SIMULATING THE REMOTE CONTROLS OF THE ELECTRIC NETWORK BY USING THE PROCESS COMPUTER DISTRIBUTION METHOD

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The abstract

Nowadays the electric energy has a very important place, starting from its production,, passing through transport and distribution and finally reaching at the curent user who is the electric energy's consumer, or its client. The article represents an information system used in a central expeditious point, which controls a limited geographical area (a region) of medium and high voltage electric networks and also the work in the "simulation" option of these networks, used for preparing the dispatchers for the unforecasted events that can happen in a power system, events which can lead to the unsteadyness of this system (the lowering of the frequency), with catastrophic consequences for the economy of the region catered by that power system.

INTRODUCTION

The main purpose :

- the operation with maximum efficiency of the plants in conditions of maximum security demanded by the technological process of the electric energy customers;
- the permanent supply of electric energy for the customers in conditions of safety, quality and efficiency ;
- the preparation of the energetic dispatcher's reaction in case of normal or special conditions (damages, etc.) by working in the <<"simulating " events >> mode .

The leading of the systems of the electric networks is realised either in the concise option, either in the distributed option. We use the SCADA concept (Supervisory Control and Data Acquisition), with the next functions :

- generating and updatig the data base : the data base is related to the process , but it's outside the process, situation that allows a quick modification of the structure;
- generate and update the schemes of the electric networks : done with the help of an electric scheme editor , named graphical characters generator ;
- the human-machine interface - it's used the the graphic window technique , taken from the Motif medium(for the UNIX operating system) or WINDOWS system ;
- the processing of the events and alarms : Event means any change which happens in the watched system; some events are seen as " alarms" and they must be treated in a special way , because some can be permanents and they will remain in an " alarm list" until the removing of the causes that generated them;
- makes calculation for processing-made as the result of the cyclic or in demand generated events; making some calculus , arithmetic operations on the sizes from power system -voltage, active power , reactive power , energy , power factor;
- make archives of the processing sizes : as a table , curves have on the abscise the times , numeric values written on the schemes of the stations or of the network;
- post mortem (after demarage) rewiev ;
- the stationary regime estimation (calculus): offers a complete solution of the variables of a network;
- analyses the contingents : is quickly establishing the effects that the appearance of some incidents in thje power system has on the safety condition of the power system ; this function is executing in both real and " simulation " modes.;

- the work in the simulation modality the preparation of the energetic dispatcher's reaction in case of normal or special conditions (damages, etc.) by working in the <<"simulating " events >> mode ; allows in any moment to be maked a copy of the process data base, used for study and analise. The process data base can be the one from the moment of the beginning or another one , saved manually by the user .

Hierarchical levels are the following :

- operative commanding centre ;
- transformation station;
- cell (departure)
- transformation point.

The hardware configuration is organised on hierarchical levels :

- the equipment for data acquisition (receiving information's from the process)
- the data's transmission support
- local equipment's for taking over the data's
- the take over system at a central point of command

The software constituent represents a packet of main and application programs, which are organised on processing levels The configuration of the system means the drawing of the monowirelar electric scheme for the remote control of the electric network (junctions, knots = electric station remote controlled STC).

An important information offered by the packet of programs is the existence or the absence of the voltage on a line, bar or equipment.

Because of the real time functioning or of the simulating mode , it's possible to:

- analyse the stability of the network
- optimise the functioning of the network (by commanding in real time the remote controls). .

The high voltage network can be modelled using an multivariable linear system. , show in fig.1

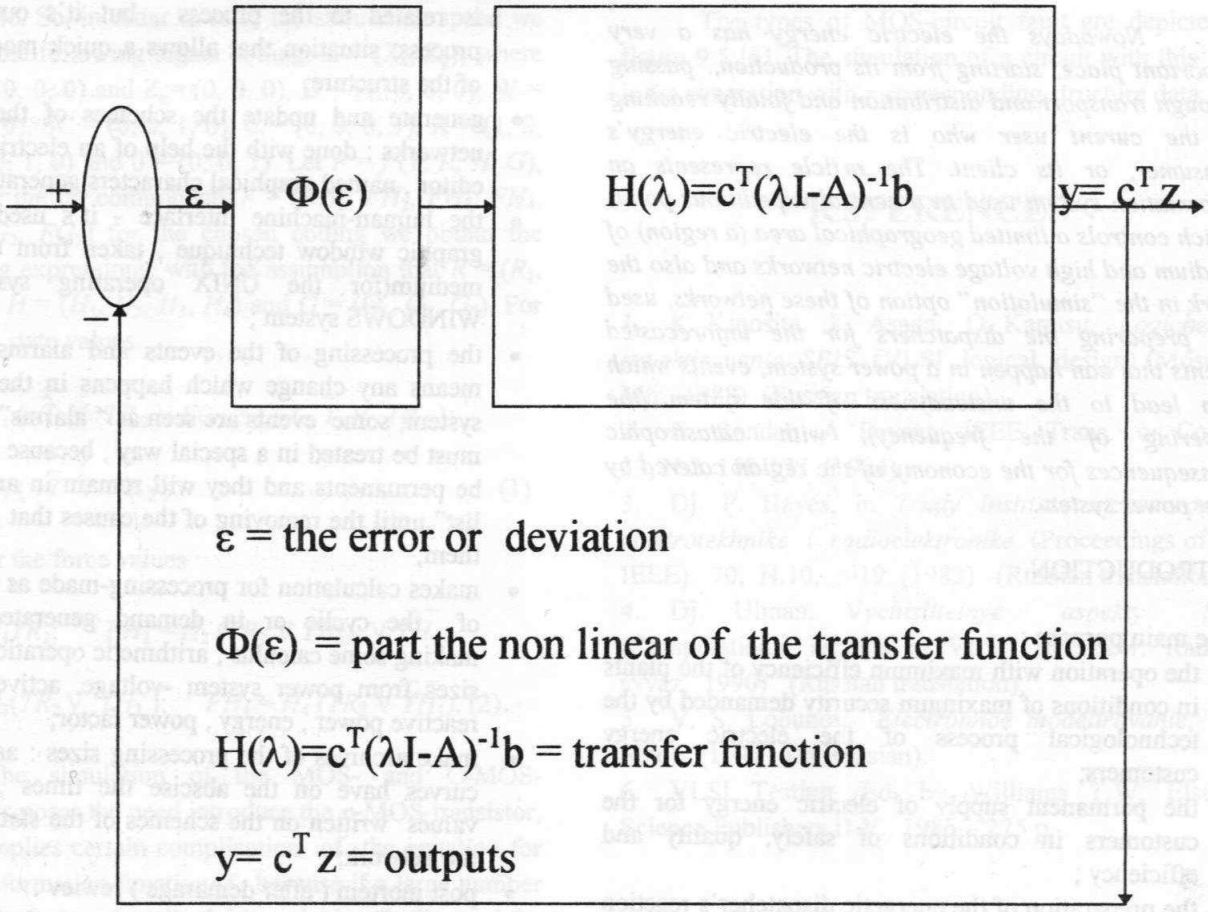

fig.1

Model of high voltage network

The linear part is given by the transfer function

$$H(\lambda)=c^T(\lambda I-A)^{-1}b \qquad [1]$$

and the non linear part is given by the transfer function $\Phi(\varepsilon)$. The system can be written this way :

$$\dot{x}=f(x,t,\mu) \text{ whith } x(t_0)=x_0 \qquad [2]$$ where :

- **x** is the n-dimensional state vector, made from voltage, actives and reactives powers, power factors, suitable to the all electric knils (electric transformation stations).
- **f** is a vectorial n-dimensional function
- μ is a constant or variable vector

The equation $\dot{x} = f(x,t,\mu)$ has only one solution , $x(t) = \psi(t,t_0,x_0,\mu)$ for an $x(t_0) = x_0$ and $t=t_0$. Then the identity $x(t_0) = \psi(t_0,t_0,x_0,\mu) = x_0$ is verified. Admiting that $x_0=0$ is an unique point for the equations worm form is $f(x,t,\mu)=0$, then the equation $f(x,t,\mu)=0 \Rightarrow f(0,t,\mu)=0$ and in this conditions , the system becomes disturbed.

The passing of the system from an initial state described by the state vector $x_0=x(t_0)$ in another state, $x_1=x(t_1)$ is modeled by the function of Liapunov type, if: for every pozitiv number given , $\varepsilon>0$ (ε arbritary small) it's possible to pick another number $\delta>0$ in such manner as the initial disturbations x_0 (which verify the inequality $|x_0|<\delta$) to determin another disturbed system, given by $x(t)=\psi(t,t_0,x_0,\mu)$ in such way as for every $t>t_0$ is verified the condition $|\psi(t,t_0,x_0,\mu)|^2 < \varepsilon$.

Briefly, for every $\varepsilon>0$, $\exists\ \delta>0$, $|x_0|^2< \delta \Rightarrow |\psi(t,t_0,x_0,\mu)|^2 < \varepsilon$, $\forall\ t>t_0$, then the undisturbed system modeled by $f(0,t,\mu)=0$ is called stable asymptotical in Liapunov way.

THE STAGE OF THE HIGH VOLTAGE NETWORK'S OPTIMISATION

An electric system can be discribed using common differential equations or with partial coefficients, integral equations, in which praises its causative structure by the state, input and output magnitudes :

The system is : $\dot{x}=f(x,u,t)$

$$y=g(x,t) \qquad [3]$$ where

- $t \in [t_0,t_1] \subset T \subseteq R$
- **x** and f are vectors in R^n representing **the state**
- **u** represent an **input vector field**
- **y** represent an **output vector field**

$$x \in X \subseteq R^n,\quad u \in U \subseteq R^m,\quad y \in Y \subseteq R^r \qquad [4]$$

$$f : XxUxT \rightarrow R^n,\quad g: XxT \rightarrow R^n$$

where x , u , t , y represents areas admitted for **state, input, output, time interval.**

The magnitudes x(0),u(0),.... verify equations following :

$$\dot{x}=f(x,u,t)$$
$$y=g(x,t) \qquad [5]$$

where $t \in [t_0,t_1] \subset T \subseteq R$ in the conditions given which determins trajectories or curves **integral** of the system, and we look for an **optim** here.

This optim is given by mathematic model:

$$y=\int_{t_0}^{t} L((x,u(t),t)dt + M(t_0,x_0,t,x) \qquad [6]$$

The optimisation is made by the criterion of :

- minimal time
- minimal consumption
- the method of the small test

THE SOFTWARE STRUCTURE OF THE CONTROL TELEGRAMS

In case remote control in real time , the lasting of the on/off impulse is adjusted at the value of 1.2 sec

The comunication networking is distributed and using a model typ with 485.

The structure of information system is show in fig.2 and contents : controllers, modems, traductors, Local Area Network with Personal Computers, monitors, keyboard and others peripherals.

The logical unit for data transfer between the central point and the microcontrols (dedicated Microsystems) is the telegram, made from a variable number of octets. Every telegram has a heading (the support of the useful information). Each octet contains 8 bits, used like this:

- 6 for the support of information
- 1 for recognising
- 1 for parity

The telegrams can also be for :

- **the control and the synchronisation of the communication** (reception confirmation, reception with errors, loosing the touch , time synchronisation).
- **especial ones** :
  - broken (damaged) remote control reception
  - signal buffer (full, empty)
  - send of an initialisation bloc
  - general control
  - state demanding cells
  - automatizations positions demanded

The schemes of the high voltage network is showing in fig.3 where :

LEA110KV TESTARE1 = line electric aerial
LEA110KV TESTARE2 = line electric aerial
Sl1 , Sl2 = separators lineas
IH1, IH2 = breakers of high voltage
TR1, TR2 = transformers high / mean voltage
S21,S22,S23,S24,S25=separators block 2
S11,S12,S13,S14,S15= separators block 1
Sb1,Sb2=separatores terminal transformers
CTV = couple transversale
Bc1,Bc2=battery capacitors
IM1,ICTV,IM2,IBC1,IBC2=breakers of mean voltage

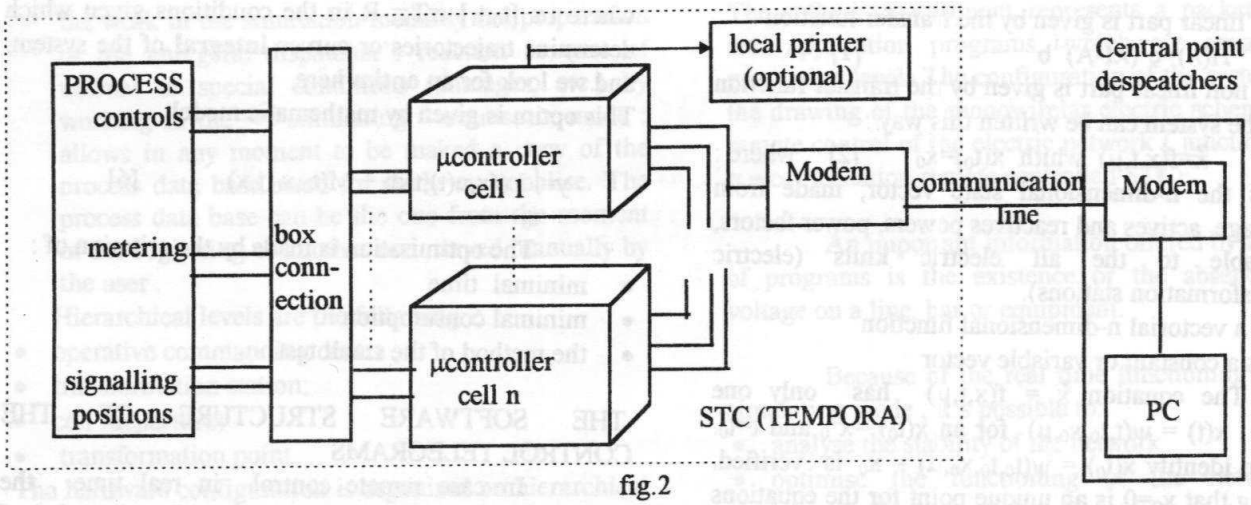

fig.2

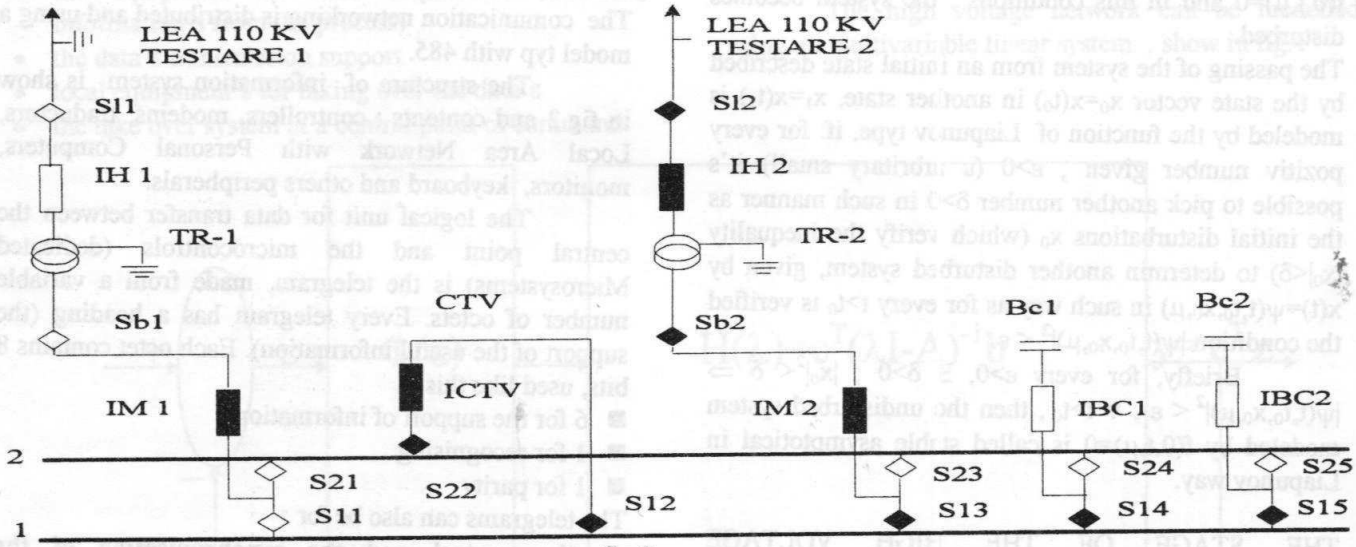

fig.3

CONCLUSIONS

When the dispatcher work in the simulating method , he has in front of him a monowirelar electric scheme of an STC , which is choosed from a list of STC , wich represents a regional geographical area of High and Medium Voltage electric networks. By simulating manoeuvres (on/off switches or pif /sdf automatizations), the dispatcher will notice the consequences appeared as a result of the execution of that remote control. The electric scheme changes its colour, the parts which are under vopltage become lighted and modifies theier colour. The dispatcher is able now to give a forecast of the future evolution of the electric network, supervised and controled by the process computers.

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