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Study of the effects of low head Pumped Hydro Storage technology on coastal environment and fish passage

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Low head Pumped Hydro Storage (PHS) has been considered an opportunity for energy storage since the rise of wind and solar energy development in Europe. The study of environmental aspects (siting, fish friendliness, and land use) therefore plays an important role in the ALPHEUS project (Augmenting Grid Stability Through Low Head Pumped Hydro Energy Utilization and Storage), which is a project funded by the European Union's Horizon 2020 program. The principal aim of the project is to improve reversible pump/turbine (RPT) technology to make pumped hydro storage economically viable in coastal environments. Within the project, one of the objectives is to evaluate the impacts on the coastal marine environments of a low head pump hydro device at a preliminary level. The area designated for the implementation of the prototype test site is in the North Sea. The project will evaluate a variety of measures to either prevent fish from entering machinery or maximize the survival rate of fish passage.

This study is part of the ALPHEUS activities that investigate environmental aspects, and, focuses on the production of a protocol for PHS with the identification of the characteristic elements of each test site as part of the application of the MSFD (Marine Strategy Framework Directives) principles. It is, therefore, possible to evaluate in advance which environmental components are potentially affected by seawater PHS devices. The descriptors that are affected by PHS interactions are D1, D3, D6, D8, D11. D1 and D3 descriptors are focused on biodiversity and on commercial fish health, for this reason, an in-depth study of the effects on fish is required. Considering this, it is applied an innovative methodology for the assessment of potential impacts, injuries, and mortality rates on selected fish species. Fish friendlessness is estimated using software called Biological Performance Assessment (BioPA) that assimilates hydraulic field data, Computational Fluid Dynamics (CFD) results, and laboratory fish-injury studies. This tool gives the probabilities that fish will encounter hazardous conditions during passage through specific regions of the turbines and the impacts induced by hydrodynamic stressors.