Abstract

This PhD thesis focuses on the development of Water Energy Point Absorber (WEPA) for efficient energy and freshwater production. The dissertation starts with the case study analysis, where it presents the input data for assessing the testing site. A comprehensive review of existing wave energy harvesting technologies, with a focus on point absorber technology, is presented, as well as the theory background necessary to build a simulation tool. The thesis explores the optimization process, including the development of a modelling tool and parametric analysis for achieving the optimal configuration. Techno-economic analysis evaluates the economic feasibility of the WEPA system. The mechanical design chapter details the design of hull components, power take-off mechanisms, spring systems, sealings, and auxiliary systems. The electrical and control system chapter covers the design of electrical components and the architecture of control and communication systems. The mooring system is examined in a dedicated chapter, including the modelling process, design steps, and analysis to ensure an efficient and reliable system. Pre-installation testing is described, encompassing characterization and functional tests. A life cycle analysis evaluates the environmental impact and energy payback time of the WEPA system. Future works and potential improvements are explored, highlighting areas for further development. Overall, the dissertation provides a comprehensive exploration of the development process of the WEPA system from concept definition to final construction, highlighting its potential for sustainable wave energy conversion and freshwater production.