

ICPE ACTEL CUSTOMIZED EQUIPMENT TO IMPROVE EFFICIENCY POWER SYSTEMS

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Rezumat. Beneficiind de experiența de peste 60 ani în domeniul acționărilor electrice de mare putere, societatea icpe actel oferă soluții personalizate și echipamente pentru controlul și reglarea proceselor industriale din domenii ca: generare și distribuție energie electrică, forajul marin și terestru, industrie, centrale solare fotovoltaice, agricultură, transporturi, etc. Soluțiile la cheie și echipamentele de acționări electrice realizate de icpe actel, bazate pe electronica de putere, pe tehnici de control numeric, sisteme moderne de achiziții de date, precum și automate programabile, asigură o eficiență energetică sporită pentru fiecare domeniu amintit.

În lucrare sunt prezentate câteva dintre abordările științifice și profesionale ale soluțiilor icpe actel în domeniul surselor de energie insularizate, în domeniul convertoarelor de putere alimentate atât de la aceste surse, cât și de la rețeaua publică de energie alternativă și în domeniul managementului energiei electrice pe fluxul producător-consumator, abordare având un scop foarte precis, eficiența energetică, o preocupare permanentă a activității societății icpe actel.

Cuvinte cheie: sisteme de acționări electrice de putere, eficiență energetică.

Abstract. Based on 62 years of expertise in the field of power electric drives equipment, ICPE ACTEL Company offers customized solutions and equipment used to control the industrial processes for power generation and distribution, offshore and onshore drilling, industries, solar photovoltaic plants, agriculture, transport, etc.

The turn-key solutions and power electric drives equipment made by ICPE ACTEL, based on power electronics, numerical control techniques, modern data acquisition systems and PLC assure a high energy efficiency for each mentioned filed.

This paper presents a few scientifically and professional tackling ICPE ACTEL's solutions used as isolated power sources, as power converters supplied by this sources and by electric main, too, and for the energy management from producer to user, with high energy efficiency, a permanent preoccupation of ICPE ACTEL' activity.

Keywords: power electric drives systems, energy efficiency.

1. INTRODUCTION

Chronologically, drilling rigs had as technical solution in terms of primary energy input in the process, two construction options:

-drilling using thermal sources, where the technological equipment (drawwork, rotary table, mud pumps) is driven by a heavy-oil engine, usually cracked gasoil or natural gas. This solution is used for the small drilling rigs (up to 100 ... 120 tones power rig), but also for higher drilling rigs with low efficiency;

-drilling using electrical power sources, where the same equipment is driven by D.C. or A.C. motors supplied by A.C./D.C. converters, respectively A.C./A.C. converters from the same sources.

Depending on the generation type of supply sources energy, they are classified into:

-isolated power supply from diesel-generator-sets;
-high voltage supply from the public electrical network.

Irrespective of the solution, the main issue of the designer, manufacturer and users of the drilling rigs is

the total efficiency of the product called drilling rig, as of the ratio between work and energy consumption in the total drilling activity.

Moreover, when the power source is the public electrical network, an additional problem appears related to international quality energy standards, namely: how to do the dynamic processes of drilling as result of using static power converters, not to influence the power supply and also the others users.

The concerns of the ICEP ACTEL's specialists have resulted in solutions that respond to the challenges of the two problems mentioned above; in this way, we try continuously to highlight the qualitative and quantitative benefits of our solutions.

2. ISOLATED A.C. POWER SUPPLY

The most used power station supply of the drilling rigs is an A.C. micro power plant consisting of 2 ... 6 diesel motor - generator sets operating on the same bus - bar.

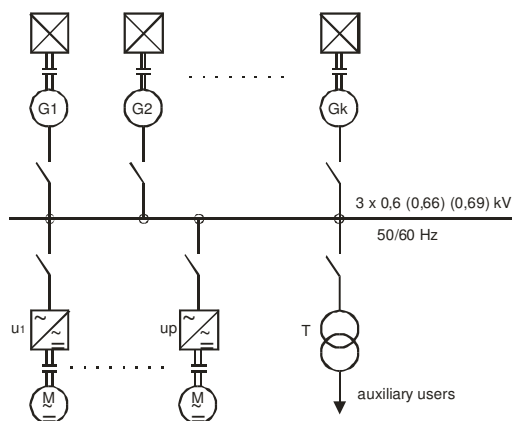


Fig. 1. The diagram of a A.C. micro power plant for electrical drilling rig.

In practice, the power requirements demanded by consumers $u_1...u_p$ and auxiliary consumers is random variable in a dynamic regime hard to be associated with mathematical and/or physical model, for this reason the drilling operators couple manually a number of generators to the bus-bar in order to provide power system cover to the most difficult condition in terms of consumer needs.

The result is a waste of fuel, due to the difference between constant installed power P_i and variable used power P_c , having the permanent condition:

$$P_i \geq P_c \quad (1)$$

noted by $\Delta P = P_i - P_c \quad (2)$

In a graphic according to time $\Delta P = f(t)$, our practice emphasizes the following evolution: (fig. 2).

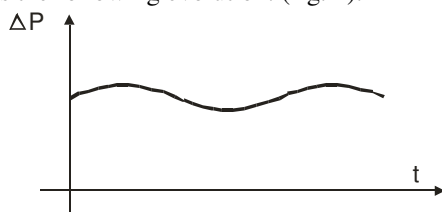


Fig. 2 Evolution of power (fuel) losses for the classic solution

The losses of power (fuel) for the power supply are:

$$\Delta W_a = \int_0^t \Delta P(t) dt \quad (3)$$

Minimizing ΔW_a is the first aim that ICPE ACTEL's solution has proposed, whose evolution in time is as follows:

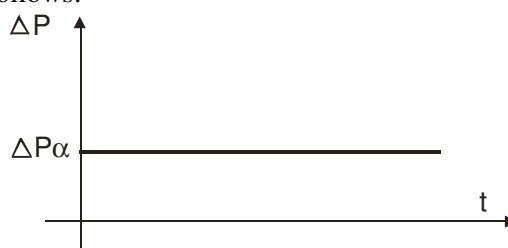


Fig. 3. The losses evolution using the proposed minimizing solution.

2.1 ICPE ACTEL SOLUTION, TYPE PMS (POWER MANAGEMENT SYSTEM)

The schematic diagram is represented in Figure 4.

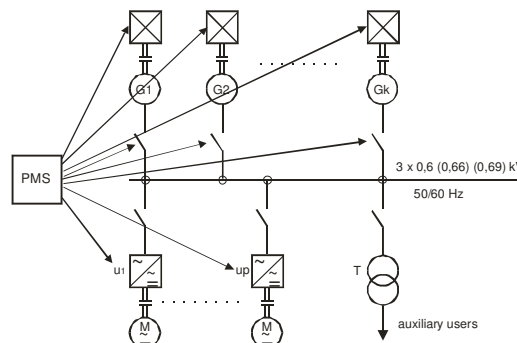


Fig. 4. A.C. micro power plant with PMS.

PMS concept highlighted by hardware and software equipment has the following functions:

- coupling and decoupling the diesel-generator sets, in function of load;
- automatic synchronization of each generator running at the same bus bar;
- automatic equalization of active and reactive power of parallel running generators;
- limiting the power of the consumer in case of overcoming P_i ;
- automatic protection at inverse power for each generator.

Fuel savings achieved by the introduction of PMS for offshore platform using as power supply 5 diesel-generator sets CAT 3512 were about 16 % from the solution without PMS.

2.2 ICPE ACTEL'S ENERGY EFFICIENCY SOLUTIONS FOR THE SOURCES USED IN ELECTRIC DRILLING

A delicate technical issue, but very important in terms of improved efficiency drilling rigs, is to reduce power converters influence on power supply.

Theory and practice confirms that power converters influence on the quality of supplied energy from power supply translates into:

- voltage and current additionally harmonics in the supplied energy of the consumer devices according with power converters;
- reactive energy flow due to variable speed of electric motors on the drilling rig.

From a quantitative perspective, additional harmonics produce additional losses that reduce energy conversion efficiency of power supply into work at the technological equipment on the drilling rig, dedicated to exploring oil and gas resources.

Also, the circulation of reactive energy to solve energy drilling process produces additional losses in the current paths, losses that reduce the conversion efficiency mentioned before.

ICPE ACTEL developed solutions are depending on the type on the electric motor of technological equipment on the drilling rigs.

2.2.1 SOLUTION FOR DRILLING RIGS WITH D.C. MOTORS

The solution is coupling the same bus - bar of a filtering and compensation in steps equipment, the command having tracking a power factor regulator (figure 5).

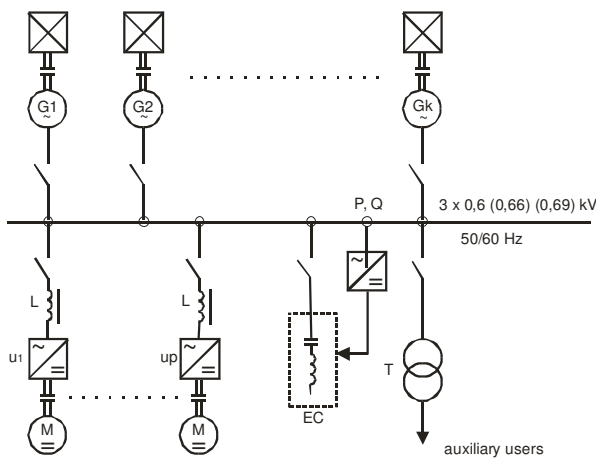


Fig. 5. EC/DEC solution with compensation equipment and harmonics filtering.

2.2.2 SOLUTION FOR DRILLING RIGS WITH A.C. MOTORS

The advantage of this solution (figure 6) is the existence of the D.C. intermediate circuit in the structure of the A.C./A.C. converters used for the motor M_j control, that provides the reactive energy needed through C condensers, so that the medium power factor obtained under this conditions goes to a high value ($\sim 0,9$).

Harmonics filtering is achieved by ingenious supply solution by transformers T_p , whose each secondary wiring have the angle of phase difference of 15° . According to the number of transformers are obtained $6p$ pulses solutions: as the number p is bigger, so both THD_u and THD_i become smaller, which removes all harmonic filters from the previous solution.

From our estimations, on the drilling rigs of the Romanian contractors heritage, the savings achieved with this type of solution is about 12% compared to the classical ones, old, in which there weren't considered some issues.

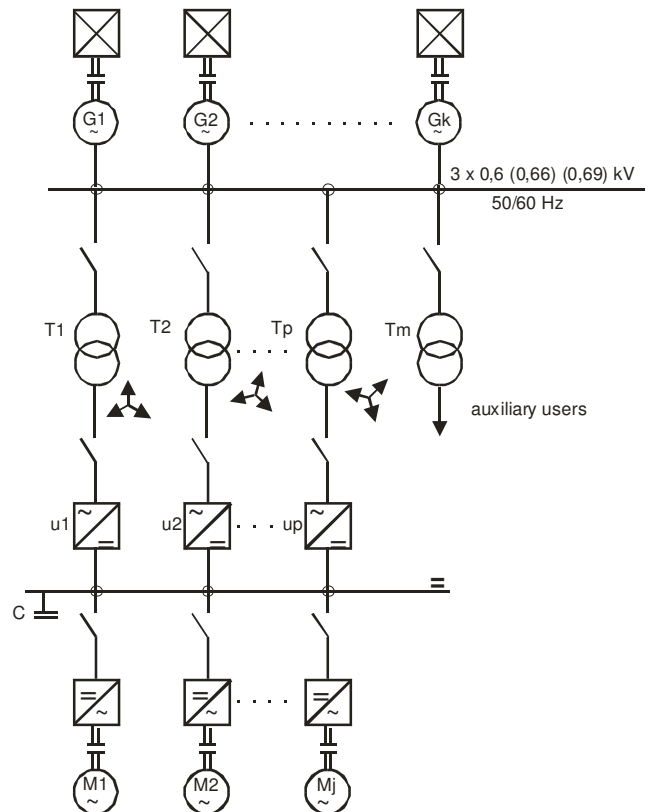


Fig. 6. EA/DEA solution.

3. CONCLUSIONS

The concerns of ICPE ACTEL's specialists in energy efficiency solutions developed in different fields are part of a general policy in the management of this company.

The paper has presented some of the theoretical possibilities, validated by practice in order to obtain significant savings by increasing efficiency of electric drilling rigs.

Quantification of these economies demonstrated a amortization of investments in such equipment in less than 12 months of continuous use.

This demonstrates once again the role of designers and researchers in developing ICPE ACTEL competitive solutions, efficiency energy in a period when the general policy of each activity if efficiency.

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