Q1.05 Are there any changes to power swing characteristics in lower inertia grid which would prompt changes to power swing blocking or out of step tripping protection settings or schemes?

Interconnection measures for small hydroelectric power generation facilities in low inertia systems

1. Introduction

To achieve carbon neutrality, as variable and inverter-based renewable energy such as photovoltaic power generation and wind power generation increases, the lowering of inertia of the grid becomes a problem. Under such circumstances, expectations for small hydroelectric power generation are increasing.

In order to renew a small hydroelectric power generation facility (Synchronous Generator, 60 Hz, 6.6 kV, 6.4 MW) installed in 1985, grid interconnection consultation was conducted. As a result of transient stability analysis, it was found that a generator equivalent to the existing one (Inertia constant, impedance, control device, etc.) could not ensure stability.

2. Measures for lower inertia

As countermeasures against low inertia, countermeasures by main equipment and protection-control equipment were examined.

The countermeasure by the main equipment is to increase the inertia constant of the generator from 1.86 s to 4.5 s. The inertia characteristics of the entire system can be improved, but the large and heavy generator cannot satisfy the constraints of the installation space and the strength of the foundation, and the cost also increases.

On the other hand, as a countermeasure by the protection-control device, the application of the overspeed relay using the generator rotational speed and the step-out relay using the voltage and current signal was examined in order to prevent instability in the system fault. These don’t contribute to normal operation of the system, but the impact on space and cost can be reduced.

In the case of overspeed relays, it is difficult to distinguish between generator failure and system failure. Therefore, it is desirable to apply a step-out detection relay. The figure shows the characteristics of a step-out relay and transition of impedance in step-out.

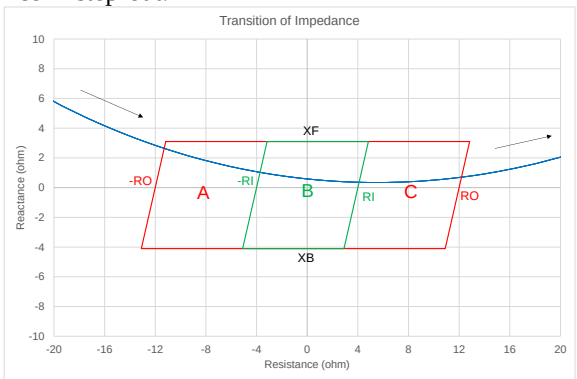

Figure Example of characteristics of a step-out relay and trnsition of impedance in step-out

3. Couclusion

Due to the decrease in inertia caused by the increase in the introduction of renewable energy, there have been cases where it is impossible to renew small-scale hydropower generation facilities which have the same specifications as existing ones. The countermeasures were compared, and it was confirmed that the application of the step-out relay was desirable.

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