29. Design for 1MW OTEC riser with HDPE pipe

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The KRISO (Korea Research Institute of Ship and Ocean Engineering) has a plan to develop the floating 1MW OTEC system at equator sea near Kiribati in South Pacific to supply the electricity to Kiribati by submarine cable. The size, configuration and construction method of an OTEC platform will depend on many factors: power output, site, type of installation (i.e. shore-based, bottom-mounted, floating but moored or cruising), method adopted for minimizing interaction between platform motions associated with sea conditions and riser motions, produced electricity transportation, and optimal system characteristics that will maximize efficiency and minimize cost.

The OTEC system designed by KRISO consists of the offshore floating structure and the plant producing electricity of 1MW from seawater temperature difference between surface and deep seawaters. The new concept for the OTEC riser is proposed in that a long and large diameter HDPE pipe in 0.95 density is reinforced with wire ropes along the riser and a lumped weight attached at the riser bottom. The main components of 1MW OTEC structure are shown as following; Floating body, Riser : Long HDPE(High Density Poly Ethylene) pipe reinforced with wire ropes and lumped weight, Mooring lines : Semi-taut mooring system in 4 points spread type

The platform specifications, materials, mooring system, internal equipment, etc. have been designed to be satisfied with the adequate safety requirements of the sea conditions. The riser pipe standing vertically hung on the platform intakes deep sea water from the depth of 1100m. The material is HDPE (high density polyethylene) in order to have a strong advantage for insulation and against oxidation and corrosion. The service life of the platform is 20 years and the design requirements for the structure are based on the return period of 100 years sea environmental conditions.

The selected HDPE pipe with lower density and weak strength is reinforced with an additional lumped weight attached to the end of a riser and connected to a floating platform with four wire ropes along the riser. This additional weight at the bottom end of a riser is to minimize the motion of the riser.

The two design requirements for riser system is defined: the first is the bottom end of riser should not be lifted over 10 % of water-depth at operating condition in order to take the deep seawater continuously. The second is the riser should be safe in the harsh ocean environmental condition. The results of dynamic riser stress analysis are performed. The maximum stress along the riser corresponds to 9.45 MPa near sea surface due to the extreme wave and floating structure motion. The bending stress near top of the riser dominates, but the axial stress near bottom of the riser does. The effect of the bending moment at the riser rapidly diminishes with the water depth by the structural and hydrodynamic damping. Safety ratio of the maximum stress on the riser is 2.75 that satisfies the allowable safety factor. It is verified that the designed riser is sufficiently safe even for the harsh ocean environmental condition.

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