

Lonato SHPP: a successful exploitation of an existing head on an irrigation canal in northern Italy

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1 Introduction

The Lonato SHPP is an example of profitable exploitation of hydro resources once considered marginal.

For a small power plant with a low head the economic feasibility is the most critical aspect, when a small output has to be compared with operating costs, and mainly building costs, usually not proportional to the installed capacity.

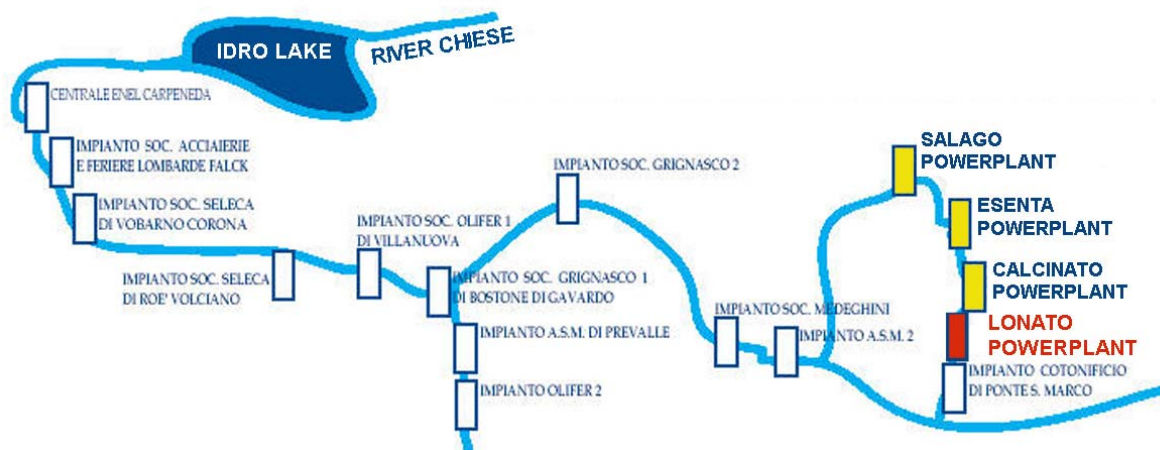
To achieve technical and economic feasibility new engineering solutions are requested, with reference to:

- plant layout, aiming to simplify it;
- civil technologies, as to reduce the building cost;
- machinery, to save money without affecting the efficiency and the reliability of the scheme.

2 Lonato site and the constraints for the design

The commissioning of Lonato SHPP is the fourth step towards the exploitation of the whole hydro potential of the irrigation network owned by *Consorzio Irriguo Medio Chiese*. The other three schemes operating are the plants called Calcinato, Salago and Esenta, each one with a capacity between 0.3 and 0.9 MW, all of them located in Eastern Lombardy, near the Garda Lake.

The canals divert water from the river Chiese downstream Idro Lake, which is a natural lake also used as a reservoir for annual water regulation.



Irrigation and hydro power system downstream the lake

In the surrounding area the human activities are relevant in any field: industry, agriculture and tourism; in spite of that the landscape has maintained a great value, due to the presence of hills and to the good weather thanks to the positive influence of the lake.

The valuable landscape and the presence of important infrastructures imposed a lot of constraints to the design of the Lonato scheme: the most important one was the need to undercross the motorway A4, one of the most trafficated roads in Italy.

Another key feature of the plant layout is connected with the multi-purpose use of the water: of course the hydroelectric use must never damage the agricultural one, which is the main mission of an irrigation consortium like the plant owner. On the contrary, a well designed power plant contributes to the network maintenance and, as a consequence, to lower the final cost of irrigation.

Due to those critical aspects, the design process lasted many years, from 1997 to 2004, to find a feasible solution.

3 The former design (1997)

The project exploits an existing height of about 10 metres in 1.2 kilometre of Lonato canal. The former design included a traditional powerhouse, with a bridge-crane, and a penstock, to join the intake structure to the power station, installed under the bed of the existing canal.

The result was a penstock extremely long (about 1,200 metres), but to short it, it should be made undercross A4 motorway and it's very hard to get the permit to stop or hold up the traffic in such an important way.

Moreover, works in the canal have to take place during the autumn-winter time, as to not affect the spring-summer irrigation, and they would last many years.

All those features meant high building costs and a lower energy production, due to the high head losses, and made the project unfeasible. So it was hang over awaiting better times.

4 A new design (2004)

The achieved design provided to follow the shortest way between the intake structure and the powerhouse, reducing the pipelines length in 630 m and burying it outside the irrigation canal.

Innovative materials and technologies permitted us to adopt a feasible layout.

4.1 The penstock

The pipe jacking technique in association with GRP pipes let us to undercross the motorway without traffic trouble and getting at the same time a good corrosion protection.

Use of trenchless technologies had already taken into account in 1997, but with traditional steel pipeline, whose external coating could be damaged by the pipe jacking; whereas the cathodic protection is too expensive for a small hydropower plant and not completely reliable taking into account the dramatic consequences of the possible leakage in the pressured pipeline under the motorway.

The adopted solutions was both economically and technologically suitable and allowed to reduce the working times too: works for undercrossing lasted only 20 days.



Length	42 m
Diametre	1,500 mm
Starting date	9th October 2006
Ending date	28th October 2006
Time	20 days

Works to undercross motorway

4.2 The powerhouse

The original design of the power station was completely rearranged with the aim to decrease costs as much as possible, through the reduction of the powerhouse volume and the building time too.

The choices which define the built powerhouse were:

- a S-type turbine completely underground;
- no bridge-crane: the unit was assembled using a mobile crane;
- rooms for electrical and hydraulic equipment partially located underground, overfilling the excavation around the machine room;
- use of a unit-mockup to carry-out the alignment before the unit availability.

The mockup allowed to quickly complete the other parts of the power plant regardless of the turbine construction time, which meant less interruptions and less concrete casting phases and so a significant cost decrease. It could be a good solution not only to reduce the building time, but also whenever the unit delivery times is not certain, a circumstance that often occur.



The mockup

An additional benefit of such a building is the very low impact on the surrounding valuable landscape.

The powerhouse is equipped with a synchronous discharge valve, which guarantees downstream water flow continuity for the priority irrigation use.

4.3 Brief characteristics

Maximum flow	4.30 m ³ /s
Head	8.76 m
Installed power	280 kW
Annual energy production	2,000 MWh
Date of commissioning	2008
Building costs	1,600,000 €
Pay-back time	~ 6 years

5 Conclusions

The exploitation of the existing heads in irrigation networks for energy production is an important opportunity for both the renewables and the irrigation consortiums, which are in charge of canals maintenance.

To guarantee the economic feasibility of those projects, often considered marginal, designers are requested to find innovative technical solutions. In particular the choices adopted in Lonato scheme (plant layout, pipe jacking technique) made it possible to commission a plant once believed unprofitable.

The Authors

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He has been working on SHP for Studio Frosio since 1989, becoming project manager in 2003.

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