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Conceptual Design of a Combined Power Generation Unit at the NPP Seaside

Kyung H. Cha
Korea Atomic Energy Research Institute
1045, Daedeok-Daero, Yusong, Daejon, 305-600, Republic of KOREA
khcha@kaeri.re.kr

1. Introduction

In order to improve operational performance, an undersea tunnel is being utilized for in-taking and out-taking seawater as coolant in Nuclear Power Plant (NPP) [1]. This paper describes a Combined solar-wind-wave Power Generation Unit (CPGU) to be specialized for in-taking and out-taking seawater as coolant in NPP. Accordingly, the purpose of the CPGU is twofold: one is to contain some tunnels to be maintained on the bottom of the CPGU body in order to in-take and out-take coolant water, and the other is to generate a combined power at the NPP seaside. Fig. 1 shows the conceptual CPGU to be configured at the NPP seaside.

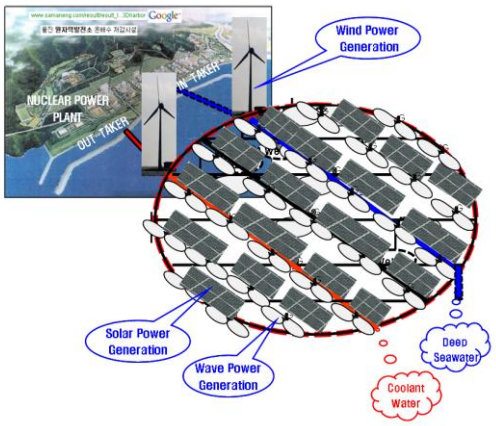

Fig.1. The CPGU concept.

2. Conceptual Design

The CPGU is designed to be maintained at the level of seawater. The CPGU consists of the Solar Power Generation (SPG) modules, Wave Power Generation (WPG) modules, WInd Power Generation (WIPG) modules, some tunnels, and body assembly including certain undersea supports. The power being generated by the CPGU can be used for maintaining the CPGU body, and the excess power can also be utilized for producing electricity. The produced electricity can be used for NPP or for charging batteries.

2.1 Configuration

The SPG modules are configured on the upper side of the CPGU body, the WIPG modules are configured between the in-taker/out-taker and the CPGU body, and the WPG modules are configured at the bottom of the CPGU body. The CPGU body can be positioned with some undersea supports or connections to an undersea tunnel if the undersea tunnel already exists.

2.2 SPG

The SPG modules are structured with the seawater-persistent solar cells. The structured SPG modules are configured on the top of the CPGU body. The SPG modules may be configured differently for WPG, in order to increase the utilization of solar cells. In this case, the SPG modules may be configured as moving up and down at the coaxes whenever a wave comes. It is assumed that the CPGU body can be maintained at the level of seawater. This configuration is purposed to maximize the WPG of the CPGU, because waves occur all night. Why the SPG sub-modules move up and down is because the solar cells can be more easily sustained against strong wind or waves. More efforts are needed for the better solution to resolve the problem.

2.3 WPG

The WPG modules are configured at the bottom of the CPGU body. The WPG can maximally activate the turbine generator when a wave length is equal to the length of two balloons. Fig. 2 shows a configuration of the WPG.

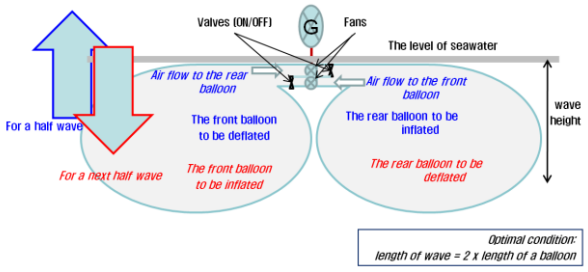

Fig.2. The WPG module using two balloons.

The wave power may be generated by the SPG modules, as described in section 2.2. The WPG of the CPGU shall be buoyant in the level of seawater, and moved up and down at the co-centric axis whenever waves occur. The WPG of the CPGU may reduce an NPP's risk to be caused by strong waves, because some power of strong waves are utilized for the wave power generation of the CPGU before strong waves come to the seashore of NPP. Fig. 3 depicts a configuration and mechanism of the WPG.

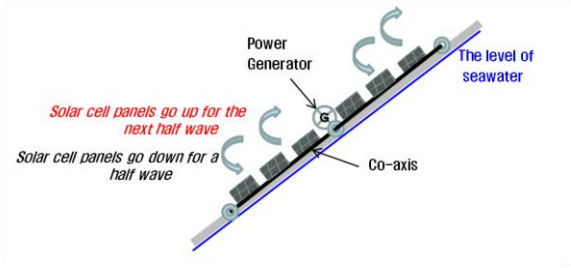

Fig.3. The WPG module using SPG modules.

2.4 WIPG

The WIPG can be realized with the commercial-off-the-shelf product for offshore, and its support can be utilized for the support of the CPGU body against hazardous weather conditions such as strong wind and waves.

2.5 In-taking and out-taking coolant water

The CPGU body contains some tunnels to be configured on its bottom, from in-taker and out-taker towards deep sea. The tunnels to be filled by coolant water can function as reducing the CPGU's up and down at the level of the seawater. Accordingly, the solar and wind power generation modules can be safe although strong wind and waves occur. This is the main reason why the CPGU contains the tunnels to be filled with coolant water. The tunnel may itself be structured for generating wave power and maintaining the CPGU at the level of seawater if greater effort is invested.

2.6 Other considerations

The CPGU can be controlled at and monitored to a computerized control center, according to weather conditions. More considerations need to realize the CPGU at the NPP seaside, because the CPGU shall not issue any problem for in-taking and out-taking coolant water. Some problems include the electric short among electric components of the CPGU, the seawater-proof of solar cells, and the protection of the CPGU components and assembly against strong wind, wave, moving objects, etc.

2.7 Application

The CPGU may reduce a strong wave power, because the wave power can be utilized for the wave power generation of the CPGU. In this case, the power to be generated by the CPGU can be utilized to reduce the strong wave power. In addition, electric power to be generated by the CPGU may be utilized for NPP or a Water Power System (WPS) for waste treatment [4].

3. Conclusions

The Combined Solar-Windy-Wave Power Generation Unit (CPGU) at the NPP seaside is a novel approach to take coolant water, and the CPGU concept can also be applied for thermal power plant. In addition, the CPGU configuration may reduce a wave power, because CPGU the wave power generation units of the CPGU utilizes the wave power. More efforts are needed for the better solution to realize the CPGU at the NPP seaside.

ACKNOWLEDGEMENT

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