Demand Response Operation Method on Energy Big Data Platform

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***Abstract*— Energy management system should predict the future energy use and generation amount for the optimal operation of ESS based on the measured energy amount, renewable energy production amount and energy usage, and establish the operation plan. In this paper, we describe the technologies that can be saved through the analysis of big data of energy resources for renewable energy and present Demand Response Operation Method through big data analysis. Through this technology, it is possible to find new information by discovering patterns and correlations hidden in data, and to respond appropriately when issuing DR.**

Keywords*— *energy management, energy big data, energy information collection

I. Introduction

Korea's power system is designed to produce about 10% more electricity than the actual electricity used. This is the amount that is matched to the maximum amount of power that you have already secured in case you need more. The current situation requires additional power generation facilities as well as fuel, and there are also a lot of discarding facilities, resulting in low energy efficiency. In addition, the burning of coal, oil, and gas increases carbon dioxide emissions. If you can produce as much electricity as you need, or if you can use electricity to match your production, you can stop the global warming while using electricity more efficiently. This is why smart grid, which can understand the usage of electric power, high-end quantity, and electric power line by converging IT technology in the electric grid, is getting attention. Ultimately, the Smart Grid is a new concept system that efficiently manages all the electricity flowing from the household appliances as well as the industrial equipment running in the factory. It is possible to check the electricity rates used at home, office, and factory in real time. It is also possible to select household appliances such as turning the washing machine at night by avoiding the daytime hours where electricity rates are high.

The bottom of the smart grid is the micro grid. Micro-grid is a small-scale network that produces electricity by itself. If it is an apartment, it produces electricity. This system can reduce greenhouse gas emissions because it does not take transmission losses into account and can reduce power consumption at the plant. If the micro grid system is activated, it is necessary to produce electricity using solar energy in areas with high sunshine and wind power in windy coastal areas. This enables the current centralized instead distributed power system. Therefore, it is recognized as an essential infrastructure for renewable energy, because it can solve the problems of renewable energy, which is generated by the natural environment. In addition, various distributed power sources can be operated independently according to the power scale, and sensors are attached to each system to respond to the demands of consumers in real time.

Storage devices that can store power generated by renewable energy are also being developed as part of smart grids. A typical example is a flywheel, a huge metal wheel with minimal friction. When the wind or the sun is abundant, it turns into electric power, constantly maintains the power of turning due to inertia even when the wind is not blowing or the sun is shining.

Home appliances also become smarter with smart grid era. Household appliances that are closed in the house are connected to the outside through the Internet. In particular, the operation button can be controlled by the electric power company. If electricity usage is not lowered even though electricity is expensive in the middle of the day in summer, the utility can take emergency measures such as forcibly raising the air conditioner temperature.

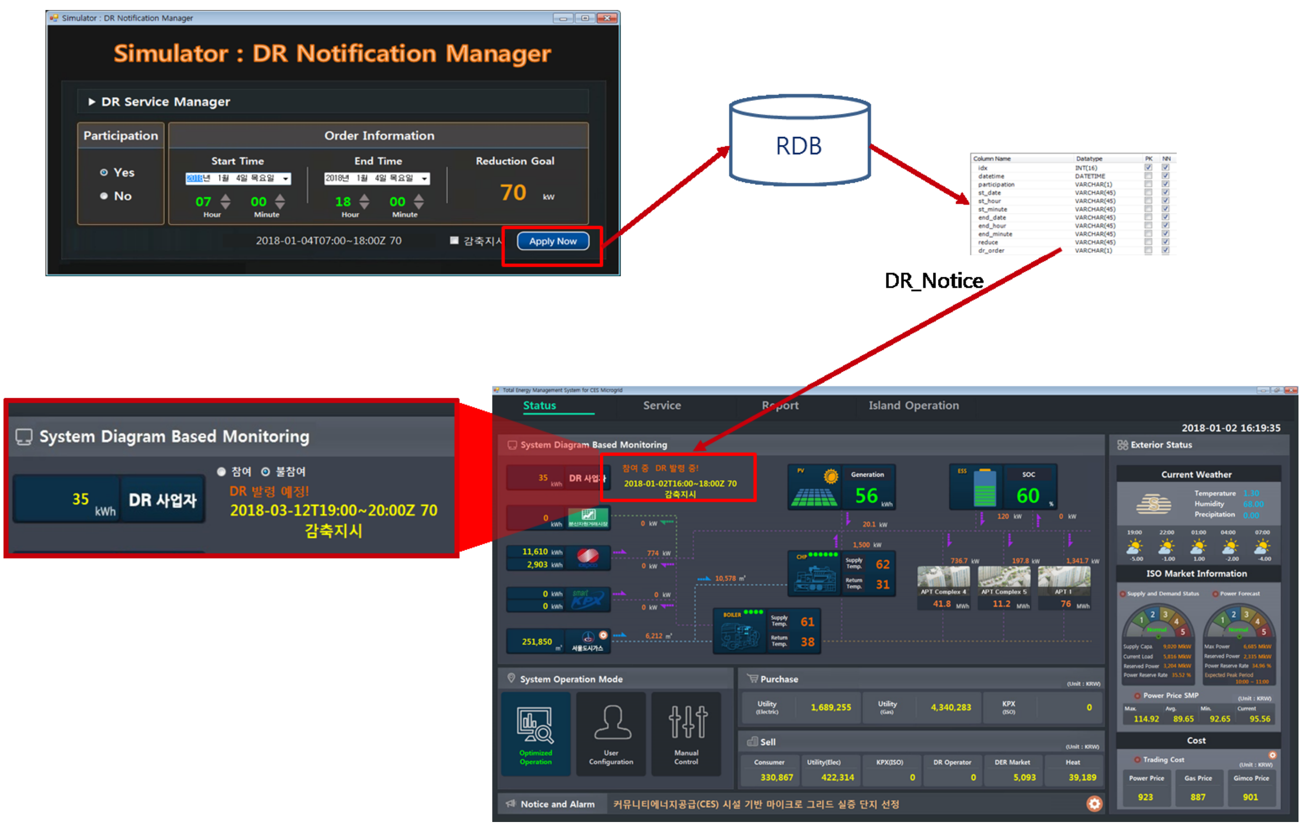
Of course, this is only possible with the consent of the owner of the appliance. In addition, the structure of the Smart Grid connected to the Internet must be exposed to hacking, and measures against security threats must be prepared.

Even with such concerns, expectations for smart grids are high. This is the most efficient way to increase energy efficiency and expand the use of renewable energy. In addition, cheap electricity is attractive to consumers. What is more important is preventing global warming through the smart grid. As much as one third of the world's greenhouse gases are made in power plants for power generation, the technology to make and use electricity smarter is essential for the planet.

II. ENERGY BIG DATA PLATFORM

Big data analysis is the process of discovering new information by discovering hidden patterns and correlations in many data. With Big Data, you can uncover incredible facts about viruses, food, crime, and the universe, and explore the hidden world behind the data.

The energy management system should predict the future energy use and generation amount for the optimal operation of ESS based on the measured energy amount, renewable energy production amount and energy usage, and establish the operation plan. In this system, the ESS charge / discharge scheduling can be established through the optimal control engine, and it can be managed and supervised by the administrator. ESS charge / discharge schedules are established every 24 hours and are updated every 3 hours. Energy production forecasting and energy load prediction are done based on the information from the Korea Meteorological Administration and ESS charge and discharge efficiency according to the climate collected so far. Based on the data obtained from the prediction, the optimal operation algorithm establishes the charge / discharge schedule of the ESS and transfers this information to the energy management system by storing the big data.The energy management system directs charge / discharge to ESS based on ESS operation scheduling stored in big data. The ESS operations manager can automatically run the ESS through the optimal engine, and if you want to modify the scheduling, you can switch to manual mode and modify the charge / discharge schedule directly. The operation information of the ESS is transmitted using the remote IO, and the charge / discharge status and the charge amount are transferred to the big data through the collector connected to the RemoteIO. The information transferred using the restAPI is stored in chronological order in big data. This is again used for optimal engine energy prediction and load prediction.



[Figure 1] Demand Response Operation Mechanism

III. Demand and Response Operation

Demand Response system is a system in which electric users sell electricity to the electric power market as much as they have saved electricity in their daily life and are compensated by money. The power consumer reacts to voluntary participation due to electricity bills or monetary incentives to adjust normal power consumption patterns.

This will result in economic benefits for all stakeholders in the electricity market. For electric users, it is possible to minimize the electricity tariff increase by reducing the demand by reducing the demand, generating the profit, and reducing the electricity cost of purchasing KEPCO. Demand management operators can generate commission fees for electricity resource recruitment, management, and energy consulting among electricity users such as buildings, apartments, and factories. For KEPCO, a sales operator, it is possible to reduce electricity purchase costs and secure stable supply and demand. The acceptance response system is largely classified into the demand reduction reaction (reliability DR) for preventing power outage and the maximum power reduction, and the charge reduction (economical DR) demand response for reducing the power supply cost.

MG demand response service is based on OpenADR 2.0. The Korea Power Exchange, designated VTN, provides VEN IDs to operators participating in DR services and provides DR services by registering demand response resources. The commands sent by KEPCO to the acceptance operator are provided as a pull type in XML String format based on openADR 2.0. This has the advantage of low cost of building firewalls and security. There are two types of transmission protocols, HTTPs and XMPP, which are built with XMPP protocol calls, which are sending messages of different values (on / off). By 2016, DRs were issued on an hourly basis, but since 2017, they have been replaced by more than one hour in 15-minute increments. Reliability In order to ensure the timeliness and accuracy required by the KPX for DR, the meter metering was designed to meet the timeliness of 5 minutes at 1 minute.

[Figure 1] shows the EMS screen when DR is issued. When DR is issued, the priority time and the amount of reduction instruction are indicated for each demand response resource. Based on this, it delivers the corresponding information to the optimal engine module. In the optimal engine module, it establishes and instructs the operation plan of the ESS to maximize the energy resources until DR start time. DR should not only promote efficient use of renewable energy, but also encourage active participation by notifying the generations within the CES complex. To this end, it notifies the invitation through the mobile service that is being serviced, and encourages voluntary participation by communicating action guidelines on energy conservation that can be implemented by generation. To reduce the public load within the complex, it is necessary to establish a policy to reduce the total power consumption by lowering the illumination of the parking lot lighting installed or by performing partial power saving. When the DR starts, the reduction amount is calculated through the meter of the demand response resource and is displayed on the DR service screen. Provides overall statistical information by showing current weighing value and cumulative reduction amount.

IV. Conclusion

The paper relates to a Demand Response operation method on energy big data platform. In this paper, we describe the technologies that can be saved through the analysis of big data of energy resources for renewable energy and present Demand Response Operation Method through big data analysis. Through this technology, it is possible to find new information by discovering patterns and correlations hidden in data, and to respond appropriately when issuing DR. It is currently being applied to apartments in Seoul and it will be possible to present a better analysis if the big data analysis technology becomes advanced through learning more data in the future.

Acknowledgment

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