THE ROLE OF THE DISTRIBUTION OPERATOR IN INCREASING THE QUALITATIVE LEVEL OF THE ELECTRIC POWER PROVIDED TO CUSTOMERS

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INTRODUCTION

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

The electric distribution networks, with the nominal voltage to 110 kV inclusive, means approximately 90% from the total of the high and medium voltage networks of the National Power System. The energy losses in these networks have important increasing as the consumption of the electric power moved to medium and low voltage.

DMS/SCADA systems are implemented, for the leadership of the Distribution Networks in Romania only in proportion of 5-6% out of these equipments. The super fluent Distribution Networks, built before 1989, give the Distribution Operator a high level of flexibility. From an economic point of view this super fleecy involves big expenses for operation and maintenance in ratio with electric power bought. The 110 kV Distribution Network studied is operating partially locked. It is located in an area of three districts and it is supplied from Transmission Network by five injection points, a Thermal Electric Power Station and ten Hydro Electric Power Stations.

The social-economic implications to the appearance of the faults into big Power Systems have imposed the selection of the properly adapted models to the real phenomena. The operative performances of the Power Systems, will be preliminary with theirs aid. In particular, case of the Distribution Systems, decision-man (Control Room Engineer) is builds 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 it is desirable that a certain solution, optimal is considered, a better answer to the multitude of the restrictive requests, which from the decision-men point of view has divergent tendencies. As has been demonstrated, to adopt the decisions on the basis of the personal experience and the intuition, can lead to erroneous decisions.

1. GENERAL ASPECTS REGARDING THE ELECTRICITY MARKET IN ROMANIA

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 Transylvania, and South Transylvania, Dobrogea and Banat distribution operators, since 2004 are private: investor – ENEL, Italy.

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.

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

2.1. 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.

- Decreasing electricity consumption because of fall down or the industrial activities and close many agricultural units.
- Positive aspects:
  - Privatization leads to on increasement 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.

Negative aspects:

<table>
<thead>
<tr>
<th>Subsidiary</th>
<th>110 kV Over Head Lines &amp; Under Ground Cables</th>
<th>MV Over Head Lines &amp; Under Ground Cables</th>
<th>LV Over Head Lines &amp; Under Ground Cables</th>
<th>110/MV &amp; MV/MV Substations</th>
<th>MV / LV Ring Mains</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Km</td>
<td>Km</td>
<td>Km</td>
<td>Nr</td>
<td>MVA</td>
</tr>
<tr>
<td>MOLDOVA</td>
<td>2685,32</td>
<td>17110,96</td>
<td>31113,23</td>
<td>134</td>
<td>4178,6</td>
</tr>
<tr>
<td>DOBROGEA</td>
<td>2169,61</td>
<td>11313,7</td>
<td>10743,61</td>
<td>295</td>
<td>5338,37</td>
</tr>
<tr>
<td>NORTH MUNTENIA</td>
<td>2160,672</td>
<td>15374,107</td>
<td>21765,12</td>
<td>208</td>
<td>5419,15</td>
</tr>
<tr>
<td>OLTENIA</td>
<td>3536,754</td>
<td>19827,084</td>
<td>27142,18</td>
<td>236</td>
<td>7016,2</td>
</tr>
<tr>
<td>BANAT</td>
<td>2014,72</td>
<td>13513,702</td>
<td>18419,02</td>
<td>140</td>
<td>4855,1</td>
</tr>
<tr>
<td>NORTH TRANSILVANIA</td>
<td>2140,192</td>
<td>16687,333</td>
<td>22383,29</td>
<td>114</td>
<td>3916,14</td>
</tr>
<tr>
<td>SOUTH TRANSILVANIA</td>
<td>2257,29</td>
<td>12883,75</td>
<td>19256,38</td>
<td>109</td>
<td>4095,8</td>
</tr>
<tr>
<td>SOUTH MUNTENIA</td>
<td>784,903</td>
<td>13311,716</td>
<td>21532,08</td>
<td>60</td>
<td>3667,2</td>
</tr>
<tr>
<td>Total SC ELECTRICA SA</td>
<td>17749,461</td>
<td>120022,352</td>
<td>172354,91</td>
<td>1296</td>
<td>38486,56</td>
</tr>
</tbody>
</table>

Figure 2.1. Volume of equipments 110 kV Distribution Network SC ELECTRICA SA

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 (figure 2.2), 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.

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestical</th>
<th>Economical Agents</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>3</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>2001</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>2002</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>2003</td>
<td>6</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>2004</td>
<td>7</td>
<td>8</td>
<td>15</td>
</tr>
</tbody>
</table>

Figure 2.2. Romanian Electricity Consumption
2.2. 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 household 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.

2.3. 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 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 sophisticated computer programs for economical working.

3. 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.

3.1. 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.

3.2. The Distribution Network under Authority Area Control Center. The distribution network under Authority Area Control Center has been completely modeled 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 color), shown in figure 3.1, reaches on its peak 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-Patarlajele 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. 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 (figure 3.2) 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.

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.

CONCLUSIONS

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. Te steps to be followed are:

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