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ALTERNATIVE ENERGY SOURCES AND MAINTENANCE PROBLEMS OF POWER ENERGY SUPPLY

A.M. Hashimov F.L. Khidirov R.B. Rustamov

Azerbaijan Research Institute of Energetics and Energy Design, "Azerenerji" JSC, Baku, Azerbaijan
ahashimov@azerenerji.gov.az, r_rustamov@hotmail.com

Abstract- Almost all the existing power sources, such as fossil fuel, solar and wind powers, thermal Ocean and hydroelectric powers can be traced back to the energy received from synthesis of the Sun and of course wind. The only exceptions in this understanding are the tidal, nuclear, and geothermal powers. The tidal energy is created due to the interaction of the gravitational potential energy of the Earth/Moon. As it is assumed geothermal power is created owing to radioactive disintegration on the Earth. Today the most popular energy source is the solar and wind energy which presents an alternative to such energy sources as coal, oil and natural gas. This source can be considered as the long-term use source whereas the other sources have the limited resources. The power sources are divided into two categories: renewable and non-renewable. Geothermal and hydroelectric powers fall in the renewable source category. The nuclear power is not classified as renewable. Space vacuum energy or energy of zero fluctuations can be applied as a source of energy. There are several approaches to the use of this energy with implementation of the modern principals of fundamental physic. An invention of the internal-combustion engine in the beginning of the XX century opened a way of development of the thermal energy and industry as well as a wide use of traditional hydrocarbon sources in power energy supply. A wide use of traditional energy sources in power energy production and other industrial areas gave a significant impact on pollution of environment, formation of atmospheric greenhouse effect and weakening of the ozone air stratum. For this reason in the last years all the countries around the world takes an attention to the alternative and renewal and the uses the solar, wind, water and other energy sources to increase of energy supply takes special attention in order to limit consequences of foregoing impact.

Keywords: Energy Resource, Solar Energy, Alternative Energy Source, Wind Power Stations, Lightning Safety, Energy, Greenhouse Effect.

I. INTRODUCTION

In conformity with the geographical and natural resources, economical infrastructure Azerbaijan has an enough big of alternative and renewable (solar and wind) energy sources. It has been developed "The State Program of use of Alternative and Renewable Energy Sources in Azerbaijan Republic" by the Azerbaijani specialist on rational use of energy sources and approved by order of 462 in October 21, 2012. The main commitments and duties are defining of the potential of alternative energy sources in energy production and consideration of exploitation such of energy sources. The target of the program is to increase of the power of alternative energy sources and provision of energy safety of the country [1].

A natural climatic circumstance of the Azerbaijan makes suitable of use of wind and solar energy which creates possibility to increase producing of energy. It is necessary to mention that the Sun shining time within a year in the USA and Middle Asia is about 2500-3000 h, in Russia is about 500-2000. It is highly perceptively of use of the solar energy in the country if the solar time consists 2400-3200 h (in Absheron peninsula and Nakhchivan district of Azerbaijan) [2].

II. ALTERNATIVE ENERGY SOURCES

A. Natural Energy Sources

Fossil fuel: Presently the fossil fuel covers the main part of the demanded energy. It is more relatively concentrated and pure energy source. Moreover it is quite easy to operate from the technical aspect and provides rather cheap energy if environmental issues are not taken into account. Today the oil provides almost all the fuel needs for transportations. The world development of energy for 2004 is shown in the Table 1.

Pollution is a big problem. Fossil fuel is the essential reason for global warming and an acid rain. The use of fossil fuel, mainly coal, causes ten thousands of fatal cases every year in the USA from the respiratory, cardiovascular disease and cancer. And derivative of hydrocarbon fuel itself like carbon dioxide and impurity like heavy metals, sulphur, and uranium contribute to the pollution. Carbon dioxide is also involved as a primary factor in global warming.

Table 1. Energy sources distribution

Energy Source	Percentage, %
Oil	40
Coal	23.3
Natural gas	22.5
Hydroelectric	7.0
Nuclear	6.5
Biomass and others	0.7

B. Natural Gas

The peak of the natural gas development will come probably a bit later than it has happened with oil. There are some of approaches to the future peak use of gas for the period between 2010 and 2020. At present there is the tendency to essential increase of the needs for the natural gas. The leading World States began to pay significant attention to the alternative ways of natural gas transportation which can satisfy their demands for power needs.

C. The Nuclear Energy

There is the resource of uranium 235 approximately for 70 years. Today the other types of uranium is planned to use as raw material for power production. The increase of uranium price would have a small influence on the nuclear power overall cost. For example, doubling in the cost of the raw uranium would increase a total cost of a nuclear energy by 5 percent. If the price of natural gas has been doubled, thus cost of gas energy will increase approximately up to 60 percent.

One of vital issues of nuclear power is the storages of a radioactive waste. The problem of the long-term radioactive waste storage has not been completely solved so far. Some of countries have considered the use of the possibilities of underground storage for radioactive wastes. From the economic point of view it is not so easy to estimate the nuclear power as it requires a very big financial expenses for construction and a very low expenses for fuel.

D. The Renewable Energy Source

Before industrial revolution renewable energy was largely the only used source. Wood as solid biofuels remains the basic energy source for developing countries with poor economic conditions.

E. The Hydroelectricity

Today hydroelectricity is the only renewable energy source which brings a big contribution to the world energy development. The long-term technical potential of hydroelectricity use is believed to be 9-12 times more than the present status of application of such sources, but in this case come up environmental problems in conjunction with a new dam construction. Therefore there is a highly interest to the mini-hydro projects which allow to avoid the big dams construction problem.

F. The Solar Energy

Presently commercial solar cells can convert about 15 percent of sunlight energy to the electric power. If the constructed solar collector will cover 1 percent of the Earth surface it can be used for growing of the grain crops and satisfaction of the pasture needs. Today the solar cells are located on the top of an existing city infrastructure for power supply. In this case there is no any necessity for selection of special areas to place the elements of solar batteries.

G. A Wind Power

Today the wind power is one of the most competitive in respect of the cost of the renewable energy sources. The estimation of experts shows that it is possible to provide approximately 13 percent of the whole Earth territory with electric power using the wind power. In relation to onshore wind resources the 90 percent of the offshore wind energy is powerful which opens a wide application of offshore wind turbines to power supply.

H. Geothermal Energy

Geothermal energy and tidal energy are the only renewable energy sources which are not dependent on the Sun. But today they are restricted with the concrete area location. Today all the accessible tidal energy is equivalent to one quarter of the full human energy consumption. Geothermal energy has a more potential considering the high internal Earth temperature. Today Iceland and New Zealand are the greatest user States of geothermal energy. There are the other States which could use the same sources of energy for power supply.

I. Ocean Thermal Energy Conversion and Wave Energy

Ocean thermal energy conversion and tidal energy are one more renewable energy sources with a big potential. Presently there are plans to construct with speed big wave farms which will make energy with the ocean wave energy use.

III. APPROACH OF THE MODERN PHYSIC ON SPACE ENERGY

The mere fact that even famous physicists at least theoretically recognized a possibility of a collection of energy from space and whose ideas were found their place on the scientific pages of the prestigious magazines is already a great achievement. As far as recognition of so-called modern physics "vacuum energy" or "zero-point energy" is not fantasy. And its technical application became an interesting theme for serious discussion. Authors of these ideas have different lines of thought concerning its practical realization. For instance, for one of them it is already in the way while for others this idea still has a long way of realization.

It is obvious that for a many long years this concept considerably was transformed and has changed. But yet the old concept of :ether" remains the basis concept of modern physics vacuum energy. From time to time up to the physic of 19th century the concept of ether in its changing forms and different names played an essential role in the physics, philosophies, biology, and medicine. The physicist Isaac Newton endorsed this idea and later on Maxwell and many others for whom the ether was the

channel of transmission of all the electromagnetic waves. According to the general condemnation, the ether theory has been denied by American physicists Albert A. Michelson and E.W. Morley at the end of the last century. In 1905, Albert Einstein, in his "Special Theory of the Relativity" rejected the idea of an ether and only used space for transmission of the electromagnetic waves.

Actually, the ether existence has not been completely denied so the vacuum has the physical properties. And with this approach the physic of 19th century only released itself from deadlock of mechanical ether and has come back to other kind of ether, more related to the original Indian "akasha". Development of quantum physics soon accepted again "empty" space with "quantum ether".

In 1916, famous great physical chemist and Nobel Prize winner in chemistry 1920, Walther Nernst (1864-1941), confirmed that even in empty space and at absolute zero temperature the electromagnetic field has continuous actions, so-called „quantum fluctuations" that confirms existence of certain energy. However, existence of "zero-point energy" (ZPE) remained disputable while Werner Heisenberg did not show in 1925 that its existence arises from a principle of uncertainty of quantum mechanics. The general recognition of ZPE was included at last in 1927 by the association into the theory of Quantum Electrodynamics Paul Dirac. Thus the vacuum is far from that concept to be empty, even in the absence of the matter filled by „sea of energy" which density according to conservative estimates has the order of the nuclear energy.

A. Space Based Energy and Solar Lasers

Solar lasers and conducted researches on Sun radiation transfers to Earth. These investigations are intended to demonstrate the possibility of generation of Sun radiation from solar panels by means of satellites. There are the following reasons:

- Top atmosphere of Sun radiation which are falling onto the Earth, makes approximately 1,400 W/m^2 (Watts per square meter); however, molecules in atmosphere absorb various wavelengths of light. Having passed atmospheric layers, intensity of sunlight radiation decreases.
- In northern Europe the comprehensible estimation makes approximately 150 W/m^2, somewhere this value can reach as much as possible to 350 W/m^2.
- In desert of Sahara energy is up to 1 000 W/m^2.

The network of satellites would be serving in this specific investigated concept as energy converters, having grasped abundance of energy from Sun and sending it down to Earth in the form of laser or microwave beam. This idea has been put forward by Peter Glaser to the scientists working in Cambridge, Massachusetts at the end of 1960. It can't be doubted that there are many difficulties and lacks during realization of this idea and technology [3, 4].

Problems of the Space Solar energy (SSP) are different. One of them is the high cost for satellite launch. NASA (in 1995) has decided to propose a new approach to technology probably involving financial and public support for future developments. Since the interest to the SSP has appeared the special group of researchers from National Research council (NRC) has chosen some technical achievements might be following up:

(a) improvements of efficiency of solar panels and fabrication of light-weight panels;
(b) progress in transformation on the Earth, especially in Japan and Canada;
(c) robotics which is considered to be essential to operate SSP assembly.

All those have shown essential improvements from the point of view of manipulators, machine systems, coordination, problem and reasoning planning.

The conclusion was accepted that for essential success in development of the technology it is necessary that the SSP might produce energy competitive by cost in comparison with the main existing on the Earth electrical power. The final success in satellite-based generation of the electrical power on the Earth depends on the reduction of the cost of transportation from the Earth to geosynchronous orbits (that is identical heights of the orbital period of satellite). It means that satellite should be at the same point concerning the Earth terrestrial surface. Under such circumstances the transmission of energy on surface is demonstrated point to point and also realization of "ground to space" and "space to ground" transfer is desirable [5, 6].

IV. LIGHTNING SAFETY PROBLEM

Scientific research works and multiyear observation conducted by the Azerbaijan Scientific Research and Design Investigation Institute, "Azerenerji" OSS Ltd have been identified that condition of use of wind energy in Azerbaijan is most suitable in Absheron peninsula, the costal of Caspian Sea, in the islands of Northern-West part of the equator. In those areas with height of 40 m an average wind velocity is about 7.5-8.5 m/sec.

It is important to indicate that the construction of the wind power stations is most expedient in Absheron peninsula and around Caspian See area not only for the reason of the wind velocity as well as in point of view of comparatively low lightning intensively ($\leq$10 h). In the Western part of Azerbaijan Ganja-Dashkesen zone and Sharur-Julfa area of the Nakhchivan Autonomous Republic an average velocity of the wind is 3-5 m/sec. It creates an excellent environment of suitable use of wind power facilities.

Azerbaijan is also have started to take special attention to the alternative (clean) energy sources (wind, solar, water etc.) for power supply as other countries around the World and in 2009 for implementation above mentioned program under umbrella of the Ministry of Industry and Energy has been established "State Agency on Alternative and Renewal Energy Sources" (SAARES) and an Agency has transferred to the State Company after abolition of Ministry of Industry and Energy in 2012 and in 2013 by the Order of President of Azerbaijan Republic has started to function as an independent entity as "State Agency on Alternative and Renewable Energy Sources" (SAARES).

A two wind power stations each of with a power of 0.850 MWt have been constructed by for exploitation private company near the Shurabat settlement of Khizi district in 2008. Later in 2011 in Gobustan (Maraza) in "Gobustan Experimental Polygon and Education Centre" of SAARES facility (total power of 2.7 MWt of three wind power stations and 1.8 MWt of power of solar battery panels and 1.0 MWt of power of biogas facility) has been constructed for exploitation with power of 5.5 MWt.

In conformity with the state program currently in SAARES as well as by different private companies in Absheron peninsula and Caspian Sea surrounded areas (Shurabad, Yeni Yashma, Pirakeshkul, Guba and other areas with different power (0.85-3.0 MWt) and high-altitude (40-120 m) some number of wind power stations and parks have been constructed and some of them are in stage of design and constructing) number of wind and solar power stations have been constructed.

Based on information of SAARES it has been undertaken to complete construction in Azerbaijan until 2015 tree wind power stations (in Pirakashkul 80 MWt, Yeni Yashma 50 MWt and Shurabad 5.3 MWt wind power stations) with the total power of 135.3 MWt. Based on other information of SAARES within the time frame of 2014-2020 in Azerbaijan is intending to construct wind power stations with total power 512.5 MWt.

Based on information of Agency design of this project has been planned in three stages implement: the first stage of 2014-2016 – 150 MWt, second stage of 2017-2018 – 150 MWt and the third stage of 2019-2020 – 212.5 MWt. In general it has been considered increasing energy sources on renewable energy up to 20%. Calculation demonstrates that Azerbaijan has a capacity of 800 MWt of wind power energy, it makes possible to safe the millions of ton standard coal and more important issue is to minimize of a big quantity of west matter to the atmosphere.

The wind power stations mainly being horizontal turbine depends of the power constructing in the towers with the altitude of 40-120 m and sail arm diameters also depends of the power 40-80 m, that is common altitude consists about 80-160 m. Towers are preparing from iron, reinforced concrete and networked iron supports and sail arms consist different compositions of isolation materials. An investigation of lightning and intensively of their influence in located areas in such of altitude is very vital.

It can be classified of wind power energy facilities depends of those power on a small (up to 100 kWt), middle (up to 100-500 kWt) and high (0.5-5.0 MWt) power.

The USA (1600 MWt) and Germany (1500 MWt) are World leaders on a quantity of constructed wind power stations. The next countries for the wind power energy capacity are Denmark (830 MWt), India (820 MWt) and The Netherlands (285 MWt).

An experience of exploitation of wind power energy stations demonstrates necessity and importance of lightning safety of those stations. Countries different companies offer variety of facilities for wind turbines safety. In general there is no any accepted method or manner directly providing lighting safety of wind turbines.

It is obvious that it selects of empty and open areas from other facilities and features for construction of wind power energy stations located one by one or as a group in order to use of high efficiency of wind energy. For this reason they have a big probability of lightning consequences and under lightning current occur different damages and fires. Figures 1 (a), (b), (c) and (d) demonstrate examples such of consequences.

Figure 1(a). An examples of lightning damage

Figure 1(b). An examples of lightning damage

Figure 1(c). An examples of lightning damage

Figure 1(d). An example of lightning damage

In some of sources of wind power energy stations for lightning safety connecting to main frame with the elastic iron rod earthing layer which has along of 2-3 m, diameter 12-16 m.

Based on search of internet materials have been shown that the lightning punch in wind power energy stations can occur in sail arms vertical as well as slopping condition. There is different explanation of reasons. The lightning punch to the wind power energy stations between earth and cloud and directed from the lightning cloud to the unloading depends of the wind power energy station height.

There is no doubt that during wind power energy station operation depends of the wind and sail arm rotation velocity a common height changes up to height of the tower from the sail arm axis and changing of the heights impacting the change of safety zones. Beside this sail arms consists composite materials during the rotation of the sail arms electrically charging.

It is known from the lightning unloading research works that the leader channel way of the lightning during the lightning is unloading between clouds or cloud-earth defining the value of the filed created by electrical charging. We assume that the reason of the wind power energy station sail arm damages to the vertical and sloping condition is an electrical charging of sail arm of the wind power energy station created maximum value of the field tension directed to the lightning leader channel developed between leader channels of field tension.

"Azerenerji" OSS Azerbaijan Research Institute of Energetics and Energy Design is implemented many long years a wide research works related to the lightning intensively, lightning unloading, progress stages of the lightning unloading and outcomes of those works have been published in the famous of journals, conferences and symposiums of the former Soviet Union and foreign countries. Based on statistical data for lightning intensively in Republic collected for a more then 40 years is enclosed to the publishing Republic National Atlas.

V. CONCLUSIONS

Depending on economic, natural and other conditions become necessary uses of appropriate resources for power supply. Therefore selection of energy sources is tightly bounded up with such factors as environmental issues, energy renewability, efficiency and others.

Today investigation of possibility of Sun radiation use becomes very significant problem. First of all, it is related to the elimination of energy natural resources. For solution of this problem advance successes in space technology can play an essential role.

The wind power energy stations are a newly using energy facility in Azerbaijan and study of the lightning safety is important issue. During the monitoring of the wind power station in Yeni Yashma area has been discovered that there is no any facility for lightning safety of station which is one more argument of importance of indicated studies.

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BIOGRAPHIES

Arif M. Hashimov was born in Shahbuz, Nakhchivan, Azerbaijan on September 28, 1949. He is a Professor of Power Engineering (1993); Chief Editor of Scientific Journal of "Power Engineering Problems" from 2000; Director of Institute of Physics of Azerbaijan National Academy of Sciences (Baku, Azerbaijan) from 2002 up to 2009; and Academician and the First Vice-President of Azerbaijan National Academy of Sciences from 2007 up to 2013. He is laureate of Azerbaijan State Prize (1978); Honored Scientist of Azerbaijan (2005); Cochairman of International Conferences on "Technical and Physical Problems of Power Engineering" (ICTPE) and Editor in Chief of International Journal on "Technical and Physical Problems of Engineering" (IJTPE). Now he is a High Consultant in "Azerenerji" JSC, Baku, Azerbaijan. His research areas are theory of non-linear electrical Networks with distributed parameters, neutral earthing and ferroresonant processes, alternative energy sources, high voltage physics and techniques, electrical physics. His publications are 280 articles and patents and 5 monographs.

Fakhraddin L. Khidirov completed his high degree education in Electrical Networks and Systems at the Institute of Oil and Chemical, Baku, Azerbaijan in 1968. He is a Ph.D. of Technical Sciences has awarded by Moscow Institute of Energetic, Russia. Currently, he has been working as a senior researcher in the Research Laboratory of High Voltage in Power Engineering at Azerbaijan Research Institute of Energetics and Energy Design, Baku, Azerbaijan.

Rustam B. Rustamov was born in Ali Bayramli, Azerbaijan, on May 25, 1955. He is an independent expert on Space Science and Technology. In the past, he was in charging of the Azerbaijan National Aerospace Agency activities as an Acting Director General. He has mainly specialized in space instrumentation and remote sensing and GIS technology. He has graduated Ph.D. at the Russian Physical-Technical Institute, S. Petersburg, Russia. He was invited for the work at the European Space Agency within the Framework of the United Nations Program on Space Applications at the European Space Research and Technology Center, The Netherlands. He has appointed for the United Nations Office for Outer Space Affairs Action Teams (member, Vienna, Austria), United Nations Economical and Social Commission for Asia and the Pacific (national focal point, Thailand), International Astronautically Federation (Federation's contact, Paris, France), Resent Advances in Space Technologies International Conference Program Committee (member, Turkey). He is an author of 9 books published by the European and United States famous publishers and more than 90 scientific papers.