UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

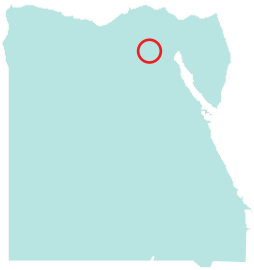
Industrial Energy Efficiency Project
Motor Systems Optimization

This case reviews the optimization of crude oil pumping system for wells using sucker rod pumps within a crude oil extraction field in Egypt. The study revealed that for the motor systems assessed in this oil field 1,240,000 kWh (or EGP 3,235,000) per annum could be saved at an investment cost of EGP 100,000. Extra savings of 480,000 kWh could be achieved with equivalent 2 million EGP (from which EGP 800,000 due to decrease in downtime) at an extra investment cost of 1.2 million EGP with a payback period of around 11 months.

EGYPT

A Case Study of General Petroleum Company (GPC)

GPC Snapshot



Industry: Oil & Gas - Exploration and Production
Location: Headquarter Cairo, Egypt

Product: Crude Oil & Natural Gas
Implementation cost: ~1000,000 EGP
System: Crude Oil Pumping Units
Annual energy savings: ~1.24 GWh
Financial savings: ~3 million EGP p.a.
GHG reduction: ~6700 tCO2eq (10 y)
Overall payback: 4 months

About GPC

General Petroleum Company (GPC) is an Egyptian company established in 1957 for exploration, production and development of hydrocarbons. Some 170 exploration wells were drilled in GPC Fields (Eastern Desert, Western Desert, and Sinai) till December, 2014. Production increased from 4.4 MBOPD (Thousand Barrels of Oil per Day) in 1960 to reach its current total Production of 45.4 MBOEPD.

MSO at GPC and the IEE Project

The Industrial Energy Efficiency Project (IEE) is a program developed and initiated by UNIDO to promote energy efficiency in industry as part of its primary objective of "promoting and accelerating inclusive and sustainable industrial development in developing countries and economies in transition."

The Motor Systems Optimization (MSO) Project forms part of the IEE Project and has the specific objectives of developing local personnel to become competent in the application of energy efficiency in industry in order to unlock the potential for energy savings within their respective local industries.

GPC joined the IEE project as a part of the cooperation with Egyptian Ministry of Petroleum represented by Oil and Gas Sector Modernization project (Group 4B). GPC is committed to improve energy efficiency where it was investigated that there is a good opportunity for MSO in eastern desert site (Ras Ghareib field) with 250 crude oil pumping units with various motors sized from 10 kW up to 60 kW and running 24/7.
The electric power source for Ras Ghareib field coming from 4 GPC gas turbines (2 of 5.2 MW and 2 of 3.2 MW) while the electrical energy cost is ~2.6 EGP/kWh as per 2016/ 2017 average.

Summary of Optimization Strategies

System	Saving Opportunity	Annual Energy Savings [kWh p.a.]	Financial Savings [EGP p.a.]	Investment [EGP]	Payback [years]
Sucker rod pumping unit driven by a 15 kW motor	1. Increase Mechanical Transmission Efficiency	**3,768**	**9,759**	**5,000**	**0.5**
	2. Using new Smaller Motor (10 kW) from existing stock	**18,144**	**46,994**	**0**	**0**
	3. Using VSD and change pulley size	**48,259**	**202,078**	**115,000**	**0.6**
Sucker rod pumping unit driven by a 37 kW motor	1. Increase Mechanical Transmission Efficiency	**10,409**	**26,960**	**5,000**	**0.25**
	2. Using new Smaller Motor (15 kW) from existing stock	**92,613**	**239,867**	**0**	**0**
	3. Using new Smaller IE3 Motors (15 kW)	**100,800**	**261,000**	**88,000**	**0.4**

The Case

In GPC, there are more than 2000 electric motors with different sizes in many sites which drive different kind of loads from which crude oil pumping units for wells (sucker rod pump or beam pump) in RAS GHAREIB field were identified as the scope of this case study. Two motor systems were selected as a pilot project, the first is a group of 15 kW motors for 10 sucker rod pumps and another group of 37 kW motors for another 10 sucker rod pumps. From each group, one pump was selected for detailed investigation.

The assessment involved reviewing process requirements, reviewing historical data, taking system measurements and developing optimization solutions. This approach requires the engineers to develop a strong understanding of the system efficiency, operation and control conditions, as well as maintenance practices impact.

Optimization Strategies

The existing motors of sucker rod pumping units have low efficiency and some are rewound twice before. The mechanical coupling of almost all motors can be maintained to improve transmission efficiency. Some operational requirements like control of flow rate is accomplished by changing the motor speed, in the current situation, this is performed either by using different size of motor pulley or changing the crank pin position which requires to stop the motor increasing the downtime. It was noticed that most of motors are oversized. After detailed investigation, three improvement opportunities were identified. First, increasing transmission efficiency and decreasing mechanical losses by using proper type and number of belts and performing braking system maintenance. Second, replacing the existing motors with smaller motor to avoid the oversizing and in some cases using motors with higher efficiency IE1 or even better. Third, installing new VSDs to increase energy efficiency and control motor speed without any downtime due to operational requirements.

Outcome

For both motor systems, the company is going to implement the first and second opportunities due to their low investment and almost immediate outcome. The third opportunity of VSD will be focused in the 15 kW motors due to its high amount of potential savings as a result of increasing productivity and decreasing downtime. After completion of the those opportunities, total savings may amount to 1.7 GWh (4.4 million EGP).

Lessons Learned

The energy efficiency improvement has a significant effect on increasing productivity.

The lack of data faced during the analysis of the motor systems in GPC is considered as a good motivation for creating an efficient database and data recording system.

For more information:
UNIDO Project Management Unit in Egypt:
Email: iee-egypt@unido.org
Phone: +20 (2) 2794 3477
+20 (2) 2794 1993
UNIDO Headquarters:
Rana Ghoneim: r.ghoneim@unido.org
Phone: +43 (1) 26026 4356
or visit: ieeegypt.org