CHAUVIN ARNOUX GROUP

How Professionals Can Reduce Their Bills

Installation of a Power Factor Correction Cabinet

Battery poultry farming

A poultry farmer in western France has seen his energy requirements rise significantly. The site's specific-tariff power supply ("Tarif Jaune": 252 kVA for long-term uses) is no longer sufficient to deal with his electrical energy needs.

On this installation, consumption is due to :

- the water treatment plant, equipped with 2 variable speed drives
- the poultry shed, fitted in particular with infrared heating lamps for the chicks
- the buildings : offices (computers, printers, etc.), housing, etc.

According to the management documents covering the last two years, the maximum power reached was 293 kVA. The overrun time for the year was 159 hours, which meant annual penalties of nearly € 2,050. To solve the power overrun problems and enable the customer to achieve substantial savings, Chauvin Arnoux and Enerdis provide a tailored solution : installation of a Power Factor Correction cabinet.

Specific tariffs

Savings

Power measurements

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Phase 1: Billing Analysis

Before any measurements on site, it is important first to examine the energy bills for the last two years in order to find the best compromise enabling the customer to remain within the subscribed power limits.

This phase helps to gain a rough idea of the power rating of the cabinet that needs to be installed. This optimization is carried out on the basis of the Displacement Power Factor (cos φ / DPF) which remains unknown. The energy bills do not include this crucial information.

EDF's Special Tariff ("Tarif Jaune")

In France, the electricity supplier EDF applies different rates for business customers.
This special tariff is suitable for customers requiring power levels between 36 kVA and 252 kVA.
It includes a fixed annual premium depending on:

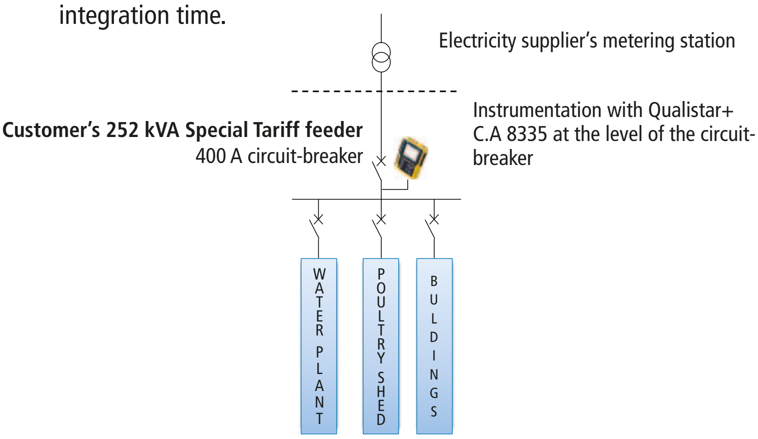
- the subscribed power
- the type of use
- the electricity consumption measured in kWh

The price per kWh varies according to:
- the time of year (winter or summer)
- the period of use during the day (off-peak hours, peak hours)
- The type of use (medium or long)

Phase 2: On-site Measurements with a Qualistar+ C.A 8335

On-site measurements and audits help to determine the type of equipment involved and how it is used.

The instrumentation is set up on the main feeder to measure all the power consumed by the installation with the shortest possible integration time.



Performed with a Qualistar+ C.A 8335 three-phase network and energy analyser, this measurement helps to identify:

- Polluting loads
- The maximum power level reached during the recording period
- Rapid power and current variations
- The Power Factor Correction requirements

The measurements are only valid if the operating cycle of the load conditions is representative of the electrical network.

Real Time

By hooking up the instrument to the installation's circuit-breaker, we can clearly see that there are not many polluting loads on the network (just a few variable speed drives in the water treatment plant). The levels of harmonics on the network are therefore negligible, so there is no need for correction.

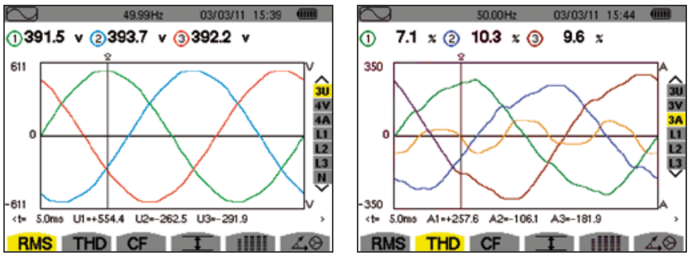


Fig.1 - Capture of Voltage and Current waveforms

However, the measurements also clearly indicate that Power Factor Correction is necessary (*see Fig.2*)
⇒ the cos φ can be improved.

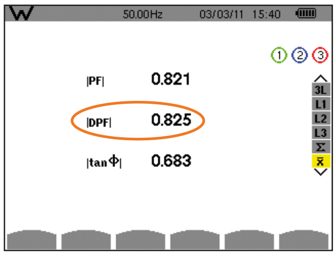


Fig.2 - Displacement Power Factor (cos φ)

Monitoring

Consumption is monitored to produce a power profile. The recordings are made with a 1 s integration period.

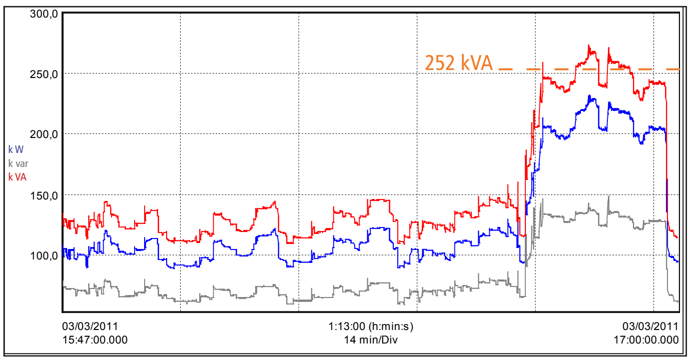


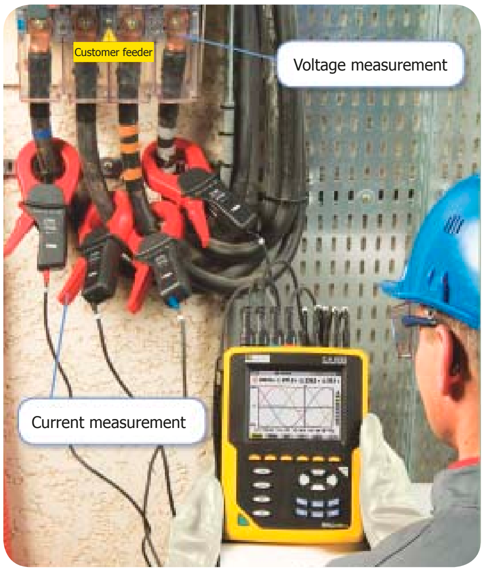
Fig.3 - Recording of power profile

The recordings (Fig.3) clearly show that the contract is exceeded during the recording period.

The power profile shows the reactive power (grey curve). This can be eliminated by installing a Power Factor Correction cabinet to ensure that the consumed apparent power is equal to the active power (< 252 kVA specified in the contract).

Phase 3: Definition of the ENERDIS® Power Factor Correction cabinet

More detailed analysis shows that installation of a Power Factor Correction cabinet would make it possible to supply the necessary reactive power instead of the power supplier.



To achieve the best gain, compensation should be implemented so that cos φ (DPF) = 1 (i.e. tan φ = 0).

The average cos φ on the installation is approximately 0.833 and the worst value is 0.743.

The Power Factor Correction cabinet must be sized as accurately as possible because it is crucial to avoid overcompensation. Indeed, overcompensation means injecting reactive or capacitive power which would be counted in the apparent power.

To define the capacitor bank correctly, we compare the recorded data (power and phase offset) with the energy bills.

Smax = 293 kVA (energy billing data)

Cos φ (DPF) = 0.743 (data from the Qualistar+ C.A 8335)

S (kVA)	293
kW with cos φ = 0.743	217.70
kvar with cos φ = 0.743	196.10
kvar target value (tan φ = 0)	196.1
Capacitor bank at 400 Vac (kvar)	207
Final kVA value with cos ϕ= 0.743	218

On the basis of these measurements, the capacitor bank that we define will have a power of 207 kvar (at 400 Vac) for a power of 196.1 kvar consumed by the installation. The target for the theoretical apparent power is 218 kVA (< 252 kVA).

The capacitor bank will neutralize the reactive energy consumed by the installation while benefiting from the maximum available power.

Did you know?

Reactive energy is consumed by electrical appliances and lighting. Consumption of this energy reduces the available output power. By having this energy produced by Power Factor Correction cabinets, you can therefore recover output power and thus avoid overruns. Another effect of installing a PFC cabinet is that it helps to reduce heating in the cables. For customers, a poor DPF value leads to voltage dips in cables, losses due to the Joule effect during transmission of the electrical energy and, in the case shown here, higher electricity bills (penalties).

Phase 4: Installation of the PFC cabinet and measurement of its efficiency ⇒ the results are convincing

When the cabinet is started up, it successfully reduces the reactive power consumed by the installation. The recording in Fig. 4 shows that the reactive power has been brought down to a negligible level close to 0. The cos φ value is now 1 (see Fig. 5).

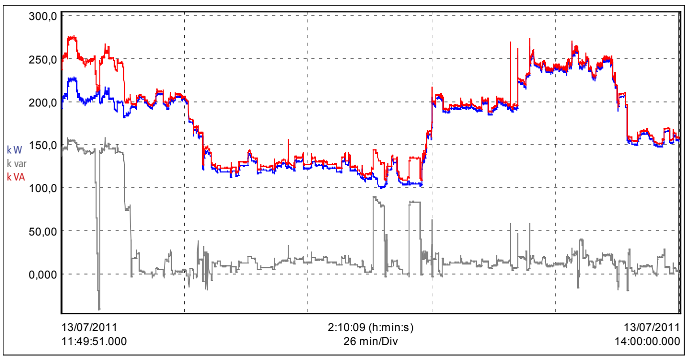


Fig.4 – Recording of the power profile with the capacitor bank

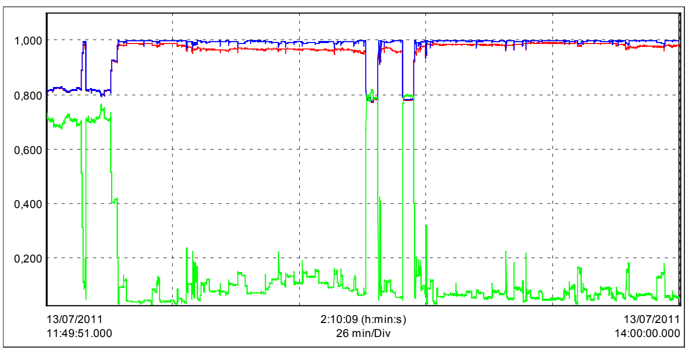


Fig.5 – Recording of the cos φ (DPF), PF and tan φ profiles

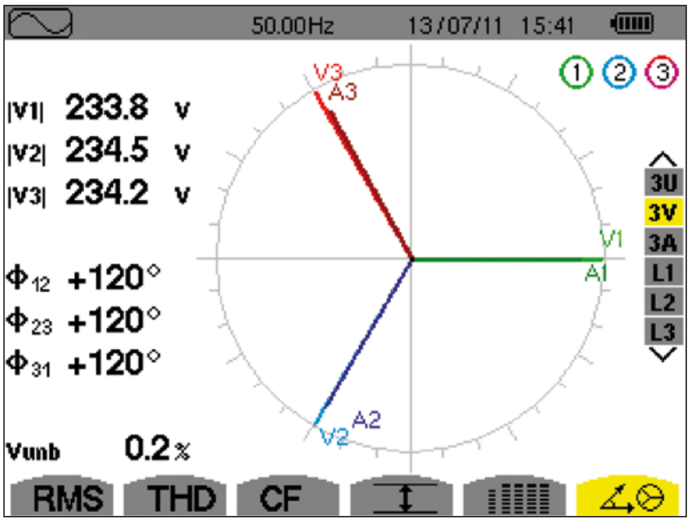


Fig.6 - Fresnel diagram after Power Factor Correction

The cos φ or Displacement Power Factor (DPF)

Appliances and motors equipped with magnetic circuits and operating on AC current absorb active energy and reactive energy, with a corresponding active current and reactive current, respectively.

- in the case of resistive loads, such as incandescent lamps, the cos φ is optimum as it is equal to 1
- in the case of inductive loads, the cos φ is degraded and usually requires correction.

Examples :

⇒ Uncompensated fluorescent lamps: cos φ ≈ 0.5

⇒ Asynchronous motors with 50% load: cos φ ≈ 0.73

Key figures:

- Elimination of overrun penalties (€ 2,000) and maintenance of the apparent power within the range stipulated by the contract
- Payback time < 2 years
- Saving on investment in a transformer (approximately € 40,000)
- Consumption cut by 3 to 5%
- CO2 emissions avoided: 2.75 tonnes of CO_2

Conclusion

With the ENERDIS® Power Factor Correction solution, the customer has successfully returned within the limits for the special tariff package while also avoiding costly investments: change of tariff with installation of a transformer + transformer maintenance and repairs (total investment of approximately € 40,000).

Furthermore, despite occasional overruns, the customer will save € 2,000 annually.

⇒ The customer is ensured that the installation will function correctly while controlling energy consumption.

PRODUCT ADVANTAGES

QUALISTAR+

Power and Energy Quality Analyser

- Recording of all the selected parameters with graphic display
- Power measurement: W, VA, var, PF, DPF, cos φ, tan φ
- Recording of all the parameters at the maximum sampling rate for up to 1 month
- Simple to use with intuitive operation
- IEC 61010 1000 V CAT III 600 V CAT IV

ENERcapTJ

Automatic Power Factor Correction Cabinets

- Dedicated range for special tariffs
- Substantial savings on energy bills
- Adaptation of the contract to the actual consumed power
- ENERPHI+ controller with RS485 port as a standard feature
- Switch as a standard feature
- Standard cabinets from 17.5 to 87.5 kvar at 400 Vac
- Tailored solutions adapted to handle any project

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