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http://www.ren-tv.com/ren-tv_news.asp?ID=801

Quasi-Superconductive Technology for Electric Power Transmission

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SUMMARY

Low cost and low losses single-wire electric power system (SWEPS) has been developed. The new technology of electric power transmission uses idle operation mode of the transmission line and reactive capacitive current for transmission of active electric power. Three different SWEPS has been constructed and tested: 230V, 10kV and 100kV each is of one-kilowatt capacity. Resonance mode of oscillation at the frequency from 3 kHz to 30 kHz was used to provide the most efficient power transmission. Frequency converter and modified Tesla transformer were applied at the generator site to generate high frequency reactive capacitive current. Reversal Tesla transformer and standard rectifier and inverter were used at the consumer end to convert the reactive high frequency electric power to standard 50-60Hz electricity. It has been experimentally proved that SWEPS has quasi-superconductivity properties for reactive capacitive current flow along the line even at high operation temperature of the electric conductor. SWEPS has no resistance losses for following tested conductor materials of the line: copper, aluminum, steel, tungsten, carbon, water, and damp soil. Analysis of theoretical calculations and experimental study shows that SWEPS can be applied both for energy transmission from renewable powerful generation site to a large energy system and for transmission lines connecting different parts of renewable energy system.

DESCRIPTION

Renewable-based electric grids are increasingly being viewed as an attractive alternative for providing power to rural communities. Technology options include small hydropower, biomass-powered generators, small geothermal, solar-thermal, wind turbines and hybrid systems with back-up diesel generator, which may be connected to the local utility. Implementation of renewable-based technologies for rural electrification would contribute to the social and economic growth of the rural communities and would serve sustainable progress of the remote regions. Electric grids face specific problems of non-efficient operations, including transmission losses and the high cost of grid extension in remote sparsely populated areas. For example off-shore wind turbine, micro-hydro or geothermal generator are often located far from consumers and requires costly installation of a long distance transmission line which usually has from 6% to 10% of electric losses.

We propose and investigate single-wire power transmission line systems instead of three-phase lines and apply steel conductor or even non-metal conductive media instead of traditionally used aluminum or copper conductor.

The OBJECTIVE of this project is to implement the original low cost and low-loss single-wire electric power system for renewable-based electric grids. Project program covers design and manufacture of 50 kW single-wire power transmission line. The complete set of equipment contains: audio-frequency converter, resonance generator - mono-stable multivibrator, rectifier and inverter. Transmitted electromagnetic energy has a voltage of 5 kV to 20 kV and a frequency of 1 kHz to 20 kHz.

SWEPS operation principle is the following: In no load operation mode the active current and the magnetic field

of the line are equal to zero, while the electric field intensity has its maximum value owing to reactive displacement current that charges the capacitance of the line, it is well-known, that the Ohm's law and Joule's law are not applicable to displacement current, and Joule (resistive) losses are equal to zero.

ACTIVITIES

Resonance mode of oscillation at the frequency from 3 kHz to 30 kHz was used to provide the most efficient power transmission.

Frequency converter and modified Tesla transformer were applied at the generator site to generate high frequency reactive capacitive current. Reversal Tesla transformer, standard rectifier and inverter were used at the consumer end to convert the reactive high frequency electric power to standard 50-60Hz electricity.

Three different SWEPSs have been developed and tested: 230V, 10KV and 100KV, each of them having capacity of 1 kVA. 5 to 100micrometer diameter wires of copper, aluminum, steel and tungsten (as well as 100 micrometer carbon wire, 10 mm plastic tube and 0.3 micrometer thick ITO film on glass substrate) were used as electric power transmission media.

LEVEL OF IMPLEMENTATION

Theoretical and experimental study of parameters of the single-wire transmission power system has been carried out demonstrating its ability of efficient operation. Different kinds of electrical apparatus and application possibilities have been investigated. Analysis of theoretical calculations and experimental study shows that SWEPS can be applied both for energy transmission from renewable powerful generation site to a large energy system and for transmission lines connecting different parts of renewable energy system.

The patents protect the transmission method and the device [1-7]. The two next implementation stages are:
Stage 1 (12 months): 20 kW to 50 kW 50 km single-wire electric power system for renewable-based electric grid ($350 000) and
Stage 2 (24 months): 1 MW quasi-superconductive line for wind-offshore and island application ($3.5M).

Three different SWEPS systems have been developed and tested: 230V, 10KV and 100KV, each of them having capacity of 1kVA.

RESULTS

Single-wire electric power system for electric grid can be applied instead of three-phase network. SWEPS uses one pole single-wire open-tuned circuit, capacitive and displacement current for transmission of active power. Modified step-up Tesla transformer was applied at the generator site to generate high frequency reactive capacitive current. Reversal step-down Tesla transformer or diode-capacitor block was used at the user's end to convert high frequency reactive power to standard AC 50 Hz or DC electricity.

Substantial reduction of distribution network construction cost is expected to reduce consumption of wires and accessories and application of light type poles and structures. Energy losses in distribution networks are much lower compared with conventional power distribution lines. It has been experimentally proved that SWEPS has no resistance losses with conductor media like: steel, tungsten and carbon wires having diameter from 5 ìm to 100 ìm, water, ITO film on glass substrate, damp soil etc.

It makes it possible to construct electric power transmission lines using steel conductors and even non-conductive materials. Computer simulation of distributed solar power system, consisting of several solar power plants installed in Spain, in European part of Russia and Far East of Russia, connected by low loss transmission line, showed that this power system generates electricity 24 hours a day 6 months a year and does not require electric accumulator or back-up generator during the night.

References

1. S. Avramenko. The Method for Electric Power Transmission and Device for its Realization. Russian Patent No. 210649 dated 11.04.1995 Published in "Russian Patent Bulletin", 10.04.98.

2. S. Avramenko et al. Apparatus and method for single line electrical transmission.European Patent No. 0639301. Priority claimed 08.05.92 (Russia). Published in European Patent Bulletin 97/36, 03.09.97.

3. S. Avramenko, K. Avramenko. Apparatus and Method for Single Line Electrical Transmission. Canadian Patent No. 2135299, issued: 2000/01/18, application: 1993/05/10, date of application availability for public inspection: 1993/11/25.

4. Strebkov D.S., Avramenko S.V., Nekrasov A.I. (1999). The method and apparatus for electric power transmission. Russian Patent No. 2143775. Priority claimed 25.03.1999. Published in Russian Patent Bulletin No. 36 of 27.12.1999

5. Strebkov D.S., Avramenko S.V., Nekrasov A.I. (1999). The method of power supply of electric transport and apparatus for its realization. Russian Patent No. 2136515. Priority claimed 26.08.1998. Published in Russian Patent Bulletin No. 25 of 10.09.1999

6. Avramenko S.V. (1998). The method for electric power supply and device for its realizations. Russian Patent No. 210649. Priority claimed 11.04.1995. Published in Russian Patent Bulletin L/d.4 10.04.1998

7. Avramenko S.V., Stupin I.V. (1997). The apparatus for tissue coagulation. Russian Patent No. 210013. Priority claimed 11.04.1995. Published in Russian Patent Bulletin No. 36 of 27.12.1997