**"Vasile Alecsandri" University of Bacău**
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# RELIABLE OPEN SOURCE SYSTEM FOR AUTOMATIC RELEASE OF RESERVES USING SCADA INTERFACE

PETRU GABRIEL PUIU AND IULIAN FURDU

**Abstract.** This paper work presents the modeling, simulation and implementation of automatic release of reserves (ARR) in a SCADA interface. In the premises known from the literature, a new method to implement AAR system was identified and applied. The classical solutions, although well known and with good results in operation are expensive. The only solution to eliminate the dependency on software and dedicated equipment is the open sources. Automated system for automatic release of the reserve (AAR) as implemented, consists of two voltage sources (Transformer 1 and Transformer 2) and two roof sections linked by a cross coupling. The project comprises three parts: simulation of real components that goes into AAR, the SCADA implementation and the parameters display.

The novelty of the work is the adoption of an Open Source software solution, both for installation control and for programmable controller implementing.

## 1. INTRODUCTION

Under the conditions the development and increasing complexity of electroenergetic installations, the need for complex automation of the production, transmission, distribution and consumption of electricity is felt more acutely.

The installations of energy systems and energy systems as a whole are equipped with devices and automation systems, whose volume and importance are growing.

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The use of automation system in electroenergetic plants, has the main advantage to eliminate operator intervention and thus to decrease the likelihood of errors in handling.

Consequently, resulting reduction in execution time of commands, and therefore the thermal and electrical requirements of synchronous machines and high voltage switchgear are minimal.

Technology development in recent decades required design of new consumer supply schemes, in order to be able to backup the supply during a fault on the line or a power supply.

Nevertheless, more and more cases of young consumers who require such facilities are appearing, (for example a pension for which heating is electric or wood-fired boilers. Frequent outages require a generator that should start automatically, to ensure heating and / or heat recirculation) [2].

Whatever the automation system discussed, the classical implementation can be unsatisfactory.

The new demands require complex achievements, for which the monitored parameters can be viewed and controlled in real time via a SCADA monitoring system.

The problem is the cost of dedicated solutions. Therefore, the study presented in this paper has focused on the identification of reliable open sources software technologies.

## 2. AUTOMATIC RELEASE OF RESERVES (AAR)

Continuity of electricity supply to consumers is one of the most important issues of the design and operation of electrical systems. Whatever the consumer, can not admit it's discontinuation, in order to repair the defect and restore normal supply. A method must be found to ensure supply during failure and for this purpose there are two possible solutions: dual power supply and backup supply.

The consumers supplying requires one connecting element (line or transformer). In the case of dual power supply it requires two components, both in operation. Thus, the connecting elements work routinely with 50% of power required by the consumer and only if one element fails, the other one takes full load (figure 1).

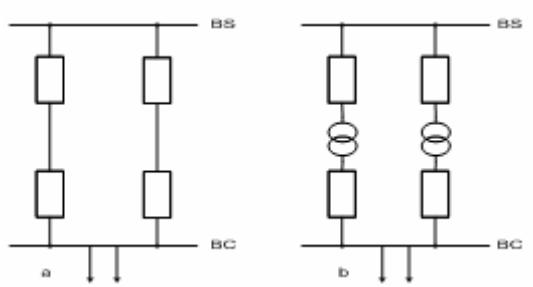


**Figure 1. Dual power supply of consumers**

This solution has several disadvantages: the connection elements are used at least more half of their power, it is used twice more connection controlgear than necessary, the short-circuit power increases on the consumer bars. Another disavantage is represented by the increasing complexity of protection system.

Thus, for increasing the operational safety it is necessary that the two connecting elements to be fed from separate sources (figure 2)

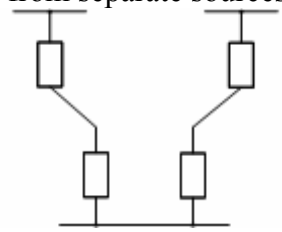

**Figure 2. Two roof systems supplied from separate sources**

These disadvantages make dual power supply solution uneconomic and inefficient and, for these reasons, the backup power solution is adopted.

The backup power solution consists in a reserve connecting element, additionally to the main connecting element, in order to replace the main element in the case of its fault. In normal operation the jumper backup is off (Figure 3).

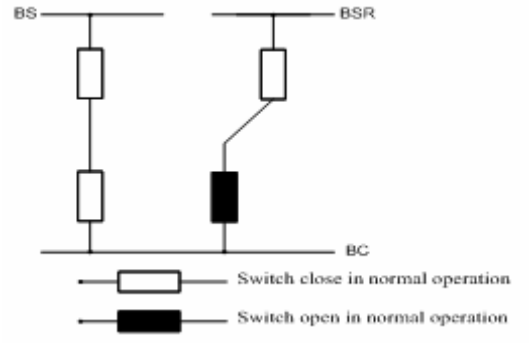


**Figure 3. The supply system with AAR**

***BS* - power supply station bars; *BSR* - power supply station reserve bars; *BC* - consumer bars**

In normal operation the backup power is switched off. The connection of power supply backup occurs only at fall of the main power. Because of this, only one backup connection element can be used for many consumers.

When adopting the AAR solution, all disadvantages of dual power supply are removed.

## 3. SIMULATIONS AND RESULTS

The methods used for simulations are mathematical modeling and computer simulation modeling. The simulations are realized taking into account the real parameters of exploitation. The novelty is the implementation of automatic release of reserves using an open sources graphical programming interface, Pro View (figure 4), according to the the block diagram of the system (figure 5).

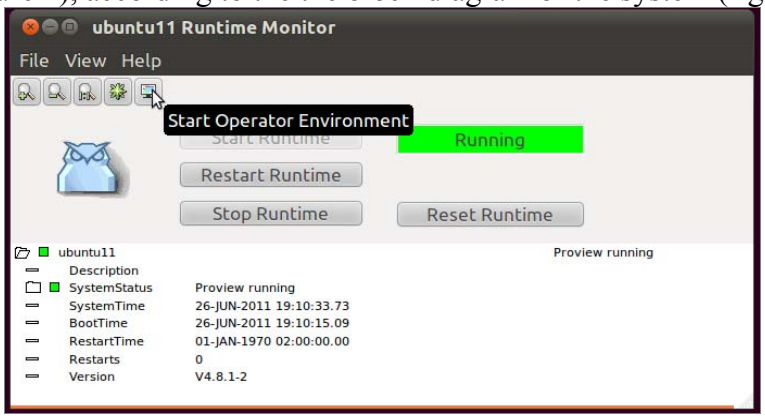


**Figure 4. The ProView applications**


**Figure 5. The block Diagram of System**

The application has three parts, represented by three functional blocks: electrical simulator, the AAR programming and the viewing of system parameters in SCADA, (figure6).

The electrical simulator supplies data to the embedded Pro View PLC control and also to the SCADA display system.

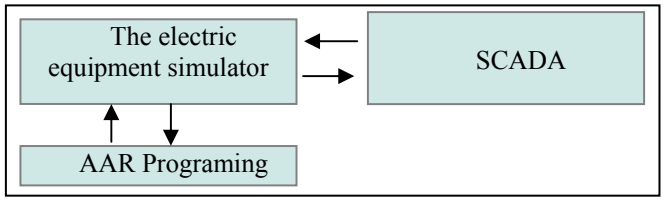

**Figure 6. The AAR system block diagram**

The Pro View software allows running several parallel programmable logic controllers, each with different scanning time. This feature permits the simulation of electrical equipment used in the application: the tension sources, the system bars, the measurement centrals, and the switchers (figure 7).

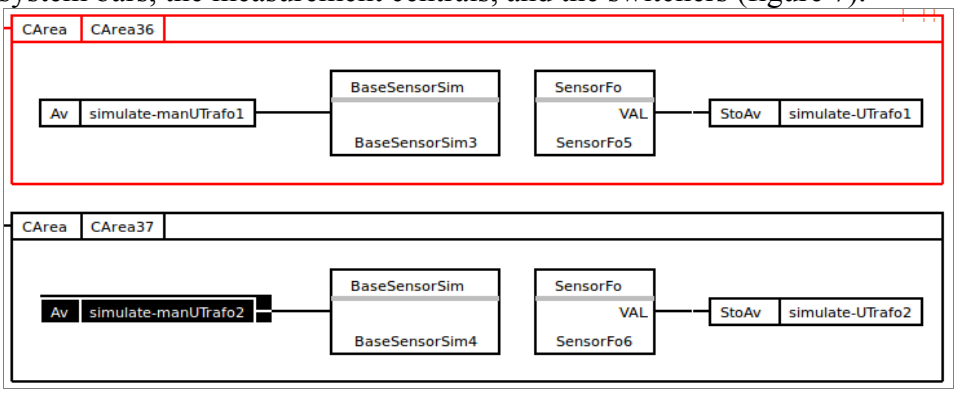


**Figure 7. The simulation of tension sources and bars systems**

It takes a central measure to monitor the tension parameters. For this simulation we used the component "base sensor" in PLC functions. This feature allows taking the voltage at the source and compares them with minimum and maximum limits set for optimal AAR. The minimum and maximum values are shown in the following figure boxes. Setting minimum and maximum limits is acting green triangle in the figure above. It will open the window given in figure 8.

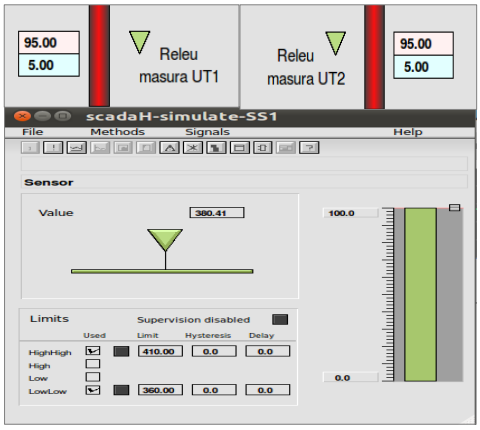


**Figure 8. Displaying voltage and the adjustment for the minimum and maximum limits**

The simulated section bars are displayed in figure 9.

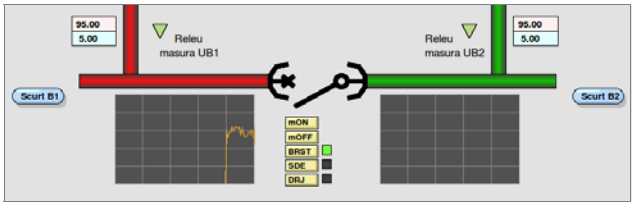


**Figure 9. The SB1 and SB2 Bars sections**

The switches simulation aimed to capture the most accurate real working conditions through a HMI (Humain machine interface), shown in Figure 10, where: mON- local actuation of switcher, mOF- local opening switcher, BRST- broaching / unbroaching switcher, SDE- fault status, DRJ- trouble condition.

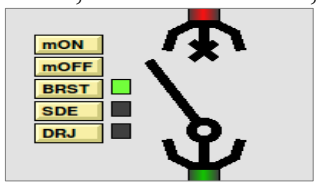


**Figure 10. HMI System**

The switcher status causes the change of color for downstream tension bar (figure 11).

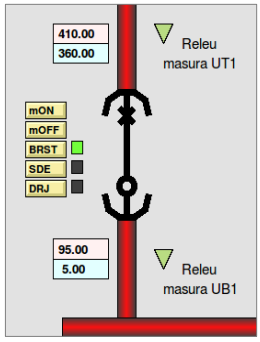


**Figure 11. Highlighting the powered status for section 1 bar**

A program fraction of a breaker simulation is given in figure 12. Simulation made through graphical interfaces is similar to "classical" computer programming, mentioning that code lines correspond to graphical icons, as we represented in figure 12.

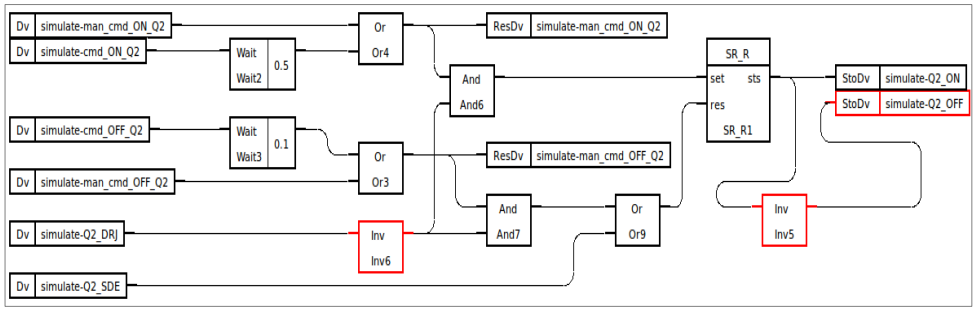


**Figure 12. The switcher simulations**

The AAR system operation is evidenced in the operator panel in figure 13.

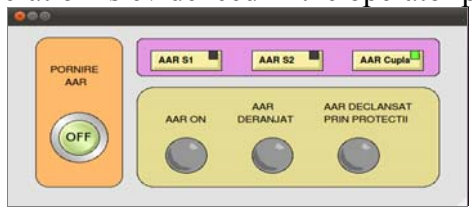


**Figure 13. AAR operator panel**

The supervised values and the state of switcher are displayed in the front panel of application (figure 14).

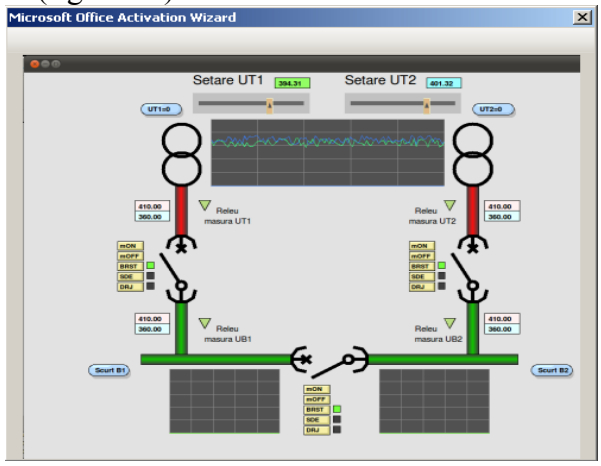


**Figure 14. The front panel of the application**

The voltage on the two sources and two bar systems are displayed through four devices oscilloscope view type. Furthermore, at voltage supply their color changes from green to red. It returns to green when the power supply goes by.

At the same time viewed the minimum and maximum voltage limits for sources and bar systems can be adjusted. The switcher status is given in HMI window.

## 4. CONCLUSIONS

The automatic release of reserve constitutes a very effective measure in power distribution installations and solutions to reduce implementation costs are desired.

The AAR implementation using Open Source solutions not only greatly reduce the cost but mainly the addiction to dedicated solutions. Although represents a novelty, the use of open sources for industrial applications is robust in terms of operational safety.

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**Petru Gabriel Puiu**
"Vasile Alecsandri" University of Bacău
Faculty of Engineering
Department of Power Engineering, Mechatronics and Computer Science
157 Calea Mărăşeşti, Bacău, 600115, ROMANIA
e-mail: ppgabriel@ub.ro

**Iulian Furdu**
"Vasile Alecsandri" University of Bacău
Faculty of Sciences
Department of Mathematics, Informatics and Education Sciences
157 Calea Mărăşeşti, Bacău, 600115, ROMANIA
e-mail: ifurdu@ub.ro