Forecasting System Development of Variable Renewable Power Generation for Kinmen Island

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(I) Background

In 2013, the Executive Yuan proposed the policy of creating a Kinmen low carbon island, with the goal of carbon neutrality by 2030. As a result, Taipower company has installed wind turbines with a capacity of 4MW in Kinmen Jinsha, and PV systems with a capacity of 791.7kW in Jinsha Cultural Park, Tashan Power Plant and Queshan Substation. In recent years, with the government's promotion and subsidy measures, the installed capacity of PV systems in Kinmen area has also increased rapidly. By the end of 2021, the installed capacity of PV systems reached 10.88MW. The generation of PV systems in Kimmen has exceeded 30% of the daytime load in winter. However, wind power generation and solar power generation are intermittent energy sources, and the fluctuating power injection into the grid would easily lead to instability of the power system. Unpredictable output would increase the difficulty of power dispatch and the cost of grid operation. In response to the increasing proportion of intermittent renewable energy in the grid, TPRI has carried out research on forecasts on wind power generation and solar power generation respectively. In addition to the flexible generator and the energy storage systems, renewable energy generation forecasts would be another key factor to whether these two kind of renewable energy sources can be integrated into the grid in large quantities or not.

(II) Method

The methods of renewable energy generation forecast include Statistic Model and Physical Model. Statistic Model is based on learning the correlation of historical power generation data or meteorological observations data to forecast. The main forecasting techniques include Persistence model, time series method (ARMA, ARIMA), Artificial Neural Networks, statistical model, wind field model and intelligent forecasting model, etc. Physical models in atmospheric science use fluid equations, atmospheric physical/chemical models, or radiation and energy conversion in the atmosphere to forecast. Forecasting techniques include TSI, Satellite and numerical weather prediction (NWP, including WRF and GFS), etc. In practical applications, different forecasting techniques would be integrated in order to improve the accuracy of forecasting, and the advantages of each technique can redeem the limitation of individual model. Therefore, the forecasting model developed by TPRI apply artificial neural network and machine learning to develop and build power generation forecasting systems. (as Figure 1)

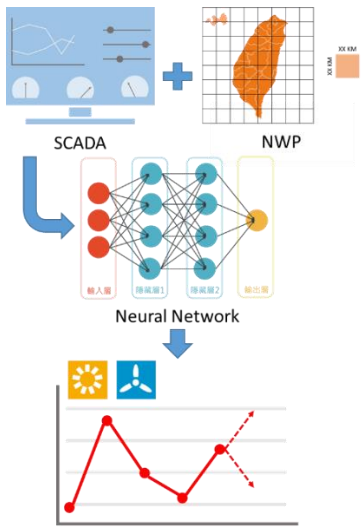

Figure 1 – Structure of forecasting system

(III) Result

TPRI has developed the following systems:

1. Net load curve of Kinmen power system. (as Figure 2)
2. 6/48 hours wind power forecasting system for Jinsha Wind Farm. Forecasting frequency is 15 minutes/1 hour. (as Figure 3)
3. Solar power forecast for Kinmen. Forecasting frequency is 1 hour. (as Figure 4)

The above forecasting systems provide dispatchers of Tashan Power Plant as a reference for unit scheduling and real-time dispatching.

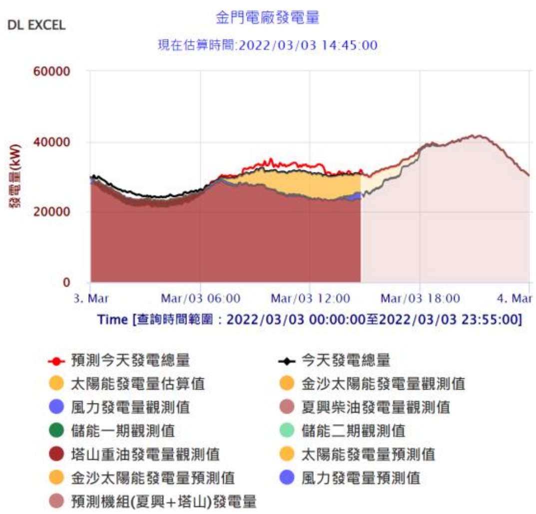

Figure 2 - Net load curve of Kinmen power system

Figure 3 - 6/48 hour wind power forecast for Jinsha Wind Farm

Figure 4 - Solar power forecast for Kinmen.

(IV) Conclusion

In order to keep the stability of power system, the supply and demand of electricity must stay in balance at all times. The output of the entire power system would follow the load changes to maintain the stability of the system frequency. Therefore, accurate and effective renewable energy generation forecast can reduce the fuel cost required for unit backup, and the uncertainty of power generation. The forecast results can also provide the dispatcher as a reference for scheduling units and estimating system backup capacity.