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Transient Analysis of FMHL+ Pumped-Storage Power Plant and New Surge Tank Design

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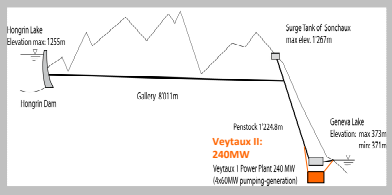
Motivations:

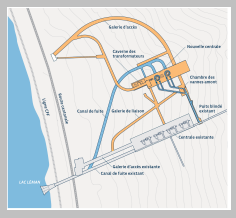
- Modification of energy context: Increasing penetration of New Renewable in Europe
- Pumped storage is massive, efficient and cost effective solution for energy storage
- FMHL PSPP in operation since 1971: Opportunity to increase capacity, flexibility and redundancy
- FMHL+ project: Increase capacity from 240MW to 480MW, limited to 420MW with 60MW reserve
- Constraints: Same waterways (headrace tunnel and penstock) with discharge increase from 32m³/s to 57m³/s in turbine mode and 24m³/s to 43m³/s in pumping mode
- Extensive Transient Analysis performed at early stage demonstrated need for surge tank modifications with respect to low pressure problem in headrace tunnel and overflow risk

FMHL+ Project:

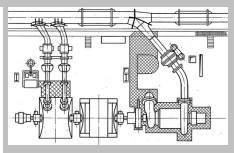
PSPP Layout:



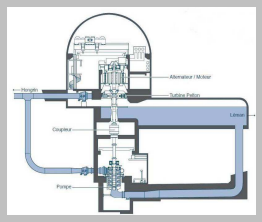
FMHL Power Houses:



Veytaux I: 4x60MW

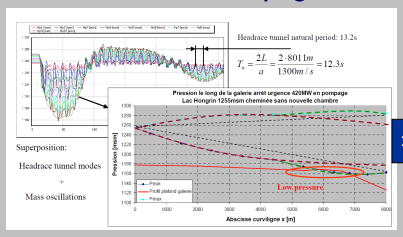


Veytaux II: 2x120MW

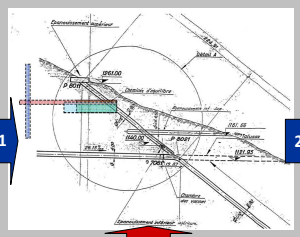


Problematic and Solutions:

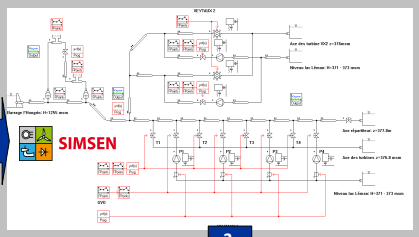
Low Pressure in Headrace Tunnel for ESD @ 420MW in Pumping mode:



Variant Study for Surge Tank Modifications:



FMHL+ SIMSEN Simulation Model:



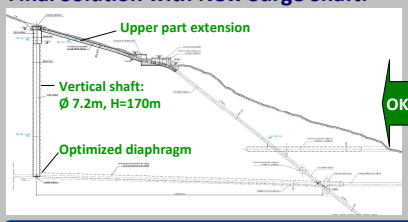
1

2

NO

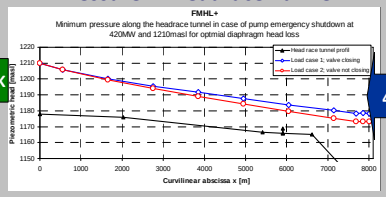
3

Final Solution with New Surge Shaft:



OK

Min. Pressure in Headrace Tunnel:



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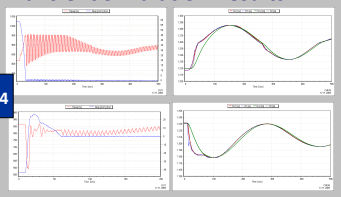
Transient Simulation Results:



Conclusions and Recommendations:

- Validate model of existing PSPP to minimize uncertainties
- Use appropriate models for the headrace tunnel with elastic behaviour with respect to low pressure risk in tunnel in pumping mode
- Have different independent transient computations performed in parallel
- Minimize uncertainties by confirming input data: using model testing, physical modeling, and Computational Fluid Dynamics (CFD)
- Have good collaboration between the Owner, the Engineer, the experts and the suppliers

Affiliations:

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