STUDY OF THE POWER PLANT OF LANAYE

UNIVERSITY OF LIEGE

Laboratory of Hydraulic Constructions and Applied Hydrodynamics

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STUDY OF THE POWER PLANT OF LANAYE

1. *Lock of Lanaye presentation*
2. *Set-up turbines study*
3. *Impact of the pumps/turbines action on the locks*
4. *Economical analysis*

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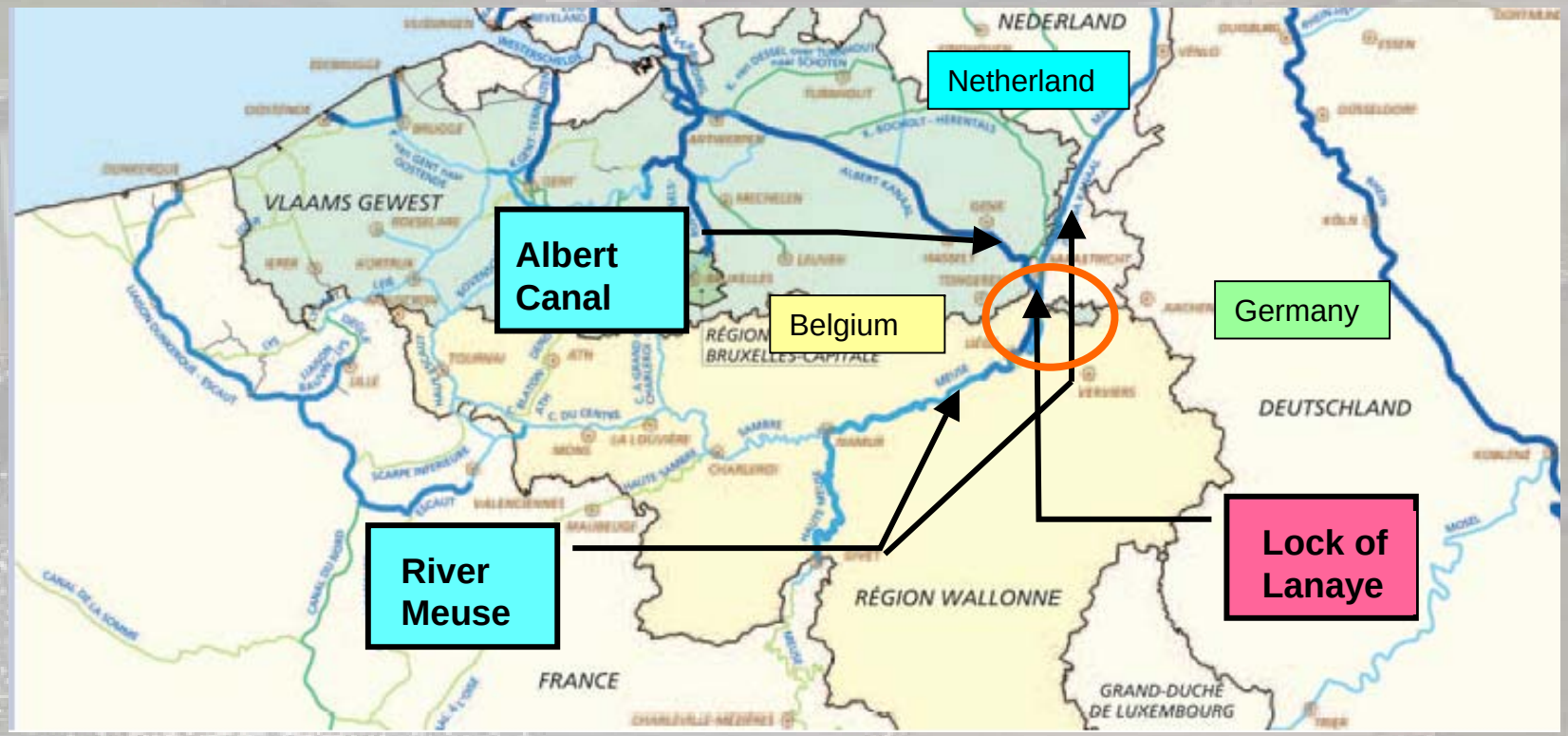
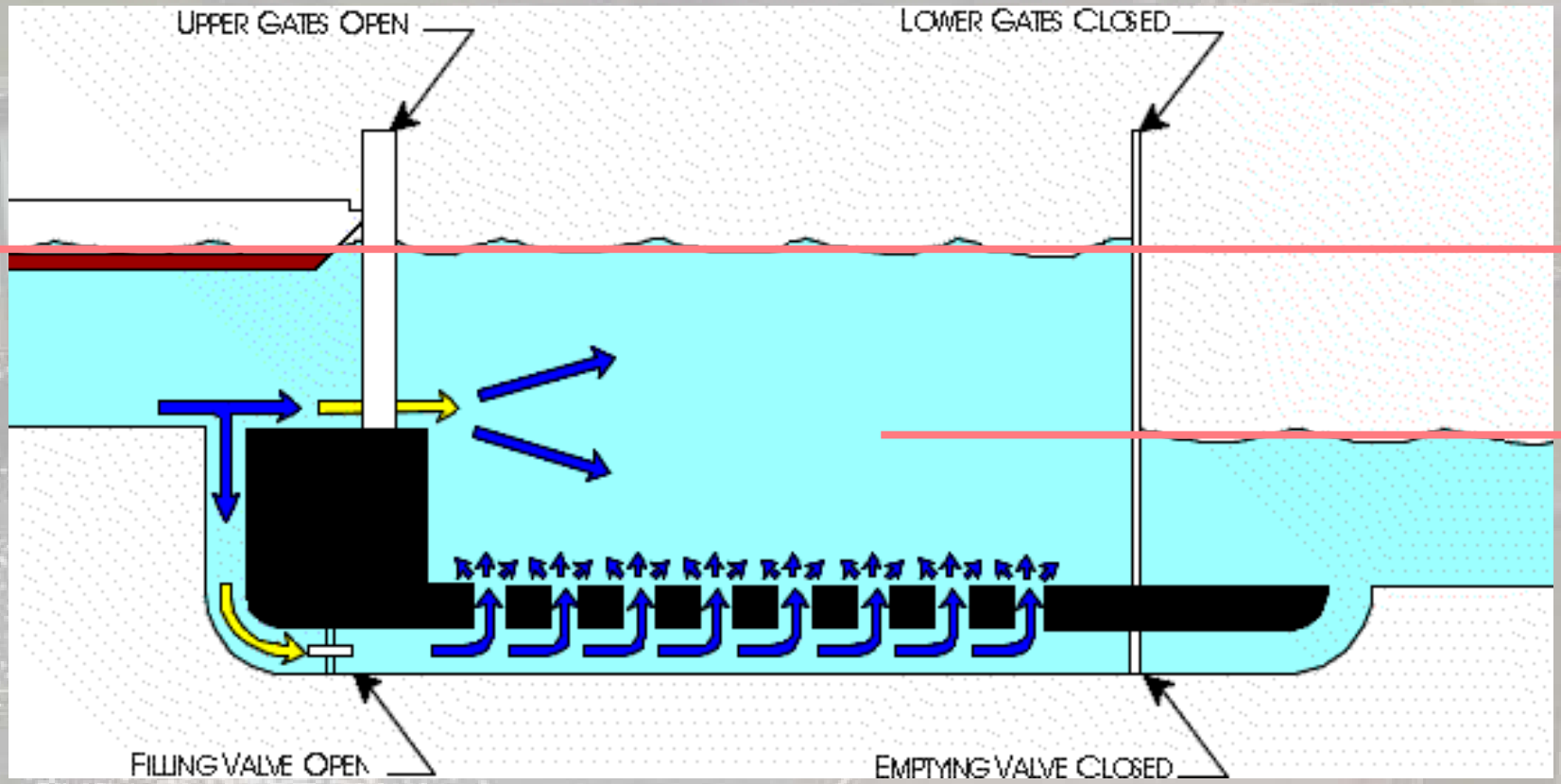
1. Lock of Lanaye presentation

Location of Lanaye navigation lock

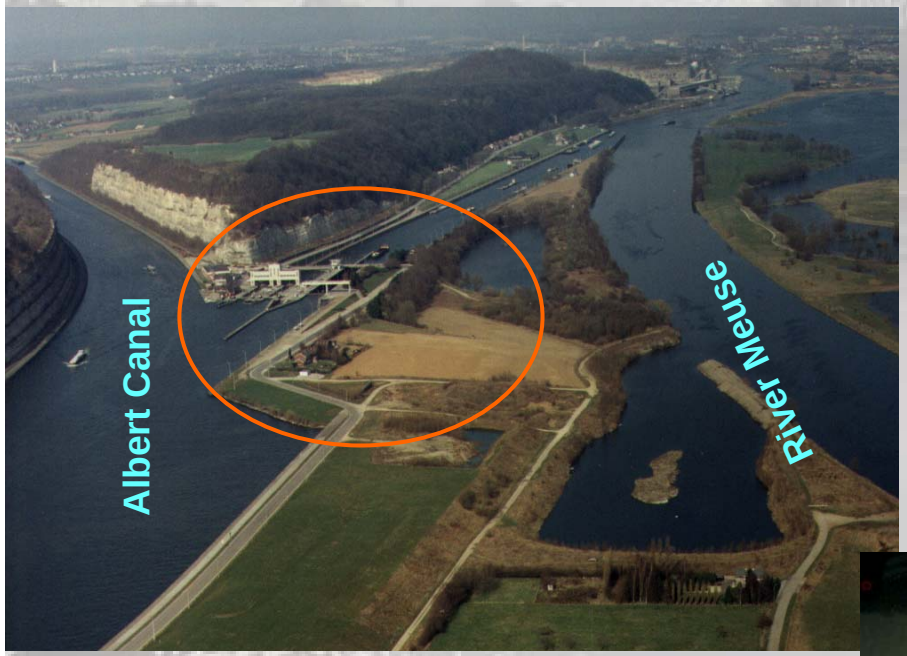


1. Lock of Lanaye presentation

Recall of operations in a navigation lock



1. Lock of Lanaye presentation

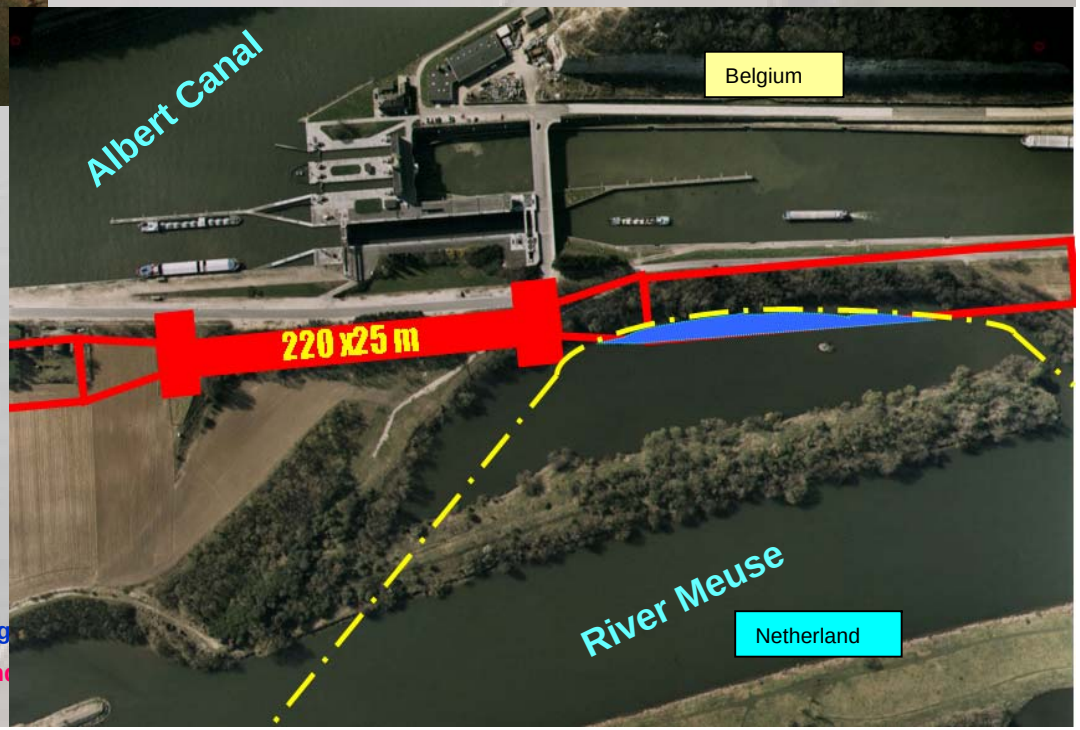


New lock : the 4th one of the site

Length: 22Om

Width: 25 m

Head : 13,6 m



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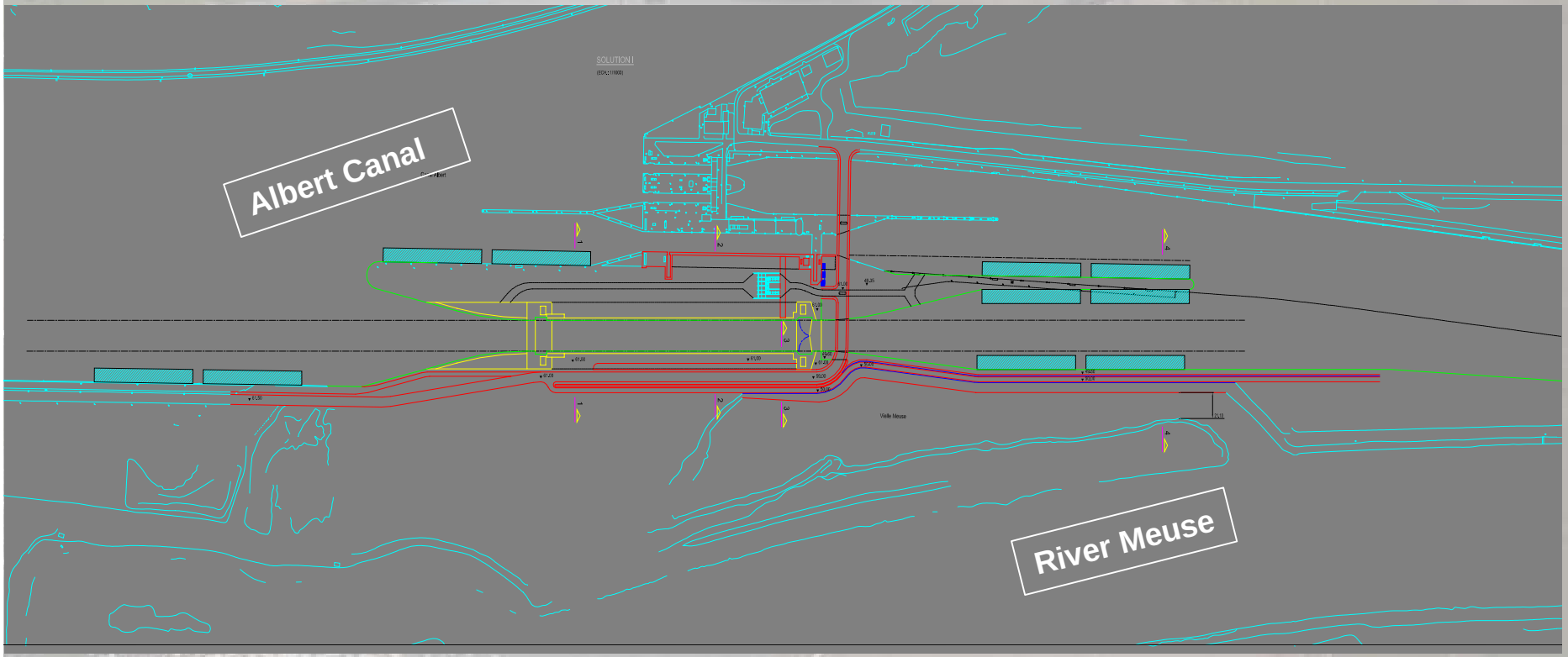
1. Lock of Lanaye presentation

Lay out of the site



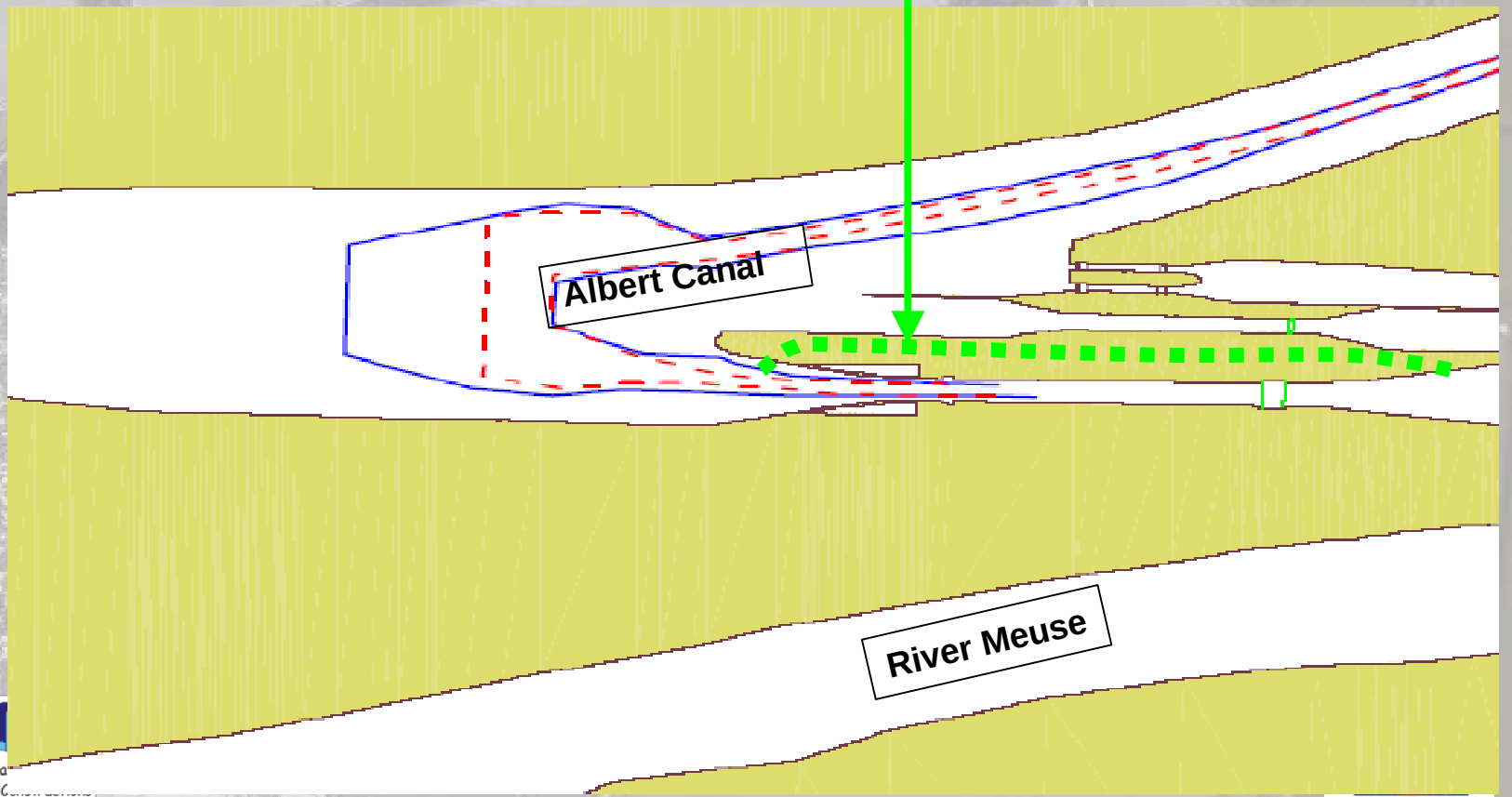
1. Lock of Lanaye presentation

Maneuvering of the ships

2. Set-up turbines study

Location of the hydro-power plant

Axis of the hydro power plant in the side wall , between the 3rd and 4th lock



Hydrauliques

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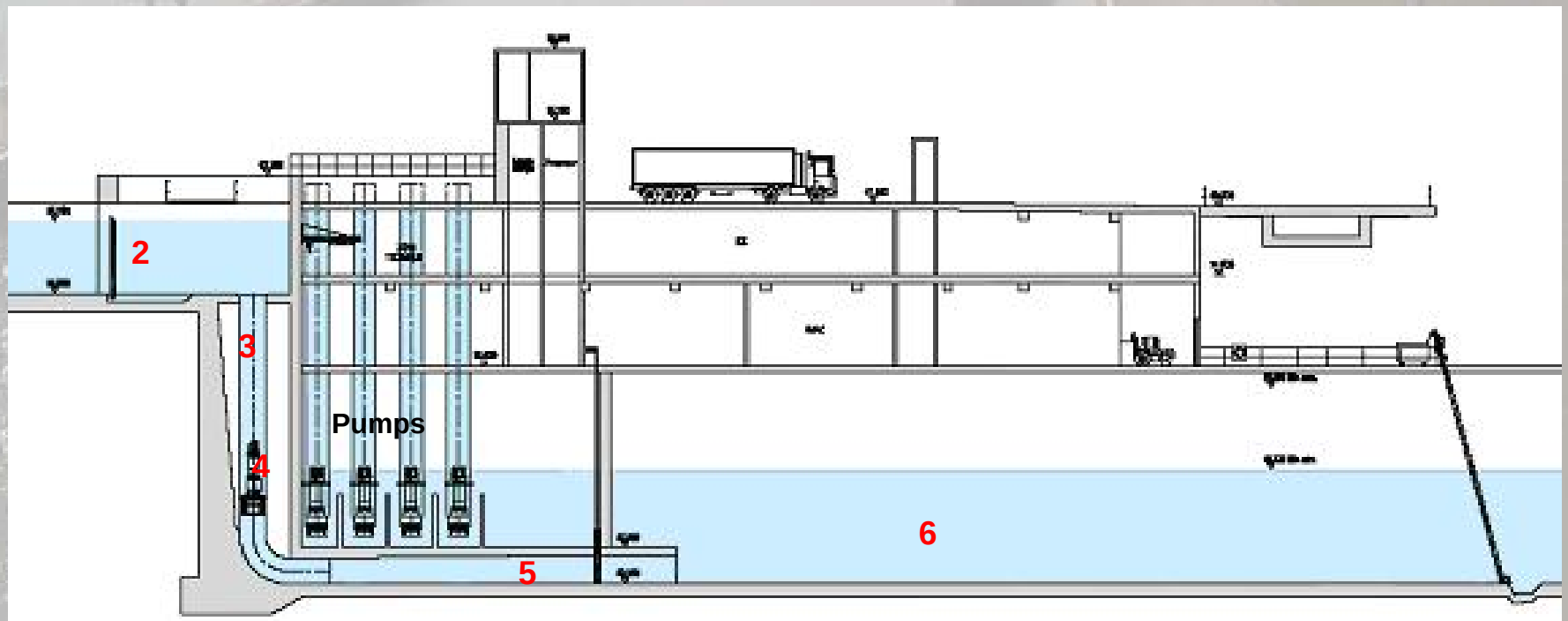
2. Set-up turbines study

1. **Forebay, intake, trash rack**
2. **Intake channel**
3. **Penstock**
4. **Turbine**
5. **Draftube**
6. **Tailrace**

Hydropower water way

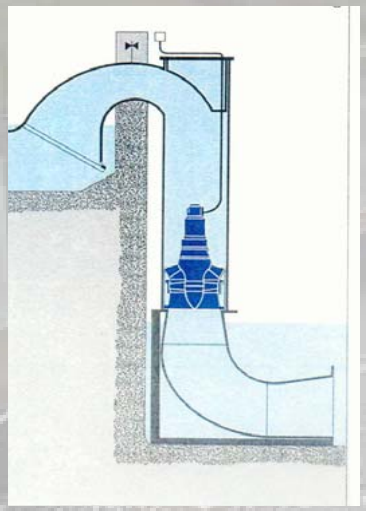


2. Set-up turbines study

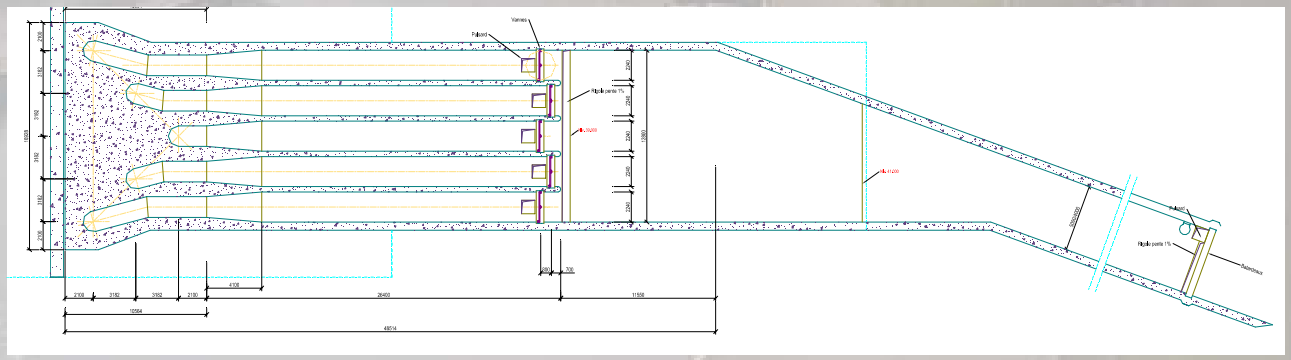
Turbines

- **5 Kaplan turbines Types Flygt**
- **Each turbine a power of 460 kW,**
- **Total installed power 2,300 kW**
- **Head 13,6 m**
- **Total nominal discharge 18 m³/s**

Type of turbine

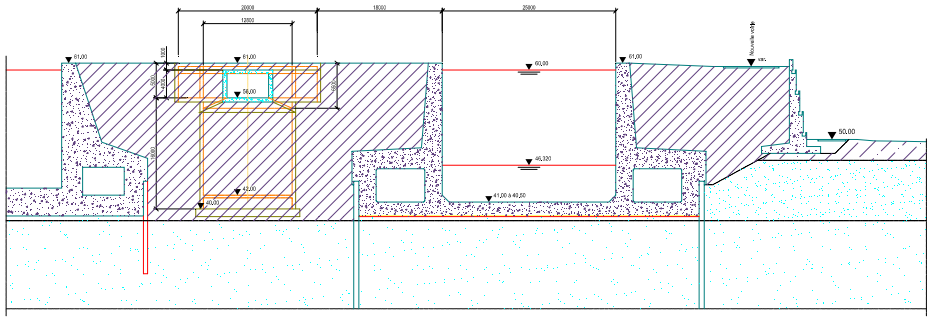


Drawtubes and tail race

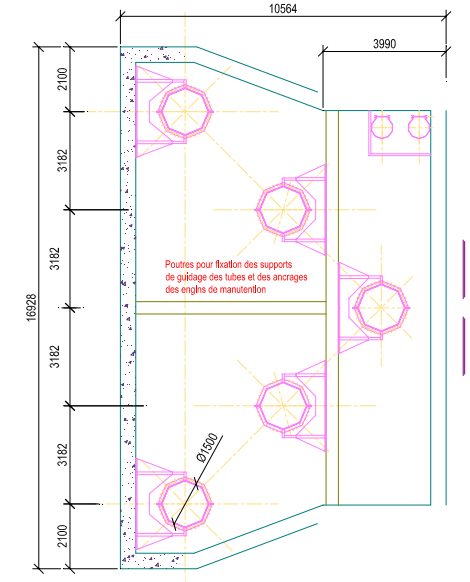


Cross section in the side wall

Details



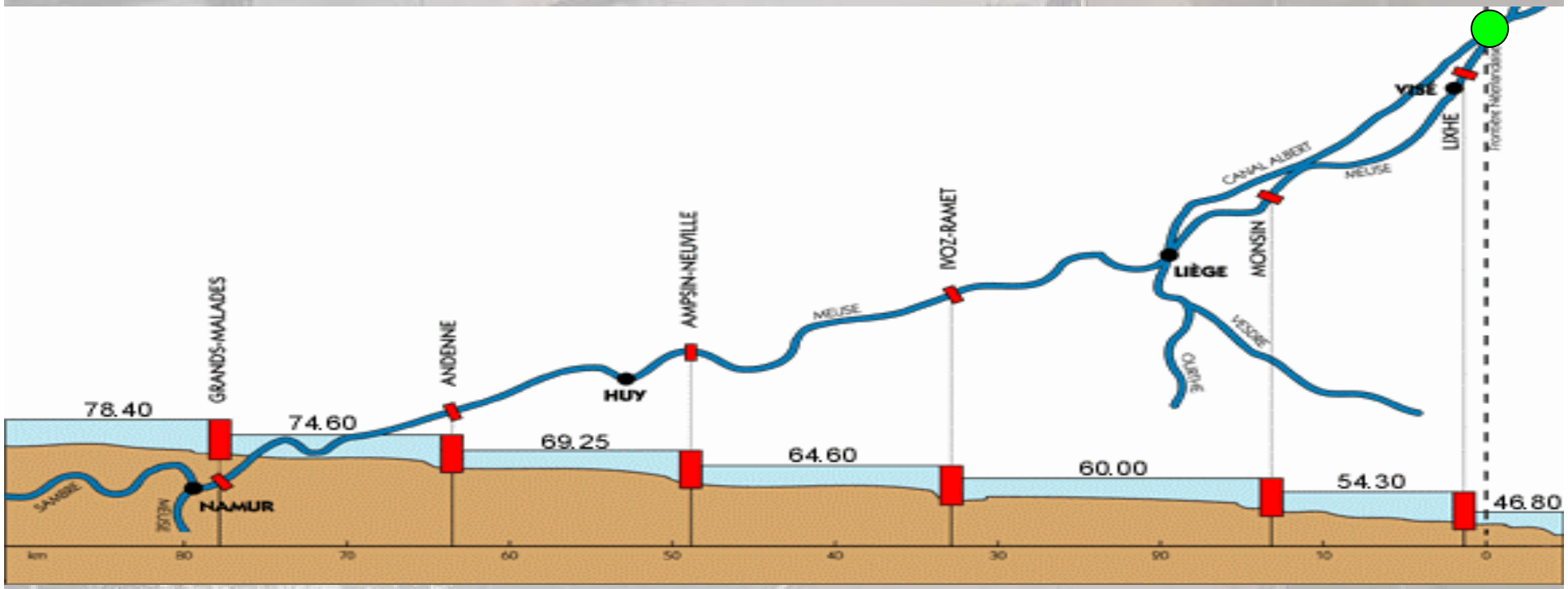
Cross section in the penstocks



2. Set-up turbines study

Others run of the river power plants along the River Meuse

- **Existing ones**
- **New one**



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3. Impact of the pumps/turbines action on the lock

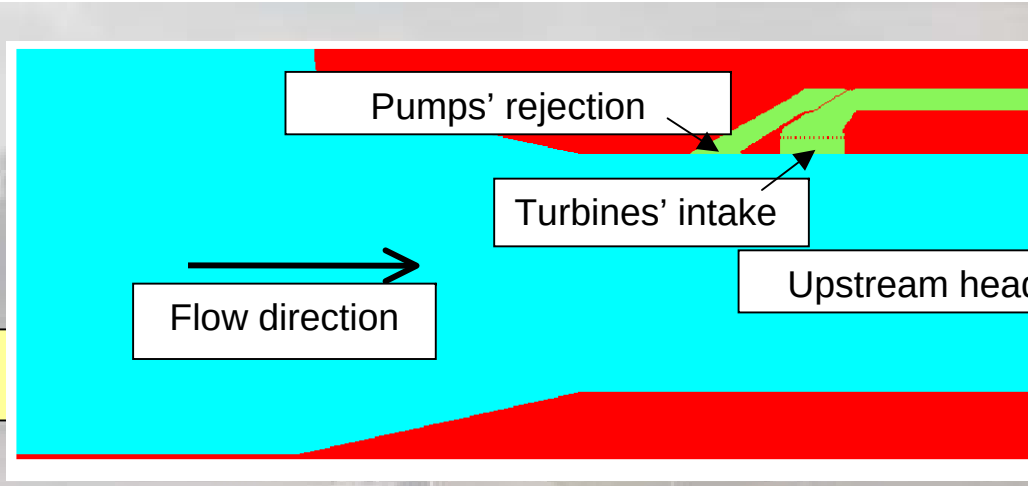
Restrictions:

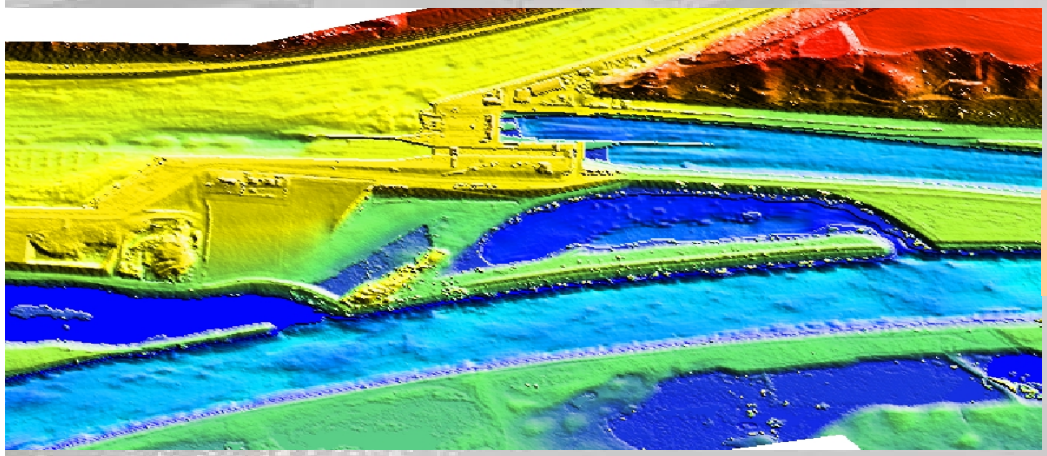
- ✓ the maximal flow : 17 m³/s for pumping and 18 m³/s for turbines action;
- ✓ currents at the place of water evacuation and intake can't block the entry/exit of the ships in the lock;
- ✓ the flow velocity in the trash rack can't exceed 50 cm/s because of the piscicultural consideration;
- ✓ avoid the swirling effects on the evacuation and intake water, which have a negative influence on shipping.

3. Impact of the pumps/turbines action

3.1 Upstream study-geometry

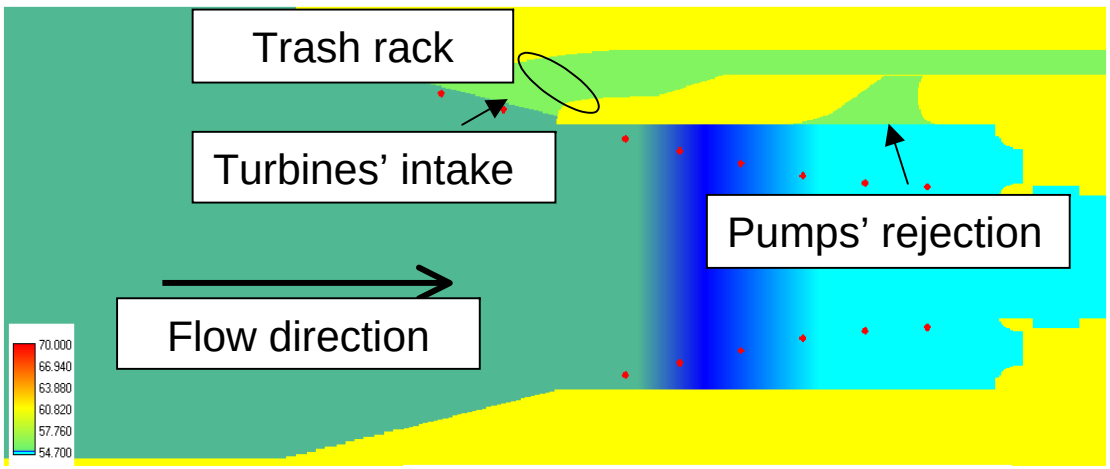
Initial geometry





Numerical topography

Optimised geometry



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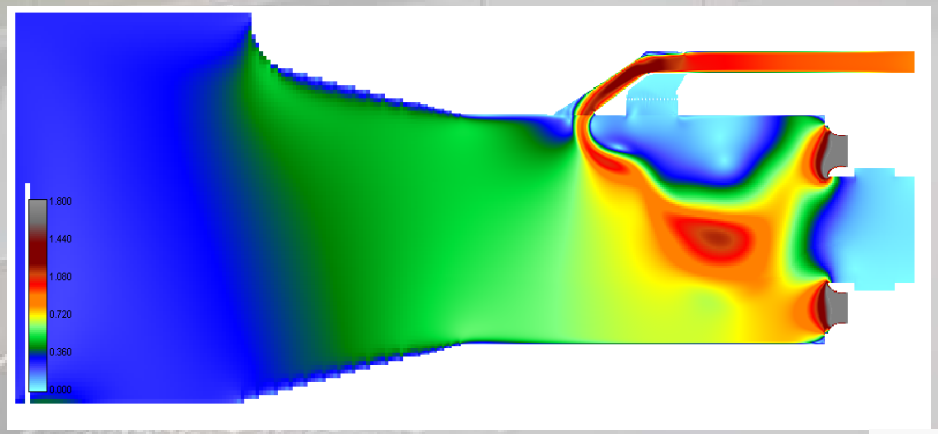
3. Impact of the pumps/turbines action on the lock

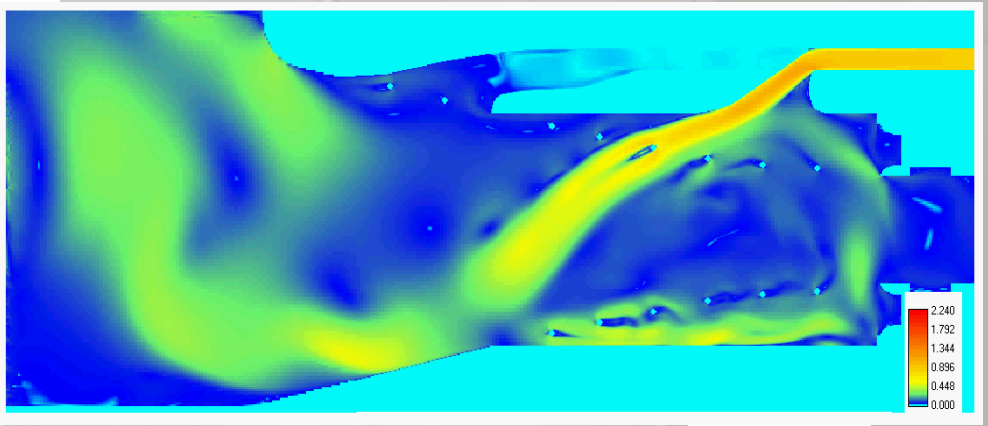
3.1 Upstream study - pumping and locking

Initial geometry



Instantaneous module velocity (t = 225 s) (m/s)

Optimised geometry

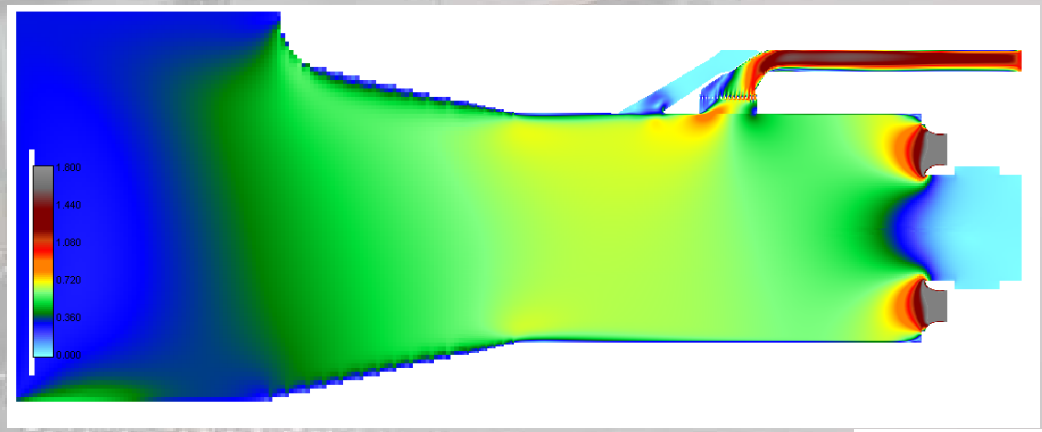


Module velocity (turbulence effect)

3. Impact of the pumps/turbines action on the lock

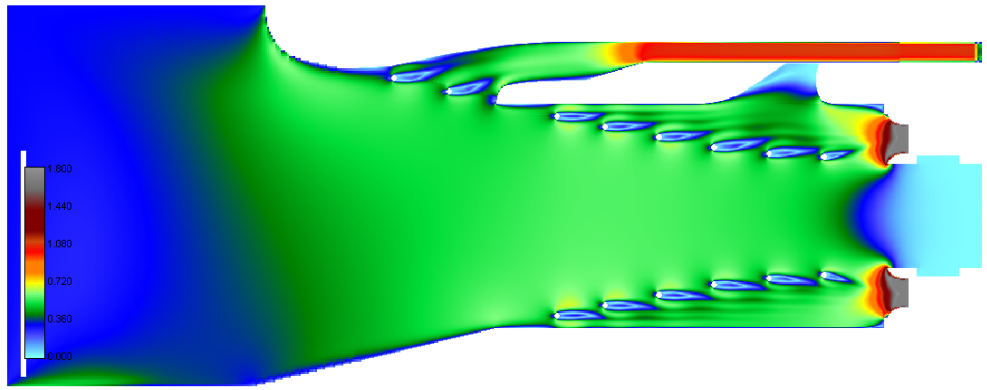
3.1 Upstream study - turbine action and locking

Initial geometry



Instantaneous module velocity (t = 225 s) (m/s)

Optimised geometry



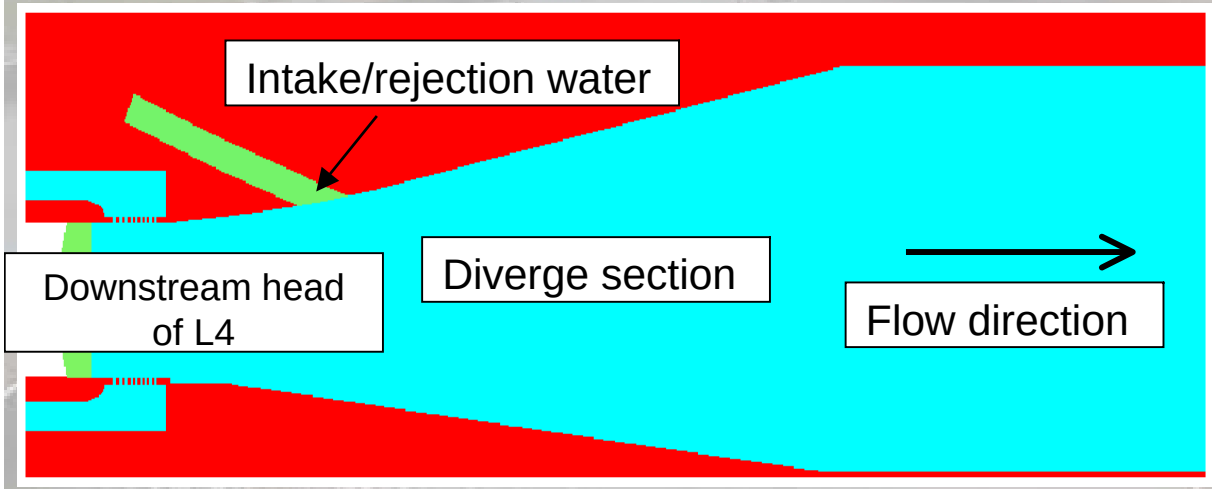
Modulate velocity

(t = 225s) (m/s)

3. Impact of the pumps/turbines action on the lock

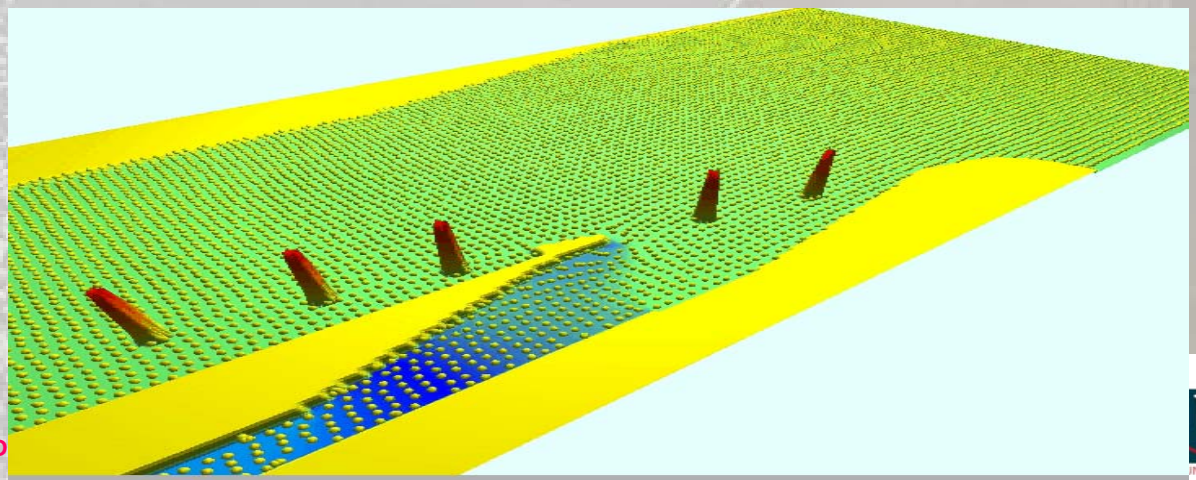
3.2 Downstream study

Initial geometry



Optimised geometry

the possibilities of modifying are limited by the obstruction of the closed structures



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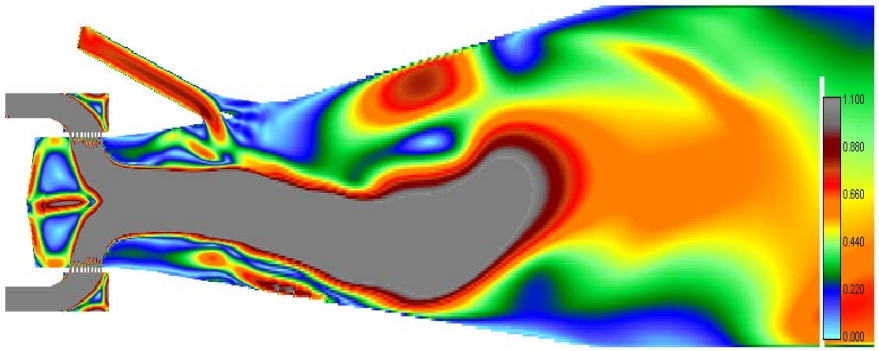
3. Impact of the pumps/turbines action on the lock

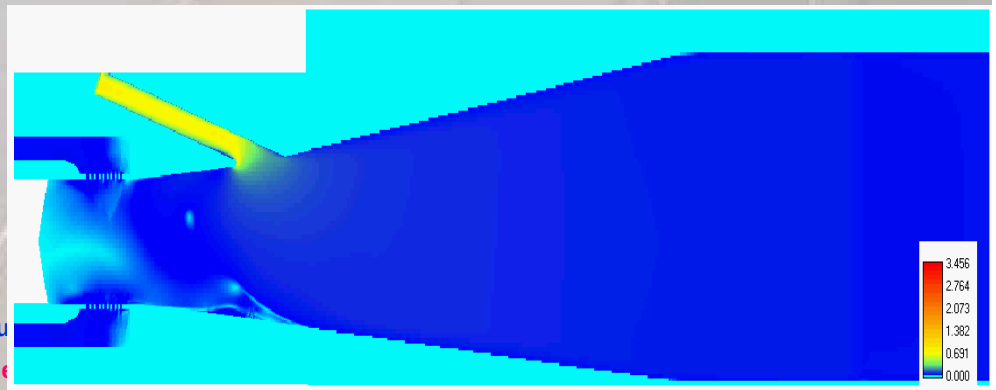
3.2 Downstream study

Initial geometry



Modules velocity (m/s)
turbine action and locking

Optimised geometry



Modules velocity (m/s)
pumping and locking

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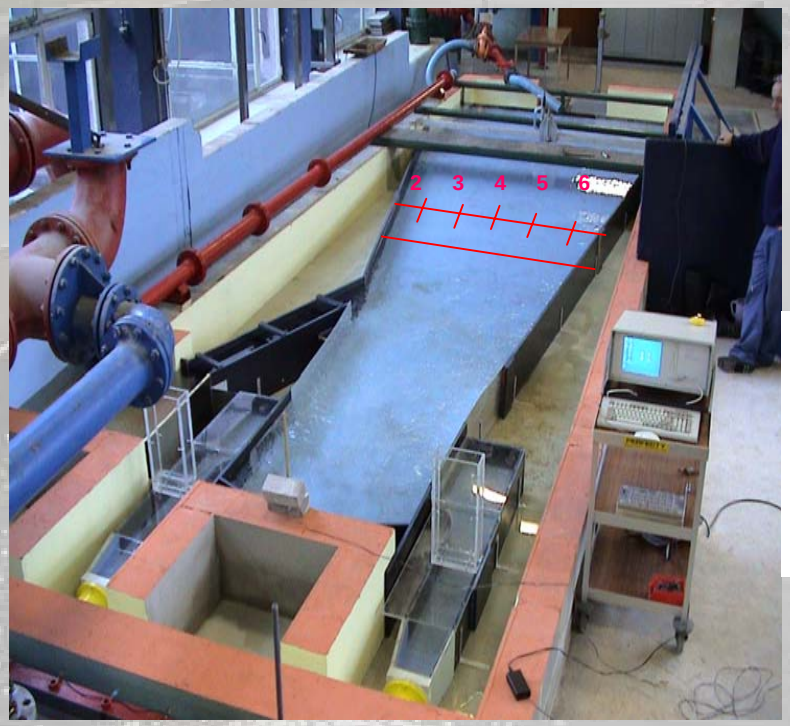
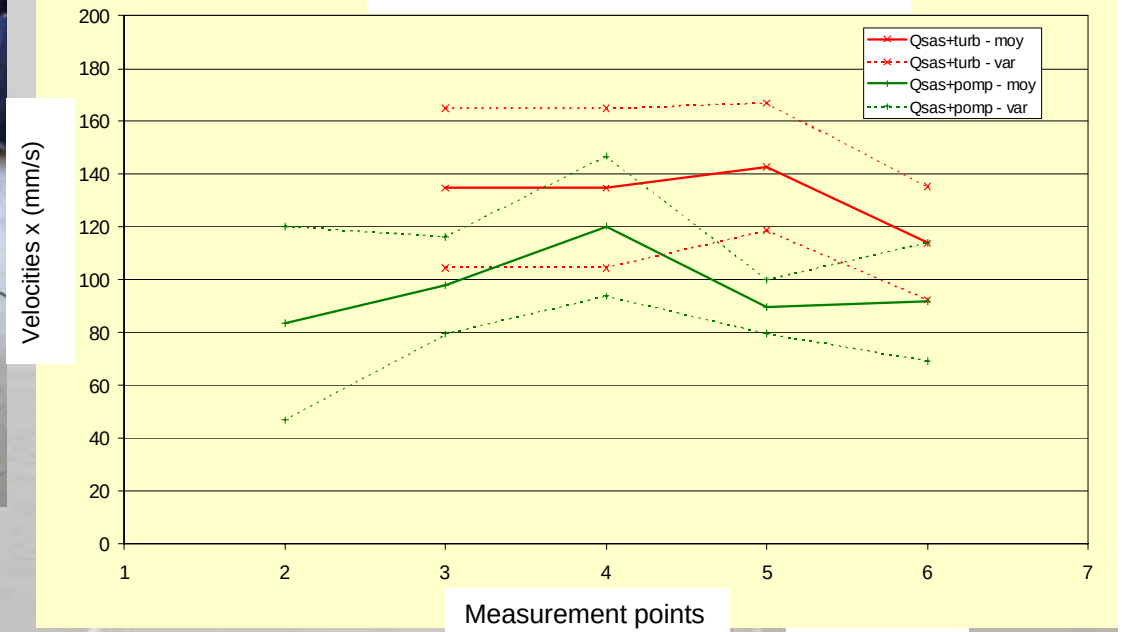
3. Impact of the pumps/turbines action on the lock

3.2 Downstream study

Physical model: scale 1/23,33





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4. Economical analysis

4.1 Economical indicators

- ***Net Actualised Value (VAN)*** consists of bringing back to the beginning of the project all the monetary flow of the lifespan of the project, and finding the global value.

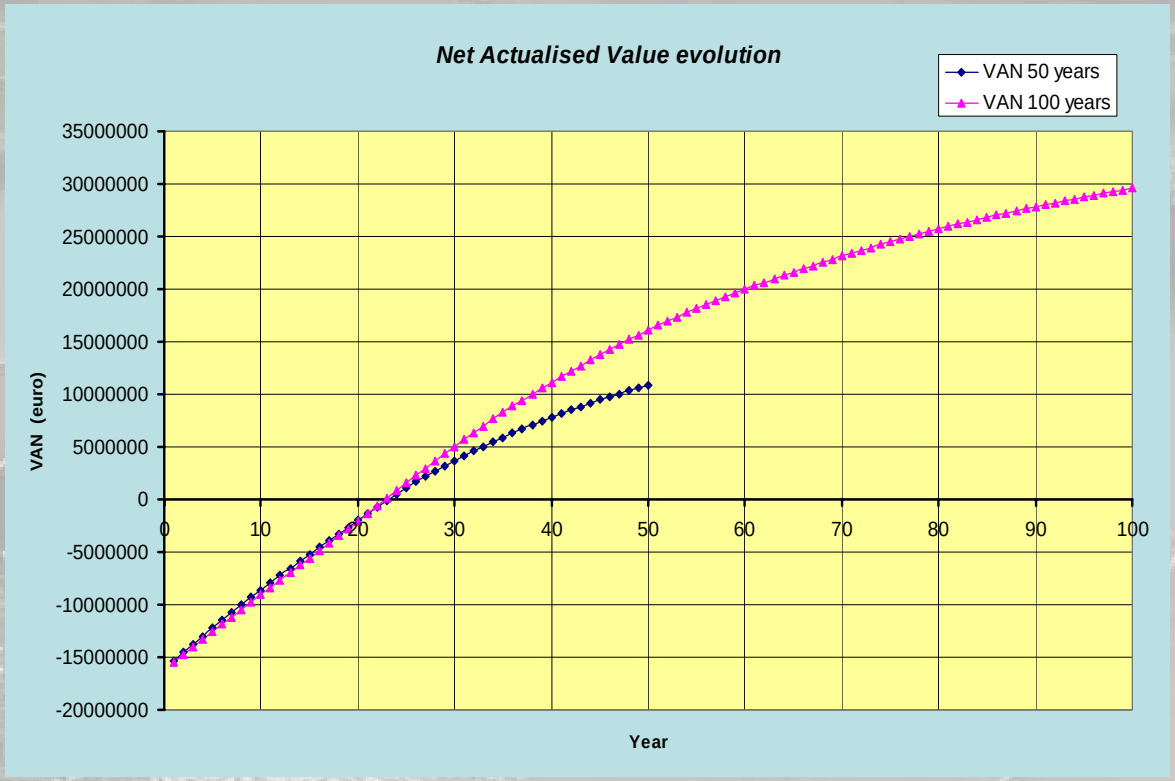
$$VAN = -I_0 + \sum_{t=1}^{n} \frac{\text{Annual Cash Flow}}{(1+i)^t}$$

- ***The Intern Profitability Rate*** shows the investment rate for which the Net Actual Value is equal to zero, like in the formula below:

$$I_0 = \sum_{t=1}^{n} \frac{\text{Annual Cash Flow}}{(1+\text{TIR})^t}$$

4. Economical analysis

4.2 Results



Net Actualised Value evolution for 50 and 100 years lifespan for the civil works/25 and 50 years for the electromechanical installations

- the initial investment will be recovered during the 23rd year when the VAN becomes positive and the project has 100-years lifespan, and in the 24th year when the project has a 50-years lifespan;

- the calculated Intern Profitability Rate is about 5,88% in both cases.

THANK YOU FOR YOUR ATTENTION!

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