European Association for the Development of Renewable Energies, Environment and Power Quality

International Conference on Renewable Energies and Power Quality (ICREPQ'09)

Valencia (Spain), 15th to 17th April, 2009

Uninterruptible Energy Production in Standalone Power Systems for Telecommunications

E. F. F. Ribeiro [1], A. J. Marques Cardoso [1] and C. Boccaletti [2]

[1] University of Coimbra, FCTUC/IT
Department of Electrical and Computer Engineering
Pólo II – Pinhal de Marrocos, P – 3030-290, Coimbra, Portugal
Phone/Fax number: +351 239 796 232/247, e-mail: **eribeiro@co.it.pt**, **ajmcardoso@ieee.org**

[2] Sapienza University of Rome
Department of Electrical Engineering
Via Eudossiana, 18, 00184 Rome, Italy
tel: (+39) -06-44585762, fax: (+39)-06-4883235, e-mail: **chiara.boccaletti@ uniroma1.it**

1. Introduction

Telecommunication has always been important for society growth and development. It started with smoke signals, in ancient times, and nowadays sophisticated equipments are used thanks to the technological progress. The world would not be as it is without telecommunications contribution. It assumed a basic importance in everyday life, political issues, scientific progress, weather problems, geographic difficulties, and many other subjects. The impact of telecommunication equipment improvement is huge and evident in all society activities.

All the necessary conditions to make telecommunications equipment work properly are achieved, not only doing efforts in this specific area, but also conceiving a robust power supply unit in order to satisfy all its requirements. The basic prerequisites imposed to telecommunications power systems are related to their safety, long life and uninterruptible power [1]. They all depend on a good power system design and predictive maintenance. Other requirements are associated to the electrical characteristics of the telecommunication equipment, such as nominal voltage and its operational range, noise and acceptable ripple levels.

Telecommunication networks were centred at the Central Office in the past. At the present time, new trends are being imposed to these networks by the technological improvements. They are getting closer to users and, subsequently, they are becoming dispersed. This also means new challenges in telecommunications power supply.

Due to recent advances in renewable energies equipments, standalone power systems are getting more and more suitable for this kind of applications. Besides being generated from natural sources and, subsequently, pollution free and naturally replenished, renewable energies are intermittent and this represents an obstacle to a proper telecommunications power supply. To overcome renewable energies limitations, a standalone power system combining different energy sources and energy storage devices seems to be an attractive way to supply telecommunications remote equipment in an autonomous way. Political actions and economical incentives, taking environmental concerns into account, promote this application as the best one to meet the telecommunications needs worldwide. In [2], different architectures are analysed and compared from an economical point of view, in order to get a procedure to select the most suitable solution. It is concluded that a gridline connection is not always the most appropriate solution to supply remote units.

A continuously energy production is the most difficult and important feature to be guaranteed when designing a standalone power system for telecommunications. This paper presents the most important issues in order to attain this difficult aim. Procedures, methodologies and important aspects that should deserve attention in a near future are discussed.

Key words

Standalone power systems, renewable energies, reliability, telecommunications, uninterruptible energy.

2. Factors influencing standalone power systems

Different renewable sources have been through a good development in the last decades. Therefore, their combination would apparently provide a good uninterruptible power system. However, a lot of requirements have to be considered first. It is important to understand all the factors that influence its behaviour,

in order to get the best of it. The most important factors are location, time and user needs (power). Location associates information about climate, energy sources availability and environment conditions. This information is very important to decide what kind of renewable generators can be used. For example, it is important to determine the hours of available sunlight and average wind speed. Time is also an important factor and two different approaches can be adopted (long and small period). In a long period approach, climate changes can assume a cyclical behaviour (e. g. seasons). Also user needs might be seasonal, but this is not the case of telecommunications systems. Instead of following a full/empty hours scheme, they are needed all the year long, therefore the load is expected to be relatively constant. A detailed study of the above factors is the first step to choose the required standalone power system topology and to make the best use of the local potentialities to supply the telecommunications equipment.

3. Sizing standalone power systems

After an in-depth study and an adequate data collection relevant to different renewable sources available in the site, the "ideal" standalone power system topology can be chosen. Another important step is to size the system. A standalone power system sizing depends on the load and on the collected source data (potentialities of the location). Due to the renewable energies intermittent behaviour, this kind of systems has to be oversized. In order to avoid very high costs, an optimisation method should be used and a really good one is described in [3] for a standalone power system that includes wind and photovoltaic generators and a fuel cell. It also calculates the system initial cost.

4. Reliability in standalone power systems

Understanding the factors influencing the standalone power system performance and a good technical and economical sizing is not enough to get an uninterruptible energy production. Once the system is installed and started up, it is necessary to keep the standalone power system at its best performance level. Although requiring lesser maintenance than other power systems (like the ones with a diesel generator, for example) and benefiting from a good reliability, they are composed by fallible units. Maintenance experience and typical failures knowledge are critical to improve standalone power systems reliability. Two areas would benefit from reliability studies: business and engineering. However, there are not so many studies on this subject.

When planning a standalone power system, only initial cost is usually evaluated from a business point of view. This limited analysis is based on an optimistic performance which does not correspond to the actual one. It is necessary to evaluate important factors influencing life-cycle costs, such as operation and maintenance costs. From an engineering point of view, a reliability study is essential to achieve better standalone power system performance. It provides useful information to improve component selection and, subsequently, system design. Operation and maintenance strategies would also benefit from this study.

To perform a reliability study, it is necessary to analyze a few systems with similar components. This is the only way to achieve rigorous and useful statistical results. For each failure and maintenance event, performance data have to be collected, such as system identification, dates of failure and repair, type of event occurred and repair cost. There are different ways for monitoring standalone power systems, such as monthly readings or daily reports with sophisticated instruments. Of course, they are characterized by different accuracy and they can be more or less cost-effective depending on the application. Their importance is not limited to research. In fact, predictive maintenance requires monitoring and it is very important for telecommunications power supply systems, in order to achieve a continuously energy production.

Only a small number of reliability reports are available for photovoltaic and wind generators. The latter has moving parts and requires regular inspections. On the other hand, photovoltaic generators use solid-state technology and no moving parts are required. However, according to these reports, the power conditioning system is the least reliable component. The quality of the DC bus capacitor is the most urgent problem [4].

5. Conclusion

Three important standalone power system aspects have been introduced, assuring an uninterruptible energy production, which is the uppermost requirement of telecommunications power systems. It is indispensable to have a full understanding of how standalone power systems are influenced by external factors related to their remote locations, to size them properly and to keep their performance at the higher level with a suitable maintenance. These subjects will be further developed in the full-paper.

References

[1] D. Reeve, DC Power System Design for Telecommunications, John Wiley and Sons, USA (2007).

[2] M. Vazquez, C. Quiaones and M. Rascon, "Procedure to select the optimised power architecture for a telecommunications network of remote units", INTELEC 1999, June 1999.

[3] D. B. Nelson, M. H. Nehrir, and C. Wang, "Unit sizing of stand-alone hybrid wind/PV/fuel cell power generation systems", IEEE Power Engineering Society Meeting 2005, Vol. 3, pp 2116-2122, 12 – 16 June 2005.

[4] A. Ristow, M. Begovic, A. Pregelj, and A. Rohatgi, "Development of a methodology for improving photovoltaic inverter reliability", Transactions on IEEE Industrial Electronics, Vol. 55, no. 7 pp 2581-2592, July 2008.