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SPACE-BASED SOLAR POWER

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Today our community think about how to solve the energy problem. A large part of the energy sources will end in the near future, and one of the best renewable sources is a Space-based solar power. Every hour, more solar energy reaches the Earth than humans use in a year [1].

Space-based Solar Power (SBSP) collects energy from sunlight in space and transmits it over the wireless network to Earth. Potential benefits of collecting solar energy include a high rate of collection, uninterrupted supply of energy to the Earth from the orbit, where is no night [2]. In space, the amount of solar energy much more than we use today. According to scientists, that the sun's lifespan is 4-5 billion years, which gives people a long-term perspective of obtaining clean energy. This energy has some advantages and disadvantages.

Advantages of Space Solar Power are as follows:

- Unlike oil, gas, ethanol, and coal plants, SBSP does not emit greenhouse gases.

- Unlike coal and nuclear plants, SBSP does not compete for or depend upon increasingly scarce fresh water resources.
- Unlike bio-ethanol or bio-diesel, SBSP does not compete for increasingly valuable farm land or depend on natural-gas-derived fertilizer. Food can continue to be a major export instead of a fuel provider.
- Unlike nuclear power plants, space solar power SBSP will not produce hazardous waste, which needs to be stored and guarded for hundreds of years.
- Unlike terrestrial solar and wind power plants, SBSP is available 24 hours a day, 7 days a week, in huge quantities. It works regardless of cloud cover, daylight, or wind speed.
- Unlike nuclear power plants, space solar SBSP does not provide easy targets for terrorists.
- Unlike coal and nuclear fuels, SBSP does not require environmentally problematic mining operations.
- SBSP will provide true energy independence for the nations that develop it, eliminating a major source of national competition for limited Earth-based energy resources.
- SBSP will not require dependence on unstable or hostile foreign oil providers to meet energy needs, enabling us to expend resources in other ways.

Nonetheless, there are some disadvantages of SBSP such as:

- High development cost. SBSP development costs will be very large, although much smaller than American military presence in the Persian Gulf or the costs of global warming, climate change, or carbon sequestration. The cost of space solar power development always needs to be compared to the cost of not developing space solar power.

Today, all of the space station in orbit is powered energy by solar panels. It means that we are already able to generate solar energy and rework it to any other kind of energy directly in orbit. The power generation in orbit is necessary because of the fact that a significant part of the solar energy lost on the way through the earth's atmosphere due to reflection and absorption. Accordingly, we need a way of transferring the energy generated in orbit to the Earth wirelessly.

Nowadays, technologies are beginning to appear that allow the transfer of various types of energy wirelessly. Wireless power transmission (WPT) of energy or transmission of electromagnetic energy is the transmission of electrical energy without wires. Wireless transmission technologies use time-varying electrical, magnetic, or electromagnetic fields. Wireless transmission use in power electrical devices where connecting wires are inconvenient, dangerous or impossible.

There are too many ways to transmit energy wirelessly [3,4]. In general, this technology consists of a transmitter connected to a power source. This transmitter converts the source energy into an alternating electromagnetic field, and the retransmission devices that are in this electromagnetic field convert it into DC or AC electric current, which is used by the electrical load (figure 1). At the transmitter the input power is converted to an oscillating electromagnetic field by some type of "antenna" device. The word "antenna" is used loosely here. It may be a coil of wire that gener-

ates a magnetic field, a metal plate that generates an electric field, an antenna that radiates radio waves, or a laser that generates light. A similar antenna or coupling device at the receiver converts the oscillating fields to an electric current. An important parameter that determines the type of waves is the frequency, which determines the wavelength.

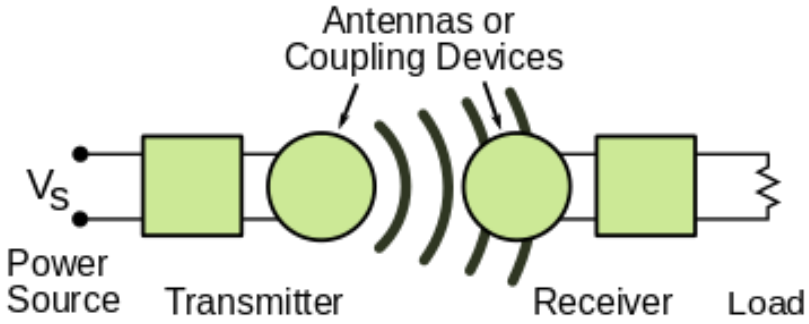

Fig. 1. Generic block diagram of a wireless power system

Type of the wireless power transmission that could transmit the power with more range than other types is a technology of Microwaves. The main difficulties in creating an energy microwave beam is a large diaphragm that is needed to use in space programs because of the diffraction limits the antenna's direction. For example, according to a NASA study of 1978, a microwave antenna with a frequency of 2.45 GHz will require a transmitting antenna with a diameter of 1 km (0.62 mi), and a receiving rectenna in diameter of 10 km (6.2 mi). These dimensions can be reduced by shorter wavelengths. However, short waves can be absorbed by the atmosphere, and blocked by rain. Because of the "curse of a narrow beam," it is impossible to narrow the beam, combining beams from several smaller satellites without a proportional loss in power. For Earth applications, an antenna with a diameter of 10 km will achieve a significant power level while maintaining a low beam density, which is important for safety reasons for humans and for the environment. The level of power density, which is safe for humans, is 1 mW/cm^2 that corresponds to 750 MW in the area of a circle with a diameter of 10 km [1]. This level corresponds to the capacity of modern power stations.

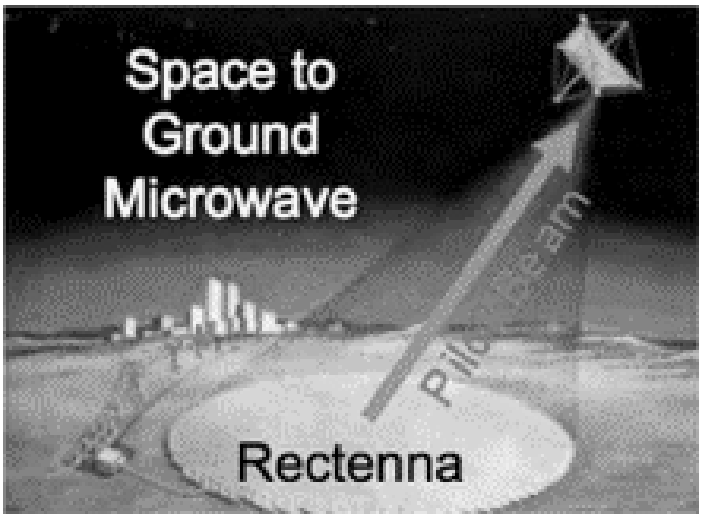

Fig. 2. A laser pilot beam guides the microwave power transmission to a rectenna

To sum up, once can be concluded that today the technology of wireless energy transfer is not developed enough to be used. This fact does not allow us to build solar stations in orbit that could pay off quickly and open up the full potential of space-based solar power. However, this source of clean energy is considered as one of the most promising because in the near future, one of such solar-based power station will be capable of providing energy to entire the Earth.

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ПРИМЕНЕНИЕ ТИРИСТОРНОГО РЕГУЛЯТОРА НАПРЯЖЕНИЯ В РАСПРЕДЕЛИТЕЛЬНЫХ ЭЛЕКТРИЧЕСКИХ СЕТЯХ 6-10 КВ ДЛЯ ПОВЫШЕНИЯ КАЧЕСТВА ЭЛЕКТРОСНАБЖЕНИЯ ПОТРЕБИТЕЛЕЙ

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Повышение качества электрической энергии, поставляемой потребителям, является ключевой задачей развития мировой энергетики. Решение данной проблемы особенно актуально для распределительных электрических сетей среднего напряжения (6-10 кВ), характеризующихся большой протяженностью и высоким уровнем электрических потерь.

Несмотря на возможность автоматического регулирования напряжения, существующие технологии морально устарели и не обеспечивают достижение важной цели – переходу к интеллектуальной электроэнергетической системе.

Интеллектуализация распределительных электрических сетей среднего напряжения связана с разработкой и внедрением полупроводниковых устройств, реализующих функции управления режимами работы сетей. Примером являются технологии D-FACTS (Distribution Flexible Alternative Current Transmission Systems), к которым относятся: унифицированные контроллеры потоков мощности (UPFC), контроллеры межсетевого потока мощности (IPFC), твердотельные устройства регулирования напряжения (SSLTC), устройства поперечной и продольной компенсации с тиристорным управлениям (TSSC, D-SSSC).