HYOSUNG CORPORATION

Study Committee C6

Active distribution systems and distributed energy resources

10331_2022

Demonstration of Cloud Based Management and Control System for Virtual Power Plant in Korea

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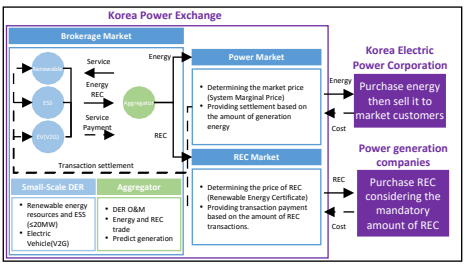
INTRODUCTION

- "Renewable Energy 3020 Implementation Plan" was announced in 2017.
  - Expand the supply of renewable energy with a goal of 20% of energy generation by 2030 in Korea
- Although a small-scale power brokerage market exists in the power market, market participation is low due to lack of economic feasibility.
- Virtual power plant(VPP) operation technology development project is in progress for the following reasons
  - cope with the uncertainty of the power system that accompanies the increasing distributed energy resources(DER)
  - expand market participation of small-scale renewable energy resources by introducing Korean VPP market system

SMALL-SCALE POWER BROKERAGE TRADE MARKET SYSTEM IN KOREA

- The small-scale power brokerage trade market system refers to a system in which brokers collect electricity energy produced/stored from small-scale DER, which capacity is less than 20MW, and trade in the power market
  Small-scale DERs include renewable energy source, energy storage system(ESS), and electric vehicles.



- The renewable energy generation forecasting incentive system was introduced in October 2020.
  Individual DER or aggregate resources which capacity exceed 20MW can be participated in system by the registration test
  Registered resources submit their forecast result for next day generation in twice and fulfil it within a certain error rate

Criteria for calculating the settlement amount of renewable energy generation forecasting incentive system

① Forecast error rate (%) = (Absolute value of (generation output − Forecasted generation) / Capacity of resource) × 100

② Capacity factor of main renewable energy resource (%) = (Electric generation output / Capacity of resource) × 100
(Apply only when the capacity factor exceeds 30%)

Forecast error rate	Less than 6% (≤ 6%)	More than 6% and less than 8% (6% ≤, ≤ 8%)
Forecasting price	4 Won/kWh	3 Won/kWh

OVERVIEW OF THE PROJECT

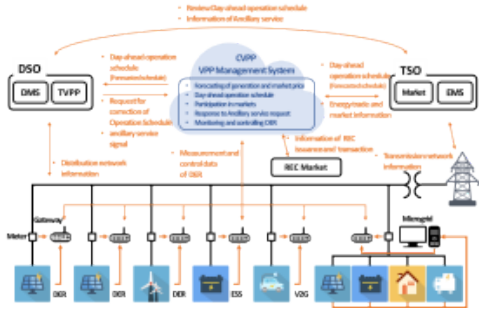
- The Purpose of the project
  - Developing VPP operation technology
  - Propose amendments in laws and systems for the introduction of the VPP market system, such as revising electricity market rules
- Types of VPP

Commercial VPP (CVPP)
- Aggregates capacity from DER units
- Optimizes revenue by scheduling operation of DERs and offering service
- The impact of the distribution network is not considered in the aggregated CVPP profile.
- Services/functions
  - Trading in the wholesale energy market
  - Provision of services to the system operator
  - Management of the aggregated DER

Technical VPP (TVPP)
- Uses individual DER inputs to manage local network
- Aggregates a distribution network area to characterize network at its point of connection with the transmission system
- Services/functions
  - Local system management for DSO
  - Providing TSO system balancing and ancillary service

CVPP MANAGEMENT AND CONTROL SYSTEM

- Concept of the CVPP system



- Functions of CVPP Mangement System

Forecasting Algorithm
- Forecasting system for establishing Day-Ahead Operation Schedule
- Aggregated renewable energy generation forecast
- Market price forecast

Optimal Day-Ahead Operation Scheduling
- Create an optimal operation schedule based on the forecasted value
- Optimization taking into account constraints to maximize profits
- Create a plan for each DER resource

Bidding Algorithm
- Submit operation scheduling results to DSO, bid on the energy market
- For successful bid, the bidding value may be modified by consensus with DSO
- Transmit the bidding results to the VPP Management system

Real-Time Dispatch
- Real-Time dispatch operation is performed based on the bidding results
- The bidding results for renewable energy may differ from the real-time generation
- In this case, the output is calibrated by the ESS
- Respond to TSO request for ancillary services

Calculating the Settlement
- Revenue is calculated according to the real-time operation result of VPP system
- The settlement ratio depends on the weight and performance of each DER resource

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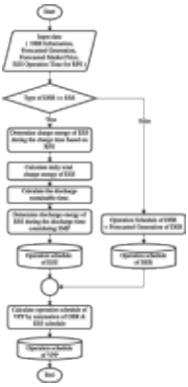
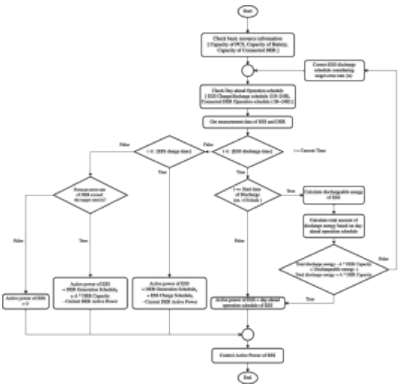
continued

Test Case

- Focus on day-ahead operation schedule and ESS schedule operation among CVPP functions.
- ESS performs charging/discharging at a set time to increase the profitability of the ESS under the influence of the renewable portfolio standard(RPS).



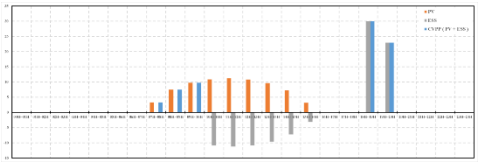
- the charge/discharge of the ESS so as not to exceed the forecast error rate range defined in the renewable energy generation forecast system.



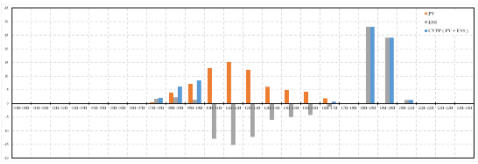
- Configuration of test system
  - 25kW photovoltaic generator
  - 30kW/68kWh ESS

Test Result

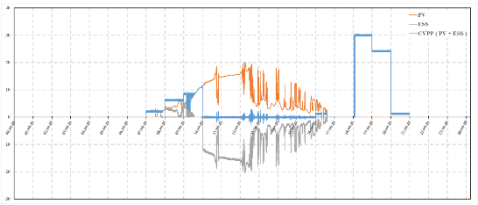
- Result of day-ahead operation schedule



- Result of daily metered generation (per hour)



- Time series data of daily metered generation (per seconds)



- the forecast error rate, which is the average normalized error of the time period when the capacity factor is 10% or more, was calculated to be 5.62%.

CONCLUSION

- Through the test, it was confirmed that data acquisition and control of DERs could be performed through the cloud-based operating system.
- After completing the construction of the demonstration site, the CVPP operation will be tested and the simulation of ancillary service response which is related to TVPP function will be conducted.