

Module 4 : Voltage and Power Flow Control

Lecture 17 : Reactive Power and Voltage Control

Objectives

In this lecture you will learn the following

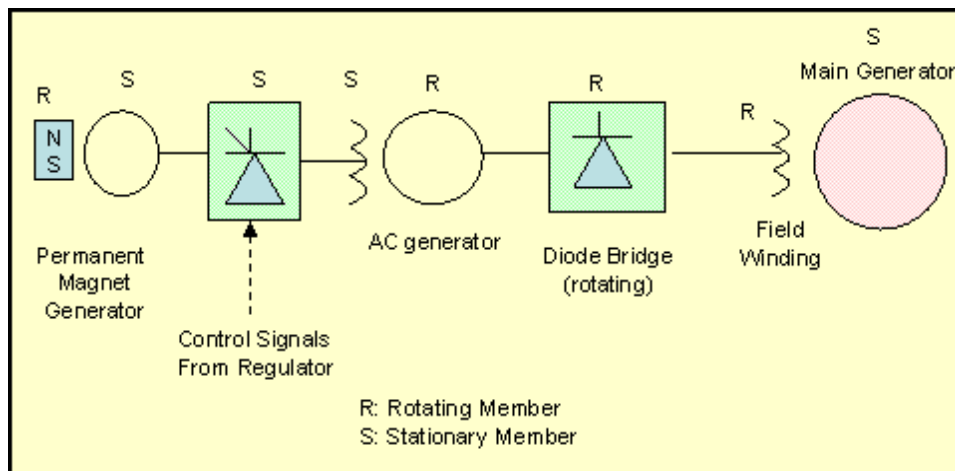
- Means of voltage control in power systems.
- Generator Excitation Systems and reactive power characteristics of power system components.

Since voltage magnitudes in a system are intimately related to the ability of various components to absorb or supply reactive power, we shall begin by reviewing these characteristics.

Synchronous Generators: Can generate or absorb reactive power by control of field voltage. The amount of reactive power which can be exchanged by a generator is given by the reactive power capability curve (discussed in [Module 2](#)).

In rotating-type excitation systems, field voltage is obtained using separate generators connected to the same shaft as the main generator. The excitation for these excitation generators themselves is obtained by self-excitation or permanent magnet generators. Control is achieved by controlled rectification using thyristor bridges.

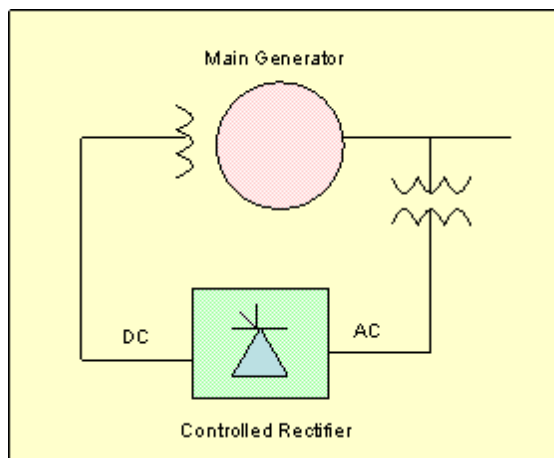
A schematic of a brushless rotating excitation system is shown on the right.



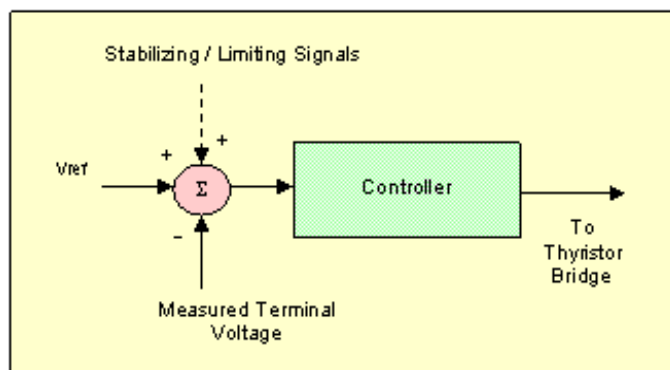
Production and Absorption of Reactive Power

In static excitation systems, the field voltage is obtained directly by rectifying (using controlled rectifiers) the output voltage of the main synchronous generator. Therefore in these systems, the generator is practically self excited with some initial voltage being obtained temporarily using station batteries (called field flashing).

In static excitation systems, it is necessary to use slip rings to convey the field voltage (output of the controlled rectifier) to the rotating field winding of the main generator.



An exciter is usually controlled so as to *regulate* generator terminal voltage. The general structure of a voltage regulator system is shown on the right. While the regulator maintains voltage close to the reference value, an operator may also slowly change the reference value itself if a change in reactive power is desired. A typical excitation system also utilizes limiting signals which change the reference voltage so that the generator works within its [reactive power capability](#).



Production and Absorption of Reactive Power: Other Power System Components

Overhead Lines: Absorb or supply reactive power based on loading conditions.

Overhead transmission lines may draw or supply reactive power depending on the loading conditions. We saw in Module 2 that a line draws reactive power if loading is higher than the Surge Impedance Loading and generates reactive power otherwise.

Cables: Surge Impedance of cables can be quite high (higher than the thermal limits) and they are typically loaded much below their Surge Impedance Loading. This leads to significant generation of reactive power and overvoltage problems if cable length is greater than 30-40 km.

Transformers: Transformers generally absorb reactive power due to shunt magnetising and series leakage reactances.

Loads: Normally absorb reactive power (see power factor of some loads in the previous [module](#)).

In the next lecture, we will consider special reactive power absorption/supply characteristics of special devices which are used to control voltages in a power system.

Recap

In this lecture you have learnt the following

- The major means of voltage control in a power system is by generator excitation control.

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- Power system components like loads and transformers generally absorb reactive power. Overhead transmission lines supply or absorb reactive power depending on their loading. Cables generally supply reactive power.

Congratulations, you have finished Lecture 17. To view the next lecture select it from the left hand side menu of the page.