Transformers Connected Directly to Generators

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Generator transformer

Power transformers connected directly to generators can experience excitation and short-circuit conditions beyond the requirements defined by ANSI/IEEE standards. Special design considerations may be necessary to ensure that a power transformer is capable of withstanding the ***abnormal thermal*** and ***mechanical aspects*** that such conditions can create.

Typical generating plants are normally designed suchthat two independent sources are required to supply the auxiliary load of each generator. ***Figure 1*** shows a typical one-line diagram of a generating station.

The power transformers involved can be divided into three basic subgroups based on their specific application:

1. ***Unit transformers (UT)*** that are connected directly to the system
2. ***Station service transformers (SST)*** that connect the system directly to the generator auxiliary load
3. ***Unit auxiliary transformers (UAT)*** that connect the generator directly to the generator auxiliary load

In such a station, the ***UAT*** will typically be subjected to the most severe operational stresses.
Abnormal conditions have been found to result from several occurrences in the operation of the station.

Instances of faults occurring at ***point F*** in ***Figure 1*** – between the UAT and the breaker connecting it to the auxiliary load – are fed by two sources, both through the ***UT*** from the system and from the generator itself.

Once the fault is detected, it initiates a trip to disconnect the ***UT*** from the system and to remove the generator excitation. This loss of load on the generator can result in a higher voltage on the generator, resulting in an increased current contribution to the fault from the generator.

This will continue to feed the fault for a time period dependent upon the generator's fault-current decrement characteristics.

Alternatively, high generator-bus voltages can result from events such as generator-load rejection, resulting in overexcitation of a UAT connected to the generator bus. If a fault were to occur between the UAT and the breaker connecting it to the auxiliary load during this period of overexcitation, it could exceed the thermal and mechanical capabilities of the UAT.

Additionally, nonsynchronous paralleling of the UAT and the SST, both connected to the generator auxiliary load, can create high circulating currents that can exceed the mechanical capability of these transformers.

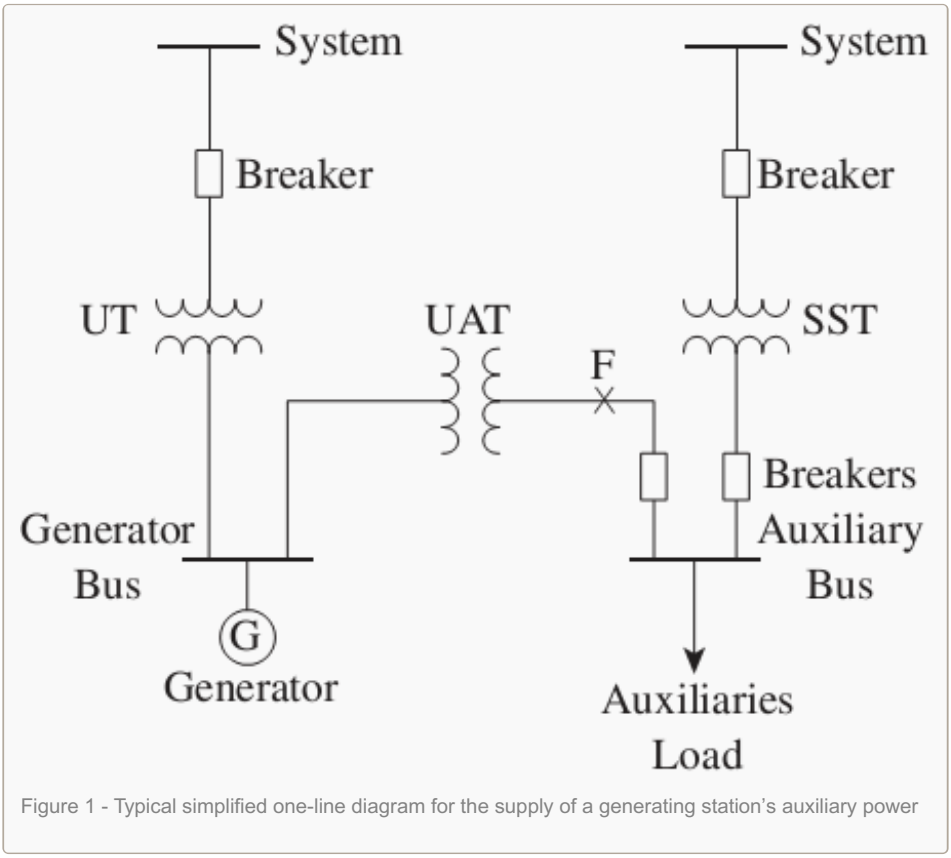

Figure 1 - Typical simplified one-line diagram for the supply of a generating station's auxiliary power

Considerations can be made in the design of ***UAT transformers*** to account for these possible abnormal operating conditions. Such design considerations include lowering the core flux density at rated voltage to allow for operation at higher V/Hz without saturation of the core, as well as increasing the design margin on the mechanical-withstand capability of the windings to account for the possibility of a fault occurring during a period of overexcitation.

The thermal capacity of the transformer can also be increased to ***prevent overheating due to increased currents***.

Resource: *Electric Power Transformer Engineering*

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