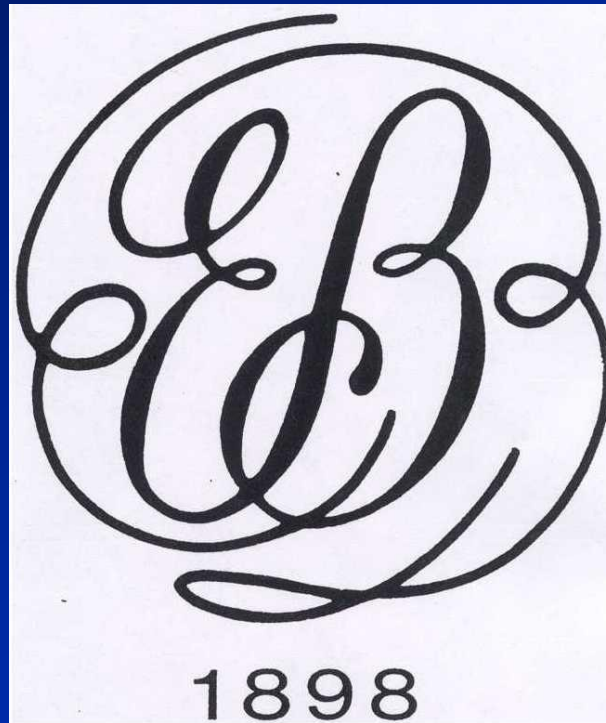


FIELD ACCEPTANCE TESTS AT MULTIPURPOSE MAROGGIA SMALL HYDROPLANT: A CASE STUDY

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STUDIO FROSIO

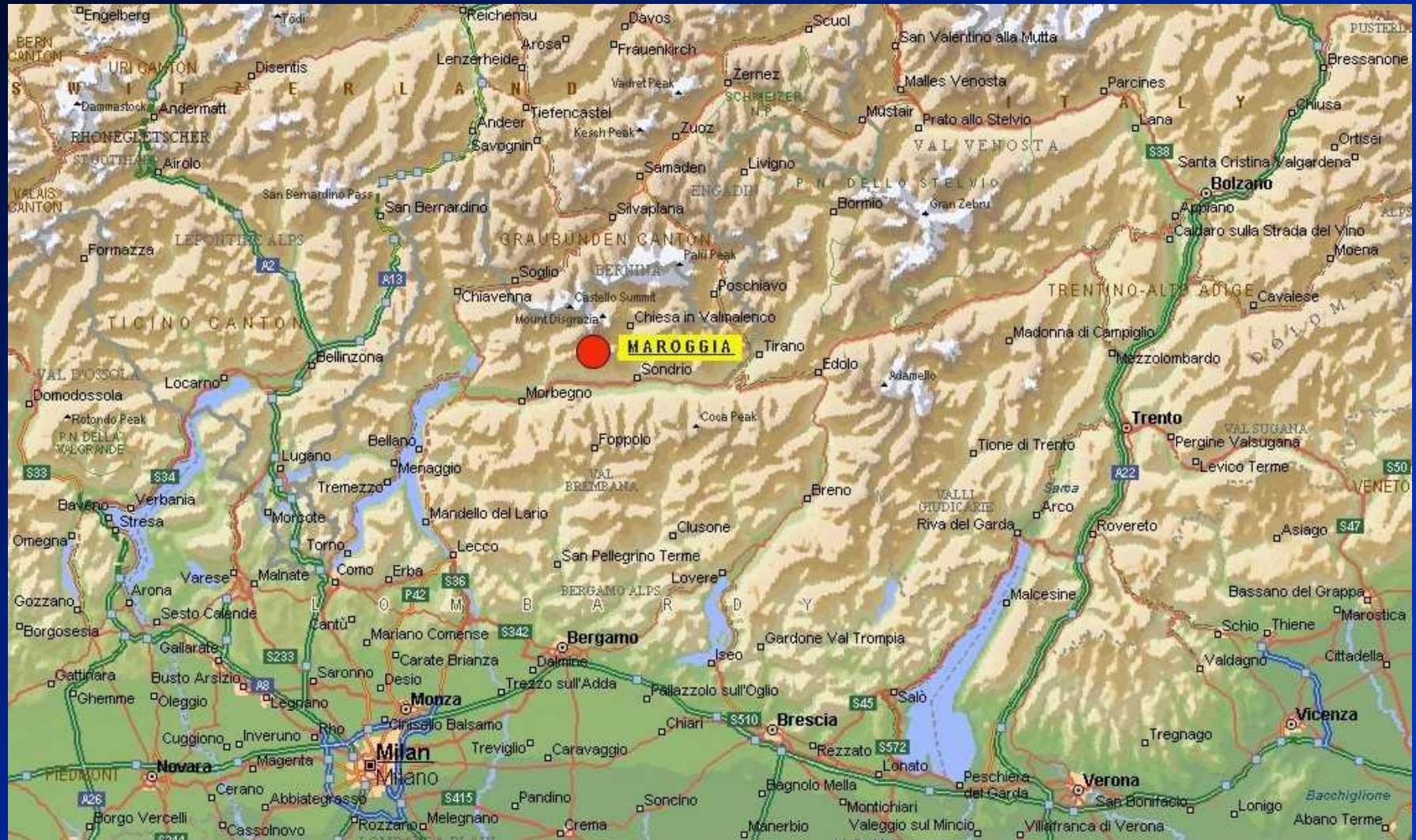
Mr. Marco Boselli

Mr. Luigi Papetti

Plan of the presentation

- Description of the plant*
- Multiple use of water and guarantees on operation requested by relevant authorities*
- Description of the efficiency measurement system*
- Tests execution*
- Conclusions*

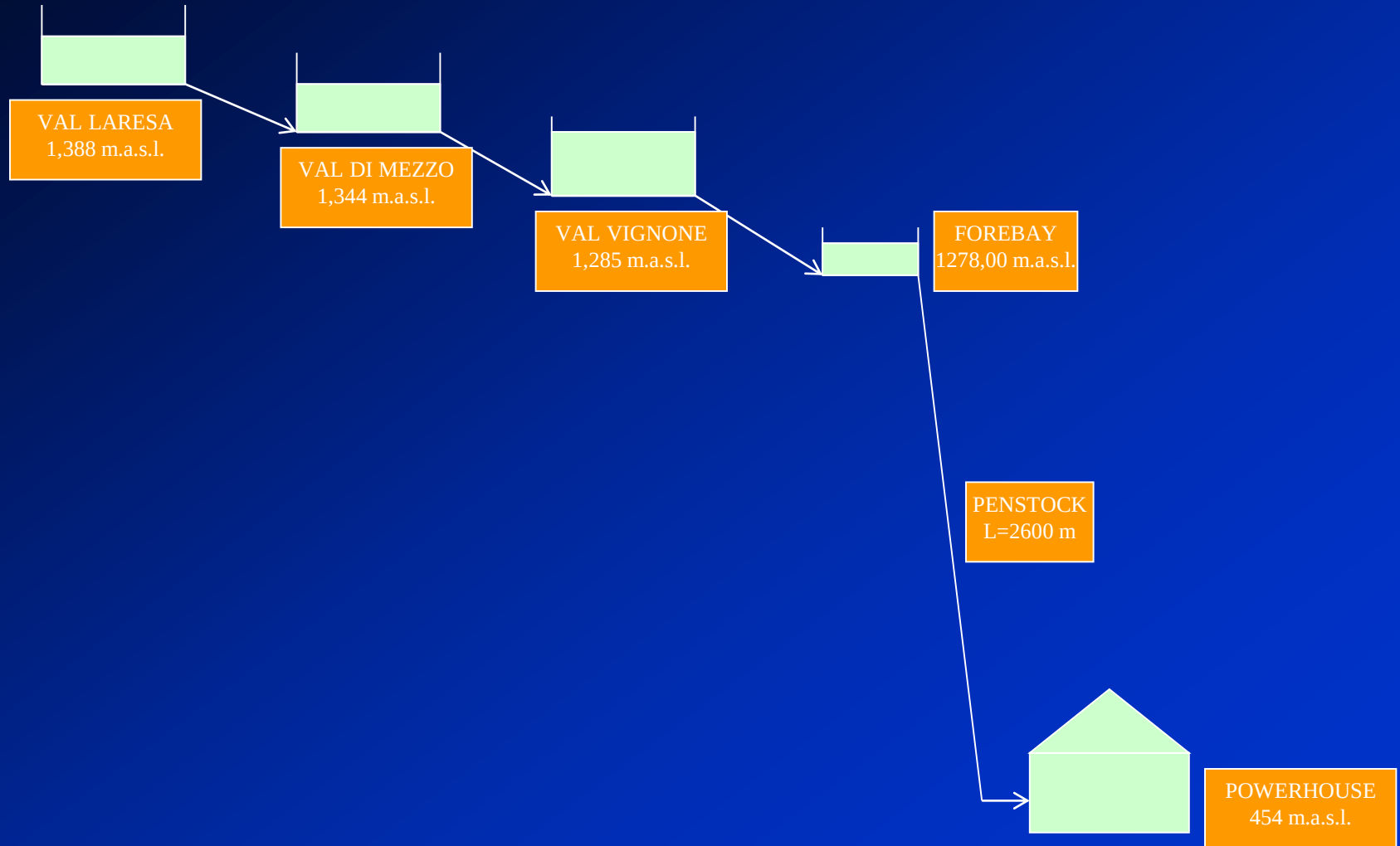
Where exactly is Maroggia ?



Maroggia SHP main characteristics

• Maximum plant flow rate	0.200 m ³ /s
• Average exploited flow rate	0.125 m ³ /s
• Gross head	814 m
• Installed capacity	1,400 kW
• Expected yearly energy production	6.3 GWh
• First kWh produced	16.11.98
• Time required for authorisations issuing	14 years !
• Building start-up	June '97
• Construction time	17 months

Schematic view of the plant



Description of the plant

Intake structures

Val Vignone (before desilting)



(continue)

Description of the plant

Intake structures

Val Vignone (after desilting)



(continue)

Intake structures

Val di Mezzo



(continue)

Description of the plant

Intake structures

Val Laresa



Forebay



(continue)

Forebay



Penstock



(continue)

Description of the plant

Penstock

Maroggia crossing



Anchoring blocks



Description of the plant

Powerhouse

From the access road



(continue)

Description of the plant

Powerhouse

From the penstock



(continue)

Powerhouse

Rear view



(continue)

Powerhouse

Generating unit



(continue)

Powerhouse

Valves



(continue)

Description of the plant

Powerhouse

Control panels



Multiple use of water and guarantees on operation

Woodland fire control and channels monitoring



Multiple use of water and guarantees on operation

Reserved flow

Val Vignone



(continue)

Multiple use of water and guarantees on operation

Reserved flow

Val di Mezzo



(continue)

Multiple use of water and guarantees on operation

Reserved flow

Val Laresa

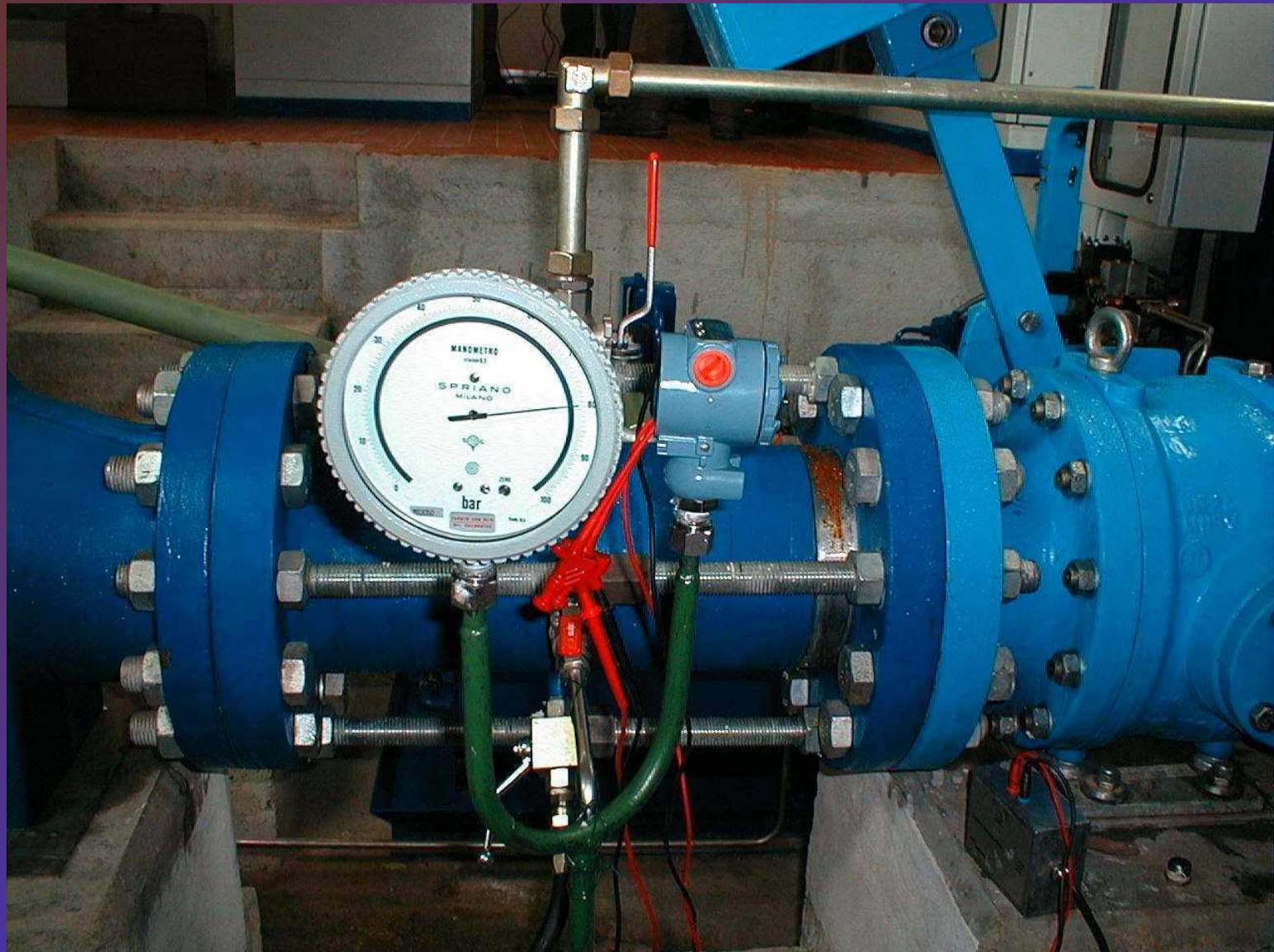


Description of the efficiency measurement system

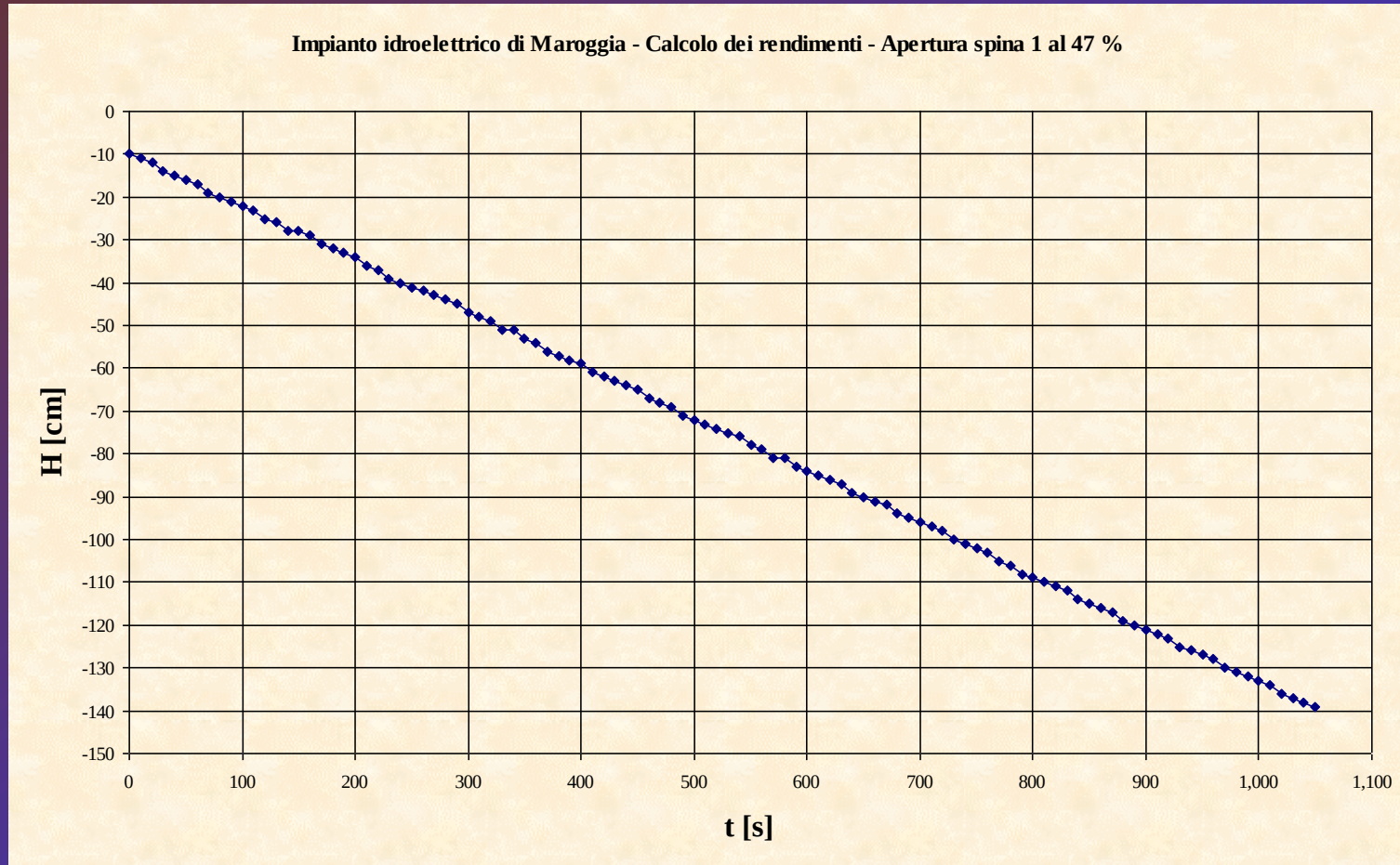
Power



Head



Discharge



Test conditions

$Q=0.2 \text{ m}^3/\text{s}$ $H=784 \text{ m}$		
Test	Nozzle 1 [%]	Nozzle 2 [%]
1	91,3	91,3
2	91,3	91,3
3	91,3	91,3

$Q=0.15 \text{ m}^3/\text{s}$ $H=798 \text{ m}$		
Test	Nozzle 1 [%]	Nozzle 2 [%]
1	57,3	57,3
2	57,3	57,3

$Q=0.065 \text{ m}^3/\text{s}$ $H=813 \text{ m}$		
Test	Nozzle 1 [%]	Nozzle 2 [%]
1	0	47
2	0	47

Test results

$Q=0.2 \text{ m}^3/\text{s}$ $H=784 \text{ m}$

Test	Duration [s]	Volume [m^3]	Flow rate [m^3/s]	Power [kW]	PF	Head [m]	η
1	398	77,40	194,47	1.281	0,977	783,03	85,74
2	430	83,40	193,95	1.284	0,990	783,03	86,19
3	429	83,40	194,41	1.270	0,786	783,03	85,03

$Q=0.15 \text{ m}^3/\text{s}$ $H=798 \text{ m}$

Test	Duration [s]	Volume [m^3]	Flow rate [m^3/s]	Power [kW]	PF	Head [m]	η
1	590	83,40	141,36	946	0,780	797,31	85,75
2	588	82,80	140,82	944	0,782	797,31	86,54

$Q=0.065 \text{ m}^3/\text{s}$ $H=813 \text{ m}$

Test	Duration [s]	Volume [m^3]	Flow rate [m^3/s]	Power [kW]	PF	Head [m]	η
1	601	36,00	59,90	399	0,778	810,56	83,11
2	593	36,00	60,71	401	0,776	810,56	83,73

Test cost

	Flow rate measurement method					
Measurement steps	<i>Thermo dynamic</i>	<i>Current meters - Penstock</i>	<i>Current meters - Open Channel</i>	<i>Salt dilution</i>	<i>Ultrasonic</i>	<i>Volumetric</i>
Calibration	2	2	2	1	1	1
Measurement preparation	9	16	16	7	8	1
Tests execution	3	3	12	9	3	2
Equipment dismounting	3	8	6	3	3	1
Data processing and final report	5	5	5	8	5	5
Logistics	0	4	4	0	2	0
Total	22	38	45	28	22	10
Measurement uncertainty	0.5-1.5	1.4-2.0	1.8-2.5	1.7-3.0	2-3.5	1.8-2.5

Conclusions

A proposal to make small hydro plants more easily accepted in the renewable energies field

- Install high efficiency units to demonstrate to relevant authorities the best exploitation of the water resource and declare the average value of the efficiency
- Carry out periodic efficiency tests on the plants - at the presence of the relevant authorities - in order to check the declared efficiency
- Financial supports to cover the major investment in high efficiency units or recognition of a higher value to the energy produced must be given by relevant authorities