

# ENGIE Geothermal Well Monitoring

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## ABSTRACT

*"A data management protocol to increase submersible pump life"*

ENGIE Geothermal Well Monitoring consists in a couple of submersible sensor installed directly on the geothermal submersible pump and a surface acquisition unit, which sends data through the pump's power supply cable (carrier current). These slight additional costs accounting for 8% of the price of one pump enable optimising the power consumption and prevent a risk of sudden damage of €500K.

## 1. CONTEXT AND PROBLEM

To produce geothermal energy, electro-submersible pumps are the heart of geothermal production. Immersed 300 m underground geothermal wells, their lifespan does not exceed 5 to 7 years under optimal operating conditions. A failure of the pumps before their replacement programmed every 5 years systematically leads to a sudden stop of production. Emergency replacement is complex, expensive (500k €) and can be risky for the following reasons:

- The pump maneuver is complex and only a small number of service providers are equipped with equipment which can pose a problem of availability.
- The supply time of a new pump is of the order of 16 weeks.
- A pump failure generates a consumption of fossil fuels, about 5 times more expensive than the energy produced by geothermal energy over several weeks.
- Exploitation authorizations generally oblige to carry out controls for each pump lift of more than two years.

It is therefore necessary to put all the means in place so as not to suffer a pump break and to anticipate its replacement before a failure in the heart of winter.

Historically, very few parameters were available to qualify the proper operation of the electro-submersible pump from the surface both during set up and during operation. Electro-submersible pump breakdown could not be foreseen or anticipated, generating a permanent fear for the production sites.

The warranty period of one year conventionally offered by the manufacturer is often exceeded when a breakdown occurs and the mode of operation is incriminated in the reduction of the normal life of the equipment.

## 2. INNOVATION DESCRIPTION

### 2.1 Description of the process

WellLift allows a high level of monitoring to act in a preventive way on the driving of the electro-submersible pumps by guaranteeing a better viability of the equipment and a continuity of service.

WellLift consists of a sensor installed directly on the electro-submersible pump and a surface acquisition unit (8k €) whose data pass through the power supply cable of the pump ( carrier current). These slight additional costs, 7% of the price of a pump can optimize electricity consumption and avoid a risk of a sudden loss of 500 k €.

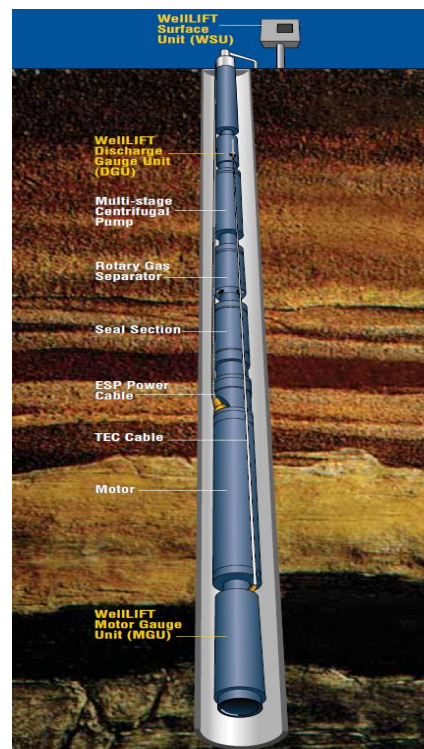


Figure 1: Diagram of the WellLift sensor coupled with and electro-submersible pump

## 2.2 Innovation

The innovation covers three aspects:

First of all, the transfer of technology from an oil industry application adapted to geothermal energy uses. This is the first time that technology has been used to monitor such submersible pumps. At a depth of 300 metres, it provides a visual display of the operating parameters (data) that directly impact the service life of the equipment: engine temperature, electrical insulation, vibrations, operating pressure, etc. This data enable defining the best setpoint settings for each operation and anticipating breakdowns by reading the deviations.

The second major innovation: WellLift (Backer Hugues software) allows both on-site and remote monitoring (direct monitoring, website and mobile application) of the critical pump operating parameters. A unique communication architecture was developed to enable data feedback and transmission.

Finally, a contractual innovation. These data are transmitted to the electro-submersible pump manufacturer in Houston, who has a contractual advisory duty on the operation of its equipment in a quarterly report, including alerts on any deviations from compliance with its recommendations. In addition, ENGIE Geothermal Well Monitoring has enabled increasing the manufacturer's warranty period by reducing the risk of improper operation.

## 2.3 birth of the solution

Discussed during the meetings of the Rex Group on geothermal energy comprising the traditional operators of the geothermal energy networks of ENGIE Réseaux, this system has become mandatory for all the supplied equipment, in coordination with the Acting Project Management in charge of the works.

Using the grouped call for tenders for the supply and installation of drain pumps within the scope of ENGIE Réseaux, we have included the supply of a specific monitoring system for our activities as an option.

## 3. RESULTS AND DEPLOYMENT

On installation, ENGIE Geothermal Well Monitoring checks the equipment's compliance to the design specifications and fine-tunes the actual performance versus the theoretical settings. This major factor eliminates the risk of premature damage.

During operation, the system provides all the data on an ongoing basis, enabling to check that the pumps remain within their operating range and that no ageing warnings have been received. Moreover, daily reports including the key parameters and alerts are distributed to operators.

Finally, quarterly reports released by the manufacturer provide an in-depth analysis and proposals for improving management.

This monitoring methodology allows anticipating the development of pump ageing, adjusting the operating conditions and planning the replacement so as to prevent a sudden pump breakdown.

## 3.1 Daily tools

The system provides a operational monitoring device that allows to continuously have access to data through a web application and a smartphone application.



Figure 2: Screenshot of the web application allowing live monitoring of operating wells.

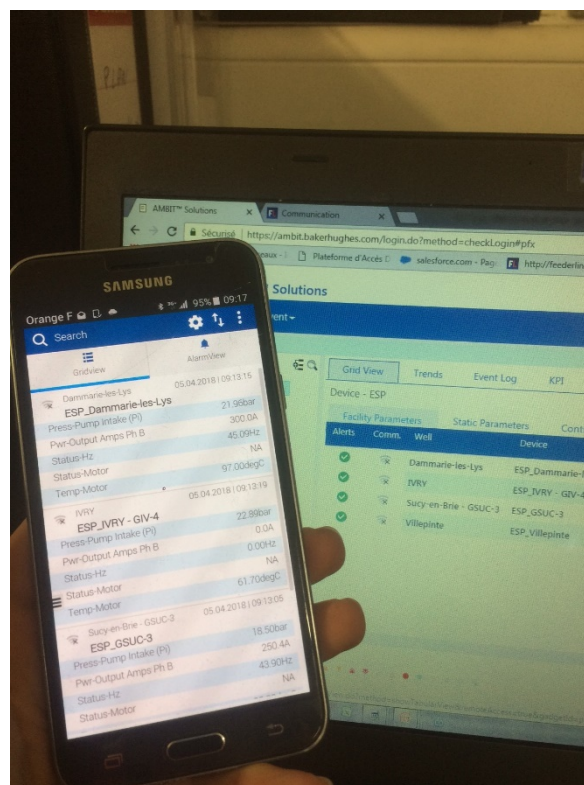


Figure 3: view of the Web application and mobile application.

A daily report regarding all the wells in operation in produced and sent, displaying data, curves and warnings. Indeed, alarm thresholds are set for several parameters. An e-mail is automatically sent to the plant manager if a deviation occurs. These deviations are summarised every day.



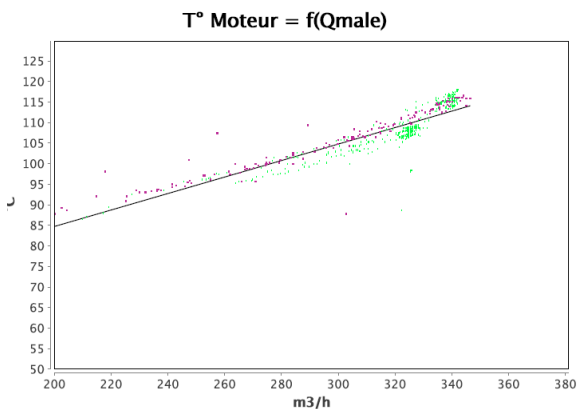
Figure 4: overview of the daily alarms report.



Figure 5: overview of the operational data report.

### 3.2 Data process analysis

Thanks to the operational parameters, some deeper analyses are feasible, by correlating data. Process monitoring reports are then edited weekly, which enables further analyse.



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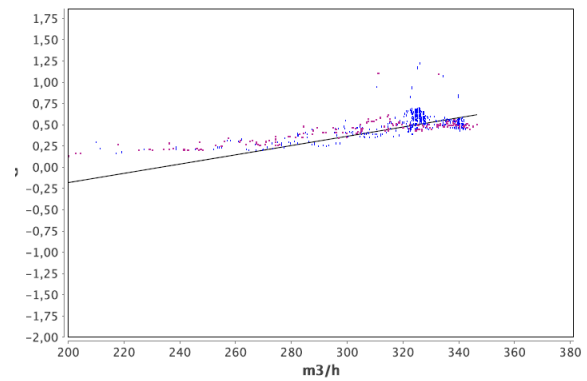


Figure 6: weekly process reports.

On installation, ENGIE Geothermal Well Monitoring checks the equipment's compliance to the design specifications and fine-tunes the actual performance versus the theoretical settings. This major factor eliminates the risk of premature damage.

### 3.3 Long Term performance monitoring and ageing

During operation, the system provides all the data on an ongoing basis, enabling to check that the pumps remain within their operating range and that no ageing warnings have been received.

Finally, quarterly reports released by the manufacturer provide an in-depth analysis and proposals for improving management.

Thanks to the data that are collected, a trimestral review of the electro-submersible pumps is carried with the provider. It allows to check that the facilities are correctly operated, respecting the recommendations.

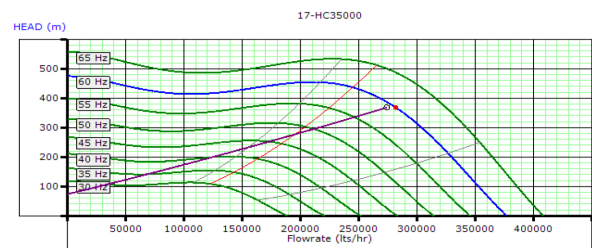


Figure 7: operational and performance monitoring of pump.

The ageing monitoring of pumps is to be developed, thanks to vibration or motor temperature monitoring for example.

This monitoring methodology allows anticipating the development of pump ageing, adjusting the operating conditions and planning the replacement so as to prevent a sudden pump breakdown.

### 3. CONCLUSIONS

Directly inspired by the oil industry, this technology transfer is a first in France for geothermal energy.

Born of an operational dilemma, this collaborative approach is currently increasing the operational efficiency of our geothermal facilities.

This monitoring methodology allows anticipating the development of pump ageing, adjusting the operating conditions and planning the replacement so as to prevent a sudden pump breakdown.

This system allows each operation to manage a financial risk of €300 to €500K for each incident for a limited initial investment .

Thanks to all our operation and maintenance geothermal team for their support and is constant innovative spirit.