Water Energy Nexus Operational Toolkit: Renewable Energy

The CHRICHIRA Hydropower project
Tunisia  SONEDE

Henri Boyé
– Senior engineer-
Coordinator of the Energy and Climate College

Regional Capacity meeting on the Water, Energy, Nexus in the Arab Region
Birut Lebanon 11-12 July 2017
The National Society of Water Exploitation and Distribution (SONEDE): created on 02 July 1968.

Its mission covers three main activities:

- production of water: production, treatment and transport.
- water distribution: management and maintenance of the network, management of customers.
- development: surveys, works and supplies.
WATER RESOURCES IN TUNISIA

Total water resources: 4.6 billion m³ / year
- 41%: groundwater - 59%: surface water
• Water stress: 430 m³ / year / inhabitant: Limited resources.

The use of water in Tunisia is divided as follows:
• 83% of the resources used are for agriculture.
• 17% of the resources used are for drinking water.
• Only 52% of water resources have a salinity of less than 1.5 g / l: Relatively high salinity - 86% of good quality resources are located in the north of the country:
• Great regional disparity
Strategy and Objectives for SONEDE

Mitigate the imbalance in the distribution of resources
Meet the water needs of all water users
in the required quantity and quality

To realize this strategy,
SONEDE has used several means, mainly:

Transfer over long distances

Use of unconventional resources:
Desalination of brackish waters

Development of a large infrastructure for the production and transfer of water
High Energy consumption at SONEDE

The production transfer and distribution of water through the complex and diverse hydraulic infrastructure of SONEDE, requires high energy consumption, which places SONEDE as one of the largest consumers of energy in Tunisia.

ENERGY MANAGEMENT ACTIONS (1997 - 2014)

For many years SONEDE has carried out many actions aimed at controlling energy costs:
the judicious choice of electricity pricing
and optimization of pumping
according to the prices of the hourly electricity stations,
Many actions aimed at controlling energy costs

For many years SONEDE has carried out **optimization of pumping**

according to the prices of the hourly electricity stations,
the strengthening of energy diagnosis,
acquisition of increasingly efficient equipment energy component

improving the energy performance
of several pumping and desalination plants

Acquisition of energy diagnostic equipment
(thermographic cameras, vibration analyzers, energy analyzers,
ultrasonic flow meters, differential pressure meters, etc.)
Introduction of Renewable Energy and Energy Management

Construction of the largest photovoltaic power plant in Tunisia (212 kWp) at the Ben Guerden desalination plant (inaugurated in June)

Energy audits of energy-intensive pumping stations
Optimization of the choice of electricity contracts.
Reduction of power subscribed to peak electricity.
Optimization of pumping times according to electricity rates
This program has been applied for the 1300 stations of SONEDE
SONEDE explores the possibility of creating photovoltaic generators installed on floating platforms on the water reservoirs.

This concept has the following advantages:

- Avoid occupying useful land
- Optimize the integration of photovoltaic production by bringing it closer to major SONEDE stations (example: Ghdir el Golla reservoir in Greater Tunis).
- Have significant potential for cooling photovoltaic cells
- Tracking the sun with a less expensive and more robust system

Feasibility study in progress: Floating platform of 1MW in Ghdir el Golla (GRAND TUNIS)
Oued el kebir Dam
1925 Francis Turbine (SONEDE)

Hydroelectricity history on the Sidi Jedidi reservoir
1953 Francis Turbine (SONEDE)

Fernana upstream and downstream power stations
Kasseb dam: 1969
Francis turbine (STEG)
A clean renewable energy using the power of water to produce electricity.

A Pilot action for SONEDE in the framework of cooperation with ESCWA:

Identification of a hydroelectric potential at the Chrichira adduction (1,3GWh / year)

The technical and economic feasibility study of the 200 kW micro-hydroelectric plant will be carried out within the framework of the cooperation with ESCWA.
The Chrichira adduction system

Ensemble des forages

Nouveau débit collecté : 670 l/s

BC 238

Cote 238

Cote 190

Branche K

Débit : 300

Jouaouda

Débit 110 l/s

Piq D06

Débit 105 l/s

Piq D12

Débit 33 l/s

Piq D22

Débit 146 l/s

Débit 24 l/s

Débit : 170 l/s

Débit : 362 l/s

El Onk

Cote 110

Grine 9

Débit : 36 l/s

Grine 8

Débit : 52 l/s

Grine 10

Débit : 44 l/s

Grine 11

Débit : 43 l/s

Grine 5bis

Débit : 39 l/s

Grine 2ter

Débit : 27 l/s

Grine 4ter

Débit : 40 l/s

Ligne STEG 30KV

Variateur de vitesse

Génératrice

Transfo 400V / 30KV

ESCWA - Henri Boyé
Proposal for Tunisia  Technical feasibility study of micro-hydro system for SONEDE

• installing a turbine on a water transmission network to generate electricity.
• assess the technical feasibility of a proposed micro-hydro installation on a water transmission line with elevation differences
• provide technical specifications in order for SONEDE to tender this project.
• Detailed technical feasibility study of micro-hydrosystem
• including site visit, data collection, meetings, etc
Reducing the energy consumption of the hydraulic system at CHRICHIRA

• This project consists of studying the possibility of reducing the energy consumption of the hydraulic system of the "Kairouanais" network (Chrichira system)

• by modifying the existing network and installing a hydroelectric micro-turbine to produce electrical energy.
Morocco the Toubkal microhydro Plant

• A French association in Morocco, managing a chalet and 4 mountain huts
• The Toubkal hut : An ecological showcase in high mountains
• 350 beds, open all year through
• Protection of nature and the environment
• The waterfall of a neighboring stream
• Using a 60 meters difference in height.
• water flow between 50 l/s and 3 l/s, all year round
• A pressure water pipeline, 350 meters long, 110 mm diameter in PVC
Toubkal technical Characteristics

• Using a 60 meters difference in height.
• Water flow between 50 l/s and 3 l/s, all year round.
• A pressure water pipeline, 350 meters long, 110 mm diameter in PVC.
• Pelton Turbine of 5 KW Constructor: IEM AC4/38.
• 450 kg equipment, carried on mule back, up 1500 meters.
• Cost 30 000 Euros with civil engineering.
The Toubkal Mountain hut
Small Hydro in Morocco
The Toubkal Micro hydro plant at 3207 m
Morroco
The Assif Ait Mizane stream

Complete survey and construction of the hydropower microturbine of the Toubkal mountain, as President of the “Club Alpin Français de Casablanca”
IREM turbine Installation by TEP, Grenoble
Cameraman of Moroccan TV
Dounya

Pelton Turbine
5 KW
Chrichira Project Outcome

• Provide technical specifications for turn key contract, ready to include in a tender document

• Project brief to highlight this pilot project to other Arab countries and lessons learned

• To encourage other countries to look into this technology

• within the water-energy nexus context
Thank you for your attention

Henri Boyé

hboye@free.fr