

IEEE Standard Criteria and Definitions for Excitation Systems for Synchronous Machines

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IEEE Standard Criteria and Definitions for Excitation Systems for Synchronous Machines

Sponsor
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of the
IEEE Power Engineering Society

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Foreword

(This Foreword is not a part of IEEE Std 421-1972, Criteria and Definitions for Excitation Systems for Synchronous Machines.)

This document presents criteria, essential elements, and new and revised definitions for excitation systems as applied to electric utility synchronous machines with particular emphasis given to the application of solid-state devices and to terminology common to feedback control systems.

A synchronous machine excitation control system is a feedback control system. Thus the Working Group on Terminology of the Excitation Subcommittee of the Power Generation Committee adopted those definitions of American National Standard C85.1-1963, Terminology for Automatic Control, and its 1966 supplement ANSI C85.1a-1966, which had common basis to excitation systems and derived others which are related to excitation systems. Efforts were made not to conflict with terms found in ANSI C85.1-1963, but to clarify or more fully define terms as related specifically to excitation of synchronous machines.

The task of the working group can be divided into two areas: (1) to gather together all the existing definitions applicable to the field and from these definitions to extract those definitions of value, and (2) to formulate new definitions where these are needed.

In carrying out this second more challenging task, there is very real danger that the group may formulate definitions which are useful only to a select few and which will rapidly fall into disuse. The working group has tried to avoid this pitfall by proposing only a relatively few new definitions which they feel fulfill a real need.

One of the new definitions is excitation control system. A definition for excitation systems already previously existed; it includes the exciter, the regulator, and manual control but excludes the synchronous machine. If we wish to refer to the entire feedback control system, the synchronous machine must be included and the term excitation control system should be used.

Four new definitions to classify exciters are included:

dc generator—commutator exciter
alternator—rectifier exciter
compound-rectifier exciter
potential-source—rectifier exciter

It is thought that these types of exciters cover most if not all of the modern excitation systems which are used on large synchronous machines.

The terms excitation control system stabilizer and power system stabilizer are new. These two definitions differentiate between the conventional stabilizer such as an exciter voltage stabilizer required to obtain adequate dynamic performance of the excitation control system shown in Fig 2, and the more recent stabilizers which usually employ shaft speed, frequency, or electric power to improve power system stability.

The working group also included the new terms excitation system duty and excitation system duty cycle. An example of a duty cycle would be a 3-phase fault at the high-voltage terminals of the generator transformer removed in the normal clearing time and followed by reclosure into the fault. The need for such a duty cycle has not arisen with the conventional dc generator—commutator exciter where the thermal time constants are of the same order as that of the generator field and are relatively long compared to normal fault durations. On the other hand, the thermal time constants of thyristors and diodes used in modern excitation systems can be relatively short and a special effort is required to ensure they meet duties imposed by faults on the power system.

Another new term, base field voltage, defines the field temperature at which this base voltage used in analytical studies is to be determined.

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