MINI HYDRO POWER

LOGROÑO (Spain)

Water is one of the most widely used sources of renewable energy. In some European countries, it covers more than 30% of the national energy demand. It is unlikely that new large-scale hydroelectric power plants will be built, due to the disruption they would cause to river beds and the restrictions imposed by environmental laws. Yet, there is a great potential for smaller installations – with a power capacity lower than 1 MW. This installation in the city of Logroño is a very good example of pre-utilisation of water serving the city and of generating additional benefits

GENERAL ASPECTS

Logroño, which has a population of more than 125,000 inhabitants, is the capital city of the autonomous region of La Rioja. The city is a commercial hub in the middle of a vast expanse of vineyards, producing the famous Rioja wines, which have made it well-known around the world.

Climatic Data :

Annual mean temperature: 13,4°C

CONTEXT

The small hydro power plant's facilities are part of a complex of buildings, processes and installations where the collection, treatment and distribution of water for the city of Logroño take place. The water for the city is treated at the Río Iregua Estación Depuradora de Agua Potable (Iregua River Drinking Water Purifying Station, henceforth known as ETAP), which is owned by City of Logroño and located in the village of Lardero, about 4 kilometres from Logroño. This small plant was projected in 1987.

Works began in 1989 and were finished in 1991. This facility was chosen by the European Commission as a Model Project for Energy Saving, under a subsidies by the European Community DG for Transport and Energy which financed 40% of the cost of equipment, up to a maximum of Eur 279,000. The balance was co-financed between the City of Logroño and the government of La Rioja.

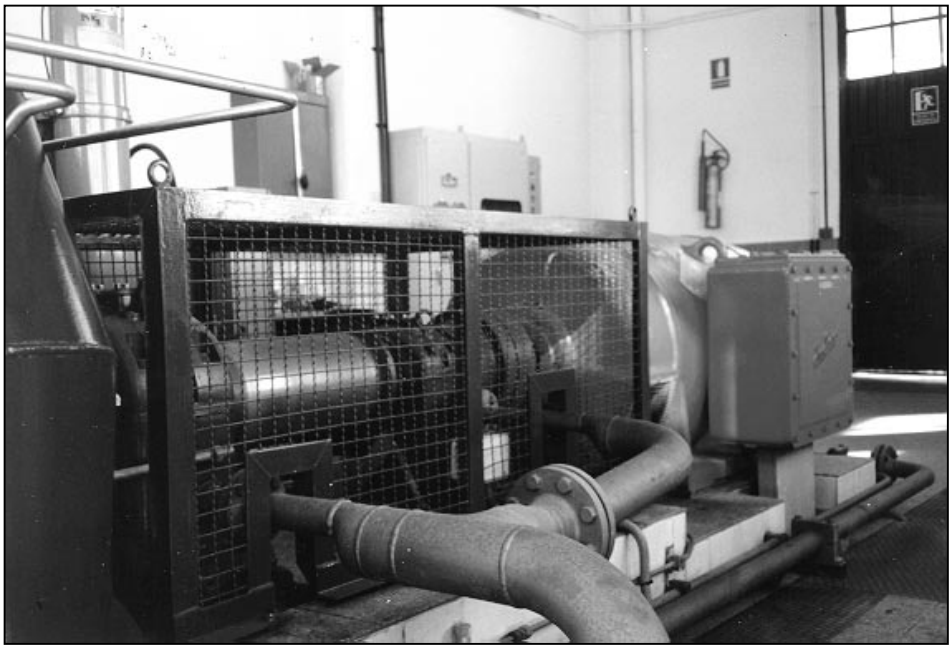
Its generator was first connected to the Compañía Eléctrica Iberdrola S.A.'s network on July 20, 1992. Since that date, except for mandatory interruptions ordered by ETAP, to which it provides water, and down times required for maintenance and equipment adjustment, it has generated energy almost continuously.

EXPERIENCE OF LOGROÑO

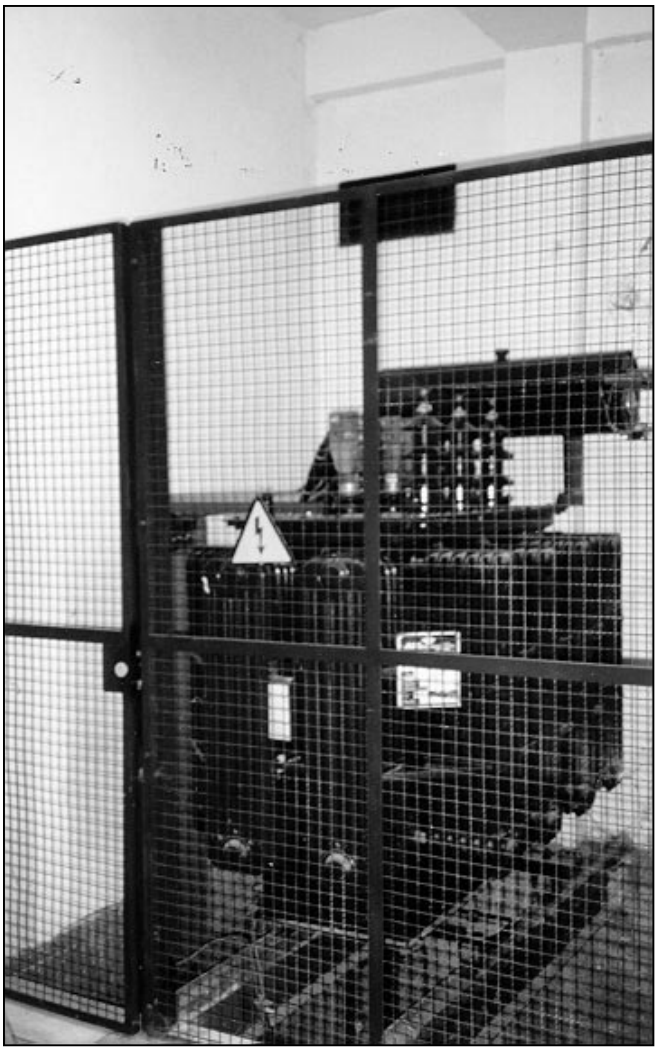
The water treated at the plant is collected from a dam on the Iregua River, located at the end of Islallana, some 14 kilometres away from the treatment plant. At these collection facilities the water is pre-treated in the gravel and sand traps, screened and subjected to chemical oxidation. Once this stage is completed, the water is sent to the treatment plant in two different ways. The first, which is most frequently used, is through a 13.7-kilometer-long closed pipeline, of which 360 meters have a diameter of 1,000 mm, and the rest has a 900 mm diameter. When this tube cannot be used due to damage, maintenance or other causes, the water is transported in an open canal. These two options guarantee raw water supply to the River Iregua ETAP.

Technical data

This facility has been designed and built for a thorough physical and chemical treatment, with a nominal capacity of 900 l/second, which can be increased to 1200 l/second. Taking advantage of a level difference of 111 meters between the collection point and the ETAP, and by carrying the water on a pressure pipeline, the energy to transport water to the entrance of the ETAP is used to produce electricity. This is achieved by way of a small hydro power plant powered by a FRANCIS spiral turbine with a horizontal axis, size 4.5/F 49.19, and an asynchronous, three-phase generator located inside its own special building. The plant's power capacity is 762 kW, its operational pressure 15-25 bar and its speed 1,500 rpm.



Maintenance



The plant has a control and protection system which, in case of down times (due to line, transportation or equipment problems), switches to an alternative system to guarantee that the plant receives the scheduled amount of raw water. Maintenance of the electrical installations is scheduled biannually and performed by a specialised company, at an annual cost of 3,330 Eur, which is 1.25% of the total revenue. Maintenance of the mechanical facilities is carried out by the ETAP's own staff, which makes it difficult to estimate its costs, as the ETAP's scheduled maintenance plan also includes the control and review of the small power plant. Official technical revisions take place every three years at an almost insignificant cost.

The treatment plant's own energy consumption is supplied by the small power plant's production, and the surplus energy – 85 percent of the total produced – is sold to the utility company (Iberdrola). Hence, energy production at this ETAP is self-supporting and, moreover, a high percentage of it is sold to the utility company, thus generating an economic benefit.

Financial aspects

The works and facilities directly linked to this power plant cost the City a Eur 750,000 expense, of which 40% was financed with the support of the European Commission. That figure includes: civil works for the machinery building at the transformer centre, electric power equipment, control, protection and generation equipment.

The figure includes components, which are shared with ETAP and, consequently, were necessary in any case, i.e. the transformer centre and the connection to the medium voltage line. It should equally be noted that the need to dissipate energy would have required the installation of some system whose savings in installation has to be deducted from the power plant's costs. Taking all of this into account, direct costs of the hydroelectric power plant amount to 600,000 Eur approximately. The contract with the utility company is subject to Time Schedule Type 2, based on a dual schedule: peak time and off-peak time. Big energy consumption operations take place during off-peak hours so as to have the maximum possible amount of energy available for sale during peak time.

The following chart indicates the evolution of several parameters (energy production, turbined water volume, average power factor, etc.) during the last six years:

	Year 1993	Year 1994	Year 1995	Year 1996	Year 1997	Year 1998
PRODUCTION						
Generated energy (kWh/year)	3.700.000	3.798.600	3.478.800	3.325.800	3.273.000	3.613.200
ETAP consumption (kWh/year)	765.000	576.300	596.100	534.200	481.000	527.000
Energy supplied (kWh/year)	2.935.800	3.225.200	2.882.600	2.791.600	2.791.900	3.086.300
Turbined water volume (Hm^3)	16	16,1	15,9	16,3	16,2	17,6
AVERAGE VALUES						
Power Factor	0,980	0,898	0,995	0,993	0,988	0,978
Production (kWh/m^3 water)	0,230	0,235	0,218	0,204	0,202	0,205
Price (Eur/kWh)	0,0642	0,0727	0,0840	0,0849	0,0822	0,0672
Invoiced to Iberdrola (Eur)	188.500	234.600	242.200	237.200	229.900	242.800

EVALUATION AND PERSPECTIVES

After reviewing the above data, there is no doubt that the total cost of the investment had paid off after the plant's third year of operation. Hence, the project's profitability is clearly evident, taking into account the scheduled maintenance costs and those of specific repairs.

Despite revisions and maintenance, any facility's components undergo a process of ageing. For this reason, during the current year 2000 a series of measures will be taken for a thorough revision of all the installations. In some cases, significant equipment or components will be replaced.

Due to an increase in the population's water demand and facing the possibility of an increase in the population to be served, works will be undertaken in the short term to enlarge the water treatment plant. This will imply a larger volume of water to enter the facilities, which in turn means a larger volume going through the turbines and, consequently, an increased work-load for the hydro power plant.

FOR FURTHER INFORMATION

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