

# Hydrogeological conditions required for Underground Pumping Storage Hydroelectricity (UPSH) in old mines

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## Abstract

Renewable energy sources, because of their intermittence, could not afford a stable production and an adequate variability according to the energy demand. Underground Pumped Storage Hydroelectricity (UPSH) using abandoned mine works is an interesting alternative, in flat regions, to store energy during low demand periods by pumping water from an underground mine to an upper reservoir.

From the hydrogeological point of view, two considerations can arise for studying the feasibility before constructing an UPSH plant: 1) the alteration of the natural conditions of surrounding aquifers, and (2) the efficiency of the plant depending on possible leakage in the cavities from the hydrogeological environment.

A potential old slate mine was selected through a multi-criterion method and its geometrical and hydrogeological characteristics are used to build a simple but typical model. With the help of the HFEMC approach implemented in the code SUFT3D (HEG-ULg), the groundwater flows are modelled for a representative cavity.

Simulations of groundwater flow induced by a UPSH system are performed and the main variables are identified. Piezometric heads around the reservoir oscillate, the magnitude of the oscillations and the time to achieve a pseudo-steady state (magnitude and head reached during oscillations not varying anymore with time) depend on the boundaries, the parameters of the aquifer and the characteristics of the underground reservoir.

The required hydrogeological conditions are deduced and a screening methodology can be proposed to assess the main impacts caused in aquifers by UPSH plants. Their efficiency regarding the water level evolution inside the reservoir is also considered accommodating the cyclic pumped storage schemes.

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