[186] Upgrade of the Grenoble High Magnetic Field Facility

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Status: build in 1990 with several upgrades in order to improve reliability and safety but with the same 24 MW power level since 25 years

Aims: Generate higher fields with 36 MW / Allow rapid field sweep with numerical control / Master electricity cost with HTB Grid access

Schedule: 30 MW on magnet will be available at the end of step 2 in 2021 and 36 MW at the end of step 3

FIRST STEP

GR2 power converter [just finished]

From 2*6 MW to 2*9 MW on GR2 including new

- HTA protection & distribution
- Process transformers
- 2*9 MW and 24 pulses rectifiers
- Numerical control on GR2 & GR1 to dedicate set control parameters for each magnet

Hydraulic upgrade from 24 to 36 MW [on going]

- OUTER LOOP: same ΔT (T_{out} = 29°C max) $\Rightarrow$ flow increases

From fixed 1200 m³/h to variable flow (800 to 2000 m³/h)

- INNER LOOP: same flow $\Rightarrow$ ΔT increases from 20°C to 30°C / new heat exchanger

SECOND STEP

225/15 kV transformer [under study; for 2021]

From HTA (15 kV) to HTB (225 kV) grid to reduce costs & increase stability

THIRD STEP

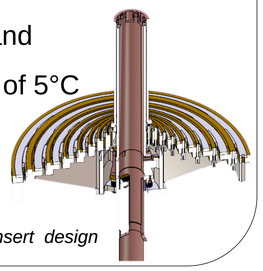
18 MW power converter for GR1 [under study]

Magnets for 30 and 36 MW [under study]

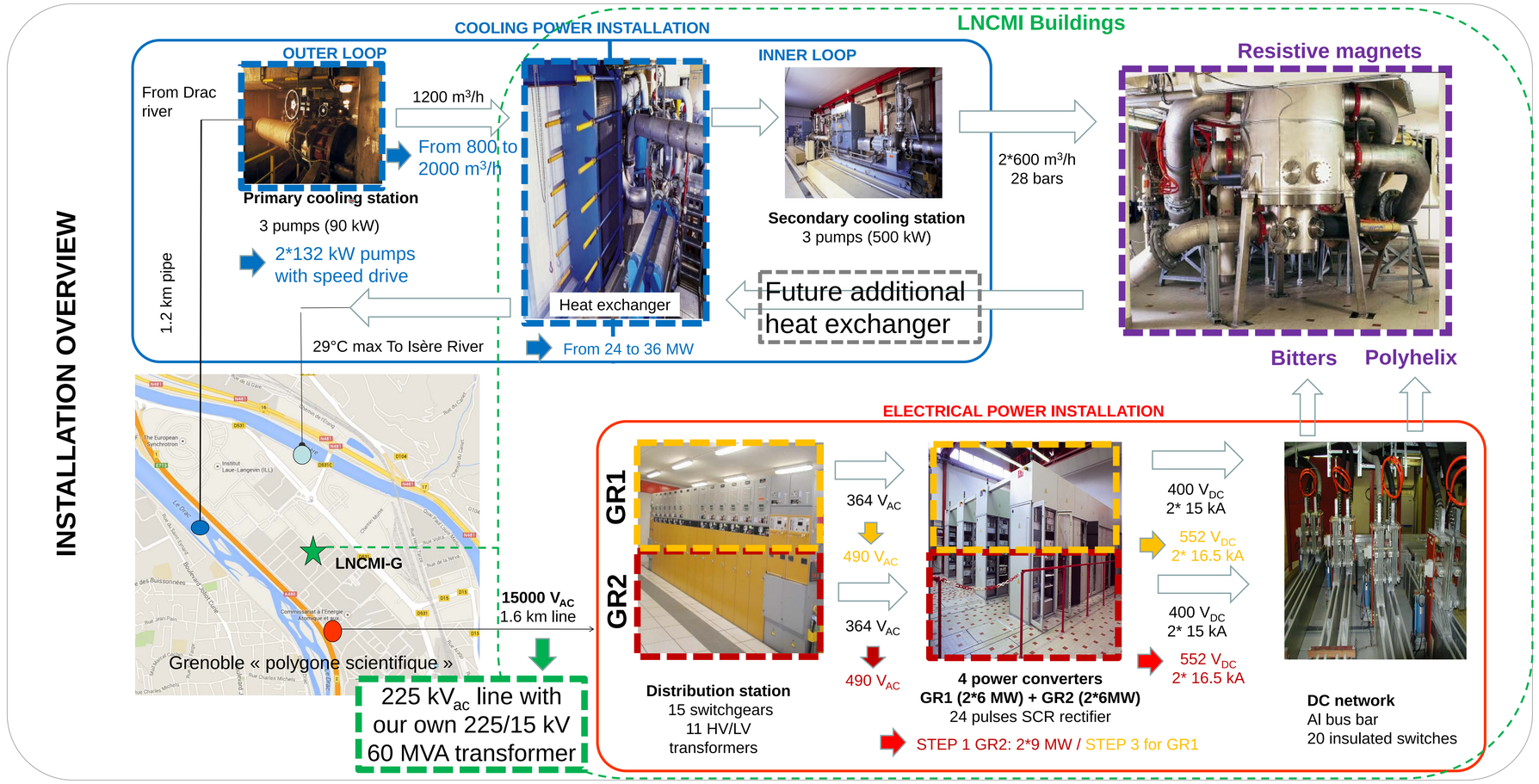
Same housing as 24 MW case

2 sub-magnet structure:

- Bitter: reach stress limit and increase mean temperature of 5°C
- Polyhelix: new design & and new materials



from 14 to 18 thinner helix insert design



Conclusion

- First step is ending
- Hybrid field of 43 T in 2019 with 24 MW
  $\Rightarrow$ 46 T in 2021 with 30 MW
- Pure resistive field of 40 T in 2021 with 30 MW

Perspectives

- Add an heat exchanger on the inner feedback loop in order to:
  - allow maximum power of 36 MW all year long
  - promote calories process by connecting to buildings heating systems
- Improve electrical power quality by reducing reactive power and harmonic pollution