1.0 INTRODUCTION

With the discovery of viable Oil and Gas reserves in the Albertine Graben, there is need to streamline and guide on the management of waste associated with the various operations necessary for the exploitation of these resources. This waste is generated by the exploration and production activities as well as from the associated activities like base camps. The Albertine Graben is coincidentally very rich in biodiversity and is also home to very sensitive ecosystems wherefore the proper management of waste from the petroleum activities is of vital importance.

Unlike the drilling and production waste, the management of all other wastes generated form the various activities in the oil and gas sector are disposed of in accordance with the relevant provisions of the National Environment (Waste Management) Regulations. As a precautionary interim measure, the drilling waste has been securely consolidated at designated locations in the Graben while characterization assessments were being undertaken to determine the best and most acceptable disposal methodology that could be adopted.

As the industry progresses from the exploration into the production phase, waste generation shall exponentially increase hence the urgent need for safe and cost effective waste management options.

Following on the various scientific analyses done on the waste in addition to other environmental management studies and tools such as the Sensitivity Atlas, the environmental monitoring indicators and in consultation with regulatory agencies on the Environmental pillar for the management of Oil and Gas activities, these guidelines have thus been developed.

2.0 GUIDING PRINCIPLES

Section 53(2) of the National Environment Act cap 153, mandates the Authority to issue guidelines for proper management of wastes. However, according to Section 52 of the National Environment Act Cap 153, and the National Environment (Waste Management) Regulations, S.I 153-2, the primary responsibility for management of waste lies with the person or company that has generated the waste. Companies generating waste from the various Oil and Gas activities are thus liable for any harm or damage to the environment that might result from this waste.

All reasonable measures and technologies will have to be instituted by operators to as much as possible in favour of the internationally recognized best practice as summarized in the waste management hierarchy illustrated below:
In deciding on the most appropriate disposal route, both environmental and economic costs and benefits need to be considered. This decision should be reached taking into account all the costs and impacts associated with waste disposal, including those associated with the movement of waste.

Wherever possible the Proximity Principle should be applied. This recognizes that transporting waste has environmental, social and economic costs so as a general rule; waste should be dealt with as near to the place of production as possible. This has the added benefit of raising awareness about waste and encouraging ownership of the problem at the local level.

3.0 WASTE CHARACTERIZATION

3.1 Nature of the Waste
The industries can and indeed generate a lot of waste that is unique to the process or stage that is being undertaken. This waste can be solid, liquid, and
even gaseous – all which have characteristics that need specialized attention for proper disposal and release into the environment.

In addition to components used in additives to aid various processes, some naturally occurring materials are also present in the waste in both the solid and liquid phases - generally referred to as Exploration & Production (E&P) Waste whose management challenge is in relation to the safe handling and disposal.

### 3.2 Chemical Characterization

While the waste was being consolidated, government committed efforts and resources to the characterization of waste so as to have a proper scientific basis upon which guidance could be offered to the operators. Representative samples of drilling waste from various wells were analyzed by different laboratories in Uganda, Norway, UK, and USA so as to have a thorough understanding of the constituents that could be of greatest threat to human and environmental health.

The waste has been found to contain substances capable of polluting the environment, mainly traces of heavy metals in addition to residual hydrocarbons. The table below illustrates the spread of the composition of selected trace heavy metals as analyzed by the different laboratories of waste samples from the entire Albertine Graben. In the absence of specific Ugandan Standards for solid (soil) waste disposal, comparison has been made to those available in Canada and the UK.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Composition (mg/kg)</th>
<th>Standards (mg/kg) from other countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Average</td>
</tr>
<tr>
<td>Arsenic</td>
<td>2.11 - 6.92</td>
<td>4.331</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.054 - 2.4</td>
<td>1.392</td>
</tr>
<tr>
<td>Chromium</td>
<td>21.1 - 98.8</td>
<td>54.46</td>
</tr>
<tr>
<td>Copper</td>
<td>24.3 - 86.4</td>
<td>44.152</td>
</tr>
<tr>
<td>Lead</td>
<td>21.3 - 1080</td>
<td>198.57</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.149 - 1.15</td>
<td>0.388</td>
</tr>
<tr>
<td>Zinc</td>
<td>24.6 - 300</td>
<td>142.54</td>
</tr>
<tr>
<td>Nickel</td>
<td>11.4 - 64</td>
<td>37.26</td>
</tr>
</tbody>
</table>
The above analytical results show that the parameter values were well within acceptable limits when compared to the standards appended above.

4.0 INTERNATIONAL PRACTICES FOR OIL AND GAS WASTE MANAGEMENT

This section focuses on the treatment and disposal methodologies and strategies of exploration and production wastes that are practised world over together with their pros and cons. These wastes handling practices together with analytical scientific data on waste characteristics have also guided the guidelines development process.

4.1 Land spreading and farming: This involves diluting cuttings with soil and then spreading onto the land. The spreading/applying waste on land allows the waste or soil’s naturally occurring microbial population to metabolize, transform, and/or assimilate organic waste constituents. Land spreading/farming is a simple methodology and requires less initial investment costs. It may also improve the soil characteristics of the area by adding some nutrients. However, this method cannot apply to wastes containing significant levels of heavy metals and persistent organic compounds; requires large land area for it to be effective; needs high technical and financial capability to undertake continuous monitoring and chemical tests; and acceptability by all Stakeholders is not guaranteed.

4.2 Re-injection of wastes: The wastes are pumped down the disposal wells into suitable underground formations. These wells are designed to provide an avenue for transporting wastes into underground reservoirs without adversely impacting on the environment. The disposal formations should be geologically and mechanically isolated from the sources of usable water. A technically sound completed disposal well has minimal chances of cross-contamination. However, it is costly, technically demanding, requires adequate subsurface geological and hydro geological studies.

4.3 Stabilisation and solidification: Stabilization is a method that reduces the hazard potential of a waste by converting contaminants into their least soluble, mobile, or toxic form. Solidification is a technique that makes the pollutants to be encapsulated in a solid of high structural integrity. In both cases, pollutants’ potential toxicity and mobility are reduced by decreasing the surface area exposed to leaching and/or by isolating the wastes within an impervious capsule. The resultant matrix is either land filled or turned into useful materials like construction materials or used as a base in road surfacing. This methodology has some concerns that include: long-term impacts (potential for ground water contamination); Land disturbance and comprehensive monitoring requirements.
4.4 **Bio treatment**: This method is used in degrading the organic compounds in the E&P wastes using biological natural processes. In-situ and/or ex-situ bio-remediation technologies are used in treating E&P wastes. This methodology is very efficient and cost effective in remediation of organic compounds in soil, and water. However, it has to be in combination with other methods to get rid of other pollutants like heavy metals.

4.5 **Onsite burial**: Burial is the placement of waste in man-made or natural excavations, such as pits. Burial is the most common onshore disposal technique used for disposing of drilling wastes (mud and cuttings). Generally, the solids are buried in the same pit (the reserve pit) used for collection and temporary storage of the waste mud and cuttings after the liquid is allowed to evaporate. Pit burial is a low-cost, low-tech method that does not require wastes to be transported away from the well site. For this method to be effective wastes must first be stabilised or else pollutants could migrate from the pit and contaminate usable water resources.

4.6 **Thermal treatment**: Thermal technologies use high temperatures to reclaim or destroy hydrocarbon-contaminated material. Thermal treatment is the most efficient treatment for destroying organics, and it also reduces the volume and mobility of in organics such as metals and salts. Additional treatment may be necessary for metals and salts, depending on the final fate of the wastes. Waste streams high in hydrocarbons (typically 10% and above), like oil-based mud, are good candidates for thermal treatment technology. Thermal treatment can be an interim process to reduce toxicity and volume and prepare a waste stream for further treatment or disposal (e.g., landfill, land farming, land spreading).

4.7 **Hybrid of methodologies**: A combination of methodologies may be used to remediate the wastes.

5.0 **APPROVED GUIDELINES FOR OIL AND GAS E&P WASTE MANAGEMENT**

These guidelines are made in reference to National Environment Act, Cap 153 which empowers the Executive Director NEMA to develop guidelines for proper environmental management. Further these guidelines are in line with National Environment (Waste Management) Regulations, 1999.

These guidelines will be used by the oil companies until as advised by the Authority and they will apply to the current consolidated and future drilling wastes as well as exploration associated wastes.
Unless advised by the Authority, the drilling wastes should be handled in the following manner:

(i) **Current consolidated wastes:**
   
   (a) The wastes should be stabilised and buried in lined pits at the sites of the current storage. The wastes should be covered by a liner and the pits leveled to fit the topography of the area by backfilling with a top soil. The buffer depth between the covering liner and the topography level should be between 1 to 1.5 meters.

   (b) The liquid wastes should be used in the solid waste stabilization process.

   (c) The burial site should be at least 500m away from a usable underground or ground water source.

   (d) After leveling, the site should be restored to almost its original position by planting **indigenous** plants species.

   (e) The burial sites shall be geo-referenced.

   (f) Underground water monitoring well on each site should be installed and the respective companies shall carry out quarterly monitoring of the water from the wells and report to the Authority.

(ii) **Future Wastes (Exploration and production wastes):**

   (a) In order to reduce the quantities of waste produced and their corresponding toxicity, all the chemicals used shall be screened and their use monitored closely. Therefore, the companies are required to submit an undertaking on the types, quantities and purity of chemicals to be used before drilling can be done.

   (b) All companies shall reduce the level of pollution from the source through substitution of more toxic chemicals with less toxic ones where applicable, and; optimum utilization of all inputs during the operations.

   (c) The exploration companies are required to recycle and re-use the oil drilling mud waste.

   (d) The companies are also required to characterize the drilling wastes immediately after drilling and submit an analysis report to NEMA within a week after completion of the drilling activity for authorization either for onsite burial or for transportation to waste treatment and disposal plant.
(e) If the wastes have pollutants that are within the acceptable standards, the waste shall be buried on site in lined pits otherwise, the waste shall be transported to the central waste treatment plant. In the absence of national standards, United Kingdom standards for solid disposal have been adopted for use until the Ugandan national standards have been developed.

(f) For production waste, especially produced water shall be re-injected back into the underground formations. The Oil companies will ensure that the re-injected waste does not contaminate usable aquifers and surface water.

(iii) Associated wastes
The other wastes associated with exploration and production activities shall be managed in accordance with the requirements of the National Environment Act, Cap 153 and National Waste Management Regulations, 1999.

DATED : 26th June, 2012

SIGNED : _________________________________________

DR. TOM O. OKURUT  
EXECUTIVE DIRECTOR