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SPECIFIC ISSUES ON THE USE OF MEANS OF MEASURING THE GENERATION "SMART – GREEN" IN ROMANIA IN POWER SYSTEM

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Abstract: Correct measurement of electrical energy in order to ensure consumer protection in commercial transactions and billing is of great importance. Static electrical energy meters have been developed as complex measuring instruments, due to technical changes in recent decades, as well as to meet the increasingly complex demands of electrical energy consumers. These modern measuring instruments - static electricity meters - are used in power system of Romania for various applications. This paper discusses some of the features of static electrical energy meters, belonging to both "smart" and "green" generations. It also represents an opportunity to present an assessment procedure of the behavior at perturbations through influence quantities.

Keywords: static meters, smart, green

1. INTRODUCTION

The classical electroenergetic field is now facing significant changes due to complex modernization and transformation phenomena. These phenomena have led to the emergence of new requirements in the electricity market such as those related to power quality. In Romania you can also find new specific issues, due to the appearance and development of the liberalized electrical energy market. Important transformations in the electroenergetic field have led to important changes in the measurement of electrical quantities [1]. The complex measuring process approached by experts constitutes the solution for quantitative and qualitative information on the electrical energy.

In Romania, the Romanian Bureau of Legal Metrology (BRML) has, among others, the concern of evaluation of the measuring instruments, subject to legal metrological control. Static electrical energy meters are part of this category. Thus BRML issued a large number of model approvals for different electrical energy meters types [2]. These meters provide measurement data that can be integrated in complex electrical energy monitoring and telemetry systems.

The actions for modernization and renewal of the Romanian electroenergetic system, also comprises such meters in the energy metering installations.

Last generation static meters along with other equipment can be put together in complex structures such as specialized telemetry and telemetering monitoring systems [3].

They provide measurement information on the amount of energy transmitted and some information on quality parameters of electricity through an appropriate communication medium.

2. "GREEN" CHARACTERISTICS OF THE "SMART" STATIC METERS

Static electrical energy meters being used in the Romanian power system presents some distinct particularities.

These meters are part of the "smart" metering instruments category. From a conceptual point of view one can visualize them as a "black-box" with a complex structure, incorporated into a single entity of common constructive dimensions[3].

Their manufacturing technologies are in close relation to green technologies: less non ferrous and polluting materials, reduced amounts of materials, modular constructive blocks.

The functions performed by static meters can be grouped into three categories:

- Measuring,
- Database management and
- Data transmission.

The implementation of these specific functions for each type of meter, leads to material and energy savings in the system, and also contributes to environmental protection. From a functional point of view it is worth pointing out the aspect of automatic device calibration. This is done simultaneously, in a special station, without any human intervention in the metering system.

The static meter is a multifunctional device that in the structure of modern monitoring systems plays a decisive role. The specialized systems can perform functions such as those represented schematically in Figure 1.

For the reasons mentioned it can be concluded that a static meter is a "measuring tool for green growth" from the design, performance and service point of view. This may be obvious even for a standard single-phase meter which is the simplest model of static meters.

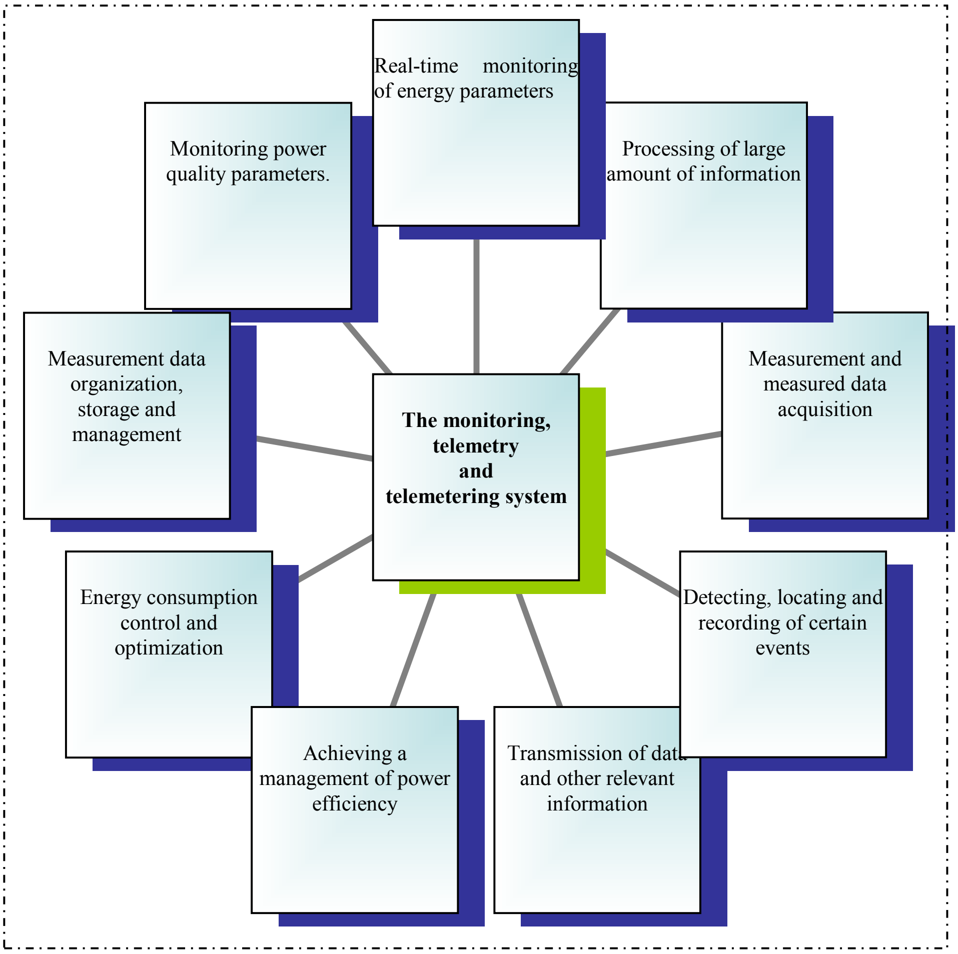

Fig. 1. Functions performed by telecontrol, telemetry and monitoring systems.

3. THE STATIC METERS BEHAVIOUR UNDER INFLUENCE QUANTITIES

The static meter's attributes have led to an innovative approach in the the measurement of electricity.

In the specificity of this approach "measuring instrument for green growth", it is presented a procedure for evaluating the behavior of static meters to deviations from reference values of influence quantities such as voltage and frequency of the supply voltage.

The proposed evaluation procedure is complementary to the method used for metrological verification tests in accordance with the requirements of specific regulations:

- "Electrical energy metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)", IEC 62053-21: 2003 [4];
- "Electrical energy meters for active energy, NML 005-05*"*, BRML, published in Monitorul Oficial al Romaniei (official journal of Romania), no.1102 bis/07.12.2005, with subsequent modification and completions published in Monitorul Oficial al Romaniei no.550/21.07.2008 [5].

It can be considered that this procedure deals with the "green growth" concept through the implementation, because it aims to obtain a whole lot of information from specific metrological checks. This applies to the conditions specified in the dedicated regulations mentioned above. One can also use some data obtained in conditions similar to those of referentials [4], [5], during the metrological verification of electrical energy meters related to voltage and frequency variation from nominal values. The current procedures provide metrological checks to determine the variation of errors due to influence quantities and, respectively, to verify whether the results obtained are within the limits provided in these documents.

The evaluation procedure proposed in this paper aims to determine the percentage error, the percentage error variation and the use of data to obtain information on that meter's behavior under different conditions of influence quantities. With that in mind, the data graphic looks like this:

$\varepsilon = f(I)$, showing the evolution of percentage errors according to different values of the current flowing through the device, with $\cos\varphi = 1$ or $\cos\varphi = 0.5$:

- $\varepsilon_{ref\_cos\varphi=1}$ – percentage error determined in reference conditions with $\cos\varphi$=1;

- $\varepsilon_{ref\_cos\varphi=0.5}$ – percentage error determined in reference conditions with *cos φ*=0,5 ;
- $\varepsilon_{u+\_cos\varphi=1}$ – percentage error determined in conditions with +10% voltage variation from nominal value, at *cos φ*=1 ;
- $\varepsilon_{u+\_cos\varphi=0.5}$ - percentage error determined in conditions with +10% voltage variation from nominal value, at *cos φ*=0,5 ;

I – intensity of electrical current flowing through the device.

Also there can be represented diagrams of the form:
$\Delta\varepsilon = f(I)$, showing the evolution of percentage error variation for different values of the current through the device.

In Fig.2, Fig.3 there are presented, for the standard, single phase, static meter, mentioned above: the graphical representation of the percentage errors variance due to +10% voltage variations from the reference voltage (DIN direct connection version), and respectively, graphical representation of the percentage errors variance due to voltage deviation from the reference voltage with +10% (BS direct connection version).

Constructively, the static single-phase meter, has two direct connection versions mentioned by the producer DIN or BS, with some additional features that can be performed.

Similarly, one can design graphic representations of percentage errors evolution due to -10% voltage variation from the reference voltage (both DIN and BS connection type versions).

Fig. 4 also presents, for the same single-phase static meter, the diagram of percentage error variation due to voltage deviation during the active electrical energy measurements. For this representation there were considered the percentage errors due to voltage variations from the reference voltage by ± 10%, both at *cos φ* = 1 and *cos φ* = 0.5.

The Fig.2, Fig.3 and Fig.4 graphical representations highlight the meter's behavior under different conditions and facilitate the analysis of the errors evolution and the errors variation.

These types of graphic representations may have different uses:
- Choosing the device type in relation to the existing conditions in the implemented measurement facility;
- Assessing the future behavior of the meter in certain operating conditions.

The results obtained by using these graphics show the adequate and relevance character of the proposed solution, because it may reveal the performance of static meters. It is considered that the percentage errors assessment procedure referred to in this paper, contributes to highlighting the changes in the static meter's behavior at influence quantities variation.

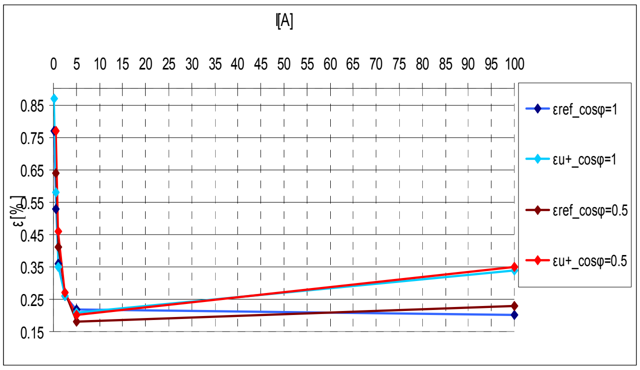

Fig.2. Graphical representation of the percentage errors variation due to +10% voltage variation from the reference voltage (DIN connection version) for a standard single-phase static meter.

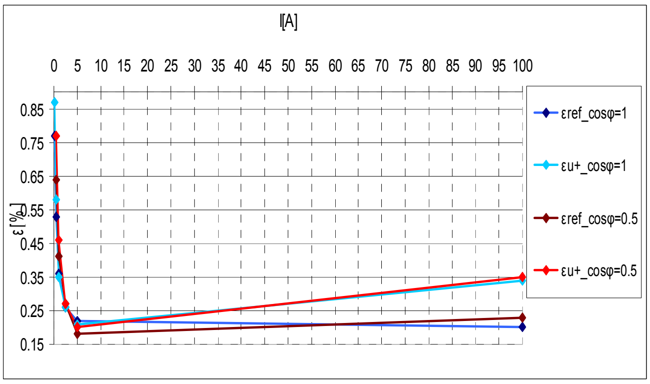

Fig.3. Graphical representation of the percentage errors variation due to +10% voltage variation from the reference voltage (BS connection version) for a standard single-phase static meter.

4. CONCLUSIONS

This paper presents a new approach regarding the performances of the static electrical energy meters, part of the "smart – green" generation.

The modern monitoring systems including static electricity meters perform the default „classical" measurement function as well as the recently acquired new function, for monitoring power quality parameters. Measurements conducted using the latest equipment gets new values, appropriate to current requirements.

It also proposes an evaluating procedure for the static meter's behavior to deviations from reference values of influence quantities, that can be used by different entities (authorities, users).

The proposed assessment procedure allows the use of suitable devices for a particular environment. The procedure can also be used to perceive the percentage errors evolution for every device type in certain situations ($\varepsilon = f(I)$ curves) and also can track the future evolution of the percentage errors for certain existing operating conditions. Also the procedure can be used for quantitative appreciation of percentage errors variation (using $\Delta\varepsilon = f(I)$ diagrams).

We note as an original contribution, the possibility to use the results from tests, carried out in conditions specific to relevant normative documents [4], [5], to obtain as much information to help improve the concept of "measuring instruments for green growth".

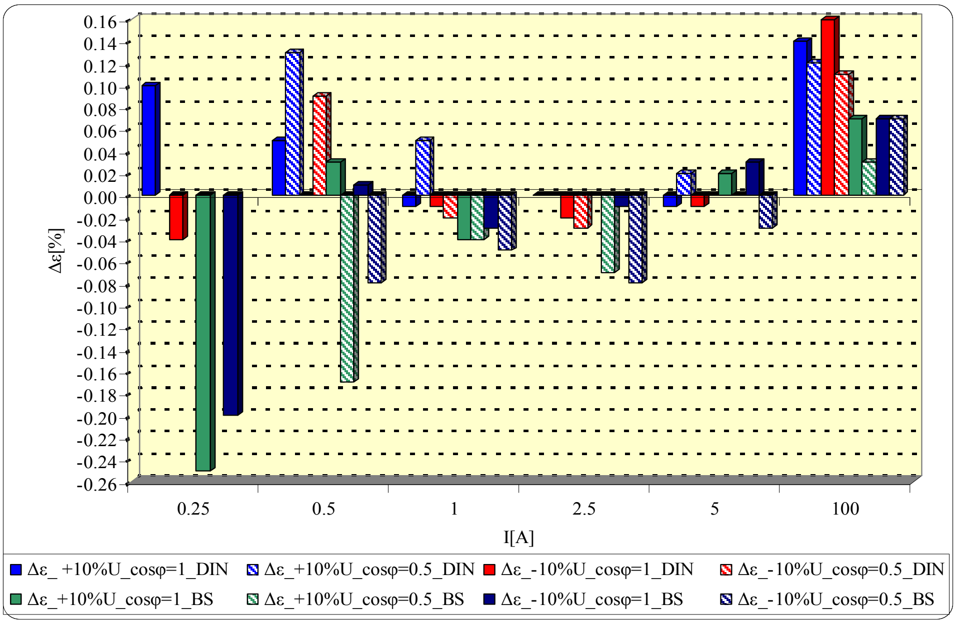

Fig.4. The diagram of the percentage errors variation due to voltage variation from the reference voltage, during active power measurements for a standard single-phase static meter.

5. REFERENCES

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