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PROPOSED USE OF WELLHEAD ELECTRICAL POWER IN DRILLING GEOTHERMAL WELLS AT OLKARIA, KENYA

Bernard Kigen
Kenya Electricity Generating Company Limited
P.O. Box 785, NAIVASHA 20117
KENYA
bkigen@kengen.co.ke

ABSTRACT

The concept of wellhead generators is to realize early generation and supply of electricity for various purposes. At Olkaria, units of 5MW have been installed at well OW-37, 12.8MW at OW-43, 27.8MW at OW-914, 10MW at OW-915 and 2MW at Eburru. All are operational and there are plans to install more units of 10MW at OW-37, 5MW at OW-39, 5MW at OW-905 and another 5MW at OW-919.
The process of drilling geothermal wells uses diesel fuel as a means of generating the required power for the several equipment in the rig. Diesel is used by generators to produce the required electric power for both the DC and AC equipment on the rig. Diesel is also used by the air compressor machines used during aerated drilling process. The total diesel used at the KenGen new rigs during drilling is estimated at 70% by the electric generators and 30% by the aerated system. The generating sets supply power to the SCR module which powers the mud pumps, draw works and the rotary table DC motors. It also supplies AC power to the top drive system, the drilling fluid circulation system and the rig lighting system. The aerated system in each rig comprise of five (5) primary compressors and two (2) booster compressors which are purely diesel engine driven. The average diesel consumption per rig per 24-hour drilling operation is 4000 litres. Part of the electrical power from wellhead units can therefore be used at the rigs to substitute electrical power from the generators and hence save 70% of the total fuel consumed by the rigs. This is possible when drilling on the same pad as the wellhead units or when the rig is drilling on a pad near a wellhead generator. The remaining 30% of the fuel will continue to be used by the rig aerated system since the equipment are engine driven. This paper will analyse and demonstrate the benefits and savings that will be realized by using wellhead power to drill geothermal wells. These include reduced carbon emissions, noise levels, fuel spillages at the rigs and importantly improved profits for the Company.

1. INTRODUCTION

The process of drilling geothermal wells uses diesel fuel as a means of generating the required power for the several equipment in the rig. In electric rigs, diesel is used by generators to produce the required electric power for both DC and AC equipment on the rig. Diesel is also used by the air compressor machines during aerated drilling process. The total diesel used at the KenGen new rigs during drilling is estimated at 70% by the electric generators and 30% by the aerated system. The average diesel consumption per rig per 24-hour drilling operation is 4000 litres. Part of the electrical power from wellhead units can therefore be used at the rigs to substitute electrical power from the generators and hence save 70% of the total fuel consumed by the rigs.

2. OBJECTIVE

This work aims to explore the possibility of powering the rig with alternate source of energy other than diesel to achieve economical and environmentally friendly drilling process.

3. LITERATURE REVIEW

Rig power requirements vary a lot with time and ongoing operation. Diesel engines operating the rig pose the problems of low efficiency and large amount of emissions. A quantitative comparison of physical size and economics shows that rigs powered by the electrical grid can provide lower operating costs, emit fewer emissions, are quieter, and have a smaller surface footprint than conventional diesel powered drilling, (Verma, 2009).

4. METHODOLOGY

The use of Wellhead electric power in drilling of geothermal wells involves tapping power from the Wellhead Power Plant and transmitting the same to the rig, which is the point of use. At the Wellhead power plant, generation is done at 11kV, which will be tapped at the same level and transmitted to the rig where, using an appropriately sized and protected transformer, it will be stepped down to 600V AC and fed into the rig bus bar located in the SCR module. Normally, electric power from the rig four main diesel generators are all synchronized to this bus bar before distribution to various consumption points and systems.

Connecting the Wellhead electric power to the rig main bus bar therefore eliminates the need to run the diesel generators during the drilling process. This in turn reduces the use of diesel fuel by 70% at any time by the rigs. This connection is represented in the single line diagram below.

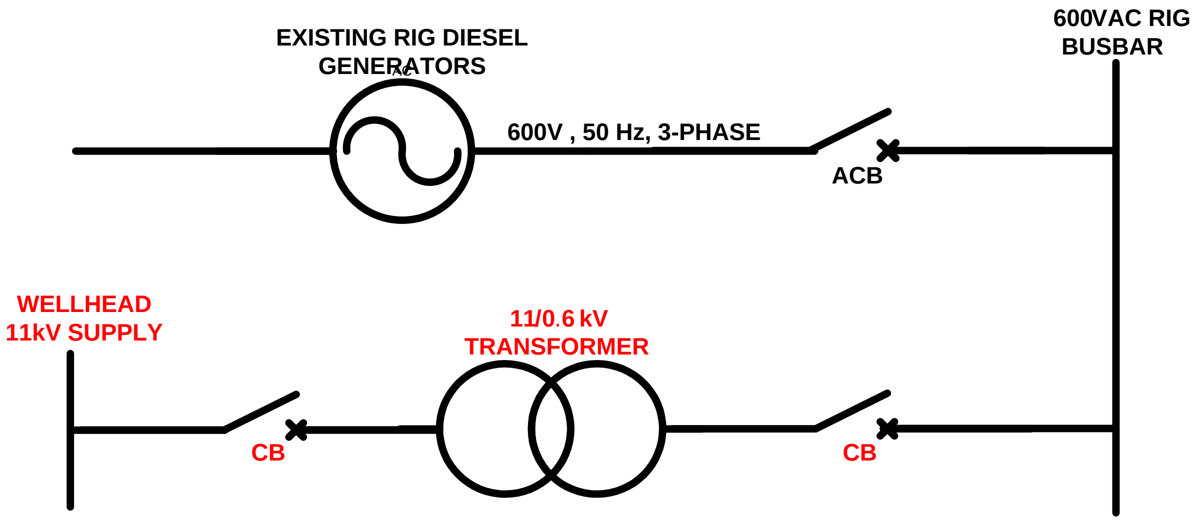

Figure 1. Single Line Diagram for Wellhead to rig power connection.

5. BENEFITS

The aim of this project is to save about 70% of diesel fuel consumed in the process of drilling any geothermal well in Olkaria. The average diesel consumption per rig per 24-hour drilling operation is 4000 litres. The average duration of drilling one geothermal well is about sixty (60) days. This translate to consumption of about 240,000 litres of diesel per well. Below is a tabulation of a case scenario during the drilling of wells OW-11A and OW-724 by the two new KenGen rigs KGN01 and KGN02 respectively.

	KGN-01 at well OW-11A	**KGN-02 at well OW-724A**
Total fuel Consumed in 2 months duration, (Ltr)	323,000	237,000
Fuel Cost per Litre, KES	104.00	104.00
Total Fuel Cost per Well, (KES)	33,592,000.00	24,648,000.00
Total Fuel Cost per Month, (KES)	16,796,000.00	12,324,000.00
Total Fuel Cost per Year, (KES)	167,960,000.00	123,240,000.00
Approximate cost of fuel per year to be used by Generators (70%), (KES)	117,572,000.00	86,268,000.00

Table 1: Fuel Consumption in wells OW-11A and OW-724A

From the table above, the approximate cost of fuel consumed by the generators is **KES 203,840,000.00** per year for the two electric land rigs. This is therefore the yearly savings that will be made by the Company by using power from the Wellhead generator to drill geothermal wells in Olkaria.

Each rig power requirement is 2MW, therefore two (2) power plants of each more than 2.5MW are required for the two KenGen rigs. Since the rig power requirements vary a lot with time and ongoing operations, the average consumption at all-time stands at 1MW. To be able to successfully connect each rig to the wellhead, a modular transformer together with associated switch gears and conductors will be required. The total cost for this infrastructure will be approximately **KES 27,000,000.00** per rig.

At a feed-in-tariff of **0.085 US cents/kWh** for wellhead power plants, the opportunity cost loss to the Company in one year, for powering each rig from the wellhead will be **KES 57,964,968.00.** This is with the assumption that the rig will be operational for 10 months cumulatively in a year, the other time being consumed by rig downs, rig moves and rig ups.

The loss in generation for powering the two rigs from the wellheads will be **KES 115,929,936.00** per year. Given that the savings from use of diesel fuel will be **KES 203,840,000.00** per year for the two rigs, the cost benefit per year will be **KES 87,910,064.00** per year.

Other benefits in using wellhead power at the rigs instead of diesel generators includes;

- Reduced carbon emissions
- Reduced noise levels
- Carbon credits
- Reduced fuel spillages at rig sites
- Reduced risk of thefts of diesel fuel
- Reduced risk of fire hazards
- Improved profits for the Company

6. DISCUSSION

This system is very ideal when the rig is drilling the same well pad as that with the Wellhead generator. It is also still very economical when the rig is drilling nearby to an existing Wellhead power plant. This is depicted as shown below.

Figure 2. Wellhead OW-37 with rig KGN02 drilling on the same pad

7. CONCLUSION AND RECOMMENDATIONS

This project is viable and is therefore highly recommended for implementation. The cost benefit per year will be KES 87,910,064.00 and KenGen can channel it to other projects to improve the financial status of the Company.

A grid of network of 33kV lines need to be built into the Olkaria geothermal field and interconnect the wellhead power plants. This will ensure availability of power in the grid from whichever wellhead power plant even when one is not generating. The existence of such a network will enable the rig to be hooked on to it whenever the rig is drilling on a pad that is away from the power plant but close to any of the ring circuits of the 33kV network.

There is need to extend the metering points of the existing utility 33kV network and tap power from it before metering. The tapped power can be used to power the rigs as part of internal loads.

REFERENCE

Verma, A. (2009). Alternate power and energy storage/reuse for drilling rigs. Thesis, Texas A&M University, USA, May 2009, pp. 16-22