DC Power Transmission Systems
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Lecture - 16
Definition: Delay angle, angle of advance, commutation margin angle

Now, for further analysis we need some definitions. So, let us look at some definitions.

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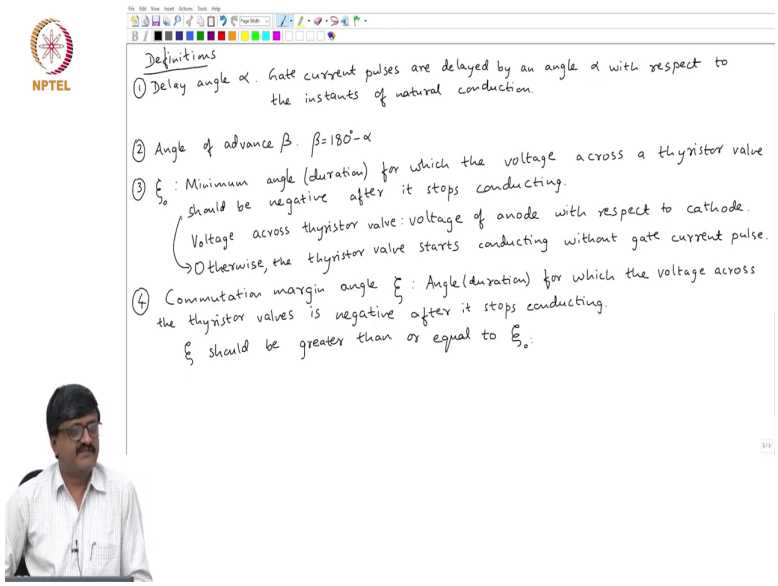

There is one definition we have already seen that is the definition of delay angle alpha. So, this is something which we have already seen, delay angle denoted by alpha. So, the delay angle alpha is given by this sentence, gate current pulses to the thyristor valves are delayed by an angle. So, we use this word angle and the word duration interchangeably sometimes, ok.

So, normally we do not talk in terms of time; I mean delay is associated with time, so since our independent variable in this course will be angle. So, we do not talk in terms of time, we will talk in terms of angle only; delayed by an angle alpha with respect to what with respect to.

Student: Natural conduction.

With respect to the instance of natural conduction. So, if continuous gate current is applied, then we what we get is natural conduction or diode operation. So, if we give only gate current pulses and that to delayed with respect to the instant of natural conduction that is what is desired if we want to have control, ok. The purpose of using thyristor valve is to have control.

We will define some more angles, most of these definitions all these definitions are angles only. So, we define a quantity called angle of advance denoted by beta. The definition is very simple, it is defined as 180 degrees minus alpha. Right now it may not be clear why we need these definitions; I mean it becomes clear as we make I mean further discussion will make this clear.

So, let us just take these definitions, then there is a quantity I mean the, I will give the notation first; this is a Greek letter psi with a subscript o psi naught. So, there is no name for this; I mean it is just a notation, but it is defined as minimum angle. So, one can look at it as minimum duration also, if the independent variable is time. Minimum angle for which the voltage across a thyristor valve should be negative after it stops conducting.

So, what does that mean? First of all what is meant by voltage across the thyristor valve say; please note voltage across thyristor valve we have defined, let us make it very clear. Voltage across the thyristor valve means voltage of anode with respect to cathode.

So, when a thyristor valve stops conducting; that means, say the whenever the thyristor valve conducts the current is flowing from anode to cathode. So, if the current goes to 0, we say the thyristor valve stops conducting. So, as soon as the thyristor valve stops conducting; that

means, the current from anode to cathode becomes 0; then the voltage across the thyristor valve should be negative. Now what happens if it is not negative for this minimum duration?

Student: Then it got kind of.

Then it again starts conducting as soon as the voltage becomes positive without gate pulse, that we do not want that. See our intention is to see that the thyristor valve conducts when we want by giving a gate pulse. So, suppose it conducts without we giving a gate pulse, then the control is lost, ok. So, this is something which should be always satisfied. So, there is a minimum angle or duration for which the voltage across the thyristor valve should be negative after it stops conducting, ok. So, if it is not, then the control is lost otherwise, ok.

See let me say otherwise see what happens if it is not satisfied; otherwise I presume that you are familiar with this, otherwise the thyristor valve starts conducting. Why it starts conducting? Because it is forward bias, but it should not start conduct; I mean should not conduct be I mean without gate pulse. So, otherwise thyristor valve starts conducting without gate current pulse, ok. So, that is something which we do not want, ok.

So, psi naught is the notation for this quantity. So, it is in terms of angle. Now why we give it in terms of angle is; once we have a system with the frequency is fixed, the nominal value of the frequency is fixed. Suppose I have this quantity psi naught given for 60 Hertz frequency. Now for 50 Hertz frequency the value will be same; if not same, it will increase or decrease?

Student: It will decrease.

It will decrease, ok. So, it will decrease ok; sorry increase or decrease?

Student: Decrease.

Decrease. So, I hope it is clear, see it is the time which is fixed; but why are fixing it as an angle is, the frequency is of course, once we are commissioning converter we know that at

what frequency it will work on the AC side, ok. So, there may be slight deviations from a nominal frequency of 50 or 60 Hertz, ok. So, that deviation is minor, ok.

So, there is one more quantity that is defined that is known as commutation margin angle. So, this has a notation psi yeah, this is not same as the previous notation; the previous notation is psi naught, there is a subscript o other, here it is there is no subscript psi. So, the definition of commutation margin angle, this is the angle or if it is in terms of time duration for which the voltage across a thyristor valve; now I will say not a thyristor valve, voltage across the thyristor valves is negative after it stops conducting. See psi naught is actually the.

Student: Minimum.

Minimum value that is required, psi is the actual value. So, psi can be.

Student: Less than 0.

Less than 0 equal, I mean less than psi naught equal to psi naught or greater than psi naught. So, psi should be?

Student: More than or equal to.

Psi should be greater than or equal to psi naught. So, we will keep these definitions in mind.