MINI HYDRO POWER PLANTS
-''GREEN'' POWER FOR USERS –

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S e r b I a

Key role of quick development is not only the investing in new technologies, but also the proper use of the existing human and technological resources, as well as in the development of new programs which can produce the product interesting and competitive on the market. And what is that programmed in which we already have the resources, including knowledge, industrial capacities and the market, and which can provides products at the same time, easily sellable on the domestic as well as on the outside market? Which are those products? How to use still unused, renewal and natural sources, and still with this usage, provide the environmental protection, with new impulse for the establishing new programmed in agriculture, fishing, transportation, water supply...? The answer to all these questions is comprehended in the title:
MINI Hydro Power Plants. These systems, which are designed to operate for minimum of 20 years, are usually `run-of-the-river` systems. This means they do not require a dam or storage facility to be constructed but simply divert water from the stream or river, channel it in to a valley and `drop` it in to a turbine via pipeline This type of hydro generating thus avoids the damaging environmental and social effects that larger hydroelectric schemes cause. Cost for a typical micro-hydro system varies depending on the project. Experience shows that community capital, financial credit and improved income make these schemes economically viable and sustainable.

These papers are based on very detail investigation which are making continually by professional staff working in HPPNS Djerdap Company in Belgrade-Republic of Serbia.

Investigations about small hydro power plants in Serbia, on river Morava, are published in many special publications, written by authors: M.Sretenovic, P. Radosavljevic,.. (Company of Djerdap) cooperated with Institute for water J.Cerni.

KEY WORDS: mini hydro power plants, natural resources, environment.

BACKGRAUND

Large scale hydroelectric power has been used worldwide for a long time to generate huge amounts of power from water stored behind massive dams. Small scale hydropower has been used for hundreds of years for manufacturing, including milling grain, sawing logs and manufacturing cloth.

However, it can also be used without a dam to generate electricity for home scale remote power systems. These so-called micro-hydro installations can be a very good complement to a solar power system, as they produce electricity 24 hours a day. Today's hydropower plants generally range in size from several hundred kilowatts to several hundred megawatts, but a few mammoth plants have capacities up to 10,000 megawatts and supply electricity to millions of people.

HOW HYDROPOWER WORKS?

Hydropower converts the energy in flowing water into electricity. The quantity of electricity generated is determined by the volume of water flow and the amount of "head" (the height from turbines in the power plant to the water surface) created by the dam. The greater the flow and head, the more electricity produced. A typical hydropower plant includes a dam, reservoir, penstocks (pipes), a powerhouse and an electrical power substation. The dam stores water and creates the head; penstocks carry water from the reservoir to turbines inside the powerhouse; the water rotates the turbines, which drive generators that produce electricity. The electricity is then transmitted to a substation where transformers increase voltage to allow transmission to homes, businesses and factories.

TYPES OF HYDRPOWER PLANTS

1. Conventional
Most hydropower plants are conventional in design, meaning they use one-way water flow to generate electricity. There are two categories of conventional plants:1 run-ofriver and 2: storage plants.

1.1. Run-of-river plants - These plants use little, if any, stored water to provide water flow through the turbines. Although some plants store a day or week's worth of water, weather changes - especially seasonal changes - cause run-of-river plants to experience significant fluctuations in power output (figure No 1).

Figure No1. The Tazimina project in Alaska is an example of a diversion hydropower plant. No dam was required

1.2. Storage plants - These plants have enough storage capacity to off-set seasonal fluctuations in water flow and provide a constant supply of electricity throughout the year. Large dams can store several years' worth of water.

2. Pumped Storage
In contrast to conventional hydropower plants, pumped storage plants reuse water. After water initially produces electricity, it flows from the turbines into a lower reservoir located below the dam. During off-peak hours (periods of low energy demand), some of the water is pumped into an upper reservoir and reused during periods of peak-demand.

3. Sizes of Hydroelectric Power Plants
Facilities range in size from large power plants that supply many consumers with electricity to mall and micro plants that individuals operate for their own energy needs or to sell power to utilities.

3.1 Large Hydropower
Although definitions vary, DOE defines large hydropower as facilities that have a capacity of more than 30 megawatts.

3.2 Small Hydropower
Although definitions vary, DOE defines small hydropower as facilities that have a capacity of 100 kilowatts to 30 megawatts.

3.3 Micro Hydropower
A micro hydropower plant has a capacity of up to 100 kilowatts. A small or micro hydroelectric power system can produce enough electricity for a home, farm, ranch, or village.

4. Hydropower in Serbia

The hydropower utilization in Serbia, we give an example, of the Velika Morava catchments basin can be archived by construction of seven typical dams in cascades within a period of 10 - 12 years. (Source of these examples is taken from papers and publications which are isued by Company Djerdap from Belgrade cooperated with Institute J. Cerni from Belgrade). The total installed capacity of the power lands with 4 bulb PIT turbines each is 260 MW, providing an output of 700 GWh annually.

Full implementation of investments and operation effects can be realized by complete development schemes of the catchments basin, resulting in power generation, navigation, protection of surface and groundwater, water supply, irrigation, etc.

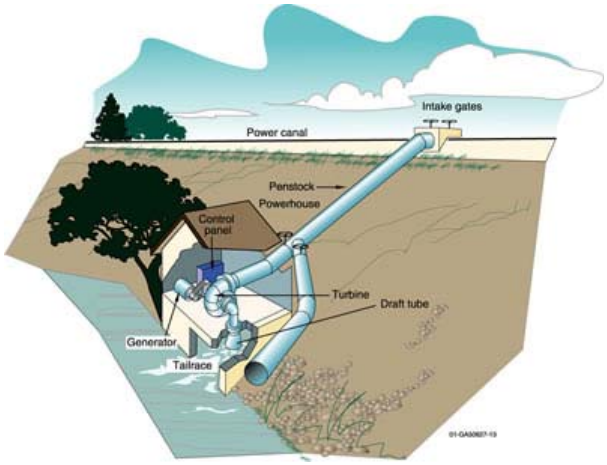
The project implementation shall be an impetus for large economic activities in the Republic, as all works can be entrusted and exacted by domestic companies covering all relevant fields: engineering, ship building, etc. The construction costs are quite favorable due to high level of standardization, vicinity of good communications and large economic canters.

Complete development scheme of the Velika Morava catchments basin can promote the overall economic development of the Republic, hardly to be presumed today, due to extremely advantageous position of the future power and navigation system (publication issued by Company Djerdap).

Figure No 3. Layout of river Velika Morava

Figure No 3. is taken from publication of Company Djerdap.

Most hydropower plants are planning to be built through federal or local agencies as part of a multipurpose project. In addition to generating electricity, dams and reservoirs provide flood control, water supply, irrigation, transportation, recreation and refuges for fish and birds.
Private utilities are more present in Serbia for built hydropower plants. Figure No 4. Energetic use of river Velika Morava.



5. Benefits

Hydropower is a clean, domestic and renewable source of energy. Hydropower plants provide inexpensive electricity and produce no pollution. And, unlike other energy sources such as fossil fuels, water is not destroyed during the production of electricity—it can be reused for other purposes.

6. Obstacles

Hydropower plants can significantly impact the surrounding area—reservoirs can cover towns, scenic locations and farmland, as well as affect fish and wildlife habitat. To mitigate impact on migration patterns and wildlife habitats, dams maintain a steady stream flow and can be designed or retrofitted with fish ladders and fish ways to help fish migrate upstream to spawn.

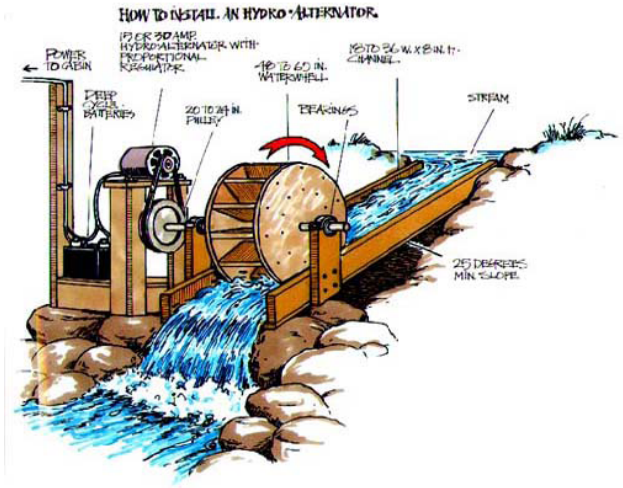


Figure No 5. New system of SHPP and old one

Literature
1. Publications issued by Company Djerdap, Belgrade/Serbia
2. Publications issued by Institute for water J.Cerni, Belgrade/Serbia
3. Micro-hydropower Sourcebook, a Practical Guide to Design and Implementation in Developing Countries by Allen Inversion,
4. Design of Small Dams. U.S. Department of Interior. Supt
5. Ponds for Water Supply and Recreation. Agric. Handbook No. 387. Soil Conservation Service
6. Reprinted in issues no. 13 and 14 Mother Earth News. “Water Power for Your Home”, Popular Science, May 1977