ATTACHMENT 205

STUDY TOUR TO SIMBI ROSES’ 55kWp BIOGAS POWER PLANT

COGEN FOR AFRICA PROJECT

Compiled by

AFREPREN/FWD

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1.0. Introduction

1.1. Background of Simbi Roses Ltd

Simbi Rose farm is located in Thika, an hour drive from capital city Nairobi. This proximity to Nairobi, the climate and constant water provision via several man-made dams in the area make the region popular with the agricultural industry. Simbi Rose farm itself is situated right in the center of a large coffee farm.

Since its inception, Simbi Roses have established a modern and efficient crop management system and high quality control within its growing infrastructure. These include the propagation of plants, and the state of art irrigation and spraying systems. These systems, combined with the ideal climate and water availability, allows Simbi Roses to produce superior Quality Roses. Currently, the company is producing over 13 different varieties of roses for the international market which include Bellerosa, Red Ribbon, Good Times, Sonarisa, Vanilla Sky, Marie Claire, Mario, High & Magic, and Upper Class. The farm was founded in the year 1995 with an original size of 2 hectares and currently occupies at least 23 hectares producing over 40 million stems per year.

1.2. Profile of Bio Power Systems

BIO POWER SYSTEMS Limited is a Renewable Energy (RE) Technology enterprise committed to development and diffusion of renewable energy and waste management technologies in East African region and beyond.

BIO POWER has the primary objective of carrying out business of designing, installation and maintenance of solar electric systems, anaerobic digesters, wastewater management, fuel substitution and energy conservation. Energy baseline surveys and energy audits are carried out to form a basis for system design and advice to the client on energy situation. It also undertake a training programme for its clients on use and post installation maintenance of systems for a longer service. The company has pioneered in the development of anaerobic wastewater treatment systems where biogas is generated from wastewater and re-use of reclaimed wastewater. In this sector it has implemented unique integrated-closed-loop wastewater management systems.
The principal behind this company is a holder of B.Sc. in Mechanical Engineering, from the University of Nairobi. He is a Registered Engineer and a Member of Institution of Engineers of Kenya (IEK). He has been involved in the field of renewable energy technologies consistently with a lot of experience in system design, energy audits, pre-feasibility and feasibility studies, site evaluation, materials selection and procurement, installation, commissioning and post installation follow-up and documentation.

Some of the previous experiences of the company are as summarized in the table below;
<table>
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<tr>
<th>Project</th>
<th>Client</th>
<th>Services Provided</th>
<th>Period</th>
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<tr>
<td>Detailed Feasibility Study for Biogas capture and sales from sewerage works at Nyahururu</td>
<td>Northern Water Services Board</td>
<td>Inception, market study, design and cost estimation for the proposed biogas capture and sale for NYAHUWASCO</td>
<td>May 2016 to August 2016</td>
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<tr>
<td>Design of Solar Water Pumping system</td>
<td>Mr. Solomon Kogo –Ibissil Kajiado County</td>
<td>Design of 7Kw solar pumping for 130m borehole pumping 40M³/day for irrigation</td>
<td>July 2016</td>
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<tr>
<td>Design of Solar Water Pumping system</td>
<td>Mr. Johnbosco Mululu-Matuu-Machakos County</td>
<td>Design of 6Kw solar pumping for 150m borehole pumping 30M³/day for irrigation</td>
<td>July 2016</td>
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<td>Upscaling Biogas Use at Este Farms</td>
<td>Este Farms-Kamwangi-Kiambu County</td>
<td>Design of biogas upscaling, biogas production and use measurements, waste heat recovery, milk refrigeration general advisory on renewable energy options and fertilizer sales options</td>
<td>March 2016</td>
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<tr>
<td>Energy Audit</td>
<td>Sports View Hotel Kasarani</td>
<td>Analysis of data on energy usage, proposing saving and renewable energy options available for the hotel.</td>
<td>August 2015</td>
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<td>Consultancy Services: Technical pre-feasibility study for Coffee Waste to Energy technology in the Kenyan coffee sector.</td>
<td>UTZ Certified – Netherlands</td>
<td>Technical pre-feasibility study to determine the potential of biogas recovery from waste arising from coffee processing in Kenya.</td>
<td>Nov. 2013 to March 2014</td>
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<tr>
<td>Design of Solar Water Heating Systems</td>
<td>PJ Dave Flowers</td>
<td>10M³ solar water heating system to replace kerosene</td>
<td>August 2013</td>
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</table>
2.0. Profile of key personnel from Bio Power Systems

The study was carried out in accordance with internationally recognized standards. The team has vast experience in conducting comprehensive renewable energy feasibility studies coupled with the ability to design, supply, install and commission study recommendations in a diverse range of facilities and industries. The project team comprised of the following experts:

<table>
<thead>
<tr>
<th>Key Staff</th>
<th>Qualification</th>
<th>Proposed Position</th>
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<tr>
<td>2 Eng. Peter Okwany</td>
<td>BSc Electrical Engineering</td>
<td>Power Systems Analyst and Master Planner</td>
</tr>
<tr>
<td>4 Godfrey Maina</td>
<td>BSc. IT</td>
<td>IT Expert</td>
</tr>
</tbody>
</table>


Eng. Peter Gichohi has an uninterrupted renewable energy experience spanning thirty years. Over these years he has been involved in a wide range of renewable energy projects. As a consultant for the Ministry of Energy and Petroleum (2010-2013) he developed, designed and supervised the biogas project at PJ Dave Flowers. As the Ministry’s Biogas Consultant, he was the principle behind the 125KVA biogas-electric project at the farm. He was a team member of the Consortium that undertook the Update of the Rural Electrification Master Plan for the Ministry of Energy and Rural Electrification Authority (REA) which was concluded in April 2009. In the Master Plan, he was an Environmentalist, Renewable and Thermal Energy Expert. His responsibility was to make an assessment of the potential for generation of power from a wide range of biomass, hydro, solar and wind resources in the country. This background gives him a very clear understanding of the objective as described in the Terms of Reference. Having designed the biogas project at PJ Dave, this offers him a great strength since he understands how best this project can be expanded.
Eng. Gichohi is a Mechanical Engineer, Registered and validly licensed by Engineers Board of Kenya. He is also registered and licensed by NEMA as a lead EIA/EA expert. He will be the team leader providing guidance on the type of data and information to be obtained in the study in respect to the whole scope of renewable energy and other areas indicated in the TORs.

2.2. Eng. Peter Okwany - Power Systems Analyser

Eng. Okwany is a Electrical Engineer, Registered and validly licensed by Engineers Board of Kenya. He served at KPLC for about twenty years rising through the ranks from an Apprentice to Commercial Manager. He then served Securicor Kenya Limited as a General Manager responsible for Technical Services which included electrification through Photo Voltaic Solar Systems. Since, then he has been a Consultant in Energy Management and Electrification. In 2005-2007 he worked as consultant in the Ministry of Energy where his responsibility was to advice the Ministry on various levels of rural energy. In 2008-2009, he was the Local Team Leader for the Rural Electrification Master Plan Project in association with MVV Decon, a German consultancy firm. In this exercise, he coordinated the team consisting of ten local consultants who were experts in diverse fields. He will analyse power supply and demand patterns, load factors, power factors and propose financially viable renewable energy options. He will also be responsible for master planning the energy future scenarios at PJ Dave Flowers.


Eng. Gichungi has a twenty six year experience working in the power sector in the employment of Kenya Power. Over these years, he was in charge of thermal stations and was instrumental in the design and implementation of solar/diesel hybrid stations in Kenya. Between 2015 and 2016, Eng Gichungi Worked with SMA Sunbelt of Germany as a business development manager in charge of hybrid solutions in Kenya. This gives him a very good understanding of the task ahead where different forms of renewable energy will be applied at PJ Dave. He will specifically be responsible for the design, equipment selection and development of cost estimate for a solar PV system for PJ Dave.

Eng. Gichungi is a Mechanical Engineer, Registered and validly licensed by Engineers Board of Kenya.
3.0. Mission/ Study tour to Simbi Roses Ltd

The team from Bio Power Systems embarked on a study tour to Simbi Roses 55kWp successful biogas plant in Thika. The purpose of the visit was for Bio Power Systems to gain more insight on the operation of the biogas plant and the challenges encountered in order to be fully informed and understand how the unstable biogas plant at PJ Dave can be retrofitted are maintain a stable performance.

From the study tour, it was discovered that unlike PJ Dave’s biogas plant which has a single stage system where the rose wastes and cow dung are directly fed into the digester after being crushed, Simbi Roses’ biogas plant employs a two stage system where the wastes/feedstock is subjected to hydrolysis and it is the liquid which is fed into the digester. This in turn reduces the chances of excessive scum accumulation which eventually block the system and severing of the mixers. The figure below illustrate this principle;
The general layout of Simbi Roses’ biogas system is as follows:
Technical set-up of the biogas system

Hydrolysis tanks:
Hydrolysis is splitting off a compound with water. This process differentiates the Simbi Roses Biogas plant from the one at PJ Dave where there are no hydrolysis tanks. All the feed stock is mixed in the biodigester. In Simbi Roses it is a solution with green matter that goes to the digester for biogas generation.

Waste production parameters:
The farm has a capacity to produce 2 tonnes of biodegradable waste from the cut flowers every day.

Feeding parameters:
On average, out of the two tonnes of daily farm flower waste, 600 kg of shredded cut flower leaves are fed into the hydrolysis tank. The shredded flower waste is mixed with water to dissolve the green matter which is then fed into the main digester. Mixing within the hydrolysis tank is done with the help of a 4 kW motor. The insoluble part of the flower waste which remains in the hydrolysis tanks is taken out once every two months.

Operation parameters:
The operation parameters of the system have to be strictly monitored to achieve high degree of gas production. The system is operated manually i.e. start and stop of the genset, manual power isolation and selection through a manual contactor switch. There is always a physical presence of staff to ensure system output optimization. The system is heated in two ways:

First through an evacuated solar heating unit installed at the site to warm the content of the hydrolysis tank and second through waste heat recovery from the biogas engine generator to heat the content of the main biogas digester. There are various thermocouple meter installed for temperature monitoring.

The 55 kWp biogas generator runs 2-3 hours a day in average to supply power to the dam, fertigation and spraying pumps. This gives a total electric loading of about 36 kW when the load is connected to the genset. The generator is loaded only to a maximum of about 65 %. At full gas bank (80 m³) the generator operates at 65 % loading for up to 4 hours projecting a gas consumption of about 20 m³ per hour. At the time of the audit, the supplied energy by the generator set was 2,368.4 kWh with a recorded corresponding gas production capacity of 3,959
m³. Thus 1.67 m³ of gas produced from the biogas plant supplies 1 kWh of energy. Automatic shutdown is initiated whenever the gas chamber is empty.

**Pre-treatment parameters:**
Gas from the digester is channeled through a pipe into the pre-treatment facility that removes and isolates both water and CO₂ from the raw biogas. The biogas is then compressed to a required pressure for the gas engine.

**Control data logging parameters:**
Within this biogas system, there are both energy and gas meters installed for recording and monitoring purposes of the production data. Energy meters are recording the power that is drawn by the load installed within the biogas generation plant while the gas meter is recording the output gas amount that is fed into the generator whenever the system is operating.