Energy Simulation Model for Disaster Prevention System by Using Renewable Energy and Hydrogen Energy

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A new energy management for disaster prevention system to use surplus energy from a solar power and battery life extension method is being developed in Sendai City to apply to facilities such as designated evacuation centers during a disaster. The energy simulation model for this disaster prevention program by using hydrogen energy technology to store a large amount of electricity is also examined.

Based on the experience of the 2011 Tohoku earthquake and tsunami, Sendai City is proceeding to establish a "Disaster-Resilient and Environmentally-Friendly City" and actively create a base for disaster-resistant, energy-efficient decentralized energy sources. It is also introducing renewable energy sources. Sendai City introduced a disaster prevention solar system equipped with a solar power generation system and a storage battery for 194 facilities as designated evacuation centers during a disaster. This disaster prevention solar system does not utilize CO_2-free electricity generated from solar power at weekends and holidays, and the battery of this system is always fully charged, which causes a battery life problem. A collaboration with Sendai City is under way for developing new energy management for next-generation disaster prevention by using surplus energy from solar power and applying a battery life extension method, as shown in in Fig. 1 [1]. In this project, a model will be built for deployment to a virtual power plant. In September 2018, a joint research agreement was reached with Sendai City and the Japan Weather Association for enhancing this energy management technology based on detailed weather forecast data [2]. Today's weather conditions are used for power demand forecasting for the facility as research for environmental improvement, and surplus power is assumed based on tomorrow's solar radiation forecast data, and it is put in control. Also, in research aimed at improving disaster prevention, the solar radiation forecast data for tomorrow will be reflected in the storage capacity of the battery, and charging of the battery will be secured immediately in response to the weather warning.

A hydrogen system is one of the most effective ways to improve a conventional battery system from the viewpoint of volumetric energy density (Wh/L). An energy simulation model is being developed for this disaster prevention system by using a hydrogen energy system to store a large amount of electricity, as in in Fig. 2. For storing a large amount of hydrogen safely and easily in this system, hydrogen storage alloy technology is the key issue compared with a conventional high pressure hydrogen gas tank. A new hydrogen storage alloy having a high hydrogen storage capacity is also being studied to apply to this energy system. In the future, it is planned to improve this simulation model, establish scenarios using real equipment, and proceed with an attempt to construct a system concept.

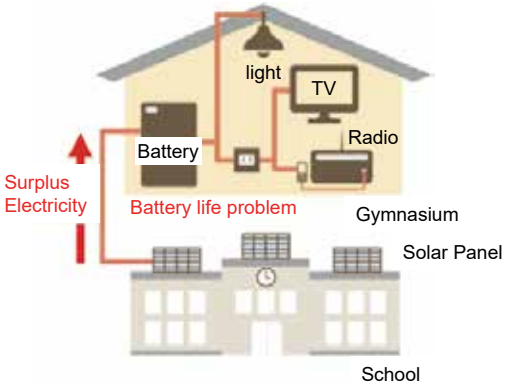

Fig. 1 Disaster prevention solar system

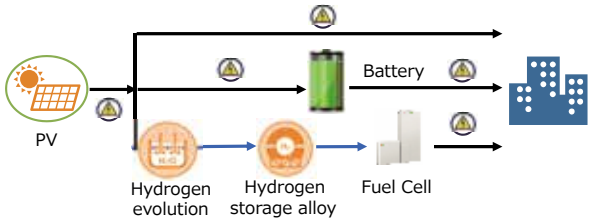

Fig. 2 Disaster prevention solar system by adapting hydrogen energy

References

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[2] https://www.tohoku.ac.jp/japanese/newimg/pressimg/tohokuuniv-press20180927_01web_kishoujouhou.pdf (2018).
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