EXPLORING ENERGY SAVINGS FROM VARIABLE DRIVING APPLICATIONS AT ONE HPP

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REZUMAT. In domeniul centralelor hidroelectrice CHE utilizarea acționărilor variabile din rețeaua serviciilor interne RSI, poate constitui o sursă viabilă de economisire energetică. Astfel, analiza atentă a structurii consumatorilor din RSI duce la concluzia justă privind regimul adecvat de antrenare a diverselor mecanisme mecano-energetice la viteze mai reduse atunci când CHE nu este lestată la parametrii nominali. În acest sens, convertoarele de frecvență CF pot fi de utilitate certă în acționările de durată la viteză variabilă pentru consumatorii oprerând de durată , precum pompele apă de răcire; pentru consumatorii de scurtă durată precum pompele de ulei sau apă-epuisment sunt mai potrivite acționările prin soft startere SSt. În acest fel, utilitatea investiției in dispozitivele electronice de putere este evidentă şi poate fi amortizată convenabil.

Cuvinte cheie: consumatori de servicii interne, centrale hidroelectrice CHE, convertoare de frecvență CF, softstartere SSt

ABSTRACT. In the field of hydro power plants HPP the use of variable drivings could be significant in energy savings. In this respect, one carefully conducted analysis will show the adequate regime of slower speed devoted to the ancillarry consumers when the HPP is not loaded at its rated parameters. In this respect, the frequency converters FC could be helpful for the ancillary operating during long range regimes, as cooling water pumping; for the ancillary consumers driven only for short period of time like pressurized oil pumps of water sewage drain, could be sufficient drivings which are using soft-starters SSt;. In this way, the new investment at one HPP could be useful, being recuperated at acceptable rate.

Keywords: ancillary consumers, hydro power plants HPP, frequency converters FC, softstarters SSt.

1. INTRODUCTION

Nowadays, the HPP also stands like the single reliable supporter as storing energy system, industrial scale, on both regimes of turbining – pumping / generating – motoring/TURBINING.

One purpose of the paper is to carefully investigate firstly the family of auxiliaries involved into one classic HPP, and later to decide which of these could be the next candidate to be driven at variable speed with some modernizing efforts through frequency converters FC or only soft-starter-soft stoppers SST.

2. CONSISTENT ENERGY SAVINGS TO COME FROM THE INNER ANCILLARY NETWORKING SYSTEM

One HPP's simplified typical electric wire diagram - medium rated power, is shown into the above fig. 1; the key role is played there by the internal network of these auxiliaries, sustaining the stable running of entire machines' room, the hydro-generator units, denoted as G 1,2.

When you have glance around the ancillary network into the HPP, the immediate conclusion is that old method of throttling is not the right answer, fig. 2,3. It is a very onerous operational mode and, therefore should not be reccomended.

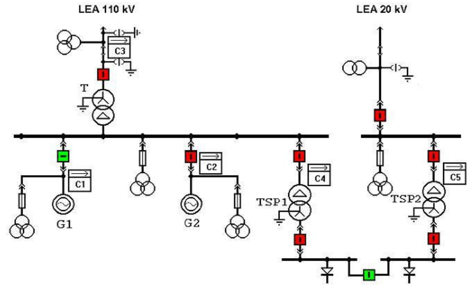

Fig. 1. The single line electric lay-out diagram for one HPP of medium rated power analyzed with the main injection to the external power grid 110 kV, via the step-up transformer T, while only some small amount of generated power is backed into the internal network to feed the HPP's auxiliaries through the step-down transformer TSP1, 250 kVA, 6/0.4 kV.

So, we do have to take a short look toward variable electric supply offered by the newly introduced power electronic devices, supervised within the limits imposed by the digital control loop, in order to cut down firmly the inner technological consumption.

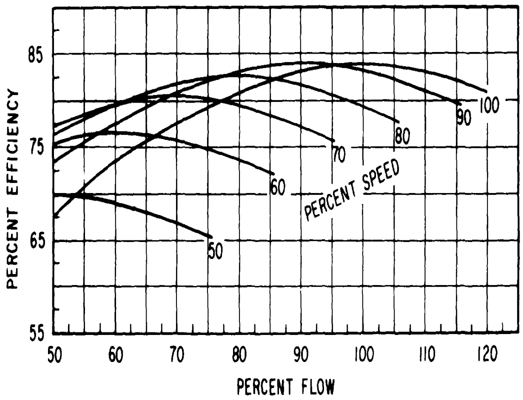

Fig. 2. System characteristics showing important loss in efficiency with flow controlled by speed regulation, as usually is recommended today, at the focused HPP *Pangarati*, rated 2·11 MW.

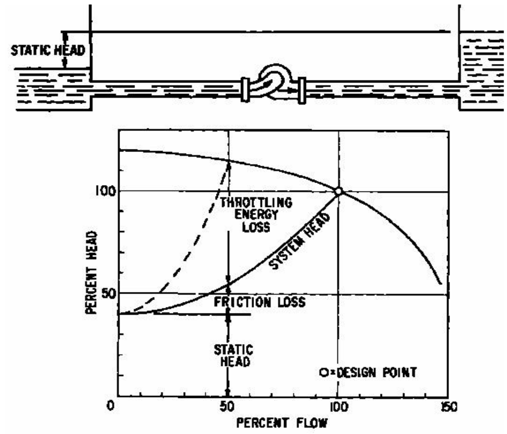

Fig. 3. Centrifugal pump P characteristics with proposed improved efficiency at lower adjustable driving speed coming from the frequency converter FC and the induction electric motor EM.

3. THE MODERN POWER ELECTRONIC DEVICES FOR VARIABLE DRIVEN AUXILIARIES AT ONE HPP

The further developed analysis will show, *the useful line of energy savings*, will continue within variable driving as well as into the acquisition of better motors for pumping or compressor units, [1,2]. In this respect, were analysed two kind of different HPPs, of classic concept-design. *How's to be done this?* Simply, following the power electronic devices into the classic HPP houses: frequency converters FC + Soft-Starter/Stopper SSt.

3. ONE TYPICAL ANCILLARY INVESTIGATED REGIME, E.G. THE COOLING WATER PUMPING

Into the below figure 4, we have already taken into account the curve H(Q) – the graphic characteristic of pumping height H[m_{H2O}] and flow Q[m^3/h], done for the pumping unit – by the manufacturer [5].

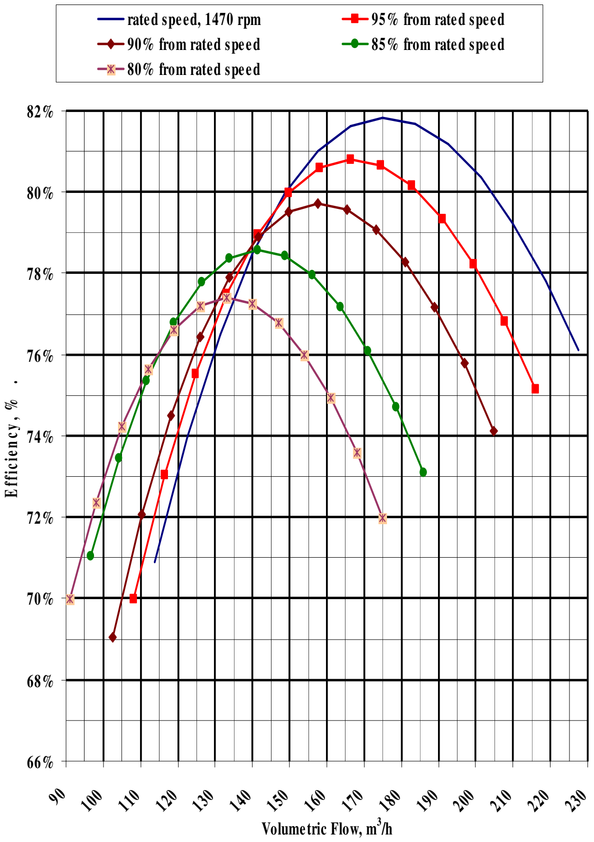

Fig. 4. The efficiency variation for the pumping unit, versus the pumped water flow and speed variations, different values.

These quite newly introduced modern devices into the HPP's domain allow us to deliver *as much as needed rotational speed* (energy) to the pumps or fans units from the 1st category of auxiliaries, in order *to better cope with the real need of cooling* or ventilation; this is to be performed in direct correlation within one automatic system to control step-by-step the output flow rate, in direct relation with the amount of heat to be extracted from the power hydro-generator's – either copper windings + iron magnetic circuits working at variable loading, also from the oiled bearing system (sensible at temperature), step-up transformers etc.

Into the figure 5, from below, for the same simple focused case of a pumping unit supplied via the inserted frequency converter FC, the absorbed power is sensible reduced and, from here, we can see clearly the opportunity and utility for these power electronic devices.

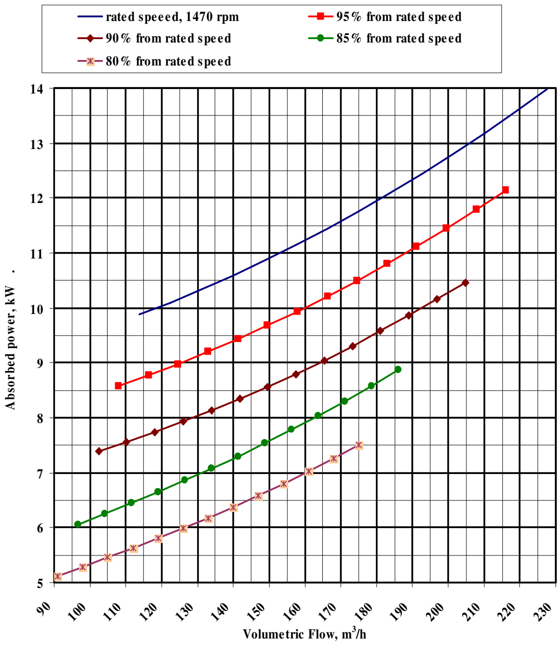

Fig. 5. The variation in absorbed power by the focused pumping unit, versus the pumped water flow and speed variation controlled for different steps: 100…80% from its rated speed of 1470 rot/min.

5. ATYPICAL INVESTIGATED REGIME FOR ONE POWERFUL PUMPING STATION PPS/HPP'S COMPLEX SCHEME

Herewith it is presented and also proposed an up-to-date concept for a non-typical powerful storage pumping systems, having its operation involved into one complex assembly, hydro-electric power system, PPS + HPP. It consists about the modality of hydraulic system's operation changes for variable speed instead of constant one; instead of acting on the throttling valve with constant rotational speed of the hydrodynamic pump, it is proposed the *controlled speeded operation.* This is to be performed through a converter-fed a.c. electric motor or, even cheaper, back-to-back within the neighboring supplying scheme - which delivers the necessary variable speed to the turbo-pump. The driving answer could easily come from the local power electric side, sensible to the aspects of overall improved efficiency.

This motivation may be explained very eloquent on the characteristic curves at the hydraulic system (the remote powerful pumping station PPS to be driven, is rated 2·10MW, 6/110kV; 2·3m^3/s, 1.000 rot/min). There are used, e. g., the plotting of the head-capacity curves of the centrifugal pump and the hydraulic network (mainly composed from a piping system, already highly pressurized so, carefully to be managed).

The initial data considered here, power hydraulic part, are: the configuration of the hydraulic system (the rated parameters of the pump and the specific geometry of the hydraulic network). Also there are known the M-maxima and m-minima water levels in the upstream and downstream reservoirs (natural or anthropic lakes), between which the piping system and the pumps make the connection, all done for *storage energy* reasons.

The initial data - power electric part, are: the present configuration of the 110 kV zonal electric power grid is linking the two machines involved.

Note, that fact - the rated parameters and the MW ratio generator / motor are already favorable, together being coupled in a back-to-back supplying scheme, just to release continue adjustable speed required by the hydraulic part, in order to gain the maximum efficiency–at the lowest possible price.

From our knowledge in the hydro-power field, this stands as an *worldwide unique case* of application.

The turbine-generator rated 24 MVA from the hydro power plant HPP - in aiming its new goal – is to change a little and adopt one special tailored power electric scheme: the simple bus bar is to be sectioned in two, one generator - remaining linked at fixed frequency via the downstream line, as before;

The other one hydro power unit in question is thought to work independently at variable frequency, at islanding conditions, via the upstream overhead 110 kV line, in feeding with its output the PPS, considered to be medium remote – located (average medium distanced, 30 km).

The process of solving this problem offers the operation parameters for every level difference between the two lakes. Especially important are the extreme levels.

For maximum and minimum heads there are established the respective rotational speeds using similitude criteria of the pump. The hypothesis of quasi-static hydraulic regimes of operation was herewith maintained.

The results, the maximum and minimum rotational speeds of the pump, gives the right interval of speeds necessary mainly to be kept on the HPP' side from its automatic frequency control (and voltage, too).

This is delivered from the hydro electric power generator to the remote motors at the PPS, just to meet at the best the overall efficiency for the pump's operation in this back-to-back local electric scheme, via the 110 kV line.

If the control is slow the quasi-static approximation of the transients is valid.

However, through the above proposed method, the new stationary regime of the pumping system has an effectiveness, namely a gain, which depends on the inclination of the long axis of the equal- efficiency curves (the ridge of the universal characteristics) – in head - capacity plot – and also from the steepness of the network curves.

The peculiarity of the hydraulic system studied here is that the network is changing not through throttling but with level differences between the two reservoirs.

So, the classic gain in efficiency is higher if the above mentioned axis (ridge) is more inclined from the vertical direction in head –capacity coordinates and if the configuration of the network head - capacity curve is steeper (with high friction losses).

Remember, that these conditions are relaxed in the case studied here, shown further and using the simulations from below.

6. MODELLING THE POWER OVERALL TRANSIENTS, HYDRAULIC AND ELECTRIC

6.1. THE HYDRAULIC SIMULATION OF THE FOCUSED CASE STUDY

The case study refers to one significant, atypical part from the Romanian hydro-electric power system, presented into the following figure 6, which was also erected into our country, during the years interval between 2000 – 2005, [5].

The essence from the hydraulic pumping system is penciled in Fig. 6,7, *worldwide unique* in this hydro-electric power applications, as far as we do know at this very moment of the presentation.

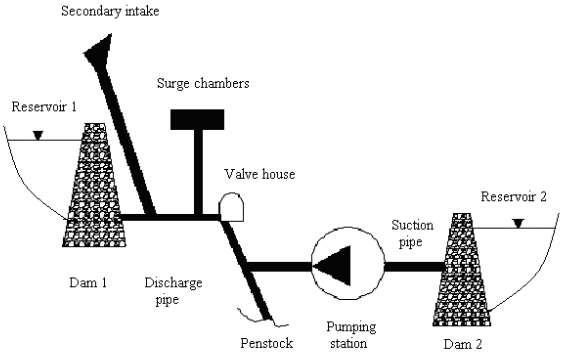

Fig. 6. Part of a hydro-energetic system.

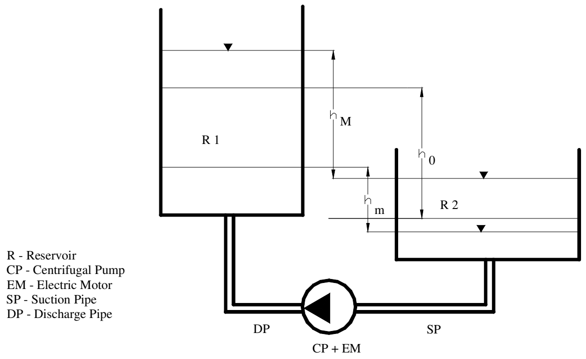

Fig. 7. Essential of the hydraulic pumping system.

The hydraulic pumping system consists from the pumping station and its hydraulic network; The main parameters of this powerful pumping station PPS, being: CP – centrifugal pumps, concrete 2 pumps operating in parallel, each double stages and double entrance.

The design parameters of each pump are:

Discharge (capacity)	$Q_0 = 3\ m^3 / s$.
Head	$H_0 = 247\ mH_2O$;
Rotational speed	$n_0 = 1000$ rev / min.
Pump efficiency	$\eta_0 = 90\ \%$.

EM - synchronous electric motor, but asynchronous mode of starting;

Power input	$P_0 = 10$ MW;

Rotational speed, $n_0 = 1.000$ rev / min.

The main characteristics of the hydraulic network are:

SP – suction pipe with the cross-section □ 1.92 x 2.76 m^2, and the length $L_2 = 6500$ m.

DP–discharge pipe with the cross-section Φ D = 1.3 m, and the length $L_1 = 360$ m.

The rated level differences between the reservoirs, in accord with figure 2, is $h_0 = 241$ m.

The maximum and minimum aloud level differences between the two reservoirs are: h_M=253 m; h_m=198 m.

These values are given as *initial design* data.

The input power for driving the pumps is a function of discharge and rotational speed established through similitude extrapolation formula:

$$P = (n/1000)^3(1.213Q + 8.87) \quad (1)$$

where P, is the power input, [MW],

n – the rotational speed, [rot / min.],

Q – the discharge flow, [m^3 / s].

The intermittent operation of the hydraulic system is the feeding of the reservoir R1 from the reservoir R2; in function of the consumption during this process, we see that R2 is empting and R1 is filling-up.

The formula (1) has more a qualitative importance and is justified from the value of the pump impeller specific speed:

$$n_s = n\,(Q_0 / 2)^{1/2}\,(H_0 / 2)^{-3/4} = 71.75 \text{ rev/ min.} \quad (2)$$

The calculus of the extreme speeds of rotation, necessary for the best pumps' operation, was investigated.

Qualitatively, what will be calculated starting from the rated regime to the extreme regimes (for maximum and minimum level differences of the reservoirs), is represented into the figure 8.

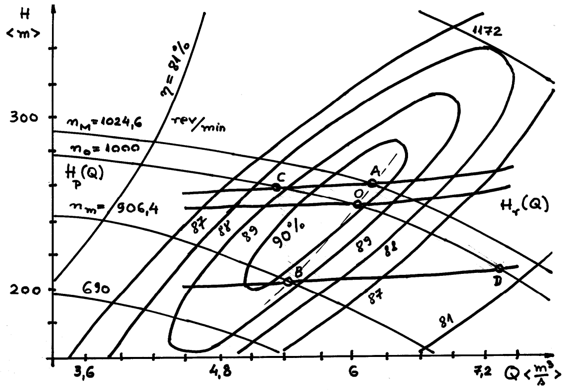

Fig. 8. A sequence of the characteristics curves of the two powerful centrifugal pumps, working in parallel.

Table 1. Main characteristics of the two powerful pumps, parallel - working

Point	Regime	H <m>	Q <m³ / s>	P_u <MW>	P_{abs} <MW>	η %	n <rev/ min>
0	Rated	247	6	14.538	16.118	90.2	1000
A=M	Variable speed	259.3	6.148	15.639	17.338	90.2	1024.6
B=m		202.9	5.438	10.824	12.094	89.5	906.4
C (M)	Constant speed	257.7	5.3	13.398	15.127	88.57	1000
D(m)		210.9	7.323	15.153	18.419	82.27	1000

Analyzing the universal characteristics of the pumps, figure 8 from above, it may be interpolated and estimated the corresponding efficiencies and power levels, is given in the above-table 1, taken from [5]. The maximum efficiency gains are about $\Delta\eta_{AC}$ = 1.63 % and $\Delta\eta_{BD}$ = 7.23 %. These values give a measure of the effectiveness for the speed control in comparison with the operation at constant speed or throttling.

6.2. THE SIMULATION OF THE POWER ELECTRIC DRIVING SYSTEM

The power electric energy – at variable frequency is to be supplied by the power plant HPP, working in this particular studied case with one single hydro-generator rated - 24 MVA, 10/110 kV; it is injecting its MVA output in islanding conditions of operation, through its second separate 110 kV, overhead line, as could be seen into the - figure 9, shown below. The same regimes could be modelled onto water-volumes, only.

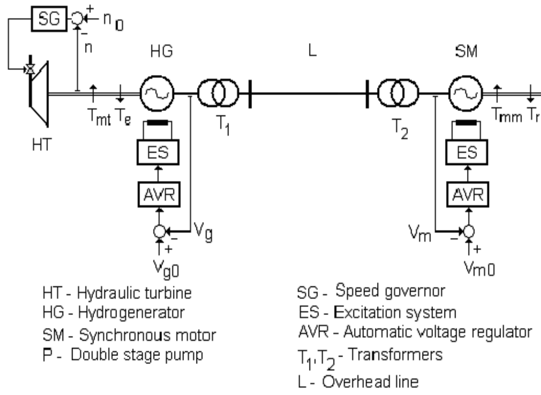

Fig. 9. The power electric, simulated system

The other one hydro generator HG2 from the booster downstream plant HPP could remain connected to the system at fixed frequency; however, the two units are to be separated by one coupling cell deliberately newly-introduced in this scheme, in order to gain the elasticity for the newer, here-proposed operational regimes.

The powerful pumping station PPS - rated 2·10 MW, 110/6 kV, 2·3m^3/s, 1000 rot·min^{-1} is located at 30 km distance approximately, up in the mountains; it is loaded by the specific hydraulic conditions given by the two lakes' levels, of *small **l*** and *bulky capacity*, ***L***.

The two levels are to be communicated via GPS to the basic generating HPP, and the whole driving system power electric energy – is working at the requested variable frequency, in order to gain the overall maximum efficiency for the PPS in question.

In this respect, the conclusion is: we see that the same specific hydraulic conditions imposes the practical spectrum of speeds to the electric power driving system; as above-indicated, *the speed limits are non-symmetric scaled and are ranging from 906.4 to 1024.6 rev/min., mainly below the synchronous speed of 1.000 rev/min.* The simulations onto the electric power indicate the fact that the regime is possible – affordable, and could be found detailed in [5]. This variable speeded application could be performed with quite expensive power electronic devices of frequency converter FC working at medium voltage m.v. of 6 kV; but, for today, the existent hydro-electric power scheme, could works well at islanding conditions, with very slight modifications.

Up to now, the fixed speed of 1.000 rev/min. was given (imposed) by the National power electric grid called SEN, closed to the rated European value of 50 Hz and, *clearly proved not to be the best chosen solution for this very case of PPS;* it is operating in some very specific hydraulic challenging conditions, between the two variable different *heights* and *capacity* regarding the quite distant located lakes - *smaller l,* and *greater L.*

6.3. THE P P S OPERATIONAL ASSUMPTIONS, READY FOR ADVANCED COMPUTER SIMULATIONS

Motor's and pump's catalog data offered by the manufacturing factory were taken into consideration. Besides, stands the supplying electric power system main adverse characteristics, like the short circuit level on the PPS 110 kV single bus bar and the step-down power transformer's - quite unfavorable short circuit voltage (u_k = 17 %) in order to do this job of ordinary direct starting, but applied to bulky powerful motors.

The unchanged list of the main parameters, during the current simulations, was:

- rated asynchronous slip s_n = 0.04 pu,

- the system excitation moment of injection which was set at 1,5 s_n,
- the short circuit level at the bus bar 110kV was set to S_{110} = 700; 1000 MVA (low; high level).

The important figures of interest, were for small, medium and high values of internal angles[el.deg.], as follows:

- $\delta = 30^o$, case 1,
- $\delta = 90^o$, case 3,
- $\delta = 150^o$, case 5 (at risk !).

The stationary regime installed after the synchronous stabilized catch, is defined as working point, and being caught irrespective the initial value for δ_i, so:

- U = 6.294 kV, I = 0.820 kA,
- P = 8.9 MW,
- Q = -0.9 Mvar,
- δ = 0.371 rad = 21.3 el.deg.

The simulations are given by the figures 10, 11 and 12.

6.4. THE RESULTS RELEASED FROM SIMULATIONS. RELEVANT CASES

The math models herewith employed were used to describe the operational regimes, both stationary and transients affecting this powerful pumping station PPS, with horizontal type units rated 2*10 MW, 110/6 kV.

The simulations ware based on the standard equations – of Park type - for the salient type synchronous machines prevented with complete rotor's dampers. It gives the below shown time-characteristics considered relevant to the proposed aim and further discussed.

This math system of program's array of subroutines was chosen because of its facilities offered especially for graphic displayed - the quality numerical simulation.

By condensing the survey, we can say that *there are three cases* under focus, those above listed especially for internal displacements of interest - small-negligible δ = 30(60)el.deg., medium δ = 90 el.deg. and quite risky displacement at which to insert the d.c. exciter's output, for δ = 150 el.deg. The comment is as follows, below.

At the 1st moment – direct starting of the motor M under full voltage 6.3 kV: we realize the important jump in the absorbed current, about 5-6 u.r and the subsequent voltage drop at the motors' terminals, about 2/3 pu; the massive absorbtion in reactive power, about 2 pu and the subsequent moderate absorbtion of active power, average 0.5 pu, as seen in the above figure.

At the 2nd important moment - when the excitation is injected, after 5 seconds (greater than the real case showed, after the programmed condition is attended for the set up slip, at 1,5 s_n !).We can see *the current and voltage curves are not so troubled* because of the small value for internal angle !

At the 3nd significant moment - the situation is a steady-state one: the evolution in MW is quite the same as in the real case when we have done the proper registrations with one even slow French made network analyser, which proved to be a very useful tool and... the last.

This case considered as a risky one, no.5 with initial displacement to couple the excitation, $\delta = 90^o$, figure 2, is now discussed below, in detail. So,

At the 1st moment – direct starting of the motor M under the full voltage 6.3 kV: one realize the important jump in the absorbed current, about 5-6 u.r. and the subsequent voltage drop at the motors' terminals, about 2/3 pu; the massive absorbtion in reactive power, about 2 pu and the subsequent moderate absorbtion of active power, average 0.5 pu.

Therefore, the need for the right, one sensitive AVR is a question of improvement which need to be fulfilled right now, in order to avoid these power oscillations disturbing the whole neighboring area together with all the adjacent consumers.

At the 3nd significant moment - the situation is a steady-state one: the evolution in MW is quite the same as in the real case (we have done the proper registrations with one even slow network analyser, French made, which proved to be a very useful tool an the single one);

One exception is done however, by the final MVArs evolution, where the motor's forced excitation is set up deliberately for the capacitive regime of nearly +1 MVAr in order to compensate the voltage drop for the stable, long term running regime.

At the 2nd important moment - the excitation is injected, over the time interval of 5 seconds (a little greater than in the real case, after the programmed condition is attended, the set up slip, is 1,5 s_n !)

We can see *the current and voltage curves quite troubled* because of the important initial internal angle for coupling !

The medium case, no.3 with the initial displacement, δ_i = 90 el.deg., supports the following comment:

At the 1st moment – direct starting of the motor M under the full voltage 6.3 kV: one realize the same jump in the absorbed current, about 5-6 u.r. and the subsequent voltage drop at the motors' terminals, also about 2/3 pu; the massive absorbtion in reactive power, over 2 pu and the subsequent moderate absorbtion of active power, average 0.7 pu.

At the 2nd important moment - the excitation is injected, over the time of 5 seconds (a little greater than in the real case, after the programmed condition is attended, the set up slip, is 1,5 s_n !)

We can see *the current and voltage curves are medium troubled* because of the medium initial internal angle for coupling! Therefore, even the need for the right, one sensitive AVR seems not a question of immediate improvement which need to be fulfilled right now; however, in order to avoid these power oscillations even small disturbing a little the whole neighboring area together with all the adjacent consumers, there is necessary one intelligent AVR equipment.

At the 3nd significant moment - the situation is a steady-state one: the evolution in MW is quite the same as in the real case when we have done the proper registrations with one even slow network analyser, French made, which proved to be a very useful tool an the single one;

One exception is done by the final MVArs evolution, where the motor's forced excitation is set up deliberately for the capacitive regime of nearly +1 Mvar in order to compensate the voltage drop for the stable, long term, stable - running regime.

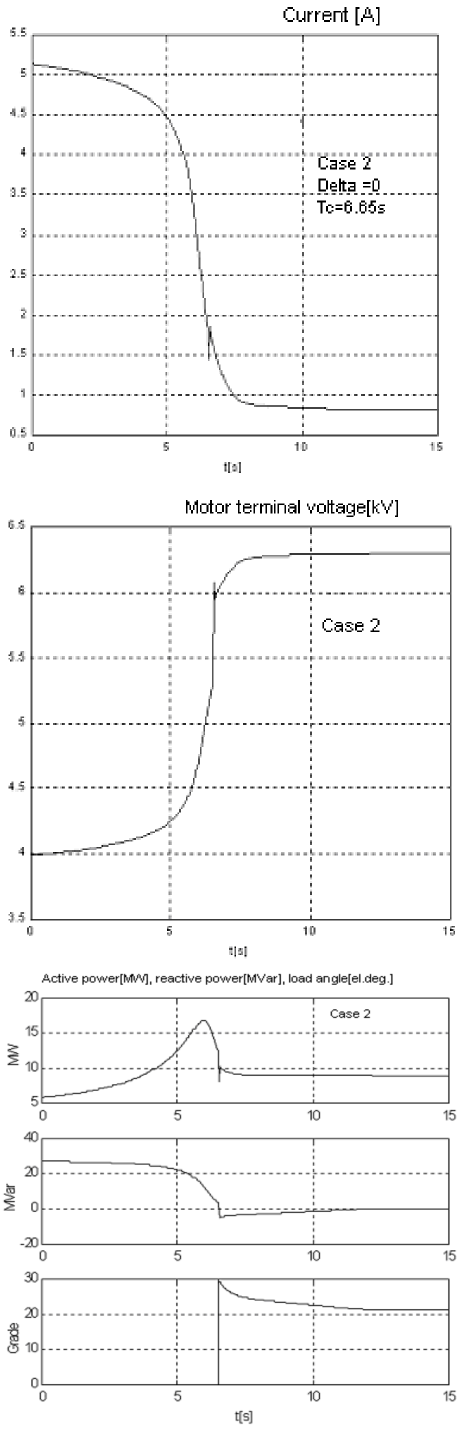

Fig. 10. The main time-variations for current, voltage, active-reactive powers, for internal displacement δ = 30 el.deg., case 1, at the starting period (the initial supply voltage was 6.3 kV at the motor's terminals).

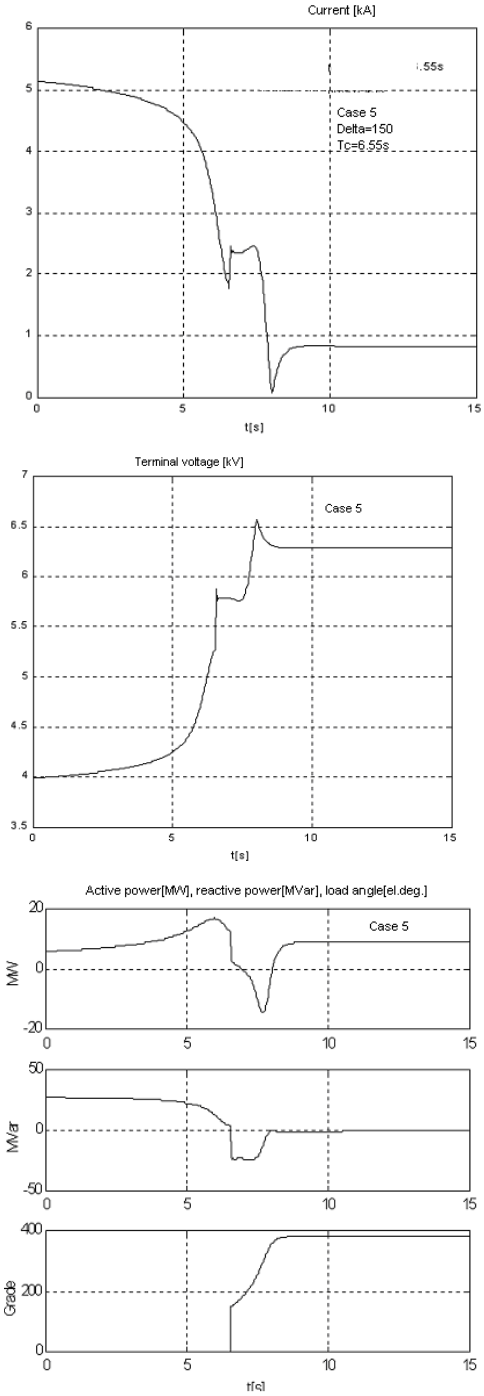

Fig. 11. Idem, figure 2, but the internal displacement angle is now δ = 150 el.deg. - stated as the the case no. 5.

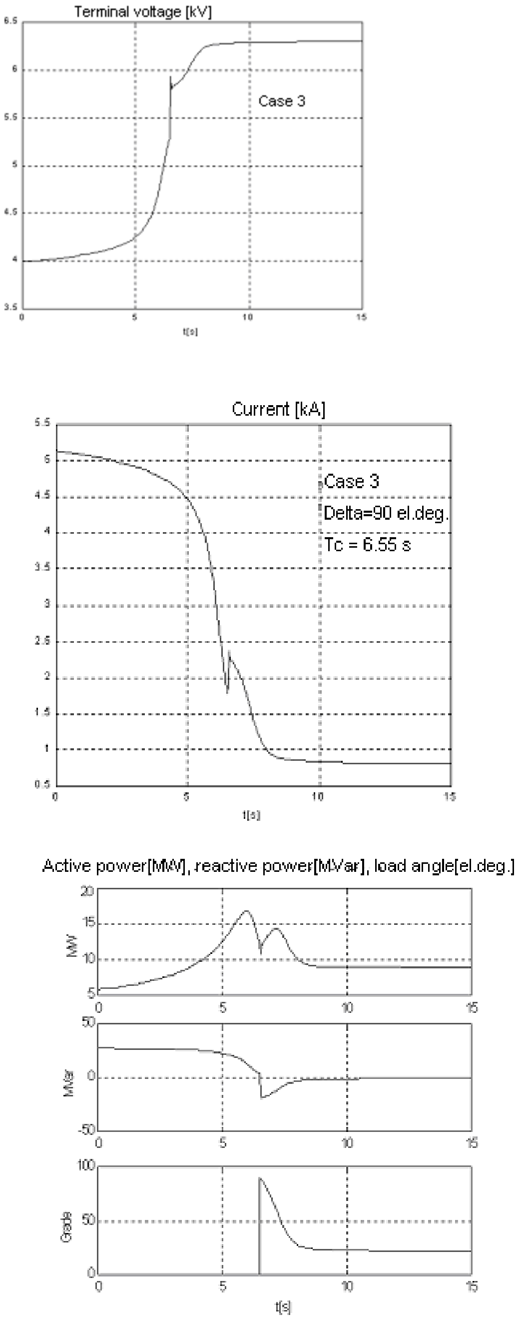

Fig. 12. Idem as in the previous figures, but for an internal displacement δ = 90 el.deg., stated as the case no. 3 (also encountered, at the very direct starting period and, the motor's supply is the highest possible level of 6.3 kV at the terminals.

7.FINAL CONCLUSIONS

This paper work begins in analysing some typical ancillary network found suitable for variable driving systems, using modern frequency converters FC and /or only soft starter-stoppers SSt, from higher to smaller

HPP ratings of power, in order to identify some possible areas of energy savings.

Additionally, one atypical application was under focus, regarding one huge hydro power complex, involving both the assembly HPP + PPS (powerful pumping station - with storing facilities), and so finding the right needed speed interval in dynamic relation with the controlled levels from the upper – lower mountain reservoirs, apart from already fixed speed of today.

Herewith regarding this atypical situation for the PPS envisaged, the important element was underlined and does consist in significant amount of energy savings, by changing the speed regimes linked with the water levels between both, upper - lower reservoirs, separate located into different mountain areas.

As far as the FC equipment is quite highly priced at medium voltage and for such rated powerful pumps 2*10 MW; 6/110 kV, so it would be better to close the power loop onto the water volumes, only: those turbined/spinning the remote HG – the overhead line LEA 110 kV – the motors M1,2 at 110/6 kV– the PPS' units, 2*3cm/s– toward the upper reservoir L from the lower reservoir l - gained av. rate is 3:1.

The analyse done herewith in the paper, was conducted to split all the auxiliaries – into three categories - in relation within their measured operational regimes, and it does reveal some significant pooling of energy savings which are to be obtained in the specific domain of every HPP - even generating or motoring, through the useful power electronic devices - like FC and SSt.

The cooling water pumping unit has to be the first candidate to FC driven at variable speed – in relation with the HG level regarding its state of warming; in so doing, the initial investment was found to be reasonably recuperated in av. 5 years, identifying significant amount of energy savings, and better protection, together within longer life expectation, to the related switchgear electrical equipment.

The 2nd analysed case, for another HPP - medium power, regards the sewage water pumping network, which proved to need SSt for only indirect starting, because its operation time isn't so long, but abundant of frequent start/stop regimes, however.

Even the starting at the powerful pumping station PPS is a routine now, considered normal, with all the induced perturbations in the electric power network 110 kV; however it allows to other consumers to be kept supplied as long as the voltage drops are commonly tolerated (the voltage of 6.3 kV at the motor's terminal is nearly halved during the very starting period).

Severe disturbances induced via the overhead 110 kV line are affecting yet the quality for electric energy, so all neighboring consumers are suffering in this respect. Probably, it is a question of time for the complete new regulations in the field of energy quality to be strictly applied, so that the actual situation in which the direct start up is simply uncontrolled, to be no longer accepted.

The bounty of transients phenomena are directly linked with this very brutal heavy duty regime, generated by the simplest but uncontrolled start-up method chosen at this time at the powerful pumping station PPS.

Technically this simplest method of direct asynchronous starting bulky synchronous motors of medium voltage stands as a success, but the quality of the process is in badly needed for further improvement to be completely *in line* with the *energy's quality* strong requirements.

It remains however the important shocks at the very starting period when the magnetic poles' position - is one unfavorable; in other words, the odd internal displacements are too high toward 180 el.deg., let say the situation in which the poles of the same name are facing each other, stator/rotor. Therefore, this aspect of the right moment of excitation injection was ignored until now and has to be taken into account

One simple electronic device conceived to measure this actual displacement will allow the excitation's injection to be performed only at favorable rotor's poles position during the asynchronous stable regime, shortly attained by seconds as the ball valve is closed at the beginning.

One detector for internal displacement will indicate additionally to one sensitive AVR the favorable moment at which the excitation injection have to be done. This is the minimum value of the internal angle and will be accepted only at one selected reduced slip.

The short circuit level at the motor's terminals is improved by gathering some compulsory measures, like the parallel transformers operation, medium voltage - highest possible level of 6.3 kV and the generous cables' cross section chosen from the project phase.

Other helping measures on the same line of improving the short circuit level at the PPS are offered by the neighboring hydro power plant HPP: it has also to start and be overexcited, by completing so, its task.

We do consider this last adjacent measure is not necessary if the technique with the excitation's injection is performed at the right moment, at one hand; on the other hand, the neighboring HPP will be not disturbed frequently as often a the PPS starts, remaining at the disposal for the local area dispatching centre.

Partially, these aspects ware taken into account and at some extent ware however by-passed, by looking in badly need for some countered measures in order to influence the higher short circuit level – to be maximized at one hand; On the other hand, we are looking to obtain the minimized, smaller voltage drops, supported by other consumers linked at the local distribution power grid leveled 110 kV.

This paper underlines the importance of avoiding the very troubled regimes at the starting period which could generates unacceptable shocks, lowering the quality for the electric energy in the area. It also gives the solution: Only small values for the internal angle will be accepted, and in these conditions the subsequent controlled excitation means safer regime for both the motors and the network; knowing this work, the well qualified power engineers at the PPS will complete the existing AVR, also in the useful direction above described.

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