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Project Summary

FLOAT WAVE ELECTRIC POWER STATION

(Installation for sea wave energy conversion to electricity)

1. The project relates to ecologically benign electric engineering. Its content is: Development of Float Wave Electric Power Station (FWEPS) as an installation for sea wave energy conversion to electricity with high productivity, efficiency and operation performance, applicable to meet a power requirement in different areas of the Earth; production and sale of single and multimodule FWEPS as well as electricity produced.

2. FWEPS DESCRIPTION

2.1. Review of products and technology

Sea waves are referred to a very perspective energy origin for ecologically safe power engineering since they manifest the highest specific power among renewable power sources. Wave power productivity of the World Ocean is estimated at the order of magnitude 10^{10} kW. Harnessing even a portion of this power could double sustainable electricity production on Earth.

Sea waves is the most visible example of natural creature characterized by space-time variability of their properties. As with any oscillatory process, the best facility for wave energy take-off is an oscillatory device matched with outer wave space. For this reason, a very promising device for wave energy conversion to electricity is the FWEPS since, in accordance with the given rule, it just employs the oscillatory drive as an electric generator actuator. The FWEPS concept uses the advanced approach when the process of energy conversion is based on efficient interaction of wave energy source and oscillatory load intrinsic for the case. From this point of view FWEPS is the sole wave energy converter under development nowadays.

A module of FWEPS is an oblong axisymmetrical capsule-float located on sea surface in the local vertical direction. Its arrangement is diagrammatically sketched in Fig. 1.

Inside the capsule there are a mechanical wave energy converter 1, consisting of an oscillatory system and drive; an electric generator 2 and energy accumulator 3.

Under waves effect the capsule-float and inner oscillatory system of a mechanical converter are in continuous oscillatory motion, while the drive engaged with the system provides a continuous spin-up of the electric generator.

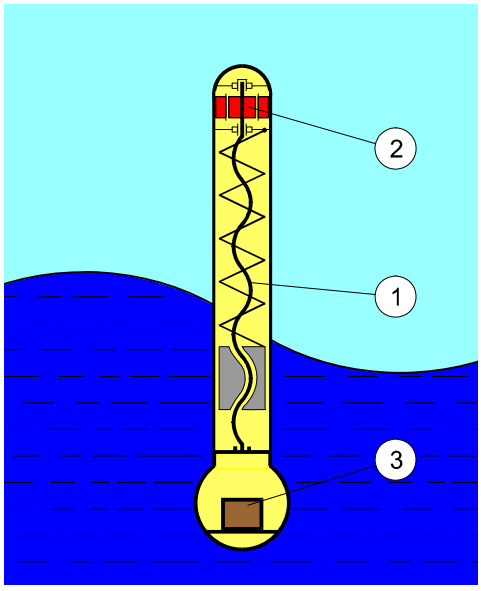

Fig.1. A diagram of single-module FWEPS.

Depending on mission it is possible to develop both a single modular FWEPS for output power from units of watts up to 50 kW and multi-modular installation in a grid form (Fig. 2).

A powerful FWEPS can be assembled out of a large number of ten - fifty kW modules of total capacity up to dozens of megawatts. The range of possible applications of FWEPS is rather wide in economics and life support spheres.

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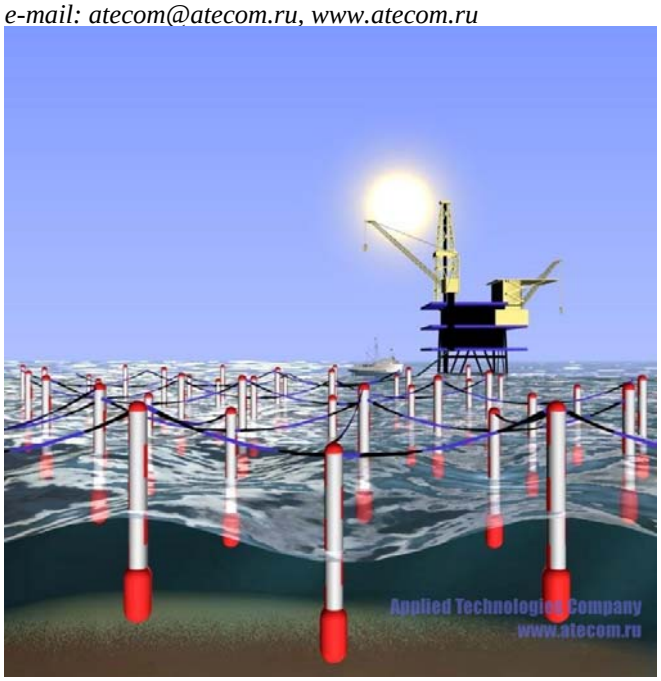

Single modular device can be a power source for the sea-going ships, light and radio beacons, as well as for meteorological, navigation and communication systems, equipment for emergency and individual life support, etc.

Multi-modular installations can be used for power supply of coastal and island settlements; for setting up the ecologically benign sea and coast based processing plants, including exploitation of sea rigs of stripped oil wells; for a large scale electrolysis production of hydrogen and oxygen, thus stimulate the formation of ecologically safe hydrogen power engineering.

Fig. 2. An example of FWEPS multimodule grid usage for power supply of processing plants, including exploitation of sea rigs of stripped oil wells.

2.2. Competitive Analysis

As compared with other types of wave energy converters, FWEPS technically has several exceptional features owing to:

- oscillatory property of the device which can be matched with outer wave space, thus giving the most effective mode for energy taking-off;
- sustainable operation at varying lengths, velocities and intensities of waves and directions of their propagation, adapting to changeable external conditions;
- reliability and long useful life because of waterproof capsule-float protects elements of the device from corrosive attack of sea water and its vapour;
- possibility of devices deployment directly in seas and oceans, in places unsuitable for human life or navigation as well as possibility of FWEPS location change in accordance with regional wave activity, seasonal or other reasons;
- simplicity of mounting and dismounting; capability to operate in the unattended mode; low operating cost;
- avoidance of fertile soils and forests withdrawal from the economic turnover; elimination of any ecosystem damage or degradation.

2.3. The research and development carried out to date has shown that:

• FWEPS using an oscillatory drive enables to be considered a perspective device for wave energy conversion to electricity. Due to its features and arrangement advantages FWEPS can be organically compatible and tuneable with sea wave space thus securing the best condition for effective wave energy taking-off.

• The experimental laboratory study of scaled FWEPS models (Fig. 3) has shown that the mechanical actuator with an oscillatory system being one of its main parts can be basically serviceable as a drive for an electric generator in the given type of energy converter.

• The study of FWEPS model irregular-sea behaviour at Sea States 4…5 numbers performed in the sea keeping basin with wavemaker (Fig. 4) has demonstrated the device survivability in stormy condition.

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Fig. 3. Laboratory test bench.

Fig. 4. The experimental model in sea keeping basin.

Now the demonstrational model of FWEPS module and assembly units are at the completing stage of manufacturing, adjustment and test preparation (Fig. 5, 6).

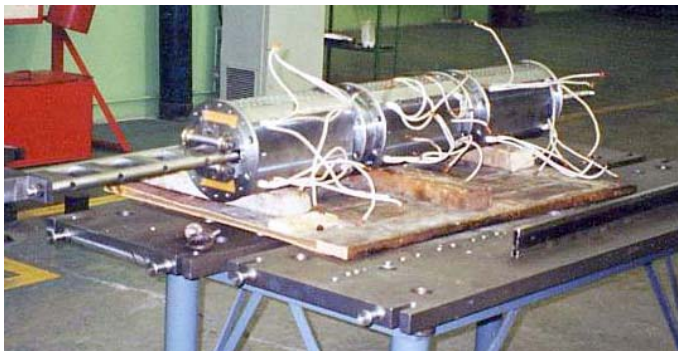

Fig. 5. Thee-sectional linear electro-generator for FWEPS pilot module under manufacturing.

Fig. 6. Hull of FWEPS demonstrational module under manufacturing.

3. MARKET: trends and opportunities

Sustainable development of any society depends on sufficiency of electric power production for economics progress and life quality improvement. By reason of the biosphere degradation threat, the solution of a problem of power production growth is more often connected with the use of renewable power resources.

3.1. Target customer market segment: Power installations for electricity producer and distributor especially in regions where sea-wave energy use is preferable & profitable for electricity generation as compared with delivered fossil fuel.

3.2. Current and forecast sizes and growth rates for relevant market segments

Ground: Sea waves are referred to a very perspective energy origin for ecologically safe power engineering since they manifest the highest specific power among renewable power sources. For many regions the use of sea-wave energy is preferable & profitable for electricity generation. Electricity production via sea wave energy conversion is motivated, basically, by the countries' aspiration for the Gross National Product increase in the population ever growing condition.

Market features: The market is huge, not occupied and predisposed to an intense development in view of high growth rate of the demand in ecologically benign power sources. The market estimated volume is up to 800 US$ billion worldwide.

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3.3. Priorities for buyers: Low price of the product and its maintenance; high operation performance and reliability, suitability for operation in a broad range of climatic zones in various geographical regions; environmental compatibility; simplicity in maintaining, quick recoupment of investments.

The cost of electric power production at FWEPS will be determined mainly by capital investments in the development and construction of power installations. After R&D period end and electric power sales beginning, the capital investments should be paid back in 2 years of operation at the total FWEPS lifetime of some tens of years.

4. Marketing / manufacturing strategy

1. Development of full scaled 10 kW FWEPS modules using sea waves as a primary source of energy with high productivity, efficiency and operation performance, applicable to meet a power requirement for economic progress and life quality improvement in different areas.
2. Development of multimodule grid installation of ten megawatt output power assembled out of a great number of 10 kW devices.
3. Production and sale of single and multimodule FWEPS as well as electricity produced.

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5. FINANCE: rough estimation of FWEPS project stages value.

Project realization period at the stage of single module development – 1,5…2,0 years. Project cost at this point – 2 M $US.

Development - construction of full scaled 10 kW FWEPS pilot module as a high efficient and cost-effective wave energy converter	2 M $US	2 years

Upon completion (it is possible simultaneously) of the singlemodule development phase the structure of the project of powerful multimodular FWEPS development, based on the experience obtained, has the following view:

Development of full scale multimodule Float Wave Electric Power Station of not less than two megawatt output power	20 M $US	3-4 years

The cost of power produced by FWEPS may be not higher than 8 EU cents per 1 kWhour. The expenses for production of FWEPS must be reimbursed during the operation period of two years at total FWEPS lifetime of some tens of years. The multimodule FWEPS having been experimentally developed, the cost of power units will be about 1700 Euro/kW, depending on place and conditions of operation. The detailed business plan should be the subject of common work.

Role of joint partner: Financing and Marketing. Other forms of cooperation are also possible.