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Numerical study of the Martelange mine to be used as lower reservoir for constructing an Underground Pumped Storage Hydropower plant

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Energy Storage Systems are needed to increase the efficiency of current and future renewable energies, whose production cannot be adapted to the demand. In this context, Underground Pumped Storage Hydropower (UPSH) using abandoned mines has been considered as a potential alternative. In these plants, the excess of electricity would be stored by pumping water from the underground reservoir (abandoned mine) to a surface reservoir, while electricity would be produced (when the demand increases) discharging the water from the surface into the underground reservoir. The main concerns arise from the water exchanges occurring between the underground reservoir and the surrounding medium. These exchanges are relevant in terms of environmental impacts and efficiency. Although the problem has been considered synthetically, real cases have not been considered.
The Martelange old slates mine (Belgium) is considered in this work to be used as underground reservoir for a future UPSH plant. The slates mine was exploited using the ‘room and pillar’ mining technique. The remaining volume that can be used as underground reservoir consists in 9 underground adjacent chambers whose bottoms are located at different depths. Impact of the water exchanges on the environment and on the efficiency are predicted numerically and considering different realistic scenarios concerning the energy demand evolution as well as different solutions to rehabilitate the site.