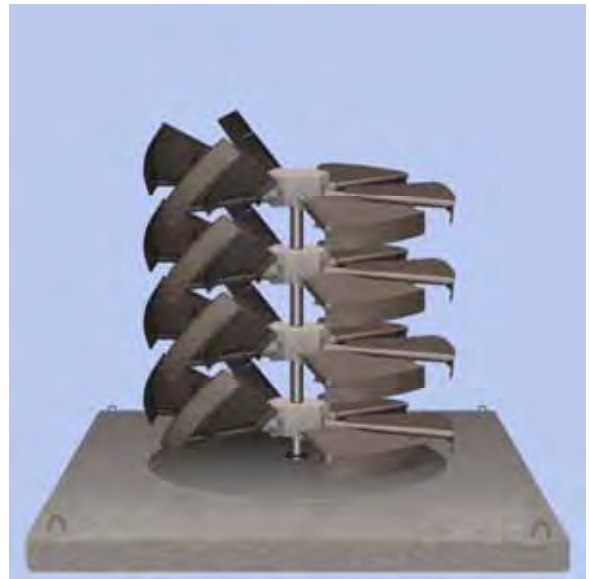
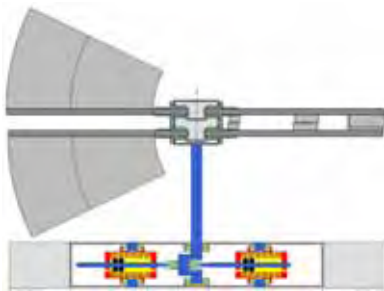
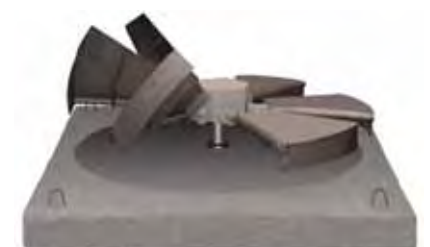
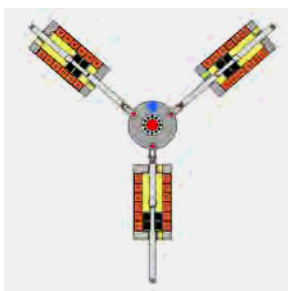


Vladimir Markovic



Logic, explanations and math of SP units 2010/8



Written in Ljubljana, 15.06.2010

SP – A NEW APPROACH IN WATER TREATMENT

All people who are involved to the problems of natural sources and human environment will probably agree that after quality of air and atmosphere, the second most important natural element is clean, drinking water. Not only due to our needs of drinking, because the most of other living creatures and vegetation could not survive without water.

Today regarding all known facts it is clear, that there are two main problems connected to water: complete quantity of existing drinking water is on nearly all continents big enough, but regarding specific needs – specially on the poorest continents like Africa, the most of Asia and many parts of Latin America, displacement of available water quantity is definitely not acceptable and it is not offering simple, cheap and easy solutions for serving the most of needs for common use and specially not for needs of irrigation. On other side in medium or highest developed countries the most of water is polluted due to industrial activities, but not less important are just classical organic pollutions as result of concentration of human population in big urban areas.

Many years ago as professional inventor I was asked from some people which were involved in mentioned problems to try inventing and creating some new system, which would be able to solve problems of easier water displacement, but on the cheapest possible way and without opening a new energetic or ecological problems on other important parts of environment.

After nearly 20 years of activities on that field, I find out technical solution, to produce submergible unit, which should be placed on the bottom of every – even smallest and slowest river. My idea was, that complete unit uses part of hydro – dynamic energy of slowly moving water masses as driving source and makes possible that proper device pumps and deliver part of the water to the areas where it is needed.

It is known fact that quantity of theoretically existing hydro - potential power in all flowing waters is incomparably higher, than potential water energy which we are exploring today. Every new demand for further exploitation of this potential energy is connected with extremely high investments because available technology requires a local high energy concentration which means construction of water dams, artificial water - storage lakes, etc. Therefore it is very clear that also in the future we won't be able to place those installations anywhere we would like to have them.

Due to above mentioned problems, since century's engineers are trying to find appropriate technical solutions for the most efficient method to explore at least part of the potential energy from slow flowing waters. Water mill wheel was the first system that worked. Number of that kind of water mills, was in early Middle Ages only in England 5.624 and in whole Europe the number was larger than 50.000. But their relatively low efficiency was never high enough. Reason for that is in fact that it uses only upper layer of water stream, whose characteristics are totally different from entire water current. All described facts tell us that for much bigger efficiency we must perform our exploitation of dynamic energy of slow water current, in biggest possible depths. Based on described laws of Physics I started to think, about inventing turbine which "behave like barrier", and which could be fixed to the bottom of the river to exploit at least a part of that extreme energy. At the beginning I made myself clear that driving - active part or "turbine" can not be shaped on the way like classic water or even wind turbines. Without possibilities to increase local speed of water and

considering that hydrodynamics and aerodynamics are totally different by their effects, problem to be solved was definitely not small. So, I designed a system in which active “wings” shall be shaped like very big surface “barriers” to water stream but on opposite side of the turbine they will automatically turn against the stream – the smallest possible face. On described way, we received extremely large leverage on active side of turbine and very small (16-28 times smaller) on passive side of turbine. At the same time, due to known reductions of efficiency on classic turbine systems caused by speed difference between speed of media and speed of turbine, our design allows to the driving media to produce incomparable longer time of active pressure on each propelled wing with small speed difference between speed of water and rotational speed of wings.



$$N = \frac{V}{O \times 2\pi}$$

N = number of revolution/minute

V = water speed (meters/minute)

O = circumference of turbine (meters)

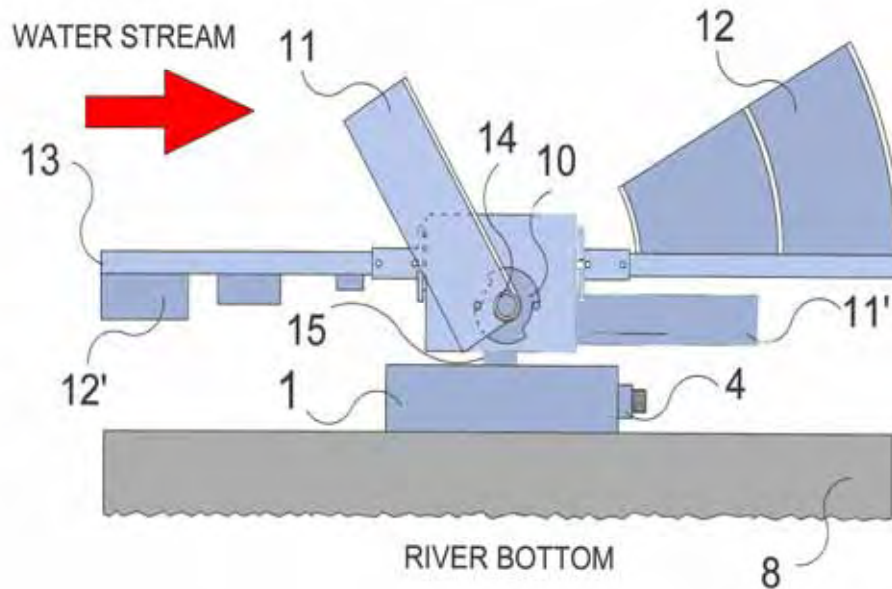
Such turbine – as presented on picture above must always turn much slower than speed of flowing water is. This means that its circumference speed – even without transferring of energy to other device – is always essentially lower than linear speed of running water.

Form for calculating (N) – number of turns of such turbine against speed of running water is shown beside the upper picture. The circumference speed of such turbine is couple of ten times lower regarding speed of water and that makes possible that each molecule of water, which presses on lifted wing of the turbine is relatively long time applying its pressure effect. Treating water at normal temperature as non squeezable media, we can conclude that molecules of water which actually perform dynamic pressure on every lifted wing of turbine do not press it individually, because from the direction of water flow, presses almost endlessly long chain of following molecules (and kinetic energy). Described case is not valid for known (classic) turbines, because in their case, pressure between the same molecules of running water and driving wings of the turbine can last only couple of hundred times shorter time. Also, this effect causes only partial change of direction of the flowing water and does not cause direct or significant reduction of local water speed, which is in Physics manifested in phenomenon called **Stagnation pressure**.

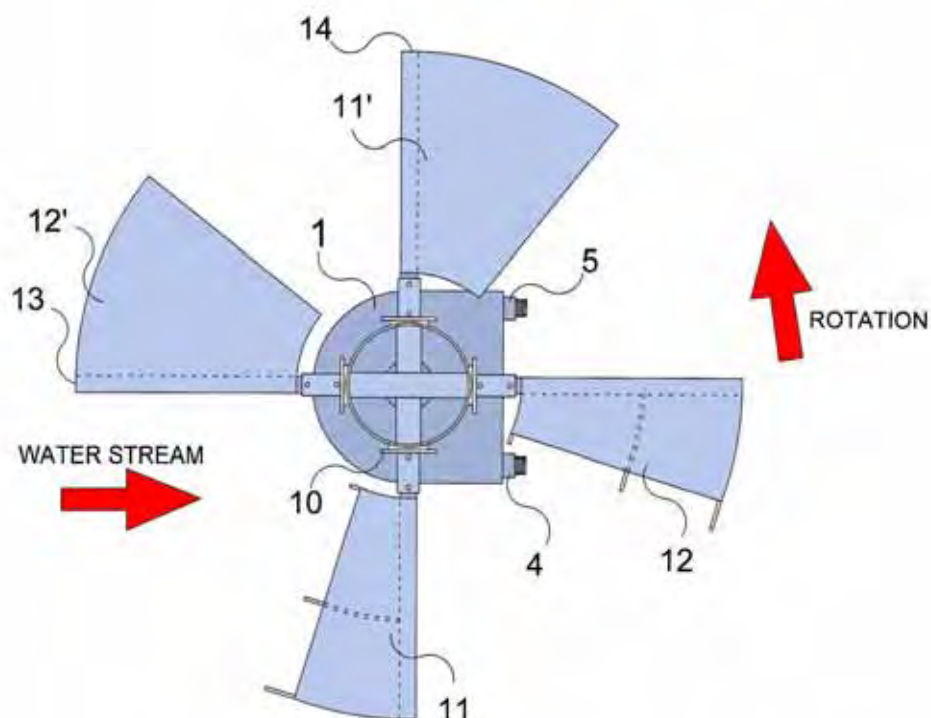
Stagnation pressure in Physics is clarified as pressure (or by calculation as Force), which is caused from horizontally running water on plain barrier inside of water stream (usually on surface of 1 m²). How enormously high is **Stagnation pressure** we can easily understand from the fact, that all under water carriers of the bridges are always rounded against water flow, because in case of their flat surface they can be easily demolished. On similar way, Energy which effects on wing of classic (and quickly rotating) turbine is couple of ten times lower than Energy which several times longer time has effect on much larger surface of slowly movable wings of SP turbine.

DETAIL EXPLANATION, HOW SP UNIT USES HYDRO – DYNAMIC ENERGY FROM SLOWLY MOVING WATER

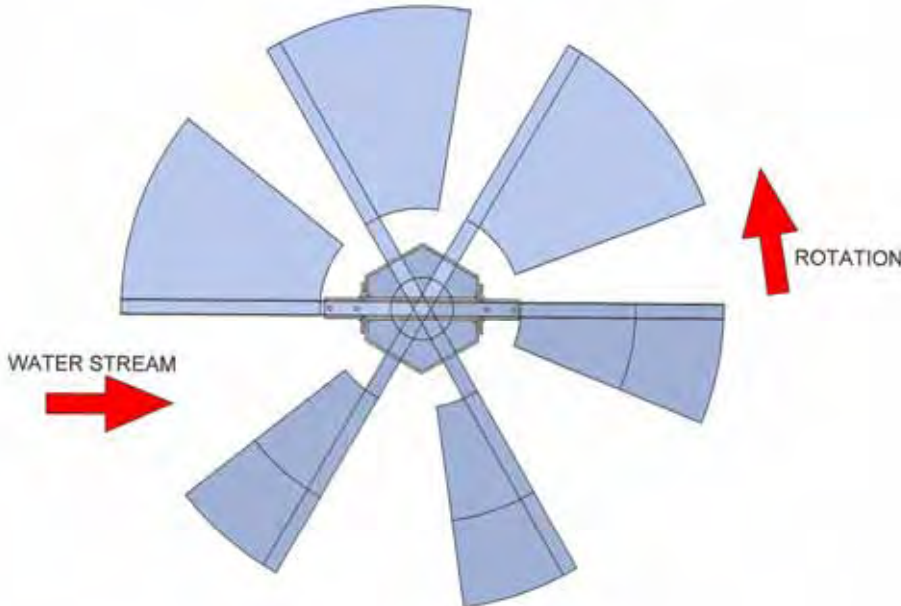
To understand how system works you must understand that our driving “wings” are operating always in pairs – two of them on the same axle. Both wings (for example 12 and 12') are fixed on the axle 13, but on such way that one wing is fixed on the axle horizontally (12') and opposite wing (12) is fixed with inclination of approx. 60°.



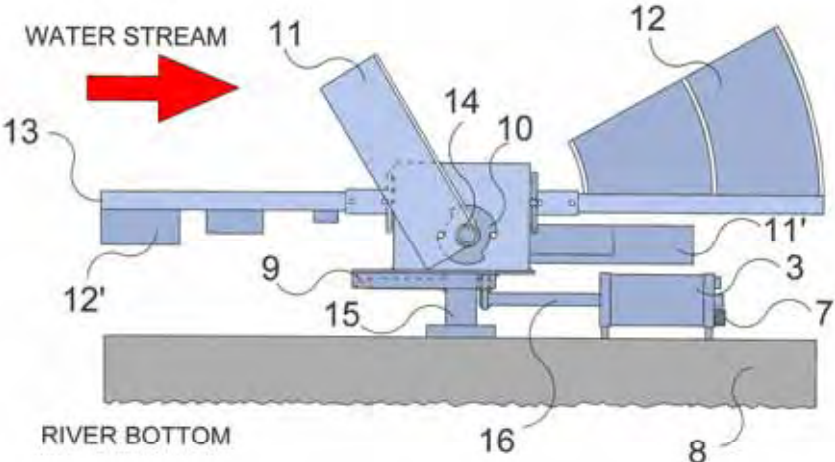
Therefore one side of such propelling system is always turning to the water stream the smallest surface and the second side (wing) is always turning to the water stream very big surface. When complete design turns around vertical axle for more than 180°, water stream is pushing down previously lifted wing and lifting up the opposite - previously horizontal wing.



Described designs we made in more prototypes with 4 and 6 wings and we already measured extremely high efficiencies comparing anything known or existing designs up to these days.



Up to now we made more designs with piston pumps, membrane pumps and very inconvenient centrifugal pumps.





The first prototype from early development



The second prototype with 1,6 m diameter

Several years ago, (due to centrifugal pump) the second prototype was able to deliver only 1 litre per second of water based on 1,2 bar of pressure.



For example, instead of submersible water pump, we can use also submersible air pump which must have attached the inlet hose for air. The opposite end of this hose must be fixed somewhere on the coast and out from the water. In that case, SP unit is sucking the Air and pressing it in very small bubbles on the bottom of the river where deficit of the oxygen is always the biggest – causing a very quick “burning” of the mud and all kinds of organic pollutions. On described way we shall be able to “turn back” to our rivers a normal “health” which was taken by too high quantity of organic sediments on nearly all bottoms of slower rivers.

Basic idea for higher capacity of irrigation is to connect outlets of more SP units to the bigger diameter of main pipe. This can be done by means of connecting 50, 60, 100 or even more hundreds of SP units to the main pipe with diameter of up to even 2000 millimetres. In such case and specially if we combine such main pipe line with inside Air injecting system (produced from some of connected SP units), we shall be able even to combine consumption of water, transport of and simultaneous cleaning of water from organic pollutions. On the following picture, you can see some other possible application in use of SP units:

In all cases where a land configuration deny possibility to build a dam and lake, both can be replaced with accumulation pipe on which we attach convenient number of high capacity SP units. On other end of such "reservoir hose" a standard Pelton or other turbine and generator are to be connected to produce electricity.

The costs of such installation are still significantly lower than usual (construction of the dam and lake) and the effects can be even much greater, because the pressure hose can deliver into turbine up to 10 Bar or higher pressure what is equivalent to water falling from almost 100 meters high dam!

Pressure - reservoir hose is the best, to be placed on the side of the river bottom and turbine and generator on the coast near the river.

From research and development we have come to the conclusion that the market will require more dimensions of SP units:

SP "hobby" unit with capacity of 1 liter of water per second and with a diameter of 1.6 m; SP unit with a capacity of 3 liters of water / second and diameter 2.4 m; medium unit with wings diameter of 3.6 m; and large SP units with 5.5 m and 7 m of diameter with pumping capacities 7 and 11 liters / second.

By multi-wings SP units shown on the right picture, the water capacity is approximately for so many times higher how many pairs of additional propelling wings we have added. Number of such multi-wings SP units can be easily calculated for each installation between 1 and 10 MW of Power but under special conditions, also much stronger installations are possible.



RENEWABLE, ALTERNATIVE OR CLASSIC SOURCES ?

Dealing with problems regarding renewable energy sources it is very typical and today, the most of efforts refer to exploitation of solar or wind energy. Despite all advantages which moving water masses are offering, efforts to increase exploitation of energy from water stream are today very small even when we know that constancy of exploitation during all 24 hours a day is by water nearly ideal. By the same speed, water has almost 800 times larger pressure on the square meter of flat surface in comparison with air (wind) pressure, etc.

Reason for described situation is very simple. Until today, exploitation of energy of moving water mass was limited on small number of technical solutions: Since centuries known water mill wheels and nearly century known water turbines. But, both mentioned solutions have enormous disadvantage, because their efficiency increases only when water speed is several times higher. That fact enlarges installation costs for several ten thousand times forcing us to create artificial lakes with water dams for local water speed enlargement. The same time, it is known fact that due to geo-physical characteristics of the soil, we will never be in position to place and build dams and artificial lakes on the most location we would like to exploit energy from the movements of water masses.

Water millwheel was the first system that worked, but it has relatively low efficiency. Reason for that is in fact that it uses only upper layer of water stream, whose characteristics are different from water current near the bottom of the river. Here we are talking about simple fact that water (in comparison with air) is not squeezable medium. But this fact refers only to water in the bigger depth because on the top level, coming to the barrier, generally not squeezable water is sliding to the upper direction of the squeezable air and completely loses characteristics of not squeezable media. For instance in the bigger depth, on every square meter of fixed barrier, water causes dynamical pressure, which is (at the same speed) app. 800 times larger than wind pressure on the identical surface of barrier! In that case water, on surfaces of the water wheel wings, does not apply stronger effect of so called **Stagnation pressure**, which always occurs when water hits the barrier.

The best way to understand how big disadvantage is caused by described facts is to be understood only after we consider a very simple physical fact that energy which is present in one mile length of slowly moving river is exactly the same as energy on the same river accumulated in one mile long lake before dam! So, extremely expensive dams and lakes we need only because all known turbines could not offer higher efficiency without much higher water speed - locally increased by tunnels in the dam. Now, if we compare all common river lengths with lengths of all artificially made lakes with dams, comparing whole World, we come to the fact that proportions are larger than 10.000:1 in favor of common river body lengths. This means, that with proper technical solution for consumption of energy from slowly movable river streams, if solution would be cheap and easy to install and use, we could overcome complete worldwide energy received today from all classical hydro - energetic power stations.

Treating theoretical background of power and efficiency possible to be reached by SP units I meet many problems regarding classic known calculations and formulas made for known turbines or propellers. At the first place I recognized that we must deal only with kinetic energy of moving water masses without using known calculations which are nearly always connected with measuring of flow and efficiency inside of the pipe.

Second reason why usually known formulas (Bernoulli or other) are not appropriate for our turbine is in the fact that by known turbines or propellers radial speed of the turbine is always very high. This is the main reason that **Stagnation pressure** effects are by classic turbines very low, what is completely different when treating our SP turbine on which the highest circumference speed is always much smaller than speed of the water.

The third reason for lower efficiency of classic turbines is in the fact that due to high RPM, the back sides of all wings are causing the braking effects because they are pushing water sidewise – out from its straight moving lines. By SP unit wings this effect is opposite and the same time when water is overtaking each lifted SP wing it is causing also part of propelling power on its back side.

Apart from mentioned and always present part of Stagnation pressure which has very high influence to efficiency of our SP unit, it is very important to remember that on the same way as water is not (practically) squeezable it has some characteristics which shows also its resistance to ductility. This practically means that in open current water area which is driving SP blades (wings), water propelling power is not limited only on the surface of lifted wings but also on slightly wider area (for approx. 1,3 times) of the water stream. Additionally, regarding higher stream speed (than blades turning speed is), it is to be recognized that water is simultaneously propelling all three active SP blades at once. This is causing important effect of actual enlargement of active driving surface for approximately 1,8 times!

All three mentioned facts are basic “secrets” of so high efficiency of SP units which many of known experts for classic turbines are simply, not able to understand.

By most classical formulas for calculating turbines power - even by formulas composed by the biggest experts on the field of Physics – inside of formulas are included data about turbine efficiency. Results of such calculations are not even theoretically correct because efficiency of any turbine is completely dependent from actual conditions of water quantity, pressure and speed. Therefore, when water quantity and water stream are changed we can never be certain for how much efficiency of turbine is changed and calculations are becoming a total nonsense.

Treating Stagnation pressure - even the exact and deeply educated people are not actually aware of how extensive and powerful it is. Therefore we must clarify that Stagnation pressure calculations are actually based on the Energy Density of Flowing Water - when the water is treated as incompressible medium. EDFW formula is as follows:

$$\text{EDFW (kW/m}^2\text{)} = 0.5 \times v^3$$

Presented means that every square meter section of river flow carries a power:

- 0,5 kW – water speed of 1 m/sec;
- 4 kW – water speed of 2 m/sec;
- 13 kW – water speed of 3 m/sec,
- 32 kW – water speed of 4 m/sec.

All mentioned values are related only to Water Density and never to Hydraulic Power, Power of some turbine or passive resistance of barrier on which water is pressing.

Considering a fact that on SP drawing wings water flow at the same time always presses at all three active (lifted) wings, we can see that on the largest SP/SG device water is simultaneously propelling almost 6 square meters of surface, which are on double wings devices (see page 18) even increased to almost 12 square meters!

Everything described so far indicates that with water stream speed of 3 m/second and built 10 pairs of double wings, each double pair (with double wings) can offer 130 kW of Power and the whole assembly (shown on page 19), theoretically can offer up to 1.3 MW of Power. Unfortunately, the lowered (horizontal) wings are braking rotation and practically received Power could not exceed 1 MW.

In modern physics to calculate the Force from Stagnation pressure we are using a math from Bernoulli equation (for incompressible media):

$$P \text{ (Pa = 1 N / m}^2 \text{ = 1 Pascal)} = 0.5 \times \rho \times v^2 + P_s \text{ (Pa)}$$

where: ρ = density of water in kg/m³ and P_s = static pressure

If we perform calculations of Force by Stagnation pressure with the last mentioned form, it looks even larger than calculated by other formulas. But, in our case SP wings are not stopping the water movement completely and that is a reason that this calculation is not realistic and correct.

It is important to know that even that calculation shows that extracting of Power from the upper water layer gives significantly worse results, since at the top of the stream static pressure do not exist at all and it is present only in lower layers of water. On the top layer water react like compressible media and reaching the barrier it withdraw up - to the direction of fully compressible air.

Regarding mentioned reasons and mistakes coming from efficiency data inside of formula, in our formula we are dealing only with known parameters of physics, and with basic dimensions of used SP unit. This means that results are always correct - even in cases when factors of outer conditions are drastically changed. After many measures and calculations we found out that correct formula for calculating power of our SP unit is:

$$P = 21 \times \Sigma A \times r_{max} \times v^2$$

P=power in watts (W)

ΣA =surface of all installed blades (m²)

r_{max} =exterior radius of blades (m)

v^2 =water stream speed (m/s)²

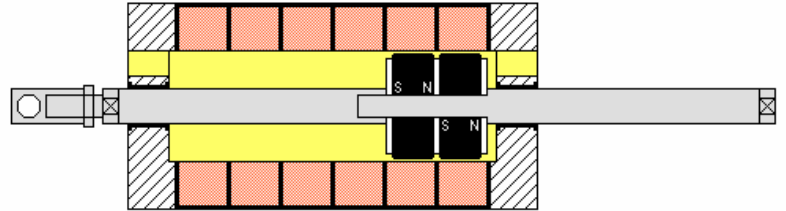
Noted formula is proved by comparing it with practical and measured results. We must also consider that sometimes each blade could not cover complete surface of 1/6 of circle. Reason for that is in often customers enquiries that complete unit must operate in very shallow water. All this means that for example seven meter diameter, single wing SP unit (without reducing blades) must operate in at least 3,6 m deep water, but in that case, with water speed of 3,5 m/s it can deliver nearly 34 kW and by 5 m/s around 69 kW of constant power. With double propelling wings, results are doubled too.

Regarding all mentioned we are still opinion that producing electricity, our SP units are nearly ideal solution for the category of “Pico” generators, where we intend to remain on the powers up to 20 – 70 kW, but it is definitely a fact that also much larger SP units can be designed with possibility to offer more than 100 kW based on constant power. Finally, our last calculations are showing us that here locally and based in 20 years of exploitation time, we can locally produce and install in water “Pico” power units (only 20 kW of constant power) based on price of only 0,0075 EUR per kWh. It is very possible that someone will not recognize real meanings of that price which is actually much lower than exploitation price for kWh reached with larger photo cell units or medium big Windmills! Even more, this price is for 8 to 14 times lower than valid prices are for electricity from public nets in different EU countries.

SOLENOIDAL GENERATOR

At the end of the year 2009, we succeeded to develop, test and apply patent of new SG generator for production of AC tension with centrally inserted magnets, which for difference from commonly known generators for its activity does not need great number of revolutions from its driving source. By its technical design, each separated part is similar like impulse generator, which works on principle of hammer stroke or spring and were created and in use in laboratories shortly after year 1780, on the first place for gaining impulses of high electric tension. These tensions were gained when proper number of coils of solenoid, which had one or more windings with different number of coils, what made for scientists like Michael Faraday, Lorentz, Maxwell and others, job much easier when they studied fundamental laws of magnetic and electromagnetic phenomena. In subsequent periods, for almost a century, solenoid structures with embedded ferromagnetic core are not exploited for industrial purposes within the meaning of electricity voltage in solenoid for several different reasons, most of whom are set down the problems of low intensity, and in particular the sustainability of permanent magnets themselves that are moving created through an electromagnetic field to rapidly lose its magnetic density. The second problem was the fact that such a generator is not appropriate to create a constant tension, because on both ends we get change of the movement direction of the magnet and at the same time, to alteration of the polarity of inducted voltage. Following the introduction of today known voltage generator and a substantial improvement of the stability and sustainability of the magnets themselves, there have been many inventions and structures, particularly the smaller generating devices incorporating permanent magnets, which many of them are still found in regular use. However, in these cases, the magnets rotate and with their rotation induce formation of voltage, or current in the solenoid coils distributed throughout the periphery of the generator. Practical examples, which are today known in exploitation of solenoid coil with axially movable core, are most common in the use of modern actuator devices, as it is for decades much known anchor for switching on automotive starter and dozens of cases of solenoids equipped with a movable core for valve systems guidance. In the opposite direction, or for the production of continuous electric tension with the axial movement of permanent magnets mounted in the center of the solenoid, there are not any serially produced products in the practical exploitation.

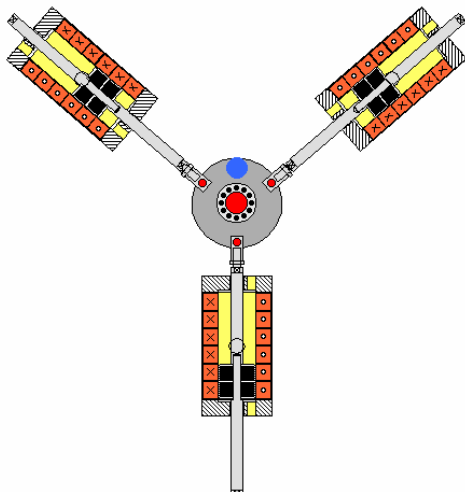
Illustration: Side – section of one out of three segments of our new generator with double permanent magnets and six solenoid coils.



Technical problem, that the SG generator successfully solves, is based on the physical fact that in solenoid we perceive induction of electric tension even when having extremely slow axial movement of the centrally – installed magnets. By that, the solenoid coils developed electric tension, which depends primarily on the number of wire windings and when moving the magnet in one direction induces DC electric tension with properly oriented polarity and by axial movement of the magnet in the opposite direction, the polarity of the induced voltage also reverses.

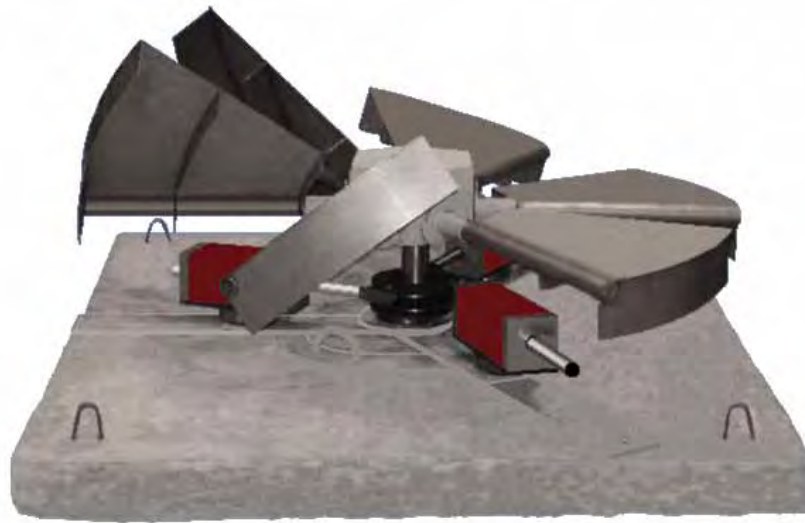
This practically means that the continuous movement of the magnet back to front in solenoids induces AC electric tension, whose frequency depends on number of changes of the direction movements of the magnet itself. In described case will, by the minimum with consumption of electricity and density of magnetic field. Induced voltage depend primarily on the number of wire windings of the solenoids, and by increased frequency of movement magnets back – front - back will mainly grow the available electric current. Described characteristics are fundamentally different from conventional operating characteristics of the known generators, alternators or DC dynamos with permanent magnet, when by small number of revolutions are obtained many interruptions of induction and self – induction. However, despite this seems productive for the generators and dynamos, in fact makes the need for a relatively high number of revolutions of rotor, otherwise it is impossible to achieve sufficient electric tension, or each stator should have unacceptably high number of coils of copper wire which means even unacceptable diameter of design. At the same time on classical generators or dynamos, losses are increased due to transverse magnetic fields coursed by the laminar structure of their magnetic cores, which can not operate at all number of revolutions of the generator by at least approximately the same efficiency. Because of all this and many other well and long known deficiencies of the known generators, the basic idea of SG generator sought to construct a useful electrical generator, which in addition to those problems, it will also not have problems of magnetic gap between the rotor and stator and also with hysteretic losses in the generator plates and long magnetic path through the magnetic segments of the stator.

SG solenoidal generator eliminates quoted and solves the technical objects on such way, that rotating driving media via appropriately designed system always and at the same time eccentric and co-axial moves, three or more axes on which are attached permanent magnets – placed in the centers of three solenoidal housings.



With the help of appropriate eccentric mechanisms, the SG generator have magnets on axles inside solenoids always placed in different positions, what causes that will never come in situation of simultaneous changes in the direction of movement of magnets front – back – front and there will never be a complete absence of induced voltage. Above all, the correct calculation of the magnetic densities and the number of coils of each solenoid or solenoids, a new SG solenoidal generator will explore the possibility of continuous and highly efficient generation of electric tension even at the minimum number of turns of driving media what will eliminate the need for the use of mechanical gearboxes or multipliers between the driving media and the main axle of the generator.

This should allow efficient generation of electricity even at two or even less number of turns per minute, without increasing the losses and at the same time allow the operation of even a hundred times higher number of turns.



Regarding everything mentioned above at the end of last year we started developing more prototypes of SG generator and we found out, that up to this days nowhere in the World something even nearly similar to SG generator was not invented, patented or designed. The most important feature of new SG generator is that its production is extremely cheap, because for example, 20 kW unit will cost in serial production much less than 1.800 EUR and even much stronger 70 kW unit will not cost more than 2.700 EUR. Even more important feature is very easy possibility of this type of generator to produce nearly constant electric tension between 3 – 250 rpm and only electric current and final power are increased by higher number of revolutions. Producing DC impulse power with nearly constant tension, which depends from requires, such generator is drastically reducing price of inverters for possibility to be connected directly to electric net system.

From descriptions of SP units you can find out that we are talking about quite unusual design, which uses only dynamical pressure of slow water current. Even more, by larger water speed, its efficiency becomes lower! Complete design is convenient to drive water pumps (for irrigation) or alternatively to drive directly submersible electric generator. It is also suitable for performing aggressive micro aeration, by which through hose is sucking air from the river bank and injects small bubbles (smaller than 0,2 mm) on the bottom of the river. That causes oxidation of organic pollutions and elimination of the organic mud, which is mostly present on the bottom of the rivers or the water dam lakes. In the following text and pictures you can see the explanations and principles how new self propelled pumps (SP) are working and nearly unbelievable possibilities of their use. Our design is working above all in slowly moving water, when stream speed is higher than 7 m/s, its efficiency even lowers.

Already in the early stages of prototypes of SP devices we have received much criticism about that, that during the operation of device under water, there is a continuous risk that floating dirt, branches and similar could block the operation of propelling pumps or generators. Therefore, when developing SG generators we take care of their protection or

complete elimination of such possibilities - for SG generators as well as for pumps and other items that we drive with the SP devices.

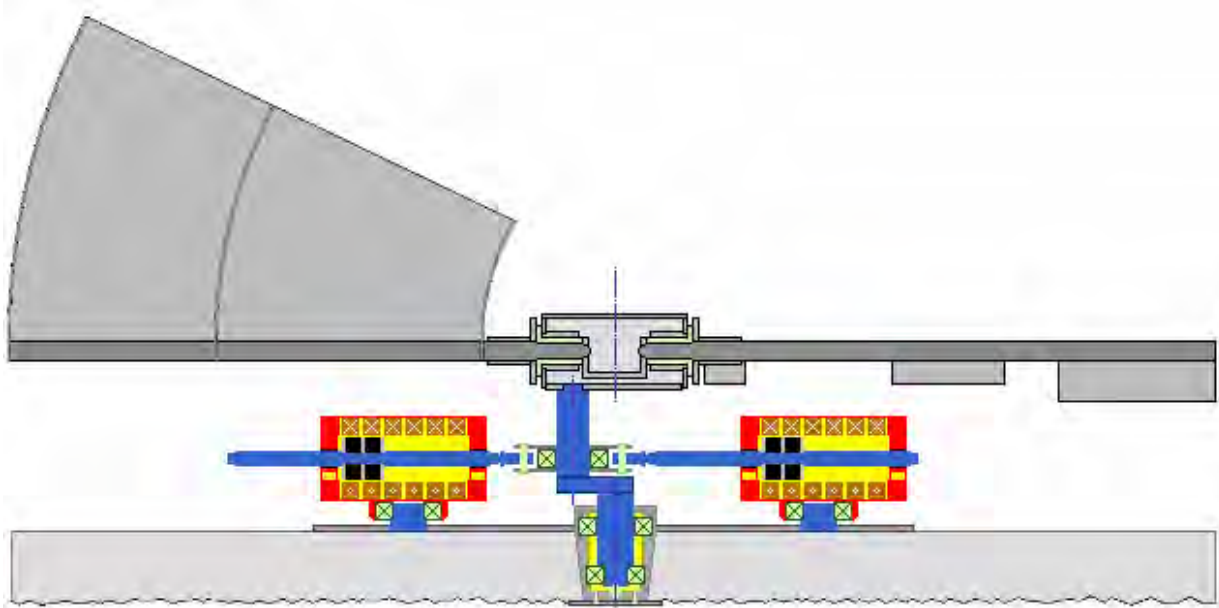


Illustration of the previous system with the SG generator, or piston pumps.

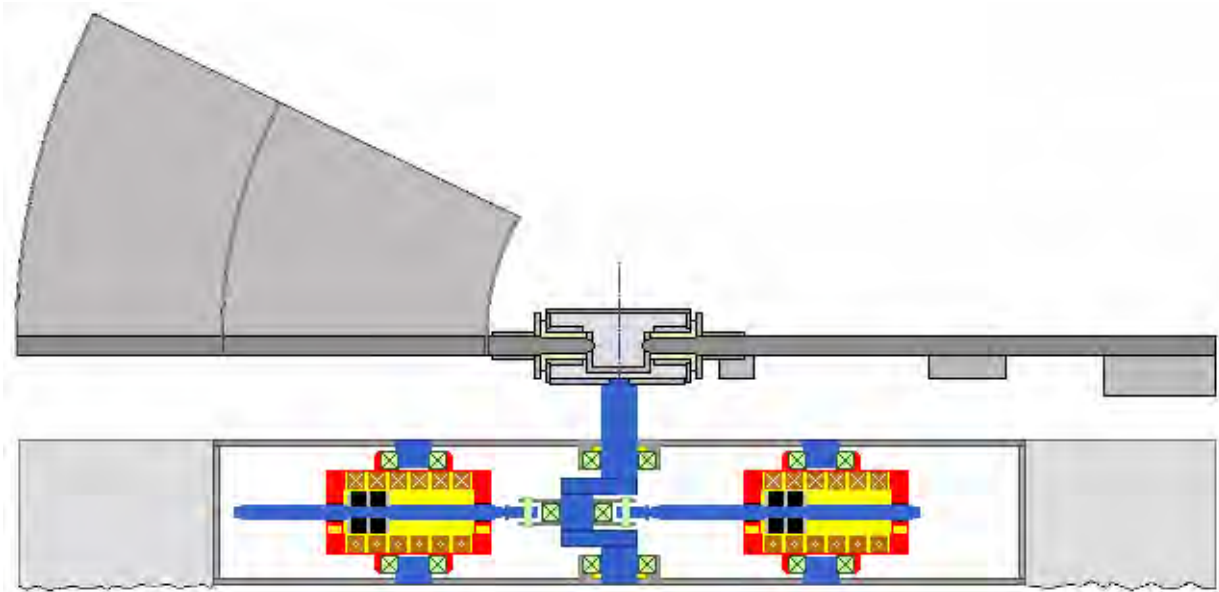
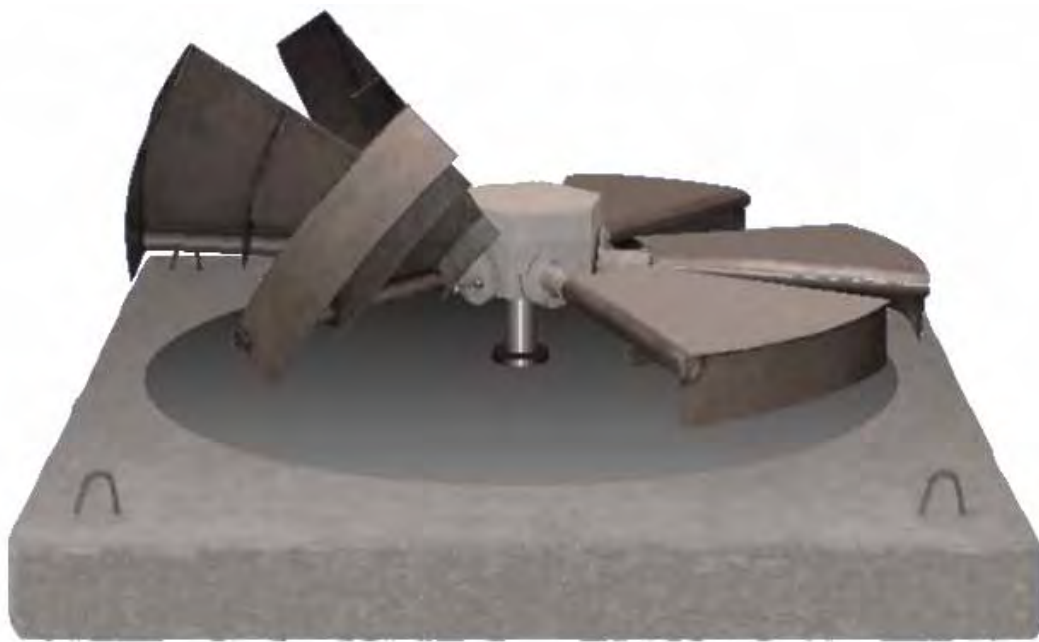


Illustration of the new system with the SG generator or (similar) piston pumps.

Regarding all mentioned, we are still opinion that for producing electricity, our SP units are nearly ideal solution for the category of “Pico” power plants, where we intend to remain on the powers up to 25 kW of electric energy. Such production as it seems can achieve far the lowest prices per kWh, which are much lower than the current lowest price. Finally, the

latest calculations shows that we will be in this year able to deliver SP units equipped with a submergible SG generators with power of 20 kW, which will be, on the basis of amortization period of 20 years, able to produce electric energy at a price of only 0.0075 EUR per kWh. Comparing our price (achieved with our SP devices) with prices for kWh received from photo cells (1,4 EUR to 12 EUR for kWh) or even with prices for electricity from larger Windmills (2 EUR to 35 EUR for kWh), we can recognize more hundred times larger difference among all other alternative energy sources.



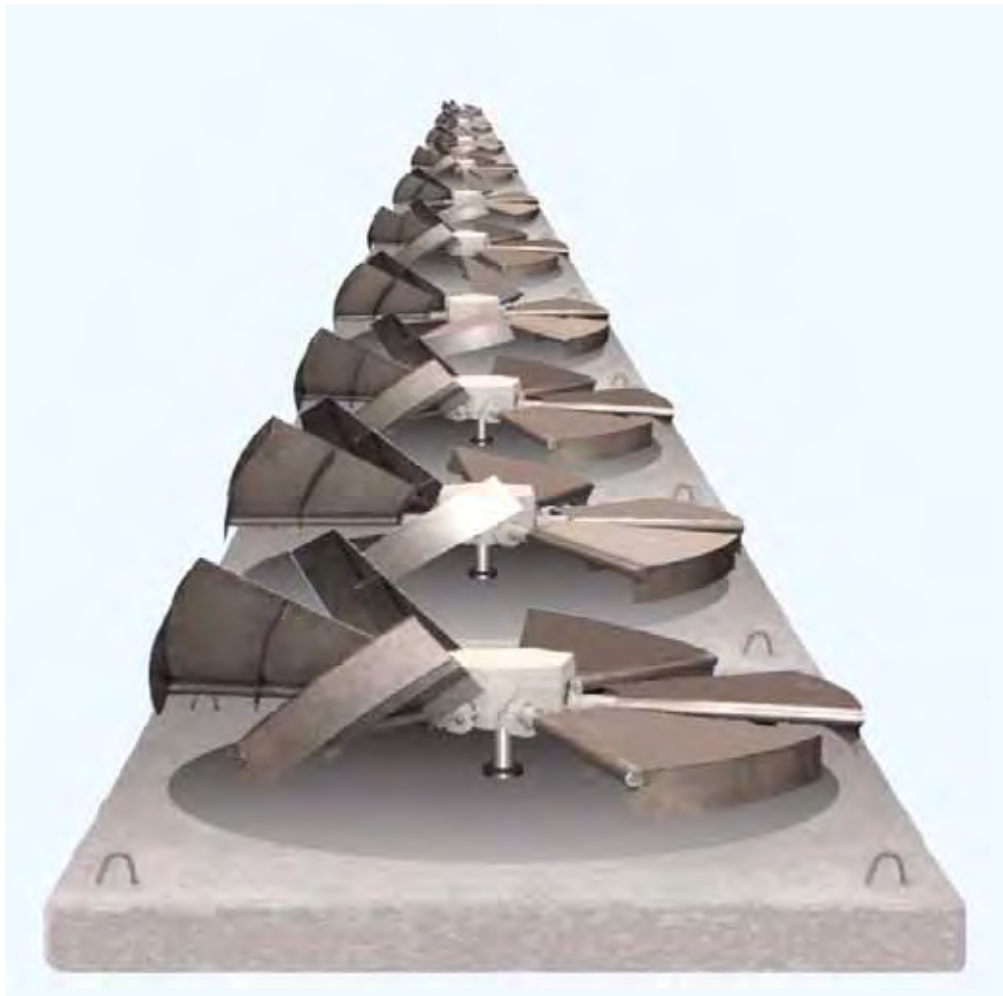
Even more interesting is comparison of prices of electric energy received from power grid, which in developed world vary between 0,06 and 0,12 EUR for kWh. **By that, we find out that the price of energy, which is obtained by the SP devices, is still 6 to 8 times lower, than electricity from the grid and represents the lowest price for gained ecologically cleanest energy in the World.**

THE POSSIBILITY OF CONSTRUCTION OF MEDIUM AND LARGE ENERGY FACILITIES USING SG UNITS CONNECTED IN COLUMNS

Although we have mentioned in the current text that smaller power plants for individual use and power of 20 to 25 kW are the most appropriate form of SG units, additional measurements and calculations indicate that there is a possibility of building a substantially larger and more powerful energy plants which would be assembled from 10, 20 or even 50 smaller SG units which are placed in the bottom of a medium-sized river – one by one or even in the more columns.

In this moment a big problem is even to imagine 250 or 300 meters long banks of the river in which practically anything is not to be detectable but at the bottom of the river are placed two or three columns assembled from 50 or 60 SG units, whose output voltage cables have

been connected to more small or one large inverter unit, which convert generated electricity and connect it to the nearest power grid.



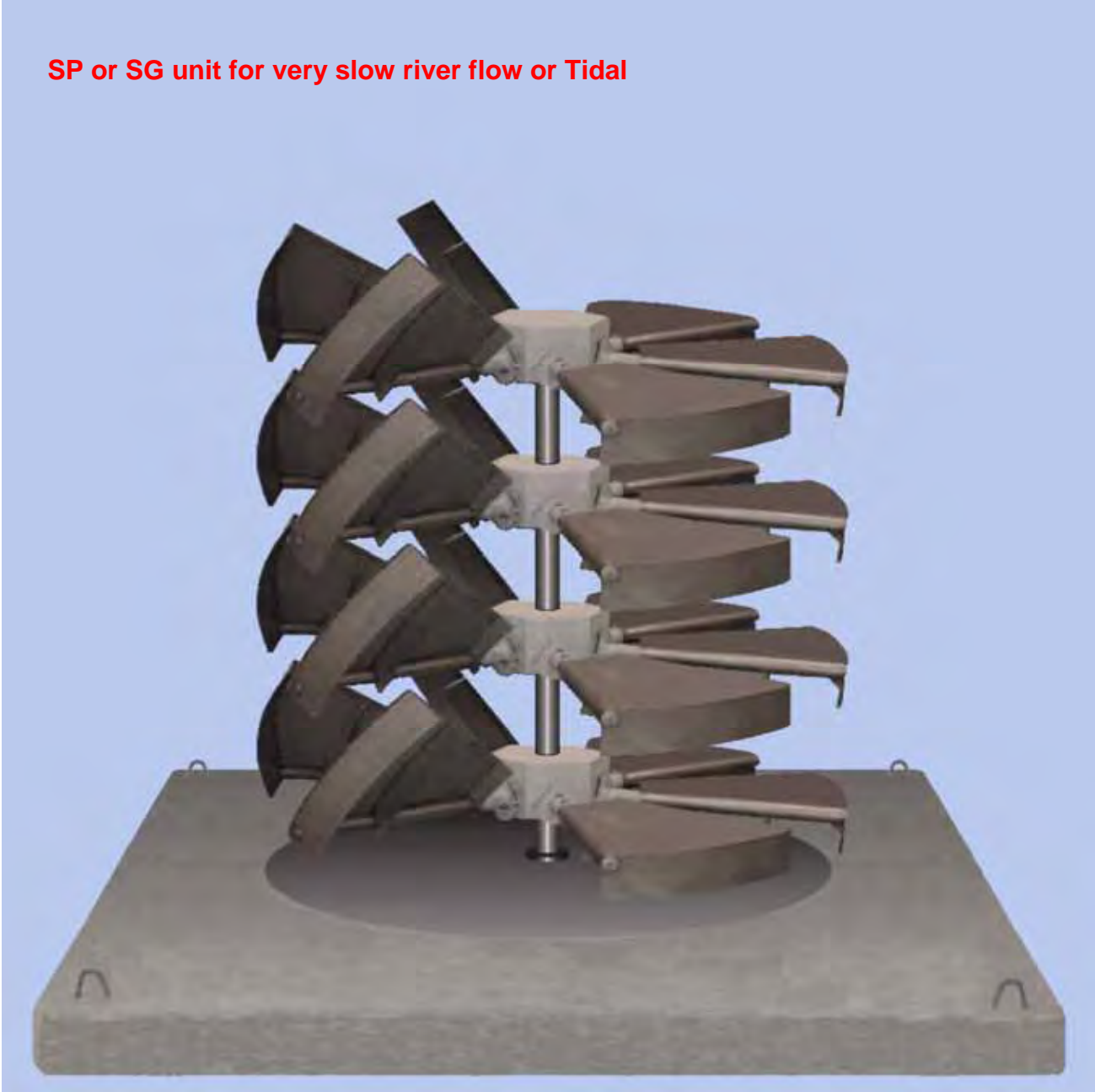
View of smaller SG power column installation with approx. 250 kW of power (at water speed of 2.8 m/sec.) and in total length of ca. 80 meters.

Approximate investment cost of such installations still don't exceed 1 EUR for each 1 W of received power, what is 2.2 times cheaper than the necessary investment for small hydro power (without major artificial lake) and 4 to 15 times cheaper than medium-sized hydro power plants with an artificial lake. For the reader who is not familiar with the actual powers of most European hydro energy sources: It is to be noted that the actual power of hundreds of plants are not so large as it is generally thought. For example, the average installed power plants in GORENJSKE ELEKTRARNE in Slovenia is not significantly exceed 450 kW of installed power, and some of them are very small: (HE Cerklje - 90 kW, HE Kranjska Gora - 152 kW, HE Rudno - 175 kW, HE Kokra - 228 kW ; HE Skofja arc - 282 kW, HE Standard - 200 kW, HE Davča - 320 kW, HE Sorica - 140 kW, HE Zvirče - 370 kW and HE Suhelj - 160 kW), and only some of their power plants are exceeding 1 MW of installed power.

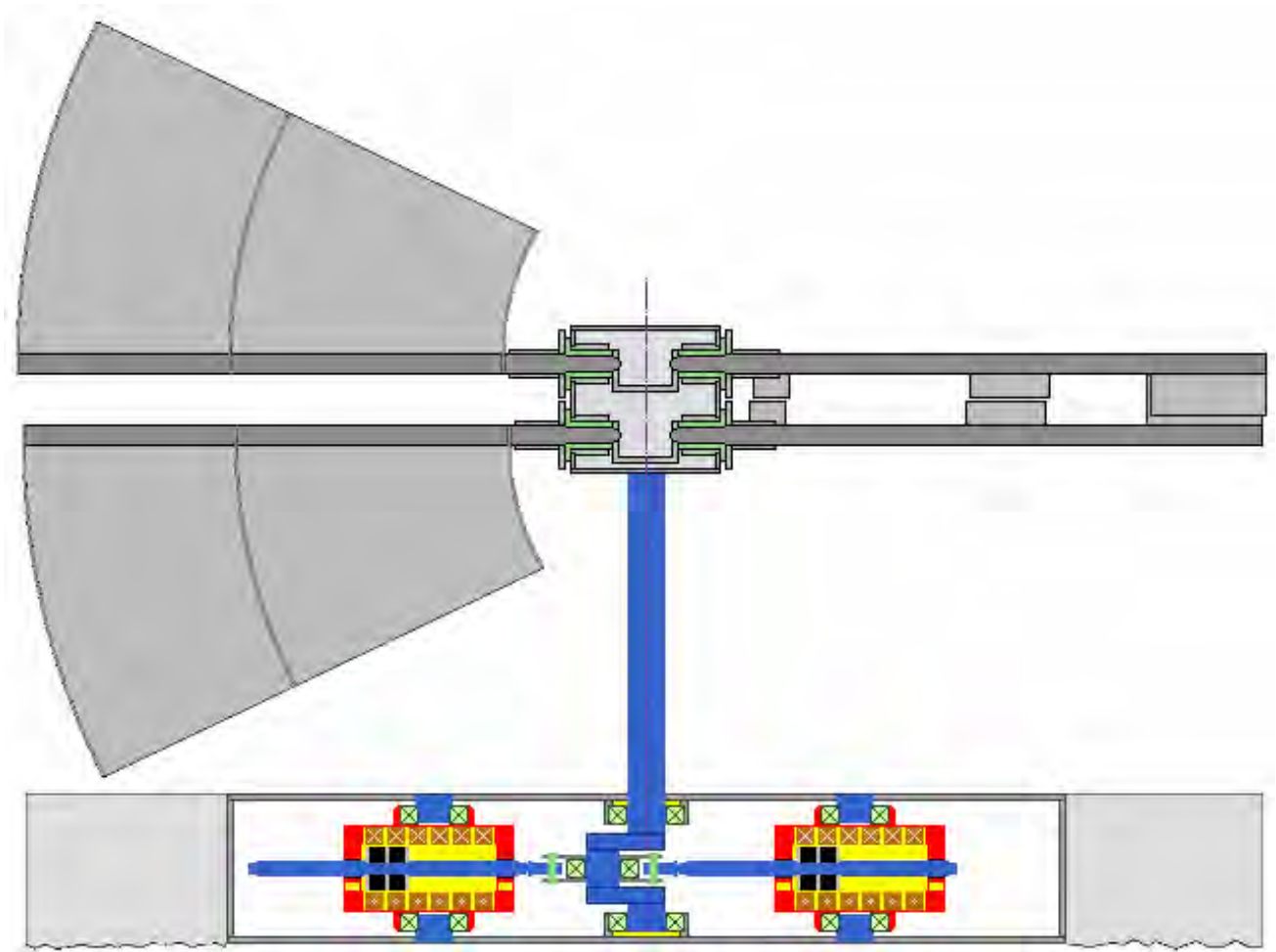
POSSIBILITY FOR DESIGNING OF HIGHLY EFFICIENT SYSTEMS FOR DEEP WATER, OR EVEN FOR TIDAL POWER

Relatively negative hydrodynamic effect of most rivers is that speed of water at the bottom is the lowest. Therefore, we have the first prototypes upgraded with the possibility of

correction of this phenomenon in the sense that on the same driving axle – but higher - we can place additional propelling turbine.



Immediately after that it was open the necessity of further enlargements of the carrier base and a vertical addition of not just one but more propelling turbines. Installation of devices as shown at the figure above is offering the cheapest, and the most effective solution to generate electricity from slow water currents in rivers and even Tidal streams in sea water.

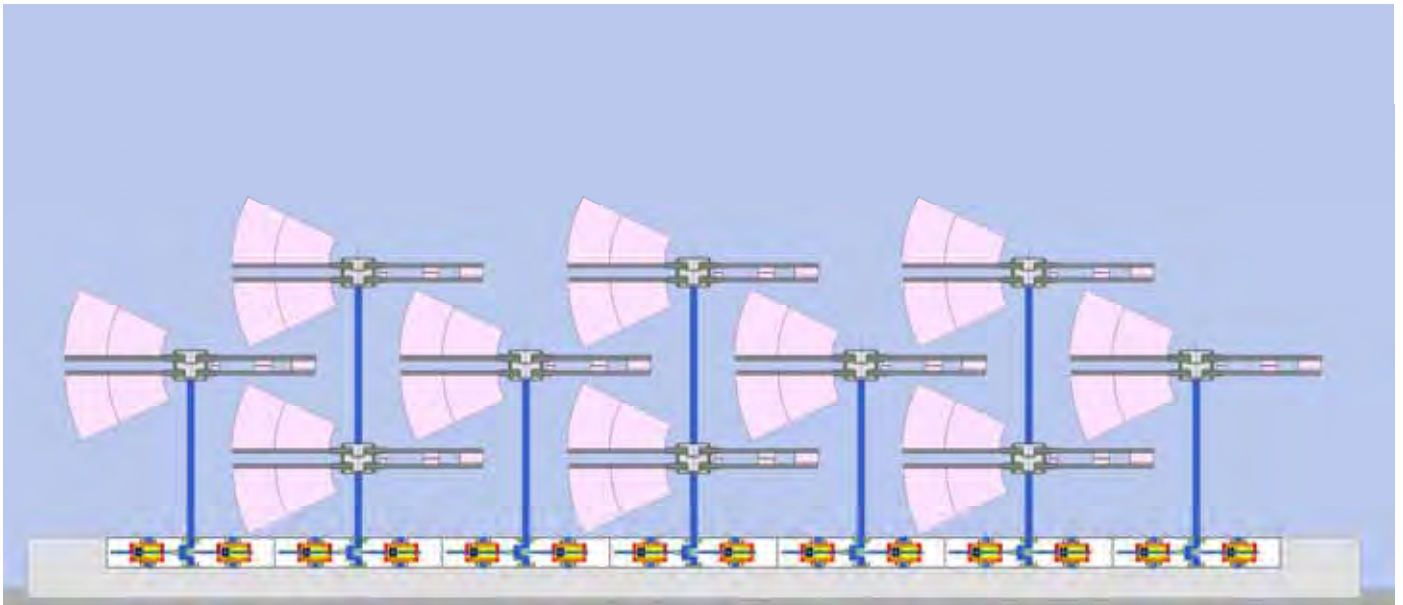


The picture shows the double (reverse) layout of the pairs of wings, is suitable for installation where water is very slow and (with much smaller power) continue to operate even at a minimum depth of water flow, which does not substantially exceed a depth of 1.3 m. SP units as described were developed mainly for irrigation systems operating in very shallow water (pumping station on river Savinja near Celje).

In the classical known calculations present on pages 9 and 10 of this brochure we perceive very important physical facts that were obviously missed out even by genius Bernoulli: If he separated his calculations on incompressible, and compressible media, remains the fact that running water in the stream is considered as incompressible media. In this case, we find almost unsolvable problem of Physics that on transverse placed barrier are not pressing only water molecules that touches it but (due to incompressibility), very long straight-line column of water molecules from the direction of water flow. So, known calculations without total mass of (incompressible) water "column" pressuring on the barrier are not taking into account. This is in direct conflict with all basic principles of Newtonian mechanics!

On pages 9 and 10 present calculations could not introduce to readers of this brochure nearly endlessly big number of possibilities for assembling of SP and SG units to different slow water streams. One, very interesting is:

THE WALL



On illustration presented "THE WALL" have to be assembled from 7, 9 or couple of moiré SP or even SG units, forming transverse placed barrier and by speed of water stream from 2,5 m/second it can easily deliver 1 MW of mechanical or electric power. Such design is in slow but larger rivers nearly ideal - as far for TIDAL Power stations in see water.

WHAT, HOW AND HOW MUCH FOR ELECTRIC POWER ?

In the past few years we reached many public misconceptions concerning the known and alternative energy sources and their real prices and effects. Let's see what and how much is realistic and what we actually get:

1. "PHOTOVOLTAICS" (Photo cell installations)

In Slovenia (unlike Saudi Arabia) within four months of summer, during a few hours a day present value of solar energy does not exceed 550 watts per square meter. Considering that the efficiency of photo cell elements was up to these days around 10%, today (II generation) rises up to 30%, and over the decade will allegedly reach up to 45%, we get the

fact that for all 365 days (and nights) a year only for permanent industrial and public use in city of Ljubljana we need surface covered with photo panels larger than 1/6 of whole country of Slovenia! So, even if the current price from 5 EUR per Wp fall below 2 EUR per Wp, all together would be without any importance. Investments required per unit of energy are extremely high - eight times larger than is necessary to pay for Thermo Power plant. When we add the cost for the carriers for solar cell panels, costs for enormous capacity of inverters and batteries (for the times when it is night or when rain clouds are present), realistic and the lowest investment cost per kW for the installation of at least 1 to 10 kW can not be lower than 12.000 EUR per each kW of Power and that is economically totally unacceptable.

Investment needed for each kW of actually gained power: approx. 12.500 EUR
The price obtained for each kWh of energy: approximately 0,5 to 1,2 EUR

2. WINDMILL

Together with heating costs in winter months, Slovenian householder uses about 137 kWh of energy per day. For so large consumption, such "alternative" energy source is not any kind of serious alternative. For example, constant wind speeds in range of 11 to 15 m/second in Slovenia are very rare and the same time, manufacturers and suppliers of Windmills are promising us that each kW of power they can deliver at a price of just 1,65 EUR for 1 W of power. Of course, while forgetting to tell us that these are just theoretical figures which indicate power installed on Windmill – but just in the case of sufficient wind speed. By slower wind speed, received Power radically reduces. Practical experience from around the world without exception, confirmed that in the longer term from Windmills we are receiving only 20% of installed power and in some cases (the second largest "wind farm" in England) has an average of just 7.8% of gained power - in relation to installed. This means that when ordering Windmills a new owner must order and install approximately five time larger capacity to receive planed power! So, credible figure of investments needed for realistically received each kW of power exceeds 8.000 EUR. Real operating cost for a kW of electrical power will depend on the size of wind turbines and local wind conditions and can vary from 0,5 and up to 4 EUR per kWh. Regarding all mentioned, it seems to be that "Photovoltaics" and the Windmills are not exactly "alternative" energy sources and their proper name should be "temporary, very expensive and additional" energy sources – because they could not be any longer time alternative to existing energy needs or prices of electricity.

Investment needed for each kW of actually gained power: approx. 8.500 EUR
The price obtained for each kWh of energy: approximately 0,5 to 2 EUR

3. THERMO POWER PLANTS

The most recent data available to us is current price of thermal power block VI of Power Plant Šoštanj (in Slovenia) - 1,000.000.000 EUR. With that investment, 600 MW of Power can be generated, so investment will not exceed 1.700 EUR for each kW installed. This almost ideal investment costs significantly deteriorate the fact that this plant will annually "burn" a huge amount of coal, and create huge atmospheric pollutants what significantly

raise the price obtained for each kWh of energy exploitation. Still, the prices of energy gain in relation to the above "alternative" sources, are not comparable.

Investment needed for each kW of actually gained power: approx. 1.700 EUR
The price obtained for each kWh of energy: approximately 0,06 to 0,08 EUR

4. HYDRO POWER PLANTS

According to official figures, the total potential of Slovenian rivers reaches 19.400 GWh per year. Economically convenient for use are about 9.000 GWh per year but Slovenia is currently using only 3.970 GWh. A problem regarding larger exploitation is in construction of dams and reservoirs. For example, only in 100 km long river Mura (through Slovenia) with about 100 meters of total high difference, in theory can be built at least 10 or 11 relatively large hydro power stations - instead of the current and relatively small Hydro Power Plant Ceršak, which is giving only 662 kW of power. However, the configuration of terrain around Mura river is so flat that such impact on the environment, would never arise.

Very expensive and technically very demanding building of dams are major causes of such a low rate of use for so great a renewable energy source such is hydro power. Also the costs of each new facility are very difficult to predict because it depends largely on the configuration of the ground and the existing water source. However, investment costs are significantly higher than that of thermal power plants, and (depending on the size and strength) in range from 2,200 EUR to 6,000 EUR (or even much more) for each kW of gained power. However, after building Hydro Power plant, additional costs are almost zero during many years of operation.

Investment needed for each kW of actually gained power: approx. 2.200 to 6.000 EUR
The price obtained for each kWh of energy: approximately 0,03 to 0,05 EUR

5. SG UNITS IN COLUMNS PLACED ON THE BOTTOM OF RIVERS

If for a moment we forget unusual view of more SG units placed on narrow area of the river bottom, (which are, during operation not detectable from the river banks), we must consider also the full environmental acceptability of such installation – regarding a very slow rotation (only ca. 3 revolutions per minute!). It is also important to know that after all previous experiences we know that such installation do not cause any serious effects on the water body with exception of temporary and slightly reduction of water speed on its bottom and small speed incensement of the water in the top layer. But, some 10 meters after SP installation comes re-alignment of water velocity in different layers.

Comparing the whole production costs of up to 19.000 EUR per single SG unit and after building approximately 50 peaces to reach 1 MW of constant power, an investment cost between 850.000 and 950.000 EUR is to be considered. This is nearly three times lower investment cost than we need for small hydro power plant with the same output power and more than eight times lower that are investments required to install wind turbines with similar capacity. The price per reached kWh is even not to be compared!

Investment needed for each kW of actually gained power: approx. 900 EUR
The price obtained for each kWh of energy: approximately 0,01 to 0,015 EUR

For example, only at the bottom of river Mura in Slovenia we are able to place between 300 and 600 SG groups of units of 1 MW of real power and in Slovenian rivers Drava, Sava, and even several smaller rivers, at least twice so much. On that way we are coming to the possibility of obtaining extremely cheap energy, which would broadcast in exploitation in electricity grid with a price that exceeded 0,012 EUR per kWh. Exactly speaking, this means also the following: Instead of more than 1,000.000.000 EUR for VI block of a new power plant in Šoštanj, SG units in the river Mura could gain the same capacity (600 MW) of electricity with significantly lower investment, all funds would stay at home and further recruited many unemployed workers.

I am expecting that in the next 4 to 5 years - spending lowest possible investment sources, in Slovenia, we can build new SG power units for the constant production of 1.300 MW of the world cheapest and cleanest electricity. For the most of the medium or high developed countries of the world relations are very similar or, existing exploitation of hydropower sources, can be for up to 200 % increased – based on very low investments and ideal ecological way.



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PS: More data, animations and movies you can get on <http://www.izumi.si>