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浮游式黑潮渦輪發電機重量估計及轉變穩度計算
Weight Estimation and Transition Stability Calculation for a Floating Kuroshio Turbine

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摘要

本研究的目的在求掌握 20kW 級浮游式黑潮發電渦輪機(Floating Kuroshio Turbine; FKT)的重量、重心、浮力與浮心及其佈放時浸沒過程的轉變穩度(transition stability)，以確保完成初步設計的 FKT 具備足夠的穩度。為了細估 FKT 機組重量、重心，本研究進行了部份包含浮力引擎模組在內的組件設計，及彙整了 FKT 研發團隊針對其它組件已完成的設計成果，並應用所撰寫的 MATLAB 程式進行機組整體重量、重心及質量慣性矩的計算。此外，亦完成了可計算機組浮力、浮心及搭配浮力引擎操作的轉變穩度計算程式的擴充，並用以計算 20kW FKT 機組分別於初始艏仰及初始艏俯等二種狀況下，從水面浸沒至水下的轉變穩度變化。

本研究的計算結果顯示 20kW FKT 機組的縱向穩度較橫向穩度低，佈放過程中需多留意縱向穩度與浮力引擎進水量的關係；而機組於初始艏仰狀況時的轉變穩度會低於初始艏俯狀況，因此機組的組件配置需考慮重心與浮心的縱向位置，避免造成過大的初始艏仰角度，而降低轉變穩度。計算結果亦顯示前述兩種初始狀況下，機組縱向及橫向定傾高全程皆不小於 0.70 公尺，其值皆遠高於 IMO 對船舶初始穩度 GM 值不得小於 0.15 公尺之規定，顯示經過重量重心細估的 20kW FKT 機組具備了足夠的穩度。

關鍵詞：浮游式、黑潮、浮游式黑潮渦輪發電機、洋流渦輪機、重量估計、轉變穩度

Abstract

The purpose of the present study is to clarify the weight, center of gravity (CG), buoyancy and center of buoyancy (CB) of a 20kW rated Floating Kuroshio Turbine (FKT), as well as its metacentric height variation in the submerging process during deployment operation, so its transition stability can be confirmed. In order to estimate the weight and CG of the FKT in more detail, some of modules and elements including buoyancy engine are designed in the present study. Besides, accomplished designs of other modules or elements conducted by the FKT R&D group are also aggregated. A program basing on MATLAB software is developed to calculate the weight, CG and moment of inertia of the FKT as a whole unit. An existing program for calculating the buoyancy and CB of the FKT is also extended to be able to calculate the transition stability corresponding to the operation of buoyancy engine. The extended program is applied to calculate the metacentric height variation of the 20 kW FKT in the submerging process from two different initial floating conditions, one is trim by stern and the other one is trim by bow.

Calculation results show that the 20kW FKT with detailed weight estimation has sufficient transition stability for deployment operation.

Keywords: Floating Type, Kuroshio Current, Floating Kuroshio Turbine, Ocean Turbine, Weight Estimation, Transition Stability