
# XFLEX HYDRO
# Extending Flexibility
# Case of Grand Maison PSP

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*JL DROMMI, B JOLY, D AELBRECHT*

*Ch NICOLET, Ch LANDRY, C MÜNCH, J DECAIX*

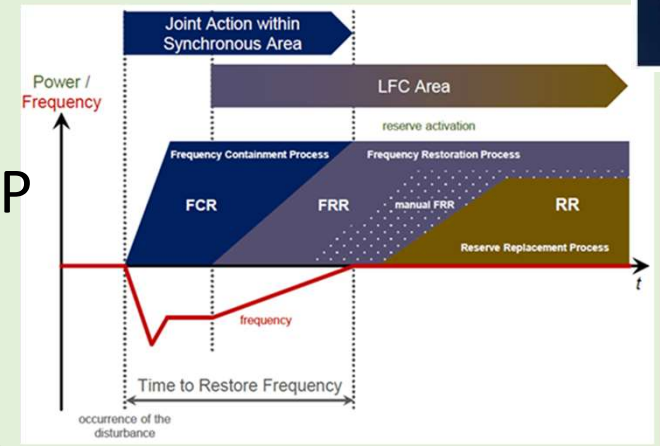


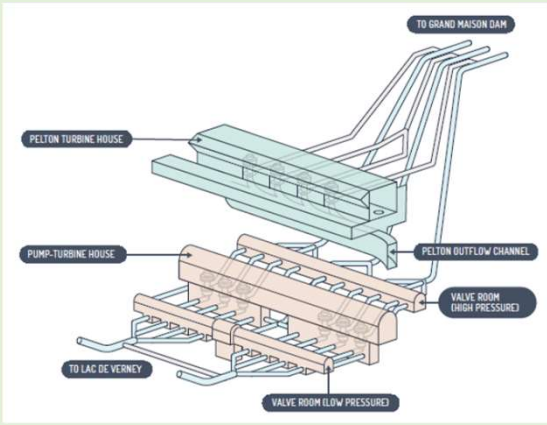
- European policy towards energy transition
- Increasing share of REN becomes a challenge
- Specific call for Hydro Flexibility improvement
  - Call for industrial scale demonstrators

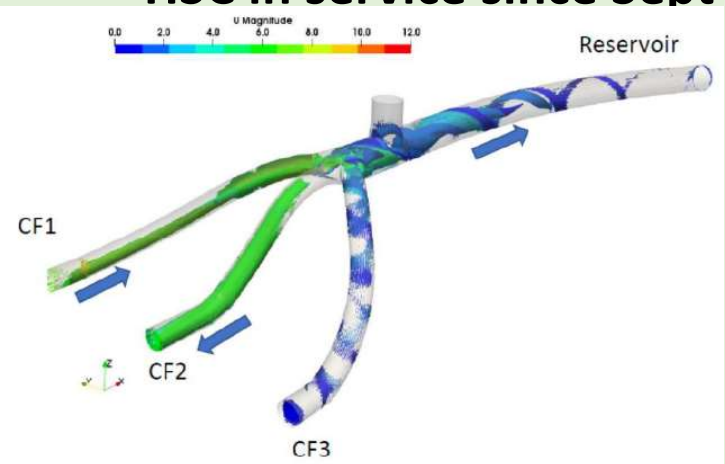

- XFLEX HYDRO : 2019-2024
- Consortium 19 partners : 20 M€ budget
- 6 demos TRL7
  - 2 at EDF Sites : Vogelgrun Hybrid; Grand Maison HSC

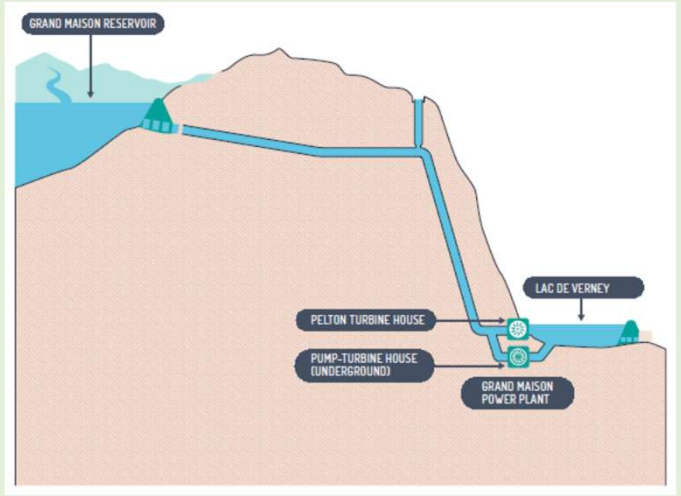
# Grand Maison : Flexibility Goal

- PSP : 1800MW largest in Europe
  - 8 Pump Turbines + 4 Pelton
- Demonstrate flexibility of existing PSP
  - Contribute to grid frequency control
    - During low demand period
    - Or excess generation
  - Provide regulating power in pump mode
  - Use Hydraulic Short Circuit technology
  - **HSC in service since Sept 2021**

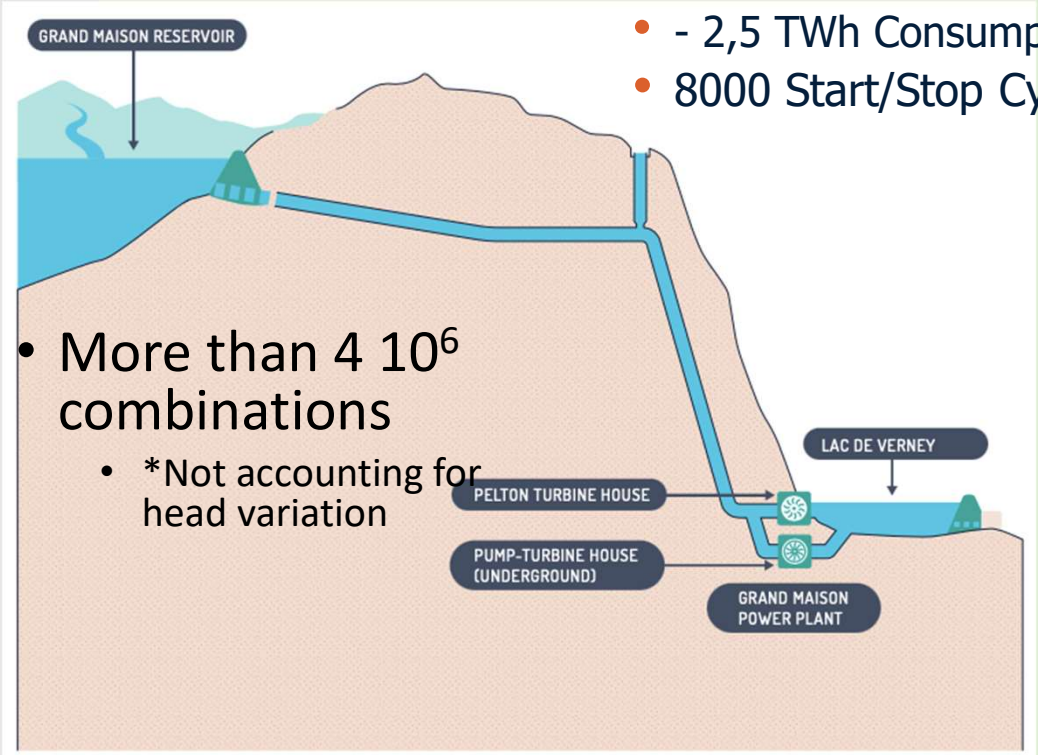
XFLEX HYDRO

# Schematic of PSP

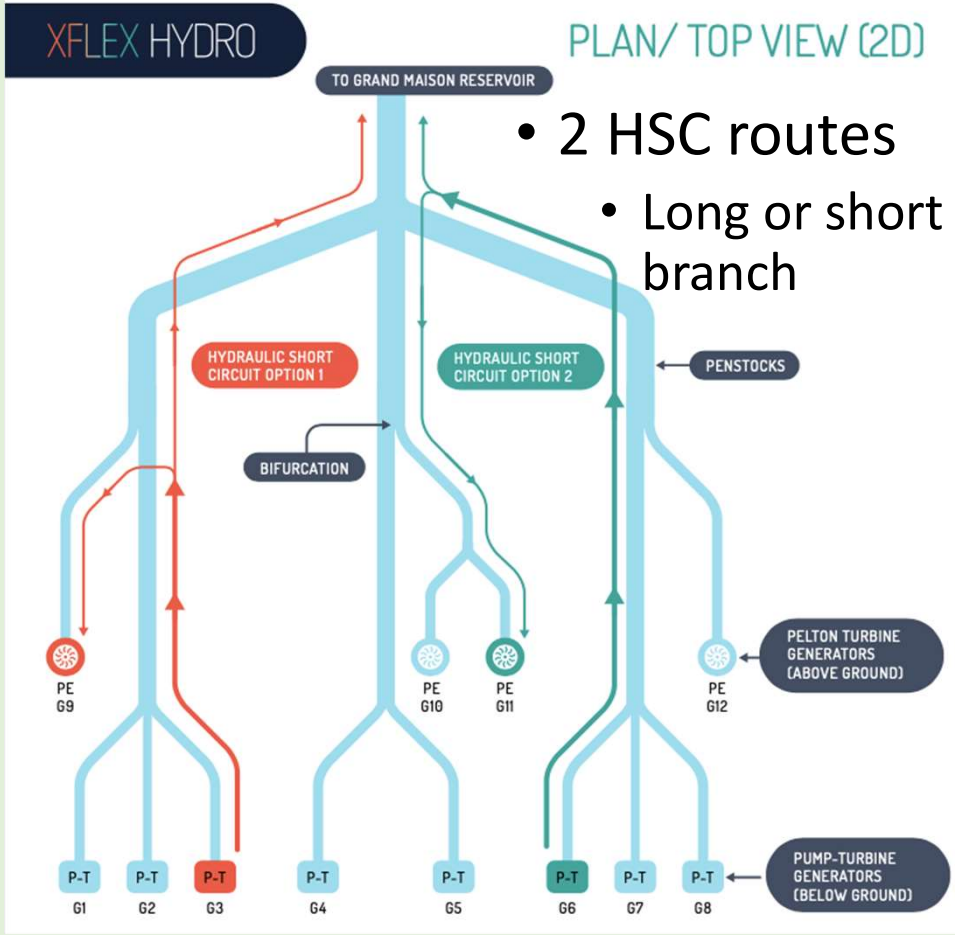
- 2 Réservoirs
  - 150Mm3
  - 15Mm3

## 2 Power station

- 4 Pelton
- 8 Pump Turbines
- 2 TWh Generation
- - 2,5 TWh Consumption
- 8000 Start/Stop Cycles




- More than 4 $10^6$ combinations
  - *Not accounting for head variation

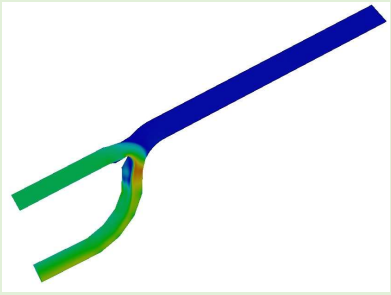


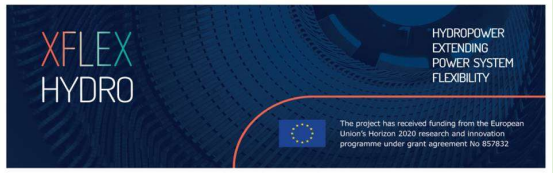

- 2 HSC routes
  - Long or short branch

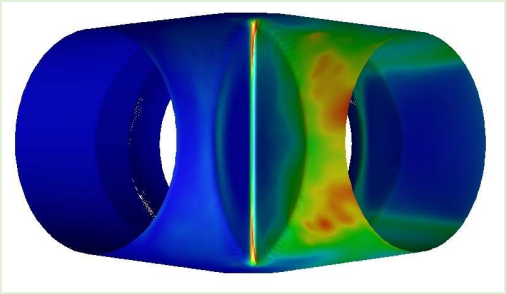
- HSC in operation Sept 2021
- >3000 hours of HSC operation so far
  - 56% of pumping time

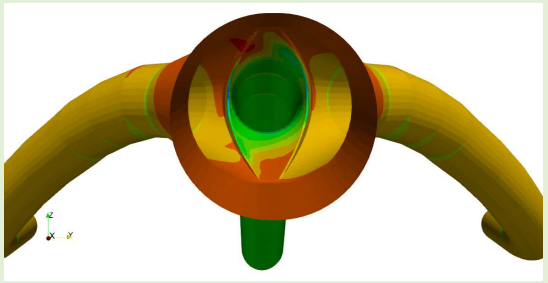
# Scalability of HSC concept

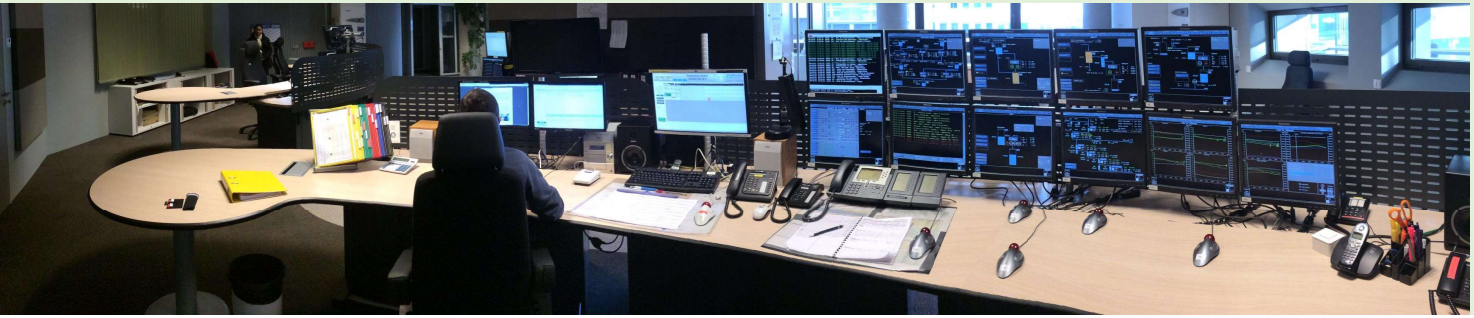
- HSC concept applicable to the whole plant
  - From 1 to all 4 Pelton at Grand Maison
  - Performance table (18 000 simulation)
  - 1D and 3D flow calculation
  - Ensure no harm to existing asset
- Looking for more flexible operation
  - On the fly turbine operation
    - Pelton Direct Tranfer from Launch to Turbine mode
    - Saves Start Stop cycles
    - Improves Pelton turbine availability





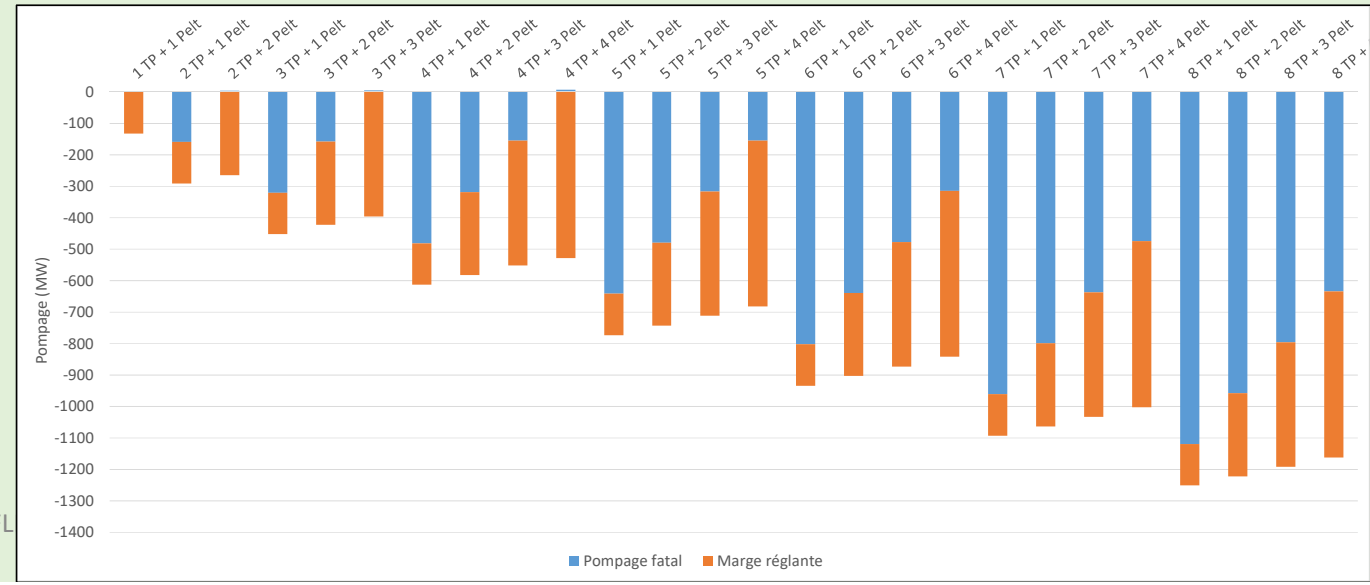







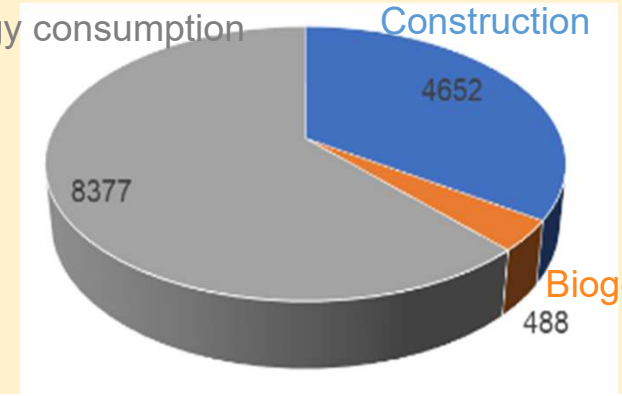
# Regulating Power in Pump mode

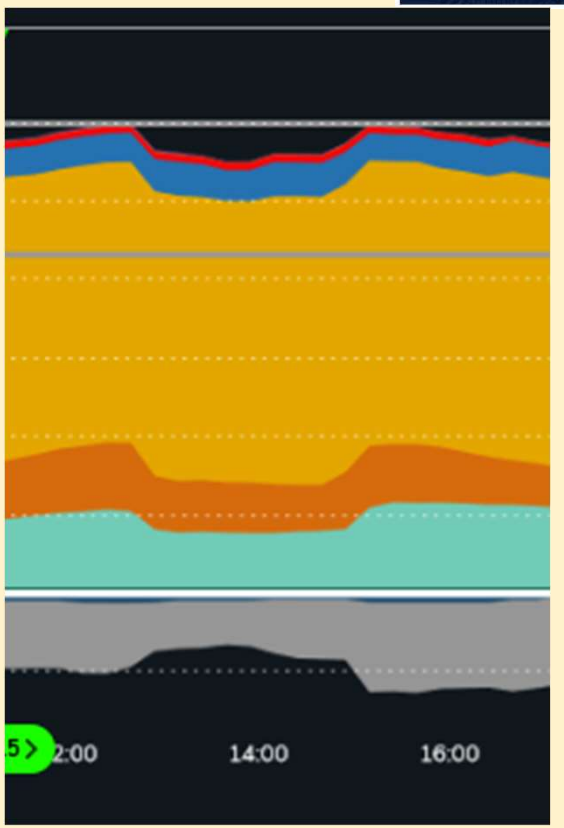
- Adjustable power in pump mode
- Offers frequency control from demand side
  - Up to 500MW adjustable band available in 100s
- Economics based on aFRR revenues
- Overall generation fleet optimisation
  - Less fossil units operated for FCR/aFRR purpose during low demand periods
  - More efficient use of the whole generation fleet



# Favourable $CO^2$ impact

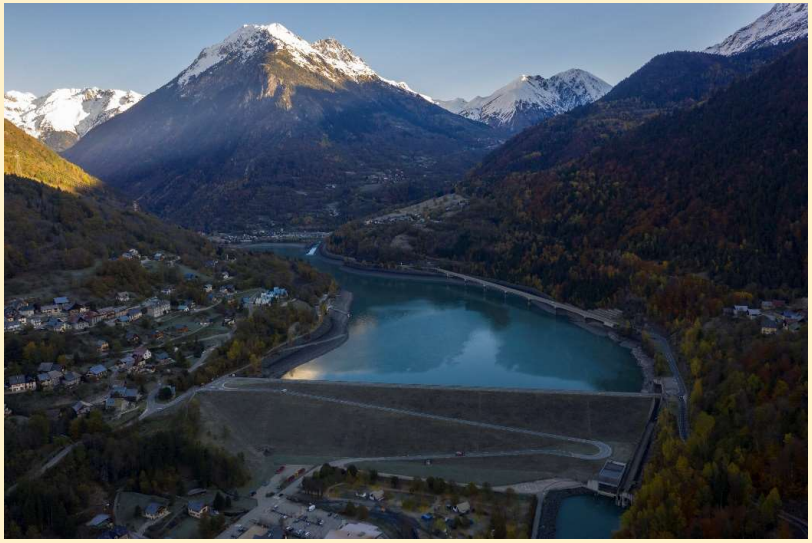
- Adjustable demand at PSP reduces  the need to call fossil (gaz) for grid frequency control
- Up to 90 000 tons reduction in $CO^2$ emission at EDF perimeter
- PSP Grand Maison carbon footprint is low
  - 4 to 6 $gCO^2/kWh$ exchanged with the grid
  - Thanks to low carbon energy during pumping



# XFLEX and Beyond

- Achievement of team work
- Easy to operate
- Positive $CO^2$ impact
- Scalable to other units and other PSP



# Thank you

*Crédit photos et illustrations :*
*IHA, EDF, Matthias Magg*

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