Hydraulic Performance of Seawave Slot-Cone Generator Pilot Plant at Kvitsøy (Norway)

Margheritini, Lucia; Vicinanza, D.; Kofoed, Jens Peter

Publication date:
2007

Document Version
Publisher's PDF, also known as Version of record

HYDRAULIC PERFORMANCES OF SEAWAVE SLOT-CONE GENERATOR PILOT PLANT AT KVITSØY (NORWAY)

L. Margheritini, D. Vicinanza, J. P. Kofoed.

INTRODUCTION

This paper presents results on wave overtopping and loading on an innovative caisson breakwater for electricity production. A key to success for this device will be the low cost and the robustness of the structure. The construction of the pilot project of the SSG is foreseen for summer 2007: the full-scale module of the onshore wave energy converter will be 10 m width and will have three reservoirs one on the top of each other. A multi-level reservoir converter results in a higher overall efficiency compared to a single-level one, because it optimizes the storage of the potential energy in incoming waves.

To determine the overtopping flow rates into the single reservoirs is then very important to understand the dynamics of the device and to evaluate its efficiency in the conversion of wave energy into electrical energy delivered to the grid. It is to be noticed that the differences between SSG and breakwaters main structure are so large that experiences from coastal protection is unreliable to determinate wave loadings on the converter.

In order to optimize the SSG structure, comprehensive 2D and 3D hydraulic model tests were carried out at the Department of Civil Engineering, Aalborg University (Denmark) in the 3D deep water wave tank. The model scale used was 1:60 of the SSG pilot plant at the selected location on the west coast of the island Kvitsøy, near Stavanger (Norway). The work reported here contributes to the European Union Sixth Framework programme priority 6.1 (Sustainable Energy System), contract 019831, titled “Full-scale demonstration of robust and high-efficiency wave energy converter” (WAVESSG).

RESULTS

With regard to the wave loading on the structure mainly two different behaviours were identified: surging waves on the front sloping plates and damped impact water jet on the vertical rear wall in upper reservoir. Spatial distribution of wave pressures on the front plates was discussed. The pressure on the front plates were comparable with the one predicted by Takahashi and Hosoyamada (1994), even if a modified version of T&H formula shows a better response in terms of spatial pressure distribution.

The overtopping tests allowed the evaluation of the hydraulic efficiency of the pilot plant. During the tests, the waves and the overtopping flow rates into the single reservoirs have been measured and a comparison between 2D and 3D tests has been performed. Based on this, it has been found that when going from 2D to 3D structure, as well as from 2D to 3D waves and head-on to oblique wave attack, a reduction in the obtained efficiency of the device occurs.

The results of these studies are used for geometrical and structural design as well as stability evaluation of the pilot plant under construction.