IEEE Standards Interpretation for IEEE Std 421.5™-2005 IEEE Recommended Practice for Excitation System Models for Power System Stability Studies

April 2008

Interpretation Request #1:
Topic: Limit in Section "5: Type DC-Direct current commutator excitors"

I have a question regarding IEEE Std 421.5-2005, in section "5. Type DC-Direct current commutator exciters."

All of the block diagrams in this section (Figures 5-1, 5-2, 5-3, and 5-4) have a minimum limit drawn on the 1/sTE block. However, the text does not discuss this limit at all. Figures 5-1, 5-2, and 5-3 do not even label this limit. Figure 5-4 labels it VEMIN. For the DC1A, DC2A, and DC3A models, how should this limit be implemented? What is the range of values it could have?

During an extended high voltage condition, this could have an important impact on the generator response.

Interpretation Response
The negative limit on a dc generator is solely based on the total flux of its field windings. The cases to consider are as follows:
1) Separately-excited by thyristor or PWM bridge. In this case, field current has a lower limit of 0 and this is also the lower limit of the dc voltage.

2) Self-excited dc generator with separate control windings (e.g. buck/boost). If the buck winding turns and source (e.g. mag amp) can produce enough flux to overcome the positive flux of the self-excited shunt field, then the total field can be reversed and negative output is possible.

Determining this level requires either measurements or a knowledge of the turns ratio of the various field windings and the source current capability of the device feeding the buck/boost windings.

I have only encountered one system where we were able to measure negative output through testing. In most cases, the buck/boost windings do not have the capacity to overcome the shunt excitation unless it is already very low.