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論　文　要　旨
Thesis Abstract

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主論文題名　（Title）

Application of Advanced Load-Frequency Control on Battery Energy Storage System in Islanded Microgrid

内容の要旨　（Abstract）

There are numerous remote islands globally, and among them, in small-scale systems independent from large-scale systems, electric power is supplied mainly by distributed energy resources (DER) or diesel generators using fossil fuel. In recent years, however, Renewable Energy Sources (RES) such as photovoltaics (PV) and wind turbines (WT) have been introduced due to problems such as global warming and depletion of fossil fuels. On the other hand, since the generated electric power of RES depends on the weather, the output wildly fluctuates in a short period, and it is feared that it causes lowering of electric power quality and solution row of generators. Moreover, a small independent system is easily affected by output fluctuation and load fluctuation of RES because of the small system capacity. A method to compensate for these fluctuations by installing a Battery Energy Storage (BES) system is proposed.

BES participation is made possible by utilizing load-frequency control (LFC). However, the traditional LFC has no frequency limitation, so it is still possible that the battery participation does not put the frequency in the allowed area. By using advanced LFC, the system frequency can be maintained in the desired range. It is possible because the proposed control uses three control areas, namely Region 1, Region 2, and Region 3. Active participation makes the battery SoC more volatile. These fluctuations should be avoided as they can shorten the life of the battery. SoC control was introduced to solve this problem. This control adopts a droop reference shift based on the SoC level up to the LFC. Hence, BES can participate in the chili system while maintaining the SoC level of the battery. These controls are examples of advanced applications of advanced LFC.

In this thesis, a discussion of battery economics is also discussed. Advanced LFC has proven influence in BES (technical) operations. However, the applicability of this control can be seen if the proposed control influences the size and investment costs of the BES. In

this study, the use of advanced LFC is proven to have a better impact than traditional LFC, both in terms of cost and system performance over frequency. However, the investigation shows that this control could not apply to all types of batteries. This study case confirms that this control is suitable only for high capacity batteries, which can operate until the end of the project lifetime.

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