

Abstract

CONTRIBUTION TO THE IMPLEMENTATION OF PERENNIAL ACTIONS ON ENERGY EFFICIENCY IN SONEDE

by KHALED ZAABAR

The mission of the National Company for Exploitation and Distribution of Water (SONEDE) is to supply drinking water on the whole country. SONEDE has worked for decades to achieve, extension and maintenance of a complex and diverse water infrastructure covering the whole country. This perspective has achieved a coverage rate of 100% in urban areas and 94% in rural areas. This gigantic infrastructure requires high energy consumption to ensure the production transfer and distribution of water, placing SONEDE as one of the largest consumers of energy in Tunisia. Indeed its consumption reached in 2014, 28 million euros, representing 24% of turnover of the company. This consumption is divided as follows:

- 370 GWh of electricity for an amount of € 27 million,
- 2 Ktep of fuels for 1 Million €.

Being aware of the stakes of energy costs in its financial balance, SONEDE conducted since 1998 several actions to control energy costs, mainly through:

- a judicious choice of electricity pricing and optimization of pumping according to the hourly price of electricity,
- strengthening energy diagnostics operations,
- Strengthening the energy component in the choice of feeding method in drinking water,
- improving the energy performance of several pumping stations and desalination plants,
- the realization of the largest photovoltaic plant in Tunisia (212kWc) in the desalination plant of Ben Guerden (inaugurated in June 2013),
- The establishment of a GPS tracking system for 450 vehicles,
- continuous training of SONEDE agents on energy efficiency.

In this article I will develop the methodology that led to the relative success of the energy control program. I will also present the results obtained for some actions.

ACTION 1: optimization of electricity contracts and operation of pumping stations taking into account the hourly electricity pricing

In 1998, the energy costs represented 9% of revenue SONEDE which already implied a relatively large load. However monitoring of electricity bills, programming the operation of pumping equipment and the choice of electricity contracts are modest and not optimized. I therefore objectified through a series of analyzes that there was significant potential for saving on the cost of purchasing electricity through small investments but require greater mobilization of stakeholders. So I started an energy efficiency program in 1300 stations SONEDE through the following steps:

- Collect all the technical information on the pumping complex,
- conduct energy audits of several major stations,
- discuss with stakeholders to identify the system operating constraints and determine the optimization boundary conditions
- make the necessary simulations and define appropriate management rules

- Conduct meetings with top officials, technical staffs and operational staffs of the 50 districts of SONEDE to present the studies and take decisions and necessary measures to implement the proposed program,
- monitor the implementation of the program (installation of pumping offloading systems, new equipment for pumping, automatic control, updating of electricity contracts, installation of capacitor banks, ...)
- check the results and make adjustments to improve or correct the guidelines of pumping,
- improve the working methods and techniques adopted through the experience feedback.

The steps outlined above are repeated each year following the PDCA model in Figure No. 4, which helped to achieve significant savings on energy costs during the period 1999-2014. The results obtained are presented in chapter III.4 of the article.

This first great action induced the outbreak of a sustainable energy control program that SONEDE has gradually enriched through the experiences acquired during several years. The creation of central structures for the control of energy was the direct consequence of the economic and political opportunity provided by the energy control component in this large public company.

ACTION 2: optimization of energy cost in the isolated and autonomous sites short-term forecasting of water supply

The pricing of electricity set by STEG (Tunisian Company of Electricity and Gas) is based on the Schedule "DAY and NIGHT TIP". As the price of electricity is more expensive during peak periods of the day and it is therefore necessary to promote the pumping outside these periods mainly the peak period, while considering the water storage capacity and flow equipment.

This chapter presents the design and construction of an electronic card for optimization of the operation of pumping station according to the timetable posts costs. The work consists of three parts:

- Develop a simplified model for forecasting daily water distribution: (. Computation time, memory, mathematical operators, precision, autonomy of decision ...) choose the best forecasting method suitable for an embedded system and determine a mathematical model ,
- determine a control strategy to manage and optimize load shedding of pumping water into a reservoir taking into account the capacity of the latter, the forecast of water consumption, and operational limits and safety conditions
- design and implement a control board suitable for the model chosen, primarily processor speed, memory capacity, the number of analog or digital inputs essential to the operation of the optimization algorithm such as flow and level Water logic inputs and outputs. This device must provide other specific options as the stop time display and saving data captured through sensors (voltage, current, temperature, suction flow rates, flow discharge ...). The card will allow to manage and optimize the operation of pumping equipment taking into account pricing schedules positions. It will also include a portion for acquiring real-time data from the pumping station and reservoir.

The advantage of this system also lies in simplifying the optimization method and reducing the cost of hardware and software necessary for such applications.

ACTION 3: study of the advisability of switching from the 3 posts tariffs to the 4 posts tariffs

The 4 posts tariffs adopted by STEG in 2001 to replace the one at 3 posts, given the change in the structure of demand and the emergence of a new morning peak electricity during the summer due to the business and industrial customers to boost the use of air conditioning.

SONEDE estimated in 2001 Following this study, the transition to 4 posts tariffs will be binding for economic management point of view of equipment operation and lead to an increase in electricity bills by 5%. After negotiations, SONEDE agreed with STEG and the Ministry of Industry (responsible for energy) to grant him a special rate called the pumping of water pricing to 3 posts tariffs.

However this new pricing saw the schedule change boundaries and tariff schedules its positions from 2006 resulting in renewed interest, as estimated in this study, for its use to SONEDE. That is why it has agreed with STEG and the Ministry of Industry in 2011 to adopt the pricing to 4 posts tariffs from 1 January 2014 for SONEDE. Indeed, the present study demonstrated a gain of 4% (€ 1 million per year) can be expected after this passage, especially with the improvement of means of control and equipment management.

The difficulty lies in estimating the future distribution of energy consumption on the 4 posts tariffs from the billing data of the 3 posts tariffs.

It should be noted that the methodology adopted in this study was similar to the calculations made in 2001 and 2011. Only rates and hourly positions boundaries of the 4 posts tariffs have changed.

In this chapter I will detail the SONEDE study leading to the adoption of pricing to 4 positions from 01 January 2014.

It is noteworthy that after a year of operation of this new 4 posts tariffs and analyzing utility bills of 2014, we observe a gain (€ 1 million per year) this which corresponds to a 3% difference between the estimated value of the gain in this study and the one carried out.

CONCLUSION

The success and sustainability of these actions during the last 16 years were provided by the coordination, technical assistance and dialogue among stakeholders, especially by direct contact through meetings, seminars, periodic training.

However, although the actions presented in this article have allowed to reduce energy costs, these latter remain relatively high compared to revenues of SONEDE. This is explained in part by the low rate of increase in the water tariff compared to that of electricity. In addition, there were constraints to promote energy management programs, in effect:

- the regulatory framework of incentives for actions to control energy was not mature enough
- national expertise in the field of energy control at the level of the drinking water sector, do not have to give an additional contribution to the existing program of SONEDE
- International cooperation and partnership program were underdeveloped
- technologies for energy efficiencies adapted to the drinking water sector were costly and not mature.
- The energy prices were relatively low and do not promote the development of such projects

In addition to the above difficulties, the future projections of changes in costs of energy are worrying given the rapid and sustained increase in energy prices, and given the trend of increasing energy consumption, following the growth of economic activity and population and the obligation to

improve the coverage rate of drinking water (in rural areas) require the extension of the pumping and distribution network and connecting inaccessible areas.

Indeed, SONEDE is obliged to have recourse to high energy solution for pumping and water production to preserve the balance between supply and demand for water in the future. Future projects will mainly concern the mobilization of all available resources, strengthening of water transfers from North to South, and the use of non-conventional resources such as desalination of brackish water and seawater.

Faced with this situation and these prospects inducing high energy cost that weigh increasingly on the cost of water and with an energy prices persistently high and volatile, SONEDE has established, in parallel to efforts saving water, an energy strategy. For this purpose a master energy plan for the period 2012-2030 to:

- limit the specific consumption (Wh / m³) to 85% of its estimated value in a normal evolution scenario for 2030,
- integrate renewable energy up to 30% of the total energy consumption in 2030 (objective of the Tunisian government)
- further optimize the pumping of water taking into account the tariff of electricity positions costs, with a goal to reduce the purchase price per kWh by 10% by 2018 (based on constant price of the year 2012),
- reduce fuel consumption by 20% by 2016,
- establish by 2017 an energy management system according to ISO 50001.

To help ensure the sustainability of the energy control program to SONEDE, a working team of young and motivated multidisciplinary engineers, was established at central and regional level. This team attend periodically high-level training in the field of energy management provided mainly by ANME (National Energy Control Agency), STEG (Tunisian Company of Electricity and Gas) and GIZ (German International Cooperation Agency).