with the efficiency of 13% can gather 150 kWh/m^2. These data are conductive to designing different autonomous devices powered by SB. The natural tests have showed that SB is reliable and effective both at the low and high temperatures.
3. The range of the working temperatures (tested) is within the range from – 39,5 to +35єC.
4. On the basis of the data of the meteorological conditions in Tomsk and the correlation between the solar activity and the power produced by the solar battery it is possible to predict its efficiency in other regions, their atmosphere conditions being taken into account.

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REFERENCES.

1. Jurchenko A.V, Bakin N.N., Kovalevskiy V.K., Plotnikov A.P., Usherenko A.A. The results of the battery climatic tests under the natural conditions in Tomsk. Atmosphere and Ocean Optics 11, no. 12, 1998, pp.1337-1340
2. Jurchenko A.V, Kovalevskiy V.K., Plotnikov A.P. The climatic tests of the solar batteries. Electronic industry no. 2-3, 2002, pp.189-192
3. Arshinov M.J., Belan B.D., Zuyen V.E., Ligotskiy A.V., Meleshin V.E., Panchenko M.V., Pokrovskiy E.V., Rogov A.N., Simonenkov D.V., Tolmachev G.N. Atmosphere and Ocean Optics, 1994 v.7. no. 8. pp. 1085-1092
4. Pivovarova Z.I., Stadnik V.V. The climatic characteristics of the solar radiation as the energy source on the territory of the USSR. L.: Gidrometeoizdat, 1988, 292p.
5. Jurchenko A.V, Minosov A.L., Jurchenko V.I. An autonomous portable station for producing sweet water from the solar battery. Materials of the international science-technical conference "Engineering and technology of water clearing and quality surveillance", TPU, 1999, pp. 164-165.

VIRTUAL POWER PLANTS (VPP) – A NEW PERSPECTIVE FOR ENERGY GENERATION?

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Motivation and Headquarters Question (VKW).

In the electric international market, energy must be provided so that it is as low-priced and reliable as possible. Strong cost pressure has caused many companies to open energy markets, which has forced them to reduce all renewing investments and implement safeguard concepts in their plants.

The use of decentralized energy plants can be a possible solution for these problems. Operation of these units will optimize the utilization ratio of heat and electric energy. A further advantage is that by fast load and speed changes of the micro plants, the energy requirements can be changed quickly to must the demand.

A goal is to couple the decentralized units so that they can be managed and regulated by a Central Power Unit named the Energy Management System (EMS). The EMS can be further subdivided into smaller managements systems, called Local Managements Systems (LMS). The LMS drive and regulate their respective Cluster and can take part of the activities of the EMS over. They are, however, subordinate to the EMS. A Cluster is therefore apart from the mean voltage network, in which little to middle-sized consumers are connected. In the framework of a virtual power plant unit, renewable energies such as, wind, photovoltaic and biomass power generators can be more effectively integrated with the use of co-generation power units.

An example of a virtual power plant configuration is shown in figure 1.0.

In order to investigate the use of virtual power units the following question must be addressed: can the virtual power system con-

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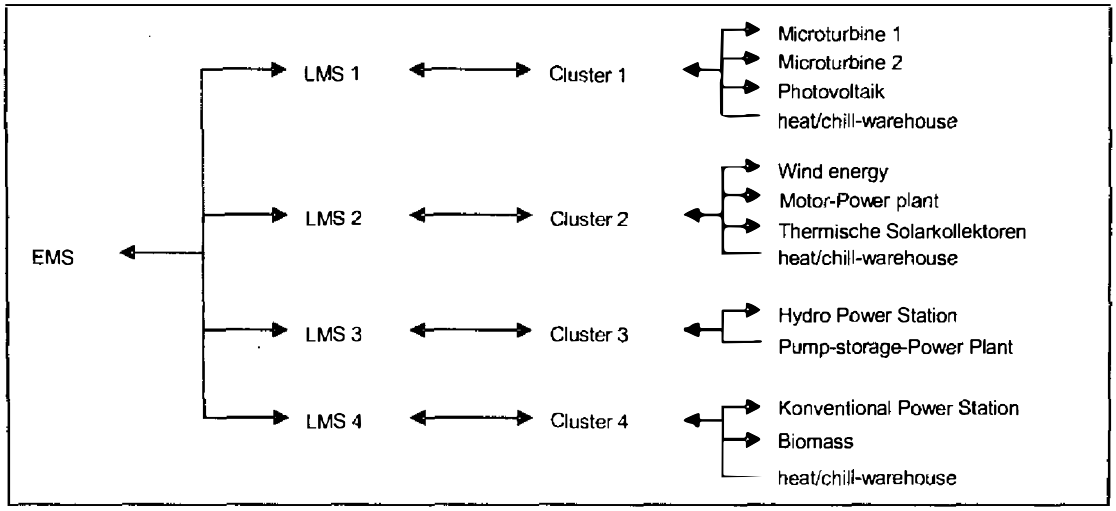

Fig.1

tribute to a reliable and environmentally oriented energy supply?

Methodological Procedure.

To the investigation of the exogenous factors for the use of the virtual power plant, the following criteria are examined:

- Development of the EMS to reach the maximum utilization ratio.
- Reliable production of electricity, heat and cooling energy.
- The use of renewable energies.
- Electric network coupling requirements of the virtual power plant.
- Generation costs of the produced energy by the virtual power plant.
- Emission of greenhouse gases (CO2-comparison).

Results.

The most important factor to the success of a virtual power plant is its use in the open energy market. These factors are based, along with other things, on the work properties of the EMS.

The EMS works with different energy plants. The goal of the EMS is to reach a maximum utilization ratio and minimal greenhouse gas emissions from the system, in a stable electric network.

In order to obtain an optimized utilization ratio the prerequisites should be:

1. Consumer gear lines
2. Reliability in
   - Current
   - Heat
   - Cooling
3. Line production of the producers, its means availability of primary energies.

The network line to the consumer (current, heat and cooling) must consider the particularities from the productions lines of the producers to guarantee the minimal primary energy use.

Another important aspect is the integration of the renewable energies into the virtual power plants. Through new weather simulation models, it is possible to predict reliably weather patterns, and so estimate the renewable energy supply available. With these results, it is possible to calculate plans of action for the remaining producers of the Clusters. This enables a simple and fast integration, for example, of wind power turbines. The load variations emerging in the Clusters can be balanced by the help of the Combined Heat and Power CHP units with its fast power change speeds. Hereby network instabilities and direct voltage breaking are avoided.

Another important point is the electric network coupling. Depending on the type of the networks (island or interconnected network), that the power plants are connected in, different requirements must be established for the energy supply to the network. Above all, the reliability of the system is of utmost importance. Clearly a better system comes through the arrangement of the virtual power plant with numerous micro units. To be sure of this, after coupling the network, it must be technically protected (direction flow security). In addition, the electro technical services play a important role, especially in frequency and constant operation

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voltage.

The most important factor concerns the price of the unit producer power plants:

The price per unit energy is lower for the virtual power plant because of the combined sale of the electrical power and the heating and cooling energy. The losses caused by the transport of the power at low and medium voltage levels, have not been considered yet.

Another factor is the intelligent control and regulation system of the power plants that must be connected with the LMS and the EMS. The costs for that are currently unknown. In the future, these costs will flow within the energy costs.

The virtual power plants have created an effective link with renewable energy sources and combined with CHP-units, there exists a large environment potential to reduce production emissions per energy unit.

Conclusion.

The first virtual power plants are in their trial stages and as yet there are no results to compare with the fuel cells and other energy equipment. However, it has been released that there exists great potential for heating, cooling and electricity production through the management of such a system by a Central Power Unit. This will achieve the optimal utilization ratio required while using as little primary energy as possible.

Adaptation must be made for the electric coupling of the virtual power plant and above all the voltage and frequency performance, as well as the reliability aspects must be examined further.

If these problems are solved, the virtual power plant has a large opportunity to deliver an important contribution as an economic, reliable and non-polluting energy supply system.

REFERENCES

1. www.dispower.org
2. www.dgnet.org
3. www.sustelnet.net

THE SIGNIFICATION OF MICRO-TURBINES AS CHP (COMBINED HEAT POWER SYSTEM)

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In the context of the decentralization of the power supply CHP's become ever more important for small achievements. The requirements these plants are high overall efficiency, as well as simple operation and maintenance. Within this range the micro gas turbine (μ-turbine) is an interesting alternative to the reciprocate engines.

Manufacturers from μ-turbines

μ-turbines are CHP systems with an electrical output of 30 to 200 KW. In time there are 5 manufacturers of μ-turbines placed on the world market:

Bowman (GB) (45 kWel, 80 kWel)
Capstone (USA) (28 kWel, 60 kWel)
Elliott (USA) (45 kWel, 80 kWel)
Honeywell power of system (USA) (75 kWel)
Ingersoll Rand (IR, USA) (70 kWel)
Turbec (ABB/Volvo) (S) (of 110 kWel)

The Systems of the different manufacturers are all suitable for natural gas enterprise. Some manufacturers offer also plants with weak gas (CH_4-Gehalt < 80% and > 30%) on, as well as for liquid fuels such as Diesels and kerosene.

The function of a μ-turbine

The development of the μ-turbine is based on the advancement of turbochargers and Auxiliary power unit (APU) from aviation. μ-turbines are usually single shaft machines, where generator, compressors and turbine are on one shaft fastened. An exception is the Ingersoll Rand turbine (Fig.1) a two-wave machine. It is based on the two stages, the first stage forms a wave, on which the turbine and the air compressor are fastened. The turbinpower is used directly for the air compression. The second stage consists of a further turbine, which is coupled with a conventional synchronous generator over a

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