UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

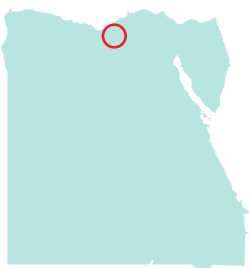
Industrial Energy Efficiency Project
Motor Systems Optimization

Electric motor driven systems globally consume approximately 70% of the electrical consumption in industrial sector. This case reviews the optimization of the utility cooling water system within a large industrial plant in the petroleum sector. The study revealed that for the cooling tower fans motor system assessed in this plant 450,000 kWh per annum could be saved (or EGP 315,000) with payback period of around 17 months.

EGYPT

A Case Study of Alexandria National Refining & Petrochemicals Co. (ANRPC)

ANRPC Snapshot



Industry:
Oil & Gas - Refinery
Location:
Alexandria, Egypt
Product: Gasoline with High Octane

Implementation cost: ~450,000 EGP
System: Cooling Water System
Annual energy savings: ~0.45 GWh
Financial savings: ~315,000 EGP p.a.
GHG reduction: ~2500 tCO2eq (10 y)
Overall payback: 9 months
Objectives period: 2015 - 2020
Time to implement EnMS: 17 months

About ANRPC

ANRPC is a refinery established in 1999, located in Alexandria, Egypt.
ANRPC mainly produces gasoline with high octane number (92 & 95) by refining gasoline 80.
Production capacity is approximately one million ton / year.

MSO at ANRPC 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.

ANRPC has joined the IEE Project to implement an energy management system for its production facility in Alexandria. It needs to reduce operating costs to increase its bottom line. The electricity tariff increases have also contributed to this need to improve energy efficiency.

The company consumes about 90,000,000 kWh of electrical energy annually from which about 85% is consumed in motor systems driving compressors, pumps and fans. Therefore, ANRPC has focused on improvements related to electric motor driven systems.

Summary of Optimization Strategies

System	Saving Opportunity	Annual Energy Savings [kWh p.a.]	Financial Savings [EGP p.a.]	Investment [EGP]	Payback [years]
Cooling Water Fans	1. Adjust the blade angles	144,000	100,000	50,000	0.5
	2. Downsizing the motors	60,000	42,000	150,000	3.5
	3. Installing 3 VSDs	450,000	315,000	450,000	1.4

The Case

In ANRPC the majority of motors are explosion proof as they are located in Hazardous area. For the purpose of having lower risk to business, safe-area motors like those in utilities were selected to be studied to implement the MSO pilot project. Successful implementation could not only realize energy savings but also serve as a stepping stone to realize more energy savings in other areas of production.

Cooling Water System (CWS) consumption represents 6.2% of the total electricity consumed by the company and is identified as a significant energy user. There are three types of motor systems inside CWS which are 2 circulating pumps to and from the units to the cooling tower basin (1 running & 1 standby), 3 pumps for lifting the water up to the cooling tower (2 running & 1 standby), and 3 air cooler fans located at the top of the tower (all are running together only in summer).

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.

The investigation resulted in focusing on the fans because their corresponding loads are varying seasonally with different ambient temperature where the other pumps are working almost on a constant load of about 70%.

Optimization Strategies

The air cooler fans consists of three fans driven by 55kW motors which were oversized during the design phase.The fan load varies with the ambient temperature, where in summer, the fans run with full load and in some times the 3 fans are working simultaneously. In winter, 2 fans run with partial load and in some cases, only 1 fan can do the job. It was investigated that there is an opportunity for energy saving in the fan motor system with different alternative solutions.

The first solution is to adjust the fans' blade angles to have higher amounts of air flow per fan. This will reduce the total operating hours of the fans but there is some difficulties due to lack of some technical data. The second solution is to replace the motor by a smaller one (downsize the motor) where the new motors could be 37 kW instead of 55 kW. The third is to install VSD(s) which may encounter replacing the existing motors with newer ones that can work with VSDs.

Outcome

The company has decided to implement the third solution (installation of three VSDs) which mandates replacing the three motors with new smaller ones which are suitable to work with variable speed drives. Total savings are estimated to be 450,000 kWh (or EGP 315,000) per annum at investment cost of EGP 450,000.

Lessons Learned

A clear replacement policy for electric motors is needed to determine whether to rewind or to replace motors. In the same context, the purchasing policy has to be changed to avoid replacing the failed equipment with a similar one regardless considering any wrong design issue like oversizing.

Focusing on improvement enhances the ideation process. A new idea for replacing the aluminum blades of the fans with PVC ones was raised but needs still under investigation.

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