SOME ASPECTS REGARDING THE ROMANIAN DISTRIBUTION SYSTEM OPERATORS ON THE COMPETITIVE POWER MARKET

Code: **068-2006**

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INTRODUCTION

Romanian Power Market, in the prospect of the EU integration, involves the eligibility of all the customers. As such Power Distribution Companies must be preoccupied to achieve an optimal ratio quality/price regarding provided electrical power.

The electrical distribution networks, with the nominal voltage up to 110 kV inclusive, means approximately 90 % from the total of the high and medium voltage networks of the National Power System. The losses in these networks have increased as the consumption of the energy moved to medium and low voltage.
For the leadership of the Romanian Distribution Networks, are implemented DMS/SCADA systems only for 5-6 % proportion from these equipments. The super fluent Distribution Networks, built before 1989, gives to the Distribution Operator a high level of flexibility. From the economic aspect this super fluent involves big expenses for operation and maintenance in ratio with electric power sold. The 110 kV Distribution Network studied is operating partial locked. It is located in an area of three districts and five injection points from Transmission Network, one Thermal Power Station and Ten Hydro Power Stations supply it.
The social-economic implications to the appearance of the faults into big Power Systems was imposed the selection of the properly adapted models to the real phenomena. With their aid will be preliminary the operative performances of the Power Systems. In particular, case of the Distribution Systems, decision-man (Control Room Engineer) is building his line of action-optimal strategy or the multitude of optimal decision alternatives, in few of the cases following the achievement of only one objective. In most of the cases is desirable that a certain solution, optimal it considered, to be better answer to the multitude of the restrictive requests which from the decision-men point of view has divergent tendentious. Like was demonstrated, to adopt the decisions on the basis of the personal experience and the intuition, can lead to erroneous decisions.
It was modeled the whole above-mentioned network and by REPER package programs we calculated the power flow's steady state (by Seidel-Gauss and Newton-Raphson method) for a big number of possible contingencies. Simultaneously we ousted insignificant nodes (by throwing the loads to the principle nodes) and by PowerWorld Simulator package programs we also studied a lot of contingencies. From both REPER and PowerWorld results we selected only the significant variants.

1. COMPETENCE DOMAINS OF THE POWER DISTRIBUTION DISPATCHER REGARDING THE POWER QUALITY

The basic quality indicators „of system" that analyze the electric power [1] refers to:

a) Power frequency;
b) Magnitude of supply voltage;
c) Temporary and transient over voltages;
d) Supply voltage dips.

The Power Distribution Dispatcher can be directly responsible for maintaining the magnitude of voltage supply between the admissible limits and he can contribute to minimize the supply voltage dips as number and duration and also the transient over voltages.

The Performance Norm for the Electric Power Distribution Service regulates the indicators that characterize this service regarding the following issues:

a) To connect the customers to the Power Distribution Network;
b) To assure the continuity of power supply and power quality;
c) Schedule shut down for the maintenance and/or the network reconfigure;
d) Resolving the complaints of customers, regarding power quality;
e) To assure transparent relations between the Distribution System Operator and Power Distribution Network customers.

Regarding the service quality, the Power Distribution Dispatcher has as main duty to assure the supply continuity and power quality. The reduction as number and duration of the schedule shut down are indicators that can also be improved by the Power Distribution Dispatcher.

2. ACTIONS OF THE POWER DISTRIBUTION DISPATCHER FOR MAINTAINING THE POWER QUALITY BETWEEN THE ADMISIBLE PARAMETERS

According to the Leadership by Dispatcher Regulation of the National Power System, a Dispatcher Control Center must contain at least:

- The Operational Control Compartment;
- The Operational Programming Compartment.

Both compartments permanently contribute to maintaining power quality, direct or indirect.

The Operational Control Compartment assures the entire leadership for the Operator's Distribution Power Network for the safety operation and technical and economical optimization. The Power Distribution Dispatcher will follow especially to assure the electric power parameters both qualitative and quantitative that transit the Power Distribution Network.

The operational leadership in real time consists of:

a) The supervisory and assuring of the continuous functioning for distribution installations in the responsibility area:

- The supervisory of the Operation Diagram, Equipments and parameter's values;
- Checking if the parameter's values are between admissible limits;
- Calculate the powers and energies:
  - Absorbed to the customers;
  - Purchased from the Transmission Network;
  - Transferred from/into the neighbors Distribution Networks;
  - Generated by the Area Hydroelectric and Thermal Power Stations.
- Calculate the total sacrifice powers automatic and manual shut down in case of low frequency.

b) The regulation of the consumption curve.

c) Direct control to equipment and afferent automation.

d) Following the balance sheet of electric power on the area.

e) The optimization of the distribution equipment operates:

- *To determine the number and load of 110 kV/MV transformers;*
- *To determine by calculus the losses on the OHL, UGC, transformers and all area;*
- *To determine the power balance sheet on entire area.*

f) The voltage regulation in 110 kV and MV networks and the reactive power compensation level.

g) Following the grounded method in entire Power Distribution Network.

h) The start and stop control of the micro-hydroelectric generators.

i) Supervisory of the DMS/SCADA System's components.

For these functions the Power Distribution Dispatcher is doing in real time the following activities:

- Follows and Optimizes:

- Power acquisition from:
  - National Transmission Network;
  - Neighbors Distribution Networks;
  - Power Stations witch are connected direct to Power Distribution Network;
- 110/MV substation's loads;
- Generation of the reactive power;
- Power Distribution Network's loses;
- Reactive compensation's regulation on the Distribution Network;
- Keep the schedule power for all customers when there is deficiency of active power;
- Check the safety level of the operation;

- Records and committing:

- Electric parameter's values;
- Changing the states equipment on/off;

- Does:

- Coordinating the operation on his authority area;
- Calculation of the absorbed powers and energy's customers;
- Calculation of the generated power and energy's PowerStation;
- Adjustment of the consumption curve;
- Determination by calculus of the lines, transformers and total area losses;
- Determination of the substations and total area balance sheet;
- Manual sacrifice shut downs.

The Operational Planning and Programming Compartment

In this compartment are effectuated the operational planning and programming of the Distribution Network, which can influence the politics of power acquisition and transit, assure the links with other Power Market participants. Also this compartment follows and analyses the Distribution Network Operation from the safety and economical operation point of view.

This compartment, which does offline activities, assures the relationship with the System Operator (SO) regarding the 110 kV normal operation diagram and the operation steady states and also with the Engross Power Market Operator.

The Operational Planning in correlation with the Investment Command contains the following components:

a) Normal operation diagram planning;

b) Maintenance and exploitation work planning for the Power Distribution Network's (PDN) equipment;

c) Protective relay and automation system planning for PDN;

d) Voltage planning for PDN.

The Operational Programming of PDN operating has the following components:

a) Normal operation programming;

b) Generator's programming which are not under authority of SO;

c) Voltage programming;

d) Protective relay and automation programming.

Also, in order to ***The Technical Code of Power Distribution Network*** the Planning and Programming Operational Compartment has the following tasks:

a) Half-yearly proposes the 110 kV Normal Operation Diagram for approving to System Operator;

b) Receives from 110 kV equipment's owners the yearly, quarterly and monthly maintenance schedule, analyses and send these to System Operator;

c) Half yearly planning the voltage limits for 110 kV Distribution Network and for MV Network, that assures the normal level voltage to all points of network and also assures to minimize the technical losses;

d) Analyses the Distribution Network Operation regarding to the operation schedule achievement, to keep The Performance Norm for the Electric Power Distribution Service;

e) Monitoring and evaluating the safety operation of 110 kV Distribution Network.

3. GENERAL ASPECTS REGARDING THE ELECTRICITY MARKET IN ROMANIA

The most important objective for Romania is the integration in European Union at January the 1st, 2007. In accordance with the energy chapter of integration, Romania must be prepared to develop a free energy market. This means that we must have private power suppliers, a National Transmission

Grid (220 – 400 kV network), private distribution operators (110 kV + MV + LV) and a National Energy Authority of Regulation.
In Romania, the work of SC TRANSELECTRICA SA (National Transmission Grid), ANRE (National Authority of Energy Regulation) is regulated now; many steps in privatization in energy sector - power plants and distribution operators are made. The open electricity market in Romania now is about 30%.
According with EU recommendation, for a free electric market, some special steps must be done:
- 2008 – eligibility for all non-household customers;
- 2012 – eligibility for all customers.
For the customer, a free market means to have direct access to electricity suppliers, to benefit from the direct result of the chain of electricity producing, transmission and distribution,.
The interests of energy suppliers, whatever ownership are:

- Advantageous prices for the sold energy;
- A safe market;
- Bills collection on time;
- To increase sold energy quantities without losses;
- To increase the number of clients;
- To reduce losses in their own network.

In the direct relation with energy suppliers, consumers have the following interests:

- To pay the energy based on a contract which could protect them;
- To pay exactly what they use;
- To have safe wiring;
- To have no interruption in energy supply;
- Not to suffer damages in their own wiring when there are problems in supplier network;
- Do not suffer damages of their commodities when there are problems in supplier network;
- The supplied energy must be at the quality standards imposed by national technical regulations;
- To reduce energy expenses.

In Romania, there are eight distribution operators, located in eight large Romanian districts: Dobrogea, Moldova, North Muntenia, South Muntenia, Oltenia, Banat, North Transilvania, and South Transilvania, Dobrogea and Banat distribution operators, since 2004 are private: investor – ENEL, Italy. Oltenia and Moldova branches was privatized during 2005 by E-ON, Germany company and
Customers, in a free market, can buy electricity from any supplier but the distribution operator must assure the following indicators:

- Supply continuity;
- Electricity quality regulated by CEI.

To satisfy these two criteria, the distribution operators develop their own electricity distribution politics regarding the increase of their capacity of transmission and also their benefits.

4. DISTRIBUTION OPERATORS - THE KEY BETWEEN CUSTOMERS AND ELECTRICITY SUPPLIERS

4.1. Electricity distribution system of 110 kV. In Romania, before 1989, National Grid was developed as a part of a centralize system. The Romanian policy was at that time to assure the development of all regions of the country. So, now, in 2005, Romania has a national network of 110 kV well represented in the entire eight-distribution region.

The fall down of communist economy in 1990, led to some aspects in working national grid.

- Negative aspects:

- Decreasing electricity consumption because of fall down or the industrial activities and close many agricultural units.

- Positive aspects:

- Privatization leads to on increase of electricity consumption;
- Increased electricity consumption at household customers.

The capacity of transmission of 110 kV network in Romania in 2005 is covered by consumption only by 30-40%. So, Romania has now enough electricity distribution capacity at 110 kV to develop economic projects in all region of the country.

For new investors, it is much easy to build new factories because the power supply is assured.
It is notable that in the last couple of years, while the production has grown by 6-8% we can see a reduction of the electric energy consumption in the economic field. This proves that the economic agents especially the private agents have adopted ways to reduce the losses of electric energy by:

- New technologies with reduced electric energy consumption;
- Reducing the losses of electric energy in the classical technological processes.

	110 kV Over Head Lines & Under Ground Cables	MV Over Head Lines & Under Ground Cables	LV Over Head Lines & Under Ground Cables	110/MV & MV/MV Substations		MV / LV Ring Mains	
Subsidiary	**Km**	**Km**	**Km**	**Nr**	**MVA**	**Nr**	**MVA**
MOLDOVA-E-ON	**2685,32**	**17110,96**	**31113,23**	**134**	**4178,6**	**10113**	**2907,84**
DOBROGEA-ENEL	**2169,61**	**11313,7**	**10743,61**	**295**	**5338,37**	**5727**	**2515,91**
NORTH MUNTENIA	**2160,672**	**15374,107**	**21765,12**	**208**	**5419,15**	**9157**	**3031,32**
OLTENIA-CEZ	**3536,754**	**19827,084**	**27142,18**	**236**	**7016,2**	**9923**	**3160**
BANAT-ENEL	**2014,72**	**13513,702**	**18419,02**	**140**	**4855,1**	**6690**	**2082,992**
NORTH TRANSILVANIA	**2140,192**	**16687,333**	**22383,29**	**114**	**3916,14**	**6182**	**2118,053**
SOUTH TRANSILVANIA	**2257,29**	**12883,75**	**19256,38**	**109**	**4095,8**	**7142**	**2359,2**
SOUTH MUNTENIA	**784,903**	**13311,716**	**21532,08**	**60**	**3667,2**	**5676**	**2976,976**
Total SC ELECTRICA SA	**17749,461**	**120022,352**	**172354,91**	**1296**	**38486,56**	**60610**	**21152,291**

Figure 4.1. Volume of equipments 110 kV Distribution Network SC ELECTRICA SA

4.2. Distribution operators in a free electricity market in Romania. According with EU recommendation, in 2007, when Romania becomes a full member of Union, all distribution operators must be private. This is the first step to introduce concurrence between operators.
The second step is to have a 100% open market for all non-household customers in 2008 and the last step is to have an open electricity market for any customers in 2012. In this time, the distribution operators must organize and improve their activities to rich these goals.
Factors, which lead to reorganize distribution operators:

- Economic development of private sector;
- Customers eligibility;
- Increased house-hold electricity consumption;
- More needs for quality electricity supply in accordance with CEI recommendation;
- Respect all contract conditions of electricity supply;
- Maintenance costs;
- New investments;
- Public relations;
- Developing marketing sector;

In a free market, distribution operators must manage their budgets carefully. They must increase their income and reduce costs.

- Increased income:
  - Encouraging electricity consumption;
  - Attract new customers.
- Reduce costs:
  - By cheap electricity on market for non-eligible customers or for distribution operator customers;
  - Reducing power losses in their network by working in an optimal network system, using modern computer solutions;
  - Implemented DMS/SCADA systems;
  - Use optimal network configuration;
  - Use reactive compensation;
  - Use new injections;
  - Monitoring maintenance cost for non-optimal use network;

- Monitoring power losses in overloaded networks and counts the performance of new investments;

Working in a private sector, distribution operators must respect all the laws regarding electricity market made by Government and ANRE - National Authority of Energy Regulation in order to obtain benefits.

4.3. Risks for distribution operators working in a free electricity market. Working as a part of Romanian Grid and also as a part of European Grid, distribution operators are well supervised by Authorities. The following must be assured:

- Electricity feeding safety to all customers;
- Respect all low regarding contracts with customers;
- Electricity quality;
- Continuity in electricity feeding;

Distribution operators, as a private sector wish to increase their income, respecting all the Govern and ANRE conditions. There are certainly many risks on a free electricity market.

- Economic recession for customers and reduce electricity consumption;
- Small transmission capacity for new customers;
- Overloaded network and big losses;
- More exigency of customers regarding electricity break;
- More exigency of customers regarding electricity quality;
- Maintenance cost for under-loaded network (for ex. Under-load network in rural area);
- Limited financial resources for new investments.

Because the big level of investments in distribution system, operators follow the same steps:

- Encouraging electricity consumption;
- Encouraging to connect new customers;

But rarely do they spend money to increase transmission capacity of network. The final results are the same: electrical system becomes overloaded and they need sophisticate computer programs for economical working.

5. USING UP-TO-DATE INFORMATIC SYSTEMS ON THE DISTRIBUTION OPERATOR LEVEL

The switch from the classical technologies characterizes the present period with sub-systems treated in a separate manner to up-to-date technologies, integration of respective equipments into interconnected and complex systems, having access to all levels. Such systems are known as DMS/SCADA. Their use may lead to a considerable increase of performances of the Distribution Networks.

Until the implementation of SCADA systems (that means very expensive investments) the Distribution Operator can use informatics simulation programs to model the Electric Network.

5.1. About PowerWorld Simulator. PowerWorld Simulator is a power system simulation package designed from the ground up to be used friendly and highly interactive. Simulator has the power for serious engineering analysis, but it is also so interactive and graphical. Version 10.0 of Simulator is easier to be use, yet even more powerful and more visual. Simulator is actually a number of integrated products. At its core is a comprehensive, robust Power Flow Solution engine capable of efficiently solving systems of up to 100,000 buses.

5.2. The Distribution Network under Authority Area Control Center. The distribution network under Authority Area Control Centre has been completely modelled and divided in interest areas regarding the power flow between districts. The need to divide the network arise form the fact that the PowerWorld package program, in the demo version, doesn't accept more than 13 nodes. The number of equipments added to the network's nodes is not limited. The studied area (right side-violet colour), shown in figure 2.3, reaches on its peek load approximately 80-100 MW, supplied in the normal operating diagram the following source:

- 200 MVA Autotransformer 220/110 kV, from Stalpu Substation;
- 110 kV Maneciu-Patarlagele Overhead Line;
- 110 kV Mizil-Sahateni Overhead Line;
- Nehoiasu, Vernesti, Candesti, Simileasca Hydroelectric Power Stations.

The contingent with major effect on the level of losses is the unavailability of 200 MVA Autotransformer from Stalpu Substation. It is the main source on the power injection of the area. Regarding the fact that local Hydroelectric Power Station's running is restricted by the water's level,

the supply of the local consumers in the situation above mentioned, is done by the 110 kV interconnected overhead lines in the areas.

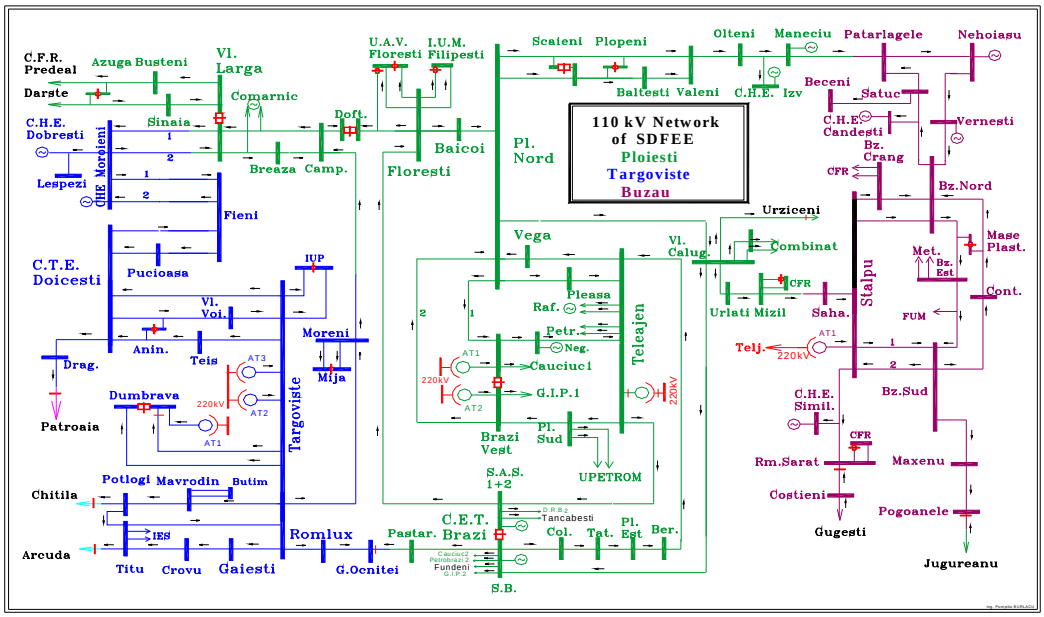

Figure 5.1. Normal operating diagram under Distribution Control Centre Authority

In the interest area the nodes less important were eliminated, throwing their loads to the important nodes. Analyzing by means of PowerWorld Simulator package program the power losses for the availability/unavailability 200 MVA Stalpu Autotransformer it is noticed that active losses are increasing with 3,86 MW (~200%) and reactive losses are increasing with 9,03 MVAr (~160%). The value estimated for these losses is about $150/hour

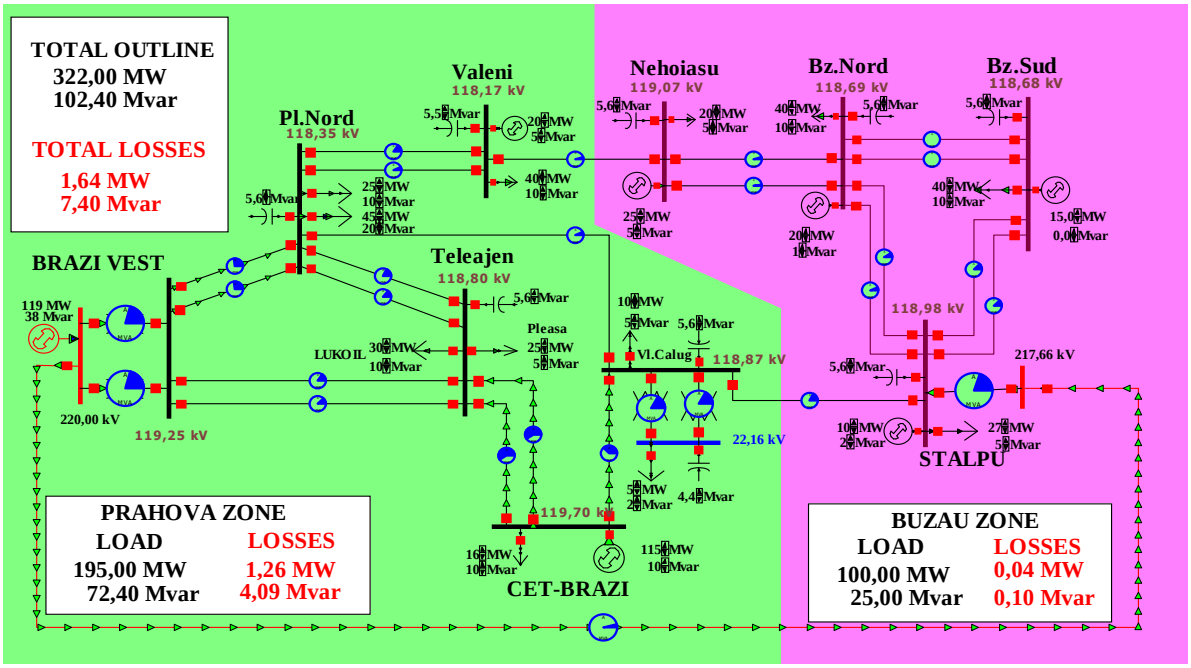

Figure 5.2. Supplying Buzau Zone on the normal operating diagram

Others significant contingencies:

- One or two transformers on operation in correlation with total substation's active load;
- One or two capacitors on operation in correlation with total substation's reactive load;
- One or two capacitors on operation in correlation with bus-bars substation's level voltage ;
- All capacitors on/off operation in correlation with area network's level voltage ;
- One or two overhead lines (underground cables) on operation (there are double circuits) in correlation with area's total load and area network's level voltage;
- Hydroelectric Power Station's running all time or to peak load only, in correlation with water's level on the storage dams;
- using the tap-changers of the autotransformers 220/110kV (transformers 110 kV/MV) in correlation with area's total load and area network's level voltage;
- changing the normal open network's points in correlations with the loop's load (network topology).
- For all these contingencies (and for many others) the following elements have been calculated by Simulator PowerWorld package program and also by "REPER" package program (to calculate steady state):
  - bus-bar's (medium and high) level voltage of each substation and ring main;
  - active and reactive loads flow to each overhead lines (underground cables) connections;
  - active and reactive power (longitudes and transverses) losses to each equipment.

CONCLUSION

According with EU recommendation for free electricity market in Romania means:

- Private distribution operators until 2007
- Eligibility for all non house-hold customers until 2008
- Eligibility for all customers in 2012

The distribution operators must improve new modern soft in leading electrical network distribution to assure quality electricity supply at customers.
The simulator programs like PowerWorld Simulator are the intermediate step until SCADA SYSTEM in monitoring 110 kV network is introduced in Romania, but it is very useful for distribution operators because:

- It can provide fully information about Distribution Network features in any operation conditions.
- It can impose new tasks for Control Room Engineers (Distribution Operators) in order to reduce the losses and to assure the energy's quality, respecting the safety criteria. The steps to be followed are:
  - To analyze the shutdown maintenance schedules by computer simulator to find the optimal solutions.
  - To analyze the significant contingents against Normal Operation Network and/or simultaneous possible forced outages, also regarding optimal power flow.
  - To know at any time the price of power energy on the Power Market.
  - To accomplish the adequate power distribution diagrams for the acquisition of the power energy to an optimal price.
  - To change network configuration taking the load curve into account.

It is remarkable the fact that PowerWorld Simulator package Program offers to Distribution Operators all information which are necessary to have optimal decision. So much the better it is the fact that this information is obtained by a very friendly and highly interactive graphical interface.
This paper wants to show that regarding Electricity Distribution field, Romania is working hard for EU integration.

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