BACKGROUND MATERIAL RELATED TO THE REASON FOR ESTABLISHING THE WORKING GROUP number 3

Events during the past few years involving the reaction of large turbine generators to transmission system transients have renewed interest in transients that have the most effect on generators. This is of particular interest since damage to shafts and internal generator components is becoming evident.

In talking with both experienced transmission and generation people within the industry, it appears that there are serious misconceptions regarding how certain types of transmission transients affect turbine generators. It is the expectation of the Electric Machinery Committee and its Generator Subcommittee that this working group will develop a paper presenting a clearer picture regarding the characteristics of transients that lead to severe responses of turbine generators. There have been numerous studies performed and papers written regarding the reactions of rotating machines to system transients and it is the purpose of this working group to build on this knowledge base by consolidating it, expanding it to include new information and propose additional investigation.

Some of the misconceptions people have regarding this subject can be answered if our working group can address the following questions:

1. What is the source of the very loud “bang” and impulse that shakes the entire turbine building?
2. Why are the most severe reactions those responding to transients from faults originating on circuits two or more voltage levels removed from the generator terminal voltage? The exception to this is with a fault occurring only one voltage level removed from the terminal voltage (GSU high side voltage) but at a distance of several hundred miles. Why does this happen when most of us have been told that close-in faults are the most severe on a generator?
3. Why does not plant and switchyard instrumentation detect and record some of the most severe transients? It should be noted that such instrumentation often does record some slight indication of a transient but nothing in proportion to how the generator reacts to it.
4. Is the chart trace or other recorded information that of the line condition before and after a switching event and not that of the switch event itself? In other words, during a high speed reclosing event are there spikes at both ends of the recorded fault that are not recorded?
5. What would the wave front look like of a transient that would produce the most severe torsional impulse?
6. How do the high frequency components of such a wave front compare with the frequency at which the reactance of the GSU transformer and stator winding would significantly affect?

7. Much has been written regarding the effects of high speed reclosing into a fault but I have not noticed any papers addressing how a machine responds to a series capacitor bank bypassing and automatically reinserting during the fault clearing sequence. How is this capacitor switching going to affect a machine?
8. Different utilities have different protective and switching schemes and they are even different within the same utility depending on the lines in service at any particular point in time. This makes predicting the result of a certain type of fault difficult, at least on a consistent basis. There are some practices that do however lead to consistently the same general result. One has to do with timing. There are papers written regarding the timing between fault and breaker action during a high speed reclosing event but I have seen nothing written about timing sequence of series capacitor bypass and reinsertion. A complicating issue here is the faulted phase bypasses first then the other phases follow; but when? Under what conditions? With what effect on the transient wave front?
9. What would be the best way to improve the sensing and capture capability for the fastest transients and at what threshold should data be saved?
10. What is the most effective way to monitor the actual torque impulses experienced on the turbine generator shafts and at what threshold level should data be saved?

The above questions are those that I, or others I have worked with, have asked over the past few years and providing the correct answers to them should increase the general understanding of the transient / torque impulse issue.

Respectfully submitted

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