SHP engineering: a new approach and a key for the future?

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In the past, engineering processes relating to small hydro have not been a simple or trivial job, but have mainly been driven by achieving economic targets and solving technical problems. At least for some 20 years the continuously increasing demands, predominantly based on ecological restrictions, have shown that the old-fashioned strategy is no longer appropriate. New challenges require new approaches, in terms of design, procedures, concepts, ownership and identity. Finding a new approach sometimes only needs critical consideration of concepts which are taken for granted. One must feel free to cross borders of competence and tradition, but never forgetting that the final target is the further exploitation of hydropower. This paper is based on a keynote address presented by the author at Hydropower 05 in Stavanger*.

To understand the present and the future it is sometimes useful to look into the past critically. The history of small hydro in Europe can be characterized, in a very simplified way, by the following periods:

- Phase 1: decentralized energy demand by industry (up to 1940/1950);
- Phase 2: economic-driven decrease until 1970;
- Phase 3: energy crisis and boom until 1990; and,
- Phase 4: decrease driven by environmental concerns up to the present.

It can be deduced that, in phase 1, there was individual economical attraction and indirect public interest (employment); in phase 2, there was no economic attraction and no public interest; in phase 3, there was a general economic attraction and some public interest; and, in phase 4, there was economic attraction but public resistance.

The crucial element thus seems to be public opinion. Even the economic attraction predominantly reflects public opinion, because policy is activated by this.

But public opinion is a very fuzzy thing; it follows certain rules which may not be logical. 'Public opinion' results whenever more than two people have to formulate their opinion at a public level. So the question remains: how to influence public opinion, and how to encourage the public to favour small hydro.

The following aspects to be discussed should not be seen as obligatory, or to be applied at any project. The idea behind the examples discussed may encourage open-minded engineers to implement small hydro projects even in conditions which may seem hopeless.

1. The tools

There are many approaches to achieving the target of public awareness and acceptance of small hydro and these should be applied together, as far as possible.

1.1 Conceptual approaches

Usually, at the very beginning of a project, the engineer faces a complete one-dimensional job, defined by the principle: design and implementation of a small hydro plant. It remains for the competence, the experience and the art of the design engineer to embed the one-dimensional idea into a wider, comprehensive concept, receiving positive public interest. Conceptual approaches belong to engineering, but need also to be multidisciplinary and it is necessary to recognize sometimes complex links between them. These are the means of transporting the core-idea.

1.1.1 Changing priorities: environmental concepts and additional small hydro development

Many of the rivers which are attractive for small hydro development have had hydraulic works installed in the past, aimed at lowering the risk of flood or increasing the river stability. The ecological quality is sometimes quite poor but little happens because of a lack of funds.

The implementation of a small hydro plant may in fact be able to increase some ecological parameters, provided the design becomes environmentally sound. Nevertheless, if the official target of the engineering project is the construction of a small hydro plant, people will tend to interpret some environmental measures as an ineffectual attempt to compensate for severe ecological destruction. The better way is to change the priorities. The main target of the project

The images of various European small hydro schemes throughout this article demonstrate that these structure can be designed to enhance the landscape.

should be environmental sustainability, including the production of renewable energy by small hydro. This is just a question of highlighting certain aspects which may not otherwise be regarded as the main topic.

1.1.2 Synergies and multipurpose plants

The traditional way of designing and engineering aims at the main target of the project, while minimizing any negative impacts or compensating them if they cannot be avoided. This is the conservative way to proceed in the fundamental sense of the word.

Thinking the other way round means to aim at the main target but also to alter conditions which are not primarily necessary, but likely to be in the interests of other people.

For example: the traditional way aims to maintain the current (recent) degree of flood protection. An open-minded engineer may, however, decide between either an improvement in protection, or the creation of a wetland area. Both of these options are much better than the conservative solution, because other people and other interests are addressed, and they may become partners in the enlarged project.

A wide range of potential synergies and multipurpose ideas exist, such as:

- installation of small hydro plants within drinking water supply systems;
- installation within irrigation systems;
- installation within wastewater treatment plants;
- installation within cooling water systems;
- implementing recreational infrastructure;
- improvement in ecological performance;
- improvement of flood protection;
- inclusion of traffic demands; and,
- providing measures to stabilize groundwater level.

In many cases, the construction of multipurpose plants will result in a sharing of costs and responsibilities.

1.1.3 Combined energy production and consumption concepts (PCC)

The energy produced by small plants is generally fed back into the grid, with guaranteed and quite acceptable tariffs being obtained. This will not provide any additional partners. It sounds better to complement production by direct consumption. The latter can be a manufacturing plant, public buildings, a whole village or district, or at least a block of flats. Depending on the respective tariff structure, such systems must be optimized to gather advantages for both the producer and the consumer. In the case of industrial units, sometimes the low price to get public energy avoids such PCCs. If it works, the effect on the public is very high, in relation to employment, identification, the 'green power image', and so on.

1.1.4 Multi-resource concepts

Multi-resource concepts mean, in the present context, renewable energy (RE), although even other combined concepts may be supported. The reason for this restriction is a strategic one. Combining RE with coal or gas may reduce the value of RE and increase those of non-renewal energy sources.

The 'green image' (a very powerful public feature) of different sources of RE is quite different. In such a ranking, the position of small hydro is not that high. A partnership will thus become an advantage. On the other hand, small hydro is reliable, predictable and highly available. Wind and PV, which are among the leaders as far as the green image is concerned, are slightly lacking in these features. Biomass or geothermal energy, however, have high availability.

Any multi-resource concept will either strengthen the green image *per se*, or do so by improving the overall availability. Such a concept does not necessarily have to achieve excellent technical values. Even some attempt counts in terms of public image.

1.2 Operational approaches

Engineering is a challenging job. The end of the initial design usually represents the start of an even more exiting and unpredictable phase. In relatively few cases there is no need for redesign, alteration or adjustment. The only requirements are: social competence, flexibility, persuasive power and authenticity, besides technical excellence. Some examples may illustrate the approach:

1.2.1 Flexibility in design

A complex engineering process has to be variable on a time axis. The variability may be based on alteration of any of the following:

- ecological knowledge;
- economic conditions;
- various other interests;
- political will; or,
- availability of technical solutions.

In general, flexibility in design means the ability to face and cope with new demands. To meet that challenge, the engineer has to understand the project completely and precisely in all its details so as to be able to react exactly to any alteration, without changing the whole contents of the project where changes are not necessary.

1.2.2 Design in the construction phase

Although a plan and a technical report should be the basis of the project implementation, that principle has a certain limit. With respect to the theory presented in Section 1.2.1, the design during the construction phase can be understood as a continuation of the design. Technical measures and precise engineering fit together quite well. But environmental measures may often escape the usual degree of precision. The result, expressed by the ecological function, is based much more on individual adjustment than on a precise design. Consequently, a reasonable part of the environmental design can only be done during the construction phase.

The design provides only the framework, the target, the principles and the tools. In reality, this procedure requires very close cooperation between the engineer and the executing staff.

1.2.3 Mental preparation

Within the engineering procedure a good and successful project is based on two main pillars:

- excellence in content and design; and,
- a conviction that the project is the best possible.

Both facts are decisive in defending a project in any approval procedure or participatory process. There must not be any doubt in the heart of the engineer that the implementation of the project is an important step in achieving a sustainable development. In this case, other people will not only understand, but also appreciate the quality of the project.

1.3 Involvement

Any positive public opinion assumes at least a certain amount of public knowledge. Managing a project involves providing that information in the quality and form required.

The second reason for public involvement, generally, is the tendency for human aversion to any new idea. Offering ideas progressively in small portions will reduce resistance, because people identify certain aspects as already known. To involve people will put a new value on an individual project, and make it more of a public one. Of course, this involves some risk, but the positive effect usually dominates.

1.3.1 Involvement of governmental representatives

Within the regular approval procedure, a group of governmental representatives will review and evaluate the project. Traditionally, this group is given details of the project in its final state. Respecting social concerns, it is recommended to contact these representatives at certain stages of the project as follows:

- 15 per cent feasibility study;
- 35 per cent general design;
- 70 per cent detailed design; and,
- 90 per cent before completion.

The level of interaction should be high because of the expertise of the governmental representative. He is more or less forced to participate in the engineering process by having his opinion or his expertise sought for certain solutions. The more familiar he is with the project, the greater the mental identification with it. Nobody will argue against their own ideas.

1.3.2 Participation in the engineering procedure

In the past, several projects have failed as a result of local public resistance. When analysing this resistance, it seems, that the main reason was the holding back of any information about the project. If people feel ignored, they may also be suspicious that they are being tricked. The content of the project, once transmitted to them, is usually not the major barrier.

Solving this issue and gaining public trust requires participation activities, which should concern local officials. A typical example could be a public presentation of the project (at least at two stages: 35 per cent and 90 per cent), and would involve inviting people to communicate their opinion, their feelings and their ideas. This process must be an interactive one. Participation is much more than giving information, and will influence the engineering contents of the scheme. The designer should not principally resist other ideas. It is his job to evaluate them and to check whether they can be implemented, modified or not.

1.3.3 Mediation in the implementation phase

If the great variety of other tools have either not been applied or could not lead to a final compromise and there is still resistance to a project, mediation is a well known and well proven tool to gain a good result. Although 'environmental mediation' is a well known term, mediation is not limited to overcoming environmental barriers.

It is a procedure to overcome any disagreement which has reached a stage where resolution would otherwise not be possible. It is carried out by a professional mediator, who must be neutral. The solution has to be found by the clients, and the participation is voluntary. The mediator simply conducts the process, and gives it the necessary structure.

1.3.4 Public monitoring in the operation phase

For scientific purposes, monitoring is a well known process, carried out by the design team or some scientific bodies, and relating directly to the aspect to be monitored.

Another kind is public monitoring, which aims to prove that the results predicted for the project have been achieved in reality.

Such public monitoring is based on very simple features, but also on the results of professional monitoring.

A very successful approach is the participation of educational bodies such as schools.

One may ask why any efforts are considered useful after the implementation of a project. The simple answer is that the success of a project does not end after its construction. There remain a lot of open questions within the operation phase, indicating an urgent need for public identification with the powerplant.

1.4 Ownership and identity

Identification is a kind of 'magic word' and can be achieved either by measures described in Section 1.3 or by real ownership. The share, of course, has some influence on the intensity of identification. In principle, even a very small percentage guarantees a positive effect. It is the actual commitment which counts, and not the amount, depending on the individual economic situation.

Identification needs a 'real' object with which to identify. In former times, small hydro installations tended to be hidden away, to avoid resistance. Resistance as well as identification are emotions, to a certain degree, and both require objects and symbols, simply a focus to emerge and to grow.

1.4.1 Public ownership

Wind energy has demonstrated this concept from the very beginning, and the mechanism works perfectly. To share ownership has at least three advantages:

• excellent public interest;
• shared risk; and,
• shared investment.

It is not clear why there is almost no experience in ownership-sharing models in the field of small hydro. There is in fact no reason.

There are many economic models, and they can be applied in the case of small hydropower. However, the public ownership model needs an operational body, like a limited liability company. The everyday business is carried out by the company, production reports for the owners may be given monthly, and a general assembly can be convened annually. The number of participants will be limited by the funds needed and by the portion.

1.4.2 Public–private partnerships

A little bit different to the model above is that of public-private ownership. The portions are then not offered like a loan or a stock, but the partnership is the result of negotiations. That concept sometimes occurs when two or even more potential investors are interested in exploiting the same situation. The inclusion of a public body like a community will serve as a neutral partner, and will be able to unite the former competitors.

Those models are also applied when the total investment exceeds the potential of one single investor. A public partner will limit the risk,. and in most cases the operational responsibility remains in the hands of the primary investor.

Besides all the economic reasons, any inclusion of public bodies is likely to encourage public interest and identification with the plants.

1.4.3 Public identity

Ownership is usually an economic fact. But in addition, it may also become a mental concept which is far from the financial aspects. To become a subject of public identity can be regarded as the highest level of acceptance.

Some examples can be given to illustrate this. Some small hydro plant operators have installed a kind of museum within the powerhouse, showing old-fashioned equipment. Others show their collections of historic agricultural tools, or collections of local art.

One excellent idea is the painting of the powerhouse by local children. Another is the installation of an energy filling station for electrically driven cars. Along a bike-track, a small hydro operator may consider offering drinks and snacks. For visitors interested in technical aspects, a screen could show the recent performance of the small hydro plant.

An educational exhibit for the public could offer a list of certain energy consumers in everyday life, with a calculation of the hours of operation with a typical day's production of the small hydro plant.

2. Final remarks

The overview given here is certainly not complete. But the way to find new approaches is quite simple and can be characterised by a few recommendations:

• discover advantages in disadvantages;
• try to be able to say: this has never been done before;
• believe in the unbelievable;
• share all your expertise – the feedback will be exciting and creative; and,
• think and act in a multi-dimensional way in interdisciplinary groups.

The life of engineers has become difficult in the last decades, but it has also become creative, exciting and satisfying. ◊

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