

# Annex E

## Waste Management Plan

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## *ABBREVIATIONS*

|        |   |
|--------|---|
| AMA1   | Anadarko Moçambique Área 1, Lda                                     |
| EHS    | Environment, Health and Safety                                      |
| EIA    | Environmental Impact Assessment                                     |
| EMS    | Environmental Management System                                     |
| eni    | Eni East Africa S.p.A   |
| LNG    | Liquefied Natural Gas   |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MSDS   | Material Safety Data Sheets   |
| OBM    | Oil Based Muds  |
| OGP    | International Association of Oil and Gas Producers                  |
| PPE    | Personal Protective Equipment                                       |
| WBM    | Water Based Muds  |
| WEEE   | Waste Electrical and Electronic Equipment                           |
| WMP    | Waste Management Plan   |
| WTN    | Waste Transfer Note (Manifest)                                      |

## **E1 INTRODUCTION**

### **E1.1 PURPOSE**

This Waste Management Plan (WMP) has been developed to facilitate evaluation and assessment of the Liquefied Natural Gas (LNG) Project (the Project) impacts associated with the generation of waste and to outline how all wastes generated during all phases of the Project will be managed in accordance with Mozambican laws and regulations and recognised good international industry practice to the extent reasonable and the Project's general environmental and waste management policies. Since FEED has not been completed, there may be some changes to the Project design after the completion of the WMP. Therefore, the WMP makes certain 'conservative assumptions' regarding the waste to be generated, treated, stored and ultimately disposed of so that the resulting EIA will address an overestimation of the potential impacts. In all cases, FEED will investigate the optimal solutions for managing waste. As the Project details and specific elements of the design become more certain, the WMP will be revised or amended to reflect more precisely the actual methods of handling, storage, treatment and disposal of all waste streams.

### **E1.2 OBJECTIVES**

The WMP is intended to achieve the following objectives:

- Minimize waste generation:
  - in all phases of the Project; and
  - through emphasis on the Waste Hierarchy illustrated in *Figure 1.1* and discussed in *Section E1.4*, which focuses on waste reduction, segregation, treatment, recycling and material reuse, to the extent reasonable.
- Minimize impacts to the environment from waste by:
  - ensuring appropriate treatment of wastes to reduce toxicity and/or volume; and
  - ensuring responsible disposal at authorised facilities.
- Ensure compliance with all applicable laws and regulations and this WMP by:
  - providing proper education and training on the WMP to all Project personnel and contractors;
  - auditing contractors for compliance with the WMP; and
  - including contractor management provisions in Project contracts.

### E1.3 SCOPE

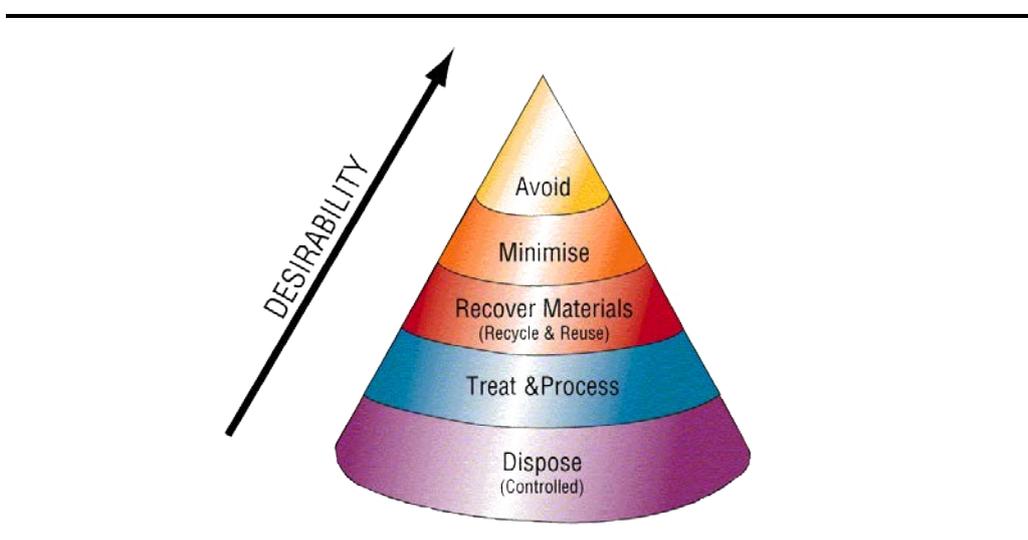
The WMP applies to the management of all wastes generated by the Project, including wastes generated during the construction (including but not limited to development drilling), operation and decommissioning phases.

### E1.4 GENERAL PRINCIPLES

#### E1.4.1 Adoption of the Waste Hierarchy

Where reasonable and appropriate, waste management activities will be performed in accordance with the internationally recognised waste management hierarchy as shown in *Figure 1.1*.

*Figure 1.1 Waste Management Hierarchy*



In order of preference, the aim will be to:

- Reduce the amount of waste generated;
- Re-use materials, where appropriate;
- Recycle wastes, where appropriate;
- Recover as many materials as practical from the remaining waste;
- Treat wastes as necessary to render them less hazardous and/or to enable them to be reused or recycled; and
- Dispose of residual wastes responsibly at authorised facilities.

The application of the above principles will be addressed during the procurement of goods and services for the Project and will be taken into consideration when reviewing waste storage and disposal methods throughout the Project's life.

#### **E1.4.2**      *Implementation*

All wastes will be managed in accordance with the principles of the Waste Hierarchy. Project contracts will include the following requirements:

- Minimisation of waste generation at all stages of the contract;
- Preparation and implementation of a materials Reuse and Recycling Plan;
- All residual waste to be treated in order to reduce its toxicity and/or volume for subsequent disposal; and
- Treated waste to be disposed of at appropriate, authorised facilities.

### E2.1 MOZAMBICAN LAWS AND REGULATIONS

For a comprehensive list of relevant Mozambican laws see *Chapter 2* of the EIA Report, but the main laws and regulations relating to the management of waste in Mozambique are as follows:

- Regulation on Waste Management, Decree 13/2006 of 15 June, published in the Boletim da República No. 24, 1st Series, of the 15 June 2006
- Regulation on Bio-Medical Waste Management, Decree No 8/2003, of 18th February 2003
- Environmental Law, Law No. 20/97, published in the Boletim da República No. 40, 1st Series, 3rd Supplement, of 7th October 1997

In addition, the following laws and regulations include provisions that are relevant to the management of Projects wastes:

- Environmental Regulations, Decree 18/2004 of 2 June, published in the Boletim da República No. 22, 1st Series, Supplement of the 2 June 2004.
- Petroleum Law No. 3/2001, of 21 February 2001, is published in the Boletim da República No. 8, 1st Series, Supplement, of 21st of February 2001.
- Petroleum Regulations, Decree No. 24/2004 is published in the Boletim da República No. 33, 1st Series, 2nd Supplement, of the 20 of August 2004.
- Law of the Sea (Law No. 4/96 of 4th January 1996, published in the Boletim da República No. 1, 1st Series, of the 4 of January 1996.
- Regulation for the Prevention of Pollution and Protection of the Marine and Coastal Environment, published in the Boletim da República N.º 48, 1st Series, Supplement of 30 November 2006.

### E2.2 INTERNATIONAL GUIDANCE AND CONVENTIONS

A complete list of relevant international guidance and conventions are included in *Chapter 2*. The following international conventions and guidance relate to the management of the Project's waste:

- International Convention for the prevention of pollution from ships (MARPOL, 1973/1978), published in the Boletim da República No. 7, 1st Series, 3rd Supplement, of 25th February 20. The MARPOL convention places various restrictions and requirements on the disposal of waste from ships and to the marine environment.

- The Basel Convention, to which Mozambique has acceded, controls the movement, storage, transport, treatment, reuse, recycling, recovery and final disposal of hazardous waste as well as requiring producers of hazardous waste to dispose of their waste in an environmentally responsible manner close to where it is generated. Any transboundary movements of hazardous waste must be pre-notified to the authorities of the prospective States of import and transit. The movement may only proceed if and when all the States concerned have given their written consent to the movement.
- The Bamako Convention is supplementary to the Basel Convention and specifically covers the movement of hazardous waste into or between signatory African countries.
- The International Association of Oil and Gas Producers (OGP) Waste Management Guidelines provide advice and examples of good practice for how wastes from oil and gas exploration and production activities should be managed.
- IFC EHS Guidelines (General Guidelines and those specific to Oil and Gas and LNG developments).

## E3.1 RESPONSIBILITIES FOR WASTE MANAGEMENT

Table 3.1 summarises the responsibilities of different organisations with respect to the management of wastes generated by the Project.

Table 3.1 Waste Management Responsibilities

| Organisation                 | Responsibilities   |
|------------------------------|--|
| AMA1 and eni                 | <ul style="list-style-type: none"> <li>• Ensure Project waste is managed in a manner consistent with Mozambican laws and the framework in this WMP</li> <li>• Development and custodianship of this WMP including: <ul style="list-style-type: none"> <li>○ collection, compilation and analysis of waste management performance statistics to ensure compliance;</li> <li>○ driving continual improvements;</li> <li>○ reporting, as required, internally to AMA1/eni management, as described in <i>Chapter 17</i> of the EIA Report;</li> <li>○ communication of changes in the WMP to AMA1/eni Staff, contractors and Mozambique authorities, as required; and.</li> <li>○ communication of waste management procedures to site personnel and contractors including provision of waste awareness training to site staff and contractors.</li> </ul> </li> <li>• Preparation of contracts that include requirements to manage Project waste in accordance with this WMP (including requirements listed below)</li> <li>• Monitoring waste management performance of Project contractors by undertaking audits. <ul style="list-style-type: none"> <li>○ Ensure all Project waste management facilities (AMA1/eni owned or third party owned) are operated in accordance with licences ; and</li> </ul> </li> <li>• Evaluate new waste treatment / disposal facilities as part of AMA1/eni commitment to continual improvement.</li> </ul> |
| General Contractors          | <p>Ensure all wastes are managed in accordance with this WMP and Contract requirements including:</p> <ul style="list-style-type: none"> <li>• compliance with Mozambican and any other relevant legislative requirements;</li> <li>• development and implementation of Waste Minimisation and Management Plan and Reuse and Recycle Plan</li> <li>• store waste in accordance with this Plan (segregation, containers, labelling)</li> <li>• provide assurance to AMA1/eni that Project wastes are being properly managed and disposed through provision of waste generation and waste management data; and</li> <li>• training of staff in Project waste management procedures and requirements of this WMP.</li> </ul>  |
| Waste Management Contractors | <ul style="list-style-type: none"> <li>• Manage wastes in accordance with Contract requirements</li> <li>• Manage all Project wastes in accordance with site authorisation or licence and Mozambican laws</li> <li>• Complete waste transfer notes and return a copy to AMA1/eni as evidence of receipt of Project wastes</li> <li>• Provide information and data to AMA1/eni regarding Project wastes managed</li> <li>• Allow AMA1/eni access to audit waste management facilities and operations</li> </ul>   |

All Project personnel (including contractors and subcontractors) will receive waste management awareness training as part of the site induction process. Toolbox talks, team briefings, safety meetings and periodic poster campaigns will be used to ensure an ongoing awareness of and compliance with correct waste management procedures as outlined herein.

The general waste management training discussed above, will be supplemented for certain personnel involved in waste treatment or disposal by additional waste management training provided by waste equipment suppliers, such as training in operation of the incinerators.

While wastes will be generated in each of the different phases of the Project and the estimations of the anticipated types and volumes of waste to be generated during each of these phases can be found in *Chapter 4* of the EIA Report (Project Description), the following addresses how these wastes will be managed and ultimately disposed of.

#### E4.1

##### WASTE IDENTIFICATION AND CLASSIFICATION

All wastes generated by the Project will be classified in accordance with the Mozambique Regulation on Waste Management (Decree No. 13/2006, dated June 15). Essentially this requires wastes to be classified as either hazardous or non-hazardous based on specific characteristics as listed in Appendix III of the decree, or as medical waste (based on its origin).

If any waste from an unidentified source is discovered, it will be treated as hazardous (taking a precautionary approach) until an investigation is carried out so as to enable the correct characterization and handling of the materials and a suitable management route identified (see below).

#### E4.1.1

##### *Hazardous Wastes*

Mozambican law defines hazardous wastes as wastes that can potentially be harmful to human health and/or could potentially damage the natural environment if not managed and disposed of appropriately. They include wastes which have any of the following characteristics:

- explosive;
- flammable;
- toxic;
- infectious;
- carcinogenic;
- radioactive;
- release flammable or toxic gases on contact with water; and
- organic peroxides and other Styron oxidants.

The full range of characteristics that define a waste as being “hazardous” may be found in Appendix III of Decree No. 13/2006. Despite being hazardous, several types of hazardous wastes can and should be recycled, to the extent practical (eg waste oils).

Naturally Occurring Radioactive Materials (NORM) originate in subsurface formations, and can be brought to the surface in formation water produced in conjunction with gas. Because the levels are typically so low, NORM in natural gas is typically not a problem unless it becomes concentrated. Produced waters may co-precipitate with barium sulfate scale or scale-bearing

sludge, forming coatings or sediment in oil field equipment, including pipes, casings, fittings, tanks and basins. These solids become sources of oil and gas NORM-contaminated equipment and waste.

Furthermore, accumulation of NORM in gas stream sections of plant might occur due to the deposition of lead-210 which is a decay product of radon-222 contained in the natural gas. NORM with relatively high concentration of lead-210 might be found in gas filters and sludge produced during pipeline pigging.

Periodic NORM monitoring is recommended at a minimum frequency of prior to major facility maintenance shutdowns. NORM can then be removed in during maintenance shutdown events. If NORM is found to consistently accumulate at hazardous levels, more frequent monitoring of selected equipment is recommended. At this time, it is assumed scale removal would be required for facility performance, and that the presence of NORM is not the driving factor. The scales together with any other radioactive waste will be managed in accordance with Mozambican law and good international industry practice. If there are no appropriately designed and operated facilities in Mozambique, any radioactive waste will be disposed of via an appropriately licensed third party waste management contractor.

#### ***E4.1.2 Bio-Medical Wastes***

Mozambican law defines bio-medical waste as wastes resulting from human medical and veterinary activities of diagnosis, treatment and research, such as the waste that would originate from the Project clinic(s) which will be classified and managed according to the Regulation on Bio-Medical Waste Management, Decree No 8/2003, of 18th February. This Decree indicates how bio-medical waste should be separated, identified, stored, removed, transported and disposed of/treated.

Specifically, in accordance with the decree, bio-medical waste will be separated into the following types:

- infectious waste;
- “sharps” (needles, knives etc);
- anatomical waste;
- ordinary waste; and
- other sorts of waste.

#### ***E4.1.3 Non-hazardous Wastes***

Non-hazardous wastes are those that do not exhibit any hazardous properties and are relatively low risk to human health and the environment. This includes a wide range of materials that may be recycled. Examples of non-hazardous wastes include domestic type wastes, such as food, packaging, plastics, various metals and wood.

It should be noted that some products are considered non-hazardous prior to their intended use (eg activated carbon or oil stained wood), however they may become hazardous wastes once used and may contain a range of hazardous chemicals or contaminants.

#### **E4.1.4**      *Other Characteristics*

For the purposes of managing the Project's different waste streams, it will be necessary to categorize wastes according to their disposal route. Examples of how some wastes may be categorized based on their disposal route are as follows:

- recyclable materials (hazardous and non-hazardous) may be recycled provided this can be done in a safe and environmentally sound manner (ie if appropriate facilities are available);
- non-hazardous combustible wastes and specific hazardous wastes may be incinerated;
- bio-medical wastes will be treated (e.g. disinfected), properly stored and eventually burned in an on-site incinerator;
- non-hazardous, non-combustible, wastes may be deposited at the Project landfill site;
- specific waste types (typically the more hazardous types of waste) may require specialized treatment and/or disposal. Some wastes may need to be stored temporarily while the most appropriate treatment or disposal facility is identified; and
- occasionally, and as a last resort, some waste for which an appropriate treatment and/or disposal option is not available in-country may have to be stored until authorized transboundary shipment for appropriate treatment or disposal can be arranged.

#### **E4.2**      *PREFERRED MANAGEMENT ROUTES*

A preliminary list of the types of waste the Project is expected to generate is presented in *Table 4.1* together with the provisional classification for each waste and its preferred management route(s). The range of wastes, together with individual classifications, will be reviewed and a revised WMP with project specific detailed information will be submitted prior to start of Project construction. Also, the management routes for the individual wastes will be reviewed and revised, as necessary, during the Project.

**Table 4.1 Anticipated Waste Streams and Preferred Management Options**

| Waste stream                         | Origin/ Source   | Estimated Quantities        |                                 | Classification             | Preferred treatment/ disposal options  |
|--------------------------------------|--|-----------------------------|---------------------------------|----------------------------|--|
|                                      |  | Construction (t)            | Operation (t/year) <sup>6</sup> |                            |  |
| Drill cuttings - WBM                 | Offshore drilling  | 1950 per well <sup>8</sup>  | -                               | Non-hazardous              | Due to the absence of a riser system during the drilling of the uppermost portions of a well, drill cuttings and the WBMs will be discharged directly to the seabed                    |
| Drill cuttings - LTOBM               | Offshore drilling  | 465 <sup>8</sup>            | -                               | Hazardous                  | Removal of oil and discharge to sea <sup>(1)</sup> or sent to shore for treatment and disposal or for management by an appropriately licensed Third Party waste management contractor. |
| Drilling mud - WBM                   | Offshore drilling  | 1,800 per well <sup>8</sup> | -                               | Non - Hazardous            | Due to the absence of a riser system during the drilling of the uppermost portions of a well, drill cuttings and the WBMs will be discharged directly to the seabed                    |
| Drilling mud - LTOBM                 | Offshore drilling  | 270 <sup>8</sup>            | -                               | Hazardous                  | Recirculation and then waste mud is either returned to supplier for reconditioning and reuse or transferred to Third Party waste contractor  |
| Oil-contaminated rags                | Offshore drilling  | 6 <sup>7</sup>              | -                               | Hazardous                  | Ship incineration<br>Transfer to authorized wastes facilities (e.g. Muxara)<br>Project Incinerator or<br>Third Party contractor  |
| Unused/out of date chemicals         | Offshore drilling  | 3 <sup>7</sup>              | -                               | Hazardous                  | Return unused portion to supplier<br>Specialist treatment/hazardous landfill <sup>(4)</sup>  |
| General solid waste                  | Offshore drilling (including support vessels)                | 1215                        | -                               | Non-hazardous              | Project incineration (combustibles)<br>Project landfill (non-combustibles) or<br>Transfer to authorized wastes facilities (e.g. Muxara) or<br>Third Party contractor                   |
| Wood or vegetation                   | Site clearance, wooden pallets from equipment shipments      | 185                         | -                               | Non-hazardous, combustible | Reuse/ Recycle<br><br>Compost (smaller vegetation)   |
| Inert wastes - concrete rubble, grit | Construction activities, demolition (after decommissioning), | 5,000                       | -                               | Non-hazardous              | Recycle (e.g. road construction)<br>Project landfill   |

| Waste stream   | Origin/ Source   | Estimated Quantities                   |                                 | Classification             | Preferred treatment/ disposal options   |
|--|--|--|---------------------------------|----------------------------|---|
|  |  | Construction (t)                       | Operation (t/year) <sup>6</sup> |                            |   |
|  | sand blasting  |  |                                 |                            |   |
| Containers (metal, plastic)  | Supply of materials  | 295                                    | 4 <sup>7</sup>                  | Non-hazardous,             | Clean & crush: reuse/recycle<br>Project landfill  |
| Process chemicals and reagents (including molecular sieve and alumina) | Feed gas dehydration, LNG process                              | -                                      | 45                              | Hazardous                  | Return unused portion to supplier<br>Specialist treatment and/or stabilization/solidification/hazardous landfill <sup>(3)</sup> |
| Oil and sludge   | LNG process, oil interceptors around site, vehicle maintenance | 375                                    | 35                              | Hazardous                  | On site incineration or Third Party waste contractor  |
| Activated Carbon   | LNG process  | -                                      | 4.4                             | Hazardous                  | Recycled (returned to supplier)/<br>On site incineration or Third Party waste contractor  |
| Food waste   | Accommodation areas, offices                                   | 6,600                                  | 82                              | Non-hazardous              | Composting/On site incineration/Third Party contractor  |
|  | Offshore rigs and vessels                                      | 200 - 270                              | -                               | Non-hazardous              | Maceration and disposal to sea  |
| Miscellaneous combustible waste  | Packaging, general waste                                       | 21 - 27(offshore)<br>480 (onshore)     | 8                               | Non-hazardous, combustible | On site incineration  |
| Textiles   | Accommodation areas, offices                                   | 21 - 27(offshore)                      | 8                               | Non-hazardous              | Recycling/<br>Project landfill/Third Party contractor   |
| Paper and cardboard  | Accommodation areas, offices                                   | 62 - 82(offshore)<br>3,500 (on-shore)  | 50                              | Non-hazardous              | Recycling/<br>On site incineration/Third Party contractor   |
| Plastics   | Accommodation areas, offices                                   | 41 - 55 (offshore)<br>1,100 (on-shore) | 16                              | Non-hazardous              | Recycling/<br>Project landfill/Third Party contractor   |
| Glass  | Accommodation areas, offices                                   | 21 - 27 (offshore)<br>580 (on-shore)   | 8                               |                            | Recycling/<br>Project landfill  |
| Metals   | Construction, maintenance, decommissioning                     | 470 (offshore)<br>760 (on-shore)       | 8                               | Non-hazardous              | Recycling   |
| Miscellaneous non-combustible  | Accommodation areas, offices                                   | 21 - 27 (offshore)                     | 8                               | Non-hazardous              | Project landfill  |
| Kitchen oil / grease   | Accommodation areas  | 4 - 6(offshore)                        | 2                               | Non-hazardous              | On site incineration, solidification and landfill   |
| Printer cartridges   | Offices  | -                                      | 0.2                             | Hazardous                  | Recycling (return to supplier)<br>Or<br>hazardous landfill (Third Party contractors)  |

| Waste stream  | Origin/ Source                             | Estimated Quantities                 |  | Classification             | Preferred treatment/ disposal options  |
|---|--|--------------------------------------|--|----------------------------|--|
|   |  | Construction (t)                     | Operation (t/year) <sup>6</sup>            |                            |  |
| Hazardous wastes (e.g. small batteries, Fluorescent and sodium lamps) | Accommodation areas, offices               | 0.2 <sup>7</sup>                     | 0.1  | Hazardous                  | Specialist treatment/hazardous landfill (Third Party contractors)                        |
| Medical wastes  | First aid/medical treatment centres        | 0.2 – 0.3(offshore)<br>10 (on-shore) | 0.5  | Biomedical                 | On site biomedical incineration, then landfill   |
| Tyres   | Vehicles                                   | 85                                   | 0.8  | Non-hazardous, inert       | Recycling/<br>Project landfill   |
| Lead-acid batteries   | Vehicles, mobile plant                     | 20                                   | 0.8  | Hazardous                  | Recycling/ Specialist treatment/hazardous landfill (Third Party contractors)             |
| Waste oil   | Vehicles, mobile plant                     | 10 <sup>7</sup>                      | 0.7  | Hazardous                  | Recycling  |
| Oil filters   | Vehicles, mobile plant                     | 8                                    | 0.1  | Hazardous                  | On site incineration, hazardous landfill, or project landfill if non-hazardous           |
| Air filters   | Vehicles, mobile plant                     | 100                                  |  | Non-hazardous              | On site incineration/ Project landfill   |
| Welding rods  | Construction                               | 80                                   | -  | Non-hazardous              | Project landfill   |
| Paint, solvents   | Construction/maintenance works             | 3 <sup>7</sup>                       | 0.5  | Hazardous                  | On site incineration/Third Party landfill  |
| Hydrostatic test water  | Pressure testing of pipelines              | 63,000                               | -  | Non-hazardous              | Settlement of solids via sedimentation pond and then discharge to sea <sup>(4)</sup>     |
| Brine and filter backwash   | Desalination Plant                         | 7.8 million                          | 540,000 – 815,000                          | Hazardous                  | On-site treatment and discharge to sea   |
| Produced water  | Gas wells                                  | -                                    | 186,000                                    | Hazardous                  | On-site treatment and discharge to sea   |
| Process wastewater  | LNG process                                | -                                    | 44,000                                     | Hazardous                  | On-site treatment and discharge to sea   |
| Stormwater run-off  | Hardstanding areas around the Project site | (54,000 – potentially contaminated)  | (35,000 – 70,000 potentially contaminated) | Non-hazardous or hazardous | Potentially contaminated stormwater treatment facility, discharge to sea                 |
| Sewage  | Accommodation areas, offices               | 2.2 million <sup>7</sup>             | 30,000 – 130,000                           | Hazardous                  | On-site treatment  |
|   | Offshore rigs and vessels                  | 60,000 – 80,000                      | -  | Hazardous                  | Maceration/on-board treatment and discharge to sea                                       |
| Sewage sludge   | Sewage treatment                           | 14,900                               | 36 - 160                                   | Hazardous                  | Incineration or Third Party landfill   |
| Incinerator Ash   | On-site incinerators                       | 500                                  | 10   | Non-hazardous              | On site landfill (if classified as non-hazardous) or Third Party landfill (if hazardous) |

| Waste stream   | Origin/ Source | Estimated Quantities                                |                                 | Classification                             | Preferred treatment/ disposal options  |
|--|----------------|---|---------------------------------|--|--|
|  |                | Construction (t)                                    | Operation (t/year) <sup>6</sup> |  |  |
| Tank bottoms   | Storage of oil | 0.001 – 0.01% of volume of oil handled <sup>9</sup> |                                 | Hazardous                                  | Incineration or Third Party waste contractor   |
| Wastewater treatment tank bottoms  | Sedimentation  | 800   | 100                             | Hazardous (to be confirmed) <sup>(5)</sup> | On site landfill (if classified as non-hazardous) or Third Party landfill (if hazardous) |
| Notes (1) In compliance with discharge limits.<br>(2) Muxara is an existing AMA1 facility which manages exploration drilling wastes under current onshore EIA, EMP and WMP<br>(3) May require transport to more distant/international facilities<br>(4) The Marine Ecology Study considers potential impacts and mitigation measures associated with hydro test water.<br>(5) Depends on characterization of waste based on analytical testing<br>(6) m <sub>3</sub> /year in the case of aqueous wastes<br>(7) ERM estimate based on similar projects<br>(8) Based on previous Anadarko drilling offshore Mozambique – (Impacto, 2008: Offshore Area 1 Volume II, Part A: Environmental Impact Study)<br>(9) USEPA, 2000: Crude Oil tank Bottoms and Oily Waste ( <a href="http://www.epa.gov/osw/nonhaz/industrial/special/oil/tb.pdf">http://www.epa.gov/osw/nonhaz/industrial/special/oil/tb.pdf</a> ) |                |   |                                 |  |  |

Section E8 provides further details on specific treatment/ disposal options.

Where materials of unknown type or composition are identified, they will be presumed to be hazardous waste until further investigation (which may include sampling) can be undertaken to provide sufficient information about the composition or origin of the material so as to enable a decision about its appropriate management.

If the material is determined to be waste and the risks have been assessed, the integrity of the storage container, if any, will be evaluated and the waste will be transferred to an appropriate management area within the nearest Project waste storage area where it can be properly managed and/or disposed of.

*E5.1**WASTE MINIMISATION*

At all stages of the Project, the first priority, in terms of waste management, will be to minimise the amount and toxicity of all waste streams generated. Waste reduction can be achieved by careful Project planning and design, as well as by ensuring the implementation of good site practices. Reducing the volume and toxicity of waste generated will reduce the potential impacts associated with the handling, storage, transport, treatment and disposal of the waste as well as reducing the amount of raw materials consumed.

Measures that will be implemented to reduce the amount and toxicity of waste that is generated include:

- during all phases of the Project, but especially during the planning and design phase, contractors will be required to verify that they have taken into consideration waste reduction techniques and strategies as part of their bid for purchasing and management;
- contractors will be required to have a Reuse/Recycle Plan for their portion of the Project work;
- all wastes will be segregated so as to minimize the volume of toxic waste by avoiding comingling of wastes; and
- where practicable, all materials will be ordered in bulk in reusable packaging that can be returned to the suppliers.

Tender documents and Contracts developed for the Project will include the above requirements. Contractors' proposals for minimising waste generation and proper management of waste will be key criteria used in the award of Project contracts.

*E5.2**REUSE AND RECYCLING*

For materials that have served their purpose and are destined to be waste or wastes which are unavoidable, the priority will be their proper segregation, containment, and storage until their reuse, recycle or return potential is determined. Wherever possible, unused or partially used materials which are surplus will be returned to the original suppliers.

There are local markets for some recyclable materials such as plastic, metals, and tyres. There may also be markets for paper and cardboard; however, there may not be suitable facilities for more complex materials such as dry cell batteries, lead acid batteries, computer or electronic waste and fluorescent light tubes. Due to the difficulty in locating proper recycling or disposal

options for these materials, where possible, they will be returned to the suppliers for recycling or proper disposal or stored until they can be properly transported out of the country (transboundary) to proper facilities.

## E6.1

*GENERAL*

Hazardous and non-hazardous wastes will be stored in separate, designated, storage areas and incompatible wastes will be segregated so as to prevent inadvertent contact in the event of leakage from a container. Waste storage areas will be indicated on facility site plans. Wastes will be stored in a manner to prevent:

- contact with rain or stormwater (eg covered storage areas, as needed);
- accidental spillage or leakage;
- impact of accidental spillage or leakage;
- loss of container integrity from accidental collision, corrosion or weathering;
- theft by people (eg by provision of fencing and/or other security measures);
- scavenging by animals, pests and rodents; and
- spread of infectious diseases (eg from medical waste).

Containers used for storing wastes will be compatible with their contents and appropriate in terms of volume and shape (for filling/emptying the material that is being stored). Only containers in good condition will be utilised. Bungs and lids will be securely fastened or other forms of covering will be provided. Waste storage containers will also be clearly labelled, indicating the characteristics of the contents, date of containerising or packing, and data on toxicity and/or other potential hazards.

Storage of waste will be carried out in accordance with the material safety data sheet (MSDS) for each waste, in a designated area, with a suitable surface and a method to contain any leakage or contaminated runoff water. MSDS records will be kept at waste storage areas for all hazardous wastes being stored on site.

## E6.2

*NON-HAZARDOUS WASTES*

All project sites/accommodation areas will have sufficient, clearly labelled containers for the waste types shown below.

Where feasible, non-hazardous wastes will be segregated into different types of waste in accordance with Decree No. 13/2006 as follows:

- paper and cardboard;
- plastic;
- glass;
- metal;
- rubbish;
- metal scrap;
- organic matter; and
- other.

Separate containers will be provided for collection of each of these waste types, as appropriate, at points where waste is generated.

The open burning (as opposed to incineration) of any waste at Project construction sites, permanent project sites or workers' accommodation camps will be prohibited apart from in special circumstances following risk assessment and approval by the Project.

### **E6.3 HAZARDOUS WASTES**

Hazardous wastes will be handled and stored so as to avoid potentially dangerous incidents due to escape of the wastes or mixing of incompatible wastes and to ensure that hazardous wastes do not enter the non-hazardous waste stream.

Storage areas for hazardous wastes will be:

- clearly labelled and used solely for the storage of hazardous wastes;
- covered and enclosed on at least 3 sides;
- in the case of liquid wastes:
  - have an impermeable floor and bunding, of capacity to retain 110% of the volume of the largest container or 25% by volume of the chemical waste stored in that area, whichever is the greatest;
  - have adequate ventilation; and
- organised so that incompatible materials are appropriately segregated and kept adequately separated.

Containers used for the storage of hazardous wastes will:

- be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;
- display a label in Portuguese, English and other local languages, if applicable, to state clearly the nature of the waste, any hazards which it

may pose and contact numbers of persons that can provide additional information in the case of an emergency; and

- display the appropriate hazard warning symbol as specified in Appendix V of Decree 13/2006.

During the operation of the LNG facility, one or more centralised locations may be used for the accumulation of recyclable materials and specific hazardous wastes collected from around the site and the accommodation facilities to make the onward transport for recycling or treatment more cost effective.

## E7 WASTE COLLECTION AND TRANSFER

### E7.1 GENERAL

AMA1 and eni recognise that any waste generated during or as a result of the Project must be collected, handled and transferred safely and in accordance with legal requirements and the IFC guidelines, to the extent practical, whether this activity is conducted by AMA1/eni or a contractor.

All waste will be collected and transferred:

- only by persons or entities that are duly authorized by the government of Mozambique.
- in a manner that ensures materials are properly packaged for transportation and that all waste containers are appropriately labelled for storage and transportation purposes.
- using a system of signed waste transfer notes (see below) to document the details of each individual load of waste. Each transfer note (manifest) will provide a written description of the waste load that will enable anyone receiving the load to dispose of it or handle it safely.

records will be maintained of all the Project wastes transferred from the Project sites – see *Section E9.2*.

Relevant MSDS sheets will accompany waste during transportation by road or sea.

### E7.2 CONTAINERS AND LABELLING

Each waste container leaving a Project site will be:

- clearly labelled to describe the waste it contains. Any old labels or markings on the container (e.g. from its original use) will be completely removed or totally obscured to avoid confusion as to the contents of the container;
- in good condition and not leaking;
- appropriate to the waste it contains;
- appropriately sealed (eg with a lid or bung); and
- not emitting any harmful gases or generating heat.

### E7.3 WASTE TRANSFER NOTE (MANIFEST) SYSTEM

In order to confirm the proper transport and transfer of each load of waste from the point of leaving the site until final disposal at an authorised facility, a

'waste transfer note' (WTN) system will be adopted. For each load of waste that leaves the site, a paper consignment / transfer note (form) will be completed that details exactly what the waste comprises in terms of type and quantity of waste. To ensure consistency, the general format required for Consignment Notes that need to accompany hazardous waste as specified in Decree 13/2006 will be adopted for all WTNs – see *Appendix A*.

A copy of the WTN will be retained at the Project site and the WTN will accompany the consignment of waste as it is transported. At each point that it is handed from one authorised handler to another, the person receiving the waste must sign the form to acknowledge safe receipt and the person handing over the waste will retain a copy. At the point of final treatment/disposal the form will be signed by an authorised person at the licensed facility and a copy of the form returned to the Project site as evidence of the safe receipt of the consignment at the intended final location. In accordance with Decree 13/2006, in the case of hazardous wastes, following receipt at the final treatment/disposal site, a copy of the WTN will be sent to the Ministry for the Coordination of Environmental Affairs and to its Provincial Directorate in Pemba.

#### **E7.4**            **VEHICLES AND CONTRACTORS**

Only waste contractors that can demonstrate they have the necessary authorisation from the Ministry for the Coordination of Environmental Affairs (MICOA) for transporting the particular type of waste will be considered for the transport of the Project's waste. The capability and track record of waste collectors will be assessed and may be confirmed with the regulatory agencies prior to the appointment of any contractors.

When a contractor collects waste from any of the Project sites, the collection vehicle will be checked to ensure that it is appropriately designed for the type of waste and containers to be transported (ie it is 'fit for purpose'), that it is carrying any necessary emergency equipment (eg spill containment kits) and that it is roadworthy and legally compliant (eg tyres in good condition and lights functioning). If not, waste will not be loaded onto the vehicle.

All waste will be suitably covered during transport to avoid windblown litter.

Contractors will be required to ensure that only qualified and trained drivers operate collection vehicles and to ensure that drivers have suitable documentation as evidence of their training. The driver's documentation will be checked when he collects the waste from the Project site and if there is any doubt about his qualifications or training, the driver will not be allowed to take the waste.

Those wastes which cannot be avoided, reused or recycled will be treated and/or disposed of in the most environmentally sound manner to minimise any potential human health and environmental impacts. Exact waste treatment and disposal methods will be determined as the Project design progresses and following an evaluation of different waste management options. The specific arrangements for the transport and disposal of the different waste types will be detailed in the finalised Waste Management Plan (WMP) at the end of the FEED.

## *E8.1 OFFSHORE WASTES*

### *E8.1.1 Drill Muds and Cuttings*

Drilling muds will be separated from the cuttings using shale shakers and returned to the drilling fluid system. The cuttings will then be discharged to the sea unless site-specific drilling and cuttings dispersion modelling indicates unacceptable environmental impacts or the discharge limits, outlined below, cannot be met in which case the cuttings would be sent to shore for treatment and disposal or for management by an appropriately licensed Third Party waste management contractor.

The optimum alternative solution for the final disposal of cuttings will be further investigated and GIIP will be applied.

As a minimum, the Project will comply with the following for discharges greater than 12nm (approximately 22km) from shore:

- Maximum concentration of metals in barite:
  - Mercury 1mg/kg (dry weight)
  - Cadmium 3mg/kg (dry weight)
- Maximum oil concentration by weight of dry cuttings in accordance with GIIP.
- Maximum discharge rate of 1,000 bbls/hour.

Following the deterioration of recirculated muds, the waste muds are either returned to supplier for reconditioning and reuse or transferred to Third Party waste contractor.

### *E8.1.2 Sewage*

Sewage from boats and vessels will be treated prior to discharge. Sewage discharges will be in compliance with all the applicable standards, regulations (national and international) and/or approval or authorization. Specifically, sewage will be treated/disinfected using an

approved process and discharged at a sufficiently low rate so as to cause no nuisance (floating solids, discoloration etc) or will be discharged at a distance greater than 12nm from land.

### **E8.1.3 Other Wastes**

Other wastes generated at offshore from vessels will be disposed of in accordance with Annex V of MARPOL 73/78 <sup>(1)</sup> or, as appropriate, incinerated in on-ship incinerator using an incinerator that meets the MARPOL Standard Specification for Shipboard Incinerators (3). Specifically, only food waste that has been ground to a particle size of less than 25mm will be discharged to sea and only if the vessel or rig or is more than 12nm from shore. All other waste that cannot be properly discharged or incinerated will be stored and shipped to the Muxara facility, the Project Site or another authorized waste facility for recycle/reuse, treatment and/or disposal <sup>(2)</sup>.

All on-board drilling wastes will be properly segregated and stored in appropriate, labelled, containers until they can be transported to shore. Different types of waste will be segregated and stored separately as discussed in *Section E6* to ensure that any recyclables are kept separate from other wastes and other wastes are segregated according to how they will be subsequently managed. Drilling wastes brought to shore that cannot be recycled will be transported to either Pemba/Muxara, the LNG Project Facility or other authorized waste facilities (dependent upon where the supply vessels are based) for treatment and/or disposal. In addition, some of the drilling wastes may be treated or disposed of by an appropriately licensed Third Party waste management contractor. Waste and waste management impacts related the management of exploration drilling wastes at to the Pemba/Muxara facility have been addressed in the existing licensed Onshore EIAs and are covered by this site's EMP and WMP. The management of the additional development drilling wastes from the LNG Project at authorized wastes facilities (e.g. the Muxara Facility) is not expected to result in a significant net increase in the volume or type of wastes or impacts from the waste management currently being handled by such facility since by the time development drilling occurs it is expected that offshore exploration drilling will be completed or reduced.

## **E8.2 ONSHORE WASTES**

### **E8.2.1 Sewage Treatment**

Sewage and grey water from the accommodation camps and other Project sites will be collected and treated (see *Section E8.3.3*) before discharge to avoid impact to the surrounding areas. All discharges will be in compliance with all applicable standards, regulations (national and international) and/or approval or authorization. The condition of the sewage treatment system and

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(1) International Maritime Organisation, MARPOL 73/78 Annex V - Prevention of Pollution by Garbage from Ships [www.imo.org]

(2) Marine Environment Protection Committee, Resolution MEPC 76(40)

tanks will be checked regularly and any accumulated sludge will be pumped out and dried. Dried sludge will be incinerated with other wastes using the on-site incinerator(s).

#### **E8.2.2**      *Stormwater Management*

Run off from the LNG processing areas will be directed to one or more internal collection systems. This potentially contaminated stormwater will be drained to the stormwater retention basin and inspected. If deemed acceptable, the water will be discharged directly into Palma Bay. If deemed unacceptable for discharge, the stormwater will be treated onsite prior to discharge into Palma Bay.

A regular cleaning and maintenance programme for all site drainage systems, sumps and/or oil interceptors will be implemented.

#### **E8.2.3**      *Brine, Process Wastewater and Produced Water*

Wastewater from the LNG process together with produced water from the MEG unit will be treated to meet all applicable standards, regulations (national and international) and/or approval or authorization and discharged into the bay together with brine from the desalinisation plant. This discharge will be subject to monitoring.

The optimum alternative solution for the management of effluent discharges will be further investigated during FEED.

#### **E8.2.4**      *Co-discharge*

Treated sewage effluent, process wastewater, produced water, desalination plant brine and stormwater runoff from the LNG process area will be co-mingled and discharged into the bay through a single discharge point (outfall). The quality of the effluent discharge will be in compliance with all standards, regulations (national and international) and/or approval or authorization.

#### **E8.2.5**      *Other Wastes*

Wastes that cannot be avoided, recycled/reused and which are not suitable for incineration or disposal at the Project landfill (see *Section E8.3*) will be temporarily and properly stored while an appropriate management route is identified.

Options for recycling materials, such as used engine oils and solvents will be investigated and, if necessary, these materials will be transported to an appropriate facility within Mozambique or, if necessary, properly exported to other countries that have authorized and suitable recycling facilities. Wastes which cannot be recycled will be stored until sufficient quantity has been accumulated to make export for treatment economic and environmentally

feasible. Any export of waste will be undertaken in full compliance with national and international legislation (eg Basel and Bamako Conventions).

The feasibility of composting food waste and any other biodegradable (organic) materials such as vegetation from site clearance and maintenance works will be investigated and facilities will be developed on the Afungi Project Site or a nearby location as appropriate.

### **E8.3 PROJECT WASTE MANAGEMENT FACILITIES**

#### **E8.3.1 Incinerators**

During the construction phase containerised multi-purpose incinerators (see specifications in Chapter 4 of the EIA report) may be used for the treatment of non-hazardous combustible wastes as well as certain hazardous wastes. During the operational phase, the incineration capacity will be adjusted to cope with the ongoing rate of waste generation.

The incinerators will be procured from specialist manufacturers and will be designed to meet all applicable GIIP. In particular, they are likely to have a two stage combustion system to ensure efficient destruction of the waste and minimal emissions to air.

All necessary approvals and operating permits will be obtained from the MICOA for these facilities. The incinerators will be selected to be capable of processing mixed residual domestic type wastes and small quantities of hazardous waste including oil impacted rags, oil filters, sludges, spill kits, paint cans and medical wastes. Incinerators will be specifically chosen to provide as much flexibility as possible in terms of the range of wastes that can be burned. They will be used for treating any combustible wastes that cannot be reused, recovered or recycled and which are compatible with the particular equipment and covered by the licence.

The incinerators will be operated in accordance with the manufacturer's procedures and will be maintained in accordance with the manufacturer's recommended maintenance schedules. All staff involved in operating the incinerators will be suitably qualified and appropriately trained. The incinerators will be specified to meet current international best practice and any Ministry permitting and emissions performance standards.

The potential impacts from the operation of multiple incinerators were evaluated based on the estimated volumes of waste to be incinerated. The number and size of incinerators that are used by the Project may be varied to provide flexibility to cope with variable amounts of waste that need to be managed at different times but care will be taken not to exceed the assumed emissions.

While the Project anticipates that the bottom ash from the Project incinerator(s) will be non-hazardous, the bottom ash from the incinerators will

be analysed to determine whether it falls within the Mozambican definition of non-hazardous waste. If it is non-hazardous, it will be deposited at the Project landfill. If it is classified as hazardous it will be disposed of at a properly authorized Third party hazardous waste disposal facility.

### **E8.3.2**      *Project Landfill*

Due to lack of adequate landfill / disposal facilities in the vicinity of the Project, it is likely that the Project will require the construction of at least one landfill designed to receive certain Project wastes. For the purpose of assessing potential impacts, it has been assumed that at least one non-hazardous landfill will be constructed on the Project Site. The precise design and specifications of the landfill will be determined during FEED and submitted to MICOA for approval, as appropriate. The Project will attempt to minimize any potential environmental nuisance associated with the landfill. It will be designed and operated with appropriate environmental controls, including measures for pollution prevention of the underlying soil and groundwater and management of stormwater run-off.

The Project will apply to the MICOA for an appropriate authorization. The design, construction and operation criteria will take into consideration the requirements contained in Appendix 1 of Decree13/2006, to the extent they apply, and the conditions that may be applied by MICOA. The design, construction and operation of the landfill will be in accordance with GIIP.

### **E8.3.3**      *Wastewater and Sewage Treatment Facilities*

Arrangements for the treatment of all the wastewater streams will be developed as part of the FEED. In the case of sewage treatment facilities, for example, proprietary and packaged systems are readily available if required. In each case the facilities will be designed to comply with Mozambican discharge standards and also international standards for such facilities.

### **E8.3.4**      *Other Waste Management Facilities*

As noted above, Third Party contractors will be used for managing a range of wastes generated by the Project. During the FEED, a detailed review will be undertaken of the options for managing all of the anticipated waste streams and, if necessary, additional waste treatment or disposal facilities will be included in the overall Project design.

**E9.1 WASTE TRACKING**

As explained in *Section E7.3*, a waste tracking system will be implemented whereby a consignment or transfer note accompanies each load of waste that is transferred off site for disposal. This system, which will include a written or electronic acknowledgement from the final disposal point that the waste has been safely received and handled, will provide assurance that all wastes are being properly managed and disposed. In the event that a final disposal acknowledgement is not received for a particular load of waste, Anadarko will undertake an investigation to determine what has happened to the consignment of waste and will:

- track down the particular load and ensure it has been properly disposed or, if necessary, arrange for its proper disposal (if feasible); and
- identify the reasons why the tracking system/designated management arrangements failed and put in place measures to help ensure that a similar problem does not occur again.

A similar tracking system will be employed for transfer of waste from one Project site to another for disposal of wastes at the Project's own incinerators and landfill site with final disposal being formally recorded.

**E9.2 WASTE REGISTER**

The data on the quantities of the different types of waste that are generated at the Project sites and the treatment/disposal method that is used, as recorded on the waste transfer notes, will be collated and kept in a register or database. These records will be kept for a minimum of five years in accordance with the requirements of Decree 13/2006.

A designated member of staff will maintain the waste register (waste log) and copies of all consignment notes (WTNs) that have been produced from the site. The waste register will be maintained as an electronic database to facilitate analysis and it will also serve as an index for all WTN consignments. Hard copies of WTNs will be kept as back up evidence of the disposal of individual waste loads.

The Waste Register will include the following information:

- information on each waste stream;
- source of wastes (eg LNG plant, accommodation blocks, offices);
- detailed waste description;
- classification of waste (hazardous/non-hazardous);
- quantity (by mass or volume);

- disposal/treatment site;
- disposal/treatment method;
- unique WTN reference number;
- dates of transfer; and
- dates of receipt at disposal/treatment site.

### **E9.3**

#### **WASTE MANAGEMENT CONTRACTORS**

Any waste management contractor employed by the Project will be required to keep records of the Project waste consignments that they have transported, treated or disposed for at least five years.

Audits will be conducted of all the waste contractors and waste disposal facilities:

- prior to using them for the first time – to ensure that they meet the Project’s standards and expectations in terms of their environmental controls and health and safety standards; and
- at regular intervals thereafter – the frequency depending on the nature of wastes being handled and the results of previous audits.

**Appendix A – Copy of Consignment Note for Transportation and Deposition of Hazardous Waste as Specified in Appendix VII of Decree 13/2006**

|                               |                               |
|-------------------------------|-------------------------------|
| Producer of Waste<br><b>A</b> | Company's Registration Number |
|-------------------------------|-------------------------------|

Name of ..... of ..... the ..... Institution

Address:.....

Tel. No.....Fax..... Telex No:.....

Name of waste.....Code of waste 

|   |  |   |  |
|---|--|---|--|
| H |  | Y |  |
|---|--|---|--|

Waste's main components.....

**Type of waste**  
 Solid       Sludge       Liquid

**Type of containers.**  
 Pallet container       Drums       Dustbin (25 l)       Others (specify).....

Quantity (Kg).....

Name and address of final destination .....

Date of delivery...../...../..... Signature of the person in charge,

|                         |                               |
|-------------------------|-------------------------------|
| Transporter<br><b>B</b> | Company's Registration Number |
|-------------------------|-------------------------------|

Name.....

Address.....Tel.....Fax.....

Driver's Name.....Vehicle Number plate.....

Provisional storage  No  Yes, address.....

Date of Receipt ...../...../.....I hereby confirm the signature of the driver.....

|   |                               |
|---|-------------------------------|
| Storage/treatment/reclamation/<br>deposition/operator of the facility<br><b>C</b> | Company's Registration Number |
|---|-------------------------------|

Company's name.....

Address.....Tel.....Fax.....

Type of operation  
 Storage       Assembling       Recovery       Landfill       Safe landfill

Physical/Chemical treatment       Incineration       Others (specify).....

Received quantity.....

Receipt date...../...../..... Signature,