UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

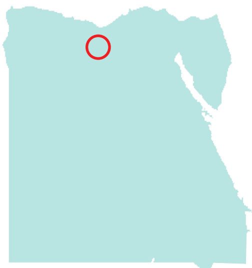
Industrial Energy Efficiency Project
Motor Systems Optimization

Electric motor driven systems globally consume approximately 70% of the industrial sector electrical consumption. This case reviews the optimization of a cooling tower fan motor system within a large industrial plant in the Iron and Steel sector. The study revealed that for the cooling tower fan motors optimization 910,000 kWh (equivalent to EGP 510,000) that represent 0.15% of the total plant electricity consumption could be saved per annum through no/low capital cost measures. This project is implemented by the UNIDO in partnership with the Egyptian Environmental Affairs Agency, Ministry of Industry, Trade and SMEs and the Federation of Egyptian Industries.

EGYPT

A Case Study of Beshay Steel Company

Beshay Steel Company Snapshot



Industry: Iron and Steel
Location: Sadat City, Monufia, Egypt
Products: Long products, rebars, wire rods
Implementation cost: 645,000 EGP
System: Cooling Tower Fans
Annual energy savings: ~910 MWh
Financial savings: ~510k EGP /year
GHG reduction: ~5 $ktCO_2eq$ (10 y)
Overall payback: 9 Moths

About Beshay Company

Beshay Steel group is one of the largest steel producers in Egypt and the Middle East. The group employs more than 4,000 personnel. Beshay has a production facility comprised of steel melt shop and two rolling mills plants. The annual production capacity of meltshop is 1,040,000 Tons /year the products are billets. The majority of the production meets the demands of the local market and the balance is exported to the Middle East, Europe and Asia.

MSO at Beshay and the Industrial Energy Efficiency Project

The Industrial Energy Efficiency Project (IEE) is a programme 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 Optimisation (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.

Global steel production and pricing have put pressure on Egyptian steel companies to improve operations in order to remain competitive. One of the strategies is to implement an energy managements system in order to reduce operational costs related to energy consumption. This has been exacerbated by the increase in local electricity prices. Beshay have implemented an energy management system and have identified area of significant energy use. The MSO project is an extension of this EnMS where Beshay have identified motors as the largest consumer of electrical energy at the plant.

Summary of Optimization Strategies

System	Saving Opportunity	Annual Energy Savings [kWh p.a.]	Financial Savings [EGP p.a.]	Investment [EGP]	Payback [Years]
Cooling Tower Fans	1.Blade Angle Adjustment	650,000	364,000	175,000	0.5
	2. VSDs Installation	30,000	16,000	740,000	43
	3. Replace Belt Transmission with Gearbox Transmission	260,000	146,000	470,000	3.2
	4. Replace Existing Motors with IE3 Motors	139,000	78,000	1,000,000	12.8

The Case

Beshay have chosen the cooling tower fans of the Water Treatment Plant (WTP). There are two identical production processes and utilities at the plant. Hence, any savings could be replicated in the second production line.

The cooling tower is composed of 18 fans set out in 6 sections of 3 fans each. This simplifies the study as only one or two fans need to be assessed, with the results being replicated across the other fans.

Beshay was also experiencing reliability problems with these fans as some of them had failed after only 9 months in service. Apart from the energy saving, Beshay was also keen on improving reliability and reducing maintenance and replacement costs.

Eight fans are driven by 30 kW and ten by 37 kW motors. The total fan motor systems energy consumption represent 21% of the total WTP.

Optimization Strategies

Using the MSO methodology of a systems approach, the mechanical load of the fans were studied in detail. The heat capacity of the cooling tower is 10°C cooling water from 45°C to 35°C.

During certain times the full 10°C of cooling is not required. Optimization strategies were developed based on this varying production requirement and also by assessing the method of power transmission along the motor system.

The measures ranged from no/low cost measures such as blade angle adjustment to medium cost measures such as retrofitting of energy efficiency transmissions. It also included VSD installation on some of the motors, and replacement of motors with high efficiency equivalents.

Outcomes

The outcomes of the assessment have shown that blade angle adjustments would improve the system efficiency allowing shutting down 4 to six fans and saving from 19% to 28% of the total system energy consumption, depending on the season.

Furthermore, the replacement of transmission belts with more efficient gearboxes would improve energy performance by a further 10%. VSD installations and replacement of existing motors with high efficiency units have long paybacks.

Beshay have chosen to implement Option 1 only (adjustment of blade angle). It is engaged with suppliers regarding new technology available for cooling fan motors that offer high environmental protection. This will ensure reliability. It will then incorporate some of the other energy savings options into the new design.

Lessons Learnt

The experience at Beshay has proved that it is possible to achieve significant savings through low cost energy efficiency measures.

It has also learnt that by studying the motor application a better understanding of motor reliability requirements can be gained. Improved energy performance can then be applied at the design stage.

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