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Research Article

Study of the Management of the Electrical Energy Production and Distribution System Within the National School of Teachers of Mamou, Guinea

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Abstract

With the energy transition, marked essentially by the mass integration of energy production based on renewable resources, the missions and challenges of electrical energy distribution networks are evolving. This study is part of this dynamic, its objective is the study of the management of the production and distribution system of electrical energy within the National School of Teachers of Mamou. It emerges from this study that the supply of electrical energy to the National School of Teachers of Mamou is ensured by a hybrid system of three power sources: photovoltaic solar fields, Generator Group and Electricity of Guinea. The current electrical energy requirements of the Mamou NST are 40 kW. The total power of the installed photovoltaic solar fields is 70 kWp; the Generator used has a power of 10 kVA; the site's Electricity of Guinea network is made up of transformers, cabin substations and protective equipment. The electricity distribution network is characterized by: Four (4) 250 A circuit breakers; a 32 A circuit breaker for the departure of lamps, sockets and fans; a 10 A circuit breaker for the lamps; a 10 A circuit breaker for the fans; a 16 A circuit breaker for the sockets and an 800 A mechanical inverter. The study shows that the power of photovoltaic solar fields is largely sufficient to cover the current electrical energy needs of the National School of Teachers of Mamou.

Keywords

Study of Management, Production System, Distribution of Electrical Energy, Network

1. Introduction

Nowadays, electrical energy is a factor of sustainable development, its transport, distribution and management are major problems that we are called upon to resolve. The hybrid energy production system in its most general view is one that combines and exploits several sources. The system that interests us brings together two parts for the production of energy through electrochemical storage (Solar energy through the PV panels, Hydrocarbon through the generator) [1-3].

The term Hybrid Energy system refers to electrical energy generation systems using several types of sources. The combination of renewable energy sources such as wind turbines, photovoltaics or small hydroelectric plants can constitute a complement or an alternative to diesel generators. Hybrid energy systems are generally autonomous from large inter-

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connected networks and are often used in isolated regions, but the presence of the diesel generator in this type of autonomous hybrid system gives rise to some discussions about the notions of "cleanliness" and sustainability [4, 5].

As for photovoltaic systems, they provide uninterrupted power without noise or environmental pollution, with the exception of recycling difficulties linked to batteries. They are easy to install, require little maintenance and are very reliable. Their disadvantage is the high investment cost necessary for their installation and the limitation of the electrical load to be satisfied [6, 7].

However, photovoltaic systems can be associated with other energy sources, most of the time controllable such as a generator, sometimes of a random nature (PV-wind association). In all cases, in these configurations of association of several sources, the advantages of each of the energy sources are cumulative [8, 9]: The photovoltaic system reduces fuel consumption, operating time and therefore the maintenance frequency of the diesel group, the presence of battery storage reduces the nominal power of the diesel group, the presence of the diesel generator reduces the size of the photovoltaic field and the storage capacity of the batteries thus reducing the cost of the system, the reliability of the overall system is increased, the powers and energies involved are greater and the load to be supplied is higher. The following problems then arise: correctly choosing the size of each component of the energy system, optimizing energy management within this system, and finally, searching for the optimal configuration [10, 11].

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The present study is part of this dynamic, its objective is to consider good management of the electrical energy production and distribution system within the National School of Teachers of Mamou. The school plan is presented in (figure 1). The premises are numbered as follows:

Administrative building (*1*); Classroom building (*2*); Computer room building (*3*); Maintenance room (*4*); Caretaker housing building (*5*); Infirmary (*6*); Pump (*7*); Documentation and information building (*8*); Generator building (*9*); Amphith (*10*); Toilet (*11*); Housing building school officials (*12*).

Figure 1. *Presentation of the study area.*

2. Materials and Method

2.1. Presentation of the Study Area

The National School of Teachers of Mamou is located in the urban commune of Mamou, in the Telico district, located 4 km from the city center. It is limited to the east by the Thiewgol district, to the west by the National School of Technical Water and Forest Agents, to the north by the Abattoir district and to the south by the Telico village (figure 1) [14]. The Mamou National School of Teachers (NST) is a public educational institution. Its mission is to ensure the

initial training of teachers for primary and preschool education, in short the academic and professional training of student teachers [15].

The National School of Teachers of Mamou includes: two blocks of six classrooms, an administrative block, a documentation and information center, a multipurpose room, a computer room, an infirmary room, a maintenance room, a pavilion, a block of official housing, a security room, a generator shelter room, toilet blocks, a water tower and a car park. The National School of Teachers of Mamou is powered by three (3) sources: a 10 kVA generator with a voltage of 230 V single-phase and 400 V three-phase no-load. This group will operate alternately with the Electricité de Guinée network; photovoltaic solar panels with a unit peak power of 270 Wp.

2.2. Work Equipment

The equipment used is: a multimeter to measure the voltage levels, a tape to measure the distance separating the poles, AutoCAD software for designing the electrical diagram of the two departures and work safety equipment.

2.3. Methodology

The methodology used for this study concerns: the field visit and the description of the production and electrical energy distribution system of the site and the readings of the various electrical parameters (current, voltage, temperature, etc.) [15, 16].

3. Results and Discussions

The different results obtained during this study are represented by diagrams in Figures 2, 3 and 4.

3.1. National School of Teachers of Mamou Energy Costs

The different energy loads of the National School of Teachers of Mamou are represented in the diagram in Figure 2.

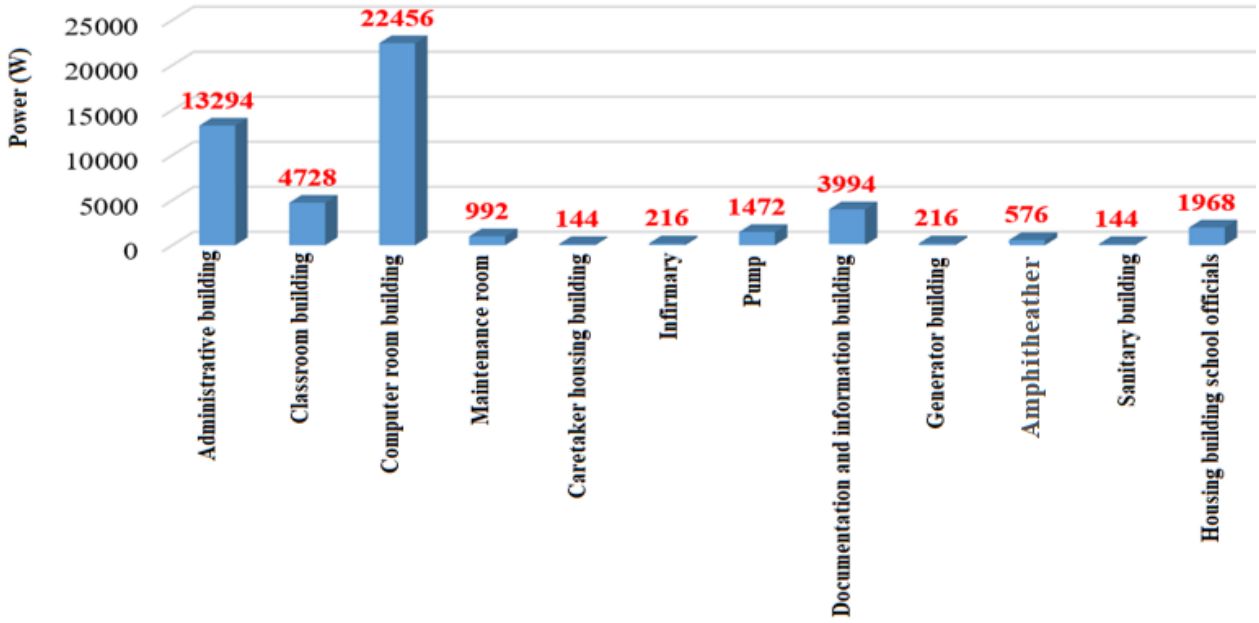

Figure 2. *Energy costs of the National School of Teachers of Mamou.*

The total energy load of the National School of Teachers of Mamou is 37,000 W (37 kW). The diagram in Figure 2 shows that the computer room and administrative blocks have the greatest load followed by the classroom block, i.e. 22456 W, 13294 W and 4728 W respectively. The caretaker's accommodation and the toilet block have the highest loads the smallest, 144 W each, followed also by the infirmary and the generator shelter room which also have 216 W each. These load differences are due to the specifications of the premises.

3.2. Power Installed in Photovoltaic Solar Panel

The different powers installed in photovoltaic solar panels at National School of Teachers of Mamou are represented in the diagram in Figure 3.

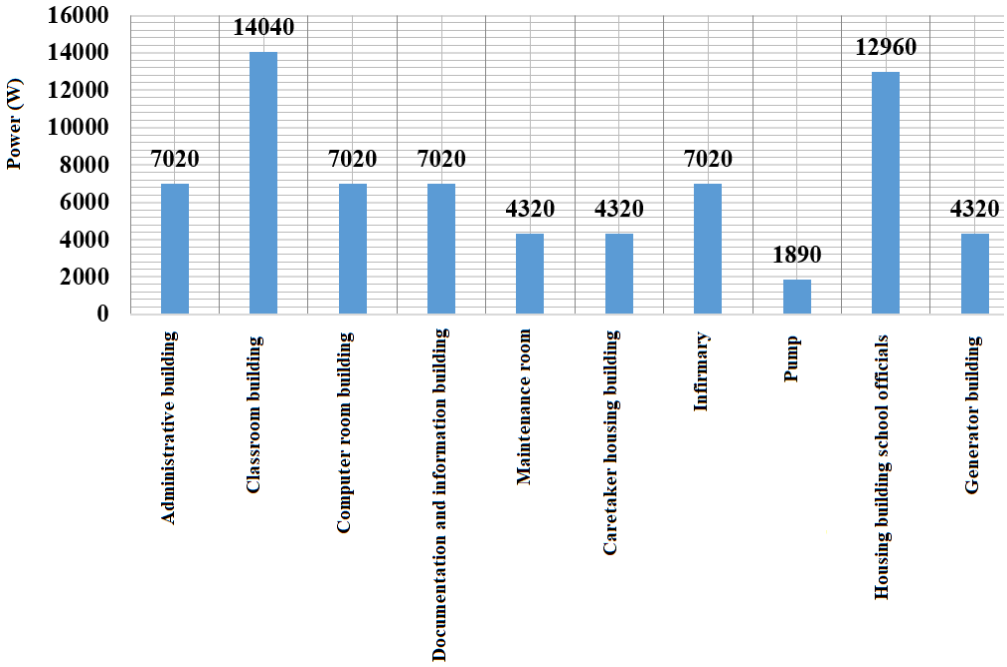

Figure 3. *Installed PV power diagram.*

The energy power installed in photovoltaic solar panels at National School of Teachers of Mamou is 70 kWp. The diagram in Figure 3 shows that the classroom block has an installed power of 14040 Wp, or more than 20% of the total power, it is followed by the staff housing block with 12,960 Wp, or 19% of the installed power. The borehole has the lowest power (1890 Wp).

3.3. Comparison Between Installed Power and Current National School of Teachers of Mamou Load

The diagram in Figure 4 shows the electrical power installed in the photovoltaic system and the current electrical energy load of the National School of Teachers of Mamou.

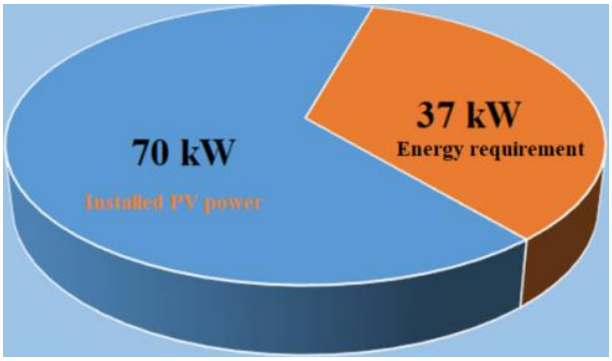

Figure 4. *Comparison between installed power and requirement.*

The diagram in Figure 4 shows that the power installed in the photovoltaic solar panel (70000 Wp) is greater than the current loads of the NST, i.e. 37000 W. This difference will be able to ensure the future energy needs of the center. The National School of Teachers of Mamou electrical network is characterized by: Four (4) 250 A circuit breakers; a 32 A circuit breaker for the departure of lamps, sockets and fans; a 10 A circuit breaker for the lamps; a 10 A circuit breaker for the fans; a 16 A circuit breaker for the sockets and an 800 A 3-way mechanical inverter (0, 1 and 2).

4. Conclusion

This study is a continuation of our research work in the context of the promotion and popularization of renewable energies. It made it possible to know the characteristics of the production and distribution system of electrical energy within the National School of Teachers of Mamou of Mamou. The supply of electrical energy to the National School of Teachers of Mamou is ensured by a hybrid system of three power sources: photovoltaic solar fields, Generator Group and Electricity of Guinea (EDG). The current electrical energy requirements of the National School of Teachers of Mamou are 40 kW. The total power of the installed photovoltaic solar fields is 70 kWp; the Generator used has a power of 10 kVA. Thus, good management and regular maintenance of photovoltaic solar installations makes the National School of Teachers of Mamou autonomous at lower cost and without greenhouse gas emissions.

Abbreviations

NST	National School of Teachers
PV	Photovoltaic

W	Watt
kVA	Kilovolt-Ampere
EDG	Electricity of Guinea

Author Contributions

Ansoumane Sakouvogui: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing

Jean Ouere Toupouvogui: Conceptualization, Formal Analysis, Methodology, Resources, Writing – original draft, Writing – review & editing

Saidou Barry: Formal Analysis, Investigation, Project administration, Validation, Writing – review & editing

Elhadj Ousmane Camara: Data curation, Formal Analysis, Investigation, Software, Visualization

Conflicts of Interest

The authors declare no conflicts of interest.

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