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Behavior of frequency on Synchronous Generator (SG) during islanding condition.

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ABSTRACT – Power system islanding is gaining increasing interest to maintain power supply continuity. It is because the islanding condition became one of the most problematical issues in power system protection perspective because of operational and safety reason. The main objective of islanding protection is to disconnect all Synchronous Generators (SG) immediately after the islanding happened. Because of that, the transient behavior of islands supported by these generators for different loading conditions is explored in detail via simulation.

1. INTRODUCTION

The concept of Distributed Generators (DGs) has been developed over the last few years. These can be categorized as decentralized, small-scale, dispersed, and on-site generation systems connected at the distribution network level [1]. DGs have expanded extensively by the electrical industry due to their environmental benefits, technical and economic. For that, the installation of DGs around the world has been growing rapidly. DG can come from renewable or non-renewable energy resources, using both modern and conventional technologies such as wind turbines, fuel cells, biomass, small hydro and solar photovoltaic. For example, Malaysia is focusing on the development of its significant small hydropower potential, with a goal of adding 490 MW by 2020 to increase renewable energy generation in the country[2]. SG's growth rate increase in power network system allows it to provide some benefits such as increased overall energy efficiency, line loss reduction reduced environmental impacts, peak shaving, and deferment of the investment required to upgrade existing generation, transmission, and distribution systems [3].

Hence, this SG development will have a positive and negative impact on the power system network. It is necessary to identify and measure SG contributions when planning for future development to achieve high security and quality of electricity supplies

2. ISSUES WITH ISLANDING

Islanding is a situation that occurs when the system remains energized by a distributed generator (DG) while the network is disconnected from the remainder of the power system[4]. DG islanding can be both intentional and unintentional. Unintentional islanding is prohibited due to the safety concerns are power quality, earthing and protection, out of synchronism reclosing and personnel safety[5].

This island should be detected instantaneously by the anti-islanding protection. However, there have several factors is hard to accomplish which might affect the success of the detection protection, as follows (a) the protection should work for any possible of islands form a (b) A reliable anti-islanding scheme must work for all possible islanding conditions.

For the anti-islanding performances, the frequency behavior can be strongly affected between the distributed generator and the islanded load [6]. However, the different load can create similar power imbalance level inside the island. The variation of the loading condition makes the frequency behavior on the different loading change [7].

3. THE EFFECT OF POWER IMBALANCE ON THE SYSTEM FREQUENCY

In order to investigate the response of the frequency in an islanding event, the following scenarios are considered for simulation studies. The SG was operated in parallel with the main grid in the beginning and the load L1 was supplied by both SG and main grid are presented in Figure 1. The total active power of the load L1 was 2MW and SG was injecting 2MW. Then, an islanding event was simulated by opening the breaker (CB1) at $t = 50s$, leaving the load L1 islanded with the SG. At this moment, the load L1 was only supplied by the SG and the frequency waveform response was being observed.

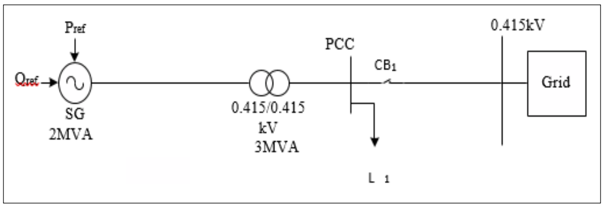

Figure 1: Test network.

The simulation was then repeated for the case as follows:

i. The surplus of active power generation of +(10%, 20 % to 100%) of the SG rating i.e. (PSG>PL1)
ii. The deficit of active power generation of -(10%, 20 % to 100%) of the SG rating i.e. (PSG<PL1)

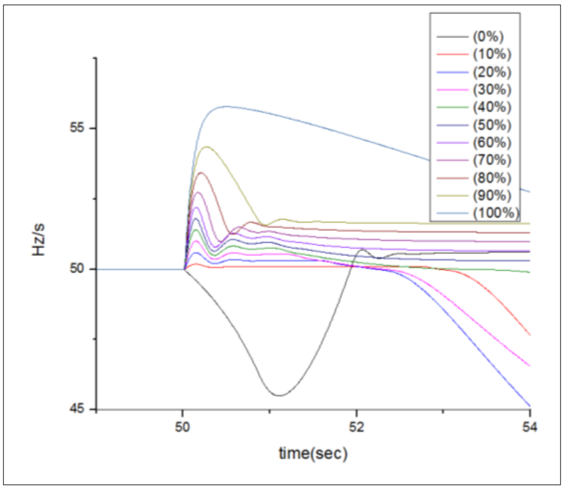

Figure 2: Frequency signal during islanding (surplus power mismatch).

The response of frequency waveform during islanding condition of the SG for case (i) are presented in figure 2. In this case, there is excess electrical power in the islanded system. It is observed that the greater the power mismatch in the island, the greater frequency is.

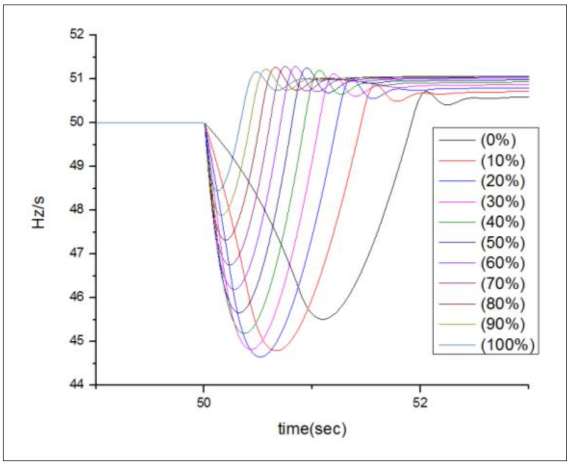

Figure 3: Frequency signal during islanding (deficit power mismatch).

On the other hand, frequency response in case (ii) is shown in Figure 3. In this case, there is a deficit of electrical power in the islanded system. The frequency response is almost similar to case (i) that previously observed. The amplitude of the frequency increases when the power imbalances increase in a negative direction.

4. CONCLUSIONS

This paper presents a behavior of Synchronous Generator (SG) during islanding condition by monitoring the conventional parameters of frequency detection. The performances or respond of the frequency are tested in Synchronous Generator (SG). Results clearly show that the respond of frequency waveform during islanding can be detected at the SG terminal. All the result can be seen detail via simulation.

5. REFERENCES

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