

# **UPGRADED STUDY REPORT**

## **PROPOSED INSTALLATION OF $3 \times 30$ MWe MENENGAI MODULAR POWER PLANTS PROJECTS IN NAKURU COUNTY**

### **(ENVIRONMENTAL AND SOCIAL MANAGEMENT & MONITORING PLAN- ESMMP)**



**SEPTEMBER 2013**

### DECLARATION BY THE ENVIRONMENTAL CONSULTANT

I, **Dr. Gelas Muse** of University of Eldoret, School of Environmental Studies (SES) submit this Updated Environmental and Social Impact Assessment (ESIA) Study Report for the Proposed 3 × 30 MW Menengai Modular Power projects in Nakuru County. The ESIA Study Report has been carried out according to the Environmental Management and Coordination Act (1999) and Environmental (Impact Assessment and Audit) Regulations, 2003. To my knowledge, all information contained in this report is accurate and a truthful representation of all findings as relating to the proposed geothermal power generation and related infrastructural development

Signed at **Eldoret** on this 21<sup>st</sup> day of September, 2013

**Signature:** 

**Designation:** EIA/Audit Lead Expert Reg. No. 0654  
Email: gelasmuse@yahoo.com

### DECLARATION BY THE PROPONENT

I, **Mr Benjamin M. Kubo** on behalf of Geothermal Development Company submit this Updated Environmental and Social Impact Assessment (ESIA) Study Report of the Proposed 3 × 30 MWe Menengai Modular Power projects in Nakuru County. To my knowledge, all information contained in this report is accurate and a truthful representation of all findings as relating to the proposed geothermal power generation and related infrastructural development.

Signed at Nakuru this ----- day of September, 2013

**Signature:** -----

**Designation:** -----

## LIST OF TEAM OF CONSULTANTS

| NAME   | QUALIFICATIONS                                       | COMPANY/ AFFILIATION                                     |
|--|--|--|
| Dr. Gelas Simiyu<br>(Lead Expert, Reg. No. 0654);<br>Team Leader | PhD. in Environmental<br>Health                      | University of Eldoret<br>School of Environmental Studies |
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## **CHAPTER 10**

### **ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)**

#### **10.1 Introduction**

Environmental and Social Management Plan (ESMP) for development projects provides a logical framework within which identified negative environmental impacts can be mitigated and monitored. In addition the EMP assigns responsibilities of actions to various actors and provides a timeframe within which mitigation measures and monitoring can be done. EMP is a vital output of an ESIA as it provides a checklist for project monitoring and evaluation. The EMP outlined in Tables 10.1-10.3 considers mitigation measures for impacts during construction, Operation and decommissioning respectively. The EMP addresses the identified potential negative impacts and mitigation measures of the proposed project during Construction, Operation and decommissioning phases, based on identified environmental impacts and mitigation measures (See Chapters 7 & 8).

#### **10.2 Construction Phase ESMP**

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the construction phase of proposed Project are outlined in Table 10.1 below. In this phase, most of the environmental responsibilities are borne by the contractor. The proponent is however required to ensure that these responsibilities are covered in the terms of reference for the contractor. One of the proponent's main responsibilities will be to ensure adherence to environmental requirements by the contractor.

**Table 10.1: Construction Phase Environmental and Social Management Plan for the Proposed Project**

| <b>Expected Negative Impacts</b>  | <b>Recommended Mitigation Measures</b>  | <b>Responsible Party</b> | <b>Time Frame</b>              | <b>Cost (Kshs. 000)</b>             |
|---|---|--------------------------|--------------------------------|-------------------------------------|
| Minimize solid waste generation and ensure efficient solid waste management during construction |   |                          |                                |                                     |
| Increased solid waste generation  | Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling  | Proponent & Contractor   | Throughout construction period | 1,000                               |
|   | Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed rather than cutting them to size, or having large quantities of residual materials | Proponent & Contractor   | Continuous                     | 0                                   |
|   | Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed off.  | Proponent & Contractor   | One-off                        | 0                                   |
|   | Ensure that damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects                                    | Proponent & Contractor   | One-off                        | 8,000                               |
|   | Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents or homeowners.  | Proponent & Contractor   | One-off                        | 0                                   |
|   | Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time  | Proponent & Contractor   | Throughout construction period | To be based on type of use selected |
|   | Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements   | Proponent & Contractor   | One-off                        | 6,000                               |
|   | Purchase of perishable construction materials such as paints should be done incrementally to ensure reduced spoilage of unused materials  | Proponent& Contractor    | Throughout construction period | 0                                   |
|   | Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste   | Proponent& Contractor    | Throughout construction period | 0                                   |

| Expected Negative Impacts   | Recommended Mitigation Measures  | Responsible Party      | Time Frame                     | Cost (Kshs. 000) |
|---|--|------------------------|--------------------------------|------------------|
| Increased solid waste generation  | Use construction materials containing recycled content when possible and in accordance with accepted standards.  | Proponent & Contractor | Throughout construction period | 0                |
|   | Reuse packaging materials such as cartons, cement bags, empty metal and plastic containers to reduce waste at the site   | Proponent & Contractor | Throughout construction period | 0                |
|   | Dispose waste more responsibly by dumping at designated dumping sites or landfills only.   | Proponent & Contractor | Throughout construction period | 20,000           |
|   | Waste collection bins to be provided at designated points on site  | Proponent& Contractor  | Throughout construction period | 85,000           |
|   | Private waste disposal company to be contracted to transport and dispose the solid waste from site   | Proponent & Contractor | Throughout construction period |                  |
|   | Running an educational campaigns amongst employees, e.g. through use of posters, to encourage reuse or recycling of the solid waste  | Proponent & Contractor | Throughout construction period |                  |
| Reduce dust emissions   |  |                        |                                |                  |
| Dust emission during construction of site infrastructure and transportation of machinery such as modular power generation equipment and their accessories | Ensure strict enforcement of on-site speed limit regulations   | Proponent & Contractor | Throughout construction period | 20,000           |
|   | Avoid excavation works in extremely dry weathers   | Proponent & Contractor | Throughout construction period |                  |
|   | Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles   | Proponent& Contractor  | Throughout construction period |                  |
|   | Personal Protective equipment to be worn   | Proponent              | Throughout construction period |                  |
| Minimization of exhaust emissions   |  |                        |                                |                  |
| Exhaust emission  | Vehicle idling time shall be minimized   | Proponent & Contractor | Throughout construction period | 0                |
|   | Sensitise truck drivers to avoid unnecessary racing of vehicle engines at loading/offloading points and parking areas, and to switch off or keep vehicle engines at these points | Proponent & Contractor | Throughout construction period | 0                |

| Expected Negative Impacts                              | Recommended Mitigation Measures   | Responsible Party      | Time Frame                     | Cost (Kshs. 000) |
|--|---|------------------------|--------------------------------|------------------|
| <b>Minimization of noise and vibration</b>             |   |                        |                                |                  |
| Noise and vibration during construction and generation | Sensitise construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.   | Proponent & Contractor | Throughout construction period | 0                |
|  | Sensitize construction drivers to avoid running of vehicle engines or hooting especially when passing through sensitive areas such as churches, residential areas and hospitals       | Proponent & Contractor | Throughout construction period | 0                |
|  | Ensure that construction machinery are kept in good condition to reduce noise generation  | Proponent & Contractor | Throughout construction period | 3,000            |
|  | Ensure that all generators and heavy-duty equipment are insulated or placed in enclosures to minimize ambient noise levels  | Proponent & Contractor | Throughout construction period | 15,000           |
|  | Workers on-site will need to wear appropriate hearing protection as a necessary safety precaution   | Proponent & Contractor | Throughout construction period | 5,000            |
|  | The noisy construction works will entirely be planned to be during daytime when most of the neighbours will be at work  | Proponent & Contractor | Throughout construction period | 0                |
|  | Comply with the provisions of Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 regarding noise limits at the workplace | Proponent & Contractor | Throughout construction period | 0                |
| <b>Minimization of energy consumption</b>              |   |                        |                                |                  |
| Increased energy consumption                           | Ensure electrical equipment, appliances and lights are switched off when not being used   | Proponent & Contractor | Throughout construction period | 0                |
|  | Install energy saving fluorescent tubes at all lighting points instead of bulbs which consume higher electric energy  | Proponent & Contractor | Throughout construction period | 5,000            |
|  | Ensure planning of transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts   | Proponent & Contractor | Throughout construction period | 9,000            |
|  | Monitor energy use during construction and set targets for reduction of energy use.   | Proponent & Contractor | Throughout construction period | 940              |

| Expected Negative Impacts   | Recommended Mitigation Measures   | Responsible Party         | Time Frame                     | Cost (Kshs. 000) |
|---|---|---------------------------|--------------------------------|------------------|
| Minimize water consumption and ensure more efficient and safe water use |   |                           |                                |                  |
| High water demand   | Install water conserving taps that turn-off automatically when water is not being used  | Proponent & Contractor    | One-off                        | -                |
|   | Promote recycling and reuse of water as much as possible  | Proponent & Contractor    | Throughout construction period | 5,500            |
|   | Install a discharge meter at water outlets to determine and monitor total water usage   | Proponent & Contractor    | One-off                        | 300              |
|   | Promptly detect and repair of water pipe and tank leaks   | Proponent & Contractor    | Throughout construction period | 5,500            |
|   | Sensitise staff to conserve water by avoiding unnecessary water use   | Proponent & Contractor    | Throughout construction period | 2,500            |
|   | Provide for breathers along the pipeline to minimize pipe busts   | Proponent & Contractor    | Throughout construction period | 2,500            |
| Minimize release of liquid effluent                                     |   |                           |                                |                  |
| Generation of wastewater  | Provide means for handling sewage generated by construction workers   | Proponent & Contractor    | One-off                        | 5,000            |
|   | Monitor spent geothermal fluids quality regularly to ensure that the stipulated discharge rules and standards are not violated  | Proponent                 | Throughout construction period | 2,000            |
|   | re-inject all geothermal fluids underground   | Proponent                 | Throughout construction period | 4,000            |
| Minimize occupational health and safety risks                           |   |                           |                                |                  |
| Posting of abstract of Act, rules and notices                           | There shall be displayed at prominent places within the site the prescribed abstract of the OSHA and the relevant notices as stipulated in section 121 of the OSHA, 2007.   | Proponent & Contractor    | One-off                        | 2,500            |
| Incidents, accidents and dangerous occurrences.                         | Ensure that provisions for reporting incidents, accidents and dangerous occurrences during construction using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place. | Proponent & Contractor    | Throughout construction phase  | 4,000            |
|   | Enforcing adherence to safety procedures and preparing contingency plan for accident response in addition safety education and training shall be emphasized.  | The Contractor, Proponent | Throughout construction phase  | 24,400           |



| Expected Negative Impacts                   | Recommended Mitigation Measures   | Responsible Party      | Time Frame                    | Cost (Kshs. 000)   |
|---|---|------------------------|-------------------------------|--------------------|
| Insurance                                   | Ensure that the premises are insured as per statutory requirements (third party and workman's compensation)   | Proponent              | Annually                      | -                  |
| Safety, health and environment (SHE) policy | Develop, document and display prominently an appropriate SHE policy for construction works  | Proponent & Contractor | One-off                       | 2,500              |
| Health and safety committee                 | Provisions MUST be put in place for the formation of a Health and Safety Committee, in which the employer and the workers are represented   | Proponent & Contractor | One-off                       | 5,500              |
| Sanitary conveniences                       | Suitable, efficient, clean, and adequate sanitary conveniences should be provided for workers   | Proponent & Contractor | One-off                       | 5,000              |
| Medical examination                         | Arrangements MUST be in place for the medical examination of all employees before, during and after termination of employment   | Proponent & Contractor | Throughout construction phase | 500                |
| Machinery/equipment safety                  | Ensure that machinery, equipment, personal protective equipment, appliances and hand tools used in construction and power generation do comply with the prescribed safety and health standards and be appropriately installed, maintained and safeguarded | Proponent & Contractor | One-off                       | 5,000              |
|   | Ensure that equipment and work tasks are adapted to fit workers and their ability including protection against mental strain  | Proponent & Contractor | Throughout construction phase | 3,000              |
|   | All machines and other moving parts of equipment MUST be enclosed or guarded to protect all workers from injury   | Proponent              | One-off                       | 2,000              |
|   | Train and supervise workers regarding construction and power generation machinery and other procedures/operations   | Proponent              | Throughout construction phase | 5,000              |
|   | Equipment such as fire extinguishers MUST be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued   | Proponent              | Throughout construction phase | 500                |
|   | Reports of such examinations MUST be presented in prescribed forms, signed by the assessor and attached to the general register   | Proponent              | Throughout construction phase | 30 per examination |

| Expected Negative Impacts  | Recommended Mitigation Measures  | Responsible Party      | Time Frame                    | Cost (Kshs. 000) |
|--|--|------------------------|-------------------------------|------------------|
| Storage of materials   | Ensure that materials are stored or stacked in such manner as to ensure their stability and prevent any fall or collapse   | Proponent              | Throughout construction phase | 8,000            |
|  | Ensure that items are not stored/stacked against weak walls and partitions   | Proponent              | Throughout construction phase | –                |
| Emergency preparedness and evacuation procedures                         | Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency  | Proponent & Contractor | One-off                       | 500              |
|  | Such procedures MUST be tested at regular intervals  | Proponent & Contractor | Every 3 months                | 500              |
|  | Ensure that adequate provisions are in place to immediately stop any operations where there is an imminent and serious danger to health and safety and to evacuate workers | Proponent & Contractor | One-off                       | 18,000           |
|  | Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site                                  | Proponent & Contractor | One-off                       | 300              |
|  | Provide measures to deal with emergencies and accidents including adequate first aid arrangements  | Proponent & Contractor | Throughout construction phase | 2,500            |
| First Aid  | Well stocked first aid box which is easily available and accessible should be provided within the premises   | Proponent & Contractor | One-off                       | 5,800            |
|  | Provision MUST be made for persons to be trained in first aid, with a certificate issued by a recognized body.   | Proponent & Contractor | One-off                       | 10,000           |
| Ensure the general safety and security of the site and surrounding areas |  |                        |                               |                  |
| Increased Pressure on Infrastructure                                     | Coordinate with other planning goals and objectives for the region   | Proponent & Contractor | Throughout construction phase | 100,000          |
|  | Upgrade existing infrastructure and services, if and where feasible.   | Proponent & Contractor | Throughout construction phase |                  |

| Expected Negative Impacts                           | Recommended Mitigation Measures  | Responsible Party                                       | Time Frame                    | Cost (Kshs. 000) |
|---|--|---|-------------------------------|------------------|
| High socio-economic interest of the communities     | Have a clear employment policy for the locals and implement it fairly to all neighbouring communities  | Proponent & GOK   | Throughout construction phase |                  |
|   | Allow access of the community to their grazing grounds and have regular consultations on matters pertains the grazing grounds and geothermal exploration interface | Proponent & GOK   | Throughout construction phase | 0                |
| Insecurity  | Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the construction site.      | Proponent & Kenya Police                                | Throughout construction phase | 100,000          |
|   | Body-search the workers on entry, to avoid getting weapons on site, and leaving site to ensure nothing is stolen.  | Proponent   | Throughout construction phase |                  |
|   | Ensure only authorized personnel get to the site   | Proponent   | Throughout construction phase |                  |
| Environmental monitoring of the project             |  |   |                               |                  |
| Environmental concern during the construction phase | Due to the magnitude of the project the proponent will monitor construction phase and ensure that the conditions of approval are adhered to.                       | Proponent, Contractor , NEMA and Environment Consultant | Throughout construction phase | 20,000           |

### 10.3 Operation Phase

The operation phase will involve production of power using the modular generators units to be installed. Table 10.2 below proposes an environment management plan in cases where the wells pass suitability test and construction and installation phases are accomplished. Noteworthy, some of the related environmental concerns are similar to those related to earlier phases.

**Table 10.2: Operation Phase Environmental and Social Management Plan for the Proposed Project**

| Expected Negative Impacts  | Recommended Mitigation Measures  | Responsible Party | Time Frame              | Cost (KShs. 000)                                      |
|--|--|-------------------|-------------------------|---|
| Balance pressure of strata above geothermal aquifer  |  |                   |                         |   |
| Increased possibility of subsidence due to higher rate of steam extraction compared to rate of natural replenishment of fluids | Reinject into the geothermal system spent geothermal liquids;<br>Carry out regular geophysical monitoring to detect any changes related to subsidence in the project area and immediate environs | Proponent         | At least twice per year | 40,000/yr (assuming no hiring required for equipment) |
| Minimize solid waste generation and ensure efficient solid waste management during construction                                |  |                   |                         |   |
| Increased solid waste generation   | Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling           | Proponent         | Continuous              | 20,000  |
|  | Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents or homeowners.   | Proponent         | One-off                 | 0   |
|  | Dispose waste more responsibly by dumping at designated dumping sites or landfills only.   | Proponent         | Continuous              | 20,000  |
|  | Waste collection bins to be provided at designated points on site  | Proponent         | Continuous              | 85,000  |
|  | Private waste disposal company could be contracted to transport and dispose the solid waste from site  | Proponent         | Continuous              |   |
|  | Running an educational campaigns amongst employees, e.g. through use of posters, to encourage reuse or recycling of the solid waste  | Proponent         | Continuous              |   |
|  | Reduce dust emissions  |                   |                         |   |
| Dust emission during operation phase   | Ensure strict enforcement of on-site speed limit regulations   | Proponent         | Continuous              | 200,000/yr  |
|  | Avoid excavation works in extremely dry weathers   | Proponent         | Continuous              |   |
|  | Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles   | Proponent         | Continuous              |   |
|  | Plant unused areas of site-compound with lawn or ornamental vegetation   | Proponent         | Continuous maintenance  |   |
|  | Personal Protective equipment to be worn   | Proponent         | Continuous              |   |

| Expected Negative Impacts            | Recommended Mitigation Measures   | Responsible Party | Time Frame | Cost (Kshs. 000) |
|--------------------------------------|---|-------------------|------------|------------------|
| Minimization of exhaust emissions    |   |                   |            |                  |
| Exhaust emission                     | Vehicle idling time shall be minimized  | Proponent         | Continuous | 0                |
|                                      | Equipment shall be properly tuned and maintained  | Proponent         | Continuous | 100,000/yr       |
|                                      | Sensitise all resident and visiting drivers to avoid unnecessary racing of vehicle engines when in project site and its immediate environs.   | Proponent         | Continuous | 0                |
| Minimization of noise and vibration  |   |                   |            |                  |
| Noise and vibration during operation | Sensitise all vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.  | Proponent         | Continuous | 0                |
|                                      | Sensitize all drivers to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as churches, residential areas and hospitals  | Proponent         | Continuous | 0                |
|                                      | Ensure that construction machinery are kept in good condition to reduce noise generation  | Proponent         | Continuous | 23,000           |
|                                      | Ensure that all generators and heavy-duty equipment are insulated or placed in enclosures to minimize ambient noise levels  | Proponent         | Continuous | 15,000           |
|                                      | Workers on-site will need to wear appropriate hearing protection as a necessary safety precaution<br>Unpermitted persons and animals should be kept off the drilling and construction site by fencing off the site. Within the project area, keep noise level below the 85 decibels | Proponent         | Continuous | 50,000           |
|                                      | Comply with the provisions of Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 regarding noise limits at the workplace   | Proponent         | Continuous | 0                |

| Expected Negative Impacts  | Recommended Mitigation Measures  | Responsible Party      | Time Frame | Cost (Kshs. 000) |
|--|--|------------------------|------------|------------------|
| <b>Minimization of energy consumption</b>                                      |  |                        |            |                  |
| Increased energy consumption   | Ensure electrical equipment, appliances and lights are switched off when not being used  | Proponent              | Continuous | 0                |
|  | Install energy saving fluorescent tubes at all lighting points instead of bulbs which consume higher electric energy                                   | Proponent              | Continuous | 5,800            |
|  | Ensure planning of transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts                      | Proponent              | Continuous | 9,000            |
|  | Monitor energy use during operation and set targets for reduction of energy use.   | Proponent              | Continuous | 940              |
| <b>Minimize water consumption and ensure more efficient and safe water use</b> |  |                        |            |                  |
| High water demand  | Install water conserving taps that turn-off automatically when water is not being used   | Proponent              | One-off    | -                |
|  | Promote recycling and reuse of water as much as possible   | Proponent              | Continuous | 5,500            |
|  | Install a discharge meter at water outlets to determine and monitor total water usage  | Proponent              | One-off    | 300              |
|  | Promptly detect and repair of water pipe and tank leaks  | Proponent              | Continuous | 5,500            |
|  | Sensitise staff to conserve water by avoiding unnecessary water use  | Proponent              | Continuous | 2,500            |
|  | Provide for breathers along the pipeline to minimize pipe busts  | Proponent              | Continuous | 2,500            |
| <b>Minimize release of liquid effluent</b>                                     |  |                        |            |                  |
| Generation of wastewater   | Provide means for handling sewage generated by site workers  | Proponent              | One-off    | 25,000           |
|  | Re-inject spent geothermal fluids back into the geothermal system.   | Proponent              | Continuous | 10,000           |
|  | Potential for contamination of groundwater by re-injected fluids should be minimized by installation of leak-proof well casings in the injection wells | Proponent & Contractor | One-off    | 5,000            |
|  | Consider use of binary power generation technology that reuses rejected geothermal fluids  | Proponent              | Continuous | -                |
|  | Monitor geothermal effluent quality regularly to ensure that the stipulated discharge rules and standards are not violated                             | Proponent              | Continuous | 2,000            |

| Expected Negative Impacts                       | Recommended Mitigation Measures  | Responsible Party | Time Frame | Cost (Kshs. 000) |
|---|--|-------------------|------------|------------------|
| Minimize occupational health and safety risks   |  |                   |            |                  |
| Posting of abstract of Act, rules and notices   | There shall be displayed at prominent places within the site the prescribed abstract of the OSHA and the relevant notices as stipulated in section 121 of the OSHA, 2007.  | Proponent         | One-off    | 2,500            |
| Incidents, accidents and dangerous occurrences. | Ensure that provisions for reporting incidents, accidents and dangerous occurrences during operation phase using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place.                                   | Proponent         | Continuous | 24,000           |
|   | Enforcing adherence to safety procedures and preparing contingency plan for accident response in addition safety education and training shall be emphasized.   | Proponent         | Continuous | 24,400           |
| Insurance                                       | Ensure that the premises are insured as per statutory requirements (third party and workman's compensation)  | Proponent         | Annually   | -                |
| Safety, health and environment (SHE) policy     | Develop, document and display prominently an appropriate SHE policy for operation works  | Proponent         | One-off    | 2,500            |
| Health and safety committee                     | Provisions MUST be put in place for the formation of a Health and Safety Committee, in which the employer and the workers are represented  | Proponent         | One-off    | 5,500            |
| Sanitary conveniences                           | Suitable, efficient, clean, and adequate sanitary conveniences should be provided for workers  | Proponent         | One-off    | 5,000            |
| Medical examination                             | Arrangements MUST be in place for the medical examination of all employees before, during and after termination of employment  | Proponent         | Continuous | 500              |
| Machinery/equipment safety                      | Ensure that machinery, equipment, personal protective equipment, appliances and hand tools used in construction and power generation do comply with the prescribed safety and health standards and be appropriately installed maintained and safeguarded | Proponent         | One-off    | 5,000            |
|   | Ensure that equipment and work tasks are adapted to fit workers and their ability including protection against mental strain   | Proponent         | Continuous | 3,000            |

| Expected Negative Impacts                        | Recommended Mitigation Measures  | Responsible Party | Time Frame     | Cost (Kshs. 000) |
|--|--|-------------------|----------------|------------------|
| Machinery/equipment safety                       | All machines and other moving parts of equipment MUST be enclosed or guarded to protect all workers from injury  | Proponent         | One-off        | 2,000            |
|  | Train and supervise workers regarding construction and power generation machinery and other procedures/operations  | Proponent         | Continuous     | 5,000            |
|  | Equipment such as fire extinguishers MUST be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued    | Proponent         | Continuous     | 500              |
|  | Reports of such examinations MUST be presented in prescribed forms, signed by the assessor and attached to the general register  | Proponent         | Continuous     | 30               |
| Storage of materials                             | Ensure that materials are stored or stacked in such manner as to ensure their stability and prevent any fall or collapse   | Proponent         | Continuous     | 8,000            |
|  | Ensure that items are not stored/stacked against weak walls and partitions   | Proponent         | Continuous     | –                |
| Emergency preparedness and evacuation procedures | Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency  | Proponent         | One-off        | 500              |
|  | Such procedures MUST be tested at regular intervals  | Proponent         | Every 3 months | 500              |
|  | Ensure that adequate provisions are in place to immediately stop any operations where there is an imminent and serious danger to health and safety and to evacuate workers | Proponent         | One-off        | 18,000           |
|  | Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site                                  | Proponent         | One-off        | 300              |
|  | Provide measures to deal with emergencies and accidents including adequate first aid arrangements  | Proponent         | Continuous     | 2,500            |
| First Aid  | Well stocked first aid box which is easily available and accessible should be provided within the premises   | Proponent         | One-off        | 5,800            |
|  | Provision MUST be made for persons to be trained in first aid, with a certificate issued by a recognized body.   | Proponent         | One-off        | 10,000           |



| Expected Negative Impacts  | Recommended Mitigation Measures  | Responsible Party                      | Time Frame | Cost (Kshs. 000) |
|--|--|--|------------|------------------|
| Ensure the general safety and security of the site and surrounding areas |  |  |            |                  |
| Increased Pressure on Infrastructure                                     | Coordinate with other planning goals and objectives for the region   | Proponent                              | Continuous | 10,000           |
|  | Upgrade existing infrastructure and services, if and where feasible.   | Proponent                              | Continuous |                  |
| High socio-economic interest of the communities                          | Have a clear employment policy for the locals and implement it fairly to all neighbouring communities  | Proponent & GOK                        | Continuous |                  |
|  | Allow access of the community to their grazing grounds and have regular consultations on matters pertains the grazing grounds and geothermal exploration interface | Proponent, & community representatives | Continuous | 0                |
| Insecurity   | Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the construction site.      | Proponent                              | Continuous | 15,000           |
|  | Body-search the workers on entry, to avoid getting weapons on site, and leaving site to ensure nothing is stolen.  | Proponent                              | Continuous |                  |
|  | Ensure only authorized personnel get to the site   | Proponent                              | Continuous |                  |
| Environmental monitoring of the project                                  |  |  |            |                  |
| Environmental concern during the construction phase                      | Due to the magnitude of the project the proponent will monitor construction phase and ensure that the conditions of approval are adhered to.                       | Proponent, NEMA                        | Continuous | 20,000           |

#### **10.4 Decommissioning Phase**

In addition to the mitigation measures provided in Tables 10.1 and 10.2, it is necessary to outline some basic mitigation measures that will be required to be undertaken once all operational activities of the proposed project have ceased. The objectives, mitigation measures, allocation of responsibilities, time frames and costs pertaining to prevention, minimization and monitoring of all potential impacts associated with the decommissioning and closure phase of the proposed project are outlined in Table 10.3.

**Table 10.3: Environmental Management Plan for the Decommissioning Phase**

| Expected Negative Impacts   | Recommended Mitigation Measures   | Responsible Party       | Time Frame | Cost (Kshs) |
|---|---|-------------------------|------------|-------------|
| 1. Demolition waste management                                    |   |                         |            |             |
| Demolition waste  | Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling.           | Proponent & Contractor  | Once-off   | 30,000      |
|   | All buildings, machinery, equipment, structures and partitions that will not be used for other purposes MUST be removed and recycled/reused as far as possible                                    | Proponent & Contractor  | Once-off   | 20,000      |
|   | All foundations MUST be removed and recycled, reused or disposed of at a licensed disposal site   | Proponent & Contractor  | Once-off   | 25,000      |
|   | Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site | Proponent & Contractor  | Once-off   | 0           |
|   | Donate reusable demolition waste to charitable organizations, individuals and institutions  | Proponent & Contractor  | Once-off   | 0           |
| Dismantling of modular power generation equipment and accessories | The wells external parts should removed up to the ground level and disposed off as any other scrap metals for recycling.  | Proponent               | Once-off   | 10,000      |
|   | The well pad should be loosened and levelled with top soils   | Proponent, & Contractor | Once-off   | 5,000       |
| 2. Rehabilitation of project site                                 |   |                         |            |             |
| Site degradation  | Implement an appropriate landscaping and re-vegetation programme to restore the site to its original status. Consider use of indigenous plant species in re-vegetation                            | Proponent, & Contractor | Once-off   | 12,000      |
|   | Trees should be planted at suitable locations so as to interrupt slight lines (screen planting), between the adjacent area and the development.   | Proponent & Contractor  | Once-off   | 0           |

## **CHAPTER 11**

### **ENVIRONMENTAL AND SOCIAL IMPACT ACTION PLAN**

The purpose of the environmental action plan is to identify adverse environmental impacts and plan action to be taken in the implementation period. The implementation period for the proposed geothermal development is subject to government approval of the suitability of the project vis-à-vis the environmental and social impact considerations. Otherwise, it would be immediate since already feasibility study has been conducted. The environment action plan presented outlines the specific steps that will need to be taken at different stages in the geothermal resources development activities and aims to minimize both short term and long-term impacts resulting from various alternative options. Environmental and social impact action plan for sustainable development of geothermal resource in proposed project area is presented in Table 11.1 below.

**Table 11.1: Summary of the Environmental and Social Impact Action Plan for 3 × 30 MW Menengai Modular Power Plants Projects**

| <b>Project Activity</b>                | <b>Potential Environmental Impacts</b>   | <b>Potential Social Impacts</b>                         | <b>Proposed Mitigation Measure(s) (Incl. Legislation and regulations)</b>   | <b>Institutional Responsibilities (Incl. Enforcement and , coordination)</b> | <b>Cost Estimates (Ksh ,000)</b>   | <b>Comments (e.g. secondary impacts)</b>                |
|--|--|---|---|--|--|---|
| Construction and implementation Phases | Noise & vibrations, Dust emissions, H <sub>2</sub> S and CO <sub>2</sub> gas emissions | Loss of grazing land, Health effects, HIV/Aids,         | Monitor air quality, acquire water abstraction permit from WRMA, Install mufflers to reduce noise from drilling and well testing, Education awareness, provision of Infrastructure and employment opportunities | the Proponent, NEMA and WRMA, KFS  | 300,000  | Moderate and highly manageable with mitigation measures |
| Operation Phase                        | Land subsidence; Noise, air, soil and water pollution; occupational health and safety  | Health effects, HIV/Aids; insecurity                    |   | Proponent, GOK agencies such as NEMA, WRMA and District development offices  | Variable hence should be estimated each year and factored in proponent's annual financial plan | Important as they are long-term impacts.                |
| Decommissioning                        | Demolition materials, dust, Noise, scrap metals  | Loss of aesthetics and scenic value, Lose of employment | Integrated waste management, landscaping and restoration of project site, donation of re-usable materials to the local community, monitoring residual impacts   | the Proponent, MoE, and NEMA   | 100,000  | Minor   |

## **CHAPTER 12**

### **CONCLUSION AND RECOMMENDATION**

#### **12.1 Conclusion**

In View of the information collected, the ESIA Team concludes that the proposed project is feasible as planned. However, like in any other project, the project is bound to have both social and environmental impacts, negative and positive. Based on the ESIA study findings, it is concluded that positive impacts outweigh negative ones notwithstanding the fact that most potential negative impacts identified can be mitigated. Outlines of these impacts and proposals of mitigation measures for the negative ones are covered in Chapters 7 and 8 of this report. It is further inferred that the developed EMPs will enable the proponent to manage or mitigate any negative environmental and social impacts.

#### **12.2 Recommendations**

Recommendations are made based on the assessment of cumulative and potential impacts of the proposed project and are summarized as:

##### **12.2.1 Environmental Issues**

- The proponent adheres to proposed EMP and action plan suggested in ESIA,
- The impacts be monitored closely by the Proponent in collaboration with NEMA and environment consultant.
- To rehabilitate unoccupied areas that are affected during implementation of the project
- H<sub>2</sub>S gas dispersion in the study area be monitored in areas of concentrations depicted by in the modelling outcomes for effective planning and manage of likely effects especially during temperature inversions

### **12.2.2 Socio-Economic Issues**

- Raise awareness of control of Human Immune Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) and health risks for construction workers and service providers
- Employment of unskilled labour be limited to local community and be distributed equitably to all locations within the project area
- Implementation of CSR plan should involve community participation.

### **12.2.3 Licensing**

- The consultant recommends licensing of the project to allow for speedy implementation of the project to contribute to electricity production in the country, towards attaining Vision 2030.
- Proponent should meet the conditions, which NEMA may set during issuance of license