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Transmission of Wireless Power using Solar Power satellite Technology

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ABSTRACT

As we know that Sun is the great source of energy on the earth & we can't even imagine the life of any living organisms on the earth .Energy can be produced in three modes 1.Induction(In which two bodies are not connected together but even there is requirement of medium) 2. Conduction (In which bodies are in contact with each other & it also requires medium) 3.Radiation(In which there is no contact of bodies but energy transmitted in form of photons). Solar energy is radiant light & heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating ,photovoltaic, solar thermal energy .It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar on how they capture and distribute solar energy or convert it into solar power. Wireless Power transmission (WPT) is a useful and convenient technology that can be employed to collect solar energy and concentrate on earth surface without the need for a wire connection called a solar power satellites (SPS). This paper provides an analysis of wireless power transfer with an assessment of its practical applicability in terms of power range and efficiency. In this paper, various technologies available so far for wireless transmission of electricity and the need for a Wireless Energy Transmission will be discussed to find its possibility in actual practices. Also, their advantages, disadvantages and economical consideration will also be presented. This paper concentrates mainly on (i) The most popular concept known as Tesla Theory, (ii) The microwave power transmission(MPT) called Solar power satellite, and (iii) The highly efficient fibre lasers for wireless power transmission. Many concepts, research papers, and patents are available on wireless transmission of electricity but the commercial technologies are yet to be materialized. This paper will also discuss the possible ways to get useful and practical results out of all researches carried out so far elsewhere. The output microwave power ranges from 50W to 200W at 2.45GHz. A coaxial cable is to connect the output of the microwave source to a coax-to-waveguide adapter. This adapter is connected to a waveguide ferrite circulator which protects the microwave source from reflected power. The circulator is connected to a tuning waveguide section to match the waveguide impedance to the antenna input impedance.

Keywords: *Wireless power transfer, Microwave Power transfer, Load balancing, Rectenna, solar Power satellites, Response time*

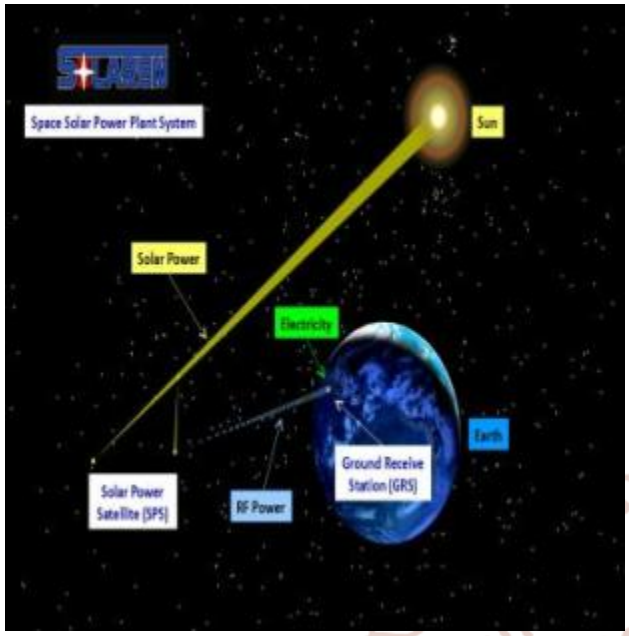
1. INTRODUCTION

In 1968 idea for solar power satellites was proposed by Peter Glaser. Between 1978 and 1981, the Congress authorized the Department of Energy (DoE). In 1999, NASA's Space Solar Power Exploratoryθ Research and Technology program (SERT) was initiated. On Nov 2, 2012, China proposed space collaboration withθ India that mentioned SBSP.

2. History of solar Power satellite

1940-50's Development of the Photovoltaic cell
1958 First US Satellite that used Solar Power
1970's Oil embargo brought increased interest & study

2. Overview



System

The objective of the solar power satellite (SPS) is to convert solar energy in space for use on earth. Its most significant benefit is the potential for continuously generating large-scale electric power for distribution on a global basis. The SPS system is outlined, and the status of the SPS concept development is reviewed. Assessments of key issues are reported including economic considerations and environmental issues as well as physical resource requirements. Legal issues and the need for international agreements on SPS operations are outlined. International SPS-related activities within the context of evolving space programs are discussed. An approach for an evolutionary advancement of SPS to meet requirements for power supplied for use on earth and in space is presented, and a growth path to achieving the potential of power from space for use on earth is outlined. The significance of advancements in technologies applicable to the development of the SPS are discussed

Generic Block Diagram Of Solar Wireless Power

Different wireless technologies

Technology	Range	Directivity	Frequency	Antenna	Current/Future Applications
Inductive coupling	Short	Low	Hz-MHZ	wire-coil	Electric tooth brush & Razor battery charging
Capacitive coupling	Short	Low	KHZ-MHZ	metal plate elctrode	Charging portable devices.Ics ,smartcards
Magneto-dynamic	Short	N.A	Hz	Rotating Magnets	Charging eletric vehicles
Microwave	long	High	GHZ	Parabolic dishes	Solar power satellite,powering drone aircrafts

Disadvantages of wired technology

i) Price is a main factor distinguishing wired & Wireless technology.

ii) Wired technology is not portable.

iii) Wired technology products occupy more space than wireless.

iv) Employees are restricted in their work location.

v) More prone to electrical surges & damage.

vi) Short circuit

vi) 26%-30% power loss

2. *Basic fundamental of wireless Solar Power transmission of electricity*

Solar Power Satellites:

A Visual **Introduction**. Glaser mixed these three **ingredients** and came up with a satellite in equatorial GEO that would use solar cells to convert sunlight into electricity, convert the electricity into microwaves, and beam the microwaves at a receiving antenna (rectenna) on Earth.

3. *Types of wireless transmission of Electricity*

i) Near Field

a) Inductive coupling (Electromagnetic Induction)

b)Resonant Inductive Coupling(Resonant Induction)

c) Air Ionization

ii) Far Field

A) Microwave Power Transmission

B) Laser Power Transmission

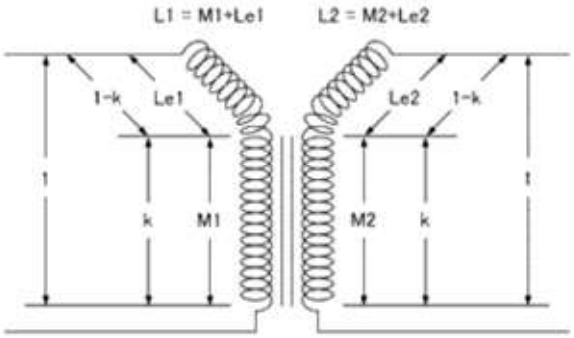
C) Tesla Theory

D) Solar Power satellite

a) INDUCTIVE COUPLING

Primary & secondary coils are not connected with wires

Energy is transfer due to mutual induction



The benefits of resonant inductive coupling lie mainly in medical applications & consumer electronics

Less use of wires, shock proof & it is preferred because it is comfortable

***Drawbacks of inductive coupling ***

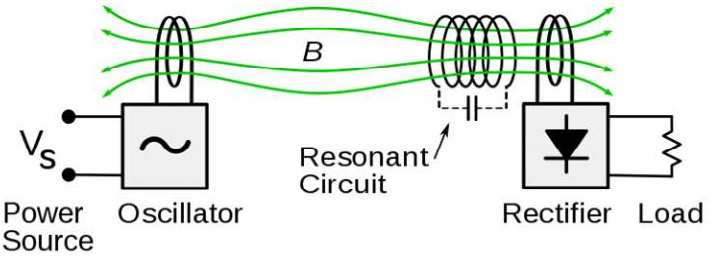
It can be used only for short range i.e For short distance

Receiver must be just close to the Transmitter.

b). RESONANT INDUCTIVE COUPLING

RIC is the combination of both inductive coupling & resonance. Using the concept of resonance it makes the two objects to interact each other very strongly. Leading to the efficient transfer of energy over a large distance

"Resonant



Inductive Coupling" is a phenomenon with inductive coupling where the coupling becomes stronger when the secondary side of the loosely coupled coil resonates.

Applications:-

Power laptops, tablets, smartphone, robot vaccumes , implanted medical devices and vehicles like electric cars & automated guided vehicles

Drawbacks:-

1. Interference in the wave of tissue that could occur anytime.

2. Disruption to security.

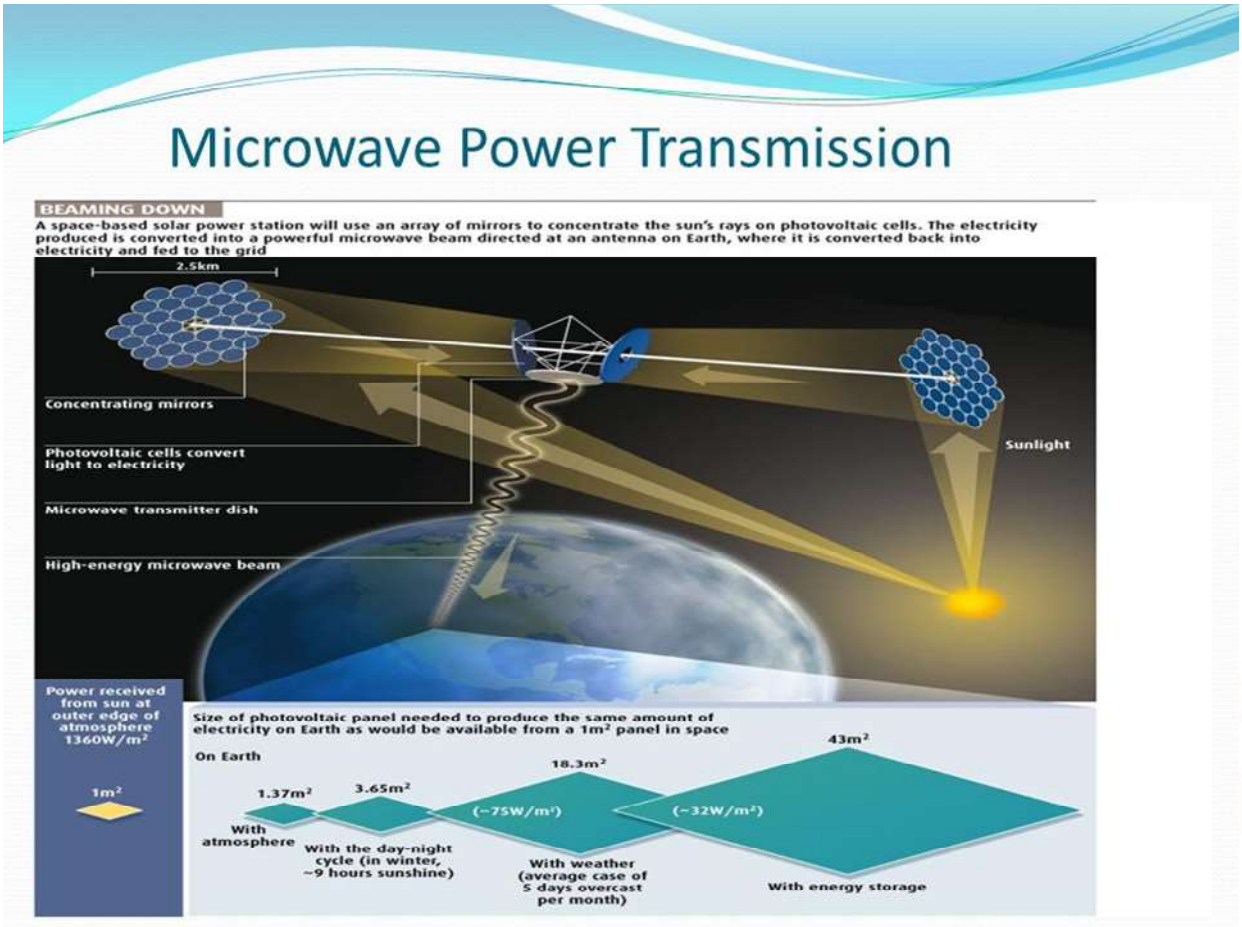
MICROWAVE POWER TRANSMISSION

MPT is one of the important method of far field transmission of electricity & energy is transmitted using radio waves without need for wires. Solar power from the satellite is sent to Earth using a microwave transmitter received at a "Rectenna "located on earth. Recent developments suggest that power could be sent earth using laser

Frequency 2.45 G.HZ microwaves beam Retro directive beam control capabilities. Power level is well below international safety standards

"AN ANTENNA COMPRISING A MESH OF DIPOLES & DIODES FOR ABSORBING MICROWAVE ENERGY FROM A TRANSMITTER & CONVERTING IT BACK INTO ELECTRIC POWER"

Microwave are received with about 85% efficiency. Around 5 Km across & 95 % of the beam will fall on the rectenna.



APPLICATIONS

1. In solar power satellite

2. Energy to remote areas

3. Can broadcast energy globally (In Future)

Disadvantages

1. Interference may arises

2. Initial cost is high

3. Not feasible

4. High frequency signals should be supplied

LASER POWER TRANSMISSION

In the case of electromagnetic radiation closer to the visible region of the spectrum, power can be transmitted by converting electricity into a laser beam that is then pointed at a photovoltaic cell. This mechanism is generally known as 'power beaming' because the power is beamed at a receiver that can convert it to the electrical energy. At the receiver, special photovoltaic laser power converts which are optimized for monochromatic light conversion are applied.

ADVANTAGES

1. Compact size

2. No radio frequency interference

3. Only receivers hit by the laser receive power

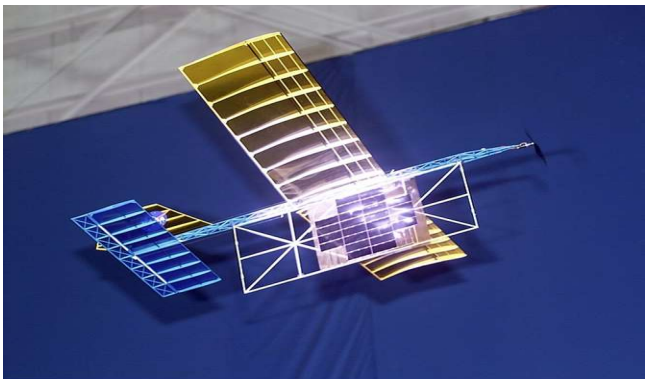
DRAWBACKS

1. Laser radiation is hazardous

2. Conversion between electricity & light is limited. Photovoltaic cells achieve 40%-50% efficiency.

3. Atmospheric absorption & scattering by clouds, fog, rain etc. Causes up to 100% losses

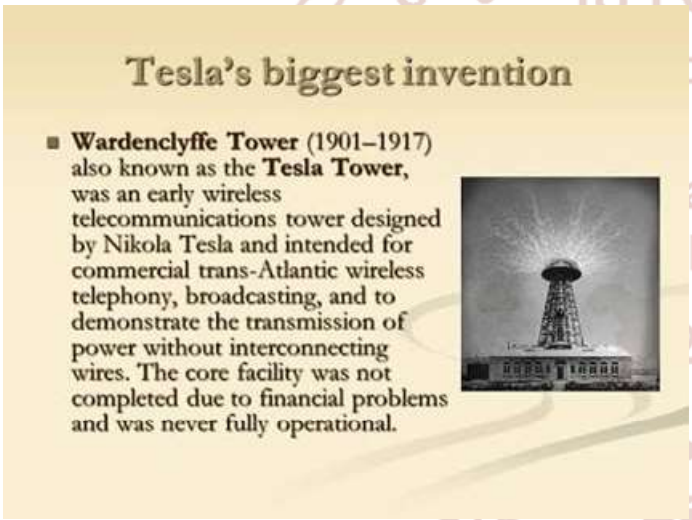
4. Requires a direct line of sight with the target



TESLA THEORY

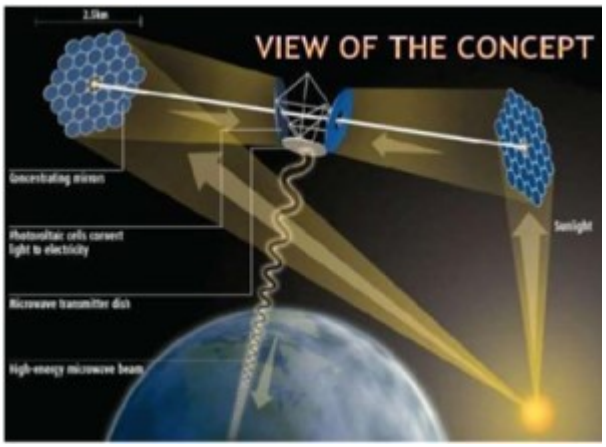
A great physician, concluded that earth is an electrical conductor, and that an electric current can made to propagate undiminished for distances of thousand for distance of thousand miles. It was also found that earth's natural electrical charge can be made to oscillate by impressing upon it very low frequency current waves of certain length

Tesla invented a ray called "Death ray"



D) Solar Power Satellite

Solar Power Satellites (Powersats)



How does it work? Solar power satellites, otherwise known as powersats, orbit the earth and are designed to capture solar energy and transmit that energy to receiving stations that are situated thousands of miles from each other on the surface of the earth. These satellites are made up of a number of modules outfitted with light weight photovoltaic solar panels.

What is so great about this technology? It is clean, it is green, and it is safe. Collecting solar power in space is also more efficient than collecting solar power on the surface of the earth for many reasons.

Types of Solar Power satellite

1. Ground Based Power Satellite
2. Spaced Based Power satellite

Space solar power is preferred **Because ……..**

1. Space gets full power 24 hours a day
2. •3X or more Watt-hours per day per peak watt
3. •No storage required for nighttime power
4. Space gets full power 7 days a week
5. •Space gets full power 52 weeks a year
6. •No long winter nights, no storms, no cloudy seasons

•Space delivers power where it's needed

***Advantages over Earth based solar power**

1. More Intense Light

2. No need for Costly Storage Devices

3. Waste Heat is back Radiated To Earth

4. An SPS Would Be Illuminated 99% over the time

How SPS Works ???????

Four basic steps involved in the conversion of solar energy to electricity and delivery are:

Step 1

Capture solar energy in space and convert it to electricity

Step 2

Transform the electricity to radio frequency energy and transmit it to Earth

Step 3

Receive the radio frequency energy on Earth and convert it back to electricity

Step 4

Provide the electricity to the utility grid

Solar radiation can be more efficiently collected in space, where it is roughly three times stronger than on the surface of the Earth. Most of these systems would utilize photovoltaic (PV) cells similar to those on Earth-based systems.

SPACETENNA: (THE ANTENNA ON SATELLITE)

"An antenna is an electrical device which converts electric power into radio waves. The transmitting antenna on the horizontal under-surface faces the Earth, and the other two sides of the prism carry solar arrays. The Microwave thus produced Travels through Atmosphere & is collected by RECTENNAS on Earth. The Spacetenna has a square shape whose dimension is 132 meters by 132 metersθ and which is regularly filled with 1936 segments of sub array. There will be about 2.6 million antenna elements in the spacetenna.

Challenges

1.Geosynchronous satellites would take up large sections of space

2. Interference with communication satellites

3. Possible health hazards

4. Effects of long term exposure

5. Exposure is equal to the amount that people receive from cell phones & microwave

6.The size of construction for the rectennas is massive

WIRELESS POWER APPLICATION

The **Solar Power Satellite** (SPS) system is a candidate solution to deliver **power** to space vehicles or to elements on planetary surfaces. It relies on RF or laser **power** transmitting systems, depending on the type of **application** and relevant constraints. ... Different frequencies can be used for the RF transmission system.

The wireless system would reduce pollution & expenses resulting from the need to generate power, and to overcome and compensate for losses in the present grid.

1.The largest application of the WPT is the production of power by placing satellites with giant solar arrays in Geosynchronous Earth Orbit & transmitting the power as microwaves to the earth known as solar power satellites.

2. WPT is used in moving targets like fuel free electrical vehicles, fuel free rockets & moving robots.

3. The other application of WPT are wireless power source, RF power adaptive rectifying circuits & wireless sensors.

Examples in the global scale are.....

Africa is in need of power to run pumps to tap into vast resources of water under the Sahara desert

CONCLUSION

This technology is still in development but with support it will become operation of reality providing a new source of clean energy. " Will be a boon as we are running out of fossil fuels".

The SPS system appears as a promising solution for power delivery to elements on planet surfaces. In both Mars and Moon cases, it could be a solution for users, which face the problem of either low solar energy density and environment attenuation or long eclipse duration. It appears as the today onlyTwo power transmission systems were considered based on laser and RF. Laser systems are well adapted to long distance and/or small receiver surfaces, but are penalised by the potential attenuation in the Mars atmosphere, in particular because of dust storm. Analyses would be necessary to assess the laser beam behaviour in that case. The RF system appears advantageous at short distances, and is better adapted in the Mars case when no constraint is applied on the receiver surface. A preliminary evaluation of the SPS systems concepts has been done, based on current or reasonably achievable technology. This leads to overall system efficiencies of a few percent, and to important SPS masses. This concept evaluation assumes an electrical propulsion system ensuring the SPS transfer from LEO to its final positioning. In the case of a laser transmission system, the SPS is

compatible with a single launch (with a possibly heavy launcher) in LEO. This preliminary evaluation is a basis to identify the critical issues driving the performances and the technology improvements to drastically reduce SPS mass down to more competitive values. Thus, in the RF case, the signal generator technologies could be improved for 35GHz in terms of efficiency and mass; likewise, the rectenna elements could be optimised for the application. On the laser system side, new technologies like solar pumped laser, or new types of fiber laser have the potential to significantly improve the on-board efficiency. Such an increase of the overall efficiency has a direct drastic impact on the SPS mass. In parallel, new or improved technologies for large solar surfaces, heat dissipation, deployable structures would reduce the SPS size. Finally, the optimisation of the SPS system (SPS and target) should take into account these areas of improvement for the balance between target surface and SPS transmitter and mass. This drives the choice of key parameters, such as the RF frequency, as a function of critical issues like e.g. mass and pointing accuracy. Therefore, there is a high potential of improvement for the SPS system from the concept presented in this alternative to nuclear energy.

REFERENCE

1) Nikola Tesla,"The Transmission Of Electrical Energy Without Wires as a Means For Furthering peace," Electrical World & Engineer. Jan. 7, p. 21, 1905.
2) Nikola Tesla, My Inventions, Ben Johnston, Ed., Austin, HartBrothers, p. 91, 1982.
3) Nikola Tesla, — The true wireless‖, Electrical Experiments
4) AntoBennet, M & JacobRaglend, —Performance Analysis Of Filtering Schedule Using Deblocking Filter For The Reduction Of Block Artifacts From MPEQ Compressed Document Images‖, Journal of Computer Science, vol. 8, no. 9, pp. 1447-1454, 2012.
5) AntoBennet, M & JacobRaglend, —Performance Analysis of Block Artifact Reduction Scheme Using Pseudo Random Noise Mask Filtering‖, European Journal of Scientific Research, vol. 66 no.1, pp.120-129, 2011.
6) Anto Bennet, M, Mohan babu, G, Rajasekar, C & Prakash, P, —Performance and Analysis of Hybrid Algorithm for Blocking and Ringing Artifact Reduction‖, Journal of Computational and Theoretical nanoscience vol.12,no.1,pp.141-149,2015
7) AntoBennet, M & JacobRaglend, —Performance and Analysis of Compression Artifacts Reduction for MPEQ-4 Moving Pictures Using TV Regularization Method‖, Life Science Journal vol. 10, no. 2, pp. 102-110, 2013
8) AntoBennet, M & JacobRaglend, ‗A Novel Method Of Reduction Of Blocking Artifact Using Machine Learning Metric approach', Journal of Applied Sciences Research,vol.8,no.5, pp. 2429-2438, 2012