BEST AVAILABLE TECHNIQUES GUIDANCE DOCUMENT ON STORAGE AND HANDLING OF PETROLEUM PRODUCTS

FOREWORD

Best Available Techniques Economically Achievable (BAT) document had been prepared as a guidance notes for the nine (9) major industries in Malaysia and to support the implementation of the new Environmental Quality (Clean Air) Regulations 20xx. These documents were prepared based on the latest state-of-the-art technologies, internationally accepted limit values but had been adjusted and tailored to local requirements.

BAT is defined as the effective methods in preventing pollution and, where generally that is not practicable, to reduce emissions from industrial activities and their impact on the environment. This definition implies that BAT not only covers the technology used but also the way in which the installation is operated, to ensure a high level of environmental protection. Implementations of BAT in any specific industrial sectors are under economically and technically viable condition.

It is hope that the technical contents of these documents will prove beneficial to the industries in their endeavour to comply with the environmental regulations and standards through more cost-efficient means. In the identification of BAT, emphasis is placed on pollution prevention techniques rather than end-of-pipe treatment. These documents will be reviewed and updated from time to time.

These documents have been prepared in consultations with the University of Malaya Consultancy Unit (UPUM), Malaysia German Technical Cooperation (GTZ) and the relevant industries/stakeholders. The Department of Environment wishes to record appreciation to representatives of the relevant industrial sectors, government agencies and individuals for their invaluable input.

DATO' HALIMAH HASSAN

Director General

Department the Environment, Malaysia

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LIST OF ABBREVIATIONS

ADO	-	
AVGAS	-	High Octane Aviation Fuel
BAT	-	Best Available Techniques
BREF	-	Best Available Technique Reference
CAR	-	Clean Air Regulation
DOE	-	Department of Environment
IFRT	-	Internal Floating Roof Tanks
IPPC	-	Integrated Pollution Prevention and Control
kg/h	-	kilogram per hour
kPa	-	kilopascal
LPG	-	Liquid Petroleum Gas
mbarg	-	meter bar gauge
MFO	-	Medium Fuel Oil
mg/Nm^3	-	milligram per cubic meter at standard temperature (273K) and pressure (1atm)
NMVOCs	-	Non Methane Volatile Organic Compounds
ppmv	-	Part per million of volume
ULG	-	
VOCs	-	Volatile Organic Compounds

1.0 PREFACE

1.1 Status of This Document

This document forms a part of a series presenting the guidance notes for selected industries in Malaysia (list given at the end of this preface) to apply best available techniques economically achievable (BAT), associated monitoring and developments in them. This series is published by the Department of Environment (DOE) in accordance to the Environmental Quality (Clean Air) Regulations 2014 (CAR 2014).

1.2 Definition of BAT

In order for the user of this document to understand the legal context of this document, the interpretation on the definition of BAT is taken from Regulation 2 – Interpretation of CAR 2014 and described as below:

"Best Available Techniques Economically Achievable" means the effective methods in preventing pollution and, where that is not practicable, generally to reduce emissions in the air from the industrial activities and their impact on the environment as a whole. In this regard:

"Techniques" includes both the technology used and the way in which the facility is designed, built, maintained, operated and decommissioned;

"Available Techniques" means those techniques that are accessible to the occupier and that are developed on a scale that allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages; and

"Best" means effective in achieving a high general level of protection of the environment as a whole;

On the basis of this assessment, techniques, and as far as possible emission and consumption levels associated with the use of BAT, are presented in this document that are considered to be appropriate to the sector as a whole and in many cases reflect current performance of some installations within the sector. Where emission or consumption levels "associated with best available techniques" are presented, this is to be understood to mean those levels representing the environmental performance that could be expected as a result of the application, of the techniques described, taking into account the balance of costs and advantages inherent within the definition of BAT. However, they are neither emission nor consumption limit values and should not be understood as such.

In some cases it may be technically possible to achieve better emission or consumption levels but due to the costs involved or cross media considerations, they are not considered to be appropriate as BAT for the sector as a whole. However, such levels may be considered to be justified in more specific cases where there are special driving forces.

The emission and consumption levels associated with the use of BAT have to be seen together with any specified reference conditions (e.g. averaging periods).

The concept of "levels associated with BAT" described above is to be distinguished from the term "achievable level" used elsewhere in this document. Where a level is described as "achievable" using a particular technique or combination of techniques, this should be understood to mean that the level may be expected to be achieved over a substantial period of time in a well maintained and operated installation or process using those techniques.

The actual cost of applying a technique will depend strongly on the specific situation such as taxes, fees, and the technical characteristics of the installation concerned. It is not possible to evaluate such site-specific economic viability of techniques drawn from observations on existing installations.

The purpose of CAR 2014 is to achieve prevention and control of pollution arising from activities listed in its First Schedule and Second Schedule. More specifically, it provides for a notification system for certain categories of industrial installations to conduct an integrated and comprehensive view of the pollution and consumption potential of their installation. The overall aim is to ensure a high level of protection of the environment as a whole based on appropriate preventative measures through the application of BAT.

1.3 Objective of This Document

The 'emission minimization principle' as cited in CAR 2014 requires that the goal of emission abatement is to achieve minimum emissions as a result of applying current BAT. Hence this guideline document is meant to provide the reference information for the permitting authorities to take into account when determining permit conditions. This document should serve as valuable input to achieve better environmental performance.

1.4 Information Sources

The information is mainly based on the European IPPC BREF document where the assessment was achieved through an iterative process involving the following steps:

- identification of the key environmental issues for the sector
- examination of the techniques most relevant to address those key issues;
- identification of the best environmental performance levels, on the basis of the available data world-wide;
- examination of the conditions under which these performance levels were achieved; such as costs, cross-media effects, main driving forces involved in Implementation of these techniques;

- selection of the BAT and the associate emission and/or consumption levels for this sector

1.5 How to Use This Document

It is intended that the general BAT in this document could be used to judge the current performance of an existing installation or to judge a proposal for a new installation and thereby assist in the determination of appropriate BAT based conditions for that installation. It is foreseen that new installations could be designed to perform at or even better than the general BAT levels presented here. It is also considered that many existing installations could reasonably be expected, over time, to move towards the general "BAT" levels or perform better. This reference document does not set legally binding standards, but they are meant to give information for the guidance of industry, the relevant government bodies and the public on achievable emission and consumption levels when using specified techniques.

The structure of the guideline document is as follows:

An overview of each particular sector in the Malaysian context is firstly covered briefly followed by process description, process optimization, sources of pollution, emission control options, recommended practices and emission values and finally emission monitoring and reporting. More often than not, trade-off judgements between different types of environmental impacts and specific site condition are the influencing factors.

Another important point to note is that BAT change over time and this guidance document needs to be reviewed and updated as appropriate.

2.0 OVERVIEW ON STORAGE AND HANDLING OF PETROLEUM PRODUCTS

2.1 Refinery

2.1.1 Storage of Petroleum Products

Crude oil, petroleum intermediates and final products are transferred to, in and from refineries, through marine terminals, via pipeline or rail vehicles. Between these movements, the products are stored in tanks. Storage tanks are used throughout the refining process to store crude oil, other raw materials and intermediate process feeds. Finished petroleum products are also kept in storage tanks before transport off site. Tanks are also needed to accommodate blocked-out operation of processing units, to link continuous refinery processes with discontinuous ones. Consequently, storage is an essential part of a refinery. Blending systems are also used in refineries to prepare feed streams to individual refinery units and to produce finished products to be sold.

2.1.2 Handling of Petroleum Products

Feed blending may be applied to prepare the optimum feed stream to a refinery unit, thereby ensuring the optimum performance of the refinery unit. For example, a refiner processes a mixture of four different low-sulphur crudes in his atmospheric distillation unit. The feed blend is selected so that the throughput in the distillation unit and further downstream units are optimized/maximized with the objective of maximizing overall profit. Alternatively, it also happens that the different quality crude’s are processed separately for a short period in so-called “block-out” operations.

Product blending is applied to produce an optimum mix of finished refinery products. The majority of the product streams as produced in different refinery units, normally identified as an intermediate product stream, can be blended into more than one finished product stream. For example kerosene product is normally blended into diesel oil, light heating oil and even heavy fuel oil, with the reminder blended into the jet fuel oil. The amount of kerosene allocated to the different product is selected so that product demands and specifications are met with the objective of maximizing overall profit. Blending products involves mixing the products in various proportions to meet specifications such index, initial boiling point and pour point and to add distinctive smells (LPG).

2.2 Fuel Terminal

2.2.1 Storage of Petroleum Products

The end product from the refineries will be stored at fuel terminal before distribute to customers. The fuel terminal receives stores and handles product such as AVGAS, MFO, ADO, ULG etc. The petroleum products receive from the refineries through vessels or pipelines. The petroleum products were stored in the various types of storage tank depends on the product and design of respective terminal. The entire tank farm is bunded with each bund has the capacity to contain the entire quantity from the biggest tank plus 10% of the biggest tank content.

2.2.2 Handling of Petroleum Products

Petroleum products can be divided into volatile (i.e. gasoline) and non-volatile (i.e. fuel oil and lubricants) products. Without proper precautions and appropriate procedures, handling petroleum products could result in casualty or product's degradation. At fuel terminal, daily dip of storage tank to monitor stock movement and product losses and at the same time check the present of water in the product were conducted. Also, daily check of the storage tanks and pipeline were conducted to prevent leakage or spillage.

2.3 Distribution of Petroleum Products

2.3.1 Port/offshore activities

At the port, all petroleum products from the refinery storage tanks were transfer into vessels for distribution. Eventually, the products will be distributed to local and overseas market. Location of Malaysian ports are as shown in **Figure 1**

Source: The National Maritime Portal

Figure 1: Location of Malaysian Ports

2.3.1.1 Distribution to the In Land Customer

The distribution of the petroleum products to inland customers normally via road tankers. The product transfer from the storage tank to road tanker at the lorry loading gantry. The loading gantry points either using bottom loading or top loading depends on the design of the road tanker receiving point.

2.3.1.2 Bunkering at Jetty

For bunkering process, petroleum product is transferred from storage tank at the fuel terminal through pipeline via jetty. The flexible hoses for connection from the vessel to the jetty facilities are used depends on the product to be transferred.

3.0 SOURCES OF AIR POLLUTANT EMISSIONS

3.1 Contribution to Total Emissions

Emissions arise as a result of evaporation from storage tanks, the displacement of vapour during volume changes, loading and unloading and spillage. **Figure 2** identifies the possible gaseous and liquid emissions and residues resulting from the storage and transfer of liquid materials. For each storage and transfer category the relevant operational activities and possible events/incidents which can result in emissions are listed.

Emissions from the storage and handling of intermediates and products typically contribute to between 1% and 6% of a country’s total NMVOC emissions from anthropogenic source.

3.1.1 Mineral Oil Refineries

Mineral oil refining is one of the important economic activities in Malaysia. The gaseous pollutant emissions from refinery operations may contribute to our air quality. **Table 1** shows the locations of currently existing oil refineries in Malaysia.

Table 1: Location of Oil Refineries in Malaysia

Oil Refineries	Locations
Petronas Penapisan (Terengganu) Sdn Bhd	Kerteh, Terengganu
Petronas Penapisan (Melaka) Sdn Bhd	Tangga Batu, Melaka
Malaysia Refining Company Sdn Bhd	Tangga Batu, Melaka
Shell Refining Company (FOM) Bhd	Port Dickson, Negeri Sembilan
Esso (Malaysia) Bhd	Port Dickson, Negeri Sembilan

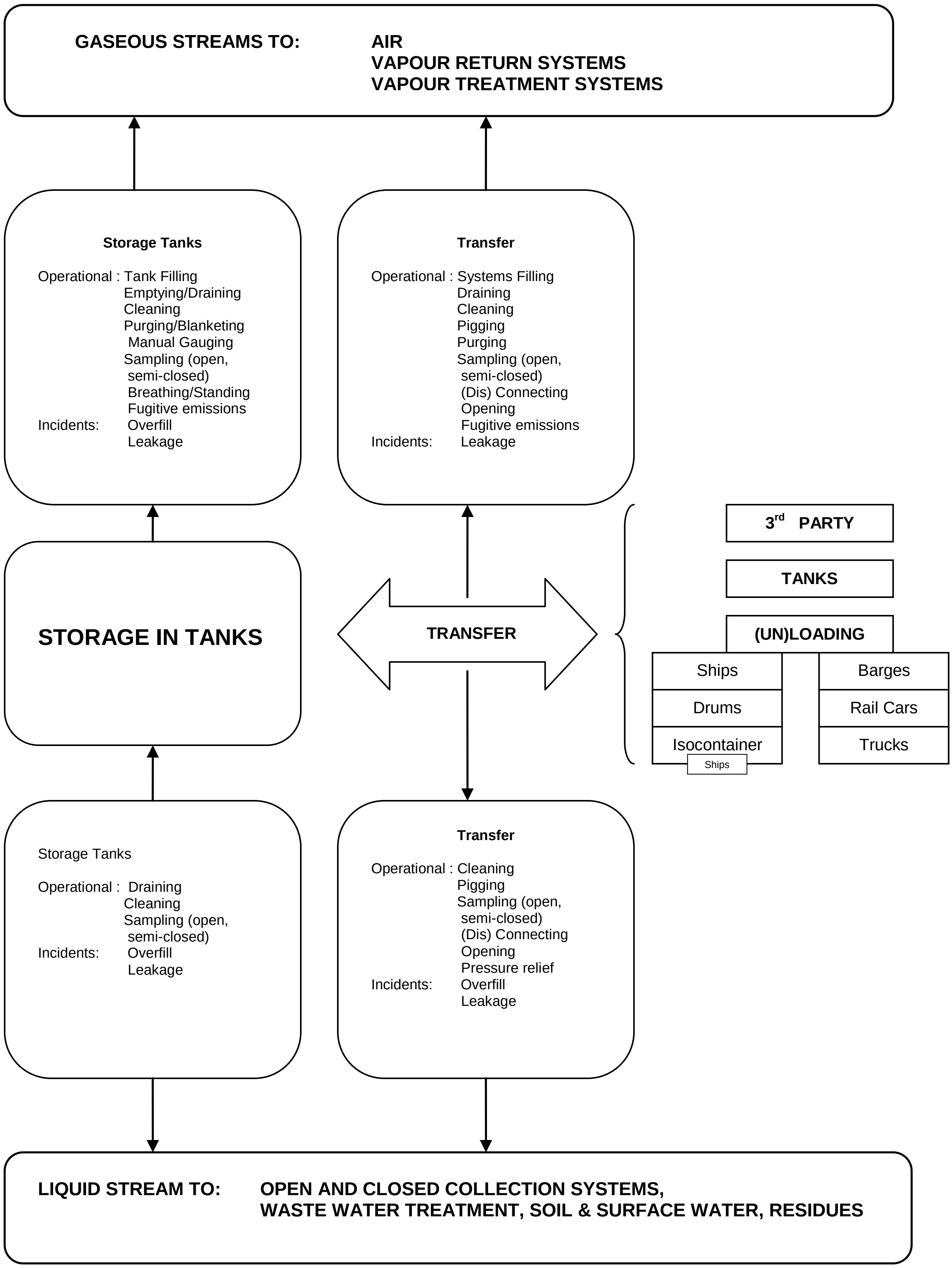

Figure 2: Flowchart Showing Potential Emissions Resulting from Storage and Transfer Facilities

3.2 Process Description

The crude oil storage systems can be located either at separate oil terminal or within the refinery complex. More than 50% of the refinery area is occupied by oil movement facilities. Storage tanks can be divided into four main types:-

a. Pressure Vessels
b. Fixed roof tanks
c. Fixed roof tank with floating cover
d. Fixed roof tank with floating roof tanks

i) *Pressure vessels* are normally used to store gases at high pressure (>91 kPa e.g LPG) Fixed roof tank can be open to atmosphere, or designed as a pressure tank, with several classes of allowed pressure build-up, from 20 mbarg (low pressure) to 60 mbarg (high pressure). The pressure tanks are provided with pressure/vacuum relief valves to prevent explosions and implosions, the vacuum setting being –6 mbarg. Floating roof tanks are constructed in such a way that the roof floats on the liquid, and moves with the liquid level (>14kPa to <19 kPa).

ii) Above-ground storage tanks are used at refineries for holding either the raw feedstock or end-products generated by the refinery processes (gasoline, diesel, fuel oil).
Underground storage tanks are used much less frequently at refineries-primarily for storing fuel for onsite boilers and vehicles, or for capturing liquids at low level drain points.

iii) Blending can be carried out in-line or in batch blending tanks. An in-line blending system consists of a manifold where individual streams are blended on flow control, and the blend ratio is normally controlled and optimized by a computer.

iv) Batch blending involves mixing the feed streams in a blend tank, from where the relevant process units are fed. The same applies to intermediate product streams, which are first sent to intermediate storage tanks, from where they are batch blended into the final product tanks.

v) Additives and odorants. The odorant is stored as a liquid, normally in fixed tanks. The odorant is not added to the gas stream prior to liquefaction but is usually added to the LPG whilst the LPG is being loaded into the delivery tankers, although in-tank odorizing is also carried out. Allowance may be made for any residual mercaptans already present in the LPG. The pump addition rate is carefully controlled. In the case of liquid propane, methanol may be added with the odorizing agent in order to prevent hydrate icing in propane evaporators.

vi) Pipes, valves and auxiliary systems, such as vacuum recovery units are found throughout a refinery. Gases, liquids and even solids are transferred from unit operation to unit operation by pipes. Process pipes are normally over ground but some pipes are under ground.

4.0 EMISSION CONTROL OPTIONS

4.1 Underground Tanks

Achieved environmental benefits

- VOC emissions from underground tanks are very low or non-existent. The main reasons are: the temperature of the underground storage tank is low and stable, the product is under pressure and the breathing gases from the underground storage tank are not led to atmosphere but to other cavers.
- The land above underground storage tanks is free for other purposes.
- Improve safety

4.2 Internal Floating Roof Tanks (IFRT)

Internal floating roof tank. Emissions primarily occur during standing storage, with an additional contribution from withdrawal emissions. In addition to the rim seal area and roof fitting penetrations, sources of standing loss from internal floating roof tanks include bolted seams in the floating roof. Some techniques that might be applied to IFRT are :

2 The replacement of primary/secondary seals with tighter seals, which can also reduce the VOC emissions

3 Drain design on floating roof tanks to avoid hydrocarbon contamination of rainwater

Achieved environment benefits

Reduction of VOC emissions. Conversion of fixed roof tanks to internal floating roof and seals to minimize evaporation of the product being stored. The control efficiency of this method ranges from 60 to 99% depending on the type of roof and seals installed and the true vapour pressure of the liquid stored.

Cross-media effects

The net storage capacity of a fixed roof tank is reduced by approximately 10 %.

4.3 Fixed-roof Tanks

The fixed-roof tank can give rise to emissions in the following ways:

- Filling losses; during tank filling the existing tank vapour space, which is more or less saturated with vapour, is expelled to the atmosphere, while when tank is emptied the incoming air is slowly saturated with vapours, which are then expelled by subsequent filling and breathing. Generally those emissions are greater than standing emissions. A technique to reduce VOC from those tanks is to reduce VOC from those tanks is to increase the storage pressure by blanketing.

- Breathing losses; during storage of the liquid there will be vapour emissions from tank breathing caused by the difference in night and day temperatures and by changes in atmospheric pressure. To a certain extent, pressure controllers and insulation can prevent breathing losses.

- Vapours released during water draining.

The techniques that are considered to reduce emissions from fixed roof tanks are:

- A technique to reduce VOC from those tanks is to blanket them
- Installation of an internal floating roof.

Achieved environmental benefits

The installation of an internal floating roof in fixed-roof tanks can reduce VOC emissions up to 90%

4.4 External Floating Roofs

External floating roof tanks- Filling and breathing losses are greatly diminished in comparison with fixed roof tanks, but the following vapour losses are inherent to this type of tank:

- Standing storage emissions from floating roof tanks include rim seal and roof-fitting emissions, which result from stock vapour pressure changes due to temperature, and pressure variations but more importantly wind effects as well as openings in the roof. The influence of wind effects is not a factor on internal floating roof tanks. Standing emissions on external floating roof tanks are generally much more significant than withdrawal emissions.

- Wetting losses; by evaporation of liquid from the wet wall, when the level of the liquid is lowered by discharge

- Vapours released during water draining

- In many cases, for an external floating roof tank, the emissions through fitting can exceed the rim seal losses especially on tanks with secondary seals. In term of fitting losses, the major source is from the slotted stillwell.

External floating roof tanks are used to store crudes, light products and intermediate stocks having a vapour pressure of more than 14kPa but less than 86 kPa at normal storage temperature. Techniques to minimize emissions there include:

- Installing wipers at the floating deck
- Sleeves around the pipe, incorporating still well wipers
- Floaters with wipers inside the slotted pipe
- Land as infrequently as possible the floating roof tanks to avoid unnecessary vapour releases.

4.5 Pressurised vessels

Pressurised vessel such as bullets and spheres are often fitted with pressure relief valves, which vent to atmosphere or flare. VOC emissions can occur if these valves or by-pass block valves have internal leaks.

5.0 RECOMMENDED PRACTICES AND EMISSION VALUES

5.1 Prevention of Leakage through Tank Bottoms.

The following techniques can be considered in the determination of BAT for prevention of leakage through tank bottoms are as shown in **Table 2**.

Table 2: Prevention of Leakage through Tank Bottoms

Prevention technique	Description
Double tank bottoms	Installing a second impervious bottom to a tank provides a measure of protection against non-catastrophic releases due to corrosion, faulty weld joints, or flaws in the bottom material or the construction details. In addition to containment, the secondary bottom provides a means of allowing detection of a bottom leak which is not obviously visible to an operator, as a similar shell defect would be.
Impervious membrane liners	It is a continuous leak barrier under the entire bottom surface of the tanks. It can be an alternative to a double bottom or it can be added as extra measure of safety below the double bottom. It is primarily intended to arrest the small but persistent leak rather than address a catastrophic failure of the entire tank. The minimum thickness of the flexible membrane is 1 mm, although 1.5 to 2 mm thick sheets are commonly used. The membranes need to be chemically resistant to the product stored in the tank.
Leak detection	Leaks through a tank bottom can be detected by a leak detection system. Conventional system includes inspection port, inventory control and inspection wells. Some techniques to consider are : 1. Equipping storage tanks with overflow alarms and automatic pump shut-offs. 2. Installing double bottoms with integrated leak detection systems on tanks where practicable.
Cathodic protection	To avoid corrosion on the underside of the tank bottom, tanks can be equipped with cathodic corrosion protection. Avoid soil and groundwater contamination and air emissions due to the prevention of corrosion.

5.2 Other Good Storage Practices

Proper material handling and storage minimizes the possibility of spill, leaks and other losses which result in waste, air emissions and emissions to water. Some good storage practices are:

- Use larger containers instead of drums. Larger containers are reusable when equipped for top and bottom discharge, whereas drums have to be recycled or disposed of as waste. Bulk storage can minimize the chances of leaks and spills as compared to drums. Applicability: safe disposal of un-refillable large containers can be a problem.

- Reduce generation of empty oil drums. Bulk purchasing (via tank truck) of frequently used oils and filling tote bins as intermediate storage. Personnel could then transfer the oils from the tote bin to reusable drums, buckets, or other containers. This would reduce the generation of empty drums and their associated handling costs.

- Storage of drums off the floor to prevent corrosion through spills or concrete ‘sweating’.

- Keeping containers closed except when removing material.

- Practice corrosion monitoring, prevention and control in underground piping and tank bottom.

- Tanks for storage of ballast water may cause large VOC emissions. They can be therefore equipped with a floating roof. Those tanks are also relevant as equalizing tanks for the waste water treatment system.

- Vents from sulphur storage tanks to pass to sour gas or other arrestment system.

- Vent collection and ducting from tank farms to central abatement procedures.

- Install self-sealing hose connections or implement line draining procedures.

- Install barriers and/or interlock system to prevent damage to equipment from the accidental movement or driving away of vehicles (road or rail tank cars) during loading operations.

- Implement procedures to ensure that arms are not operated until inserted fully into the container to avoid splashing where top loading arms are used.

- Apply instrumentation or procedures to prevent overfilling of tanks.

- Install level alarms independent of normal tank gauging system.

6.0 EMISSION REDUCTION TECHNIQUES

The emission reduction techniques are as summarized in the following **Tables 3, Table 4** and **Table 5.**

Table 3 Control Options for the Abatement of NMVOC Emissions

Characteristics of reference installation	Control Options	Abated mass flow (MgNMVOC/Year)
Mineral oil refineries: Petroleum products processing		
Refinery; capacity: 5,000,000 Mg crude/year; Operating time:8,000 h/year	Quarterly monitoring, repair and replacement and routing of pressure relief systems to closed systems and use of closed-loop sampling systems	1,100
	Completely closed waste-water collection and treatment system control	180
	Incineration of non-condensable emissiofrom blowdown systems and gas collection systems in a flare	9600
	Recovery of other condensable vent emissions (absorption, carbon adsorption)	500
Mineral oil refineries; storage and handling of petroleum products in refinery		
Fixed-roof tank; Diameter: 40 m; High vapour pressure : VP> 10 kPA; operating time: 8,000 h/year	Improved operational procedures and external paint finish of light shade	50
	Conversion to internal floating-roof tank	4,100
	Vapour balancing and recovery	3,700
External floating-roof tank; diameter : 40 m; High vapour pressure: VP> 10kPa; Operating time: 8,000 h/year	Improved operational procedures and improved primary seal and secondary seal and roof fitting controlled and external paint finish of light shade	
Throughput: 8,800 m3/year; 8 double-walled underground tanks, 16 refuelling nozzles; already equipped with stage I control; operating time: 8,760 h/year	Stage II control	10

Source: Guidance Document on control techniques for Emission of VOC from Stationary Source

Table 4: Emission Sources and Selected NMVOC control measures with Achievable Emission Factors for Mineral Oil Refineries.

Emission source	Combination of control measures	Achievable emission factor for NMVOC
Storage and handling of petroleum products in mineral oil refineries		
Fixed-roof tank		
Low vapour pressure (0 <VP< 10 kPa)	Conversion from fixed-roof to internal floating-roof tank	1-3 g/Mg throughput
High vapour pressure (VP > 10 kPa)	Conversion from fixed-roof to internal floating-roof tank	10-40 g/Mg throughput
	Vapour balancing and recovery	150-160 g/Mg throughput
External floating-roof tank		
Low vapour pressure (0<VP≤ 10 kpa)	Improved operational procedures and improved primary seal and secondary seal and controlled roof fitting and external paint of light shade	0.5 -2 g/MG throughput
High vapour pressure (VP >10 kPa)	Improved operational procedures and improved primary seal and secondary seal and controlled roof fitting and external paint of light shade	5-25 g/Mg throughput
Internal floating-roof tank		
Low vapour pressure	Improved operational procedures and improved primary seal and secondary seal and controlled roof fitting and external paint of light shade	1-3 g/Mg throughput
High vapour pressure	Improved operational procedures and improved primary seal and secondary seal and controlled roof fitting and external paint of light shade	10-40 g/Mg throughput

Source: Guidance Document on control techniques for Emission of VOC from Stationary Source

Table 5: Emission Sources and Selected NMVOC Control Measures with Achievable Emission Factors for the Extraction and Distribution of Fossil Fuels

Emission source	Combination activities measures	Achievable emission factor for NMVOC
Offshore activities (liquid fossil fuels)		
Combined oil and gas facilities, facilities producing oil only	Gas removal during drilling and flaring instead of venting and recovery systems for loading and transport	150 g/Mg crude oil extracted
Land-based activities (gaseous fossil fuels)		
Facility producing gas or gas terminal	Gas removal during drilling	1.5 g/Mm^3 gas
Marine terminals (liquid fossil fuels excluding petrol)		
Crude oil storage and handling in external floating-roof tanks, ballasting of oil tankers	Vapour balancing	40 g/Mg crude oil
Other handling and storage (liquid fossil fuels excluding petrol)		
Fixed-roof tank storing low vapour pressure products	Vapour balancing and improved inspection and maintenance	80 g/Mg fuel
External floating-roof tank storing high pressure products and crude oil	Vapour balancing and improved inspection and maintenance	10 g/Mg fuel
Mineral oil refinery dispatch stations (petrol)		
Loading of ocean ship	Modified top loading technique and vapour return and recovery system	30 g/Mg petrol
Loading of barge	Modified to top loading technique and vapour return and recovery system	70 g/Mg petrol
Loading of rail tanker	Top-submerged loading technique and vapour return and recovery system	75 g/Mg petrol
Loading of road tanker	Bottom loading technique and vapor return and recovery system	60 g/Mg petrol
Transport and depots (petrol)		

Unloading of dedicated or switch loaded cargo tank at marketing depot or border terminal, Submerged loading into road tanker	Fixed-roof tank retrofitted with internal floating cover or floating-roof tank and white painted tank shell	700 g/Mg petrol
	Vapour balance line between tank and loading gantry and vapour recovery unit or combustion in a thermal oxidation unit	300-400 g/Mg petrol
Service stations		
Service station without abatement device	Stage I and II control	200 g/Mg petrol
Service station equipped with stage I control	Stage II control	200 g/Mg petrol
Local gas distribution		
Jointed pipes		
Small diameter : Pressure P<0.075 hPa	Reduced number of flanges, valves etc and improved inspection and maintenance	400 g/year/km
Medium diameter : pressure 0.075 <P<2 hPa	Reduced number of flanges, valves, etc and improved inspection and maintenance	4 g/year/km
Large diameter : Pressure 2<P<7 hPa	Reduced number of flanges, valves, etc and improved inspection and maintenance	20 g/year/km
Welded pipes		
Small diameter : pressure P<0.075 hPa	Improved inspection and maintenance	0.40 g/year/km
Medium diameter: pressure 0.075<P<2 hPa	Improved inspection and maintenance	0.004 g/year/km
Larger diameter: pressure 2<P< 7 hPa	Improved inspection and maintenance	0.020 g/year/km

7.0 EMISSION MONITORING AND REPORTING

- Several monitoring systems, using both continuous and periodic measurement methods, are available. However, quality measurements vary. Measurements are to be carried out by qualified institutes using measuring and monitoring systems that meet international standards. To this end, a certification system can provide the best assurance.

- In framework of modern and automated monitoring systems and process control equipment, reporting does create a problem. The collection of data for further use is a state-of-the-art technique. However, data to be reported to competent authorities differ from case to case. To obtain better comparability, data sets and prescribing regulations should be harmonized. Harmonization is also desirable for quality assurance of measuring and monitoring systems. This should be taken into account when comparing data.

- To prevent discrepancies and inconsistencies, key issues and parameters, including the following, must be well defined:
  a. Definition of standards expressed as ppmv, mg/Nm^3, g/Gj, kg/h or kg/Mg of product. Most of these units need to be calculated and need specification in terms of temperature, humidity, pressure, oxygen content or heat input values;
  b. Definition of the period over which standards are to be averaged, expressed as hours, months or a year, and of the measuring method.
  c. Definition of failure times and corresponding emergency regulations regarding bypass of monitoring systems or shutdown of the installation.
  d. Definition of methods for backfilling data missed or lost as a result of equipment failure;
  e. Definition of the parameter set to be measures. Depending on the type of industrial process, the necessary information

may differ. This also involves the location of the measurement point within the system.

REFERENCES

1. European Integrated Pollution Prevention and Control Bureau (EIPPCB), (July 2006). Best Available Techniques (BAT) Reference Document on Emissions from Storage. Joint Research Centre, Institute of Prospective Technological Studies, EIPPCB