


کد سند: RO-S-F-28-02	معاونت پژوهشی	
تاریخ صدور: ۱۳۹۹/۴/۲۲		
تاریخ ویرایش: ۱۳۹۹/۵/۱۵	فرم خلاصه انگلیسی طرح/پروژه	پژوهشگاه نیرو

Project Title: The Application of Bulk Transmission Systems to Grid Integration of Wind Power Generation Plants

Department:	The Center of Bulk Transmission Systems	Employer:	Niroo Research Institute
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Project Financial Code:	126006	Project Quality Code:	PPTPN03
Type of Project/Program:	In-House	Assistant:	Technology

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Project Necessity:

Today, the use of wind turbines to generate electricity at high speeds is expanding. On the other hand, with the development of wind turbine manufacturing technology, the capacity of these turbines has increased to high values, and this has caused the production capacity of wind farms to increase to GW. The transfer of this volume of wind farm production capacity to the network has become one of the main problems in the use of wind turbines, because:

- Windy areas are usually far from residential areas (on the one hand, urban buildings reduce wind speed, and therefore in residential areas, wind speeds are usually low, and on the other hand, humans are less inclined to live in windy areas). On the other hand, power transmission networks are usually developed near residential areas. Therefore, there is usually a large gap between windy areas and the transmission network.

- Due to the high negative impact of wind turbines on the power quality of the network (such as dip voltage, harmonic and flicker production), wind farms are usually connected to higher voltage levels than thermal power generation units with similar capacity.

- Some wind farms are built in the sea (offshore wind farms) and therefore the transfer of production capacity of these farms must necessarily be from the water and from the sea floor.

- In some cases, there are special natural features in the distance between the wind farm and the access point to the network (such as the forest) that environmental laws do not allow the construction of high pressure lines in that area or impose restrictions on line privacy (almost In Sweden, the construction of a high-potential wind farm was canceled due to the location of a forest along the farm to the point of access to the network).

Due to the above, the use of new power transmission technologies to connect large wind farms to the network has been considered by researchers and experts in the electricity industry and has been used in several projects. In addition to the above, another use of new power transmission technologies to connect wind farms to the grid is related to direct drive type wind turbines. In this type of turbine, a synchronous generator is used to generate electricity. Due to changes in wind speed and therefore changes in mechanical power generated by wind turbines, the frequency of electricity generated by this generator is variable. Therefore, it is necessary for one converter to first convert the generated power to DC power and then by another converter, this DC power to be converted to AC power with a constant network frequency. In some projects, instead of converting DC power to AC at the same wind farm location, this DC power is transmitted by HVDC lines to the grid connection point and then converted to AC. In other words, if HVDC lines are used to transmit power to direct drive type wind farms, there is no need to construct an inverter substation at the beginning of the HVDC line.

Project Goals:

- 1- Feasibility study of using high capacity power transmission technologies to connect wind farms to the network for Iran in the future
- 2- Applications of high capacity power transmission systems for connecting wind farms in 1410 in Iran

Abstract:

In this project, in the first step, the desired call and inquiry for outsourcing was done and after technical and economic review of the submitted proposals, a suitable contractor was selected to carry out the project and a contract was concluded with him to carry out the project.

In the second step, projects in which high-capacity power transmission technologies have been used to connect wind farms to the network, as well as the references that have been presented in this regard, and the characteristics of the farm have been introduced. Wind and network were checked.

In the third step, by examining the references introduced in the first stage, indicators were introduced that in what conditions and with what characteristics (from the network and wind farm), to connect the wind farm to the network of power transmission technologies Used with high capacity. In this regard, items such as wind farm type, wind farm capacity, wind farm utilization coefficient, wind farm distance to the network, environmental conditions of the area for wind farm power transmission, special characteristics of power transmission network, type of high capacity power transmission technology used The economic issues of the project were also considered.

In the fourth step, projects with a license or under construction for a high-capacity wind farm in Iran were identified. Also, by reviewing the published sources, areas of Iran where there is a high potential for the construction of high-capacity wind farms were identified. Then, by examining the conditions of the region, potential areas for the construction of high-capacity wind farms in Iran were introduced and the estimated capacity of the wind farm to be constructed in that region was determined.

In the fifth step, by considering the indicators introduced in the second stage, and by examining the characteristics of the potential areas introduced in the third stage, it was examined in which of these areas the conditions for using the technology There are high-capacity power transmitters for connecting the wind farm to the grid (mentioning the type and general characteristics of the technology).

Steps and Methodologies:

- 1 -Review of thematic records
- 2- Identifying and introducing indicators for using high-capacity power transmission technologies in connecting large wind power plants to the grid
- 3- Identifying and introducing potential areas for the construction of high capacity wind farms in Iran
- 4- Identifying and introducing potential cases of using high capacity power transmission technologies to connect wind farms to the network in Iran

Main Results (technical outputs, patents, papers, books, reports, etc.):

- 1- Technical report Identifying and introducing indicators for using high-capacity power transmission technologies in connecting large wind power plants to the grid
- 2- Technical report identifying and introducing potential areas for construction of high capacity wind farms in Iran
- 3- Technical report identifying and introducing potential cases of using high capacity power transmission technologies to connect wind farms to the network in Iran