ГОДИШНИК НА УНИВЕРСИТЕТА ПО АРХИТЕКТУРА, СТРОИТЕЛСТВО И ГЕОДЕЗИЯ – СОФИЯ

Юбилейна приложна научно-техническа конференция
„65 години Хидротехнически факултет и 15 години немскоезиково обучение"

6–7 ноември 2014
6–7 November 2014

International Jubilee Conference
„65th Anniversary Faculty of Hydraulic Engineering and 15th Anniversary Hydraulic Engineering in German"

ANNUAL OF THE UNIVERSITY OF ARCHITECTURE, CIVIL ENGINEERING AND GEODESY – SOFIA

XLVII том vol. 2014 св. fasc. I-A

HYDROPOWER STUDY OF THE BULGARIAN BORDER REGION TO SERBIA AS PART OF THE PROJECT RIVERS

D. Kisliakov[1], O. Todorov[2], S. Petkova[3]

***Keywords*:** *hydropower, Bulgaria-Serbia cross-border region, development*

***Research area*:** *hydraulic engineering, hydropower*

ABSTRACT

The Hydropower study for the Bulgarian side of the cross-border area to Serbia was prepared following the specifications of the research project "Reclaiming Rivers for Implementation of Vital and Environment-friendly Renewable energy Source (RIVERS)". The present work summarizes the Bulgarian national report on the conditions for hydropower development in the specified region identified in the frame of the mentioned project.

The main objective of this project was to research the possibilities for and to promote the use of hydropower as renewable energy source by providing methodological and technical background and support for sustainable environmental-aware development.

In the frame of this work, the above mentioned fields of interest are discussed in some more detail. At the end, the conclusions drawn as result of the work in the project are presented as well as some formulated possibilities for future development.

1. Introduction

The present study represents a part of the project "Reclaiming Rivers for Implementation of Vital and Environment-friendly Renewable energy Source (RIVERS)",

[1] Dimitar Kisliakov, Assoc. Prof. Dr. CEng, Dpt. "Hydraulic Engineering", UACEG, 1 H. Smirnenski Blvd., Sofia 1046, e-mail: kiss_fhe@uacg.bg
[2] Ognyan Todorov, Senior ass., CEng, Dpt. "Hydraulic Engineering", UACEG, 1 H. Smirnenski Blvd., Sofia 1046, e-mail: ogytod@gmail.com
[3] Silviya Petkova, Senior ass. Dr. CEng, Dpt. "Hydraulic Engineering", UACEG, 1 H. Smirnenski Blvd., Sofia 1046, e-mail: silvia_petkova@mail.bg

financed by the Bulgaria-Serbia Cross-border Cooperation Programme [1]. The cross-border region between Bulgaria and Serbia was an object of special multi-disciplinary interest in the frame of this project. The carried out analysis presented here further below only for the Bulgarian side of the area of interest comprises three main topics most closely related to the challenging symbiosis between Hydropower as renewable energy source (RES) and the relatively well preserved natural environment in the cross-border region with quite specific social and economic conditions. These are:

- Hydropower development conditions in the region;
- Legal and institutional framework in Bulgaria;
- EU strategies and legislative framework.

The main objective of this project was to research the possibilities for and to promote the use of renewable energy sources by providing methodological and technical background and support for attracting potential investments in the cross-border area for sustainable environmental-aware development.

In the following, the above mentioned fields of interest are discussed in some more detail. In the project assignment, the cross-border area was defined in Bulgaria as comprising the catchment basins of the rivers Erma and Nishava and the related part of the catchment basin of the Struma river adjacent to the Bulgarian-Serbian border.

2. Background information for the hydropower development state

The background for the identification of the state of hydropower development in the considered cross-border area consists of collected important information regarding the following main problem-related issues:

- Issued water right permits for hydropower use: The information about these water right permits was collected from the officially available sources of the corresponding River Basin Directorates managing the analysed parts of the considered catchment areas. This data was further processed since not all items of the available information were related to the scope and the aims of the performed study or to the part of the particular catchment basins covered by the investigated cross-border area.
- Hydropower plants in operation with their characteristics;
- Other hydraulic facilities with impact on the natural run-off regime.

There are in general three possibilities when existing hydraulic facilities can influence the natural run-off regime in some river reach or area. These are:

- The diversion reach of a diversion type HPP;
- The presence of a dam reservoir with certain capacity;
- The transfer of certain run-off part into another catchment area.

On the Bulgarian territory, only the systems of intakes and collecting canals “Sreburna-Ginska” (Bulg.: „Сребърна-Гински”, Q_{max} = 1,2 m^3/s) on the West and “Iskrets” (Bulg.: „Искрец”, Q_{max} = 0,65 m^3/s) on the East of the head pond “Petrohan” should be mentioned in this connection as systems of hydraulic facilities with some impact on the natural run-off regime in the region.

In Bulgaria, only the dam reservoir “Pchelina” (Bulg.: „Пчелина”) was specified in the project assignment as representative for the regional impact of a large dam.

2.1. Analysis of the background information

The analysis of the collected information was further performed based on particularly formulated criteria as follows:

- **Type of the hydropower system (i.e. run-off-river, storage / barrage, diversion etc.)**: With very few exceptions of river power plants, the hydropower plants (HPP) built and operated as well as the planned new ones are of diversion type. Thus, higher head values are achieved. All HPP built and set in operation in the last 25 years are run-of-river power plants. The very few river SHPP in the bed of river Struma represent the exploding interest for investments especially in such type of HPP in Bulgaria due to the promoting and considerably higher feed-in prices of electrical energy from river power plants [2].
- **Conditions of common grid connection**: The feed-in of the produced electrical energy from the listed HPP is without any exception at middle voltage (i.e. 20 kV). In fact, all mentioned HPP are planned and operated only for common grid operation.
- **Ownership (private, public)**: To our knowledge, all of the HPP are privately owned although some of the owners represent foreign state companies (such as EDF for example). In some cases, the particular municipality might have some participation in the project, too.
- **Level of impact on the river**: While obtaining the water rights permit by the corresponding Basin Directorate and thus fulfilling a list of all necessary environmental protection related requirements, the project owner sets his development plan in conformity with the national environmental legislation in general and the water-related one in particular. As required by law, each activity in the frame of a superficial water body has to ensure both the continuity of the affected water body and the residual discharge in the diversion reach. However, there are unfortunately some cases with purely formal fulfilment of the mentioned legislative requirements.
- **Purpose of the water use (other than hydropower)**: In all cases in the considered region, the purpose of planning and constructing a SHPP and its appurtenant facilities serves only the production of electrical energy.

Based on the collected specific information as well as on the carried out summarising analysis, the following qualitative conclusions may be drawn with respect to particular characteristics:

Level of hydropower potential usage in the main rivers within the considered basins: In general, the available hydropower potential is not completely mined out in the basins of the specified water bodies. This identification corresponds quite well to the overall decay in the industrial and agricultural (and thus – demographic and social) development in the studied regions, especially in the last 25 years. It should be noted however, that the longitudinal profile of the water streams is not very favourable for the development of larger hydropower systems of regional industrial significance.

Level of environmental impact on the rivers: Due to the relatively poor hydropower development and potential use in the observed regions, the whole cross-border area is at the same time characterized by relatively large regions of natural mountainous environment of high quality. The relatively poor exploration of the hydropower potential in the investigated river basins has definitely its positive impact on preservation the environmental status and quality in the area.

Geographical conditions for further hydropower use (available run-off, slope, concentrated head locations etc.): The geographical conditions for further development of hydropower systems and exploration of the usable potential, respectively, are quite complex. On one hand, the available set of geographical (i.e. topographical, geological etc.) conditions is favourable and comprises large perspectives for further development in this field. On the other one however, there are a lot of arguments against such development. The most important of them may be summarized as follows:

- The relatively intact environment in the area, being not strongly affected by an intensive industrial development so far, constitutes a region with highly valuable natural environment;
- The infrastructural conditions in the area are not intensively developed, either. Thus, any hydropower project in the mentioned area would require additional building activities with severe environmental impact;
- The consumption of electrical energy in the area is not large. Hence, the feed-in of additional capacities would lead to some difficulties for the common grid at middle voltage where the SHPP are usually connected;
- Such projects would be driven only by private investment interests. Therefore, the contribution to the overall development of the affected area would be in fact negligible in the sense of labour market, production capacities and social development;
- Due to the specific topographical and infrastructural conditions, only small-scale hydropower developments are possible on particular sites. Especially such projects might have significant negative impact on so far highly intact long reaches of relatively small mountainous rivers.

It should be mentioned that the study of the hydrological conditions on the Bulgarian territory of the considered cross-border area was subject to another special report in the frame of the project and hence it is not discussed here despite its crucial importance for any assessment of the hydropower potential.

3. Legal and institutional framework for development of (SHPP)

In this part of the report, relevant regulating documents and administrative procedures currently related to the decisive issues of a small hydropower project development were presented. For Bulgaria, the collected and correspondingly processed information was structured in the following main groups of analysed topics:

- Legal and institutional framework in the field of hydropower use;
- Overview of the procedure for development of a SHPP.

For the purpose of analysis of the current national legislative situation in Bulgaria in this field, some further issues have also to be addressed herewith in the following with particular emphasis on all three most important points:

- Sustainable environmental development and protection;
- Real possibilities and legislative climate for development of hydropower investment projects;
- Critical issues of conflict and open problems.

In the following, these issues are addressed in some more detail.

The current status of the Bulgarian national legislation in the field of hydropower is characterized by some specific features, as follows.

- According to the Bulgarian Water Act [3], some hard restrictions are formulated in issuing water right permits for hydropower use by the Basin Directorates. This feature is typical for the very recent development of the Bulgarian legislation in this field. In fact, the set of all these restrictions has stopped the further development of hydropower projects of any kind and capacity. From the viewpoint of the investment possibilities and business perspectives on the hydropower market this situation is a non-sense. However, it has its long and very characteristic preceding story. For many years, long reaches of environmentally highly sensitive mountainous rivers were used for development of diversion-type hydropower projects. All they were privately owned, and in fact did not contribute to the infrastructural, social or environmental development of the affected regions. Now, when the situation is already quite severe, the Ministry of Environment and Waters has tried to limit the negative impacts at least in the field of hydropower by introducing such restrictive measures. However, this could neither be a sustainable solution to the problem, nor is well professionally based so that the current result is a series of court procedures and comprehensive juridical achievements in particular cases which yet enable the further project development.
- Due to particular (and powerful enough) private interests, the official state Regulator in the sector – the State Energy and Water Regulatory Commission (SEWRC), has introduced special higher feed-in prices only for some types of HPP (run-off-river) [2]. Of course, the market reacted immediately, and the investment strategy of interested parties was quickly directed predominantly to this type of hydropower projects. This is a very typical example for the market results of a certain change in the current legal framework.

Based on the presented characteristics of the legislative environment in Bulgaria, the following conclusions can be drawn:

- There is a permanent effort by all involved entities of the state regulatory administration for further development of the environmental legislation towards an effective and really working formal framework where all open problems have to be solved in a sustainable and professionally based way.
- The harmonization of the Bulgarian national environmental legislation with the one of the European Union is a permanent task for development of the national legislative framework, too. The same process is running in the field of the use of RES including hydropower.
- There is a clearly identified need for a sustainable and well based legislative solution to the problem of the environmental protection of the water bodies in the field of hydropower, especially of the diverted reaches. The formal restrictive and prohibitive measures and statements cannot serve as such solution.

Any real perspective for further hydropower development in the considered cross-border area should be regarded with respect to the actual conditions in terms of a long-term development strategy. In this connection, some statements can be formulated as follows:

- The natural environment conditions in the considered region are of a relatively high quality and sensitivity. In this connection, the further preservation of this environmental quality can be formulated as a future task with highest priority.

- Some other branches of the water resources use in general (for example such as drinking water supply) may set higher priorities in future than hydropower.
- Recently, efforts have been demonstrated from all state authorities responsible for environmental protection for finding professionally well based long-term solutions for both group of problems: on one hand – the sustainable environmental development of the country, and on the other – the conflict of this strategic aim with the direct interests of the hydropower business. Indeed, these efforts should continue. They comprise and require a decisive work on the legislation in this field.
- The practicing engineers in the field of Hydraulic Engineering strongly need clear regulations and guidelines for development of environmental-friendly solutions in the design and construction of future HPP.

4. European strategies and legislation

It is not the aim of this report to list and present all documents issued in the European Union (EU) relevant to the above discussed topics. However, the most important of them directly related to the scope and aims of the presented here research project have to be shortly presented in the following.

4.1. Strategies, policies and incentives

There are some key documents accepted for implementation by the member states of the EU which cover more or less these topics. It has to be emphasized however that these documents are neither guidelines nor specific codes precisely regulating all aspects of the investment process. The decisive documents of the European Parliament and of the Council on these issues are composed and written as strategies giving both the general principles of the national development of a member state in this field and the specific milestones to be achieved in this development process.

These strategies, comprising and representing the essentials of the European environmental policies, are directly related to the main spheres of social, economic, technical and environmental infrastructure of the contemporary human civilization. The most important of them directly related to the present project are as follows.

- Green infrastructure (GI) is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services.
- Biodiversity Strategy: Natura 2000 is the centerpiece of EU Nature and Biodiversity policy.
- Sustainable development is set out in the Treaty as the overarching long-term goal of the EU.
- Resource efficiency means using the Earth's limited resources in a sustainable manner while minimising impacts on the environment.
- Europe 2020 (2010) is a 10-year strategy proposed by the European Commission in March 2010 to revive the European economy.

4.2. Directives, plans and programmes

In the following, the main Directives and Programmes, as well as the Kyoto Protocol, are mentioned which directly treat considered spheres within the European Community by strongly influencing the corresponding development of the particular national legislation in the member states.

- Directive 2009/28/EC on the promotion of the use of energy from renewable sources:
- Directive 2009/72/EC concerning common rules for the internal market in electricity.
- Directive 2000/60/EC (The Water Framework Directive).
- Directive 85/337/EEC (Environmental Impact Assessment (EIA) Directive).
- Directive 92/43/EEC of 21 May 1992 of the Council on the conservation of natural habitats and of wild fauna and flora (The Habitats Directive). All areas that are protected under the Birds and Habitats Directives form an ecological network known as NATURA 2000.
- Kyoto Protocol to the United Nations Framework Convention on Climate Change.
- Energy Services Directive (2006)
- Energy Efficiency Plan (2011).
- National Reform Programmes [4,5].

4.3. Other characteristic features of the current European legislation in the field of small hydropower as renewable energy source

Some issues of very practical importance with respect to the considered project should be shortly addressed furthermore here as follows.

- **Identified problems with the European legislation in particular national applications in Bulgaria.** As an example, the important and widely used term of "small hydropower" should be mentioned here. In the EU legislation, only the so-called SHPP are considered as RES. However, there is no precise definition of a SHPP. It is assumed in Europe that such HPP has in general installed capacity up to 10 MW. In Bulgaria, the licensing regime and the feed-in price determination by the SWERC (Bulg.: ДКЕВР) are related to the capacity values of 200 kW and 10 MW [2]. It should be emphasized that the treatment of SHPP as renewable energy source is connected with much more favourable administrative procedures, grid connection conditions and feed-in prices of the electrical energy. In our opinion however, the term "small HPP" could yet have its deep and useful sense in an electric power system but if defined on a completely different base [6].
- **Related particular needs**: We hope that during the forthcoming actualization of the River Basin Management Plans, the necessary measures will be taken on time for clearance of their identified numerous deficiencies. The problem of hydropower development in general (and particularly in the considered area) cannot be treated separately from the much more general problem of water resources management with strategic national importance.

5. Conclusions and some perspectives for development

Based on the above discussion and analyses performed in the frame of the presented project, the following main conclusions can be drawn:

- The considered cross-border area of Bulgaria represents geographical characteristics of high territorial value: diverse mountainous topography, relatively well preserved environment (water, land, forests, biodiversity in general), relative under-development regarding heavy industrial facilities;
- Only small-scale hydropower developments may be regarded as perspective on particular sites. As mentioned above however, since especially such projects might have significant negative impact on so far intact long reaches of relatively small mountainous rivers, all project developments in this field should with highest priority serve the sustainable environmentally consistent development of the region.
- There are still some open problems related to the possibilities for development of (small) hydropower projects. These reflect deficiencies in administrative procedures, legislative acts, relations and requirements, particular regulations and frameworks.

Based on the performed presentations and discussions above, the following perspectives for future cooperation between Bulgaria and Serbia and development in the cross-border area may be shortly formulated at the end as follows:

- A cooperation and exchange between the responsible authorities in both countries regarding procedures and studies related to projects in the cross-border area would be a subject of great importance and mutual interest for all involved parties.
- If the efficiency of a hydropower system in a future hydropower project is much higher when the system of facilities covers territory of both countries, there will be the possibility for the development of such more efficient joint project. The formal hinges in this connection will certainly become less and smaller, especially after the finalization of the membership procedure for Serbia in the EU.

6. References

1. *Kisliakov, D. et al*. Research project: Reclaiming Rivers for Implementation of Vital and Environment – Friendly Renewable Energy Source (RIVERS), Hydropower renewable energy study of the Bulgarian-Serbian cross-border region – Final report, Bulgaria – Serbia IPA Cross-border Programme 2007CB16IPO006 2011-2-229, Aquapro Engineering OOD, Client: Regional Environmental Center (REC) for Central and Eastern Europe, Branch Bulgaria, 2013.

2. Decision No. Ц-13 from 01.07.2014 of The State Commission for Energy and Water Regulation (SEWRC) (in Bulgarian: Решение No. Ц-13 от 01.07.2014 г. на ДКЕВР)

3. Закон за водите, посл. изм. 27.06.2014 (Water Act, last 27.06.2014).

4. The Energy Strategy of the Republic of Bulgaria till 2020, Ministry of Economy, Energy and Tourism, Bulgaria, June 2012.

5. National Renewable Energy Action Plan, Ministry of Economy, Energy and Tourism, Bulgaria, 20 April 2011.

6. *Kisliakov, D., S. Petkova*. Possibilities for use of the water power potential of river Mesta in its own catchment area, Proc. International Jubilee Conference „UACEG 2012: Science & Practice“*,* 15–17 November, UACEG, Sofia, Bulgaria, 2012.

ИЗСЛЕДВАНЕ НА ХИДРОЕНЕРГИЙНИЯ ПОТЕНЦИАЛ НА ГРАНИЧНИЯ РЕГИОН МЕЖДУ БЪЛГАРИЯ И СЪРБИЯ, КАТО ЧАСТ ОТ ПРОЕКТ „RIVERS" (РЕКИ)

Д. Кисляков[1], О. Тодоров[2], С. Петкова[3]

***Ключови думи*:** *хидроенергетика, граничен район със Сърбия, развитие*

***Научна област*:** *хидротехническо строителство, хидроенергетика*

РЕЗЮМЕ

Изследването на хидроенергийния потенциал от българска страна на трансграничния район между България и Сърбия е проведено според изискванията на изследователския проект „Подготовка на реките за прилагане на екологично съобразни източници на възобновяема енергия – РЕКИ" ("Reclaiming rivers for Implementation of Vital and Environment-friendly Renewable energy Source – RIVERS"). Настоящата работа обобщава българският национален доклад относно условията за развитие на хидроенергетика в този район, идентифицирани в рамките на споменатия проект.

Главната цел на този проект беше изследването на възможностите за развитие на хидроенергетиката, както и популяризиране на нейното използване като възобновяем източник на енергия посредством осигуряване на методична и техническа основа и помощ за устойчиво развитие във връзка с околната среда.

В рамките на настоящата работа се разглеждат по-подробно споменатите области. Накрая се представят изводи в резултат на работата по проекта и се формулират някои възможности за бъдещо развитие.

[1] Димитър Кисляков, доц. д-р инж., кат. "Хидротехника", УАСГ, бул. Хр. Смирненски № 1, 1046 София, e-mail: kiss_fhe@uacg.bg

[2] Огнян Тодоров, гл. ас. инж., кат. "Хидротехника", УАСГ, бул. Хр. Смирненски № 1, 1046 София, e-mail: ogyto_fhe@uacg.bg

[3] Силвия Петкова, гл. ас. д-р инж., кат. "Хидротехника", УАСГ, бул. Хр. Смирненски № 1, 1046 София, e-mail: silvia_petkova@mail.bg