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Energy Quality in a Hospital of West Africa (Cameroon – Bafang District Hospital)

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***Abstract*—This work deals with the quality of energy in a hospital in West Africa. The Bafang Hospital, a district hospital whose energy quality depends on the out datedness of the apparatuses used and the electrical installation itself. Qualimetrics measurements are taken know, the quantity of absorptive energy weekly (active / reactive), the quality of the voltage, the quality of the current and the quality of the frequency. The imbalance, one of the defects that persists in the network of the hospital because of the bad distribution of the loads leading to the increase of the global rate of the harmonic 5 for the current and 3 for the tension. On the other hand, the frequency is always in the standards at 99% of the measurement time, which is well ensured by the energy distributor. So the energy quality of the hospital depends on their consumption and their own distribution**

***Index Terms*— quality of electrical energy, Bafang Hospital**

I. INTRODUCTION

Electricity, factor of development of a country, is used to operate the various appliances that are domestic or industrial. Since all this time, people have only thought of consuming electric energy without worrying about the quality of the latter. The rise of new technologies has pushed us to take this quality into account because these modern devices are sensitive to all kinds of disturbances [3]. In this work, the quality of energy in a hospital in West Africa is the center of the subject. This hospital has devices that are very sensitive and vital to human life. For greater clarity, we will initially see the energy management and the standards related to ensure there a good quality of electrical energy, which then directs us with the implementation of the quality of the energy measured within the hospital of Bafang (Cameroon).

II. ENERGY MANAGEMENT

The goal of energy management is to ensure energy efficiency, which is to say to minimize the cost of energy while keeping the comfort, the service and the productivity of optimal quality. The benefits include [2]:

- Improvement of comfort;
- the cost cutting of exploitation and maintenance;
- reduction of breakdowns of system and equipment;
- increasing the value of the building;
- improving the productivity of equipment and staff;
- increasing the lifetime of the equipment and building;
- reduction of energy consumption;
- improvement of the environmental performance.

III. ENERGY STANDARDS FOR THE HOSPITALS

The standard is a collection of rules, description or methodology which a manufacturer use as reference in order to define the product that it manufactures and also to carry out the test of the elaborate products [1]
EN 15 193 recommends the energy performance of buildings and energy requirements for lighting.
Based on ABB automation and protection relays, developed in accordance with the IEC 61850 standard, the automatic loop configurator makes it possible to make electrical installations more reliable, to increase their availability, and to secure the operation of high-voltage substations [6].
Standard NF C 15-211 describes the methods for designing, implementing and operating LV power supply in a health facility. This standard contains the requirements for the electrical safety of persons (especially patients who are usually in vulnerable situations where their physical resistance is greatly diminished) in medical premises [5].
The EN 50160 standard developed by CENELEC (European Committee for Electrotechnical Standardization) deals with the characteristics of low- and medium-voltage electricity products.
IEC 61000-3-2 and IEC6100-3-4 (International Electrotechnical Commission) specify the harmonic limitations to be respected. They indicate the permissible current harmonic emission for each phase. Less than 16 A for IEC61-3-2 and greater than 16 A for the other [1].

IV. ENERGY QUALITY OF THE BAFANG HOSPITAL

The health care institutions are among the most energy-intensive buildings. That is due to various specific rooms such as kitchen, laundry, sterilization, radiology, internal laboratories and surgical units.
We can define the energy quality as the current and the voltage quality, the frequency, the behavior of the real and reactive power [3]. Thus, in our case, the quality of energy for a week was analyzed for this hospital.

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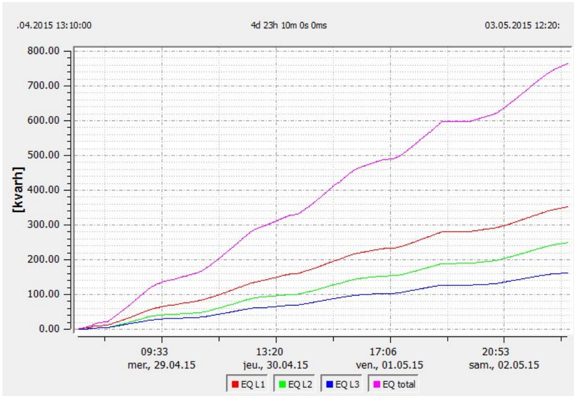
A. The weekly consumption of the hospital

The measurements are qualitative measurements of each phase of the hospital supply network.



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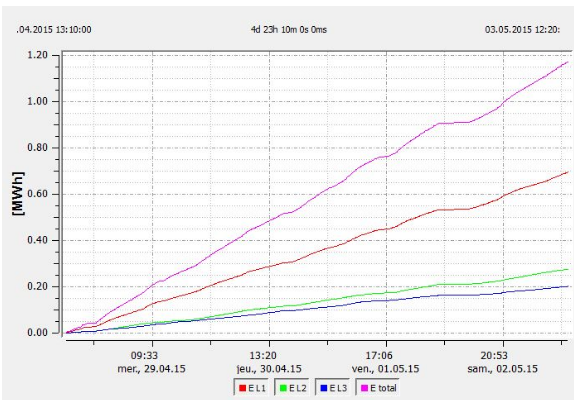
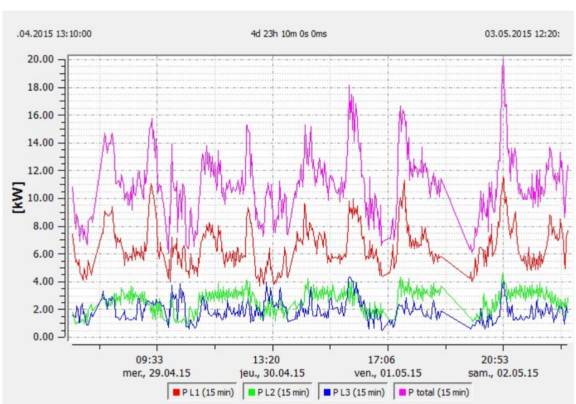


(b)

Figure 1 :Active (a) and reactive (b) energy of the hospital



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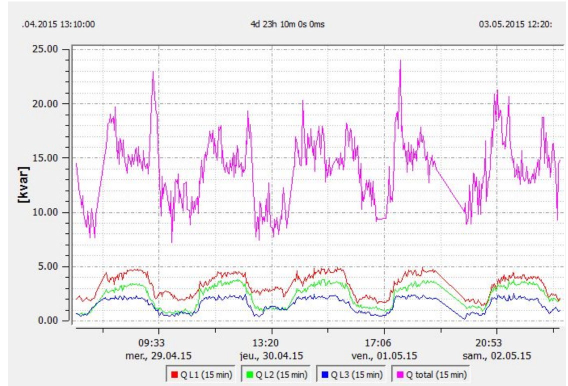

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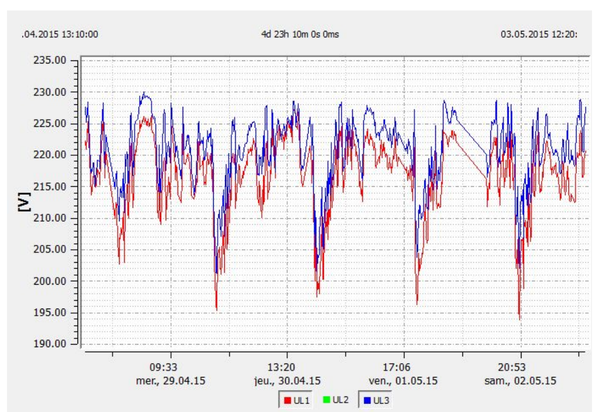
Figure 2 : weekly active (a) and reactive (b) power of the Bafang hospital

The quantity of energy consumed by the hospital is close to 1.2 MWh / week. The consumption by each phase is not equal because of the unbalance of related load there. For L1phase, the energy demand has twice the other two phases because the active power demanded at the load (fig 2) of this phase presents a peak of the order of 12 kW compared to the other phases which are only of 4 kW. The consumption of the reactive power is more or less periodic for each phase. The demand for reactive energy is of the order 750 kVAr / week. This demand is accentuated by the existence of electrical motors (single-phase or three-phase) in various devices which the hospital.

B. Quality of voltage

The quality of the voltage in a reference term explains by maintaining the waveform of the voltage near or equal to the sinusoid [4]. The effective value of the Bafang hospital voltage during this period varies between 193.83 V and 230.47 V.



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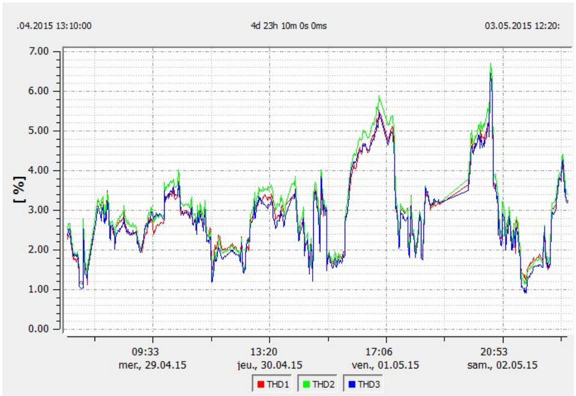
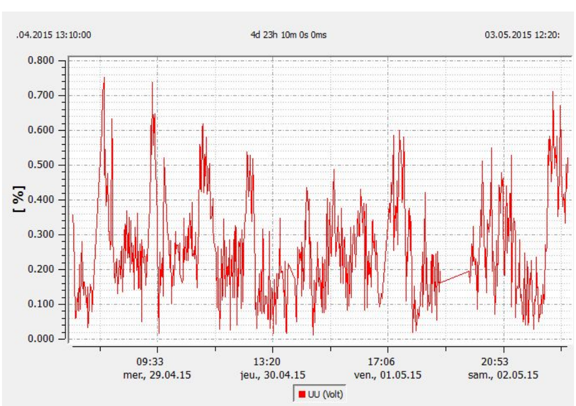


(b)

Figure 3 : RMS value of each phase of voltage (a) and THD (b)

A voltage dip which is periodic occurs every evening from 8:30 pm which is due to the sterilization of the metallic materials of the hospital.

(a)



(b)

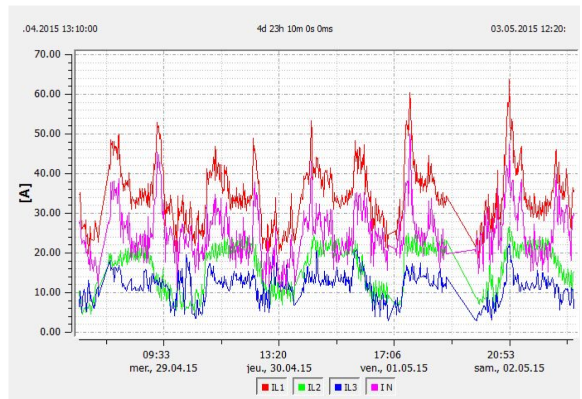
Figure 4 : Pace of the individual harmonics (a) and the rate of voltage imbalance (b)

Imbalances (fig. 4) which are mainly due to the current flow unbalanced by the impedances of the network and result in parasitic braking torques and overheating which lead to premature degradation of the electrical equipment especially those which contain electrical machines . These imbalances remain minimal as they remain below the allowable margin of 2% [1].

The harmonic distortion rate for each phase represents an average of 4% with a minimum value of 0.95% and a maximum value of 6.6%, which is still within the margin of the standard, which should not exceed 8 % .The effects can be instantaneous or long-term resulting in downgrading, even destruction of equipment.

C. Current quality

The RMS value ranges from 4 to 62 A. Current peaks are periodic. These peaks are presented as of the opening of the hospital (the morning) and the evening in the vicinity of 21: 00. The L1 phase twice is requested than phase L2 and L3, which accentuates presents it of an imbalance to the level of the load of the hospital.



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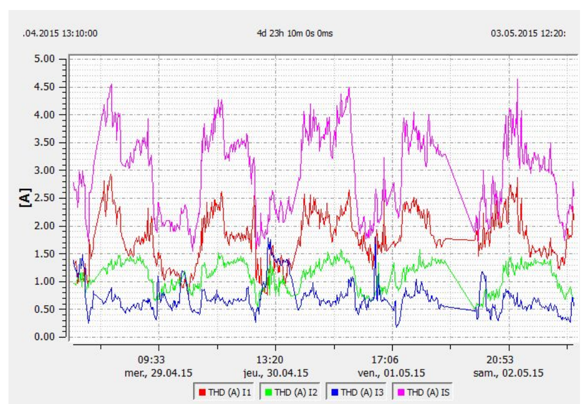

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Figure 5 : RMS Current and THD

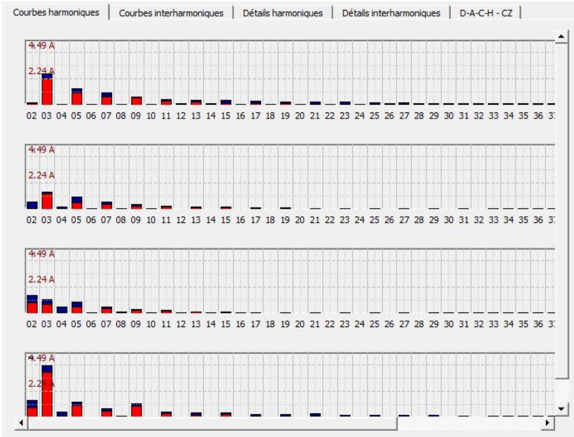

Figure 6 : Individual harmonics of current

The harmonic distortion rate of the current varies from 0.3 to 4.6%. Phase L1 shows a higher rate than the other two. At 95% of the measurement time, the individual value of each harmonic always remains within the permissible range except for phase L1 and L2 for the third-order harmonic, causing the overall harmonic third harmonic to exceed the three Phases. The latter has an impact on the receptors of the network: increased losses by Joule effect and skin effect, increased energy billing due to degradation of the power factor

D. Quality of frequency

The quality of the frequency is paramountespecially for equi pment sensitive to any abrupt change of the frequency value such as inverters, rectifiers, electric motors, etc. According to the current standard, the value of the frequency must remain within the frequency range. Frame of 50 Hz plus or minus 1%.

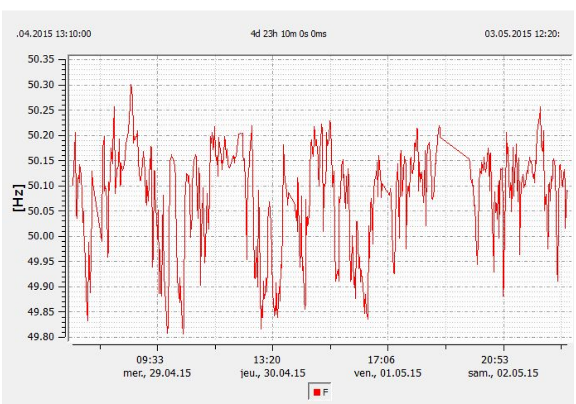

Figure 7 :Temporal evolution of the frequency over a given period

In the case of the Bafang hospital, the average frequency remains within the standard for the 100% of the measure. This favors the energy distributor in terms of quality of frequency as this eliminates additional losses in the power grid.

V. CONCLUSION

Energy quality in hospitals is a high-tech field to ensure a good performance of the hospital and not to put patients' lives at risk.In this work the quality of the energy to know, the voltage, the current and the frequency of Bafang hospital (Cameroon) is the subject of an in-depth study.

The weekly consumption of real and reactive energy of the hospital is 1.2 MWh / week and 750kVAr / week distributed inequitably in all three phases.

This distribution involves imbalances in voltage; voltage dips every night and harmonics, all of which are within the framework of the standard.

The distortion rate of the total current harmonic varies on average from 0.3 to 4.6%. The individual value of each harmonic remains in the standard.

The average frequency has peaks that are above the standard but do not persist. About 99.5% of the time of the measurement, the average frequency value remains between 50Hz plus or minus 1%.

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