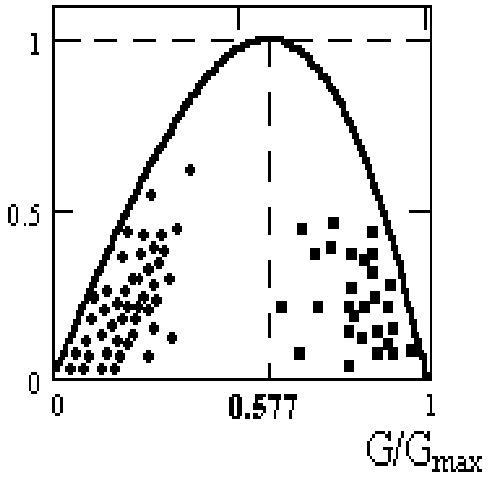
Any apparatus that is using a fluid medium as a working body, which carries the energy that is transformed into a useful work, belongs to the Tornado-stream Technique if at the design of this apparatus priority was given to the constructive and technological provisions of a laminar flow of a working body, according to the exact solutions of the equations of fluid dynamics that are describing a stationary laminar tornado.

In other words, we are talking about the tornado that is confined into a working machine – turbine, compressor, pump, separator, mixer, burner, oven, chimney, etc, etc…

"… if all needed information is known, one can easily calculate the efficiency and QI… and become surprised, just as very surprised was I, when I compared QI of different stream devices and apparatus for the first time.

$$QI \equiv N / \text{Max } N$$



$$QI=(3^{3/2}/2)(G/G_{max})[1-(G/G_{max})^2]$$

To live in peace with all manufacturers of the stream technique, I provide results of my own calculations of several turbines, pumps, compressors, ventilators, etc., I have considered, without mentioning manufacturers.

As this anonymous comparison shows, the conclusion was obvious: in spite of all of our progress, we do not design and manufacture really good stream technique apparatus with high QI".

TORNADO-STREAM TECHNIQUE

The best response to energy crisis

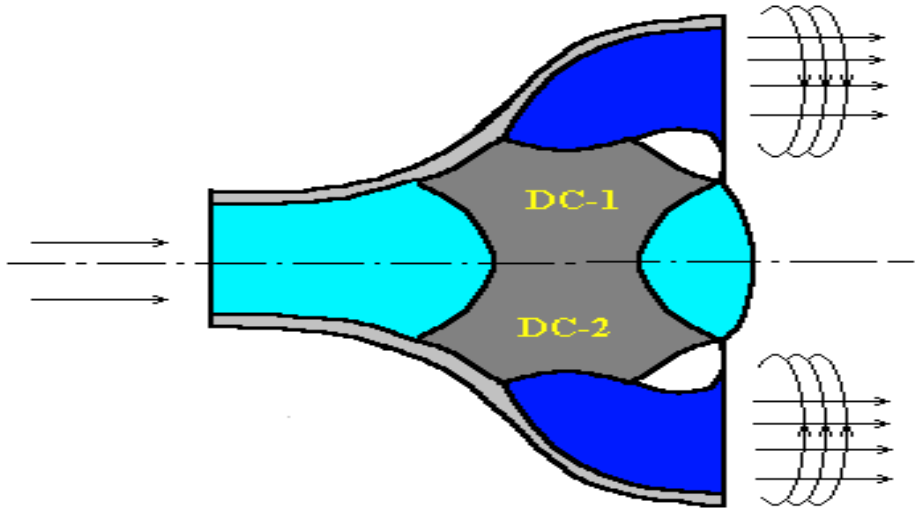
Presentation of the Project.

Developed by
Qualitics, Inc. Cleveland, Ohio, USA.

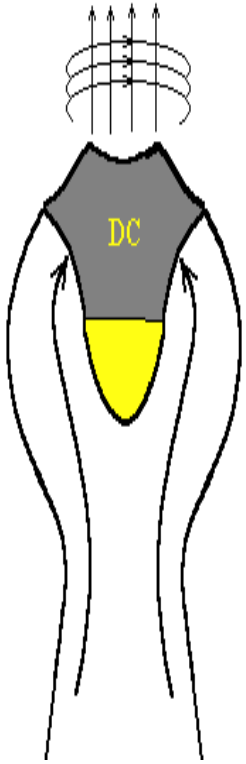
The project that is presented in this brochure is based on research that was accomplished during 1982-92 in the Laboratory of Advanced Research of the Khurchatov Institute of Atomic Energy in Moscow. The physical mechanisms of all considered phenomena are described in the book "***The Qualitics***" that is available at **www.thequalitics.com**

The panoramic photo of ITAIPU hydroelectric power station. One can see a huge white tail of breakers and surfs in stream that is leaving the power station. It is exactly where the essential part of energy of flow goes – not in electric power, not in discharging of worked up water, but in useless turbulence. And the reason is only the one – turbines of this power station cannot provide laminar water-tail…

Interested parties should contact Yuriy Y. Krasnov,
President of Qualitics, Inc.
26111 Brush Avenue, Suite 213, Euclid, OH 44132.
Phone: 216-289-6491, Fax: 216-289-6493
E-mail: **yyk@thequalitics.com**



Tandem of two diagonal TC with intake helices is shown. In this embodiment all axial forces are compensated. The torsion moments of two flowing out whirling streams are also compensated.



Another example concerns the use of a ***static*** tornado chamber inside the chimney to create a structure of exhaust gases in a form of a twirling tornado-like column. Such a column will be a very stable dynamic formation, tough to be destroyed by wind, and will lift exhaust gases much higher, which is necessary for a good dissolution of them in ambient atmosphere (to decrease their possible harmfulness at high concentrations).

The yellow color marks a fairing nozzle, which easily can be used as a waste disposal. Indeed, it is easy to combine functionality of whirling of stream with functionality of separation of solid components of exhaust gases.

If that is done, the solid particles will fall out of the main stream, just inside the disposal nozzle. The dust can be easily transported from that nozzle in a disposal on the ground.

The huge accumulation of research, experimental and technological data developed and collected by specialists that started, investigated and invented all those ideas and designs that we know today as the Tornado-Stream Technique, allow us to state that implementation of this technique correctly, in the contemporary conditions, could almost double our ability to generate electrical power from existing hydroelectric power stations, just by replacing present turbines and channels with those that are designed and built to the exact specifications of Tornado-Stream Technique.

Such doubling of production of hydroelectric energy does not require more usage of water than is used today. Water's gravitational energy, in the same reservoirs, will be used with much higher efficiency and not wasted in the turbulent outflow to the rivers below the dams, but will be transformed into additional electricity for plants, homes, streets…

Qualitics, Inc., with expertise of one of the inventors of Tornado-Stream Technique, Yuriy K. Krasnov, and New Technology Network, LLC, with expertise of another one of inventors of Tornado-Stream Technique, Gennadiy I. Kiknadze, can provide many new technologies that have organically adopted features and ideas of Tornado-Stream Technique. These companies have in their portfolios several very powerful projects, in many of areas of Engineering Science: stream techniques, heat-exchange techniques, magneto-heat transformation of mechanical energy into electricity, low inertial ship design, etc.

The remarkable fact is that Tornado-Stream technique can be implemented into many industries right now, without any big investments and/or organizational efforts. Indeed, a quick look at the following two examples will tell a lot to anyone who is experienced in the engineering art.

Tornado chamber built in Wind tunnel of the Hamburg University, Germany.

What this brochure is about?

There is no need for justification of the conclusion that the World is currently in an energy crisis. There is no need to prove, for example, that every Californian experiences the negative consequences of this crisis. The pressure of those circumstances will affect us more and more during the global climate change process…

We have to act now to keep the progress of civilization under our control and heading in the right direction. We all have to do appropriate actions together, with all responsible people on Earth.

There already are a lot of projects that have been started or proposed, many very useful, and promising new actions, procedures, technologies, apparatus, materials, etc. There is no doubt that humanity will prevail in this current crisis as it has many times in the past…

This brochure is an attempt to attract the attention of responsible people to one more possibility of achieving victory in the current "*battle for efficient use of energy*" that does not require any more sacrifices or huge investments, but calls for doing the same that we have being doing for many decades, but in a way, which is consistent with features of Nature. In other words,

if we have to harm Nature, let us do it in the least harmful way…

In a previously mentioned book, "***The Qualitics***", the proof that adhering to such a Principle we will always reward us with much more efficient equipment, than we have now…

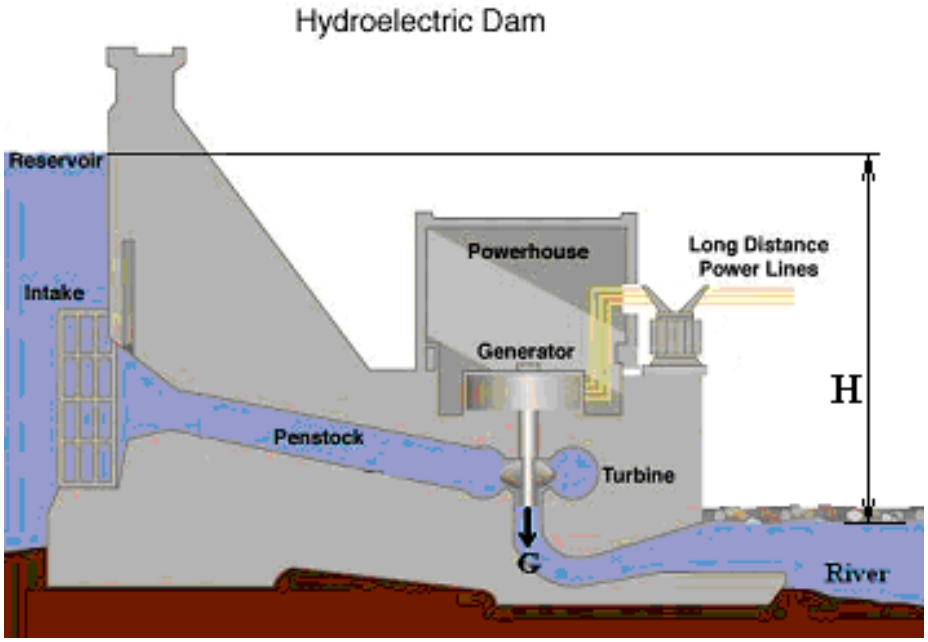
This brochure will try to convince everybody that exactly the same situation we have in the area of hydro-electric power stations; that only following features of Nature and changing hydraulic turbines of our stations with ones that better fit these features, we will dramatically increase the efficiency of said power stations and will save Nature from more dams and artificial reservoirs.

Hoover Dam by Ansel Adams Nevada-Arizona, USA

Let us recall High school Science:

How a hydroelectric power station works?

The schematic of a hydroelectric power station is shown in the following picture:



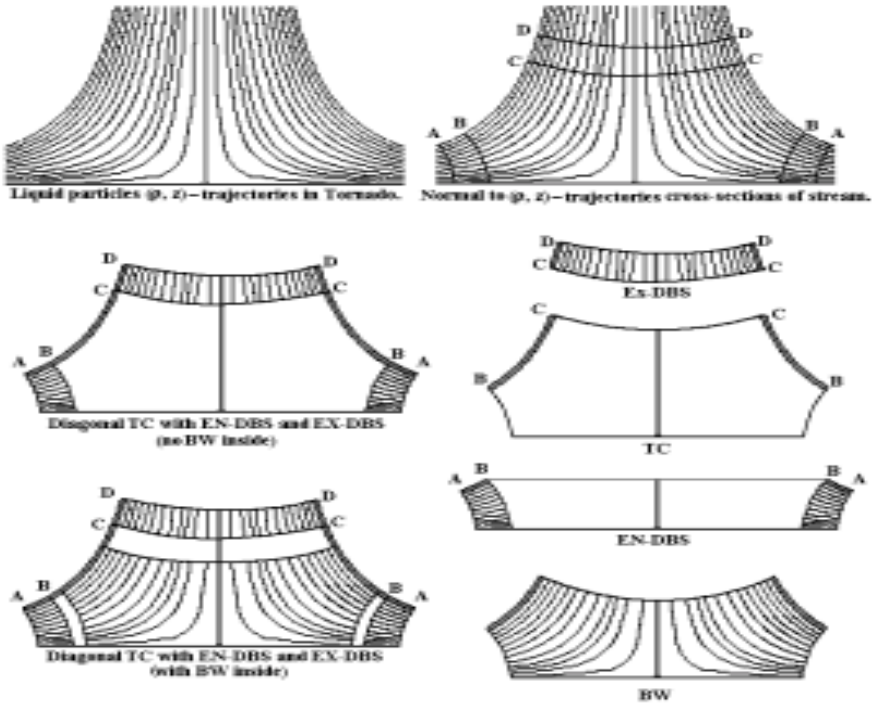
First of all, we should recall that water is practically an incompressible substance: ***no matter what the channel of water is, the same amount of water is passing through every cross-section of it.*** This feature of water provides very convenient measure of its flow – the outlay, G, which is a product of the ***local average velocity*** *of water in some normal cross-section of channel*, <v>, and the ***area of that cross-section***, $S_{\perp}$, i.e.

$$G = \langle v \rangle S_{\perp} \qquad (1)$$

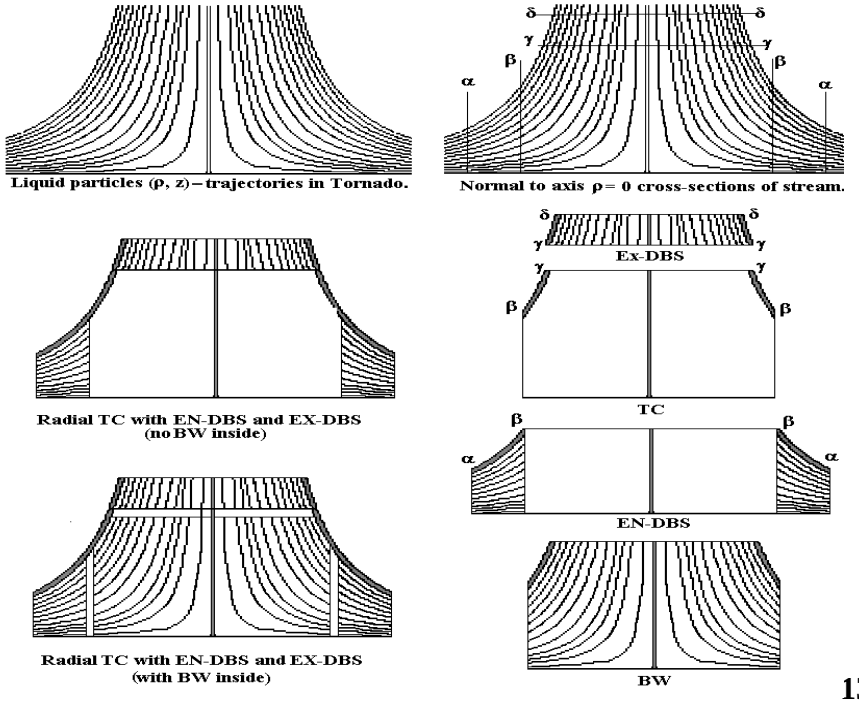
The incompressibility of water provides that G is the same for any motion of water in any channel, no matter how curved and/or variable its profile is:

$$G = \text{constant} \qquad (2)$$

Outlay G shows how many units of liquid volume is passing any cross-section of channel of flow.



Above picture shows procedure of building a diagonal type TC and picture below shows procedure of building a cylindrical type TC.

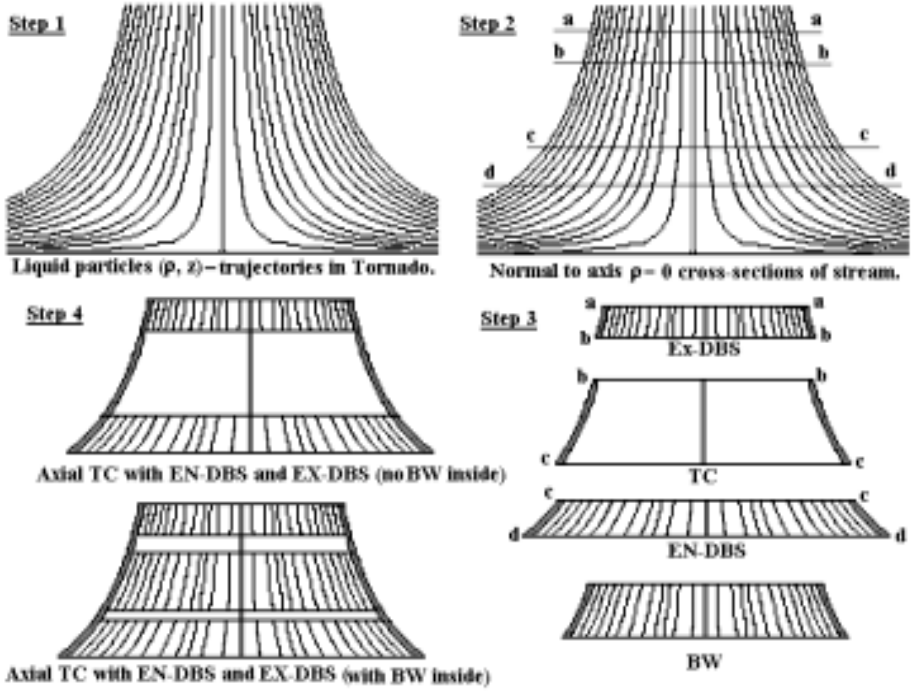


With the discovery of the exact solution (**), almost immediately came the idea that there is a way to design stream apparatus to provide flow of the rotating liquid according to the solution (**) in every cross-section. This will give us a system of energy transfer without creating additional parasitic turbulence in that liquid. In other words, it would be **a laminar tornado-stream technique**. There arrives an obvious question:

How to put a tornado into a glass?

The answer to this question forms the physical basis for developing a technology of the tornado-stream technique.

In the book "*The Qualitics*" there were proposed three basic types of tornado-stream apparatus: ***axial, diagonal*** and ***radial Tornado Chambers*** (TC). Strictly speaking, the design of, for example, axial TC consists of the following steps.



One should start with building the family of trajectories of the flow (**), the (ρ,z)-projection of which is shown in figure above. Then by choosing appropriate normal cross-sections (like a-a, b-b, c-c, etc. in shown figure) one can find needed form of the exit directing blade system (Ex-DBS), TC itself, entrance directing blade system (En-DBS), and somewhere between sections b-b and c-c – the working blade wheel or BW.

Keeping this fact in mind, one can describe the physical processes that happened in the power station.

Intake of the water with outlay G passes a penstock and falls on the turbine. Pushing turbine to rotate, water flows out of turbine channel through its exit cross-section and outflows into the river.
If the normal exit cross-section of channel is $S_\perp$, than the average velocity of water on this cross-section, according to (1), is:

$$\langle v \rangle = G / S_\perp \qquad (2)$$

Therefore, any unit of volume of the water at the exit of channel has a kinetic energy, equal to

$$K = d \langle v \rangle^2 / 2 = d G^2 / 2 S_\perp^2 \qquad (3)$$

Where does this energy come from? Of course, it is what has remained of initial potential (gravitational) energy

$$P = d g H \qquad (4)$$

which any unit of a liquid volume with density d had in the feeding reservoir before the dam (in respect to level of water in river below the dam), ***after stream of water has passed some energy to turbine***. Let the energy that any unit of liquid volume passes to turbine be *A*. Then one can conclude that

$$P = A + K \qquad (5)$$

which is the inevitable consequence of the energy conservation law. Multiplying (5) on G, one can obtain the main result:

$$GP = GA + GK \qquad (5)$$

Noticing that product G*A* actually is ***a mechanical power passed to the turbine***, N, and using (3) and (4) in (5), one can obtain the general formula:

$$N = G\, d\, g\, H - d\, G^3 / 2\, S_\perp^2 \qquad (6)$$

Dividing each term in (6) by product $dgHS_\perp (2gH)^{1/2}$, one will have:

$$N / dgHS_\perp (2gH)^{1/2} = G / [S_\perp (2gH)^{1/2}] - G^3 / [S_\perp^3 (2gH)^{3/2}] \qquad (7)$$

But product $S_\perp (2gH)^{1/2}$ is exactly the maximum outlay of water through the same channel (if channel would be free of turbine), G_{max} ; i.e. G_{max} is ***the outflow of water at free gravitational falling from height*** **H** (so called "*Torricelli outflow*"):

$$G_{max} = S_\perp (2gH)^{1/2} \qquad (8)$$

Therefore, one can rewrite our main result for mechanical power to hydraulic turbine in the following form:

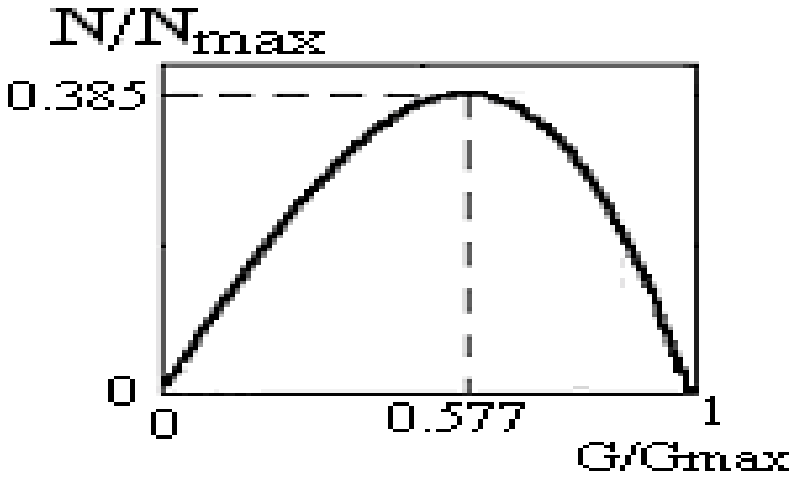
$$N/dgHG_{max} = G/G_{max} - G^3/G_{max}^3 \qquad (10)$$

But $N_{max} = dgHG_{max}$ is actually the maximum power that water could have at gravitational outflow through the given channel (at free falling, for instance, if channel would be free of turbine).

So that, we come to the following simple, but very important, general formula that describes the power N, which is passed to hydraulic turbine of any kind:

$$N/N_{max} = G/G_{max} - G^3/G_{max}^3 \qquad (*)$$

The graph of this formula is shown right here:



This wonderful graph shows the most important quantitative features of any process of the energy transfer between falling stream and hydraulic turbine. First of all, it shows that ***there is no energy transfer*** (N = 0) ***from water to turbine at*** **G = 0** (water does not move) ***and*** **G = G_{max}** (water freely moves from reservoir to the river: there is no turbine in channel or turbine does not rotate).
Second, it shows that ***there is no chance to transfer to any turbine more than*** **0.385** ***part of the maximum power that water could have at free gravitational falling from height*** **H**, $N_{max} = dgHG_{max}$.
Third, it shows that ***the maximum power***, which is equal to $0.385dgHG_{max}$, ***is passed to the turbine in the regime of flow when*** **$G = 0.577G_{max}$**.

Such a definition of laminarity is based on the fact that flow is determined locally, if the evolution of all sources of energy, all boundary walls and all free surfaces of a medium are known, and if the all these are not breaking the stability of flow.
Then the mechanics of a continuous medium guaranties the existence of the streamlines of the flow (but not the stream tubes, in common case!), which is *a necessary* (but not a sufficient) *condition of the existence of the laminar flow.* Therefore, we can formulate the following strategy of intensification of quality of the contemporary stream technique:

- Elaborating and advancing the theory, methodology, and technology of the artificial laminarization of flows of a working media in the stream processes and devices on the basis of well known laminar flows;
or
- Elaborating the basics of the design and creation of the stream machines, which are using, from the beginning, the appropriate new types of the laminar flows of a working media.

As one can see, all that needs to be done is to provide engineers with the appropriate set of exact solutions of the equations of fluid dynamics that describe water's motion. Having such solutions, our engineers will build turbines that provide maximum power transfer without adding parasitic turbulence in the water's stream…

There was only one problem: **there was no single known exact solution of the equations of the viscose fluid dynamics – the Navier-Stockes equations – that would be appropriate for twisted outlying flow!**

In 1981 G. I. Kiknadze and Y. K. Krasnov found such a solution and published it in "*Reports of USSR Academy of Science*".
Basically, we are talking about ***stationary tornado stream***, which is described by the following formulas:

$$v_\rho(\rho) = -\Omega\rho,\quad v_\varphi(\rho) = (\gamma/2\pi\rho)[1 - \exp(-\Omega\rho^2/2\nu)],\ v_z(z) = 2\Omega z \qquad (**)$$

where (ρ, φ, z) is the cylindrical coordinate system with axis z along the symmetry axis of flow, v_ρ, v_φ, and v_z are components of the local velocity of fluid, ν is the kinematic viscosity of fluid, and $\Omega[1/sec]$ and $\gamma\,[m^2/sec]$ are some corresponding constants that are defined by kinematics of the stream on some control surface.

In 1982 Yuriy K. Krasnov proved that in Nature there are many more surfaces that can not be streamlined without self-turbulization of the stream, even by a non-viscose liquid, than those surfaces that do allow non-turbulent streamlining. The author has shown the mechanism of such self-turbulization and has proven that at such self-turbulization, which is due to a streamlining of surface, the stream will create micro- and mezo-vortices that will fulfill the nucleus of stream. It takes a lot of energy to be concentrated in such vortices…

But engineers, who designed turbines, never analyzed whether designed blade wheels and profiles of boundaries of the turbine allow streamlining without self-turbulization, or not. It was simply "*terra incognito*" for engineering science… **And this is the main reason why our hydroelectric power stations are wasting so much gravitational energy of water!**

Until Krasnov's work, it was commonly accepted that any liquid can move in a laminar regime (i.e. without any turbulence inside of it) through any channel, at least, at low enough velocity, i.e. at low enough outlay. At least, the nucleus of flow should be moving in laminar regime. Krasnov did show that it is not true: there are multitudes of very smooth surfaces of channels that can not be streamlined by even a non-viscose liquid in a laminar regime even at any small outlay. Streamlining of such surfaces, ergo - passage through a channel with such surfaces, is possible only in regimes, when liquid generates turbulence inside of itself.

It means that at projecting some type of turbine, we have to choose such surfaces of blades and walls, which will allow the liquid flowing through to remain in the laminar regime. Therefore, we are talking about making **the requirement of laminar flow** in turbines to be a main principle of construction of these turbines. *At the construction of any stream machine, priority should be given to the constructive and technological providing of a laminar flow of the working continuous media into each channel of its transportation and at any of its interaction with the moving parts of executive mechanisms*. In other words**, we have to start building the laminar stream machines and apparatus**. The only question is:

How to build a laminar stream machine?

The answer to this crucial question is found directly in the scientific definition of the notion "*a laminar flow*": ***the laminar flow is the one, which can be described by the exact solution of the appropriate reologic equations of a considered fluid into the limits of its stability.***

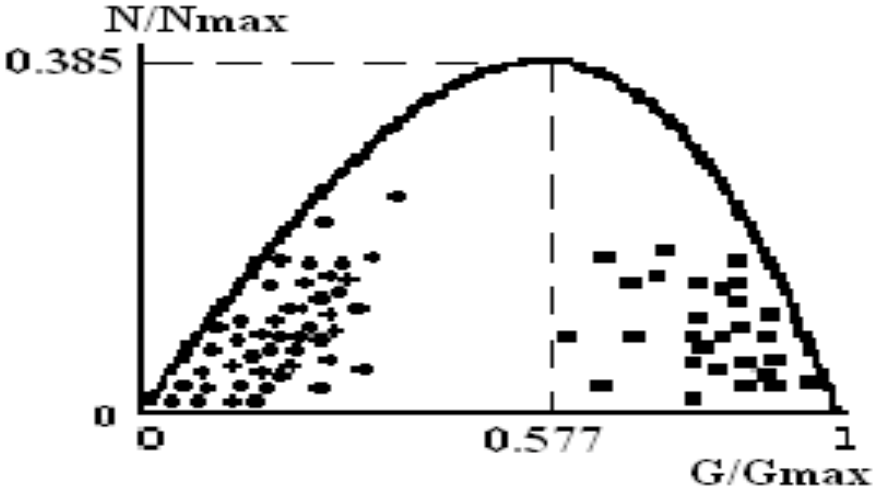
Knowing these fundamental facts of Nature, that it reveals during any process of energy transfer from falling water to a hydraulic turbine, let us analyze the functional efficiency of contemporary hydroelectric power stations. All that we need for that is to know H – a full drop of water between its levels in reservoir before dam and in river after dam; $S_{\perp}$ – an exit cross-section of water on the end of the channel; N – actual power transferred to a turbine; and G – an actual outlay that provides this power N. Then one can calculate G_{max} according to simple formula (8), which gives for G_{max} :

$$G_{max} = S_{\perp}(19.62\ H)^{1/2}\ m^3/sec \qquad (11)$$

and calculate N_{max} according simple to formula $N_{max} = dgHG_{max}$, which gives for N_{max} :

$$N_{max} = 9.81\ S_{\perp}(19.62\ H)^{1/2}\ KWt \qquad (12)$$

After these simple calculations, one can place a point on the graph (N/N_{max}, G/G_{max}) that will represent the considered hydroelectric power station in respect to possibilities that Nature has provided us at building station on the given river. Comparing this representative point with points of curve (*), one will be able to estimate the functional quality that was realized in the construction of the considered hydroelectric power station.
The results of some research made by Qualitics, Inc. among several existing hydroelectric power stations are shown in the following picture.

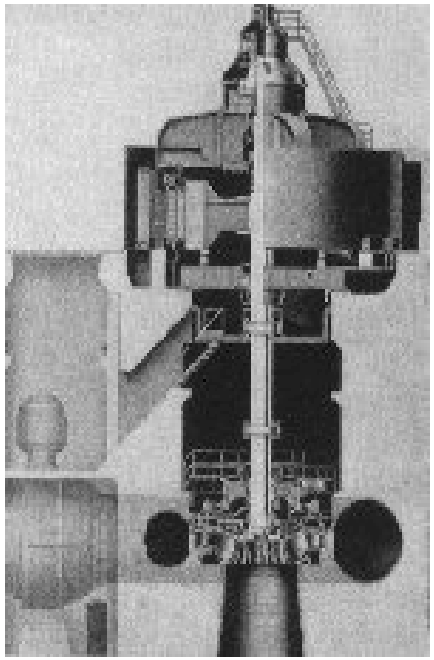


As one can see in the last picture, all hydroelectric power stations investigated were far from the functional perfection that Nature provides us. One can follow the described procedure and find that any present hydroelectric power station is wasting a lot of gravitational power of the water in the reservoir, without transforming it into electricity. This raises a question:

Why do our hydroelectric power stations waste so much of the gravitational energy of water?

The Hoover Dam is the symbol of industrial perfection of the United States of America, isn't it? Of course, it is! Look at this beautiful picture, isn't it convincing enough?
Maybe the turbine or the generator, or both, are not perfect enough, and are wasting a lot of mechanical energy without transforming it into electricity.

Every educated engineer will easily prove to you that either turbine or generator, or both of them in connection with each other, are the most perfect engineering constructions with a very high efficiency of transformation of mechanical energy of the rotating turbine's rotor into energy of electrical current.



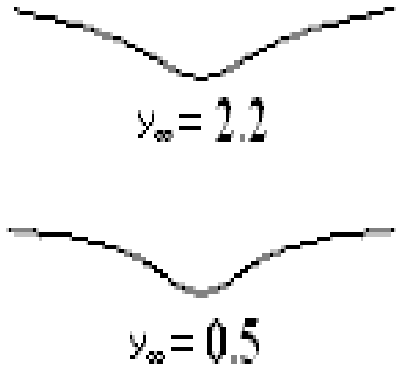
So, ***where does the imperfection of the entire process of energy transformation by hydroelectric power stations come from?***

Anyone who has watched the outflow of water from the power channels of a hydroelectric station has noticed that water comes out of these channels much more "dynamically excited", i. e. whirling, ***turbulent***, than is needed for the simple transportation of water in the river. But every whirl, vortex, even a small curvature in trajectory of a liquid particle requires some additional energy. As more whirling the stream is, the more energy it accumulates in those whirls inside of it.

The dominant source of imperfection of energy transformation in hydroelectric power stations is a process of turbulization of water at its passage through the turbine.

Engineers have known about this feature of Nature for a long time, and in their practical designs do provide for every eventuality of turbulization like the existence of cavities, tear-off jets, tearing-off the boundary layer (so called "Prandtle's layer" that is created on the boundaries of channel due to viscosity of liquid), cavitations due to dissolved air, creation of vortices, etc. This is done because engineers know that all of these processes lead to the turbulization of stream.

But what engineers do not know, is the fact that there is one more source of turbulization of the stream of liquid, which is not connected even with liquid's viscosity. Engineers do not know that Nature does not allow even a non-viscose liquid to streamline some boundaries without turbulization of itself. Amazing, but it is the fact of Nature!



For instance, let us consider two ditches that should be streamlined by water, and whose profiles are shown in the picture (on the left). Both those ditches are very similar: smooth and not too deep. But flows of water above them are dramatically different: upper ditch can be streamlined by laminar flow of water in a very wide range of velocity, but the lower ditch can not be streamlined by laminar flow of water at any, even arbitrarily small, velocities of water or any other, even non-viscose fluid. This last ditch always creates vortices that penetrate into a nucleus of stream and dramatically increases the stream's turbulence.