

Offshore wind farm construction within precautionary action zone of nuclear power plants

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Summary

Most critical obstacles for offshore wind farm construction in Korea are environment impact, public acceptance and grid connection. Although the government sets up Renewables 3020 which intend to produce 20% of national total energy production by renewables up to 2030, it's not easy to achieve the goal without any breakthrough overcoming those obstacles. Considering those given circumstances in Korea, a nuclear power plant shut down or to be shut down permanently can be a possible way out. In this regard, an offshore wind farm built in precautionary action zone of a nuclear power plant has been studied in aspect of technological and economic feasibility.

1. Introduction

Kori nuclear power plant has 4 nuclear reactors with total installed capacity of 2.8GW. Unit #1 reactor commissioned in 1978 and permanently shut down in 2017. As a consequence of the shutdown, the substation of Kori NPP has reserve capacity of 585MW, which can be utilized to accommodate offshore wind farm. For safety purpose, every nuclear power plant has precautionary action zone (PAZ), which is 5km in radius for Kori NPP as indicated in Fig. 1.

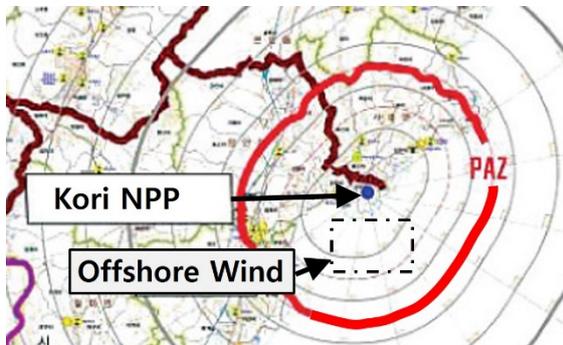


Fig. 1: Precautionary Action Zone for Kori NPP

If offshore wind farm can be built in PAZ, then the government initiative of Renewables 3020 could gain more support from stakeholders and the public.

2. Grid connection thru Kori substation

Kori Unit #1 and #2 are connected with 345kV switchyard. As Unit #1 is shutdown, power output from offshore wind farm has to be transmitted to 345kV line, which is shared with Unit #2 still in operation.

Power output from wind energy changes continuously in terms of wind speed that could affect on safe operation of Unit #2 reactor.

In this regard, fault current and power flow in steady state have been analysed. In dynamic analysis, transient stability with grid frequency and voltage has been simulated.

3. Structural safety analysis

Structural failure of wind turbine tower or blades have been observed due to diverse causes in many wind farms. When offshore wind farm in PAZ is considered, the first priority is to secure structural safety of nuclear power plant in any circumstances caused by wind turbine failures. In structural safety study, the authors assume that debris of failed blade hit concrete containment building of a nuclear reactor and performs numerical analysis using smooth particle hydrodynamics modelling to prevent from mesh distortion.

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