A TACKLING MANNER CONCERNING THE POWER SYSTEM PARTICIPATION TO THE ENERGY MARKET

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Abstract: By definition the power system is an integrator system: the system activity on the whole techological chain can be tackled in the same integrator and pragmatic manner which to allow the investigation of any side.Presently, any power politic has three fundamental elements: security of the energy supply, compatibility with the environment and competitivity.
Obviously, the energy market creation have no contribution to increasing of the energy supply security because:

- the market encourages a short term interests while the security assurance of the energy supply asks a long term approach.
- the market by the utilisation of the cheapest solution of energy represents a danger for the economic balance on the long term.

In this paper are tackled the elements concerning the behaviour in operation of the automation and protection equipments, the framing of the power plants in the loads curve and the system services integration as part as the safety of the system activity.
This paper has like the basic reference an experience in the infrastrucure of the production, transport and distribution system over thirty years, paper which is detailed by all teaching staff from the Electrical Power Engineering department, within Valahia University of Târgoviste.

Keywords: power system, generated power, reliability, load variations

1. INTRODUCTION

By definition Power System is an integrator system; all working problems: stability, reliability, security so quality from producer till to final user have to approach in a integrator and synchroniyed manner.
The central objective for the integration of the Romanian Power System in UCTE is the safety grant in the keeping conditions of a dimension criteria n-1, for a simple variant thus:

- The system remains unitary;
- The systems passes in a steady-state regime with normal and stable parameters;
- Conditions and contracts aren't affected, concerning the power transfer by the National Power System;

this dimensions criteria is fulfilled when the generated power in a area can be transported in the outcome conditions of an element from the transport electrical networks, keeping the working normal limits;

- The unitary power of a group hasn't to be bigger than 2-3% from the system load in any moment of the load curve.

Major requirements of the Power Szstem working must led at the following:

- the reactive power sources distribution in the szstem has to be realiyed in manner that can prevent the equalizing evolution between different areas of the system, on long distributions networks that can involve great breakdowns and will decrease the transport capacity;

- the reactive power of the generator and synchronous compensator must be enough to attain the reactive load of the system and power losses in power networks at frequency voltage and assessed voltages;
- the available active power of the power station must attainin every moment the active loads and power losses in power networks at frequency voltage and assessed voltages.

2. THE BEHAVIOUR OF THE PRIMARY TECHNOLOGICAL EQUIPMENT

In the case of a big perturbations, in the system there are the load modifications having a decisive role in the re-establishment of the equilibrium and finally of the primary parameters of the power quality (tension and frequency). The decisive role, have the groups behaviour from plants, dued to the frequency modification and so, the active power.
By its regulations, the groups from the system have to react at the fast and big changes of the fundamental parameters in the sense of their contribution with the excess power which is provided for the primary control in the useful time.
If behind the perturbation and interference, the primary regulation of the power doesn't establish at a nominal value, then interferes the secondary regulation (active power- frequency) and the groups which are necessary for this operation, will interfere in the frequency establishment at the desired value preveded by the central regulation.
The errors from the equilibrium between the production and consumption which drive to a difference between the network frequency and desired value are compensated in the first moment by kinetic energy of the rotary masses of the generator groups and the proper services aggregations, then with another time constant are driven the primary regulations of the groups working in the primary regulation.
The regulation systems of the speed, indifferent to their type which equpiped the hydraulic and thermic turbines of the little and mean power as well the modernized electro-hydraulic turbines, don't correspond largely from insensibility point of view.
Any automatic regulation system in any technological process can't work than in the limits 2-3% being dependent by other maximum and minimum 2 limits which are existent in the process at the respective moment.
Aside from these limits caused by fast partial or total load variations, on a zonal consumption or on proper services affects the operation of the whole technological process of the group, thus can operate the automatizations and sequential, partial and total technological protections.
The behaviour analysing in operation only for regulator isn't relevant because in the behaviour of the whole group appear the regulation of the primary fluid by many input sectors (steam or water) of the oiling oil pressure, which is dependent exponential by turration, the packing –oiling system, the active power control and finally by the control of the measures of the electric power quality to the output from group.

3. RECOMMANDATIONS REGARDING OPERATIONAL BEHAVIOUR IMPROVEMENT OF THE POWER PLANT AND THE LARGE INTERCONNECTION POINTS

In case of disturbances which produce the big load variations, an important role in balance establishment has the behaviour of the stations adjusment groups, which has to react on fast and big changes.
The rate charge of the bloc depends by boiler and turbine types and the vapor-water circuit. Used averages in countries with developed power energy are presented in Table 3.1.

Table 3.1

Fuel type	Fuel oil Gases	Coal	Nuclear
Bloc working area (%P_n)	$40 \div 100$	$40 \div 100$	$40 \div 100$
Charge average procent $\frac{P_{en}}{P_{medie}}$	$8 \div 12$	$4 \div 8$	$5 \div 10$

System groups have to allowed collateral connections with the network, if the frequency of those is in $58 \div 51{,}5$ kHz area. At fast and big frequency variations, the groups must react in primary adjusment band with power variation speed shown in Fig.3.1.

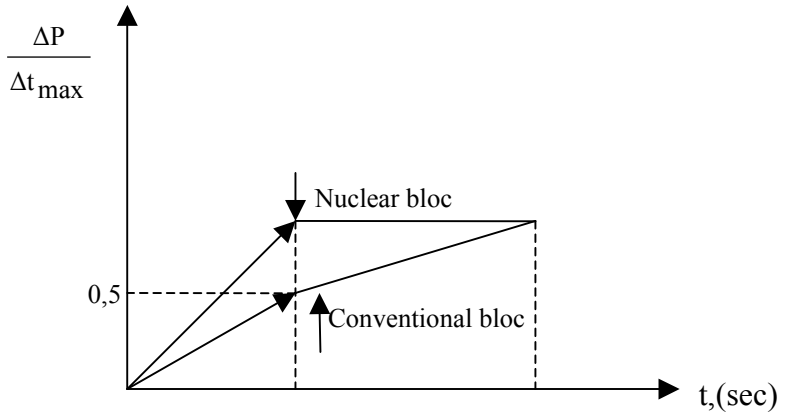


Fig.3.1. The variation speed of the power groups

It is necessary that these power changes have to be achieve in both directions in ±5%P_n area (Fig.3.2.).

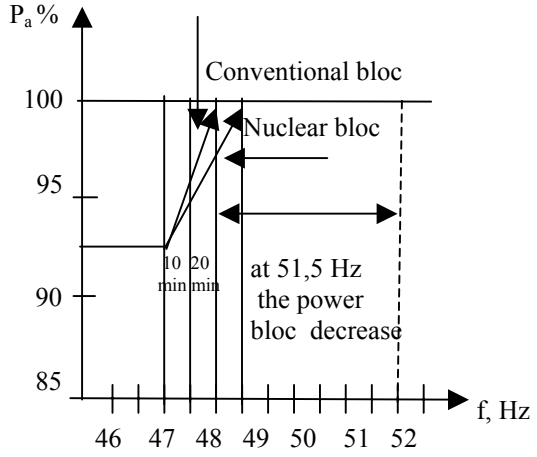


Fig.3.2. Working area groups at variable frequencies

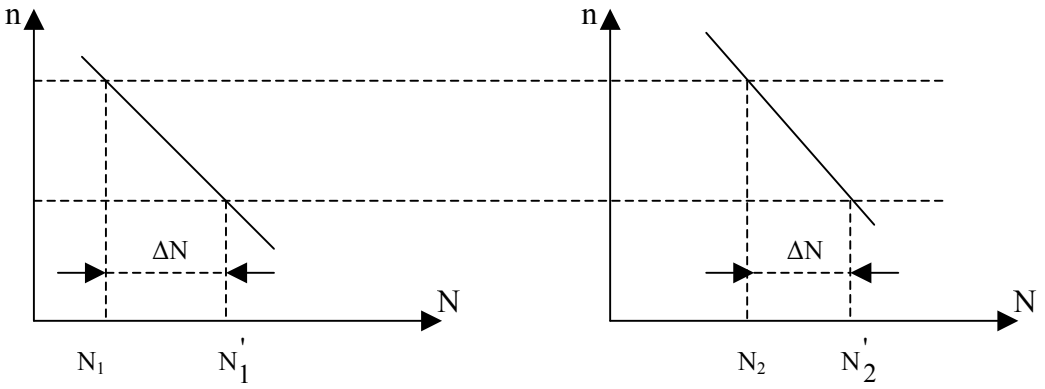
Accumulated and lived experience shows that at an instantaneous appearance of an source and consuming major imbalance, correlative with load characteristic, appear variations with a certain decreasing frequency speed $\frac{df}{dt}$ even a frequency racing $\frac{d^2f}{dt^2}$ which can bring unexpected actions of the technological protections and even groups beraking. In this manner the working stability is very affected.

Keeping under control the perturbation has come from such an event impose the existence of an enough primary supply, easy to hand and placed on working unities assembly. The power distribution on collateral aggregates is related to every group offset characteristic.

In two groups cases which are operated collaterally and have the offset characteristic, as shown in Fig.3.3, the load charge is distribuited between offset characteristic inverse proportional groups.

The groups that work at base load in constant manner of operation is necessary to have a large offset characteristic, and in alternative regime the peak groups is necessary to have a small offset characteristic. Is for noticed that an offset characteristic can led at functioning instability and can causethe power variations which can't be easily damped.

Active power primary adjusment must be able activate 2,5% minimum primary adjustment reserve from all instantaneous power of plant. In that case the primary adjusment reserve uity must be fast activated in 5 seconds and the reserve in 30 seconds in case of a frequency deviation.



Big offset characteristic Little offset characteristic

Fig.3.3. The offset characteristic

Because replay time must be lower as possible, is necessary that the power variation should be equally distribuited on many as possible blocs with smaller as possible power for each of the blocks.
The offset characteristic define through:

$$S = \left(\frac{\Delta f}{f_s}; \frac{\Delta P}{P_n} \right) \cdot 100 \tag{3.1}$$

is a value that shows the relation between power and frequency variation.
System offset charactersistic variations are according to turbine type thus: (4-6)% units from classical plants (4-8)% units from nuclear power stations, (2-6)% units from hydroelectric power stations.
Resultant system offset characteristic must be S<12% with the following expression:

$$S = \frac{1}{\frac{\rho}{S_g} + \frac{1}{S_c}} \tag{3.2}$$

$$\rho = \frac{\sum_{1}^{n} P_{ni}}{\sum_{1}^{n} P_{ci}} = \frac{P_n}{P_c} \tag{3.3}$$

in which:
P_{ni} - the power rating of the group
P_n - the power rating of the active group
n – the number of groups that works at a certain moment
P_{ci} – the active power absorbed by consumer
P – the reserve factor, $\rho=(1,1 \div 1,4)\%$
These relations show the generators participation way which adjust the frequency using RAV (speed automatic regulator).
Is to mentioned that at (48, 5-51,5)Hz frequency, the groups must be capable to supply the nominal active power and at least 95% from the groups must supply at 47,5 Hz. In these conditions, accumulated operating time is:
20 min at a frequency of f=48, 5…48Hz ; 10 min at a frequency of f=48, 0…47,5 Hz, one hour per year.
Those requirements must be realized only if voltage drops at $85\%U_n$. If from different causes a frequency increase appear, is necessary that at frequency bigger than 51, 5 %, the power bloc must be automatically or hand reduced, operation that will be correlated with frequency decrease in resonable limits.

4. POWER PLANT SIMULATION

According to the responsabilities of certain groups in system concerning the frequency control, it can consider the following the variants of diagrams thus:

1. the working diagram "turbine drives the cauldron" where the power error is the input variable for the adjusment group of the steam pressure in head of turbine and the pressure error is for the command of the cauldron load;
2. the working diagram "cauldron drives the turbine" in which the power error is given to the command input of the cauldron load, and the pressure error is given for the adjusment of the steam pressure in head of the turbine;
3. the working diagram "the combustible drives the bloc" is used in all situations in which the application of two presented variants isn't possible, because anyone from two variants can't assure the active power deficit from the system; in this diagram is used the maximum fuel flow which is disponible .

5. CONCLUSIONS

In this paper it was analysed a few aspects of working of the National Energy System in concordance with the requirements of the power market concerning the quality conditions.
These aspects impose the nominalization of an ensemble general competencies, the competencies of general speciality and the competencies of net speciality on all technological flow: generation-transport-distribution.
Is necessary to take into account the analyze problems of stability and safety problem when 706 MW Number 2 Nuclear Power Station will be given in function. Is considered to be necessary the analyze and speeding the process to accomplish 1000MW Pumped Storage Power Station for achieving power transfer from goal load to peak load.
The authors are certain that don't try to set solid some specialized compartments can be improved the environment-power relation, but thru qualitative changes in technical-economical-ecological manner of thinking, and thru responsibility in the future of the present actions.
The registered events in period the realization of the power system from country and also from another developed power systems, impose the re-analysing of the last phenomenons registered by system history, the definition of a diagnosis for it doesn't repet the anterior mistakes.

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