.

The protective coating exceeds international hydrocarbon-related Specifications & Approvals including, but not limited to API, NFPA, and Lloyd's Register.

Compliance to UL 1709, Jet Fire, Three-Bar Blast Overpressure with Subsequent Jet Fire, Three-Bar Blast Overpressure with Subsequent Torch Fire and Hose Stream.

14.2.4 Suction Line

The pump suction line will be insulated with 50mm PIC insulation with vapour barrier and aluminium cover. The insulation will prevent solar heat ingress and the formation of two-phased liquid / vapour flow, which is exacerbated by extended suction lines with consequent pump cavitation. The suction line will comprise of the following:

Design Reference	**Detail**
Design Pressure	17 bar
Operating Pressure	2 – 5 bar
Design Temperature	-20°C to +65°C
Operating Temperature	+5°C to +30°C
Flange Rating	CL300#

- ASTM A106 GrB Sch40 Seamless Carbon Steel Pipe
- Block and bleed suction section with manual and auto isolation valve assy. complete with non-return valve
- Fail Safe Spring Return Fire Safe air operated Flow Control Valves
- Fire Safe manual operated Isolation Valves
- Inline Strainer per transfer pump
- Local pressure indicators complete with block and bleed assembly
- Thermal Relief Valve piped away to vent header
- Modbus integration with a SIL 2 rated PCMS, SCADA monitoring with segregated Emergency Shutdown System

14.2.5 Loading Gantries

14.2.5.1 *Road Tanker Loading*

Road tanker loading shall be completed by an automated loading system. Loading takes place directly on a Multideck (multi-axle weighing) Weighbridge, which is provided per loading gantry.

New road tankers are increasingly built to a maximum of 27t payload whereas many older road tankers are as small as 22t. All road takers are bottom loading, liquid and vapour connections are centrally located on the passenger side of the barrel. The connections for liquid and vapour are 2” male Evertite cam lock fittings.

The weighbridge shall be an aboveground installation with ramp on and ramp off access. The aboveground installation provides for ease of maintenance without the problems associated with water and drainage from pit mounted weighbridges.

Weighbridge loading removes the issue of temperature compensation and provides legal loading with vapour return. Loading will be against the maximum Gross Vehicle Mass (GVM) of the combined trailer and horse or 85% (+2% margin) volume of the trailer whichever is level is reached first.

14.2.5.2 *Loading Operation*

An online vehicle booking system could be provided allowing customers to book loading slots, controlling paperwork issues that slow down throughputs.

Each weighbridge provides loading of up to 15 road tankers per day taking into account positioning, administration, weigh in and weigh out procedures. The design shall allow for the future installation of extra weighbridges to meet additional future demand.

Design Reference	**Detail**
Design Pressure	17 bar

Operating Pressure	8 – 12 bar
Design Temperature	-20°C to +65°C
Operating Temperature	+5°C to +30°C
Flange Rating	ASTM CL300#
Loading Rate	60m3/hr per gantry

The system will comprise of the following:

- ASTM A106 GrB Sch40 Seamless Carbon Steel Pipe
- Fail Safe Spring Return Fire Safe air operated Flow Control Valves.
- Fire Safe manual operated isolation valves
- Thermal Relief Valve/s piped away to vent header
- Earth Bonding Link integrated to ESD System.
- Fail Safe Spring Return Fire Safe air operated Flow Control Valves.
- Local pressure indicators complete with block and bleed assy.
- Local temperature indicators complete with thermowell.
- Break-Away couplings
- Local Stop/Start Station for pumping systems.
- Local lock and turn ESD control is locally provided.
- 60t 5 5kg x 22m Hot Dipped Multideck Galvanised Custody Transfer Weigh Bridge
- Weighbridge Room
- Local operator controller
- Individual firewater deluge system per loading gantry.
- Modbus integration with a SIL 2 rated PCMS, SCADA monitoring with segregated Emergency Shutdown Systems.

4.6.5 Overview of Loading Operation

- Vehicle Booking System– Weighbridge 15 slots a day allocation on-line completion by customer. SAP or other administration system handshake.
- Order details captured Driver Name, Driver ID, Trailer Registration & GVM, Horse Registration & GVM.
- VBS system verifies account status of customer, verifies Driver is registered and approved, verifies Horse & Trailer are registered and approved.
- On VBS approval Order No. is generated for the loading transaction with the client and the terminal operations department. A unique Order No. or a unique bar code will allow access to the terminal.
- Road Tanker arrives at terminal and presents VBS Order Documentation and at access gate provides unique Order No. or unique bar code to gain access.
- The loading system will recognise the unique Order No. or unique bar code for the weighbridge operation.
- Road Tanker is escorted to weighbridge where its axles are positioned on individual axle decks. Driver will leave the loading area to the driver waiting room.
- Operator ensures the type of axle arrangement e.g. double, tridem, etc. is correctly selected on the weighbridge PC (ensures legal axle loading parameters)
- LPG Operator will key in Order No. to logical controller where the following questions will be requested and a YES/NO Selection is required;
  - **Key In Operator ID No.**
  - Operator Name will appear and Operator Confirms
  - **Key In Order No. which will pick up all order details**
  - Order confirmation will follow with YES / NO Operator Key
  - Weigh Bridge 01
  - Trailer Registration
  - Trailer GVM
  - Horse Registration

- Horse GVM
- Order Load Value GVM or Other
- Connect Loading Arm
- "Weigh-In"
- Start Loading

- On the confirmation of start to load PCMS shall open liquid and vapour flow control valves at the gantry.
- PCMS shall engage VFD motor controller/s to start pumps as necessary and shall monitor flow rate, pressure and temperature throughout the loading. The VFD shall adjust the loading speed ensuring pumps do not run off their pump curve or experience excessive back pressures.
- The Operator monitors the weighbridge totalizer/s loading at the weighbridge room together with control room operator who monitors all plant operations via the SCADA.
- At + 100KG (adjustable system set point) lower than the final loading requirement the pumps and loading valve shall auto set to a final slow fill transfer to maintain accuracy of loading.
- On the loading value being reached the loading valves shall close and if there are no other road tankers being loaded the pumps will stop.
- The logic controller shall now ask the Operator the following questions;
  - Key In Operator ID No.
  - Operator Name will appear and Operator Confirms
  - Disconnect Loading Arm
  - "Weigh-Out"
  - Loading Complete
- On confirming the load is complete the "Weigh-In", the "Weigh-Out" and the nett loading is updated to the accounting system and final documentation is printed at the weighbridge room for the driver to depart.
- The final documentation presented is the waybill and the axle loading detail.

14.3 PIPELINE EVACUATION SYSTEM

To provide a safe manner of evacuating pipelines for maintenance purposes the evacuation system allows liquid LPG to be drained to a drain tank, which is then transferred back to storage tank. The residual LPG vapour pressure remaining in pipelines can also be recovered to a safe level where it can be released through a strategically placed vent stack. Two identical systems shall be provided and shall consist of the following;

- 2 x LPG reciprocating compressors with liquid trap, directional change valve for liquid transfer and vapour recovery, instrumentation monitoring of low oil pressure, low suction pressure, high discharge pressure, high temperature and DOL motor control.
- $80m^3$/Hr @ 800rpm
- 22kW 1440rpm
- Drain tank complete with level, pressure, and temperature monitoring
- Fail Safe Fire Safe Spring Return air operated flow control valves
- Fire safe manually operated flow control valves
- 2 x $4m^3$/Hr Multistage Mag Drive Pump complete with 4kW VFD motor control
- Auto and manual operation options
- Local Stop/Start Station for compressor and pumping systems
- Local lock and turn ESD control is locally provided
- Modbus integration with a SIL 2 rated PCMS, SCADA monitoring with segregated Emergency Shutdown Systems

14.4 LPG CHILLER PLANT

The LPG storage shall be normally a chilled condition of 5°C to 10°C this provides for increased fill levels based on the lower thermal expansion of the stored contents and faster transfer times to road tankers, rail wagons and ship export.

14.4.1 Chiller Unit

2 x air cooled glycol closed loop commercial chiller pack system.

14.4.2 Plate Condenser

Each LPG storage tank shall have a plate condenser designed to condense vessel vapours and return condensed chilled liquids back to storage.

14.4.3 Glycol Water Circuits

Chilled glycol water system will be pumped in a closed loop system between chiller and condenser plate arrangements.

15.5. Frequency Analyses

Flammble Installations

PROJECT: **SFF Saldanha**

Vessels and Tanks (BEVI)

Equipment Description	Scenario	Base Frequency	Reasons for Adjustment	Adjustment
Crude Oil Tank	Atmos Tank U/G Instant Release	1.00E-08	Very Best - Fully Accredited	0.5
Overfill Crude	Atmos Tank A/G 10mm Leak	1.00E-04	Very Best - Fully Accredited	0.5
Crude Tank Flare Failure	Pressure Vessel Mounded or U/G 10mm Leak	1.00E-05	Very Best - Fully Accredited	0.5
LPG Flare Tank	Pressure Vessel A/G Instant Release	5.00E-07	Typical Average System 2	0.9
LPG Flare Tank	Pressure Vessel A/G 10 Minute Release	5.00E-07	Typical Average System 2	0.9
LPG Flare Tank	Pressure Vessel Mounded or U/G 10mm Leak	1.00E-05	Typical Average System 2	0.9
	Pressure Vessel A/G Instant Release	5.00E-07	Typical Average System 2	0.9
LPG Sphere	Pressure Vessel A/G Instant Release	5.00E-07	Typical Average System 3	0.75
LPG Sphere	Pressure Vessel A/G 10 Minute Release	5.00E-07	Typical Average System 3	0.75
LPG Sphere	Pressure Vessel Mounded or U/G 10mm Leak	1.00E-05	Typical Average System 3	0.75
Crude Oil Pump	Reciprocating Pump/ Compressor Leak	4.40E-03	Typical Average System 2	0.9
LPG Pump	Centrifugal Pump/ Compressor Leak	4.40E-03	Typical Average System 2	0.9
		#N/A		#N/A
		#N/A		#N/A
		#N/A		#N/A
		#N/A		#N/A
		#N/A		#N/A
		#N/A		#N/A
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#N/A	#N/A

Loading (BEVI)

	Frequency of Use Per Annum	Scenario	Base Frequency	Conversion from /hr to /pa	Reasons for A
Road Tanker Flare Leak	150	Leak in Loading /	3.00E-07	5.13699E-09	Typical Averag
Road Tanker Flare Rupture	150	Rupture Loading/	4.00E-06	6.84932E-08	Typical Averag
Road Tanker Flare BLEVE	150	Road Tank Pressu	5.80E-10	9.93151E-12	Typical Averag
Road Tanker Leak	1500	Leak in Loading /	3.00E-07	5.13699E-08	Typical Averag
Road Tanker Rupture	1500	Rupture Loading/	3.00E-08	5.13699E-09	Typical Averag
Road Tanker BLEVE	1500	Road Tank Pressu	5.80E-10	9.93151E-11	Typical Averag
			#N/A	#N/A	
			#N/A	#N/A	
			#N/A	#N/A	
			#N/A	#N/A	
			#N/A	#N/A	
			#N/A	#N/A	
			#N/A	#N/A	
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			#N/A	#N/A	

15.6. HSE Development Sensitivity Tables

Table 1 Development type: People at work, parking
DT1.1 – Workplaces
DT1.2 – Parking area

Development type	Examples	Development detail and size	Justification
DT1.1 – Workplaces	Offices, factories, warehouses, haulage depots, farm buildings, non-retail markets, builder's yards	Workplaces (predominantly non-retail), providing for less than 100 occupants in each building **and** less than 3 occupied storeys – **Level 1**	Places where the occupants will be fit and healthy, and could be organised easily for emergency action. Members of the public will not be present or will be present in very small numbers and for a short time
	Exclusions		
		DT1.1 x1 Workplaces (predominantly non-retail) providing for 100 or more occupants in any building **or** 3 or more occupied storeys in height – **Level 2** (except where the development is at the major hazard site itself, where it remains **Level 1**)	Substantial increase in numbers at risk with no direct benefit from exposure to the risk
	Sheltered workshops, Remploy	**DT1.1 x2** Workplaces (predominantly non-retail) specifically for people with disabilities – Level 3	Those at risk may be especially vulnerable to injury from hazardous events and/or they may not be able to be organised easily for emergency action
DT1.2 – Parking areas	Car parks, truck parks, lock-up garages	Parking areas with no other associated facilities (other than toilets) – **Level 1**	
	Exclusions		
	Car parks with picnic areas, or at a retail or leisure development, or serving a park and ride interchange	**DT1.2 x1** Where parking areas are associated with other facilities and developments the sensitivity level and the decision will be based on the facility or development	

Table 2 Development type: Developments for use by the general public
DT2.1 – Housing
DT2.2 – Hotel/hostel/holiday accommodation
DT2.3 – Transport links
DT2.4 – Indoor use by public
DT2.5 – Outdoor use by public

Development type	Examples	Development detail and size	Justification
DT2.1 – Housing	Houses, flats, retirement flats/ bungalows, residential caravans, mobile homes	Developments up to and including 30 dwelling units **and** at a density of no more than 40 per hectare – **Level 2**	Development where people live or are temporarily resident. It may be difficult to organise people in the event of an emergency
	Exclusions		
	Infill, backland development	**DT2.1 x1** Developments of 1 or 2 dwelling units – **Level 1**	Minimal increase in numbers at risk
	Larger housing developments	**DT2.1 x2** Larger developments for more than 30 dwelling units – **Level 3**	Substantial increase in numbers at risk
		DT2.1 x3 Any developments (for more than 2 dwelling units) at a density of more than 40 dwelling units per hectare – **Level 3**	High-density developments
DT2.2 – Hotel/ hostel/holiday accommodation	Hotels, motels, guest houses, hostels, youth hostels, holiday camps, holiday homes, halls of residence, dormitories, accommodation centres, holiday caravan sites, camping sites	Accommodation up to 100 beds or 33 caravan/ tent pitches – **Level 2**	Development where people are temporarily resident. It may be difficult to organise people in the event of an emergency

Table 2 Development type: Developments for use by the general public (continued)

DT2.2 – Hotel/ hostel/holiday accommodation	**Exclusions**		
	Smaller – guest houses, hostels, youth hostels, holiday homes, halls of residence, dormitories, holiday caravan sites, camping sites	**DT2.2 x1** Accommodation of less than 10 beds or 3 caravan/tent pitches – **Level 1**	Minimal increase in numbers at risk
	Larger – hotels, motels, hostels youth hostels, holiday camps, holiday homes, halls of residence, dormitories, holiday caravan sites, camping sites	**DT2.2 x2** Accommodation of more than 100 beds or 33 caravan/tent pitches – **Level 3**	Substantial increase in numbers at risk
DT2.3 – Transport links	Motorway, dual carriageway	Major transport links in their own right, ie not as an integral part of other developments – **Level 2**	Prime purpose is as a transport link. Potentially large numbers exposed to risk, but exposure of an individual is only for a short period
	Exclusions		
	Estate roads, access roads	**DT2.3 x1** Single carriageway roads – **Level 1**	Minimal numbers present and mostly a small period of time exposed to risk. Associated with other development
	Any railway or tram track	**DT2.3 x2** Railways – **Level 1**	Transient population, small period of time exposed to risk. Periods of time with no population present

Table 2 Development type: Developments for use by the general public (continued)

DT2.4 – Indoor use by public	**Food & drink:** Restaurants, cafes, drive-through fast food, pubs **Retail:** Shops, petrol filling station (total floor space based on shop area not forecourt), vehicle dealers (total floor space based on showroom/sales building not outside display areas), retail warehouses, super-stores, small shopping centres, markets, financial and professional services to the public **Community & adult education:** Libraries, art galleries, museums, exhibition halls, day surgeries, health centres, religious buildings, community centres. Adult education, 6th-form college, college of FE **Assembly & leisure:** Coach/bus/railway stations, ferry terminals, airports. Cinemas, concert/ bingo/dance halls. Conference centres. Sports/leisure centres, sports halls. Facilities associated with golf courses, flying clubs (eg changing rooms, club house), indoor go-kart tracks	Developments for use by the general public where total floor space is from 250 m^2 up to 5000 m^2 – **Level 2**	Developments where members of the public will be present (but not resident). Emergency action may be difficult to co-ordinate

Table 2 Development type: Developments for use by the general public (continued)

DT2.4 – Indoor use by public	**Exclusions**		
		DT2.4 x1 Development with less than 250 m^2 total floor space – **Level 1**	Minimal increase in numbers at risk
		DT2.4 x2 Development with more than 5000 m^2 total floor space – **Level 3**	Substantial increase in numbers at risk
DT2.5 – Outdoor use by public	**Food & drink:** Food festivals, picnic areas **Retail:** Outdoor markets, car boot sales **Community & adult education:** Open-air theatres and exhibitions **Assembly & leisure:** Coach/bus/railway stations, park & ride interchange, ferry terminals. Sports stadia, sports fields/ pitches, funfairs, theme parks, viewing stands. Marinas, playing fields, children's play areas, BMX/go-kart tracks. Country parks, nature reserves, picnic sites, marquees	Principally an outdoor development for use by the general public, ie developments where people will predominantly be outdoors and not more than 100 people will gather at the facility at any one time – **Level 2**	Developments where members of the public will be present (but not resident) either indoors or outdoors. Emergency action may be difficult to co-ordinate
	Exclusions		
	Outdoor markets, car boot sales, funfairs. Picnic area, park & ride interchange, viewing stands, marquees	**DT2.5 x1** Predominantly open-air developments likely to attract the general public in numbers greater than 100 people but up to 1000 at any one time – **Level 3**	Substantial increase in numbers at risk and more vulnerable due to being outside

	Exclusions (continued)		
DT2.5 – Outdoor use by public	Theme parks, funfairs, large sports stadia and events, open-air markets, outdoor concerts, pop festivals	**DT2.5 x2** Predominantly open-air developments likely to attract the general public in numbers greater than 1000 people at any one time – **Level 4**	Very substantial increase in numbers at risk, more vulnerable due to being outside and emergency action may be difficult to co-ordinate

Table 3 Development type: Developments for use by vulnerable people
DT3.1 – Institutional accommodation and education
DT3.2 – Prisons

Development type	**Examples**	**Development detail and size**	**Justification**
DT3.1 – Institutional accommodation and education	Hospitals, convalescent homes, nursing homes. Old people's homes with warden on site or 'on call', sheltered housing. Nurseries, crèches. Schools and academies for children up to school leaving age	Institutional, educational and special accommodation for vulnerable people, or that provides a protective environment – **Level 3**	Places providing an element of care or protection. Because of age, infirmity or state of health the occupants may be especially vulnerable to injury from hazardous events. Emergency action and evacuation may be very difficult
	Exclusions		
	Hospitals, convalescent homes, nursing homes, old people's homes, sheltered housing	**DT3.1 x1** 24-hour care where the site on the planning application being developed is larger than 0.25 hectares – **Level 4**	Substantial increase in numbers of vulnerable people at risk
	Nurseries, crèches, schools for children up to school leaving age	**DT3.1 x2** Day care where the site on the planning application being developed is larger than 1.4 hectares – **Level 4**	Substantial increase in numbers of vulnerable people at risk
DT3.2 – Prisons	Prisons, remand centres	Secure accommodation for those sentenced by court, or awaiting trial etc – **Level 3**	Places providing detention. Emergency action and evacuation may be very difficult

Table 4 Development type: Very large and sensitive developments
DT4.1 – Institutional accommodation
DT4.2 – Very large outdoor use by public

(Note: All Level 4 developments are by exception from Level 2 or 3. They are reproduced in this table for convenient reference)

Development type	**Examples**	**Development detail and size**	**Justification**
DT4.1 – Institutional accommodation	Hospitals, convalescent homes, nursing homes, old people's homes, sheltered housing	Large developments of institutional and special accommodation for vulnerable people (or that provide a protective environment) where 24-hour care is provided and where the site on the planning application being developed is larger than 0.25 hectare – **Level 4**	Places providing an element of care or protection. Because of age or state of health, occupants may be especially vulnerable to injury from hazardous events. Emergency action and evacuation may be very difficult. The risk to an individual may be small but there is a larger societal concern
	Nurseries, crèches. Schools for children up to school leaving age	Large developments of institutional and special accommodation for vulnerable people (or that provide a protective environment) where day care (not 24-hour care) is provided and where the site on the planning application being developed is larger than 1.4 hectare – **Level 4**	Places providing an element of care or protection. Because of age the occupants may be especially vulnerable to injury from hazardous events. Emergency action and evacuation may be very difficult. The risk to an individual may be small but there is a larger societal concern
DT4.2 – Very large outdoor use by public	Theme parks, large sports stadia and events, open air markets, outdoor concerts, and pop festivals	Predominantly open air developments where there could be more than 1000 people present at any one time – **Level 4**	People in the open air may be more exposed to toxic fumes and thermal radiation than if they were in buildings. Large numbers make emergency action and evacuation difficult. The risk to an individual may be small but there is a larger societal concern

Decision matrix

47 Having determined which zone the development falls into and also the sensitivity level of the development, the following matrix is used to decide the type of advice.

Level of sensitivity	Development in inner zone	Development in middle zone	Development in outer zone
1	DAA	DAA	DAA
2	AA	DAA	DAA
3	AA	AA	DAA
4	AA	AA	AA

DAA = Don't Advise Against development
AA = Advise Against development

48 If all developments result in DAA then DAA is the final HSE advice.

49 If any one development gives an AA result then the interim result for the consultation is AA. Each AA result is always subjected to an additional rule check (Rule 4) to determine if it will remain AA or change to a DAA. If any one development is still AA after application of this rule then the final advice will be AA.

How the rules are applied

Overview of the rules

50 The rules have been developed to allow consideration of the more complex planning consultations. More detail on each of the rules is given after this overview.

51 There are five main rules to consider for each development:

- **Rule 1 – Straddling developments.** When the site area of the proposed development lies across a zone boundary you need to use this rule to decide which zone will be used in the decision matrix. The CD is considered a zone boundary in this context.
- **Rule 2 – Multiple major hazards.** For each major hazard, you need to determine which zone the development is in, after applying the straddling rule if necessary. The final advice is decided on the basis of the most onerous of the zones that the development is in.
- **Rule 3 – Multiple-use developments.** You need to use this rule when the planning consultation is for a multiple use development (eg a mix of housing, indoor use by the public and a workplace). You need to identify the separate parts of the proposal according to the development types. You then need to group together all facilities of the same development type before proceeding (for example before going on to use the straddling rule – Rule 1).
- **Rule 4 – Developments which involve a small extension to an existing facility.** This rule is concerned with Advise Against responses and taking any

existing development on the site into account, if the proposed development is a **small** extension to the existing development, before deciding on the final advice. It is only concerned with 'extensions' to existing developments, not to new developments, or change of use, on sites which may have an existing use.

- **Rule 5 – Temporary/time-limited planning permissions.**

The rules in detail

Rule 1 – Straddling developments

52 Use this rule set (1a, then 1b if applicable) when the site area of the proposed development lies across a zone boundary.

53 Rule 1a: Developments that 'straddle' zone boundaries will normally be considered as being in the innermost zone to the major hazard unless either of the two following conditions applies. The development is in the **outermost** of the zones if:

- less than 10% of the site area marked on the application for that development type is inside that boundary; or
- it is only car parking, landscaping (including gardens of housing), parks and open spaces, golf greens and fairways, or access roads etc, associated with the development that are in the inner of the zones.

54 Rule 1b: For the special case where the development straddles the CD boundary, follow the rule above, then:

- If, after using the rules, the development is 'considered' to be outside the CD, then there is no need to categorise further; a DAA response is appropriate.
- If, after using the rules, the development is 'considered' to be within the CD then look at all the facilities that make up the development proposal. Any that are **entirely outside** the CD should be discounted when coming to a decision about the sensitivity level. All the facilities that are **completely and/or partly inside** the CD are then considered together for the purpose of determining the sensitivity level. (If appropriate, apply the 'multiple-use developments' rule – Rule 3.)

(NB: Rules 1a and 1b do not apply where the development type is a [sensitivity level 2] transport link. Even though this type of development is likely to 'straddle' zone boundaries, it must always be considered as being in the innermost of the zones to the major hazard that it straddles.)

Rule 2 – Multiple major hazards

55 Where the development is in the CD of more than one hazardous installation and/or pipeline, it is necessary to determine which zone the development is in for each major hazard (after applying the straddling rule (Rule 1) if necessary). The overall advice is decided on the basis of the most onerous of any of the zones the development is in (inner zone more onerous than middle zone, middle zone more onerous than outer zone).

56 In some cases HSE has provided a composite three-zone map for complexes of adjacent major hazards and has merged the zones. In this case the assessment is simplified, as only the one three-zone map needs to be considered.

Rule 3 – Multiple-use developments

57 This rule set is used when the planning consultation is for multiple-use developments (eg a mix of housing, indoor use by the public and a workplace).

- First identify the separate parts of the proposal according to the development types, as in column 1 of Tables 1–4. Group together all facilities of the same development type and determine the sensitivity level of each of the groups. The only exception, where facilities are not grouped together, are sensitivity level 4 examples of 'Outdoor use by the public' and 'Institutional accommodation and education' development types. These should be considered separately to other (sensitivity level 3 and below) facilities of the same development type, but as part of the same consultation record.
- Determine which zone each development is in, if necessary using the straddling rule (Rule 1) for each development type.
- Determine the appropriate AA or DAA response from the decision matrix for each development.
- Apply Rule 4a.

Rule 4 – Developments which involve a small extension to an existing facility

58 Many proposed developments are not on 'green field' sites. They may involve extension to an existing development.

59 Rule 4a. First **consider the development in the application on its own merit** according to the normal procedure and rules. There are two outcome options:

- a DAA outcome, in which case there is no need to apply Rule 4b. (For 'multiple-use developments', if the application of Rule 3 results in all outcomes from the matrix being DAA, then that is the final advice. In which case there is no need to apply Rule 4b); or
- an AA outcome, then Rule 4b should be applied if appropriate. (For 'multiple-use developments', if the application of Rule 3 results in one or more AA outcomes from the matrix, then apply Rule 4b individually to every one of the development type groups resulting in these AA outcomes.)

NB only the details supplied with the planning application or pre-planning enquiry are used to determine if, and how, Rule 4b applies.

56 Rule 4b. Extensions **(including minor modifications, alterations, or additions)**:

If…	**Then…**
the proposal is for an extension to an existing development, and the proposed extension is of the same development type as the existing development that is going to be extended. **And** the population at the development will not increase by more than 10% (or, if the population data is not readily available, the total floor area will not increase by more than 10%).	the consultation should be treated as though the proposed extension had a sensitivity level one less than the sensitivity level of the existing (ie not that of the proposed) development. If this reduced sensitivity level, combined with the zone that the extension is in, produces a DAA response, then this will replace the initial AA response.
For 'multiple-use developments', if the application of Rule 4b changes ALL of the AA outcomes to DAA.	this will replace the initial AA response. If at least one outcome remains AA, then an AA response is the final advice. Any remaining AA from 4b dominates for 'multiple-use developments' and an AA response is the final advice.

Rule 5 – Temporary/time-limited planning permissions

57 HSE treats proposals for these the same way as any other planning permission consultations; no allowance is given for the time restriction. Existing temporary/time limited permissions are not taken into account when applying Rule 4, however.

Glossary

beds the number of residents/visits for which sleeping accommodation is provided.

consultation the enquiry that comes to HSE (normally from a PA) for HSE's comment on a proposed change to land usage within a CD. The consultation will consist of at least one 'development'.

development to consider any planning proposal using the PADHI system, all proposed new buildings (or extension, change of use of land etc) need to be categorised into a PADHI 'development type'. A proportion of planning proposals will consist of more than one development type. Having identified all development types, each is subsequently assessed using the decision matrix. An Advise Against decision for any single development will dominate the final PADHI advice for the proposal.

development type (see the first column in the development type tables) term used to group together developments (and/or facilities) that are considered to be of the same sensitivity level.

DPZ development proximity zone.

dwelling units mean the smallest individual unit of accommodation, eg house, apartment, caravan.

extension clarification on what constitutes an extension is provided on the relevant PADHI+ Help screen, which can be accessed by clicking on the 'Help' button on the screen which asks if the proposed development is an extension to an existing development. If you do not have access to PADHI+, then contact the PA or HSE if you need further information.

facilities buildings and other provisions (eg picnic area, children's play area, park-and-ride bus stop) where people may congregate.

'green field' site site to be developed where the current use generally involves minimal buildings and also does not attract people to it in significant numbers. Typically agricultural land, but can also be parkland or other open spaces of a similar nature.

hectare unit of area equal to 10 000 square metres (m^2) in any shape (eg rectangles 10 m x 1000 m or 25 m x 400 m; square 100 m x 100 m; or other regular and irregular shapes).

LUP land use planning.

multiple-use development see 'development'.

PA planning authority.

PADHI planning advice for developments near hazardous installations.

pre-planning enquiry (PPE) an informal, non-statutory LUP consultation made by a developer (or a PA) to determine what HSE's advice is likely to be before submitting a formal planning permission application to the PA.

protective environment there is provision of some element of supervision or care, eg by a warden being available on site or on call.

school leaving age the minimum age at which a young person can leave school – currently 16.

sensitivity level the scale used in the PADHI system to define the vulnerability of a development population to major accident hazards. It is based on pragmatic criteria; the type of development, likely numbers present and whether any vulnerable people will be present. The scale ascends from Level 1 to Level 4: the more vulnerable the population, the higher the sensitivity level.

total floor space – the area of buildings enclosed by the exterior walls multiplied by the number of floors (units are m^2).

use class – the way different types of development are described by planners. They are not identical to HSE's development types or sensitivity levels.

vulnerable people – people who by virtue of age (children and elderly) and/or ill health may be particularly susceptible to the effects of a major accident.

Annex 1

HSE's land use planning advice provision

1 HSE's land use planning (LUP) advice is based on the recommendations of the Advisory Committee on Major Hazards (ACMH) enshrined in Government-agreed principles and framework; see for example Planning Circular 04/2000. These principles remain valid today. A failure to adopt them can only lead to non-compliance with Article 12 of the Seveso Directive. Indeed the principles and objectives HSE uses in giving its advice received strong support in a public consultation in 2007 (CD211 *Proposals for revised policies for HSE advice on development control around large-scale petrol storage sites*).

2 It is currently delivered promptly and transparently through the PADHI (planning advice for developments near hazardous installations) scheme, which is a codification of that given by HSE over the last 30 years or more. Pre-PADHI, HSE staff in local offices used a codified matrix from which the majority of consultations could be quickly turned around with either an 'allow' or 'refuse' decision. However, the system still required a significant number of consultations to be forwarded to a central HSE team of specialist risk assessors. The need for this risk assessment work resulted in a lengthy turnaround time on these consultations and was extremely resource intensive for HSE. Following a review of its position on land use planning around hazardous installations HSE developed a comprehensive, codified methodology, PADHI, which allowed all consultations to be dealt with at a local level, significantly speeding up the provision of advice to PAs.

3 Under Section 16 of the Town and Country Planning (Development Management Procedure) (England) Order 2010 (the 'DMPO'), Article 10 of the Town and Country Planning (General Development Procedure) Order 1995 as

amended (the 'GDPO') in Wales, and section 25 of the Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2008, decision-makers are required to consult HSE on certain planning proposals around major hazard establishments and major hazard pipelines and to take into account HSE's representations when determining associated applications. This is to ensure that the UK complies with Article 12 of the Seveso II Directive which has the specific objective of controlling certain new development to maintain adequate separation, including residential areas, buildings and areas of public use around major hazards when the development is such as to increase the risk or consequences of a major accident. In essence, decision-makers should ensure that new development does not significantly worsen the situation should a major accident occur.

4 In some instances there may already be existing development which is closer to a potentially hazardous installation. In these cases HSE has recognised the views of the ACMH as expressed in paragraphs 108 and 109 of their Second Report which read as follows:

> *'108... The HSE is also frequently asked to comment on proposals to develop or to redevelop land in the neighbourhood of an existing hazardous undertaking where there may already be other land users which are closer and possibly incompatible. In these cases, HSE tells us that it takes the view, which we fully endorse, that the existence of intervening developments should not in any way affect the advice that it gives about the possible effects of that activity on proposed developments which may appear to be less at risk than the existing ones.*
>
> *'109... The overall objective should always be to reduce the number of people at risk, and in the case of people who unavoidably remain at risk, to reduce the likelihood and the extent of harm if loss of containment occurs…'*

5 HSE's approach balances the principle of stabilising and not increasing the numbers at risk with a pragmatic awareness of the limited land available for development in the UK. An HSE discussion document in 1989 *(Risk criteria for land-use planning in the vicinity of major industrial hazards* ISBN 978 0 1188 5491 7, available from HSE Books) sets out the basis of HSE's approach at that time.

6 The Government committee of experts, ACMH, which originally proposed HSE's role in the LUP system, did recognise *'the remote possibility that in some instances a local planning authority may not feel inclined, for a variety of reasons, to follow the advice of the Executive on particular applications for potentially hazardous developments or other developments in their vicinity.'* As a consequence, arrangements were set up so that in this rare circumstance, a planning authority is required by Planning Circular 04/2000 (England and Wales) or Circular 3/2009 (Scotland) to formally notify HSE of its intention to grant against HSE's advice. This is so that HSE can decide whether or not to request the Secretary of State to call-in the application for his own determination. There have been recent changes to procedures in Scotland. Part 3 of the Planning etc. (Scotland) Act 2006 introduced changes to the way in which the planning system will operate in Scotland. See Scottish planning circular 6/2009 *Planning Appeals*, and planning circular 7/2009 *Schemes of Delegation and Local Reviews*. These circulars accompany the Town and Country Planning (Schemes of Delegation and Local Review Procedure) (Scotland) Regulations 2008.

7 HSE's consideration of call-in should not be confused with its LUP advice delivered through PADHI; it is the latter which is provided to enable LUP decision-makers to comply with the objectives of Seveso II, Article 12. In line with Government policy, HSE normally requests call-in only in cases of exceptional concern (there have been only four such requests over the last 30 years in England

and Wales). However if HSE decides not to make such a request this does not mean that it has withdrawn its advice against permission, which remains on file and is likely to be published on the HSE website. **A decision not to request call-in does not disregard HSE's LUP advice**.

8 HSE's role in the LUP process is to provide independent advice on the residual risks from major accidents to people at certain proposed new developments. This is delivered through PADHI+ and planning authorities must 'seriously consider' it in accordance with Planning Circular 04/2000, which advises decision-makers that:

> *'A5. In view of their acknowledged expertise in assessing the off-site risks presented by the use of hazardous substances, any advice from HSE that planning permission should be refused for development for, at or near a hazardous installation or pipeline, ..., should not be overridden without the most careful consideration.'*

Furthermore the Courts (Regina v Tandridge District Council, Ex parte Al Fayed, Times Law Report 28 January 1999) have decided that on technical issues, local authorities, while not bound to follow the advice of statutory bodies such as HSE, *'should nevertheless give great weight to their advice'* when determining planning applications.

A published external review, *Analysis of planning appeal decision reports CRR262/2000, concluded 'It is clear the HSE's risk policies have largely been upheld at planning appeals. It is viewed as a competent and expert body, and its advice provides considerable support to PA decisions.'*

Annex 2

Types of development on which to consult HSE under the Town and Country Planning (Development Management Procedure) (England) Order 2010, the Town and Country Planning (General Development Procedure) Order 1995 (as amended) in Wales, and the Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2008

The following circulars provide further guidance on when HSE is a statutory consultee:

DCLG Circular 04/2000
SOEnD Circular 5/1993 (This document is not available on the internet)
National Assembly for Wales Circular 20/01

They identify the following developments:

1 Within the Consultation Distance (CD) of major hazard installations/complexes and pipelines, HSE should only be consulted on developments involving:

- residential accommodation;
- more than 250 square metres of retail floor space;
- more than 500 square metres of office floor space;
- more than 750 square metres of floor space to be used for an industrial process;
- transport links (railways, major roads etc);
- a material increase in the number of persons working within, or visiting, a CD;
- and then only if the development is within the CD.

2 For licensed explosive sites the criteria are the same as above, but only if within the explosive site's safeguarding zone.

3 The Office for Nuclear Regulation (ONR) is a non-statutory consultee for certain developments near licensed nuclear sites. The criteria are:

- any development involving more than 50 people (or 20 people if previously advised of this figure by ONR) within the detailed emergency planning zone;
- any development of more than 500 people within the outer zone (only applies on sites which have an outer zone).

4 HSE will also:

- advise hazardous substances authorities prior to them determining a hazardous substances consent application;
- comment on planning developments involving quarries.

5 HSE does not give retrospective advice on planning applications where the decision has already been made by the planning authority.

Annex 3

Information needed when using PADHI

To properly apply the PADHI methodology to a planning proposal you will require the following information:

1 Sufficient details of the location of the proposed development to relate it to the consultation distance and the zones of all the relevant hazardous installations, complexes and pipelines.

2 Sufficient details of the proposed development, and those people likely to be there, to enable you to categorise the development within its 'sensitivity levels'. (If the proposal involves the extension of an existing facility then, to be able to take account of that when formulating the final advice, it is necessary to have similar information for that existing use.) These details should include:

- Principal purpose of the proposed development.
- The area (hectare or m^2) of the development site.
- Certain building sizes:

Development type	**Indication**
predominantly workplaces (ie not retail, community, leisure, accommodation etc) – the number of normally occupied storeys. Or at the very least an indication that:	■ all buildings have less than 3 occupied storeys; or ■ at least one building has at least 3 occupied storeys.
for **retail, community, assembly or leisure** etc use – the total floor area (m^2). Or at the very least an indication if this total is:	■ less than 250 m^2; or ■ between 250 m^2 and 5000 m^2; or ■ more than 5000 m^2.

Development type	Indication
institutional accommodation and educational facilities where day-care is provided – the total site area (hectares). Or at the very least an indication if this is:	■ 1.4 hectares or less; or ■ more than 1.4 hectares.
institutional accommodation and educational facilities where 24-hour care is provided – the total site area (hectares). Or at the very least an indication if this is:	■ 0.25 hectares or less; or ■ more than 0.25 hectares.

- For certain developments it is essential that there is an indication of the maximum number of people likely to be at the development at any one time. These may be actual numbers or best estimates/guesses. This can be in the form of:

Development type	Indication
predominantly workplaces (ie not retail, community, leisure, accommodation etc) – the number of people and the number of normally occupied buildings. Or at the very least an indication:	■ that no building is likely to contain more than 100 people; or ■ if any building is likely to contain more than 100 people.
for **houses, flats, residential caravans** etc – the actual number of 'dwelling units'. Or at the very least an indication if it is for:	■ less than 3 dwelling units; or ■ between 3 and 30 dwelling units; or ■ more than 30 dwelling units.
for **hotels, hostels, campsites, caravan sites** etc – the actual number of beds. Or at the very least an indication if it is for:	■ less than 10 beds, or less than 3 caravan/tent pitches; or ■ between 10 and 100 beds, or between 3 and 33 caravan/tent pitches; or ■ more than 100 beds, or more than 33 caravan/tent pitches.
for **predominantly outdoor events** and outdoor facilities – the number of people anticipated. Or at the very least an indication if the event will attract a peak attendance of:	■ less than 100 people; or ■ between 100 and 1000 people; or ■ more than 1000 people.

Annex 4

HSE office addresses

Only HSE offices that deal with land-use planning are listed. Please address any correspondence to Health and Safety Executive, Hazardous Installations Directorate, Chemical Industries Division at the addresses below.

Offices	**Geographical coverage**
SCOTLAND AND NORTH EAST	
Belford House 59 Belford Road Edinburgh EH4 3UE	Scotland
BP6301 Benton Park View Newcastle-upon-Tyne NE98 1YX	Cleveland, Durham, Tyne & Wear, Northumberland, North Yorkshire (except Selby District Council)
Marshall House Ringway Preston PR1 2HS	Cumbria, Greater Manchester, Lancashire
WALES & WESTERN ENGLAND	
Redgrave Court (HID CI2) Merton Road Bootle Merseyside L20 7HS	Merseyside, Conwy, Gwynedd, Isle of Anglesey, Denbighshire, Flintshire, Wrexham, Shropshire, Staffordshire, Cheshire
1 Hagley Road Birmingham B16 8HS	West Midlands, Powys, Worcestershire, Gloucestershire, South Gloucestershire, Bristol
Government Buildings Ty Glas Llanishen Cardiff CF14 5SH	Cardiganshire, Pembrokeshire, Carmarthenshire, Swansea, Neath and Port Talbot, Bridgend, Rhondda Cynon, Taff, Blaeunau Gwent, Merthyr Tydfil, Vale of Glamorgan, Cardiff, Caerphilly, Torfaen, Newport, Monmouthshire, North West Somerset, Bath and North East Somerset, Somerset, Devon, Cornwall, Isle of Scilly

SOUTH & EAST ENGLAND	
Foundry House 3 Millsands Riverside Exchange Sheffield S3 8NH	South Yorkshire, Humberside, Derbyshire, Nottinghamshire, Lincolnshire
The Lateral 8 City Walk Leeds LS11 9AT	West Yorkshire, Selby District Council
Wren House Hedgerows Business Park Colchester Road Springfield Chelmsford Essex CM2 5PF	Essex, Norfolk, Suffolk
900 Pavilion Drive Northampton Business Park Northampton NN4 7RG	Leicestershire, Northamptonshire, Oxfordshire, Bedfordshire, Buckinghamshire, Cambridgeshire, Warwickshire, Hertfordshire, London boroughs north of the Thames
Priestley House Priestley Road Basingstoke RG24 9NS	Berkshire, Dorset, Hampshire, Wiltshire, Isle of Wight, East & West Sussex, London boroughs south of the Thames, Surrey
Phoenix House 23–25 Cantelupe Road East Grinstead West Sussex RH19 3BE	Kent