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再生可能エネルギー電源の導入による電力系統負荷 周波数制御手法

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論文要旨

Title: Power System Load Frequency Control Approach by introducing Renewable Energy Sources

論文題目： 再生可能エネルギー電源の導入による電力系統負荷周波数制御手法

In most remote and isolated areas, electric power is often supplied by diesel generators. However, diesel generators cause serious impacts on the environment as every little of diesel releases about three kilograms of CO₂. Also, diesel is expensive because transportation to remote area adds extra cost. Moreover, diesel generators are inherently inefficient when operating at a low load factor (below 40%- 50% of their rated capacity). Due to these environmental and economic influences of the diesel generator, the environment pollution had been attracting most researchers' attention recently, and it is solved by renewable energy sources (RESs) as an alternative to non-renewable sources. Among them, Wind, solar, sea, biomass, and geothermal powers are sustainable and clean sources. Wind and solar attracted a lot of attention nowadays and became the most widely utilized renewable energy sources in power systems. Also, fuel cell (FC) could be considered as one of the green power sources of the future. However, the sharp fluctuations in the generated power of RESs devices caused by conditions of weather, temperature and season leads to the deterioration of the supply-demand balance, which may also affect the systems stability and reliability, especially in isolated systems with renewable energy sources such as WTG and PV, faces some stability problems because the power supplied by these sources is not constant, diverges quickly and cannot be easily predicted. So, these oscillations in the renewable power sources can produce instantaneous mismatch in the vital balance between generation and demand. Consequently, continuous variations in frequency and voltage levels usually appear which negatively affect the electric power system stability. Therefore, a continuous control for the supplied power by these renewable sources is required to ensure robust performance of the power system.

One of the most serious problems in power system is frequency deviation. In small-scale and isolated power system like isolated islands power system or remote areas power system, the output power fluctuation of RESs causes a huge frequency fluctuation. The fluctuation in system frequency causes the supply unstable and large-scale blackout in the worst case. To eradicate the frequency fluctuation phenomenon, power deviation needs to be controlled. Many research efforts have been conducted based on the load frequency control methods using battery technology. However, it is hard to compensate the supply-demand balance by using batteries, since the implementation cost of the battery is high. In order to increase the penetration of RESs in the future power system, a system frequency control method is necessary.

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