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GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF WASTES IN UPSTREAM PETROLEUM INDUSTRIES

Department of Environment
Ministry of Science, Technology and the Environment

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Ministry of Science, Technology and the Environment
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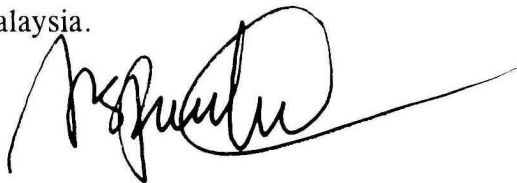
FOREWORD

The Environmental Quality (Scheduled Wastes) Regulations, 1989 have been enforced since May 1989. In the course of implementing the regulations, many difficulties and shortcomings were encountered by waste generators. In view of this, various Technical Working Groups were established in July 1992. One of the Technical Working Group was for Petroleum Industries which was formed to review the current status of scheduled wastes management and to formulate guidelines that can be used by waste generators of the Petroleum Industries to ensure compliance with the requirements of the Environment Quality (Scheduled Wastes) Regulations, 1989.

The guidelines, among others, provide an outline of the concept of the waste minimization and the handling, storage, treatment and disposal of scheduled wastes. In addition Emergency Response Procedures were also described.

The guidelines have been prepared in close consultation and cooperation between the Department of Environment and Petroleum Industries in Malaysia. In this respect, the Department of Environment would like to acknowledge with gratitude the contributions and involvement of ESSO Production (M) Inc, PETRONAS, Malaysia LNG Sdn. Bhd., and Sarawak Shell Bhd. for the preparation of the guidelines and in making this publication possible.

I hope that these Guidelines shall be used in addition to and not in derogation of any written law of Malaysia.

A handwritten signature in black ink, appearing to read 'Abu Bakar Jaafar', with a long horizontal line extending to the right.

Dato' Dr. Abu Bakar Jaafar
Director General of Environment,
Malaysia

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GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF GLYCOL

1. Scope Of The Guidelines

The guidelines cover the management and disposal of spent or contaminated glycol generated from gas processing plants or gas dehydration systems that utilize glycol for gas drying.

2. Objective

The objective of the guideline is to provide petroleum industry generators with the options to safely manage and dispose of glycol wastes. Adherence to the guideline will ensure that the waste will not pose a threat to public health and the environment.

3. Classification And Definition Of Waste

Contaminated ethylene glycol from gas processing plant is specifically regulated under the Environmental Quality (Scheduled Wastes) Regulations, 1989, and the Waste Code is S071. Therefore, the management and disposal of waste glycol from upstream petroleum industry are subject to all the regulatory requirements.

4. Characteristic Of Waste

Glycol is a fairly inert product. Inhalation, eye and skin contacts are not expected to be a hazard. Ingestion may cause irritation in the mouth, throat or stomach. There are different types of glycol. Therefore, for actual characteristics of the glycol used in the gas processing plant/system, please consult the Material Safety Data Sheet.

4.1 **Emergency Response Procedure**

In the event of a spill, use sorbents to soak up as much of the spill as possible. If spilled on land, use a shovel to scoop up the contaminated soil. Refer to the Guidelines on the Management of Contaminated Debris and Soil for handling and disposal. In the event of a fire, acceptable fire extinguishment systems include foam, chemical and carbon dioxide.

5. **Waste Production/Management**

Generation of glycol waste can be minimal if the gas dehydration systems are designed in conjunction with a glycol regeneration system. This allows repeated use of the glycol and generally, no waste is generated. Rather, the system only needs to be refilled due to fugitive losses.

However, it is recognized that some systems are not designed this way, and there may be occasions where the glycol sludges or contaminated glycol needs to be removed and disposed.

Below are some management options for minimizing glycol waste for disposal:

REDUCE	:	Improve housekeeping procedures
REUSE	:	Not applicable
RECYCLE	:	Not applicable
RECOVER	:	Certain glycol solutions may be reclaimed. However, there are no commercial vendors in Malaysia who currently provides this service. Include return of contaminated glycols in service contracts.

6. **Storage**

Store in steel drums or containers. Keep containers closed and store in a cool, well-ventilated place away from sources of ignition and heat. Segregate from other waste sludges that are not compatible. Glycols are incompatible with oxidizing agents, and sources of heat and ignition. A means of collecting liquids from leaks or precipitation is necessary, so that the wastes do not contaminate the environment.

The drums or containers containing the glycol must also be suitably labelled as stipulated under Environmental Quality (Scheduled Wastes) Regulations 1989. An inventory of the stored wastes should be maintained at the storage site.

7. **Handling**

Minimize the generation of mists or vapors. In confined spaces, provide mechanical ventilation with explosion proof equipment. Where concentrations in air may exceed the exposure limits for the specific glycol (e.g. the occupational exposure limit for ethylene glycol is 125 mg/m^3), and the concentrations cannot be reduced by mechanical means, then approved respirators may be necessary to prevent over exposure through inhalation.

8. **Transportation**

The transportation of glycol is subject to the Environmental Quality (Scheduled Wastes) Regulations, 1989. The waste glycol can only be disposed of at a licensed premise and be transported by licenced transporter. All scheduled waste transportation must be accompanied by the required consignment notes for waste tracking purposes.

The containers must not be leaking and must be securely fastened to the truck or carrier. The contents should be clearly marked "Waste Glycol" and labelled "Flammable" .

In the event of a spill, the transporter shall immediately set up appropriate barriers and inform the police/fire brigade (if there is risk of fire). The transporter shall also inform the waste generator of the incident. The emergency response procedures discussed in Item 4.1 should be practised.

9. Treatment And Disposal

There is currently no approved or suitable means of disposing of waste glycol, and thus, they must be stored. See Item 6 on Storage to ensure all waste chemicals are appropriately stored.

However, if approved commercial facilities are available in future, the glycol can be disposed of through:

- o Approved hazardous waste disposal facility
- o Secured landfill
- o Approved incineration

Please note that burial or open burning of glycol is strictly prohibited.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF BATTERIES

1. Scope Of Guidelines

Spent, discarded or off specification batteries from both manufacturer and the end users are included under this guideline.(Lead-acid, Nickel-Cadmium)

2. Objective

The objective is to provide a guideline for end users as to the proper batteries handling and disposal method as well as to create awareness to the potential hazards posed to safety of personnel, public and the environment.

3. Classification And Definition Of Waste

Under the Environmental Quality (Scheduled Wastes) Regulations, 1989, under the First Schedule, waste batteries are classified as:

S271 Discarded or off specification batteries from batteries manufacturing plant.

This category shall encompass discarded batteries from end users in view of its content and potential safety and environmental hazards if significant quantity is disposed off improperly.

4. Characteristic Of Waste

The general physical characteristic of batteries are its hard outer shell (containment unit) and internal content make-up (e.g. acid) and metal cathodes and anodes. (copper, lithium, cadmium). Exact physical and chemical content is usually listed in Material Safety Data Sheet (

M.S.D.S) and obtainable from supplier.

5. Hazards

5.1 Health and Environmental Hazards

The content of batteries normally posed hazards to safety and the environment. Acids are corrosive and heavy metal can accumulate in human bodies which will affect health status of persons involved. Contamination of ground water by heavy metal leaking can occur if batteries is disposed into improperly built landfill. Contaminated or unclean batteries shell can pose hazards to safety and environment.

5.2 Control of Hazards

When handling batteries, proper personal protection equipment with respirator and chemical resistant gloves must be worn. Storage areas must be well ventilated to avoid accumulation of acid fumes. Store in cool, well ventilated place and ensure no leakage of batteries content is allowed.

6. Emergency Response Procedure

In the event of spill of batteries content, the affected area must be condoned and contaminated soil is collected and disposed off in a proper manner. Intense heat or fire may occur if the acids is in contact with incompatible waste as defined in the Fourth Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989.

7. Waste Production

7.1 Sources

Batteries are used for power generation in both offshore and

onshore facilities. This may range from domestic use (e.g. torch light) and equipment start-up apparatus (e.g. generators). No distinction, is therefore applied based on the potential hazards to safety and environment in terms of disposal.

7.2 Waste Management

7.2.1 Reduction

Alternative batteries which is less hazardous to safety and environment may be used. Examples are lead acid batteries which can easily be recycled in Malaysia. Another alternative is to use rechargeable batteries.

7.2.2 Reuse

Use rechargeable batteries.

7.2.3 Recycle

Certain portions of the batteries (e.g. nickel and cadmium) is recyclable. Include buy-back clauses to manufacturers/suppliers during procurement process.

7.2.4 Recover

This is a similar process to recycling where metals can be recovered.

8. Storage

Batteries should be stored in corrosion-resistant (lined) containers. Keep containers closed and store in a cool, well-ventilated place off the ground and away from incompatible materials. Containers should be labelled 'corrosive'.

Record of inventory and movement of batteries should be kept.

9. **Handling**

Personal protection equipment and chemical resistant hand gloves must be worn at all times when handling batteries.

Avoid inhalation of fumes, spillage of battery contents, and exercise care at all times.

Take note of manufacturers precaution and warnings, particularly relating to safety aspects of battery handling.

10. **Transportation**

Although waste batteries generated by end users are not regulated, nevertheless, care should be taken to ensure responsible transporters are used for transferring or disposing waste batteries. Depending on the quantity being transported, in the event of an accident, the transporter should contact the Police, Fire Brigade and waste generator. The waste generator should always give the necessary assistance and information when required.

11. **Treatment And Disposal**

11.1 Treatment

It may be beneficial to segregate the outer shell from the batteries contents. The shell must be cleaned thoroughly and ensure no chemical residue is left.

11.2 Disposal

Cleaned batteries shell can be disposed in municipal dump sites. Alternatively, shell can be recycled. For acid batteries, the acids can be disposed off as per Guidelines On the Management and Disposal of Acid and Bases. Metals (lead, nickel or cadmium) can be recovered. Alternatively, the whole batteries is sent for recycling at the recycling plant.

GUIDELINE ON THE MANAGEMENT AND DISPOSAL OF WASTE OIL

1. Scope Of Guidelines

The guidelines cover the proper storage, handling, collection, transportation, treatment and disposal of waste oil of petroleum hydrocarbon and synthetic nature as a result of upstream oil and gas activities at the drilling rigs, production platforms, crude oil terminals, gas terminals, floating storage and supply bases. The waste oil considered in this guideline includes spent diesel, spent oil or grease and waste oil or oily sludge which by nature of its environmental hazards are classified as Scheduled Wastes under the Environmental Quality (Scheduled Wastes) Regulations, 1989 (First Schedule Waste Code N011 and Waste Code - S011).

2. Objective

The purpose of this guideline is to provide waste generators a guide in the management of waste oil including spent oil or grease, waste oil or oily sludge and hydrocarbon or synthetic lubricating oil. The proper management of these wastes safe guards not only human life but also the integrity of our environment.

3. Classification And Definition Of Waste

Under the First Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989, waste oils are classified under Scheduled Wastes from both Non-Specific Sources - Mineral Oil and Oil Contaminated Wastes: Spent Oil or grease used for lubricating industrial machines (N011) and Scheduled Wastes from specific Sources - Mineral Oil and Oil Contaminated Wastes: Waste oil or oily sludge from waste water treatment plant of oil refinery or crude oil terminals (S011).

4. **Data Sheet/Characteristic Of Waste**

A basic understanding of the characteristic and properties of waste oil is an important precursor in evaluating treatment and disposal techniques.

4.1 Name and Description

Waste oils are found in all oil and gas exploration and production operations. This waste is generated from hydrocarbon and synthetic lube oils used in engine and rotating equipment lubricating systems, tank cleaning, pigging operations and waste oil treatment systems.

4.2 Type of Hazards

The major hazards encountered from the improper handling and storage of waste oils is potential ground water and surface water contamination (hydrocarbons and metals) if applied to ground surfaces.

The health risk resulted from the exposure to waste oil through eye and skin contact, inhalation and ingestion are provided in the Appendix 1.0 - Health Effects

4.3 Control of Hazards

Hazards arising from the storage of waste oils shall be minimised by exercising extreme precaution in storage and handling. The wastes shall be stored in steel tanks or drums kept in closed container and stored in a cool, well- ventilated place away from sources of heat and ignition. Storage area shall be built on a hardstanding base with a proper drainage for surface run-off and covered against downpour.

Handling precautions shall minimize generations of mists or vapour, avoid frequent and prolonged skin contact and avoid inhaling vapours. In confined spaces, mechanical ventilation

using explosion-proof equipment shall be provided.

4.4 Protective Equipment

Personal protective equipments such as chemical safety goggles, chemical resistant gloves and long sleeves shall be worn to protect against prolonged and/or repeated skin and eye contact.

Where concentrations in air may exceed the occupational limits, and cannot be reduced by mechanical ventilation or other means, approved aspirators may be necessary to prevent over exposure by inhalation.

4.5 Emergency Response Procedures

Depending on severity, first aid shall be immediately administered to person who incidentally inhaled, ingested and make bodily contact with waste oil. (Refer to Appendix 2.0: First Aid Measures)

5. **Waste Oil Production**

5.1 Sources of Waste Oil

Waste oils are generally generated from all oil and gas exploration and production operations. The operations include drilling operations, gas and crude oil production and storage, pipeline transmission and gas compression. The common sources are engine and rotating equipment lubricating systems, storage tanks, wastewater treatment systems and pigging system. Also includes oil and grease from fleet vehicles. Components of waste oil is shown in Appendix 3 .0

5.2 Procedures for Waste Reduction at Source

Below are some management options for minimizing waste oil for disposal:

- | | | |
|---------|---|--|
| Reduce | : | Optimize maintenance procedures on machines/engines. Optimize operations to minimize accumulation of sludges, waste oil. |
| Reuse | : | Nil |
| Recycle | : | Waste oil can be processed back into the crude oil process system. |
| Recover | : | Waste oil can be sent for approved commercial recycling and blending into fuels, or making into low grade oils |
| | : | May be used as a supplementary fuel for plant operations. |

6. Storage

6.1 Types of Containers

Storage facilities and containment systems for waste oil shall include steel or durable containers (drums, slop tanks) and be impounded with impermeable containment system. The containers shall be closed and stored in a cool, well-ventilated place away from sources of heat and ignition.

6.2 Waste Compatibility

The materials used for the construction and manufacture of containers and containment system shall be chemically

compatible with the stored wastes. As such, waste characteristic analysis should be conducted (if unknown) prior to construction and manufacture of containment system for waste storage.

6.3 Waste Inventory

Facilities that generate waste oil are required to record the type of waste, amount generated and stored annually, amount stored to-date and methods of treatment and final disposal. It is the waste generator's responsibility to maintain an accurate and up-to-date inventory of their wastes stored on-site.

6.4 Labelling

It is required that waste oil stored on-site shall be properly labelled and identified. Information on each label shall be in accordance to the Third Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989. Other information to be available on-site include the toxicity of the waste, the hazards posed and precautions to be taken.

7. **Handling**

Proper personal protection equipment for handling of waste oil shall include protective clothing, rubber boot, glove, and face mask.

8. **Collection And Transportation**

8.1 Containers and Packing

Containers or drums that are used for the storage and transportation of wastes shall be leak proof or durable. It shall also be expected to withstand impacts and handling requirements.

8.2 Marking of Packages

Drums and containers for the transportation of wastes to disposal facilities shall be properly marked with the name and address of the generator, name of the wastes, name and location of disposal facility.

8.3 Labels Identifying Risks

All containment systems shall be labelled as 'Flammable Liquid' in accordance with the Third Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989.

8.4 Compatibility

Wastes being collected and transported shall be chemically compatible with the other waste being transported on the same vehicle. Preferably wastes with the same hazards should be transported in the vehicles. For storage, the waste shall be in accordance with the Fourth Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989.

8.5 Consignment Note

A Consignment Note For Scheduled Wastes as per the Sixth Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989 shall be signed and acknowledged by the generator, collector, transporter, and the operator of the disposal facility. Acknowledgement by all parties shall include the date and amount of wastes transferred, personnel designation, and the type of wastes.

8.6 Responsibility of Generator and Carrier/Transporter

From the moment the wastes are transferred from the generator to the licensed transporter, the waste generator shall provide all the necessary information on the facility and waste as per the Seventh Schedule of the Environmental Quality

(Scheduled Wastes) Regulations, 1989 and also provide technical expertise/advise in any clean-up operation.

8.7 Communication of Information

In the event of an accidental spill during transportation of wastes (depending on the spill size/volume), the fire chief, emergency response team, spill prevention and control team, medical personnel and the police shall be informed immediately. Contact number of these personnel shall be maintained with the licensed transporter and shall be displayed at a conspicuous locations. The waste generator and the Department of Environment shall also be informed of the incident.

8.8 Containment of Spill

In case of a spill with no fire, prior to arrival of professional assistance the emergency response team, spill prevention and control team, the driver shall carry out an initial abatement procedure to control and contain the spill as far as possible. When there is a fire involved, the driver shall exercise his best judgment to fight the fire while waiting for the arrival of the fire fighting personnel. However, it is prudent that the driver to barricade the area, or contain the spill where possible and to ensure that no movement of spilt material to the surrounding area that will endanger lives and the environment.

8.9 Clean-up of Spill

Clean-up of the contaminated soil at the spill site shall be carried out immediately after the fire hazard are eliminated. Clean-up efforts for the spill site shall include the followings depending on the size and location of the spill i.e excavation and disposal of contaminated soil, dilution with solvent without further contamination and clean-up of excess spill with absorbent and other clean-up device.

8.10 Monitoring Effects of Spill

In case of spill where size and the impact on the environment is significant, monitoring at the immediate surroundings of the spill site should be instituted so as to ensure that the clean-up are satisfactory. Site monitoring can be achieved with the installation of monitoring wells, periodical observation of stressed vegetation at the vicinity of the spill site, observation of spill residual at the adjacent watercourse and the behaviour of the existing wildlife and aquatic life.

8.11 Disposal of Spill Materials

For disposal of spill materials, please refer to the Guidelines on the Management of Contaminated Soils and Debris".

9. Treatment And Disposal Of Waste

9.1 Treatment Methods

Waste minimization as outlined in this Guideline under "Procedures for Waste Reduction at Source" shall be practised as far as possible.

9.2 Disposal Methods

The following are options for disposal of waste oil

- o Facility Approved to Used Waste Oil As Fuel
- o Approved Incinerator
- o Approved Hazardous Waste Disposal Facility

APPENDIX 1.0 - HEALTH EFFECTS

WASTE INFORMATION GUIDELINE

NAME OF WASTE : WASTE OIL

ACTUAL HEALTH EFFECTS:

INHALATION : Generally not considered to be a hazard at normal temperatures (up to 38 deg C). High organic vapour concentrations may irritate the nose, throat and lungs; may cause headaches and dizziness; may be anaesthetic and may cause other central nervous system depression effects.

EYE CONTACT : May cause irritation, but will not damage eye tissue.

SKIN CONTACT : May cause irritation or other skin disorders.

INGESTION : May be irritating to mouth, throat and stomach and may cause digestive disorder and/or damage. Small amounts of waste drawn into the lungs either from swallowing or vomiting may cause severe health effects (eg. bronchopneumonia or pulmonary edema).

CHRONIC HEALTH EFFECTS OF COMPONENTS:

May contain chlorinated hydrocarbons. Prolonged or exposure can cause liver or kidney damage, or may cause abnormal heart rhythms. Some chlorinated hydrocarbons are carcinogenic.

May contain aromatic hydrocarbons, of which the most significant are benzene, toluene, xylene, ethyl benzene, and trimethyl benzene. Prolonged and/or repeated exposures to benzene may cause damage to the blood

producing system and serious blood disorders, including leukaemia. Benzene is listed as a known carcinogen.

May contain a number of heavy metals in trace amounts. Repeated or prolonged exposure can cause damage to kidneys, liver, reproductive, blood forming or nervous systems, mutations, or tumours.

QUANTITATIVE TOXICITY DATA ON THIS WASTE:

Not available.

OCCUPATIONAL EXPOSURE LIMITS:

For benzene, a OEL-TWA of 30 mg/m³. For phenol, a OEL-TWA of 19 mg/m³.

APPENDIX 2.0 - FIRST AID MEASURES

- INHALATION : In emergency situations, use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.
- EYE CONTACT : Flush eyes, including under eyelids, with a continuous flow of fresh water for at least 15 minutes. Get prompt medical attention.
- SKIN CONTACT : Flush with large amounts of fresh water. Use soap if available. Remove severely contaminated clothing (including shoes) and clean thoroughly before reusing.
- INGESTION : DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Keep at rest and get prompt medical attention.

APPENDIX 3.0

TYPICAL COMPONENTS OF WASTE LUBE OIL

	<u>COMPONENT</u>	<u>CONCENTRATION RANGES</u>
A :	HYDROCARBONS	
	Chlorinated solvents	0-500 mg/kg
	Napthalene	330 mg/kg
	Benzene	20 mg/kg
	Toluene	380 mg/kg
	Xylenes	550 mg/kg
	Lead	3-240 mg/kg
	As, Cr, Cd	0-1-mg/kg

B : SYNTHETIC

Triphenyl Phosphate	25-30%
Butylated Triphenyl Phosphate	70-75%
Anti-rust additives	< 1%
Anti-oxidant additives	< 1%
Metals	No data

Reference : Canadian Petroleum Association, Production Waste Management Handbook for Alberta Petroleum Industry

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF OILFIELD SLUDGES

1. Scope Of the Guidelines

The guidelines cover the management and disposal of sludges generated from the production and processing of oil and gas. Sludges are generated where there are sediment accumulations in processing vessels, separators, tanks, and pipelines.

2. Objective

The objective of the guideline is to provide petroleum industry generators with the options to safely dispose of sludges. Adherence to the guideline will ensure that the waste will not pose a threat to public health and the environment.

3. Classification And Definition Of Waste

All sludges generated from crude oil terminals and gas processing plants are subject to the Environmental Quality (Scheduled Wastes) Regulations, 1989. Those waste codes that apply to the upstream petroleum industry are:

- o Oil tanker sludges NO14
- o Sludge from oil storage tank NO06

Other than these specifically regulated wastes, sludges are also generated from other separators and vessels and have to be similarly treated and disposed off responsibly. They are not however subject to the regulatory requirements.

Sludges are basically waste accumulations at the base of any tank, drum, container, separator, vessel or receptacle. They consist of basic water, accumulated heavy hydrocarbons, solids, sand and emulsions. Sludge is found predominantly in crude oil production facilities and to a lesser extent in gas production or processing facilities.

4. Characteristic Of Waste

The characteristics of sludge will depend on the characteristics of the crude and the other materials such as hydrogen sulfide or sand, that are produced with the crude. In Malaysia, most crudes are sweet (that is, does not contain hydrogen sulfide). Crude oil tank sludges typically contain silica (38%), iron oxides (22%), oil (7 to 16%), heavy metals and other solids (variable).

High vapour concentrations of sludge are irritating to the nose, throat and lungs, and may cause headaches and dizziness. Vapour from the waste can cause suffocation (asphyxiant) if allowed to accumulate. Unless wearing self-contained breathing apparatus, personnel should never enter a confined space where sludge is stored.

4.1 Emergency Response Procedures

In the event of a spill, use sorbents to soak up the liquids. If spilled on land, prevent spill from running into surface waters using appropriate barriers or booms. In addition, scoop up all the solids associated with the sludge. Refer to the Guidelines on the Management of Contaminated Soils and Debris for proper handling and disposal of the spilled materials. Ensure no ignition sources are present. If spilled on water, use booms to prevent the spill from spreading to other parts of the water body.

In the event of a fire, acceptable fire fighting systems include foam, dry chemical or carbon dioxide. Respiratory and eye protection service and protective clothing should be worn for fire fighting personnel. In addition, self-contained breathing apparatus should be used for all indoor and major outdoor fires. Water hose must not be used except to cool fire-exposed surfaces and protect the personnel.

5. **Waste Production/Management**

In general, proper design as well as housekeeping can minimize the generation of sludges in vessels and tanks. Avoiding dead legs and low velocity flow in vessels and separators can avoid accumulation of sludges. In storage tanks, periodically stirring the tank and faster turn around of tank contents can minimize sludge accumulations. If accumulations are unavoidable, good housekeeping to remove fresh sludge is advisable. Aged sludge are normally much harder to treat and dispose.

Below are some management options for minimizing sludge:

REDUCE	:	Improve housekeeping procedures
REUSE	:	Not Applicable
RECYCLE	:	Not Applicable
RECOVER	:	Sludge wastes containing more than 3% oil may be reclaimed, either on-site or off-site. The reclaimed oil can be recycled into the process system as saleable crude oil.

6. **Storage**

Sludges should be stored in closed steel or plastic drums or tanks, and stored in a cool, well-ventilated place away from sources of heat and

ignition, and away from combustible materials. Segregate from incompatible wastes such as oxidizing agents. A means of collecting liquids from leak or precipitation is necessary, so that the wastes do not contaminate the environment.

The drums or containers containing the sludges must also be marked, "Waste Sludge" and labelled "Flammable" per the Third Schedule of Environmental Quality (Scheduled Wastes) Regulations 1989. An inventory of the stored wastes should be maintained at the storage site.

7. Handling

Sludges can accumulate static charges which may cause a spark. Therefore, use proper grounding procedures when handling the waste especially when transferring from one container to another. Handle and open containers with care. Avoid skin contact and avoid inhaling the vapours. In confined space entry, mechanical ventilation using explosion-proof equipment must be provided including self-contained breathing apparatus.

Where eye contact is unlikely, but may occur as a result of short and/or periodic exposure, safety glasses with side shields should be worn. Where there is prolonged handling of the sludge, in addition to wearing safety glasses with side shields, long sleeves and chemical resistant gloves should be worn.

8. Transportation

The transportation of sludges is subject to the Environmental Quality (Scheduled Wastes) Regulations, 1989. The sludge can only be disposed of at a licensed premise and to be transported by licensed transporter. All scheduled waste transportation must be accompanied by the required consignment notes for waste tracking purposes.

If the sludge is not a scheduled waste, it must nevertheless be transported in a responsible manner. The container must not be leaking and must be securely fastened to the truck or carrier. The contents should be clearly marked and labelled as discussed in Item 6.

In the event of an accident during transportation in which the waste is spilled onto the environment, the transporter must inform the Police and/or the Fire Brigade, and the waste generator. The transporter should take appropriate steps to ensure the safety of passing traffic and pedestrians. The Emergency Response Procedure in Item 4.1 should be used to minimize impact to people and the environment.

9. Treatment And Disposal

On-site treatment of sludge should first be explored prior to disposal. Examples are:

- o Recover as much as possible of the oil as stated in Item 5 above.
- o Dewatering the sludge to reduce the volume of sludge for disposal. The recovered water should be channeled to a waste water treatment facility.
- o Biodegrade the sludge through landfarming. Note that landfarming requires approval from the Department of Environment.
- o Biodegrade the sludge through use of enriched paraffin-eating bacteria.

There is currently no approved or suitable means of disposing of sludges, and thus, they must be stored, if on-site treatment is not feasible. See Item 6 on Storage to ensure all waste chemicals are appropriately stored.

However, if approved commercial facilities are available in future, the sludges can be disposed of through:

- o Incineration
- o Approved Landfarming
- o Oil recovery processes
- o Biological treatment
- o Landfill

Please note that burial or open burning of sludge is prohibited.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF SPENT SOLVENTS

1. Scope Of Guidelines

The guidelines cover the proper handling, storage, collection, transportation and disposal of spent solvents from upstream oil and gas activities carried out at the drilling rigs, production platforms, crude oil terminals, gas terminals, floating storage and supply bases. The spent solvents considered in the guidelines include spent thinners, spent paints and spent solvent from equipment cleaning operations.

2. Objective

The objective of the guidelines is to provide waste generators with the available options to manage and dispose off spent solvents. This is to ensure that the public health and the environment are safeguarded.

3. Classification And Definition Of Waste

Under the First Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989, spent solvents are classified as Scheduled Wastes from Non-specific Sources - Waste Code: N031, N041 and N051. Spent solvents can be classified as spent organic solvents, spent aromatics solvents and spent non-aromatic solvents.

4. Characteristic Of Waste

Spent solvents may contain chlorinated (halogenated) hydrocarbons, sulphur, oil and grease and water.

4.1 Name and Description

This waste is also identified as halogenated/non-halogenated spent solvents.

4.2 Types of Hazards

The major hazards encountered from improper handling and storage of spent solvents is groundwater and soil contamination. Other environmental hazards may include toxic vapour and fire hazards.

The health risk resulted from the exposure to spent solvents through eye and skin contact, inhalation and ingestion may cause variety of health effects. (Refer to Appendix 1.0: Health Effects).

4.3 Control of Hazards

Hazards arising from the storage of spent solvents shall be minimised by exercising extra precaution in handling and storage. The wastes shall be stored in covered steel tanks or drums. The containers shall be closed and stored in a cool, well-ventilated place away from incompatible materials. The unused solvents should be stored in closed original containers (and packed with absorbent if necessary) .

Handlers should avoid frequent and prolonged skin contact and avoid inhaling vapour. In confined spaces, mechanical ventilation shall be provided using explosion proof equipment at all times.

4.4 Protective Equipment

Personal protective equipment such as long sleeves, chemical safety goggles, and chemical resistant gloves shall be worn to protect against skin and eye contact. In an enclosure, approved respirators should be worn to prevent over exposure

by inhalation.

4.5 Emergency Response Procedures

First aid shall be immediately administered to person who incidentally inhaled, ingested and came into bodily contact with this waste. (Refer to Appendix 2.0: First Aid Measures).

5. Solvents Production

5.1 Sources of Solvents

Spent Solvents are generated from all phases of oil and gas exploration and production operations. The operations include drilling operations, gas and crude oil production and storage and gas compression.

5.2 Procedures for Waste Reduction at Source

The generation of this waste shall be reduced or minimised by improving housekeeping procedures and using non-hydrocarbon based wash fluid whenever possible.

Waste management options include the following:

Reduce	:	Change design, maintenance or operational procedures to eliminate.
Reuse	:	Extend use of solvents as much as possible by filtering.
Recycle	:	Can be recycled into crude oil process.
Recover	:	Can be sent to approved reclaimers; or approved fuels. Blend into plant's fuel oil pool to be burned as fuel.

6. Storage

6.1 Type of Containers

Storage facilities and containment systems for spent solvents shall include strong and durable steel containers (drums, tanks) and be impounded with impermeable containment system. The containers shall be closed and stored in a cool, well-ventilated, and dry place away from incompatible materials such as oxidizing materials and away from source of ignition.

The storage area shall be preferably cordoned-off and shaded.

6.2 Waste Compatibility

The materials used for construction and manufacture of containers and containment system shall be chemically compatible with the stored wastes. As such, waste characteristics should be known prior to construction and manufacture of containment system for waste storage.

6.3 Waste Inventory

All facilities that generate spent solvent shall be required to record the amount/quantity of waste generated, stored and final disposal. The waste generators shall be responsible to maintain an accurate and up-to-date inventory of their wastes stored on-site.

6.4 Labelling

The containers used to store spent solvent shall be properly labelled with the "Flammable Liquid" label, in accordance to the Third Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989. Other information to be available on-site include the toxicity of the waste, the hazard posed, precautions to be taken, and the date it was first stored.

7. Handling

Handling precautions shall be taken to avoid frequent and prolonged skin contact, and avoid inhaling vapour. In confined spaces, mechanical ventilation using explosion-proof equipment shall be provided.

Proper protective equipment for handling of spent solvents shall include long sleeves, chemical safety goggles, chemical glasses with side shields, chemical resistant gloves and chemical cartridge respirators.

There shall be strictly no ignition source or smoking during handling.

8. Collection And Transport

8.1 Containers & Packing

Containers or drums that are used for the storage and transportation of spent solvents shall be air-tighten and leak proof. The containers shall be designed and made of corrosion resistant material and be able to withstand expected impact.

8.2 Label Identifying Risks

Containers or drums for the transportation of spent solvents to disposal facilities shall be labelled "Flammable Liquid". Information to be marked on the container shall include name of generator, name of waste, name and location of disposal facility.

8.3 Compatibility

Spent solvents being collected and transported shall be chemically compatible with the materials used for the manufacture of the containment system and handling equipment. Prior to collection and transportation of the spent

solvents, laboratory analysis on the wastes characteristics shall be carried out in order to determine the risks involved in transporting these wastes. Ignitability, corrosivity, reactivity, and toxicity of spent solvents shall be evaluated prior to collection and transportation.

8.4 Responsibilities of Waste Generators and Transporters

Documentation of the spent solvents that is been collected and transported shall be provided and maintained in the custody of the waste generator. The documentation shall include name of waste, waste characteristics, quantity of wastes, date of the collection and transportation, name of the generator, collector, transporter, and the disposal facility as per Seventh Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989.

8.5 Consignment Note

A Consignment Note For Scheduled Wastes as per the Sixth Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989, shall be signed and acknowledged by the generator, collector, transporter and the operator of the disposal facility. Acknowledgement by all parties shall include the date and amount of wastes transferred, personnel designation, and the type of wastes.

8.6 Communication of Information

In the event of an accidental spill during transportation of scheduled wastes, the Department of Environment shall be informed immediately.

8.7 Containment of Spill

In case of a spill with no fire, prior to arrival of the spill prevention and control team, the driver shall carry out an initial abatement procedure to control and contain the spill.

When there is a fire involved, the driver will need to exercise his best judgement to fight the fire while waiting for the arrival of the fire fighting personnel. However, it is prudent that the driver shall contain the spill and to ensure that no movement of the spill materials to the surrounding that will endanger the immediate livelihood and the environment.

8.8 Clean-up of Spill

Clean-up of the contaminated soil at the spill site shall be carried out immediately. Clean-up operations shall include excavation and disposal of the contaminated soil and clean-up of excess spill with absorbents.

8.9 Monitoring of Spill

Continuous monitoring at the surrounding areas of spill site shall be conducted to ensure that the clean-up operations are complete and to the satisfactory of the authority.

8.10 Disposal of Spill Materials

Contaminated soil at the spill site can be either treated by in-situ technologies such as enhanced volatilization, bioremediation, soil flushing, soil washing, and landfilling or by ex-situ technologies such as surface and enhanced remediations, thermal stripping, chemical extraction, solidification and isolation/containment as an option.

9. **Treatment And Disposal Of Waste**

Spent solvents shall be disposed off at the hazardous waste disposal facility if not recycled or incinerated.

APPENDIX 1.0 - HEALTH EFFECTS
WASTE INFORMATION GUIDELINE

NAME OF WASTE : SPENT SOLVENTS

ACUTE, HEALTH EFFECTS :

INHALATION : May irritate the nose, throat and lungs; may cause headaches and dizziness; may be anaesthetic and may cause other central nervous system depression effects.

EYE CONTACT : May cause irritation.

SKIN CONTACT : May cause irritation or other skin disorders.

INGESTION : May cause irritation to mouth, throat and stomach and may cause digestive disorder and/or damage. Small amounts of hydrocarbons drawn into the lungs either from swallowing or vomiting may cause severe health effects (eg. bronchopneumonia or pulmonary edema).

CHRONIC HEALTH EFFECTS OF COMPONENTS:

May contain chlorinated hydrocarbons. Prolonged or repeated exposure can cause liver or kidney damage, or may cause abnormal heart rhythms. Some chlorinated hydrocarbons are carcinogenic.

QUANTITATIVE TOXICITY DATA ON THIS WASTE:

Not available

OCCUPATIONAL EXPOSURE LIMITS:

Not established.

APPENDIX 2.0 - FIRST AID MEASURES

- INHALATION** : In emergency situations, use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.
- EYE CONTACT** : Flush eyes, including under eyelids, with a continuous flow of fresh water for at least 15 minutes. Get prompt medical attention.
- SKIN CONTACT** : Flush with large amounts of fresh water. Use soap if available. Remove severely contaminated clothing (including shoes) and clean thoroughly before reusing.
- INGESTION** : DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Keep at rest and get prompt medical attention.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF ACIDS AND BASES

1. Scope Of Guideline

The guidelines cover both obsolete and spent acids and bases related to exploration and production of hydrocarbon activities. Specifically, crude oil terminals, oil and gas drilling rigs and production facilities are the potential generators of these types of wastes.

2. Objective

The objective of the guidelines is to provide the necessary guidance on the management of acids and bases waste and to provide the operators with the available management options. This is to ensure that the waste will not pose a hazards in terms of safety and environment.

3. Classification And Definition Of Waste

The Environmental Quality (Scheduled Wastes) Regulations, 1989, under the First Schedule classified these waste as follows:

N211 Spent or discarded acids with pH of less or equal to pH 2.0

N212 Spent or discarded alkali with pH of greater or equal to pH 12.5

However, due to the corrosive nature of acids and bases, all such waste shall be treated and disposed off in a responsible manner.

4. Characteristic Of Waste

This waste will come in variation of physical and chemical properties depending on its uses in the field. For specific information for each

acids and bases, reference should be made to the Material Safety Data Sheet (MSDS).

5. Emergency Response Procedure

Two possible scenarios of more serious consequences are spill and fire outbreak. A spill should be contained and ensure no unauthorised person without personal protection equipment is allowed to enter the affected areas. All contaminated material shall be treated in responsible manner. Fire outbreak would normally create hazardous and toxic fumes. Self breathing equipment may be necessary when trying to control the fire. The waste transporter should contact the Police, Fire Brigade and the waste generator in the event of accidents. The waste generator shall provide all the necessary assistance and information to the authorities when required.

6. Hazards

6.1 Health and Environmental Hazards

This waste may be highly corrosive. Contact with naked skin may impart permanent damage to human tissue. Any spill may cause heavy metal (acid batteries) contamination to ground water if present in sufficient quantity. Improper disposal into water body may result in surface water contamination

6.2 Control of Hazards

Wear personal protective equipment at all time when handling these wastes. Generally this will include long sleeves, chemical resistant hand gloves and fume mask. Self containing equipment may be necessary when heavy fume is present. Avoid inhalation of this fume. When working indoors, ensure that ventilation is provided. Avoid spillage and always neutralise and dilute the waste prior to disposal into a water body.

7. Waste Production

7.1 Sources

The main generator of these type of waste are crude oil terminals, drilling rig and production chemistry laboratory. The eventual properties of this waste may differ depending on its usage.

7.2 Waste Management

7.2.1 Reduction

Bulk ordering of acids and bases for use within a targeted time frame taking into account their expiry dates. This may reduce the quantity obsolete chemicals for disposal.

7.2.2 Reuse

Normally acids and bases can be used for neutralisation process. This options will have cost savings benefits.

7.2.3 Recycle

This may require liaison with the supplier to buy back any obsolete and unused waste for recycling. However this option may be restricted to waste that have recently expired. Therefore, it is advisable to obtain the suppliers agreement prior to expiry dates.

7.2.4 Recover

Not applicable.

8. Storage

- 8.1 Store in corrosion resistant drums to avoid leakage. Drums must be closed and segregated from other incompatible waste otherwise contact may induce spontaneous generation of heat and violent reactions.
- 8.2 Inventory and movement of waste must be recorded. This inventory may be presented to the Department of Environment on request.
- 8.3 Waste should be labeled as " Corrosive Substances " and the Department of Environment recommended sign (label 10) in the Third Schedule must be clearly posted on the drums.

9. Handling

- 9.1 Personal protection equipment with fume respirators and chemical resistant hand gloves must be worn at all time when handling these wastes.
- 9.2 Avoid inhalation of fumes, spillage of waste and exercise care at all time.

10. Transportation

Under the Environmental Quality (Scheduled Wastes) Regulations, 1989, a licensed transporter is required to transport these wastes for disposal at prescribed premises. Another requirement is the issuance of the waste consignment note together with the shipment of waste. In the event of accidents, contact the Police, the Fire Brigade and the waste generator. Waste generator is to provide assistance and information on waste consignment if required to do so. Ensure affected area is secured by fencing with warning signs. Materials are put in separate containers to be disposed off in a responsible manner.

GUIDELINES ON THE MANAGEMENT OF CONTAMINATED DEBRIS & SOIL

1. Scope Of Guidelines

The guidelines cover waste generated from spills and clean-up operation of substances such as condensate, oil, solvents, and oilfield chemicals. All facilities that handle these chemicals potentially have this waste.

2. Purpose/Objective

The objective of the guidelines is to provide the petroleum industry/generators with available options on how to manage and dispose of this waste in an environmentally sound manner. Adherence to the Guidelines will ensure that the waste does not pose potential problems to the environment and public health.

3. Classification And Definition Of Waste

Contaminated debris and soil is governed under the Environmental Quality (Scheduled Wastes) Regulations, 1989, as a scheduled waste. It is classified under Scheduled Waste Code N231, - "Contaminated soil, water, debris or matter resulting from clean-up of a spill of chemical or scheduled waste."

4. Characteristic Of The Waste

The characteristics of the waste will depend on the characteristics of the chemicals that have contaminated the soil/debris. It is essential that the generator has the Material Safety Data Sheet for the spilled chemical to determine how to handle the waste.

4.1 Emergency Response Procedure

In the event of any spill, it is necessary to assess the situation (that is, the location, the size of the spill and the risks to people and the environment). Generally, all spills should be contained to prevent it from spreading and contaminating a larger area. All the spilled material and contaminated soil and debris should be collected and stored in containment systems such as drums or tanks.

5. Waste Production

Contaminated soil and debris should not be generated as part of normal petroleum operations. Spills can be eliminated or kept to an absolute minimum through the following waste minimization practices:

- o Proper design of equipment such as having drip pans below the equipment
- o Regular preventive maintenance of equipment
- o Proper storage/handling of chemicals such storing on concrete pads with curbs
- o Good overall housekeeping
- o Implement action of safe practices

When a spill does occur, waste minimization can still be practised through the recovery of as much of the spilled chemical as possible. Depending on the chemical, it may be reused or recycled into the process system. Sorbent materials such as straw and sorbent pads should be used where applicable to minimize chemical seepage to the ground or minimize contamination to other areas. Quick response can normally avert generation of significant amount of wastes. Contaminated soil and debris should be scooped up and stored in

metal drums.

For small spills (eg. less than a 55 gallon drum) of highly volatile but non-toxic chemicals, it is acceptable to allow normal weathering to volatilize the chemical.

6. Storage

Contaminated soils and debris should be appropriately stored in strong metal or plastic containers, and covered while awaiting disposal. Care should be taken to ensure incompatible wastes are not stored together. Containers shall be marked and labelled per Third Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989, indicating the hazard of the waste (eg. "Flammable", "Corrosive"). The base of storage areas should be made of impermeable material such as concrete with a 4 to 6-inch curb. Keep away from ignition sources.

An inventory of the name and amount of waste generated, and how it is being handled should be kept at the waste generator's site.

7. Treatment And Disposal

Depending on the physical and chemical properties of the waste, the following treatment and disposal methods are recommended.

7.1 Treatment

Neutralisation of acids and bases until the mixture achieve a pH of 7 prior to disposal into a water body This is recommended if no other use of the waste is envisaged.

7.2 Disposal

Neutralised waste may be disposed into a water body. For obsolete waste, it is recommended for recycling via the suppliers and manufacturer. Another option is to spike the waste into the crude oil system when the operation parameters permits. This may require that exact chemical content of the waste be predetermined prior to spiking into the system.

GUIDELINE FOR THE DISPOSAL OF EMPTY CONTAINERS

1. Scope Of Guidelines

The guidelines cover empty containers of all shapes and sizes used in the crude oil and gas production facilities, gas processing plants and crude pipeline facilities, that previously contained a hazardous material. Examples of such wastes are crude oil sample bottles, chemical drums and pesticide containers. Most containers are made of steel, although increasingly, plastic drums are also used. Glass containers are typically used for collecting samples for analysis.

2. Objective

The objective of the guideline is to provide the petroleum industries/generators with available options on how to manage and dispose of this waste in an environmentally sound manner. Adherence to this guideline will ensure that the waste does not pose potential problems to the environment and public health.

3. Classification And Definition Of Waste

Empty containers and bags containing the following hazardous residues are regulated under the Environmental Quality (Scheduled Wastes) Regulations, 1989 and are thus subject to all the regulatory requirements in the regulations:

Contaminated with pesticide or herbicide residues Code: S261	Waste
Contaminated with cyanide, arsenic, chromium, Code: N271 lead or lead compound or salts	Waste

All other empty containers are not currently regulated. Despite this, they should be treated and disposed of responsibly since the residues are potentially hazardous.

4. **Characteristic Of the Waste**

How empty is empty? Practically, a container is classified as empty when it has been emptied by best practical means such as pouring and pumping. Because of this, some residue remains.

The characteristic or hazard of an empty container will depend on the amount of residue remaining and the hazard of the prior content. In general, it should be treated as hazardous unless proven to be otherwise. Since the scope is wide, it is important that the waste generator obtains a copy of the Material Safety Data Sheet of the original content of the container to determine how to handle, treat and dispose of the container. Hazardous characteristics include flammability, reactivity, toxicity and corrosivity.

5. **Waste Production/Management**

Empty containers are generated throughout the petroleum industry, from raw materials to product, and is generally unavoidable. However, proper management can reduce the volume of waste generated.

Waste management options include the following:

- REDUCE : Purchase in bulk wherever possible.
- REUSE : Include "Return to Supplier" clause in purchase contracts.
- RECYCLE : Send used non-hazardous empty drums to scrap metal dealers. Hazardous empty drums can be rendered non-hazardous if cleaned of original contents. The wash water must be collected and treated before discharge. Drums sent to scrap dealers should be punctured or crushed to prevent reuse by the public.
- RECOVER : If compatible with original contents, use to store other wastes.

6. **Storage**

Keep all empty drums closed and in a sheltered place away from sources of heat ignition. In general, empty containers that have not been cleaned of the residues should be stored as if they were full of the original contents. Ensure compatibility of the drum residues when storing the drums together in one location. Do not transfer residues from one drum to another without knowing their compatibility.

7. **Handling**

Handling precautions, and the selection of personal protective equipment will vary depending upon the original contents of the drum. It should be treated as hazardous unless proven otherwise. Handle and open all drums with care. Avoid skin contact with any residue, and avoid inhaling vapours.

8. **Transportation**

If empty containers are classified as scheduled wastes (that is, S261, formerly containing pesticides), it must be transported by a DOE-licensed contractor. Disposal must also be to a DOE-approved disposal facility. They are prohibited from disposal in a municipal dump or landfill. Appropriate labels must be placed on the drums. Consignment notes and waste tracking requirements must be complied with.

There are no specific regulations governing the transport of other empty drums or containers. Nevertheless, appropriate care should be taken. Ensure the drums are not leaking residue, and that they are securely loaded onto the truck or carriers to avoid movement during the course of transportation.

9. **Treatment And Disposal**

The waste minimization options listed in Item 5 should be explored seriously so that waste treatment and disposal of empty drums are

minimal, if any.

If an empty drum is hazardous, it should be disposed off in an approved Hazardous Waste Disposal Landfill. No prior treatment of the drum is necessary since the landfill facility will handle its proper disposal.

A drum with hazardous residue can be rendered non-hazardous if steps are taken to clean the drum of its residue. This would typically involve a triple rinse with some solvent cleaner, and the washwater would have to be treated prior to disposal. In a generator site that has waste water treatment facility, this approach is encouraged since the cleaned drum can be sent for reuse or recycle.

If the cleaned drum cannot be sent for reuse or recycle, then it should be crushed and send to a landfill for disposal. Generally, this should not happen for metal drums since it can be sold as scrap metal. However, this is generally true for plastic drums.

GUIDELINE ON THE MANAGEMENT AND DISPOSAL OF SULFINOL SLUDGE, FILTERS AND OXAZOLIDONE

1. Scope Of Guidelines

The guidelines cover the management and disposal of sulfinol sludge, filters and oxazolidone generated from the removal of acid gas in sour gas treating plants.

2. Objective

The objective of the guideline is to provide gas processing industry/generators with the options to safely dispose of sulfinol filters and sludges and oxazolidone (sulfinol by-product). Adherence to the guideline will ensure that the waste causes no threat to human being and the environment.

3. Classification And Definition Of Waste

Although sulfinol sludge, filters and oxazolidone are not specifically regulated as a scheduled wastes in the Environmental Quality (Scheduled Wastes) Regulations, 1989, they have to be treated and disposed of in a responsible way. Oxazolidone, formed from the reaction of Diisopropanol amine (DIPA) with carbon dioxide in the regenerator reboilers at elevated temperatures, is handled at high concentrations as reclaimer bottoms.

4. Characteristic Of Waste

Sulfinol vapour is irritating to eyes, skin, mouth, throat, or stomach. Depending on the application, the sulfinol filters and sludges may contain a number of heavy metals in trace amounts that on repeated or prolonged exposure can affect kidneys, liver, reproductive, blood forming or nervous systems; cause mutations, or tumours.

4.1 Emergency Response Procedure

In emergency situations, proper respiratory protection is required to remove the victim from exposure. Administer artificial respiration if necessary. In case of eye and skin contacts, flush eyes and skin, respectively, with excessive fresh water until irritation subsides. If ingested, give milk or water to the conscious victim in order to dilute the stomach contents. In all cases, get prompt medical help.

5. Waste Production/Management

It is advisable to optimize the reclaimer operating procedures in order to minimize the generation of wastes. In addition, good housekeeping is necessary to remove fresh sludge.

Below are management options for minimizing sludge:

REDUCE	:	Optimize operating temperature.
REUSE	:	Not applicable
RECYCLE	:	Not applicable for sludge and filters but oxazolidone can be hydrolysed at a specialised facility.
RECOVER	:	High levels (above 3 %) of hydrocarbon in wash water from the sulfinol filters may be recycled for oil recovery.

6. Storage

Sulfinol sludges and oxazolidone should be stored in lined ponds or in sealed steel tanks or drums. Keep containers closed and store in a cool, well-ventilated place away from sources of heat and ignition. Incompatible wastes should be segregated from this waste (e.g. oxidizing agents).

The drums or containers containing the sludges must also be suitably labelled and an inventory of the stored wastes should be maintained at the storage site.

Prior to disposal of sulfinol filters, they must be drained and/or steamed to remove liquids. Store filters separately from non-amine type of filters.

7. Handling

The generation of mists and vapours should be minimized. In confined spaces, provide mechanical ventilation using explosion-proof equipment. Handle and open containers with care. Avoid frequent and prolonged skin contact, and avoid inhaling vapours.

Wear long sleeves, chemical resistant gloves, and chemical safety goggles when handling this waste.

8. Transportation

Although the sludge, filters and oxazolidone are not categorised as scheduled wastes, they must nevertheless be transported in a responsible manner. The container must not be leaking and must be securely fastened to the truck or carrier. The contents should be clearly marked.

In the event of accident, damage or leakage during transport, minimise body contact. Long sleeves, rubber boots and heavy rubber gloves should be worn when cleaning the spills. Self-contained breathing apparatus may be necessary to prevent over exposure by inhalation. Cover with an activated carbon adsorbent and remove the spilled waste as completely as possible. Collect spill and place in closed containers. Final traces can be dispersed with water.

9. **Treatment And Disposal**

Oxazolidone can be incinerated in boilers, in such a way that sufficiently high temperatures ($> 850\text{ }^{\circ}\text{C}$) and residence times ($> 1.5\text{ sec}$) are maintained and no violation of emission permits (NO_x) occurs.

The sulfinol sludge and filters can be disposed of through the following methods if the facilities are available:

- o Hazardous Waste Disposal Facility
- o Landfill
- o Solidification (for sludges only)

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF LABORATORY CHEMICALS

1. Scope Of Guidelines

This guidelines cover the disposal of all type of spent or obsolete laboratory chemicals inclusive of both organic and inorganic chemicals. It is generated by on site quality and process control laboratories in all oil and gas processing and transmission facilities.

2. Objective

The objective is to dispose spent or obsolete laboratory chemicals in a proper manner to ensure safety of personnel and public and to protect the environment.

3. Classification And Definition Of Laboratory Wastes

Laboratory chemicals are chemicals in used in quality and process control laboratory in environmental quality operations and relatively in small quantities. This may include both organic and inorganic chemicals. Laboratories chemicals is not individually specified under the Environmental Quality (Scheduled Wastes) Regulations, 1989. However, they are generally toxic and hazardous to human and the environment and may content elements that have been classified as scheduled waste in the regulations. Refer to specific disposal guidelines in the E&P Hazardous Waste Disposal Guideline for specific chemical waste.

4. Characteristic Of Laboratory Chemicals

Laboratory chemicals come in variety of physical and chemical properties. The exact properties are listed in their respective Material Safety Data Sheet (MSDS)

5. Hazards

5.1 Health and Environmental Hazards

Laboratory chemicals can pose health hazards through inhalation of fume, physical skin contact and ingestion. The degree of hazards depends on the chemical content and even may cause death. (e.g. cyanide indigestion). Heavy metals may accumulate and cause illness in time. Laboratory chemicals may also cause contamination of ground water and soil. Vegetation may not survive in areas contaminated with chemicals.

5.2 Control of Hazards

Practice good housekeeping and personnel hygiene. Provide washing and cleaning up facilities. Do not consume food at work.

5.3 Provide proper ventilation and personal protection equipment is worn at all time.

5.4 Avoid leakage of chemicals into the drainage or sewage systems. Ensure containers are not leaking.

6. Emergency Response Procedure

6.1 In the event of emergencies, follow instruction on the Material Safety Data Sheets and seek medical attention immediately.

6.2 During spillage, fence off the affected areas. Follow manufacturer's recommended fire extinguishers. Contact the Police, Fire Brigade and waste generator immediately. The waste generator shall provide assistance and information when required.

7. **Waste Production**

7.1 Sources

Laboratory chemicals is generated by production quality and process control laboratory.

7.2 Waste Management

7.2.1 Reduction

Optimize operating and house keeping procedures. Chemical stock should be well plan to avoid obsolete chemicals waste. Where practical and possible, use method which generate less chemical waste.

7.2.2 Reuse

Some laboratory chemicals can be reused. (e.g. acids and bases).

7.2.3 Recycle

Include buy-back clauses for expired and unused chemicals. Chemical can also be recycled into crude oil process systems.

7.2.4 Recover

Certain chemical may be recovered by the manufacturers (e.g. Silver Nitrate (AgNO_3))

8. **Storage**

Storage in the respective original chemical containers. Alternatively, use chemical resistant containers. Avoid usage of concrete containers due to potential reactions which eventually may causes leakage.

Segregate chemicals from incompatible ones. Store away from sources of heat or ignition.

Record volume and movement of stored waste.

9. **Handling**

Handle and open containers with care. Chemicals with fumes should be opened only in a fume hood. Avoid inhaling vapours or fumes.

Personal protection equipment, laboratory coats, chemical resistant hand gloves should be worn at all time.

Provide ventilation and cleaning and washing facilities.

10. **Transportation**

Clearly label all chemical hazards and the relevant signs as stipulated in the Third Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989.

Place containers securely in boxes and cushion with inert materials.

Record quantity, type, destination of chemical waste as per the waste consignment note.

11. **Treatment And Disposal**

11.1 Treatment

Physical segregation of the types of chemicals is required to avoid/prevent contact with the incompatible ones.

11.2 Disposal

Laboratory chemical waste can be incinerated or spiked into crude oil when the operating parameter permits. This may be possible in view of the small amount involved.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF WASTE OILFIELD CHEMICALS

1. Scope Of Guidelines

The guidelines cover the management and disposal of waste chemicals used in the petroleum industry. Because of the wide variety of oilfield chemicals used, the scope of the guideline is wide and general. However, it will contain important elements of responsible management and disposal of the wastes.

2. Objective

The objective of the guideline is to provide "upstream" petroleum industry/generators with the options to safely dispose of the waste chemicals. Adherence to the guidelines will ensure that the waste will not pose a threat to public health and the environment.

3. Classification And Definition Of Waste

Chemicals used in the petroleum industry for production processes are typically solvents, acids, bases, alcohols, salts, hydrocarbons and amines. These chemicals are used for varied reasons, most of which are for corrosion protection, water treatment, demulsification, and scale/wax inhibition. These waste chemicals whether spent, contaminated or off-specification are not currently regulated as scheduled wastes. However, these wastes should be treated as potentially hazardous by virtue of their characteristics.

Because of the vast variety of chemicals used, the generator is advised to refer to the Environmental Quality (Scheduled Waste) Regulations, 1989 to ensure that the waste chemicals are not specifically listed in the regulations. If it is listed, then the waste must be stored, treated, handled and disposed in compliance with the regulatory requirements.

4. Characteristic Of Waste

The best source of information for obtaining the characteristics of waste chemicals is the Material Safety Data Sheets (MSDS). Purchasers of chemicals must insist on obtaining a copy of the MSDS prior to taking delivery of the material. In addition, the appropriate hazard labels should already be displayed on the drums.

Commonly, chemicals used in the petroleum industry are either flammable or corrosive, or a combination. Except for some exceptions, most are not acutely toxic or immediately dangerous to life.

5. Waste Production/Management

Typically, chemicals are purchased for a specific use and therefore waste chemicals should not exist if they are all consumed. For example, corrosion inhibitors should be used up through injection into the process equipment. Unfortunately, waste chemicals are generated mainly due to:

- o Old stocks that have passed their shelf lives
- o Old chemicals that are no longer used in the process
- o Chemicals that are contaminated and can no longer be used
- o Chemicals that are not completely used up in a drum

Once the reason for waste chemicals can be determined, chemical waste generation can be eliminated or minimized, examples are through appropriate planning, inventory control and communication. Chemical inventories should be kept to a minimum, if at all, and chemical users should implement an efficient supplier-customer system. Operators should be made accountable for unfinished chemicals and advised to ensure all chemicals are used up. There are economic incentives for such a system but more importantly, this will eliminate waste generation.

6. Storage

Waste chemicals should be stored similar to how they were stored when they were still usable. However, they should be stored in a segregated area from usable materials to avoid contamination. In addition, incompatible wastes must not be stored together. Also, aqueous and non-aqueous wastes should be segregated. Always keep containers/drums closed and store in a cool, well ventilated place away from sources of heat and ignition, and away from combustible materials. A means of collecting liquids from leaks or precipitation is necessary, so that the wastes do not contaminate the environment.

7. Handling

Handling precautions, and the selection of personal protective equipment will vary depending on the chemical being handled.

It is generally recommended that long sleeves, chemical resistant gloves, chemical safety goggles and/or a face shield be worn whenever handling chemicals. Handle and open containers with care. Avoid skin contact and avoid inhaling the vapours. In confined spaces, provide mechanical ventilation using explosion proof equipment.

8. Transportation

If a waste chemical has been classified as scheduled waste, it must comply with the transportation requirements stipulated in the Environmental Quality (Scheduled Wastes) Regulations, 1989.

If the waste chemical is not a scheduled waste, it must nevertheless be transported in a responsible manner. The container must not be leaking and must be securely fastened to the truck or carrier. The contents should be clearly and appropriately marked and labelled.

9. **Treatment And Disposal**

On-site treatment of waste chemicals should first be explored prior to disposal. Examples are:

- o Acids and bases can be neutralized on-site and the liquids channeled into the waste treatment facility.
- o For other petroleum-based chemicals, if compatible, they can be recycled into the process facility

There is currently no approved or suitable means of disposing of chemical wastes, and thus they must be stored. See Item 6 on Storage to ensure all waste chemicals are appropriately stored.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF ION EXCHANGE RESIN

1. Scope Of Guidelines

The guidelines cover the management and disposal of spent ion exchange resin generated from gas processing plants and oil production facilities where ion exchange resins are used for water demineralization.

2. Objective

The objective of the guidelines is to provide waste generators with options to dispose of spent resins in an environmentally sound manner. Adherence to the guidelines will determine that the waste causes no threat to public health and the environment.

3. Classification And Definition Of Waste

Spent ion exchange resin- H^+ and OH^- is not specified as a scheduled waste under the Environmental Quality (Scheduled Wastes) Regulations, 1989. However, it has to be treated and disposed of in a responsible way.

4. Characteristic Of Waste

Inhalation and skin contacts are not expected to be hazardous. Eye contact and ingestion may cause irritation and digestive tract disturbance and/or damage, respectively.

Thermal decomposition will produce toxic fumes of carbon monoxides, carbon dioxides, nitrogen oxides, and hydrogen chloride gas. Styrene monomer and divinylbenzene may also be formed.

4.1 Emergency Response Procedure

If a person is unconscious due to exposure, use proper respiratory protection to remove the victim to fresh air. Administer artificial respiration if necessary. If eye contact occurs, flush eyes with excessive fresh water until irritation subsides. In case of skin contact, flush with copious amounts of water for at least 15 minutes. Remove contaminated clothing and shoes. If ingestion occurs, have the victim rinse his mouth with water if individual is conscious. Give milk or water in order to dilute stomach contents. In all cases, get prompt medical help.

5. Waste Production/Management

Generation of spent ion exchange resins can be minimal if replacement requirements is reduced by optimizing operation of pretreatment equipment.

Below are some waste management options for minimizing waste for disposal:

REDUCE	:	Reduce replacement requirements by optimizing operation of pretreatment equipment (e.g. chlorine injection).
REUSE	:	Strong acid cation resins may be reused by the water softening equipment industry.
RECYCLE	:	Return to supplier.
RECOVER	:	Not applicable
RECLAIM	:	At approved facilities

6. **Storage**

Keep containers closed and store in a well-ventilated place away from sunlight. Segregate from compatible materials such as nitric acid and other strong oxidizing agents that can cause explosive type reactions when mixed with Ion Exchange Resins.

7. **Handling**

Handle with normal precautionary measures. Avoid frequent and prolonged skin contact. When handling the waste, wear long sleeves, gloves, and safety glasses with side shields.

8. **Transportation**

Though the transportation of spent ion exchange resin - H^+ and OH^- is not subject to the Environmental Quality (Scheduled Wastes) Regulations, 1989, it nevertheless has to be transported in a responsible manner. The containers must not be leaking and must be securely fastened to the truck or carrier. The contents should be clearly marked and labelled.

If a spillage occurs, wear respirator, chemical safety goggles, rubber boots, and heavy rubber gloves. Sweep up the waste; place in a bag and hold for waste disposal. Wash spill site after material pickup is complete.

9. **Treatment and Disposal of Waste**

Neutralization is carried out in-situ at the unit prior to landfill.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF ACTIVATED CARBON

1. Scope Of Guidelines

The guidelines cover the management and disposal of spent or contaminated activated carbon generated from gas and crude processing units that utilize activated carbon for filtration of recirculating solvents, in water treatment, and contaminated adsorption systems.

2. Objective

The objective of the guideline is to provide gas processing plants/waste generators with options to safely handle and dispose of activated carbon wastes. Adherence to the guideline will ensure that the waste causes no threat to human being and the environment.

3. Classification And Definition Of Waste

Waste classification of the spent carbon depends on service and characteristics of the absorbate. Spent activated carbon should be treated as potentially hazardous by virtue of their use. An example is spent activated carbon from mercury treatment process which falls under the Environmental Quality (Scheduled Wastes) Regulations, 1989.

4. Characteristic Of Waste

Activated carbon is normally stable. Adsorbed materials are likely to cause chemical burns to the eye, mouth, throat, stomach, and permanent tissue damage. Inhalation may be irritating to the nose, throat, and lungs. Small amounts of waste may cause severe health effects (bronchopneumonia or pulmonary edema).

4.1 Emergency Response Procedure

In emergency situations, proper respiratory protection is required to remove the victim from exposure. Administer artificial respiration if necessary. If eye contact occurs, flush eyes with excessive fresh water until irritation subsides. In case of skin contact, wash the skin with soap and remove severely contaminated clothing (including shoes). Clean clothes thoroughly before reusing. Do not induce the victim to vomit if ingestion occurs. In all cases, get prompt medical help.

5. Waste Production/Management

Specific waste sources are process units, water treatment, mercury removal, glycol and amine filters, and for spill clean-ups. Below are management options for minimizing activated carbon waste for disposal:

REDUCE	:	Good housekeeping.
RECYCLE	:	Not applicable
REUSE	:	Not applicable
RECOVER	:	Regeneration, if possible, via the carbon manufacturer.

6. Storage

May be stored in steel containers (tanks or drums). Allow to drain and collect leachate. Keep containers closed and store in a cool, well-ventilated place away from sources of heat and ignition. Segregate from other waste sludges that are not compatible (e.g. oxidizing agents). Indoor venting equipment should be explosion-proof.

7. Handling

Minimize generation of dust. In confined spaces, provide mechanical ventilation using explosion-proof equipment. Handle and open containers with care. Avoid frequent and prolonged skin contact, and avoid inhaling vapours.

Where skin and eye contact is unlikely, but may occur as a result of short and/or periodic exposure, long sleeves, chemical resistant gloves, chemical safety goggles and a face shield should be worn. Where there is prolonged handling of the waste, chemical resistant gloves, impervious body cover, rubber boots, chemical safety goggles and a face shield should be worn.

8. Transportation

Though the waste is not regulated as a scheduled waste, it must nevertheless be transported in a responsible manner. The container must not be leaking and must be securely fastened to the truck or carrier. The contents should be clearly marked.

In the event of accident, damage or leakages during transport, shut off all sources of ignition. Wear respirator, chemical safety goggles, rubber boots, and heavy rubber gloves. Sweep up, place in a bag and hold for waste disposal. Avoid raising dust. Wash spill site after material pick-up is complete.

9. Treatment And Disposal Of Waste

Leachate, amine and hydrocarbon analysis, and dewatering may be required prior to landfill. However, if approved commercial facilities are available in future, spent activated carbon can be disposed of through:

- o Approved hazardous waste disposal facility
- o Approved incineration

- o Land treatment

Preference is given to rerouting the spent carbon to the manufacturer.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF MOLECULAR SIEVES

1. Scope Of Guidelines

The guidelines cover the management and disposal of spent or contaminated molecular sieve from gas processing plants that utilise molecular sieves for the regenerable dehydration and/or sweetening of sour gas.

2. Objective

The objective of the guidelines is to provide the gas processing industry with options to discard molecular sieve wastes in an environmentally acceptable manner. Adherence to the guidelines will ensure that the waste causes no threat to human being and the environment.

3. Classification And Definition

Currently, spent molecular sieve is not specified as a scheduled waste under the Environmental Quality (Scheduled Wastes) Regulations, 1989. However, spent molecular sieves have to be treated and disposed of in a responsible way.

4. Characteristics Of Waste

Dust is irritating to nose, throat, lungs, skin and may cause damage to eye tissue. It also may cause digestive tract disorder and/or damage.

4.1 Emergency Response Procedure

If eye or skin contact occurs, flush eyes or skin with excessive fresh water until irritation subsides. In case of ingestion, give milk or water to the conscious victim in order

to dilute stomach contents. In all cases get prompt medical attention.

5. **Waste Production/Management**

Below are management options for minimizing molecular sieve waste for disposal:

REDUCE	:	Optimise operation.
REUSE	:	Not applicable.
RECYCLE	:	Return to supplier for recycle.
RECOVER	:	Not applicable.

6. **Storage**

The waste may be stored in concrete cribs, steel tanks or drums. Keep containers closed and store in a well-ventilated place away from high temperatures and moistures which may cause a rise in temperature. Segregate the waste from materials with high heats of absorption such as olefins, hydrogen chloride, etc.

The drums or containers containing the molecular sieves must also be labelled and an inventory of the stored waste should be maintained at the storage site.

7. **Handling**

Material will accumulate static charge which may cause a spark. Therefore, proper grounding procedure is required, especially when transferring from one container to another. Handle and open containers with care and minimize generation of dust. Avoid frequent and prolonged skin contact, and avoid inhaling dusts. In confined spaces, provide mechanical ventilation.

8. Transportation

Though the waste is not a scheduled waste, it must nevertheless be transported in a responsible way. The container must not be leaking and must be securely fastened to the truck or carrier.

In the event of accident, damage, or leakages during transport, respirator, chemical safety goggles, rubber boots and heavy rubber gloves should be worn. Use non-sparking tools to collect the spill and place in a bag and hold for waste disposal. Avoid raising dust. Wash spill site after material pick up is complete.

9. Treatment And Disposal Of Waste

Molecular sieves should first be regenerated before unloading and storage. Disposal method for molecular sieves could be via landfill or fixation or for road building.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF FILTERS

1. Scope Of Guidelines

The guidelines serve to provide handling and disposal procedure for various types and usage of spent filters such as amine, lube oil, process water, glycol and etc. common to E&P operations.

2. Objective

The objective of the guidelines is to dispose all spent or discarded filters in a proper manner and to ensure safety of personnel and public as well as to conserve and protect the environment from possible contamination.

3. Classification And Definition Of Waste

Filters are not specified as scheduled waste under the Environmental Quality (Scheduled Wastes) Regulation, 1989. However, the usage of filters may result in filters contaminated with toxic and hazardous wastes such as glycol, cyanide, phenol, heavy metals. Therefore, based on potentially harmful content, it is appropriate to dispose filters in a proper manner.

4. Characteristic Of Waste

Each type of filters will defer physically and chemically as specified in its respective Material Safety Data Sheet (M.S.D.S). Handlers must have access to these data sheets at all times for reference.

5. Hazards

5.1 Health and Environmental Hazards

Filters may contain toxic and hazardous residues and may result in chronic health effects. Avoid inhalation, physical contact and consumption of food when handling this waste. Environmental hazards is normally in the form of leaching of the toxic and hazardous into the ground water and soil during accidents or when disposed off in improper disposal site.

5.2 Control of Hazards

Personal protection equipment with chemical resistant rubber gloves and fume respiration is worn at all times. Provide ventilation to avoid accumulation of gaseous release from filters. Practice good personal hygiene and provide washing facilities. All contaminated soils are treated as toxic and hazardous waste. Dispose filters only in a proper disposal site or prescribed premises.

6. **Emergency Response Procedure**

For medical emergency, follow the instructions on the Material Safety Data Sheets and seek medical attention immediately. In case of accidents, condoned off the affected areas with signs and follow instruction on the Material Safety Data Sheet.

7. **Waste Production**

7.1 Sources

These filters may be used in gas processing and compression facilities, crude oil production and heavy oil production.

7.2 Waste Management

7.2.1 Reduction

Optimize operating procedures to prolong usage of the filters.

7.2.2 Reuse

Not applicable

7.2.3 Recycle

Not applicable

7.2.4 Recover

High levels of hydrocarbon in wash water may be recycled for oil recovery.

8. **Storage**

Store in separate filter bins with screened liquid collection. On-site storage should have provision for bin drainage. Keep containers closed and store in a cool, well ventilated place away from heat source.

9. **Handling**

Personal protection equipment with chemical resistant hand gloves and fume respirator is worn at all time. Minimize generation of mist or vapour or dust. Avoid frequent and prolonged skin contact. In confined spaces, provide mechanical ventilation using explosion-proof equipment.

10. **Transportation**

Placed filters in drums, closed and securely placed onto its transporting vehicle.

Label filter waste as 'Filter Toxic Waste'. Include all known chemical content.

Each shipment is accompanied by a waste consignment note.

11. Treatment And Disposal

11.1 Treatment

Drain and/or steam filters to recover liquids. Filter pressing may be applicable to extract most of the liquids. Classify the liquids and dispose off appropriately.

11.2 Disposal

Filters is preferably disposed off in a prescribed landfill which have been approved by the Department of Environment. Ensure that no leachate containing heavy metals or toxic and hazardous waste is contaminating the ground water. Another option is to incinerate the non-metallic filters at the approved facility.

GUIDELINES ON THE TREATMENT AND DISPOSAL OF PRODUCED WATER

1. Scope of Guidelines

The guidelines cover the proper treatment and disposal of produced water generated from crude oil production and gas processing in the production platforms/facilities and crude oil terminals.

2. Objective

The objective of the guidelines is to provide waste generators a guide in the management of produced water. The proper management of this waste shall safeguard human health and the integrity of our environment.

3. Classification And Definition Of Waste

Produced water is not listed under the First Schedule of the Environmental Quality (Scheduled Wastes) Regulations, 1989 as a scheduled waste. The guideline considered this waste as "effluent" and thus should be managed and disposed to meet the Environmental Quality (Sewage and Industrial Effluent) Regulations, 1979 (for onshore discharges), the Environmental Quality (Amendment) Act, 1985 (for discharges beyond foreshore waters) and/or the Exclusive Economic Zone Act, 1984 (for offshore discharges).

4. Data Sheet/Characteristic Of Waste

A basic understanding of the characteristic and properties of produced water is of primary importance in evaluating treatment and disposal technologies.

4.1 Name and Description

Produced water includes all water separated from hydrocarbon

streams during all phases of oil and natural gas production.

Most produced water is strongly saline (high salinity), typically containing between 100 ppm to 1000 ppm of oil and between several hundred ppm to over 150,000 ppm of total dissolved solids (TDS). Produced water also tends to contain petroleum hydrocarbons and trace quantities naturally occurring metals, heavy metals and organics. It may also contain trace amount of additives (chemicals) necessary for the production process such as coagulants, corrosion inhibitors, cleaners, dispersants, emulsion breakers, scale inhibitors, etc.

4.2 Type of Hazards

Major hazards due to improper treatment and disposal of produced water is potential ground water contamination through tubing and casing leaks (if disposed by injection) and potential surface water and soil contamination (if discharged to surface waters).

Exposure to produced water through bodily contact, inhalation and ingestion may cause variety of physical effects. (Refer to Appendix 1.0: Health Effects)

In addition, the discharges may affect the ecological system and marine life in surface waters (lakes, rivers, seas).

4.3 Protective Equipment

Personal protective equipment such as gloves and protective clothing shall be worn to protect against hazardous components during handling and treatment of produced water.

When in enclosure, mechanical ventilation or other means shall be provided.

4.4 Emergency Response Procedures

First aid shall immediately be administered to person who incidentally inhaled, ingested and came into bodily contact with the produced water. (Refer to Appendix 2.0: First Aid Measures)

5. Waste Production

5.1 Sources of Wastes

Produced water are generally- generated from crude oil production, gas processing and heavy oil production.

5.2 Procedures for Waste Reduction at Source

Produced water cannot be reduced at the generating source. Below are some waste management options for minimizing produced water:

Reduce	:	Not applicable
Reuse	:	Not applicable
Recycle	:	Produced water can be processed/separated back into the crude oil system.
Recover	:	Recovered oil can be spiked into the crude oil system.

6. Collection And Transport

Not Applicable

7. Treatment And Disposal Of Waste

7.1 Treatment Methods for Onshore/Offshore Facilities

Produced water should be segregated from all other waste waters.

Produced water shall be treated using the best practicable methods. This shall include physical treatment such as gravity separation (Corrugated Plate Interceptor, API, Caisson/sump pile), gas flotation, hydrocyclones and filtration. The physical treatment selected shall be of the approved type and capable of treating the produced water to meet the standards stipulated under the Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979, the Environmental Quality (Amendment) Act, 1985 and the Exclusive Economics Zone Act, 1984.

Other treatment methods include biological treatment and chemical treatment. Biological treatment involves the use of fungi or bacteria to remove or reduce the oil contents such as controlled aerated reactor and trickling filter system. Chemical treatment shall be the injection of the right demulsifiers at either downstream or upstream of production separators to break the oil/water emulsions.

Often, a combination of physical-chemical treatment system is selected (for oil recovery only) where chemicals are added to assist in the water treatment process. Ultimately, the technology selected for produced water treatment is the characteristics of the water to be treated and the most economically feasible to treat to regulatory limits of discharge.

7.3 Disposal Methods

Treated produced water shall be discharged in an environmentally sound and acceptable manner in such a way that minimizes its impact on environment and protect human health and shall comply with the regulatory limit set by the

Malaysian Government.

Produced water may be disposed through by deep well injection into the reservoir. Should this disposal method be adopted, the injection water must be treated for particulate removal, sterilisation, corrosion inhibitor, and scale formation to prevent plugging of the formation, damage to the injection wells or other parts of the injection system.

APPENDIX 1.0 - HEALTH EFFECTS

WASTE INFORMATION GUIDELINE

<u>NAME OF WASTE</u>	:	PRODUCED WATER
ACUTE HEALTH EFFECTS	:	
<u>INHALATION</u>	:	Generally not considered to be a hazard at normal temperatures (up to 38 deg C). High organic vapour concentrations may irritate the nose, throat and lungs; may cause headaches and dizziness; may be anaesthetic and may cause other central nervous system depression effects.
<u>EYE CONTACT</u>	:	May cause irritation.
<u>SKIN CONTACT</u> skin disorders.	:	May cause irritation or other
<u>INGESTION</u>	:	May cause irritation of mouth, throat and stomach and may cause digestive disorder and/or damage. Small amounts of hydrocarbons drawn into the lungs either from swallowing or vomiting may cause severe health effects (eg. bronchopneumonia or pulmonary edema).

CHRONIC HEALTH EFFECTS OF COMPONENTS:

May contain benzene. Prolonged and/or repeated over exposure to benzene may cause damage to the blood producing system and serious blood disorders, including leukaemia. Benzene can cross the placenta and enter fetal blood. It is listed as a known carcinogen.

May contain phenols. Absorption through skin contact is the primary route of entry. Severe dermatitis may result from prolonged contact with dilute phenols. Prolonged or repeated exposure to phenols may cause liver or kidney damage, dark urine, increased skin pigmentation, and muscle pain and weakness.

QUANTITATIVE TOXICITY DATA ON THIS WASTE:

Not available.

OCCUPATIONAL EXPOSURE LIMITS:

For benzene, a OEL-TWA of 30 mg/m³. For phenol, a OEL-TWA of 19 mg/m³.

APPENDIX 2.0 - FIRST AID MEASURES

INHALATION : In emergency situations, use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.

EYE CONTACT : Flush eyes, including under eyelids, with a continuous flow of fresh water for at least 15 minutes. Get prompt medical attention.

SKIN CONTACT : Flush with large amounts of fresh water. Use soap if available. Remove severely contaminated clothing (including shoes) and clean thoroughly before reusing.

INGESTION : DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Keep at rest and get prompt medical attention.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF HYDROTESTING WATER

1. Scope Of Guidelines

The guidelines cover the proper management and disposal of hydrotesting water generated by the upstream activities (pipeline transmission) in the Malaysian oil and gas operations. The hydrotesting water considered in the guidelines is fluids consisting of inhibited seawater and chemicals injected during the pipeline testing.

2. Objective

The objective of the guidelines is to provide waste generators with a guide on the management and disposal of hydrotesting water. Adherence to the guidelines ensure that the waste will not pose a threat to public health and the environment.

3. Classification And Definition Of Waste

Hydrotesting water generated from the upstream petroleum industry can be considered as effluent or waste water and thus should be managed and disposed to meet all the relevant Malaysian government regulatory standard as stipulated under the Environmental Quality (Sewage and Industrial Effluent) Regulations, 1979 (for onshore discharges), the Environmental Quality (Amendment) Act, 1985 (for discharges beyond foreshore waters) and the Exclusive Economic Zone Act, 1984 (for offshore discharges).

4. Characteristic Of Wastes

4.1 Name and Description

Hydrotesting water consisted of seawater and treated with chemicals such as corrosion inhibitor, biocide, oxygen scavenger and red colouring dye (Rhodamine B). Hydrotesting

water for gas transmission may contain methanol.

4.2 Types of Hazards

The major environmental hazards due to improper handling and disposal of hydrotesting water containing methanol is its potential toxicity to aquatic life. The environmental hazards posed by the hydrotesting water containing inhibited seawater and chemicals is dependent on the toxicity of chemicals added, and the amount of sediment present in the pipeline.

The health risk resulting from exposure to hydrotesting water containing methanol through bodily contact, inhalation, are provided in (Appendix 1.0: Health Effects)

4.3 Control of Hazards

Hazards arising from the storage of hydrotesting water containing methanol shall be minimised by exercising extreme precaution in handling and storage. The hazardous combustion product is oxides of carbon. Should the waste be stored, it shall be stored in steel tanks or drums and be segregated from other wastes. The storage containers shall be closed and stored in a cool, well-ventilated place away from sources of heat and ignition.

4.4 Protective Equipment

Depending on handling requirements, personal protective equipment such as chemical resistant gloves, chemical safety goggles and approved respirators should be worn to protect against possible hazards when handling the chemicals.

4.5 Emergency Response Procedures

First aid shall be immediately administered to person who incidentally ingested, and bodily contact with the hydrotesting water. (Refer to Appendix 1.0: First Aid Measures)

Emergency response procedure is not generally required with hydrotest liquids.

However, if chemicals are spilled, they should be contained and cleaned up to avoid contamination of the environment.

5. Waste Production

5.1 Sources Of Wastes

Hydrotesting water containing inhibited seawater and chemicals are generally generated from pipeline commissioning while hydrotesting water containing methanol generated from gas transmission in the upstream sector of oil and gas operations.

The waste is usually discharged into the sea after completion of pipeline commissioning.

5.2 Procedures For Waste Reduction At Source

The generation of this waste could be minimized by optimising the amount of chemicals needed to treat the seawater. Over treatment may cause hazards of the hydrotest water to increase.

6. Storage

Not Applicable.

7. Handling

Not Applicable.

8. Collection And Transport

Not applicable.

9. Treatment And Disposal Of Waste

9.1 Treatment Methods

Hydrotesting water containing seawater and chemicals is not possible to be reused or recovered as the chemicals have been diluted to low concentrations.

9.2 Disposal Methods

Hydrotesting water containing seawater and chemicals can be disposed into the sea if concentrations of chemicals added do not pose harm to the environment and within the limits stipulated by the Environmental Quality Acts 1974 and Exclusive Economic Zone Act, 1984.

APPENDIX 1.0 - HEALTH EFFECTS

WASTE INFORMATION GUIDELINE

NAME OF WASTE : HYDROTESTING WATER

ACUTE HEALTH EFFECTS:

INHALATION : Vapours may irritate the nose, throat and lungs; may cause headaches and dizziness; may be anaesthetic and may cause other central nervous system effects, particularly to the optic nerve.

EYE CONTACT : Vapour may cause eye irritation. Liquid can cause superficial, reversible lesions of the cornea.

EYE CONTACT : Methanol is readily absorbed by skin, producing central nervous system effects.

INGESTION : Methanol ingestion may irritate the mouth and throat. Ingestion may cause blindness or death.

CHRONIC HEALTH EFFECTS OF COMPONENTS:

Prolonged or repeated exposure may cause dermatitis, impaired vision, or damage to kidneys or heart.

QUANTITATIVE TOXICITY DATA ON THIS WASTE:

Not available.

OCCUPATIONAL EXPOSURE LIMITS:

For methanol, a OEL-TWA (skin) of 260 mg/m³ and a STEL (skin) of 310 mg/m³.

APPENDIX 2.0 - FIRST AID MEASURES

- INHALATION** : In emergency situations, use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.
- EYE CONTACT** : Follow first aid instructions for drum contents. Get medical attention.
- SKIN CONTACT** : Flush with a continuous flow of fresh water. Use soap if available. Remove severely contaminated clothing (including shoes) and clean thoroughly before reusing.
- INGESTION** : DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Keep at rest and get prompt medical attention.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF WORKOVER FLUIDS

1. Scope Of Guidelines

The guidelines cover the proper storage, handling and disposal of workover fluids generated in the upstream operations of oil and gas industry.

The workover fluids considered in the guidelines include acid water, chemicals, seawater and hydrocarbon.

2. Objective

The purpose of the guidelines is to provide the waste generators a guide on the management of workover fluids. Adherence to the guidelines ensures that the waste will not pose a threat to public health and the environment.

3. Classification And Definition Of Waste

Workover fluids are not classified as scheduled wastes under the Environmental Quality (Scheduled Wastes) Regulations, 1989. Workover fluids generated in the upstream petroleum industry can be considered as 'effluent or waste water' which should be managed and disposed to meet the Environmental Quality (Sewage and Industrial Effluent) Regulations, 1979 (for onshore discharges), the Environmental Quality (Amendment) Act, 1985 (for discharges beyond foreshore waters) and the Exclusive Economic Zone Act, 1984 (for offshore discharges).

4. Data Sheets/Characteristics Of Waste

Workover fluids can contain a vast combination of chemicals and fluids depending on the remedial actions planned for a well. Some of these are hydrochloric acid, hydrofluoric acid, trace metals, biocides,

inhibitors, surfactants, diesel fuel, crude oil, clay stabilizers, fluid control agents, potassium chloride, sodium chloride, produced water, formation and pipe scale and cement cuttings.

4.1 Name and Description

Workover fluids encountered in the upstream activities of oil and gas operations in Malaysia are commonly found in the form of brine, oily water and acid water. Brine may contain KCl or NaCl and other trace metals and chemicals used to treat the solution. Acid water may contain spent HCl or HF and other trace metals and chemicals.

Components of workover fluids is shown in Appendix 1.0.

4.2 Type of Hazards

Accidental leakage of workover fluids may cause environmental hazards such as potential groundwater contamination (if injected downhole for disposal) and potential soil and/or vegetation damage.

The health risk from exposure to workover fluids through bodily contact, inhalation, and ingestion are provided in to Appendix 2.0: Health Effects.

4.3 Control of Hazards

Hazards arising from the storage of workover fluids can be minimised by exercising extreme precaution in handling and storage. Incompatible wastes shall be segregated and stored in a properly designed containment system.

4.4 Protective Equipments

Depending on the workover fluid being handled, personal protective equipment such as face masks, impervious glove, rubber boot, protective clothing, and respiratory protection may be required.

4.5 Emergency Response Procedures

First aid shall immediately be administered to a person who incidentally ingested, and make bodily contact with workover fluids. If, however, first aid can not be provided at the site, medical personnel shall be informed regardless whether the person affected was given first aid treatment or not.

Emergency response procedure shall also include immediate containment of spill of the waste. Extreme precaution shall be taken against any source of ignition, precursor of chemical reaction, and migration of spilled wastes to the adjacent property and other sensitive receptors.

5. Waste Production

5.1 Sources of Wastes

Workover operations are performed for many reasons such as:

Reduce excessive water on oil and gas production

Repair mechanical failures

Recomplete or stimulate a well to gain additional production

6. Waste Reduction At Source

Waste reduction at generating source shall be achieved by improving housekeeping procedures. The water streams shall be segregated for potential recycle processes where lower quality water is acceptable (utility water). The hydrocarbon portion generated during the initial stage of workover operations shall be recycled by spiking them into the separation processes onboard the platform.

Waste management options include the following:

Reduce	:	Avoid contamination of chemical used. Mix sufficient amount of fluids for intended purpose.
Reuse	:	Not Applicable
Recycle	:	Produce all the workover fluids into the production process so that the water will be channelled through the water treatment system and any oil recovered.
Recover	:	Not Applicable

7. **Storage**

7.1 Types of Containers

Where applicable storage facilities and containment system for workover fluids shall be stored in corrosion-resistant (lined) drums or tanks. The containers shall be kept closed and stored in a cool, well-ventilated place away from caustic high pH materials, heat and sources of ignition.

7.2 Waste Compatibility

The materials used for the construction and manufacture of the containers shall be chemically compatible with the stored wastes. As such, waste characteristic analysis shall be known prior to construction and manufacture of containers for waste storage.

8. **Handling**

The generation of mists or vapours shall be minimised. Body contact and inhalation of vapours or mists shall be avoided at all time. In confined spaces, mechanical ventilation shall be provided using

explosion-proof equipment.

The selection of personal protective equipment will vary depending upon site safety regulations/procedures and the actual conditions of use.

Examples of personal protective equipment for handling the workover fluids shall include chemical resistant gloves, chemical safety goggles, approved respirators, long sleeves, face shields, rubber boots and impervious body cover.

9. Collection And Transport

Not Applicable

10. Treatment And Disposal Of Workover Fluids

10.1 Treatment Methods

Where there is an excess workover fluids, pretreatment of workover fluids can be performed through neutralization of acidic fluids where applicable and the removal of suspended solids by filtration or settling.

10.2 Disposal Methods

Current practice adopted by oil industry in Malaysia is by returning the workover fluids into the process system. Occasionally, if fluids is spent brine (saltwater) only, it is discharged into the sea.

Other disposal options include underground injection.

APPENDIX 2.0 - FIRST AID MEASURES

- INHALATION** : In emergency situations, use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.
- EYE CONTACT** : Flush eyes, including under eyelids, with a continuous flow of fresh water for at least 15 minutes. Get prompt medical attention.
- SKIN CONTACT** : Flush with large amounts of fresh water. Use soap if available. Remove severely contaminated clothing (including shoes) and clean thoroughly before reusing.
- INGESTION** : DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Keep at rest and get prompt medical attention.

APPENDIX 1.0

TYPICAL COMPONENTS OF WORKOVER FLUIDS

COMPONENT CONCENTRATION RANGES

A : ACID

Hydro chloric acid	0 - 60%
Hydro fluoric acid	0 - 10%
Sulphuric acid	0 - 60%

B : TRACE METAL

Arsenic	< 0.025 - 9.3 mg/kg
Cadmium	0.1mg/kg
Chromium (Cr6+)	80.5 - 198 mg/kg
Lead	140 - 1200 mg/kg
Mercury	< 0.01 mg/kg
Nickel	0. 1-14 mg/kg
Thalium	No data
Selenium	No data

C : HYDROCARBONS

Diesel fuel	0 - 60%
Kerosene	0 - 60%
Crude oil	0 - 60%
Distillate	0 - 60%
Methanol	0 - 8S %
Toluene	0 - 100 %
Xylenes	0- 100%
Other Components	No data
(gelling agents, surfactants	
clay stabilisers, fluid control agents)	

- Reference : Canadian Petroleum Association, Production Waste Management Handbook for Alberta Petroleum Industry.
- Notes : Malaysian composition on these component vary.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF OIL-BASED MUD

1. Scope Of Guidelines

The guidelines cover all oil-based mud and cuttings used for the drilling of oil wells at onshore and/or offshore facilities.

2. Objective

To provide guidelines for waste generators to properly dispose of oil-based muds and cuttings.

3. Classification And Definition Of Waste

Oil based mud is not specified as scheduled waste in the Environmental Quality (Scheduled Wastes) Regulations, 1989. However, it might be toxic to aquatic life forms depending on the oil being used. Therefore, its disposal should be properly managed. Oil based mud is sometimes known as drilling fluids or OBM.

4. Characteristic Of Waste

The physical and chemical properties of oil based mud differ according to its drilling usage. Generally, it is semi-solid and dark brown in color, and with varying chemical and oil content. Oil used in oil based muds today is extremely low in toxicity.

5. Hazards

5.1 Health and Environmental Hazards

Oil based mud may incur health effects with prolonged skin

contact or if accidentally ingested. Oil and chemical mixtures in the mud may contaminate the environment unless disposed of properly. Oil may deteriorate the water quality and may be toxic to aquatic organisms.

5.2 Control of Hazards

Personal protection equipment should be worn at all times. Avoid food consumption when at work around drilling areas. Practise good hygiene. Washing and cleaning facilities should be provided at drill sites.

6. Emergency Response Procedure

In the event of a spill on land, cordon off the spilled area and proceed with the clean up process. This would typically involve physical removal of the mud into tanks and containers. For offshore spill, monitor the spill and let it disperse and biodegrade naturally. Follow manufacturer's instruction and seek medical attention immediately in the event of personnel emergencies.

7. Waste Production

7.1 Sources

This waste originates from the drilling operations of exploration and production wells.

7.2 Waste Management

7.2.1 Reduction

Use low toxicity oil based muds, vegetable oil based muds or other replacement muds. Optimize need to drill wells with oil based mud.

7.2.2 Reuse

Separate mud from cuttings and reuse in drilling operations.

7.2.3 Recycle

Return the mud to the supplier/manufacturer for recycling.

7.2.4 Recover

Same as 7.2.2

8. **Storage**

8.1 Oil based mud should be stored in corrosion resistant containers especially if storage is expected to be on long term basis.

8.2 Periodically check the integrity of the containers for possible leakage.

9. **Handling**

Personal protection equipment should be worn at all times to avoid unnecessary exposure. Avoid skin contact. Practise good hygiene when handling this waste.

10. **Transportation**

Ensure the containers are securely fastened onto its transporting vehicle. Wood pallets are recommended for use when transporting oil based mud in drums.

11. **Treatment And Disposal**

11.1 Treatment

Segregate mud from cuttings (as stated in Section 7.2.2) for reuse in drilling operations. For offshore drilling, the separated cuttings are disposed into the sea.

- 11.2 The preferred disposal option of the mud is recycling via suppliers and manufacturers. Alternative methods of mud disposal include downhole injection, or landfarming. Landfarming of oil based mud would require approval from the Department of Environment.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF MERCURY-CONTAMINATED SOIL AND SLUDGE

1. Scope of the Guidelines

The guidelines cover the management and disposal of mercury-contaminated soil and sludges.

2. Objective

The objective of the guidelines is to provide the waste generators with the options to safely handle and dispose of mercury-contaminated soil and sludge. Adherence to the guidelines will ensure that the waste causes no threat to human being and the environment.

3. Classification And Definition Of Waste

Mercury-contaminated soil and sludge are classified under Environmental Quality (Scheduled Wastes) Regulations, 1989: Code N231, "Contaminated soil, water, debris or matter resulting from clean-up of a spill of chemical or scheduled waste".

4. Characteristic Of Waste

Mercury vapour is highly toxic and corrosive. It may affect central nervous system or gastrointestinal tract. It is also irritating to eyes and may cause dermatitis or skin sensitization.

4.1 Emergency Response Procedure

In emergency situation, use proper respiratory protection to remove the victim from overexposure. Administer artificial respiration if necessary. If eye contact occurs, flush eyes, including under eyelids, with excessive fresh water until irritation subsides. In case of skin contact, flush with copious

amounts of water. Wash with soap. Destroy severely contaminated clothing (including shoes) and clean thoroughly before reusing. If ingestion occurs, give milk or beaten egg whites in order to dilute stomach contents to a conscious victim. In all cases, get prompt medical help.

5. **Waste Production/Management**

Mercury spills or contamination of soil with mercury can be eliminated or kept to an absolute minimum if mercury manometers and level switches are replaced with electronic instruments. Provide adequate protection of mercury bulks during use and storage.

Below are some management options for minimizing mercury-contamination soil and sludge for disposal:

- | | | |
|---------|---|--|
| REDUCE | : | Replace mercury manometers and level switches with electronic instruments. Provide adequate protection of mercury bulks during use and storage. Good housekeeping is maintained when cleaning equipment. |
| REUSE | : | Not applicable |
| RECYCLE | : | Not applicable |
| RECOVER | : | If large quantity of mercury is cleaned for reuse. |

6. **Storage**

Keep containers closed and store in a well-ventilated place away from sunlight and incompatible materials (mercury reacts violently with acetylene, ammonia, chlorine dioxide, methyl azide, and sodium carbide).

The drums or containers containing the wastes must also be suitably labelled per the Environmental Quality (Scheduled Wastes) Regulations, 1989. An inventory of the stored wastes should be maintained at the storage site.

7. Handling

Avoid all body contacts and inhaling vapours. In confined spaces, provide mechanical ventilation with explosion-proof equipment. Do not stir prior to clean-up operations.

When handling the wastes, wear impervious body cover, chemical resistant gloves and chemical safety goggles. Monitor the concentration in the ambient air frequently. Where concentrations in air exceeds the occupational exposure limits (for elemental mercury, a OEL-TWA (skin) of 0.05 mg/m³), and which cannot be reduced by mechanical ventilation or other means, respirators may be necessary to prevent over exposure by inhalation.

8. Transportation

The transportation of mercury-contaminated soil and sludge is subject to the Environmental Quality (Scheduled Wastes) Regulations, 1989. Licensed transporters must be used and the wastes can only be disposed off at a prescribed premise only. All scheduled waste transportation must be accompanied by the required consignment notes for waste tracking purposes.

The containers must not be leaking and must be securely fastened to the truck or carrier. The contents should be clearly marked and labelled.

In the event of accident, damage or leakages during transport, evacuate the area. Localized spills should be contained with sulphur to prevent mercury fumes from causing air pollution. Sodium Polysulphide solution for mercury decontamination. Mix in the ration

of 5 grams sodium thiosulphate and 2 grams of 100 - mesh powdered sulphur per 100 ml of water. A wetting agent may be added if necessary to facilitate getting the sulphur into suspension.

9. Treatment And Disposal Of Waste

Currently, there are no approved or suitable methods of disposing mercury-contaminated soil and sludge. Hence, they must be stored at site awaiting for approved commercial facilities available in the future.

Mercury-contaminated wastes shall be disposed off at an approved Hazardous Waste Disposal Facility.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF ASBESTOS

1. Scope Of Guidelines

The guidelines encompass all personnel which are using, removing, handling, transporting and disposing off asbestos roofing, walls, gaskets, insulation.

2. Objective

The objective of the guidelines is to create awareness of the potential health hazards pertaining to handling and disposal of asbestos waste as well as creating a detail guideline to protect or ensure safety of workers, public and environment.

3. Classification And Definition Of Waste

No specific regulation governs the type of asbestos mention in Item 1 except for asbestos sludge from asbestos manufacturing plant. However, the potential health hazards particularly via inhalation of asbestos dust warrants it to be treated as hazardous and toxic waste.

4. Characteristic Of Waste

Asbestos is normally used in mixture with other materials (e.g. cement) and rarely in pure form. The percentage of asbestos contents depends on the usage. Roofing, gaskets, walls and insulation are the common usage in exploration and production operations. This type of asbestos are normally solid and hard in nature.

5. Hazards

5.1 Health and Environmental Hazards

Asbestos is most hazardous via inhalation of dust into the lungs. It is known to cause cancer of the lungs lining (mesothelioma) and asbestosis. The shape and sizes of asbestosis fibres are deemed to be very important in determining the risk from asbestos. Fibres that are longer than 200/um in length are generally cleared from the nasal passages, however shorten fibres possessing a diameter of 2/um or less may penetrate deeper into the lungs, and it has been estimated that the hazard posed by asbestos fibres is greatest with fibres that are between 5 - 10/um long and less than 1.5 or 2/um in diameter. The American Conference Governmental Industrial Hygienists (A.C.G.I.H) has recommended the threshold limit value:

TLV

Amosite	0.5 fibre > 5/um/cc
Chrysotile	2 fibers > 5/um/cc
Crocidolite	0.2 fiber > 5/um/cc
Other forms	2 fibers > > 5/um/cc

5.2 Control of Hazards

Suppression of dust is the foremost priority in handling asbestos. This can be done via wetting of the asbestos surface with water before work is done. Avoid dust generation by reducing or eliminating grinding, sawing and drilling. Wear personal protection equipment and dust respirators at all time.

6. Emergency Response Procedure

Asbestos is inert and does not pose fire hazards. However, in case of accidents, wear personal protection equipment with high efficiency

dust respirators. Contained off the affected area. All contaminated materials (soil, grass. etc.) are treated as asbestos waste.

7. Waste Protection

7.1 Sources

Older buildings on shore contributes the majority of this waste. Off-shore contribution may be limited to gaskets, walls, roofing and insulation materials.

7.2 Waste Management

7.2. 1 Reduction

Alternative materials should be used when practicable.
An asbestos phase out program may be suitable.

7.2.2 Reuse

Not applicable

7.2.3 Recycle

Asbestos waste can be sent to asbestos recycling company.

7.2.4 Recover

Not applicable

8. Storage

8.1 All asbestos waste must be encapsulated in dual layer thick plastic bags/sheets with thickness of 500/um to ensure no dust leakage.

- 8.2 Store separately in well ventilated place. Inventory and movement of waste must be kept.
- 8.3 Label waste clearly as 'Asbestos Waste'.

9. Handling

- 9.1 Condoned off the work areas with warning signs.
- 9.2 Equipment or furniture within the immediate vicinity is removed or covered with tarpaulin or plastic sheets.
- 9.3 Entry into work area is limited to workers with personal protection equipment. Planned of work must be prepared and safety briefing is conducted by site supervisor prior to starting of work.
- 9.4 Avoid or reduce generation of dust such as during sawing, grinding or drilling.
- 9.5 All asbestos waste is immediately placed into its containment units.
- 9.6 Washing and cleaning facility should be provided for workers.
- 9.7 Avoid any food and drinks in the course of work or before cleaning up after work.

10 Transportation

- 10.1 Ensure all waste is securely placed onto its transporting vehicle.
- 10.2 Cover the waste with tarpaulin or equivalent.
- 10.3 Ensure no breakage of the dual plastic encapsulation. Replace any broken encapsulation.

11. Treatment And Disposal

11.1 Treatment

Asbestos waste may be encapsulated by cement into blocks to further reduce the potential of dust escaping.

11.2 The preferred method of disposal is into an approved landfill site.

GUIDELINES ON THE MANAGEMENT AND DISPOSAL OF SCRAP METAL

1. Scope Of Guidelines

The guidelines cover all scrap metals and crushed metal drums from onshore and offshore constructions and operations. This waste include scrap metals generated by all areas of industry during facility maintenance and turnaround construction.

2. Objective

To provide end user the management options and scrap metal disposal method.

3. Classification And Definition Of Waste

Scrap metal is not a scheduled waste and normally classified as industrial waste. However, it may be contaminated with insulation, asbestos and sulfur or other contaminants which should be separated when practicable.

4. Characteristic Of Waste

Scrap metals are solid and normally generated as leftover metals from construction works. The metal made up of scrap metals is inclusive of iron, tin, aluminium or steel.

5. Hazards

5.1 Health and Environmental Hazards

Scrap metals may be contaminated with traces of toxic and hazardous chemicals and NORM (Naturally Occurring Radioactive Materials) in formations producing Barium

Sulfate (BaSO_4). Therefore avoid inhalation of dust and prolonged physical contact.

5.2 Control of Hazards

Personal protection equipment is worn all the time. Practice good hygiene and provide washing and cleaning facilities. Ensure storage area is well ventilated. Alternatively, scrap metals can be stored in open space.

6. Emergency Response Procedure

Scrap metals is solid, hard, inert and not flammable. Therefore, emergency response is deemed redundant.

7. Waste Production

7.1 Sources

Scrap metals are generated in construction, maintenance and operations (e.g. metal drums).

7.2 Waste Management

7.2.1 Reduce

Improve construction and maintenance practices and materials conservation.

7.2.2 Reuse

Reuse on-site or through waste exchange programme

7.2.3 Recycle

Recycle through waste exchange programme of scrap metal companies

7.2.4 Recover

Scrap metals can be recovered through metal manufacturing companies.

8. **Storage**

Scrap metals are stored orderly and segregate as to type or usage. Open space can be use as storage space.

9. **Handling**

9.1 Scrap metals are normally heavy and therefore suitable equipment may be used in lifting (e.g. fork lift, cranes)

Personal protection Equipment is worn at all times.

10. **Transportation**

Scrap metals can be placed onto open back trucks and covered with tarpaulin. Alternatively, small pieces of scrap metals can be placed in containers which in turn loaded onto the trucks. Do not overload trucks and this may undermine the safety of personnel and public and increase risk of accidents.

11. **Treatment And Disposal**

No treatment is required. The preferred disposal method is as described under the Item 7. It is a common practice to recycle scrap metals.

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