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THE ENERGY OF THE FUTURE

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Abstract - Our papers is about nuclear energy, wind energy and sun energy (solar energy). It is describe techniques, natural transform of solar energy in electrical energy. We study if those methods are already competitive on the market and costs for implementations of those methods.

I. INTRODUCTION

From old the time people try to find new form of the energy.

Many people think nuclear energy will be the energy of the future but this isn't the solution because we have many theories about the energy of the future. For example, I might mention: mechanical energy, electrical energy, hydro energy, nuclear energy, wind's energy, geological energy, thermodynamic energy, kinetic energy, solar energy, geothermal energy, atomic energy etc. All forms of energy are interconvertible by appropriate processes.

Today I speak about nuclear energy, solar energy and wind energy.

II. NUCLEAR ENERGY

Nuclear energy, energy released during the splitting or fusing of atomic nuclei. The energy of any system, whether physical, chemical, or nuclear, is manifested by the system's ability to do work or to release heat or radiation (Fig.1). The total energy in a system is always conserved, but it can be transferred to another system or changed in form.

Until about 1800 the principal fuel was wood, its energy derived from solar energy stored in plants during their lifetimes.

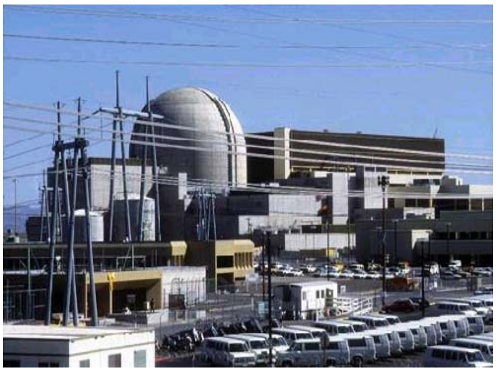

Fig. 1. The Palo Verde Nuclear Power Facility in Arizona

Since the Industrial Revolution, people have depended on fossil fuels-coal, petroleum, and natural gas-also derived from stored solar energy. When a fossil fuel such as coal is burned, atoms of hydrogen and carbon in the coal combine with oxygen atoms in air. After we know, nuclear energy can be released in two different ways: by fission (splitting) of a heavy nucleus, or by fusion (combining) of two light nuclei. In both cases energy is released because the products have a higher binding energy than the reactants.

The probability that a fission neutron with an initial energy of about 1 MeV will induce fission is rather low, but the probability can be increased by a factor of hundreds when the neutron is slowed down through a series of elastic collisions with light nuclei such as hydrogen, deuterium, or carbon. This fact is the basis for the design of practical energy-producing fission reactors.

A variety of reactor types, characterized by the type of fuel, moderator, and coolant used, have been built throughout the world for the production of electric power. The steam produced in the reactor pressure vessel is piped directly to the turbine generator, is condensed, and is then pumped back to the reactor (Fig. 2).

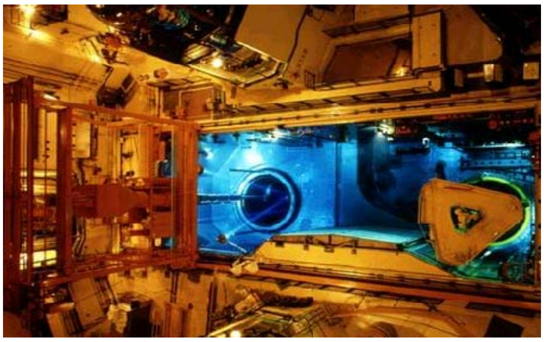

Fig. 2. The hole at the far end of the blue cavity is the core of a nuclear reactor.

The nuclear power programs in Canada, France, and the United Kingdom therefore centered about natural uranium reactors, in which ordinary water cannot be used as the moderator because it absorbs too many neutrons.

This limitation led Canadian engineers to develop a reactor cooled and moderated by deuterium oxide (D_2O), or heavy water. The Canadian deuterium-uranium reactor known as CANDU has operated satisfactorily in Canada, and similar plants have been built in India, Argentina, and elsewhere.

In the United Kingdom and France the first full-scale power reactors were fueled with natural uranium metal, were graphite-moderated, and were cooled with carbon dioxide gas under pressure. A variety of small nuclear reactors have been built in many countries for use in education and training, research, and the production of radioactive isotopes.

Any electric power generating plant is only one part of a total energy cycle. Uranium, which contains about 0.7 percent uranium-235, is obtained from either surface or underground mines. The spent fuel still contains almost all the original uranium-238, about one-third of the uranium-235, and some of the plutonium-239 produced in the reactor. In cases where the spent fuel is sent to permanent storage, none of this potential energy content is used. Radioactive materials emit penetrating, ionizing radiation that can injure living tissues.

III. REACTOR SAFETY SYSTEMS

The safety of the power reactor itself has received the greatest attention. In an operating reactor, the fuel elements contain by far the largest fraction of the total radioactive inventory. A number of barriers prevent fission products from leaking into the air during normal operation (Fig. 3).

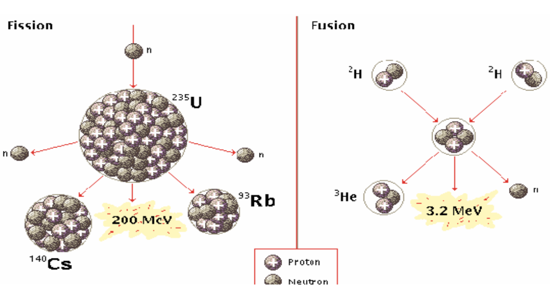

Fig. 3. Fission and Fusion Processes

Reactor systems relay on elaborate instrumentation to monitor their condition and to control the safety systems used to shut down the reactor under abnormal circumstances. The last step in the nuclear fuel cycle, waste management, remains one of the most controversial. The principal issue here is not so much the present danger as the danger to generations far in the future. Many nuclear wastes remain radioactive for thousands of years, beyond the span of any human institution. The technology for packaging the wastes so that they pose no current hazard is relatively straightforward. The energy radiated by stars, including the Sun, arises from such fusion reactions deep in their interiors.

The basic problems in attaining useful nuclear fusion conditions are (1) to heat the gas to these very high temperatures and (2) to confine a sufficient quantity of the reacting nuclei for a long enough time to permit the release of more energy than is needed to heat and confine the gas. A subsequent major problem is the capture of this energy and its conversion to electricity (Fig. 4).

Fig. 4. In 1993 scientists at the Tokamak Fusion Test Reactor, at Princeton University's plasma physics laboratory in New Jersey, produced a controlled fusion reaction, during which the temperature in the reactor surpassed three times that of the core of the sun.

In a tokamak reactor, massive magnets confine hydrogen plasma under extremely high temperatures and pressures, forcing the hydrogen nuclei to fuse. When atomic nuclei are forced together in nuclear fusion, the reaction releases an extraordinary amount of energy. Most of the news consisted of descriptions of experiments on the transmutation of the elements and on absorption and deflection of neutrons and other nuclear particles.

IV. NATURAL TRANSFORMATION OF SOLAR ENERGY

Natural collection of solar energy occurs in the earth's atmosphere, oceans, and plant life. Interactions between the sun's energy, the oceans, and the atmosphere, for example, produce the winds, which have been used for centuries to turn windmills. Modern applications of wind energy use strong, light, weather-resistant aerodynamically designed wind machines that, when attached to generators, produce electricity for local, specialized use or as part of a community or regional network of electric power distribution.

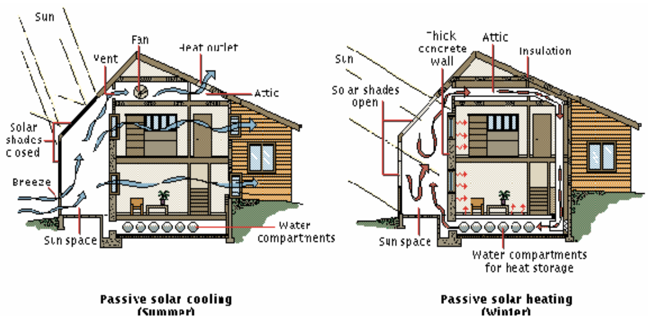

Fig. 5. Active solar heating systems involve installing special equipment that uses energy from the sun to heat or cool existing structures.

Approximately 30 percent of the solar energy reaching the outer edge of the atmosphere is consumed in the hydrologic cycle, which produces rainfall and the potential energy of water in mountain streams and rivers. The power produced by these flowing waters as they pass through modern turbines is called hydroelectric power.

The oceans also represent a form of natural collection of solar energy. As a result of the absorption of solar energy in the ocean and ocean currents, temperature gradients occur in the ocean. In some locations, these vertical variations approach 20° C (36° F) over a distance of a few hundred meters. Active solar heating systems involve installing special equipment that uses energy from the sun to heat or cool existing structures.

Passive solar energy systems involve designing the structures themselves in ways that use solar energy for heating and cooling. For example, in this home (Fig. 5), a “sun space” serves as a collector in winter when the solar shades are open and as a cooler in summer when the solar shades are closed. Thick concrete walls modulate wide swings in temperature by absorbing heat in winter and insulating in summer.

Water compartments provide a thermal mass for storing heat during the day and releasing heat at night. The direct collection of solar energy involves artificial devices, called solar collectors, that are designed to collect the energy, sometimes through prior focusing of the sun’s rays. The energy, once collected, is used in a thermal process or a photoelectric, or photovoltaic, process. In the photovoltaic process, solar energy is converted directly to electrical energy without intermediate mechanical devices.

Solar collectors are of two fundamental types: flat plate collectors and concentrating collectors.

The carrier fluid, which in this case is water, flows through copper tubing in the solar collector, and in the process absorbs some of the sun’s energy. Next, the carrier fluid moves to the heat exchange, where the carrier fluid warms water that is used by the household. Finally, a pump moves the carrier fluid back to the solar collector to repeat the cycle. Central electric power generation from solar energy is under development. In the central receiver, or “power tower,” concept, an array of reflectors mounted on computer-controlled heliostats reflect and focus the sun’s rays onto a water boiler mounted on a tower. The steam thus generated can be used in a conventional power-plant cycle to produce electricity.

Cells with conversion efficiencies in excess of 30 percent are now available.

Because of the intermittent nature of solar radiation as an energy source, excess solar energy during periods of small demand must be stored in order to meet demands when solar energy availability is insufficient. The timing of these advances could be of critical importance to the future of modern civilization. Most experts believe that an energy system based on fossil fuels cannot be sustained for another century.

V. WIND POWER

Technological advances are breathing new life into an energy source long tapped by humans: the wind.

The Danes invented a machine composed of three propeller-like fiberglass blades that point upwind of a steel tower, on which they are mounted. The latest versions, manufactured by companies based in Germany, India, Spain, and the United States, have aerodynamic blades up to 40 m (130 ft) long. These spinning blades use a system of gears to translate their power an electronic drive with sophisticated microprocessor controls. The generator is housed atop the tower, and like all electric generators it uses spinning magnets to create an electrical field. Wind energy is a widely available resource.

One obstacle to the development of wind energy on a greater scale is that some of the world's largest wind resources are found significant distances from major urban and industrial centers.

But as the cost of wind turbines continues to fall, developers in some remote wind-rich regions, including Patagonia and the state of Wyoming, are considering building the additional transmission lines that are needed. It has been nearly a century since the world had a comparable opportunity to change its energy system.

Some observers believe that a series of revolutionary new technologies-including advanced solar cells, wind turbines, and fuel cells-are in about the same place today that the internal-combustion engine and electromagnetic generator occupied in the 1890s.

Now for what many scientists believe is the biggest environmental problem ahead, global warming.

VI. CONCLUSIONS

1. In conclusion I think that the energy of the future could be: nuclear energy, solar energy and wind energy.

2. The 21st century may be as profoundly shaped by the move away from fossil fuels as the 20th century was marked by the move toward them. But most experts believe a new energy system will take decades to develop. Investment in the current system is massive, and enormous resources will be required to build a new one.

3. The main impediment to increased reliance on solar power is cost. Most experts believe the cost of solar cells must fall by 50 to 75 percent to be fully competitive with coal-fired electricity.

4. Solar power is another ancient energy source that has benefited from developments in modern technology. The oldest forms of solar power used sunlight as a direct source of heat energy. A relatively new form of solar power, the photovoltaic cell, converts sunlight directly into electricity.

5. In one new application, several companies have integrated solar cells into a new generation of roofing shingles, tiles, and window glass, allowing homes and office buildings to generate their own electricity.

6. Solar cells, for example, have gone from powering satellites and remote communication systems to providing energy for a growing range of applications that are not connected to a main power grid, including consumer electronic devices, highway signals, and water pumps.

7. The cost of wind-generated electricity is already competitive with coal-fired plants, the world's leading source of electricity.

8. Burning fossil fuels gives off carbon dioxide, and the build-up of that greenhouse gas causes half of global warming processes.

9. The nuclear energy is cheaper but may be very dangerous.

REFERENCES

1. Los Angeles Times, March 31, 1979;
2. Will Renewable Energy Come of Age in the 21st Century? - By Christopher Flavin and Seth Dunn;
3. Bloman, Leo, J. M. J., and Mugerwa, Michael N. Fuel Cell Systems. Plenum, 1994;
4. DePalma, Anthony. "The Great Green Hope." New York Times, October 8, 1997;
5. Flavin, Christopher, and Lenssen, Nicholas. Power Surge: Guide to the Coming Energy Revolution. W.W. Norton, 1994;
6. Gipe, Paul. Wind Energy Comes of Age. John Wiley & Sons, 1995;
7. Hoffmann, Peter. The Forever Fuel: The Story of Hydrogen. Westview Press, 1981;
8. Hills, Richard L. Power From Wind: A History of Windmill Technology. Cambridge University Press, 1996;
9. Klass, Donald L. Biomass for Renewable Energy, Fuels, and Chemicals. Academic Press, 1998;
10. Zweibel, Kenneth. Harnessing Solar Power: The Photovoltaics Challenge. Plenum, 1990;
11. Environment: The Good News - By Norman Myers;
12. Nemzer, Marilyn Levin, B.A., M.A. - Executive Director, Geothermal Education Office.