



RusHydro



Workshop Report “Design, Construction and Operation of Small Hydropower Plants”

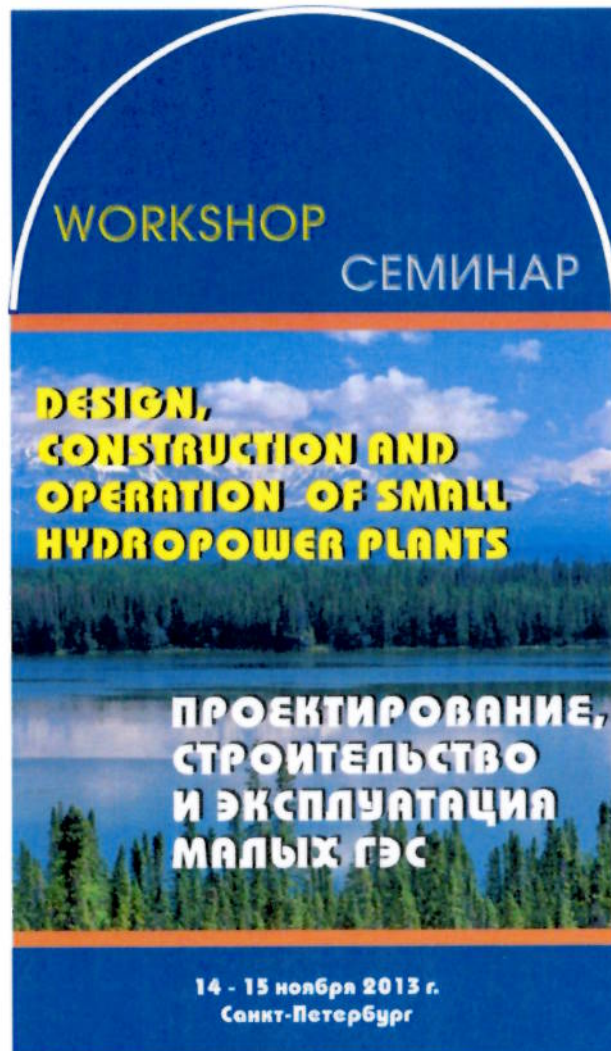


Figure: model of a streetline installed on workshop participants' route to the conference hall

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Workshop Report

“Design, Construction and Operation of Small Hydropower Plants”

The workshop was organized on the basis of the resolutions, adopted at the ministerial meeting in Berlin on 14-15 May 2012. The purpose of workshop was to share information on best practices in the field of small scale hydro power plants design, construction and operation, and to exchange ideas, regarding possibilities for cooperation within BASREC activities.

The workshop was held on 14-15 November, 2013 in St. Petersburg, Russia at B.E. Vedeneev VNIIG JSC (part of RusHydro holding).

58 people from six countries of the Baltic region – Finland, Poland, Sweden, Latvia, Iceland and Russia, representing 32 organizations (state energy authorities, scientific and design organizations, hydropower and other companies), took part in the workshop.

Workshop participants were welcomed by the BASREC leaders and the Deputy Minister of Energy of the Russian Federation.

11 papers were delivered (including 1 extra report not included in the program).

1. Major Areas of Work in the Field of Small Hydropower Engineering in the Countries of the Baltic Region

Classification of small hydropower plants

Small scale hydropower plants generally include hydropower installations, with installed capacity less than 5 MW (Germany, Poland, etc.). Latvia and Sweden consider small hydropower plants to be those whose installed capacity does not exceed 2 MW, and in some other countries this is up to 10 MW (Finland). In accordance with the definition given by the European Small Hydropower Association, hydropower plants can be deemed small if their installed capacity does not exceed 10 MW.

In USSR, in accordance with Construction Rules and Regulations (SNiP) 2.06.01-86, hydropower plants with installed capacity less than 30 MW, with the runner being not more than 3 m in diameter, could be considered small. Small hydropower plants conditionally include micro HPPs, with installed capacity less than 0.1 MW.

Role of small hydropower engineering in the countries of the Baltic region

The share of small hydropower engineering differs across the countries of the Baltic region. The share of small hydropower plants in the total country capacity is 2 % in Finland and 3.2 % in Sweden. It is 1 % in Russia, though the technical potential of small hydropower engineering in Russia is very high and amounts to 360 billion kW/hour annually.

State policy

In Finland there are nearly 160 HPPs, each with capacity of up to 10 MW, and state support is rendered only to the projects of reconstruction of small HPPs. At the discretion of state authorities, up to 30 % of expenditures are reimbursed in the form of direct investments, and up to 40 % of expenditures are reimbursed with respect to innovation projects. Moreover, in accordance with the law of February 1, 2003, there are certain payment benefits for connection to the grids of small HPPs.

In Poland there are two variants of earning profit for investors and electricity producers using renewable energy sources (including small hydropower engineering):

- sale of electricity at a fixed price guaranteed by the law (an average cost in 2012 – 50 euro/1 MW-hour);
- market certificates for energy exchange (45 euro/1 MW-hour – an average cost of the right of ownership in 2013).

Moreover, a new mechanism of support of renewable energy sources is currently being introduced in Poland – support of new investments based on auctions.

Pursuant to the Law On Power Engineering of September 3, 1998, the Latvian government guarantees power purchase from small HPPs at a double price for 8 years from the commissioning date. In accordance with the law of Latvia and the Decree of the Cabinet of Ministers on Protection of Fish Resources, it is currently prohibited to build a hydro dam or reconstruct small HPPs on certain Latvian rivers.

Many countries (Latvia, Poland, the process has been launched in Russia and other countries) widely use a system of incentives for investors through a “green certificate” or a “green tariff”. The use of “green” documents means guaranteed purchase of the electricity produced, connection to a power system and preferential taxation.

Pursuant to the Decree of the Government of the Russian Federation No. 449, the following support mechanisms are proposed in Russia:

- on the wholesale capacity and power market (for generation objects, with capacity of more than 5 MW) – a special mechanism of sale of capacity generated using renewable energy sources;

- provision of subsidies for compensation of the cost of the technical connection in the amount not exceeding 50 % of the cost, but not more than 30 million rubles;

- on the retail market (for generation objects, with capacity of up to 25 MW) – the obligation of grid companies to purchase power generated using renewable energy sources at regulated prices;

- in isolated power systems: 1) establishment of long-term tariffs for the purchase of electricity generated using renewable energy sources during the payback period, 2) inclusion of projects related to renewable energy sources into the Federal Target Programs.

2. Review of Workshop presentations



Photo: Co-Chairmen of the workshop Ari Aalto (Finland, AF Hydro), Vyacheslav Glagovsky (Russia, B.E. Vedeneev VNIIG JSC)

On the first day (November 14, 2013) Ari Aalto, Co-Chairman of the Workshop, Head of AF Hydro (Finland), presented a report on the energy policy of Finland and the role of small hydropower industry in that country. It was noted that the economically efficient potential for construction of new hydropower plants in Finland is almost exhausted, so attention is directed to the reconstruction of small hydropower plants, as well as construction

of small hydropower plants at operating non-energy hydro installations. It was also mentioned that the history of hydropower industry in Finland helps to develop recommendations for countries with the potential to build hydropower plants. This specifically refers to development of cascade construction of plants and serious consideration of environmental protection issues. Mr. Aalto spoke in detail about implementation of the Kissakoski small hydropower plant construction project with a capacity of 1.6 MW based on the replacement of two small hydropower plants at a drop between lakes. All stages of project implementation, from the process of initiation, approval, obtaining of state support as a renewable energy source facility to construction and operation, were analyzed.



Photo: Ingela Lindqvist (Swedish Energy Agency)

Ingela Lindqvist, Program Head at the Swedish Energy Agency, spoke about issues of preserving biological diversity during construction and operation of hydropower facilities in Sweden.



Photo: Edgar Login (PROFEKTO Engineering Center of the Latvian Small Hydropower Association)

Edgar Login, Executive Director of PROFEKTO Engineering Center, of the Latvian Small Hydropower Association, spoke on the reconstructed low pressure small hydropower plants on the rivers of Latvia. He noted that it is currently prohibited to build small-scale hydropower plants with dam in Latvia. In his report he gave examples of electric power generation with free-flow low-power hydraulic turbine. It does not require a dam to operate and the river flow remains natural.



Photo: Viktor Elistratov (Russia, Research and Education Institute "Renewable Energy Sources and Related Installations")

The report of Prof. Viktor Elistratov, Director of the Research and Education Institute "Renewable Energy Sources and Related Installations" at St. Petersburg State Polytechnical University, centered on the legislative basis for implementation of renewables usage in Russia at federal and regional levels. Though the legislative framework for development of renewable energy sources usage in Russia features a range of federal laws and bylaws, represented by Decrees and Executive Orders of the Government of the Russian Federation, including, particularly, Decree of the Government No. 449 on the economic stimulation of implementation of renewable energy sources facilities in the wholesale market, work is currently being done on the development of mechanisms for stimulation of renewables usage in the retail market in isolated zones. At the same time, it was mentioned that despite these laws, implementation of renewables usage proceeds slowly because of significant obstacles during validation, approval, connection and substantiation of compensation.



Photo: Yakov Blyashko (Russia, MNT O INSET CJSC)

The report of Yakov Blyashko, CEO of CJSC MNT O INSET (prepared in cooperation with Prof. Elistratov), was dedicated to innovative solutions in the area of the small hydropower energy industry. Considering outlooks on the construction of small hydropower plants the speaker gave examples of different schemes for locating small hydropower plants (for instance, by existing waterworks facilities: in the bay of

melioration dam, by an irrigation reservoir, at thermal plant waste discharge etc.). Yakov Blyashko also noted that there are now solutions to scientific and technical problems related to the development of new equipment for small hydropower plants and production facilities are available for development of this equipment, but in fact there are no requests for such equipment, which should come first of all, at a regional level.

The topic of innovations for small hydropower industry was taken up in the report of Roman Gorodnichev, Engineer at the Research and Development Center of Tidal and Renewable Energy Sources at the Research and Development Institute of Power Facilities, regarding a prototype small HPP with an orthogonal turbine.



Photo: Vladimir Privizentsev (Iceland, VERKIS)

Participants of the workshop listened to a report on implemented projects of small HPPs in Iceland, Greenland and Norway, presented by Vladimir Privizentsev (the Iceland company VERKIS). Main features of plants in the Northern region include the cold climate, sparsely populated and isolated territories, ice coating problems, use of glacial meltwater, ever-frost soil, and use of natural reservoirs without flooding of new territories. The report featured practical examples of how the construction of small hydropower plants has improved the economics of the region, and has served as the basis for development of small communities and underdeveloped Northern territories.



Photo: Petr Chopek (Ministry of Economics of Poland)

Participants of the workshop also listened to the report of Bernhard Pelikan, VP of the European Small Hydropower Association, on development of the small hydropower industry in Europe and learned about the mechanisms for support of renewables usage in Poland from Petr Chopek, Expert of the Renewable Energy Sources Department of the Ministry of Economics of Poland. Kuzma Zaytsev, Chief Specialist of the Strategic Planning Office of the Investment Department at TGK-1, shared experience in the operation of the Cascade of Paz HPPs of the Kola branch of TGK-1.



Photo: Timofei Ivanov (All-Russian Vedeneyev Hydraulic Engineering Research Institute)

The workshop ended with a presentation by Timofei Ivanov, Head of the Department of Geoinformation Systems and Technologies at the All-Russian Vedeneyev Hydraulic Engineering Research Institute, on methods of research of the hydropotential of rivers using GIS-technologies.

3. Experience and Areas of Work of Certain Companies Participating in the Workshop on Small Hydropower Engineering

AF Group

AF Group is one of the leading international energy consulting companies. The company is represented in 25 countries and has about 7,000 employees, 150 of whom work with HPP and hydraulic structures. The company specializes in rendering of the following services:

- optimal design solutions, in terms of total cost of ownership;
- 6 D design and management of all the phases of project life cycle;
- provision of access to the data base of suppliers, management of supplies
- coordination of construction and installation works;
- technical and economic project modeling.

Renewable Energy Sources Scientific and Education Center (St. Petersburg, Russia)

Renewable Energy Sources Scientific and Education Center of St. Petersburg State Polytechnic University (SPbSPU)

The major activities of the scientific and education center are as follows:

- arrangement and contractual performance of scientific, research and educational work
- development of innovation activities
- protection of intellectual property (patents, useful models, trademarks, know-how, etc.)
- participation in implementation of educational programs of higher and post-graduate professional education together with SPbSPU departments
- organization of scientific events – workshops, conferences, symposiums, etc.
- participation in international programs and projects

MNTO INSET CJSC (St. Petersburg, Russia)

Joint Stock Company INSET was founded in the year 1988 and is specialized in design and production of the units for small HPPs, rated up to 5000 kW and micro HPPs with the outputs ranging from 3 to 100 kW. Since 1995 "INSET" is a member of International Hydropower Association (IHA).

The company employs highly qualified specialists having an experience in hydro power development

As a rule, hydro units developed by INSET are delivered as a complete set includes hydro turbine, generator, automatic control device and valve.

There is a successful operating experience of the above equipment on the cross-head of existing dams, channels, water supply systems and water spillways of the factories and public utilities, sewage and irrigation systems and drinking water conduits. INSET's production line includes units with propeller, Francis and Pelton turbines and consists of more than 35 types of them. More than 50 power plants were equipped by INSET's units in more than 20 countries.

From the year 1996 it was created the project department and INSET now can offer for its customers the full package of services which includes as site investigations, feasibility study reports and projects design as equipment manufacturing, installation, supervision and commissioning.

INSET has an experience of practical implementation of the regional small rivers potential recourses utilization programs.

PROFECTO Engineering Center LLC (Ikšķile, Latvia)

Engineering Center "PROFECTO" has more than 15 years of experience in dam operation and safety in the Baltics with the primary focus on improving the efficiency of electric energy production

Major areas of work:

- design of hydrotechnical structures, project management, and construction supervision;
- • electromechanical equipment maintenance at power plants and design of building services.

Verkis (Reykjavik, Iceland)

Verkis was founded in 1932 and is the oldest engineering and consulting company in the country. It has 350 employees, of whom more than 30 are experienced experts in the field of hydropower engineering, who have been professionally trained in many countries all over the world. Alongside Iceland, the company has experience operating in Greenland, Norway, India, Ukraine, Georgia and Russia. The company performs the following work:

- General designer under an EPC contract for construction of a turnkey plant
- Technical design, 3D modeling;
- Calculation of an estimate value, calculation of a work scope;
- Development of tender documentation and specifications for supply of equipment and work;
- Examination of engineering documentation executed by equipment suppliers;
- Performance of factory acceptance tests;
- Analysis of risks, modeling of permafrost processes;
- Preparation of operational manuals for HPPs.

NIIES JSC (RusHydro, Moscow, Russia)

Over a number of years NIIES JSC (RusHydro) has been developing a technological platform of "orthogonal turbines". Small hydropower engineering is one of the potential areas of usage of orthogonal turbines. NIIES (RusHydro) is currently developing a parametric series of power units of low-pressure mini HPPs with orthogonal turbines, with installed capacity of 10, 30 and 60 kW and pressure of 1-4 m.

TGK-1 OJSC (St. Petersburg, Russia)

TGK-1 OJSC is a leading company generating electric and thermal power in the western part of Russia, as well as the second territorial generating company in Russia in terms of its installed electric capacity. It unites 55 power plants in four constituent territories of the Russian Federation: St. Petersburg, the Republic of Karelia, the Leningrad and the Murmansk regions, and it has a number of small HPPs, 19 of which are located north of the Arctic Circle. In comparison with other territorial generating

companies of Russia, TGK-1 has a unique structure of business assets. 40 % of its installed capacity falls on hydropower generation. TGK-1 exports power to Norway and Finland from its hydropower plants.

4. Technical Tour to the Volkhovskaya HPP

The second day of the workshop, November 15, 2013, was dedicated to a technical tour to the Volkhovskaya HPP – one of the oldest operational HPPs in Russia, located on the Volkhov River in the Leningrad Region.



Photo: technical tour participants in Machine Hall of the Volkhovskaya HPP



Photo: the dam of the Volkhovskaya HPP

The capacity of the HPP makes up 86 MW (initially it was 58 MW). 10 radialial hydropower units operating at an estimated pressure of 11 meters are installed in the HPP building: 4 units with capacity of 12 MW each produced by the Leningrad Metal Plant, 4 units with capacity of 9 MW each produced by a Swedish plant, and 2 units with capacity of 1 MW each.

5. Description of the Preparatory and the Technical Work Performed within Arrangement of the Workshop

Work scope:

- Preparation of information materials (invitation letters, mailing lists)
- Correspondence with potential workshop participants
- Preparation of invitations needed to obtain visas
- Development of the workshop program, introduction of amendments in the current mode
- Preparation of list of reporters, receipt of a brief content of reports from the reporters
- Translation of materials into Russian and English
- Booking of hotel rooms
- Arrangement of negotiations and leasing of premises for meetings to be held within the workshop
- Arrangement of catering for the workshop participants
- Fulfillment of orders and order of equipment for the workshop
- Order of logistics and transportation
- Preparation of materials and preparation of a delegate's pack
- Arrangement of technical tour to the Volkhovskaya HPP

At registration each workshop participant received a delegate's pack, including a brief case (+ a plate on a chain with the BASREC logo), a pen, a notebook, a workshop program and annotations in English (for Russian participants – in Russian), and gift art publications (about St. Petersburg in the English language for foreign participants, and about the Hermitage for Russian participants).

The meeting room was equipped with special devices needed to show speakers' presentations, 8 displays, the presidium table and chairs for participants. Interpretation from English into Russian and from Russian into English was provided at the symposium. Each workshop participant had a headset. There were hand microphones for questions asked and opinions expressed from one's place.



Photo: registration of workshop participants

Coffee breaks and lunches were arranged for the participants during the meetings and the technical tour. There was a house supper after work on November 14, 2013.

Upon the request of certain workshop participants, a transfer from the airport (train station) to the hotel and back was organized for them.

The workshop participants were transported from their hotels to the meeting venue.

Photos were taken during the seminar, and the photos were then given to the workshop participants.

6. Conclusion

Small hydropower engineering increases power safety in the region, ensures independence from fuel suppliers located in other regions, saves the insufficient organic fuel. Construction of such a power generating site does not require much capital investment, a lot of energy-consuming construction materials and significant labor costs, and it is paid back rather quickly. Moreover, there is a possibility to decrease the construction cost with the help of unification and certification of equipment. While generating electricity, a HPP does not produce greenhouse gases and does not pollute

the environment with combustion gases and toxic wastes, which corresponds to the requirements of the Kyoto Protocol. Such objects do not lead to induced seismic activity and are relatively safe in case when earthquakes appear for natural reasons. They do not cause negative effect on the lifestyle of the population, the fauna and local microclimate conditions. The above traits of small hydropower engineering guarantee its future successful development.

Small hydropower engineering needs constant and efficient state support.


There are enough firms and high-quality experts in the Baltic region, who can ensure performance of all the work needed to create a small HPP – design, scientific research, construction, production and manufacture of equipment, and operation.

Of current interest is the coordination of activities in the field of construction of small hydropower plants, specialists and organizations of the countries of the Baltic region.

The BASREC workshop on *Design, Construction and Operation of Small HPPs* held on November 14-15, 2013 in St. Petersburg, Russia, was well organized and gave an additional stimulus to development of small hydropower engineering in the region.

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