EPFL

Exercise 1

Hydroelectric facilities for power generation and pumping
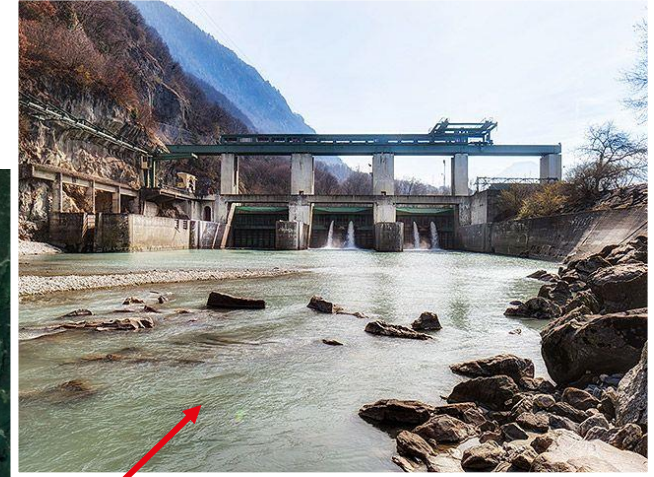
CIVIL – 469

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EPFL, 21.09.2023

Part A – Lavey hydropower plant

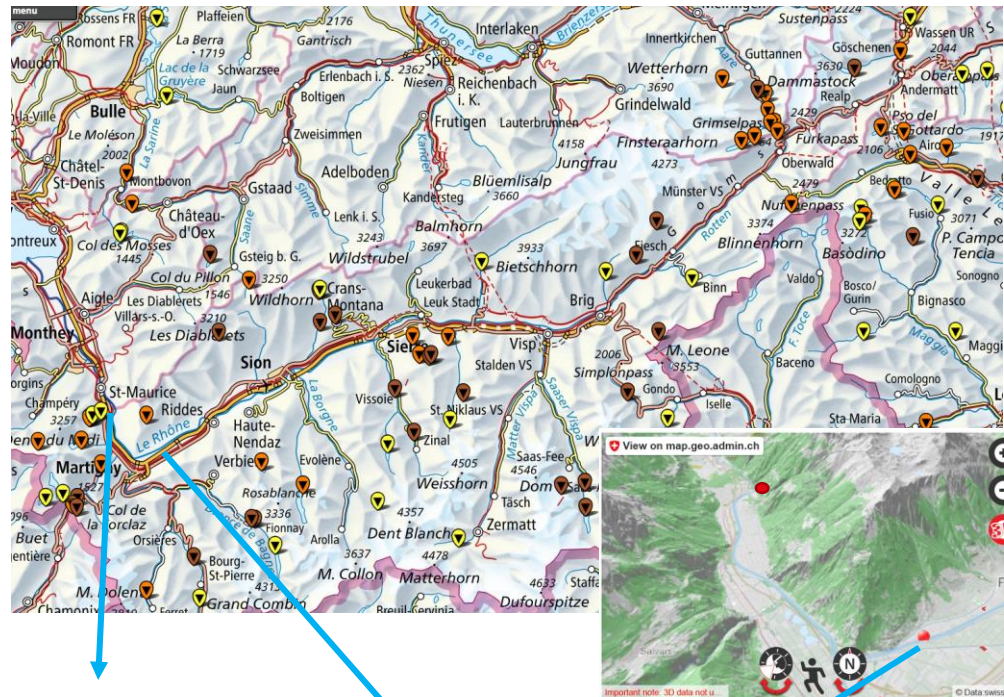▪ Lavey HPP and dam on the Rhône River commissioned in 1948

Upstream view of the dam

Upstream view of the outlet

Part A - Lavey hydropower plant

Daily-average flow discharge at Branson gauge station

1944

1960

1990

Lavey dam

Branson gauge station

PL - LCH

Part A - Lavey hydropower plant

- Questions:
  - Calculate the energy produced annually considering the flow duration curve (FDC) available in 1948 and a design flow rate of 250 m³/s (additional data at https://www.hydrodaten.admin.ch/en/seen-und-fluesse/stations/2024).
  - Calculate the energy produced annually considering the FDC of 1990.
  - Comment on the contribution of upstream seasonal reservoirs to the evolution of the distribution of Lavey's energy produced annually in summer and in winter.
  - According to the 1990 FDC, estimate the energy produced annually from increasing the design flow rate to 300 m³/s.
  - Estimate the loss of production related to ecological flow ("residual flow"), estimated at a total of 800 l/s.

Part B – Lutry pumping station

- Lake Léman water pumping facility at Lutry (2001)

Reservoir E_{res} = 600 m a.s.l.

Penstock

Lake E_{lake} = 377 m a.s.l.

Pumping station

Part B – Lutry pumping station
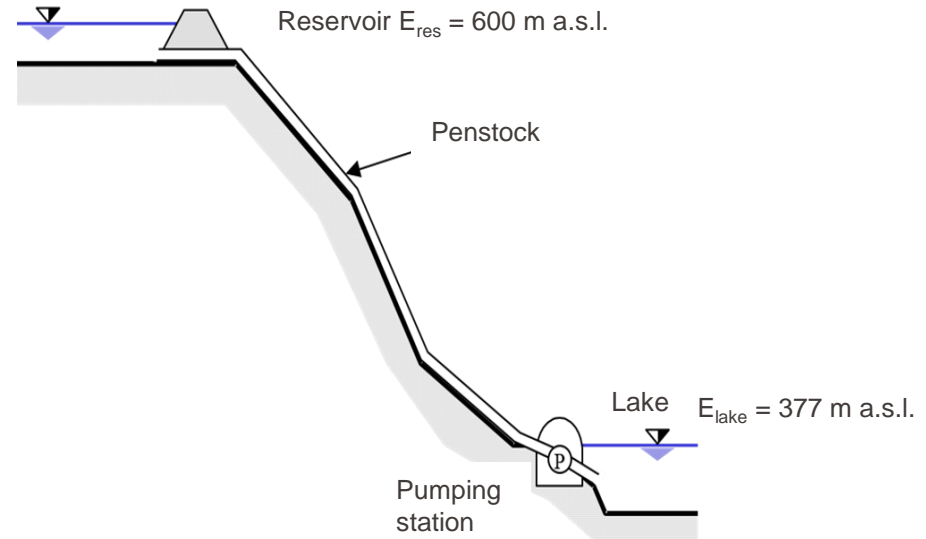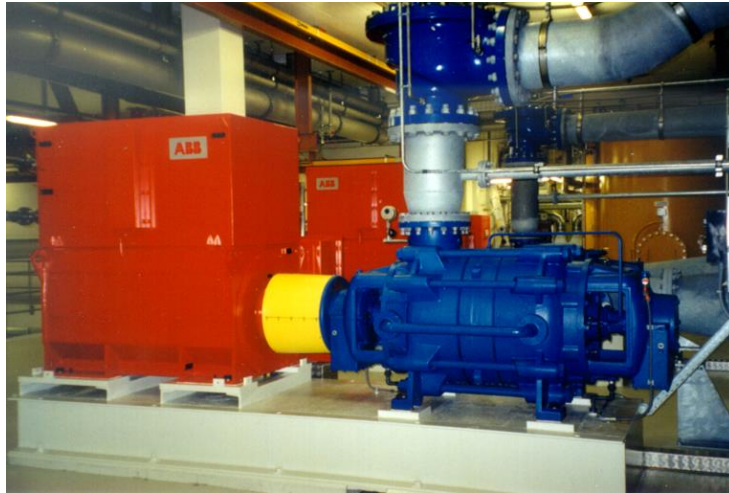
- Questions:
  - Calculate the head losses between the pumping plant and the reservoir.
  - Draw schematically the energy head (red) and pressure (blue) lines for steady state flow regime. Also draw the energy line for the static condition (black).
  - Estimate the total pumping power, assuming a pump efficiency of $\eta = 0.60$.
  - Calculate the total construction costs of the penstock, by considering a price of 3600 CHF/ton for the steel and an additional cost of (900 + 230 d_{ext}) CHF/m, where d_{ext} is the external diameter of the penstock.
  - Calculate the operational costs on an annual basis

Report

- Deadline according to course schedule: 11th.Oct.2023

- In groups of two

- Format:
  - Report in English
  - Max. 10 pages
  - Includes:
    - Title page, with identification of subject, date, speakers;
    - Brief introduction to the problem, including a summary of the statement and the proposed approach to solving it;
    - Basic data (synthesis, critical review);
    - **Calculation assumptions**;
    - Questions and solutions;
    - Conclusions and references (if any).

Submit the report

- On Moodle

- Report layout will be included in the evaluation
  - Quality of the figures

Questions about the exercise

- Session on Thursday from 10 to 12 a.m.

- Questions with the Forum on Moodle