CONTRIBUTIONS TO THE MANAGEMENT OF WIND POWER IN ROMANIA. THE ABSORPTION SEN WIND ENERGY 2013. ELECTROMAGNETIC INTERFACE

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Abstract – *Nowadays, Romania confronts with a storm of the already implemented projects or in development as regards the wind and photovoltaic power plants, located to a great extent in Dobrogea, an area where the power consumption is low. Also, the capacities of discharge power lines on this area are limited. Compare with the wind power plants, the photovoltaic power plants have a more uniform spreading in the country. A great importance have the aspects that concerns the level where the wind power plants penetrates the National Power System. Considering the practice used in EU countries, which have a high penetration potential of the renewable energy in the National Power System, Romania needs to reorganize the current structure taking into account the adopting of one organizational structure dedicated in that meaning. As follows, there are presented a number of solutions to be adopted for this purpose.*

1. INTRODUCTION

In the European Parliament and European Council there is a mechanism which regulates the promotion and the use of renewable energy (Directive 2001/77/EC, replaced later with Directive 2009/28/EC).

The mentioned directives are designed to determine the share of renewable energy in the EU's GDP in 2010 and for the period 2010-2020 (20% in 2020). Therefore by the Law 220/2008 Romania established:

- The objectives regarding gross final consumption of electricity produced from renewable sources are: 35% for 2015 and 38% for 2020;
- The obligatory quotas for the electricity produced from renewable sources, with a promotion system are: 16% for 2015 and 20% in 2020.
- This system of green certificates promotion of E-RES (electricity produced by renewable energy sourses) with the help of each 1 MWh produced or delivered by the E-RES producers receives two green certificates for wind power plants (untill 2017).

The reasons to promote E-RES are likely:

- **economic**: aims particulary the security of the energy supply and the industries which use E- RES;
- **social**: aims the employment;
- **environmental**: as clean sources or as contribution to reduction of climate changes etc.

In Romania, there are today many projects implemented, located in a continuous development of wind power. Dobrogea region is dominated by the wind. In that part of the country's consumption is quite low, there is also a nuclear power plant. The region is lacking by the power plants able to take swings electricity production and for energy removal products to other areas there are severe limitations.

2. THE SITUATION IN ROMANIA INSTALLATION IN SEN A CEE

At the end of July 2013, in Romania, there were installed 2198.9 MW in 66 wind power plants. Regarding the maximum power that the wind power plants produced in Romania, we can say that it has tended the maximum of 1,840 MW on 04/14/2013 at 10:49 p.m. hours. In that time, this power was approximately 87.6% of the total capacity installed in the wind power plants which operated in Romania at that time (around 2,100 MW). Taking into account the data provided by NC Transelectrica, we find that the total capacity installed and affordable at the first octombre 2013 in the wind power plants, was 2,325 MW.
We present an overview about the situation existing projects in September 2013 of wind power plants, taking as reference points the connection requests and the situation commissioning.

Table 1 - The situation existing projects in September 2013 of wind power plants, taking as reference points the connection requests and the situation commissioning.

	CEE connected at RET [MW]	CEE connected at RED [MW]	Total [MW]

CEE with tehnical connections	3.105	1.354	4.459
CEE with connection contracts	9.431	5.181	14.612
Total	12.536	6.535	19.071
CEE with completed commissioning	1.005,6	1.304,8	2.310,4

It is estimated that by the end of 2015 in Romania will exist a total installed capacity of wind power plants of about 4,200 MW. Also, it is possible that for periods of strong winds these plants will produce a maximum power around 3,680 MW and the average power will be 1,050 MW.

Following the studies made by experts, we can say that there are a lot of situations where the energy production related to the wind power plants sincreases or decreases rapidly, sometimes in short intervals. We conclude that the energy from renewable sources, particularly the wind and the solar, have certain special characteristics because they are intermittent and uncontrollable. Thus, it requires:

- providing electrical power sources;
- forecasting accurate, regularly updated and the control of energy from both renewable and distributed generation sources.

3. SOLUTION FOR A DEDICATED MANAGEMENT STRUCTURES INTEGRATED RENEWABLE ENERGIES

3.1 Preliminary Notions

If we want to integrate the production of electricity from renewable sources (wind, solar etc..), we will face some operational difficulties regarding the power systems. It requires finding solutions: dispatching balancing or control. These problems not depend only on the technical side, but are closely related with the organizational, economic or regulatory side, all of them can be solved with a balanced approach of all the parts together.

IWES Fraunhofer Institute in Germany has introduced and developed the concept of "Virtual Wind Power Plant" applied to a plant or a cluster (a group of wind power plants), which has led to the concept of wind power generation control. Currently, rising is the concept of Virtual Power Plants based on renewable energies that we apply to countries like USA, Germany, Portugal, Spain etc. Thus, more renewable sources are involved for the complementary generation (with priority access to the grid and dispatching).

Considering the previous context, we propose a dedicated structure in terms of leadership and management by dispatching.

3.2. The Grouping into Clusters of Wind Power Plants Based on RES

After the model of west countries, in such a group we have engaged plants based on RES with different locations, but connected directly or indirectly to the same node belonging to the electricity transmission network in order to form / function like a "Virtual Power Plant based on RES."

In Figure 1 we represent a cluster.

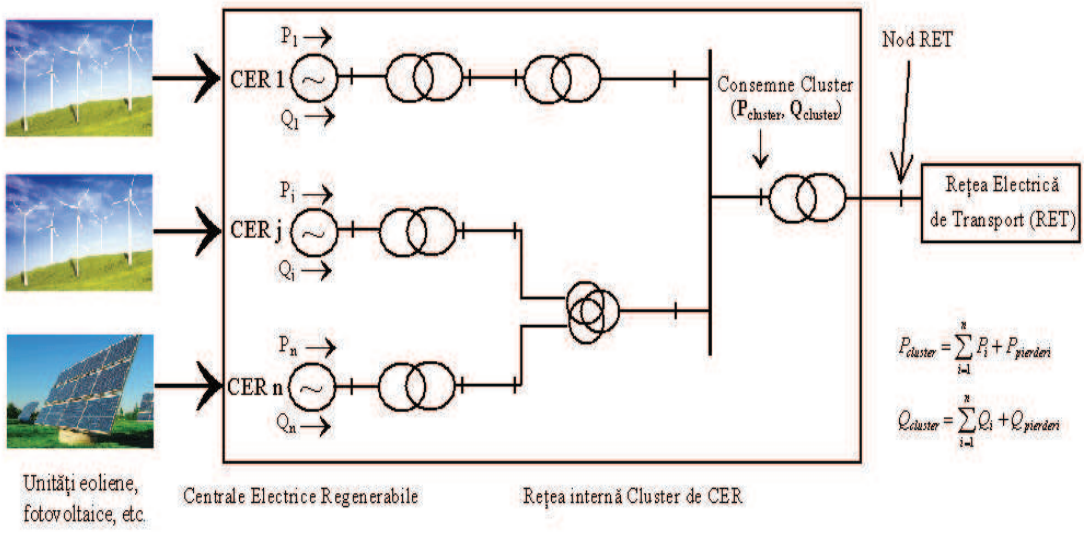

Figura 1 –The definition of a cluster of CER

If in a cluster there will be some unregulated plants, they will be filled by those where the control is possible. The fact that the engagement of these plants is made on the principle of direct or indirect connection to a common node grid (electricity transmission network , in order to achieve the Virtual Power Plant), is due to the transmission system operator (TSO) which is interested in power consumption, the injections and the grid node voltages in order to generate scheduling and real-time analysis with the objective : the power flows on the grid lines, the analyse of the wrong and random inputs in the grid, the transformers in grid nodes, the node voltage grid, the reactive power etc and, on the base of centralizing the data from grid nodes, we'll be able to execute a series of actions (in real time) aimed at: balancing, adjusting voltages of nodes, the power-frequency control, optimization, safety in operation RET and SEN.

In countries like Germany, USA etc. the concept "Virtual Power Plants based on Renewable Energy" (VRPP - Virtual Renewable Power Plants) is already widespread, thus generating electricity in photovoltaic power plants associated with the wind power plants (which produce energy at night). Another combination is that of the wind power plants with in the electric power plants, based on biomass or thermo (both with a certain capacity in terms of the output adjustment). The concept mentioned will above:

- that the wind power plants are grouped in order to smooth the power injected into SEN, the reduction of power in the large wind power plants and its control;
- the strengthening of distributed generation (DG) using biomass localy or regionaly with wind or photovoltaic power plants;
- a correlation of the distributed renewable resources, to evaluate the excess of the energy produced, to determine the need for local storage capabilities etc.

3.3. A Proposed System for Managing the Clusters of Electric Power Plants Based on RES

We propose the adoption of the SEN control over the generation of electric power plants based on the RES by clusters of electric power plants with renewable sources basing on:

- A hierarchical management system;
- The OTS control the clusters to the needs of SEN;
- A Management System of Cluster based on renewable energy sources (SMCR), which contains an organizational structure and a hardware or software one, hierarchically on two levels (1 - Central Dispatch Renewable DEC / DCR , 2 - Centers of Dispatch of Clusters Renewable Plants DCCR).

Thus, the SMCR system management (Figure 2) will be in the DEC, helping the dispatchers in DEC's control room when each cluster should be operated separately, as SEN required.

For a better function (safely), both at SEN and at the energy transport networks should be followed some management strategies:

- the tension control, as in conventional electric power plants;
- the reducing of gradients at loading and unloading of the wind power plants;
- the photovoltaic and wind power plants must provide a reactive power as well as the conventional ones;
- the photovoltaic and wind power plants must provide a balancing power as well as conventional ones;
- a management of congestions in the transmission network;
- a programming of wind power and photovoltaic plants generation for the achievement of a safe operationfor the power system planning.

The Figure 3 shows the implementation of Power Management Systems (PMS), generated by the electric power plants which composed a cluster. Using the cluster PMS, we can apply a set of management strategies:

- the providing of reactive power in an usually domain without depending on the characteristics of the wind for wind power plants or weather conditions if we talk photovoltaic plants.
- the generation programming must be configured (active power), to be followed by a given program for wind power plants, depend on wind, the photovoltaic plants depending on atmospheric conditions.

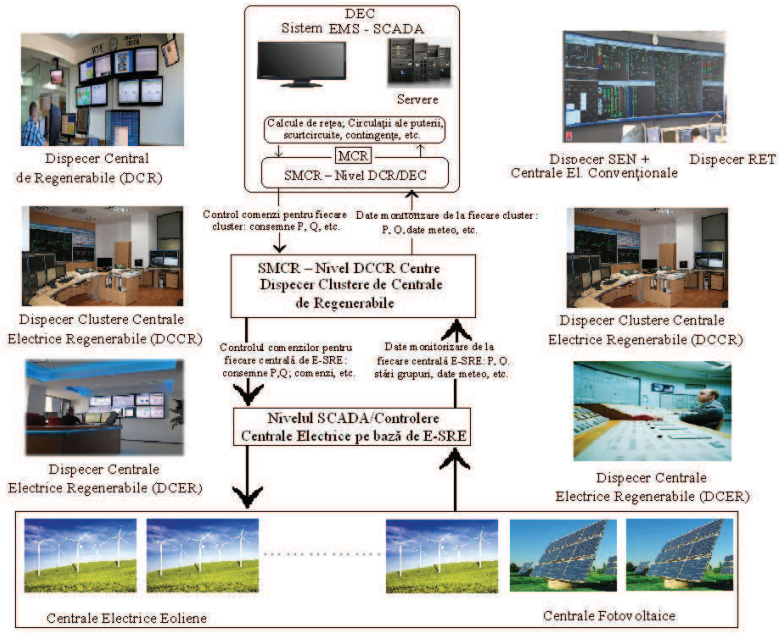

Figure 2 – The structure for monitoring and control SMCR system

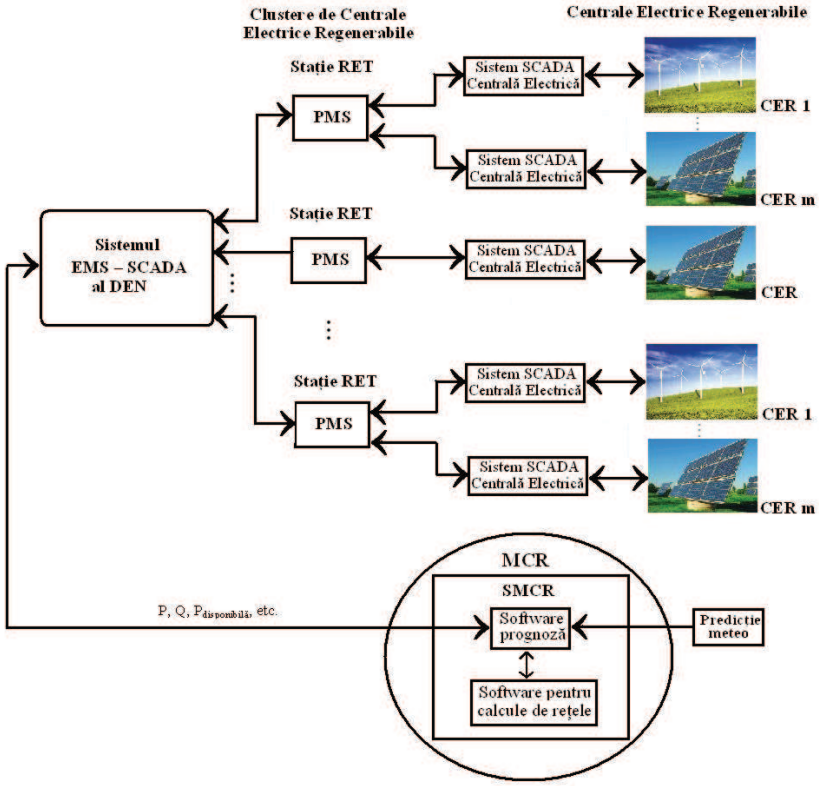

Figure 3 – The movement of data between SMCR, PMS and EMS SCADA for the Transmission Operator and System

According to figures 2 and 3, the SMCR subsystem found at DEC headquarters will receive data (Pproduct, Qproduct, Pavailable) from each SMCR subsystem related. In turn, all SMCR subsystems related to the dispatcher cluster plants will receive instructions for

clusters from the SMCR subsystem located in DEC headquarters.

The day before, after receiving weather forecasts, MCR will estimate a forecast of the power that could be generated for each cluster the next day. This forecast is sent to DEN, as we can see in Figure 4.

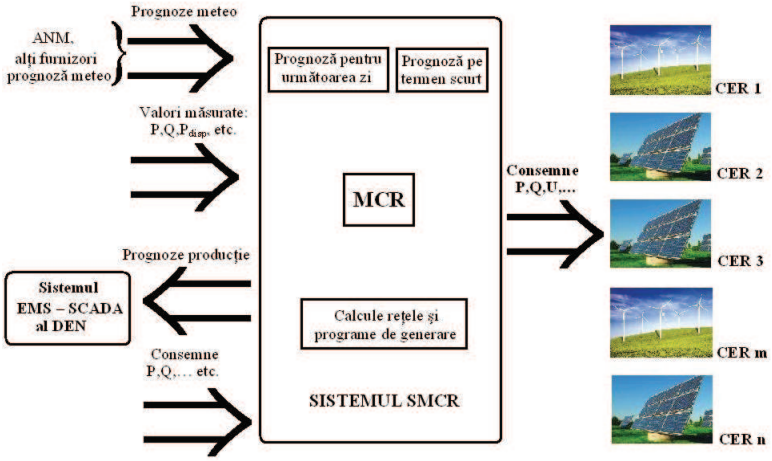

Figure 4 – The SMCR subsystem

Using this forecast in the next day programming of power which will be generated in SEN, the DEC / DEN are designed to calculate the circulations of the power transmission network, to detect the possible congestions, achieving a primary programming of power that will be generated each cluster in the next day, to balance the production and consumption in the SEN, this appointment being sent to MCR. The EMS SCADA system located in DEN will calculate the power requirements to a specific node of RET. Also, here are calculated the contingencies, the transfer capability of RET, the maximum power generated allowed in the network, the short circuit level, from DEN, for the evaluation of the SEN and RET safety. The corroboration of these calculations becomes active and reactive power requirements (P, Q) for the generation of RET nodes where the clusters are connected.

If necessary, MCR will recover the calculations, aiming DEN's compliance requirements refering to the programming of the power that will be generated the next day each cluster. Like this, the generated programms established for each power plant in part, to ensure that the cohesion of all power plants in clusters will lead to DEN requirements.
Noteworthy is that the weather forecast for next day uses only like estimation of the generation by the power plants.

Throughout the operation of the MRC is able to more accurately estimate the power in each cluster can lead to, for time intervals of up to 4-6 hours, measuring and interpreting the current weather data.
Taking into account the current requirements regarding the power that each cluster must ensure, that are received every 15 minutes from EMS-SCADA to DEN, MCR will forecast power to be generated by each cluster for the next interval, for up to 4 hours, then the

generation programming of each power plant will be recalculated. Black lists will be referred from the SMCR subsytem of DEC to all SMCR subsystems related to the dispatch centers of clusters. Once received the Clusters requirements dispatch centers and the power plants that are in authority, they must execute them. The distribution of black lists for power plants will be conducted by the SMCR subsystems related to the dispatch centers of clusters.

In parallel with the existing control flow from the DEC Dispatch centers of clusters, we will find a flow monitoring data from the SMCR subsystems of the dispatch centers of clusters at the SMCR subsystem of DEC headquarters, thus allowing for the SMCR subsystem DEC to identify the current state of the cluster and the power plants, thus performing their own forecasts.

All these specific monitoring data allow us to know the current status of the cluster generation, so it is always necessary to have a way of communication between the levels (two in number) of SMCR system for a continue circulation of the information. Thus, we can use up the infrastructure communications SCADA system in order to move the required data of SMCR system.

IV. ELECTROMAGNETIC INTERFERENCE IN THE WIND FARMS

It is known that both radio waves and microwaves are used on a large scale in order to communicate. Generally any structure gauge which has moving parts will result in electromagnetic interference (Figure 5).

The turbine's blades causes interfaces reflecting electromagnetic signals, so that the handsets nearby will take direct and the reflected signal. Such signals are out of phase (the reflected one is delayed due both wavelength equivalent natural frequency of the blades and the blades due to rotation - Doppler effect).

Figure 5 – Electromagnetic Interference in the Wind Farms

The metallic materials, hightly reflected benefit by a more pronounced interference compared to wood or epoxy resins. The modern blades are made of a durable metal longeron,

dressed in polyester, reinforced with fiberglass, they are less transparent electromagnetic waves. The communication frequencies will not be visible altered if the wavelength of the transmitter will be 4 times greater than the height of the wind plant. The frequency limit is of 1.5 - 2 MHz (150-200 m), theoretically there is no upper limit.

The types of signals for civily and military communications, which may be subject to electromagnetic disturbances include: radio and TV signals, air or naval traffic control radar systems, mobile phone.

Occasionally there may be interference with a small number of TV receivers. It can suppress these problems, using multiple transmitters and / or receivers targeted or wired network.

To find technical beneficial solutions is necessary to require at the specialized organisms. Thus, we have previously to analysed the placement of wind power plants installations, considering the transmitters and receivers nearness.

V. CONCLUSION

The article capture some aspects concerns the wind power plants penetrate the National Power System. The reasons to promote E-RES are: economic, social and environmental. The energy from renewable sources, particularly wind and solar, have certain special characteristics because they are intermittent and uncontrollable. Thus, it requires:

- the providing electrical power sources;
- the forecasting accurate, regularly updated and the control from both renewable energy and distributed generation sources.

It proposes a system for managing the clusters of the power plants based on RES.

All groups wind / solar / mixed related to a wind / solar / mixed power plant will be connected to a LAN (local area network), which in turn is connected to a remote control system involved in managing the collected data, in adjusting the settings of the wind groups, in warning, troubleshooting and reporting to the National Control Centre.

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